Course content for MT3140/MT4140, Principles of Algorithm Design

Prerequisites:
MT3140: MT2630
MT4140: MT2630 or MT3540

Aims:
The development of efficient algorithms is essential when considering problems with large inputs. Usually an algorithm has certain specifications, for example that it should solve a problem and take at most $f(n)$ steps on any input of size n. This course is about the design of efficient algorithms and proving that they meet the desired specification. The course introduces basic principles and methods of algorithm design and analysis and considers fundamental problems like sorting numbers and multiplying matrices.
Key aims of the course include:
-    to provide an introduction to the theory of algorithms;
-    to develop the skill of designing algorithms.

Learning outcomes:
1. understand and apply the fundamental principles of algorithm design;
2. analyse basic algorithms; know amortised, average-case and worst-case analysis;
3. know basic data-structures
4. know efficient algorithms for sorting numbers; know lower bounds on comparison based algorithms for sorting numbers;
5. know asymptotic notation;
6. MT4140: demonstrate a breadth of understanding appropriate for an M-level course.

Course content:
Basic algorithmic principles: Greedy algorithms, divide-and-conquer, dynamic programming, randomised algorithms.
Analysis of algorithms: Recurrences, O-notation, worst-case analysis, amortised analysis, probabilistic analysis; lower bounds for comparison-based sorting and finding the
median.
Basic data structures: arrays, stacks, balanced search trees, hashing.