

## CSCI 338: Assignment 4 (7 points)

This assignment is due on **Thursday, April 1, 8:00pm**. It is strongly encouraged that you use Latex to generate a single pdf file and upload it under *Assignment 4* on D2L. But there will NOT be a penalty for not using Latex (to finish the assignment). This **could** be a group-assignment, and you can form a group of at most 2 people (you must put both names on the group assignment and it is enough for one of the 2 students to submit it); certainly, you can also finish the assignment all by yourself.

### Problem 1

Let  $\mathcal{B}$  be the set of all infinite sequences over  $\{a, b\}$ . Show that  $\mathcal{B}$  is uncountable, using a proof by diagonalization.

### Problem 2

Let  $T = \{(i, j, k) | i, j, k \in \mathcal{N}\}$ . Show that  $T$  is countable.

### Problem 3

Let  $INFINITE_{PDA} = \{ \langle M \rangle \mid M \text{ is a PDA and } L(M) \text{ is an infinite language} \}$ . Show that  $INFINITE_{PDA}$  is decidable.

/\* ————— the above contents have been covered by March 12 ————— \*/

### Problem 4

Let  $\Sigma = \{a, b\}$ . Define the following language  $ODD_{TM}$ :

$ODD_{TM} = \{ \langle M \rangle \mid M \text{ is a TM and } L(M) \text{ contains only strings of odd length} \}$ .

Prove that  $ODD_{TM}$  is undecidable.

### **Problem 5**

Show that  $EQ_{CFG}$  is undecidable.

### **Problem 6**

Show that  $EQ_{CFG}$  is co-Turing-recognizable.

### **Problem 7**

Problem 5.3 (page 239—third edition of Sipser).