Analysis of Algorithms and Heuristic Problem Solving, 2021/22, 29 June 2022, Written exam**.**

All questions count equally. Literature, electronic and communication devices are not allowed. It is allowed to use 1 sheet of A4 format paper. You can write your answers in either English or Slovene. Duration: 90 minutes.
Students who wish to look into the written exam results can do so on Monday, 04 July 2022, at 12:00 in the room of Prof Robnik Šikonja (2nd floor, room 2.06).

1. Find the solution of the recurrence
    $$T(n) = T\left(\frac{n}{2}\right) + T\left(\frac{n}{3}\right) + 3T\left(\frac{n}{4}\right) + n^2$$

2. Given a set of m linear inequalities on n variables $x_1, x_2, \ldots x_n$, the linear inequality feasibility problem asks whether there is a setting of the variables that simultaneously satisfies each of the inequalities. Show that if we have an algorithm for the linear-inequality feasibility problem, we can use it to solve a linear-programming problem. The number of variables and linear inequalities that you use in the linear-inequality feasibility problem should be polynomial in n and m, the number of variables and constraints in the linear program.

3. Suppose we can insert an element into a hash table in a constant time. In order to ensure that our hash table is always big enough, without wasting a lot of memory, we will rebuild the table after an insertion, if the table is more than 3/4 full. In this case, we will allocate a new table twice as big as the current table and insert everything into the new table, and then free the old table. Show that for any sequence of insertions the amortized time per operation is still a constant.

4. Describe the similarities and differences between the differential evolution (DE) and particle swarm optimization (PSO). How would you set the parameters of both algorithms so that the algorithms will be very similar? Justify your answer.