Theoretical Computer Science II

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Exercise Sheet 11

Due: January 23, 2012

Exercise 11.1 (TM computation, 1 + 0.5 + 0.5 marks)

(a) Design a Turing Machine that decides the language $\{0^n1^n \mid n \geq 1\}$. Explain your choice.

(b) Give the sequence of configurations for the input string 0011.

(c) Give the sequence of configurations for the input string 0010.

Exercise 11.2 (TMs, 2 marks)

Describe a TM that decides the language
$L = \{$The set of strings with an equal number of $0's$ and $1's\}$. Explain your choice.

Exercise 11.3 (PDAs and TMs, 3 marks)

How would one simulate a PDA on a Turing machine? Please do not write the Turing machine itself, but rather write the key idea in plain English.

Exercise 11.4 (Non deterministic TMs, 3 marks)

We call a natural number *divisible* if that number is the product of two natural numbers greater or equal two. We define the set of divisible numbers as:

$$\{n \in \mathbb{N} \mid \text{ exists } m, k \in \mathbb{N} \text{ with } m \geq 2 \text{ and } k \geq 2, \text{ such that } n = m \cdot k\}$$

Give a nondeterministic Turing machine of the alphabet of vertical bars $\Sigma = \{|\}$ that recognizes the language of divisible numbers encoded as unary numbers.
You do not have to give a formal construction, but describe the idea behind your construction as precise as possible.