

## COSC 545, Spring 2020: Problem Set #4

**Due:** Tue 4/14, submit electronically using Canvas by the beginning of class.

**Covers:** Lectures 20 to 22.

**Collaboration:** You must work alone on the problem set and not consult outside sources. See the syllabus for details on the academic integrity policy for problem sets.

### Problems

1. The following two questions concern the proof of Savitch's Theorem we studied in class:
  - (a) How did we show that the height of the recursion tree explored by CANYIELD is  $O(f(n))$ ?
  - (b) What breaks in this proof if we remove the constraint that  $f(n) \geq n$  from the theorem statement?
2. This problem contains two parts that concern the language  $EQ_{NFA} = \{\langle N_1, N_2 \rangle \mid N_1 \text{ and } N_2 \text{ are NFAs and } L(N_1) = L(N_2)\}$ .
  - (a) Prove that  $\overline{EQ_{NFA}} \in \text{NPSPACE}$ .
  - (b) Use the result from Part (a) to prove that  $EQ_{NFA} \in \text{PSPACE}$ .
3. Let  $\text{ANA} = \{\langle w_1, w_2 \rangle \mid w_1 \text{ and } w_2 \text{ are anagrams}\}$ . Assume I am able to prove  $\text{TQBF} \leq_p \text{ANA}$ . Show that this implies  $\text{PSPACE} = \text{P}$ .