Tutorial 07

University of Victoria

CSC 320 - Spring 2023

Foundations of Computer Science

Teaching Team

Learning Outcomes:

- Construct High Level Turing Machines.
- Distinguish between different Turing Machine variants.
- Become familiar with Deciders vs Looping.

Interesting Article:

"Note on A Universal Quantum Turing Machine" [1]
"Quantum Chaos in Quantum Turing Machines" [2]

March 7th, 2023

Question 7.01

Construct a PDA from the following CFG:

$$S \longrightarrow S1 \mid 1S0S \mid \epsilon$$

Question 7.02

Give a high level description of a Turing Machine which decides:

$$A = \{0^{2^n} \mid n \geq 0\}$$

Question 7.03

Give a high level description of a Turing Machine which decides:

$$B = \{a^i b^j c^k \mid i \times j = k \text{ and } i, j, k \geq 1\}$$

Question 7.04

Give a high level description of a 2-tape TM which recognizes the language (binary palindromes):

$$L = \{w \in \{0,1\}^* \mid w = w^r\}$$

Question 7.05

Give a high level description of a nondeterministic TM which recognizes the language:

$$L = \{1^n \mid n \text{ is a composite number}\}$$

Question 7.06

Prove that the following language is decidable by constructing (high level) Turing Machines which decide the language.

$$A_{DFA} = \{\langle B, w\rangle \mid B \text{ is a DFA that accepts input string } w\}$$

Question 7.07

Prove that the following language is decidable by constructing (high level) Turing Machines which decide the language.

$$E_{DFA} = \{\langle A \rangle \mid A \text{ is a DFA and } L(A) = \emptyset\}$$

Question 7.08

Prove that the following language is decidable by constructing (high level) Turing Machines which decide the language.

$$EQ_{DFA} = \{\langle A, B\rangle \mid A \text{ and } B \text{ are DFAs and } L(A) = L(B)\}$$

Bibliography

[1] S. Iriyama, T. Miyadera, and M. Ohya, "Note on a universal quantum turing machine," English, *Physics letters. A*, vol. 372, no. 31, pp. 5120–5122, 2008, ISSN: 0375-9601.

[2] I. Kim and G. Mahler, "Quantum chaos in quantum turing machines," English, *Physics letters. A*, vol. 263, no. 4, pp. 268–273, 1999, ISSN: 0375-9601.