CST 370 – Spring A 2020
Homework 2

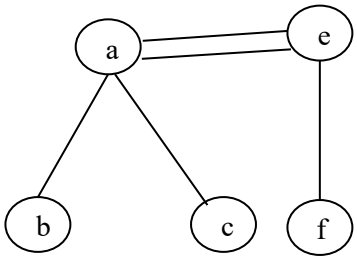
Name: _____

Class ID: _____

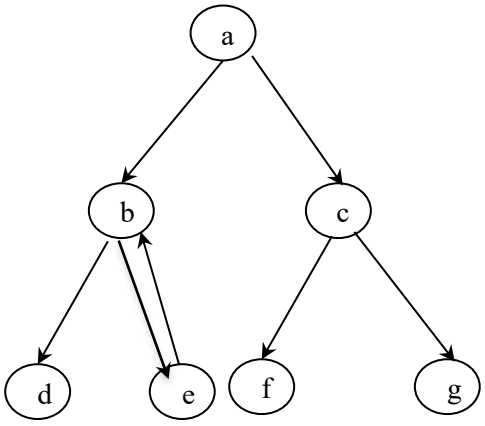
How to turn in?

- Write your answer to the questions 1 to 7, and submit it on the iLearn. You can submit the file in PDF format. Don't forget to write your name and class ID number at the beginning of the file.
- For Questions 8 and 9, you should submit your C++ source files on the iLearn.
- Thus, you have to submit three files (one PDF file and two C++ source file) on the iLearn.
- Note that the due date is 11:55(PM). This is the iLearn's timestamp, not your submission time. Since there could be a long delay between your computer and iLearn, you should **submit early**.

1. (5 points) (a) Based on our textbook's definition, is this a graph? (True/False) Explain to support your answer.



(b) Based on our textbook's definition, is this a graph? (True/False) Explain to support your answer

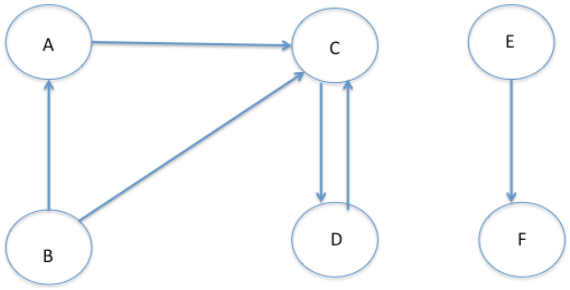


2. (10 points) Assume that you should search a number in a list of *n* numbers. How can you take advantage of the fact that **the list is known to be sorted**? Give separate answers for the following two cases.

(a) A list represented in an array.

(b) A list represented in a linked list.

3. (5 points) Represent the following graph in the adjacency list as you learned in the class. Note that there are **six vertices** (= A, B, C, D, E, and F) in the graph.



4. (5 points) Assume a binary tree with six vertices such as v1, v2, v3, v4, v5, and v6. Determine the maximum number of edges possible in the tree.

5. (5 points) (a) If your program takes $n*log\ n$ time and your classmate's program takes n^2 time, whose program is faster? Pick one between "You" and "Your Classmate".

(b) If your program takes *log n* time and your classmate's program takes *constant* time, whose program is faster? Pick one between "You" and "Your Classmate".

6. (10 points) Consider the following algorithm.

Algorithm *Compute* (A[0.. n – 1])
1. num1 ← A[0];
2. num2 ← A[0]
3. i ← 1

```
4.  while i < n do
5.      if A[i] < num1
6.          num1 ← A[i];
7.      if A[i] > num2
8.          num2 ← A[i];
9.      i ← i + 1
10. return (num2 – num1);
```

(a) Present the basic operation of the algorithm. When you present the basic operation, you should indicate the line number of the basic operation clearly.

(b) Present the time complexity category of the algorithm among the eight most popular time complexity categories we covered in the lecture.

7. (10 points) Consider the following algorithm

```
1. Algorithm Mystery(n)
2. // Input: A nonnegative integer n
3. S ← 0
4. for i ← 1 to n do
5.      k ← i * i
6.      S ← S + k
7. return S
```

(a) What does this algorithm compute?
(b) What is its basic operation?
(c) Present the time complexity category of the algorithm among the eight most popular time complexity categories we covered in the lecture.

8. (25 points) Write a C++ program called **sieve.cpp** that implements the **sieve of Eratosthenes** algorithm in our textbook (page 6 ~ 7). The following video will help your understanding of the algorithm:
https://youtu.be/klcIklsWzrY

For the assignment, you can assume that the user always enters a positive integer which is bigger than 1. For the program, you have to use a **dynamic memory** to create array(s) to store data. For details on the dynamic memory, read http://www.cplusplus.com/doc/tutorial/dynamic/

For the assignment, you **have to write your program based on the pseudocode in our textbook**. If you use other algorithm or library, you will get penalized.

Grading guide and test cases for the sieve.cpp:

- Missing head comment elements (= Title, Abstract, ID, Name, and Date).
- Compilation failed → It will be very serious.
- Your program should use the dynamic memory for array(s).
- Test case 1: Input number 2 → 2
- Test case 2: Input number 10 → 2, 3, 5, 7

- Test case 3: Input number 25 → 2, 3, 5, 7, 11, 13, 17, 19, 23
- Test case 4: Input number 101 → 2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47, 53, 59, 61, 67, 71, 73, 79, 83, 89, 97, 101

9. (25 points) Write a C++ program "palindrome.cpp" that reads a string of characters from user and determines if the string is a palindrome or not. For the program, you should store each character of the string in an array (use **dynamic memory** to create array(s)) and follow the algorithm described in the lecture.

Palindrome is a string that reads the same from both the beginning and the end. Here are sample test cases:

(1) Input string 1: racecar
Output: Yes, it's a palindrome
(2) Input string 2: abcdefghijihgfedcba
Output: Yes, it's a palindrome
(3) Input string 3: CSUMB
Output: No, it's not a palindrome