Exam

November 20, 2024

Name: _**Solutions**_

CSE Net ID (username):

This exam is closed book, closed notes. You have **50 minutes** to complete it. It contains 43 questions and 8 pages (including this one), totaling 102 points.

Before you start, please check your copy to make sure it is complete. When you are finished, turn in all pages, together. **Write your initials on the top of *ALL* pages you turn in** (in case a page gets separated during test-taking or grading).

When you are asked for multiple answers, give answers that are as different as possible. Always give the most important answers.

Unless otherwise directed, answer in **one phrase** (when one answer line is given) or **one sentence** (when two or three answer lines are given).

If your answer to a T/F or multiple-choice answer is contingent on missing information, *briefly* note that. This should be very rare.

Please write neatly; we cannot give credit for what we cannot read.

Good luck!

1   True/False

Circle the correct answer. T is true, F is false. (1 point each, 15 points total)

1. **T** / **F**   It can be a good practice to write tests for a different specification than that advertised to clients. *If you write your program to satisfy a stronger specification than that advertised to clients, then it is a good idea to test against that specification. These tests are only for the benefit of the developers, and they would not work on a different implementation that satisfies the advertised specification.*

2. **T** / **F**   Trade secrets expire after 20 years. *Patents expire after 20 years, but trade secrets do not expire.*

3. **T** / **F**   A build system ensures that tests are run upon every push. *Continuous Integration ensures this, and a build system can exist independently of CI.*

4. **T** / **F**   Feature creep is when you start a project with too many features for you to feasibly implement. *Feature creep is when new requirements are constantly added, delaying release.*

   For each of the following, is it a question on the Joel Test?

5. **T** / **F**   Do you have testers?

6. **T** / **F**   Do you write tests before you write code?

7. **T** / **F**   Do you have an up-to-date schedule?

8. **T** / **F**   Do you have a spec?

9. **T** / **F**   Do you write unit tests?

10. **T** / **F**   Do you do a build on every commit to your main branch?

11. **T** / **F**   Can you make a build in one step?

12. **T** / **F**   Do you fix bugs before writing new code?

13. **T** / **F**   Do you have coding standards?

14. **T** / **F**   Does all code go through code review?

15. **T** / **F**   Do you use source control?

Circle the correct answer. T is true, F is false. (1.5 points each, 12 points total)

Consider the following class, subclass, and type hierarchies. In the type hierarchies, H is a subtype of G, I is a subtype of H, etc.

```
class C {                              G          K
  H foo(L arg) { ... }                 |          |
}                                      H          L
                                       |          |
class D extends C { ... }              I          M
```

Which of the following declarations of `foo` in class D satisfy behavioral subtyping?

16. **T** / $\boxed{\textbf{F}}$ `G foo(L arg)`

17. $\boxed{\textbf{T}}$ / **F**   `I foo(L arg)`

18. $\boxed{\textbf{T}}$ / **F**   `H foo(K arg)`

19. **T** / $\boxed{\textbf{F}}$ `H foo(M arg)`

20. **T** / $\boxed{\textbf{F}}$ `I foo(M arg)`

21. $\boxed{\textbf{T}}$ / **F**   `I foo(K arg)`

22. **T** / $\boxed{\textbf{F}}$ `G foo(M arg)`

23. **T** / $\boxed{\textbf{F}}$ `G foo(K arg)`

2   Multiple choice

Choose the best answer. (3 points each, 12 points total)

24. What is the relationship between `git fetch` and `git pull`?

    (a) they do the same thing

    (b) git fetch does more

    (c) git pull does more

    (d) neither is a subset of the other

25. What's a commonly-used tool to detect array bound errors in C code?

    (a) VS Code

    (b) valgrind

    (c) gcc

    (d) gdb

    (e) clang

    (f) reiserfs

    (g) lint

    (h) heimdallr

    Valgrind keeps track of what memory is allocated and/or initialized. A program should only write to memory that is allocated, and a program should only read memory that is allocated an initialized.

26. What is the relationship between regression tests and unit tests?

    (a) they are different terms for the same concept

    (b) every unit test is a regression test

    (c) every regression test is a unit test

    (d) neither concept subsumes the other

27. What should be the relationship of the specification of method `Superclass.foo()` and the specification of `Subclass.foo()`, where `Subclass` is a subclass of `Superclass`?

    The specification of `Subclass.foo()` *is stronger than or the same as* the specification of `Superclass.foo()`.

    (a) is the same as

    (b) is stronger than

    (c) is stronger than or the same as

    (d) is weaker than

    (e) is weaker than or the same as

    (f) none of the above is necessary

3   Choose all that apply

Mark all the correct answers, by circling the appropriate letters. (1 point per subitem, 15 points total)

28. Which of the following is a good requirement?

    (a) The product will never crash.

    (b) The product will crash in $<0.01\%$ of sessions.

    (c) The product will be secure against hacks.

    (d) Product crashes will not impact security.

29. Which of the following is a best practice for writing project requirements?

    (a) Assign priorities.

    (b) Describe goals at a high level. ***Requirements are more specific than goals.***

    (c) Leave UX/eng as unconstrained as possible.

    (d) Avoid rigid templates/formats.

30. Suppose you have two different programs P and Q written to the same specification, and the developers (who are competent) have created a white-box and a black-box test suite for each. Mark all of the following that are true.

    (a) The white-box test suite for P passes on Q.

    (b) The black-box test suite for P passes on Q.

    (c) The two black-box test suites are similar or identical.

    (d) The two white-box test suites are similar or identical.

31. Which of the following is a potential *downside* to a God class?

    (a) It modularizes functionality

    (b) It is difficult to test

    (c) It leads to tight coupling

4   Very short answer

Answer in one word or phrase. (4 points each, 28 points total)

32. In a successful project, which stage of the software development lifecycle contains the majority of work?

    Maintenance. A successful system will be used for a long time by many customers after release, so the majority of its lifetime will focus on maintenance.

33. Please mark the following features as P0, P1, or P2 for a team making a to-do list app.

    (a) **P0** Can add items to list

    (b) **P1** Can prioritize different tasks

    (c) **P2** Can send task notifications
        To-do lists are not necessarily time-sensitive, so this is not a P1 feature.

    (d) **P2** Can share lists

    (e) **P0** Can mark items as complete

34. State a fact about connectors in a layered architecture that is not true about connectors in a pipe-and-filter architecture.

    They are bidirectional.

35. What two things does InterConnect connect to each other? (This is a question about the user view of the project, not its architecture or implementation.)

    Newbies to experts, to help the newbies to learn.

36. What is the biggest limitation of the beta product for FitQuest?

    It only accommodates weightlifting, not other kinds of exercise.

37. What is the only technique that is taught in the beta product for Journey of the Voice?

    Box breathing. Just "breathing" is acceptable.

38. What is the most important disadvantage of a client–server architecture?

    The server is a single point of failure. A less important disadvantage is that response times may be high.

5 Short answer

(4 points each, 12 points total)

39. What is representation exposure?

    Representation exposure occurs when data is not fully encapsulated: a client can observe and/or modify the representation of a class or data structure.

    At most partial credit for saying that representation exposure is when the representation is exposed.

40. What are two ways that representation exposure can occur?

    (a) *By a client passing in a mutable value (say, to a constructor or setter) that the class stores without making a defensive copy.*

    (b) *By some method returning a mutable value that the class stores without making a defensive copy.*

    (c) *A representation field of the class is public. Partial credit for saying that a method is public. Partial credit for saying a representation field of the class is final, because the object stored in a final field can be mutated.*

41. Define "technical debt".

    Technical debt is bad code incurred by doing something quick but unprincipled. It must be addressed in a future development cycle.

(4 points each, 8 points total)

42. Team A has decided to use the waterfall model as its SDLC and Team B has decided to use prototyping. Suppose that each team has chosen well. State the main difference between the *requirements* of Project A and Project B.

    Project A has requirements that were known from the beginning of the project and will not change. Project B has requirements that are not well defined, and Team B will discover them by creating prototypes.

    No credit for answers that discuss the implementation processes of the teams.

43. Describe the difference between a "north star" metric and a "balance" metric.

    A north star metric is the single most important metric that focuses the team's decisions. A balance metric ensures that a team's focus on* only *the north star metric doesn't negatively impact other aspects of the business.

    No credit for saying that the north star metric is more important than the balance metric. No credit for saying that there are multiple balance metrics. No credit for saying that the balance metric provides balance.