

Engr 9874 FinalExam

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Instructions: Answer all questions. Write your answers in the space provided. Request a yellow booklet if more space is required. This is an **closed** book test. Textbooks, notes, and electronic devices are not permitted. However, paper inter-language dictionaries are permitted. Cell phones that ring during the exam become property of the instructor.

Total points: 105

Name:

Student #:

Q0 [10] Draw a UML class diagram corresponding to the following description of entities in the real-world. Show attributes, and operations. Show multiplicities as appropriate.

Routes 'R' Us provides real-time driving routes to drivers in a major metropolitan area, based on current and predicted traffic congestion.

The city consists of a set of intersections and a set of street segments. Each street segment connects one intersection to another and has a length. While intersections are one kind of location, another kind of location is a building. Each building is on one or more street segments. A route connects two locations via a series of street segments and intersections. For each street segment and each time in the future, there is a congestion-level object, which contains the expected speed at which vehicles will be able to traverse the segment.

Student #: _____

Q1 [15] The Composite pattern

(a) [5] Use a class diagram to illustrate the Composite Pattern

(b) [5] Use a sequence diagram to illustrate the Composite Pattern

(c) [5] Explain the circumstances when it is most appropriate to use the Composite Pattern. Given an example.

Student #: _____

Q2 [10] Liskov Substitution Principle

(a) [5] Explain what is meant by the Liskov Substitution Principle (LSP).

(b) [5] Give an example of the Liskov Substitution Principle.

(c) [5] Why does application of the LSP require thorough documentation?

Student #: _____

Q3 [10] Several (say n) concurrent threads communicate via WorkBag object as follows. Each thread repeatedly obtains (gets) an item of work and does the work specified by that item. In doing the work it may generate new items of work, which it puts into the bag. When there is no more work and all threads are looking for work, the job is totally done and all threads return with null. The interface to the WorkBag is as follows

```
interface WorkBagI {  
    public void put(WorkItem i) ;  
    public WorkItem get() ; }
```

(a) What considerations are there that make this class different from a class intended to be used by only one thread?

(b) What techniques can you use in a language such as Java to make the use of a WorkBag class safe?

(c) What special considerations are there for testing such a class?

Student #: _____

Q4 [10] Give a contract for a function that copies data from one array to another only backwards. As a precondition, both array pointers should be nonnull and the arrays should have the same length.

```
// requires  
  
// modifies  
  
// ensures  
  
void reverse( double [] a, double [] b ) { ... }
```

Q5 [10]

```
class A {  
    void accept(V v) { v.acceptA(this) ; }  
    void opA() { }  
}
```

```
class B {  
    void accept(V v) { v.acceptB(this) ; }  
    void opB() { }  
}
```

```
class CV implements V {  
    void acceptA( A a ) { a.opA() ; }  
    void acceptB( B b ) { b.opB() ; }  
}
```

Give a sequence diagram for the following code.

```
A a = new A() ;  
B b = new B() ;  
V v = new CV() ;  
a.accept( v ) ;  
b.accept( v ) ;
```

Be sure to indicate each invocation (execution) with a box (rectangle).

Student #: _____

Q6 [30] You are asked to design a new web browser. The browser must be able to obtain html files from the internet or from the local disk and render them to the screen. It also needs to maintain a “back stack,” which records the addresses of files recently visited.

Using UML diagrams, English prose, Java (or C++) code, and/or pseudo code, present a design for the web browser. Consider the major data structures and processes involved. Comment on likely future changes.

(There is more room on the next page.)

Student #: _____

(Continue question 6 here.)

(There is more room on the next page.)

Student #: _____

(Continue question 6 here.)

(If you need more space, ask for a yellow book.)

Student #: _____

Q7 [10] Explain your use of design patterns and design principles (such as SRP, OCP, LSK, and DIP) in the design of your animation editor project for this course.

Have a happy holiday and a refreshing break.