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T-79.4202 Principles of Algorithmic Techniques (5 cr)
Exam Thu 9 June 2016, 4–7 p.m.

Write down on each answer sheet:
- Your name, degree programme, and student number
- The text: "T-79.4202 Principles of Algorithmic Techniques 9.6.2016"
- 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. 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 3.

```
function f(n)
  if n > 1:
    print_line(''foobar'')
    f(n/3)
    f(n/3)
```

12p

2. Explain how the "twice-around-the-tree" approximation algorithm for the metric Travelling Salesman Problem works, and prove the associated approximation ratio bound. *12p*

3. Give an algorithm with running time $O(nt)$ for the following task.

   Input: A list of n positive integers $a_1, a_2, \ldots, a_n$ and a positive integer t.
   Question: Decide (output "yes" or "no") whether there is a subset of the a_i's whose sum is equal to t. Each a_i may be used at most once.

   15p

4. Design a linear-time algorithm for the following task: given a connected undirected graph G, find a vertex v that can be removed from G without making it disconnected. (*Hint:* Think about other linear-time graph algorithms that you know.) *15p*