Assignment 3
Due no later than June 20 at 13:00

For full credit it is enough to accumulate 5 points.

Exercise 1 (**1 point**.) Find the book *How to Solve It* by George Pólya. Outline in at most one page the problem-solving strategy described there. (This book is available at the library and there are many internet resources which discuss it.)

Exercise 2 (3 points).

a) For the alphabet $\Sigma = \{a, b, c\}$, write a context-free grammar for the language

$$L_1 = \{w \in \Sigma^* | \ w \text{ does not contain both } a \text{ and } b\}.$$

Show a derivation of the strings *caac* and *bbb* using your grammar.

b) For the alphabet $\Sigma = \{a, b\}$, write a context-free grammar for the language

$$L_2 = \{w \in \Sigma^* | \ |w| \equiv 0 \bmod 3 \text{ and all the characters in the first third of } w \text{ are the same}\}.$$

Show a derivation of the string *bbbaaaaaa* using your grammar.

c) For the alphabet $\Sigma = \{a, b, c, d\}$, write a context-free grammar for the language

$$L_3 = \{a^i b^j c^k d^l | \ i + l = j + k\}.$$

Exercise 3 (1 point). Let $\Sigma = \{0, 1\}$ and consider the following recursive function

$$\text{stutter}(w) = \begin{cases} \epsilon & \text{if } w = \epsilon \\ aa \cdot \text{stutter}(x) & \text{if } w = ax \text{ for some } a \in \Sigma \text{ and } x \in \Sigma^*. \end{cases}$$

For example stutter$(0101) = 00110011$. Prove that for any regular language L, the language

$$\text{STUTTER}(L) = \{\text{stutter}(w) | w \in L\}$$

is also regular.

Exercise 4 (1 point). Let the grammar $G = (V, \Sigma, \langle \text{STMT} \rangle, R)$ be as follows.
$\Sigma = \{\text{if, condition, then, else, } a = 1\}$
$V = \{\langle \text{STMT} \rangle, \langle \text{ASSIGN} \rangle, \langle \text{IF-THEN} \rangle, \langle \text{IF-THEN-ELSE} \rangle\}$
The set of rules R is

$$\begin{aligned} \langle \text{STMT} \rangle &\to \langle \text{ASSIGN} \rangle | \langle \text{IF-THEN} \rangle | \langle \text{IF-THEN-ELSE} \rangle \\ \langle \text{IF-THEN} \rangle &\to \text{ if condition then } \langle \text{STMT} \rangle \\ \langle \text{IF-THEN-ELSE} \rangle &\to \text{ if condition then } \langle \text{STMT} \rangle \text{ else } \langle \text{STMT} \rangle \\ \langle \text{ASSIGN} \rangle &\to a = 1 \end{aligned}$$

a) Show that the grammar G is ambiguous.

b) Give an unambiguous grammar that generates the same language as G.

Submission

You may turn in your assignment using the drop boxes on the second floor in the math science building, or by giving your assignment in person to one of the TAs. You must submit your assignment on or before Monday, June 20, 2016, 13:00. No late submissions will be accepted. The deadline is **firm**. For extenuating circumstances please contact the instructor.

Use the last page of this assignment as the front page of your assignment. Assignments submitted without the front page will be deducted 1 point.

Collaboration and plagiarism

You are welcome to work and discuss the assignment with other students enrolled in this course (i.e., CPSC 313 Spring 2016). You must clearly state whom your collaborators are, if any, for each problem on the assignment.

Verbal collaboration is allowed. Written collaboration is strictly forbidden. For instance, notes, papers, emails, messages, texting, twitter, chats, blogs, discussion boards, whiteboards, blackboards, and photos used as communication devices are strictly forbidden. All written work that you submit must be your own sole work. Anything else will be considered plagiarism. When you are discussing this assignment with others, do not use any form of writing.

The use of published literature is allowed. If you use any published literature (texts, articles, websites, etc) to complete your assignment, you must quote your sources. I suggest that you develop your own solutions however, without the use of any published materials. You will be asked to answer similar questions on the exams for this course and during the exams no such sources will be available.

You may read about the regulations on plagiarism in the calendar here: `http://www.ucalgary.ca/pubs/calendar/current/k-2.html`. If you have any doubt whether a collaboration is allowed or not, ask the lecturer before entering the collaboration.

CPSC 313 Assignment 2 Spring 2016

Name: _____

My sources and my collaborators, if any, on this assignment were:

Exercise 1: _____

Exercise 2: _____

Exercise 3: _____

Exercise 4: _____