Creating, Visualizing, and Exploring Knowledge Maps

Colorado Reed
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Knowledge Maps

This is a section of a Khan Academy knowledge map for math concepts.

- nodes represent concepts
- edges specify prerequisite relationships
- associated content with each node/edge

Tools for Creating Knowledge Maps

OmniGraffle diagramming software

Graphic graph placement and visualization software

Cmap Tools concept mapping software

Graph Creation Toolbox

- upload/download graph
- optimize graph placement
- preview final graph
- clear graph
- add existing concepts

Knowledge Map Creation

Knowledge map creation tools tend to fall into four broad categories:

1. general purpose diagramming software
2. general purpose graph placement and visualization software
3. specific purpose diagramming software
4. research software

Knowledge map creation objectives:

- balance human and algorithmic placement
- allow quick editing of large graphs
- allow sharing/collaborating/version control
- export/import graphs to/from common formats
- incorporate meta information (e.g. discussion)

Both Khan Academy and Metacademy use text-based (e.g. xml) to create/edit the maps and then use graphviz to generate the placement

Visualization and Exploration

This is the original knowledge map rendering using a layered (Sugiyama) graph placement (Metacademy’s system). [41 edges]

- large number of nodes and edges
- difficult to visualize relationships
- difficult to follow paths

Placement

- Remove transitive edges (transitive reduction)
  (e.g. remove edge C->A if C->B, B->A exists)
- only show short edges and structure edges
  (make sure every node has at least one outlink)
- draw “wisp” edges to indicate absent edges
  (small edge segments protruding from nodes)

Interaction

- hovering over a node highlights all dependencies, outlinks, and shows all related edges
- clicking an edge shows associated content on graph
- clicking a node transitions to showing only the dependencies and outlinks of that node (see left)
- search/filter concepts using the sidebar
- directly show associated concept information on node

Goal: Create a visual, specific-purpose knowledge map editor

Goal: clean, interactive, mental-map-preserving knowledge maps

Training/Courseware

Only included features that benefitted the following operations

- add/remove concept
- add/remove relationship between concepts
- add/remove associated content
- preview the knowledge map

This is the associated concept editor that overlays the displayed graph