Independent Software Engineering Trial Exam 2025

Marking Guidelines

Question 1 (1 mark)

Correct Answer: D (Building software with data protection measures integrated from the outset.)

Question 2 (1 mark)

Correct Answer: A (Cross-Site Request Forgery (CSRF))

Question 3 (1 mark)

Correct Answer: A (SMTP)

Question 4 (1 mark)

Correct Answer: B (Handling user interface interactions and dynamic content display in the browser.)

Question 5 (1 mark)

Correct Answer: C (Encourage collaboration between policymakers, educators, and businesses to promote inclusivity, skill development, and sustainability.)

Question 6 (1 mark)

Correct Answer: C (Logistic regression, because the goal is to classify whether a house will be sold within a specific time frame.)

Question 7 (1 mark)

Correct Answer: B (Phased)

Question 8 (1 mark)

Correct Answer: B (Suited to projects with evolving requirements and performance is not considered to be critical.)

Question 9 (1 mark)

Correct Answers:

- Prevents untrusted code from damaging the host system
- Allows developers to test software in a controlled environment
- Reduces the risk of security vulnerabilities affecting other parts of the system
- Prevents changes to live data during development and training

Question 10 (1 mark)

Correct Answers:

- Paragraph text is displayed in white
- Only the h1 heading text is centred
- The background of the page is blue
- All fonts will have serifs if Arial is not available
- Text not within `<h1>` or `<p>` tags will be green

Question 11 (1 mark)

Correct Answers:

- Reduction in demand for some low-skilled jobs
- Improved safety in high-risk work environments
- Reduced labour costs for employers
- Need for workforce reskilling and upskilling

Question 12 (1 mark)

Correct Answers:

- This is a level 0 data flow diagram
- Food outlets, Customers and Financial Institutions are external entities
- The system is shown as a single process
- The Food Ordering App sends a message to the Customer once their order has been shipped by a Food Outlet

Question 13 (2 marks)

Feature	**Correct Security Testing Strategy**
Simulates cyber attacks to find and exploit vulnerabilities.	Penetration Testing
Requires either the source code or binary.	Static Application Security Testing (SAST)
Checks for security vulnerabilities without executing the code.	Static Application Security Testing (SAST)
Evaluates environment and runtime issues.	Dynamic Application Security Testing (DAST)
Utilises scanning tools to understand how a target responds to intrusions.	Penetration Testing
Checks for security vulnerabilities while the program is running.	Dynamic Application Security Testing (DAST)
A purely white box testing strategy.	Static Application Security Testing (SAST)

Question 14 (2 marks)

Role	**Correct W3C Initiative**
Creates standards and working groups to protect user data and privacy	Privacy
Develops standards and guidelines for secure web applications	Web Security
Defines open formats (like XML) for data to be processed by computers	Machine-readable data
Supports web standards for multiple languages and cultural contexts	Internationalisation
Ensures web content is usable by people with disabilities	Web Accessibility Initiative (WAI)

Question 15 (2 marks)

Scenario	**Correct Machine Learning Model**
Training a robot to navigate a maze	Reinforcement learning
Labelling a small set of medical images and using them to classify a larger set	Semi-supervised learning
Predicting student grades based on past results	Supervised learning
Teaching an AI agent to win a game through trial and error	Reinforcement learning
Classifying email as spam or not spam	Semi-supervised learning
Grouping customers based on shopping habits	Unsupervised learning

Question 16 (2 marks)

Task	**Correct Software Project Phase**
Decide on a suitable software development approach.	Research and planning
Develop, construct and document algorithms.	Producing and implementing
Explore tools used to develop ideas and generate solutions.	Identifying and defining
Use a language-dependent code optimisation technique.	Testing and evaluating
Explore social and ethical issues associated with project work.	Research and planning
Define and analyse the requirements of a problem.	Identifying and defining
Compare actual with expected output	Testing and evaluating
Code the solution in a programming language	Producing and implementing

Question 17 (2 marks)

Sample Answer

Authentication
Authentication is the process of verifying who you are. The question it answers is: "Are you who you say you are?" It's the first step in granting access to a system. To authenticate, a user provides credentials, which are then checked against a trusted database or system.
Common examples include:

- **Username and Password:** You enter your username and a password. The system checks if the combination is valid.
- **Biometrics:** Using a fingerprint or facial recognition to unlock a device.
- **Multi-Factor Authentication (MFA):** This is a more robust method that requires two or more forms of verification. For example, after entering your password, you might also have to enter a code sent to your phone.

Authorization
Once a user has been authenticated, authorization determines what they are allowed to do. The question it answers is: "What are you permitted to access or do?" This process involves checking the user's permissions and access rights.
Examples of authorization include:

- **Role-Based Access Control (RBAC):** Users are assigned roles, and these roles have specific permissions. A "Student" role might allow a user to view course materials, while a "Teacher" role would allow them to create and edit them.
- **Discretionary Access Control (DAC):** The owner of a resource can decide who can access it and what they can do.
- **Attribute-Based Access Control (ABAC):** This is a more granular method that uses a set of attributes, like a user's department, the time of day, or the data's sensitivity, to decide access.

The Key Difference
Authentication is a prerequisite for authorization. You can't decide what a person is allowed to do until you've confirmed who they are.

Question 18 (3 marks)

Sample Answer

A race condition is a problem that can happen in multi-threaded or multi-process applications when multiple threads or processes try to access and modify the same shared resource at the same time. The final outcome depends on the unpredictable timing or order of execution.

How it affects purchase_item

Without the lock, a race condition could lead to a user purchasing an item that is out of stock. Here's how it could happen:

- A user checks if an item is in stock. The inventory for that item is 1.
- At the same exact moment, another user also checks the inventory for the same item. The inventory is still 1.
- The first user purchases the item, and the inventory count goes down to 0.
- The second user's purchase request goes through based on their earlier check, and they also get the item.

The inventory is now at -1, which is not what you would want.

The **threading.Lock()** object is a mutual exclusion lock that makes sure only one thread can access the code within the **with lock:** block at any given time, preventing this from happening.

Question 19 (4 marks)

Sample Answer

Confidentiality
Confidentiality is about making sure that information is only accessible to those who are authorised to view it. In this case, the school portal failed to protect the students' assessment files from unauthorised access. The confidentiality of the files was compromised when the student was able to modify the URL to access and download other students' work. This means the system didn't properly check if the user had the correct permissions to view the file they were requesting. This is often referred to as an Insecure Direct Object Reference (IDOR) vulnerability.
Integrity
Integrity refers to maintaining the accuracy and consistency of data. The integrity of the assessment files was compromised because students could re-upload their work multiple times. Allowing a file to be overwritten without a proper version history or logging system means there's no way to verify the file's state at a specific time, such as the due date.
Accountability
Accountability is the ability to trace actions to a specific user. Accountability was compromised because the system didn't detect or log the multiple re-uploads after the due date. Without a clear audit trail of file submissions, it's impossible for a teacher to verify when a file was last changed or who changed it.

Question 20 (6 marks)

No marking criteria or sample answer available.

Question 21 (2 marks)

Sample Answer

The Domain Name System (DNS) acts like the internet's phonebook. Its primary purpose in web data transmission is to translate human-readable domain names (like www.example.com) into machine-readable Internet Protocol (IP) addresses (like 192.0.2.1). When you type a domain name into your browser, DNS lookups occur to find the corresponding IP address of the web server hosting that site, allowing your browser to connect to the correct server and retrieve the web page.

Question 22 (3 marks)

Sample Answer

Web Content Management Systems (CMS) are software applications that allow users to create, manage, and modify digital content on a website without needing extensive technical knowledge.

Functions of a CMS

- **Content Creation and Editing:** Provides a user-friendly interface to write and format content.
- **Workflow Management:** Allows for drafting, reviewing, and approving content before publishing.
- **Content Organisation:** Helps organise content using categories, tags, and navigation.
- **Design and Layout:** Uses templates to separate content from design for a consistent look.
- **User Management:** Manages user roles and permissions.
- **Version Control:** Tracks changes to content over time.
- **Publishing:** Handles the process of making content live.

Examples of CMS

- **WordPress:** One of the most popular and widely used CMS platforms in the world. Its open-source nature and vast library of plugins and themes make it highly flexible.
- **Squarespace:** An all-in-one CMS platform famous for its simple, drag-and-drop interface and professional-looking templates.

Question 23 (4 marks)

Sample Answer

Confirm the Identity of the Web Server

- **Browser Hello:** The browser sends a "Client Hello" message to the web server with its supported SSL/TLS versions and cryptographic algorithms.
- **Server Hello and Certificate:** The server responds with a "Server Hello," choosing the SSL/TLS version and sending its SSL/TLS certificate.
- **Authentication:** The browser verifies the certificate's authenticity, checking its validity, expiration date, domain name match, and that it's signed by a trusted Certificate Authority (CA).

Establish a Secure Session

- **Session Key Exchange:** The browser generates a unique pre-master secret and encrypts it using the server's public key from the certificate.
- **Decrypting the Secret:** The server receives and decrypts the secret with its private key.
- **Symmetric Key Generation:** Both the browser and server use the pre-master secret to independently generate the same symmetric session key.

Communicate Securely During the Session
Once the symmetric session key is established, all subsequent communication is encrypted using this key, ensuring confidentiality and integrity for the duration of the session.

Question 24 (6 marks)

Sample Answer

Font Selection and Typography
Select a legible, simple, sans-serif font like Open Sans or Comic Sans. Use a large font size to ensure text is easy to read. Maintain consistent font size and weight to reduce cognitive load.
Colour Schemes and Contrast
Use a vibrant and engaging color palette with high contrast between text and background (e.g., dark blue text on a light yellow background). Use color for visual cues but avoid using color alone to convey meaning to support colorblind students.
The Use of Audio and Video Elements
Use narrated text and animations to reinforce concepts. Provide audio cues for feedback (e.g., a chime for a correct answer). All audio and video content must have closed captions and transcripts to support students with hearing impairments.
Navigation Design
Navigation must be simple and intuitive, featuring large, clear icons with short, easy-to-read text labels. Implement a hierarchical structure with a clear "Home" button. Interactive elements should be generously spaced for easy tapping.

Question 25 (2 marks)

Sample Answer

Supervised Learning
In supervised learning, the algorithm is trained on a labelled dataset, where each piece of training data has a correct "answer." The goal is for the model to learn a mapping from input data to the correct output, which can then be used to predict labels for new, unseen data.
Unsupervised Learning
In unsupervised learning, the algorithm is given an unlabelled dataset. The goal is for the model to find hidden patterns, structures, or relationships within the data on its own, without any correct answers to learn from.

Question 26 (3 marks)

Sample Answer

Weights
Weights are values associated with each connection between neurons in a neural network. They represent the strength of the connection. Initially set to random values, the goal of training is to adjust these weights so the network's predictions become more accurate. A higher weight means the input from a neuron is considered more important.
Backpropagation
Backpropagation is the algorithm used to adjust the weights. It works as follows:

1. **Forward Pass:** The network makes a prediction on a training example.
2. **Calculate Error:** The prediction is compared to the actual answer, and the difference (error) is calculated.
3. **Backward Pass:** The error is propagated backward through the network, calculating how much each weight contributed to the total error.
4. **Weight Adjustment:** The weights are adjusted to reduce the error.

This cycle of forward pass, error calculation, and backward pass allows the network to iteratively learn from its mistakes.

Question 27 (4 marks)

Sample Answer

The most appropriate machine learning regression algorithm is **Simple Linear Regression**, as the problem involves a single independent variable (hours studied) and a single dependent variable (test score) with an assumed linear relationship.
Implementing with OOP
You could create a **ScorePredictor** class.

- **Class:** ScorePredictor
- **Attributes:** `slope`, `intercept`
- **Methods:**
  - `__init__(self, hours_studied, test_scores)`: Constructor to take training data.
  - `train(self)`: Calculates the slope and intercept from the data.
  - `predict(self, new_hour)`: Predicts a score for a new hour value using the trained slope and intercept.

Required Model Features

1. **A training dataset:** A set of historical data points, consisting of pairs of "hours studied" and "test score."
2. **An equation for prediction:** The linear regression equation (y=mx+b) to make predictions.

Question 28 (6 marks)

Sample Answer

```
function knn(newPoint, tData, tLabels, k):
    // 1. Create an empty list to store distances and labels
    distancesAndLabels = []

    // 2. Loop through each point in the training data
    for i from 0 to length(tData) - 1:
        // 3. Get the current training point and its label
        currentPoint = tData[i]
        currentLabel = tLabels[i]

        // 4. Calculate the distance between the new point
        //    and the current training point
        d = distance(newPoint, currentPoint)

        // 5. Add the distance and its label to the list
        distancesAndLabels.append([d, currentLabel])

    // 6. Sort the list of pairs in ascending order by distance
    sortedDistances = sort(distancesAndLabels)

    // 7. Create a new list for the k nearest labels
    kNearestLabels = []

    // 8. Loop k times to get the labels of the k closest points
    for i from 0 to k - 1:
        // 9. Add the label to the kNearestLabels array
        kNearestLabels.append(sortedDistances[i][1])

    // 10. Find the most frequent label
    predictedLabel = mode(kNearestLabels)

    // 11. Return the predicted label
    return predictedLabel
```

Question 29 (2 marks)

Sample Answer

Gantt charts assist project managers in meeting deadlines through several key functions:

Visualizing the Timeline: They break down a project into smaller tasks represented by bars on a timeline. This makes it easy to see the project's overall schedule and quickly identify if tasks are on track.

Identifying Dependencies: They visually show relationships where one task must be completed before another can begin. This helps managers understand how a delay in one task will impact subsequent tasks and the final deadline, allowing for proactive adjustments.

Progress Tracking and Resource Management: As work is completed, the chart is updated to show task progress. By comparing planned progress with actual progress, managers can identify tasks that are falling behind, reallocate resources as needed, and make informed decisions to keep the project on schedule.

Question 30 (3 marks)

Sample Answer

```
BEGIN FindItem(itemToFind):

    // Check if the item exists in the list
    Found = ItemExists(itemToFind)

    initialise Location TO -1

    // If the item was found, get its location
    IF Found IS TRUE THEN:
        Location = CheckLocation(itemToFind)
    ENDIF

    // Return the location (-1 if not found)
    RETURN Location

END FUNCTION
```

Question 31 (4 marks)

Sample Answer

Programmed Data Backup

- **Role:** The primary role is to create and store automated, regular copies of files and data. It acts as a safety net against data loss from hardware failure, accidental deletion, cyber-attacks, or other disasters.
- **Importance:** Its importance lies in disaster recovery. A recent backup allows developers to restore a codebase quickly after a catastrophic event, minimizing downtime and data loss. It is the last line of defense.

Version Control

- **Role:** The main role of version control (e.g., Git) is to track every change made to the code over time, creating a detailed history. It also facilitates collaboration by allowing multiple developers to work on the same project simultaneously without overwriting each other's work.
- **Importance:** Its importance is in change management and collaboration. It allows developers to revert to a previous, stable version of the code if a new change introduces a bug. It also enables efficient teamwork through features like branching and merging.

In summary, data backup protects against catastrophic loss, while version control manages the evolution of the codebase and enables effective teamwork.

Question 32 (6 marks)

Sample Answer

Key Characteristics
Agile: An iterative and flexible approach focused on:

- **Iterative Development:** Projects are broken into short cycles called sprints.
- **Flexibility:** Welcomes changing requirements.
- **Collaboration:** Constant communication between the team and customer.
- **Working Software:** The primary measure of progress is a functional product.

Wagile: A hybrid model combining Waterfall and Agile elements:

- **Waterfall-like Planning:** Significant upfront planning and requirements gathering.
- **Agile-like Execution:** Development is done in sprints after the planning phase.
- **Documentation-Heavy:** Often maintains extensive documentation.
- **Limited Flexibility:** Changes after the initial planning phase are difficult.

Advantages and Disadvantages
Agile

- **Advantage:** High adaptability to changing requirements and customer feedback.
- **Disadvantage:** Lack of predictability in final timelines and budgets from the outset.

Wagile

- **Advantage:** Provides structured flexibility, combining upfront planning with iterative development.
- **Disadvantage:** The clash of two different philosophies can lead to confusion and an inefficient process.

Project Scenario for Pure Agile A pure Agile approach would be more suitable than Wagile for a startup developing an innovative mobile application for a new, unpredictable market. The success of such a project depends on the ability to "fail fast," pivot based on early user feedback, and adapt to market trends. The extensive upfront planning required by Wagile would be counterproductive, as the initial requirements are highly likely to change. Agile allows the team to build a Minimum Viable Product (MVP), gather real-world feedback quickly, and iterate in short cycles to ensure the final product meets actual user needs.