Using **Computational Thinking** to foster learning curiosity
Computational Thinking

“Computational Thinking is the thought processes involved in formulating problems and their solutions ... in a form that can be effectively carried out by an information-processing agent.”

- Cuny, Snyder, Wing
Characteristics of Computational Thinking:

**Decomposition**
Break 1 complex problem into a collection of smaller/simpler problems

**Abstraction**
Mathematical modelling
- Symbolic representation
- Block diagrams

**Algorithms + Automation**
Formulating solution as a series of steps
Transforming between Modelling paradigms

**Simulation**
What happens when?
**How does MATLAB support Computational Thinking?**

**Characteristics of Computational Thinking:**

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  - Break 1 complex problem into a collection of smaller/simpler problems

- **Abstraction**
  - Mathematical modelling
    - Symbolic representation
    - Block diagrams

- **Algorithms + Automation**
  - Formulating solution as a series of steps
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- **Simulation**
  - What happens when?

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**Centralize**

- Narration
- Rationale
- Implementation

**Makes it easy to do this**
Characteristics of Computational Thinking:

- **Decomposition**: Break 1 complex problem into a collection of smaller/simpler problems

- **Abstraction**: Mathematical modelling
  - Symbolic representation
  - Block diagrams

- **Algorithms + Automation**: Formulating solution as a series of steps
  
  - Transforming between Modelling paradigms

- **Simulation**: What happens when?

Centralize:
- Narration
- Rationale
- Implementation

Makes it easy to do this

Tedium is reduced.
Spend more time thinking about the core science.
There is a pathway from small to big problems

How does this foster curiosity?
Today’s case study:

From this

Solution pathway

To this

Motivate me.

Computational Thinking

Decomposition  Abstraction (Model Building)  Algorithms + Automation  Simulation
Demo these concepts
Using Computational Thinking and MATLAB to foster learning curiosity

Centralization of thought process

Tedium busters

Modelling Choices

MATLAB Live scripts

>> diff()

>> matlabFunctionBlock()

\[
\text{our}_\text{EOM}(t) = \quad m \frac{d^2}{dt^2} x(t) + k x(t) = F - b \frac{d}{dt} x(t)
\]

\[
g(t) = \sin(z(t))^2
\]

\[
dg_{dt}(t) = 2 \cos(z(t)) \sin(z(t)) \frac{d}{dt} z(t)
\]
Student’s desires:

- How does what I already know:
  - Extend to NEW things
  - Scale from simple to complex things
- I do NOT want to do boring things

Professor’s desires:

- I do want my students to:
  - focus on the science/engineering
  - Think, explore, build

Solution pathway
How is Computational Thinking Introduced?

Computational Thinking

Do students just “pick up” computational thinking?

VS

Math Skills

Isn’t math taught systematically and reinforced throughout the curriculum?
How Math is introduced in the curriculum

How is Computational Thinking introduced?
Fostering a Curiosity to Learn:

- There is a pathway from simple to complex problems.
- Tedium is reduced.
- Spend more time thinking about the core science.