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Question 1. Word Bank Matching (1 point each, 15 points)

For each statement below, input the letter of the term that is *best* described. Note that you can click each word (cell) to mark it off. Each word is used at most once.

A. — Adapter Design Pattern	B. — Bug Bounties	C. — Concurrency Bug	D. — Delta Debugging
E. — Fault Localization	F. — Functional Requirements	G. — Fuzz Testing	H. — Informal Goal
I. — Mocking	J. — Multi-Language Projects	K. — Mutation Testing	L. — Perverse Incentives
M. — Productivity	N. — Profiling	O. — Quality Requirements	P. — Readability
Q. — Requirement Elicitation	R. — Risk	S. — Singleton Design Pattern	T. — Stakeholder
U. — Strong Conflict	V. — Top-Down Design	W. — Traceability	X. — Triage
Y. — Validation			

Q1.1:

A

A developer can use **THIS TERM** to create a custom Stack data structure using only a Queue data structure.

Q1.2:

I

Yunchi is working on automatically removing users from the company's system when they quit or get laid off. When writing tests for this code, Yunchi does not want to remove an actual employee, so they use **THIS APPROACH** to create a fake one to test with.

Q1.3:

H

During a design meeting, GlazeBook's CTO stipulates that their new photo editing software should have a "robust set of security features", but does not specify what features they have in mind. In this scenario, a "robust set of security features" is a(n) example of **THIS TERM**.

Q1.4:

C

Some of Amazon's users are reporting an issue where they try to purchase a product that the website says is available. However, when they click "Purchase", an "Out of Stock" error comes up. Amazon engineers believe that this may be caused by **THIS TERM** when multiple users purchase the product at the same time.

Q1.5:

G

One potential strategy for HW 1b is to generate random images (including malformed and unexpected ones) to achieve the threshold code coverage for the libpng library.

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Q1.6:

O

[Stakeholders of EECS Depot's delivery application would like a customer's request to appear on drivers' screen within five seconds of the customer placing an order.

Q1.7:

U

During the development of 123movies's newest video game, Cybermonk 2088, two stakeholders find themselves in disagreement. One says that the game should be an open-world RPG, while the other requires that it must be a turn-based strategy game.

Q1.8:

L

Alex notices that their manager tends to praise developers who submit massive changes to the codebase. Hoping to get on their good side, Alex inflates each of their PRs with lines of verbose comments and dead code.

Q1.9:

Y

Appa just finished meeting with a client and has a list of requirements that the client wants to see in the mobile app. However, while performing **THIS PROCESS**, Appa notices that some of the requirements are inconsistent with each other and others do not relate to the client's goals.

Q1.10:

M

Toph manages 10 developers but has noticed that they all take a very long time to submit Pull Requests (PRs) when working alone. Toph suggests that the developers practice pair programming with each other. Almost instantly, **THIS TERM** improved - development sped up and the engineers were more efficient at submitting PRs.

Q1.11:

R

MoonChips Inc. is creating highly important military software. They decide to use spiral development methodology in order to mitigate **THIS TERM**.

Q1.12:

X

Boogle just launched their new game, Fortday! Unfortunately, on release day, players reported hundreds of bugs. Yang analyzed each bug and assigned a priority to it to help developers determine which bugs should be fixed first.

Q1.13:

P

Pylint is a quality checker for Python code and can identify areas where the developer should improve the code style, limit the line length, or fix indentation issues, all of which will boost **THIS CHARACTERISTIC**.

Q1.14:

K

Arian wants to ensure that their test suite is thorough and robust before using one of their submissions on the Autograder. They make a minor change to their code and verify that at least one test will catch the bug.

Q1.15:

T

Aang wants to create a social media app catered towards the elderly. When doing research, she goes to a local nursing home to consult and get feedback from the residents. Elderly people, like the nursing home residents, are considered to be **THIS TERM**.

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Question 2. Delta Debugging (20 points)

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(a) (4 points)
Consider running the delta debugging algorithm (based on the pseudocode in the "Debugging as Hypothesis Testing" lecture) with input `[0,1,2,3,4,5,6,7,8,9]`. The sequence of calls to `Interesting()` is shown below along with the result (either interesting or not interesting). Based on this information, please determine the minimal interesting subset returned by the algorithm.

Please format your answer as an array of integers in ascending order: for example, **[0, 1, 2]**.

Subset	Result
[0, 1, 2, 3, 4]	Not Interesting
[5, 6, 7, 8, 9]	Not Interesting
[0, 1, 2, 3, 4, 5, 6]	Not Interesting
[0, 1, 2, 3, 4, 7, 8, 9]	Not Interesting
[0, 1, 2, 3, 4, 5, 6, 7]	Not Interesting
[0, 1, 2, 3, 4, 5, 6, 8, 9]	Interesting
[0, 1, 2, 3, 4, 5, 6, 8]	Not Interesting
[0, 1, 2, 3, 4, 5, 6, 9]	Not Interesting
[0, 1, 2, 3, 4, 7, 8, 9, 5]	Interesting
[5, 6, 7, 8, 9, 0, 1]	Not Interesting
[5, 6, 7, 8, 9, 2, 3, 4]	Not Interesting
[5, 6, 7, 8, 9, 0, 1, 2]	Not Interesting
[5, 6, 7, 8, 9, 0, 1, 3, 4]	Interesting
[5, 6, 7, 8, 9, 0, 1, 3]	Not Interesting
[5, 6, 7, 8, 9, 0, 1, 4]	Interesting
[5, 6, 7, 8, 9, 2, 3, 4, 0]	Not Interesting
[5, 6, 7, 8, 9, 2, 3, 4, 1]	Not Interesting

Your answer here.

ANSWER:
[0, 1, 4, 5, 8, 9]

(b) (6 points)
Similar to the previous question, consider running a delta debugging algorithm with a list of integers to find a minimal interesting subset. However, in this question the particular input list is not relevant and therefore is not given.

The following table shows 6 calls to `Interesting()`. For 3 of them, the table gives the return value (either Yes meaning interesting, or No meaning not interesting). **The rest are left for you to deduce.** Suppose the three assumptions (namely, Unambiguity, Monotonicity, Consistency) all hold.

Please fill in the blanks with either Yes or No, and choose which assumption allows you to conclude that. In particular, for each blank, `Yes` means `Interesting()` returns `True` given the input (i.e., interesting), whereas `No` means `False` (i.e., not interesting). While we believe each question can be answered with a unique assumption, if you believe multiple assumptions each of which can lead to your answer, feel free to select any one of those assumptions.

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Call	Result
`Interesting({4, 5, 9})`	Yes
`Interesting({5, 6, 7})`	(bi) (2 points) ○ A) Yes (Consistency) ○ B) Yes (Unambiguity) ○ C) Yes (Monotonicity) ○ D) No (Consistency) ○ E) No (Unambiguity) ○ F) No (Monotonicity) ANSWER: D) No (Consistency)
`Interesting({5, 9})`	(bii) (2 points) ○ A) Yes (Consistency) ○ B) Yes (Unambiguity) ○ C) Yes (Monotonicity) ○ D) No (Consistency) ○ E) No (Unambiguity) ○ F) No (Monotonicity) ANSWER: B) Yes (Unambiguity)
`Interesting({1, 5, 9})`	Yes
`Interesting({2, 4, 5, 9})`	(biii) (2 points) ○ A) Yes (Consistency) ○ B) Yes (Unambiguity) ○ C) Yes (Monotonicity) ○ D) No (Consistency) ○ E) No (Unambiguity) ○ F) No (Monotonicity) ANSWER: C) Yes (Monotonicity)
`Interesting({5, 6, 7})`	No

(c) (2 points)
Given a set `S` of `n` changes that induced a failure for a given program `P`, you want to use Delta Debugging (DD) algorithm (discussed from the lecture) to identify the failure-inducing subset of these changes. Suppose each call to `Interesting()` takes constant time. Unless otherwise specified, we assume Unambiguity, Monotonicity, and Consistency.

(ci) (1 points)
Suppose the failure must be induced with multiple changes. What is the time complexity of DD?

○ A) O(n)
○ B) O(n*log(n))
○ C) O(n^2)
○ D) O(log(n))
○ E) O(2^n)
ANSWER: C) O(n^2)

(cii) (1 points)
Is it true that simultaneously executing multiple different calls to `Interesting()` in parallel can help improve the overall performance of DD?

○ A) Yes, since Interesting calls can be run in parallel, thereby reducing the overall total running time.
○ B) No, because interesting calls must run sequentially.
○ C) Yes, if there are no interesting calls that return UNKNOWN.

○ D) No, because parallel interesting calls might induce a subset that is not the smallest.
ANSWER: E) Yes

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(d) (8 points)
In each of the following scenarios, please answer if delta debugging can be applied to solve the problem or not.

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(di) (2 points)

Suppose you have a set of 100 different integers, where there is exactly one minimal subset of integers from it that add up to 500. You want to find this subset.

○ A) Yes
○ B) No
ANSWER: B) No → If another number is added to an interesting subset, it will no longer be interesting since the sum changed (Not Monotonic)

(dii) (2 points)

A customer reported a bug and also provided a long sequence of steps that led to this bug, such that anyone can replicate it. You observed some of these steps in the sequence actually are unnecessary and can be removed while still reproducing the bug. Therefore, you would like to find a smallest subsequence of steps that can still lead to the bug.

○ A) Yes
○ B) No
ANSWER: A) Yes

(diii) (2 points)

You are developing an update (with contains many code changes) for your web application. At some point, a test that previously was passed now is failing. Now, you want to identify a smallest set of code changes from this update, such that (1) applying all of them would cause the test to fail and (2) the test would pass if any one of the changes in this set is omitted. We assume all changes in the update are independent of each other.

○ A) Yes
○ B) No
ANSWER: A) Yes

(div) (2 points)

You are trying to identify the single change---from a set of thousands of changes---that broke performance-critical code on a device with severely limited resources, where each test execution takes several minutes and costs significant resources. Is delta debugging recommended in this scenario?

○ A) Yes
○ B) No
ANSWER: B) No → The iterative nature of delta debugging is too resource intensive and would introduce too much overhead. If you know that there's only one change that introduced the error, there are simpler ways to identify it.

Question 3. Short Answer (20 points)

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(a) (4 points)

Jordan, a backend engineer at a financial technology company. During an audit, Jordan discovers that error logs lack sufficient details, making it difficult for engineers to diagnose issues when transactions fail. To address this, Jordan enhances the logging mechanism by including unique transaction IDs, error codes, and additional contextual information. After verifying that the new logs provide clearer debugging insights without exposing sensitive data, Jordan commits the changes with the following message:

Commit Message:
Improved logging for transactions.

Argue whether or not this commit message is a high quality commit message. If it is not a high quality commit message write, for the same change, a new commit message (using no more than 2 sentences) that is high-quality. For your argument, use no more than 4 sentences.

Your answer here.

ANSWER:

- +2 points for saying not high quality commit
- +2 points for providing a high quality commit (includes why)

Humans should focus on including "why" information in commit messages. This is not a high quality commit as it mentions "what" the commit does, but not "why".

Sample high quality commit:
Improved logging for transactions to make it easier for engineers to diagnose issues when transactions fail.

(b) (4 points)

You have a large dataset containing product codes that are stored in various formats, such as ABC123, abc-123, and A.B.C.123. Your goal is to standardize all product codes to the format ABC-123. Manually editing thousands of entries would be too time-consuming, and writing a script to handle all variations is beyond your programming knowledge.

What is one tool from the *Program Synthesis* lecture that will help solve this problem? Describe how this tool works, and provide one piece of evidence from the lecture that supports your answer. Limit your answer to no more than 4 sentences

Your answer here.

ANSWER:

- +1 points for choosing FlashFill as tool
- +1 point for description of FlashFIll
- +1 point for evidence
- +1 points for explanation

Sample Answer:
FlashFIll is a tool that could help. From the Program Synthesis lecture, "FlashFill is an Excel feature that automatically transforms strings using examples." By providing a few correctly formatted product codes, FlashFill detects patterns and applies them to the entire dataset. This allows us to efficiently standardize product codes without manually editing each entry.

(c) (4 points)

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Jamie, a software engineer at a cybersecurity firm, is investigating a failing unit test in a critical authentication module. The test consistently fails; however, given the complexity of the codebase Jamie is struggling to find the cause of the bug. Jamie asks you if EECS 481 taught you any techniques that could help find the bug.

Using tools that are covered in EECS 481, is it possible to find the bug? If so, please describe one of such tools and provide evidence from the corresponding lecture slides or readings (such as the slide number, or title of the reading and which section of it) to support your argument. Limit your entire answer to at most 4 sentences.

Your answer here.

ANSWER:

- + 1 point for providing tools talked about in EECS 481
- +1 point for describing the tool
- + 2 points for providing evidence from the slides (including lecture and slide number)

Sample Answer:
A tool that could help is Facebook's Sapfix. Facebook's SapFix is an automated program repair tool that can automatically generate fixes for specific bugs, and then propose them to engineers for approval and deployment to production. From the Automated Program Repair lecture, slide 70, "We have used SapFix at Facebook to repair 6 production systems, each consisting of tens of millions of lines of code, and which are collectively used by hundreds of millions of people worldwide."

(d) (4 points)

AI is becoming increasingly prevalent in software engineering for various purposes such as improving programming productivity. What software engineering concepts can be used in the "AI for SE" era to address a limitation of current AI techniques? Please reference a specific limitation mentioned in one of the **guest** lectures, and name the corresponding lecture and speaker. Then, identify one relevant software engineering concept that could help address this limitation and explain how. Limit your entire answer to no more than 5 sentences.

Your answer here.

ANSWER:

- +1 point for providing one limitation
- +1 point for referring to a specific guest lecture
- +1 point for providing one software engineering concept
- +1 point for explanation

Sample Answer:
One limitation of current AI techniques is its possible tendency to produce faulty output due to preverse incentives. As discussed by José Cambronero in his guest lecture about agentic software engineering, one limitation of Google's AI tool GITS is its tendency to produce patches that fail non-functional properties, with José stating, "You can imagine a patch that fixes some underlying bug, but maybe now it performs a bunch of unnecessary data accesses." One software engineering concept that could help address this limitation is requirements elicitation. By gathering a complete and comprehensive list of (functional and non-functional) requirements for some system, AI tools can be prompted more thoroughly, providing little to no possibility for perverse incentives.

(e) (4 points)

Please describe one tool that was discussed in one of the **guest** lectures, and briefly explain it (e.g., its primary use cases, how it works, etc.). Then compare and contrast this tool with a related one covered in the **non-guest** lectures in EECS 481. Please mention which guest lecture and/or include points to the lecture recording/slides. Limit your entire answer to at most 6 sentences.

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Your answer here.

ANSWER:

- +1 point for providing one tool from guest lecture
- +1 point for explaining the tool
- +1 point for comparing the tool with one from EECS 481
- +1 point for referring to a specific lecture

Sample Answer:
One tool that was discussed in José Cambronero's guest lecture was the Google Issue Tracking System (GITS), a tool used to help Google developers automatically fix bugs in Google's multilingual, monorepo code base. With access to Google's workspace, GITS is able to examine a bug report and dyanmically generate a patch, using curated datasets of relevant bugs to derive a functional solution. This tool is similar to Facebook's SapFix tool discussed in lecture, as SapFix similarly generates patches to fix various bugs. Like GITS, SapFix works for large code bases, as stated, "We have used SapFix at Facebook to repair 6 production systems, each consisting of tens of millions of lines of code, and which are collectively used by hundreds of millions of people worldwide." However, unlike GITS, SapFix may struggle with multilingual code bases due to its design specializing in Java code bases.

Question 4. Fault Localization (15 points)

(a) Consider the following table of program runs for some test cases. Each row corresponds to the execution of one test case. In other words, each row reports one run of the program in which it takes some input and produces an output that is either correct (passing the test case) or incorrect (failing). Each row also includes the lines (in the form of line numbers) visited while the program executes on that input.

Test Case	Status	Lines Visited
1	Pass	[4, 10, 12, 14, 18]
2	Pass	[1, 4, 7, 10, 14, 15, 18]
3	Fail	[1, 5, 7, 15, 19]
4	Pass	[4, 5, 7, 10, 12, 14, 18]

(ai) (4 points) Among the total of 10 visited lines in the program, please list the **top-4** most suspicious lines according to the Tarantula suspiciousness metric below. Include also their corresponding scores in your answer.

```
susp(s) = (fail(s)/total_fail) / (fail(s)/total_fail + pass(s)/total_pass)
```

Please format your answer following this example: `(1, 1.00), (3, 0.80), (2, 0.80), (4, 0.12)`, where the first number in each pair is the line number and the second is the corresponding score (rounded to two decimal places). List the line numbers in the descending order of their scores; in case of a tie, list the higher line number first.

qweqweqweq

ANSWER: [(19, 1.00), (15, 0.75), (5, 0.75), (1, 0.75)]

(aii) (1 points)
Which line(s) from the above list do you think is causing the failing tests? Please pick at most 2 lines, and explain your intuition as to why they are causing the problem. If you think none of the lines caused the failure, please indicate so and explain why. Please limit your entire answer to at most 4 sentences.

qwqeqweqw

ANSWER: Line 19 → Only run during fail test cases

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(b) Consider a program for a simulated chess game, where players take turns moving pieces on the board. The main function is run with an event-based profiler, which generates a hierarchical function call profile as well as self-time information for each sub-function (see below).

In this question, a function's self-time is defined to be the time the function's stack frame spends on the top of the stack for one single call to that function. (Equivalently, the self-time of a function is the time taken by one single run of that function not including the time taken by any children or parent functions.) For example, `main()` takes 100ms to run, without considering calls to `playGame()` or `endGame()`. Note that the function call profile specifies how many times a function is called in its individual context. For example, each time `main()` is called, `playGame()` is called twice, and everytime `playGame()` is called, `player1Move()` will run 4 times.

```
Function call profile:
main() * 1
    playGame() * 2
        player1Move() * 4
        validateBoard() * 4
        player2Move() * 3
        validateBoard() * 3
    endGame() * 2
        reset() * 1

Self-times of functions:
main() - 100ms
playGame() - 60ms
```

(bi) (4 points)
Assuming that the self-times remain constant across runs, please list the names of each function in descending order of probability that a random probe of the profiler would interrupt the program in that function. If there is a tie, list the function with the alphabetically-earlier name first.

1 qwq
ANSWER: `validateBoard()`

2 ...
ANSWER: `player1Move()`

3 ...
ANSWER: `endGame()`

4 ...
ANSWER: `player2Move()`

5 qweqw
ANSWER: `reset()`

6 ...
ANSWER: `playGame()`

7 ...
ANSWER: `main()`

(bii) (1 points)
Users have been reporting performance issues, which are due to a bug in one of the functions. Based on profiling results, which function is the bug likely in?

ddd

ANSWER: player1Move() should not be executing for 3x longer than player2Move() since the logic is the same

(ci) (2 points)
True/False - Profilers that use sampling analysis are unlikely to affect the program's execution but may have a high error rate.

- (●) A) True
- ( ) B) False

ANSWER: True

---

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(cii) (3 points)

In addition to the above board game example, please give a **different** example to illustrate when you can use profiling to help understand and debug your program. Please make this example as realistic as you can. Limit your answer to at most 4 sentences.

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ddda

ANSWER: An example could be how Amazon's pages are taking a long time to render. We could use a profiler to figure out that loading the images is taking much longer than usual so we should probably search there.

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Question 5. Design Patterns (15 points)

(a) Choose the design pattern that best matches each of the following scenarios. Each scenario is described using text or code snippet.

(ai) (2 points)

A graphical user interface (GUI) framework allows developers to create UI components like buttons, text fields, and panels. Panels can contain multiple UI components, including other panels. The framework provides a uniform interface, so that a panel and an individual component can be treated the same way when rendering or applying styles.

Which design pattern does this description best illustrate?

- (●) A) Singleton
- ( ) B) Composite
- ( ) C) Prototype
- ( ) D) Command
- ( ) E) None of the Above

ANSWER: B) Composite

(aii) (2 points)

A weather station collects data about temperature, humidity, and pressure. Multiple devices, such as displays and alarms, need to update automatically whenever the weather data changes. The devices subscribe to the weather station, and when the station's data changes, all subscribed devices are notified to update accordingly.

Which design pattern does this scenario best illustrate?

- ( ) A) Strategy
- (●) B) Observer
- ( ) C) Command
- ( ) D) Factory Method
- ( ) E) None of the Above

ANSWER: B) Observer

```
1 class Enemy {
2 public:
3     virtual void attack() = 0;
```

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```
    virtual ~Enemy() {}
};

class Orc : public Enemy {
public:
    void attack() override {
        std::cout << "Orc attacks with a club!" << std::endl;
    }
};

```

(aiii) (2 points)

Consider the above code snippet:

Which design pattern does this code snippet best illustrate?

- A) Singleton
- B) Factory Method
- C) Prototype
- D) Builder
- E) None of the above

ANSWER: B) Factory Method

```
class ReportProcessor {
public:

    void processReport() {
        retrieveData();
        formatData();
        generateReport();
    }

protected:

    virtual void retrieveData() = 0;
    virtual void formatData() = 0;
```

(aiv) (2 points)

Consider the above code snippet:

Which design pattern does this code snippet best illustrate?

- A) Strategy
- B) Observer
- C) Command
- D) Factory Method
- E) None of the above

ANSWER: E) None of the above

(b) Choose the anti-pattern that best describes each of the following code snippets.

```
class PaymentProcessor {
public:
    void processPayment() {
        PaymentDetails paymentDetails;
        paymentDetails.setAmount(100);
        paymentDetails.setCardNumber("1234-5678-9876-5432");

        Transaction transaction;
        transaction.process(paymentDetails);
```

```
    }
};

```

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(bi) (2 points)

Consider the above code snippet:

Which anti-pattern does this snippet best illustrate?

- ○ A) Big Ball of Mud
- ○ B) God Class
- ○ C) Magic Numbers
- ○ D) Poltergeists
- ◉ E) None of the above

ANSWER: D) Poltergeists

```
class LoanCalculator {
public:
    double calculateLoanAmount(double principal, int years, double interestRate) {
        double monthlyRate = interestRate / 12.0 / 100.0;
        return principal * monthlyRate * pow(1 + monthlyRate, years*12) / (pow(1 + monthlyR
1);
    }

    double calculateTotalPayment(double loanAmount, double interestRate) {
        double monthlyRate = interestRate / 12.0 / 100.0;
        return loanAmount * monthlyRate * pow(1 + monthlyRate, 360) / (pow(1 + monthlyRate,
    }

```

(bii) (2 points)

Consider the above code snippet:

Which anti-pattern does this snippet best illustrate?

- ◉ A) Big Ball of Mud
- ○ B) God Class
- ○ C) Magic Numbers
- ○ D) Poltergeists
- ○ E) None of the above

ANSWER: C) Magic Numbers

(c) (3 points)

In Homework 3, the AST library (in particular, the parser) utilized a specific design pattern. What design pattern was implemented in this library? Briefly describe one advantage *and* one disadvantage of using this pattern. Include evidence from the wikipedia reading Wikipedia's Software Design Pattern. Limit your entire answer to no more than 5 sentences.

adasdasdwdadsdadawda

ANSWER:

- +1 points for advantage of visitor pattern
- +1 point for disadvantage of visitor pattern
- +1 point for at least one piece of evidence

Sample Answer:
The AST library utilized the visitor design pattern. The visitor pattern "lets you define a new operation without changing the classes of the elements on which it operates." The visitor pattern "makes extensions to the class hierarchy more difficult, as new classes typically require a new visit method to be added to each visitor."

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Question 6. Requirements Elicitation and Interviews (15 points)

(a)
You are tasked with designing and developing a messaging application that is integrated within a social media platform. The scope of your project is limited to just the messaging application, not the entire social media platform, but the company wants your messaging application to be integrated as seamlessly as possible within the entire platform.

(ai) (2 points)
List 2 possible functional requirements for the application. Each requirement should be described using exactly 1 sentence. In other words, use 2 sentences for your entire answer.

Your answer here.

ANSWER: Answers may vary Could relate to input, output, interface, response to events. Examples include allowing users to send and receive real-time messages; the ability to store chat history; supporting sending and receiving text, image and videos; the ability to synchronize messages across multiple devices.

(aii) (2 points)
List 2 possible non-functional requirements for the application. Each requirement should be 1 sentence.

Your answer here.

ANSWER: Answers may vary. Could relate to any of the category 1) Confidentiality requirement, 2) Privacy requirement, 3) Integrity requirement, 4)Availability requirement, 5) Reliability requirement, 4) Accuracy requirement, 5) Performance requirement. Examples include ensuring end-to-end message encryption, message integrity, low latency.

(aiii) (2 points)
For this social media application, consider the two requirements below. What specific type of flaw is present with each of these two requirements? Please list 1 flaw for each requirement. Use 1 sentence for each flaw; that is, your entire answer should be 2 sentences in total.

1. Users should see relevant notifications in the dashboard.
2. Sending the message should be fast.

Your answer here.

ANSWER: 1. Inadequacy (what is relevant? What kind of notification? What is a dashboard?) Ambiguity as well (what is a relevant message) 2. Ambiguity (How fast is it?)

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(aiv) (2 points)
Identify 2 different stakeholders for this social media messaging app, and describe a potential conflict that might arise between the two identified stakeholders during the requirements elicitation process for this app. Please limit your entire answer to at most 4 sentences.

Your answer here.

ANSWER: Answers will vary. An example is how the collection of personal information of the app creates conflicts between users and potential advertisers

(b)
Brian is tasked with interviewing an applicant Anna for a software development position and evaluating Anna's technical skills. Brian asks Anna to write a function to sort an array of integers. Anna began writing a python program to perform the sort, and delivered the following:

```
1  def sort_array(array):
2      arr = [x4 for x4 in array]
3      for x2 in range(len(arr) - 1):
4          min_index = x2
5          for x3 in range(x2 + 1, len(arr) - 1):
6              if arr[x3] < arr[min_index]:
7                  min_index = x3
8          arr[x2], arr[min_index] = arr[min_index], arr[x2]
9      return arr
10
```

(bi) (2 points)
Identify two things that Anna should have done or could have done better. Limit your entire answer to at most two sentences.

Your answer here.

ANSWER: Asking about requirements(time, space, in-place, stable vs unstable); comments; meaningful variable naming; type declaration

(bii) (1 points)
Brian looks through Anna's code and tells her that there is a bug with regards to the two `for` loops. Explain what this bug is. Limit your answer to at most three sentences.

Your answer here.

ANSWER: Should len(arr) not len(arr) - 1.

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(biii) (2 points)
Please provide a test case that can catch this bug and explain how this test case would result in an incorrectly sorted array when using Anna's code. Limit your answer to no more than four sentences.

Your answer here.

ANSWER: Anything where the largest element is not in the last position. Ex. [4,3,1,2] >>> [1,3,4,2] (last element is not swapped).

(biv) (2 points)
Brian then asks Anna to come up with more general test cases that she would use to catch potential edge case bugs. Provide a test case and explain why it would be a useful test case for somebody to have when testing a sorting function. Please limit your answer to at most four sentences.

Your answer here.

ANSWER: Tests can be empty input, one input, an already sorted list and a reverse order list (to check if the algorithm is unstable).

Extra Credit

(1) (2 points) How do you like the guest lectures this term? We had in total 4 of them. Would you like to see more or fewer in the future? What are some specific topics that you would like to focus on in these guest lectures? Let us know what you think! We would love to use your feedback to invite guest speakers in the future.

Your answer here.

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(2) (1 point) What do you think we should do more of next semester (or what is the thing you would most recommend that we change for future semesters)?

Your answer here.

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(3) (1 point) For the regular (non-guest) lectures, what is one **new** topic (which is not covered yet) that you would like to see? Adding a new lecture means we might need to take out an existing one. What is an existing lecture that you think we can replace?

Your answer here.

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(4) (2 points) Identify **one course non-professor** staff member (e.g., Adit Kolli, Arjav Patel, Hanchi Li, Rohit Saripalle, Derek Yang, Leena Khan, Max Liu, Prajna Polamarasetti) by name and either describe one instance in which you had a positive interaction with that person or describe a potential area for improvement for that person as an instructor. (We take these comments seriously and use this information to determine who we ask back next year and to put people up for awards and recognition.)

Your answer here.

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Honor Pledge and Exam Submission

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