Exercise sheet 4

Chapter 2: Propositional logic

Exercise 1: Revisiting Resolution
Check if the given formula is satisfiable or not using resolution.
The formula already is in CNF, so you can immediately apply resolution

$$\begin{aligned} F = &(C \vee \neg A) \wedge D \wedge (D \vee A) \wedge (E \vee B) \wedge \\ &(\neg C \vee A \vee B) \wedge E \wedge (\neg D \vee \neg A) \wedge \\ &(C \vee \neg B) \wedge (\neg E \vee \neg B) \wedge C \end{aligned}$$

4 points

Chapter 3: Computability

Exercise 2: Introduction to Computability
Establish an (informal) proof (by contradiction) to show that it is in general undecidable whether a given program run on a given input will always eventually halt. Your solution should include pseudo-code for all the tester functions and **detailed** step-by-step explanations.

Hint: *2 tester functions succeed to derive the desired contradiction*

This will be similar to the proof for the 'Hello, World' program seen in course, take a look at that proof, similar arguments can be made for this proof.

6 points

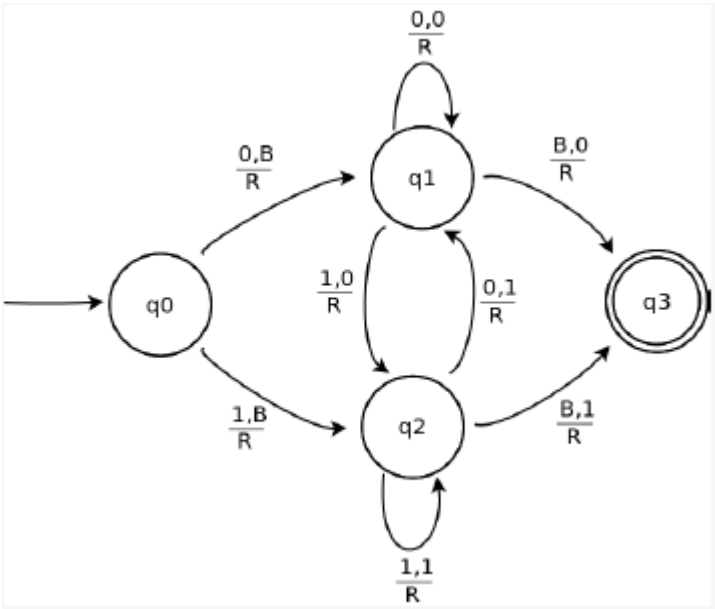
Chapter 4: Computability and Complexity

Exercise: Deterministic Turing Machines

Turing Machines can be represented in different ways. Below you see a TM M_1 described by a finite state diagram and a TM M_2 described by a formal description.

Give the formal description of M_1 as well as the finite state representation of M_2, then, for both M_1 and M_2, explain their behaviour in your own words and give a sample input and output (using the notation from the simulator seen in class). The working alphabet for both will be $\Gamma = \{0, 1, B\}$, where B is the "blank symbol".

M_1:



$M_2 : (\{q_0, q_1, q_2, q_3\}, \{0, 1\}, \{0, 1, B\}, \delta, q_0, B, \{q_3\})$ where:

$$\delta(q_0, 0) = (q_0, 0, R)$$
$$\delta(q_0, 1) = (q_0, 1, R)$$
$$\delta(q_0, B) = (q_1, 1, L)$$
$$\delta(q_1, 0) = (q_2, 0, R)$$
$$\delta(q_1, 1) = (q_3, 1, R)$$
$$\delta(q_2, 1) = (q_3, 0, R)$$

Optionally, you can implement the two Turing Machines M_1 and M_2 in the TM Simulator if you want to get familiar with its syntax or check the outputs on different inputs

10 points