# Assignment 4
# Due no later than June 28 at 17:00

*For full credit it is enough to accumulate 8 points.*

Please give succinct, unambiguous, and well-phrased answers to the problems on the assignment. These qualities will be taken into account in the assessment.

**Exercise 1** (**2 points**.) The Euclidean algorithm computes the greatest common divisor of two nonnegative integers:

```
int gcd(m,n)
{
  if (n==0) return m
  else return gcd(n, m mod n)
}
```

Give a Turing machine with input alphabet $\{1, \#\}$ that on input $1^m\#1^n$ halts with $1^{\gcd(m,n)}$ written on its tape. Your description should be at the level of the description in the class for the Turing machine that accepts the set $\{1^n |\ n \text{ is a power of } 2\}$. In particular, do not give a list of transitions.

**Exercise 2** (**3 points**.) Let $\Sigma$ be an alphabet, and suppose that $A, B \subseteq \Sigma^*$ are Turing recognizable languages for which both $A \cap B$ and $A \cup B$ are decidable. Prove that $A$ is decidable.

**Exercise 3** (**3 points**.) Recall that $w^R$ denotes the reversal of the string $w$; for example $abc^R = cba$. Prove that the following language is undecidable.

$$\text{REVACCEPT} = \{\langle M\rangle |\ M \text{ accepts } \langle M\rangle^R\}$$

**Exercise 4** (**2 bonus points**, no partial credit.) Suppose you are given an array $A[1..n]$ of numbers, which may be positive, negative, or zero, and which are not necessarily integers.

a) (Not graded, included here for practice. Do not submit.) Describe and analyze an algorithm that finds the largest sum of elements in a contiguous subarray $A[i..j]$ in time $O(n)$.

b) Describe and analyze an algorithm that finds the largest product of elements in a contiguous subarray $A[i..j]$ in time $O(n)$.

For example, given the array $[-6, 12, -7, 0, 14, -7, 5]$ as input, your first algorithm should return the integer 19 and your second algorithm should return the integer 504. For the sake of analysis, assume that comparing, adding, or multiplying any pair of numbers takes $O(1)$ time.

## 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 28, 2016, 17:00. 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:** _____