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Simultaneous Coprimeness of Values

Discovering Thoughts, Inventing Future

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Future Revolution of IT Industry-Radio Frequency Identification Technology

By Arun Kumar Uppala, Chandrasekhar B & Ranjith J

Abstract- This document will give an overview of how RFID technology can play a vital role in various industries. Besides RFID which is being used to improve the efficiency of supply chain management, retail industry and many other areas so it's time to adopt and explore implementing RFID in various industries. In addition to this, RFID is also used to enhance the efficiency, productivity, tracking of the products and various tools, security and cost. This paper also covers various industry problems and advantages/disadvantages of using RFID technology. Many other organizations in service sector start to accomplish RFID technology to be functional and useful in tracking the customer's data, safety, and stock control. Being RFID technologies with low cost and privacy issues which are contend to growth and effectiveness of RFID in industrial environment. Moreover, this study also explains that there are several ways to install RFID devices safely in order to progress the Return on Investment (ROI) management processes of the industries.

Keywords: *RFID, ROI, RTLS, AIDC.*

GJCST-H Classification: *I.4.1*

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Future Revolution of IT Industry–Radio Frequency Identification Technology

Arun Kumar Uppala[α] , Chandrasekhar B[σ] & Ranjith J[ρ]

Abstract- This document will give an overview of how RFID technology can play a vital role in various industries. Besides RFID which is being used to improve the efficiency of supply chain management, retail industry and many other areas so it's time to adopt and explore implementing RFID in various industries. In addition to this, RFID is also used to enhance the efficiency, productivity, tracking of the products and various tools, security and cost. This paper also covers various industry problems and advantages/disadvantages of using RFID technology. Many other organizations in service sector start to accomplish RFID technology to be functional and useful in tracking the customer's data, safety, and stock control. Being RFID technologies with low cost and privacy issues which are contend to growth and effectiveness of RFID in industrial environment. Moreover, this study also explains that there are several ways to install RFID devices safely in order to progress the Return on Investment (ROI) management processes of the industries. Therefore, RFID technology systems can help in analyzing the costs, benefits through readers and tags devices in order to trace and locate the implanted products with the real-time locate systems (RTLS) implementations, Automatic Identification and Data Capture (AIDC) which can read customer's details to provide more efficient as well as estimate the reduction in inventory associated to operational cost.

Keywords: RFID, ROI, RTLS, AIDC.

I. Introduction

Radio Frequency Identification (RFID) technology is a system that identifies objects without the constraint of line-of-sight and helps in real-time data collection unlike bar code technology. In general, the basic RFID technology consists of tags, readers, and end servers to read and identify the unique EPC code from tag (Wu, Ip, Kwok, & Chan, 2011, p. 1).

This RFID technology enhances the efficiency, productivity, tracing the information of the product as well as automatic derivation of the data with the help of technology called *Automatic Identification and Data Capture (AIDC).*

a) Purpose

Over the past few decades, RFID technology has widely adopted and standardized with innovative applications such as personal services as well as part of our daily life. After manufacturing and retail industry, *IT Asset Tracking industry* is considered as the next generation in market to implement RFID. Most of the industries are investing more money in the *information technology (IT)* in order to minimize the operating costs, undetected lost, improve safety and efficiency, and it is expected that RFID and its applications can make the changes in the implementation of the infrastructure to become more productive and effective towards services without any errors. The purpose of RFID technology helps to detect the objects through tags and readers.

II. Overview of RFID

In modern phrases, Radio Frequency Identification (RFID) technology describes, "A system identification without the constraint of line-of-sight provides a perfect way for real-time data collection and object identification" (Wu, Ip, Kwok, & Chan, 2011, p. 1). In general, the basic RFID technology consists of tags, readers, and end servers to process the data from tag. The functions of the RFID technology are to detect the object through the electromagnetic fields that attached to the tag and with the help of these tags, it is possible to trace the asset data and track the products. To implement the RFID solution, an integrated RFID system should contain five components such as tag, reader, antenna, application software, and communication infrastructure. A microchip placed internally to tag where it can store the information and reader can read the data through electromagnetic waves. "According to the requirements and specifications of the area or organization, the reader and tag are adjusted based on different power output and frequency used" (Cheng & Chai, 2012). There are three types of RFID tags- active tag, semi-active tag, and passive tag. The active tags are more expensive when compare to passive tags because it consists of internal power source, strong signals, and perform two-way flow of data.

An integrated communication between the reader and tag uses methods to control the ID signals such as low frequency (LF), high frequency (HF), microwave frequency, and ultra-high frequency (UHF). "Compared with traditional scan-based data collection technologies such as barcodes, RFID operates at higher data communication speeds, has a larger data storage capacity, and performs the automatic retrieval of data without physical line of sight" (Ting, Kwok, Tsang, & Lee, 2011). Therefore, large quantities of data would generate and in order to control this data issue, a kind of software is used acts as buffer between RFID and the information technology.

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The entire RFID system consists of the actual technology from the tag as well as readers together having access to global standardized databases, to make sure the real time up-to-date data on the items. These tags involve with a unique identification number known as *Electronic Product Code (EPC) technology* that enables the automatic information acquisition and distribute effective data. The communication process between reader and tag can managed through several protocols. Two standardized protocols can operated such as ISO and EPC according to the requirement of the filed. When reader switched on, "these protocols (ISO 15693 and ISO 18000-3 for HF or the ISO 18000-6, and EPC for UHF) begin the identification process and operated on selected frequency bands (e.g. 860 - 915 MHz for UHF or 13.56MHz for HF)" (Ahsan, Shah, & Kingston, 2010, p. 2).

a) Advantages of using RFID

RFID technology will be an advantage and useful in tracking asset data, and reducing supply overstock. According to Wen, Chao-Hsien et al., (2010), explains the benefits of RFID technology according to services such as, "increased safety or reduce errors, real-time data access, time saving, inventory control (cost saving) as well as product supply, resource utilization, and customer satisfaction" (as cited as Abijith & Fosso Wamba, 2012, p. 2).

b) Disadvantages of RFID

Customer's confidential information and privacy may not be maintained. Interference, high cost, some material create signal problem, and overloaded reading (Ahsan et al., 2010, p. 4).

c) RFID Standards

Having ISO and GS1 EPC standards in place are very critical.

The communication process between reader and tag can be managed through several protocols. Two standardized protocols can operated such as ISO and EPC according to the requirement of the field. When reader switched on, "these protocols (ISO 15693 and ISO 18000-3 for HF or the ISO 18000-6, and EPC for UHF) begin the identification process and operated on selected frequency bands (e.g. 860 - 915 MHz for UHF or 13.56MHz for HF)" (Ahsan, Shah, & Kingston, 2010, p. 2).

"GS1 standards are available for UHF tags only (known as Gen 2) in the form of EPC (Electronic Product Code) numbers and the EPC global network" (Lawrence & Jenkins, 2009, p. 6). Through the GS1 technique, various other applications can also track the documents, instruments by using RFID tag which inlayed within the livestock.

Here are some of the specific standards applied in various industries:

d) ISO/TR 20514:2005 Standard

This standard describes, "a pragmatic classification of electronic records , provides simple definitions for the main categories of EHR and provides supporting descriptions of the characteristics of electronic records and record systems" ("ISO," n.d.).

e) ISO/TS 27527:2010 Standard

Data Informatics provided a framework to improve the identification of the organization individuals and the data elements required to maintain the perspective system processing. This standard outlines, "The details of both data and processes for collection and application of identifying information for providers to maintain the records on providers" ("ISO," n.d.).

f) ISO/IEC 18000 Standard

This standard is used to "achieve communication across the air interface for specific frequencies between the IC in the RFID tag and reader" ("HIBCC," n.d.).

Some of the protocols those are included in this standard are-

- Transmission-Reader Talks First (RTF)
- Tag Unique Identifier (UID)
- Memory size
- Command structure and extensibility

g) ISO/IEC 15434:2006 Standard

This standard explains in such a manner that, "data is transferred to high-capacity *automatic data capture (ADC)* media from a supplier's information system and the manner in which data is transferred to the recipient's information system" ("ISO," n.d.). The benefits of using *ADC technology* is to receive the data in a standard form and deliver the information in a standard form. This standard specifies in the data encoded that involves in shipping, receiving, and inventory of the transport units and consists of supporting documentation in the electronic form ("ISO," n.d.).

III. Implementation of RFID in IT Asset Management System

RFID technology plays a significant role in supply chain management and retail marketing industry. In recent years mainly, "the use of RFID in *asset tracking and management* is already a popular application in many organization" (Ting et al., 2011). An important consideration for the development of undetected loss, *RTLS*, stock control. The study shows that, with an increase in demand and a number of challenges in the market, the RFID technology is implemented in various sectors. Depends on the situations, the best technology should be evaluated and used. In most cases, the *RFID* and *RTLS* are used together to identify the products.

On the other hand, some studies review that when launching an RFID system, there are some

implementation issues with RFID, related to issues seen in other environments. Generally, the main issue considered is inventory or *return-on-investment (ROI) such as cost of tags, tag readers, application of tags, software development, and system maintenance* (Cho et al., 2013, p. 4). In addition, another common issue in the implementation of RFID is the actual requirement and types of systems used in the environment. Depends on the requirements and the type of system, the purchasing cost and initial installation of the RFID can be excessive. However, with the implementation of the new technology improves the efficiency and performance of the systems, tracking and tracing the product, stock control and inventory. In current business, RFID technology has already implemented and made important variation in accordance to efficiency, performance, and tracking in many industrial environments.

a) ROI on RFID

The study shows that, the implementation of an RFID cost is complex task and requires a lot of money to invest ranging from $9 million to $25 million in *hardware, software, consulting services, and labor* (Ting et al., 2011, p. 11). The resources of the devices can be trace through the RFID tags and observe their maintenance. The administrators and professionals with the keystrokes of the RFID technology can locate all devices. Most common issue around the world is the equipment rentals and advertisement, but with the implementation of RFID, businesses have improved the resource utilization rates and equipment shrinkage has drop down from $150,000 per year to zero (Kohler, 2012).

The system that composed of development framework concerns in three propositions such as preparation, implementation, and maintenance that identified significantly to affect the industry through the implementation of RFID technology successfully. During the preparation stage, it mainly focuses on the planning, analyzing, hardware selection, and installation. The next stage is to implement the system design according to the environment and apply security and document policies. Lastly, maintenance stage is used for the system in order to monitor, evaluate the performance, and update the system with further extensions. The changes in the document polices of the services enhance the system alterations that need to be fit according to the organization. Therefore, RFID improves the safety, productivity, and track and trace the products.

IV. Conclusion

The implementation of the *RFID* system in various industries is an intricate task in the aspect of approval of budget from top management. The purpose of the RFID system is to integrate the technology into different services to identify the products and reduce the waste to improve efficiency. To reduce the error from the human mistakes, increase productivity, stock control, efficiency, safety, and track and trace the products this new technology can emerge into *logistics and supply chain visibility* sector. For the better accomplishment in this sector, the RFID application is most important to save the resources and reduce number of errors. Therefore, RFID technology in *IT services* intended to assist the managers in implementing RFID to several processes for the safety, inventory, tracking the product details, and *stock control.*

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Appendix

RFID usage in the IT environment maximizes the efficiency, productivity, and reduces the wastage. With the impact of RFID technology, the system can identify and track the instruments as well as product details with the help of real time location systems (RTLS).

Having RFID technology, the system can identify and track the instruments and product details with the help of RTLS devices.

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"Information" and "Information Resources"- Primary Theoretical Notions of Information Resource Studies

By T. F. Berestova
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Abstract- The article defines the phenomenon of information as the adaptation means of a subject to natural, social and spiritual world. The definition is based on the cognitive potential of the ascent method from abstract to concrete, conceptual restoration of the genesis of primeval informational process and methods of creating notions by means of extensional and intentional characteristics of the object under study. These approaches allow to reveal the essence of the "information" phenomenon and determine a number of its characteristics. Among them are tribal features of information such as evaluation, communicativeness, significance. The "information resources" phenomenon is considered as one of information kinds defined on the basis of its instrumental function and inherence of information tribal features and resource separation signs such as consumer value, purposefulness of creation and usage in activity. "Information" and "Information resource" notions are presented as a new scientific direction of information resource studies primary definition terms.

Keywords: theory, methodology, information resource studies, concepts, properties, definitions, information, information resources, documentation resources, nondocumentation resources.

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“Information” and “Information Resources” – Primary Theoretical Notions of Information Resource Studies

«Информация» и «Информационные ресурсы» - исходные теоретические понятия информационного ресурсоведения

T. F. Berestova

Abstract- The article defines the phenomenon of information as the adaptation means of a subject to natural, social and spiritual world. The definition is based on the cognitive potential of the ascent method from abstract to concrete, conceptual restoration of the genesis of primeval informational process and methods of creating notions by means of extensional and intentional characteristics of the object under study. These approaches allow to reveal the essence of the “information” phenomenon and determine a number of its characteristics. Among them are tribal features of information such as evaluation, communicativeness, significance. The “information resources” phenomenon is considered as one of information kinds defined on the basis of its instrumental function and inherence of information tribal features and resource separation signs such as consumer value, *purposefulness* of creation and usage in activity. “Information” and “Information resource” notions are presented as a new scientific direction of information resource studies primary definition terms. The author of the article also proves the overgrowing of classical information-resources knowledge into non-classical one. Such conclusion has been reached by recognition of the advanced organizational-methodological and technological branches of information science and due to the last publications in theory of information resources.

Keywords: theory, methodology, information resource studies, concepts, properties, definitions, information, information resources, documentation resources, non-documentation resources.

В статье феномен «информация» дефинируется как средство адаптации субъекта к природному, социальному и духовному миру. Дефиниция создана с помощью познавательного потенциала метода восхождения от абстрактного к конкретному, умозрительного восстановления генезиса первородного информационного процесса и методологии создания понятий посредством экстенсиональной и интенсиональной характеристик изучаемого объекта. Данные подходы позволяют выявить сущность феномена «информация» и назвать ряд его характеристик. Среди них родовые свойства информации: оценочность, коммуникативность, знаковость/языковость. Феномен «информационные ресурсы» рассматривается как один из видов информации, который дефинирован на основе наличия у него инструментальной функции, присущности родовых свойств информации и отграничительных признаков ресурса: потребительской ценности, целенаправленности создания, использования в деятельности. Понятия «информация» «информационные ресурсы» представлены как исходные термины понятийного аппарата нового научного направления информационного ресурсоведения. Представлены доказательства перерастания классического информационно-ресурсоведческого знания в неклассическое, это выводится из признания уже достаточно развѝтыми организационно-методических и технологических разделов информационной науки и появления публикаций по теории информационных ресурсов в настоящее время.

Ключевые слова: теория, методология, информационное ресурсоведение, понятия, свойства, дефиниции, информация, информационные ресурсы, документные ресурсы, недокументные ресурсы.

I. Introduction

В настоящее время активно развивается новое научное направление, названное нами Информационное ресурсоведение (1,2,3) и которое рассматривается как одно из научных направлений информатики, которую мы, вслед за Гиляревским Р.С., считаем «….научной дисциплиной о структуре, общих свойствах и закономерностях представления, передачи и получения информации…» (4,С.30). Развитие информационного ресурсоведения сейчас, в основном, осуществляется на подходах характерных для классического (эмпирического) познания, заметим, что такие подходы типичны и для других направлений ресурсоведения (геологического, трудового и т.д.). Вот как характеризует один из сетевых авторов Интернета эмпирическую стадию развития ресурсоведческих научных направлений. Им выделены следующие этапы: «1) сбор фактического материала; 2) группировка, классификация, систематизация; 3) выявление эмпирических закономерностей для данной выборки; 4) переход от выборочных данных к обобщениям, свойственным генеральной совокупности изученных объектов. На

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этом эмпирическая стадия заканчивается. Важно заметить, что заканчивается она при полном непонимании смысла (сущности) изученных явлений» *(http://coolreferat.com/37604)*.

Для классического этапа развития науки характерно существование «…дескриптивной (описательной) теории, решающей задачу описания и систематизации объектов….основной акцент здесь делается на выбор и обоснование научного языка, используемого в описаниях, а раскрытие ранее неизвестных сущностных закономерностей откладывается на следующие этапы исследований» (5, С. 148). По канонам классической науки теория строится за счёт обобщения «опытных фактов», а «….подтверждается опытом и очевидностью (наглядностью) её фундаментальных постулатов…» (6, С.188).

Науковедение показывает, что в генезисе любой науки (научного направления) есть несколько точек отсчета: во-первых, формируется сфера специализированной практической деятельности, только на этой основе происходит зарождение отраслевой науки (научного направления), далее идёт этап классической науки, нацеленной на описание, обобщение, познание существующей практики. В большинстве случаев это направление формирует такой раздел науки как организация, методика, а затем и технология, в ряде описательных наук (например, ботаника), другие разделы отраслевого знания не формируются совсем или формируются очень медленно. Развитáя практика создает условия для формирования спрофилированного или отраслевого исторического знания. Развитие исторических и организационно-методических (технологических) аспектов научного познания создает в свою очередь, условия для формирования теоретического и методологического знания, что часто соответствует статусу неклассической науки, и уже только после этого созревают условия для постнеклассической отраслевой науки. Классическая наука описывает явления, неклассическая объясняет их появление и развитие, постнеклассическая даёт прогнозы. Характеристики классической, неклассической и постнеклассической рациональности и науки сформулированы в работах В. С. Степина, (6,7) а применительно к циклу наук документально-коммуникационной сферы приложены А. В. Соколовым (5,8). Опираясь на эти методологические основания, рассматривая достижения и проблемы современного ресурсоведения, позволим высказать предположение, что современное информационное ресурсоведение может диагностироваться как классическое научное знание, создаваемое за счёт обобщения практического опыта.

Научное знание развивается по определенным законам и имеет строго определенную последовательность и логику развития. Проблемы, которые не могут быть сняты за счет развития организационно-методического или технологического знания, успешно решаются за счёт теоретического и методологического знания. Все аспекты научного познания взаимосвязаны и отсутствие теории, как части отраслевого научного знания, становится тормозом для развития организации, методики и технологии. Вот тогда появляются объяснительные (детерминистские) теории, и ставятся вопросы, характерные для появления неклассической рациональности, а, именно, вопросы о сущности явления и его структуре, о его функциях, о познании объективных законов развития данного феномена и т. д. и т.п. Для перехода на новый уровень познания недостаточно таких научных процедур как экспликация, классификация (систематизация, предметизация), возникает необходимость в системном подходе, в воссоздании генезиса явления, в использовании процедур восхождения от абстрактного к конкретному и др. Напомним, что теория – это такая форма научного знания, которая дает **целостное** и относительно истинное представление об изучаемом предмете, теория раскрывает **закономерности** его появления и развития. Классическое научное знание, ограниченное определенными научными процедурами и подходами, не может создать развитую теорию, а потому не обладает характеристиками целостного знания, ему не под силу вскрыть закономерности появления и формирования изучаемых феноменов.

Закономерности развития научного знания работают и при изучении информационных ресурсов, а потому среди ученых-информатиков постепенно осознается потребность в абстрактно-теоретическом познании, и об этом свидетельствует появление публикаций, посвященных темам, характерным для научной теории (9,10,11,12,13). В этих публикациях речь идёт о сущности явления «информационные ресурсы», о законах их появления и функционирования, всё чаще поднимаются вопросы, связанные с уточнением терминологии и дефинировании основных понятий. Понятия, как известно, используются и в науке, и в других видах деятельности, но в науке у них особая роль, они составляют ядро, «костяк» профессиональной терминологии, они инструмент профессиональной коммуникации субъектов каждой отрасли знания. Известно, что в теоретической части любой науки основным инструментом познания выступает абстрактное мышление, которое есть ни что иное как оперирование понятиями.

Вот и мы, поставив задачу разработки теоретического раздела информационного ресурсоведения, пришли к необходимости выбора той или иной конструкции, которая может быть использована в качестве теоретического основания для концепта «информационные ресурсы». Безусловно, теория информационных ресурсов должна опираться на понятие «информация». А значит нам необходимо четкое понимание: ***что такое информация?*** Но надо признать, что этот сакраментальный вопрос уже много

лет занимает умы философов, филологов, науковедов, кибернетиков, информатиков, биологов, физиологов, документологов, библиотековедов, библиографоведов и ученых многих других отраслей знания. Уже написаны Гималаи книг и статей на эту тему, а к консенсусу ученые не пришли до сих пор. Связано это с тем, что словом «информация» в разных науках называются разные явления, и даже если изучается одно и то же явление, то в разных отраслях науки оно раскрывается (понимается) по-разному. Выскажем предположение, что понять загадки феномена «информация» можно только в том случае, если проанализировать его глубокую укорененность в биологические и социальные процессы. А потому считаем: понимание того, как возникает информация, может быть сформировано через экскурсы к очень ранним этапам эволюции живой природы и к истории социума, без этого трудно сформулировать дефиницию феномена «информация» и выявить свойства и функции этого чрезвычайно сложного явления, не говоря уже о познании закономерностей функционирования различных видов информации.

Всех ученых, занимающихся проблемой дефинирования понятия «информация», можно подразделить на две большие группы: в первую входят те, которые считают информацию атрибутом материи и признают её существование в неживой и живой природе; во вторую группу входят те, которые считают информацию присущей только человеку и рассматривают её в качестве продукта сознания.

Ряд ученых пытаются создать самое общее определение феномена и понятия «информация». В связи с этим можно назвать имя американского ученого Н. Винера (14), испанского социолога М. Кастельса(15) и других. Среди российских коллег, предложивших своё понимание феномена «информация», назовём В.М. Глушкова (16), Ю.А. Шрейдера (17,18,19), Ершова А.П.(20) и их последователей. На статус общенаучного и даже философского определения информации претендует и дефиниция Д. А. Урсула: «Информация – отраженное разнообразие, как разнообразие, которое отражающий субъект содержит об отражаемом» (21,С.153). Противоречие этой дефиниции уже в том, что, если признается существование информации в неживой природе, то, как может идти речь о субъекте, субъектность – характеристика, используемая для человека.

Создание дефиниций наиболее общих понятий натыкается на трудность подбора родового понятия, ведь родовое понятие должно обладать ещё большим уровнем обобщения, чем дефинируемое. Попробуем преодолеть эти трудности через рассмотрение условий появления информации, осознание объективности её возникновения, через указание её предназначения и рассмотрения возможностей её включения в социальные процессы.

Слово «информация» в России появилось в Петровскую эпоху, но широкого распространения оно не получило. Позднее, когда пришло время создавать теории управления и коммуникации, термин «информация» стали использовать для того, чтобы объяснять сущность таких явлений как управленческие и коммуникационные процессы, и, вот тогда понятие «информация» получило широкое распространение. Лишь в начале XX века термин «информация» стал использоваться в документах, книгах, газетах и журналах и употребляться в смысле сообщения, осведомления, сведений о чем-либо. В этом значении он зачастую и сегодня используется в гуманитарных науках [1].

В технических науках очень часто информацию определяют через перечисление форм её существования, например, один из известных российских информатиков В. М. Тютюнник считает, что в процессе коммуникации в качестве элементарных частиц функционируют сигналы, данные, сведения, сообщения, и для обозначения совокупности всех этих элементов используется термин «информация» как обобщающее понятие (23). Можно ли обобщающее понятие признать дефиницией того или иного феномена? Согласно энциклопедии эпистемологии и философии науки: «Понятие – одна из форм отражения мира на рациональной ступени познания, мысль, которая выделяет из некоторой предметной области и собирает в класс (обобщает) объекты посредством указания на их общий и отличительный признак», каждое научное понятие имеет «две основные логические характеристики – экстенсиональную (объём) и интенсиональную (содержание)» (24, С. 719), именно в этих характеристиках заключен научно познавательный потенциал категории «понятие». Определение феномена информации, данное В. М. Тютюнником, фактически раскрывает объём понятия и даёт его интенсиональную (содержательную) характеристику. Объём понятия – это «класс объектов, выделяемых из универсума и обобщаемых в данном понятии. Отдельные объекты из данного класса – это элементы объёма понятия» (24. 719]. Объём понятия может быть представлен через перечисление объектов, выделяемых на основе общего содержательного признака. Структурирование внутри одного понятийного класса обычно производится на основе учёта специфики элементов, входящих в объём понятия. Определение объёма основных понятий это процедура, характерная для первоначального этапа развития науки или научного направления, нередко через перечисление объектов определяются границы изучаемых явлений, так ученые «столбят» отраслевое или направленческое поле познания, и зачастую именно так появляются самые первые дефиниции. Для создания дефиниции

[1] Например, «Информация – содержание какого-либо сообщения, сведения о чем-либо… значение данных, фактов». – См. 22, С. 430.

требуется интенсиональная (содержательная) характеристика изучаемого феномена.

Объём и содержание понятия тесно взаимосвязаны. Содержание понятия – это признак, с помощью которого производится обобщение, очень часто содержание понятия познается через выявление сущности отражаемого явления, и именно сущность должна быть положена в основу дефиниции научного понятия.

Дефиниции могут создаваться разными способами. Достаточно часто при создании дефиниций в их определяющей части используют описание структуры феномена, т.е. перечисление элементов его составляющих. Например: «Информационные ресурсы – отдельные документы и отдельные массивы документов, документы и массивы документов в информационных системах (библиотеках, архивах, фондах, банках данных, других информационных системах)» (25).

Распространенной является практика создания дефиниций через описание процесса или производимого действия. Примером такой дефиниции можно назвать определение информации, данное Г. Кастлером. Это определение наиболее признанно в биологии и звучит оно так: «Информация есть случайный и запомненный выбор одного варианта из нескольких возможных и равноправных» (26, С. 29). Данное определение использует и Д. С. Чернавский (27), родоначальник динамической теории информации. Очень распространенными подходами, используемыми при изучении информации, стала абстрактно-математическая (статистическая) теория информации К. Шеннона (28), который создал формулу количества информации.

Наиболее полный анализ имеющихся концепций, направленных на выяснение сущности феномена «информация» провёл А. В. Соколов. Он, представив результаты изучения феномена и понятия «информация», вскрывает противоречия, которые есть в информатических концепциях. К его оценке можно присоединиться, знакомство с перечисленными концепциями показывает: авторы информатических концепций в своих рассуждениях и примерах постоянно «соскальзывают» в зону информационных процессов, протекающих в человеческой деятельности. А. В. Соколов подвергает сомнению существование информации вне человеческого мышления, и для нас убедительно звучат его слова о том, что «… информация только тогда может иметь какое-то значение…, если кто-то или что-то её воспринимают и на неё как-то реагируют… . Можно рассматривать механистические, тепловые, гравитационные, электромагнитные взаимодействия в качестве информационных процессов… и даже моделировать их в виде уравнений. Но это будут знания о физической реальности, добытые людьми, а вовсе не атрибут материи, то есть это будет социальная, а не материальная информация» (5, С.166). И биологическая, и машинная информация, с точки зрения А.В. Соколова, по сути, являются семантической информацией, и эта информация выражает смыслы, которые могут быть биологическими, духовными, а могут быть и средством имитации соответствующих процессов в технических устройствах.

А.В. Соколов настаивает на том, что информацию может создать только человек, потому что только он обладает развитым сознанием, и это всегда будет семантическая (смысловая) информация. Важнейшей характеристикой информации он считает амбивалентность, т.е. существование информации в качестве единства материального и идеального: идеальны – смыслы, они созданы сознанием, но они могут быть явлены миру через материальность коммуникационных знаков. «Единство материальных и идеальных элементов свидетельствует о реальности феномена информации» (5, С.160). А. В. Соколов определяет феномен информации следующим образом: «…информация в сущности – амбвивалентный феномен, выражающий смыслы[2] в форме коммуникабельных знаков» (5, С. 257). В определение информации он вводит в качестве обязательного элемента Знак, тем самым снимая очень распространенное заблуждение в отождествление информации и смысла. Равенство между смыслом и информацией провозглашалось очень многими информатиками. Например, Р. С. Гиляревский пишет: «Информатика – наука об информации, которая является содержанием, смыслом сообщений, передаваемых людьми друг другу» (4, С. 30). Итак, из всех представленных выше определений информации наиболее убедительно звучит дефиниция А. В. Соколова.

Но тогда встает вопрос о том, каким словом должны обозначаться процессы и феномены, изучаемые в технике, биологии, генетике и других естественных и технических науках. Можно ли для этого использовать термин «информация» через конкретизацию его видовой характеристики: «биологическая», «генетическая», «машинная»? Вопрос о подборе термина в этих случаях, конечно, должен решаться учеными, изучающими природные явления и/или занимающихся созданием технических устройств. Но поискать рациональное зерно в этих подходах мы обязаны, это будет способствовать объективности рассмотрения существующих позиций.

В биологии и в математической теории информации часто приводят определение информации как запомненного выбора одного варианта из нескольких возможных и равноправных, иногда подчеркивается случайность выбора. Выбор того или

[2] Под смыслами понимаются – знания, умения, эмоции, волевые побуждения, фантазии, т.е. продукты индивидуальной психической деятельности, которые могут быть сообщены другим людям.

иного варианта действий, конечно, направлен на обеспечение выживания живого организма, выбор производится на основе реакции живого организма на внешнее воздействие, эта реакция выражает стремление живого организма к установлению динамического равновесия со средой обитания. Установление динамического равновесия становится возможным благодаря свойству раздражимости, проявление раздражимости обеспечивает изменение состояния живого организма или его местоположения. Можно ли этот процесс назвать информационным ? Нам думается, что «запомненный выбор» – это ещё не информация, это положительная или отрицательная маркировка внешнего воздействия и изменений состояния организма. Отрицательные или положительные изменения, происходящие в организме, сохраняются в памяти живого существа за счет условных и безусловных рефлексов, и это обеспечивает адаптацию к среде обитания. В дальнейшем действия живого организма опираются на уже сформировавшийся рефлекс (на уже имеющийся опыт), и процесс выбора происходит уже не случайно, выбор регулируется на основе оценки возможных и наиболее реальных последствий на те или иные воздействия внешней среды. Безусловно, подобными реакциями обладает и человек, у него, как у всякого живого организма, есть первоначальные реакции/ответные действия на воздействия внешнего мира, их первоначальный выбор также может быть случайным, но впоследствии при повторении подобной ситуации человек чаще всего осуществляет выбор уже осознанно, т.е. осмысленно. В процессе эволюции свойство раздражимости перерастает в психические процессы, у home sapiens это обусловлено физиологическими особенностями строения нервной системы и головного мозга. У животных, уже находящихся на очень высокой ступени эволюции, появляются сенсорные образы, которые есть не что иное как отражение фрагментов среды обитания, и это есть форма связи/взаимодействия высокоорганизованного животного с миром, в котором оно проживает. Отражательность – как функция мозга и как одна из самых важных его характеристик признана философами, биологами, нейрофизиологами, культурологами и представителями многих других научных специальностей. Безусловно, без признания существования отражательности мозга трудно понять феномен «информация», трудно сформулировать её дефиницию.

Анализ способов создания дефиниций дает нам примеры того, что дефиниция явления конструируется на основе признания дефинируемого явления в качестве внутреннего компонента системы, и в этом случае при определении феномена чаще всего используют описание его структуры, перечисление его элементов. Но сущностная дефиниция феномена должна раскрыть природу определяемого феномена, она должна вскрывать и причину его появления и отражать механизм, обеспечивающий встроенность данного феномена в более обширную систему. Причины появления феномена чаще всего находятся вне внутренней системы, в которой функционирует изучаемое явление. При создании определения изучаемого феномена, кроме указаний на причины его появления, очень важно раскрыть отличие дефинируемого явления от исходного, родового, с этой целью вводятся видовые отличия.

Более обширной системой (метасистемой) в рамках которой зарождается и функционирует феномен информации является система «Человек – Окружающий мир (среда обитания/бытования)». Окружающий мир неоднороден, он включает в себя природный мир и мир социальный и духовный, последний создан людьми. Первоначально феномен «информация» появляется в этой дуальной системе как посредник, обеспечивающий связь индивида с реальным миром, и его предназначение обеспечить выживание индивида. Н. Винер писал, что информация – это "обозначение содержания, полученного из внешнего мира в процессе нашего приспособления к нему и приспособления к нему наших органов чувств" (29, С.19). Мы, как и Н. Винер, приходим к выводу, что информация является средством/инструментом, обеспечивающим сначала выживание людей, а затем освоение ими территорий, на которых они проживали. Далее информация используется уже для адаптации не только к материальному миру, но и к миру, произведенному социумом и сознанием индивида, т.е. к миру идей и фантазий, эмоций и волевых побуждений, которые являются продуктами индивидуальной психической деятельности и которые обозначаются термином «смыслы». Адаптация может быть биологической и социальной. «Человек – адаптивно-адаптирующее существо. Адаптация человека – процесс двусторонний»: индивид приспосабливается к условия проживания и/или условия приспосабливает к своим нуждам и потребностям. (24, С.23)

Важно заметить, что любой субъект, адаптируясь к материальной и духовной (интеллектуальной) среде своего обитания и адаптируя их к себе, вступает в процессы развития, а на основе развития индивидов формируется социальный, в том числе и научно-технический прогресс. Постоянная обновляемость реалий природного и социального мира обуславливают непрерывность процессов адаптации всех живых организмов, но человек справляется с задачей функционирования в постоянно обновляющемся мире более успешно, чем это делают другие организмы, в первую очередь, из-за того, что он преобразует окружающую среду, он создает «мир под себя».

Согласно системному подходу появление любого нового феномена всегда обусловлено и направлено на разрешение проблемной ситуации, но появившийся феномен может стать относительно

самостоятельным явлением и породить новые феномены, имеющие общую с ним природу, и, в тоже время, обладающие отличиями по сравнению с исходным. Именно так возникает видовое разнообразие нашего мира. Все сказанное в полной мере относится к феномену «информация». Первыми условными актами создания информации были ответы на проблемные ситуации, связанные с выживанием человека, с обеспечением его безопасности, с поддержанием жизнедеятельности его организма и с удовлетворением естественной потребности в продолжении рода.

Ещё в 1958 году один первых исследователей информации Н. Винер писал, что информацию можно рассматривать как процесс. Разработка этого положения ввела понятие «информационный процесс», и есть резон рассмотреть инфопроцесс более пристально. Описание информационного процесса мы позаимствовали у В.З. Коган (30), но в его схему были внесены дополнения и уточнения. Инфопроцесс начинается со столкновения индивида с реальностью – это предфаза, в неё входит созерцание и восприятие, через которые происходит отражение фрагментов действительности (реальности) в сознании и так формируются чувственные образы. Создание образа открывает фазу производства информации**,** в ней выделяются следующие процедуры: представление, формирование образа и внесение в него смыслов, а также и установление взаимосвязей между смыслами. Но чувственный образ трудно сохраняется в памяти, через короткое время он может исчезнуть, об этом пишет А. И. Каптерев (31,С.12). Недолговечность сохранения образа приводит к необходимости его обозначения/кодирования через код, символ, т.е. через Знак. Обозначение смысла через знак обеспечивает материализацию смысла, создание/использование знака – это важнейший элемент процесса возникновения информации, и в результате инфопроцесса появляется информационный продукт. Знаки возникают, как особая договоренность между индивидами. Фаза производства информации, которая по своей сути является семантическим процессом, заканчивается созданием информационного продукта. Созданная информация сохраняется в памяти или фиксируется на каком-либо носителе – это фаза сохранения информации. Сохраненную информацию можно передать другому индивиду, который примет знаки, раскодирует их, извлечет смысл – это процедуры фазы передачи информации. Передача информации есть начало коммуникационной деятельности. Фаза передачи информации включает временные и пространственные характеристики, т.е. коммуникация может характеризоваться временем, необходимым для передачи информации и возможным расстоянием (доступным для связи) между участниками коммуникации. За фазой передачи следует фаза потребления информации, она включает восприятие знака и процесс его распознания, т.е. перевод знака в смысл. Затем идёт «встраивание» смыслов в сознание индивида, принявшего информацию, то есть происходит установление отношений между смыслами, их обозначающими, все эти процедуры также можно диагностировать как семантические явления. Постфаза инфопроцесса – это использование информации; постфаза информационного процесса – это начало других, чаще всего не информационных видов деятельности.

В постфазе происходит метаморфоза: информационный продукт превращается в информационный ресурс, который наряду с сырьём, инструментом используется Человеком во всех видах деятельности, подобные процессы присутствуют в очень многих сферах деятельности, например, мука – продукт мукомольного производства и сырьевой ресурс – для хлебопечения, примеры можно продолжать, и продолжать. А по поводу информационных ресурсов скажем: сегодня общепризнано, что они необходимый и обязательный компонент в производстве материальных и духовных благ. Создание информационного ресурса – это цель любого информационного процесса. Достигнутая цель – это результат информационного процесса, а достижение цели – критерий, который позволяет нам признать процесс успешным, к сказанному добавим: созданная информация может иметь чёткое прикладное назначение или быть ресурсом для продолжения процесса научного познания.

Умозрительное восстановление информационного процесса позволяет уточнить дефиницию информации, предложенную А.В. Соколовым. Уточнение дефиниции вызвано необходимостью указать на причины возникновения информации и показать механизм возникновения информации. В нашей формулировке сущностное определение информации выглядит так: «Информация – это средство адаптации субъекта к окружающему миру через созданные или присвоенные/заимствованные смыслы, выраженные коммуникативными знаками». Адаптационных механизмов природа создала немало, нам важно было дать отличие информационной адаптации от других способов приспособления живых организмов к среде обитания. Думается, данное определение эту задачу решает.

Мы уверенны в том, что в данном определении «схвачена» сущность феномена «информация»? Наша уверенность порождена многократно проверенной методологией познания через восстановление генезиса явления, через обращение к процедурам восхождения от абстрактного к конкретному, а именно, воспроизведение движения от исторически первичного к исторически производному, от простого (первородного) к сложному. «Сама история объекта производит абстракции, в которых удерживаются сущности, освобожденные от преходящего исторического содержания» (32, С.195). Историческое (эволюционное) развитие феномена зачастую «затушевывает» его первозданность, маскирует

причины его появления, и это не позволяет выявить сущность объекта изучения, отразить сущность в его дефиниции.

Определяя информацию как средство адаптации, мы должны сказать, что самым главным и наиболее эффективным средством адаптации стала преобразовательная деятельность человека. Деятельность возникает как ответ на потребности, она обеспечивает удовлетворение и физических, и социальных, в том числе и духовных потребностей. Под влиянием развития индивидов и социума деятельность дифференцируется и при этом происходит дифференциация информации, которая является обязательным инструментом деятельности. Через информацию человек адаптируется к условиям протекания деятельности, которая может быть различной по целям и по сложности, усложнение деятельности требует специальной подготовки субъекта её осуществляющего. И такая подготовка в свою очередь идёт через создание и использование информации, поэтому все информационные процессы, сопровождающие деятельность, могут быть охарактеризованы по-разному в зависимости от целей и содержания деятельности, но, по сути, они – адаптационны, информация – это средство/инструмент приспособления человека к той или иной деятельности. Умозрительно воспроизведя абстрагированный информационный процесс и описав условия, предшествующие его появлению, мы можем выявить объективность и органичность формирования у информации её родовых характеристик/свойств, которые информация получает от феноменов, предшествующих её появлению. Далее эти родовые свойства будут присутствовать во всех явлениях производных от информации, они будут генетически наследоваться и таким феноменом как информационный ресурс, и в значительной степени свойства информационных ресурсов будут определять закономерности их функционирования в информационном пространстве социума.

В статье «Свойства информации как потенциал её иерархического функционирования и видового многообразия» (33) нами была предпринята попытка выявить функции информации, которые могут возникнуть на основе её свойств. При этом функция определялась как «…внешнее проявление свойств какого-либо объекта в данной системе отношений» [34,С. 719]. Мы выяснили: природа или родовые функции формируются на основе родовых свойств феномена, а сами свойства наследуются феноменом от его предшествующих состояний; видовая функция, возникающая при рождении нового феномена, объясняет причину его появления и его предназначение. Совокупность родовых и видовых свойств – это и есть сущностная характеристика исследуемого феномена. Ведь давно известно: ничто не уходит и не исчезает бесследно, а обязательно остается в явлении в снятом «скрытом» виде. Сущностные характеристики сохраняются на протяжении всего периода существования явления. При разрушении сущностных свойств изучаемого феномена, он перестает функционировать, а то и просто исчезает.

Осознание важности родовых свойств информации заставляет нас остановиться на их характеристике более подробно. Как средство адаптации информация обладает свойством **оценочности**, это свойство есть у всякого живого организма. У человека, благодаря развùтой нервной системе и включенности в социальные и духовные процессы, оценка отходит от вердикта «полезно или опасно для организма», оценка становится многомерной, многовариантной, осмысленной, расцвеченной всеми характеристиками, отражающими индивидуальность и социальность субъекта.

Информация обладает свойством **коммуникативности:** 1) через информацию осуществляется связь индивида с миром природы, социума; 2) передача информации – это начало коммуникационной деятельности. Фаза передачи информации при развитии социума формирует специальные коммуникационные системы и целые отрасли народного хозяйства/бизнеса, специализирующиеся на передаче информации. Ярчайшими примерами таковых является деятельность образовательных учреждений, органов СМИ, учреждений индустрии досуга и сферы искусства.

Материализация смыслов в форме знаков, интегративность существования смысла и знака в феномене «информация», формирует у информации свойство **знаковости, языковости**, и это свойство обеспечивает существование информации на разных естественных и искусственных языках. Благодаря этому свойству получила развития и устная речь, и письменность, и рукописная и печатная форма коммуникации, и машинная информация, благодаря последней стало возможно возникновение компьютеров и телекоммуникационной инфраструктуры современного общества. Свойство знаковости есть и у сигналов, отправляемых и получаемых животными, а вот полноценного вербального (словесного) языка, сохраняющего и передающего смыслы, у животных нет. О неразрывности языка и мышления сказано было немало, нет необходимости приводить соответствующие цитаты, это положение стало общепризнанным во всех науках о человеке. Языковость, как осмысленность, – это свойство присуще только социальной, т.е. семантической информации.

Каждое из названных родовых свойств информации в процессе её эволюции, при возникновении её различных видов и разновидностей может модифицироваться, конкретизироваться, но важно в данном случае то, что эти свойства будут присутствовать во всех видах информации, потому что

они присущи, атрибутивны феномену информации, неотделимы от него. Без этих свойств феномен информации не возникнуть, не существовать, не функционировать не может. Все сказанное вполне справедливо по отношению к информационным ресурсам, однако, данное понятие – порождение нового времени, и оно требует особого объяснения и собственного дефинирования.

Прежде всего, отметим, что в словосочетании «информационный ресурс» прилагательное информационный указывает на родовые связи изучаемого феномена, а термин ресурс очень хорошо выражает его предназначение и показывает его место в системе разных сфер деятельности, и это может быть использовано как видовое отличие в ряду различных информационных явлений. Таким образом, видовая характеристика информационного феномена через понятие ресурс может быть использована как один из признаков отграничения этого феномена от родственных явлений. Возникновение информации как способа разрешения проблемной ситуации задает у информации свойство **инструментальности,** это происходит при превращении результата/продукта информационного процесса в информационный ресурс, об этом уже было сказано выше. Инструментальность позволяет информации проявляться виде «инструмента» в системе отношений между элементами духовной, материально-производственной или любой другой деятельности. В различных сферах человек, выступающий субъектом деятельности, использует информацию как средство или инструмент, наряду с инвентарем, механизмами, сырьём.

Информация как цель и результат информационной деятельности существовала всегда, и всегда использовалась в самых разных сферах, но термин «информационный ресурс» появился сравнительно недавно, он родился в наше время, когда заговорили об информатизации, о возникновении и развитии информационного рынка. Отсюда определять информационный ресурс через понятия результат и продукт информационного процесса верно, но явно недостаточно, в дефиниции должны присутствовать и иные смысловые (содержательные) характеристики. Использование понятия «информационный ресурс», в качестве научного концепта, обязывает исследователя этого феномена предложить его определение (дефиницию).

Обратимся к уже существующим дефинициям «информационные ресурс» и поищем в них смысловые, т.е. содержательные характеристики. Дефиниций понятия «информационный ресурс» создано немало. Так, А. Б. Антопольский, говоря об информационном ресурсе, включил в это понятие такие его элементы «как отдельные документы, и отдельные массивы» [9, С. 1], подобным образом этот феномен определяется в российских законодательных актах (25). В приведенном определении А.Б. Антопольского информационные ресурсы обозначаются через производное и уже потому более частное понятие, в таком варианте дефиниции не даны родовые и видовые характеристики, а значит, не может быть выявлена и определена сущность феномена. Смыслы, один из обязательных элементов информации, создаются в процессе интеллектуальной деятельности, признание этого факта отражено в одной из самых первых дефиниций понятия «информационный ресурс»: «Информационный ресурс – это интеллект людей, проживающих на определенной территории» – такая дефиниция, предложена в монографии Г. Р. Громова (35). Наиболее часто используется дефиниция информационных ресурсов, представленная в ГОСТе 7.0-99 «Информационно-библиотечная деятельность, библиография. Термины и определения»: «Информационные ресурсы – это совокупность данных, организованных для эффективного получения достоверной информации» (36). Однако, предложенная дефиниция вызвала критику, потому что «она невнятна и тавтологична» [37,С.17-18]. Такая оценка справедлива и по отношению к понятию «информационные ресурсы», и к понятию «данные».

Несостоятельность дефиниций понятия «Информационный ресурс» в терминологических ГОСТах и ряде публикации породило у нас желание «дойти до самой сути», и выработать собственную дефиницию. При этом мы руководствовались следующим правилом: для отделения (конкретизации) новой сущности от родовой субстанции используются те или иные видовые характеристики дефинируемого явления, среди которых наиболее продуктивно обращение к понятию «функция».

Так в результате восстановления генезиса информационных ресурсов при использовании родовых и видовых характеристик данного феномена было создано определение, раскрывающее интенсиональную (содержательную) сущностную характеристику изучаемого объекта: «Информационный ресурс – это целенаправленно созданная информация, реализующая её инструментальную функцию через использование в качестве средства определенного вида деятельности, обладает потребительской ценностью, может выступать в качестве товара на информационном рынке». Целенаправленно созданная информация может рассматриваться как теоретическое и/или практическое знание, первый вид знания содержит в себе факты, концепции и другие результаты научных поисков и рефлексии, во втором – в качестве знания транслируются научно-технические разработки, описания технологий, методики, обобщение опыта и многое другое. Целенаправленность создания информации в процессе подготовки ресурса нужно оговорить особо, информация, созданная как побочный продукт учёта или других процедур, не может быть полноценным информационным ресурсом, потребительская ценность такой информации не велика.

В предлагаемом определении информационных ресурсов в качестве родового понятия выступает информация, а видовой характеристикой, выделяющей определяемое понятие из всего многообразия информационных объектов, названы инструментальная функция, предназначение информационного продукта в качестве средства деятельности, его потребительская ценность, т.е. востребованность в структурах социума и/или индивидов. Потребительская ценность информационных ресурсов вытекает из основной инструментальной функции и тесно связана с их целевым предназначением.

Понятие «информационные ресурсы» – исходное понятие информационного ресурсоведения. Это понятие ложится в основание всего понятийного и терминологического аппарата данного научного направления. На его основе создаются другие термины и от него отталкиваются при дефинировании и классифицировании различных видов информационных ресурсов. С этой целью общее понятие «информационные ресурсы» «расклеивают» на более частные понятия. Мы рассмотрим только несколько этих частных понятий.

Появление фиксированного знака порождает Документ[3], и он становится важнейшим информационным ресурсом. Однако, Документ усложняет информационный процесс и порождает документальную коммуникацию, т.е. деятельность по производству и распространению Документа. Одно из усложнений информационного процесса связано с тем, что теперь человеку приходится извлекать информацию из документа, а одновременно из информации извлекать смыслы, и только потом их можно использовать в той или иной деятельности. Появление Документа подразделяет общее понятие «информационный ресурс» на два понятия Документный и Недокументный ресурсы.

Недокументный ресурс с появлением письменности не исчезает, он существует одновременно с рисунком, с нанесением насечек, с начертанием иероглифов и др. После возникновения Документа роль и значимость недокументного ресурса уменьшается. Но, всё-таки, этот информационный ресурс очень часто остается важным инструментом социальной коммуникации, ведь он – процессуально первороден: смыслы формируются и обозначаются словесными знаками в сознании, мысленно и вслух произносятся, и лишь потом могут быть закреплены на материальном носителе. Так, и в наше время существуют многообразные формы социально-значимого информационного недокументного ресурса, это – неформальное устное общение, консультации, лекции, доклады и многое другое. Значительная часть недокументных информационных ресурсов представлена на информационном рынке в секторе информационных услуг: консультации по созданию программного обеспечения, работе с базами данных, по техническому обслуживанию и ремонту, услуги по обучению, подготовке и переподготовке персонала, услуги по управлению сетями, сетевой обработке данных и передаче сообщений в сетях и др. В настоящее время передача информационного ресурса может осуществляться при непосредственных контактах или при прямой трансляции с помощью телефона, скайпа, радио или телевидения.

Разделение информационных ресурсов на отдельные виды на этом не заканчивается. На современном этапе развития социума и информационной сферы происходит разделение на:

1. ресурсы, предназначенные для использования в профессиональных сферах деятельности в качестве особого инструмента, такие ресурсы далее могут подразделяться по отраслям: информационные ресурсы для медицины, сельского хозяйства, информационные ресурсы образования, информационные ресурсы управления и т. д. и т. п.
2. ресурсы, имеющие гуманистическое содержание и гуманистическую цель, предназначенные фактически для всех групп потребителей, их условно называют «информационные ресурсы-общественное достояние».

Первая группа информационных ресурсов нередко готовится и используется в предпринимательской среде, чаще всего распространяется на платной (коммерческой) основе. Вторая группа информационных ресурсов может бытовать и вне коммерции, и являться условно бесплатным ресурсом, чаще всего эти ресурсы используются потребителем не в целях получения дохода, а в целях досуга, самообразования или самосовершенствования, а также для защиты прав и достоинства Человека.

Два вида информационных ресурсов, описанных выше, имеют разные потребительские характеристики и создаются субъектами, исповедующими разные социальные ценности и работающими в разных условиях. Подготовка гуманистических информационных ресурсов нередко осуществляется людьми, вдохновляемыми идеями просветительства, общественного блага и общественной пользы, значительная часть этих людей работает в бюджетных государственных учреждениях, немало людей, производящих информационные ресурсы, воспринимаемых как общественное благо, трудится в благотворительных и просветительных организациях. Для создателей информационных ресурсов, предназначенных для профессиональной деятельности, на первое место всё чаще выдвигаются ценности, характерные для бизнеса. Ценностное кредо этих

[3] Фиксирование информации, связанное с разрешением проблемы сохранения информации, считаю сущностным признаком документа, потому что здесь кроется причина появления Документа. Свои позиции я обосновывала в дискуссии с Ю. Н. Столяровым в 2011 г. – См. 38,39.

индивидов связано с развитием информационного рынка, который сегодня также называют рынком информационных продуктов и информационных услуг. Рыночная форма отношений между создателями информационных продуктов и потребителями информационных ресурсов способствует превращению информации в товар, и эти информационные продукты/ресурсы предоставляются за определенную цену. В условиях рынка у информации появляются стоимостные показатели, при её производстве и распространении используются маркетинговые технологии, рассчитываются размеры потенциальной и полученной прибыли и т.п.

Реализация – сложнейший и важнейший вопрос любого рынка. Разработчики информационных продуктов и первого, и второго вида чрезвычайно обеспокоены сбытом своей продукции, и потому разработчики и продавцы используют для обозначения создаваемой ими продукции термин «информационный ресурс». При этом упор сделан на понятие «Ресурс», потому что для потенциальных покупателей/потребителей предлагаемый условно бесплатный продукт или товар, обладающий рыночной ценой, – это будущий ресурс их деятельности. Сами приобретатели в предлагаемом товаре ищут смыслы, выраженные понятными для них знаками, т.е. они ищут/приобретают информацию. Именно это важно для них, гораздо меньше их интересует то, что продаваемые/распространяемые информационные ресурсы чаще всего существуют в документной форме. «Схватывать» смыслы из «недокументных» ресурсов гораздо быстрее, чем извлекать смыслы из документа, а далее, когда всё-таки приходится иметь дело с документными ресурсами, то потребитель по-прежнему делает упор на понятие «информационный ресурс», оно более точно отражает смысл искомого им объекта. Потребительская ценность – одна из важнейших характеристик информационного ресурса, это связано с тем, что информационный ресурс всегда создается или подбирается/отбирается целенаправленно для определённого вида деятельности.

Характеристики информационного ресурса, предложенные в вышеприведенной дефиниции, могут использоваться как отграничительные признаки, на основе которого совокупность информационных объектов можно разделять: на явления, подпадающие под это определение, которые и есть информационные ресурсы; и явления, не подпадающие под него, последние **не** могут относиться к классу «информационные ресурсы», так как **не** соответствуют экстенсиональным характеристикам этого информационного феномена, таким образом, они не могут быть включены и в объём понятия «информационные ресурсы». Как уже было сказано, во многих структурах социума, нацеленных на материальное или духовное производство, в качестве побочного продукта возникает различная информация, но эти информационные массивы (эти данные) могут превратиться в информационный ресурс только через целенаправленные поиски своего потребителя и через обязательную предпродажную или другую специальную обработку, через создание потребительской ценности.

Конечно, дифференциация информационных ресурсов не исчерпывается только перечисление данных видов. Очень важным признаков считаем деление информационных ресурсов на первичные и вторичные, в частности во вторичные информационные ресурсы входят те, которые содержат библиографическую информацию и метаданные. Об этом достаточно подробно мы уже писали (40,41).

Теория информационных ресурсов только начинает развиваться. Рассмотрение понятия «информация» как основание для определения феномена «информационные ресурсы» и создание сущностной дефиниции информационных ресурсов – это начало целенаправленной и осознанной работы по формированию научно-понятийного аппарата информационного ресурсоведения. Очень может быть, что проделанная нами работа вызовет активную критику у представителей традиционных подходов к изучению информационных ресурсов, а может быть это станет началом создания новых научных концепций. В любом случае очень хочется, чтобы наши размышления и выводы будили желание заниматься теоретическими аспектами информационной науки, и мы уверены, что это будет способствовать развитию нового научного направления, получившего название «Информационное ресурсоведение».

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Prediction of Total Electron Content using Nonlinear Autoregressive Models with Exogenous Input Recurrent Neural Network

By S. Kalita, B. Chetia, M.Devi & A.K. Barbara
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Abstract- The satellite navigation system needs the prediction of the ionospheric information. It is crucial to select a competent ionospheric model and predict the value of Total Electron Content (TEC) data. Determining the TEC from dual-frequency GPS observations has become important since it is used by many researchers for different research areas. In this paper, an attempt is made for predicting TEC parameter by using Nonlinear Autoregressive models with eXogenous input recurrent neural network. The work is based on TEC data collected from the GPS receiver at Guwahati (26^{o} 10' N, 91^{o} 45' E).

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I. Introduction

Total Electron Content (TEC) of ionosphere measured by GPS satellite is an important parameter since it is used by many researcher around the globe in different application areas. TEC is a measure of the total number of electron per square meter along the line of sight from the satellite to receiver on ground where 1 TECU (TEC Unit) = $1x10^{16}$ electron/m^2. TEC provides an overall description of the ionosphere and used in many applications like satellite navigation, time delay, relative positioning etc. The variations and characteristics of TEC at low, high and middle latitudes have been studied by a number of research workers (Shim J. A., 2009, Bagiya et. al., 2009). The time series analysis has been used for prediction in the field of atmospheric study, market analysis, earthquake prediction and so on (Kalita S, 2012, Devi M et. al., 2001, Kothari et. al., 1997). In this paper, based on time series analysis, we have developed and analyzed a new ionospheric TEC prediction technique using Nonlinear Autoregressive models with eXogenous input recurrent neural network (NARX) to perform short-term regional ionospheric TEC prediction. Thus, the predicted TEC were compared with the TEC measured by GPS located at Gauhati University to assess the performance and feasibility of the forecasting model built. For the experiment the GSV4004 receiver have been utilized for collection of TEC in Gauhati University Laboratory. The receiver can track up to 11 GPS signals at the L1 frequency (1575.42 MHz) and the L2 frequency (1227.6 MHz). It measures phase and amplitude (at 50-Hz rate) for each satellite and computes TEC from combined L1 and L2 carrier phase measurements which also collects ionospheric Scintillation data.

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II. Description of Modeling and Prediction Mechanism

The ionosphere is greatly affected by the solar activities, the sunspot index and the solar radio flux index can be regarded as the main independent variables which impact the variation of the TEC, and therefore for the experiment the 10 minute average data of the TEC parameter is considered as the input to the model. The slant TEC data are converted to the vertical TEC (TEC_v) using mapping function. Given a time series $X = \{TEC_v(t), t = 1, ..., n\}$, where $TEC_v(t)$ is a value at discrete time t and n is the number of data points in the time series, we wish to predict the value $TEC_v(t + 1)$ at time $t + 1$.

In the first step, the vertical TEC is transformed to an equivalent volatility index using the following formula:

$$V(t)=\log\left((TEC_v(t+1)/TEC_v(t)\right)$$

Volatility is used to determine the abrupt local changes in the TEC time series. Since the neural networks do not provide accurate predictions for the data that are not within the range of training data sets, therefore, instead of the estimated TEC data, the volatility TEC time series is considered as training data instead of original VTEC data.

In the second step, the nonlinear autoregressive network with exogenous inputs (NARX) prediction model is constructed using the volatility series. The NARX is a recurrent network (dynamic), with feedback connections containing several layers of the network. The model is based on the linear ARX model, which is basically used in time-series modeling.

The defining equation for the NARX model is:

$$y(t)=f(y(t),y(t-1),\ldots,y(t-d_y),u(t),u(t-1),\ldots,u(t-d_u))$$

where u(t) and y(t) denotes the input and output of the model at time t, the lags of the input and output of

the system are represented by du and dy respectively and f is a nonlinear function.

NARX networks are better for time series prediction than conventional recurrent neural networks because (a) Learning is more effective in NARX networks than in other neural network and
(b) These networks converge much faster and generalize better than other networks.

The state space representation of recurrent NARX neural networks can be expressed as (O. M. Mohamed Vall and R. Mhiri, 2008)

$$Z_k(k+1)=\begin{Bmatrix}\phi\big(u(k)\big), z_i(k)), & i=1,\\ z_i(k), & i=2,3,\dots N\end{Bmatrix}$$

where the output y(k) = z_i(k) and z_i, i=1,2, … N, are state variables of recurrent neural network.

The NARX model for approximation of a function f can be implemented in many ways, but the simpler seems to be by using a feed forward neural network with the embedded memory and a delayed connection from the output of the second layer to input.

In this paper, an artificial neural network models with two levels i.e. input layer, output layer are considered for the general prediction equations. For computing the next value of the time series $TEC_v(t+1)$ using model, the past observation TECu(t), TECu(t-1), …, TECu(t-d_u) and the past outputs TECy(t), TECy(t-1), …, TECy(t-d_y) as inputs, may be written in the form:

$$TEC_v(t+1)=\phi\Big\{w_{b0}+\sum_{h=1}^{N} w_{h0}\,\phi_h(w_{h0}+ i{=}0duwihTECut-i+j{=}0dywjhTECy(t-j))$$

For learning, a dynamic back-propagation algorithm is required to compute the gradients, which is more computationally intensive than static back-propagation and takes more time.

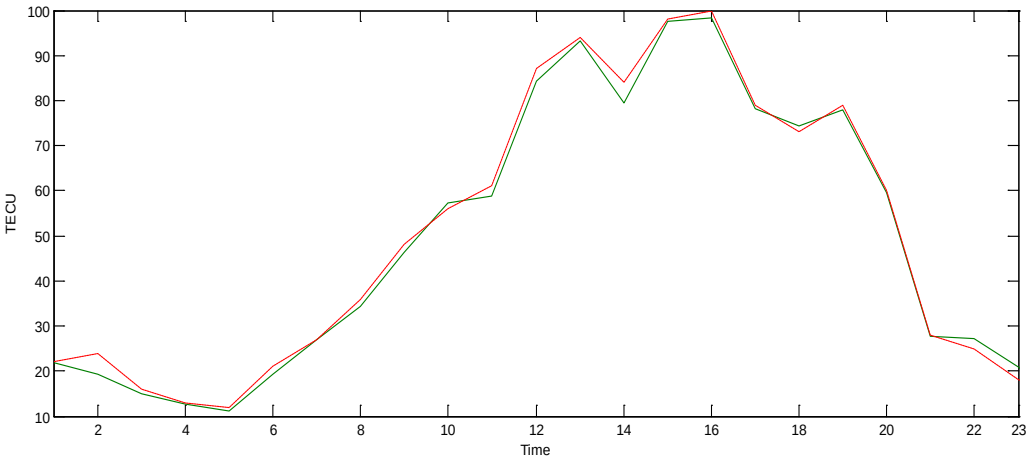
In this research work, Marquardt optimization (Martin T et. al., 1994) was modified for network training function to include the regularization technique. It reduces the squared errors and the weights and, then determines the correct combination so as to construct a network which generalizes well which is called Bayesian regularization. In function approximation problems, for networks that contain a few hundred weights, the Marquardt algorithm provides the fastest convergence, since this advantage is noticeable if very accurate prediction is required.

In the third step, the output volatility predicted by the NRAX model is converted for comparison with the original data using.

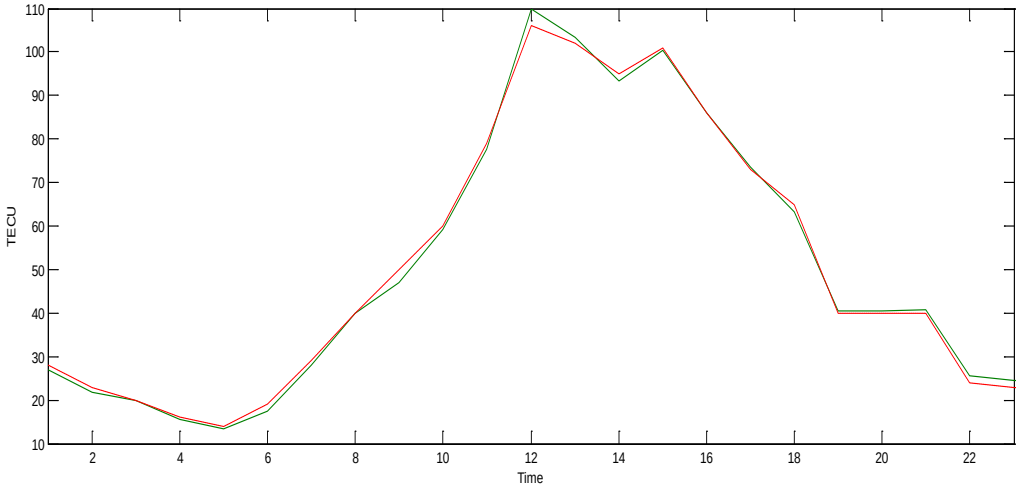
$$TEC_v(t+1)=\exp(V(t))\,.TEC_v(t)$$

III. Experimental Results

The ionospheric TEC data for the year 2011 to 2012 was considered for analysis and for each day the 10 minute average TEC data have been utilized for modeling and prediction. The network is trained according to the seasonal variation of the ionospheric TEC values. For each month the first ten quietest days are considered for modeling and the next day is considered for checking the validity of the prediction. The prediction of TEC data on 14 Sep 2011 and 20 March 2012 are presented in figure 1 (a) and (b) respectively.



(a)



(b)

Figure 1(a, b): Comparison of the predicted TEC values by the model and the observed TEC values at Guwahati for (a) 14 Sep 2012 and (b) 20 March 2012

Table 1: Precision statistics of the TEC predicted by models (δ =predicted value-observed value)

Forecast time	δ<=1TECU	1TECU<= δ<=2TECU
24 Hours	84%	22%
48 Hours	53%	29%
72 Hours	37%	33%

In Table 1, the statistical deviations between the predicted TEC by model and the observed TEC at Guwahati for 24 Hours, 48 Hours and 72 Hours respectively, are listed. The accuracy of prediction for the 24 Hours is remarkably very good than that of prediction for 48 Hours and 72 Hours.The results indicate that the model produces very well prediction of TEC over time and have good performance. From the experiment it is also observed that the performance of prediction of short term TEC values is better than long term prediction.

IV. Conclusion

In this research, a new technique for the ionospheric TEC prediction based on time series analysis theory and technology has been developed and analyzed. From the experiments it is observed that the NRAX model can be used for TEC prediction. The Predicted TEC by the developed model is then compared with the TEC measured by GPS Gauhati University station to assess the performance of the model. Preliminary results show that NRAX model could well describe the variation trend of the ionospheric TEC and has a good short-term performance of the ionospheric TEC prediction. The prediction model can be made more efficient if certain other parameters like kp, Rz, fof2 data on the inputs and targets are performed. Further study will necessary.

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Some NP-Hard Problems for the Simultaneous Coprimeness of Values of Linear Polynomials

By Starchak M.R, Kosovskii N.K & Kosovskaya T.M
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Abstract- The algorithmic-time complexity of some problems connected with linear polynomials and coprimeness relation on natural numbers is under consideration in the paper.

We regard two easily stated problems. The first one is on the consistency in natural numbers from the interval of a linear coprimeness system. This problem is proved to be NP-complete. The second one is on the consistency in natural numbers of a linear coprimeness and discoprimeness system for polynomials with not greater than one non-zero coefficient. This problem is proved to be NP-hard.

Then the complexity of some existential theories of natural numbers with coprimeness is considered. These theories are in some sense intermediate between the existential Presburger arithmetic and the existential Presburger arithmetic with divisibility.

Keywords: NP, NP-completeness, NP-hardness, coprimeness of values of linear polynomials, simultaneous divisibility of linear polynomials, existential theories with coprimeness.

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Then the complexity of some existential theories of natural numbers with coprimeness is considered. These theories are in some sense intermediate between the existential Presburger arithmetic and the existential Presburger arithmetic with divisibility. In the form of corollaries from the theorems of the second section we prove NP-hardness of the decision problem for the existential theories of natural numbers for coprimeness with addition and coprimeness with successor function. In the conclusion section we give some remarks on the NP membership of the latter problem.

Keywords: NP, NP-completeness, NP-hardness, coprimeness of values of linear polynomials, simultaneous divisibility of linear polynomials, existential theories with coprimeness.

I. Introduction

The proof of NP-hardness of a certain computational problem gives us rather strong assurance of the absence of any polynomial-time algorithm for this problem. Hence, the existence of such proof gives us not only theoretical but also an important practical result for a working programmer. On the other hand, number-theoretical relations like divisibility or coprimeness of integers provides us one of the most natural languages for stating computational problems. We thus come to the study of the algorithmic-time complexity of the decision problems for various subclasses of arithmetic which are sometimes referred as weak arithmetics (see [16]). These reasons motivate the appearance of this paper.

The problem of integer linear programming (ILP) is well-known and one of the first to be proved NP-complete (see, [2] and [6], problem MP1). It can be regarded as a problem of consistency in non- negative integers of a system of linear equations with integer coefficients. In the sense of the weak arithmetics complexity this result can be interpreted as the NP-completeness of the decision problem for the existential Presburger Arithmetic $\exists Th\langle \mathbb{N};+,=,0,1\rangle$ (abbreviated as ∃PA). The decidability of Presburger Arithmetic is a classical result [15] and the complexity of its subclasses is studied rather extensively. For example, the paper [7] completes the classification of the time-complexity results corresponding fixed number of quantifier alternations and fixed maximum number of variables in each quantifier group. The lowest level of this sub-problem hierarchy is just the famous H.W.Lenstra Jr. theorem [13] on the polynomial algorithm for ILP with a fixed number of variables. As was shown in [5] this result provides us with polynomial algorithms for various practical graph problems when we fix the value of some natural parameter of a given graph. In other words, there was proved the fixed-parameter tractability of these problems by rewriting each one as an instance of ILP. In this paper, we will prove NP-hardness of some problems from the extensions of ∃PA.

The time-complexity of ∃PA extended with the divisibility relation $x \mid y \Leftrightarrow \exists z(y = x \cdot z)$ was studied in [12, 14]. For this problem we will use the abbreviation ∃PAD. In non-deterministic polynomial time the problem is reducible to the consistency in non-negative integers of a system of linear divisibilities of the form

$$\bigwedge_{i=1}^{m}(a_{i,0} + a_{i,1}x_1 + \ldots + a_{i,n}x_n \mid b_{i,0} + b_{i,1}x_1 + \ldots + b_{i,n}x_n). \qquad (1)$$

L.Lipshitz in [14] proved that this problem is NP-complete for every fixed number of divisibilities $m \geq 5$, whereas the general problem, as was shown in [12] by A.Lechner, J.Ouaknine and J.Worrell, is in NEXPTIME. The exact complexity of ∃PAD remains an open problem, and the answer is of considerable interest as it will effect on the related problems of formal verification (see, for example, [3,11]). Some NP-complete problems with an arbitrary number of divisibilities but with restrictions on the values of the coefficients of linear polynomials are presented in [10].

One of the possible approaches to solve this problem is to establish complexity of some intermediate theories, that is, simultaneously extensions of ∃PA and subclasses of ∃PAD. This question has not been studied apparently because of the common belief that ∃PAD is in NP citing the paper [14]. This inaccuracy was firstly pointed at by the authors of [12]. For example, the paper [4] which considers existentially definable subsets

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of ∃PAD has the following sentences: "In [5] the algorithm of [4] is made into decision procedure of class NP: hence each subdivisibility set is in the class NP. […] Here we focus on other structural properties of these sets […]". In [8, 9] it was proved NP-completeness for some kinds of systems of linear congruences ≡, incongruences ≢ and dis-equations ≠, supplemented in some cases with geometric interpretations.

The object of consideration of this paper is the complexity of linear systems with coprimeness relation of the form

$$\bigwedge_{i=1}^{m}(a_{i,0}+a_{i,1}x_1+\ldots+a_{i,n}x_n \perp b_{i,0}+b_{i,1}x_1+\ldots+b_{i,n}x_n). \quad (2)$$

Here we use the notation $x \perp y \Leftrightarrow \mathrm{GCD}(x,y)=1$, where $\mathrm{GCD}(x,y)$ is the greatest common divisor of non-negative integers x and y, assuming $\neg(0 \perp 0)$. The problem of consistency of the linear system (2) will be denoted as SIMULTANEOUS COPRIMENESS OF LINEAR POLYNOMIALS (⊥LP). We will state the NP-completeness of a series of ⊥LP problems with the values of the variables taken from an interval of non-negative integers. The relation $x \in [a,b]$ is existentially definable using equality predicate. As a corollary, we get NP-hardness of the decision problems for existential theories of natural numbers with addition, equality and coprimeness relation and also its restriction to the theory without equality. It is not known whether the equality predicate $x = y$ is definable even in universal theory. It was only proved in [17] (see also the survey [16]) that the definability of equality within arithmetic with addition and coprimeness is equivalent to the truth of the number-theoretic Erdös-Woods conjecture.

We will further prove NP-hardness of a system of linear coprimeness and discoprimeness for linear polynomials with not greater than one non-zero coefficient in each polynomial. Formally, this system has form

$$\bigwedge_{i=1}^{m_1} f_i(\overline{x}) \perp g_i(\overline{x}) \wedge \bigwedge_{j=1}^{m_2} \neg(f_j(\overline{x}) \perp g_j(\overline{x})), \quad (3)$$

where $\overline{x}=(X_1, \ldots, X_n)$ and each linear polynomial $f_i(\overline{x}), g_i(\overline{x})$ has the form $a_{i,0}+a_{ij}X_j$ for some $j \in [1,n]$. From this result we can derive NP-hardness of the decision problem for the existential theory of natural numbers for the successor function $S_{X=X+1}$ with coprimeness relation ∃Th⟨ℕ;S,⊥⟩.

Note that all thus defined problems on simultaneous coprimeness of values of linear polynomials can be rewritten in a form of a system of divisibilities of values of linear polynomials. One has to introduce new variables to use the following formulas:

$$\begin{aligned} x \perp y &\Leftrightarrow \exists u(x \mid u \wedge y \mid 1+u) \\ \neg(x \perp y) &\Leftrightarrow \exists v(2+v \mid x \wedge 2+v \mid y). \end{aligned} \quad (4)$$

We therefore can conclude that each NP-hard problem mentioned above is in NEXPTIME complexity class. The simple definition of coprimeness in terms of divisibilities suggests that ∃Th⟨ℕ;S,⊥⟩ can be proved to be in the class NP using the complexity analysis of the ∃PAD decision problem from [12]. This possibility is discussed in some concluding remarks after the ∃Th⟨ℕ;S,⊥⟩ NP-hardness proof.

II. Two NP-Hard Problems for the Simultaneous Coprimeness of Values of Linear Polynomials

By natural numbers we will further assume non-negative integers ℕ= {0, 1, 2 …}. As it was defined in the introduction, the relation $x \perp y$ on natural numbers is true iff the greatest common divisor of *x* and *y* equals , thus we have $\neg(0 \perp 0)$ and that for every $x \in$ the formula $x \perp 1$ is true. We can now define a series of problems, depending on the parameter $k \in$.

Simultaneous Coprimeness of values of Linear Polynomials in the interval [k, k+1] (⊥LP[k, k+1]).

INPUT: A set of *m* pairs of (*n*+1)-dimensional vectors $((a_{i,0}, a_{i,1}, \ldots, a_{i,n}), (b_{i,0}, b_{i,1}, \ldots, b_{i,n}))$ with natural entries for $i \in [1,m]$.

QUESTION: Is the linear system

$$\bigwedge_{i=1}^{m}(a_{i,0}+a_{i,1}x_1+\ldots+a_{i,n}x_n \perp b_{i,0}+b_{i,1}x_1+\ldots+b_{i,n}x_n)$$

consistent in natural numbers from the interval [*k*, *k*+1]?

Let ⊥0-3LP[*k*, *k*+1] be a subproblem of ⊥LP[*k*, *k*+1] in which each pair of coprime linear polynomials contains one with exactly three non-zero coefficients and the other is a natural number.

Theorem 1. For every $k \in$ the problem ⊥0-3LP[*k*, *k*+1] is NP-complete.

Proof. That the problem is in the class NP is obvious because every variable takes it values from the given interval of natural numbers.

To prove NP-hardness of ⊥0-3LP[*k*, *k*+1] we will construct a polynomial reduction of ONE-IN-THREE 3SAT from [6] to our problem. The truth of exactly one literal in every clause can be expressed via expression

$$3k(3k+2) \perp x_{i,1}+x_{i,2}+x_{i,3}. \quad (5)$$

Logical constants *true* and *false* are encoded respectively by numbers *k*+1 and *k*. Every negated literal ¬*x* is substituted in the corresponding expression by a new variable *x'* and we add to the system three new expressions

$$\begin{aligned} 3k(3k+2) &\perp x+x'+u \\ 3k(3k+2) &\perp x+x'+v \\ 3k(3k+2) &\perp u+v+w, \end{aligned} \quad (6)$$

which are simultaneously satisfiable only in the case $u=v=k$ and $w=k+1$. As the reduction is obviously polynomial, this completes the proof. ■

Corollary 1 from the Theorem 1. For every $k \in$ the problem ⊥LP[k, $k+1$] is NP-complete.

Let us now consider one related problem that is an extension of the previous one by the discoprimeness predicate. More formally, this problem is defined as follows.

Simultaneous Coprimeness and Discoprimeness of values of Linear Polynomials(⊥& Dis⊥LP)

INPUT: Two sets of (m_1+ m_2) pairs of (n+1)-dimensional vectors: $\{((a_{i,0}, a_{i,1}, \ldots, a_{i,n}),(b_{i,0}, b_{i,1}, \ldots, b_{i,n}))\}$for $i \in [1, m_1]$ and $\{((a_{i,0}, a_{i,1}, \ldots, a_{i,n}),(b_{i,0}, b_{i,1}, \ldots, b_{i,n}))\}$for $j \in [1, m_2]$ with natural entries.

QUESTION: Is the system

$$\bigwedge_{i=1}^{m_1}(a_{i,0}+a_{i,1}x_1+\ldots+a_{i,n}x_n \perp b_{i,0}+b_{i,1}x_1+\ldots+b_{i,n}x_n)\wedge$$
$$\bigwedge_{j=1}^{m_2}\neg(a_{j,0}+a_{j,1}x_1+\ldots+a_{j,n}x_n \perp b_{j,0}+b_{j,1}x_1+\ldots+b_{j,n}x_n)$$

consistent in natural numbers?

Let ⊥&Dis⊥1-1LP be a subproblem of ⊥&Dis⊥LP such that each linear polynomial has not greater than one non-zero coefficient and every coefficient and constant term is represented in unary.

Theorem 2. The problem ⊥&Dis⊥1-1LP is NP-hard.

Proof. To prove the NP-hardness of the problem, we will construct a polynomial reduction of a special case of SIMULTANEOUS INCONGRUENCES problem which is named "anti-Chinese remainder theorem" in [1]. It could be seen from the NP-completeness proof in [1], that every modulus in a system is square-free and its value is bounded polynomially in the number of the incongruences. This follows from the fact that in the polynomial reduction from 3SAT to SI, there were generated first n primes for every propositional variable from the instance of 3SAT and every modulus of the corresponding SI instance did not exceed $p_n p_{n-1} p_{n-2}$. Thus the proof from [1] implicitly gives us the NP-completeness of the following problem.

Simultaneous Incongruences (SI) (Implicit in [1, Theorem 5.5.7]

INPUT: A set of ordered pairs $(a_i\, b_i)$ of positive integers, represented in unary, with $a_i \le b_i$ and for every $i \in [1, m]$ the moduli b_i are square-free.

QUESTION: Is there an integer X such that $\bigwedge_{i=1}^{m} x \equiv a_i \pmod{b_i}$?

Every incongruence $x \equiv a_i \pmod{b_i}$ can be equivalently rewritten as a dis-divisibility: $\neg(b_i \mid x-a_i)$ or $\neg(b_i \mid x+(b_i-a_i))$. As every b_i is square-free or, in other words, $b_i = \prod_{j=1}^{k_i} p_j$ for distinct primes p_j, by introducing new variables u_j, we can represent every dis-divisibility by the formula $\neg(u_i \perp b_i) \wedge u_i \perp x+(b_i-a_i)$. Thus, for every SI instance we have constructed the instance of ⊥&Dis⊥LP of the form

$$\bigwedge_{i=1}^{m}(u_i \perp x+(b_i-a_i)) \wedge \bigwedge_{i=1}^{m}\neg(u_i \perp b_i). \quad (7)$$

As this construction takes not greater than polynomial number of steps of a Turing machine, the problem ⊥&Dis⊥LP is NP-hard. ■

Corollary 1 from the Theorem 2. The problem ⊥&Dis⊥LP is NP-hard.

Note that in fact we have proved a stronger theorem as every coefficient in the constructed system (7) equals to one. This provides us with one subclass of ∃Th⟨ℕ;S,⊥⟩ formulas with NP-hard decision problem. We will state some corollaries from these two theorems, concerning complexity of decision problems for existential theories in the following section.

III. Some Corollaries on the Time-Complexity of the Decision Problems for Existential Theories with Coprimeness Relation

The problems ⊥LP[k, $k+1$] and ⊥&Dis⊥LP can be interpreted as problems of validity in natural numbers for some classes of existentially closed formulas of the first-order language for coprimeness with addition or with successor function. We should only take care of the length of each formula that corresponds to an instance of ⊥LP[k, $k+1$] or ⊥&Dis⊥LP. Let us first prove some lemmas on the definability of certain predicates in the theories with coprimeness.

Lemma 1. The relations $X=0$ and $X=1$ on natural numbers are existentially definable by successor $S_{X=X+1}$ and the coprimeness relation $x \perp y$.

Proof. These definitions are: $x=1 \Leftrightarrow x \perp x$ and $x=0 \Leftrightarrow 1+x \perp 1+x$. ■

Lemma 2. The unary relation $x=a$ and the binary relation $x=a\cdot y=\underbrace{y+y\ldots+y}_{a\ times}$ for every natural number a is existentially definable by addition function, equality and coprimeness relation. The length of the definition is bounded polynomially on the length of the binary representation of the number a.

Proof. Let $n=\lfloor \log(a) \rfloor$. As the relation $x_0=1$ is definable, we can define $x_1=2$, $x_2=4$, $x_3=8\ldots$ $x_n=2^n$ by the formulas

$x_i=x_{i-1}+x_{i-1}$, and finally $x=\sum_{i=0}^{n}\varepsilon_i\cdot x_i$, where $\varepsilon_n...\varepsilon_1\varepsilon_0$ corresponds to the binary representation of the natural number *a*. The relation $X=a$ *yy* can be defined analogously by taking $X_0=X$. ■

Corollary 2 from the Theorem 1. Every instance of ⊥LP[*k*, *k*+1] can be rewritten in polynomial time as a formula of ∃Th⟨ℕ;+,=,⊥⟩.

Proof. Indeed, we only have to supplement the conjunction $\bigwedge_{i=1}^{m} f_i(\bar{x})\perp g_i(\bar{x})$ from the instance of ⊥LP[*k*, *k*+1] with the system of inequalities $\bigwedge_{i=1}^{n}(k\le x_i\wedge x_i\le k+1)$. The predicate $x\le y$ is definable by the formula with equality: $\exists u(x+u=y)$. From Lemma 2 it follows that every linear term $f_i(\bar{x})$ and $g_i(\bar{x})$ can be defined by a formula of polynomial size on the length of the binary representation of the integer coefficients. Thus, introducing *n* new variables we construct in polynomial time a formula from ∃Th⟨ℕ;+,=,⊥⟩ which is true iff the given instance ⊥LP[*k*, *k*+1] is solvable. ■

We thus have a series of NP-complete sub-problems of the decision problem of ∃Th⟨ℕ;+,=,⊥⟩ and NP-hardness of the general decision problem of this theory.

As it is not known whether the relation of equality is definable by addition and coprimeness, we have to independently consider the theory without equality. Let us define the problem ⊥LP as the problem of consistency in natural numbers of a system of coprime values of linear polynomials. That is, unlike ⊥LP[*k*, *k*+1], this problem does not have any restriction on the values of the variables. As the formulation of ⊥LP is very similar to the one of ⊥LP[*k*, *k*+1], we do not give it explicitly. The pairs of coprime polynomials in the proof given below will provide us with the NP-hardness proof for the decision problem of the corresponding theory without equality.

Corollary 3 from the Theorem 1. The problem ⊥LP is NP-hard.

Proof. Consider the formulas from the proof of Theorem 1 in the case of *k*=0. The system has form:

$$\bigwedge_{i=1}^{m} 0\perp x_{i,1}+x_{i,2}+x_{i,3} \qquad (8)$$

For every natural number, we have $0\perp x\Leftrightarrow x=1$, therefore the restriction on the variables $x_i\in[0,1]$ is necessary satisfied. NP-hardness of ⊥LP is proved by restriction to the NP-complete problem of the consistency in natural numbers of a system of the form (8). ■

As the relation $X=0$ is definable by Lemma 1 in the theory ∃Th⟨ℕ;+,⊥⟩, and the coefficients of linear polynomials from (8) all equal one, we immediately get the following corollary.

Corollary 4 from the Theorem 1. The decision problem of the theory ∃Th⟨ℕ;+,⊥⟩ is NP-hard.

Note that we use in this corollary that the problem ⊥LP remains NP-complete even in the case of the unary representation of the coefficients of polynomials in a system from its instance. Let us now consider formulas of the theory ∃Th⟨ℕ;*S*,⊥⟩ with the successor function $S_{X=X+1}$ in place of addition. The formula (7) provides us with the following

Corollary 2 from the Theorem 2. The decision problem of the theory ∃Th⟨ℕ;*S*,⊥⟩ is NP-hard.

Proof. To prove NP-hardness we can continue the polynomial reduction presented in the proof of Theorem 2. The relation $X=1$ is definable in the considered theory, and therefore the unary relation ¬(*X*⊥*a*)*y*is also definable for every positive integer *a*. As every natural number from the formula (7) is represented in unary, each polynomial *a*+*x* can be rewritten in the form $\underbrace{SS...S}_{a\ times}x$. By taking existential closure of every formula of the form (7) we define some formula from ∃Th⟨ℕ;*S*,⊥⟩. This concludes the polynomial reduction of SI to the decision problem of ∃Th⟨ℕ; *S*,⊥⟩.

A natural question is whether the decision problems considered above are in fact NP-complete. As every formula of these theories can be rewritten as a ∃PAD formula, one can go through the complexity analysis of the ∃PAD decision procedure from [12] for some restricted class of formulas. In conclusion, we will give some remarks corresponding **NP** membership of the decision problem for ∃Th⟨ℕ;*S*,⊥⟩ formulas. ■

IV. Conclusion

Two easily formulated number-theoretic problems for coprimeness relation on natural numbers were defined in the first section. The problem of consistency of a coprimeness system of the form (2) was shown NP-complete on every interval [*k*, *k*+1] of natural numbers. The related problem of consistency in natural numbers of a coprimeness and discoprimeness system of the form (3) was proved NP-hard when the linear polynomials have not greater than one non-zero coefficient.

We then derive some corollaries from these two theorems. There was established NP-hardness of the existential theories of natural numbers for coprimeness with addition ∃Th⟨ℕ;+,⊥⟩ and for coprimeness with successor function ∃Th⟨ℕ;*S*,⊥⟩. These problems naturally arise in such fields of computer science as formal verification or cryptography.

It could be an interesting problem i to determine whether if ∃Th⟨ℕ;*S*,⊥⟩ is in **NP** and the same question in

the case of every term from this theory of the form $\underbrace{SS\ldots S}_{a\ times}x$ written on the tape of a Turing machine as the string $a+x$ for the integer a represented in binary. Introducing new variables u_i and v_i while rewriting every coprimeness formula in the form of divisibility formula using the formulas (4), we get a ∃PAD instance of rather convenient for the subsequent complexity analysis form. Every linear polynomial has form $a+x$, and the formula is already increasing (in the sense of [12]) with respect to the total ordering $0 \le v_1 \le \ldots \le v_k \le x_1 \le \ldots \le x_n \le u_1 \le \ldots \le u_l$ on the variables. An attempt to apply the ∃PAD decision procedure from [12] on such restricted class of divisibility formulas to get an **NP** upper bound could be the subject of the subsequent research.

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Intrusion Detection System based on Ant Colony System

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Abstract- Challenge of designing and building of the current Network Intrusion Detection System not only improves the ability for discriminating the improper internet behaviors, but also considers the plenty of computer resources which will be cost during the analysis of the network packets and behaviors. During the establishment of a fast intrusion detection system, the major purpose of the research is to intensify the data handling capacity when the network management system faces the mass network behavior. In the research, the modules stored in the network packets of the intrusion detection system are analyzed, and then the network flow data by applying the clustering algorithm based on the ant colony system is classified. Finally, a kind of algorithm which can remove repetitive computation is designed so that the flow can accelerated and the velocity can be distinguished. Experimental results show that the proposed fast clustering algorithm can significantly reduce the original computation time while sacrificing or promoting a very small accuracy, and then the computation speed of the intrusion detection system can be accelerated.

Keywords: intrusion detection system, clustering algorithm, ant colony system.

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Intrusion Detection System based on Ant Colony System

H. Fathima[α] & Dr. A.Syed Musthafa[σ]

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I. Introduction

Owing to the network attack and the improper behavior, the loss of the internet work environment is up to 140 million dollars in 2004. Although the loss has descended into 130 million dollars in 2005, these problems still caused great damage to the internet work performance. When the network bandwidth and flow is substantially developing, analyzing the network behavior and finding out the improper/attacking behaviors by the Intrusion Detection System [2-4] have been becoming very difficult and important. From the network safety perspective, the research is discussed, and then finds out the improper network behavior and illegal network attack by analyzing the network flow and user's network behavior. Finally, the improper net is managed and controlled. From the data mining perspective, Intrusion Detection System is discussed. The major challenge of the research is to rapidly and real-time identify the normal and abnormal network behavioral characteristics. The major two goals are the necessary computation resources and the accuracy distinguished by the network behavior. According to the detection method, the system design is classified [4-5] as follows:

a) Misuse Detection System

The research is to collect the known attacking signatures from the network flow, and then establish a database to store these signatures. These signatures in the monitoring network are compared. If those signatures are similar to the attacking signatures or the same network behavior, it can judge that it belongs to an improper network behavior. The major advantage of the system is to improve the high accurate resolution. The system cannot rapidly and effectively find out the new-type intrusion behavior for it cannot real-time update the attack signature style.

b) Anomaly Detection System

The research is usually to find out the normal network behavior style signature and then establish a normal network behavior model. If the flow is different to the normal behavior style collected from the system in the monitoring network, it will be judged as the improper/attack behavior. The research [3-5] shows that the major advantage of the system can fast find the new type intrusion behavior. The disadvantage of the system is that its precision is not so insufficient that much inaccurate warning information can be produced. C. Hybrid Detection System The system is to achieve more accurate intrusion behavior judgment by combining the signatures of the improper detection system with the signatures of the anomaly detection system, or integrating multifarious detection strategies. Many machine learning and data mining technology have been widely applied to the system, and then the accuracy of the system can be improved. Although the system occupies the merits of the above all systems, but its demerits are that it needs to cost many computation resources when it conducts different kinds of the detection procedures and the judging procedures with the use of the machine learning. The major purpose of the research is to reduce the necessary computation time in the intrusion detection system when the network behavior does not affect the judgment of the module's accuracy. It has its real time in the face of the more scaled flow information. Firstly, the research will design a fast algorithm for it can shorten the computation time which is spent in analyzing and judging the modules, and then improve the system's performance. In addition,

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it completes a high-performance intrusion detection system. The system not only tests all developed algorithms, but also is applied in the real network management system. In Chapter two (the related researches), the related researches and design frameworks about the intrusion detection system are introduced, and then the intrusion detection system based on the ant colony optimization is discussed. In Chapter three (fast ant colony clustering algorithm), the conception of the designed fast clustering algorithm and the design details of the method are introduced. In Chapter four, the system design illustrates the network environment applied in the established intrusion detection system and its practical design. In Chapter five, the experimental results introduce the experimental results and the related analysis. In Chapter six, it includes the conclusion and the future research fields.

c) Intrusion Detection System

The present intrusion detection system research not only considers the accuracy judged by the network behavior, but also its extensibility in the face of the mass network flow data. Figure1 designs the framework [2] for an intrusion detection system. The framework is divided into the above several basic modules and an Audit Database, Monitored Entity module is in charge of determining the necessary monitoring network behavior; Audit Collection module is in charge of collecting the data from the host or network, its data is used for Analysis and Detection module; Audit DB is in charge of storing the mass collected data. Analysis and Detection is the core of the system. The intrusion detection system judges whether the network flow is normal or improper behavior in the module with users' designed algorithm. The part of the research, as previously stated, can be divided into improper detection system, anomaly detection system and hybrid system. Configuration Data module is in charge of setting up the corresponding strategies for the normal or improper flow and other related setup program. Reference Data module stores the relevant data related to the intrusion detection, and it can be used as the foundation for Analysis and Detection module makes the judgment. Active/ Processing Data module is in charge of storing the routine data. Alarm module is in charge of the intrusion detection warning information in the output system, and then transmits the related information to Entity Security Authority and Monitored Entity modules. Entity Security Authority module is in charge of authenticating whether the network behavior is normal, and then transmits the information to Monitored Entity modules. A more effective intrusion detection system can make the webmaster manage the anomaly behavior of the network. These applications include: packet retrieval and filter; packet discrimination; signature comparison and other researches [7-15]. Many researches analyzes and discriminates the network flow information with the high-efficient hardware framework for analyzing the signatures of the packet content is very time consuming and expensive. Improving the algorithm performance is another method to improve this kind of systems. For example, According to the style comparison algorithm, it develops into a fast comparison packet signature method. As to the information retrieval technology, data mining technology and heuristic algorithm, the mass data analysis has remarkable progress and achievements in recent years. Partial researches begin to import the above technologies into the intrusion detection system research, and then it can design a more effective intrusion detection system. It improves the judging precision to the packet, as well as intensifies the computing performance.

The intrusion detection system should analyze mass information in the large-scale network environment. The first bottleneck can be happened in the data compilation, supervisory and related modules. Partial network flow can increase the computing resources as well as the storage space without being real-time analyzed. The research [6] can solve this kind of problems by the sampling method. Analysis and Detection module is another link which would affect the resolution and performance of the intrusion detection system for many current methods could not effectively influence mass data. Considering the system's performance and the real-time problems, it uses the machine learning method and trains the classifiers with the existing data. The topic of many researches in recent years is to speed up the network behavior discrimination with the previously established classifiers while it conducts the system. The intrusion detection system based on the machine learning cannot effectively and real-time train the classifiers again for the traditional machine learning method would consume much computation time and need oversize internal memory. The intrusion detection system's achieved effects are subject to a large limitation for it cannot dynamically update the classifiers. B. Ant Colony Optimization applied in the Intrusion Detection System The performance of the traditional regulation judgment or the discrimination method based on the statistics is insufficient in the face of the mass network flow data. It solves these problems with the use of heuristic algorithm [4]. Many achievements have proved its feasibility and effectiveness. Many researches attempt to use it as the judging algorithm of the intrusion detection system for the effect of the heuristic algorithm based on the ant behavior is remarkable. These researches can be divided into two kinds: ant-based clustering algorithm (ACA) [16-17] introduced by Deneubourg and ant colony optimization (ACO) [18-19] introduced by Dorigo.

1. Randomly create initial solutions
2. While the termination criterion is not met

3. For each ant i
4. For each pattern x ∈ X
5. Calculate the distance of x to all the centroids, denoted ij c for j 1, 2....k.
6. Assign x to the cluster the centroid of which is nearest to x.
7. Local update each path and move ant i
8. End
9. Global update each path
10. End
11. Detect the set of patterns R that are static and that are within a predefined radius r to its centroid.
12. Compress the set of patterns R into a single pattern r and remove R: that is X = ∪ X r { } and X X R.
13. End
14. Output result

The basic conception of ACA mainly uses ants randomly move in the specific range. It classifies the objects in terms of the object's picking-up and dropping methods. Unlike ACA, ACO is regarded as a kind of the artificial ant algorithm, but its major conception is derived from the real ant's foraging behavior model. There are three major procedures: establishing the separation procedure, the pheromone updating procedure and the alternative procedure zone to search. In the research [20-21], Tsang and Kwong uses the ant colony clustering algorithm based on ACA to establish the intrusion detection system, it is called ant colony clustering model (ACAM). In their researches, it measures the clustering results by adding the regional entropy and average similarity methods. Tsang and Kwong use the tournament selection method to add ACA's searching range, except for improving the probability computation method in which the ant picks up and drops the data in each node. In the KDD99 data test, the achieved results in ACAM are superior to k-means, SOM, ACA and other algorithms. In the research [22], Ramos and Abraham use the technologies in the intrusion detection system are as follows: linear genetic programming, decision trees and support vector machine. In the research, Ramos and Abraham introduce my modules and links in the intrusion detection system. It illustrates that it can use principal component analysis (PCA) or genetic algorithm to help ACA reduce the number of the data signatures and then speed up its computing time. In the research [23-24], Banerjee develops an intrusion detection mechanism based on ACO algorithm, and then applies it in the sensor network environment; it is called the intrusion detection based on emotional ants (IDEAS). Using the IDEAS to alter ACO mechanism and join into emotional ant and emotion template for exchanging information, and then detect anomaly place to find out the improper behavior in the sensor network. In the research [25], Gao etl uses ACO to integrate the support vector technology and then improve the intrusion detection system's performance.

II. Fast Ant Colony Clustering Algorithm

Conception From the previous research [26-27], we find that most searching procedure in the heuristic algorithm has repetitive computations in the procedure of solving many complex problems for the partial segment solution have achieved to the optimal or final states before the searching procedures finished. The time for the partial solving segments reach to the final result is successively different. The early segment solution of reaching the final result can become the repetitive computation in the subsequent searching procedure. If it can find out and remove these repetitive computations in the searching procedure, it is unnecessary for us to calculate the repetitive contents again. In the situation, the whole searching computation time can be largely reduced. The research deigns a fast ant colony clustering algorithm with the use of the conception, it Is called Fast Ant Colony System; FACS. The algorithm can make the intrusion detection system have the performance in the face of the mass flow data by reducing the necessary calculated quantity and maintaining the solution quality. B. Method Design Figure 2 illustrates that the research judges the clustering algorithm of the modules with the use of the packet. The algorithm is to reduce the computation time on the basis of Ant Colony System and pattern reduction algorithm. Firstly, FACS randomly produces the initial solution, and then initializes pheromone form. Similar to the traditional ACS clustering algorithm, it passes each input data x (network flow data) in the searching procedure of each ant. Data x must be compared with centroid (ij c) in all clusters. It conducts x the clustering affiliation, k represents the species quantity of the flow. We can put these data into their affiliated classifications by calculating the distance from each data to centroid. When each flow data is judged and put in its affiliating clusters by the algorithm, FACS will conduct the regional updating to the passes routes, and then move the ant to the next data node. When the ant goes through all nodes, FACS will conduct all regional updating. Detect and compress proceeds before the finish of each round. Detect procedure in the FACS is in charge of judging the input data, and later it can repeat the computational data. The current used method is used to make x data node in all ants affiliate to the same clustering, and then it judges the x data node as the repetitively computational data node. It removes and compresses the current analyzed datasets. In the successive FACS iterative procedure, the compressed data node will be avoided by the FACS's computation procedure. Many methods can reduce the repetitively computational procedures, such as the distance from x to centroid, the

clustering group in the affiliating points, the regional and the whole regional updating. Therefore, the procedure can reduce much computation time. We firstly establish an intrusion detection system as the developed algorithm which tests the research in the practical part of the system. The following chapter introduces the system's design and practice, and further illustrates the design conception and method used in the packet judging modules. C. Network Environment The network topology framework in the research is as the figure 3 shown, the regional network and the internetwork connect the router or network switch. All input or output network flow will pass through the network equipment (router or network switch). Take the figure as the example, the network switch remains a copy of the input and output network flow to IDS and it offers analysis flow packet information and maintains the network quality. It can collect the necessary testing data flow, analyze the later designed packet and conduct the test and analysis of the packet judging the modules through the method. It can further make the judgment module have more high accuracy with the effective training.

a) System Design and Experiment

Figure 4 is the sketch map of the system module framework. The system developed in the research is based on the Linux exercise system of the openly original code. The retrieval method of the packet is to start up the Promiscuous mode in the network card, and then require the network card to receive all packets from the network exchangers. It makes the packet capturing modules on the basis of the glib and data link layer socket. Therefore, Packet Capturing is used to receive the complete picket contents, dismantle the received, retrieve the external information of the packet and record the flow information. The achievement of the packet external information uses the external Protocol segments in the IP, the total length segments of the packet, the external source port and destination port in the TCP and UDP and other information as the flow classified references. The Traffic Clustering is designed on the basis of FACS algorithm and uses the flow to cluster. When it is abnormal, the system will initiatively send the anomaly notification to the network managers. At present, the anomaly notification module sends the anomaly notification by the E-mail format. The intrusion detection system includes packet capturing, packet encapsulation, packet collection, flow classification and anomaly notification module. The performance of the Traffic Clustering module has a great influence on the intrusion detection system.

In the system performance test experiment, we use the famous testing data KDD99 [28] to test, and use its results to improve the system's performance. The research conducts the numerical attributes regulation in the preprocessing phase and make its values situate in [0:1] range. If the non-numerical attributes are the same in the algorithm operating procedure, it sets its difference as 0; If the non-numerical attributes are different, it sets its difference as 1. KDD99 has 4,898,431 data in total; the normal data is 972,781 which is about 20% of the total data. In the research, we adopts the probability sampling method as shown in the table 1, its probability sampling is from 1% to 5%. It produces five datasets used in the experiments from DS1 to DS5. The related statistics of the datasets is as shown in the table 1. It samples 8,298 data to conduct the experiment in DS1; the normal flow information has 9,618 data. The data number from DS2 to DS5 is gradually increasing. KDD 99 is the most often used as the dataset in - $\beta = 100\% \beta \beta \beta \Phi \Psi \Psi \Delta \times$ (1) Formula 1 improves AS's and ACS's computation time respectively for calculating the FAS and FACS algorithm developed in the research in the part of the performance measurement. $\beta \Phi$ Represents FACS's computation time; $\beta \Psi$ represents ACS's computation time and $\Delta\beta$ represents the improving computational time percentage. Table 2 analyzes experimental data. The retrieval KDD99 data in divided into 10 clusters (k=10). Precision (P) and recall(R) [29] is used for measuring the data judging accuracy conducted by all algorithms. Time represents computation time; $\Delta\beta$ represents the saving computation time percentage. All testing repeats 30 times. AS represents Ant System [19]; ACS represents Ant Colony System [18]; FAS and FACS represent AS, ACS and the proposed speeding strategy. From the experimental results, we can find that the designed speeding strategy can effectively reduce about 37%to 60% computation time on the basis of the ant optimization in the sacrifice of the slight accuracy. Partial experimental results show that FAS and FACS can improve the discriminated accuracy, except for reducing large computation time. For example, ACS's precision is 95.29; recall is 97.44, FACS can improve precision and recall up to 96.94 and 98.41. From the size of data quantity perspective, the accuracy of ACS and FACS will not be descended with the growing of the data quantity. When the data quantity is becoming big, the shortened computation time has increasing trend. It will have the essential assistance to the intrusion detection system in the face of the mass data.

III. Conclusion

The paper speeds up the analysis and the judgment of the modules in the intrusion detection system by the use of the designed fast clustering algorithm. The intrusion detection system can analyze and manage the large network flow behavior by reducing the computation time of the modules. In the practical application, it firstly establishes a prototype of the intrusion detection system in order to test and analyze the related data. In the theoretical design, it makes several algorithms based on the heuristic

computation, and then applies them in the analysis and the judgment of the modules in the intrusion detection system. As to the research on improving the intrusion detection system's performance, we design a pattern reduction algorithm on the basis of the ant optimization which can reduce the repetitive and unnecessary computations. The experimentally simulation results show that the proposed method in the research can effectively reduce the original computation time for analyzing and judging modules on the basis of the ant optimization without losing overdue correct rate. In the future research, we will regard the algorithm developed in the research and the ant optimization applied in the intrusion detection system as the foundation. It further designs and modifies the current algorithm in order to effectively detect the repetitive computation and reduce large computation time.

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Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Color Charges: It is the rule of the Global Journals Inc. (US) for authors to pay the full cost for the reproduction of their color artwork. Hence, please note that, if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a color work agreement form before your paper can be published.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

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The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

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Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

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- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

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Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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