Learning graphs: A strategic approach to computing curriculum planning

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Background

- The National Centre for Computing Education (NCCE) is developing a comprehensive curriculum package of more than 500 hours worth of teaching resources, to support the delivery of the English Computing Curriculum.
- The scale and complexity of planning the resources is tackled by organising the content into learning graphs.

Learning graphs

- The nodes in a learning graph are *learning waypoints* that relate to concepts, knowledge, skills or learning objectives.
- Two nodes are connected if they represent adjacent waypoints in the learning process, i.e. if one is a prerequisite for the other.
- Nodes will often form clusters, corresponding to specific themes.

Related work

- Approaches exist for describing learner journeys through knowledge, concepts or skills: e.g. *learning trajectories*, *learning progressions* and *learning maps* [1, 2, 3, 4, 5, 6].
- Significant variation in how these approaches are defined and to what purpose they are used.
- There is recent work on learning trajectories for Computational Thinking concepts [8, 9].

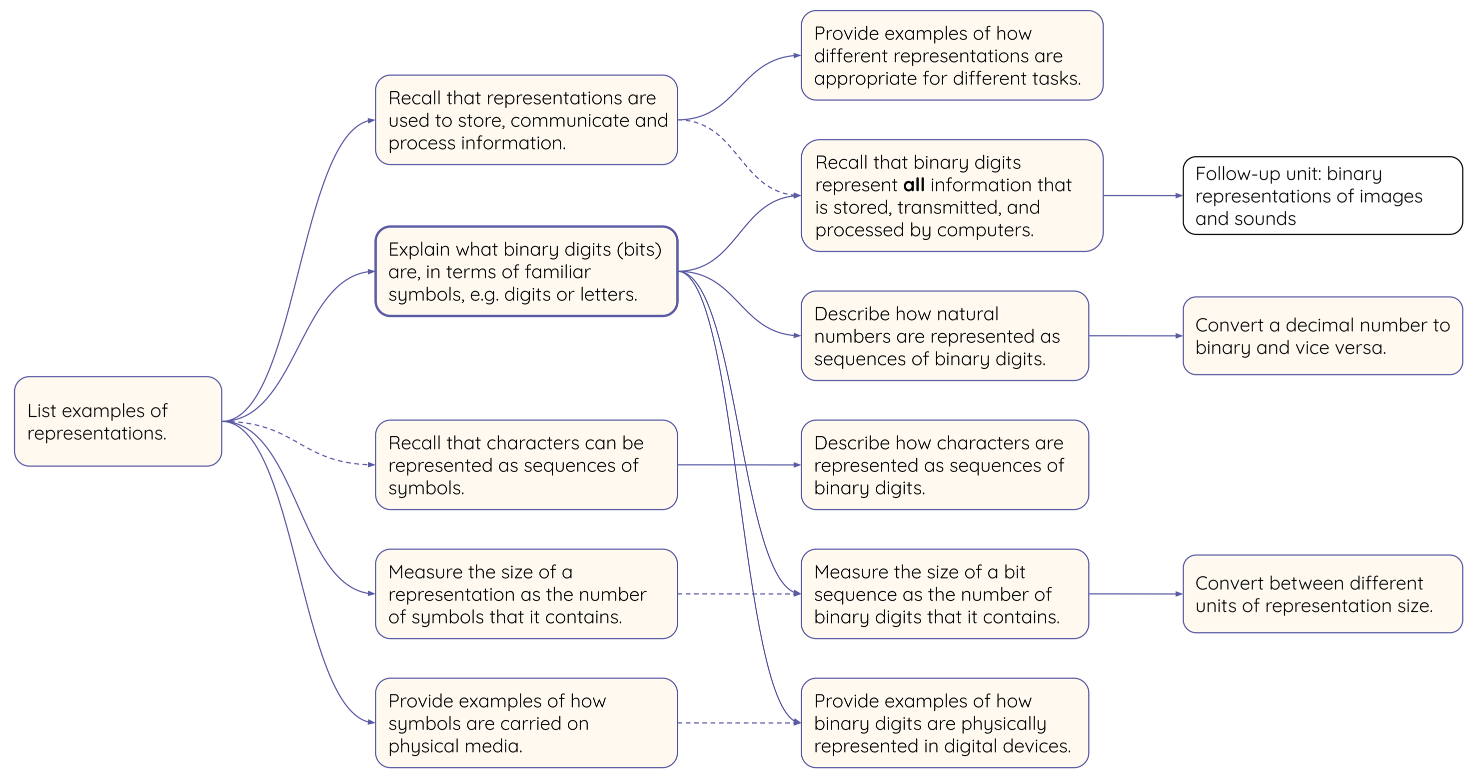
In relation to similar approaches:

- Learning graphs directly inform lesson planning decisions.
- Learning graphs are (currently) empirical, instead of research- or evidence- based, since little is known about learning waypoints in Computing [7].

Construction

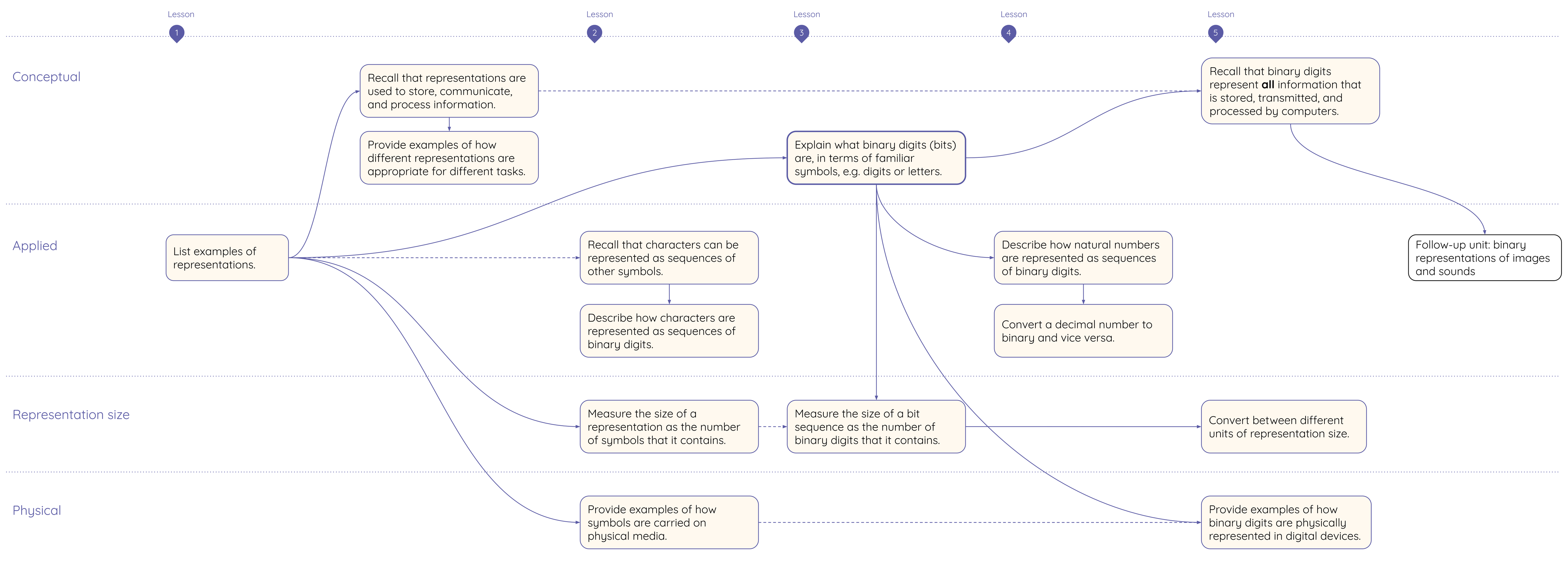
A collaborative, iterative process involving content developers, teachers, researchers and members of the NCCE academic board.

1. **Generate nodes**: For planning a unit of lessons, the nodes would contain the learning objectives.
2. **Establish relationships**: Link nodes when there is a direct connection between them, if they should be adjacent in any learning journey.
3. **Commit to a specific journey**: Structure the graph to reflect decisions on how the content will be delivered.
4. **Identify themes**: Possibly structure the graph to reflect how nodes can be grouped into themes.



fluid graph uncovers structure, relationships and possible journeys ▹ not bound to a specific teaching pathway

solid graph further structured to reflect specific suggestions on the order of content delivery



Evaluation: findings

Evaluation of learning graphs through a series of interviews and discussions with content developers.

Merits

- Reveal the non-linear structure of the content.
- Lead to critical thinking about the relationships between different components ▹ direct impact on the structure and sequence of the lessons.
- Highlight possible gaps between learning waypoints that need to be addressed by inserting intermediate nodes.
- Instrumental in (debating and) agreeing on terminology and then using it consistently.

Issues

- Can get large, complicated and interwoven. Structuring them clearly can be challenging.
- It is evident that a purpose-built tool is necessary for working efficiently with them.

Further work

- Investigate how learning graphs could inform assessment.
- Investigate how learning graphs could inform pedagogy.
- Investigate how learning graphs could be combined with concept maps.
- Capture teacher feedback on the content of the learning graphs, to improve and refine them.
- Capture teacher feedback to understand their perception of learning graphs

Our vision is that the learning graphs produced in the context of the NCCE will serve as the **starting point for a comprehensive set of learning waypoints for Computing education** .

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