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Computer Society Chapter

PROCEEDING

2019 INTERNATIONAL CONFERENCE OF ARTIFICIAL INTELLIGENCE AND INFORMATION TECHNOLOGY (ICAIIT 2019)

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13 - 15 March 2019

**Platinum Adisucipto Hotel & Conference Center
Yogyakarta**

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2019 International Conference of Artificial Intelligence and Information Technology

IEEE Conference Number #45307

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International Conference of Artificial Intelligence and Information Technology 2019 (ICAIIT)

(IEEE International Conference #45307)

Message from Conference Chair

Dear professors and distinguished delegates,

It is our great honor and pleasure to welcome you to 2019 International Conference on Artificial Intelligence and Information Technology to be held in Platinum Adisucipto Hotel & Conference Center, Yogyakarta, Indonesia during March 13-15, 2019. ICAIT 2019 is hosted by Universitas Atma Jaya Yogyakarta and Kalbis Institute Jakarta and also supported by Universitas Pancasila Jakarta. The objective of ICAIT 2019 is to bring together researchers, scientists, academics, and engineers in area of Artificial Intelligence and Information Technology from all over the world, who share much more than technical interests, among another things, like culture and history, etc.

We wish to express our sincere appreciation to all individuals and organizations who have contributed to ICAIT 2019. We extend our heartfelt gratitude to our colleagues in technical program committee for their thorough review of all the submissions, which is vital to the success of the conference, and also to the members in the organizing committee and the volunteers who had dedicated their time and efforts in planning, promoting, organizing, and helping the conference. Our special thanks also go to the invited speakers as well as all the authors for contributing their latest research to the conference.

This conference program is highlighted by four invited keynote & plenary speakers: Associate Professor Wladyslaw Homenda from Warsaw University of Technology, Poland; Prof. Andrea Corradini from Copenhagen School of Design and Technology, Denmark; Wu Hai Yong, Ph.D. from Nanjing Xiaozhuang University, China; Dr. Suryadiputra Liawatimena from Universitas Bina Nusantara, Indonesia.

We strongly believe that the conference will provide you a memorable experience, and we do wish all of you have a good time in Yogyakarta, Indonesia.

Best regards
Your sincerely,

Yulius Denny Prabowo,S.T.,M.T.I. and Martinus Maslim,S.T.,M.T.
General Chair of ICAIT 2019

Welcome Speech from The Indonesia Section Computer Society Chapter Chair

On behalf of The Indonesia Section Computer Society Chapter Chair, we are pleased to welcome you all to The 2019 International Conference of Artificial Intelligence and Information Technology (ICAIT 2019), March 13-15 2019, at Yogyakarta, Indonesia. The conference which is held by Informatics Engineering Department of Universitas Atma Jaya Yogyakarta and Kalbis Institute aims to establish a platform and to provide opportunities for researchers and academicians from all over the world to present the research results, ideas, and knowledge related to the latest issues of Artificial Intelligence and Information Technology. The conference will encourage the delegates to exchange the ideas and experiences, to collaborate in the future business and research, and to empower the nation.

We strongly believe that this conference will provide an excellent platform to exchange research ideas and findings. We hope that ICAIT 2019 will definitely give its participants, both young and experienced researchers, the opportunity to explore new areas of research, enhance their current knowledge and understanding of the scope of Artificial Intelligence.

ICAIT 2019 invited full papers from academia, industries and research centers around the world. A total of 276 submissions were received and reviewed through our expert reviewers' panel. The technical program committee comprised which as external reviewers are 44. Each paper was reviewed by at least two or more reviewers. We would like to thank all the reviewers for their great efforts and valuable time. After a rigorous review based on novelty and technical merit, only 105 full papers (out of 276 with the acceptance rate of about 38%). We would like to thank all the authors for submitting their articles in ICAIT 2019.

The conference features keynote speeches from three esteemed researchers: Keynote speaker from Associate Professor Wladyslaw Homenda (Warsaw University of Technology, Poland), Prof. Andrea Corradini (Copenhagen School of Design and Technology, Denmark), Wu Hai Yong, Ph.D. (Nanjing Xiaozhuang University, China) and Dr. Suryadiputra Liawatimena (Universitas Bina Nusantara, Indonesia). We would like to thank all the keynote and invited speakers for attending this conference and giving excellent talks.

ICAIT 2019 could not be successful without sincere efforts of its organizing members. We thank the members of the organizing committee. We also thank its program committee members and advisory members for their continuous supports. We would specially like to thank IEEE Indonesia Section. We also would like to thank Informatics Engineering Department of Universitas Atma Jaya Yogyakarta and Kalbis Institute. We hope that ICAIT 2019 would bring opportunities to share your knowledge. We wish all the success of this conference.

Dr. Suryadiputra Liawatimena
The Indonesia Section Computer Society Chapter Chair

Welcome Speech from Dean of Industrial Technology Faculty, Universitas Atma Jaya Yogyakarta

To all Speakers and Participants of ICAIT 2019

Since 2012, the Department of Informatics Engineering of Universitas Atma Jaya Yogyakarta (UAJY) has held a National Seminar on Information and Communication Technology SENTIKA. Now the Department of Informatics Engineering UAJY is collaborating with the Kalbis Institute to hold an International Conference on Artificial Intelligence and Information Technology ICAIT 2019 with the theme of Artificial Intelligence and Implementation.

As we know that the development of information technology is very fast, especially now that we are in the era of industry 4.0. There are several key technologies to support the fourth industrial revolution, including Big Data, Cloud Computing, Internet of Things, System Integration, Cyber Security, Additive Manufacturing and Autonomous Robots. These technologies require artificial intelligence to build the smart system. Therefore, choosing the theme of Artificial Intelligence and Implementation is very appropriate for this conference.

This conference can be held for contributions from various parties. For this reason, on behalf of the Industrial Technology Faculty UAJY we would like to offer our gratitude to the following distinguished speakers:

1. Prof. Andrea Corradini, Copenhagen School of Design and Technology, Denmark.
2. Associate Professor Wladyslaw Homenda, Warsaw University of Technology, Poland.
3. Wu Hai Yong, Ph.D., Nanjing Xiaozhuang University, China.
4. Dr. Suryadiputra Liawatimena, Universitas Bina Nusantara, Indonesia.

We also appreciate all the presenters and participants for your participation in this conference. Hopefully through knowledge sharing and discussion can inspire the development and implementation of artificial intelligence technology so as to provide greater benefits for improving the quality of human life. Have a good conference. Good luck.

Yogyakarta, March 2019

Dr. A. Teguh Siswanto

Dean of Industrial Technology Faculty, Universitas Atma Jaya Yogyakarta

Welcome Speech from Rector of Universitas Atma Jaya Yogyakarta

To all Speakers and Participants of ICAIT 2019

The machines haven't taken over our life as a whole. Not yet, at least. However, they are seeping their way into almost every part of our life, affecting how we live, work and entertain ourselves. Penetration of influence can be witnessed from voice-supported personal assistants such as Siri and Alexa, which is equipped with Speech Synthesis Markup Language (SSML), to more underlying and fundamental technologies such as behavioral algorithms, suggestive searches and autonomously-powered self-driving vehicles boasting powerful predictive capabilities.

Besides Siri and Alexa, there are several examples and applications of artificial intelligence that are used today, such as: 1. Tesla (this is quite possibly one of the best cars ever made); 2. cogito (is quite possibly one of the most powerful examples of behavioral adaptation to improve the emotional intelligence of customer support representatives that exists on the market today); 3. Boxever (machine learning to improve the customer's experience in the travel industry and deliver 'micro-moments,' or experiences that delight the customers along the way); 4. John Paul (a highly-esteemed luxury travel concierge company, is another powerful example of potent A.I. in the predictive algorithms for existing-client interactions, able to understand and know their desires and needs on an acute level); 5. Amazon.com (Amazon's transactional A.I. is something that's been in existence for quite some time, allowing it to make astronomical amounts of money online); 6. Netflix (Netflix provides highly accurate predictive technology to suggest films that you might like based on your previous reactions and choices of films); 7. Pandora (Pandora's A.I. is quite possibly one of the most revolutionary techs for recommending songs that would otherwise go unnoticed but that people inherently love); 8. Nest (This learning thermostat that was acquired by Google uses behavioral algorithms to predictively learn from your heating and cooling needs).

A true artificially-intelligent system is one that can learn on its own. That type of A.I., the kind that we see in wonderful stories depicted on television through the likes of HBO's powerful and moving series, *Westworld*, or Alex Garland's, *Ex Machina*, are still way off. This will be at the hands of artificial intelligence. A.I. will also become smarter, faster, more fluid and human-like, thanks to the inevitable rise of quantum computing. Quantum computers will not only solve all of life's most complex problems and mysteries regarding the environment, aging, disease, war, poverty, famine, the origins of the universe and deep-space exploration, just to name a few, it'll soon power all of our A.I. systems, acting as the brains of these super-human machines.

ICAIT 2019 is an expression of UAJY's excellent and humanistic value. It is as well an expression of mutual concern for those who are in need and are very interested in the development of science, opening themselves to the widest possible range of all groups of knowledge in a pluralistic Indonesia. This international seminar embraces the theme: "Artificial Intelligence and its Implementation" as it relates that nowadays all fields of life

have been penetrated by information technology, especially “smart” information technology. As intelligent computers are significant field of research in technology, scientific discussions that address the implementation of artificial intelligence are suitable topics for this international program.

As the Rector of UAJY, I hope that ICAIIT 2019 will be the first step for a continuing and productive collaboration to bring progress in the advancement of Artificial Intelligence in serving and caring for the interests of mankind along with upheld values of humanity, as Albert Einstein affirms, "The human spirit must prevail over technology ". Once again, I would like to wish you a successful conference.

Dr. Gregorius Sri Nurhartanto, SH. LL.M.
Rector of Universitas Atma Jaya Yogyakarta

Welcome Speech from Rector of Kalbis Institute, Indonesia

Greetings from Jakarta,

On behalf of Kalbis Institute, I would like to thank you for being here with us today. We are very pleased to be able to welcome you at the 1st International Conference of Artificial Intelligence and Information Technology 2019 (ICAIT 2019). Before we get started, may I express my sincere gratitude to our chairs, sponsors, program chairs, technical committee members, organizing committee members, authors and delegates, who made a lot of efforts and contributions. Thanks to your support and help, we could not be able to hold this conference successfully without you.

You have been chosen to be a part of our conference, to a mutual passion for academic research inquiry. We are grateful to have you join us at the 1st International Conference of Artificial Intelligence and Information Technology 2019 (ICAIT 2019).

During the next few days, we will learn about the different initiatives through our planned activities, seminar, and special events where you will be able to join in and get hands on experiences. I hope these will help us to grow better and more productive in knowledge development.

Wish you will enjoy this conference, contribute effectively toward it and take back with you all the knowledge, experiences, contacts and happy memories of these days.

Thank you for your attention!

Yours sincerely,

Ir. Sablin Yusuf, M.Sc., M.Comp.Sc.
Rector of Kalbis Institute, Indonesia

Special Region of Yogyakarta



In Javanese it is pronounced [jogja'kartɔ], and named after the city of Ayodhya in Javanese-Hindu mythology. The Dutch name of the Special Region is **Djokjakarta**.

The Sultanate has existed in various forms through prehistory, and survived through the rule of the Dutch and the 1942 invasion of the Dutch East Indies by the Japanese Empire. In August 1945 Indonesia's first president, Sukarno proclaimed the independence of the Indonesian Republic, and by September of that year, Sultan Hamengkubuwono IX and duke Sri Paku Alam VIII had sent letters to Sukarno expressing their support for the newly-born nation of Indonesia, in which they acknowledged the Yogyakarta Sultanate as part of the Indonesian Republic. The Sunanate of Surakarta did the same, and both of the Javanese kingdoms were awarded special status as special regions within Indonesian Republic. However, due to a leftist anti-royalist uprising in Surakarta, the Sunanate of Surakarta lost its special administrative status in 1946 and was absorbed into the province of Central Java.

Yogyakarta's overwhelming support and the Sultan's patriotism were essential in the Indonesian struggle for independence during the Indonesian National Revolution (1945-1949). The city of Yogyakarta became the capital of the Indonesian Republic from January 1946 to December 1948 after the fall of Jakarta to the Dutch. Later, the Dutch also invaded Yogyakarta causing the Indonesian Republic's capital to be transferred again to Bukittinggi in West Sumatra on 19 December 1948. In return for Yogyakarta's support, the declaration of Special Authority over Yogyakarta was granted in full in 1950 and Yogyakarta was given the status as a Special Administrative Region, making Yogyakarta the only region headed by a monarchy in Indonesia.

The Special Region was struck by a 6.3-magnitude earthquake on 27 May 2006, killing 5,782 people, injuring approximately 36,000 and leaving 600,000 people homeless.^[7] The region of Bantul suffered the most damage and deaths.

The Special Region is located near the southern coast of Java, surrounded on three sides by the province of Central Java, and with the Indian Ocean on the south side. The population at the 2010 Census was 3,452,390 people, but according to the latest official estimate (January 2014) has risen to 3,594,290. It has an area of 3,133.15 km², making it the second-smallest area of the provinces in Indonesia, after the Jakarta Capital Region. Along with surrounding areas in Central Java, it has some of the highest population densities of Java.

Mount Merapi is located to the immediate north of the city of Yogyakarta and Sleman Regency. It is the most active volcano in Indonesia and has erupted regularly since 1548. It last erupted in October–November 2010, killing and injuring many people and temporarily displacing approximately 100,000 residents.^{[8][9]}

Indonesia has numbers of geo-heritage sites in Yogyakarta Special Region. It has been declared by Geological Agency of the Energy and Natural Resources Ministry. The sites consists of 9 sites: Eosen limestone in Gamping (Sleman regency), pillow lava in Berbah (Sleman), pre-historic volcanic sediment in Candi Ijo, Prambanan (Sleman), sand dunes in Parangtritis Beach (Bantul regency), Kiskendo cave and former manganese mining site in Kleripan (Kulonprogo regency), the prehistoric volcano in Nglanggeran (Gunungkidul regency), Wediombo-Siung beaches (Gunungkidul) and Bioturbasi site in Kalingalang (Gunungkidul). The most unusual one is pillow lava in Berbah (Sleman) which is a big, rough black rock lays on the bank of narrow Dengkeng River. The prehistoric volcano in Nglanggeran (Gunungkidul regency) has already been developed as a tourist destination.

Located within the Special Region of Yogyakarta, the city of Yogyakarta is known as a center of classical Javanese fine art and culture such as batik, ballet, drama, music, poetry and puppet shows. It is also one of Indonesia's most renowned centers of higher education. At the city's center is the Sultan's palace called the *kraton*. While the city sprawls in all directions from the kraton, the core of the modern city is to the north.

Yogyakarta is served by Adisucipto International Airport. There are two train stations: Lempuyangan and Yogyakarta (also called Tugu station). Yogyakarta is considered one of the major hubs that links the west-east main railway route in Java island. Tugu railway station is the main train station located in center, and Lempuyangan train station is the second train station in the city. The two stations have own schedule from and to other cities in Java island. To the south, in the Bantul region, is the Giwangan bus station, the largest bus station in Indonesia. The centre of metropolitan Yogyakarta is surrounded by a ring road.

Yogyakarta is home to more than 100 institutions of higher education in Indonesia, the highest number of higher education institutions of any province in Indonesia. Hence, Yogyakarta earned its nickname "Kota Pelajar" (The City of Students).

Yogyakarta is the home of the first established state university in Indonesia, the Gadjah Mada University.

The Special Region is also the home of the first-established private university in Indonesia, the Islamic University of Indonesia, which was founded in 1945. The Indonesia Institute of Arts, the first-established university in fine arts, is also in the region. Other large universities include Universitas Atma Jaya Yogyakarta, State Islamic University of Yogyakarta, University of Sarjanawiyata Tamansiswa in Yogyakarta, Yogyakarta State University, and Muhammadiyah University of Yogyakarta.

Universitas Atma Jaya Yogyakarta

Universitas Atma Jaya Yogyakarta (UAJY) is a private higher education institution that was founded by the common catholic followers and managed by Slamet Rijadi organization – Yogyakarta, supported by Saint Albert Magnus. Universitas Atma Jaya Yogyakarta was founded in 1965, 26th of September, to participate in improving our country through education means, that is globally oriented.

Since august 31st 1973, Yogyakarta branch of Indonesia University of Catholic Atma Jaya separate itself from Indonesia University of Catholic Atma Jaya Jakarta, and stand by itself as **UNIVERSITAS ATMA JAYA YOGYAKARTA**

The name Atma Jaya came from Sanskrit. Atma means spirit, and Jaya means superior or excellent; thus Atma Jaya means superior spirit. UAJY's dream has always been establishing higher education based on morale values.

UAJY currently has 6 faculties with 11 undergraduate programs and 5 postgraduate program, including 4 international class for the undergraduate program, with a number of students approximately 11,307 students; supported by 6 professor, 58 doctor, 206 master and 6 graduates as permanent lecturer. UAJY is also supported by lecturers from specialist to professionals in their own field, local and also internationally. All undergraduate and postgraduate programs have been accredited by BAN-PT (Badan Akreditasi Nasional Perguruan Tinggi ;national higher education accreditation organization).

Develop academic community in a smart and critical way to help protect and improve human values and also cultural heritage through education, research and also other services that are given to local community, national and also internationally with the spirit of *serviens in lumines veritatis* (service in the light of truth).

UAJY will always give its efforts in creating a culture in organization that is capable in building a community with human resources that have the capability and high commitment in accordance to the vision and mission of the university, and alumni that is capable in competing not only nationally but also internationally. The university will also put its effort in creating a network of cooperation with other party in national and also international level.

The development of UAJY cannot be separated from the development of the city of Yogyakarta.

With a relatively safe and peaceful environment, Yogyakarta is the most appropriate choice for high school graduates students in search of knowledge for the development of their future quality of life. Supported by relatively low living cost, and also supporting facility such as books shops, public library, transportation, communication, recreational place, dormitory, hospital and many more.

UAJY is located in a strategic location that will ease the students in fulfilling their needs. Students of UAJY will be able to socialize with students from other universities with different background easily. This is the factor that will prepare the students to be able to survive in the society.

As a catholic university, UAJY runs its education process in catholic beliefs. In that effort, UAJY will always strive for academic excellence and option for the poor, and produce graduates that have the spirit and courage in becoming “Men and Women for Others”. On top of that, UAJY will be a university as an alternative for higher education due to its excellence and supported by its human resources that are committed, and capable in handling and managing the university.

With its slogan ***Serviens in lumine veritatis*** which means service in the light of truth, UAJY is ready to prepare the future of its students.

KALBIS Institute

KALBIS Institute is a private university located in Jakarta, Indonesia. KALBIS Institute is under the auspices of the Yayasan Pendidikan KALBE (YPK) and collaborating with Bina Nusantara Education Foundation (BINUS) for its higher education management.

KALBIS Institute was established by Yayasan Pendidikan KALBE (YPK) in 1992 under the name STIE KALBE and opened diploma in Finance and Banking and Accounting. In 1996, STIE KALBE developed by adding bachelor program in Management and Accounting. The next two years, the master program in Management was added. In 2002, STIE KALBE changed its name to STIE SUPRA.

In 2011, the KALBE Education Foundation (YPK) collaborated with Bina Nusantara (BINUS) and changed the name of ITBK to KALBIS Institute. In 2012, the Kalbe Education Foundation built a new campus located at Jalan Pulomas Selatan Kav. 22, East Jakarta.

Keynote Speaker

Professor Andrea Corradini (Copenhagen School of Design and Technology, Denmark)

With Speech Title: Multimodal Data Analysis



Andrea Corradini studied mathematics at the University of Trento, Italy.

He received his Ph.D. in computer science from the Department of Neuroinformatics and Cognitive Robotics at the Technical University of Ilmenau, Germany.

After his PhD, Dr. Corradini held the position of senior research associate at the Center for Human-Computer Communication at the Oregon Graduate Institute of Science and Technology, Oregon, USA.

Later, he took on faculty positions at different institutions like e.g.

- the University of Southern Denmark,
- the IT University of Copenhagen,
- the University of Copenhagen,
- the Estonian IT College, and
- the Kolding Design School.

For two years, he was a Marie Curie Fellowship at the Department of Computational Linguistics at the University of Potsdam in Germany.

He was the first professor in Welfare Design in Denmark.

Currently, he is at the Copenhagen School of Design and Technology and the University of Liverpool.

His research interests include multimodal interaction, natural language processing, gesture/face recognition and analysis, embodied conversational characters and interactive computer games.

Keynote Speaker

Associate Professor Władysław Homenda (Warsaw University of Technology, Poland)

With Speech Title: Cognitive Maps for Time Series Modeling



Mr Władysław Homenda received the M.Sc. and Ph.D. degrees from Warsaw University of Technology, Warsaw, Poland, and the D.Sc. degree from the System Research Institute of Polish Academy of Sciences, Poland, in 2008.

He is currently an Associate Professor with the Faculty of Mathematics and Information Science, Warsaw University of Technology.

He is also with the Faculty of Economics and Informatics in Vilnius, University of Bialystok, Lithuania.

He collaborates with the System Research Institute, Polish Academy of Sciences, where he has conducted several research grants.

His main research interests include theoretical foundations of computer science, knowledge representation and processing and intelligent computing technologies, specifically in the areas of man-machine communication and human-centric computing, fuzzy modelling and granular computing, knowledge discovery, and data mining. He has published many papers in these areas.

His academic activities are related to mathematical aspects of computer science: mathematical linguistic, complexity theory, computability etc. He has authored five monographs covering various aspects of his research and academic activities. He has also authored several technologies related to music information processing, which were applied in prototype and commercial computer programs. He has been intensively involved in reviewing activities of several journals and many international conferences in his areas of interest. He has received numerous awards for his research.

He currently serves as a member of several Editorial Boards of international journals and is a member of scientific and steering committees of many international conferences.

Keynote Speaker

HAIYONG WU, Ph. D (School of Information Engineering, Nanjing Xiaozhuang University)

With Speech Title: Deep Learning in Tractography



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EDUCATION

Southeast University, Nanjing, China

Ph.D. in Computer Science and Technology, 06/2014

Major Area: Image analysis, Image retrieval, Pattern recognition

Advisor: Dr. Huazhong Shu

Nanjing University of Aeronautics and Astronautics

M.S. in Communication and Information Systems, 06/2003

Major Area: Digital signal processing, Circuit Design.

Advisor: Dr. Jie Cao

Jiangsu Normal University

B.S.; Physical Education; September, 06/1997

RESEARCH EXPERIENCE

The University of North Carolina at Chapel Hill

Visiting scholar; The IDEA group and MIND Lab in the Department of Radiology and the Biomedical Research Imaging Center (BRIC), School of Medicine.

06/2017 ~ 10/2017

- Major Area: Longitudinal infant global tractography.
- Advisor: Dr. Dinggang Shen and Dr. Pew-Thian Yap

09/2014 ~ 09/2015

- Major Area: Parallel accelerate the global tractography.
- Advisor: Dr. Dinggang Shen and Dr. Pew-Thian Yap



Woosong University, South Korea.

Visiting scholar, School of Information Technology.

12/2002 ~ 03/2003

- Major Area: IT new technology in operate system and network

RESEARCH INTEREST

- The construction of feature descriptors and feature invariants in object recognition
- Image fusion technology for enhancing remote satellite imaging.
- Diffusion weighted MRI and tractography, Human Brain Connectome.

PUBLICATIONS:

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* Corresponding Author

WORKING EXPERIENCE:

1. Nanjing Xiaozhuang University, China. 08/1997 - present
2. Woosong University, South Korea, 05/2004 – 02/2005

TEACHING EXPERIENCE:

Nanjing Xiaozhuang University, Nanjing, China

Assistant Professor, 1997-2003

Lecturer, 2004-2008

Associate Professor, 2009-present

- Lectured on iOS application programming, 2016-present
- Lectured on Fundamental of Electrical and Electronic Technology, 2006-present
- Lectured on FPGA Design using VHDL, 2001-2013
- Lectured on C/C++ programming, 1998-2009
- Lectured on Digital Signal Processing & Processor, 2003-2008

PROFILE:

- Matlab and C/C++ programming experience for more than 10 years
- Circuit design experience for more than 10 years
- Willing to perform basic tasks and move on to solve complex problems
- Able to learn new knowledge and adapt to new environments quickly
- Strong independent work style and excellent teamwork skills
- Well-organized and passionate

International Conference of Artificial Intelligence and Information Technology 2019 (ICAIT)

Organizing Committees (IEEE International Conference #45307)

Honorary Chair:

- Dr. Gregorius Sri Nurhartanto, S.H., LL.M. (Universitas Atma Jaya Yogyakarta)
- Dr. A. Teguh Siswantoro, M.Sc (Universitas Atma Jaya Yogyakarta)
- Dr. Hadi Sutopo (Institut Teknologi dan Bisnis Kalbis)
- Prof. Andrea Corradini (Copenhagen School of Design and Technology, Denmark)
- Associate Professor Wladyslaw Homenda (Warsaw University of Technology, Poland)
- Dr. Suryadiputra Liawatimena (The Indonesia Section Computer Society Chapter, Indonesia)
- Wu Hai Yong, Ph.D.(Nanjing Xiaozhuang University, China)

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- Surjandy, S.Kom., M.M. (Bina Nusantara University, Indonesia)
- Dr. Sudi Mungkasi (Sanata Dharma University, Indonesia)
- Iwan Binanto, S.Si., M.Cs. (Sanata Dharma University, Indonesia)
- Teny Handhayani, S.Kom, M.Kom (Tarumanagara University, Indonesia)

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Papers in International Conference of Artificial Intelligence and Information Technology 2019 for media communication only which is spread among the authors, Keynote speakers, and other academic colleagues in the International Conference of Artificial Intelligence and Information Technology 2019, at 13-14 March 2019 at Platinum Adisucipto Hotel & Conference Center, Yogyakarta, Indonesia.

Each paper which is shown in this International Conference of Artificial Intelligence and Information Technology 2019 can be appeared at proceeding of International Conference of Artificial Intelligence and Information Technology 2019 where the authors of each paper should :

1. Present their paper
2. Submit the paper's revision to icaiit.reg@uajy.ac.id

Failing to do the requirement will be subjected to eliminated from proceeding of International Conference of Artificial Intelligence and Information Technology 2019.

International Conference of Artificial Intelligence and Information Technology 2019 Conference Schedule

Wednesday, 13 March 2019

| Time | Activity | | |
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| 08.00 - 09.00 | Participants Registration & Materials Collection | | |
| 09.00 - 10.00 | Welcome Speech & Opening Ceremony - General Chair of ICAIIT 2019 - Rector Kalbis Institute - Rector Universitas Atma Jaya Yogyakarta | | |
| 10.00 - 10.30 | Coffee Break | | |
| 10.30 - 11.15 | Keynote Speech 1 Professor Andrea Corradini (Copenhagen School of Design and Technology, Denmark) Speech Title: Multimodal Data Analysis | | |
| 11.15 - 12.00 | Keynote Speech 2 HAIYONG WU, Ph. D (School of Information Engineering, Nanjing Xiaozhuang University) Speech Title: Deep Learning in Tractography | | |
| 12.00 - 13.00 | Lunch | | |
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| 5:14.00-14.15 6:14.15-14.30 7:14.30-14.45 | | | | |
| 15.00 - 15.30 | Coffee Break | | | |
| 15.30 - 17.00 (15 Minutes presentation per paper) Session 2: 1:15.30-15.45 2:15.45-16.00 3:16.00-16.15 4:16.15-16.30 5:16.30-16.45 6:16.45-17.00 | Titanium 1 1.1570515432 2.1570526222 3.1570526304 4.1570526319 5.1570526544 6.1570526452 | Titanium 2 1.1570513614 2.1570497900 3.1570497821 4.1570512658 5.1570523975 6.1570525893 | Titanium 3 1.1570526455 2.1570526552 3.1570516699 4.1570513732 5.1570509093 6.1570526401 | Ballroom 1 1. 1570521650 2. 1570526538 3. 1570526466 4. 1570526453 5. 1570524081 6. 1570513593 |
| 18.00 - 20.00 | Gala Dinner at Rama Shinta Resto Prambanan Temple | | | |

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| Time | Activity | | | |
|--|---|--|--|--|
| 08.00 - 09.00 | Registration & Coffee Break | | | |
| 09.00 - 09.45 | Keynote Speech 3 Dr. Suryadiputra Liawatimena, S.Kom., PgDip.App.Sci (Universitas Bina Nusantara, Indonesia) Speech Title: Artificial Intelligence in Agriculture & Fishery | | | |
| 09.45 - 10.30 | Keynote Speech 4: Associate Professor Władysław Homenda (Warsaw University of Technology, Poland) Speech Title: Cognitive Maps for Time Series Modeling | | | |
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| Time | Activity |
|---------------|-----------------------------------|
| 07.00 - 20.00 | Excursion (for Full Package only) |



International Conference of Artificial Intelligence and Information Technology 2019

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Determining the Neural Network Topology from the Viewpoint of Kuhn's Philosophy and Popper's Philosophy

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Abstract—Determining the number of hidden layers and the number of neurons are very important and have a large influence on deep neural network(DNN) performance. In some studies, there is no clear guideline on how to determine the number of hidden layers or neurons optimally; even the roles and functions of both are explained minimally. Although it is difficult, researches to determine the number of hidden layers and neurons must continue to be carried out, because both will greatly determine the performance of DNN. According to Kuhn, the method for determining neural network topology in deciding the number of hidden layers and hidden neurons is still in pre-paradigm phase. New studies continue to be made in an effort to find methods that can be generally accepted, so that they will become normal sciences. The proposed new methods can be tested by using Popper's falsification which will determine whether the methods can eventually become normal sciences or not.

Keywords—topology, neural network, pre-paradigm, falsification

I. INTRODUCTION

Since the increase in the computer capabilities, the use of a neural network that has more than one hidden layer has attracted interest from researchers, especially since the use of deep neural networks to solve problems in the real world. Deep neural networks can be interpreted as a technique that uses neural networks for learning that utilize many hidden layers between input and output layers [1]. One of the challenges in the successful implementation of deep neural networks is setting values for various hyper parameters, one of which is the network topology, which is closely related to the number of hidden layers and neurons. Determining the number of hidden layers and neurons is very important and has a large influence on the performance of deep neural networks [2]. Determining these two manually (usually through 'trial and error' method) to find a fairly optimal topology is a time-consuming process.

Some studies on neural network topology have focused on determining the numbers of neurons because they only use one hidden layer, some focus on the number of hidden

layers (one or two hidden layers), some also determine the number of hidden layers and neurons in each hidden layer. Researches on determining the number of hidden neurons have been going on since the 1990s and are still an interesting topic for researchers [3][4]. Studies comparing the performance of one or two hidden layers are still an interesting topic to date [5][6]. While researches calculating the number of hidden layers and neurons have been done in recent years, since the emergence of deep learning [1][2][5]. Determining the right number of neurons is important to avoid under-fitting or over-fitting, and is also prominent in increasing the level of accuracy of the neural network. Deciding the right number of hidden layers and neurons is important to reduce the complexity of processing time and to maintain the accuracy of the neural networks [2].

A number of methods have been carried out to calculate the number of hidden layers and neurons, for example: model-based automatic method using particle swarm optimization(PSO) [1][7], automatic method without model using grid search (GS) or random search [8][9]. Some manual methods are also proposed, for example: the number of hidden neurons is 2/3 of the number of inputs plus the number of outputs, the number of hidden neurons per hidden layer follows the rule of pyramid geometry, the relationship between the number of hidden layers and hidden layers is logarithmic [10]. In some the literatures mentioned above, there is no clear guideline on how to determine the number of hidden layers or neurons optimally, even the roles and functions of both are explained minimally. Some literatures propose methods or ways to determine the number of hidden layers or neurons, but they are not generally applied. It depends on the type of the input and output data. Researches in this area still leaves difficult research tasks [11]. Some of the methods mentioned apparently cannot be applied to different types of data. Some researchers determined the number of hidden layers or neurons based on their past experience, while beginner researchers even did it with 'trial and error' method. Although it is still a difficult area of research, researches to determine the number of hidden layers and neurons must continue to be carried out, because

these two will greatly determine the deep neural network learning performance.

The development of methods for determining the number of hidden layers and neurons in the neural network can be explained from a philosophical perspective by using several key concepts of Kuhn's thoughts related to his theory of the structure of scientific revolution in the book entitled *The Structure of Scientific Revolution* published in 1962. This theory is a new offer for scientific discourse based on the history of the development of science [12][14].

As it does not yet have established guidelines in determining the neural network topology, and each of the method developed is only applied to certain datasets, it is difficult to do a verification test with the ultimate goal of generalizing to existing methods, as well as to new methods that will be developed later. One test that can be done to find out whether the methods developed to determine the neural network topology is true or not is to use the theory of falsification that was put forward by Karl Raymond Popper [13][14]. Popper's theory asserts that the truth of the proposition of a science is not determined through verification tests, but through an attempt to deny the truth through various systematic experiments. The greater the effort to deny a theory, and if the theory turns out to continue to be able to survive, the more solid its existence will be..

II. LITERATURE REVIEW

A. Thomas Kuhn's Philosophy

Kuhn offered a new theory related to science that refers to the process of the scientific development rather than the product it produces. Kuhn tried to shift the subject of science to the activity of science (to produce). Thus, he shifted logical analysis and explanation of a science as a product that has been established to a natural or historical explanation of the scientific process[12].

Paradigm

One of the key words when speaking of Thomas Kuhn's thinking is "paradigm". This idea would like to emphasize that scientific theory is not only limited to a set of theoretical principles, but also includes world views in science, which is what Kuhn then initiated as a "paradigm".

The Science Revolution

According to Kuhn, science developed revolutionary from one paradigm to another. The *Structure of Scientific Revolution* book contains the stages of scientific revolution meant by Kuhn. Thomas Kuhn mapped the stages of the development of science into four main phases.

Pre-paradigm Phase

This phase is also called as the immature science phase. This phase is a period that takes a long time. Here, scientific researches on certain things are carried out without specific directions and purposes. This period also emerges various kinds of thoughts that compete with each other and exclude each other. It has different conceptions about the basic problems of scientific discipline and what criteria should be used to evaluate theories.

Normal Science Phase

To become a science, a scientific discipline must reach a consensus that is in the shade of a particular paradigm. Of the various sciences that developed in the pre-paradigm phase, one thought or theory will emerge which then dominates other theoretical or scientific disciplines. Schools or other thoughts are oriented and recognize the superiority of the dominant school or thought. In this case, it promises more accurate problem solving and a more advanced future research so that it is more dominant than its competitors.

When a consensus has been reached, Kuhn claimed that scientists had begun to get into normal sciences. The normal science precondition is that there is a commitment to the existence of a shared paradigm that will determine the rules of the game and all standard benchmarks in scientific practice. "Normal" scientists will not make new discoveries outside the prevailing paradigm. Instead, they are fully involved in using the paradigm to better understand the symptoms of natural symptoms in more detail.

Anomaly and Crisis Phase

This phase is also called as the phase of the emergence of extraordinary sciences. At this time, knowledge, both in examples of scientific practice (copies) and disciplinary matrices, can no longer be relied upon in solving problems that arise. The emergence of a very crucial and unsolved problem does not only make scientists confused, but it also creates a crisis in the scientific community. Since then, they began to question the prevailing paradigm.

The Emergence of a New Paradigm Phase

In the midst of competition during a crisis, one of the emerging thoughts will be able to overcome scientific problems and then be able to generalize and promise the future of better scientific researches. At this point, extraordinary sciences become normal sciences. This change is the climax of Kuhn's scientific revolution. He explained this as "an episode of non-cumulative development in which an older paradigm is replaced in whole or in part by a new paradigm that is more compatible."

B. Popper's Philosophy

According to Popper, a theory or proposition of science or knowledge is not seen as scientific only because it can be verified by verification as the scientists think, but because it can be tested (testable) through various systematic experiments to deny it (falsification). If a hypothesis or a theory can survive against all denials, then the truth of the hypothesis or theory is further strengthened. He calls it as corroboration. The greater the effort to deny a theory, and if the theory turns out to continue to be able to survive, the more solid its existence will be.

Furthermore, Popper explained that every scientific theory is always hypothetical, in the form of conjecture, there will never be a final truth. Every theory is always open to be replaced by a new theory that is more appropriate. Related to this, he preferred to use it with the term hypothesis rather than theory, only solely based on the nature of its temporality. He asserted that a hypothesis or proposition is said to be scientific if in principle it has the possibility to be denied (refutability) [13].

III. DISCUSSION

This section describes the development of methods for determining the neural network topology by using Thomas Kuhn's philosophy and on how to test the correctness of methods by using Popper's theory of falsification..

A. The Development of the Neural Network Topology Determination Method from Kuhn's Point of View

Pre-Paradigm Phase

From the studies determining the neural network topology that have been done, the phase can be categorized into three:

1. Researches that focus only on determining the number of hidden neurons in one hidden layer [15][16][17]
2. Researches that focus on comparing the use of one hidden layer and two hidden layers [18]
3. Researches that focus on determining both number of hidden layers and hidden neurons [19][1]

The first group of researches is carried out with the assumption that the use of one hidden layer is able to approach almost all functions. In addition, the majority of studies in this group does not consider the characteristics of the input feature, but only pay attention to the number of features or amount of data. The second group of researches is conducted by looking at the opportunity that the use of two hidden layers could improve the network performance in line with the increase in computer capabilities. The comparison results are obtained without looking at the characteristics of the input features, even though the characteristics of the input features can be considered when deciding whether to only use a hidden layer or multilayer. The third group of researches focuses on determining the number of hidden layers and neurons at once. The majority of the researches are conducted by trial and error method or using rule of thumb for experienced researchers. Therefore, this group does not pay attention to the characteristics of the input feature to determine the network topology. The input feature character that can be considered is by calculating the correlation or variation between or intra input features.

Of the three research groups, almost all the proposed methods cannot be used as a guideline for determining the right neural network topology for other researchers. Consequently, based on Kuhn's thinking, the method for determining neural network topology is still in the pre-paradigm phase.

Normal Science Phase

Although in the pre-paradigm phase, there are some researchers who try to determine the neural network topology that can be more general. For example, as was done by Tej and Holban [20], who tried to determine the neural network topology by using clustering and regression method. The method developed has begun to consider the characteristics of the dataset's input features. However, because it is still a new research and the results have not been tested by other researchers, it still needs time to test whether the method proposed by Tej and Holban can be normal science..

B. Testing the Determination of the Neural Network Topology Method from the Perspective of Popper

Several studies conducted before Tej and Holban have been difficult to apply by other researchers for different datasets so that they are difficult to be falsified, whereas the research conducted by Tej and Holban must be systematically tested to be denied. The tests to deny the method proposed by Tej and Holban can be done with the following scenario:

- Testing the method proposed by Tej and Holban by using certain datasets that have objective functions for predictions
- Testing the method proposed by Tej and Holban by using certain datasets that have objective functions for classification
- Comparing the neural network topology obtained by the method proposed by Tej and Holban with several other neural network topologies, whether the topology proposed by Tej and Holban provides better performance or not.

If the proposed method can stand up against all denials, then the truth of the method is increasingly strengthened, or what Popper calls as corroboration.

IV. CONCLUSION

From the explanations in the previous chapters, it can be concluded that there are three researches groups in determining the neural network topology, namely: researches that only focus on the number of hidden neurons in one hidden layer, researches that focus on the comparison of one hidden layer and two hidden layers, and researches that focus on determining both number of hidden layers and neurons. None of the three researches groups can be used as a guide in determining the neural network topology for other researchers. Therefore, according to Kuhn's thought, researches in the area of determining neural network topology are still in the pre-paradigm phase. New researches conducted in this area are being directed so that it can be generally accepted as normal sciences. Popper's theory of falsification can be used to test new methods produced.

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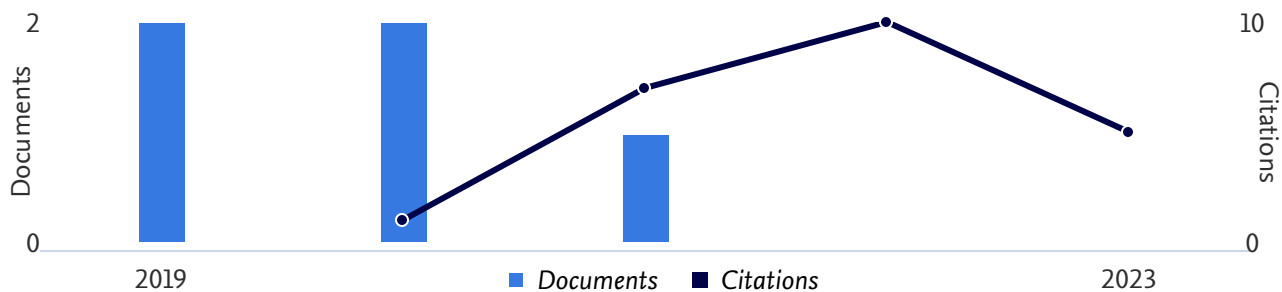


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