ENGR 244 – ENGINEERING COMPUTING – SPRING 2018 – FINAL EXAM

Recommendation: Solve two out of the three given problems.

- You have **110 minutes** from the moment that the beginning of the exam is announced.
- This exam consists of three problems. Each is worth up to 25 credits, out of 100 credits for the whole course. At most 35 credits can be gained from the present term exam.

  You need to **work on two problems** to achieve an optimal outcome.
- If you **choose to work on two problems**, the problem with the best outcome will count normally (i.e., up to 25 credits), and the other problem will be scaled by a factor of 40% (i.e., up to ten credits), yielding an **optimum total of 35 credits**.
- If you choose to work on all three problems, the outcomes will be ordered by the number of credits achieved. **The best problem counts with a factor of 100%**, and **the second best problem is scaled by a factor of 40%**, yielding up to 35 credits for the exam as a whole. The outcome of the remaining problem does not influence your grade.
- On the last page, there is also a bonus problem, yielding up to seven credits additionally.

Make sure that **every paper** that you submit contains your **name** and **student ID**. Any access to means of communication is a case of cheating irrespective of what is communicated. It is enough to **turn off your cell phones**. *You absolutely do not need to place your cell phones on the front desk.*

Recall that it is sufficient to **solve two out of the three present exam problems**. Feel free to hand in your submission at any time and leave the room without disturbing the other participants.

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FINAL EXAM – PROBLEM 1

Prove that the following problem has linear time complexity:

"For n given integer values (e.g., given as an integer array with indices from 0 to n – 1), determine the **sum of all given values that are even** (divisible by two), ignoring the odd values."

FINAL EXAM – PROBLEM 2

Consider the following Java program:

```
public class ArrayExample
{
  public static void modify(int[ ] x)
  {
    for(int i = 0; i < x.length; i++)
    {
      int j = -1;

      int k = x[ i ];
      if(k < 0)  k = - k;

      for(int m = 0; m < k; m++)
      {
        for(int n = 0; n < k; n++)  j++;
      }
      x[ i ] = j / (x[ i ] + 1);
    }
  }

  public static void main(String[ ] args)
  {
    int[ ] a = {1, 2, 4, 8, 16};

    modify( a );

    for(int i = 0; i < a.length; i++)  System.out.println(a[ i ]);
  }
}
```

a) What is the **program output**?

b) **Simplify the method** "modify", such that it contains three or less statements, but still does exactly the same task as before.

FINAL EXAM – PROBLEM 3

Write a method with a single argument, **double** *x*, that returns the value given by

$$1 \;/\; (y + y^3 + y^5 + y^7 + y^9 + y^{11} + \ldots),$$

wherein $y = 1 / (x^2 + 2)$. In other words, write a method which for a given value of *x* returns

$$\left[\sum_{k=0}^{\infty} (x^2+2)^{-2k-1} \right]^{-1}.$$

A call to your method must actually **return a value**, i.e., it may **not remain in an infinite loop** and run forever. Therefore, it is advisable not to try to determine the exact value of the infinite sum, but to truncate the sum at an appropriate point, according to your judgement.

The **level of accuracy** that is guaranteed by your method will influence the grade. However, it is not necessary for you here to characterize the accuracy or make any statement on it.

Bonus problem: Write a Java program (it is sufficient to write the main function), with only a single statement, which never stops and, instead, **continues to run forever**.

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