

CS 249a Final Exam - Closed Book In-Class Exam

Time allotted: 180 minutes December 10, 2007

Answer all questions. Each question is worth the points as indicated. You can answer in point form if you prefer when English is called for. You can use sketch code that is not necessarily complete AS LONG AS IT CLEARLY INDICATES you understand the approach or technique we are after. We are not looking for a full essay on each question, but rather a short concise set of points or sketch code that responds to the question and indicates you understand the point being explored. Make sure you print your name legibly and sign the honor code below.

The following is a statement of the Stanford University Honor Code:

- A.** *The Honor Code is an undertaking of the students, individually, and collectively:*
- (1) *that they will not give or receive aid in examinations; that they will not give or receive unpermitted aid in class work, in the preparation of reports, or in any other work that is to be used by the instructor as the basis of grading;*
 - (2) *that they will do their share and take an active part in seeing to it that others as well as themselves uphold the spirit and letter of the Honor Code.*
- B.** *The faculty on its part manifests its confidence in the honor of its students by refraining from proctoring examinations and from taking unusual and unreasonable precautions to prevent the forms of dishonesty mentioned above. The faculty will also avoid, as far as practicable, academic procedures that create temptations to violate the Honor Code.*
- C.** *While the faculty alone has the right and obligation to set academic requirements, the students and faculty will work together to establish optimal conditions for honorable academic work.*

I acknowledge and accept the Honor Code.

(Signature)

(Print name)

1	2	3	4	5	6	7	Total
30	30	30	30	30	30	30	210

1. **30 Points** Attributes

- (a) Rewrite the following class according to the discipline of this course.

```
class Vehicle : public NamedInterface {
    Velocity getVelocity() throws(exception) const;
    void adjustThrottle( float );
    Wheel * wheelArray( int ) const;
    void setTimeout( Seconds );
    Vehicle& operator++();
};
```

- (b) Your coworker, Gale Snottle, claims that transactional semantics for mutators is an academic fantasy that is infeasible in lots of cases. For example, if you tell a document to print itself, an airplane to take off or a cash dispenser to give out money, you cannot undo the action by just rolling back the state. Argue why you can always implement transactional semantics in a mutator if you follow the CS249a regime, or argue that you can't.

2. **30 Points** Entities, Values and Shared Descriptions

- (a) Considering Cheriton's distinction between entity and value types, give an example of an entity type that compromises the distinction and describe how it illustrates a rationale for the distinction. Similarly, give an example of a value type that compromises the distinction and describe how it illustrates a rationale for the distinction.
- (b) Cheriton claims that his attribute approach supports incremental evolution of an interface from simple to more detailed while retaining backwards compatibility and supporting even multi-level simulation. Illustrate how this is achieved with class interface for a Car object, for instance (or any type of real-world object you care to choose.)

3. **30 Points** You have a rare opportunity to explain Cheriton's notification approach to Britney Spears!
- (a) She cannot believe you are taking seriously this notion of all "listeners" for class being specified in a generic form, independent of the application requirements, and suggest you are the one that needs rehab. Justify why this notification approach makes sense to the degree that it does (i.e. any concerns about this approach).
 - (b) Britney is also shocked, shocked, shocked at rumors she hears of us using multiple inheritance in the definition of reactors, given all the disadvantages of MI. Specify a class definition of a reactor class to an EtherPort entity type that illustrates how multiple inheritance can arise with reactors, and justify why it makes sense to use.

4. **30 Points** Hillary Clinton disparages Cheriton's approach to smart pointers, claiming that he just pushes all the complexity of distributed, persistence, legacy software, etc. into the proxy types to "stifle the diversity" and only have a single Ptr type.
- (a) Describe to what degree she is right and whether or not it makes sense to do something different, justifying your answer.
 - (b) Describe the disadvantages of the CS249a smart pointer scheme versus conventional garbage collection, and how one can handle these issues.

5. **30 Points** You join a company whose software is littered with try-catch blocks and after grimacing a lot, you make the comment that you were taught in academia to minimize try-blocks. One of those "all-knowing" senior engineers points you at the following code and challenges you to apply your fancy "school book" learning to clean this up.

```
AirplaneManager::airplaneIs( Name n, VirtualSpace * vs ) {
    // create a new airplane call n in virtual space vs with two wings
    Airplane * a = 0;
    Engine * e = 0;
    try {
        a = new Airplane(n);
        if(!a) throw AirplaneCreationException;
        vs->objIs(n,a);
        try {
            Wing * lw = new Wing(a);
            if(lw) try {
                a->leftWingIs(lw);
                Wing * rw = new Wing(a);
                if(rw) try {
                    a->rightWingIs(rw);
                }

                catch(...) {
                    vs->objDel(n);
                    delete a;
                    delete lw;
                }
            } else {
                vs->objDel(n);
                delete a;
                delete lw;
            }
        } catch(...) {
            vs->objDel(n)
            delete a;
            delete lw;
            throw AirplaneCreationException;
        }
        else {
            vs->objDel(n);
            delete a;
            throw AirplaneCreationException;
        }
    } catch(...) {
        throw;
    }
    else throw DirEntryFailed;
}
catch( AirplaneCreationException& ace ) {
    throw Exception;
}
return a;
}
```

To put this smarty boy in his place,

- (a) Rewrite this function with as few try blocks and throw statements, etc. as possible, stating and justifying any assumptions you are making about the functions that are called.
- (b) Describe why your rewritten version is superior from a software engineering standpoint, including pointing out any problems that original code has.

Continued for problem 5.

6. **30 Points** George Bush (GB) is proposing to adopt our 249a story and require that all name-able objects have an interface that is derived from a common NamedInterface class, causing John Edwards (JE) to argue that this is another right-wing conspiracy against diversity.
- (a) Describe to JE why the GB is technically mandated, or else, if you can, come up with an alternative that actually works for JE, i.e. no common base class.
 - (b) JE also argues that having every object implement its own part of the directory system is like every person being their own lawyer, cutting to the fees he and his cronies collect. Ignoring the fees issue, describe to what degree JE is wrong again by considering the alternative, or how an alternative could work.

7. **30 points** Consider modeling an all-wheel drive all-terrain vehicle (ATV) object with 4 Wheels objects. You need to be able to handle a Wheel being removed from the ATV, added back to the ATV and the ATV communicating torque/force to each wheel and also force from each Wheel back to the ATV to reflect interaction with the Terrain.
- (a) Draw the object structure to connect Wheel objects to the ATV according to the state machine/reactor structure recommended in the course.
 - (b) Describe three issues with using a base-class/inheritance approach to provide Wheel's as part of an ATV compared to the composition approach.
 - (c) Describe how to provide efficient force handling between the Terrain and the wheels of the ATV, allowing for all the crazy off-road driving one can do with an ATV.

Continue for question 7.

The End, Happy Holidays!