CSC463S **Problem Set 2 (Question 3 corrected)** **Winter, 2017**

Due: Friday, February 17, beginning of tutorial

NOTE: Each problem set counts 10% of your mark, and it is important to do your own work. You may consult with others concerning the general approach for solving problems on assignments, but you must write up all solutions entirely on your own. Copying assignments is a serious academic offense and will be dealt with accordingly.

1. Let $A = \{\langle M \rangle \mid M \text{ is a Turing machine and } |L(M)| = 5\}$

   Is A semidecidable? Is $\overline{A}$ semidecidable? Justify your answers.

2. Let q be a state in a Turing machine M. We say that q is *wasted* if there is no input w such that the computation on input w reaches q.

   Let $B = \{\langle M \rangle \mid M \text{ is a Turing machine and } M \text{ has no wasted states}\}$

   Is B semidecidable? Justify your answer.

3. Let us call a language $A \subseteq \Sigma^*$ *complementary* if $A \leq_m \overline{A}$. Prove that there exists an undecidable complementary language.

4. Suppose $\Sigma = \{0, 1\}$ and let ODDONES be the subset of Σ^* consisting of strings with an odd number of 1's. Let

   $$C = \{\langle G \rangle | G \text{ is a context free grammar and } L(G) = \text{ODDONES}\}$$

   Is C semidecidable? Is $\overline{C}$ semidecidable? Justify your answers.