
Quantum Computation

Problem 1

16 March 2021 - 30 March 2021

This exercise focus on Turing machines and computability. Please provide a complete, individual answer and quote suitably any reference (paper, book, software) used.

1. Consider the following program and explain which function does it compute.

$(s, \prec, s_1, \prec, R)$

$(s_1, 0, s_1, \prec, R)$

$(s_1, 1, s_1, \prec, R)$

$(s_1, \prec, s_2, \prec, L)$

$(s_2, \prec, s_2, \prec, L)$

$(s_2, \prec, s_3, \prec, R)$

$(s_3, \prec, t, 1, -)$

2. Specify a total Turing machine that accepts an input string if its length is prime.

Hint. Give an implementation of the Sieve of Eratosthenes. To check whether n is prime, start writing down all the numbers from 2 to n in order. Then repeat: find the smallest number in the list, declare it prime, then cross off all multiples of that number. Repeat until each number in the list has been either declared prime or crossed off as a multiple of a smaller prime.

3. Look in the www for Turing machine simulators. Select one, make a brief description of how it works and give some examples.
4. In the Turing machine simulator selected, try the machines mentioned in the two first items of this exercise.