



IJAIO



**INTERNATIONAL
JUNIOR
ARTIFICIAL
INTELLIGENCE
OLYMPIAD**

INFO PACK 2026
INTERNATIONAL



WELCOME MESSAGES

President's Welcome Message

International Junior Artificial Intelligence Olympiad (IJAIO)

Dear Students, Teachers, and Parents,

It is my great pleasure, on behalf of the Singapore International Mastery Contests Centre (SIMCC), to warmly welcome you to the International Junior Artificial Intelligence Olympiad (IJAIO)—a new global initiative to be launched in August/September 2026.

Artificial Intelligence is profoundly transforming how we live, learn, and work. From education and healthcare to business, science, and the arts, AI is no longer a distant concept—it is already part of our daily lives. This rapid pace of technological advancement brings tremendous opportunities, but also new responsibilities. Young people today must therefore not only learn *how* AI works, but also *how to think responsibly and ethically* about its use and impact.

IJAIO was created with this vision at its core. Building upon SIMCC's long-standing commitment to nurturing higher-order thinking and global citizenship, IJAIO integrates computational thinking with AI thinking, placing strong emphasis on ethics, fairness, safety, and human-centred decision-making. It is designed to be age-appropriate, accessible, and internationally benchmarked for students from Grades 1 to 12, regardless of prior coding experience.

In September 2025, SIMCC was honoured when Mr. Henry Ong was invited by UNESCO to share this vision at their meeting in Paris. The strong interest from global educational leaders reaffirmed our belief that ethical AI education must begin early, empowering teachers and students alike to navigate an AI-ubiquitous world with confidence, discernment, and responsibility.

We look forward to working closely with educators, schools, academic advisors, and policy leaders worldwide to bring IJAIO to classrooms across diverse communities. Together, we aim to equip students not just to compete, but to become thoughtful problem-solvers, creative innovators, and responsible leaders who can contribute positively to society.

To all our contestants: your participation in IJAIO marks an important step in preparing for a future shaped by AI. We encourage you to stay curious, think critically, act ethically, and enjoy the learning journey ahead. We wish all students every success and hope this experience inspires you to shape a better, more inclusive future with artificial intelligence.

Best regards,

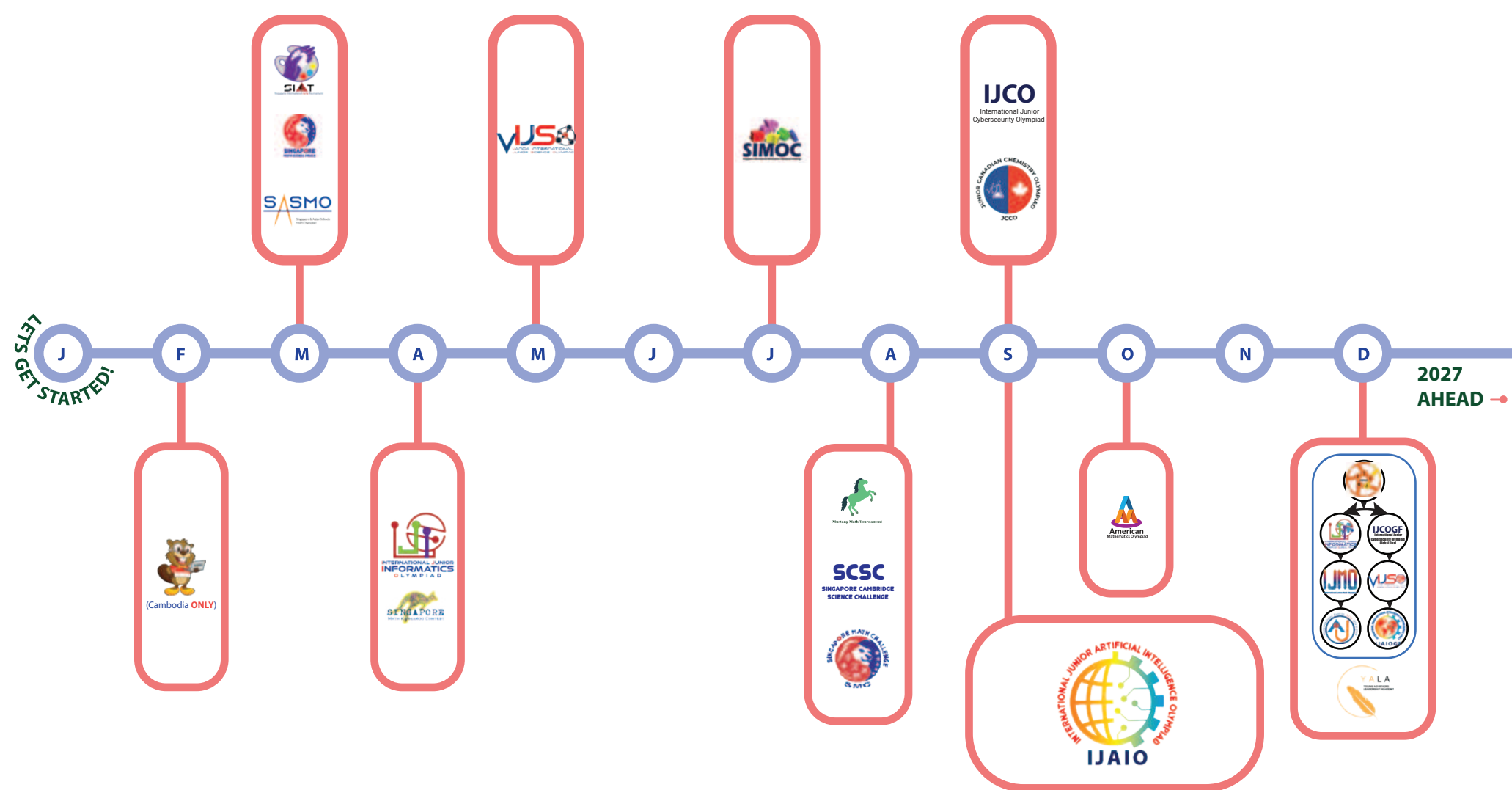
Henry Ong
President



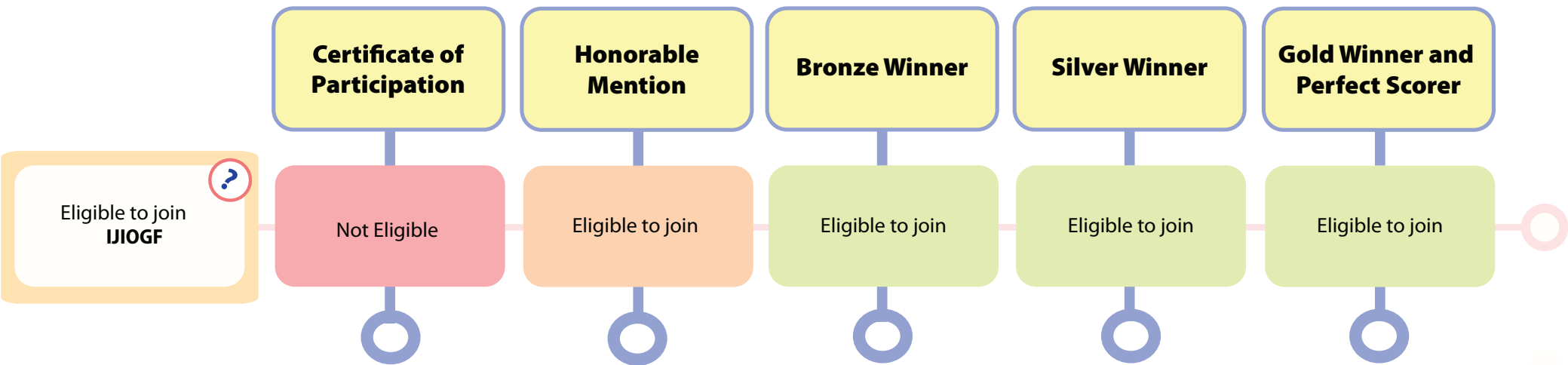
2020 Honouree, Brands for Good, SIMCC Pte Ltd
<https://www.brandsforgood.asia/2020-winners/simcc-henry-ong-lay-hong>

2024 Honouree, Brands for Good, Scholastic Trust Singapore Ltd
<https://www.brandsforgood.asia/2024-winners/sts-henry-ong-lay-hong>

SIMCC Competition Timeline: 2026

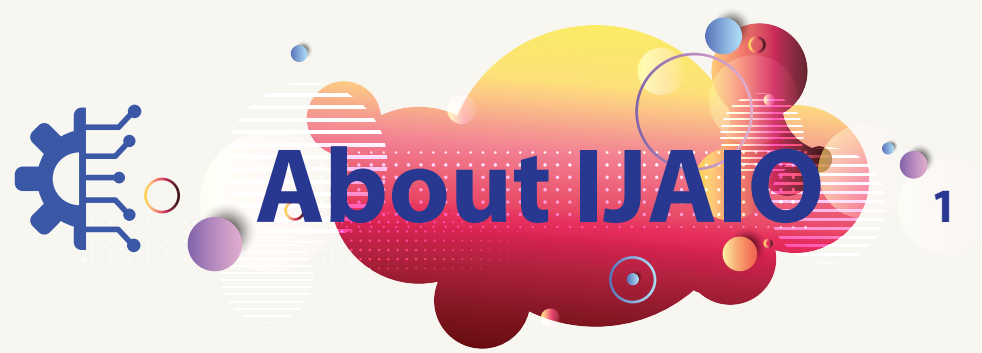


SIMCC COMPETITION PROGRESSION: IJIOGF



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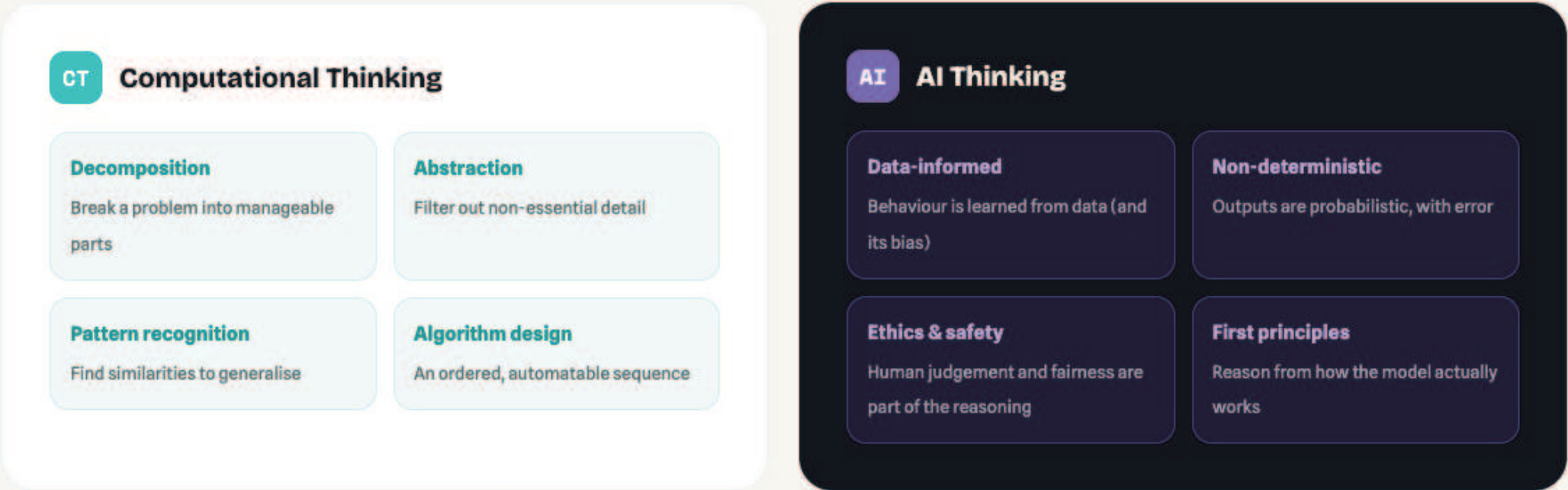
The IJAIO completes SIMCC's informatics suite, empowering young learners to become **future-oriented**, **innovative** and **responsible** problem solvers.

COMP. THINKING Bebras Computational thinking challenges.	PROGRAMMING Junior Informatics Algorithmic problem solving in code.	SECURITY Junior Cybersecurity Adversarial thinking & forensics.	ARTIFICIAL INTELLIGENCE Junior AI First principles understanding and application.
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/ THE THINKING MODEL

Computational Thinking + AI Thinking

Classical computational thinking is the deterministic foundation; AI thinking augments it for the probabilistic, data-driven nature of modern generative AI.



/ THE FIVE AI PILLARS

One spine, from first principles

Five Pillars spiral across every band, each led by a disposition and deepening from play to design. Generative AI sits at their heart, because the aim is to grow learners from users of AI into creators of it.

PILLAR 1 Representation Turning the world - words and images - into numbers AI can work with.	PILLAR 2 Learning Finding patterns in data, from simple rules to neural networks.	PILLAR 3 Generation Predicting and creating new things, the heart of generative AI.	PILLAR 4 Interaction & Agency Directing AI and how it acts: prompting, agents, tools, retrieval.	PILLAR 5 Responsibility Truth, fairness, safety and human impact, woven through every band.
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Benefits of IJAIO

2

/ FORMAT AT A GLANCE

Knowledge, Skills, Dispositions

Lower Primary

Grades 1–3

45 min

20 MCQ [60] + 2 structured tasks [40] · 100 marks

Upper Primary

Grades 4–6

60 min

30 MCQ [60] + 2 structured tasks [40] · 100 marks

Lower Secondary

Grades 7–8

90 min

20 MCQ [40] + 3 structured / practical tasks [60] · 100 marks

Upper Secondary

Grades 9–12

90 min

20 MCQ [40] + 3 structured / design / practical tasks [60] · 100 marks

One machine, two depths, three ways in

The same journey, from numbers to a machine that writes, told at two depths. Each track offers the ideas as a hands-on **explainer**, an interactive **story**, and a one-scroll **poster**, and finishes with **AI agents**: the model put to work with tools.

Primary track

Grades 1–6

EXPLAINER · START HERE

First Principles of AI · The Eight Little Ideas →

Patterns, numbers, mixing and clever guessing: the eight small ideas inside every big AI, each with a hands-on toy to play with.

STORY

The Robot in the Storeroom: an interactive mystery



POSTER

How a Robot Learns to Write, in 8 little ideas



AGENTS

Meet Robo: how AI agents work



Secondary track

Grades 7–12

EXPLAINER · START HERE

First Principles of AI · Nine Steps →

From a humble multiplication to a machine that writes: vectors, neurons, gradient descent, embeddings, attention and the transformer.

STORY

The Overnight Build: nine repairs before nine a.m.



POSTER

The machine that writes, in nine pictures



AGENTS

Build an AI agent from scratch





For Secondary School / ITE / JC / Polytechnic Students (Grades 7–12)

For older students, IJAIO transitions from recognition and play into **design, critique, and experimentation** with AI systems.

1. Deeper AI Literacy

- Exposure to **machine learning pipelines, datasets**, and the concept of **model evaluation**.
- Students explore symbolic vs statistical AI, precision vs recall, and real-world failure cases.

2. Critical Thinking Foundations

- Practice in debating **AI ethics, fairness, governance, and global impact** (jobs, sustainability, digital divide, surveillance).
- Learn to spot and analyse **bias in datasets**, misinformation, and fairness trade-offs.

3. Practical Experimentation

- Engage in **pseudo-code and simple Python tasks** (train/test split, confusion matrices, threshold classification).
- Progress to **hands-on AI coding** with PyTorch, CNNs, and NLP in upper secondary.

4. Pathway to Pre-Tertiary AI Competitions

IJAIO serves as the **foundation** for advanced Olympiads:

- **National Olympiad in Artificial Intelligence (NOAI, Singapore)**
 - Secondary students who excel in NJAIO can move to NOAI, where tasks involve **real-world AI challenges** (vision, NLP, reinforcement learning).
 - Provides deeper exposure to research-style tasks and project-based AI innovation.
- **International Olympiad in Artificial Intelligence (IOAI)**
 - Outstanding NOAI participants may qualify for IOAI.
 - IOAI brings together **the best global secondary students** to solve **cutting-edge AI problems**—from algorithmic fairness to multi-modal AI.
 - This global stage inspires students to pursue **AI research, university-level studies, and careers in AI/tech innovation**.

5. Career & Higher Education Readiness

- Builds a portfolio of **practical AI projects** (from simple rule classifiers to CNN/NLP tasks).
- Positions students strongly for **future AI-related courses and scholarships**.
- Encourages entrepreneurial thinking about how AI can support the **UN SDGs** (e.g., food waste, health, environment).

Objectives

Make AI technologies and their underlying working concepts and impact relatable to younger students so that they can recognise AI in their daily lives, identify patterns, understand fairness and safety, and engage with simple perception and decision scenarios.



Lower Primary Grades 1 to 3

A gentle, playful, mostly-unplugged start: recognise AI, follow rules and patterns by hand, and meet generative AI safely.

Who it's for

Students, parents and teachers who want a simple picture of what Lower Primary learners should understand, practise, and demonstrate in IJAIO.

What success looks like

Learners recognise familiar AI examples, follow simple rule-based processes, talk about safety and privacy, and complete visual or unplugged tasks with clear explanations.

The five AI Pillars Each Pillar leads with a disposition - the attitude a learner brings, then plain learning outcomes that combine what a learner knows and can do. The same five Pillars return in every band, a little deeper each time.		
Pillar 1	Representation	Disposition. Looks for the rule or pattern behind a behaviour rather than calling it magic.
1.1 Explain that AI is a computer program made by people, not alive, with no real feelings. 1.2 Describe how computers store words and pictures as numbers, not letters. 1.3 Encode and decode a short word using a letter-to-number code sheet. 1.4 Sort objects or pictures into groups by a shared feature (early classification).		
Pillar 2	Learning	Disposition. Believes behaviour is learned from examples, not magic; keeps trying and checking.
2.1 Explain that AI learns from many examples: many cat pictures help it learn “cat”. 2.2 Continue a pattern and predict what comes next (the seed of prediction). 2.3 Carry out a simple rule by hand, like a robot following instructions. 2.4 Find a way through a simple maze by trying and checking (the seed of search).		
Pillar 3	Generation	Disposition. Curious about how new things are made; tells “making” apart from “finding”.
3.1 Tell apart making something new (generative AI) from finding what already exists (search). 3.2 Play “what comes next?” guessing games to experience prediction at work.		
Pillar 4	Interaction & Agency	Disposition. Asks clearly and kindly; designs helpers with care and safety.
4.1 Ask an AI helper a clear, kind question (the seed of prompting). 4.2 Describe how a helper machine works as a loop: Sense - Think - Act. 4.3 Draw and label a simple helper robot: what it senses (its sensors) and the steps it follows.		
Pillar 5	Responsibility	Disposition. Cares for safety and others; checks before trusting and is honest about AI help.
5.1 Identify private information - home address, phone number, passwords - and keep it private. 5.2 Check important AI answers with a trusted adult, because AI can be wrong. 5.3 Choose the safer or kinder action in a simple scenario and explain why. 5.4 Say honestly when an AI helper was used, for homework, drawings or answers.		



Upper Primary Grades 4–6

Rules versus learning from data, the first generative-AI mechanics - next-word prediction and prompting - and checking AI for fairness.

Who it's for

Students, teachers and parents who want to see how Upper Primary learners move from recognising AI ideas to shaping simple solutions and responsible-use habits.

What success looks like

Learners compare rules with learning from data, improve prompts, spot simple bias or hallucination risks, and present short design ideas with justification.

The five AI Pillars

Each Pillar leads with a disposition, then plain learning outcomes that combine what a learner knows and can do. The same five Pillars return in every band, a little deeper each time.

Pillar 1 Representation Disposition. Trusts that meaning can be measured; looks for the numbers behind words and pictures.

1.1 Turn words into numbers and show that similar things get similar numbers (proto-embeddings).
1.2 Group items by their features and explain what makes a group alike.
1.3 Collect and label a small set of examples (a mini dataset).
1.4 Check whether the sample is fair or leaves some things out.
1.5 Hand-tokenise a short sentence and notice that one word is not always one token.
Evidence. Build and label a small picture set, group it by feature, and say whether the set is fair.
Key terms feature label vector (number-list)

Pillar 2 Learning Disposition. Believes behaviour is learned from data - and that data can be fair or unfair.

2.1 Distinguish following rules from learning from data, the idea of machine learning.
2.2 Train a simple classifier by giving and refining labelled examples.
2.3 Tell fair from unfair training examples.
2.4 Group items with no labels, the idea of clustering (unsupervised learning).
2.5 Learn from rewards by trial and error, the idea of reinforcement learning.
2.6 Describe a single neuron as a tiny decision-maker: inputs → weighted sum → fires (or not).
Evidence. Train a simple classifier from your examples, improve it, and explain one unfair case you fixed.
Key terms training data classify generalisation: working on NEW examples

Pillar 3 Generation Disposition. Curious about how machines make new things; experiments and improves.

3.1 Explain how a chatbot predicts a likely next word.
3.2 Explain how an image generator builds a picture from a description.
3.3 Write a clear prompt (role + instruction + example) and improve it after seeing the result.
3.4 Create something new with a generative tool and refine it through better prompts.
3.5 Tell apart generating something new from retrieving (searching for) something that already exists.
Evidence. Improve a prompt across two tries and explain why the second output is better.
Key terms next-word prediction prompt temperature (the randomness dial) diffusion (painting from noise)

Pillar 4 Interaction & Agency Disposition. Directs the tool with care; designs solutions with people in mind.

4.1 Trace how a helper senses the world (its sensors), decides, then acts: perceive → decide → act.
4.2 Sketch a solution’s architecture (inputs → model → outputs → user).
4.3 Name one likely failure case and suggest a fix.
4.4 Design a small AI helper for a real classroom or home problem.
Evidence. Design an AI helper, label what it senses and does, and name a failure case and its fix.
Key terms AI agent sense → think → act tool

Pillar 5 Responsibility Disposition. Honest about AI help; fair-minded and caring about effects on people and the planet.

5.1 Recognise that generative AI can “hallucinate”: sound confident yet be wrong.
5.2 Cross-check an AI claim against a reliable source before sharing it.
5.3 Acknowledge AI help honestly rather than passing it off as one’s own.
5.4 Explain that AI uses energy and water to run, so using it has a real-world cost.
Evidence. Spot a likely hallucination, verify it against a source, and name one real-world cost of AI.



Lower Secondary Grades 7–8

Hands-on mechanics by hand and in simple Python: n-gram language models, tokenisation, a single neuron, the ML pipeline, and AI agents.

who it's for

Students, teachers and coaches preparing for the first band with explicit model mechanics, coding-related reasoning, and practical AI problem framing.

what success looks like

Learners explain how simple language models and ML pipelines work, analyse bias and failure points, and reason with short Python-based tasks.

The five AI Pillars

Each Pillar leads with a disposition, then plain learning outcomes that combine what a learner knows and can do. The same five Pillars return in every band, a little deeper each time.

Pillar1 Representation Disposition. Reasons from how a representation is built rather than treating it as given.

- 1.1Describe tokenisation: how text is split into tokens, then turned into numbers.
- 1.2Hand-tokenise a sentence into tokens and IDs.
- 1.3Explain why a model can miscount the letters in a word.
- 1.4Inspect an embedding space: similar words sit close together, and analogies are directions.
- 1.5Represent an image as a grid of number-pixels, the start of how a computer “sees”.

Pillar2 Learning Disposition. Treats learning as a workflow to reason about, not a black box.

- 2.1Explain how a neuron computes a weighted sum and “fires” via an activation, and how a network stacks many.
- 2.2Tell apart the three ways machines learn: supervised, unsupervised (clustering, e.g. k-means) and reinforcement.
- 2.3Follow the machine-learning workflow (data → train → test → evaluate) and read a confusion matrix.
- 2.4Code a single neuron and a simple classifier (k-nearest neighbours or a rule) in Python, with a train/test split.
- 2.5Explain why dataset quality and balance change what a model learns.

Pillar3 Generation Disposition. Wants to know why generative output looks the way it does.

- 3.1Explain how a language model (LLM) predicts the next token from probabilities learned over data (n-gram → neural).
- 3.2Build a bigram/trigram next-token predictor by hand and use it to generate text (be-the-LLM).
- 3.3Trace how attention re-weights earlier words and changes which token comes next.
- 3.4Explain how diffusion makes images by reversing noise, steered by a prompt.

Pillar4 Interaction & Agency Disposition. Designs and traces systems; reasons about where they fail.

- 4.1Use a prompt framework (e.g. CLEAR) with few-shot examples.
- 4.2Compare the outputs of two prompts and say which works better and why.
- 4.3Trace how an AI agent runs a Sense → Think → Act loop and calls tools to reach a goal.
- 4.4Identify where a tool call is needed in an agent’s loop, noting that sensors feed the perceive step.

Pillar5 Responsibility Disposition. Verifies before trusting; designs safeguards with people in mind.

- 5.1Explain why a model can sound confident yet be wrong: its objective is plausibility, not truth.
- 5.2Explain how deepfakes and synthetic media enable misinformation.
- 5.3Apply a verification routine to a generative output and flag its risks.
- 5.4Propose safeguards such as human oversight, explainability and inclusive design.
- 5.5Trace how bias in a dataset becomes bias in a model’s behaviour.



Upper Secondary Grades 9–12

Implementation and evaluation: the transformer pipeline, sampling and temperature, embeddings and bias, diffusion, and grounded agentic / RAG design - bridging to NOAI and IOAI / IAIO.

who it's for

Students, teachers and coaches preparing for the most advanced IJAIO band - including learners in Upper Secondary and equivalent applied pathways.

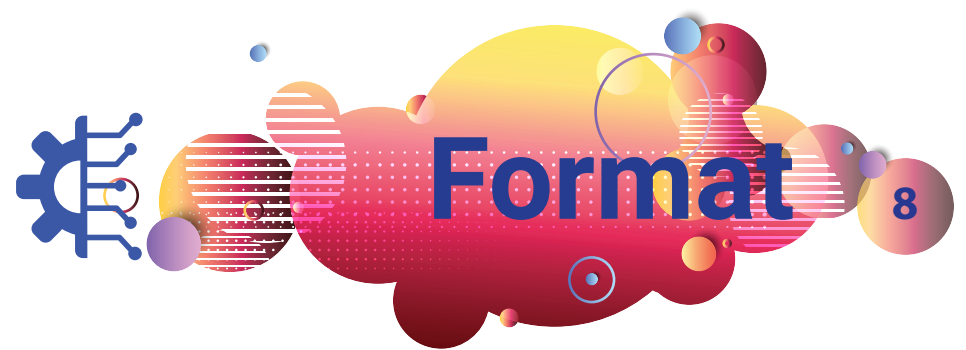
what success looks like

Learners explain end-to-end generative-AI systems, evaluate models with explicit metrics and trade-offs, and present defensible design choices for agentic or retrieval-grounded systems.

The five AI Pillars Each Pillar leads with a disposition, then plain learning outcomes that combine what a learner knows and can do.		
Pillar 1	Representation	Disposition. Reasons rigorously about representation; surfaces what is hidden inside it.
1.1 Compute embedding similarity with cosine similarity and demonstrate vector arithmetic. 1.2 Demonstrate the bias baked into embeddings. 1.3 Judge the impact of embedded bias on a downstream use. 1.4 Explain how computer vision and convolutional neural networks (CNNs) read images as pixel grids. 1.5 Explain sub-word tokenisation and how token IDs index the embedding layer.		
Pillar 2	Learning	Disposition. Practises rigorous, reproducible work; is honest about a model's limits.
2.1 Explain neural-network mechanics: forward pass, activation, loss, and gradient-descent / backpropagation intuition. 2.2 Distinguish deep learning's layers, pretraining vs fine-tuning vs RLHF, and training vs inference. 2.3 Implement a forward pass and a small classifier in Python. 2.4 Evaluate the model on accuracy, precision/recall and overfitting, then iterate. 2.5 Curate a small dataset for a task, justifying what is included, and document it.		
Pillar 3	Generation	Disposition. Reasons from the pipeline; weighs usefulness against reliability.
3.1 Trace the transformer pipeline end to end: tokens - embeddings - attention - next-token probabilities & sampling / temperature. 3.2 Explain how diffusion generates images by reversing noise, conditioned on a prompt. 3.3 Compare outputs at different temperatures and interpret the usefulness-versus-reliability trade-off. 3.4 Compare diffusion with GANs as two ways to generate images: iterative denoising versus generator-vs-discriminator.		
Pillar 4	Interaction & Agency	Disposition. Innovates responsibly; keeps a human in the loop by design.
4.1 Construct chain-of-thought reasoning, system prompts and few-shot prompts. 4.2 Explain how an agentic system plans, calls tools, observes results and re-plans. 4.3 Explain how retrieval-augmented generation (RAG) grounds answers in sources. 4.4 Design a multi-step agent or RAG system against a defined metric. 4.5 Evaluate the system and surface its limitations.		
Pillar 5	Responsibility	Disposition. Exercises civic responsibility; defaults to transparency and accountability.
5.1 Interpret fairness metrics and error types (false positives / false negatives). 5.2 Explain AI governance, accountability and explainable AI. 5.3 Explain why hallucination follows from the next-token objective, and the limits of RLHF and retrieval (RAG). 5.4 Audit a model or dataset for bias and document it in a model card. 5.5 Weigh the societal and environmental costs of a deployment.		

Learning Resources

Given the dynamic changing landscape of AI technologies advancements, a compiled list of online and offline resources will be regularly updated at <https://computing.sg/ijaio>.



No marks are deducted for incorrect answers.

Lower Primary / Grades 1 to 3 (45 minutes) 20 MCQ questions [60] 2 structured questions [40] Total 100 marks	Upper Primary / Grades 4 to 6 (60 minutes) 30 MCQ questions [60] 2 structured questions [40] Total 100 marks
Lower Secondary / Grades 7 to 8 (90 minutes) 20 MCQ questions [40] 3* structured theory problems / practical programming tasks [60] Total 100 marks	Upper Secondary / ITE / Junior College / Polytechnic / Grades 9 to 12 (90 minutes) 20 MCQ questions [40] 3* structured theory problems / design challenge / practical programming tasks [60] Total 100 marks

*1 problem / task will be based on an emerging AI technology theme which will be announced two months before IJAIO. This is to keep pace with AI technologies' rapid developments and more significantly, for students and teachers to inculcate the growth mindset of lifelong learning and the critical life skill to effectively and efficiently learn, unlearn and relearn. For example, IJAIO 2026 will be conducted from mid to end January 2026. In mid November 2025, the emerging AI technology theme (eg AI agents) with associated high level overview and scope will be made available at <https://computing.sg/ijaio>.

Software (Secondary school division / Secondary 1 to Junior College 2 / Grades 7 to 12 only)
For practical programming tasks, the language and platform used will be the current stable version of Python 3 and Jupyter Notebook / Google Colab

Hardware (Secondary school division / Secondary 1 to Junior College 2 / Grades 7 to 12 only)
A Windows or MacOS laptop is recommended. Candidates using Chromebooks, Android and iOS devices may encounter compatibility issues with editing, testing and executing local Python programs/scripts for practical programming tasks.

Sample Questions 9

Lower Primary / Grades 1 to 3

Section A • Multiple Choice

Choose the one best answer. There is no penalty for a wrong try.

Q1 First Principles

3 marks

Using A=1, B=2, C=3, D=4 ..., write the word "BAD" as numbers.

BAD → ? ? ?

A 214

B 123

C 412

D 241

Q2 First Principles

3 marks

A robot reaches a dead-end while trying to get through a maze. The smart thing to do is...

A try the exact same path again

B go back and try a different path

C smash through the wall

D switch itself off



Sample Questions

10

Section B - Structured Tasks

Write, draw or describe your answer, then reveal the suggested marking points.

Task 1 - Be the Sorting Robot

20 marks

First Principles

A robot sorts fruit using **only two rules**:

- **Rule 1:** IF the fruit is **yellow**, THEN put it in **Basket A**.
- **Rule 2:** IF the fruit is **red**, THEN put it in **Basket B**.

The fruits are: 🍌 banana (yellow), 🍏 apple (red), 🍋 lemon (yellow), 🍓 strawberry (red), 🍏 green apple (green).

- a) For each fruit, write which basket it goes in. (Be the robot - follow the rules exactly.)
- b) The green apple does not match any rule. What should the robot do? Explain your idea.
- c) Why does a robot need clear rules to do its job well?

Write, draw or describe your answer here...

Show model answer & marks

Task 2 - Design a Helper Robot (AI Agent)

20 marks

AI Agent

AI Ethics

An **AI agent** is a helper that can do three things by itself to reach a goal:

SENSE (look or listen) → **THINK** (decide what to do) → **ACT** (do something).

Imagine a friendly helper robot for your classroom whose goal is to **keep the classroom tidy**.

- a) Draw or describe your helper robot. What can it sense (see/hear)?
- b) Write its three steps for tidying up: SENSE → THINK → ACT.
- c) **Think carefully:** Your robot sees a drawing lying on the floor. It is told to throw away rubbish, but this might be someone's special artwork. What should the robot do, and why?

Write, draw or describe your answer here...

Show model answer & marks

Upper Primary / Grades 4 to 6

Section A • Multiple Choice

Choose the one best answer. There is no penalty for a wrong try.

Q1 First Principles

2 marks

A child sorts [shark, goldfish, eagle, sparrow] into two groups. The most useful FEATURE to group them by is...

- ☐ A whether its name is long or short
- ☐ B whether it mainly swims or flies
- ☐ C which animal you like best
- ☐ D the order they were listed in

Q2 Generative AI

2 marks

Your first AI image of “a cat” looks too plain. The BEST next step to improve it is to...

- ☐ A press generate again with the very same words
- ☐ B add detail to your prompt, e.g. “a fluffy ginger cat in a hat, cartoon style”
- ☐ C type the word CAT in capitals
- ☐ D give it no words at all

Sample Questions 12

Q3 First Principles

2 marks

A computer turns words into number-lists so similar meanings get similar numbers. Which PAIR should be CLOSEST?

- A** cat and car
- B** cat and Tuesday
- C** cat and kitten
- D** cat and bicycle

Q4 AI Agent First Principles

2 marks

You design an AI “lost-property helper” that photographs an item and names its owner. A likely FAILURE to plan for - and a fix - is...

- A** it works slowly at busy times; fix: skip the owner check
- B** it shows the photo too small; fix: ignore any mistakes
- C** it needs many photos to learn; fix: train it on none
- D** it confuses two look-alike bags; fix: have a person confirm first

Section B • Structured Tasks

Write, draw or describe your answer, then reveal the marking guide.

Task 1 • Be the Next-Word Predictor

20 marks

First Principles

Generative AI

A tiny language model has read many sentences. It counted which words come right after the word “play”:

after “play”: football → 5, piano → 3, games → 2, outside → 2

- a) The model has just written “I want to play ...”. Which single word is it MOST likely to pick next? Why?
- b) There were 12 counts in total. Write the chance (as “... out of 12”) that it picks “piano”.
- c) Two children give the exact same prompt and get *different* next words. Explain how, using the idea that the model sometimes picks from its likely words instead of always the top one.

Write, draw or describe your answer here...

Show model answer & marks

Task 2 • Prompt Detective & Fact-Checker

20 marks

Generative AI

Ethics & Safety

System Design

Maya types this weak prompt into a chatbot: “*tell me about volcanoes*”. The chatbot replies with a long answer that includes the “fact” that the world’s tallest volcano is in Singapore.

- a) Rewrite Maya’s prompt so it is clear and useful. Include a role, a clear instruction, and one constraint (length or audience).
- b) The “fact” about Singapore is wrong. What is this kind of confident-but-false AI answer called, and what should Maya do before using it?
- c) Maya uses the answer in a project. Write one sentence she should add to be honest about how she used AI.

Write, draw or describe your answer here...

Show model answer & marks

Lower Secondary (Grades 7 to 8)

Section A • Multiple Choice

Choose the one best answer. There is no penalty for a wrong try.

Q1 First Principles Generative AI

2 marks

A tokeniser splits “unhappiness” into [“un”, “happi”, “ness”]. This best explains why a language model...

- A can miscount the letters inside a word
- B always spells every word perfectly
- C treats grammar as more important than meaning
- D reads text one letter at a time

Q2 Ethics & Safety Generative AI

2 marks

A realistic AI-made video shows a mayor “announcing” a policy they never proposed. Why are such deepfakes so dangerous to public trust?

- A they look real, so false claims spread before anyone checks
- B they are always obviously low quality
- C they can only copy cartoon characters
- D they are easy for anyone to spot

Section B • Structured Tasks

Write, draw or describe your answer, then reveal the marking guide.

Task 1 • Be the Language Model (n-gram from first principles)

20 marks

First Principles Generative AI

A mini language model is trained on just three sentences:

```
the cat sat on the mat
the cat ran to the dog
the dog sat on the log
```

- List every word that appears immediately after “the”, with its count, then write each probability.
- Starting from “the”, the model must pick the most likely next word. Is there a single winner? What does a model do on a tie?
- Generate a short sentence starting at “cat”, always going to a most-frequent next word. On a tie, pick either; stop after 4–5 words. (after cat → sat 1, ran 1; after sat → on; after on → the.)
- Why does this n-gram method become impossible to store for real language, and what do real LLMs use instead?

Write, draw or describe your answer here...

Show model answer & marks

Task 2 • One Neuron, from First Principles and in Python

20 marks

First Principles Python

A single neuron takes two 0/1 inputs and outputs 1 (fires) when $w_1 \cdot x_1 + w_2 \cdot x_2 + b \geq 0$, else 0. Here $w_1 = 1, w_2 = 1, b = -1.5$.

```
def step(z):
    return 1 if z >= 0 else 0

def predict(x1, x2, w1=1, w2=1, b=-1.5):
    z = w1*x1 + w2*x2 + b
    return step(z)

for x1, x2 in [(0,0),(0,1),(1,0),(1,1)]:
    print(x1, x2, '->', predict(x1, x2))
```

- Compute the output for (0,0), (0,1), (1,0), (1,1). Which everyday logic gate is this?
- Change **only the bias b** so the neuron fires when *at least one* input is 1 (an OR gate). Give the new value.
- Run the code to confirm your answers, then describe what “learning” would change.

Write, draw or describe your answer here...

Show model answer & marks



Sample Questions

16

Upper Secondary / ITE / JC / Polytechnic (Grades 9 to 12)

Section A • Multiple Choice

Choose the one best answer. There is no penalty for a wrong try.

Q1 First Principles

2 marks

Word embeddings place $\text{king}=(4,4)$, $\text{man}=(3,1)$, $\text{woman}=(1,1)$. $\text{king} - \text{man} + \text{woman}$ gives...

A (8, 6)

B (2, 4)

C (6, 2)

D (0, 0)

Q2 Generative AI

2 marks

The transformer's attention mechanism mainly lets the model...

A store images as raw pixels

B connect itself directly to the live internet

C weigh which other tokens are most relevant

D delete its own training data



Sample Questions

17

Q3 First Principles

2 marks

A CNN classifies X-rays. An early convolutional filter slides over the pixel grid and fires wherever a sharp light-to-dark change occurs. What has it most likely learned?

- A The overall class label directly
- B The stored image file format
- C Edges / local intensity changes
- D Global colour balance only

Q4 First Principles

2 marks

A tiny network outputs 0.8 for an example whose true label is 1. After one gradient-descent step its output for that example becomes 0.85. What does this step demonstrate?

- A Inference adjusting its own weights
- B The activation function being replaced
- C Overfitting being corrected
- D Weights moving to reduce the loss



Sample Questions

18

Q5 First Principles

2 marks

A company takes a general open-weights language model and keeps training it only on its own legal contracts so it writes in-house clauses well. This process is best called:

- A Pretraining a model from scratch
- B Inference-time prompting only
- C RLHF reward modelling here
- D Fine-tuning a pretrained model

Q6 First Principles

2 marks

A fraud classifier scores 99% accuracy, but only 1% of transactions are fraud and it labels everything 'legitimate'. Which metric best exposes the real problem?

- A Accuracy on the full set
- B Number of model layers
- C Recall on the fraud class
- D Training-set size used



Sample Questions

19

Q7 Generative AI

2 marks

At one decoding step, candidate logits are 'help'=2.0, 'hello'=1.0, 'hex'=0.0, and the model picks 'help' every time it reaches this state. Which setting matches this?

- ☐ A High temperature random sampling
- ☐ B Uniform random token sampling
- ☐ C Re-tokenising the prompt differently each time
- ☐ D Greedy / argmax decoding step

Q8 Generative AI

2 marks

A text-to-image diffusion model is asked for 'a red bicycle in snow'. Starting from pure random noise, what does it do across its denoising steps?

- ☐ A Removes noise gradually toward the prompt
- ☐ B Adds more noise until a structure appears
- ☐ C Looks up the closest stored photo online
- ☐ D Sharpens a photo you uploaded yourself



Sample Questions

20

Q9 Generative AI

2 marks

A team runs one brainstorming prompt at temperature 0.2 and at 1.1. Versus 0.2, the 1.1 outputs are more varied but include more off-topic, wrong lines. This illustrates:

- A More reliability, less creativity
- B More creativity, less reliability
- C Faster speed, but higher cost
- D Shorter context, longer outputs

Q10 Interaction & Agency

2 marks

A maths tutor model gives wrong final answers when asked directly, but improves sharply when the prompt adds 'show each step before the final answer'. Which technique explains the gain?

- A Lowering the temperature value
- B Expanding the context window size
- C Chain-of-thought step prompting
- D Switching to greedy decoding



Sample Questions

21

Q11 Interaction & Agency

2 marks

A travel system gets 'What's the weather where my 3pm meeting is?'. It checks the calendar tool, finds the city, calls a weather API, then writes the reply. Which loop is this?

- A Generate one token at a time only
- B Retrieve some documents then stop
- C Fine-tune on each new request
- D Plan, call tools, observe, respond

Q12 Interaction & Agency

2 marks

A RAG study-helper retrieves textbook passages before answering. To measure whether retrieval is actually helping accuracy, which evaluation is most informative?

- A Count the model's total parameters
- B Compare accuracy with vs without it
- C Measure the average response length
- D Check the model's training cut-off



Sample Questions

22

Q13 Ethics & Society

2 marks

A loan model's false-positive rate (approving applicants who later default) is twice as high for one neighbourhood as another at equal incomes. Most appropriate governance response?

- A Ignore it since overall accuracy stays high
- B Raise the decision threshold for everyone
- C Audit the disparity and assign accountability
- D Hide the metric from the regulators entirely

Q14 Ethics & Society

2 marks

A support LLM confidently invents a refund policy that does not exist. The team added RLHF and a RAG knowledge base, yet rare fabrications persist. Best explanation?

- A It predicts plausible text, not verified facts
- B The model is broken and must be retrained
- C RLHF removes all hallucination by design
- D RAG guarantees only true outputs always



Sample Questions

23

Q15 Ethics & Society

2 marks

Before deploying a city-wide face-matching CCTV tool, a board reads its model card. Which combination should most influence the go/no-go decision?

- A Headline accuracy and inference speed only
- B Public download count and brand reputation
- C Model parameter size and training cost only
- D Per-group errors, intended use, societal cost

Q16 First Principles

2 marks

Two headline embeddings are $a=(3,4)$ and $b=(4,3)$. A junior says they mean the same thing because both have length 5. Why is that reasoning flawed?

$$\cos = (12 + 12) / (5 * 5) = 24 / 25 = 0.96$$

- A Equal magnitude need not mean equal direction
- B Length always equals meaning in embeddings
- C Cosine ignores both vectors entirely here
- D Only negative vectors carry any meaning



Section B • Structured Tasks

Write, draw or describe your answer, then reveal the marking guide.

Task 1 • Sampling, Greedy Decoding & Temperature

20 marks

First Principles Generative AI Python

At one step, a language model assigns these probabilities over a 4-token vocabulary for the next word:

```
{ "sunny": 0.50, "cloudy": 0.30, "rainy": 0.15, "banana": 0.05 }
```

- Under greedy decoding, which token is emitted? State the rule you used.
- Explain, in terms of this distribution, why raising the temperature increases the chance of emitting “rainy” or even “banana.”
- Complete the Python to (i) return the greedy token and (ii) sample a token by the probabilities. Describe an experiment to show sampling gives varied outputs.
- Why might a support bot use low temperature while a brainstorming tool uses higher temperature?

Write, draw or describe your answer here...

Show model answer & marks

Task 2 • Meaning as Vectors - Embeddings & Bias

20 marks

First Principles Generative AI Ethics & Safety

Three words have tiny 2-D embeddings: **cat** = (2, 3), **dog** = (3, 2), **car** = (5, 0). Cosine similarity measures the angle between vectors: $\cos(u,v) = (u \cdot v) / (|u| |v|)$; closer to 1 = more similar.

```
import math
vecs = {"cat":(2,3), "dog":(3,2), "car":(5,0)}

def cosine(u, v):
    dot = u[0]*v[0] + u[1]*v[1]
    return dot / (math.hypot(*u) * math.hypot(*v))

print(round(cosine(vecs['cat'], vecs['dog']), 3))    # 0.923
print(round(cosine(vecs['cat'], vecs['car']), 3))    # 0.555
```

- Compute the cosine similarity of cat–dog and cat–car. Which pair is more similar? Does that match meaning?
- Use cosine() to find cat’s nearest neighbour.
- A real model places “nurse” closer to “woman” and “engineer” closer to “man.” Explain in first-principles terms where this bias comes from, and one consequence if it powers a hiring tool.

Write, draw or describe your answer here...

Show model answer & marks



Sample Questions

25

Task 3 · Build & Evaluate a Classifier in Python

20 marks

First Principles

Python

Skill

You are given a tiny labelled dataset and starter Python for a one-neuron classifier. Complete the forward pass, split the data, and judge how well it really generalises.

```
w = [1.5, -2.0]; b = 0.5
z = w[0]*x[0] + w[1]*x[1] + b
out = 1 if z >= 0 else 0    # step activation
```

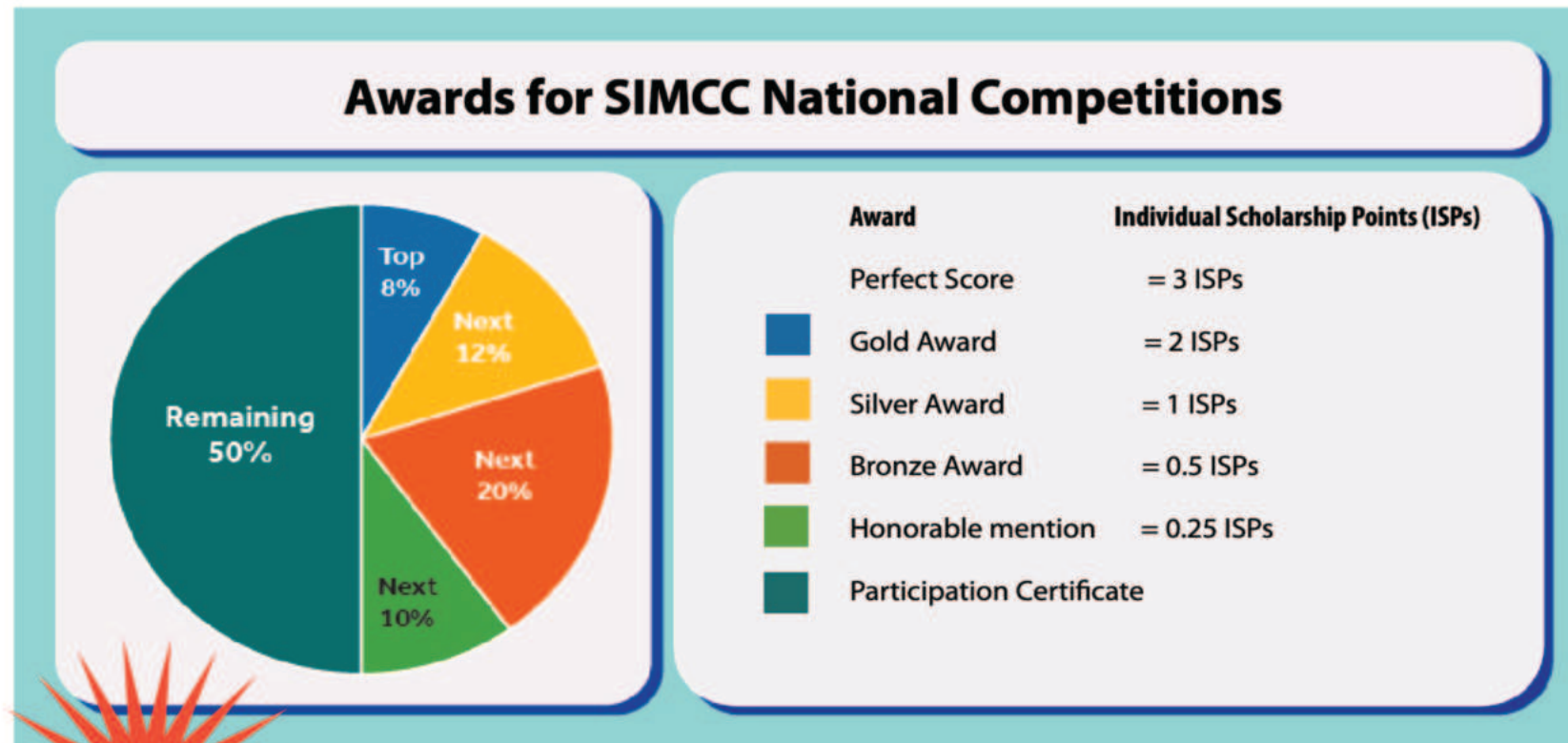
- a) Complete the forward pass. With $w = [1.5, -2.0]$, $b = 0.5$ and input $x = [2, 1]$, compute $z = w \cdot x + b$, then the neuron's output after the step activation (fires if $z \geq 0$). Show z .
- b) You split 100 rows 80/20. The model scores 100% on the training rows but 60% on the held-out test rows. Name what is happening and give one concrete fix.
- c) The test confusion matrix is $TP = 8$, $FP = 2$, $FN = 6$, $TN = 4$. Compute precision and recall. For a disease screen, which should you prioritise, and why?

Write, draw or describe your answer here...

Show model answer & marks



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About ComputingSG 28

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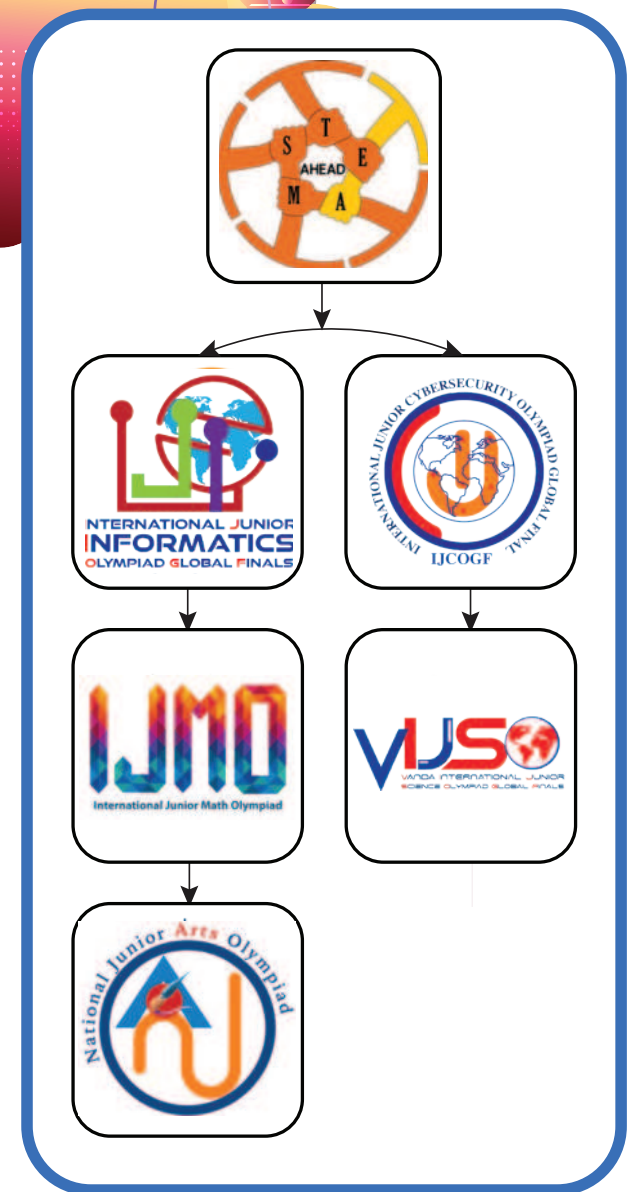
Prof Tan Chee Wai is an ardent computing/coding/ai education advocate and is an advisor to NJAIO.

Dr. Tan received the M.A and Ph.D. degrees in Electrical Engineering from Princeton University. His research interests are Generative AI, wireless networking, health informatics, machine learning systems and distributed optimization. Some of his research has been published in ACM SIGCOMM, USENIX ATC, IEEE INFOCOM, ACM SIGMETRICS. Dr. Tan has served as the Editor for IEEE Transactions on Signal and Information Processing, IEEE Transactions on Cognitive Communications and Networking, IEEE/ACM Transactions on Networking, IEEE Transactions on Communications and as IEEE ComSoc Distinguished Lecturer. He received the Princeton University Wu Prize for Excellence, Google Faculty Award, 2024 IEEE CAI Honorable Mention Award in Foundation Models and Generative AI, several teaching excellence awards, and was selected twice for the U.S. National Academy of Engineering China-America Frontiers of Engineering Symposium.





STEAM AHEAD



A COMBINATION OF 6 COMPETITIONS: International Junior Math Olympiad (IJMO), Vanda International Junior Science Olympiad Global Finals (VIJSOGF), International Junior Informatics Olympiad Global Finals (IJIOGF), International Junior Arts Olympiad (IJA), and International Junior Cybersecurity Olympiad Global Finals (IJCOGF)

The Singapore's National Cybersecurity R&D Lab (NCL) will be offering Capture the Flag (CTF) as part of the International Junior CyberSecurity Olympiad Global Finals (IJCOGF). Online Video training recorded will be provided by NCL professors and the contest certificates and medals will be provided by NCL.

STEAM stands for Science, Technology, Engineering/Entrepreneurship, Arts and Mathematics. STEAM AHEAD is our initiative to combine our international academic competitions to educate students and bring them international exposure about possible career choices in these fields.

So, STEAM AHEAD offers multiple opportunities for students to win awards in IJMO Individual, VIJSOGF Individual & Team, IJIOGF individual & Team, IJCOGF Individual & Team, together with IJA Individual, plus Overall Champion in each grade level for IJMO, VIJSOGF, IJIOGF, and IJCOGF. The President's Award for Excellence in STEAM STAR (PAExS STAR) awarded to students with 10 or more Individual Scholarship Points (ISPs). PAExS Gold awarded to students with 8 to 9 Individual Scholarship Points (ISPs).

Please refer to the STEAM AHEAD info pack for more details or visit our website.

<https://steamahead.simcc.org/>



About SIMCC



Created in 2006, SASMO is one of largest math olympiad competitions in Asia. More than 500,000 participants from over 20,000 schools participated in SASMO to date. In 2025, we now have more than 50 countries and territories.

The SASMO Team with the support of Advisory Council spend countless hours carefully developing contest papers which touch on both school and Olympiad maths. This combined effort allows participants to do better compared to pure-Olympiad papers, since they are familiar with some questions and can put on their thinking caps for others, bringing out the inner mathematician in them.

With realistic and high standards, SASMO contests aim to stretch the untapped thinking potential of the student population, their participation in SASMO will help them improve in school mathematics as well as higher order thinking skills (HOTS).



