CSE 102 – Final Exam

June 1, 2018

Name Surname:

ID:

S1 (15)	S2 (10)	S3 (10)	S4 (15)	S5 (25)	S6 (25)	Total (100)

Rules:

- You are allowed one A-4 sized sheet of paper with **handwritten** notes on it
- Lecture notes, text books, or any similar materials CAN NOT be used during the exam.
- All electronic devices (including cell phones) must be **switched off** during the exam. In case you use an electronic device, your exam booklet will be taken and your exam score will be 0.
- The duration of the exam is **110 minutes**, starting at **10.30** and ending at **12.20**.

Instructions:

- Read each problem carefully.
- If you need extra paper, please notify the instructor or proctor
- This exam has 6 sections. Please make sure that all pages are included in your exam.

Section 1 Quick Answer (15 points)

True/False: If the statement(s) is(are) true, circle T. Otherwise, circle F.

1. **T** **F** A Stack is a type of First In First Out data structure.
2. **T** **F** Set is a Collection that allows duplicate elements.
3. **T** **F** Given two reference variables t1 and t2, if `t1==t2` is true, `t1.equals(t2)` must also be true.
4. **T** **F** The keys must be unique for a HashMap.
5. **T** **F** The size of an ArrayList can grow and shrink at runtime.

Multiple Choice: Circle the answer that is **most correct**.

6. Which of the following sorting algorithms is considered "slowest" in the average case?
   a. Merge Sort
   b. Quick Sort
   c. Bubble Sort
   d. All of these are the same complexity
7. All of the following are parts of a well-written recursive method except:
   a. Recursive Call
   b. Iteration
   c. Base Case
   d. Convergence
8. Blocks of code that begin with which of the following keywords will **always** execute?
   a. `catch`
   b. `if`
   c. `while`
   d. `finally`
   e. All of the above
9. Which of the following can have abstract methods?
   a. Abstract classes
   b. Non-abstract classes
   c. Interfaces
   d. A and C
   e. All of these must have abstract methods
10. Which of the following is a valid identifier in Java?
    a. `*oftheShow`
    b. `2BorNot2B`
    c. `true`
    d. `int`
    e. None of these are valid identifiers

Ordering: Order the given Big O complexities from least to greatest.

$O(\log n)$, $O(n^2)$, $O(2^n)$, $O(n^3)$, $O(n)$

$O(\log n)$	<	$O(n)$	<	$O(n^2)$	<	$O(n^3)$	<	$O(2^n)$
11.		12.		13.		14.		15.

Section 2 Longer Answer (10 points)

Given below are two (2) system definitions that use a group of Objects. For each, indicate the most ideal type of core data structure we should use to implement the group (such as Array, Set, List, etc.). Give a two to three sentence justification for your choice.

1. A group of students that are in a class so we can keep track of grades
    a. Order does not matter
    b. We should use their Student ID number as a key to access each student
    c. The group will consist of not more than 99 students

Map

We can use the student ID as a key to quickly access the student object. In a Map, order does not matter.

2. A group of students waiting to see their advisor
    a. Order matters
    b. A new student arriving should be placed at the end of the line
    c. The student who has been waiting the longest should be the next seen
    d. The group will consist of not more than 60 students

This describes a Queue. Likely answers would be ArrayList, List, or array.

Section 3 Big O (10 points)

For the code segment below, determine the Big O complexity of the algorithm.

```
public int myMethod(int n){
    if(n <= 0)
        return 0;
    int sum = 0;
    for(int i = 1; i <= n; i++)
        if(i % 2 == 0)
            if(n % 2 == 0)
                sum += 3;
            else
                sum += 2;
        else
            for(int j = 1; j <= i; j++)
                sum += 1;
    return sum;
}
```

$O(n^2)$

Section 4 Write a Method (15 points)

In the box provided, write a method called *calculateInterest(double p, double r, int m)* that takes the principal amount (p) and calculates the total amount to be paid using the interest rate (r) and the number of months (m). This is compound interest (it is calculated monthly and the new principal is used for the next month). Examples given below. Assume the interest rate (r) will be between 0 and 1.

NOTE: A bonus **10 points** will be given if your solution runs in *O(1)* (constant) time.

```
calculateInterest(1000, 0.01, 1) -> 1010.0
calculateInterest(1000, 0.01, 2) -> 1020.1
calculateInterest(1000, 0.01, 3) -> 1030.301
```

```
public static double calculateInterest(double p, double r, int m){
    // iterative approach
    double sum = p;
    for(int i = 0; i < m; i++)
        sum *= 1 + r;
    return sum;
}

public static double calculateInterest(double p, double r, int m){
    // recursive approach
    if(m <= 0)
        return p;
    return calculateInterest(p, r, m - 1) * (1 + r);
}

public static double calculateInterest(double p, double r, int m){
    // O(1) approach
    return p * Math.pow(1 + r, m);
}
```

Section 5 Design (25 points)

Draw a UML class diagram and write the java classes for the following system. Also, draw other UML diagrams that are requested. You may use the empty space provided below for any additional classes you feel are necessary.

1. Classes and Properties
    a. A **Product** has a numerical ID, Name, Description, and price
    b. **Food** is a type of Product that also has Calories, Fat, and Carbs
    c. **Clothing** is a type of Product that has a Style and Size
    d. A **Customer** has a Name, Phone Number, Address, and Birthdate
    e. A Customer will have a **Cart** that will contain Products they want to purchase
2. Operations
    a. Product has a *discount()* method that takes an double parameter. This double must be between 0.01 and 1. and represents the percentage decrease in the price of the product. It should return the calculated amount. It should **NOT** change the price of the item.
    b. Cart has an *addProduct()* method that takes a Product and an integer count parameter. This will add the number of Products to the customer's Cart.
    UML: Draw a UML Sequence Diagram showing how a Customer will add a Product to their Cart. (NOTE: Sequence diagrams not discussed in 2019 semester)
    c. Cart has an *removeProduct()* method that takes a Product parameter. It will remove all Products of the parameter type from the Cart. If the Product is not found in the Cart, this method will throw a ProductNotFound Exception.
    UML: Draw a UML Activity Diagram showing the process flow for the removeProduct method.
    d. Cart has a *clearCart()* method that takes no parameter. It removes all Products from the Cart.
    e. Cart has a *checkout()* method that displays (prints) all Products in the Cart, their individual counts and prices, and a total amount due.
    f. Cart has a *confirmCheckout()* method that removes all Products from the Cart and returns the total amount due.

```
public class Product
```

public class Food
public class Clothing
public class Customer

```
public class Cart
```

Section 6 Group Project (25 points)

On this page (front and back), answer the following questions:

1. Draw the UML class diagram for your group's project.
2. Draw **one** of the other UML diagrams your group created for the Project Design Report. Identify what type of diagram you choose to draw.
3. Identify one of the **major** classes or methods you were primarily responsible for. Write a short summary of the purpose for and the technical details of this class/method.
4. Identify one disagreement or difficulty that your group had concerning the appropriate way to design or implement the system. How was this resolved?