Department of Education Software Engineering Exam Marking Criteria

Question 1 (1 mark)

What is a key feature of progressive web apps (PWAs)?

Sample Answer

B, Can be installed like native apps

Question 2 (1 mark)

Which language is typically used for client-side programming?

Sample Answer

C, JavaScript

Question 3 (1 mark)

A common machine learning model for unsupervised machine learning is:

Sample Answer

C, Neural network

Question 4 (2 marks)

Match the correct definition to the concept.

Sample Answer

- **Converts encrypted data back into a readable format:** Decryption
- **Used to verify the authenticity and integrity of a message:** Digital Signature
- **Converts readable data into a coded format to protect privacy:** Encryption
- **Converts data into a fixed-length value that cannot be reversed:** Hashing
- **Data that has not been encrypted or protected:** Plain Text
- **Security protocols that enable encrypted communication over a network:** SSL/TLS

Question 5 (1 mark)

Which of the following best describes the Agile software development approach?

Sample Answer

- A, It produces code faster than the Waterfall approach
- C, It uses an iterative workflow.

Question 6 (2 marks)

List 3 reasons why a web development team might use version control in the development of a website?

Marking Guide

Sample Answer

1. **Collaboration:** Version control systems allow multiple developers to work on the same project simultaneously without overwriting each other's changes. This facilitates teamwork and helps manage contributions from different team members effectively.

2. **Tracking changes:** Version control provides a complete history of changes made to the codebase, allowing developers to track modifications over time. This makes it easy to identify when changes were made, by whom, and the reasons behind those changes.

3. **Backup and recovery:** With version control, developers can easily revert to previous versions of the code if something goes wrong. This ensures that there is a safety net in place, allowing the team to recover from mistakes or bugs introduced in the development process.

Question 7 (2 marks)

Briefly describe the difference between input validation and input sanitisation as defensive data input handling practices, providing an example of each.

Marking Guide

Marking Criteria

Criterion	Marks
Describes validation and sanitation with appropriate examples.	2
Describes validation and sanitation with poorly chosen examples or no examples.	1

Sample Answer

Input validation involves checking the data provided by users to ensure it meets specific criteria, e.g., ensuring a phone number is numeric.
Input sanitation involves cleaning or altering the input data to remove or neutralise potentially harmful elements, e.g., removing script tags to prevent SQL injection or XSS.

Question 8 (3 marks)

Discuss the differences between front-end and back-end web programming.

Marking Guide

Marking Criteria

Criterion	Marks
Clearly identifies and explains at least three key differences between front-end and back-end web programming. Demonstrates a strong understanding of the roles and technologies involved in both areas. Uses relevant examples or terminology to support the explanations.	3
Identifies and explains at least two key differences between front-end and back-end web programming. Shows a basic understanding of the roles and technologies, but may lack depth in explanation. Provides some examples or terminology, but they may not fully support the discussion.	2
Identifies only one difference or provides a vague explanation of the terms front-end and back-end. Lacks clarity and depth in understanding the roles and technologies involved. May include irrelevant information or examples that do not contribute to the discussion.	1

Sample Answer

Front-end web programming refers to the development of the client side of a web application. It involves everything that users see and interact with in their web browsers. The primary focus is on user interface (UI) and user experience (UX).
Back-end web programming refers to the server side of a web application. It involves the logic, database interactions, and server configuration that power the application behind the scenes.

Question 9 (2 marks)

Match the terms for these tools and processes to their definition.

Sample Answer

- **A set of processes or rules to be followed to solve problems:** algorithm
- **A table which represents data items, their data types, format, size, and validation rules if they apply:** data dictionary
- **Performance of tasks to ensure that developed software continues to meet requirements:** quality assurance
- **A set of instructions written in a programming language to perform specific tasks:** source code
- **Checking if developed software meets requirements or specifications:** evaluation
- **A sequence of sketches or mock-ups to represent how users navigate through different screens:** storyboard

Question 10 (a) (1 mark)

In which software development step would a software engineering team need to decide on the specific algorithm they will use?

Sample Answer

B, Design

Question 10 (b) (3 marks)

Hashing algorithms are used to create a unique representation of data. Identify 3 essential features of a hashing algorithm.

Marking Guide

Marking Criteria

Criterion	Marks
Clearly identifies and explains three essential features of a hashing algorithm. Each feature is accurately described, demonstrating a strong understanding of how it relates to encryption and security. May include relevant examples or implications of each feature.	3
Identifies and explains two essential features of a hashing algorithm. Provides reasonable descriptions but may lack depth or clarity in some areas. Examples or implications may be minimal or not entirely relevant.	2
Identifies only one essential feature of a hashing algorithm or provides vague descriptions of features. Lacks clarity and depth in understanding the implications of the identified feature(s). May include irrelevant information or fail to relate features to encryption and security.	1

Sample Answer

Answers may include:

- **One-way:** It is computationally infeasible to recover the original data from the hash.
- **Fixed-size output:** The hash value will always be the same fixed length, regardless of the input size.
- **Deterministic:** The same input will always produce the same hash output.
- **Collision resistance:** It should be extremely difficult to find two different inputs that produce the same hash output.
- **Efficiency:** The hashing function should be fast to compute for any given input.

Question 11 (a) (1 mark)

Which Machine Learning model is most appropriate for predicting new values based on the data given in the graph?

Sample Answer

B, Polynomial regression

Question 11 (b) (5 marks)

Explain why a Neural Network would not be the best choice of model for the training data and propose an alternative model.

Marking Guide

Marking Criteria

Criterion	Marks
Explains limitations for training or predicting simple curvilinear data with a Neural Network. Shows a thorough understanding of Neural Networks.	5
Outlines 2 or 3 limitations of Neural Networks relating to simple data. Shows an understanding of Neural Networks.	4
Outlines 1 or 2 limitations of Neural Networks.	3
Outlines some features of Neural Networks or the curvilinear form.	2
Provides some relevant information.	1

Sample Answer

The dataset exhibits a straightforward curvilinear relationship, characteristic of polynomial data. For such cases, polynomial regression is an ideal approach because it can efficiently and directly fit the data to a polynomial equation, providing both accuracy and interpretability.

In contrast, employing a neural network would be excessive. Neural networks are designed to handle much more complex, non-linear relationships. When applied to this simple dataset, a neural network introduces a significant risk of **overfitting**. Instead of capturing the true underlying relationship, it may learn the random noise in the data, reducing its ability to generalize to new data.

Furthermore, training a neural network requires considerably more **computational resources** compared to polynomial regression. Neural networks require iterative training cycles, which consume substantial memory and processing power. For simple polynomial data, this is an unnecessary use of computational power.

Question 12 (3 marks)

Create a class diagram for the rocket and satellite relationship described in the stimulus.

Marking Guide

Marking Criteria

Criterion	Marks
Clearly represents both the Rocket and Satellite classes with appropriate attributes and methods. Correctly illustrates the relationship between the Rocket and Satellite classes (e.g., association, composition).	3
Represents both classes but may miss one or more attributes or methods. Indicates a relationship, but it may be unclear or improperly represented. Uses some UML notation, but with minor errors.	2
Represents only one of the classes or provides vague representations. Fails to indicate a relationship or represents it inaccurately. Lacks proper UML notation.	1

Question 13 (3 marks)

Write a SQL query to show the albumName and albumPrice for all albums where the format is 'Vinyl', ordered by price from highest to lowest.

Marking Guide

Marking Criteria

Criterion	Marks
Provides a correct SQL query that selects the correct columns, filters by 'Vinyl', and orders by price descending.	3
Provides a SQL query that addresses some of the requirements (e.g., correct selection and filtering but incorrect ordering).	2
Shows some understanding of SQL (e.g., a basic SELECT statement).	1

Sample Answer

```
SELECT albumName, albumPrice
FROM albums
WHERE format = 'Vinyl'
ORDER BY albumPrice DESC;
```

Question 14 (4 marks)

Write Python code that implements the function `has_symbol(username, password, symbols)` which only checks whether either the username or password contains a symbol from the given list and prints a message if not.

Marking Guide

Marking Criteria

Criterion	Marks
The solution fully implements the function with all required checks for symbol presence. Well-structured code. Provides a clear feedback message for validation failure.	4
The solution implements most of the required functionality but may have minor issues. The feedback message is present but may lack clarity.	3
The solution implements some functionality with omissions or errors. Provides minimal feedback.	2
Does not implement the required functionality or is fundamentally incorrect.	1

Sample Answer

```
def has_symbol(username, password, symbols):
    symbol_present = False

    # Check for symbols in the combined string of username and password
    for char in username + password:
        if char in symbols:
            symbol_present = True
            break  # Exit loop once a symbol is found

    if not symbol_present:
        print("No symbol present in the username or password.")
        return False
    else:
        return True

# Example usage:
symbols = ['#', '$', '!', '^', '&', '[', ']']
has_symbol("user", "password123", symbols) # Will print message and retu
has_symbol("user#", "password123", symbols) # Will return True
```

Question 15 (4 marks)

Explain how Machine Learning and Business Process Automation can help 'Click Shoe Warehouse' achieve its goal.

Marking Guide

Marking Criteria

Criterion	Marks
Comprehensive explanation of how ML can analyse sales data for seasonal patterns. Detailed understanding of how BPA can streamline processes. Clear integration of ML and Automation for forecasting and inventory. Provides specific, relevant examples.	4
Good explanation of how ML identifies patterns. Describes how BPA improves efficiency, though with less depth. Some integration of ML and BPA concepts. Offers examples that may be less specific.	3
Basic mention of ML with limited explanation. Brief or unclear description of BPA. Minimal integration of the two concepts. Provides vague or general examples.	2
Inadequate or incorrect explanation of ML. Little to no mention of BPA. No integration of concepts. Lacks practical examples.	1

Sample Answer

Machine Learning (ML) can analyze the 10 years of sales history to identify complex patterns. It can determine which specific shoe styles and sizes are most popular during different seasons (e.g., sandals in summer, boots in winter). ML models can create predictive forecasts for future demand, allowing the warehouse to optimize stock levels, reduce overstocking of unpopular items, and prevent stockouts of high-demand items. This leads to reduced waste and maximized profit.

Business Process Automation (BPA) can then use the insights from the ML models to automate operational workflows. For example, when the ML model predicts a surge in demand for a certain shoe, BPA can automatically generate purchase orders to suppliers. It can also automate inventory management by updating stock levels in real-time and triggering reorder alerts. This reduces manual effort, minimizes human error, and ensures the business can respond quickly to changing market trends identified by the ML system.

Question 16 (4 marks)

Describe TWO strategies an online service could implement to reduce the risk of dictionary attacks.

Marking Guide

Marking Criteria

Criterion	Marks
Explains how TWO relevant strategies harden accounts against dictionary attacks.	4
Explains how ONE relevant strategy would protect against dictionary attacks OR outlines how TWO relevant strategies could be applied.	3
Outlines relevant strategy(ies).	2
Provides some relevant information.	1

Sample Answer

1. **Implement Account Lockout and Rate Limiting:** This strategy temporarily locks an account after a certain number of failed login attempts from the same IP address or for a specific username. For example, locking an account for 15 minutes after 5 failed attempts. This dramatically slows down a dictionary attack, as the attacker cannot rapidly cycle through their word list, making the attack impractical and easy to detect.

2. **Enforce Strong Password Policies:** The service can require users to create passwords that are less susceptible to dictionary attacks. This includes mandating a minimum length (e.g., 12+ characters), and requiring a mix of character types (uppercase, lowercase, numbers, and special symbols). Additionally, the system can check new passwords against a blocklist of common and previously breached passwords, preventing users from choosing easily guessable options found in typical dictionaries.

Question 17 (4 marks)

Explain why an experienced web developer would choose to use HTML and CSS while a beginner would use a CMS.

Marking Guide

Marking Criteria

Criterion	Marks
Provides a clear and coherent explanation for both user types. Accurately describes advantages of HTML/CSS for experienced developers (control, performance) and CMS for beginners (user-friendliness, quick setup). Effectively compares and contrasts the two approaches.	4
Offers a good explanation but may lack some clarity. Describes some advantages for both but with less detail. Provides a comparison that may not be fully developed.	3
Provides a basic explanation with limited clarity. Mentions a few advantages for each but lacks depth. Offers minimal comparison.	2
Explanation is inadequate or unclear. Fails to describe advantages adequately. Lacks comparative analysis.	1

Sample Answer

Experienced Developer (HTML and CSS): An experienced developer would choose to code a website from scratch using HTML and CSS for maximum **control and flexibility**. This approach allows for a completely custom design, tailored precisely to project requirements without the constraints of a CMS template. They can write clean, optimized code, leading to better **performance** and faster load times. It also avoids the code bloat and potential security vulnerabilities that can come with CMS plugins.
Beginner (CMS): A beginner would choose a Content Management System (CMS) like WordPress or Squarespace because it offers a **user-friendly interface** and a much lower barrier to entry. A CMS allows them to build a functional website quickly using pre-built **templates and drag-and-drop editors**, without needing to write code. Features like content management, SEO tools, and plugins are built-in, simplifying the process and allowing the beginner to focus on content rather than technical implementation.

Question 18 (5 marks)

Assess positive and negative impacts of machine learning and artificial intelligence on production efficiency, waste and the environment.

Marking Guide

Marking Criteria

Criterion	Marks
Elaborates on several positive and several negative potential impacts, providing a reasonable balance.	5
Provides several positive and several negative potential impacts, but does not elaborate them sufficiently.	4
Elaborates on only positive impacts OR only negative impacts.	3
Outlines only 1 positive AND 1 negative potential impact without elaborating.	2
Outlines only 1 positive OR 1 negative potential impact without elaborating.	1

Sample Answer

Positive Impacts:

- **Increased Production Efficiency:** AI and ML can optimize supply chains and manufacturing processes. Predictive maintenance algorithms can forecast when machinery will fail, reducing downtime and increasing output.
- **Waste Reduction:** By analyzing data to predict consumer demand more accurately, companies can avoid overproduction, which is a major source of waste. In manufacturing, AI can optimize cutting patterns or chemical processes to use fewer raw materials.
- **Environmental Optimization:** AI can be used to optimize energy consumption in data centers and factories. It can also help in monitoring and managing natural resources, such as predicting deforestation or monitoring pollution levels.

Negative Impacts:

- **High Energy Consumption:** Training complex ML models, especially deep learning models, requires immense computational power. This is often provided by large data centers that consume vast amounts of electricity, contributing significantly to carbon emissions if powered by fossil fuels.
- **E-waste Generation:** The rapid advancement of AI hardware (like GPUs and TPUs) can lead to a shorter upgrade cycle. This contributes to a growing problem of electronic waste, which is often difficult to recycle and contains hazardous materials.

Question 19 (a) (3 marks)

Design a user interface for library registration. Label all form fields clearly.

Marking Guide

Marking Criteria

Criterion	Marks
Provides a user interface suitable for users to register with all form fields labelled, including input validation indicators.	3
Designs the user interface with some relevant features.	2
Shows some understanding of the problem.	1

Question 19 (b) (3 marks)

Explain how accessibility considerations improve the usability of web forms for a wide range of users, including those with disabilities.

Marking Guide

Marking Criteria

Criterion	Marks
Provides a detailed explanation of multiple accessibility features and how they support users with specific needs. Uses correct terminology and relevant examples.	3
Outlines at least two accessibility features clearly, explaining how they help improve usability for users with disabilities.	2
Provides some relevant information about accessibility or usability in web forms.	1

Sample Answer

Accessibility considerations improve web form usability by making them perceivable, operable, and understandable for everyone. For example:

- **Screen Reader Compatibility:** Using proper HTML semantics, like the `<label>` tag correctly associated with its `<input>`, allows screen readers to announce the purpose of each field to visually impaired users. This makes it possible for them to fill out the form independently.
- **Keyboard Navigation:** Ensuring that all form fields and buttons can be accessed and operated using only the Tab and Enter keys is crucial for users with motor impairments who cannot use a mouse. A logical tab order makes navigation predictable and efficient.
- **Clear Error Messaging:** Providing clear, descriptive error messages (e.g., "Email address must include an @ symbol") that are programmatically associated with the relevant field helps users with cognitive disabilities or anyone who makes a mistake to easily identify and correct the issue.

Question 20 (4 marks)

Describe the K Nearest Neighbour (KNN) algorithm for regression, predicting y for a new data point using a training data set of x and y values given the K value parameter of 3.

Marking Guide

Marking Criteria

Criterion	Marks
Describes the KNN algorithm for regression, including distance calculation, selection of K neighbors, and the prediction as the mean of the K neighbors' values.	4
Outlines most of the KNN algorithm but may miss a key detail.	3
Outlines some features of the KNN Algorithm.	2
Provides some relevant information.	1

Sample Answer

The K-Nearest Neighbour (KNN) algorithm for regression predicts the value of a new data point based on the values of its neighbors in the training data. Given K=3, the process is as follows:

1. **Calculate Distances:** For a new, unseen data point (x), the algorithm calculates the distance (commonly Euclidean distance) between this new point and every single data point in the training set.
2. **Find the K-Nearest Neighbors:** The algorithm then sorts all the training data points based on their calculated distance to the new point, from smallest to largest. It selects the top K (in this case, 3) data points with the smallest distances. These are the "nearest neighbors."
3. **Predict the Value:** For regression, the final prediction for the new data point's y-value is the **average (mean)** of the y-values of its 3 nearest neighbors.

Question 21 (a) (1 mark)

Implement this stub in python code.

Sample Answer

```
def login(username, password):
    """
    A simple login stub that checks for a specific
    username and password combination.
    """
    if username == "user1" and password == "pass123":
        return "Login successful"
    else:
        return "Login failed"
```

Question 21 (b) (2 marks)

Provide at least TWO more tests that could be used, with a comment justifying the use of each one.

Sample Answer

```
# Test case 2: Test with a correct username but incorrect password.
# This ensures the function correctly rejects invalid credentials.
if login("user1", "wrongpassword") == "Login failed":
    print("Test case 2 passed")
else:
    print("Test case 2 failed")

# Test case 3: Test with an incorrect username but correct password.
# This checks another path for login failure and ensures both fields are v
if login("wronguser", "pass123") == "Login failed":
    print("Test case 3 passed")
else:
    print("Test case 3 failed")
```

Question 21 (c) (2 marks)

You are tasked with writing an error message to return to users in situations where their login attempt fails. What should you consider when creating these messages?

Marking Guide

Marking Criteria

Criterion	Marks
Identifies two considerations, including one related to security.	2
Identifies one security consideration OR identifies TWO non-security considerations.	1

Sample Answer

When creating login error messages, you should consider:

1. **Security:** The message should be generic to avoid revealing sensitive information. For instance, use "Invalid username or password" instead of "Username does not exist" or "Incorrect password." This prevents attackers from using the error message to confirm valid usernames (user enumeration).

2. **User Experience (UX):** The message should be clear, concise, and helpful without being alarming. It could also provide a constructive next step, such as a link to reset the password, to help legitimate users who may have forgotten their credentials.

Question 22 (a) (3 marks)

Explain communications issues that may arise due to stakeholders being located all over the country.

Marking Guide

Marking Criteria

Criterion	Marks
The response clearly identifies and explains multiple communication issues (e.g., time zones, lack of non-verbal cues, tech issues) relevant to the context. Demonstrates a strong understanding of the implications.	3
The response identifies and explains some communication issues, but may lack detail or direct relevance. Shows a moderate understanding of implications.	2
The response identifies at least one communication issue, but the explanation is limited or unclear.	1

Sample Answer

Communication issues that may arise from geographically dispersed stakeholders include:

- **Time Zone Differences:** With offices across Australia, stakeholders in Perth (AWST) will be 2-3 hours behind those in Sydney (AEST/AEDT). This makes scheduling real-time meetings difficult and can cause delays in decision-making and feedback loops.
- **Lack of Non-Verbal Cues:** Relying on email, chat, or even phone calls removes the non-verbal communication (body language, facial expressions) present in face-to-face meetings. This can lead to misunderstandings, misinterpretations of tone, and a weaker sense of team cohesion.
- **Technological Barriers:** Teams may face issues with unreliable internet connections, incompatible software, or difficulty using collaboration tools. This can disrupt meetings, hinder the sharing of important documents, and create frustration among team members.

Question 22 (b) (2 marks)

Compare and contrast Hybrid (WAgile) and Waterfall software development methodologies in developing software to control the manufacturing of their toys.

Marking Guide

Marking Criteria

Criterion	Marks
Clearly identifies and describes both methodologies. Effectively compares and contrasts them in the specific context of toy manufacturing, offering a well-reasoned analysis.	2
Identifies and describes both methodologies but may lack detail. Provides some comparison but with insights that may be less relevant to the context.	1

Sample Answer

Waterfall: This is a traditional, linear approach. It would involve gathering all software requirements upfront, followed by distinct phases of design, implementation, testing, and deployment.

- **Contrast/Advantage:** It is highly structured and documented, which is beneficial for meeting the strict regulatory requirements of AusToy, as compliance can be planned and verified at each stage.
- **Disadvantage:** It is inflexible. If a manufacturing process needs to change mid-project, it is very costly and difficult to go back to a previous stage.

Hybrid (WAgile): This model combines elements of both Waterfall and Agile.

- **Comparison/Advantage:** It might use a Waterfall approach for the initial high-level planning and requirements gathering (to satisfy regulatory frameworks) but use an Agile (iterative) approach for the actual development and testing phases. This allows for flexibility and adaptation during development while still maintaining initial structural integrity. It provides a good balance between the need for upfront planning for compliance and the flexibility to adapt to manufacturing floor feedback.

In summary, for toy manufacturing software where safety and regulations are critical, a pure Waterfall model offers control. However, a Hybrid model is likely superior as it provides the upfront planning needed for compliance while allowing the flexibility to refine the software based on real-world factory floor needs.

Question 23 (8 marks)

Discuss the ethical, legal, and technical ramifications for both users and the enterprise

stemming from a cross-site scripting (XSS) security breach.

Marking Guide

Marking Criteria

Criterion	Marks
Discusses ethical, legal, and technical ramifications for both users and the enterprise in detail.	8
Outlines ethical, legal, AND technical ramifications for both the user AND the enterprise.	6-7
Outlines ethical, legal, AND technical ramifications for the user OR the enterprise.	4-5
Shows some understanding of ethical OR legal OR technical ramifications for either users OR the enterprise.	2-3
Provides some relevant information.	1

Sample Answer

A Cross-Site Scripting (XSS) attack has wide-ranging ramifications:
For Users:

- **Ethical:** The breach is a severe violation of user privacy and trust. Users entrust their personal data to the platform with the expectation of security. An XSS attack can lead to the unauthorized access and misuse of this data, which is a significant ethical failure by the company.
- **Legal:** Users whose data is breached may be victims of identity theft, financial fraud, or harassment. They may have legal recourse to sue the company for damages under data protection laws like the GDPR or Australia's Privacy Act.
- **Technical:** Users' accounts can be hijacked (session hijacking), their credentials stolen, or malicious software can be installed on their devices through the compromised website. They may unknowingly spread the malicious script to other users.

For the Enterprise:

- **Ethical:** The enterprise has an ethical duty of care to protect its users' data. Failing to prevent a known vulnerability like XSS is a breach of this duty and severely damages the company's reputation and public trust, which can be difficult to regain.
- **Legal:** The company faces significant legal consequences. This includes massive fines from regulatory bodies (e.g., up to 4% of global turnover under GDPR), mandatory data breach notifications to users and authorities, and potential class-action lawsuits from affected users.
- **Technical:** The immediate technical ramification is the need to identify and patch the XSS vulnerability, which can be complex and resource-intensive. The company must also conduct a full security audit, implement better security practices (like input sanitization and output encoding), and invest in ongoing security training for developers to prevent future incidents.