Abstract Data Types

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What do these have in common?

Problem 1:

- Given a map showing flights between cities around the world, with the duration of each flight, find the route from city A to city B with the least overall flight time.

Problem 2:

- Given a map showing flights between cities around the world, with the cost of each flight, find the route from city A to city B with the least overall cost.

Problem 3:

- Given a map showing flights between cities around the world, with the air miles earned by each flight, find the route from city A to city B with the greatest overall airmiles.

Problem 4:

- Given the arts and science calendar and timetable, plan when to take your courses so that you can take a given course as soon as possible.

Capturing general concepts

- Computer scientists look for structures that are useful across many problems.
- Whatever we learn/build/solve can be used for all of those problems:
  - algorithms, code, analyses, proofs.
- We have identified some that are very useful!
  - graph: like a map (not the x-y axes kind)
  - stack: like a pile
  - queue: like a lineup
  - string, pixel, ...

Abstract Data Types

- We call these Abstract Data Types, or ADTs.
- To define an ADT, we specify data and operations on it.
- Example: str (a built-in type)
  - Data: a sequence of characters
  - Operations: isdigit(), find(substr), strip, ...
- Example: Pixel (from the media module)
  - Data: a location and an RGB colour
  - Operations: get_x(), set_x(), get_color(), ...

Stack ADT

A stack contains items of various sorts. New items are pushed on to the top of the stack, items may only be removed from the top of the stack. (We say that an item is "popped" from the stack.) It's a mistake to try to remove an item from an empty stack. We can tell how big a stack is, and what the top item is.

Stack example

- Push “dark”
- Push “blue”
- Pop
- Push “is”
- Push “my”
- Push “favourite”
- Pop
- Pop
- Push “night”
- Push “the”

Uses for stacks

- Tracking function calls as a program runs
- Keeping track of pages visited in a browser tab
- Keeping an undo/redo history in an editor
- Checking for balanced parentheses