CS 169 Software Engineering Fall'13 Midterm #2

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PLEASE FILL IN ANSWER BOXES CAREFULLY.
We will be very stingy about regrade requests arising from ambiguous markings.

- Point values are in square brackets, e.g. [3], and are intended to approximate the difficulty of the questions at about a minute-and-a-half per point with **73 points total for questions, plus 2 points for your Glookup ID**.
- There is NO PENALTY for wrong answers/guessing. For "select all that apply" questions, if there are N choices, correctly identifying whether each choice should be selected or not selected contributes 1/N of the points.
- Fill in ALL ANSWERS on the answer sheet. **Please don't make any other marks on the answer sheet that could interfere with the automatic grader.**
- A one-page double-sided set of notes is allowed, but no other resources: No electronic devices, Internet connectivity, computers, or communication devices, and no consulting with anyone in any way. If you are caught cheating, your exam will be over, you will tentatively receive a grade of zero for the exam, and we will refer the case immediately to the Office of Student Conduct.
- You agree that you will not discuss the exam with anyone until after solutions are released.
- We will ask you to hand back the exam as you leave the exam room, but we will provide a copy with solutions later. You agree that any copies of the exam or solutions that are provided to you are for your personal use only, and at no time will you make them available to anyone else either in hardcopy form or digitally.

•1. and •2. [1 each] Use the letter boxes to fill in the two letters of your Glookup ID. (Implication: if you have to contact your GSI because we couldn't import it based on this ID, you won't get these 2 points.)

Miscellaneous Short Answer (16 points total)

•3. [1] Which statements are TRUE regarding characterization tests? Select all that apply.
(A) You can only create them at the integration-test level, since you don't yet understand the class- or method-level logic of the software
(B) You can create them by writing a test you know will fail, then replacing the failed expectation with the app's observed behavior.
(C) You can create them by watching a customer interact with the app and automating what she does.
(D) You can only run them against the app in development mode.
(B) and (C)

•4. [1] The **single best predictor** that a software project is likely to come in excessively over budget or late schedule is:
A) project's scope or size is very large
B) project uses P&D methodology rather than Agile
C) project uses Agile methodology rather than P&D
D) project's testing/QA is done by a separate team rather than by the developers
(A)

•5. [1] Given the success rate of small software projects versus large software projects presented in class, what technique(s) that we have covered would give us our best chance at building a large project from many small projects?

A. The software architecture developed during the design phase of a Plan-and-Document lifecycle
B. The model-view-controller design pattern
C. The Façade design pattern
D. Following a Service-Oriented Architecture

(D)

•6. [1] Class Customer has a subclass VIPCustomer. Assuming well-structured code that observes Liskov substitution, which of the following statements are true? Select ALL that apply:
A) Any method that takes an instance of Customer can safely be passed an instance of VIPCustomer.
B) Any method that takes an instance of VIPCustomer can safely be passed an instance of Customer.
C) If you call a nonexistent method on a VIPCustomer, the call will still work if Customer or one of its ancestors responds to that method.
D) The set of instance variables of a VIPCustomer must be the same as the set of instance variables of a Customer.
(A) and (C)

•7. [4] The two pieces of code at right have the same logical functionality but different structure. Which statements are TRUE about comparing them? Select all that apply.

A) Version 1 exposes more testing seams
B) Version 1 has higher per-method cyclomatic complexity
C) Version 1 has a lower ABC score
D) Version 1 cannot be tested to 100% C2 coverage
(B)

```
# version 1:
def foo(x,y)
  if x
    if y
      z()
    end
  else
    if y
      w()
    end
  end
end
```

```
# version 2:
def foo(x,y)
   if x
     check_y_z(y)
   else
     check_y_w(y)
   end
end
def check_y_z(val)
  z() if val
end
def check_y_w(val)
  w() if val
end
```

•8. [2] Of the ten principles below (ordered alphabetically), which ones are associated with security?

A) Demeter
B) Dependency injection
C) Don't repeat yourself
D) Fail-safe defaults
E) Least privilege
F) Liskov substitution
G) Open/closed
H) Psychological acceptability
I) Representational state transfer
J) Single responsibility

D, E, H

•9. [2] From the same list of ten principles, which ones are associated with the design of classes and the relationships among them?

A, B, F, G, J

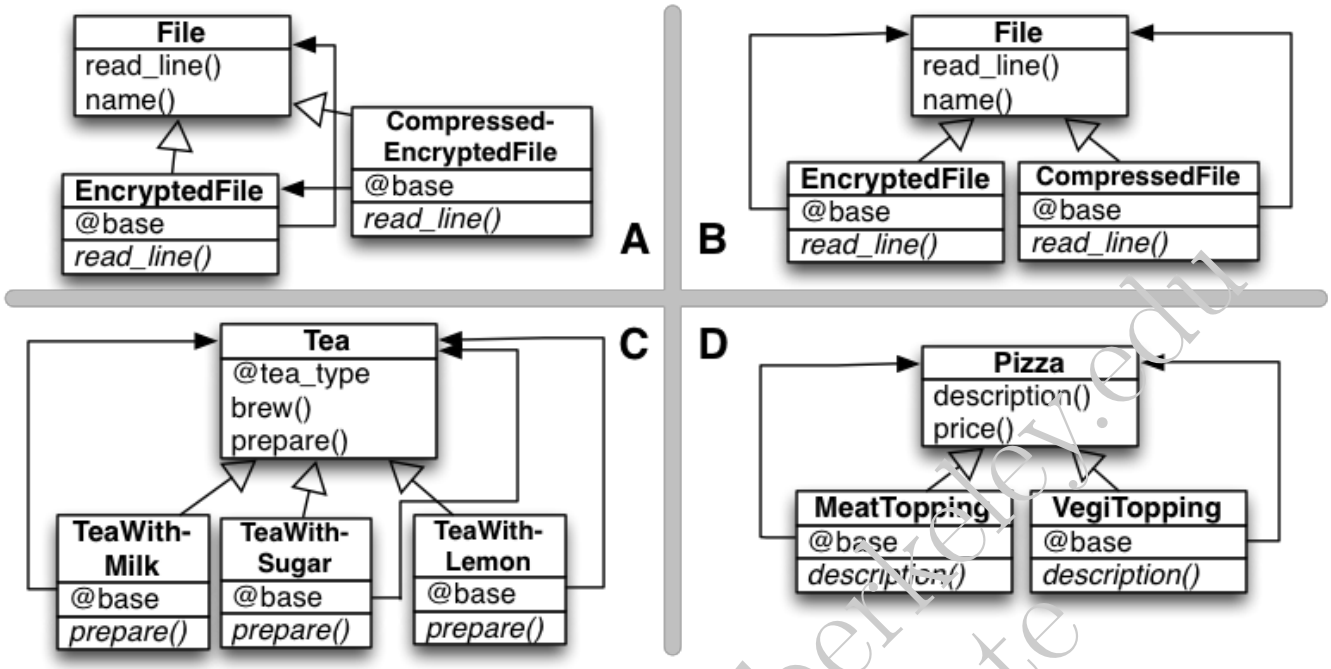
•10. [2] Which of the below are required for a company building software to receive the ISO 9001 standard for quality management?

A. A company has a software development process in place
B. The software development process is one of the processes listed in standard, such as waterfall, spiral, or the rational unified process
C. A company has a method to see if the software development process is followed
D. A company records results to improve the software development process
E. The code output of the software development process exceeds the minimum quality metric of the standard
F. A survey of the customer satisfaction exceeds the levels required by the standard

A,C,D

•11. [2] Which of the following four UML class diagrams (A, B, C, D) represents a **misapplication** of the Decorator design pattern? (*Italics* represent an overridden method.)

D, because toppings cannot in general behave like a pizza, whereas in the other examples the decorations result in a class that can behave like the base class.



Legacy: Alien Code Review (20 points total)

For the next few questions, you've been assigned to review some code written by aliens. Since they named classes and variables in their own language, the names don't mean anything to you. But happily you can still spot bad design practices.

Only a subset of the methods is shown below, but you also have the following information from running metrics on the code. Recall that the LCOM (Lack of Cohesion of Methods) formula is $1-((\sum_i m_i)/M*V)$ where M is the number of instance methods in the class, V is the number of instance variables, m_i is the number of instance methods that access the i'th instance variable. The metric's value is 0 if every instance variable is mentioned in every instance method, and 1 if each instance variable is mentioned in exactly 1 instance method.

Class	LCOM	C0 coverage	Class	LCOM	C0 coverage
Blurk	0.1	95%	BlortVeem	0.3	90%
Veem	0.9	98%	JitVeem	0.3	95%
SnitVeem	0.2	60%			

```
class Veem
  attr_reader :woop
  def initialize ... end
  def snirp ... end
  def zike ... end
end
class SnitVeem < Veem
  def zike
    raise BlurkError, "zike blurk!"
  end
end
class BlortVeem < Veem
  def snirp ... end
end
class JitVeem < Veem
  def snirp ... end
  def zike ... end
end
```

```
class Blurk
  attr_accessor :veem
  def initialize(arg)
    @veem = get_veem(arg)
  end
  def get_veem(blurk)
    case blurk
      when :goo then SnitVeem.new
      when :blort then BlortVeem.new
      else JitVeem.new
    end
  end
  def wurgle
    return (veem.woop.snork.bort?)
  end
end
```

For each of the following pairs of questions:

- If a likely violation of the given principle occurs, identify which class the violation occurs in **and** which method the violation occurs in. For which method, you can also select (E) if the violation is not localized to any specific method but rather affects the class as a whole.
- If **no violation** is present, select (F) "No Violation" for both questions in the pair.

A likely violation of the Single Responsibility principle:
•12. [2] Which class? (A) Veem (B) Blurk (C) SnitVeem (D) BlortVeem (E) JitVeem (F) No Violation
(A), based on the information that Veem has a poor LCOM score;
•13. [2] Which method?
(A) `zike` (B) `initialize` (C) `get_veem` (D) `wurgle` (E) the class as a whole (F) No Violation
(E) since SRP refers to class, not any one method
A likely violation of the Open/Closed principle:
•14. [2] Which class? (A) Veem (B) Blurk (C) SnitVeem (D) BlortVeem (E) JitVeem (F) No Violation
(B)
•15. [2] Which method?
(A) `zike` (B) `initialize` (C) `get_veem` (D) `wurgle` (E) the class as a whole (F) No Violation
(C): no additional subclasses of Veem can be added without modifying Blurk#get_veem
A likely violation of the Liskov Substitution principle:
•16. [2] Which class? (A) Veem (B) Blurk (C) SnitVeem (D) BlortVeem (E) JitVeem (F) No Violation
(C)
•17. [2] Which method?
(A) `zike` (B) `initialize` (C) `get_veem` (D) `wurgle` (E) the class as a whole (F) No Violation
(A): the exception indicates a refused bequest
A likely violation of the Injection of Dependencies principle:
•18. [2] Which class? (A) Veem (B) Blurk (C) SnitVeem (D) BlortVeem (E) JitVeem (F) No Violation
•19. [2] Which method?
(A) `zike` (B) `initialize` (C) `get_veem` (D) `wurgle` (E) the class as a whole (F) No Violation
(F) and (F): no violation
A likely violation of the Demeter principle:
•20. [2] Which class? (A) Veem (B) Blurk (C) SnitVeem (D) BlortVeem (E) JitVeem (F) No Violation
•21. [2] Which method? (A) zike (B) initialize (C) get_veem (D) wurgle (E) the class as a whole (F) No
(B) and (D)

OO Design & Associations: *Casebook* (16 points total)

As an example of procurement reform in government, Ray Ells' software consultancy has been awarded a contract to develop Casebook, a SaaS app to keep track of the status of civil court cases. Here's some notes from an early customer interview:

- Each case has two parties: the plaintiff and the defendant.
- The same plaintiffs and defendants may be parties in more than one case. A party that is a plaintiff in one case might be a defendant in another case.
- Each case is assigned to exactly one judge and its proceedings administered by exactly one court clerk. Every court officer is either a judge or a court clerk.
- The only people who can login to the app and access the data are court officers. Login should be required for all app actions, that is, the only publicly-viewable page should be the login page.
- A case has a variable number of supporting documents associated with it. Examples of documents include motions, depositions, evidence (photographs, scanned documents, audio or video clips, etc.), and others.

•22. [2] Which foreign keys would we expect to see in the Cases table? Select all that apply.

A) `judge_id` B) `clerk_id` C) `plaintiff_id` D) `defendant_id`
E) `party_id` F) `document_id` G) `case_id` H) None of the above

A, B, C, D

•23. [2] Which foreign keys would we expect to see in the Judges table? Select all that apply. (same choices)

H

•24. [2] Which foreign keys would we expect to see in the Documents table? Select all that apply. (same choices)

G

Which **two** ActiveRecord associations are **required** to support the query: "Return all the defendants whose cases have been assigned to this judge"? (Answers have the form "X has many Y", "X belongs to Y", and so on. Be sure to use the correct letter choices for each blank!)

First blank: A) Judge(s) B) Defendant(s) C) Case(s)
Second blank: D) has many E) has one F) belongs to G) through
Third blank: H) Judge(s) I) Defendant(s) J) Case(s)
Fourth blank: K) Judge(s) L) Defendant(s) M) Case(s)

Association #1 (pick THREE items): [3] •25. _____ _____ _____
[A, B or C] [D,E,F, or G] [H, I, or J]

A, D, J (Judge has many Cases)

Association #2: (pick FOUR items) [3] •26. _____ _____ _____ through _____
[A, B or C] [D,E,F, or G] [H, I, or J] [K,L, or M]

A, D, I, M (Judge has many Defendants through Cases)

What index would speed up the query "Show all cases assigned to a particular judge"?
Tables: A) judges B) defendants C) cases
Foreign key columns: A) `judge_id` B) `clerk_id` C) `plaintiff_id`
D) `defendant_id` E) `party_id` F) `document_id` G) `case_id`

Add an index to the •27. [2] _____ table…
on the •28. [2] _____ column
C, A (index Cases table on judge_id)

Design Patterns: *Java the Hut* coffee shop (8 points total)

You're writing software to help manage Ru B. Hacker's new coffee shop, Java the Hut:

```
# original class is Coffee: models a cup of coffee that customer can purchase
class Coffee
  def price ; ... ; end          # calculate price
  def brew ; ... ; end           # brews the coffee
  def prepare ; ... ; end        # steps to take after brewing
  def serve ; ... ; end          # serve to customer
end
```

For the following questions, indicate which **one** technique or design pattern from the following list would **best** address the design problem:

A) Template or Strategy pattern
B) Decorator pattern
C) Adapter or Façade pattern
D) Null Object pattern
E) Proxy pattern
F) Subclass inheritance with no other design pattern

•29. [2] Customers can add milk, syrup, whipped cream, or any combination of these to their coffee. Each ingredient adds to the price and adds a preparation step after brewing.
B) Decorator, since it allows dynamically adding behaviors to a "base" class and having the resulting object still behave like a member of the base class.

•30. [2] Customers who drink their coffee in the restaurant have the option of getting free refills. The `CoffeeWithFreeRefill` product behaves the same as a Coffee except it also has a `refill()` method.
F) Simple inheritance: it can be a subclass of Coffee that also provides the refill method.
•31. [2] Alyssa would like to sell gift cards for specific coffee drinks. Gift cards don't need to be brewed or prepared, but in all other respects, gift card purchases should be recorded as and behave the same as the purchases of regular drinks, and be able to respond to the same methods as regular drinks.
D) Null object: a CoffeeGiftCard can substitute do-nothing implementations of brew and prepare, and still be able to participate in all the behaviors that Coffee can participate in.

•32. [2] Ben Bitdiddle is opening a tea shop next door, Tea or Nil, which will serve both coffee and tea. You'd like to adapt your code to also handle tea. Like coffee, tea must be brewed, prepared after brewing, and served, but the brewing and preparation *processes* are quite different than for coffee.
A) Template or Strategy, since the task and steps are the same but implementation of the steps is different.

Client-side programming/JavaScript (7 points total)

A JavaScript-enhanced Rails app includes a user-visible timer showing how long the user has been on each page. The HTML element(s) for the timer are set as follows:

```
1 var MyApp = {
2   setup: function() {
3     setupTimerHtml();  // function that creates extra elements for timer
4   },
5   startTimer: function() { /* starts the timer */ },
5 };
```

•33. [1] The `MyApp.setup` function must be called:
A) Only once at the beginning of the session
B) Only once at the beginning of the session, but must be for the "root" route of the app
C) On the initial page load for every page in the app during a given session
D) On the initial page load AND on every AJAX interaction during a given session
(C)

•34. [1] The `MyApp.startTimer` function must be called:
A) Only once at the beginning of the session, on the initial page load of any page in the app
B) Only once at the beginning of the session, but must be for the "root" route of the app
C) On the initial page load for every page in the app during a given session
D) On the initial page load AND on every AJAX interaction during a given session
(C)

Choose **A** for TRUE or **B** for FALSE for each statement about good practices for enhancing SaaS apps with JavaScript. (If necessary, assume the user's browser includes a modern and enabled version of JavaScript.)

•35. [1] Your JavaScript functions must not block, or the browser UI will become unresponsive.
(A) True, (B) False
T

•36. [1] Using JavaScript to validate user input in the browser saves you the duplication of validating that input on the server, thus helping DRY
(A) True, (B) False

F (you can't trust the client)

•37. [1] Since XmlHttpRequest is asynchronous, an event handler that wants to communicate state to the AJAX callback should do so via the global object

(A) True, (B) False

F

•38. [1] AJAX functionality can be tested even when the server side of the app is not running

(A) True, (B) False

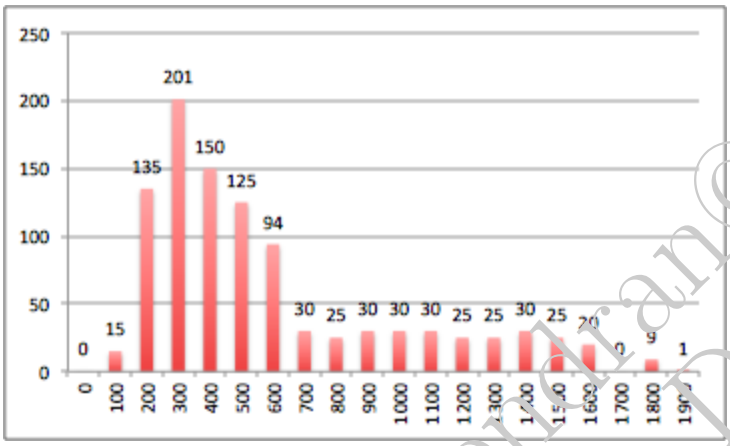
T (using stubs/spies and fixtures)

•39. [1] The server's response to an AJAX request must consist of HTML

(A) True, (B) False

F

Ops & Performance (6 points total)



For the following questions, use the histogram at left, which represents RottenPotatoes' response times in milliseconds over the last minute, during which **1000** requests were served. For simplicity, assume every request completes in a multiple of 100ms. For example, 135 of the 1000 requests had a response time of 200ms, 15 had a response time of 100ms, and so on.

The Apdex satisfaction threshold for this app is 400ms.

•40. [2] The median response time, to the nearest 100ms, is:

A) 200ms B) 300ms C) 400ms D) 500ms E) 800ms F) 900ms G) 1000ms
H) 1100ms I) 1200ms J) 1500ms K) 1600ms L) 1700ms M) 1800ms N) 1900ms

C) 400ms, since 500 (50%) of requests have a response time less than that

•41. [2] The strongest claim that could be made for the 99th percentile response time, to the nearest 100ms, is. (use same choices as #39)

K) 1600ms, since 990 requests have a response time less than or equal to that

•42. [2] Suppose the bucket sizes for the last three buckets (1700ms, 1800ms, 1900ms) were changed to 10, 0, 0 (from their current values 0, 9, 1) while the other buckets are unchanged. Which quantities, if any, would **change** as a result:

A) Apdex score, median response time, and 99%ile response time would all change
B) Apdex score & 99%ile response time would change, but median response time would stay the same
C) 99%ile response time would change, but Apdex and median response time would stay the same
D) Apdex, median, and 99%ile response time would all stay the same

C) 99%ile would change from 1700 to 1600. Apdex is unchanged since we get "no credit" for anything over 1600ms anyway, so the distribution above 1600ms doesn't affect Apdex. Median and 90%ile are unchanged since we haven't changed the number of data points in the top 10%, just their distribution.