Written exam – mock exam

Name: ....

Data structures and algorithms (GEMAK117-MA)

June 3, 2024

Neptun code: ....

PART 1: THEORETICAL QUESTIONS (20 POINTS)

I will ask a few definitions and theorems and one algorithm – from the UPDATED glossary, now containing material on graphs as well.

Exercise 1 (9 points). State the following definitions (1 point each):

   a) whole quotient, div operation

   b) small o notation

   c) algorithm

   d) Fibonacci numbers

   e) prime

   f) congruence

   g) multiplicative inverse

   h) directed graph

   i) path (in a graph)

Exercise 2 (8 points). State the following theorems (2 points each):

   a) reduction theorem (of the greatest common divisor)

   b) number of digits (in base b)

   c) the "master theorem"

   d) lower bound on comparison-based sorting

Exercise 3 (3 points). Write down the algorithm for **modular exponentiation**.
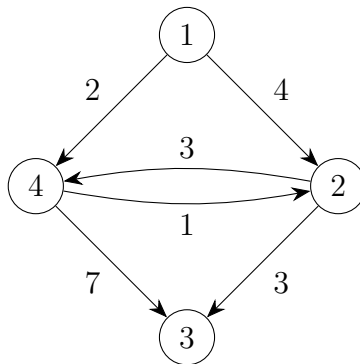
PART 2: EXERCISES (20 POINTS)

I will pick 4 exercises from 8 possible types, 5 points per exercise. Possible exercise types: 6 already known from the practical midterm (you can find worked out exercises of each type in the lecture notes) + 2 new types: linear congruence equation and Dijkstra algorithm. Only showing new types and their solutions below:

Exercise 4 (Linear congruence equation).

- variant 1: "Solve the linear congruence equation $4x \equiv 2 \mod 10$."

- variant 2: "Calculate the multiplicative inverse $x = 8^{-1} \mod 11$."

Exercise 5 (Dijkstra algorithm)**.** Find the shortest paths using Dijkstra's algorithm from source $s = 1$ in the following graph: