# Homework 7

## 1 Coin changing (50')

Consider the problem of making change for $n$ cents using the fewest number of coins. Assume that each coin's value is an integer. We recommend to read the chapter 6 of book *"Introduction to Algorithms" (3rd Edition).*

- **a.** Describe a greedy algorithm to make change consisting of quarters, dimes, nickels and pennies. Please give the pseudocode, and prove that your algorithm yields an optimal solution.
- **b.** Suppose that the available coins are in the denominations that are powers of $c$, i.e., the denominations are $c^0; c^1; \cdots; c^k$ for some integers $c > 1$ and $k \geq 1$. Show that the greedy algorithm always yields an optimal solution.
- **c.** Give a set of coin denominations for which the greedy algorithm does not yield an optimal solution. Your set should include a penny so that there is a solution for every value of $n$.

## 2 Genetic Algorithm (50')

Use genetic algorithm to find $x^*$ that

$$x^* = \arg\min_x x \cdot \sin(x)$$
$$x \in (-1, 15)$$

Use 16-bit binary digits to represent the chromosome of an individual.

- Implement your code in a *.cpp* file. Print the individual $x$ with the best fitness score in each generation.
- Describe the implementation details, such as the stopping criterion, the selection method, the crossover method, the mutation method and so on, in a README file.

Hint: $x^* = \arg\min_x x \cdot \sin(x) \approx 11.0857$

## 3 Bonus (Voluntary) (50')

Answer the question 15-5 (a) in book *Introduction to Algorithm (3rd Edition), chapter 15.* Write down the dynamic progamming pseudo-code.

## 4 Due

1. Due: Nov. 21st, 23:59.
2. Please write all your answers in a PDF file. Submit on canvas a ZIP file containing the PDF, the code and README.