# Introducing CT Skills to Early Learners through Graph Theory

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# Setting the Stage

It can be challenging to introduce computational thinking (CT) skills to early learners who aren’t yet comfortable reading.

What if we could use shapes, colors, and counting to reinforce those CT skills in a fun way tied to a computer science discipline?

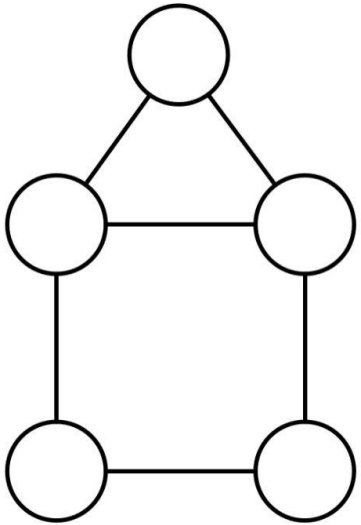
# Graph Theory

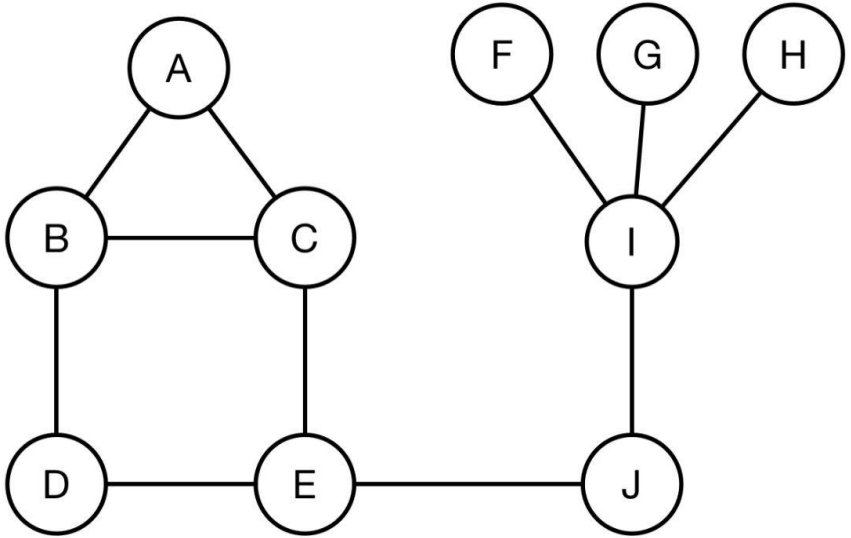
The study of graphs (vertices/nodes, edges/links) and their properties.

Great for modelling problems in networks, resource management,

Some classic problems in graph theory are easily explained, easily understood, and can yield rich problem solving exercises for young learners.

# Graphs?





# An example exercise

Here’s an example exercise we would give an undergraduate computer science student:

Given an arbitrary graph, describe an algorithm to label the vertices such that no adjacent vertices have the same label, using the fewest labels.

# What’s being exercised?

- CT skills: decomposition, abstractions, algorithms
- Problem solving
- Reasoning
- Mathematical representation

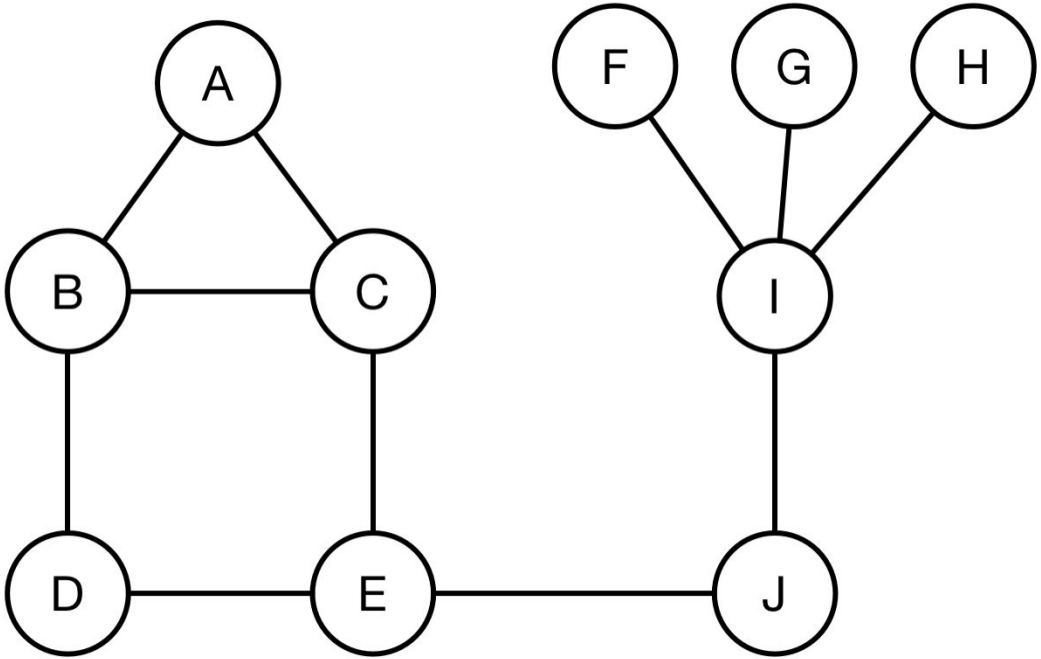
# A levelled exercise

This kind of problem is called a coloring problem. Another way to state the problem is “Can I color the circles so that no connected circles have the same color?”

Other than the actual act of coloring (everyone loves coloring), you can give learners colored tokens/LEGO/(candy if you’re about to send them home).

You can even go the route of patterns and have the learners build a tower of LEGO.

Here’s a graph. What’s the smallest number of colors that you need to color this graph? Color in the graph!



# Another example: independent set

- Definition: select vertices such that no two vertices I select are next to each other.
- Potential exercises:
  - Have learners put down tokens on a printed graph.
  - Two-player game where learners can add and take away tokens on a printed graph.
  - Give them a graph and a goal and have them puzzle out where to place tokens to match the goal.

# One more: matchings

- Definition: Select edges so that every vertex is connected to one and only one selected edge
- Potential exercises:
  - Connect capital letter to lower case letter
  - Two player game where each student tries to make the most matches
  - Given two versions of the same graph (vertices rearranged, edges remain the same), challenge the students to find as many matches as possible

# Kindergarten curricular alignment - Maine

Math: K.CC.C.6 (Comparison of objects/numbers); K.G.A.1 (describing relationships between objects - above, below, beside); K.MD.A.2 (directly compare two objects with a measurable attribute in common)

Language: Vocabulary Acquisition & Use - Standards 1e (produce complete sentences in shared language activities); 3 (apply knowledge of language in different contexts); 5a (sort objects into categories); 6 (use words and phrases acquired through conversation, etc)

Career and Life Skills: B1 (engage in new experiences and ask questions);

***There can be others, depending on the activity you choose***

# Resources

The classic CS Unplugged site has a few activities that are tied to graph theory in general, including some of the topics from today:

https://classic.csunplugged.org/activities/graph-colouring/
https://classic.csunplugged.org/activities/dominating-sets/
https://classic.csunplugged.org/activities/minimal-spanning-trees/

We are also developing a repository for graph theory activities for PreK-2 learners.

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# Thanks for listening!

Questions?

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In-Development Resource Website:
https://bit.ly/GraphCT