# AI, ASSESSMENT, AND THE STUDENT AND EDUCATOR EXPERIENCE

*Facilitators*

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# LAND ACKNOWLEDGEMENT

We would like to begin by acknowledging that the land on which we gather is the unceded territory of the Coast Salish Peoples, including the territories of the xwməθkwəy̓əm (Musqueam), Skwxwú7mesh (Squamish), Stó:lō and Səl̓ílwətaʔ/Selilwitulh (Tsleil- Waututh) Nations.




https://indigenous.ubc.ca/2018/04/25/musqueam-street-signs-at-ubc-2/; https://www.musqueam.bc.ca/

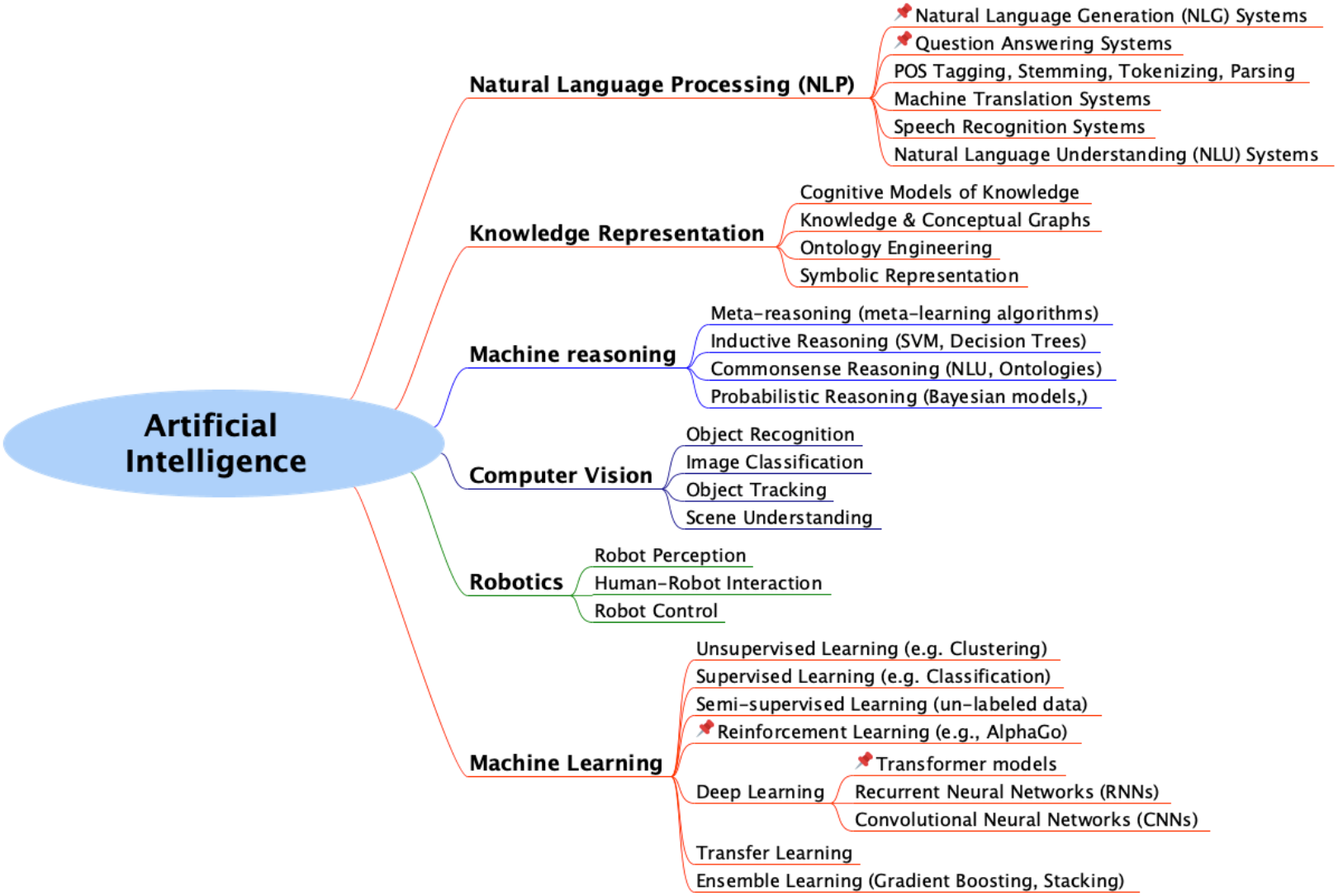
# AGENDA

- **Introduction (15 minutes)**: A (brief) discussion of AI, LLMs, and consequences to the educator.
- **Finding the limits of LLMs (15 minutes); Breakout Activity**: Led by Noureddine, learn the limits of LLMs
- **Examples from different fields (10 minutes)**: Some examples from chemistry, statistics, mathematics about using AI in student work and student assessment.
- **Short Break (5 minutes)**: Stretch!  Get water!
- **Your own course/activity design; Breakout Activity**: Working with the provided guiding worksheets, consider how you can use AI to design your own assessment activities OR how you can design an activity that will be assessed where students use AI.
- **Final Wrap-up:** suggestions, questions, and future working groups!

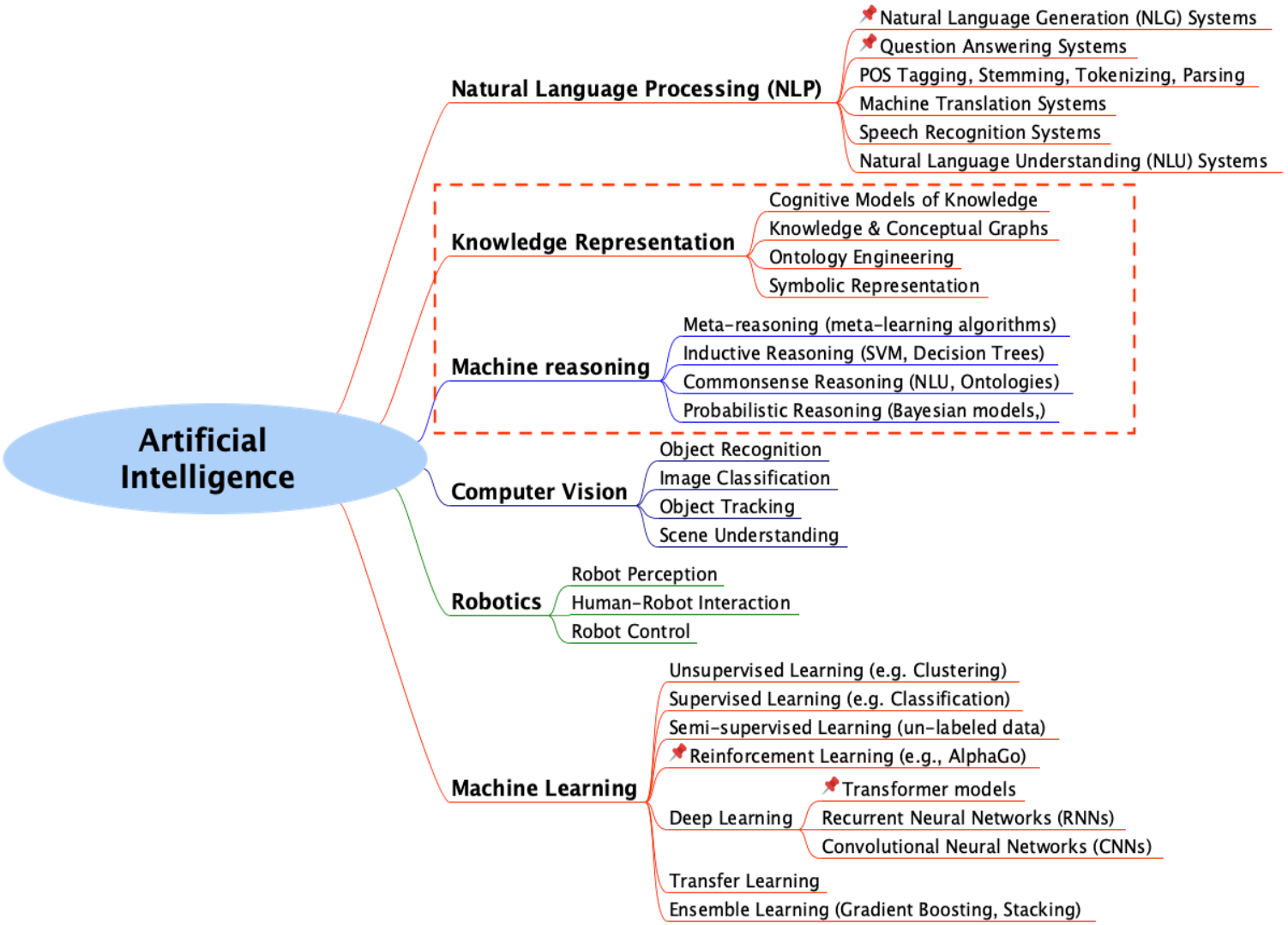
***Acknowledgments***: We are grateful to our colleagues who shared their work and some of whom couldn't attend today.

- Lucas Wright of the CTLT for the guidance in prompt engineering
- Dr. Christopher Addison (CHEM 300, CHEM, Faculty of Science, UBC)
- Dr. Nahid Walji (MATH 200, MATH, Faculty of Science, UBC)
- Dr. Joel Östblom (DSCI 573,  DSCI 100, STATS, Faculty of Science, UBC)

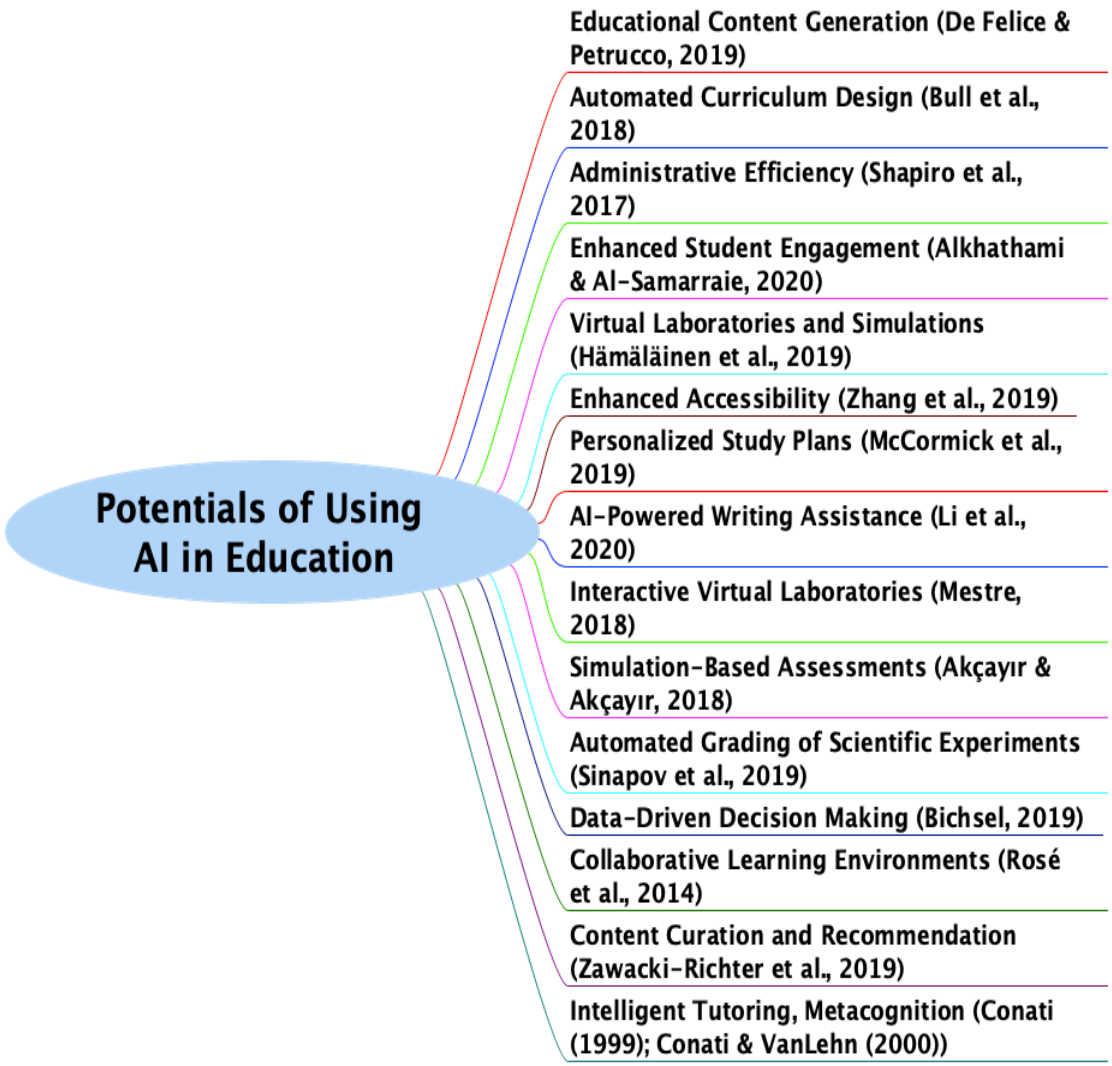
# AI FOR SCIENCE EDUCATION: WHICH AI?



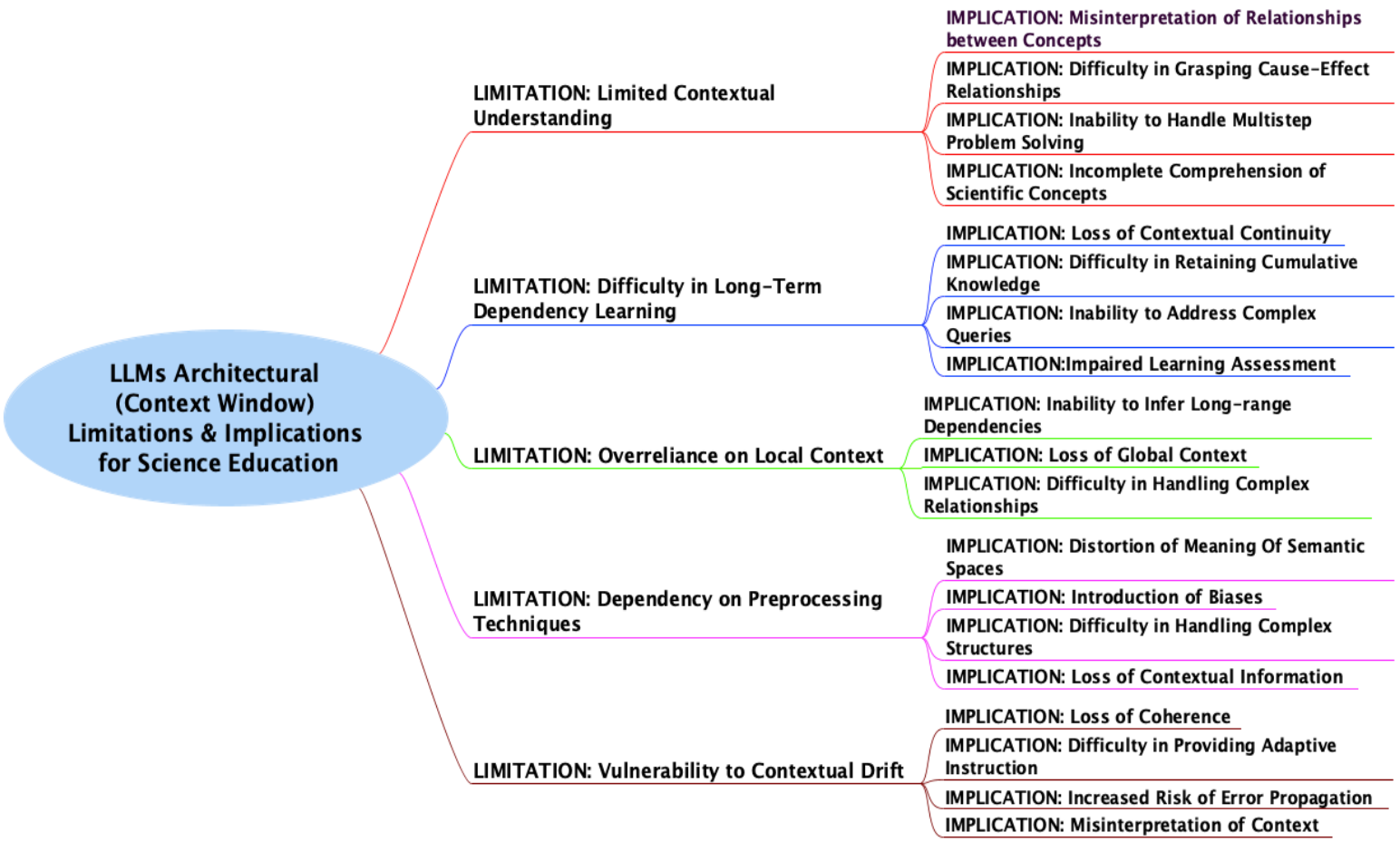
# AI SUB-DISCIPLINES LEVERAGED TO CREATE THE INTERNAL ARCHITECTURE OF AN LLM



# POTENTIALS OF USING AI IN SCIENCE EDUCATION



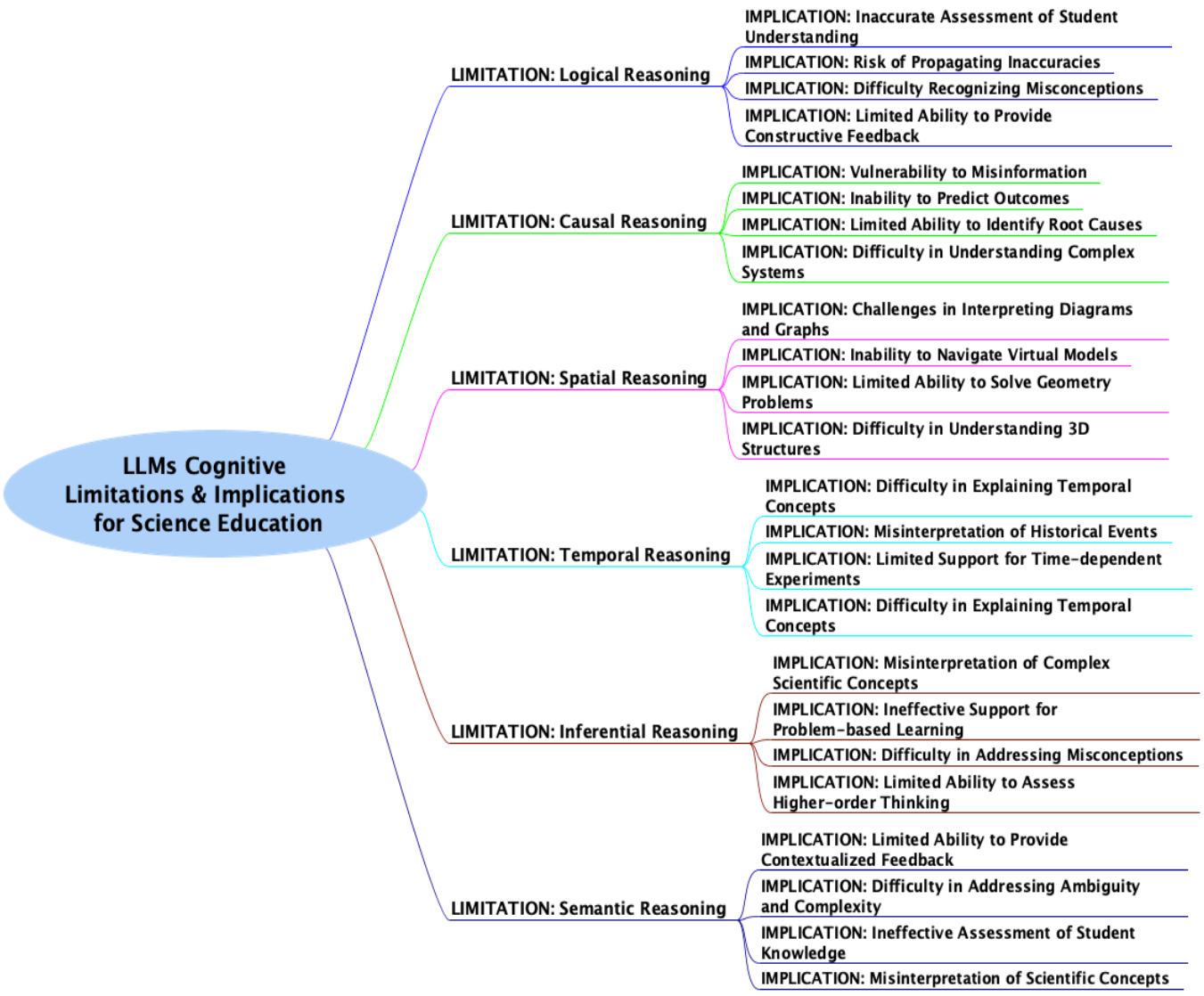
# LLMS ARCHITECTURAL (CONTEXT WINDOW) LIMITATIONS & IMPLICATIONS FOR SCIENCE EDUCATION



# DELIMITING THE COGNITIVE (IN)-ABILITIES OF AN LLM

| COGNITIVE TESTS | GPT | Claud | Gemini | Co-Pilot |
|---|---|---|---|---|
| Antonyms | ? | | | |
| Temporal reasoning | ? | | | |
| Spatial reasoning | ? | | | |
| Causal relationships | ? | | | |
| Inference & deduction | ? | | | |
| Analogical reasoning | ? | | | |
| Counter-factual reasoning | ? | | | |
| Belief Evaluation | ? | | | |
| Truth verification | ? | | | |
| Metacognition | ? | | | |

# LLMS COGNITIVE LIMITATIONS & IMPLICATIONS FOR SCIENCE EDUCATION



# DELIMITING THE COGNITIVE (IN)-ABILITIES OF AN LLM

| COGNITIVE TESTS | GPT | Claud | Gemini | Co-Pilot |
|---|---|---|---|---|
| **Antonyms** | FAIL/PASS | | | |
| **Temporal reasoning** | FAIL | | | |
| **Spatial reasoning** | FAIL | | | |
| **Causal relationships** | FAIL | | | |
| **Inference & deduction** | FAIL | | | |
| **Analogical reasoning** | FAIL/PASS | | | |
| **Counter-factual reasoning** | FAIL | | | |
| **Belief Evaluation** | FAIL | | | |
| **Truth verification** | FAIL | | | |
| **Metacognition** | FAIL/PASS | | | |

## SOME OF THE IMPLICATIONS FOR THE EDUCATOR

- **Understanding the limitations of AI systems**: Draw a clear distinction between situations where AI can help streamline part of the logistics of learning (e.g. information retrieval and organization) and situations where AI can hinder critical thinking.

- **Shifts in role of the educator**: the use of AI might induce a shift in the role of the educator, shifting more towards facilitating learning, scaffolding learning, enabling critical thinking.

- **Narrowing of Curriculum**: By design, AI algorithms are designed to assess the easily quantifiable skills and knowledge aspects. This might narrow the aspects of the curriculum that enable critical thinking and deeper understanding and synthesis of complex concepts.

- **Epistemic atrophy**: Bake into the design of the assessment rail-guards to guard against the "epistemic atrophy", which might be caused by excessive and unprincipled use of AI to "consume" information (information is not insight).

- **Depersonalization**: Mitigate the depersonalization impact that might be created by AI-driven assessments that might lack the personal touch and individualized attention. AI algorithms (especially black box algorithms type) may prioritize objective metrics and quantifiable data in assessment processes, neglecting the subjective aspects of learning.

# LIMITATION TESTS WITH LLM

**Breakout Activity : 15 minutes**

# CHEM 300: COMMUNICATING CHEMISTRY

- 3rd year course for students in a Chemistry of Chemical Biology specialization.
- Focus is on communication in written, oral, and pictorial forms.
- Classes are 25-27 students; 4 sections run each year.
- In **Fall 2023**, supported by a **SOTL Seed Grant**, we implemented an assignment using Generative AI

***Course Policy:*** *Students could use Generative AI (for all but one assignment) but they had to write a small section on how and why they used it and they had to submit their chat logs.*

**Week 2**: Unit of Academic Integrity (searching, citing the literature)

**Week 2**: Pre-Generative AI survey

**Week 3**: Submission of "Who Are You?" Assignment

**Week 6**: Generative AI training (2.5 hours of class time on prompt engineering, text transformations, and citations; 1 hour class time working on class project)

**Week 8**: Submission of reflection on Generative AI-generated "Who Are You?"

**Week 14 (Last Week)**: Post-Generative AI survey

## Who Are You?

500 words

Who are you as a chemist/writer/person

Generative AI **can not** be used

Graded based on a *specifications grading* rubric which assesses students on a sentence, paragraph, and assignment level (7 specifications)

## Who Are You (Now with Generative AI)?

Students asked to replicate their original "Who Are You?" assignments (to the assignment details we provided)

Students **not** required to use ChatGPT (we provided alternatives)

500 word *reflection* on their experience and their annotated chat logs

Graded based on a *specifications grading* rubric which assesses students on a sentence, paragraph, and assignment level (7 specifications)

## Types of Proofs

To prove that the square root of 22 is irrational, we need to show that it cannot be expressed as a ratio of two integers, that is, it is not a rational number.
Suppose, for the sake of contradiction, that the square root of 22 is rational. Then we can write it in the form of: $\sqrt{22} = p/q$ where p and q are coprime integers (i.e., they have no common factors other than 1) and q is not zero.
Squaring both sides, we get:

$$22 = p^2/q^2$$

Multiplying both sides by $q^2$, we get:

$$22q^2 = p^2$$

This means that $p^2$ is even since $22q^2$ is even (the product of an even number and any other number is even). Therefore, p must be even, and we can write $p = 2k$ for some integer k.
Substituting 2k for p in the above equation, we get:

$$22q^2 = (2k)^2 = 4k^2$$

Dividing both sides by 2, we get:

$$11q^2 = 2k^2$$

This means that $2k^2$ is odd since $11q^2$ is odd (the product of an odd number and any other number is odd). Therefore, k must be odd, and we can write $k = 2m + 1$ for some integer m.
Substituting $2m + 1$ for k in the above equation, we get:

going sideways

$$11q^2 = 2(2m+1)^2 = 8m^2 + 8m + 2$$

Dividing both sides by 2, we get:

$$11q^2/2 = 4m^2 + 4m + 1$$

This means that $11q^2/2$ is odd since $4m^2 + 4m + 1$ is odd. Therefore, $q^2$ is odd (since 11 is odd), which means that q is also odd.
But this contradicts our assumption that p and q are coprime, because both p and q are even. Therefore, our initial assumption that the square root of 22 is rational must be false. Hence, we have proven that the square root of 22 is irrational.

Courtesy of Dr. Nahid Walji (Course 220, Maths department, Faculty of Science, UBC

- The questions used are typical of what I would assign to students in Math 220 (a class on an introduction to proofs).
- ChatGPT was asked to prove something that isn't true, and it duly obliged.
- ChatGPT response shows that the proof could have been finished off earlier, but it continues with unnecessary wrong work.

# Types of Proofs

**Prove that the square root of 49 is irrational**

The square root of 49 is 7. We can prove that 7 is irrational by assuming the opposite, that it is rational and then arriving at a contradiction.

Suppose, for the sake of contradiction, that the square root of 49 is rational. Then we can write it in the form of:

$$\sqrt{49} = p/q$$

where p and q are coprime integers (i.e., they have no common factors other than 1) and q is not zero.

Squaring both sides, we get:

$$49 = p^2/q^2$$

Multiplying both sides by $q^2$, we get:

$$49q^2 = p^2$$

This means that $p^2$ is divisible by 7, and hence p is divisible by 7. Let p = 7k for some integer k. Substituting 7k for p in the above equation, we get:

$$49q^2 = (7k)^2 = 49k^2$$

Dividing both sides by 49, we get:

invalid

$$q^2 = k^2$$

This means that q is also divisible by 7. But this contradicts our assumption that p and q are coprime.

Therefore, our initial assumption that the square root of 49 is rational must be false. Hence, the square root of 49 is irrational.

incorrect conclusion

Courtesy of Dr. Nahid Walji (Course 220, Maths department, Faculty of Science, UBC

- The questions used are typical of what I would assign to students in Math 220 (a class on an introduction to proofs).
- ChatGPT was asked to prove something that isn't true, and it duly obliged.
- ChatGPT response shows that the proof could have been finished off earlier, but it continues with unnecessary wrong work.

**Breakout Activity : 40 minutes**

# A THANKS AND WHAT COMES NEXT

- **Thank you for attending today!**
- Please fill out the Padlet below with any follow-up questions or requests! We will plan some future workshops/working groups based on your feedback here.
- Please access the OneDrive below for resources from today and your future course planning.
- You can reach us at:
  - Emma: edavy@chem.ubc.ca
  - Noureddine: noureddine.elouazizi@science.ubc.ca

**Access the Feedback Padlet here!**

**Access Workshop Resources here!**