


Structure of Knowledge

Engineering curricula: how are facts connected?

Clearly sequential: concepts build on each other, within and across courses

Example: calculus comes before college physics. Reason: equations of motion are explained by calculus. Newton invented calculus to explain the motion of the heavens

Most of the rest of the curriculum goes in a similar way: mathematical basics, simplified physical models, move on to more complicated math and models

This can be described as a directed acyclic graph

Why are concept graphs important?

Professors build courses this way: looks at what student should know already, then build progression to where they should be by the end

Also how the entire curriculum is built: every engineering program follows a graph of pre-read from one course to another

But this is not made explicit to students—students typically only see it in their study notes

Once created, a very powerful study tool: illuminates concepts behind the problems, and connections to what you already know; a graph helps to remember it.

Ex: Newtonian Mechanics

Diff., Integ. \rightarrow a, v, p relations (1)

Vectors \rightarrow Resolution of force vector on object (2)

$$\vec{F} = m\vec{a} \quad (3)$$

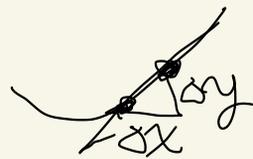
(1) + (2) + (3) \rightarrow compute a, v, p over time (5)

Gravitational force eqn (4)

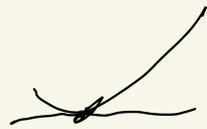
(4) + (5) \Rightarrow Newtonian mechanics for motion of planets

Differentiation Def:

1) function concept

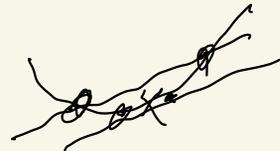


2) difference equation



3) concept of slope

4) concept of tangent



5) concept of limit

Computation of derivatives: what else?

The most useful is Taylor's theorem

Relevance to mentor ship?

Most likely reason a student struggles is that they're missing some information further back in the graph

Problems can be broken down into the concepts needed to solve them: 1) practice in breaking things down this way will assist students in the solutions 2) Conversation can get to the concepts that are actually causing difficulty

Tasking students to create concept maps can improve study for research: analyze what's behind the research problem, make it easier to understand new concepts by placing it in context of what they know