

Massachusetts Institute of Technology
6.170 Laboratory in Software Engineering
Spring 2003

Quiz 1

Wednesday, March 12, 2003

Name: _____

Athena username: _____

Section (circle one):

- 1: Eugene Shih 2: Yuriy Brun 3: Connie Cheng 4: Naveen Goela
5: Greg Harfst 6: Lee Lin 7: Jennifer Louie 8: Matt Notowidigdo
9: Zeeshan Syed 10: Stefanie Tellex
-

This quiz is 50 minutes long. It contains 22 questions and 7 pages (excluding this one). Please check your copy to make sure it is complete before you start. Turn in all pages, together, when you are finished. **Write your username and section on the top of *ALL* pages.**

Please write neatly; we cannot give credit for what we cannot understand.
Good luck!

True/False [2 points each]

Circle the correct answer.

1. **T/F** The representation of an immutable object must not contain mutable objects.
2. **T/F** Once it has been returned by the creator, the representation of an immutable object should not be changed.
3. **T/F** If a field is declared `final`, the object referenced by the field is immutable.
4. **T/F** There may be multiple implementations with different observable behavior that satisfy a given specification.
5. **T/F** There may be multiple incomparable specifications that a given implementation satisfies.
6. **T/F** The `modifies` clause of a specification specifies the objects (and/or specification fields) that an implementation is required to mutate.
7. **T/F** A change to the abstract state of an ADT implies a change to its concrete state.
8. **T/F** A change to the concrete state of an ADT implies a change to its abstract state.
9. **T/F** Using immutable types increases the possibility of bugs caused by aliasing.

Consider the following two specifications for procedure `foo(int)` for the next three questions.

SPECIFICATION A

```
/**
 * @requires true
 * @modifies nothing
 * @return a positive integer
 */
int foo(int arg);
```

SPECIFICATION B

```
/**
 * @requires arg > 0
 * @modifies nothing
 * @return arg
 */
int foo(int arg);
```

Answer the following true/false questions. Circle the correct answer.

10. **T/F** Any implementation that satisfies A also satisfies B.
11. **T/F** Any implementation that satisfies B also satisfies A.
12. **T/F** Any program that works correctly using a correct implementation of A will also work correctly if a correct implementation of B is substituted.

Consider the following three classes for questions 13–17. For brevity we do not list all methods and fields. You can assume that omitted fields and methods are the same for all classes. The only difference between ASet and CSet is CSet has the method isFull().

```
// A set that has a limit on its number of elements.
class ASet {
    /** @requires true
     * @modifies this
     * @effects if this.size < 10, this' = this U {e};
     *          otherwise, this' = this
     */
    void add(Object e);
}

// A finite set.
class BSet {
    /** @requires true
     * @modifies this
     * @effects this' = this U {e}
     */
    void add(Object e);
}

// A set that has a limit on its number of elements.
class CSet {
    /** @requires true
     * @modifies this
     * @effects if this.size < 10, this' = this U {e}
     *          otherwise, this' = this
     */
    void add(Object e);

    /** @requires true
     * @modifies nothing
     * @return true if the Set has nine elements; false otherwise.
     */
    boolean isFull();
}
```

Answer the following true/false questions. Circle the correct answer.

13. **T/F** ASet is a true subtype of BSet.
14. **T/F** BSet is a true subtype of ASet.
15. **T/F** BSet is a true subtype of CSet.
16. **T/F** CSet is a true subtype of BSet.
17. **T/F** CSet is a true subtype of ASet.

Short Answer Questions

18. (8 points) Assume class A is a true subtype of class B. Under what circumstances will a program that works correctly using B also work correctly using A? Limit your answer to 20 words.

19. (16 points) Answer the following questions with no more than 3 sentences.

(a) Describe a class of programming error that is more likely to be caught by black box test data than by glass box test data. Use an example if necessary.

(b) Describe a class of programming error that is more likely to be caught by glass box test data than by black box test data. Use an example if necessary.

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20. (15 points) Consider the following two specifications for a method that operates on a set. Assume that the set contains only natural numbers (non-negative integers).

SPECIFICATION A

```
/**
 * @requires true
 * @modifies nothing
 * @return   if set.size > 0, return the smallest number in the set
 * @throws   EmptySetException if set.size == 0
 */
int getSmallest() throws EmptySetException;
```

SPECIFICATION B

```
/**
 * @requires true
 * @modifies nothing
 * @return   if set.size > 0, return the smallest number in the set
 *           otherwise return -1.
 */
int getSmallest();
```

Answer the following questions. Use no more than 5 sentences for each answer.

- (a) Which specification defines a better abstraction? Explain.
- (b) For specification A, should `EmptySetException` be a checked exception or an unchecked exception? Explain.

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21. (15 points) Answer the following questions using no more than 3 sentences each.

Java has both run-time and compile-time type checking.

(a) Why have type checking at all?

(b) Why not have just compile-time type checking?

(c) Why not have just runtime type checking?

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22. (12 points) Specify (*do not implement*) an iterator class that yields the elements of a collection of `GeoSegments` in order of ascending length. The class should have only two methods.