CSE/IT 326: Software Engineering
Spring 2021

Final Exam, May 4^{th}, 2021

Your Name: _____ **Student ID:**_____

Instruction: *This is a take-home exam, and following is the general instruction for the exam. Students are expected to follow this instruction, and failing to do so may result in a grade reduction or an Honor Code violation.*

1. *You can work on the exam for 24 hours. Please print out the exam on 8.5" x 11" paper, single sided, and complete the exam.*
2. *To submit your exam answer, submit your finished exam as a* ***PDF*** *to CANVAS by* ***May 4th (Tuesday), 11:59pm****.*
3. *You may refer to the lecture notes, homework, and textbook/print. You are not allowed to refer to any other material.*
4. *You may not consult with any other person regarding the exam. You may not check your exam answers with any person.*

	POINTS	YOUR SCORES
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
Total	100	

1. [**Software Process Models, 10 points**] Answer the following questions.

   a. Give the correct order of activities in the following software design workflow. **[2 points]**

      A. *Subsystem design*

      B. *Object design*

      C. *Architecture design*

      D. *Use case design*

   b. Briefly discuss Capability Maturity Model in terms of ***i***) when a software development process is defined to be *mature*, and ***ii***) what are the five levels in the model. **[4 points]**

   c. Briefly discuss the software development lifecycle (SDLC) model adopted for your final project of this class. Is it a sequential or iterative approach? Provide at least two advantages of the SDLC model your team has used. **[4 points]**

2. [**Modeling with UML, 10 points**] Modeling is to build an abstraction of reality.

   a. Consider a Banner system such as NMT Banweb. Identify at least **four** different actors that interact with this system. **[2 points]**

   b. What is the difference between a scenario and a use case? When do you use each construct? **[2 points]**

c. Use class diagram to model the following. **[2 points]**

- The relationship among **Person**, **Parent**, and **Child**
- The relationship among **Graph**, **Node**, and **Link**

d. Consider a system that has a Web server and two database servers. Both database servers are identical: the first acts as a main server, and the second acts as a redundant backup in case the first one fails. Users use Web browsers to access data through the Web server. They also have the option of using a proprietary client that accesses the databases directly. Draw a UML deployment diagram representing the hardware/software mapping of the system. **[4 points]**

3. [**Requirement Elicitation and Analysis, 10 points**] As the head of Information Technology at Acme, Inc., you are tasked with building a new payroll system to replace the existing system that is hopelessly out of date. Acme needs a new system to allow employees to record time card information electronically and automatically generate paychecks based on the number of hours worked and total amount of sales (for commissioned employees). Following is the Flow of Events of the **Delete an Employee use case** of the payroll system:

Flow of Events

1. The system requests that the Payroll Administrator specify the employee id.
2. The Payroll Administrator enters the employee ID. The system retrieves and displays the employee information.
3. The system prompts the Payroll Administrator to confirm the deletion of the employee.
4. The Payroll Administrator verifies the deletion.
5. The system removes the employee from its database.

a. Construct a class diagram using the Flow of Events. **[5 points]**

b. Construct a sequence diagram based on your class diagram solution of the question above and the Flow of Events. **[5 points]**

4. [**Object Design, 10 points**] Object design (OO) is the process of adding details to the requirements analysis and making implementation decisions.

   a. Briefly discuss the four key activities for object design. [**2 points**]

   b. Briefly discuss the OOD principle of "*Liskov Substitution*", along with its example and benefits. [**4 points**]

   c. Briefly discuss the OOD principle of "*Dependency Inversion*", along with its example and benefits. [**4 points**]

5. [**Design Patterns I, 10 points**] Answer the following questions.

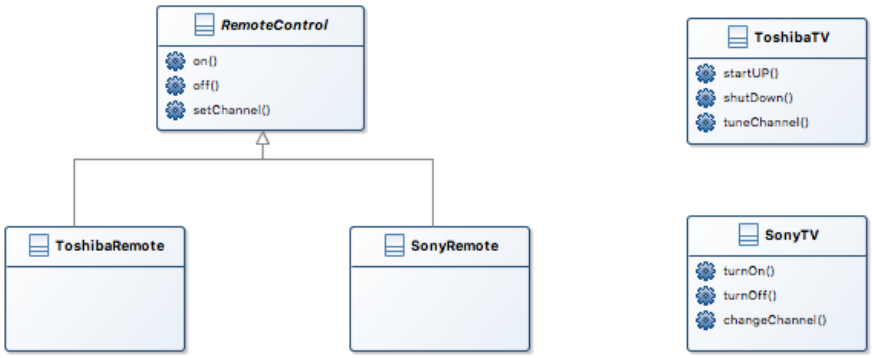
   a. Briefly discuss what design patterns are. [**2 points**]

   b. List two situations where it would be appropriate to apply the **Decorator** design pattern. **[4 points]**

   c. List two consequences of using the **Abstract Factory** design pattern. **[4 points]**

6. [**Design Patterns II, 10 points**] Answer the following.

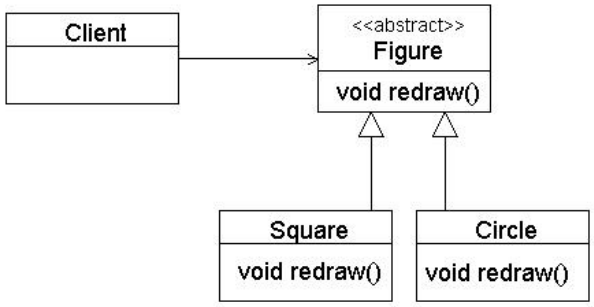
   a. Modify the following design using the **Bridge** design pattern so that you can vary the implementation over two TVs as well as the interface (*RemoteControl*). Use two new concrete classes, **TouchRemoteControl** and **VoiceRemoteControl**, as variations of the interface. [**5 points**]



b. Transform your class diagram solution of the question above into Java (or pseudo) code. [**5 points**]

7. [**Design Patterns III, 10 points**] Answer the following questions.

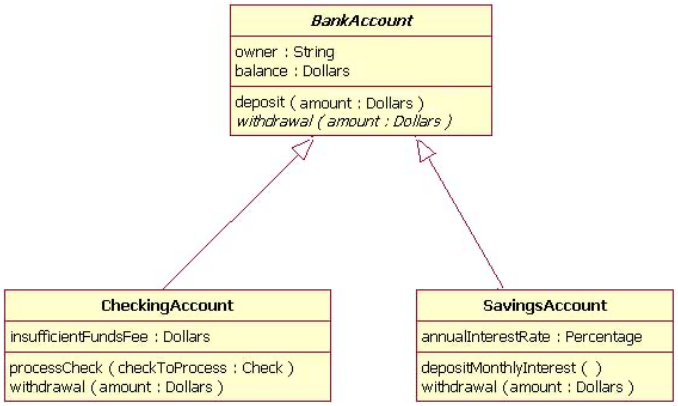
a. Modify the following design using the **Composite** design pattern so that a Client can interact transparently with either a single Figure or a group of Figures. [**5 points**]



b. Transform your class diagram solution of the question above into Java (or pseudo) code. [**5 points**]

8. [**OCL and Mapping Models to Codes, 10 points**] Answer the following questions.
   a. Consider the `Stack` class in the `java.util` package for a last-in-first-out (LIFO) stack of objects. Write post conditions in OCL for the following operations: [**6 points**]
      i. `E pop()` removes the object at the top of this stack and returns that object
      ii. `E push(E item)` pushes an item onto the top of this stack
      iii. `E peek()` looks at the object at the top of this stack without removing it from the stack

   b. Map the following inheritance relationship among BankAccount, CheckingAccount, and SavingAccount to relational tables using vertical mapping. [**4 points**]



9. [**Software Security, 10 points**] Answer the following questions.

   a. Briefly define what the least privilege principle is and discuss also at least one example of security ramification when violated. [**4 points**]

b. Cryptography is one of the fundamental security techniques to protect communications and data used by applications. Consider you are going to develop an online banking system that will allow customers to check their account balance and transfer fund. Instead of using AES algorithm, considering performance, your team member proposed to use a much faster encryption algorithm based on XOR as follows:

```
void EncryptData(char *szKey, DWORD dwKeyLen,
                    char *szData, DWORD dwDataLen){
    for (int i = 0; i < dwDataLen; i++) {
        szData[i] ^= szKey[i % dwKeyLen];
    }
}
```

Discuss why this is a bad idea. [**6 points**]

10. [**Software Testing, 10 points**] Answer the following questions.

c. Briefly define the difference between validation and verification. [**3 points**]

d. Briefly discuss the four testing steps. [**4 points**]

e. White-box testing focuses on structural aspects; black-box test focuses on the functional requirements. Identify at least three white-box testing techniques. [**3 points**]