2021 IEEE CIS Summer School on Computational Intelligence for High-School Student Learning

Physical Venue: JanFuSun Resort Hotel, Yunlin, Taiwan
Date: August 10-12, 2021

IEEE CIS High School Outreach Subcommittee
Taiwan AI Academy, Taiwan
KWS Center, National University of Tainan, Taiwan
Information Education Center, National Kaohsiung Normal University, Taiwan
Artificial Intelligence Industry and Academia Alliance, Taiwan
E. Sun Commercial Bank, Taiwan
Taiwanese AI Association, Taiwan
Community-centric Systems Research Core, Tokyo Metropolitan University, Japan
Nojima Lab, Osaka Prefecture University, Japan
AI-FML International Academy

1. Objectives

Computational Intelligence (CI), including fuzzy logic, neural network, and evolutionary computation, is a sub-branch of AI. It is an important core technology of AI and plays an important role in developing successful intelligent systems, including games, multilayer perceptron, and cognitive developmental systems [1]. The main contents in this summer school are the basics of fuzzy systems, neural networks, and evolutionary computation. Fuzzy logic is suitable for computing the degree of human perception such as hot or cold. Different people have different feelings of hot and cold even at the same temperature. The neural network is one of the important models for machine learning which can compute the mathematical feature functions. Evolutionary computation is based on the observation of the animals’ behavior patterns and it is one of the important machine learning models, too.

Learning has become a very popular approach for cybernetics systems. This topic has always been considered a research in the Computational Intelligence (CI) area. Human-in-the-loop (Hit-Loop) is a branch of artificial intelligence that uses human intelligence and machine learning to jointly create the model of machine learning. In a Hit-Loop, a human operator is a crucial component of an automated control process, handling challenging tasks of supervision, exception control, optimization, and maintenance. Hit-Loop AI puts human learning and machine learning in a good circle. Humans can train, adjust, and test specific algorithms or training processes in this circle to allow them to independently participate in human behavior simulations to label training data for machine learning. Human-centered AI learns from human input and collaboration, as well as its goal is to bridge the gap between machine and human beings by developing machine intelligence to understand human language, emotion, and behavior.

In 2018 and 2019, we hold a summer school on “Computational Intelligence for Human and Robot Co-learning” in Kaohsiung, Taiwan. In 2020, owing to the COVID-19 pandemic, 2020 IEEE CIS Summer School on Computational Intelligence for Human and Robot Co-learning was held in the form of the Virtual Seminars @ Zoom in Japan and Taiwan. Additionally, 2020 CI High School Education Program on Computational Intelligence for AI-FML Robotic Learning was held in Taiwan in a physical seminar together with 2020 IEEE CIS Summer School on Computational Intelligence for Human and Robot Co-learning to promote the Computational Intelligence concept and knowledge to Junior High School students and Elementary School students in Japan and Taiwan. Hence, in 2021, we proposed a Summer School on Computational Intelligence for High-School Student Learning proposal in Japan and in Taiwan to gather more students from high-school students to teach the students to learn the Computational Intelligence knowledge and CI tools for real-world applications.
2. Venue and Dates

The basic details, including the venue, dates, duration, and a web link to the CI High School Education Program webpage are listed as follows.

- Physical Venue: JanFuSun Resort Hotel, Yunlin, Taiwan

Note: This summer school was held in a hybrid style, including a virtual (Japan, Taiwan and Indonesia) and a physical (Taiwan) summer school.

- Dates: August 10-12, 2021
- Duration: 3 days
- Website: https://sites.google.com/asap.nutn.edu.tw/2021-ieee-cis-summer-school/home

- Co-sponsors
  IEEE CIS High School Outreach Subcommittee
  E. Sun Commercial Bank, Taiwan
  Community-centric Systems Research Core, Tokyo Metropolitan University, Japan
  Nojima Lab., Osaka Prefecture University, Japan
  KWS Center, National University of Tainan, Taiwan (http://kws.nutn.edu.tw)
  Taiwan AI Academy, Taiwan (https://aiacademy.tw/)
  Artificial Intelligence Industry and Academia Alliance, Taiwan (https://aiiaa.narlabs.org.tw/)
  Taiwanese AI Association, Taiwan
  Information Education Center, National Kaohsiung Normal University, Taiwan
  AI-FML International Academy

3. Lectures and Courses Program

Invited Lecture 1: Chang-Shing Lee and Leo Guo
Affiliation: Department of Computer Science and Information Engineering
National University of Tainan, Taiwan / NUWA Robotics, Taiwan
Topic: CI for Real-World Applications (I)

Invited Lecture 2: Naoyuki Kubota
Affiliation: Department of Mechanical Systems Engineering
Tokyo Metropolitan University, Japan
Topic: Neural Network (I)

Invited Lecture 3: Amir Pourabdollah
Affiliation: School of Science & Technology
Nottingham Trent University, UK
Topic: Neural Network (II)

Invited Lecture 4: Keeley Crockett
Affiliation: Department of Computing and Mathematics
Manchester Metropolitan University, UK
Topic: Fuzzy Logic (I)

Invited Lecture 5: Marek Reformat
Affiliation: Department of Electrical and Computer Engineering
University of Alberta, Canada
Topic: CI for Real-World Applications (II)
**Invited Lecture 6:** José María Alonso Moral & José Manuel Soto Hidalgo  
**Affiliation:** Centro Singular de Investigacion en Tecnoloxias Intelixentes (CiTIUS)  
University of Santiago de Compostela, Spain  
Department of Computer Architecture and Technology  
University of Granada, Spain  
**Topic:** Fuzzy Logic (II)

**Invited Lecture 7:** Marie-Jeanne Lesot  
**Affiliation:** Department of Computer Science  
Sorbonne Université, France  
**Topic:** Fuzzy Logic (III)

**Invited Lecture 8:** Giovanni Acampora  
**Affiliation:** Department of physics “ettore pancini”  
University of Naples Federico II, Italy  
**Topic:** Evolutionary Computation (I)

**Invited Lecture 9:** Yusuke Nojima  
**Affiliation:** Department of Computer Science and Intelligent Systems  
Osaka Prefecture University, Japan  
**Topic:** Evolutionary Computation (II)

### 4. Program

#### 2021 IEEE CIS Summer School on Computational Intelligence for High-School Student Learning

|--------|---------------|----------------|-------------------|-----------------------|-----------------------|-----------------------|
| 10:45-11:00 | 09:45-10:00   | 08:45-09:00    | Opening Address   | Hung-Duen Yang, Piu-Chio (Julia) Chung  
Toru Yagaguchi, Richi Tsai, Po-Hsun Cheng, Hong-Yu Kao  
Nia Kurnianingsih  
Representative of Education Bureau of Kaohsiung City Government  
Representative of Education Bureau of Tainan City Government |
| 11:00-12:00 | 10:00-11:00   | 09:00-10:00    | Lecture 1         | Chang-Shing Lee / Leo Guo  
Taiwan  
CI for Real-World Applications (I)  
Chair: Naoyuki Kubota |
| 12:00-13:30 | 11:00-13:30   | 10:00-12:30    | Lunch & Break     |                         |                         |
| 13:30-15:30 | 12:30-14:30   | 12:30-13:30    | Lecture 2         | Naoyuki Kubota, Japan  
Neural Network (I)  
Chair: Totti Yamaguchi |
| 15:30-16:00 | 14:30-15:00   | 13:30-14:00    | Break             |                         |                         |
| 16:00-17:00 | 15:00-16:00   | 14:00-15:00    | Lecture 3         | Amir Pourabolghah, UK  
Neural Network (II)  
Chair: Yusuke Nojima |
| 17:00-17:30 | 16:00-18:00   | 15:00-16:30    | Break             |                         |                         |
| 17:30-18:30 | 16:30-17:30   | 15:30-16:30    | Lecture 4         | Keeley Crockett, UK  
Fuzzy Logic (I)  
Chair: Yusuke Nojima |
| 18:00-19:00 | 17:00-18:00   | 16:00-17:00    | Lecture 5         | Marek Reformat, Canada  
CI for Real-World Applications (II)  
Chair: Po-Hsun Cheng |
| 19:00-20:00 | 18:00-19:00   | 17:00-18:00    | Workshop on AoT (I)  
Chairs  
Chang-Shing Lee  
Yusuke Nojima |
| 20:00-21:00 | 19:00-20:00   | 18:00-19:00    | Workshop on AoT (I)  
Chairs  
Hung-Duen Yang |
| 21:00-22:00 | 20:00-21:00   | 19:00-20:00    | Lecture 6         | José María Alonso Moral  
Jose Manuel Soto Hidalgo  
Spain  
Fuzzy Logic (II)  
Chair: Yusuke Nojima |
| 22:00-23:00 | 21:00-22:00   | 20:00-21:00    | Lecture 7         | Marie-Jeanne Lesot, France  
Fuzzy Logic (III)  
Chair: Chang-Shing Lee |
| 23:00-00:00 | 22:00-23:00   | 21:00-22:00    | Lecture 9         | Yusuke Nojima, Japan  
Evolutionary Computation (II)  
Chair: Giovanni Acampora |
| 00:00-01:00 | 23:00-00:00   | 22:00-23:00    | Lecture 8         | Giovanni Acampora, Italy  
Evolutionary Computation (I)  
Chair: Yusuke Nojima |
| 01:00-02:00 | 00:00-01:00   | 23:00-00:00    | Lecture 9         | Giovanni Acampora, Italy  
Evolutionary Computation (I)  
Chair: Yusuke Nojima |
5. Organizers

- **General Chair**
  
  **Name** Chang-Shing Lee  
  **Affiliation** Department of Computer Science and Information Engineering  
  National University of Tainan, Taiwan  
  **Contact and Email** leccs@mail.nutn.edu.tw

- **General Co-Chairs**
  
  **Name** Toru Yamaguchi  
  **Affiliation** Department of Computer Science and Information Engineering  
  Tokyo Metropolitan University, Japan  
  **Contact and Email** yamachan@tmu.ac.jp

  **Name** Naoyuki Kubota  
  **Affiliation** Department of Mechanical Systems Engineering  
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  **Contact and Email** kubota@tmu.ac.jp

  **Name** Yusuke Nojima  
  **Affiliation** Department of Computer Science and Intelligent Systems  
  Osaka Prefecture University, Japan  
  **Contact and Email** nojima@cs.osakafu-u.ac.jp

  **Name** Hung-Duen Yang  
  **Affiliation** Department of Physics, National Sun Yat-Sen University, Taiwan  
  **Contact and Email** yang@mail.nsysu.edu.tw

  **Name** Po-Hsun Cheng  
  **Affiliation** Department of Software Engineering and Management  
  National Kaohsiung Normal University, Taiwan

- **Organizing Committee Members**
  
  **Name** Marek Reformat  
  **Affiliation** Department of Electrical and Computer Engineering, University of Alberta, Canada

  **Name** Giovanni Acampora  
  **Affiliation** Department of physics “ettore pancini”, University of Naples Federico II, Italy

  **Name** José María Alonso Moral  
  **Affiliation** Centro Singular de Investigación en Tecnologías Intelixentes,  
  University of Santiago de Compostela, Spain

  **Name** José M. Soto Hidalgo  
  **Affiliation** Department of Computer Architecture and Technology, University of Granada, Spain

  **Name** Marie-Jeanne Lesot  
  **Affiliation** Department of Computer Science, Sorbonne Université, France

  **Name** Amir Pourabdollah  
  **Affiliation** School of Science & Technology, Nottingham Trent University, UK

  **Name** Jiann-Shu Lee  
  **Affiliation** Department of Computer Science, National University of Tainan, Taiwan

  **Name** Richie Tsai  
  **Affiliation** Taiwan AI Academy, Taiwan

  **Name** Hung-Yu Kao  
  **Affiliation** Department of Computer Science, National Cheng Kung University, Taiwan
6. **Posters, Banner, and Logos**

- **Poster**

2021 IEEE CIS Summer School

Try CI-High School Outreach @ IEEE CIS

- **Website Banner and Logos**

Home

IEEE Summer School Logo

Try CI Logo

AI-FML Int'l Academy Logo

- **Lecture Materials**

__Day 1__

<table>
<thead>
<tr>
<th>Lecture 1</th>
<th>Lecture 2</th>
<th>Lecture 3</th>
<th>Lecture 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>GitHub Repository</td>
<td>ICAI 2021</td>
<td>Neural Networks</td>
<td>Fuzzy Logic</td>
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__Day 2__

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<thead>
<tr>
<th>Lecture 3</th>
<th>Lecture 4</th>
<th>Lecture 5</th>
<th>Lecture 6</th>
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<tbody>
<tr>
<td>CI for Real-World Applications</td>
<td>Workshop on AI@T</td>
<td>AI-Impact Talks</td>
<td>Evolutionary Computation</td>
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</tbody>
</table>

__Day 3__

<table>
<thead>
<tr>
<th>Lecture 6</th>
<th>Lecture 7</th>
<th>Lecture 8</th>
<th>Lecture 9</th>
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<tbody>
<tr>
<td>Workshop on AI@T</td>
<td>Workshop on AI@T</td>
<td>Evolutionary Computation</td>
<td>Genetic Algorithms</td>
</tr>
</tbody>
</table>

**Slide and Recorded Videos**

https://sites.google.com/asap.nutn.edu.tw/2021-ieee-cis-summer-school/lecture-materials

Onsite Recorded Videos

https://sites.google.com/asap.nutn.edu.tw/2021-ieee-cis-summer-school/videos/recorded-videos

**Fast-Forward Videos**

https://sites.google.com/asap.nutn.edu.tw/2021-ieee-cis-summer-school/videos/fast-forward-videos
7. Activity Photos

- Summer School Environment Setup and Testing in Taiwan on August 9, 2021

![Image 1](image1.png)

**AloT devices @ JanFuSun Room 202**

![Image 2](image2.png)

**AloT devices @ JanFuSun Room 202**

![Image 3](image3.png)

**AloT devices @ JanFuSun Room 203**

![Image 4](image4.png)

**Group photo**

![Image 5](image5.png)

**Environment Setup @ JanFuSun Room 202**

![Image 6](image6.png)

**Environment Setup @ JanFuSun Room 202**

![Image 7](image7.png)

**Environment Testing @ JanFuSun Room 202**

![Image 8](image8.png)

**Environment Testing @ JanFuSun Room 202**
• **Day 1 on August 10, 2021**

Chang-Shing Lee (General Chair) @ Opening address

Yusuke Nojima (General Chair) @ Opening address

Naoyuki Kubota (General Chair) @ Opening address

Nia Kurnianingsih @ Opening address

I-Hsien Yu (President of JanFuSun) @ Opening address

Group photo after opening address

Chang-Shign Lee @ Lecture 1

Chang-Shign Lee @ Lecture 1

Chang-Shign Lee @ Lecture 1

AIoT devices @ JanFuSun Room 202
• **Day 2 on August 11, 2021**
José María Alonso Moral @ Lecture 6

Marie-Jeanne Lesot @ Lecture 7

Group photo
• Day 3 on August 12, 2021

Workshop on AIoT (II)

Workshop on AIoT (II)

Workshop on AIoT (II)

Workshop on AIoT (II)

Workshop on AIoT (II)

Workshop on AIoT (II)

Workshop on AIoT (III)

Workshop on AIoT (III)

Workshop on AIoT (III)
Workshop on AIoT (III)

Group photo

FUZZ-IEEE 2021 FML-based competition award

Group photo

Giovanni Acampora @ Lecture 8

Yusuke Nojima @ Lecture 9

Q&A @ Lecture 8
8. Activity Videos

Day 1: https://youtu.be/0c-byuR4U-Q

Day 2: https://youtu.be/bQWPbdJOPrk

Day 3: https://youtu.be/mctCERsoOTA

FUZZ-IEEE 2021 FML-based Machine Learning Competition Award Ceremony
https://youtu.be/ungw4WulReU

Note: For activity videos, visit: https://sites.google.com/asap.nutn.edu.tw/2021-ieee-cis-summer-school/videos/activity-videos

Day 1: https://youtu.be/xmN9tF9Y1RM

Day 2: https://youtu.be/vejibWF4Mh8

Day 3: https://youtu.be/9u4LOlNFafo

Workshops on AIoT (I)(II)(III)
https://youtu.be/Q0-6FY11394
9. Information of Participants

- Basic information of participants
  - Total number of people who registered for 2021 IEEE CIS Summer School is 214, including 82, 15, 107, and 10 from Taiwan, Japan, Indonesia, and the other countries, respectively. There are 13 graduates, 93 undergraduates, 31 senior high school students, 16 junior high school students, 21 elementary school students, and 7 non-students.

- Information

<table>
<thead>
<tr>
<th>Country</th>
<th>Graduate</th>
<th>University</th>
<th>Senior High School</th>
<th>Junior High School</th>
<th>Elementary School</th>
<th>KMS/NUI/T</th>
<th>Student</th>
<th>Total</th>
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<td>21</td>
<td>4</td>
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</tbody>
</table>

Basic Information of Participants

Number of Participants from different countries

Number of Participants from different Groups of Students

10. Short Report and Feedback Survey

- Total number of people who attended at least two thirds of lectures and workshops on AIoT is 78, including 48, 9, and 21 from Taiwan, Japan, and Indonesia, respectively. The ratio of people who were awarded a certificate of participation is 0.585, 0.6, and 0.196 from Taiwan, Japan, and Indonesia, respectively. Total number of people who submitted short report and feedback survey is 80 and 77, respectively.

- Results of feedback survey: From the pie chart of the feedback survey, most people have briefly understood computational intelligence, neural network, fuzzy logic, and evolutionary computation much more than before.
11. Impacts and Discussions

Our summer school has some impacts on Computational Intelligence education to high-school students or undergraduate students of Computer Science, Mathematics, Electrical Engineering, Robotics, and related areas. Meanwhile, it is disseminated by having CIS co-funding the summer school. The scientific goal of the summer school is to promote CI and expands the attendee from college and graduate students to high-school students or elementary school students. Further, such an expansion is also interacting with the policy of Taiwan and Japan to push the new course outline of computational thinking concepts in fundamental education in Taiwan and Japan. It includes the participation of national and international leading researchers in the area of CI, members and senior members of the IEEE. The Summer School on Computational Intelligence for High-School Student Learning has promoted the Computational Intelligence concept and knowledge from elementary-school, high-school, university students to graduates in Taiwan and Japan, as well as the AIoT Workshop are good for students to learn the AI-FML Robotic knowledge and CI tools for real-world applications.

However, the main target of this summer school was high school students. But, the registered people covered from 13 graduates, 93 undergraduates, 31 senior high school students, 16 junior high school students, 21 elementary school students, and 7 non-students. It will be better to distinguish “Senior” and “Junior” High School students next time. Elementary school students were out of focus. In addition, there are some elementary school students joined this summer school, but the lecturers did not prepare their lectures for elementary school students. No Japanese high school students also expect elementary school students attend the same event.

We had to care of elementary school students during the event. For example, we received a comment from audience "It is too difficult for elementary school students to understand." after one lecture. Yes. It is true because the lecture was for high school students. For example, one elementary school student continued drawing lines and rectangular on Zoom screen and Jamboard during two Evolutionary Computation lectures. Of course, we understand elementary school students in general feel boring for some lectures because of lack of fun for them. But this event was for high school students, we will focus on the main target and divide the event into several levels in the future. We should check the eligibility if someone from different age categories want to attend the event next time. The organizers of this summer school really work hard to promote computational intelligence to young students. For students and lectures, we will provide appropriate contents to them in the future. We think this event is a well-organized summer school, as well as are very happy to join this event and see many participants, both students & teachers, from Taiwan, Japan, Europe, and Indonesia.

Finally, we summarize some feedbacks after the summer school as follows. This is a great event to introduce students to computational intelligence at a young age, stimulate them to be involved in rapidly evolving fields, and foster participation in future research adventures. In addition, it is in line with IEEE's mission to advance technology for humanity. Moreover, IEEE offers STEM education opportunities for pre-university students & teachers across the globe. After joining this event, hope they have a big passion & feel motivated to be involved in global issues & trends.

12. Acknowledgement

The organizers would like to express many thanks for the support of the IEEE CIS High School Outreach Subcommittee members, the Ministry of Science and Technology (MOST) in Taiwan, JanFuSun Resort Hotel, E. Sun Commercial Bank, Zystem Technology Company, NUWA Robotics, Tainan City Government, and Kaohsiung City Government in Taiwan.