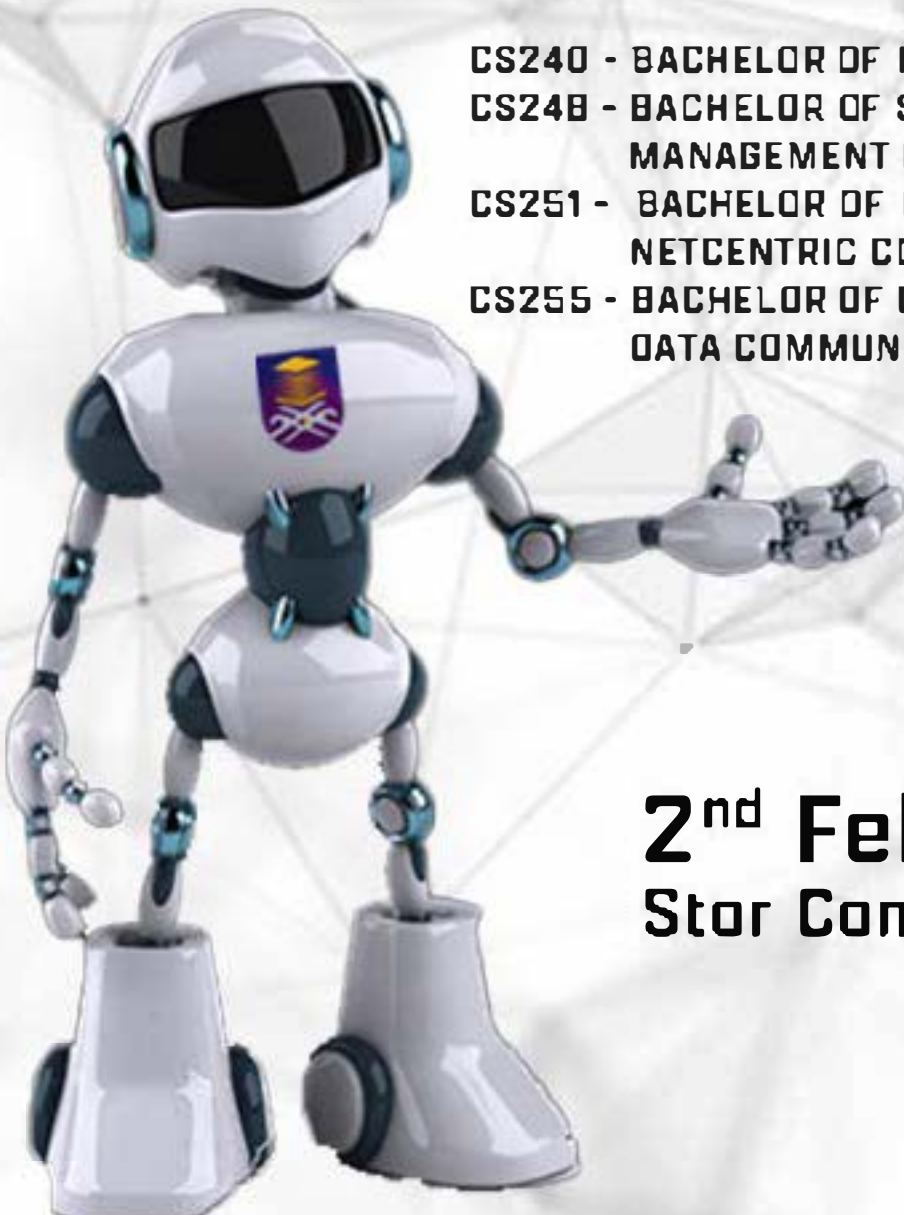

RESEARCH EXHIBITION IN MATHEMATICS & COMPUTER SCIENCES

REMACS 5.0

- 
- CS240 - BACHELOR OF INFORMATION TECHNOLOGY [HONS.]
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2nd February 2023
Stor Complex, UiTM Perlis

Organized by:
College of Computing, Informatics and Media
Universiti Teknologi MARA Perlis Branch

**Research Exhibition in Mathematics and Computer Sciences
(REMACS 5.0)**

Research Exhibition in Mathematics and Computer Sciences (REMACS 5.0)

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CONTENTS

Preface	iii
Committee	iv
Event Schedule	v
List of Papers	vi-xxiii
Articles	1-278

Preface

It is with great pleasure that we present this extended abstract book, titled "The 5th Research Exhibition in Mathematics and Computer Sciences (REMACS 5.0)". This book is a collection of research work in the fields of Computer Science and Mathematics, contributed by the final year students from Universiti Teknologi MARA, Perlis Branch. The aim of this book is to showcase the diversity and depth of research in these two interrelated fields.

Mathematics and Computer Science are two fields that have seen tremendous growth and advancement in recent years. With the rise of new technologies and the increasing demand for data-driven solutions, researchers in these fields have been working hard to develop new theories, algorithms, and models that can help solve some of the most pressing problems of our time. This book is a testament to their hard work and dedication.

The abstracts in this book cover a wide range of topics, including algebra, analysis, logic, computer architecture, algorithms, artificial intelligence, machine learning, computer network, netcentric computing and many more. The work presented here is both theoretical and practical, and has the potential to impact many areas of society, from finance and healthcare to education and security.

We hope that this book will serve as a valuable resource for future students in the fields of Mathematics and Computer Science. We also hope that it will inspire more students to pursue innovative and groundbreaking research in these two fields. Finally, we would like to express our gratitude to all the contributors for their hard work and dedication, without which this book would not have been possible.



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REMACS 5.0

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EVENT SCHEDULE

8:00 – 8:30 am

- Registration

8:00 am – 12:00 pm

- FYP Project Presentation

12:00 - 2:00pm

- Lunch Break

2:15 – 2:35 pm

- National & Wawasan Setia Anthems
- Doa Recitation

2:35 – 2:45 pm

- Welcoming Address by Director of REMACS 5.0

2:45 – 2:55 pm

- Officiating & Closing Remarks from Rector of UiTM Perlis

2:55 – 3:00 pm

- REMACS 5.0 Montage

3:00 – 4:00 pm

- Awarding of Winners:
 - Best Poster
 - Best Project Award
- Photo Session
- End of Ceremony

Dress Code: Formal / Corporate

List of Papers

Article Title	Page
WEB-BASED BLOOD DONATION MANAGEMENT WITH REWARDS SYSTEM Ahmad Syakir Mohd Sakeri and Nadia Abdul Wahab	1
FINAL YEAR PROJECT MANAGEMENT SYSTEM (FMS) Aimuni Nadhrah Yazit and Ros Syamsul Hamid	3
UNIBUKU: UiTM Book Reselling Web Application Anis ‘Aisyah Md Nazri and Mohammad Hafiz bin Ismail	5
STUDENT INTERNSHIP PLACEMENT USING PERSONAL DECISION AID Anis Nabila Azizi and Azmi Abu Seman	7
INTERNSHIP MONITORING AND ASSESSMENT SYSTEM Ezza Liyana Jalaludin and Azmi Abu Seman	9
AR FOR PLANTATION AND AGROTECHNOLOGY AREA AT UITM PERLIS Faizah Ahmad Rodi and Nor Arzami Othman	11
MOBILE APPLICATION FOR COLLEGE LAUNDRY BOOKING SYSTEM IN UITM PERLIS Haizatul Zulaikha Annual and Siti Zulaiha Ahmad	13

SKIN CARE E-COMMERCE MOBILE PLATFORM WITH PRODUCT RECOMMENDATION BASED ON SKIN TYPE	15
Haziq Asyraf Abu Hanifah and Nadia Abdul Wahab	
HEALER – MENTAL HEALTH PERSONAL DECISION AID	17
Huda Nabila Ishak and Norfiza Ibrahim	
VETERINARY CLINIC MANAGEMENT SYSTEM	19
Mas Nur Alya Binti Mohd Yusof and Prof. Madya Ts. Dr. Shukor Sanim Bin Mohd Fauzi	
SOCIAL MARKETPLACE WEB APPLICATION FOR UITM PERLIS STUDENTS	21
Mohamad Azimi Zakariah and Muhammad Nabil Fikri Jamaluddin	
FASTBLOOD: BLOOD DONOR MOBILE APP INTEGRATED WITH QR CODE	23
Muhamad Saifullah Yussri and Nora Yanti Che Jan	
MOBILE APPLICATION FOR HEALTHY SLEEP RECOMMENDATION WITH CALM TECHNOLOGY	25
Muhammad Arif Haikal Meli and Romiza Md. Nor	
ROADMATE: IMPROVING RIDESHARING AND CARPOOLING VIA MOBILE APP	27
Muhammad Farid Muhammad Dahri, Arifah Fasha Rosmani	
FELINERINARY: CAT HEALTH MANAGEMENT APP WITH APPOINTMENT REMINDERS USING PUSH-NOTIFICATION	29
Muhammad Hakimie Azraei Mahzir, Siti Sarah Md. Ilyas	

MOBILE INTERVENTION FOR USED CLOTHING MANAGEMENT WITH GEOLOCATION	31
Muhammad Haziq Anuar, Siti Sarah Md Ilyas	
UITM ARAU BICYCLE RESERVATION APP WITH IMPLEMENTATION OF QR CODES (UBIKE COLLEGE)	33
Muhammad Nur Hakimi Azman, Siti Zulaiha Ahmad	
EASYRENT: A WEB BASED RECOMMENDATION SYSTEM FOR SHOP RENTAL – A CASE STUDY IN JITRA, KEDAH	35
Nur Azlina Ariffin, Nora Yanti Che Jan	
MEDCARE: A WEB-BASED CLINIC APPOINTMENT SYSTEM WITH SHORT MESSAGE SERVICE (SMS) NOTIFICATION	37
Nur Elya Fhazlein Zamri, Mohd Nizam Osman	
FASTPARK MOBILE APPLICATION USING GEOLOCATION	39
Nur Hazmiera Mohd Hazline, Nora Yanti Che Jan	
AN ISLAMIC MULTIMEDIA LEARNING APPLICATION OF MENSTRUATION FOR ADOLESCENT GIRLS	41
Nur Irham Atikah Mohd Rafee @ Sukiman, Aznoora Osman	
FUTSAL BOOKING WEB BASED SYSTEM INTEGRATE WITH TELEGRAM NOTIFICATIONS	43
Nur Izzat Hakim Bin Norazam, Mohd Nizam Bin Osman	
HOUSE RENTAL MANAGEMENT SYSTEM FOR STUDENT IN UITM PERLIS	45
Nur Nadiyah Husna Samsudin, Muhammad Nabil Fikri Jamaluddin,	

PENANG TRAVEL SERVICE PROVIDER APPLICATION USING GEOFENCING	47
Nurezzatul Husna Ismail, Mohd Nizam Osman	
MOBILE APPLICATION SYSTEM FOR CARDIOVASCULAR DISEASE PATIENT	49
Nurul Azwa Atikah Ahmad Tarmizy, Abdul Hapes Mohammed	
WEB-BASED CARBON FOOTPRINT CALCULATOR FOR BAKERY FOOD WASTE	51
Nurul Fatihah Mohamed Yusof, Romiza Md Nor	
FOOD TRUCK FINDER	53
Qistina Amirah Abdul Hadi, Iman Hazwam Abd Halim	
RESPONSIVE WEB-BASED CAFE FOOD ORDERING SYSTEM USING BOOTSTRAP AND QR CODE	55
Siti Nadzirah Parsikun, Khairul Anwar Sedek	
WHEELS4RENT: A WEB-BASED VEHICLE RENTAL AND MANAGEMENT SYSTEM WITH SHORT MESSAGE SERVICE (SMS) NOTIFICATION	57
Siti Zulaikha Zaidi, Mohd Nizam Osman	
IMPLEMENTATIONS OF QR-CODE FOR BUS TRANSPORT PASS USING MOBILE APPS	59
Wajeedah Hamdzar Hamizan, Norziana Yahya	
DEVELOPING A CATERING SERVICES MOBILE APPLICATION FOR LOCAL COMMUNITY	61
Masturina Binti Azmi, Ts Dr Norziana Binti Yahya	

ON-DEMAND HOME SERVICES USING MOBILE APPS FOR DIGITAL HOUSEHOLDS	63
Sarah Nurhasya Abd Aziz, Norziana Yahya	
FAKE NEWS CLASSIFICATION USING MACHINE LEARNING TECHNIQUES	65
Adib Farhan Ahmad Rashdi and Mohd Nizam Osman	
DATA VISUALIZATION OF FAMILY INCOME AND EXPENSES	67
Aimi Amisha Ahmad Sabri and Mohd Nizam Osman	
DATA VISUALIZATION : CAUSES AND RISK FACTORS OF DEATH	69
Amirah Mohd Yusof and Jiwa Noris Hamid	
DEVELOPING GRAPHICAL VISUALIZATION FOR UNDERSTANDING THE PATTERN OF STUDENTS PERFORMANCE IN EXAM	71
Anisah Rosli and Norfiza Ibrahim	
DIABETES RISK PREDICTION SYSTEM AND DATA VISUALIZATION	73
Azizah Mohamad Imran and Hawa Mohd Ekhsan	
WEB-BASED APPLICATION FOR PLACES RECOMMENDER USING MACHINE LEARNING	75
Farah Nurshaziela, Ruzita Ahmad and Shukor Sanim Mohd Fauzi	
DATA VISUALIZATION OF CHRONIC KIDNEY DISEASE SYMPTOMS	77
Hanif Ikmal Ahmad Akibi and Hawa Mohd Ekhsan	

SMART SUPPLY CHAIN MANAGEMENT USING DATA VISUALIZATION	79
Hidayah Hushairi and Jiwa Noris Hamid	
DATA VISUALIZATION OF BLOOD DONATION DURING CORONAVIRUS DISEASE (COVID-19) IN PERLIS	81
Maisarah Aisisa and Khairul Anwar Sedek	
DIABETES PREDICTION USING MACHINE LEARNING	83
Muhammad Adib Mohd Nazri and Mahfudzah Othman	
THE DEVELOPMENT OF DISEASES PREDICTION SYSTEM BASED ON SYMPTOMS	85
Muhammad Faiz Mohd Faisol and Mohd Nizam Osman	
LUNG CANCER PREDICTION USING MACHINE LEARNING TECHNIQUES	87
Muhammad Muhaimin Mohd Fauzi and Mohd Nizam Osman	
OBJECT DETECTION MODEL FOR MANGO LEAF DISEASES	89
Muhammad Norzakwan Mohd Sham and Mohammad Hafiz bin Ismail	
ANALYZING ON HOW FOOD CONSUMPTION CAN AFFECT IN DIABETES	91
Muhammad Saiful Azim Mohd Ariff and Khairul Anwar Sedek	
DASHBOARD : RISK PERCEPTION AND TRAVEL SATISFACTION USING PUBLIC TRANSPORT DURING COVID-19	93
Nafeis Sukaiynah Noor Azli and Jiwa Noris Hamid	

DASHBOARD VISUALIZATION OF MOBILITY COVID-19	95
Noor Syarafana Nordin and Noorfaizalfarid Mohd Noor	
DEVELOPING GRAPHICAL VISUALIZATION FOR ANALYZING STUDENT ADAPTABILITY LEVEL IN ONLINE EDUCATION	97
Nur Balqis Mohd Azuddin and Norziana Yahya	
DATA VISUALIZATION ON STUDENT STRESS LEVEL	99
Nur Syifa Ramzi, Mohammad Hafiz bin Ismail and Tajul Rosli Razak	
DASHBOARD: DATA VISUALIZATION OF COVID-19 CONFIRMED AND DEATHS IN MALAYSIA (COVIM)	101
Nurul Izzati Iddarus, Ruzita Ahmad and Shukor Sanim Mohd Fauzi	
DATA VISUALIZATION OF HUMAN STRESS DETECTION LEVEL	103
Nurul Syahirah Md Saad and Hawa Mohd Ekhsan	
DASHBOARD VISUALIZATION ON RENTAL HOUSE DATA IN PERLIS FOR UITM ARAU STUDENTS	105
Putera Mohd Aliff Bakhtiar Mohd Zahir and Khairul Anwar Sedek	
DATA VISUALIZATION OF HIGHER EDUCATION STUDENTS' PERFORMANCE EVALUATION	107
Siti Nur Syahirah Osman and Hawa Mohd Ekhsan	
FUZZY ANALYTIC HIERARCHY PROCESS TO STUDY THE IMPACTS OF OPEN DISTANCE LEARNING ON UiTM PERLIS STUDENTS	109
Adriana Nazihah Cha Ariff and Norpah Mahat	

FORECASTING UNEMPLOYMENT RATE IN MALAYSIA: COMPARISON BETWEEN ARIMA AND FUZZY TIME SERIES	111
Ahmad Faidhi Amir Faisol and Nur Azriani Mohamad Nor	
STAGNATION POINT FLOW OF NANOFLUIDS OVER STRETCHING/SHRINKING SURFACE WITH HEAT SOURCE/SINK AND CONSTANT WALL TEMPERATURE	113
Aifa Afrina Ahmed Rodzuan, Nur Fatihah Fauzi and Nurizatul Syarfinas Ahmad Bakhtiar	
EVALUATION OF FORECAST PERFORMANCE OF COVID-19 WITH DIFFERENT TIME HORIZONS	115
Amirul Rashid Che Samsol and Azlan Abdul Aziz	
SELECTION THE TYPE OF INVESTMENT IN MALAYSIA USING FUZZY ANALYTIC HIERARCHY PROCESS (AHP)	117
Ardini Athirah Mhd Munawar and Mohd Fazril Izhar Mohd Idris	
PREDICTING STROKE USING ANT COLONY OPTIMIZATION ALGORITHM	119
Azfaruddin Azri and Rizauddin Saian	
STAGNATION POINT FLOW OF HYBRID NANOFLUIDS OVER STRETCHING/SHRINKING SHEET WITH HEAT SOURCE/SINK AND CONSTANT WALL TEMPERATURE	121
Fatin Nur Ayuni Mohd Nor, Nur Fatihah Fauzi and Nurizatul Syarfinas Ahmad Bakhtiar	
ANALYSING THE EFFICIENCY OF LOCAL AND FOREIGN CARS IN MALAYSIA USING DATA ENVELOPMENT ANALYSIS (DEA)	123
Khairul Sanusi Samuil and Anas Fathul Ariffin	

APPLICATION OF VANILLA LONG SHORT-TERM MEMORY NETWORKS (LSTM) AND AUTO-REGRESSIVE INTEGRATED MOVING AVERAGE (ARIMA) ON EXCHANGE RATE FORECASTING 125

Mysarah Haslan and Nor Hayati Shafii

RANKING THE EFFECTIVE PREVENTION MEASURES AGAINST COVID-19 BY USING FUZZY AHP METHOD 127

Nur Afifah Zabidi and Teoh Yeong Kin

A NUMERICAL STUDY ON A HIV TRANSMISSION MATHEMATICAL MODEL 129

Nur Izyan Hasna Suhaili, Nur Izzati Khairudin and Nurizatul Syarfinas Ahmad Bakhtiar

APPLICATION OF FUZZY DELPHI ON THE FACTOR INFLUENCING BUYING BEHAVIOUR FOR ORGANIC FOOD 131

Nur Syafiqah Abdul Rashid and Mohd Halimi Ab Hamid

THE USE OF TRAPEZOIDAL RULE TO APPROXIMATE THE VOLUME OF CLOUDS OF SOIL AT GUNUNG PERLIS TAMAN NEGERI PERLIS 133

Nur' Afaf Zahiah Khairulfahmi, Mohamad Najib Mohamad Fadzil and Zaki Ahmad Dahlan

THE USE OF TRAPEZOIDAL RULE TO APPROXIMATE THE VOLUME OF CLOUDS OF SOIL AT GUNUNG PERLIS TAMAN NEGERI PERLIS 135

Nur' Afaf Zahiah Khairulfahmi, Mohamad Najib Mohamad Fadzil and Zaki Ahmad Dahlan

AN APPROACH OF FUZZY AHP TO ANALYZE THE FACTORS OF DOMESTIC VIOLENCE AMONG WOMEN IN MALAYSIA 137

Nurain Syahirah Mahusin and Norpah Mahat

THE USE OF SIMPSON’S RULE TO APPROXIMATE THE VOLUME OF CLODS OF SOIL AT GUNUNG PERLIS, TAMAN NEGERI PERLIS 139

Nurliyana Najwa Husaini Failos, Mohamad Najib Mohamad Fadzil and Zaki Ahmad Dahlan

FACTORS INFLUENCING THE SELECTION OF HALAL PRODUCTS AMONG PERLIS COMMUNITY USING FUZZY AHP 141

Nurul Asyqin Abu Bakar and Siti Nor Nadrah Muhamad

ANALYSING ON INFLUENCING FACTORS OF STUDENTS’ CAREER CHOICE USING FUZZY ANALYTIC HIERARCHY PROCESS (FAHP) 143

Salsabila Saimuddi and Khairu Azlan Abd Aziz

APPLICATION OF FUZZY AHP ON THE SELECTION OF ONLINE SHOPPING PLATFORM IN MALAYSIA 145

Siti Nurmaisarah Zakaria and Khairu Azlan Abd Aziz

CLASSIFICATION OF DIABETIC PATIENTS WITH IMBALANCED CLASS DISTRIBUTION BY USING A COST-SENSITIVE FOREST ALGORITHM 147

Umami Asyiqin Che Muhammad and Muhammad Hasbullah Mohd Razali

A FUZZY CONJOINT ANALYSIS APPROACH FOR EVALUATING CREDIT CARD SERVICES: A CASE STUDY OF MALAYAN BANK 149

Umami Umira Mohd Akhir and Zurina Kasim

SELECTION THE BEST TYPE OF INVESTMENT IN MALAYSIA USING FUZZY TOPSIS 151

Muhamad Aizat Iman Roslan and Fazril Izhar Mohd Idris

ONLINE EMPLOYMENT PLATFORM SELECTION BY USING FUZZY ANALYTIC HIERARCHY PROCESS	153
Muhammad Iqbal Muhamidi and Mohd Halimi Ab Hamid	
TOURIST TRIP DESIGN PROBLEM WITH USER PREFERENCE AND POPULARITY: A CASE STUDY OF LANGKAWI ISLAND	155
Nabilah binti Anuar Ahmad and Huda Zuhrah Ab. Halim	
ANALYZING FACTORS AFFECTING TO E-LEARNING SUCCESS BY FUZZY ANALYTIC HIERARCHY PROCESS (FAHP)	157
Nor Syahazlin Mohd Zaki and Jasmani Bidin	
EARLY DIABETES RISK PREDICTION USING ANT COLONY OPTIMIZATION ALGORITHM	159
Nur Aisyatul Husna Ahmad Yusri and Rizauddin Saian	
COMPARISON BETWEEN ARIMA MODEL AND FUZZY TIME SERIES: FORECASTING ENDEMIC COVID-19 CASES IN MALAYSIA	161
Nur Atikah Mohd Razali and Nor Azriani Mohamad Nor	
ANALYSING STUDENTS' PERCEPTIONS OF ONLINE MATHEMATICS LEARNING	163
Nur Izza Hazwani Azali Azman and Zurina Kasim	
Reconstruction the Rational Quadratic Bezier Curve Using Properties of Rational Quadratic Bezier and Segmentation	165
Nur Nabilla Azmi and Siti Sarah Raseli	
ANALYSING INFLUENTIAL FACTORS IN UNIVERSITY SELECTION USING FUZZY TOPSIS	167
Nurul Athilah Azaman and Jasmani Bidin	

NUMBER OF STAFF OPTIMIZATION OF TOLLMAN SCHEDULING WITH INTEGER LINEAR PROGRAMMING 169

Nurul Athirah Syuhadah Ruslan and Diana Sirmayunie Mohd Nasir

A FUZZY PROMETHEE APPROACH FOR CHOOSING THE MOST PREFERABLE HEALTH INSURANCE COMPANIES 171

Nurul Qistina Mohd Kamal and Raihana Zainordin

THE NUMBER OF EMPLOYED PEOPLE AND TOURIST ARRIVAL IN MALAYSIA USING ARIMA AND FUZZY TIME SERIES MODEL: PRE, DURING AND POST COVID-19 173

Siti Norashikin Roslan and Siti Fatimah Abd Rahman

THE PREFERRED SOCIAL NETWORKING SITE (SNS) FOR INFORMATION DISSEMINATION AMONG UiTM STUDENTS USING FUZZY AHP METHOD 175

Siti Nuraisyah Syafiqah Abdullah and Noorzila Sharif

MATHEMATICAL MODELLING ANALYSIS OF DIET PLANNING FOR THALASSEMIA PATIENTS 177

Siti Sarah Md Zulkifli and Siti Nor Nadrah Muhamad

RANKING FIVE MODELS OF LAPTOPS USING FUZZY PROMETHEE 179

Wan Nur Syahirah Wan Muhammad Sukardi and Raihana Zainordin

PREDICTION OF BREAST CANCER DISEASE USING MACHINE LEARNING APPROACH 181

Wan Nashua Amira and Nor Hayati Shafii

HEAT SOURCE AND CONSTANT WALL TEMPERATURE OF MHD FERROFLUIDS ON EXPONENTIALLY STRETCHING AND SHRINKING SURFACE UNDER STAGNATION POINT REGION	183
Natasya Syafina Ismail, Nurizatul Syarfinas Ahmad Bakhtiar and Nur Fatihah Fauzi	
WEB-BASED UITM BOOK STORE MANAGEMENT SYSTEM INTEGRATED WITH WHATSAPP API AND GOOGLE SERVICES	185
Amir Imran Ahmad and Mohd Nizam Osman	
FACIAL EXPRESSION RECOGNITION USING DEEP LEARNING TECHNIQUES	187
Aznal Anas Azlan and Muhamad Arif Hashim	
ANALYSIS ON RANSOMWARE CHARACTERISTICS USING STATIC ANALYSIS METHOD	189
Maryam Adreena Mohd Mokhtaruddeen and Mohd Faris Mohd Fuzi	
WEB-BASED JEWELRY MANAGEMENT SYSTEM USING WEB SCRAPPING	191
Mohd Irfan Hafizi Bin Fakhurrrazi, Ts. Noorfaizalfarid bin Mohd Noor	
EMPLOYEE ATTENDANCE SYSTEM USING FLUTTER	193
Muhamad Faiz Akmal Bin Mohamad Noor and Sir Alif Faisal Ibrahim	
STAFF RESIDENT COLLEGE (SRK) REPORT MANAGEMENT SYSTEM USING FLUTTER	195
Muhammad ‘Atif Abdul Rahim and Ahmad Yusri Dak	
UiTM PRIHATIN DONATION SYSTEM USING A RESPONSIVE WEB DESIGN APPROACH	197
Muhammad Aiman Bin Rosli and Zulfikri Paidi	

FOOD COURT MANAGEMENT SYSTEM	199
Muhammad Alif Rusyaidi Bin Abdul Rashid and Alif Faisal Bin Ibrahim	
INVENTORY MANAGEMENT SYSTEM FOR SMEs IN KULIM	201
Muhammad Bilal Hakim Bin Azmi and Muhammad Nabil Fikri Bin Jamaluddin	
FINAL YEAR PROJECT SUPERVISOR ACCEPTANCE SYSTEM (FYPSA)	203
Muhammad Fikri Bin Mohd Firdaus and Ros Syamsul Hamid	
UiTM ARAU STUDENT ORIENTATION APPLICATION EXTENDED ABSTRACT	205
Muhammad Hafiz Bin Ghazali and Nurzaid Mohd Zain	
VOAS: VETERINARY ONLINE APPOINTMENT BOOKING SYSTEM	207
Muhammad Harith Bin Mokhtar and Arifah Fasha Binti Rosmani	
ZAKAT MANAGEMENT SYSTEM WITH ELECTRONIC MAIL	209
Muhammad Najmi bin Othman and Noorfaizalfarid bin Mohd Noor	
PINEAPPLE DISEASE DETECTION SYSTEM USING MOBILENETV2 MODEL	211
Muhammad Nu'man Hakim Abdul Aziz and Iman Hazwam Abd Halim	
FIGHTING FISH IDENTIFICATION USING DEEP LEARNING	213
Muhammad NurSyafiq and Mohammad Hafiz bin Ismail	
C++ RUSH: INTERACTIVE GAME IN LEARNING COMPUTER LANGUAGE FOR NOVICE	215
Muhammad Salman Hakim bin Shaiful Nizam and Arifah Fasha binti Rosmani	

E-EXAMINATION SYSTEM FOR ANSWERING OBJECTIVE AND SUBJECTIVE QUESTIONS	217
Muhammad Yasir Zulfikri and Nurzaid Muhd Zain	
SPORT FACILITIES AND EQUIPMENT BOOKING SYSTEM FOR UITM PERLIS	219
Musfira Mohd Azmir and Nurzaid Muhd Zain	
ONLINE HOSPITAL APPOINTMENT CARD WITH QR CODE	221
Nabilatulwidad Binti Abdul Mueiz and Mahfudzah Binti Othman	
MYBUKU PINK MOBILE APPLICATION USING ANDROID	223
NorHafizah Ayob, Mohammad Hafiz bin Ismail and Tajul Rosli Razak	
MOBILE APPLICATION FOR ORDERING FOOD FROM UITM ARAU CAMPUS CAFETERIA	225
Norsyuhana binti Noordin and Nurzaid Mohd Zain	
UITM WEB PRACTICAL LOGBOOK SYSTEM	227
Nur Arifa Najiha Bt Ahmad Zawawi and Mahfudzah Bt Othman	
BLOOD BANK MANAGEMENT SYSTEM	229
Nur Syamimi Izzati Binti Zulkifli and Ros Syamsul Bin Hamid	
WEB-BASED FOR UiTM ARAU FOOD ORDER	231
Nur Zahirah Izzati binti Mohd Zahir and Zulfikri Paidi	

MASK AWARE: IOT FOR FACEMASK DETECTION AND MONITORING	233
Siti Nurfatim Binti Mohtar and Aznoora Osman	
IOT-BASED FLOWER GARDEN CARE SYSTEM USING ESP8266 WIFI MODULE AND TELEGRAM APPLICATION	235
Syahida Atirah Binti Che Omar and Rashidah Binti Ramle	
UITM STUDENT’S ATTENDANCE SYSTEM BASED ON BIOMETRIC FINGERPRINT WITH IoT IMPLEMENTATION	237
Wan Muhammad Rahimi bin Wan Fadzli and Abidah Hj Mat Taib	
CORN LEAF DISEASE DETECTION SYSTEM USING CONVOLUTIONAL NEURAL NETWORK	239
Wan Nurul Izzah Binti Abd Hadi and Iman Hazwam Abdul Halim	
HOMENETSEC: ENHANCING HOME NETWORK SECURITY BY SURICATA INTRUSION DETECTION SYSTEM USING RASPBERRY PI	241
Ahmad Shariff and Abidah Hj Mat Taib	
MALWARE DETECTION IN WINDOWS USING DEEP LEARNING CLASSIFICATION APPROACH	243
Aishah Anuar and Mohd Faris Mohd Fuzi	
E-VOTING SYSTEM PROJECT IN LARAVEL BASED ON WEB-BASED APPLICATION	245
Anis Natasha Zahimi and Ros Syamsul Hamid	
WATER LEVEL MONITORING USING WIFI	247
Azizie Azizan and Iman Hazwam Abd Halim	

FACE SKETCH RECOGNITION SYSTEM USING CLOUD-BASED DEEP LEARNING	249
Faiz Elmie Shah Izahar Shah and Muhamad Arif Hashim	
AN ENHANCEMENT OF SMART TRAFFIC LIGHT IN LORA NETWORK FOR SMALL SCALE AREA	251
Lutfi Hadi Azizul Adry and Rafiza Ruslan	
REMOTE CONTROL DESKTOP SYSTEM	253
Muhammad Akmal Idlan Hissamuddin and Ros Syamsul Hamid	
IoT-Based Smart Chili Farm Monitoring Using Arduino and GSM Module	255
Muhammad Baihaqi Bakar and Rashidah Ramle	
IMAGE AUTHENTICATION SYSTEM USING DEEP LEARNING	257
Muhammad Faisal Amer Faudzli and Muhamad Arif Hashim	
NETWORK AUTOMATIONS ON ACCESS CONTROL LIST (ACL) FOR MULTIVENDOR DEVICES USING ANSIBLE AND NAPALM IN GNS3	259
Muhammad Haziq Ikhmal Suhaimi and Rafiza Ruslan	
PERFORMANCE ANALYSIS OF HTTP FLOODING ATTACK AT APPLICATION LAYER IN MOBILE AD-HOC NETWORK (MANET)	261
Muhammad Hilmi Hafizi Muhamad and Ahmad Yusri Bin Dak	
PERFORMANCE ANALYSIS OF DOS ATTACK AT MAC LAYER IN WLAN	263
Muhammad Naufal Abdul Rahim and Ahmad Yusri Dak	

SMART IRRIGATION SYSTEM USING LORA-BASED IOT DEVICE	265
Muhammad Nizamuddin Abd Muttalib and Iman Hazwam Abd Halim	
ANDROID MALWARE DETECTION USING DEEP LEARNING CLASSIFICATION APPROACH	267
Nur Amirah Amri and Mohd Faris Mohd Fuzi	
STUDENT ATTENDANCE REGISTRATION SYSTEM USING QR CODE FOR TUITION CENTRE	269
Nur Farizah Ishak and Zulfikri Paidi	
STUDENT ATTENDANCE SYSTEM USING FACIAL RECOGNITION BASED ON DEEP LEARNING	271
Syahila Aina Haris and Zulfikri Paidi	
REDUCING DOS ATTACKS BY RUNNING MULTI INSTANCES OF NGINX WEB-SERVER IN DOCKER USING SHELL SCRIPT	273
Ismail Arif M. Zulkepli and Abidah Mat Taib, Nor Alifah Rosaidi	
SMART CHICKEN FEEDER SYSTEM USING NODE MCU ESP8266	275
Ilham Syahmin Nasruddin and Mohd Nizam Osman	
REMOTE MONITORING AND CONTROLLING OF LIGHTS USING IOT	277
Nurul Najihah Yusra Zolkarnain, Nurzaid Muhd Zain and Mahfudzah binti Othman	



EXTENDED ABSTRACTS

RESEARCH EXHIBITION IN MATHEMATICS & COMPUTER SCIENCES
REMACS 5.0

REDUCING DOS ATTACKS BY RUNNING MULTI INSTANCES OF NGINX WEB-SERVER IN DOCKER USING SHELL SCRIPT

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Abstract

Denial of Service (DoS) attacks are a common type of attack that affect many websites in today's modern internet. Web-servers and applications are mostly vulnerable to DoS attacks by default and require some extended knowledge to have a good or even a decent level of security. However, with automation, web developers would have less time to set-up their servers and have more time developing their websites without compromising their own security. With containerization and load balancing, by using the same machine with the same specs, web-developers will require less time and effort to scale their web-production without sacrificing the security of their web-servers. The engine (nginx) web-server application and reverse proxy has the ability to provide an application-level load balancing. Meanwhile Docker containers can manage many instances of a web-application inside a single web-server with little overhead on system resources unlike their virtual machine counterpart. With these solutions, in addition to automation within a single shell script and a docker compose configuration, the web-server application can be hardened to a higher extend compared to the default configuration of a normal web-server. With attacks such as SYN-flood and HTTP request flood in the wild, the research finds that the automation script has been successful in setting-up the application load balancer as the DoS attacks such as SYN-flood and HTTP request flood attacks has been mitigated. However, there are few enhancements that can be made such as using a ICMP firewall rules and further automation of the web-server application configuration.

Keywords: load-balancer, DoS attacks, shell script, automation, JMeter, Wireshark

1. Introduction

The increase of Denial of Service (DoS) attacks in modern world wide web has prompt web-developers into the process of manually hardening their server configuration thus limiting their time and effort on developing their website and the possibility of misconfiguration. This research discusses the use of an automation script based on UNIX shell, an application load balancer and containerization to automate the process of setting up a secure web-server for web-developers.

2. Methodology

The topology will include load balancer and application containers to help reduce the load of the web-server from large spikes of requests. Several software and hardware are needed for the success of the script. The engine X (nginx) web-server application and reverse proxy will act as the main load balancer that will forward and distribute requests from the internet. The requests will then be handled by multi-instances of Docker containers. A shell script and a Docker Compose script will help set-up the load balancer and containers with minimal user interaction as they will be left to configure the basics of the web-server listener, DNS entries, and define their own upstream configuration. Three common DoS attacks has been executed during testing, which is SYN-flood attack by using hping3 to execute SYN-flood and Wireshark for ACK response analysis. ICMP flood attack using hping3 to send ICMP flood and real-time logging for analysis of ping requests. And HTTP-request flood attack executed and analysed by using Apache JMeter to record the spikes in response time.

3. Results and Discussion

The web-server is running as all components of the web-server process is validated by the system's command-line. DNS and firewall entries are also functioning well as the website can be accessed from the local network and the public internet, making it available from around the globe. Thus, making the automation process a success on the script's and docker-compose's configuration. For DoS attacks, the web-server and load balancer has managed to reduce the spikes of response time from HTTP-request flood attacks analysed from Apache JMeter. From Wireshark packet analysis, SYN-flood attacks using hping3 shown to have a reduction of effect as the rate of ACK-response has increased as the number of nginx instances increase. However not all DoS attacks can be prevented as shown from the result of ICMP flood attacks as the attack only focuses on the main web-server application and not the load balancer nor the docker containers.

4. Novelty of Research / Product

There are many areas of a computer system that are susceptible of security risks and errors that might be ignored by the end-user. Prevention methods is also discussed such as securing databases and the operating system (Divyaniyadav et al., 2018). Previous research also discusses about security countermeasures in a web-application, such as the use of a fortified firewall to secure the web-application and the flow of how a web-application works (Sharma et al., 2019). Another study focuses on the rise of DoS attacks in the current age and also the methods available in preventing the attacks. This study proposes several improvements include load balancing and containerization (Idhom et al., 2021) that will be the base of the research project being conducted the research will utilize the automation process based on recommendations provided by the mentioned researches, a shell script is used for the automation process and execute the setup with minimal user intervention.

5. Conclusion

Utilizing nginx for application load balancing can be beneficial for novice developers, as it can reduce setup time and effort through the use of shell scripts. Additionally, it can protect against some forms of DoS attacks, but other security measures should also be implemented such as a network firewall and a more powerful hardware for running more containers.

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