Precept Outline

- Review of Lectures 19 and 20:
  - Dynamic Programming
  - Maxflow/Mincut and Ford-Fulkerson

Relevant Book Sections

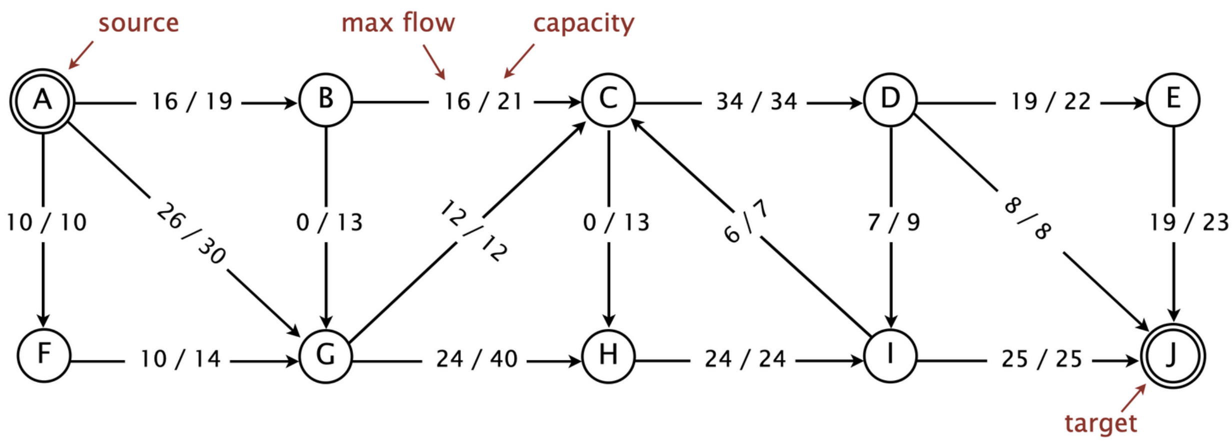
- Book chapters: 6

A. Review: Dynamic Programming and Maxflow/Mincut

Your preceptor will briefly review key points of this week's lectures.

B. Maximum Flow

Consider the following flow network with a flow f from source vertex A to sink vertex J.



What is the value of f? Compute the *capacity* of the cut $\{A, B, C\}$ and the net *flow* across this cut.

Find the maximum flow in the network.

Find a minimum cut in the network. Which vertices are on the source side of the cut?

C. Assignment Overview: Seam Carving

Your preceptor will introduce and give an overview of your sixth assignment. Please don't hesitate to ask questions!

Summary of the assignment.

- Implement a `SeamCarver` class that finds and remove seams in a pixel image.
  - A $W \times H$ **-pixel image defines a** $W \times H$ **energy matrix** (you'll be given a formula to compute energies in your assignment, so in this precept you can assume that your input is the energy matrix).
  - A **vertical seam** is a path of pixels connected from the top row to the bottom row , where a pixel at column x and row y is connected to bottom left/bottom/bottom right pixels (i.e., at positions $(x-1, y+1), (x, y+1)$ and $(x+1, y+1)$), if they exist. Note that these row/column indices, which are standard in image processing, are the reverse of the standard in math. We can similarly define a **horizontal seam**.
  - The **energy of a seam** is the sum of the energies of the pixels in the seam.
  - The **minimum energy vertical seam** is the vertical seam with the minimum energy.
- There is also a `readme.txt` where you will perform experiments to determine the runtime of your solution.

D. Seam Carving Practice

Consider the 3×4 image and corresponding energy values above. Find the minimum energy vertical seam and compute its energy.

(15,10,16)	(31,15,19)	(15,10,3)
(5,18,0)	(80,18,0)	(120,100,80)
(35,20,12)	(36,17,13)	(15,10,3)
(5,1,13)	(13,1,16)	(120,110,40)

RGB Values of the 3x4 Image

32	72	45
123	163	75
32	75	41
156	161	9

Energy Values

In order to find the minimum energy vertical seam, you will have to find the shortest path from any pixel in the top row to any pixel in the bottom row.

Draw the implicit graph represented by the energies matrix. (That is, draw the graph whose paths correspond to seams and whose lengths correspond to the energies of the seams.) Show all the edges and edge weights.

What is the order of growth of the algorithm that finds a minimum energy vertical seam on the graph represented by a $W \times H$ image (as a function of W and H), if it uses Dijkstra to find shortest paths? What if it uses Bellman-Ford instead? (Assume edges are relaxed from the bottom to the top.) Explain how you can compute vertical seams faster than with either shortest-path algorithm above.