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**CS-E3190 Principles of Algorithmic Techniques (5 cr)**
**Exam Thu 7 June 2018, 4–7 p.m.**

Write down on each answer sheet:
- Your name, degree programme, and student number
- The text: "CS-E3190 Principles of Algorithmic Techniques 7.6.2018"
- The total number of answer sheets you are submitting for grading

*Note:* You can write down your answers in either Finnish, Swedish, or English.

1. Arrange the following functions according to their increasing order of growth:

$$n, \quad \sqrt{n}\log(n^2), \quad 2^n, \quad n^{(\log n)}, \quad \log n, \quad n/\log n,$$
$$(\log n)/n, \quad n\log\log n, \quad n!, \quad (\sqrt{n})^{\sqrt{n}}, \quad 42, \quad n^{1/2}+n^{1/3}.$$

   (Notation $\log n$ denotes here logarithm in base 2.) You do not need to prove the correctness of your ordering. *12p*

2. How many lines (as a function of $n$) does the following program print? Derive a recurrence and solve it exactly. You may assume that $n$ is a power of 2.

```
function f(n)
  if n > 1:
    print_line(''foobar'')
    f(n/2)
    f(n/2)
    f(n/2)
```
*12p*

3. Two teams, $A$ and $B$, are playing a tournament where the goal is to win $n$ games, for some fixed value of $n$. Suppose that for any given game, both of the teams have a 50% chance of winning, and that they have already played $k = i + j$ games, of which $A$ has won $i < n$ and $B$ has won $j < n$. Design a dynamic programming algorithm to determine the probability that from such an initial state, $A$ will go on to win the tournament. *15p*

4. A mouse wishes to eat a cubical piece of cheese. Being a very systematic little animal, she divides the cube in her mind into $3 \times 3 \times 3 = 27$ subcubes, and plans to proceed so that she starts in one of the corner cubes, eats one full subcube at a time, always proceeds to a neighbouring cube, and finishes at the central subcube. Can the mouse succeed in this plan? (Provide a justified answer.) *15p*