GROUP HOMEWORK 9, CPSC 421/501, FALL 2021

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Please note:

(1) You must justify all answers; no credit is given for a correct answer without justification.
(2) Proofs should be written out formally.
(3) Homework that is difficult to read may not be graded.
(4) You may work together on homework in groups of up to four, **but you must submit a single homework as a group submission under Gradescope.**

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(1) Problem 8.7.2(a) of the handout Uncomputability OR Ruining the Suprises in CPSC421.

(2) Problem 8.7.3 of the handout Uncomputability OR Ruining the Suprises in CPSC421; you can summarize the main points, since this is easy once you get used to working with oracle Turing machines.

(3) Problem 8.7.4 of the handout Uncomputability OR Ruining the Suprises in CPSC421.

(4) Show that if a connected graph has no odd length cycles, then it can be (legally) 2-coloured.

(5) Problem 7.8 [Sip]: show that the language, CONNECTED, of (descriptions of standardized) undirected graphs that are connected can be decided by a Turing machine in polynomial time; you may use the algorithm in [Sip], or any other algorithm that works.

Bonus problem worth addtional an additional 20%, and solutions will not be released:

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(6) Let $M = (Q, \Sigma, \Gamma, \delta, q_0, q_{\mathrm{acc}}, q_{\mathrm{rej}})$ be a Turing machine that (1) is a decider (i.e., always halts in either the accept or reject state), and (2) cannot change the contents of any of its tape cells, in the sense that for all $q \in Q$ and $\gamma \in \Gamma$, if

$$\delta(q, \gamma) = (q', \gamma', \mu),$$

so that $q' \in Q$, $\gamma' \in \Gamma$, $\sigma \in \Sigma$, $\mu \in \{L, R\}$, then necessarily $\gamma' = \gamma$. Show that the language that M decides is a regular language. [Problem courtesy of Ryan Mansour, November 2021.]

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