Midterm Exam 1: Wednesday Sep. 28, 2022

Individual Work

Format

- Closed books and notes
- Digital media, internet access, or communication of any kind is **NOT** allowed

- Can have one two-sided, 8.5" × 11" crib sheet
- Crib sheet must be your own & include your Posting ID at top right corners
- The crib sheet must be turned in with the exam

Partial points will **NOT** be given to True/False and Fill-in-the-blank questions

Exam Coverage
All materials (including textbook chapters, course notes, homework assignments, and review sessions) covered from Aug. 22 through Sept. 27, 2022

Tempe Locations: CDN 60 and CAVC 359
Polytech Location: PRLTA 122

Classroom assignments for Tempe will be announced by 8 AM, Sept. 28, 2022

You MUST HAVE your ASU ID card to take the exam; NO other ID card is acceptable

Please arrive a few minutes early

Read questions <u>carefully</u> and answer what is <u>asked for</u>. Answer all questions.

As necessary, make appropriate <u>assumptions</u> & include them in your answers.

Total points: 100

NOTES:
- All specifications to be developed according to the UML standards (Astah)
- Use the Java Programming Language as needed

*** Any answer written on the last page will not be graded ***
*** Answers to questions should be written in their provided spaces ***

1. [8 points] Fill-in-blank. The items in the table below may be used never, once, or multiple times.

simple	restrained	applicable	Attributes	discrete	few	whole
abstractions	continuous	whole	parts	limitation	many	complex

Quality attributes defined for ____discrete____ systems are applicable to software.

A system should have ____few____ interactions among its ____parts____.

Software complexity is required to be ____complex____ to achieve its user needs.

Distinct ____parts____ of software are necessary given ____abstractions____ of human reasoning.

The hidden order property of ____continuous____ systems should be engineered for ____complex____ systems.

2. [4 points] Modularity is one of the Basic principles of the Object Model.

   (a) [2 points] Is the Modularity principle needed mainly for the behavior or structure of an object's abstraction? Mark **X** for either **Behavioral** or **Structural** below. Choose only one answer.

   Behavioral _____ ;   Structural ____X____

   (b) [2 points] Explain your answer to Part (a).

   Modularity is the property whereby if it is removed or replaced, it will not affect other modules. Thus the object's structural modules parts should work into without must much dependence on the other modules and able to function as a whole.

3. [8 points] Consider Object-Orientated programming languages.

(a) [4 points] Name two concepts of the Object-Oriented programming languages that distinguish them from the late 3rd generation programming languages. Add your answer to the table below.

(b) [4 points] What are the benefits of the two concepts from Part (a). Provide one benefit for each concept separately. Add your answer to the table below.

	Concepts	Benefits
1	✶ Proper semantics ~~Object Based~~	✶ Allows for better understanding of the purpose of the objects. ~~The individual item # of object are well define in terms of their role in the problem or solution domain.~~ It also reduced ambiguity.
2	Object based	The object are ~~in div~~ individual items well defined in ~~te~~ terms of its role in the problem or solution domain

4. [8 points] Consider a calculator that can add and multiply operations for natural numbers (positive numbers). Assume two algorithms can be used for the multiplication operations.

(a) [4 points] What kind of abstraction (entity, action, virtual machine, coincidental) is appropriate for this calculator? ___entity___

Explain your answer:

The calculator can be seen as an entity that performs some particular operation on natural numbers.

(b) [4 points] What kind of abstraction (entity, action, virtual machine, coincidental) is appropriate for the multiplication operations? ___action___

Explain your answer:

The multiplication operations depend on the action that will be performed over natural numbers and thus the kind of abstraction is action.

5. [8 points] The Object Model is defined to have two categories of principles named *Basic* and *Advanced*. Consider a digital calculator hosted on a remote computer. A user's computer may lose connection to the remote computer. Suppose the user enters the numbers needed for the calculation. Before the calculator can complete the calculation, the user computer loses connection to the remote computer. Once the connection is restored, the remote computer provides the result of the calculation to the user. Chose either **Needed** or **Not Needed** for each row and provide an explanation.

	Needed	Not Needed	Explanation
Basic principles		✓	Basic principles of object model is only relevant to their simple structures and behaviors.
Advanced principles	✓		Advanced principles is needed for edge cases like the one stated in the question to specify how object Model should behave in the event such a special case were to occur.

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6. [16 points] Consider a microphone. When it receives a sound, it converts it to electrical signals. It is used in devices such as phones.

The answers to the following question should be limited to the description provided above.

   (a) [4 points] Define one useful variable with a suitable name for the microphone.

   Name 1:   voltage

   Description 1:   It records the instantaneous voltage based on the sound which have vibrated the microphone's membrane to generate the voltage.

   (b) [6 points] Define two useful functions with suitable names for the microphone. Each operation should have a name and description of what it does.

   Name 1:   current Amplitude ()

   Description 1:   It takes ~~a sliding the~~ sliding window array of voltage and averages the highest intensity.

   Name 2:   current Frequency ()

   Description 2:   It takes a sliding window array of voltage and perform fast fourier transform to determine the frequency.

   (c) [3 points] Is the microphone a **Passive** or **Active** object? Mark **X** for you answer below.

   Passive _____ ;   Active _____X_____ ;

   (d) [3 points] Explain your answer for Part (c).

   It takes the sound from the environment and represents in terms of voltage which can then be notified to devices like our phone and can change the behaviour of the phone if the phone is using microphone to say record audio.

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7. [20 points] Consider a water tank. It has a finite capacity. It can be filled using an inflow pipe. The tank can be emptied using an outflow pipe. The water volume in the tank should exceed some designated amount called *ReleaseVolume*. The outflow pipe is opened using a nozzle opens when the volume reaches the designated amount. Otherwise, the outflow pipe is closed. This question should be answered in terms of an **Object** defined to have state, behavior, and identity.

The answers to the following questions should be limited to the description provided above.

(a) [4 points] Identify one useful state variable. Complete the table below.

State name	dimensions
Description	It is an array of 3 floating point numbers representing the length, breadth and height of tank
Values	greater than 0.00
Unit	gallons

(b) [4 points] Identify another useful state variable. Complete the table below.

State name	is Nozzle Open
Description	~~Sta~~ The state of the outflow pipe whether is it open or closed.
Values	either ~~open or clos~~ true or false.
Unit	boolean

(c) [4 points] Identify one useful behavior that **can find something useful** about the water tank. Complete the table below.
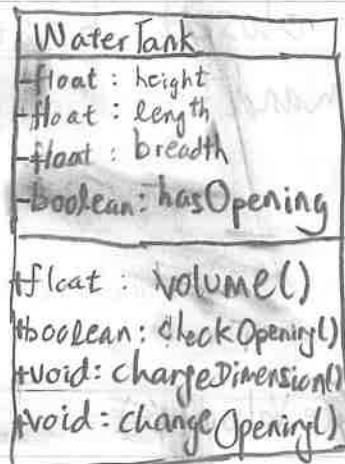
Behavior name	~~open~~ Control Nozzle
Behavior description	Controls whether the nozzle will be opened or closed based on the given command.

(d) [8 points] Identify another useful behavior that **can result in a meaningful change** to the water tank. Complete the table below.
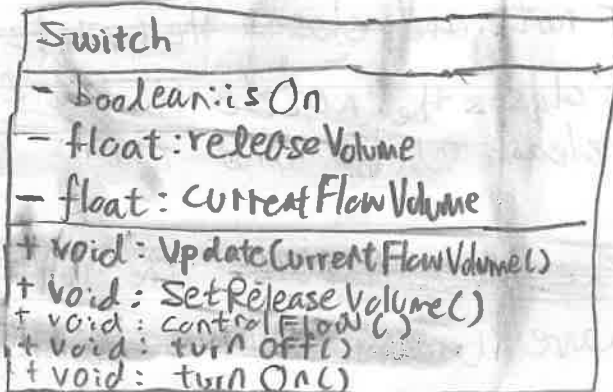
Behavior name	check Release Volume ~~⊠~~
Behavior description	checks the current nozzle flow volume and see if it is greater than Release Volume or not. ~~and closes the nozzle~~ It closes the nozzle if the flow exceeds release volume and opens otherwise.
One pre-condition	~~The nozzle must~~ The water tank must have water in the tank and not empty.
One post-condition	~~The tank~~ The flow rate of nozzle should be regulated close to the ReleaseVolume given.

8. [22 points] Consider the water tank above. Answer the following questions according to the UML standard visual notation. The Parts (a), (b), and (c) questions should be answered separately. Don't combine the answers for the parts into one.
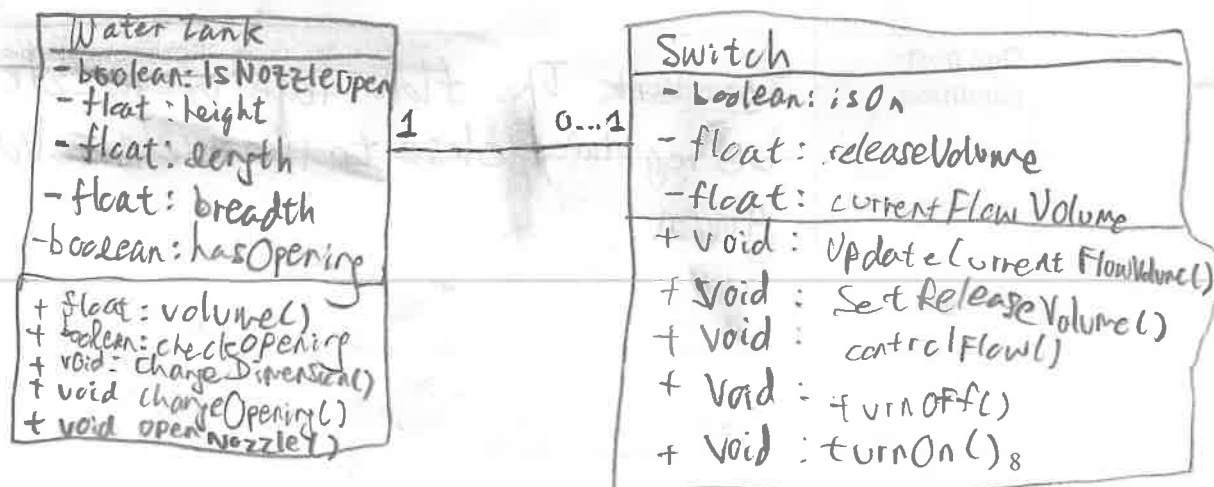
(a) [12 points] Specify a class for the water tank. Name this class **WaterTank**. Include brief description for the attributes and methods.

```
WaterTank
-float : height
-float : length
-float : breadth
-boolean : hasOpening

+float : volume()
+boolean : checkOpening()
+void : changeDimension()
+void : changeOpening()
```

(b) [6 points] Consider a switch that can turn on or turn off the nozzle for the outflow pipe of the water tank. The nozzle is opened when it is notified the water tank amount is equal to *ReleaseVolume*. Specify a class for the switch.

```
Switch
- boolean : isOn
- float : releaseVolume
- float : currentFlowVolume

+ void : Update(currentFlowVolume)
+ void : SetReleaseVolume()
+ void : controlFlow()
+ void : turnOff()
+ void : turnOn()
```

(c) [4 points] Specify a UML class diagram for the water tank and switch.

```
WaterTank
-boolean: IsNozzleOpen
-float : height
-float : length
-float : breadth
-boolean : hasOpening

+ float : volume()
+ boolean : checkOpening
+ void : changeDimension()
+ void : changeOpening()
+ void : openNozzle()
```

1   0...1

```
Switch
- boolean : isOn
- float : releaseVolume
-float : currentFlowVolume

+ void : UpdateCurrentFlowVolume()
+ void : SetReleaseVolume()
+ void : controlFlow()
+ Void : turnOff()
+ Void : turnOn()
```

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9. [6 points] Consider the above UML class for the water tank.

(a) [2 points] Should any object of this class (i.e., instances) be identifiable by other objects?

Yes _____X_____ :   No _____

(b) [2 points] Can the water tank class specification include its own identity? Mark your answer with **X**.

Yes ____X_____ :   No _____

(c) [2 points] Explain your answer for Part (b).

We could have identity for the water tank class if we use "extend" to inherit from water tank class and create new classes that have more specific water tank specifications.