Master Syllabus for TCSS 343
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The **primary goals** of the course are:

1. Knowledge of fundamental algorithms and algorithmic design techniques.
2. Ability to reason about programs (correctness, performance, elegance) using formal and informal methods.
3. Ability to apply algorithmic concepts via program implementation.

Prerequisites: TCSS 342, TCSS 322.

Topics covered

1. Fundamentals of algorithm analysis
    a. RAM model
    b. Big oh notation, worst case and best case analysis
    c. proof techniques: proof by contradiction, proof by induction
    d. logarithms, exponents, summations, modular arithmetic
    e. pseudocode
2. Algorithmic design techniques
    a. Brute-force, exhaustive search
    b. Divide-and-conquer
        i. mergesort, quicksort, binary search
        ii. large integer multiplication, Strassen's matrix multiplication
    c. Decrease-and-conquer
        i. selection sort
        ii. depth-first search, breadth-first search, topological sort
        iii. interpolation search
    d. Transform-and-conquer
        i. presorting: finding the mode, element uniqueness
        ii. Horner's rule, exponentiation
        iii. string matching algorithms
    e. Dynamic programming
        i. optimal binary search trees
        ii. 0-1 knapsack
    f. Greedy algorithms
        i. Prim's algorithm, Kruskal's algorithm
        ii. Dijkstra's algorithm
    g. Lower bounds and limits of computation
        i. information-theoretic lower bound for comparison-based sorting
        ii. bucket sort, radix sort
        iii. P, NP, NP-completeness

    Alternatively, the material in the course can be organized as a mixture of problem types and algorithmic techniques. For example,

    - Searching and sorting algorithms
    - Divide-and-conquer technique

- Greedy technique
- Dynamic programming technique
- String matching algorithms
- Numerical algorithms
- Graph algorithms
- Lower bounds, NP-completeness

3. Algorithm analysis
    a. Correctness
    b. Performance
    c. Recurrence relations