# 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.

   **Example graph**

   ![Example Graph](image)

   **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.

   **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.

As ever, your code must ...

- separate structure from presentation.
- be professionally formatted yet uniquely yours (show some personality) \[ \leq -\infty \text{ if not} \]
- 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.)