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DESIGN OF DECISION SUPPORT SYSTEM APPLICATION FOR DETERMINING SCHOLARSHIP GRANTEE USING ANALYTICAL HIERARCHY PROCESS AND FACTOR RATING

Afrin Fauzya Rizana, Rayinda Pramuditya Soesanto

Scholarship refers to a program provided by organization that is given to students to relieve the tuition fee. There are several criteria and requirements that have to be fulfilled to get the scholarship. In practice, all the requirements will be checked manually for each applicant to determine who deserves...

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DESIGN OF GEOGRAPHIC-BASED DECISION SUPPORT SYSTEM FOR ROAD REPAIRMENT WITH GDSS METHOD: CASE STUDY IN BANDUNG DISTRICT

Dicky Faisal Dramar, Farid Wira Darmawan, Audira Zuraida, Rayinda Pramuditya Soesanto, Ika Arum Puspita

In an effort to make road improvements effective and efficient in Bandung Regency, the Public Works Service performed road repairs based on the most damaged areas. In the implementation there is a problem of limited information possessed by the Office of Public Works Bandung Regency so that road improvements...

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THE PROPOSED OF VENDOR SELECTION IN GOODS PROCUREMENT USING FUZZY ANALYTICAL HIERARCHY PROCESS (FAHP) METHOD AT PT. PERTAMINA HULU ENERGI OFFSHORE NORTH WEST JAVA (PHE ONWJ)

Kristoforus Maximinus Krisnabayu Tandra Widyatama, Ika Arum Puspita, Mumu Natapriatna

Along with the change of strategic system in the government that changed the scheme of contracts for oil and gas product from Cost Recovery to Gross Split in the oil and gas company like Pertamina Hulu Energi Offshore North West Java (PHE ONWJ), the company is required to be more effective and efficient...

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Information System Planning for Emerging Start-Up Company: A Case from Software House

Company: A Case from Software House

Rayinda Pramuditya Soesanto, Wawan Tripiawan, Afrin Fauzya Rizana, Amelia Kurniawati, Fadillah Ramadhan

The use of IS believed to bring positive impact on the productivity and competitiveness of the organization. Most organizations in all sectors of industries, commerce, and government become fundamentally dependent on the use of information system especially startup companies. Start-up companies are considered...

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Wojciech Macyna, Michal Kukowski

Flash memory become the very popular storage technology. Recently, it may be treated as a main storage memory in mobile devices, PDA and personal computers. However, the architecture based on flash memory has some limitations. They suffer from poor write performance, as the flash blocks must be erased...

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Latent Dirichlet Allocation Modeling for CPS Patent Topic Discovery

Usharani Hareesh Govindarajan, Amy J.C. Trappey, Gopal Kumar

Industry 4.0 is an organized framework to infuse the latest technology in the manufacturing sector. The inclusion of next-generation technologies such as Cyber-Physical Systems (CPS), cloud computing, big data and artificial intelligence approaches increases productivity and manufacturing output in today's...

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Self-Adaptive Cybersecurity System

Aradea Aradea, Iping Supriana, Kridanto Surendro, Husni Mubarok, Irfan Darmawan

Complexity of cyberspace environment nowadays, arouse security vulnerabilities for all owned assets. Appropriate way out or solution for every obstacle in a case like this is a must for ICT role. However, user trust for ICT usage raises concerns. Cyberspace environment is caused by rapid increase in...

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Self-Adaptive Load Balancing System for Grid Computing

Irfan Darmawan, Aradea Aradea

Load balancing is a necessary way of a computer network infrastructure services, with the aim of balancing of computing resources to achieve optimal load processing time. When this has been many methods that can be used for load balancing techniques, namely by adjusting the load on the computing resources...

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A Comparison of Naïve Bayes and Bayesian Network on The Classification of Hijaiyah Pronunciation with Punctuation

Letters

Adiwijaya Adiwijaya, Annisa Riyani, Mohamad Syahrul Mubarok

Arabic is a unique language because it really concerns in makhraj (the way of sound is made) that differentiate letters and words. The difference in pronouncing letters and words make the meaning of those words different,

because pronunciation in Qur'an letters really concern in harakat (the length of...

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Model Tree with Modified L1 Loss Function for Predicting Missing Attendance Data of Faculties

Mohammad Arif Rasyidi, Rachmadita Andreswari

The problem of missing attendance data in our university often arises due to the negligence of faculties. In this study, we address the problem by directly predicting the work duration of faculties. The nature of the problem require us to not only make accurate predictions, but also minimize the rate...

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Web Application Design Using Single Page Application To Increase Website Performance on Rumantara

Ilham Farobi, Soni Fajar Surya Gumilang, Muhammad Azani Hasibuan

One of the travelers needs when going to some places is a place to stay for a while and put their things. More importantly, a place that fits their needs and budget. This matter makes most of the travelers difficult to find a place to stay because of most of them is hotels with unneeded amenities that...

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Web-Based Food Delivery Management System

Soni Fajar Surya Gumilang, Nia Ambarsari, Mei Dina Isti Nurmala

The process of ordering a meal in an organization still using a conventional system or in other words, the civitas organization must come to the cafeteria to order the desired menu. The conventional system uses paper for order recording process. So the problem happens repetitively, such as redundancy...

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Mohammad Hafiz Hersyah, Kridanto Surendro

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Information System Strategy and Application Governance in The Government of Bandung Regency

Soni Fajar Surya Gumilang, Heru Nugroho

Utilization of information system for support of the government process improve the efficiency, effectiveness, transparency and accountability of governance. This statement is in line with Presidential Decree No. 3 of 2003 which confirms that the use of technology in government will improve the...

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High Security Adaptive BCH Code Discrete Wavelet Transform Copyright Protection

Irma Safitri, Rizki R. Ginanjar, Yosa Yunawan

In this research, we analyzed the audio watermarking system with combining adaptive wavelet with SVD in various BCH Codes. The host audio signal is embedded with a watermark signal in the form of an image signal accompanied by several attacks on the watermarking system. The results showed that ODG and...

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Copyright Protection High Robustness Arnold Transform Wavelet Method

Bruguiera A. F. Agradriya, Irma Safitri, Ledya Novamizanti, Muhammad Ainul Yaqin

Audio watermarking is a technique of information insertion into an audio signal without altering the significant origin of the audio host. Audio watermarking is usually used to protect the copyright of a work in the form of songs, recording of state and other secrets to avoid irresponsible persons. Audio...

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Extending the UTAUT Model to Understand the Citizens' Acceptance and Use of Electronic Government in Developing Country: A Structural Equation Modeling Approach

Deden Witarsyah Jacob, Irfan Darmawan

The rapid development of information and communication technologies had a positive impact on the government to provide better and efficient services to the community. Despite some criticisms of electronic government services (e-gov) but so far, its utilization has continued to improve. The citizens need...

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Cost-Based Storage of the R-tree Aggregated Values over Flash Memory

Wojciech Macyna, Krzysztof Majcher

The flash memory due to its shock - resistance, power economy and non-volatile nature is considered as a very popular storage device. It is widely used in mobile phones, sensor networks and hand-held devices. What attracts the attention is the data storage in the flash memory. Database vendors try to...

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Face Recognition Using Local Binary Pattern (LBP) and Local

Enhancement (LE) Methods At Night Period

Abdurrahman Fi Zhilali'l, Muhammad Nasrun, Casi Setianingsih

Face recognition is a technique that is widely used in the field of identification of a person or in the field of security. This technique basically

determine the similarity on each face of a person who will be identified with the face already stored in a storage (database). In this paper the facial...

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Development of Project Document Management System Based on Data Governance With DAMA International Framework

Hanung Nindito Prasetyo, Regina Nathania Djepapu, Ferra Arik Tridalestari, Irman Hariman

Information will continue to grow in an organization, Various forms of information formed such as file documents, archives, policies, procedures, and so forth. In the current era of information technology, document management becomes an absolute thing for the organization. All business processes, activities...

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On the Relationship of Travel Time and Energy Efficiency of Industrial Robots

Kai Eggers, Zygimantas Ziaukas, Jens Kotlarski, Tobias Ortmaier

This paper presents an approach to quantify the energy saving potential with regard to travel time of industrial robot motions. In order to minimize the

influence of the exemplary considered trajectories and, thus, provide gen results, the evaluation is done on a large set of automatically generated...

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Localized Island Model Genetic Algorithm in Population Diversity Preservation

Alfian Akbar Gozali, Shigeru Fujimura

Premature convergence in island model is a consequence of the selection in migration mechanism. It is a process of migrating several individuals (usually the best one) from a source into destination island to keep its diversity. The main reason is the similar characteristic of relocated individual because...

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Privacy Protection and Role of Technology: Citizen Perception on Electronic Voting Initiative

Muharman Lubis, Tien Fabrianti Kusumasari

This study seek to identify factors that might increase the likelihood of acceptance of electronic voting in which bring satisfaction from citizen to meet their expectation in having better voting experience than before in relation to privacy protection. For the purpose of this study, the researcher...

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PROPOSAL OF MAINTENANCE POLICY ON BARMAG PRO[redacted] MACHINE IN FT3 PT XYZ USING RELIABILITY-CENTERED MAINTENANCE AND RISK-BASED MAINTENANCE METHOD

Irsalina Maharani, Fransiskus Tatas Dwi Atmaji, Nopendri Nopendri

XYZ is a company that is engaged in the textile industry since 1974. XYZ has some different kinds of yarns which through several production processes in 24 hours a day to fulfill the market demands. Therefore, all machines have to be in the best condition as it can be. These machine should be maintained...

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Factors That Influence An Academic Institution's Intention To Accept CloudIOT: A Proposed Framework

Ali Mehimed Ahmed Ireda, Mohommed Awadh Ben-Mubarak, Adubhahir Buhari

The combination of Cloud Computing (CC) and Internet of things (IOT) which is known as CloudIOT are two different kinds of technologies that are already part of our lives. The growing usage of CloudIOT in the education sector is changing the Teaching and Learning processes. There is very limited study...

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MAINTENANCE POLICY of JET DYEING MACHINE USING LIFE CYCLE COST (LCC) AND OVERALL EQUIPMENT EFFECTIVENESS (OEE) IN PT.XYZ

Akbar Perwira Wibowo, Fransiskus Tatas Dwi Atmaji, Endang Budiasih

PT. XYZ is one of the textile companies located in Majalaya, Bandung Region, West Java Province established since 1976. In the production process, one of the important roles is the process of dyeing. The dyeing machine K has the

highest frequency of damage compared to other jet dyeing machine in th

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OLAP Cube Processing of Production Planning Real-life Event Log: A Case Study

Rachmadita Andreswari, Mohammad Arif Rasyidi

Business process modeling in an application log can be done by using process mining technique. To analyze the process flow in more detail in several dimensions needs cube process. Multidimensional depiction in star schema to perform Online Analytical Processing (OLAP) can be done by drill-down, roll-up,...

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DESIGN OF AUTOMATION SYSTEM FOR CERAMIC SURFACE QUALITY CONTROL USING ARTIFICIAL NEURAL NETWORK AT BALAI BESAR KERAMIK

Puspita Ayu Lestari, Haris Rachmat, Mohd. Rasidi Ibrahim, Denny Sukma Eka Atmaja

Indonesia's ceramic tiles production is currently ranked between fifth and sixth of the world, that showed ceramic tiles is one of the largest commodities in Indonesia. So, ceramic quality becomes very important to be considered in it used as one of the basic building materials. The existing ceramic...

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High Imperceptible Copyright Protection: Adaptive Wavelet for Security

Irma Safitri, Rizki R. Ginanjar, Aliffian S. Laksono

This work extends our previous research in [14]. This work showed the imperceptibility of audio watermarking system with Bose-Chaudhuri-Hocquenghem (BCH) code, Discrete Wavelet Transform (DWT) and Singular Value Decomposition (SVD) methods. Watermarked image is embedded in the audio host signal accompanied...

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Inventory Control Policy for Farm-Out Parts at Cold Section Module CT 7 Engine with Periodic Review (R, s, S) and (R, S) to Minimize Total Inventory Cost

Pratya Poeri Suryadhini, Ayulia Fitriane Setiawan, Widia Juliani

This paper proposes a policy for parts at maintenance service industry, which is the number of parts not as many as manufacture industry but it may involve in late deliveries. The importance of inventory also occurs in maintenance service industry of aircraft engines and industrial machines such PT....

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Low Cost Electronic Seal for Tanker Truck in Indonesia

Ahmad Musnansyah, Bernando Arianto

The amount of loss of petroleum product in transit has always been an

ubiquitous problem in Indonesia. This system using RFID, microcontroller Raspberry PI and specially designed mechanical sensors aims to answer safe delivery of petroleum product from depot to the gas stations. The electronic seal...

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Behavior Proportion According to Merapi Volcano Eruption Evacuations in 2010

Dwi Handayani, Bertha Maya Sopha, Budi Hartono, M. Kusumawan Herliansyah

This paper presents the need of contingency plan for evacuation of Merapi Volcanic eruption by considering the behaviour proportion of people in the slopes of Mount Merapi when facing emergency response phase. The research had used exploratory retrospective view survey with face-to face interview. The...

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Chao Ou-Yang, Indy Cesara

Design process scheduling is conducted by optimizing human resources or workers allocation to several tasks in project with several real constraints to achieve the objective, minimizing the project makespan. In real business case, despite the tasks are already allocated to the optimal workers, rework...

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An Analysis of Core Competencies and Business Performances in Software SMEs : A Conceptual Framework

Atya Nur Aisha, Iman Sudirman, Joko Siswanto, Yassierli Yassierli

To survive in the high competition, the SME need to determine and develop their superior internal capability. The aim of this study is to develop a conceptual model that could use to understand the relationship between core competencies and business performance in accordance with the external environment...

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Performance Appraisal Design Using 360 Degree Feedback at University X

Deniar Yudithama, Fida Nirmala Nugraha, Devi Pratami

Directorate of Information Systems is a unit that provides information technology services, at University X, that needs to perform at its best most of time. Its employees' performance directly affects the unit performance. One problem in employee assessment due to its high subjectivity. Currently the...

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Ranita Windriani, Ibnu Asror, Dana Sulistyo Kusumo

The development of e-commerce in Indonesia is increasing, now make e-

The development of e-commerce in Indonesia is increasing, now make e-commerce as the land of very large data. The data is also used not only a[redacted] content in e-commerce, but with the existence of Web Mining, the data is processed in such a way that will generate new information to be utilized in system...

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Mohammad Tubishat, Norisma Idris

Huge volume of reviews by customers published on different products websites has become an important source of information for both customers and companies. Customers require the information to help them in decision making for buying products, while companies analyze these reviews to improve their products....

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Analysis on Opinion Mining Using Combining Lexicon-Based Method and Multinomial Naïve Bayes

Geriska Isabelle, Warih Maharani, Ibnu Asror

Opinion mining is the analysis of the opinion by looking at the sentiment, behavior, or emotions contained in a product. Some of the opinion mining methods are using the lexicon-based and supervised learning. Lexicon-based method has a low recall, while supervised learning has good accuracy but requires...

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Group-Centered Framework Towards a Positive Design of Digital Collaboration in Global Settings

Irawan Nurhas, Jan Pawlowski, Stefan Geisler, Maria Kovtunenko, Bayu Rima Aditya

globally distributed groups require collaborative systems to support their work. Besides being able to support the teamwork, these systems also should promote well-being and maximize the human potential that leads to an engaging system and joyful experience. Designing such system is a significant challenge...

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Optimizing Woven Fabric Defect Detection using Image Processing and Fuzzy Logic Method at PT. Buana Intan Gemilang

Ratna Safitri, Tatang Mulyana

The development of textile industry which 3rd position in the largest export values in Indonesia prove that the quality of textile must be one of factors that should be considered for all of textile companies. Buana Intan Gemilang is one of the companies that produce woven fabric. This company's produce...

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Mira Rahayu, Muhamad Adhi Guna Dwyantoro

The process of picking the tea leaves is done in three different ways, the first one is using the farmer hands, the second is using a scissors, and the third is

using a cutting machine. When the farmer using the tea leaf cutting machine, the fatigue level is increasing compared with using the other tools...

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Measuring project performance using Earned Value Management (EVM) in XYZ software development project

Olivia Permata Ariputri, Ika Arum Puspita, Wawan Tripiawan

The project of the research is a project-based service that develops customized reporting platform for the X multi finance company. It observed at the project execution stage and focusing on the monitor and control established in the project. The percentage of the problem occur based on the interviewees...

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DETERMINING THE SUITABLE MATERIAL HANDLING EQUIPMENT IN PT. XYZ.

Zhafran Ega, Judi Alhilman, Fransiskus Tatas Dwi Atmaji

Selection of appropriate material handling equipment for specific conditions is found to be a multi-criteria decision-making problem. The selection procedure is found to be unstructured, characterized by subject knowledge and requiring the application of an effective and efficient multi-criteria

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Investigation on Simulation of Wind and Solar Power Hybrid Systems through Human Machine Interface by InTouch Wonderware Software

Tatang Mulyana, Hari Setiawan, Rasidi Ibrahim

Human Machine Interface (HMI) serves as a bridge for operators to understand the processes that occur in a production system. Without the HMI, operators have difficulty in monitoring and controlling the production system. It serves to facilitate the operator in monitoring the plant, plant control, plant...

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Fishery Supply Chains in Indonesia: Improvement Opportunities on The Downstream Side

Niniet Indah Arvitrida, Dian Rahmawati, Dwi Lastomo, Rindawati, Kusnadi

This paper investigates improvement opportunities for fishery supply chains in Indonesia. A downstream perspective is taken, and Surabaya is employed as a case study. This research applies desk study and exploratory work to obtain existing landscape of the fisheries supply chains. This landscape is used...

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Design and Marketing Performance Analysis on Unit Business Government and Enterprise Service Unit at Telkom XYZ Area by Using Balanced Scorecard for Marketing

Fauziyyah Fauziyyah, Endang Chumaidiyah, Sari Wulandari

Measuring the performance of marketing division still rarely to be encountered, due to the limited measurement tool. Evaluation of marketing performance is usually associated only with the number of 'sales' both in volume and revenue, for instance the BGES unit at Telkom XYZ area. Thus, it cannot be...

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Development of Inventory Control Application for Pharmaceutical Product Using ABC-VED Cycle Counting Method to Increase Inventory Record Accuracy

Fadhilah Amin Fathoni, Ari Yanuar Ridwan, Budi Santosa

A good inventory control system is needed in the organization to reduce costs and stay competitive. One of the inventory control strategy is stock-taking. This research aims to develop a new stock-taking policy for a pharmaceutical company using ABC-VED Cycle Counting. Proposed stock-taking policy using...

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Deduplication for Data Profiling using Open Source Platform

Margo Gunatama, Tien Fabrianti, Muhammad Azani Hasibuan

Many companies still yet to know the importance of data quality for the company's improvement. Many companies in Indonesia, especially BUM and Government companies have only single application with single database, which cause a problem related to duplication of data between columns, tables and applications...

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Web Services to Overcome Interoperability in Fingerprint-based Attendance System

Alam Rahmatulloh, Rohmat Gunawan, Irfan Darmawan

The fingerprint-based attendance management process generally consists of recording, management, and reporting. The method of recording attendance data is done with the help of fingerprint attendance machine. Even though the computer connection is running online, the administrator still needs to process...

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Comparison of Web Scraping Techniques : Regular Expression, HTML DOM and Xpath

Rohmat Gunawan, Alam Rahmatulloh, Irfan Darmawan, Firman Firdaus

Data collection is the initial stage of research. There are various data sources on the internet that can be used in the research process. The process of taking data or information from sites on the internet is called web scraping. Some methods of web scraping include Regular Expression (Regex), HTML...

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Data Mining Approach to Classify Tumour Morphology using Naïve Bayes Algorithm

Shahmirul Hafizullah Imanuddin, Irfan Darmawan, Rahmat Fauzi

Tumours are a very sickly disease and recorded as the second killer disease in the world. This is because until now tumour still not found a drug that can really cure it. In Indonesia itself has many people who have suffered from tumours. Ignorance makes people reluctant to observe the early symptoms...

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OPERATIONAL RISK ANALYSIS FOR BARCODING PROJECT IN PT. XYZ WITH ENTERPRISE RISK MANAGEMENT METHOD

Amanda Putri Kusumawardhani, Endang Chumaidiyah, Rita Zulbetti

PT. XYZ is running the Bacoding Project to facilitate the process of recording raw material data in the production process. This Barcoding Project certainly has operational risks that may occur, therefore by using the Enterprise Risk Management approach (ERM) that is a process, effected by an entity's...

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Measuring Schedule Performance of Fiber to The Home Project Using Earned Value Management

Reynaldy Prayogi, Devi Pratami, Ika Arum Puspita, Ageak Raporte Bermano

Fiber to the home (FTTH) is the current project that awarded by XYZ company to vendors. This project experience several months delay against the baseline

to vendors. This project experience several months delay against the bas

To meet the due date both parties want to give a proper corrective action toward the project. Since the project is still completing the remaining...

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An Inventory System For Packaging Material Under The Probabilistic Demand Using Joint Replenishment Method At Cocoa Company

Rafif Prayogi, Ari Yanuar Ridwan, Budi Santosa

Company XYZ is a company runs in the cocoa industry located in Bandung. Currently, Company XYZ has the problem in controlling inventory system of packaging materials because there is only one supplier who supply the material, variation of lead time, high stocks of packaging material that pile up in the...

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Design of Business Model on Digital Printing Startup Using Business Model Canvas Approach

Muhammad Miftah Nur Huda, Endang Chumaidiyah, Farda Hasun

PT. ABC is a startup engaged in the field of printing that offers online-based printing services with a variety of printing products. As time goes by, more and more competitors are entering the online printing business with considerable growth. To be able to survive in competition, PT. ABC requires a...

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Company Strategy Based on Linier Regression of Stocks Return to the EPS and Dollar Exchange at Pharmaceutical Industry in Indonesia Stock Exchange 2010-2016

Nico Septian, Endang Chumaidiyah, Rita Zulbetti

Pharmaceutical Industry one of industry that has a great effect on health aspect and it affects the economy in a country. This study aims to determine the effect of Earning Per Share, Debt to Equity Ratio, Return On Asset, Inflation and Dollar Exchange at simultaneosly and partially to stock return in...

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Muharman Lubis, Rahmat Fauzi, Ahmad Almaarif

Privacy is the capability of individuals or groups to isolate the information about themselves from the eyes of everybody partially or physically, then express themselves selectively. Therefore, there are differences in term of content or boundaries among culture and society on what is considered private...

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Analysis Comparison of Data Mining Algorithm for Prediction Student Graduation Target

Rachmadita Andreswari, Muhammad Azani Hasibuan, Dela Youlina Putri, Qalbinuril Setyani

The main objective of a higher education institution is to provide quality

education for its students. The most important indicator to measure the quality of higher education performance is the percentage of student graduation on time. However, not all student can successfully have completed their studies...

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Muhammad Hanif Ramadhan, Haris Rachmat, Denny Sukma Eka Atmaja, Rasidi Ibrahim

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Model Tree with Modified L1 Loss Function for Predicting Missing Attendance Data of Faculties

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***Abstract*— The problem of missing attendance data in our university often arises due to the negligence of faculties. In this study, we address the problem by directly predicting the work duration of faculties. The nature of the problem require us not only to make accurate predictions, but also to minimize the rate of overestimation. To address the problem, we propose the implementation of model tree with modified L1 loss function and simple prediction result reduction. Experimental results show that our proposed method is able to lower the overestimation rate while maintaining accuracy within acceptable range.**

Keywords—model tree; loss function; prediction; attendance

I. INTRODUCTION

It is a common practice for organizations to require their employees to meet certain work hours or duration, and Universitas Internasional Semen Indonesia (UISI) is no exceptions. To monitor the attendance, employees in UISI are required to report their attendance by clocking in and out on the provided fingerprint scanners. Contrary to staffs that are expected to be punctual, faculties' attendances in UISI are monitored by their working hours or durations. These durations can be obtained by subtracting clock in time from clock out time for each faculty.

One of the problems faced by UISI is that employees, especially faculties, often fail to report their attendance either by clocking in or out because of their' negligence as well as other problems, such as device and electrical failures. When either clock in or clock out time is missing, we cannot calculate the daily work duration of the corresponding faculty. These attendance records missing either clock in or clock out times make up a large proportion of our attendance data, and therefore they cannot be left untreated.

Some ways to mitigate this problem are by setting default clock in/out times, setting a fixed daily work duration for faculties, predicting the missing data, or ignoring the problem altogether by considering the faculty to be absent from work. In this study, we try to solve the problem by predicting the missing data. Instead of predicting the missing clock times, we try to directly predict the work durations using the known clock times (either in or out) as well as other attributes, such as day of week, month, and other time related features. This problem falls into a type of machine learning task called regression: the problem of predicting numerical values using some known available data. Many prediction methods have been developed and widely used in practice for doing regression, for example linear regression [1], nearest neighbors [2], artificial neural network [3], and model tree [4], [5]. In this study, we employ linear regression and model tree, a tree and linear-based model, to tackle the problem of predicting work duration of university faculties. These methods have been extensively used in practice for solving numerical prediction problems in various fields, e.g. traffic prediction [6], [7], road accident prediction [8], and water level forecasting [9]. One specific feature of our problem is that accuracy is not the main purpose. Average error rate of under an hour is considered acceptable as per university requirement. However, the predictions should be made so that they should not overestimate the actual work duration as much as possible. Overestimation is undesirable since the fault of missing clock data often lies in the negligence of faculties and therefore it is better to underestimate than to overestimate the work duration while still keeping prediction accuracy in check.

The rest of this paper is organized as follows. Section II will give brief overview of prediction algorithms employed in our study. Our proposed method is described in section III. In section IV, we describe our experiment setup. Experimental results are presented and discussed in section V. Finally conclusion is given in the final section.

II. BRIEF OVERVIEW OF PREDICTION ALGORITHMS

A. Linear Regression

Linear regression as illustrated in Fig. 1 is one of the most popular prediction methods in machine learning because of its simplicity. It is parametric and easy to implement. In linear regression models, the target value is expressed as linear combination of the attributes or features with some predetermined weights:

$$y = f(\mathbf{x}) = w_0 + w_1x_1 + w_2x_2 + \ldots + w_jx_j \qquad (1)$$

where y is the target value, $\mathbf{x} = (x_1, x_2, \ldots, x_j)$ is an instance vector with j attributes, w_0 is intercept (constant), and $\mathbf{w} = (w_1, w_2, \ldots, w_j)$ is the weight vector.

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One of the common method to build linear regression model is the ordinary least square method first published by Legendre [10] and Gauss [11] which finds function $\hat{f}$ that minimizes the sum of squared error (L2 loss function):

$$\hat{f} = \arg\min_{f} \sum_{i} L_2(y_i, f(\mathbf{x}_i)) . \quad (2)$$

This problem can be solved analytically and a unique global solution exists.

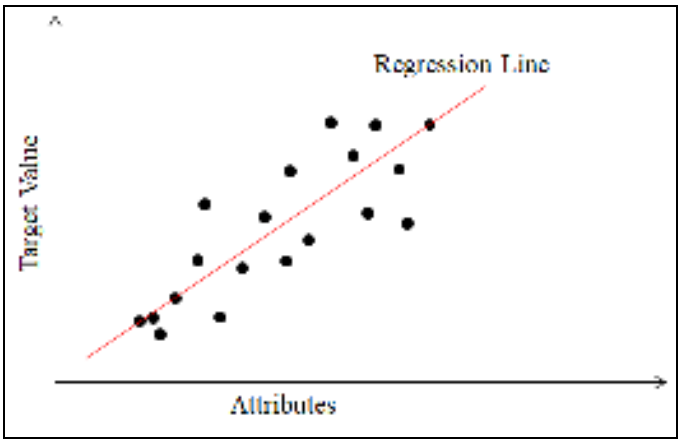

Fig. 1. Illustration of Linear Model

B. Model Tree

Decision tree is a type of predictive model that has been commonly used for both classification and regression (numerical prediction). Decision trees for regression generally can be differentiated into two categories: regression trees and model trees. Contrary to regression trees that have constants at their leaves, model tree is a type of decision tree that has nontrivial model at its leaves as illustrated in Fig. 2. In this study, we are employing M5, an algorithm developed by Quinlan [4] and improved by Wang and Witten [5] to build model trees with linear regression models at their leaves. Similar to the way decision trees for classification are build, M5 model tree uses reduction of variance to choose the best split in each node. Once the target values of all examples that reach certain node only very slightly vary or only few examples are remained, the split are terminated. A linear regression model (as explained in the previous subsection) is then built using those examples and placed at the leaf. Model simplification, pruning, and smoothing are also performed in order to avoid overfitting as well as discontinuity of adjacent linear models. This makes model trees generally superior to linear regression model since it can handle nonlinearity very well. For details on how to build the M5 model tree, one may refer to [4], [5].

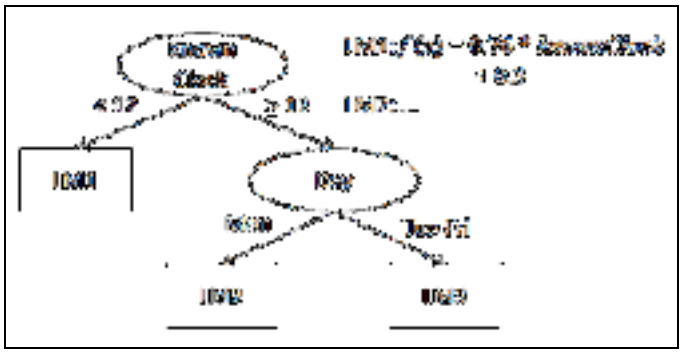

Fig. 2. Example of a model tree

III. Proposed Method

In this study, we propose three methods to handle our problem of making accurate prediction while minimizing number of estimation. Three methods are discussed below: prediction result reduction, loss function modification, and combination of both of them.

A. Prediction Result Reduction

Fig. 3 shows two regression lines with some training examples. Examples that fall below the line are those that are overestimated, while examples above the lines are those that are underestimated. Intuitively, we can push the regression line down at the cost of accuracy by simply reducing the prediction result or model intercept by some amount δ. The final prediction can then be calculated as

$$y = \max(f(\mathbf{x}) - \delta, 0) . \quad (3)$$

This method effectively lower the regression line, puts more examples above the line, and thus lowering the number of overestimation. This method is simple, it can be implemented for all prediction models, and it does not require modification to the way we build our prediction model.

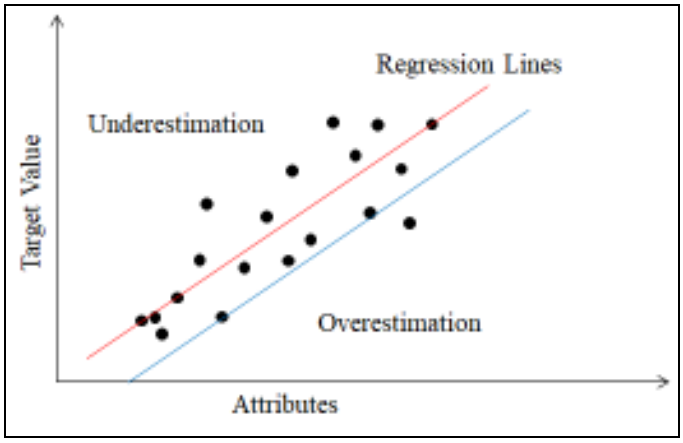

Fig. 3. Illustration of two regression lines. The blue line has lower overestimation rate than the red one.

B. Loss Function Modification

Traditionally, single linear regression model, as well those that are used in M5 model tree are built by minimizing the sum of squared error or L2 loss function:

$$L_2(y, f(\mathbf{x})) = (y - f(\mathbf{x}))^2 . \tag{4}$$

Variants exist, such as least absolute deviation that minimizes sum of absolute error or L1 loss function:

$$L_1(y, f(\mathbf{x})) = \left| y - f(\mathbf{x}) \right| . \tag{5}$$

These loss functions however, are symmetric. They punish overestimation and underestimation equally which is not suitable for our purpose.

To accommodate our problem, in this study, we use a modified L1 loss function to direct our prediction algorithm to produce models that tends to avoid overestimation. The idea is that we punish overestimation more than we do underestimation. Hence, our modified loss function is as follows

$$L_{1\mathrm{M}}(y, f(\mathbf{x})) = \begin{cases} y - f(\mathbf{x}), & y \geq f(\mathbf{x}) \\ k(f(\mathbf{x}) - y), & \text{otherwise} \end{cases} \tag{6}$$

where k denotes a positive constant greater than or equal to 1. When k equals to 1, this is the same as least absolute deviation, while when k is less than 1, overestimation is more preferred than underestimation which is contrary to what we are trying to achieve.

Building the linear model is then straightforward. Any linear programming technique can be used to obtain the weight vector and intercept that minimize our loss function:

$$\sum_{i=1}^{n} L_{1\mathrm{M}}(y_i, f(\mathbf{x}_i)) = \sum_{i=1}^{n} L_{1\mathrm{M}}(y_i, \mathbf{w} \cdot \mathbf{x}_i) \tag{7}$$

which is equal to

$$\text{Minimize} \sum_{i=1}^{n} e_i \tag{8}$$

with respect to $\mathbf{w}$, u_1,..., u_n, subject to

$$\begin{aligned} e_i &\geq y_i - \mathbf{w} \cdot \mathbf{x}_i && \text{for } i = 1 \text{ to } n \\ e_i &\geq k(\mathbf{w} \cdot \mathbf{x}_i - y_i) && \text{for } i = 1 \text{ to } n \end{aligned} . \tag{9}$$

C. Combination of Loss Function Modification and Prediction Result Reduction

Reduction of prediction results can be employed in conjunction with loss function modification. Predictions that are made using models built with our custom loss function can be lowered further by reducing them with some specified amount.

IV. Experiments

A. Data Preparation

The datasets that we use in this study are attendance logs of 64 faculties in UISI from October 1, 2016 to March 31, 2017. We take examples that are complete, meaning that there are no missing values. We divide every example into two: one with known clock in data, and another with known clock out data. We set the known clock in and out as the same feature, added several time related features such as day of week, day of month, month, and year, and set the daily work duration as the target attribute. This resulted in 64 datasets (one for each faculty, containing his/her own attendance data) with a total of 12650 examples.

B. Prediction Methods

We implement original linear regression (LR) and M5 model tree as well as our three proposed methods: reduction of prediction results, loss function modification, and their combination for each datasets. For comparison purpose, we also implement baseline predictor: historical average prediction model (HA). Historical average, as the name suggests, simply make prediction by returning the average work duration of the same day of week:

$$\overline{WorkDurati\,on}(t) = \frac{1}{w} \sum_{i=1}^{w} WorkDurati\,on(i,t) \tag{10}$$

These prediction methods are coded in Java as RapidMiner [12] extensions. For modified LR and M5, we extend the Weka [13] extension available in Rapidminer. Apache Commons Math [14] is also used for doing linear programming when building models with loss function modification.

C. Performance Measurement

To evaluate the performance of our predictors, we perform ten-fold cross validation. There are three performance measures that we use: mean absolute error (MAE) shown in (11), overestimation rate, and average of overestimation. The lower their values, the better the performance of the models.

$$\mathrm{MAE} = \frac{1}{n} \sum_{i=1}^{n} \left| y_i - f(\mathbf{x}_i) \right| \tag{11}$$

V. Results and Discussion

A. Performance of Ordinary Prediction Models

The results obtained by our prediction models without any modification are shown in Table I. Out of the three methods we test, model trees perform best while linear regression models are the worst. The performance of linear regression is even worse than our base predictor, historical average. As can be seen, all prediction methods are able to produce acceptable accuracy, showing average error under one hour. However, as we have suspected previously, the percentage of predictions that overestimate the work duration of faculties is noticeably high, which is undesirable as per our requirement.

TABLE I. Performance Comparison of Ordinary Predictors

Prediction Method	MAE	% Overestimation	Avg. of Overestimation
HA	43.23	35.26%	21.62
LR	45.16	36.62%	22.58
M5	38.38	35.29%	18.99

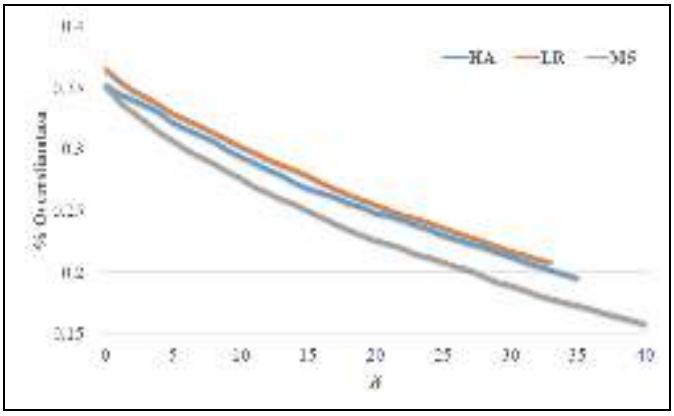

Fig. 4. Overestimation rate of ordinary prediction models with various amount of prediction reduction.

B. Performance of Models with Prediction Result Reduction

Fig. 4 shows the change of overestimation rate of our ordinary predictors with different amount of prediction result reduction δ. Only values that have MAE under one hour are displayed. We can see that once again, model tree models managed to lower the overestimation rate better than the other models.

C. Performance of Models with Modified Loss Function

Table II shows the performance comparison of model trees and linear regression models with modified L1 loss function. We can see that as the rate of overestimation decreases, the error rate increases. It is also inferred from Table I and II that when the error levels are similar, our proposed method managed to produce lower overestimation rate. The best performance is once more shown by M5 where it can decrease overestimation rate to 16.81% while keeping accuracy within acceptable range.

TABLE II. Performance Comparison of Prediction Models with Modified L1 Loss Function

k	MAE		% Overestimation		Avg. of Overestimation	
	LR	M5	LR	M5	LR	M5
1	40.77	35.62	44.95%	42.73%	29.32	23.33
2	45.63	40.06	32.01%	30.53%	19.94	16.27
3	54.04	46.74	**24.85%**	23.46%	**14.65**	12.62
4	*61.50*	53.43	*20.25%*	19.23%	*11.29*	10.05
5	*69.04*	59.05	*17.19%*	**16.81%**	*9.34*	**8.59**
6	*75.19*	*63.80*	*14.78%*	*14.40%*	*8.03*	*7.33*
7	*80.82*	*68.73*	*13.12%*	*12.93%*	*6.95*	*6.64*
8	*86.22*	*72.49*	*11.88%*	*12.11%*	*6.14*	*5.98*
9	*90.44*	*76.06*	*11.08%*	*10.77%*	*5.58*	*5.36*
10	*94.59*	*79.47*	*10.13%*	*10.06%*	*5.10*	*4.99*

D. Performance of Models with Combination of Loss Function Modification and Prediction Result Reduction

Fig. 5 and 6 show the overestimation rate of linear regression models and model trees with different values of k and δ (note that LR-i and M5-i both denote modified linear regression models and model trees with $k = i$). Here, we can see that both methods produce lowest overestimation rate when $k = 2$. We can also see that the higher the value of k, the less amount of reduction is required to lower the overestimation rate.

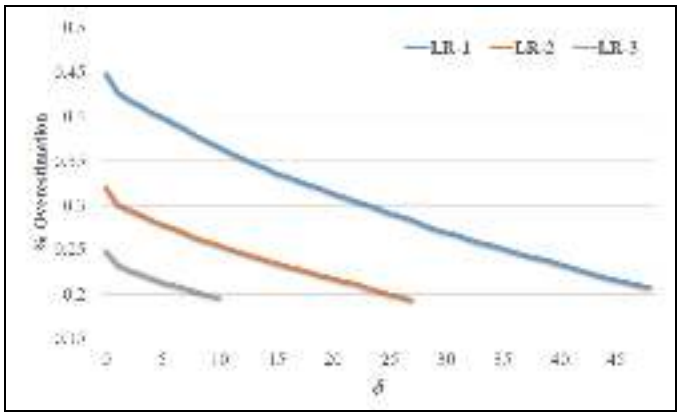

Fig. 5. Overestimation rate of linear regression models with modified L1 loss function with various amount of prediction reduction.

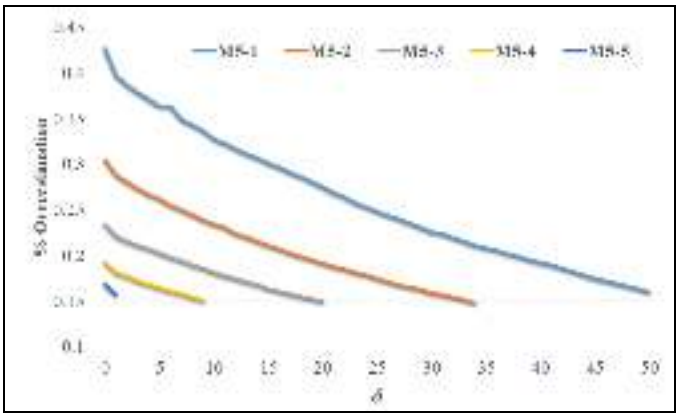

Fig. 6. Overestimation rate of model trees with modified L1 loss function with various amount of prediction reduction.

E. Performance Comparison

We compare the performance of proposed methods in Table III. We can see that when using L1 loss function modification, model trees deliver the lowest average amount of overestimation. Although the overestimation rate is higher than that of prediction result reduction, when it is combined with prediction results reduction, better overestimation rates are obtained.

TABLE III. PERFORMANCE COMPARISON OF PROPOSED METHODS

Method	Prediction Models	δ	k	% Over-estimation	Avg. of Overestimation
Pred. Result Reduction	HA	35	-	19.60%	12.34
	LR	33	-	20.86%	13.47
	M5	40	-	***15.85%***	9.55
L1 Modifi-cation	LR	-	3	24.85%	14.65
	M5	-	5	16.81%	**8.59**
Reduction + L1 Mo-dification	LR	27	2	19.33%	13.34
	M5	34	2	**14.84%**	***9.15***

VI. CONCLUSION

The problem of predicting missing work duration of university faculties requires us to minimize overestimation while still keeping prediction accuracy in check. In this study, we have proposed the implementation of model tree with modified L1 loss function and simple prediction result reduction to address the problem. The experimental results show that our proposed method manage to lower the overestimation rate to as low as 14.84% from the ±36% rate previously obtained by ordinary prediction models while maintaining accuracy within acceptable range. In future works, we will incorporate more data and try to identify whether there are some patterns or similarities of the work behavior of the faculties. We will also investigate whether we can achieve better result by grouping or clustering faculties based on their attendance behaviors and use their data instead of individual data for training the prediction models.

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