St. Francis Xavier University
Department of Computer Science

CSCI 355: Algorithm Design and Analysis
Final Examination Review
Winter 2024

1 Topics Covered

The following list gives an overview of every topic covered in CSCI 355. You should ensure you have a good understanding of each topic. All final examination questions will test some topic on this list, but not all topics will be tested on the final examination.

Although the final examination is a comprehensive examination, there will be a greater emphasis placed on topics covered after the midterm examination.

- **Pre-Midterm Material**
  - Stable matching/Gale–Shapley algorithm
  - Algorithm analysis
  - Greedy algorithms
- **Divide and Conquer**
  - Divide and conquer paradigm
  - Mergesort
  - Recurrence relations/trees
  - Sorting lower bound
  - Randomized quicksort & quickselect
  - Master theorem
  - Integer multiplication
  - Matrix multiplication
- **Dynamic Programming**
  - Dynamic programming paradigm
  - Top-down vs. bottom-up
  - Optimal subproblems/solutions
  - Binary choice: interval scheduling
  - Multiway choice: segmented least squares
  - Multiple variables: knapsack problem
  - Intervals: RNA structure
  - Sequence alignment
  - Bellman–Ford–Moore algorithm
- **Network Flow**
  - Flow networks
  - Minimum cuts
  - Maximum flows
  - Residual networks/augmenting paths
  - Ford–Fulkerson algorithm
  - Max-flow min-cut theorem
- **Intractability**
  - Polynomial-time reductions
  - Common decision problems (Independent set, vertex cover, set cover, SAT, 3-SAT, etc.)
  - The class P
  - The class NP
  - NP-completeness

2 Format

The final examination is 150 minutes (2.5 hours) long. It consists of 6 questions worth a total of 70 marks.

The first question is divided into ten multiple-choice style parts. Multiple-choice questions test both pre- and post-midterm material.

The second question is divided into five short answer style parts. Short answer questions test both pre- and post-midterm material.

The third question is about the divide-and-conquer paradigm.

The fourth question is about the dynamic programming paradigm.

The fifth question is about network flows.

The sixth question is about intractability.

3 Tips and Tricks

- Double-check the date, time, and room of the final examination. You will not get extra time to write if you arrive late.
- Use your time wisely. Short and long answer questions will likely take more time than multiple choice questions, so make sure you allocate the appropriate amount of time for each question.
- Use the resources you are given. The lecture notes contain everything you need to know. The assignment questions are similar in content and difficulty to the final examination questions. The course textbook serves as great supplementary material.
- Don't leave your questions until the last minute. Seek help before the final examination if you have questions. Send an email or make a post on Moodle.
- Don't try to memorize concepts. Instead, focus on understanding the meaning behind a concept and how it is applied.
- Don't panic!