



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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National University of Tainan, Taiwan

Nov. 22, 2023





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



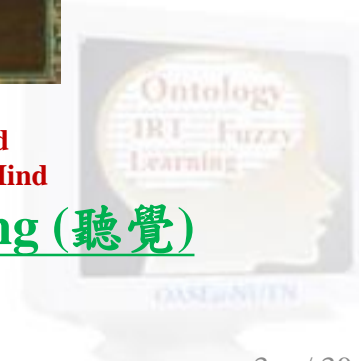
Turing Test



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 Stanford University Human-Centered Artificial Intelligence

Artificial Intelligence Definitions

Intelligence might be defined as the ability to learn and perform suitable techniques to solve problems and achieve goals, appropriate to the context in an uncertain, ever-varying world. A fully pre-programmed factory robot is flexible, accurate, and consistent but not intelligent.

Artificial Intelligence (AI), a term coined by emeritus Stanford Professor John McCarthy in 1955, was defined by him as "the science and engineering of making intelligent machines". Much research has humans program machines to behave in a clever way, like playing chess, but, today, we emphasize machines that can learn, at least somewhat like human beings do.

Autonomous systems can independently plan and decide sequences of steps to achieve a specified goal without micro-management. A hospital delivery robot must autonomously navigate busy corridors to succeed in its task. In AI, autonomy doesn't have the sense of being self-governing common in politics or biology.

Machine Learning (ML) is the part of AI studying how computer agents can improve their perception, knowledge, thinking, or actions based on experience or data. For this, ML draws from computer science, statistics, psychology, neuroscience, economics and control theory.

In **supervised learning**, a computer learns to predict human-given labels, such as dog breed based on labeled dog pictures; **unsupervised learning** does not require labels, sometimes making its own prediction tasks such as trying to predict each successive word in a sentence; **reinforcement learning** lets an agent learn action sequences that optimize its total rewards, such as winning games, without explicit examples of good techniques, enabling autonomy.

Deep Learning is the use of large multi-layer (artificial) neural networks that compute with continuous (real number) representations, a little like the hierarchically organized neurons in human brains. It is currently the most successful ML approach, usable for all types of ML, with better generalization from small data and better scaling to big data and compute budgets.

An **algorithm** lists the precise steps to take, such as a person writes in a computer program. AI systems contain algorithms, but often just for a few parts like a learning or reward calculation method. Much of their behavior emerges via learning from data or experience, a sea change in system design that Stanford alumnus Andrej Karpathy dubbed **Software 2.0**.

Narrow AI is intelligent systems for one particular thing, e.g. speech or facial recognition.

Human-level AI, or **Artificial General Intelligence (AGI)**, seeks broadly intelligent, context-aware machines. It is needed for effective social chatbots or human-robot interaction.

Human-Centered Artificial Intelligence is AI that seeks to augment the abilities of, address the societal needs of, and draw inspiration from human beings. It researches and builds effective partners and tools for people, such as a robot helper and companion for the elderly.

Text by Professor Christopher Manning, September 2010

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

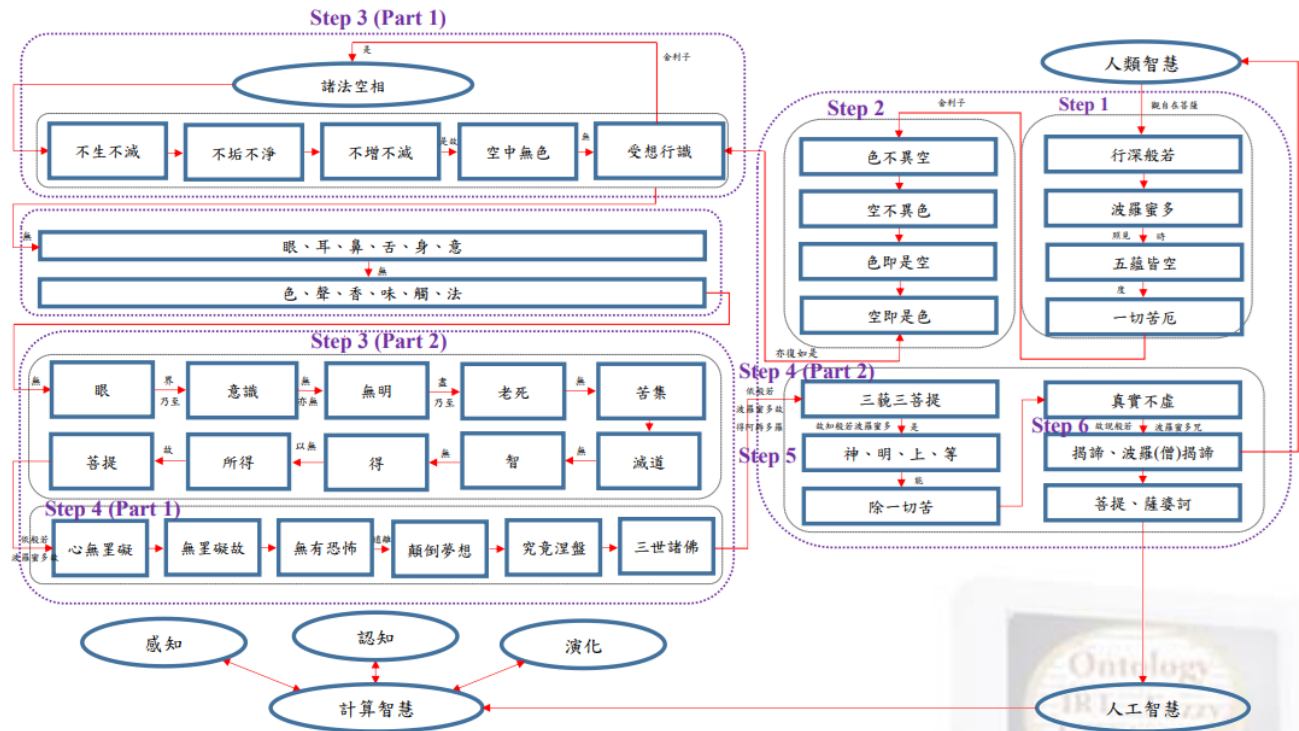
- With Prof. Marek Reformat, Canada
- Accepted in 2023

- 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

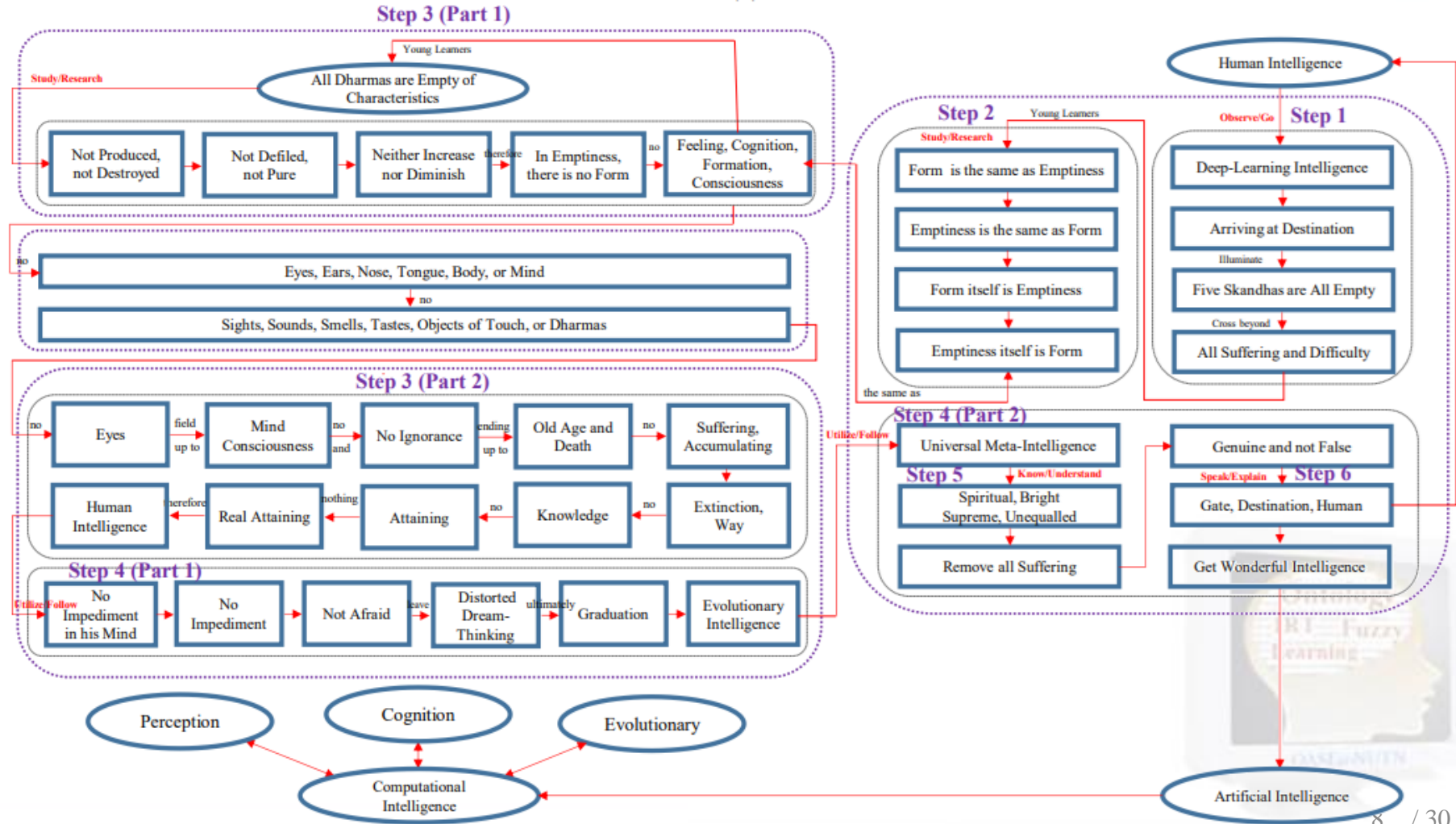
- 人本智慧本體論

<https://youtu.be/ETfYQknqFJw>



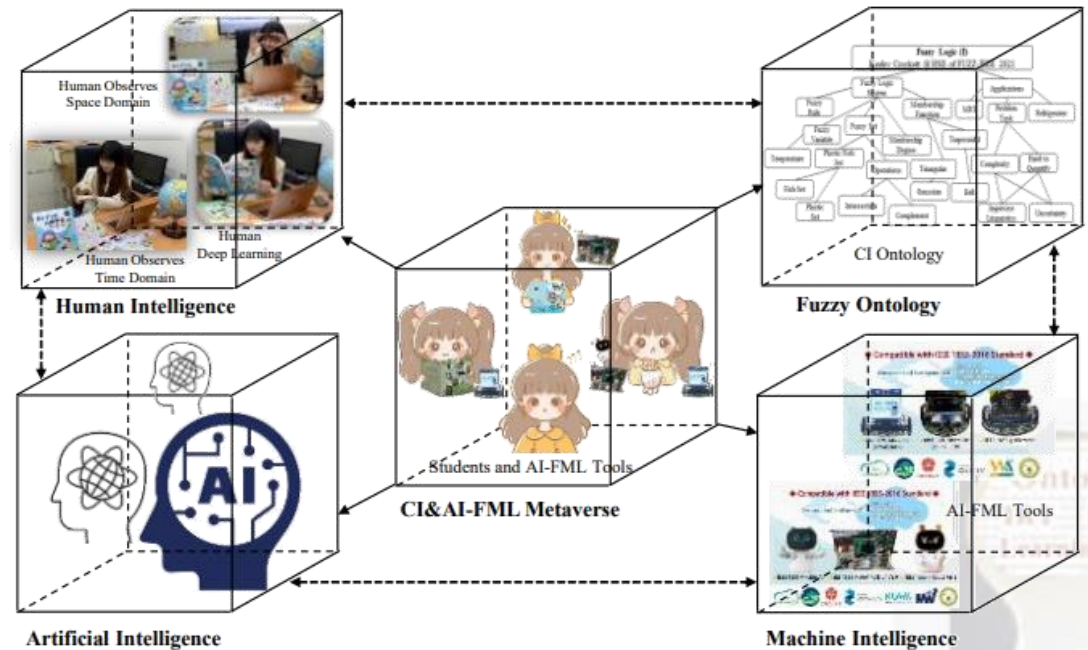
CKIP-based NLP for HI Ontology Construction and Understanding of Heart Sutra

- 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
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CI&AI-FML Human-Robot Co-Learning

• Ground Truth

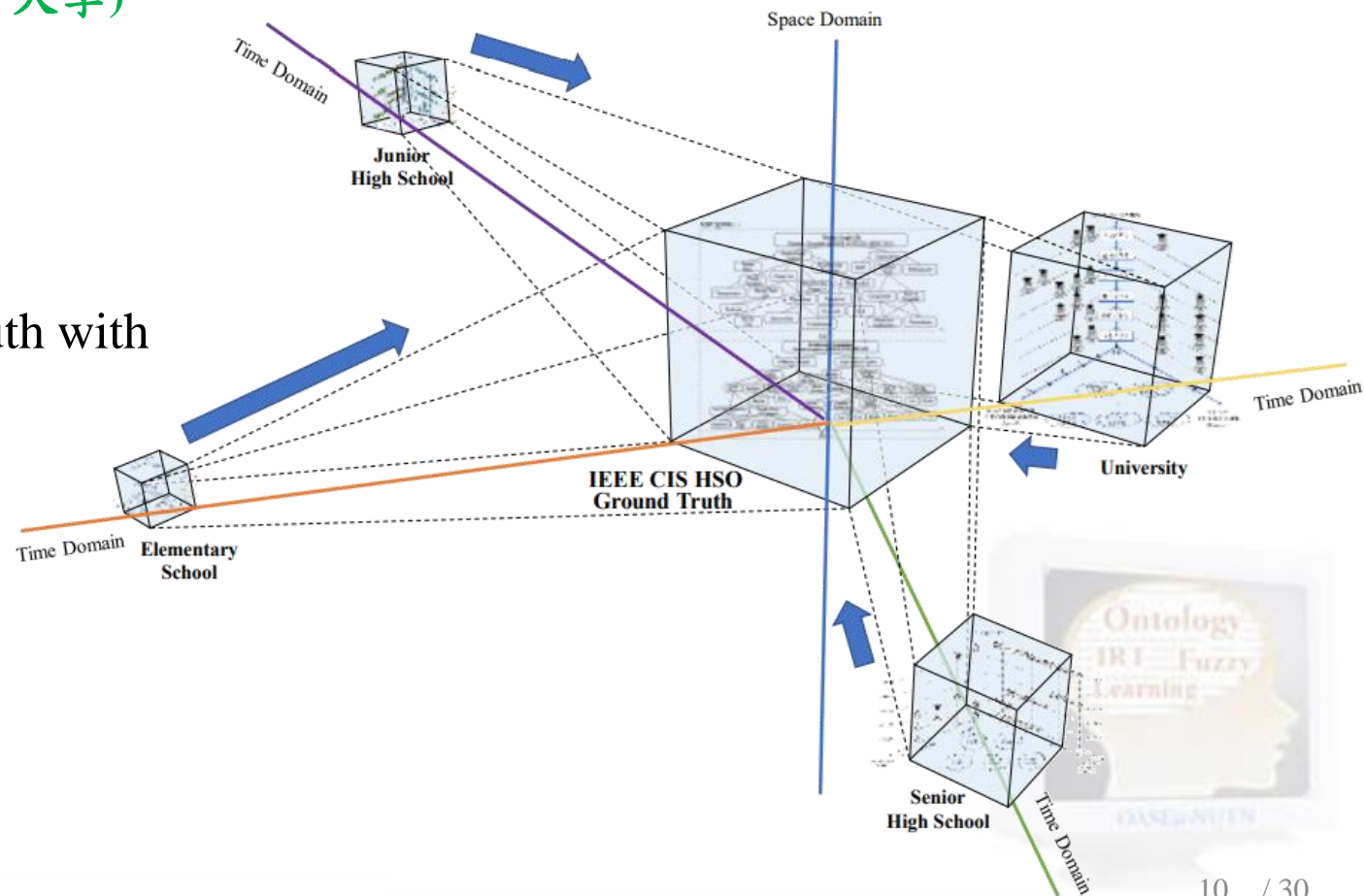
- provided by IEEE CIS HSO (國小、國高中、大學)
 - 觀察自己時空領域、環境互動智慧本體
 - 觀自在菩薩
 - 深度學習人類智慧、設計目標達成任務
 - 行深般若、波羅密多

• 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

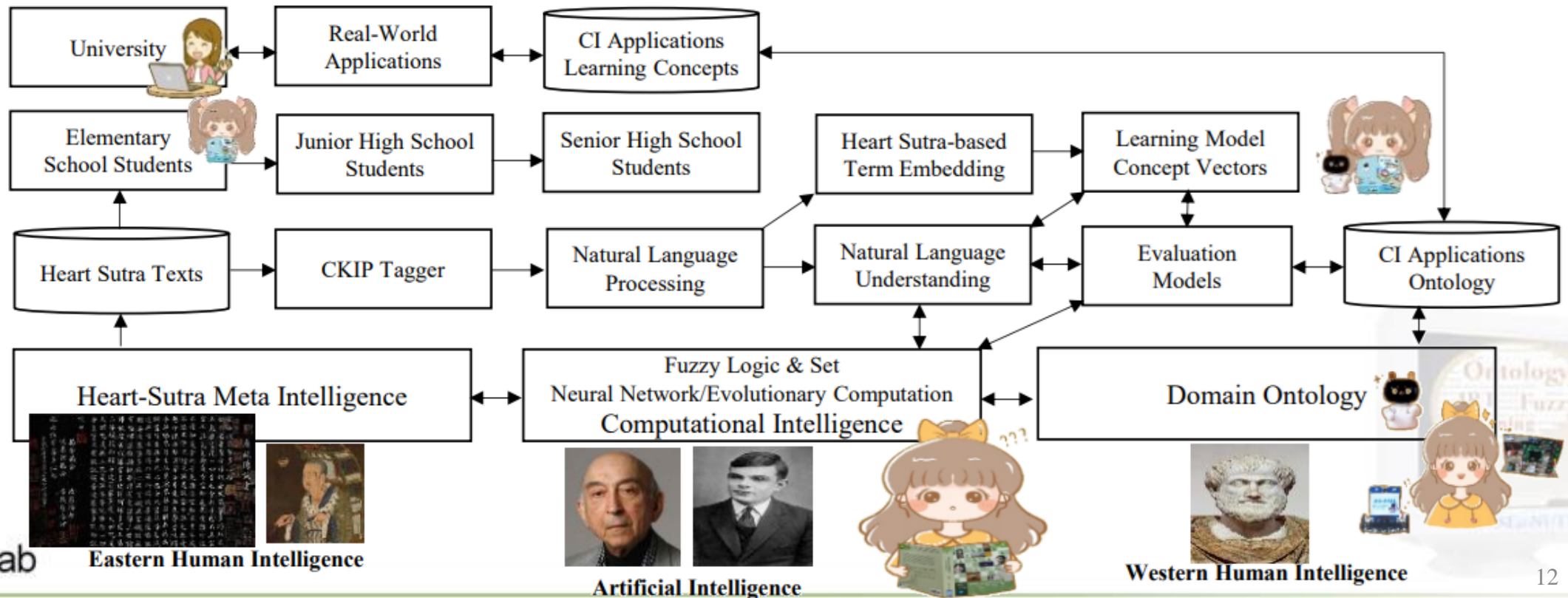




Heart Sutra-inspired CI&AI-FML

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

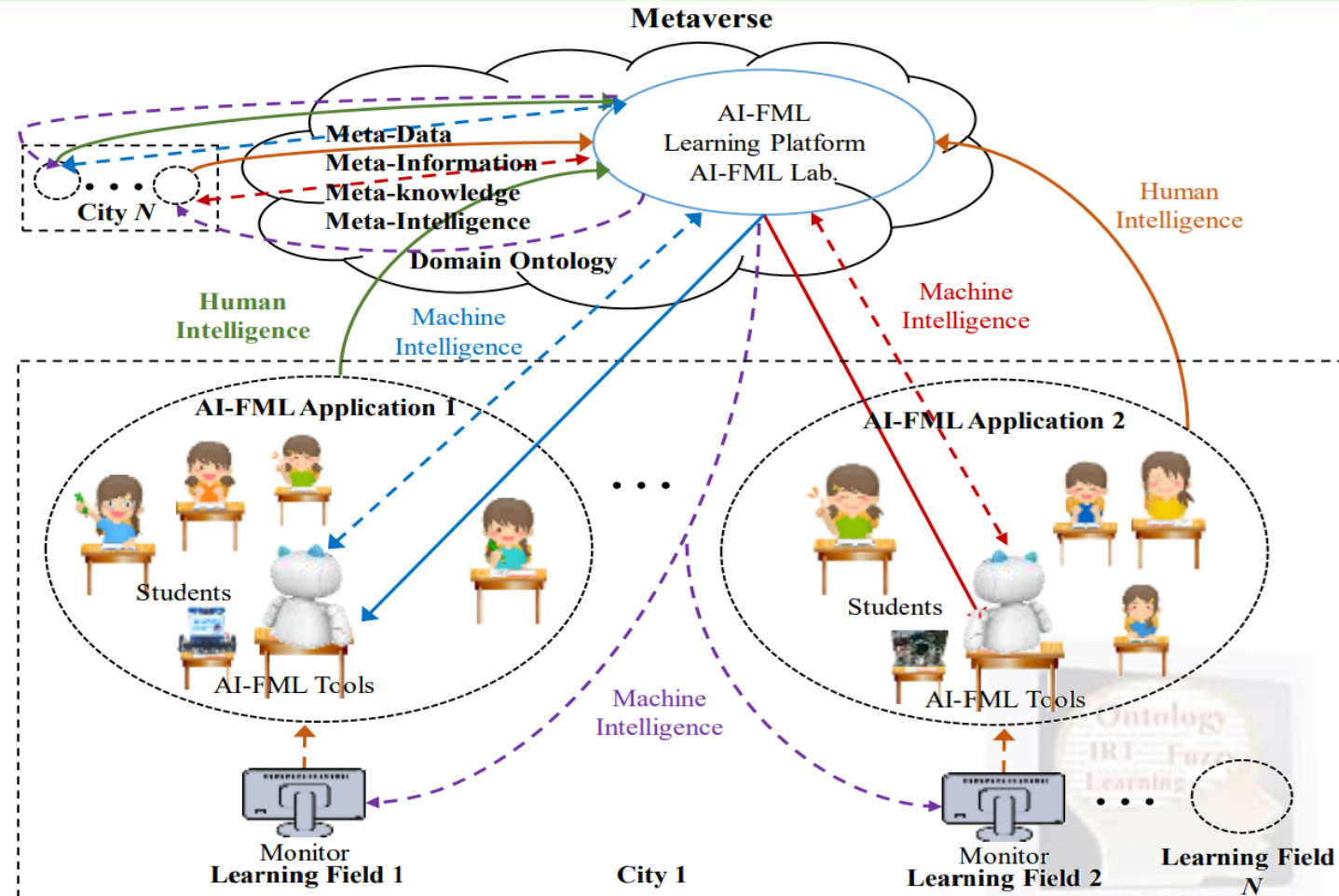




CI&AI-FML Human-Robot Co-Learning

Student Experience and Learning

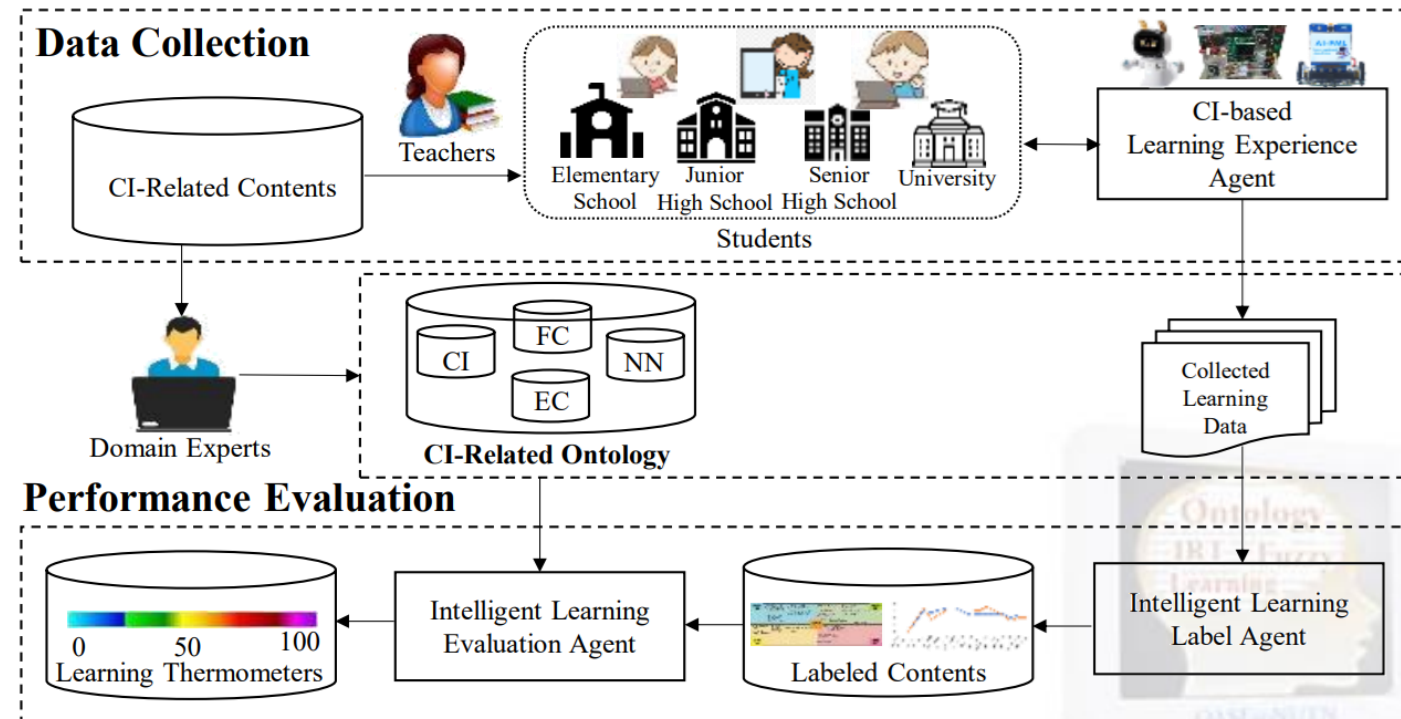
- **Students with Ontology**
 - Co-learn with **CI&AI-FML Tools**
 - in different **learning fields** (學習場域/波羅)
 - in different **cities** (學習場域/波羅)
- **Students with Human Intelligence**
 - **HI** (人本智慧/般若)
 - **KB&RB Vector/ Matrix**
 - **CI&AI-FML Learning platform**
- **Machine Intelligence with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

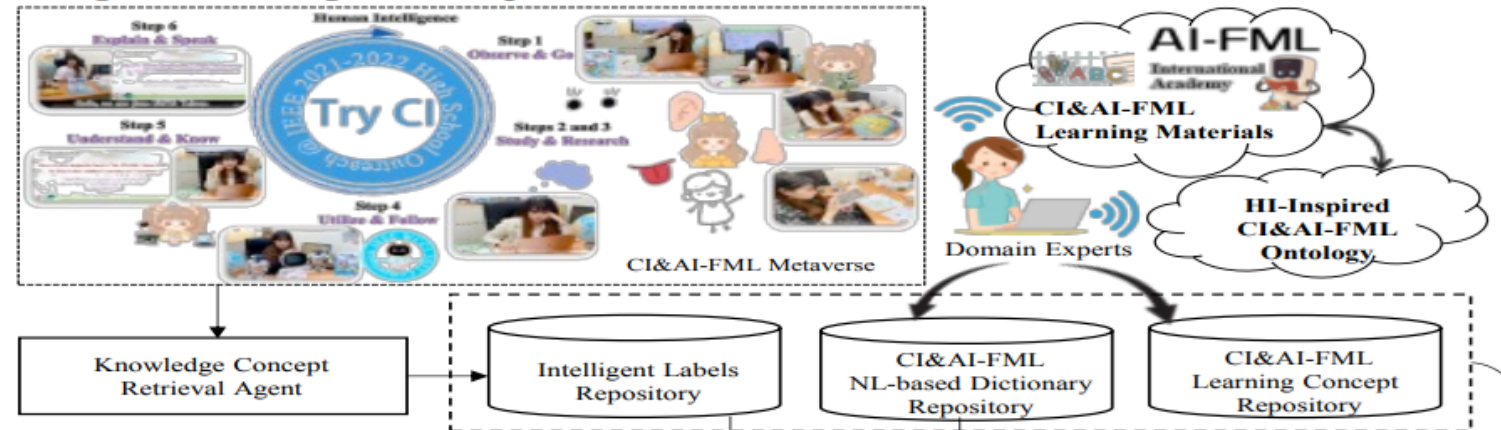
• Four-Stage Structure

– Learning Data

- Preparation
- Collection
- Preprocessing
- NLP
- Qualitative analysis
- Quantitative analysis
- Evaluation
 - Meta AI fastText
 - Sentence BERT

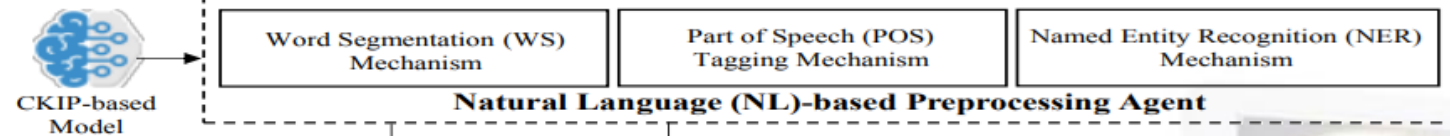
Stage 1: Human Learning Objectives (HLO)

Stage 1: Learning Data Preparation & Collection

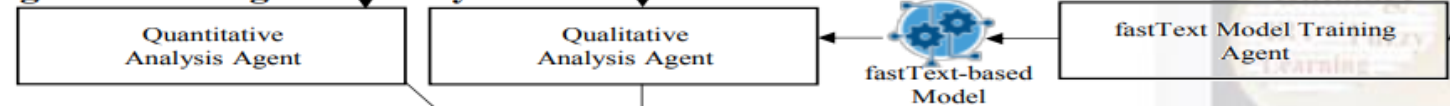


Stages 2, 3, and 4: Machine Learning Objectives (MLO)

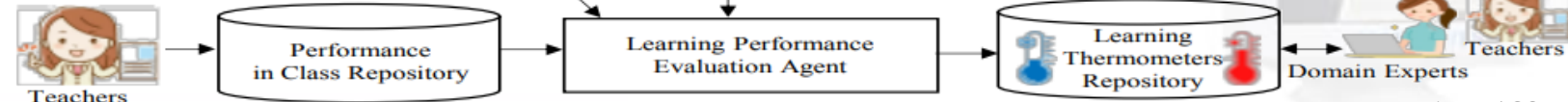
Stage 2: Learning Data Preprocessing



Stage 3: Learning Data Analysis



Stage 4: Learning Data Evaluation





Introduction (3/3)



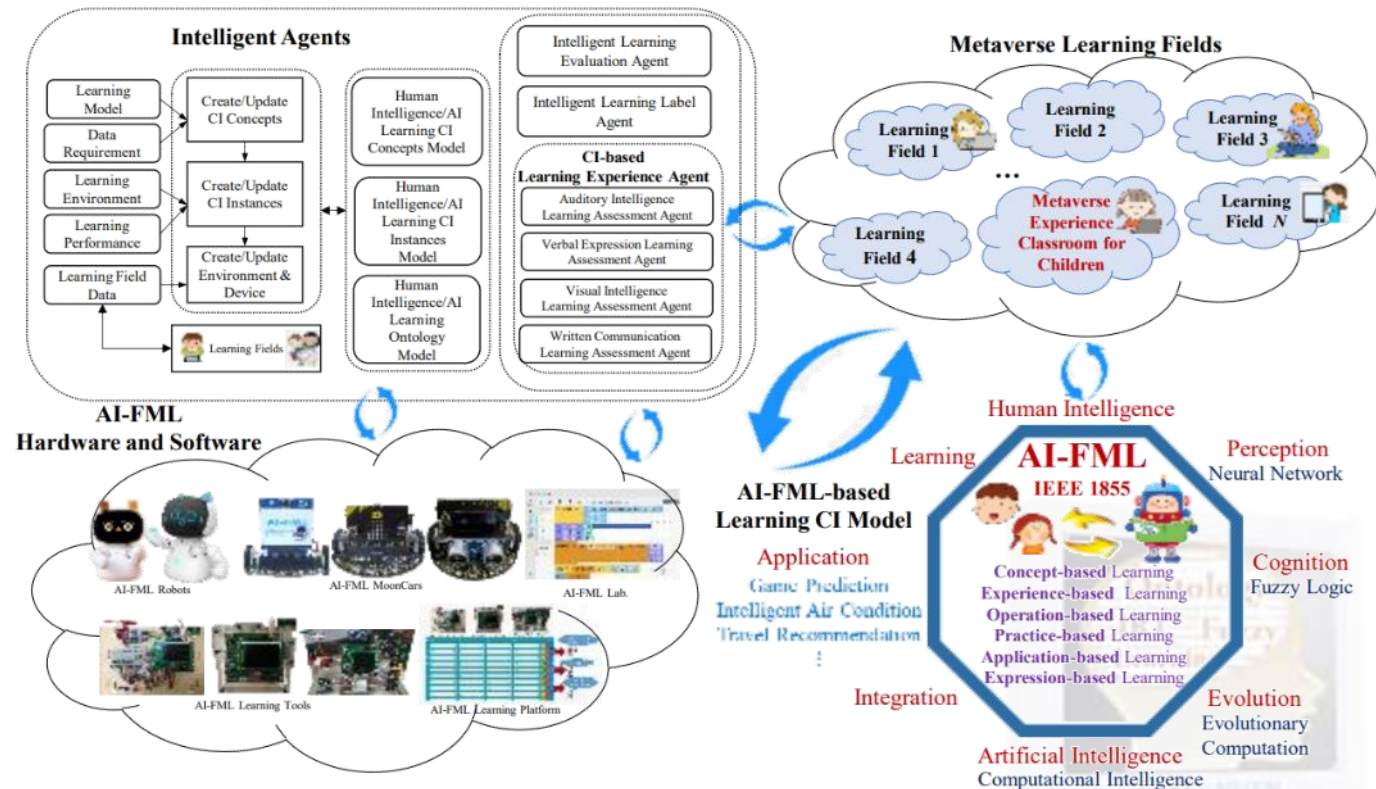
- This talk
 - 西遊記: Teacher (唐玄奘) + 3 Students (孫悟空、豬八戒、沙悟淨)
 - Introduce the **CI&AI-FML Human-Robot Co-Learning (人機共學)**
 - **Experience** and **practice** the **applications of CI** for **young students**
 - Combine the core technologies of **CI&AI-FML** with the tenets of the **Heart Sutra (心經, with 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



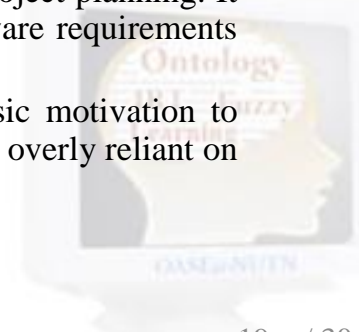


ChatGPT @ NUTN

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.



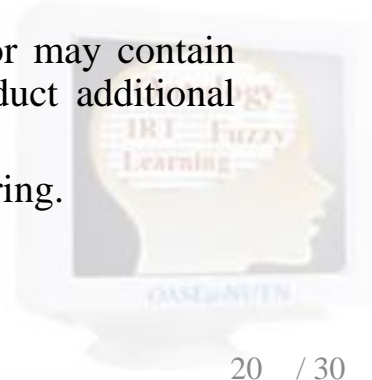


ChatGPT @ NUTN

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.

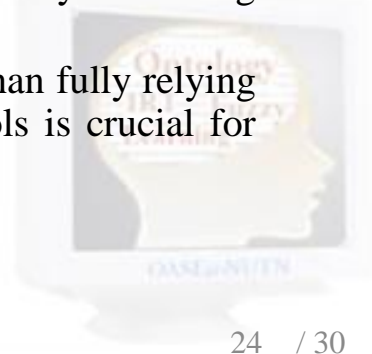


ChatGPT @ NUTN

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)



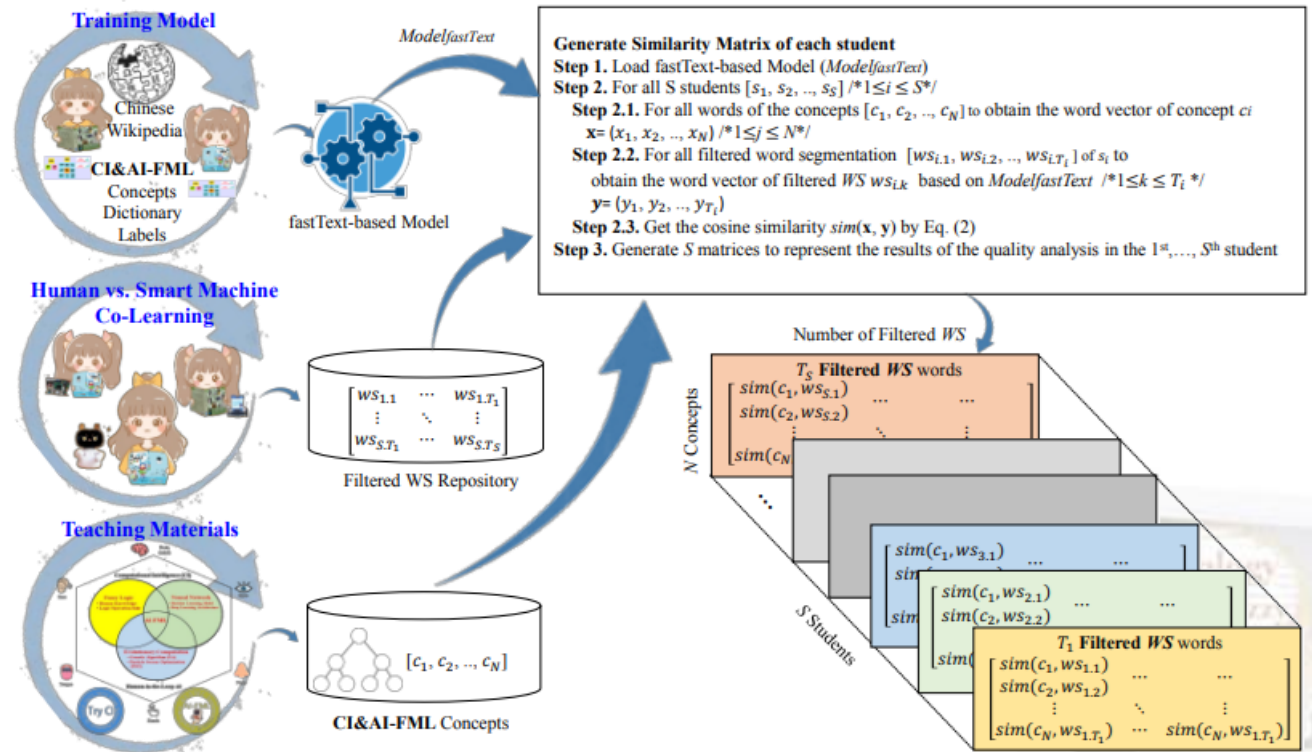
Qualitative Analysis Agent 質性分析代理人

- Estimate the **quality of the students' learning**

– Cosine similarity

$$sim(x, y) = \frac{x \cdot y}{|x| |y|}$$

- where x and y denote
- the constructed **CI&AI-FML concepts**
- $[c_1, c_2, \dots, c_N]$ and
- the filtered **word segmentation** results
- $\{[ws_{1,1}, \dots, ws_{1,T_1}], \dots, [ws_{S,1}, \dots, ws_{S,T_S}]\}$



Student's Labels on Software Engineering

- 國立臺南大學場域驗證

- Software Engineering on Mar. 11, 2022

One student's intelligent labels in Chinese

第九組:

- 需求種類**: 使用者需求較抽象 ↔ 系統需求較明確
功能性需求
系統應該提供的服務
非功能性需求
品質的要求與限制等
- 軟體品質**: 產品操作 → 正確性、可靠性、效率性、整合性、可使用性
產品開發 → 可維護性、可測試性、彈性
產品移交 → 可移植性、再利用率、互聯操作性
- 需求工程**: 需求建置:
> 需求擷取
> 需求分析
> 需求規格化
> 需求確認
- 雛型法**: 捨棄式雛型法特色是開發發展中的雛型系統將會對其較沒有理解的系統需求而設計，目的是用來與需求端做進一步的釐清需求之用。
漸進式雛型法立意有把握且應為明確的需求開始發展雛型系統，此系統經與需求端確認無誤後，再逐步擴充到其他的功能需求。

Corresponding English Version excluding two pictures

- Requirement Type**: User requirements are more abstract ↔ system requirements are more explicit functional requirements
Services that the system should provide
non-functional requirements
Quality requirements and restrictions, etc.
- Software Quality**: Product Operation → correctness, reliability, efficiency, integrity, usability
Product Development → maintainability, testability, flexibility
Product Transition → portability, reusability, interoperability
- Requirement Engineering**: Requirements Construction
> Requirement Elicitation
> Requirements Analysis
> Requirements Specification
> Requirements Validation
- Prototyping**: Throwaway Prototyping: The prototype system developed by the development side will be designed for the poorly understood requirements, and its purpose is to further clarify the requirements from the demand side
Evolutionary Prototyping: It will start developing a prototype system from best understood requirements, and then expand it to other functional requirements after this prototype system is confirmed with the demand side.

Post-it Notes Text Notes Pictures

需求種類: 使用者需求較抽象 ↔ 系統需求較明確
功能性需求
系統應該提供的服務
非功能性需求
品質的要求與限制等

軟體品質: 產品操作 → 正確性、可靠性、效率性、整合性、可使用性
產品開發 → 可維護性、可測試性、彈性
產品移交 → 可移植性、再利用率、互聯操作性

需求工程: 需求建置:
> 需求擷取
> 需求分析
> 需求規格化
> 需求確認

雛型法: 捨棄式雛型法特色是開發發展中的雛型系統將會對其較沒有理解的系統需求而設計，目的是用來與需求端做進一步的釐清需求之用。
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需求種類	軟體品質	需求工程	雛型法
使用者需求較抽象 ↔ 系統需求較明確 功能性需求 系統應該提供的服務 非功能性需求 品質的要求與限制等	產品操作 → 正確性、可靠性、效率性、整合性、可使用性 產品開發 → 可維護性、可測試性、彈性 產品移交 → 可移植性、再利用率、互聯操作性	需求建置: > 需求擷取 > 需求分析 > 需求規格化 > 需求確認	捨棄式雛型法特色是開發發展中的雛型系統將會對其較沒有理解的系統需求而設計，目的是用來與需求端做進一步的釐清需求之用。 漸進式雛型法立意有把握且應為明確的需求開始發展雛型系統，此系統經與需求端確認無誤後，再逐步擴充到其他的功能需求。

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

需求種類(Na) 軟體品質(Na) 需求工程(Na) 雛型法(Na) 使用者需求(Na) 抽象(VH) 系統需求(Na) 明確(VH) 功能性需求(Na) 系統(Na) 提供(VD) 服務(VC) 非功能性需求(Na) 品質(Na) 要求(Na) 限制(Na) 產品操作(Na) 正確性(Na) 可靠性(Na) 效率性(Na) 整合性(Na) 使用性(Na) 產品開發(VC) 可維護性(Na) 可測試性(Na) 彈性(Na) 產品移交(Na) 可移植性(Na) 利用(VC) 性(Na) 互助(VA) 運作性(Na) 需求(Na) 建置(VC) 需求擷取(VC) 需求分析(Na) 需求規格化(VHC) 需求確認(VA) 捨棄式(Na) 雛型法(Na) 特色(Na) 開發端(Nc) 發展(VC) 雛型(Na) 系統(Na) 沒有(VJ) 把握(Na) 系統需求(Na) 設計(VC) 目的(Na) 需求(Na) 端(Ncd) 做(VC) 釐清(VC) 需求(Na) 雛型法(Na) 把握(Na) 明確(VH) 需求(Na) 發展(VC) 雛型(Na) 系統(Na) 系統(Na) 需求(Na) 端(Ncd) 確認(VE) 無誤(VH) 擴增到(VCL) 功能(Na) 需求(Na)

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)
- C. S. Lee, M. H. Wang, S. H. Huang, F. J. Yang, C. H. Tsai, and L. Q. Wang, “*Fuzzy ontology-based intelligent agent for high-school student learning in AI-FML Metaverse*,” 2022 IEEE World Congress on Computational Intelligence (IEEE WCCI 2022), Padua, Italy, Jul. 18-23, 2022.



Thank You

