MetaACES Forums 2023

The role of Generative AI in building humane Artificial Learning Companions (ALCs)

PANEL 3:
Artificial Learning Companions and Social Impact of AI in Education

Human Intelligence-based Student & Robot Co-Learning Model

Ontology + Heart Sutra

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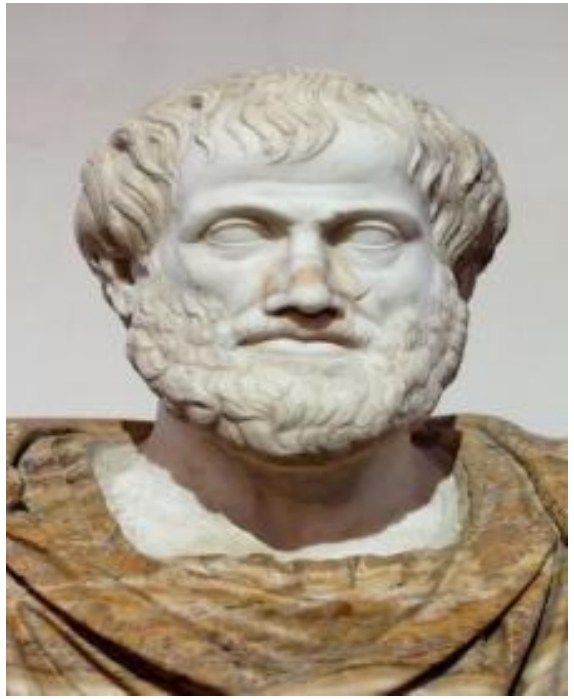
Student-Robot Co-Learning Model

- Introduction
- **Fuzzy Ontology-based Intelligent Agent**
  - CI&AI-FML **Metaverse Learning**
- **Fuzzy Ontology with Heart Sutra Concept**
  - **Ontology & Heart Sutra**
  - Semantic Understanding in CI&AI-FML **Metaverse**
- **Intelligent Agent on CI&AI-FML Metaverse Platform**
  - Students and Robot Co-Learning
  - **CI** with Meta AI **fastText** & **Sentence-BERT** open source
- Reference

Introduction (1/3)

- **CI- Computational Intelligence with Human Intelligence**
  - One of the core technologies of **AI**
    - Composed of **Fuzzy Logic** (FL),
    - **Neural Network** (NN), and
    - **Evolutionary Computation** (EC)
- **Fuzzy Markup Language** (**FML**)
  - Proposed by a European research team in 2003
  - Published in IEEE International Journal in 2005
  - **IEEE 1855 Standard in 2016**

CI&AI-FML
Human-in-the-Loop/ West HI & East HI



Ontology

Turing Test

Eyes, Ears, Nose, Tongue, Body, Mind
Sights, Sounds, Smells, Tastes, Touch, Mind

Consciousness (意識), Sight (視覺), Smell (嗅覺), Touch (觸覺), Taste (味覺) and Hearing (聽覺)

眼、耳、鼻、舌、身、意/ 色、聲、香、味、觸、法

Content of Heart Sutra (Human Intelligence)

- Written by a calligrapher: **260 words**

HAI for Reinforcement Learning

- Human-Machine Co-Learning / HAI for RL
  - **Human-centered AI** for Reinforcement Learning
  - 代理人觀察自己
    - 代理人
    - **Agent**
    - 觀察自己
    - **Observe Teacher & Student**
  - 處在時空領域
    - 處在時空領域
    - **It's Location with Time/Space Domain**
  - 與環境互動知識本體
    - 環境互動
    - **Interactive Environment**
    - 知識本體
    - **Ontology**
  - 代理人觀察自己處在時空領域與環境互動知識本體

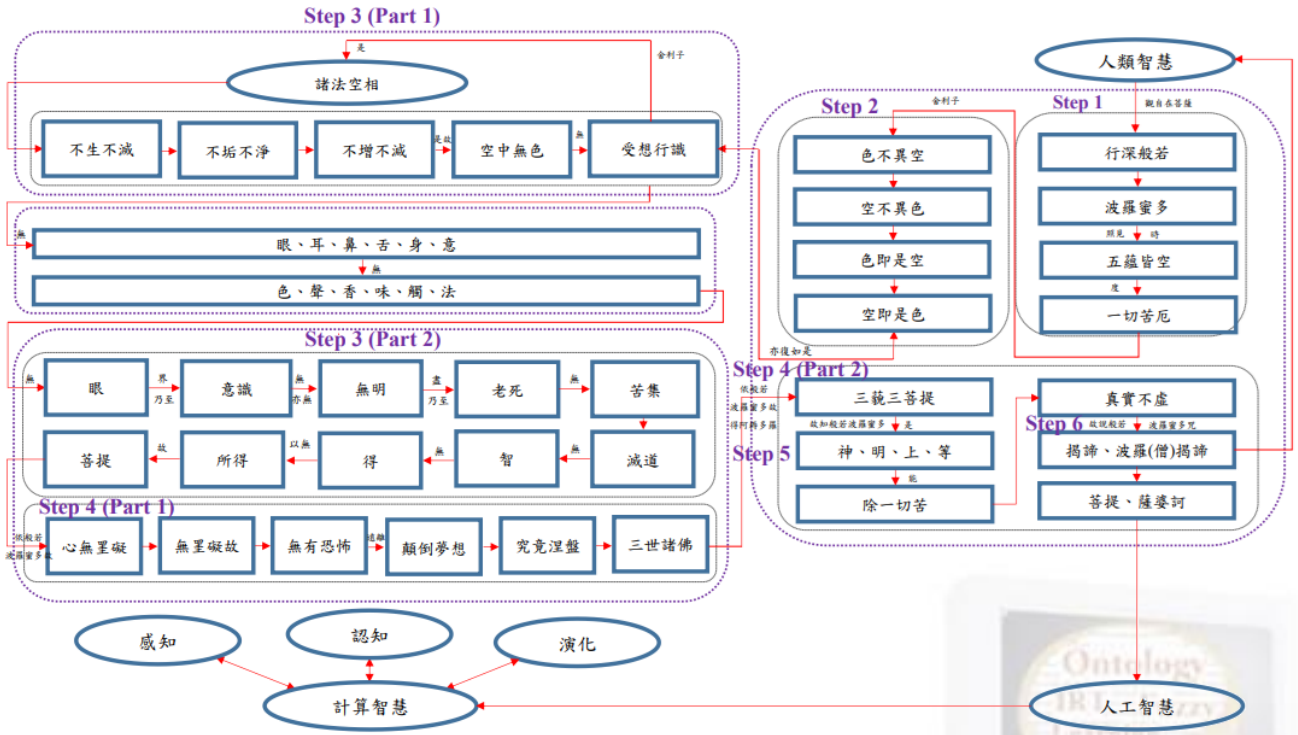
HAI for Reinforcement Learning

- **Teacher/GAI & Student/GAI**
  - 深度學習
  - Deep Learning
  - 人類智慧
  - Human Intelligence
  - 行深般若
- **Teacher/GAI:** 設計目標函數及損失函數
  - 設計目標函數
  - Design Objective Function
  - 損失函數
  - Loss Function
  - 波羅
- **Student/GAI:** 達成目標任務
  - 達成
  - Achieve
  - 目標任務
  - Goal & Task
  - 密多
- 深度學習、人類智慧、設計目標、達成任務
  - 行深般若、波羅密多

CKIP-based NLP for HI Ontology
Concept of Heart Sutra

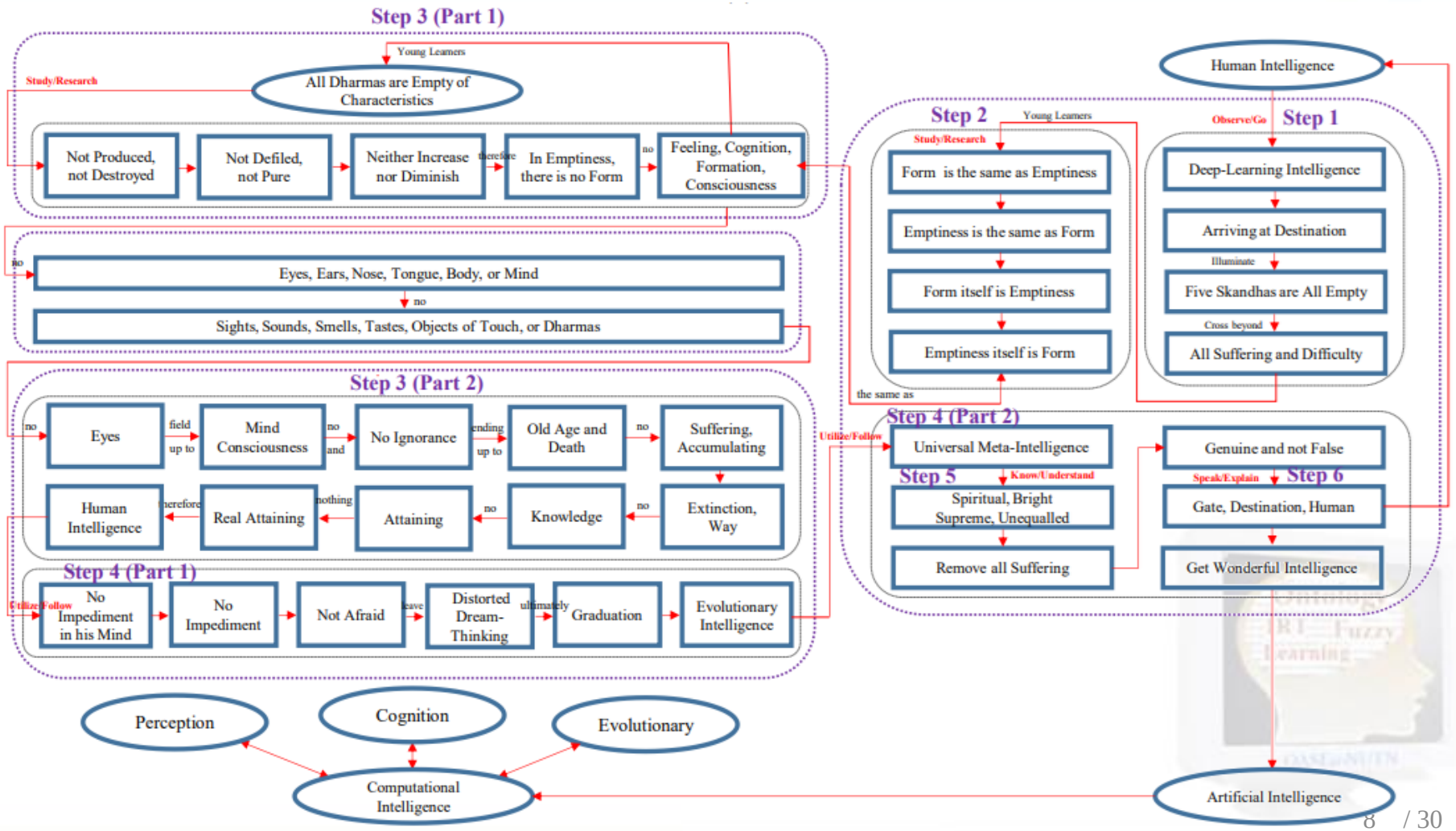
- Chinese Version
  - Six Steps
    - With **Prof. Marek Reformat, Canada**
    - Accepted in 2023
  - **概念影片**
    - **觀察自己時空領域、環境互動智慧本體**
      - 觀自在菩薩
    - **深度學習人類智慧、設計目標達成任務**
      - 行深般若、波羅密多
  - **人本智慧本體論**

https://youtu.be/ETfYQknqFJw



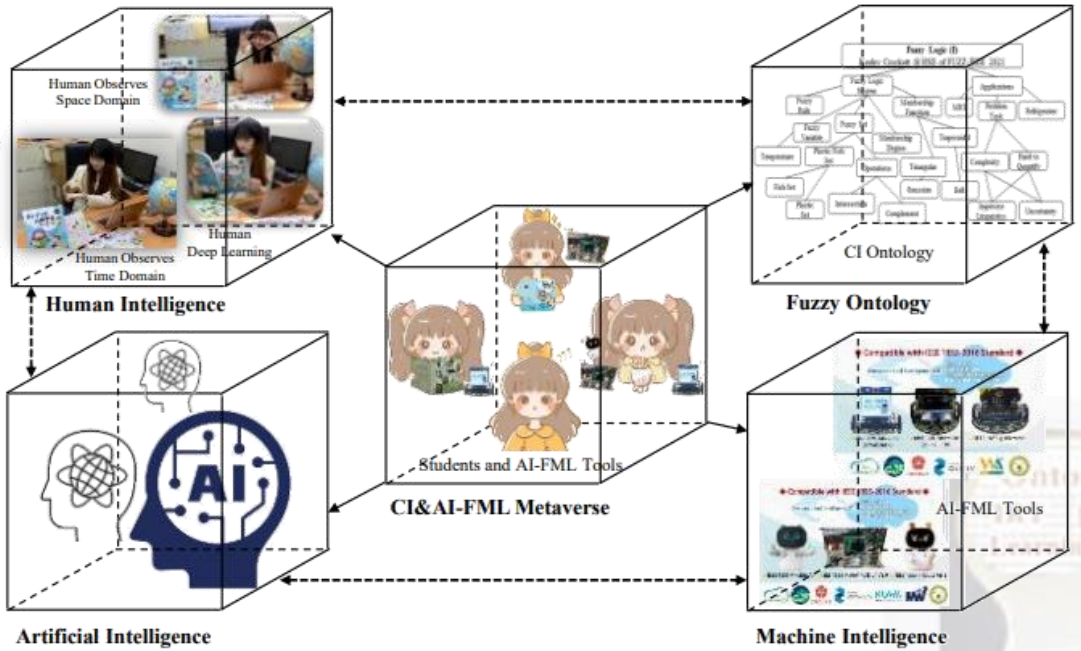
CKIP-based NLP for HI Ontology Construction and Understanding of Heart Sutra

- English Version



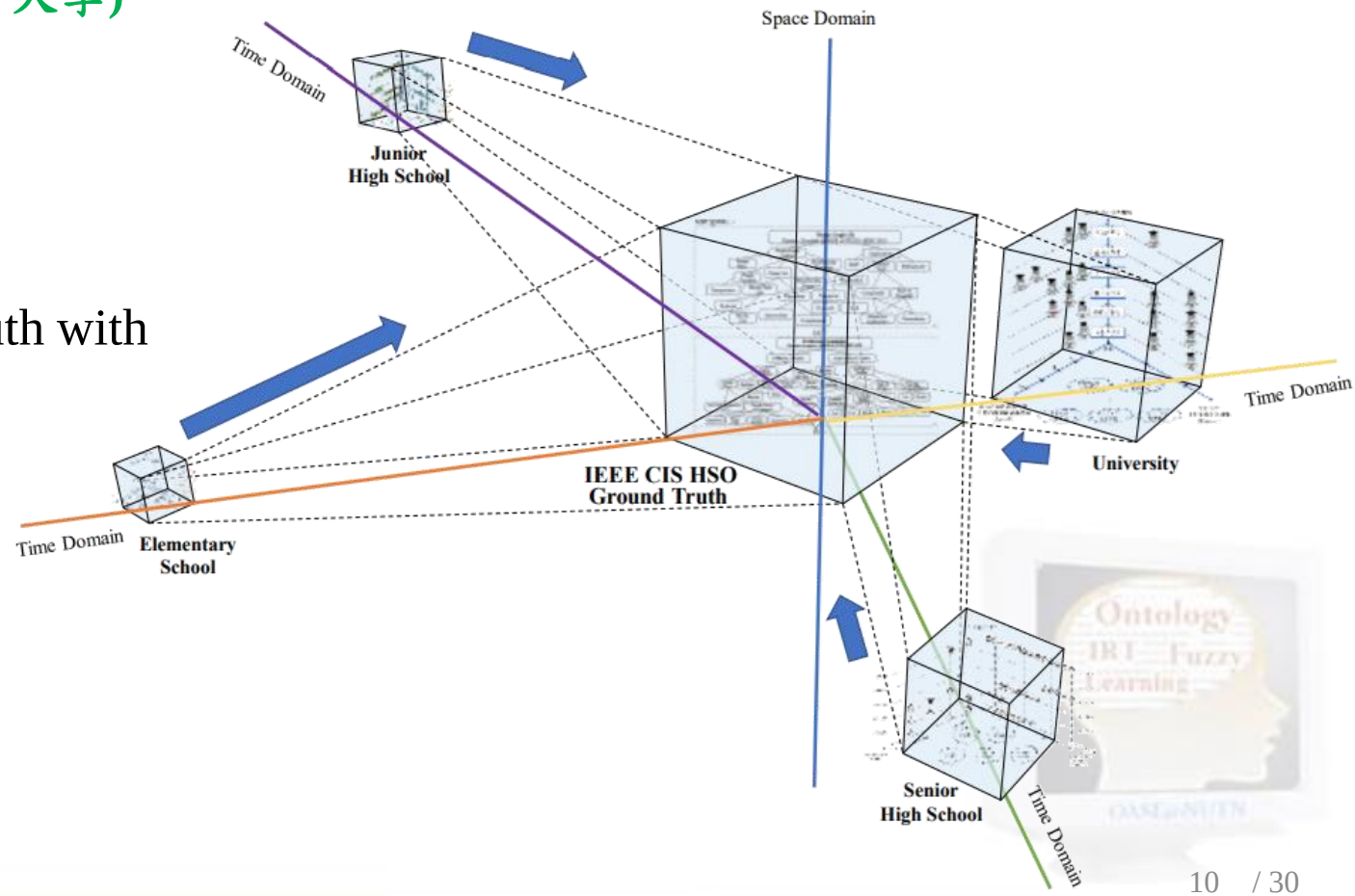
CI&AI-FML Human-Robot Co-Learning

- Young students explore and discover the proposed learning environment
  - **Fuzzy Ontology**
    - Human Intelligence
  - **Machine Intelligence**
    - Artificial Intelligence
- CI&AI-FML @ TMU, Japan
  - https://youtu.be/TfRbXDRS7AY
  - **概念影片**
  - **觀察自己時空領域、環境互動智慧本體**
    - 觀自在菩薩
  - **深度學習人類智慧、設計目標達成任務**
    - 行深般若、波羅密多



CI&AI-FML Human-Robot Co-Learning

- **Ground Truth**
  - provided by IEEE CIS HSO (國小、國高中、大學)
    - 觀察自己時空領域、環境互動智慧本體
      - 觀自在菩薩
    - 深度學習人類智慧、設計目標達成任務
      - 行深般若、波羅密多
- **Meta-Intelligence (描述智慧的智慧)**
  - Approach closer and closer to the ground truth with Time
  - Vector Space & Subspace
  - Mapping Function
  - KB&RB Vector/ Matrix/ Tensor
- **Knowledge Quantity**
  - Elementary/ Junior High-School
  - Senior High-School/ University

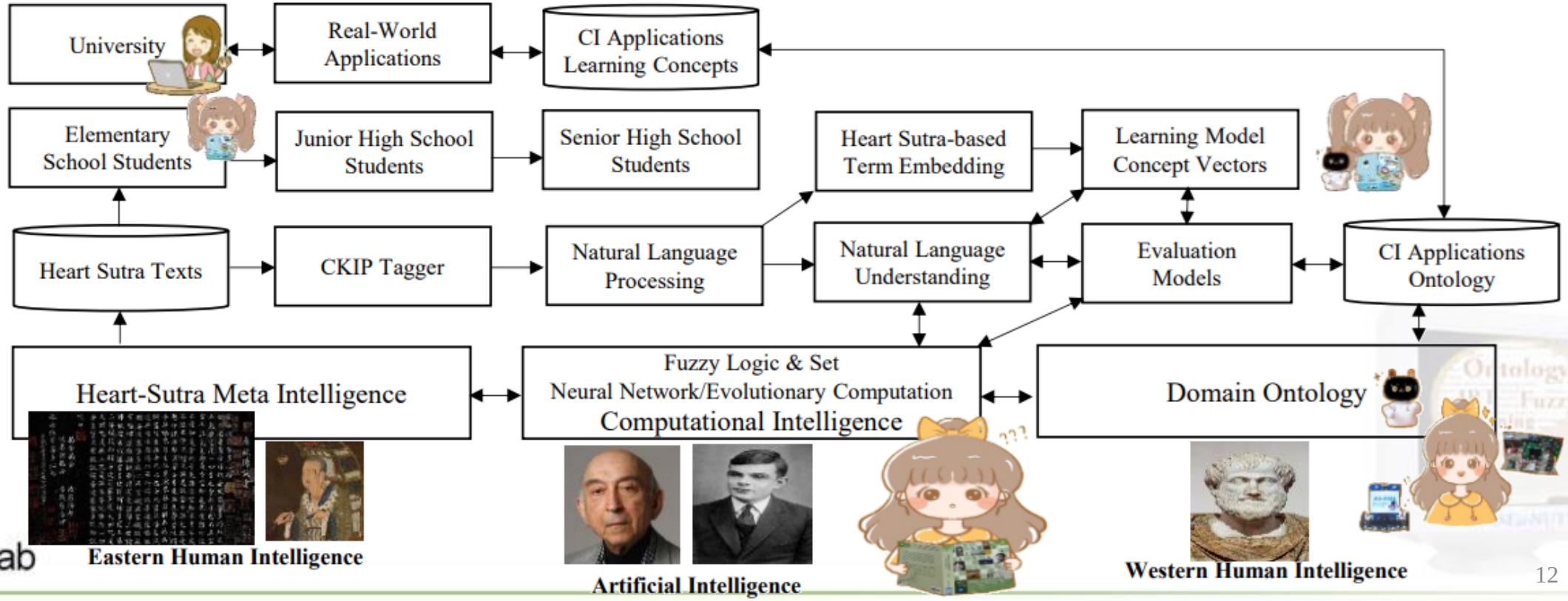


Introduction (2/3)

- **AI Meta Learning (描述AI學習)**
  - Empower AI to increase efficiency by **learning how to learn AI**
  - Visual world that blends the **physical world** and the **digital world**
  - **Education** is one of the **AI Metaverse applications (虛實時空AI學習應用)**
    - audiovisual-based education and problem-based learning (**PBL**) methods
- **AI Experiential Learning (AI體驗式實驗學習)**
  - important for **young students** and children
  - what you see in writing is different from how you feel while **experiencing** it
    - **觀察自己時空領域、環境互動智慧本體**
      - 觀自在菩薩
    - **深度學習人類智慧、設計目標達成任務**
      - 行深般若、波羅密多

Heart Sutra-inspired CI&AI-FML
人本智慧AI人機共學模型-國小/國高中/大學

- Relationship between its components
  - Eastern and Western **Human Intelligence** and **Artificial Intelligence**



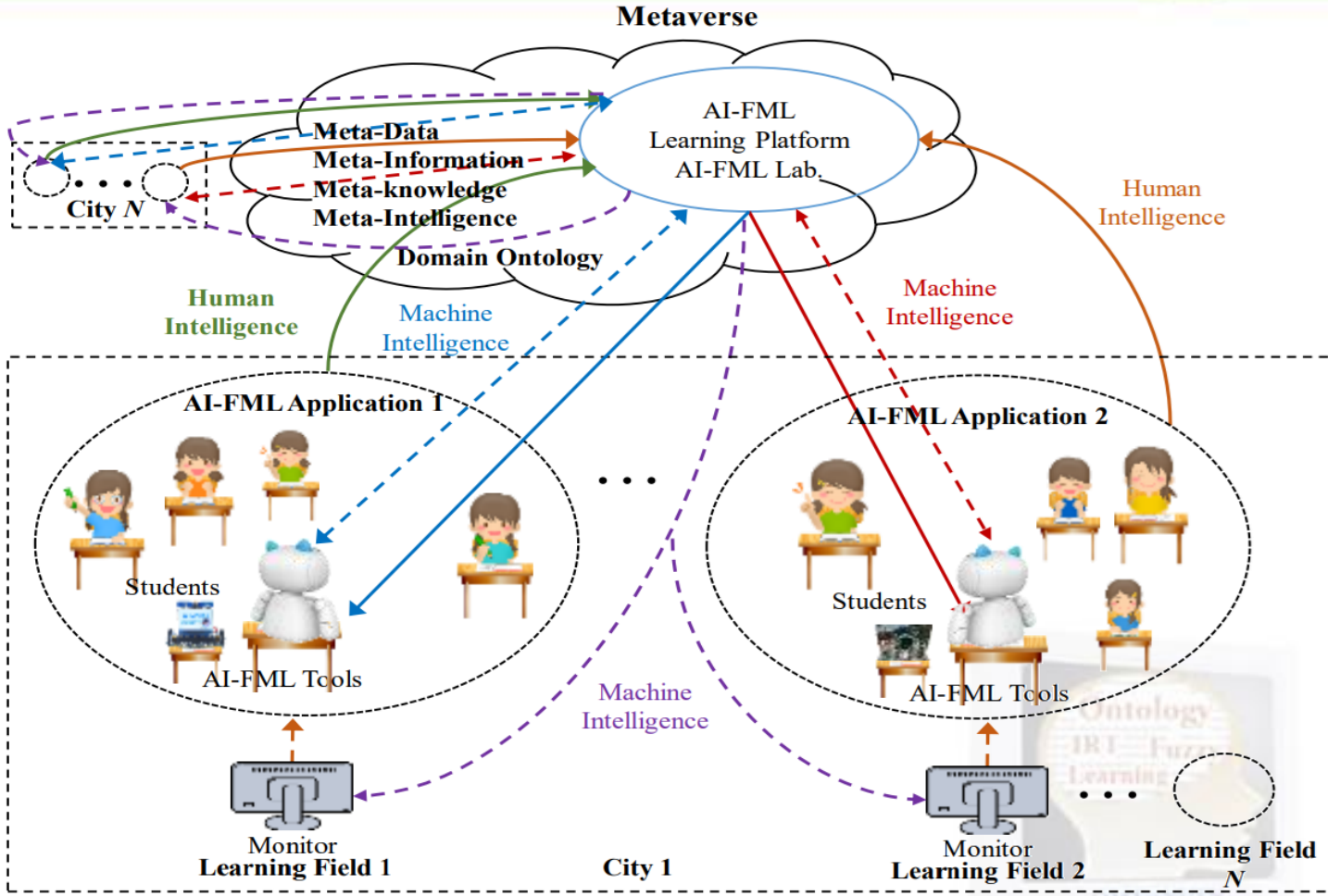
HI-based Semantic Understanding

CI&AI-FML Human-Robot Co-Learning - 人本語意理解

- Six-step methodology
  - Step 1: **Observe & Go**
  - Steps 2 and 3: **Study & Research**
  - Step 4: **Utilize & Follow**
  - Step 5: **Understand & Know**
  - Step 6: **Explain & Speak**
- **IEEE R10 EAC & 2023 CIS Education Portal Event** (03252023-No. 5)
- 概念影片 https://youtu.be/B_VgIo5TfpM

CI&AI-FML Human-Robot Co-Learning
Student Experience and Learning

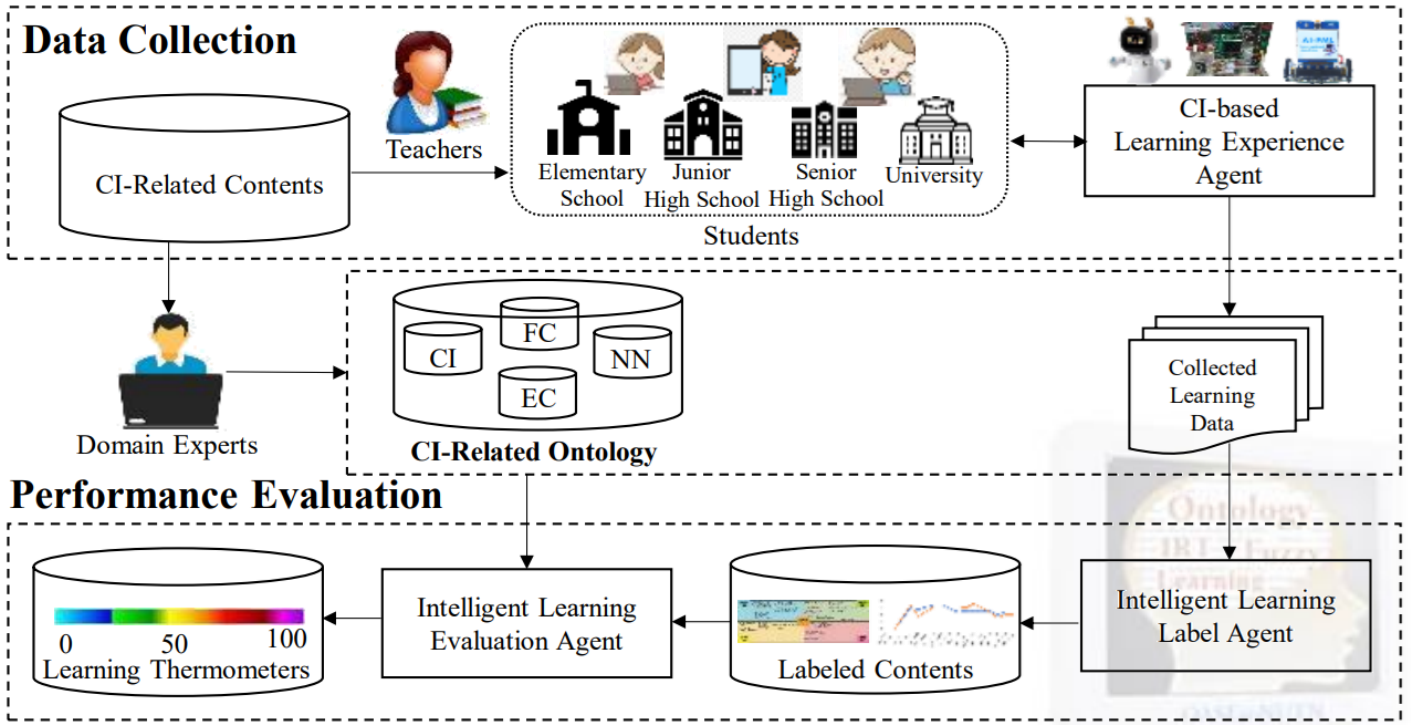
- **Students** with **Ontology**
  - Co-learn with **CI&AI-FML Tools**
  - in different **learning fields** (學習場域/波羅)
  - in different **cities** (學習場域/波羅)
- **Students with Human Intelligence**
  - HI (人本智慧/般若)
  - **KB&RB Vector/ Matrix**
  - **CI&AI-FML Learning platform**
- **Machine Intelligence with GAI**
  - **CI&AI-FML Learning platform**
  - with **CI&AI-FML Tools**
  - **Meta AI fastText**
  - **Sentence-BERT**
  - **ChatGPT**



CI&AI-FML Human-Robot Co-Learning

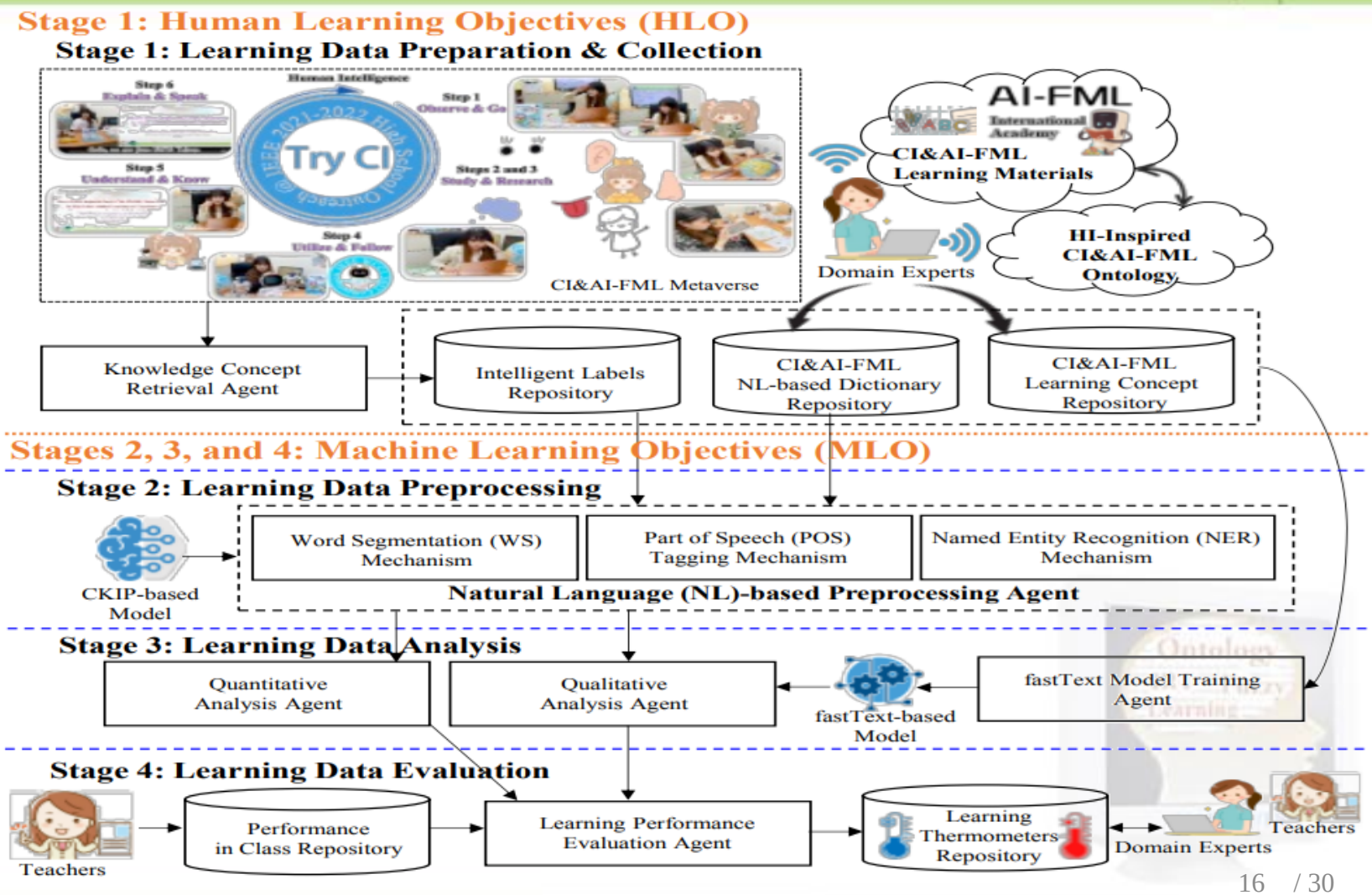
Meta-Knowledge Construction

- Two Stages: **Data Collection** and **Performance Evaluation**
- CI-related Contents constructed by **domain experts**
- **Data Collection**
  - Students learn CI
  - **Interact with CI&AI-FML Tools**
  - **CI-based learning experience agent**
- **Performance Evaluation**
  - Extract key **concepts**
  - Evaluate learning Performance
  - **Qualitative analysis**
  - **Quantitative analysis**



Structure of HI-based CI&AI-FML
人本智慧AI人機共同學習模型

- Four-Stage Structure
  - Learning Data
    - Preparation
    - Collection
    - Preprocessing
    - NLP
    - Qualitative analysis
    - Quantitative analysis
    - Evaluation
      - Meta AI fastText
      - Sentence BERT

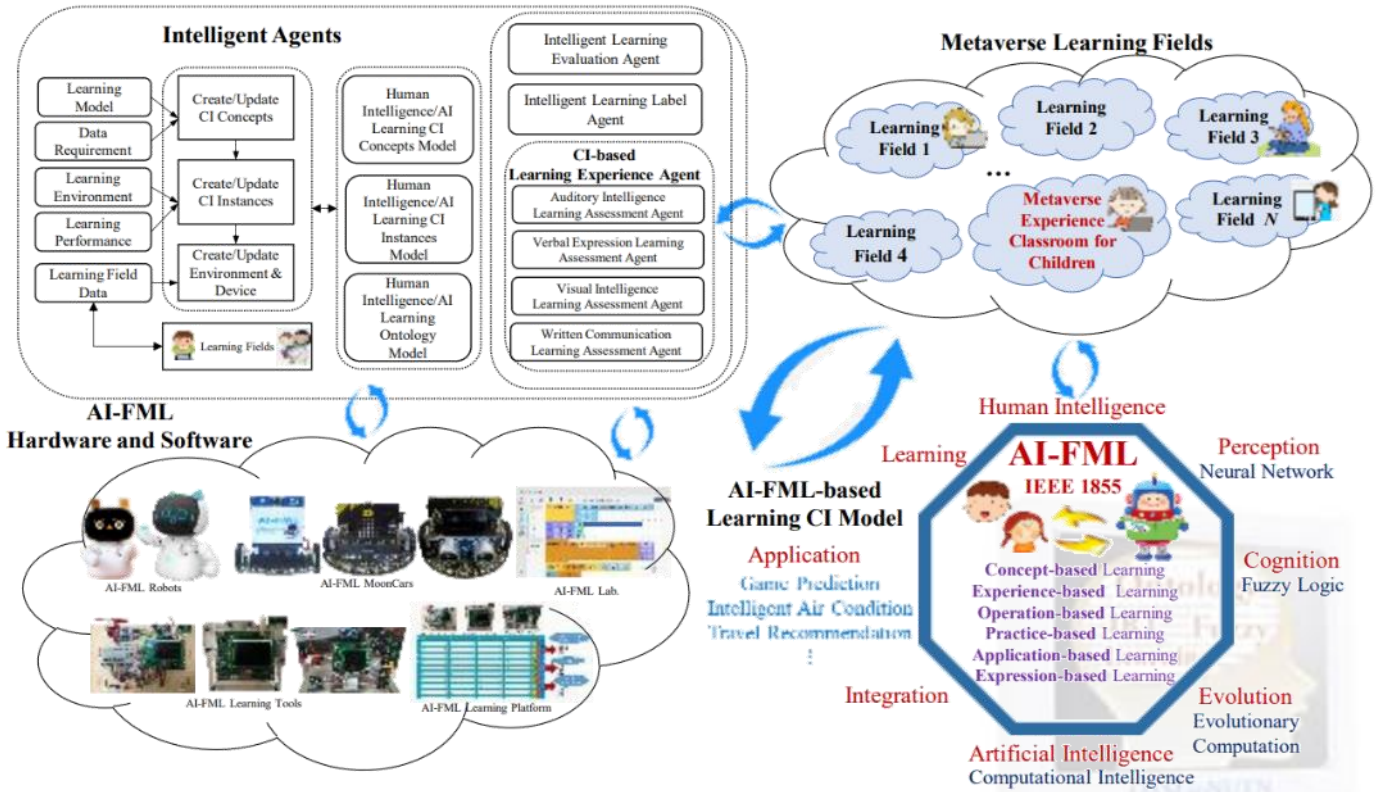


Introduction (3/3)

- This talk
  - 西遊記: Teacher (唐玄奘) ＋ 3 Students (孫悟空、豬八戒、沙悟淨)
  - Introduce the **CI&AI-FML Human-Robot Co-Learning (人機共學)**
  - **Experience** and **practice** the **applications of CI** for **young students**
  - Combine the core technologies of **CI&AI-FML** with the tenets of the **Heart Sutra (心經，with Prof. Marek Reformat in Canada)**
  - Introduce the **concepts of the CI&AI-FML** in the learning fields of **elementary and high schools in Taiwan (台灣學習場域驗證)**
- CI&AI-FML Learning **(概念影片)**
  - https://youtu.be/T6udzVS21gI

CI&AI-FML Metaverse Framework

- **Human-Machine Co-Learning Model (人機共學模型)**
  - Suitable for different age-group students
- **Intelligent Agents (智慧代理人)**
  - Evaluate learning thermometers
  - **Generative AI / ChatGPT @NUTN**
- **Hardware & Software (輔助學習工具)**
  - CI&AI-FML **Robots**
  - CI&AI-FML **MoonCar**
  - CI&AI-FML **Learning Tools**
  - **AI-FML Lab/ ZAI-FML軟體平台**
  - **AI-FML Learning Platform**
- Metaverse Learning Fields
- AI-FML-based **Learning CI Model**



ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner A (2023/06/Software Engineering)**
  - **學習效率提高**：ChatGPT可以幫助我更快地理解和學習軟體工程知識。它可以回答我的問題、提供解釋和澄清軟體工程的概念，使學習變得更加容易和有效率。
  - **創造力發展**：ChatGPT可以幫助我提升需求工程、專案規劃的創造力和創新能力。它可以生成創意的規畫和軟體工程專業文字，激發我軟體需求工程及專案規畫的想像力和創造力。
  - **學習動機降低**：ChatGPT的高度自動化和自動生成文字可能會降低我的主動學習動機。由於Chat GPT可以回答軟體工程問題和提供解釋，我可能會變得過度依賴它，而降低我主動學習軟體工程和專案規畫思考的能力。
  - ChatGPT
    - Learning Efficiency Improvement: ChatGPT can help me understand and learn software engineering knowledge more quickly. It can answer my questions, provide explanations, and clarify concepts in software engineering, making learning easier and more efficient.
    - Creativity Development: ChatGPT can assist me in enhancing creativity and innovation in requirements engineering and project planning. It can generate creative plans and professional text in software engineering, inspiring my imagination and creativity in software requirements engineering and project planning.
    - Reduced Learning Motivation: The high level of automation and text generation by ChatGPT may decrease my intrinsic motivation to actively learn. Due to ChatGPT's ability to answer software engineering questions and provide explanations, I might become overly reliant on it, diminishing my ability to actively learn and think critically about software engineering and project planning.

ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner B (2023/06/ Software Engineering)**
  - ChatGPT 可以促進我自主學習和主動探索軟體工程，因為ChatGPT可以提供即時的回饋和指導。
  - 有助於我獲得更高的學習動機和積極性，進一步促進自主學習的能力
  - 但ChatGPT 生成的回答可能不是完全準確或是有不完整的部分
  - 所以我應該謹慎對待它提供的資訊，並進行進一步的驗證和確認
  - 對我來說 ChatGPT 是正面的。
  - ChatGPT
    - ChatGPT can facilitate my self-directed learning and active exploration of software engineering because it can provide real-time feedback and guidance. This contributes to a higher level of learning motivation and initiative, further enhancing my ability for independent learning.
    - However, it's important to note that the responses generated by ChatGPT may not be entirely accurate or may contain incomplete information. Therefore, I should approach the information it provides with caution and conduct additional verification and confirmation.
    - For me, ChatGPT has a positive impact as a tool for learning and exploration in the field of software engineering.

ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner C (2023/06/ Software Engineering)**
  - 我覺得對我來說，正面學習效益大於負面
  - 生成式 AI 的出現，加速了我學習的過程，讓我在學習中的彎路減少很多
  - 他所提供的解答雖不全為正解， 但正確率也很高，所以對我來說生成式 AI 工具的學習效益很大。
  - ChatGPT
    - For me, I find that the positive learning benefits outweigh the negative ones. The emergence of generative AI has accelerated my learning process, reducing many detours in my learning journey. While the answers provided may not always be entirely correct, the accuracy is generally high. Therefore, the learning benefits of generative AI tools are significant for me.

ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner D (2023/06/Computer Game)**
  - 生成式 AI 工具對我學習電腦對局課程的影響非常大，比起學習艱澀難懂的公式、理論，這種讓我們可以實際操作的課程反而吸收得更多
  - 每當碰到問題，就可以詢問 ChatGPT 答案，雖然有時候可能是誤導我們，但其實只要加入多方的檢查可以讓這個錯誤趨近於 0 ，這讓我們可以從中學習的不僅僅是理論知識
  - 而且 ChatGPT 是一位不用休息、24 小時都在的”老師” ，無論 何時都可以找的到他， 他也不會因為有事或開會而不在。
  - ChatGPT
    - Generative AI tools have had a significant impact on my learning in computer chess courses. Compared to grappling with complex formulas and theories, courses that allow practical hands-on experience resonate with me more. Whenever I encounter problems, I can seek answers from ChatGPT. While there may be occasional misleading information, incorporating multiple checks can minimize errors, making the likelihood of mistakes close to zero. This allows us to learn not only theoretical knowledge but also practical insights.
    - Moreover, ChatGPT serves as an "ever-present teacher" who doesn't require rest, available 24 hours a day. Regardless of the time, it can be accessed, and it doesn't have scheduling conflicts or meetings that might make it unavailable.

ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner E (2023/06/ Computer Game)**
  - **正面學習效益**：之前沒有ChatGPT這個工具時，都需要到Google搜尋並篩選自己需要的資訊，花費許多時間後才能獲得自己想要的答案，但現在有了這個工具，它會直接將它知道的資訊完整描述給我們，我們只需要去驗證它是否有說錯的地方，大幅提升了學習的效率。
  - **負面學習影響**：因為可以透過ChatGPT來產生作業文件，久而久之就會有點怠惰，只將一些明顯的錯誤修正，過度依賴未來可能會削弱思考的能力。
  - **對我學習之影響**：我認為ChatGPT這個工具對我上電腦對局這堂課的影響是正面的，可提升我們的學習效益，只要適時的提醒自己這個工具只是我們的助理，不要讓助理取代我們即可讓我們的能力提升。
  - ChatGPT
    - Positive Learning Benefits: Before the existence of ChatGPT, I used to rely on Google searches and sift through information to find what I needed. It took a considerable amount of time to obtain the answers I was looking for. Now, with this tool, it directly provides comprehensive information, and I only need to verify its accuracy, significantly enhancing the efficiency of my learning.
    - Negative Learning Impact: The ability to generate assignment documents through ChatGPT might lead to a sense of complacency. Over time, there may be a tendency to only correct obvious errors, and excessive reliance could potentially weaken my ability to think critically.
    - Impact on My Learning: I believe that ChatGPT has a positive impact on my learning in the computer chess course, enhancing the efficiency of my studies. It's crucial to remind myself that ChatGPT is merely an assistant and not a replacement for my own thinking. By doing so, I can ensure that the tool complements and elevates my capabilities rather than substituting them.

ChatGPT @ NUTN
Impact of GAI in Learning & Education

- **NUTN-Learner F (2023/06/ Computer Game)**
  - 整體而言，對我來說是有正面影響的
  - 只要對於問ChatGPT 的問題所生成的答案有一定的知識背景，並且能夠分辨出生成的答案準不準確，ChatGPT 是一個很好的輔助工具
  - 可以加快作業的產出以及完成任務的時間，也帶給我更多靈感，提高完整度
  - AI生成工具還是會有失誤、錯誤，因此還是需要從旁糾正，互相輔助，而非將工作全交給 AI 生成工具。
  - ChatGPT
    - Overall, it has a positive impact on me. As long as I possess a certain knowledge background regarding the questions posed to ChatGPT and can discern the accuracy of its generated answers, ChatGPT serves as a valuable supplementary tool. It accelerates the production of assignments, reduces task completion time, and provides more inspiration, thereby enhancing overall efficiency.
    - AI-generated tools may still make mistakes, so it's important to correct and assist them from the side rather than fully relying on them to perform tasks independently. The collaboration between human judgment and AI-generated tools is crucial for ensuring accuracy and completeness.

CI&AI-FML Human-Machine Co-Learning

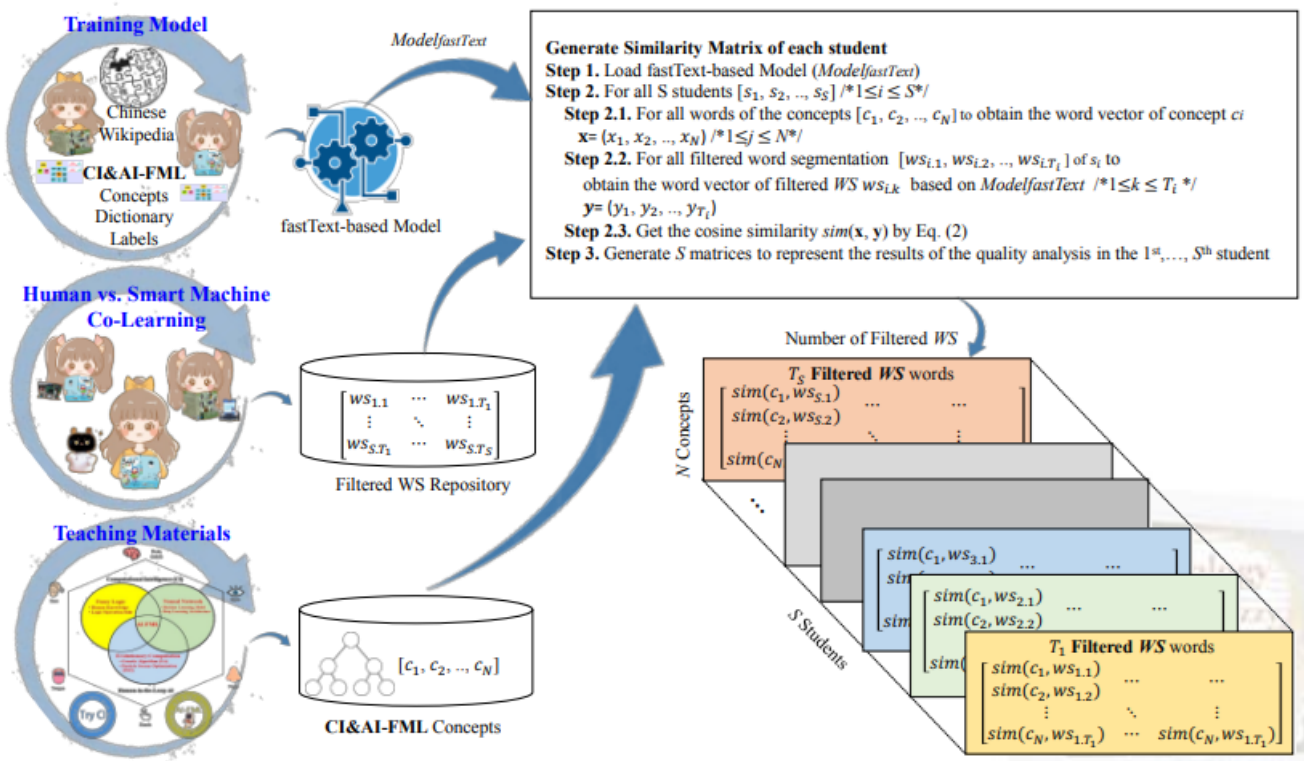
- **Introduction to Language Learning Application by Human (00:43)**
  - https://youtu.be/ofsxoiIpHZk **(概念影片)**
- **Introduction to Language Learning Application by Machine (2:16)**
  - https://youtu.be/dMarvERmgII **(概念影片)**
- **Introduction to Language Learning Application by Human (3:09)**
  - https://youtu.be/sgdHmYsiuW4 **(概念影片)**

Basic CI Domain Knowledge for Young Student Learning (1/3)

- IEEE CIS **High School Outreach (HSO) Subcommittee's** goal
  - Facilitate the **outreach to high-school students**
  - between the ages of 12-18
  - and their **teachers**
- IEEE CIS High School Outreach (HSO) Subcommittee's vision
  - Find ways of bringing **CI**
  - **into the classroom**
  - to inspire young computer scientists
- CI&AI-FML @ TMU, Tokyo, Japan
  - 2023/02/16
  - https://youtu.be/kN7zRE5YX44 **(概念影片)**

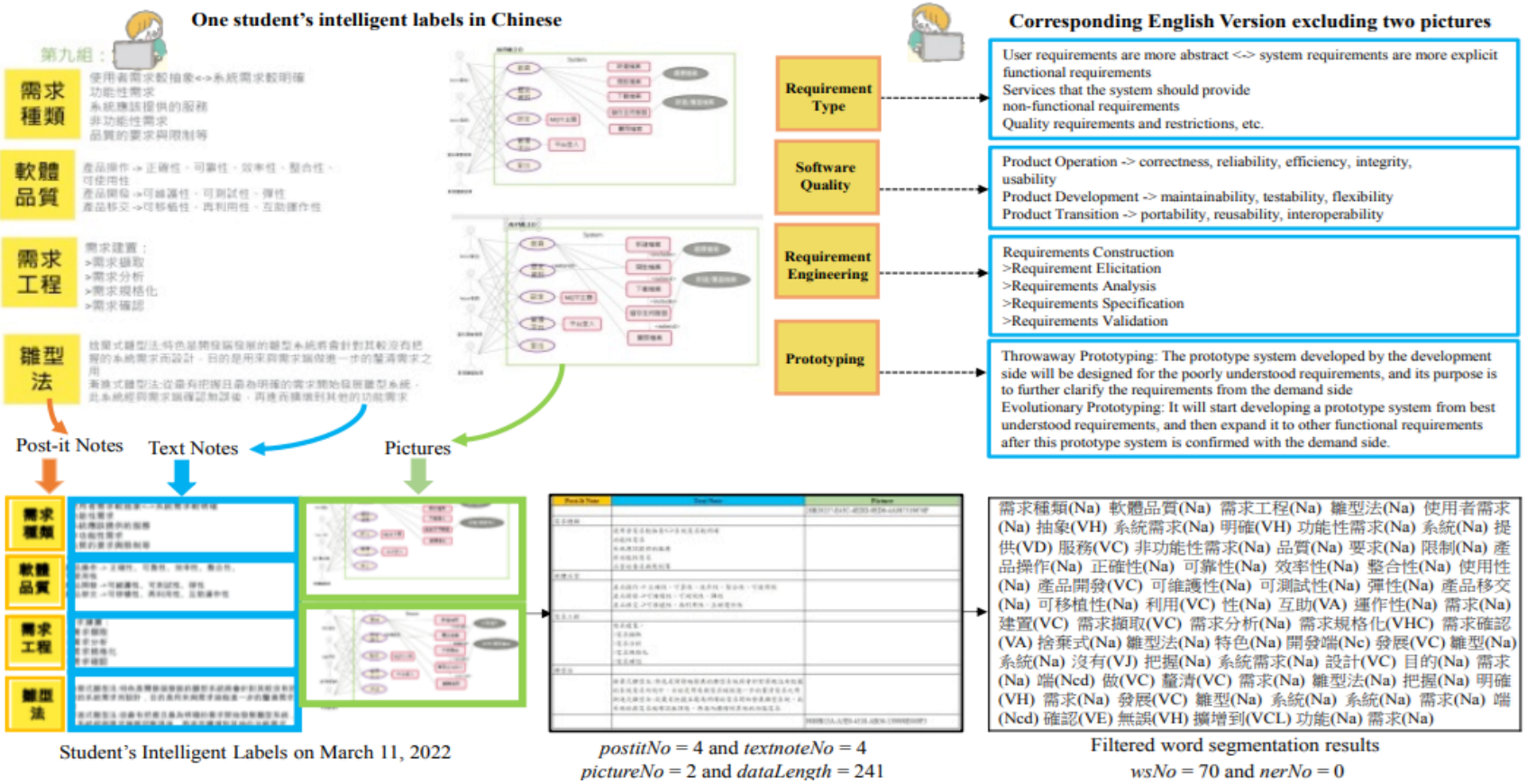
Qualitative Analysis Agent 質性分析代理人

- Estimate the **quality of the students' learning**
  - **Cosine similarity**
  - $sim(x, y) = \frac{x.y}{|x||y|}$
    - where x and y denote
    - the constructed ***CI&AI-FML* concepts**
    - $[c_1, c_2, .., c_N]$ and
    - the filtered **word segmentation** results
    - $\{[ws_{1.1}, \ldots, ws_{1.T_1}], \ldots, [ws_{S.1}, \ldots, ws_{s.T_s}]\}$



Student's Labels on Software Engineering
- 國立臺南大學場域驗證

- Software Engineering on Mar. 11, 2022



Student's Intelligent Labels on March 11, 2022

postitNo = 4 and *textnoteNo* = 4
pictureNo = 2 and *dataLength* = 241

Filtered word segmentation results
wsNo = 70 and *nerNo* = 0

Reference

- C. S. Lee, M. H. Wang, M. Reformat, S. H. Huang, "***Human intelligence-based Metaverse for co-learning of students and smart machines***," Journal of Ambient Intelligence and Humanized Computing, 2023. (與**加拿大**亞伯達大學**合作研究**)

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Thank You