# Algorithms
CMPT 435

Assignment 5 - 100 points

Goals

(1) to implement the Bellman-Ford dynamic programming algorithm for Single Source Shortest Path (SSSP) on a few weighted, directed graphs;
(2) to implement a greedy solution to an intergalactic instance of the fractional knapsack problem; and
(3) to analyze these algorithms' performance in asymptotic terms.

Requirements and Notes

(1) Modify your graph implementation from Assignment Four to model directed and weighted graphs. The file `graphs2.txt` contains data describing multiple directed and weighted graphs. Read it and create a linked object representation for each graph. Then, for each graph, run SSSP (with vertex #1 as the single source) and output the results. **[50 points]**

Example graph
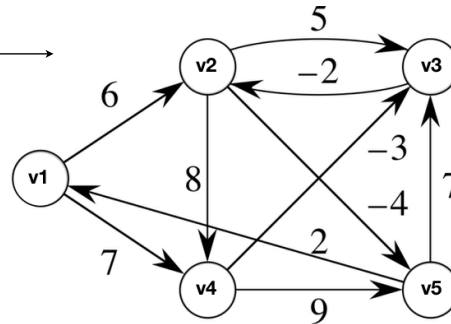
Example output:
1 → 2 cost is 2; path is 1 → 4 → 3 → 2.
1 → 3 cost is 4; path is 1 → 4 → 3.
1 → 4 cost is 7; path is 1 → 4.
1 → 5 cost is -2; path: 1 → 4 → 3 → 2 → 5.

(2) Imagine you are traveling to Arrakis for a spice heist. You must fill a few knapsacks with as much of the most valuable spice as they will hold. The file `spice.txt` contains the details of available spice and knapsacks you can use. Implement the fractional knapsack algorithm to maximize your take. **[40 points]**

Example output:
Knapsack of capacity 1 is worth 9 and contains 1 of orange.
Knapsack of capacity 6 is worth 38 and contains 2 of orange, 4 of blue.

(3) In your LaTeX analysis document, **explain the asymptotic running time** of both SSSP and fractional knapsack and why it is that way. **[10 points]**

As ever, your code must …
- separate structure from presentation.
- be professionally formatted yet uniquely yours (show some personality) **[−∞ if not]**
- use and demonstrate best practices.
- make me proud to be your teacher.

Resources

- Dynamic programming is described in our text in section 15.
- The greedy strategy is described in our text in section 16.2.

Submitting Your Work

In addition to your source code, commit your LaTeX document in both .tex and .pdf forms to your GitHub repository. For your code, make **many** commits to GitHub. If you don't make enough commits, I will not accept your work. Be sure that you make your final commit for this assignment on or before the due date. (See our syllabus for those details.)