HSC STUDY DAY SERIES

2025

SOFTWARE ENGINEERING STUDENT BOOKLET

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HSC STUDY DAY SERIES

2025

SOFTWARE ENGINEERING STUDENT BOOKLET

HSC Digital Examination

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2025 HSC STUDY DAY SERIES

SOFTWARE ENGINEERING

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Preparing for the Digital Examination

Software Engineering
HSC Study Day
Presenter : Ryan Chadwick
Sydney Secondary College
(30 mins)

Outline

This session will cover

- Overview of the exam
- Hardware and general skills
- Preparing for the exam
- Strategy during the exam

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SOFTWARE ENGINEERING

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1. About the exam in general

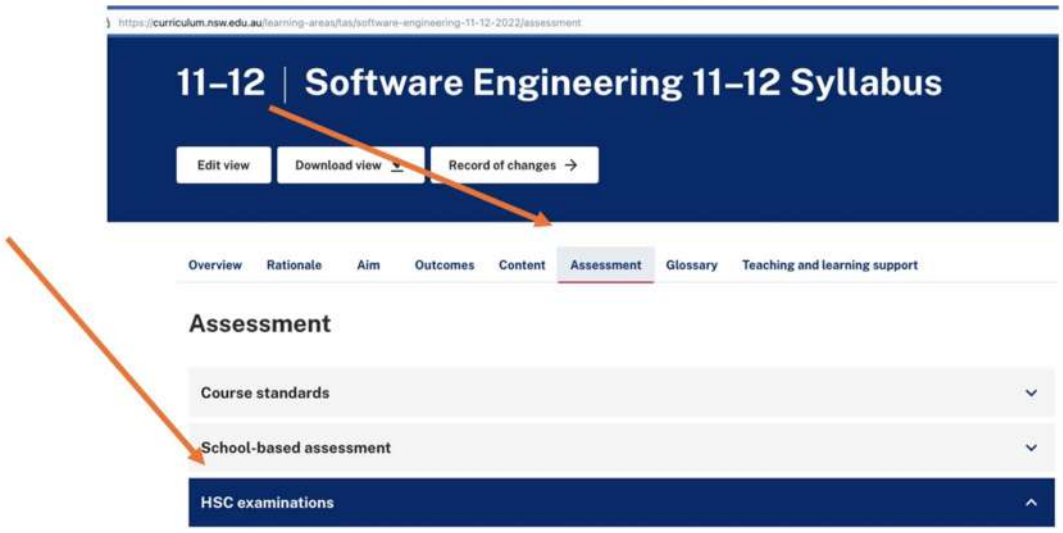
Know what to expect

Overview

- This will be the first HSC exam for this subject.
  It is also the first digital exam for a lot of people.
- The exam will be marked out of 80
- The time allowed is 2 hours and 30 minutes (including 10 minutes reading time, so only 2 hours 20 minutes exam time)
- Headphones are required (must be wired)
- The online Python environment does not allow loading modules so only need to know base Python

4

More details may be found here



5

2. Think about your setup

Hardware and general skills

Hardware

- Think about your keyboard and mouse. You want a comfortable and efficient input experience.
- If possible, think about the size of your screen. Larger could make it easier to read and work with material.

7

Preparing for the exam

- Make sure you have the correct exam skills for this type of exam
  - Learn to touch type

  - Be familiar with your particular work environment (use the sample exam to ensure you are familiar with the hardware and software layout and can work comfortably for the exam time).
  - If you want to change the font/ colour/ font size etc, work it all out now before the actual exam.

8

3. Preparing for the exam

Get game ready

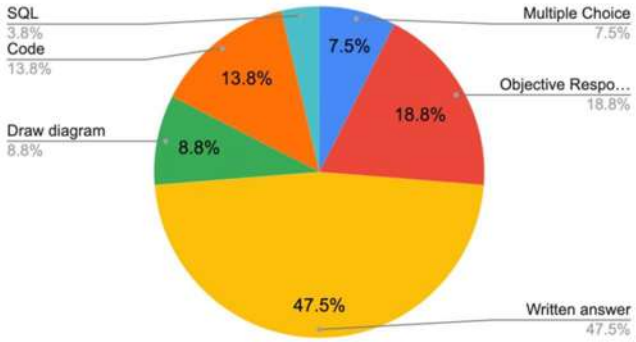
Studying

- Study the material as usual
- Need to make sure you have knowledge as well as skills
  - Some questions are just **write** an answer
  - Other questions are **do** a thing (this is anticipated to be a bigger part of the exam now that it is online)

10

A guess about exam breakdown

- Looking at the structure of the Sample Exam
- Objective response / multiple choice (just over a quarter)
- Written answer (almost half)
- Applying skills (just over a quarter)



11

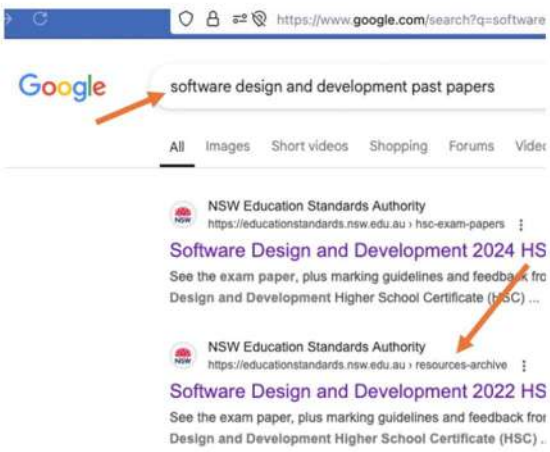
Look over

- HSC Familiarisation questions
- Online Sample exam (get your teacher to enrol you)

12

Look over Software Design and Development past papers

- Some questions overlap with the old syllabus.
- Get an idea of styles of questions to expect.
- Can also see suggested answers
  - Get an idea of style and depth of answer that markers are looking for



13

From the 2024 Paper

12 An array called List contains the following data.

index	1	2	3	4
List(index)	X	A	W	C

Consider the following code fragment.

```
Temp = List(1)
List(4) = List(1)
List(1) = Temp
FOR index = 1 to 4
    Display List(index)
NEXT index
```

What is the output produced by the code?

A. A, C, W, X

B. C, A, W, C

C. C, A, W, X

D. X, A, W, X

2 A software solution is to be developed by a team, initially with a small number of features. More features will be added over the life of the project in response to user feedback.

Which development approach would be most suitable for this software solution?

A. RAD

B. Agile

C. End-user

D. Prototyping

14

From the 2024 Paper

(b) Describe how a Gantt chart could be used to manage the development of this application. **3**

(c) Complete the partial data dictionary for this website. **3**

Data item	*Data type*	*Storage size bits/bytes*	*Description*	*Examples*
Surname	String	40 bytes	Surname of customer	Faruga
ItemName		20 bytes	Name of item	2 L skim milk
Quantity			Number of items	4

15

From the 2024 Paper

(a) An algorithm called AllocateTickets is required to allocate ticket numbers to customers. **5**

Customers are selected at random to receive their requested tickets until all available tickets are allocated. The tickets allocated will always be sequentially numbered.

The Cust_ID of the chosen customers are stored next to the relevant ticket number in a 10 000-element array of records called Ticket_Array.

For example:

TicketNumber	AllocatedCustomer
1	Jones34
2	Jones34
3	Jones34
4	Abu507
5	Abu507
...	...
9998	Wong4567
9999	Rakash234
10000	Rakash234

As the last tickets are allocated, a customer may not get all the tickets they have requested (as there may be no more tickets left). Some customers may not be allocated any tickets at all.

In the example shown above, even if Rakash234 requested five tickets, there will only be two allocated because that is all that is left.

Design an appropriate algorithm for AllocateTickets.

You may use this function:

- Rand (Min, Max) generates a random integer between Min and Max, inclusive

16

Strategy for content

- Make assumptions about the content and how it will be assessed in the exam.
- Look at SDD papers to get an idea as well.
- Software Automation will most likely be more "discuss" questions rather than "do" questions.
- Four dot points is asking for a scenario question and select most appropriate and justify. Eg. Implementation methods

17

Strategy for content - continued

- SQL could be having a sample table of data and you have to create a query to achieve a goal.
- Something else

A good activity for revision is to go through the syllabus and make a prediction on what types of questions would be appropriate for each syllabus dot point.

Combine into a spreadsheet

18

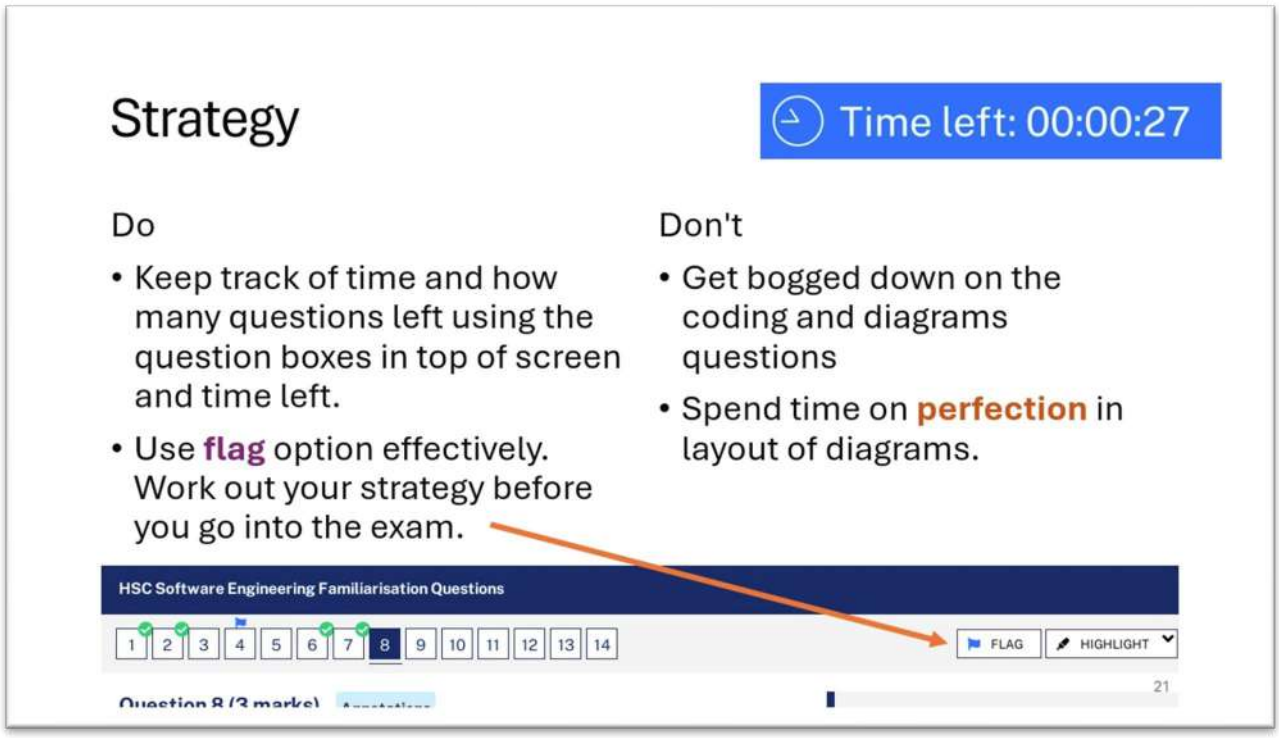
4. Strategy in the exam

Make the most of your time

Strategy

- Blank paper is allowed in the exam. Can use this for planning. eg. for programming questions.
- Highlighting of text in questions can be done during reading time. Use this feature wisely.
- Word counts are a guide only. Being under or over will not affect your mark.

20


Strategy
Time left: 00:00:27
Do
• Keep track of time and how many questions left using the question boxes in top of screen and time left.
• Use flag option effectively. Work out your strategy before you go into the exam.
Don't
• Get bogged down on the coding and diagrams questions
• Spend time on perfection in layout of diagrams.
HSC Software Engineering Familiarisation Questions
1 2 3 4 5 6 7 8 9 10 11 12 13 14
FLAG
HIGHLIGHT
21

MY NOTES

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Secure Software Architecture

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Secure Software Architecture

Ben Jones

Head Techer TAS, Tempe High School

70 minutes

Secure Software Architecture

- Designing software
- Developing secure code
- Impact of safe and secure software development

Designing software

Secure SLDC

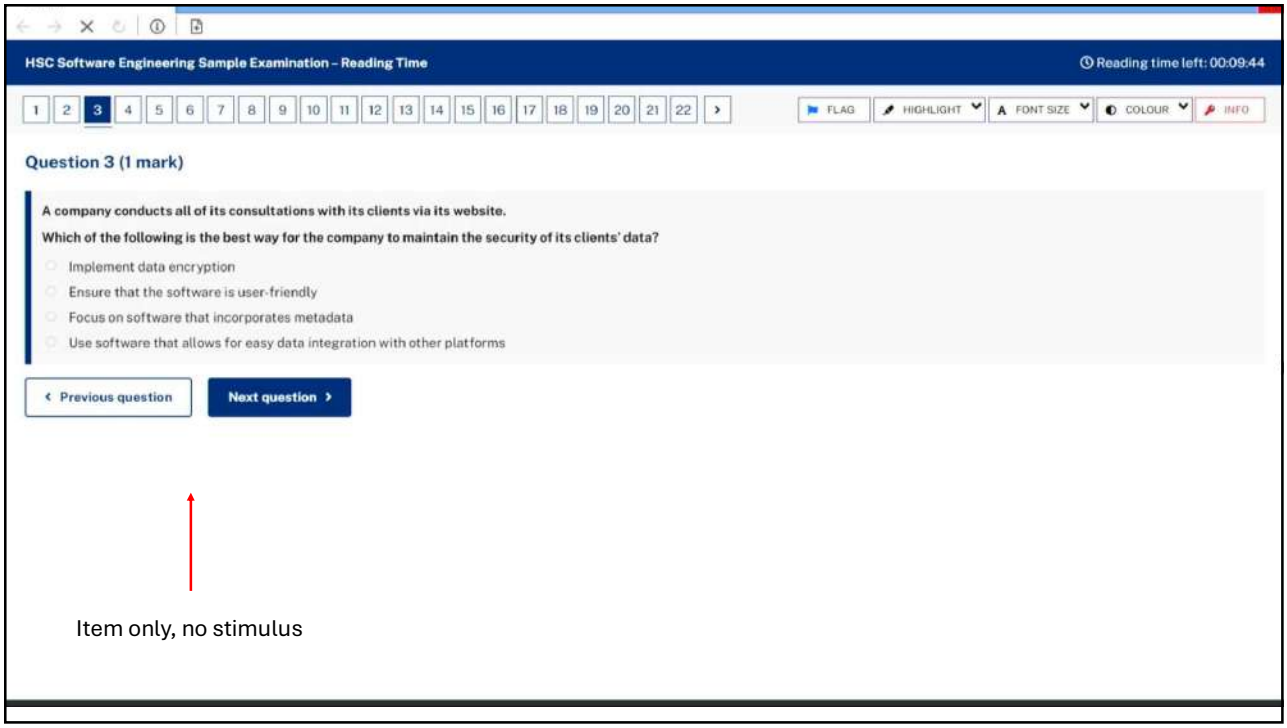
- Know the steps
- Know secure processes for each step
- Know the impact of secure processes
- Reference the SDLC through all questions

- Interpret and apply fundamental software development steps to develop secure code

Including:

- requirements definition
- determining specifications
- design
- development
- integration
- testing and debugging
- installation
- maintenance

Phase	Security by Design Processes
Requirements definition	•Gather specific security and privacy requirements •Vulnerability assessment
Determining specifications	•Explicit security and privacy specifications •Risk assessment
Design	•Threat modelling •Security design review •Security tests included in test designs
Development	•Code reviews •Static application security testing
Integration	•Risk assessment •Code reviews •Dynamic application security testing •Grey-box penetration testing
Testing and debugging	•Code reviews •Static application security testing •Dynamic application security testing •Penetration testing
Installation	•Penetration testing •Vulnerability assessment
Maintenance	•Log monitoring & reporting •Vulnerability assessment



Item only, no stimulus

Developing secure code

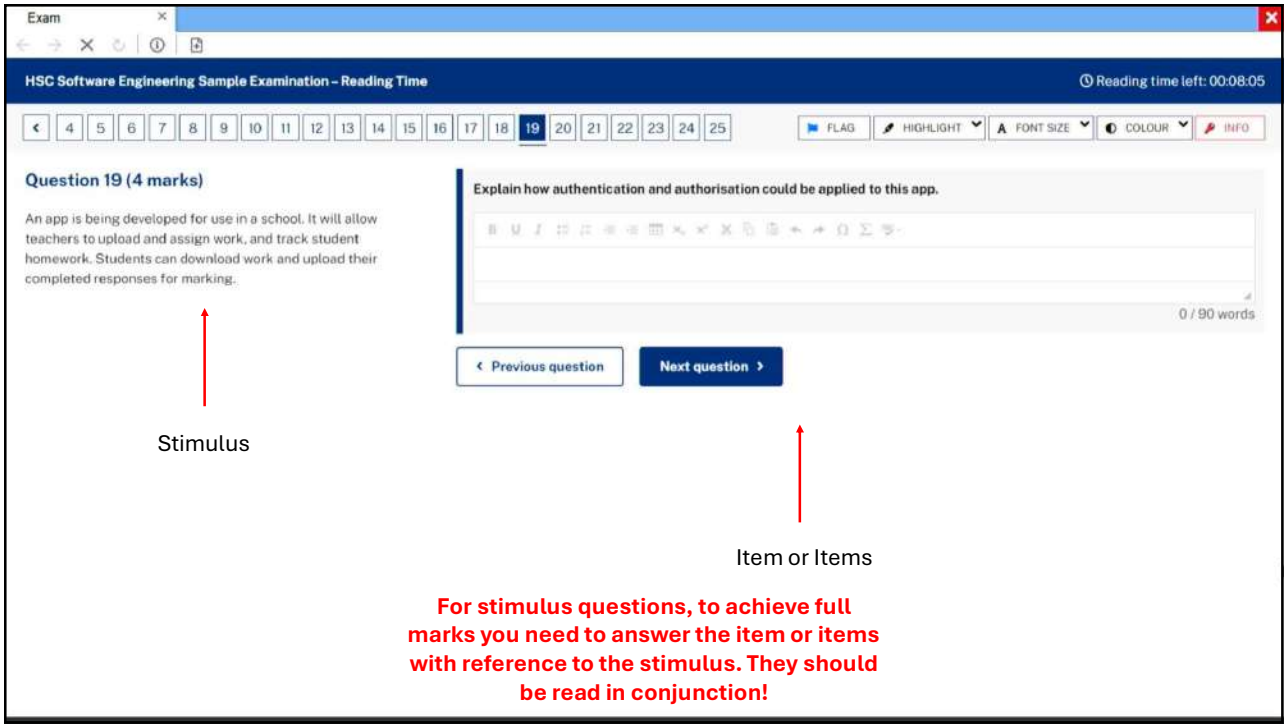
Fundamental concepts

- Have a clear understanding of each concept.
- Be able to define or compare any of them.
- Be able to apply them to a common exam context (student system, library system, canteen system).

- Explore fundamental software design security concepts when developing programming code

Including:

- confidentiality
- integrity
- availability
- authentication
- authorisation
- accountability


Exam
HSC Software Engineering Sample Examination – Reading Time
Reading time left: 00:08:05
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
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Question 19 (4 marks)
An app is being developed for use in a school. It will allow teachers to upload and assign work, and track student homework. Students can download work and upload their completed responses for marking.
Explain how authentication and authorisation could be applied to this app.
0 / 90 words
Previous question
Next question
Stimulus
Item or Items
For stimulus questions, to achieve full marks you need to answer the item or items with reference to the stimulus. They should be read in conjunction!

Question 19

Criteria	Marks
• Explains how authentication and authorisation could be applied to the app	4
• Explains how authentication or authorisation could be applied to the app OR • Outlines how authentication and authorisation could be applied to the app	3
• Outlines some features of authentication and/or authorisation	2
• Provides some relevant information	1

Sample answer:

Authentication ensures that only staff and students with valid usernames and passwords, which should be encrypted in storage (eg using hashing), can access the app. Authorisation controls access to specific features of the app based on user roles or groups. Teachers may have permissions to upload, assign and track homework, while students can only download tasks and upload completed work. By organising users into specific roles or groups, the app restricts access to appropriate functionality, ensuring that each user can only perform actions relevant to their role or group.

Developing secure code

Privacy by design

A proactive privacy-focused approach to the design, development and deployment of a program that involves any collection, use, or disclosure of personal information. It aims to ensure privacy is considered before, at the start of, and throughout the development and implementation of a program.

- Understand the concept
- Recall the legislation is 'Privacy Act 1988 (Privacy Act)'
- Describe technical and non-technical implementations that contribute to privacy by design

- Use and explain the 'privacy by design' approach in the development of software solutions

Including:

- proactive not reactive approach
- embed privacy into design
- respect for user privacy

Privacy by design implementation

Non-Technical

- A privacy policy which is a statement that explains in simple language how an organisation or agency handles personal information.
- Do not collect or store private information not required for application functionality.
- User opt-in to data sharing or data selling (monetisation).

Technical

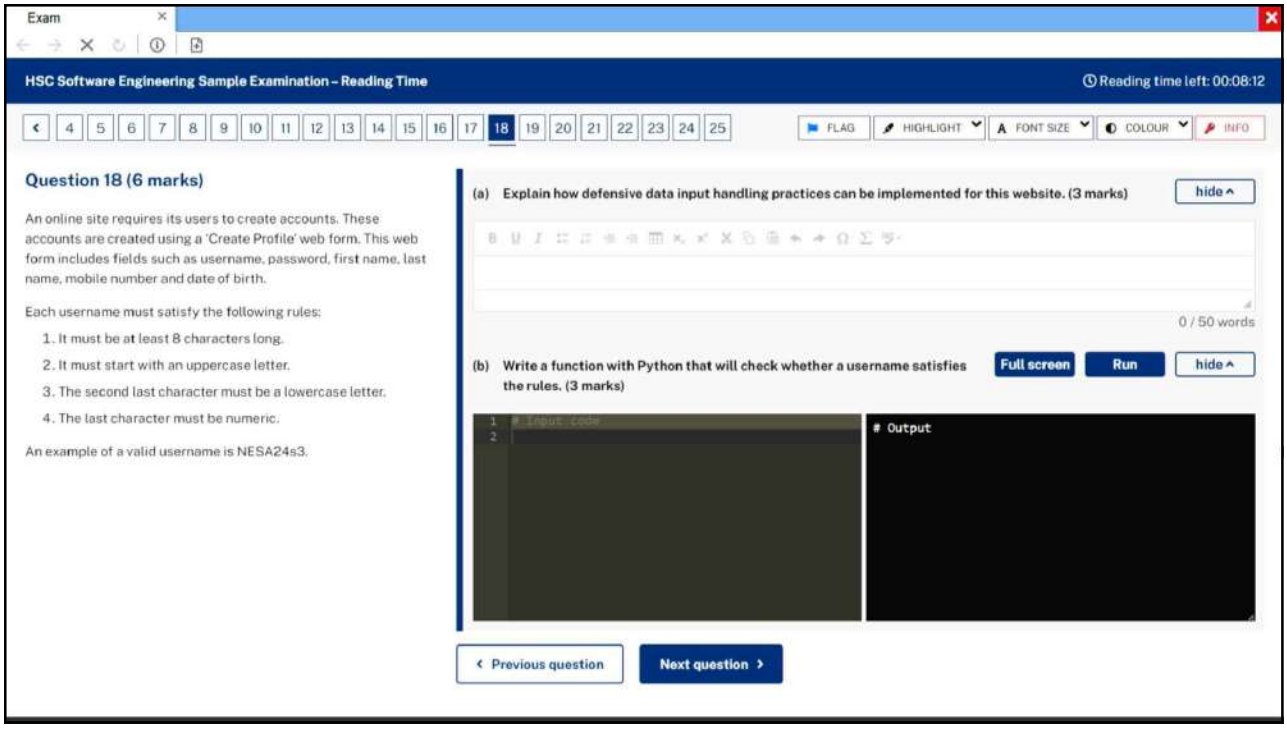
- Authentication and authorisation (Zero trust approach)
- Salt and hash passwords
- All data is encryption (SSL/TLS)
- Allow users to download and delete their data
- Ensure private data is not disclosed in logs
- Ensure employees do not have access beyond their authorisation

Developing secure code

Defensive data handling and API's

- Have a clear understanding of the strategy and how when it is implemented in the SDLC.
- Be able to define, compare or contrast any of the concepts.
- Be able to code in Python solutions for input validation. Sanitisation or error handling.

- Design, develop and implement code using defensive data input handling practices, including input validation, sanitisation and error handling
- Design, develop and implement a safe application programming interface (API) to minimise software vulnerabilities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4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
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Question 18 (6 marks)
An online site requires its users to create accounts. These accounts are created using a 'Create Profile' web form. This web form includes fields such as username, password, first name, last name, mobile number and date of birth.
Each username must satisfy the following rules:
1. It must be at least 8 characters long.
2. It must start with an uppercase letter.
3. The second last character must be a lowercase letter.
4. The last character must be numeric.
An example of a valid username is NESA24s3.
(a) Explain how defensive data input handling practices can be implemented for this website. (3 marks)
hide
0 / 50 words
(b) Write a function with Python that will check whether a username satisfies the rules. (3 marks)
Full screen
Run
hide
Input code
Output
Previous question
Next question

Question 18 (a)

Criteria	Marks
• Explains how defensive data input handling practices can be implemented for the website	3
• Outlines some features of data input handling practices	2
• Provides some relevant information	1

Sample answer:

Data sanitisation using client-side scripting can clean the data and remove dangerous input. Input validation on the client-side can check that entered data meets all of the requirements before getting processed by the server. Errors generated by data not meeting rules can be shown to the user.

Question 18 (b)

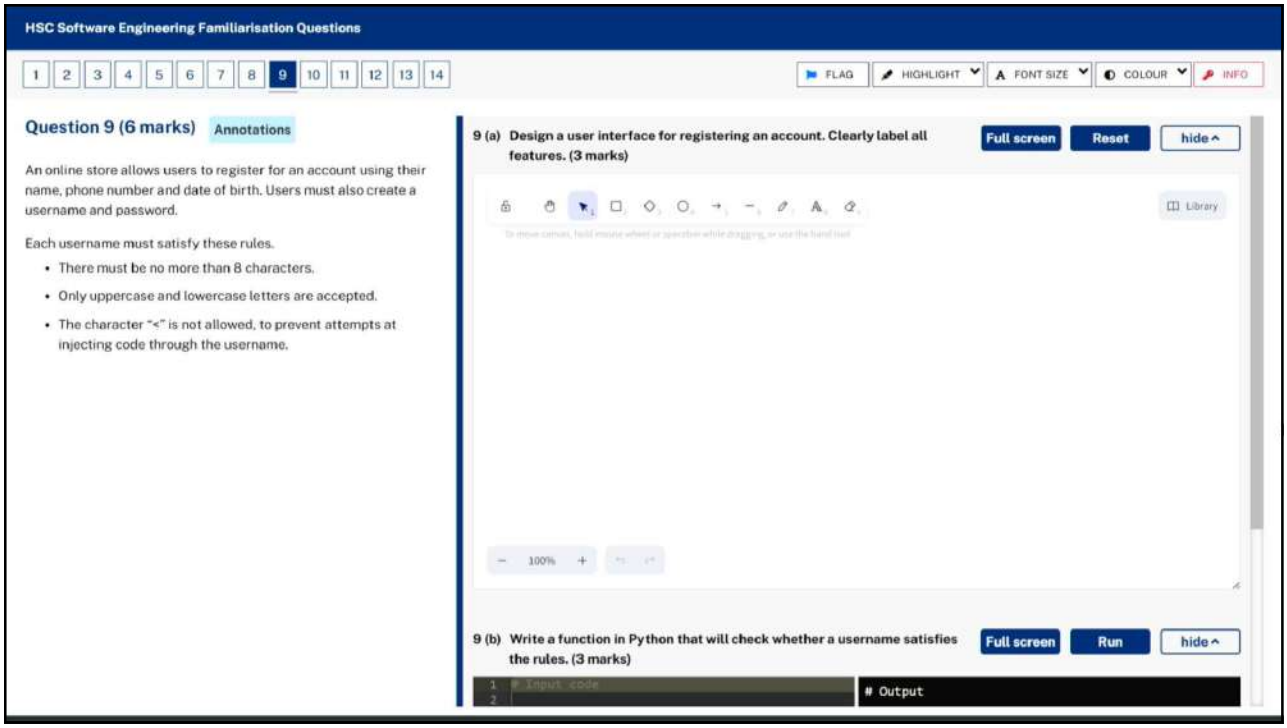
Criteria	Marks
• Provides a correct function in Python to check whether a username satisfies the rules	3
• Provides a partially correct function in Python to check the username	2
• Shows some understanding of the problem and Python programming	1

Sample answer:

```
def validate_username(username):
      valid = True

      # length check
      if len(username) < 8:
            valid = False
      elif (not username[0].isupper()):
            valid = False
      elif (not username[-2].islower()):
            valid = False
      elif (not username[-1].isdigit()):
            valid = False

      return valid
```


HSC Software Engineering Familiarisation Questions
1 2 3 4 5 6 7 8 9 10 11 12 13 14
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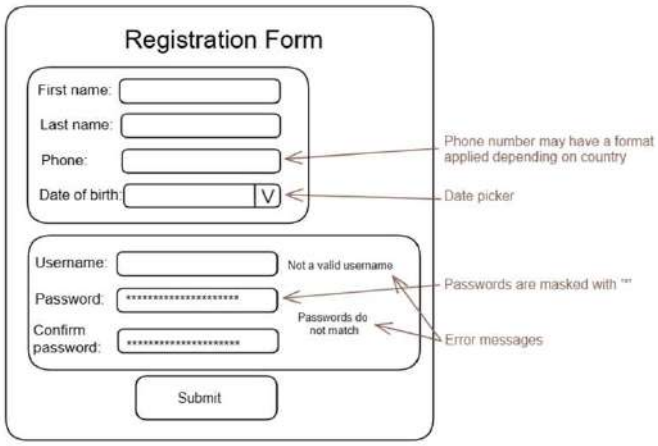
Question 9 (6 marks)
Annotations
An online store allows users to register for an account using their name, phone number and date of birth. Users must also create a username and password.
Each username must satisfy these rules.
• There must be no more than 8 characters.
• Only uppercase and lowercase letters are accepted.
• The character "<" is not allowed, to prevent attempts at injecting code through the username.
9 (a) Design a user interface for registering an account. Clearly label all features. (3 marks)
Full screen
Reset
hide
Library
100%
9 (b) Write a function in Python that will check whether a username satisfies the rules. (3 marks)
Full screen
Run
hide
Input code
Output

Question 9 (a)

Criteria	Marks
• Provides a user interface suitable for users to register an account, with features labelled	3
• Designs a user interface with some relevant features	2
• Shows some understanding of the problem	1

Sample answer:



Question 9 (b)

Criteria	Marks
• Provides a correct function in Python that checks whether a username satisfies the rules	3
• Provides a partially correct function in Python that attempts to check whether a username satisfies the rules	2
• Shows some understanding of the problem and Python programming	1

Sample answer:

```
def validateUsername(username):

    # Length check
    if len(username) > 8:
        return False

    # Alpha character only check
    elif username.isalpha() == False:
        return False

    # < character check
    elif "<" in username:
        return False

    # If we reach here then the username meets the requirements
    return True
```

Developing secure code

Strategies used by software developers to manage the security of programming code

- Have a clear understanding of the strategy and how when it is implemented in the SDLC.
- Be able to define or compare any of them.

- Apply and evaluate strategies used by software developers to manage the security of programming code

Including:

- code review
- static application security testing (SAST)
- dynamic application security testing (DAST)
- vulnerability assessment
- penetration testing

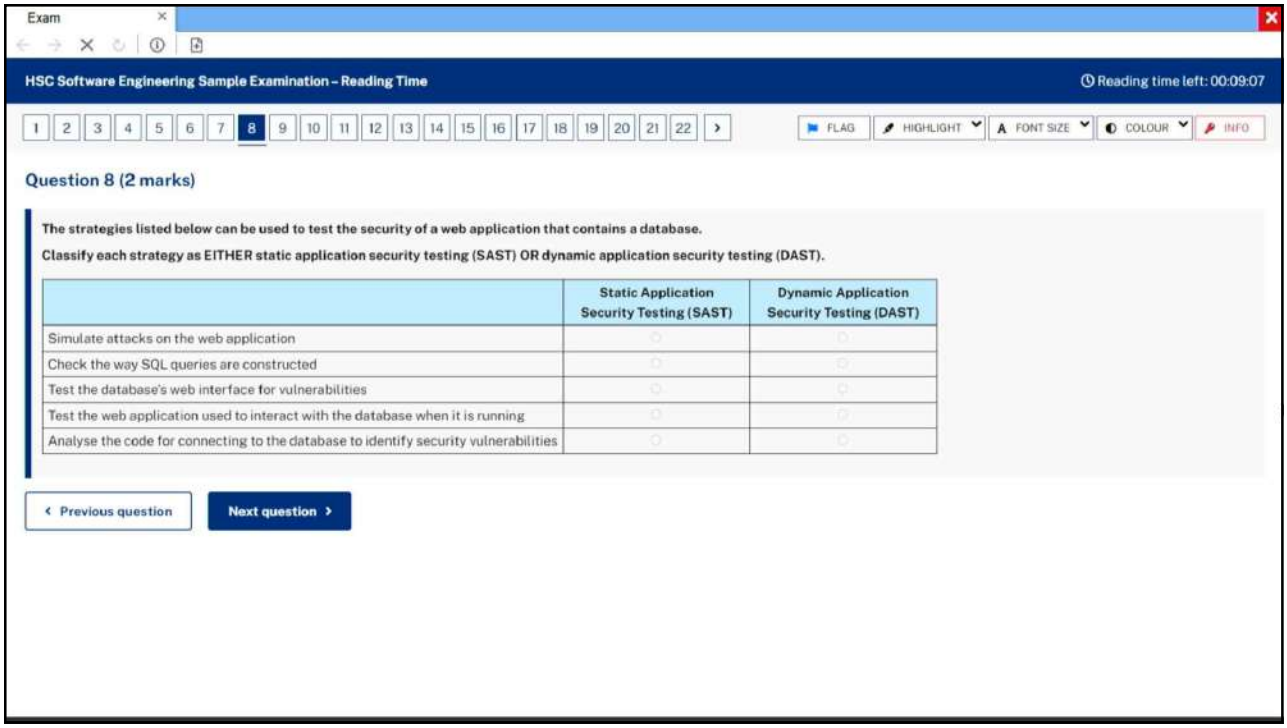
Strategies used by software developers to manage the security of programming code

Code review

Code review is the process of thoroughly examining and evaluating an application's source code to identify potential security vulnerabilities at the code level. It is a manual approach to white-box testing.

Vulnerability assessment

A vulnerability assessment is a systematic review of a system's security weaknesses. It evaluates whether the system is susceptible to any known vulnerabilities, assigns severity levels to those vulnerabilities, and recommends remediation or mitigation. The focus of a vulnerability assessment is infrastructure, processes, and practices. It is more about the organisation than the source code of a single application.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Question 8 (2 marks)
The strategies listed below can be used to test the security of a web application that contains a database.
Classify each strategy as EITHER static application security testing (SAST) OR dynamic application security testing (DAST).
Static Application Security Testing (SAST)
Dynamic Application Security Testing (DAST)
Simulate attacks on the web application
Check the way SQL queries are constructed
Test the database's web interface for vulnerabilities
Test the web application used to interact with the database when it is running
Analyse the code for connecting to the database to identify security vulnerabilities
‹ Previous question
Next question ›

Developing secure code

Vulnerabilities

- Understand what 'user action control is'
- Know the architecture of each vulnerability (how is it exploited)
- Know how to identify the vulnerability in code (JS, Python or Pseudocode as relevant)

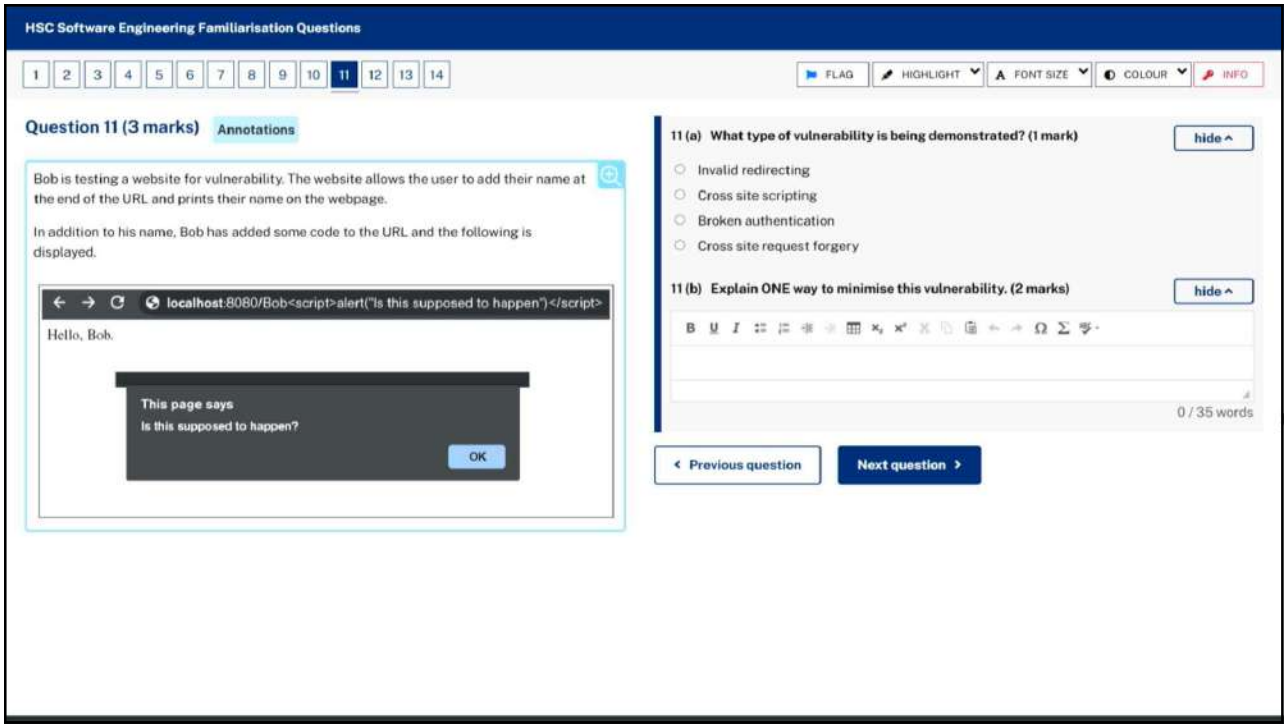
Design, develop and implement secure code to minimise vulnerabilities in user action controls

Including:

- broken authentication and session management
- cross-site scripting (XSS) and cross-site request forgery (CSRF)
- invalid forwarding and redirecting
- race conditions

Design, develop and implement secure code to protect user file and hardware vulnerabilities from file attacks and side channel attacks

Vulnerability	Architecture	Code	Counter Measure
Broken authentication			
Broken session management			
Cross Site Scripting (XXS)			
Cross Site Request Forgery (XSRF)			
Invalid forwarding and redirection			
Race condition			
File attacks			
Side channel attacks			


HSC Software Engineering Familiarisation Questions
1 2 3 4 5 6 7 8 9 10 11 12 13 14
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Question 11 (3 marks)
Annotations
Bob is testing a website for vulnerability. The website allows the user to add their name at the end of the URL and prints their name on the webpage.
In addition to his name, Bob has added some code to the URL and the following is displayed.
localhost:8080/Bob<script>alert("Is this supposed to happen")</script>
Hello, Bob.
This page says
Is this supposed to happen?
OK
11 (a) What type of vulnerability is being demonstrated? (1 mark)
hide
Invalid redirecting
Cross site scripting
Broken authentication
Cross site request forgery
11 (b) Explain ONE way to minimise this vulnerability. (2 marks)
hide
0 / 35 words
Previous question
Next question

Question 11 (a)

Criteria	Marks
• Identifies the correct answer	1

Answer:

Cross site scripting

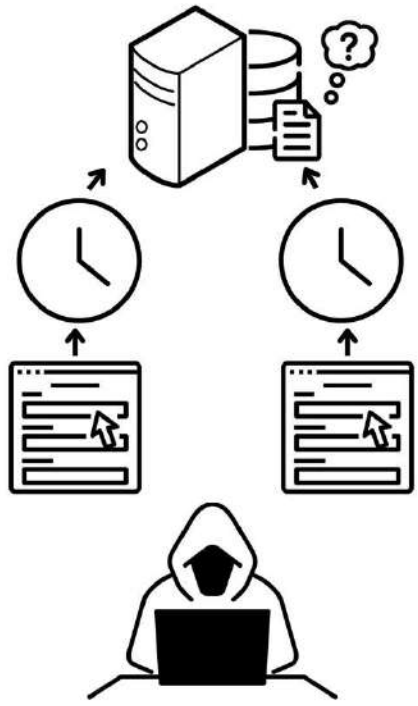
Question 11 (b)

Criteria	Marks
• Explains ONE way to minimise the vulnerability	2
• Provides some relevant information	1

Sample answer:

The website could check and change user input so that markup and script become plain text. This will still allow the page to display the information but will prevent it from executing script code.

Note:
For example, special characters such as < > and ( ) would be encoded to their HTML equivalent (%3C %3E and %28 %29).



Race Conditions

- Architecture

1. A threat actor will place the infrastructure underload with a DoS-style attack.
2. The threat actor makes multiple HTTP requests in parallel, such as repeatedly applying a discount coupon to a shopping cart in very quick succession.
3. The treat actor hopes to exploit an unmanaged thread schedule by effectively "racing" multiple HTTP requests to access/change shared data to their advantage.

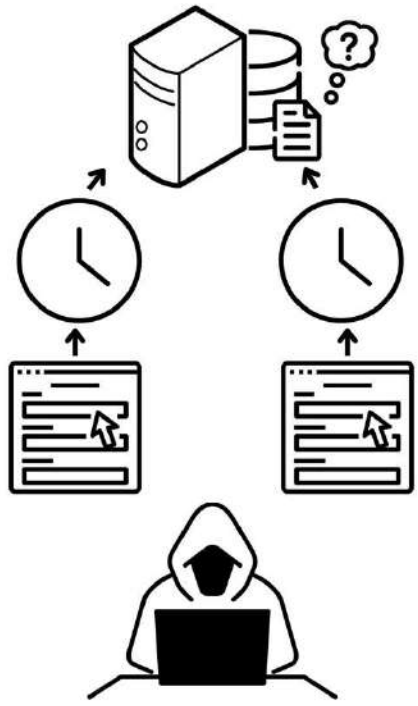
25

Race Conditions

- Code

```
1 BEGIN apply_voucher(v, cart)
2     IF GET voucher_applied() = TRUE
3         RETURN
4     ENDIF
5     apply_disc(calc_disc(v), cart)
6     SET voucher_applied(TRUE)
7     RETURN render_front_end()
8 END apply_voucher
```

Processor	Thread 1	Thread 2
01	`BEGIN apply_voucher(v, cart)`	
02		`BEGIN apply_voucher(v, cart)`
03	`IF GET voucher_applied() = TRUE`	
04	`RETURN`	
05	`ENDIF`	
06		`IF GET voucher_applied() = TRUE`
07		`RETURN`
08		`ENDIF`
09	`apply_disc(calc_disc(v), cart)`	
10	`SET voucher_applied(TRUE)`	
11		`apply_disc(calc_disc(v), cart)`
12		`SET voucher_applied(TRUE)`
13	`RETURN render_front_end()`	
14	`END apply_voucher`	
15		`RETURN render_front_end()`
16		`END apply_voucher`

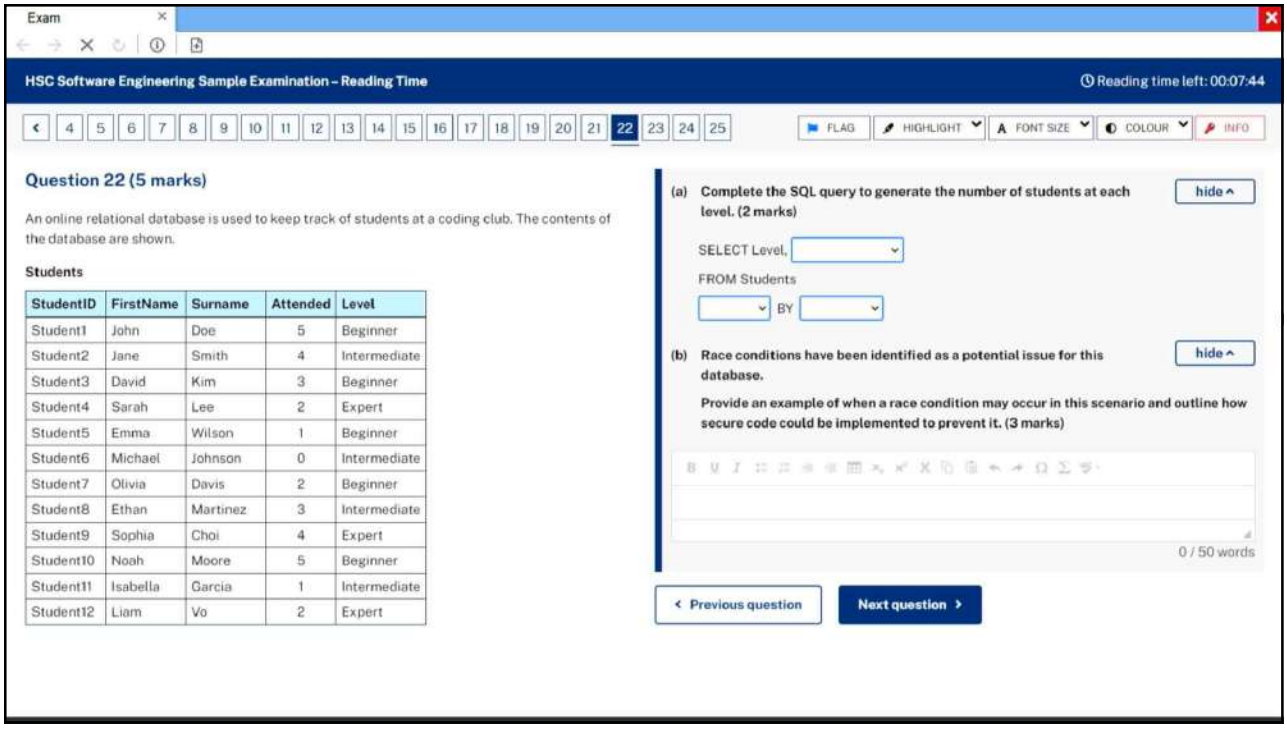


Race Conditions

- Countermeasures

1. Consider multithreading in any shared resource process, including (discounts, login processes, session ID creation, etc).
2. Implement a lock using the 'session ID' as a key in the algorithm, and most importantly, minimise the processing time between the lock's GET (or check) and SET.
3. Implement rate limiting.

27


Exam
HSC Software Engineering Sample Examination – Reading Time
Reading time left: 00:07:44
4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
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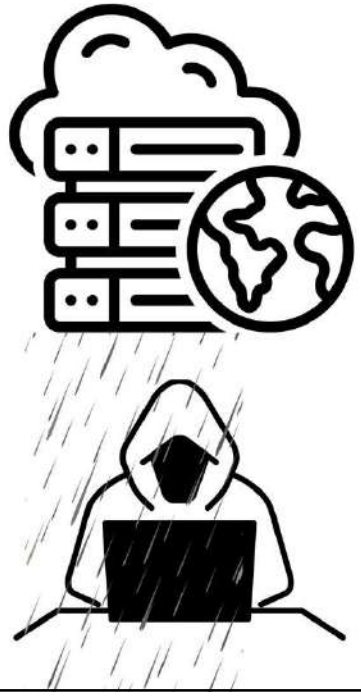
Question 22 (5 marks)
An online relational database is used to keep track of students at a coding club. The contents of the database are shown.
Students
StudentID | FirstName | Surname | Attended | Level
Student1 | John | Doe | 5 | Beginner
Student2 | Jane | Smith | 4 | Intermediate
Student3 | David | Kim | 3 | Beginner
Student4 | Sarah | Lee | 2 | Expert
Student5 | Emma | Wilson | 1 | Beginner
Student6 | Michael | Johnson | 0 | Intermediate
Student7 | Olivia | Davis | 2 | Beginner
Student8 | Ethan | Martinez | 3 | Intermediate
Student9 | Sophia | Choi | 4 | Expert
Student10 | Noah | Moore | 5 | Beginner
Student11 | Isabella | Garcia | 1 | Intermediate
Student12 | Liam | Vo | 2 | Expert
(a) Complete the SQL query to generate the number of students at each level. (2 marks)
hide
SELECT Level,
FROM Students
BY
(b) Race conditions have been identified as a potential issue for this database.
hide
Provide an example of when a race condition may occur in this scenario and outline how secure code could be implemented to prevent it. (3 marks)
0 / 50 words
Previous question
Next question

Question 22 (b)

Criteria	Marks
• Provides an example of when a race condition may occur in this scenario • Outlines how secure code could be implemented to prevent it	3
• Outlines some features of race conditions	2
• Provides some relevant information	1

Sample answer:

With multiple teachers potentially accessing the database at the same time, race conditions can allow malicious users to gain unauthorised access. Authentication could be used to restrict access to the database, and code can be written to use atomic transactions and database locks to time the reading and writing of data.



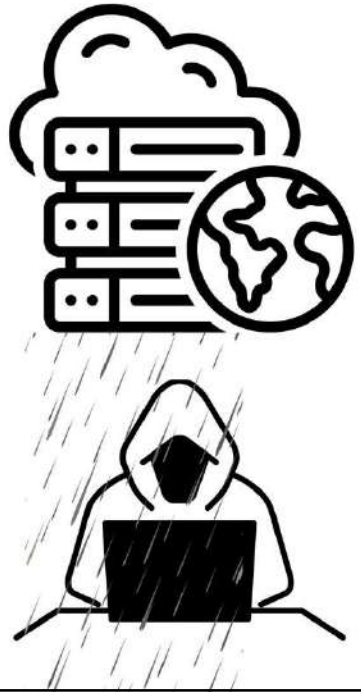
Side Channel Attack

- Architecture

- A side-channel attack is any attack based on extra information that can be gathered because of the fundamental way a computer protocol or algorithm is implemented.
- Leaking data includes:

1. Time
2. Cache
3. Power/electromagnetic/thermal energy, etc
4. Frequency outputs
5. Exception response
6. Error response

30



Side Channel Attack

- Countermeasures

1. Understand how the attack can be executed in the specific context of the application and user, then code review with specific scenarios in mind.
2. Randomise operations and data access patterns for all cryptography processes
3. Introduce noise through random micro delays
4. Isochronous functions so the software runs for an exactly constant amount of time, independent of secret values.
5. Implement tighter rate limiting on login pages. For example, install and configure Flask Limiter

31

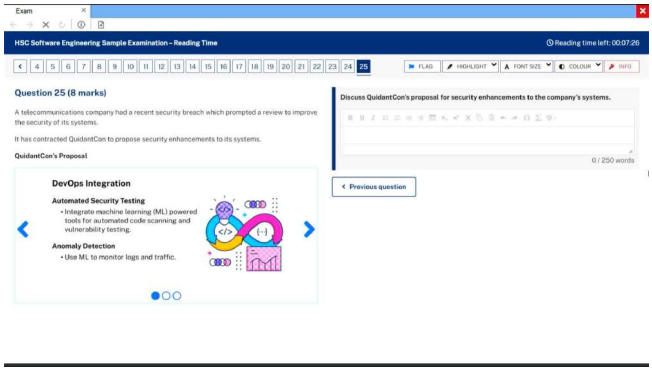
Impact of safe and secure software development

Any of these could be an 8 mark question:

Apply and describe the benefits of collaboration to develop safe and secure software

Investigate and explain the benefits to an enterprise of the implementation of safe and secure development practices

Evaluate the social, ethical and legal issues and ramifications that affect people and enterprises resulting from the development and implementation of safe and secure software



MY NOTES

HSC STUDY DAY SERIES

2025

SOFTWARE ENGINEERING STUDENT BOOKLET

Programming for the Web

AURORA COLLEGE

IGNITING NEW WAYS OF LEARNING: CELEBRATING 10 YEARS

https://aurora.schools.nsw.gov.au

2025 HSC STUDY DAY SERIES

SOFTWARE ENGINEERING

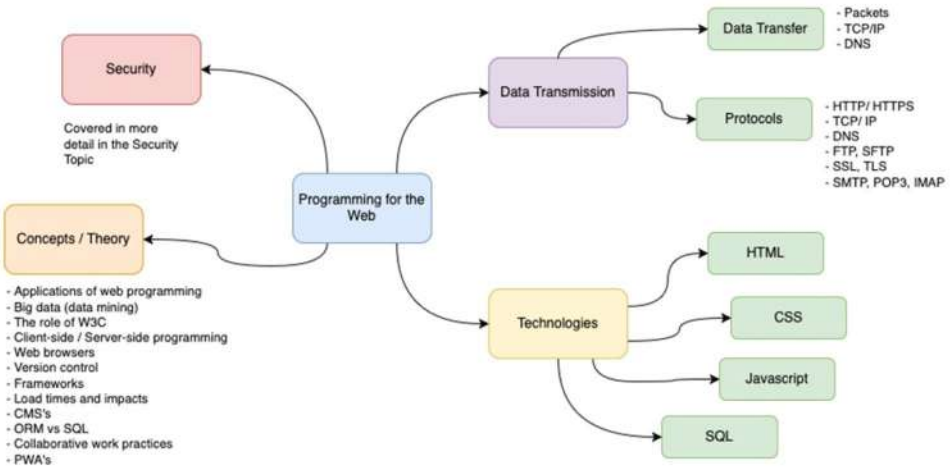
AURORA COLLEGE

IGNITING NEW WAYS OF LEARNING: CELEBRATING 10 YEARS

Programming for the Web

Software Engineering
HSC Study Day
Presenter : Ryan Chadwick
Sydney Secondary College
(1 hour 10 mins)

Content overview



2

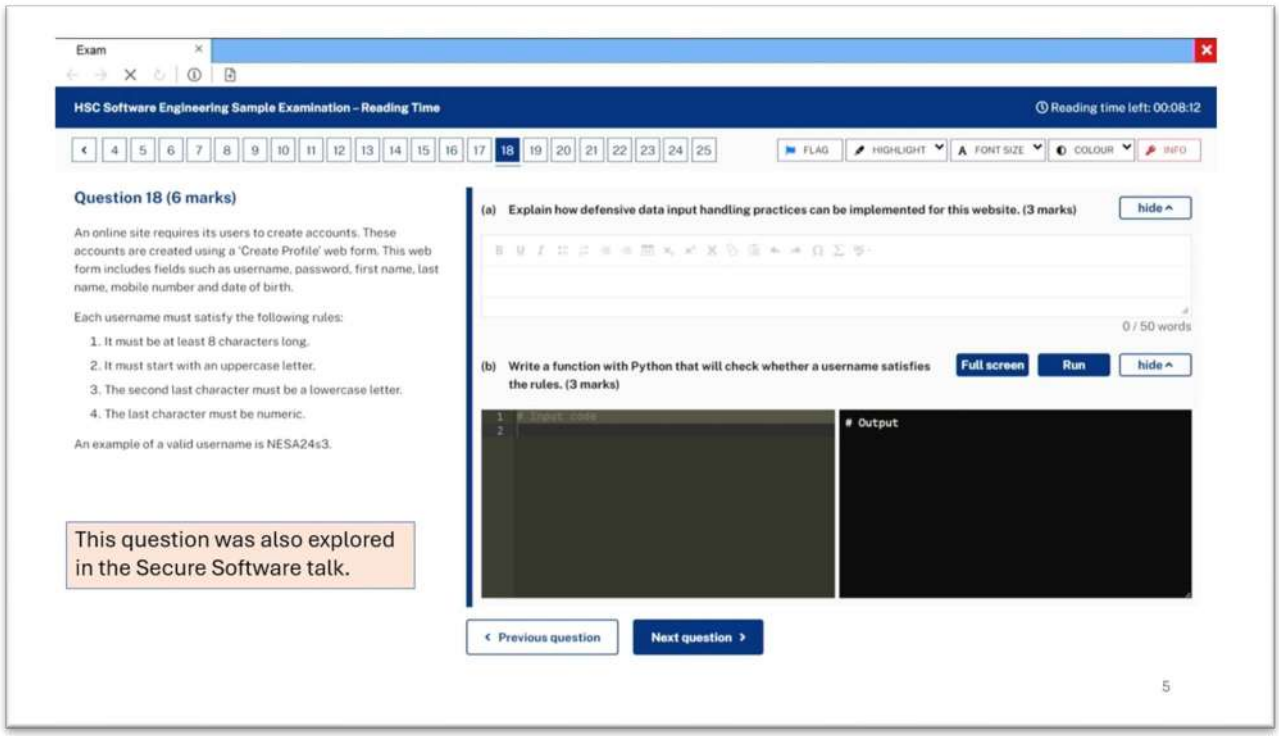
1. Security

Overlaps a bit with Secure Software Architecture

Securing the Web

- SSL – A protocol for managing encryption
- SSL certificates – keys used in the SSL protocol
- Encryption – modifying content so it is unreadable without the key
- Authentication – verifying who a user is
- Authorisation – what a person is allowed to do or access
- Hash values – a fingerprint on data to ensure integrity and authenticity
- Digital signatures – an encrypted code that acts as a means of proving a message came from a particular person

4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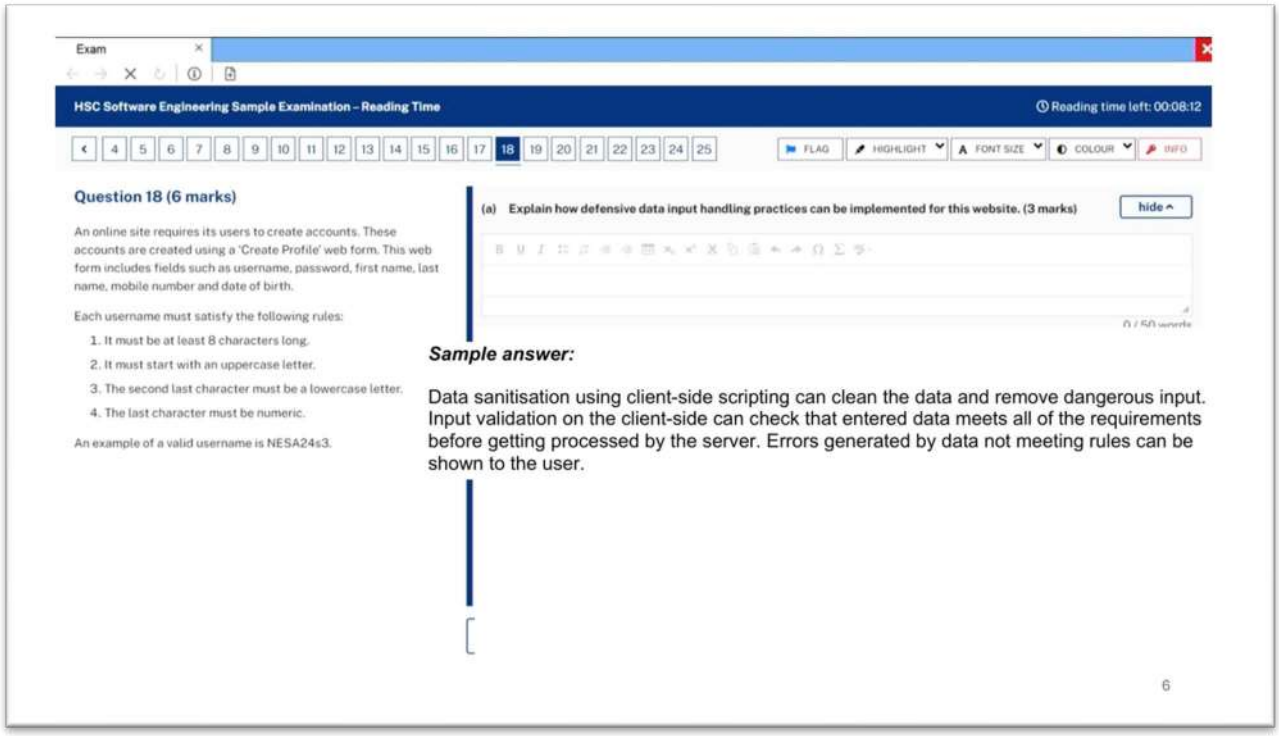
Question 18 (6 marks)
An online site requires its users to create accounts. These accounts are created using a 'Create Profile' web form. This web form includes fields such as username, password, first name, last name, mobile number and date of birth.
Each username must satisfy the following rules:
1. It must be at least 8 characters long.
2. It must start with an uppercase letter.
3. The second last character must be a lowercase letter.
4. The last character must be numeric.
An example of a valid username is NESA24s3.
This question was also explored in the Secure Software talk.
(a) Explain how defensive data input handling practices can be implemented for this website. (3 marks)
hide
0 / 50 words
(b) Write a function with Python that will check whether a username satisfies the rules. (3 marks)
Full screen
Run
hide
Output
Previous question
Next question
5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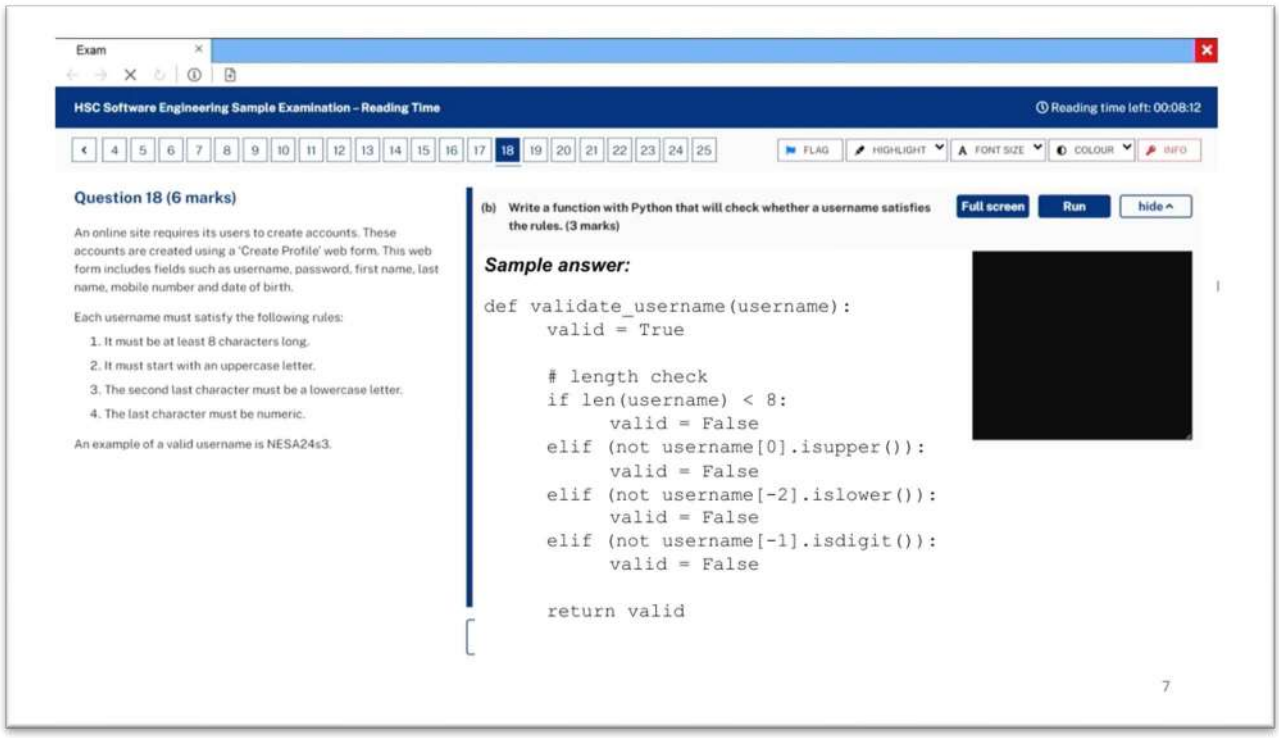
2. It must start with an uppercase letter.
3. The second last character must be a lowercase letter.
4. The last character must be numeric.
An example of a valid username is NESA24s3.
(a) Explain how defensive data input handling practices can be implemented for this website. (3 marks)
hide
Sample answer:
Data sanitisation using client-side scripting can clean the data and remove dangerous input. Input validation on the client-side can check that entered data meets all of the requirements before getting processed by the server. Errors generated by data not meeting rules can be shown to the user.
6



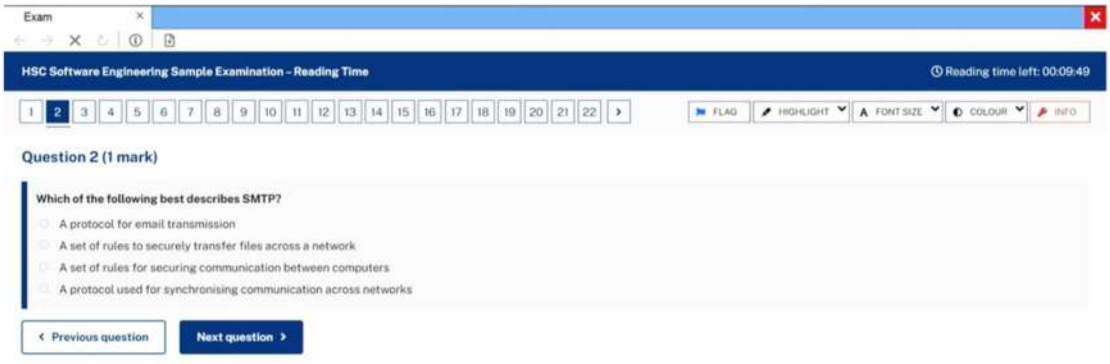
2. Data Transmission

Understand and be able to discuss the concepts

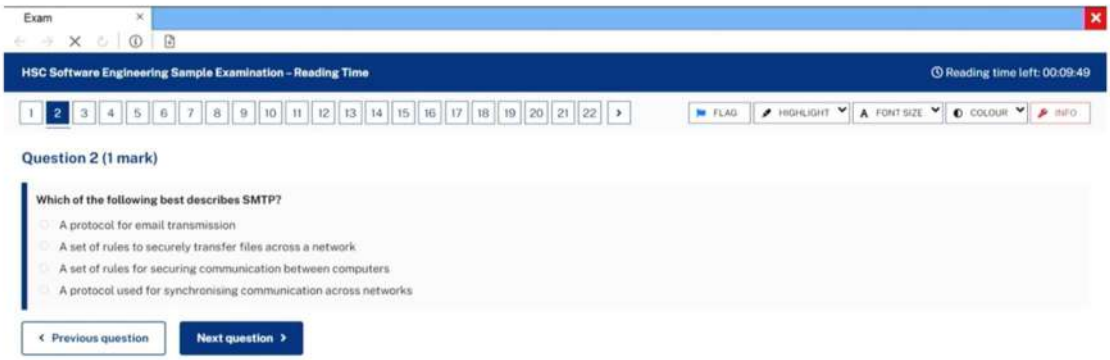
Protocols – application based

Protocol	Port	Description
HTTP (HyperText Transfer Protocol)	80	A means for requesting a resource, identified by a URL, from a webserver.
FTP (File Transfer Protocol)	20	A basic system for transferring files between a server and a client.
SMTP (Simple Mail Transfer Protocol)	25	Used by email clients and email servers to forward emails to another email server.
POP3 (Post Office Protocol)	110	Allows an email client to list, retrieve and delete emails from an email server.
IMAP (Internet Message Access Protocol)	143	Allows you to access, read and manage emails that remain on the server. Good for accessing your emails from multiple devices.

9



10



a. A protocol for email transmission

11

Question 3 (2 marks) Annotations

3 Match each of the features to the relevant protocol(s). (2 marks)

	POP3	SMTP	IMAP
Commonly used for sending email	☐	☐	☐
Commonly used for receiving email	☐	☐	☐
Allows email to synchronise across devices	☐	☐	☐
Server deletes messages when they are downloaded and opened	☐	☐	☐

12

Question 3 (2 marks) Annotations

3 Match each of the features to the relevant protocol(s). (2 marks)

	POP3	SMTP	IMAP
Commonly used for sending email	☐	☑	☐
Commonly used for receiving email	☑	☐	☑
Allows email to synchronise across devices	☐	☐	☑
Server deletes messages when they are downloaded and opened	☑	☐	☐

Note that there can be multiple correct answers in a row.

13

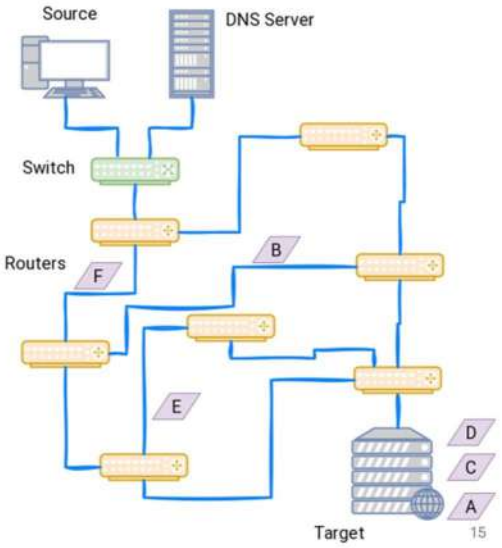
Protocols 2 – lower level

Protocol	Port	Description
TCP (Transfer Control Protocol)		Provides for reliable, ordered and error free delivery of a stream of data packets.
IP (Internet Protocol)		Works out the routes between networks that a data packet will take to get from its source to its destination based upon IP addresses.
DNS (Domain Name Service)	53	A hierarchical and distributed name service that allows devices to locate the network that another device resides on.
SSL (Secure Socket Layer)	443	A means for providing security, integrity and authenticity in communications by way of cryptography.
TLS (Transport Layer Security)		The successor to SSL as SSL was found to have a few vulnerabilities.

14

How data is transferred on the internet

- Data is broken up into packets (small chunks of the data)
- DNS is used to identify the target machine for the data
- IP is used to work out the path to the target machine
- TCP is used to ensure the packets arrive without error and assemble them back to the original data



15

16

Sample answer:

Protocols are important in data transfer as they establish rules for communication between devices connected to a network, such as the internet. HTTP (Hypertext Transfer Protocol) enables browsers to request web content from servers, which respond with the requested data. The protocol defines the structure of requests and the response so that data transfer can occur.

Answers could include:

- TCP/IP
- DNS
- FTP, SFTP
- SSL, TLS
- SMTP, POP 3, IMAP
- Data packets.

17

3. Technologies

Understand and be ready to apply / interpret.

HTML

- Understand the basic framework
- Know basic tags (H1, p, a, img, ul, table etc)
- Understand the purpose and effect of meta tags in the head
- Understand elements that will affect page load speed

```
<html>
    <head>
        <title>My page</title>

        <link rel='stylesheet' href='style.c
        <script src='javascript.js' />
    </head>

    <body>
        <h1>A funky heading</h1>

        <p>Some boring content</p>

        <img src='unicycle_hockey.jpg' alt='

    </body>
</html>
```

19

CSS

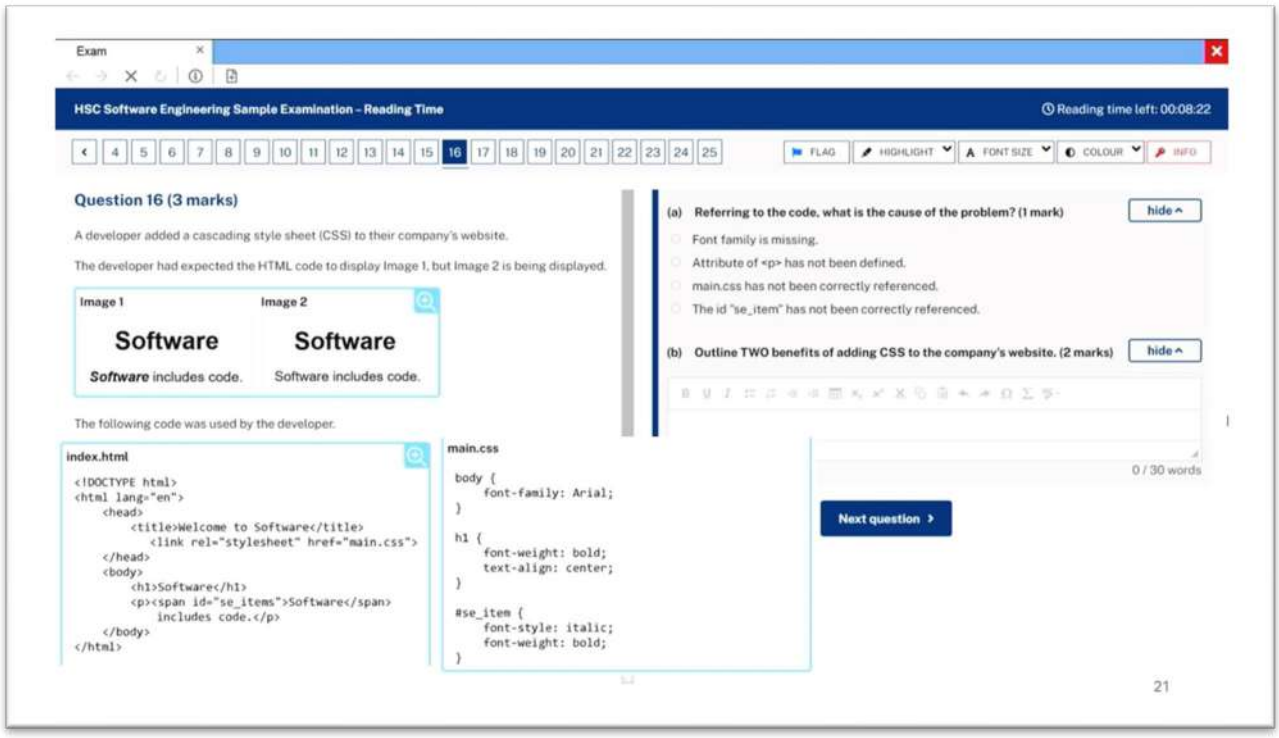
- Understand the general layout (Selector, Property, values)
- Element vs ID vs Class
- Understand general impact on HTML elements
- Appreciate impact on page load times

```
/* Use an element to target HTML */
h1 {
    font-size: 18px;
}

/* Use an ID to target HTML */
#welcome {
    font-style: italic;
}

/* Use a Class to target HTML */
.red-text {
    color: red;
}
```

20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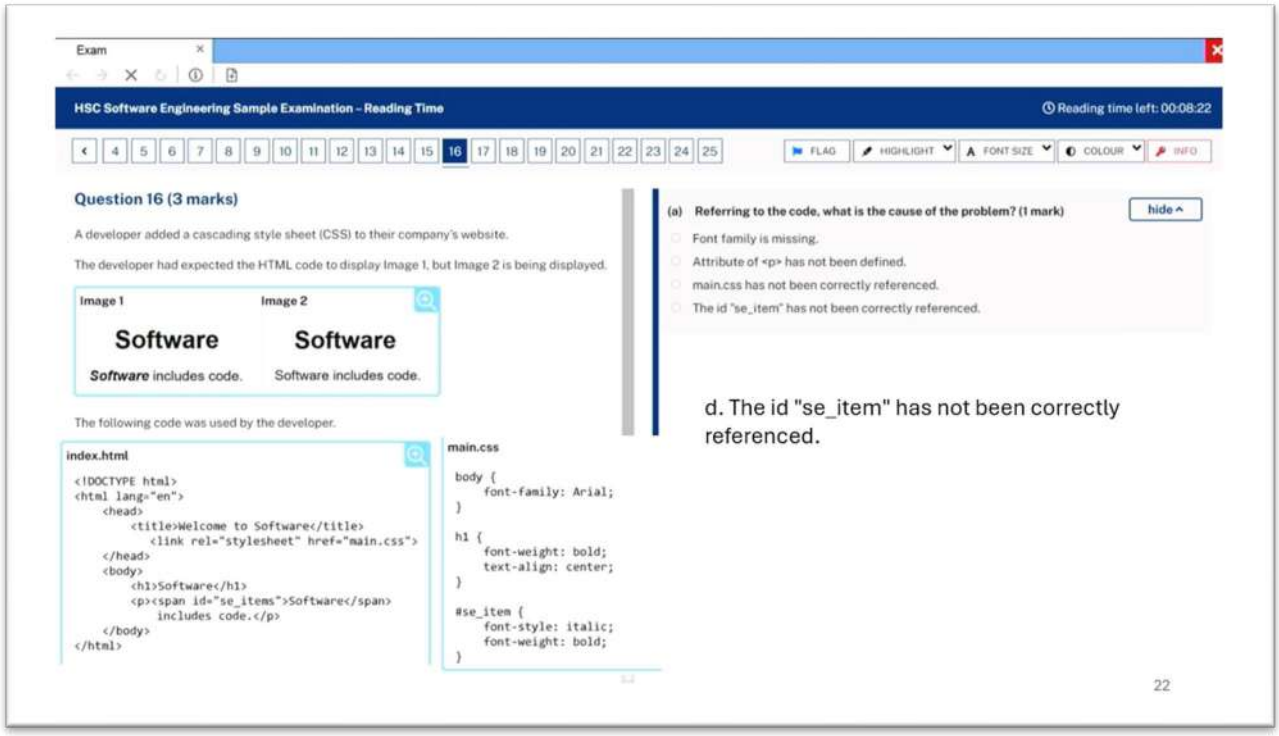
Question 16 (3 marks)
A developer added a cascading style sheet (CSS) to their company's website.
The developer had expected the HTML code to display Image 1, but Image 2 is being displayed.
Image 1
Software
Software includes code.
Image 2
Software
Software includes code.
The following code was used by the developer.
index.html
<!DOCTYPE html>
<html lang="en">
<head>
<title>Welcome to Software</title>
<link rel="stylesheet" href="main.css">
</head>
<body>
<h1>Software</h1>
Software
includes code.
</body>
</html>
main.css
body {
font-family: Arial;
}
h1 {
font-weight: bold;
text-align: center;
}
#se_item {
font-style: italic;
font-weight: bold;
}
(a) Referring to the code, what is the cause of the problem? (1 mark)
hide
Font family is missing.
Attribute of has not been defined.
main.css has not been correctly referenced.
The id "se_item" has not been correctly referenced.
(b) Outline TWO benefits of adding CSS to the company's website. (2 marks)
hide
0 / 30 words
Next question
21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}
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hide
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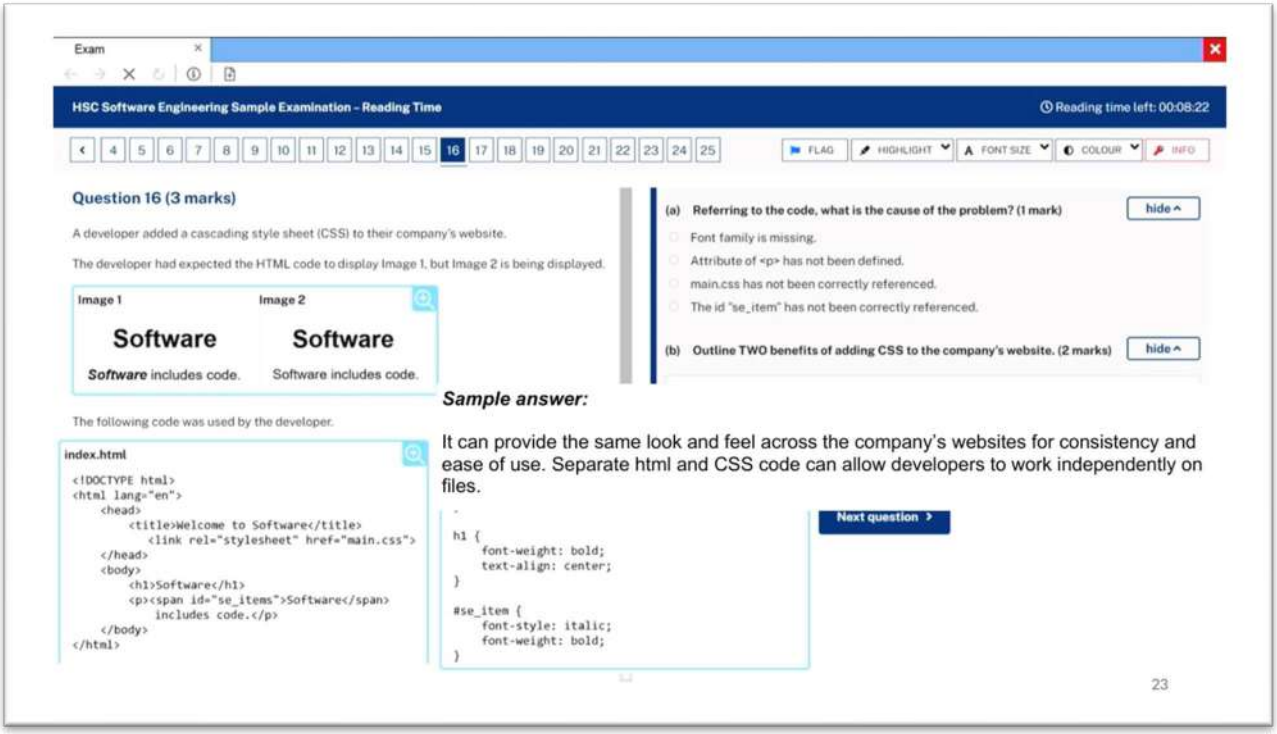
Attribute of has not been defined.
main.css has not been correctly referenced.
The id "se_item" has not been correctly referenced.
d. The id "se_item" has not been correctly referenced.
22



JavaScript

- From the course specifications document :
- "Students should be able to interpret fragments of JavaScript related to cross-site scripting (XSS)

JS

```
const params = new URLSearchParams(window.location.search);
const user = params.get("user");
const welcome = document.querySelector("#welcome");

welcome.innerHTML = `Welcome back, ${user}!`;
```

HTML

```
<a
  href="https://my-bank.example.com/welcome?user=<img src=x
onerror=alert('hello!')>">
  Get a free kitten!</a
>
```

24

Question 10 (4 marks) Annotations

Consider the following source code for a web page.

```
<html>
    <body>
    <link rel="stylesheet" href="style3.css"/>
    <script src="image-gallery.js"/><!--this script is slow to load-->
    <link rel="stylesheet" href="styles1.css"/>
    <link rel="stylesheet" href="styles2.css"/>
    <h1>My Awesome Website!</h1>
    <p>I hope you like my website, I spent a lot of time designing it.</p>
    <h2>Photos from my holiday</h2>
    <img src="holiday1_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday2_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday3_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday4_4000x3000.jpg" width="640" height="480"/>
    </body>
</html>
```

10 The web page is loading too slowly.

Explain how the load time of this page can be improved. (4 marks)

0 / 90 words

25

Question 10 (4 marks) Annotations

Consider the following source code for a web page.

```
<html>
    <body>
    <link rel="stylesheet" href="style3.css"/>
    <script src="image-gallery.js"/><!--this script is
    <link rel="stylesheet" href="styles1.css"/>
    <link rel="stylesheet" href="styles2.css"/>
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    <p>I hope you like my website, I spent a lot of time designing it.</
    <h2>Photos from my holiday</h2>
    <img src="holiday1_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday2_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday3_4000x3000.jpg" width="640" height="480"/>
    <img src="holiday4_4000x3000.jpg" width="640" height="480"/>
    </body>
</html>
```

Sample answer:

The images can be resized to 640 x 480 beforehand so that the webpage does not need to load the large 4000 x 3000 images. The multiple CSS style sheets could be converted into a single .css file, reducing the number of HTTP requests the browser needs to send. If the "image-gallery.js" JavaScript file at the top of the source code loads slowly, it can be moved to the bottom just above </body> so that it will not block the rest of the page from loading.

Answers could include:

If the "image-gallery.js" JavaScript file at the top of the source code loads slowly, the "async" property can be added to the <script> tag so that it can load in parallel with the rest of the page.

10 The web page is loading too slowly.

Explain how the load time of this page can be improved. (4 marks)

0 / 90 words

26

SQL

Know the basic pattern :

SELECT *fields*
FROM *tables*
WHERE *conditions*
ORDER BY *fields*

- Also need to know how to join data across tables.

SELECT Customers.name, Orders.total
FROM Customers, Orders
WHERE Customers.id = Orders.customerID AND Orders.customerID > 50
ORDER BY Customers.name ASC

27

Question 2 (3 marks) Annotations

An online business is planning to use a database to keep track of its products. The contents of the Products table during testing are shown.

Products

ProductID	ProductName	ProductPrice
P001	The Plant (DVD)	28.00
P002	Discovery 1 and 2 (DVD)	26.98
P003	Travel 1 and 2 (Blu-Ray)	22.00
P004	The Best Movie (DVD)	19.98
P005	Celebration (DVD)	12.00

After executing a SQL query, the following results were obtained.

ProductName	ProductPrice
Discovery 1 and 2 (DVD)	26.98
The Plant (DVD)	28.00
Travel 1 and 2 (Blu-Ray)	22.00

2 Select the correct item from each dropdown menu to show how the results were obtained. (3 marks)

SELECT [ ] [ ]
FROM [ ]
WHERE [ ] [ ] [ ]
ORDER BY [ ] [ ]

28

Question 2 (3 marks) Annotations

An online business is planning to use a database to keep track of its products. The contents of the Products table during testing are shown.

Products

ProductID	ProductName	ProductPrice
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P002	Discovery 1 and 2 (DVD)	26.98
P003	Travel 1 and 2 (Blu-Ray)	22.00
P004	The Best Movie (DVD)	19.98
P005	Celebration (DVD)	12.00

After executing a SQL query, the following results were obtained.

ProductName	ProductPrice
Discovery 1 and 2 (DVD)	26.98
The Plant (DVD)	28.00
Travel 1 and 2 (Blu-Ray)	22.00

Answer:

SELECT [ProductName] [ProductPrice]
FROM [Products]
WHERE [ProductPrice] [>=] [22.00]
ORDER BY [ProductName] [ASC]

2 Select the c Products / ProductID / ✓ ProductName / ProductPrice **h dropdown menu to show how the results were obtained. (3 marks)**

SELECT [oductPrice]
FROM
WHERE [ProductPrice] [>=] [22.00]
ORDER BY [ProductName] [ASC]

29

Question 12 (5 marks) Annotations

An online business is planning to use a database to keep track of its products, customers and orders. The contents of the Products, Customers and Orders tables during testing are shown.

Products

ProductID	ProductName	ProductPrice
P001	The Plant (DVD)	28.00
P002	Discovery 1 and 2 (DVD)	26.98
P003	Travel 1 and 2 (Blu-Ray)	22.00
P004	The Best Movie (DVD)	19.98
P005	Celebration (DVD)	12.00

Customers

CustID	CustName	CustEmail
C001	Nicky Singh	N.Singh@nesa.edu.au
C002	Casey He	C.He@bos.edu.au
C003	Ash Lee	A.Lee@bosnsw.edu
C004	Kim Smith	K.Smith@nesa.edu.au
C005	Pat Alvardo	P.Alvardo@bos.edu.au

Orders

OrderID	CustID	ProductID	OrderQuantity
T001	C001	P004	2
T002	C004	P005	1
T003	C002	P003	1
T004	C001	P002	2
T005	C005	P002	2

12 (a) The following SQL query is run to test the database.

```
SELECT ProductName, ProductPrice
FROM Products
WHERE ProductPrice > 22.00
ORDER BY ProductPrice ASC
```

Fill in the table below with the result of running the SQL query. You may not need to use all the rows or columns. (2 marks)

12 (b) The contents of the Orders table need to be displayed as follows. (3 marks)

Full screen Run Rese

Customer	Product	Quantity
Nicky Singh	The Best Movie (DVD)	2
Kim Smith	Celebration (DVD)	1
Casey He	Travel 1 and 2 (Blu-Ray)	1
Nicky Singh	Discovery 1 and 2 (DVD)	2
Pat Alvardo	Discovery 1 and 2 (DVD)	2

Write a SQL query that can produce this result.

Query

```
1 SELECT CustName
2 FROM Customers
3 ORDER By CustName ASC
```

30

Question 12 (5 marks) Annotations

An online business is planning to use a database to keep track of its products, customers and orders. The contents of the Products, Customers and Orders tables during testing are shown.

Products

ProductID	ProductName	ProductPrice
P001	The Plant (DVD)	28.00
P002	Discovery 1 and 2 (DVD)	26.98
P003	Travel 1 and 2 (Blu-Ray)	22.00
P004	The Best Movie (DVD)	19.98
P005	Celebration (DVD)	12.00

Customers

CustID	CustName	CustEmail
C001	Nicky Singh	N.Singh@nesa.edu.au
C002	Casey He	C.He@bos.edu.au
C003	Ash Lee	A.Lee@bosnsw.edu
C004	Kim Smith	K.Smith@nesa.edu.au
C005	Pat Alvardo	P.Alvardo@bos.edu.au

Orders

OrderID	CustID	ProductID	OrderQuantity
T001	C001	P004	2
T002	C004	P005	1
T003	C002	P003	1
T004	C001	P002	2
T005	C005	P002	2

12 (a) The following SQL query is run to test the database.

```
SELECT ProductName, ProductPrice
FROM Products
WHERE ProductPrice > 22.00
ORDER BY ProductPrice ASC
```

Fill in the table below with the result of running the SQL query. You may not need to use all the rows or columns. (2 marks)

Sample answer:

ProductName	ProductPrice
Discovery 1 & 2 (DVD)	26.98
The Plant (DVD)	28.00

31

Question 12 (5 marks) Annotations

An online business is planning to use a database to keep track of its products, customers and orders. The contents of the Products, Customers and Orders tables during testing are shown.

Products

ProductID	ProductName	ProductPrice
P001	The Plant (DVD)	28.00
P002	Discovery 1 and 2 (DVD)	26.98
P003	Travel 1 and 2 (Blu-Ray)	22.00
P004	The Best Movie (DVD)	19.98
P005	Celebration (DVD)	12.00

Customers

CustID	CustName	CustEmail
C001	Nicky Singh	N.Singh@nesa.edu.au
C002	Casey He	C.He@bos.edu.au
C003	Ash Lee	A.Lee@bosnsw.edu
C004	Kim Smith	K.Smith@nesa.edu.au
C005	Pat Alvardo	P.Alvardo@bos.edu.au

Orders

OrderID	CustID	ProductID	OrderQuantity
T001	C001	P004	2
T002	C004	P005	1
T003	C002	P003	1
T004	C001	P002	2
T005	C005	P002	2

Sample answer:

```
SELECT Customers.CustName as 'Customer', Products.ProductName as 'Product',
Orders.OrderQuantity as 'Quantity'
FROM Products, Customers, Orders
WHERE Orders.ProductID = Products.ProductID
AND Orders.CustID = Customers.CustID
ORDER BY Orders.OrderID ASC
```

12 (b) The contents of the Orders table need to be displayed as follows. (3 marks)

Full screen Run Rese

Customer	Product	Quantity
Nicky Singh	The Best Movie (DVD)	2
Kim Smith	Celebration (DVD)	1
Casey He	Travel 1 and 2 (Blu-Ray)	1
Nicky Singh	Discovery 1 and 2 (DVD)	2
Pat Alvardo	Discovery 1 and 2 (DVD)	2

Write a SQL query that can produce this result.

Query

```
1 SELECT CustName
2 FROM Customers
3 ORDER By CustName ASC
```

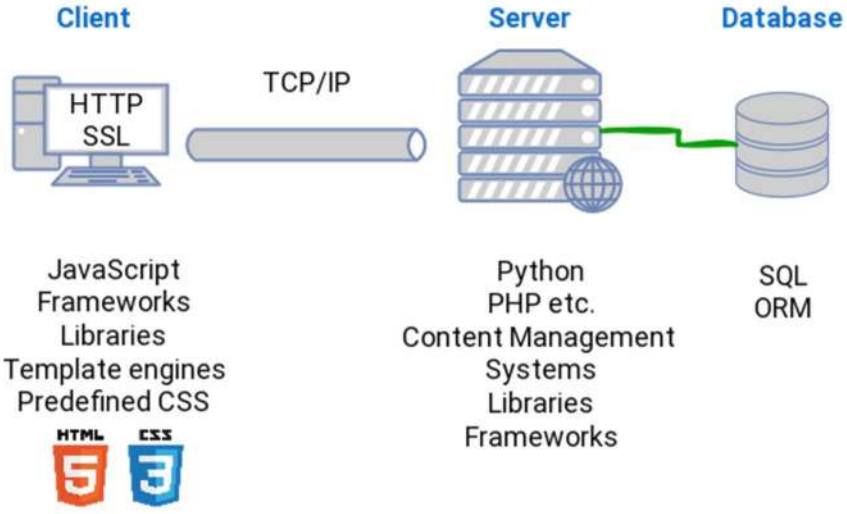
32

Object Relational Mapping (ORM) vs SQL

- ORM uses a wrapper to allow coders to interact with database entries in a way that matches up to the attributes in their objects.
- Can be more intuitive and secure but sacrifices speed and complexity of interacting with data.
- SQL allows you to write direct queries to interact with the data in the database.
- You can manipulate the data in the database in complex ways.
- Can be easier to troubleshoot if you know what you are doing.

33

A Web Request



34

4. Concepts / Theory

Will probably need to discuss

Big Data

- Data Mining – analysing very big data sets (and combinations of data sets) to find patterns and insights of value.
- Metadata – data about data : helps the system understand the data it is analysing and put it in context.
- Streaming service management – an ideal example of data mining where there is potential for large amounts of data created and effective recommendations can be created.

36

Big Data (continued)

- The internet usually is involved in collecting and transferring that data to be stored in databases, files and other means.
- Data mining is used to analyse the data and find non-obvious trends and patterns
- Can be used for positive outcomes eg. Managing outbreaks of viruses.
- Can also be used for negative outcomes, Profiling, invasion of privacy etc.

37

W3C

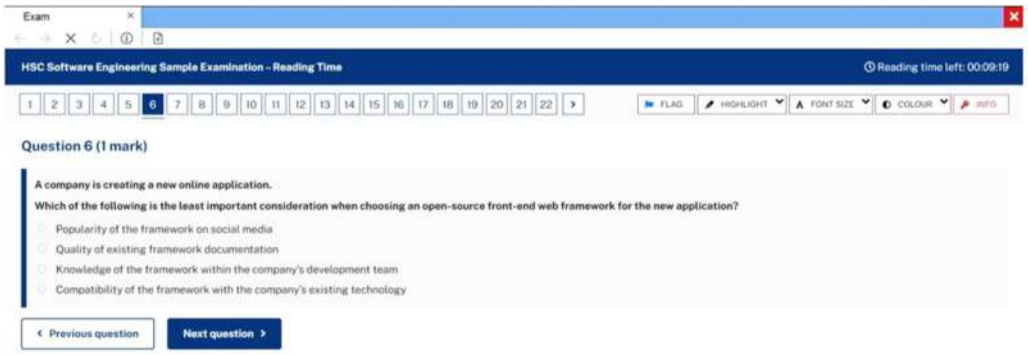
- A group that develops standards and guidelines to help developers build sites and applications :
  - Web Accessibility Initiative (WAI)
  - Internationalisation
  - Web Security
  - Privacy
  - Machine-readable data
- They also define the standards for HTML and CSS

38

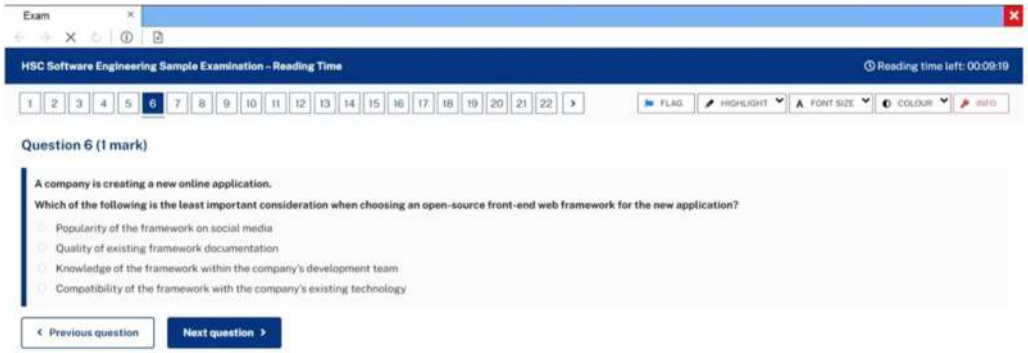
Progressive Web Apps (PWA's)

- A web page / set of web pages that is set up to look and behave like an app.
- Done well, can combine the best features of traditional websites and native apps.
- Can run offline and deliver a similar experience across platforms
- Not quite as powerful or fast as a native app but not far off
- They are built using HTML, CSS and JavaScript.
- Needs certain things set up properly so that the browser can identify it as a PWA and install it properly.
- Used in many areas including gaming and e-commerce

39

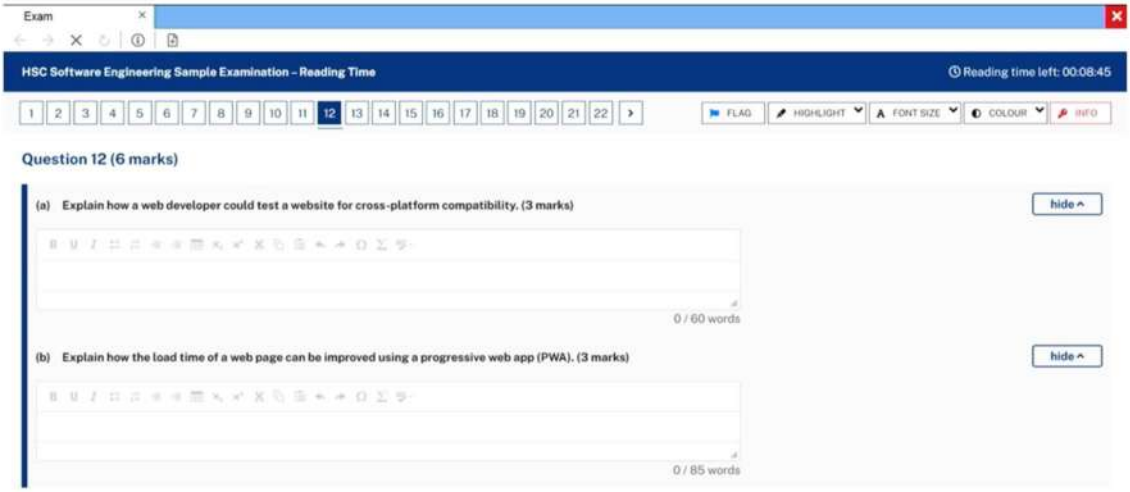


40

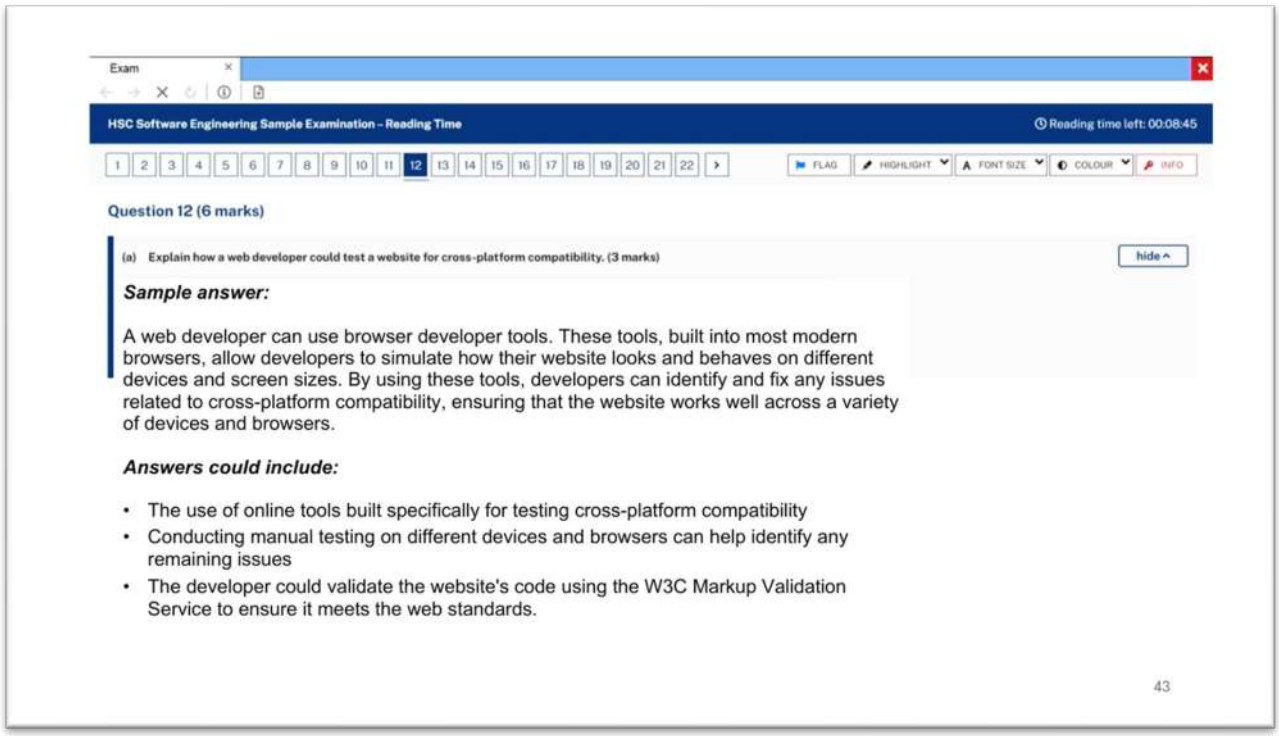


a. Popularity of the framework on social media

41



42


Exam
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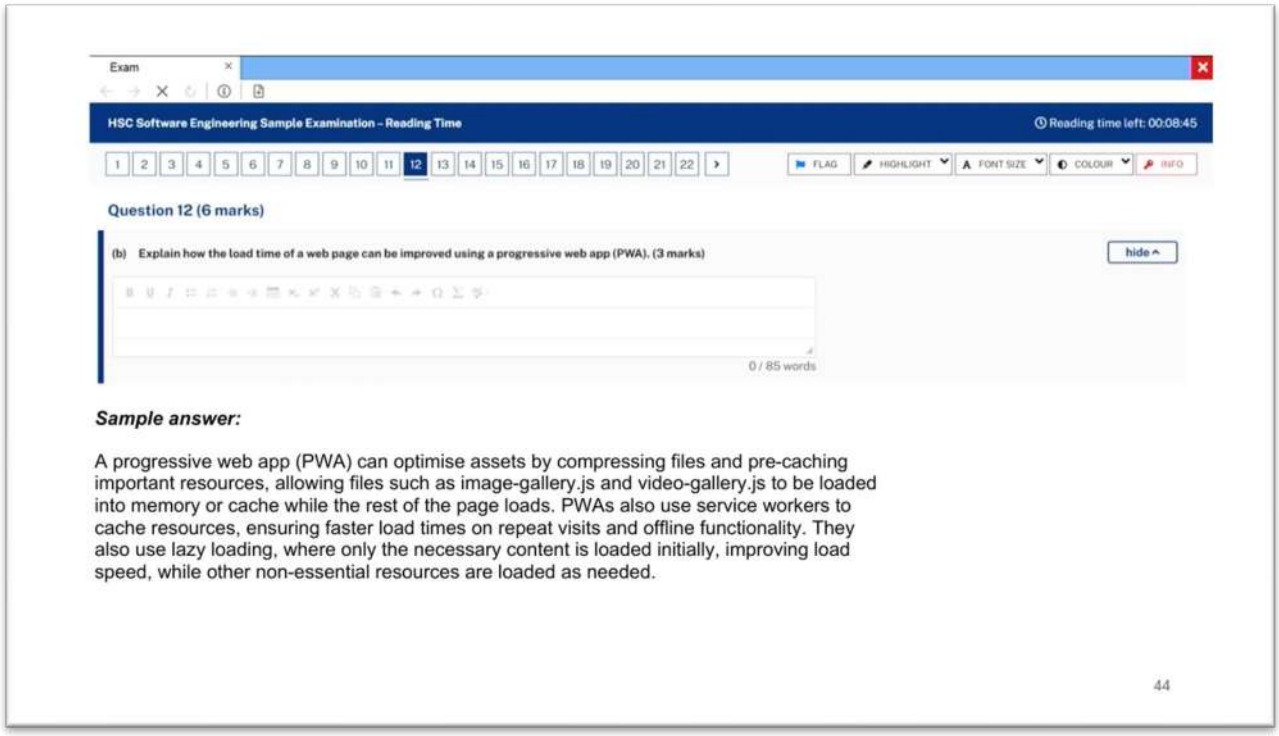
Question 12 (6 marks)
(a) Explain how a web developer could test a website for cross-platform compatibility. (3 marks)
hide
Sample answer:
A web developer can use browser developer tools. These tools, built into most modern browsers, allow developers to simulate how their website looks and behaves on different devices and screen sizes. By using these tools, developers can identify and fix any issues related to cross-platform compatibility, ensuring that the website works well across a variety of devices and browsers.
Answers could include:
• The use of online tools built specifically for testing cross-platform compatibility
• Conducting manual testing on different devices and browsers can help identify any remaining issues
• The developer could validate the website's code using the W3C Markup Validation Service to ensure it meets the web standards.
43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Question 12 (6 marks)
(b) Explain how the load time of a web page can be improved using a progressive web app (PWA). (3 marks)
hide
0 / 85 words
Sample answer:
A progressive web app (PWA) can optimise assets by compressing files and pre-caching important resources, allowing files such as image-gallery.js and video-gallery.js to be loaded into memory or cache while the rest of the page loads. PWAs also use service workers to cache resources, ensuring faster load times on repeat visits and offline functionality. They also use lazy loading, where only the necessary content is loaded initially, improving load speed, while other non-essential resources are loaded as needed.
44

MY NOTES

HSC STUDY DAY SERIES

2025

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2025 HSC STUDY DAY SERIES

SOFTWARE ENGINEERING

AURORA COLLEGE

IGNITING NEW WAYS OF LEARNING. CELEBRATING 10 YEARS

Software Automation

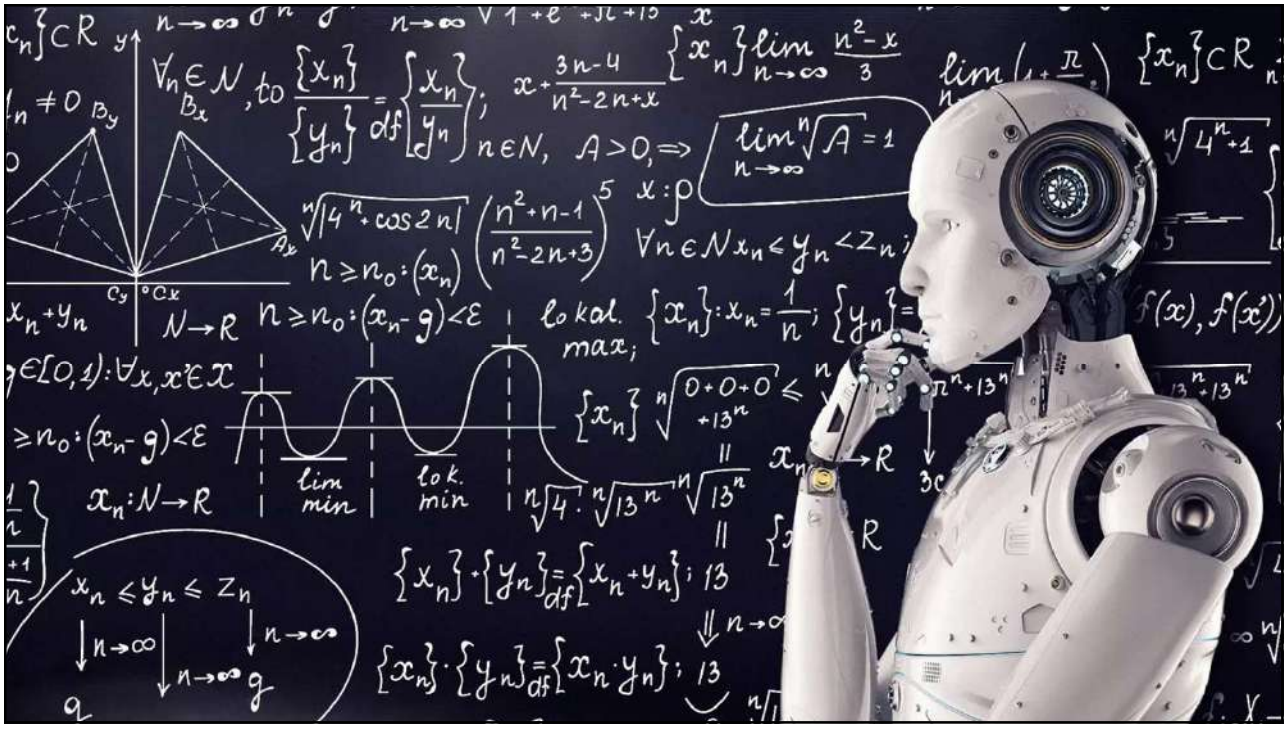
Ben Jones

Head Techer TAS, Tempe High School

70 minutes

Software Automation

- Algorithms in machine learning
- Programming for automation
- Significance and impact of ML and AI



Algorithms in machine learning

- Have a definition of ML/AI and be comfortable comparing and contrasting
- Have a definition of RPA/BPA and be able to apply them in various contexts

- Investigate how machine learning (ML) supports automation through the use of DevOps, robotic process automation (RPA) and business process automation (BPA)
- Distinguish between artificial intelligence (AI) and ML

AI & ML

Artificial Intelligence (AI) is the ability of a computer system to perform tasks that would normally require human intelligence, such as learning, reasoning, and decision-making. In simpler terms, it's about making machines think and act like humans.

Machine learning is a subfield of artificial intelligence where algorithms learn from data without explicit programming. This is achieved by providing algorithms with large datasets, allowing them to analyse patterns, make predictions, and make informed decisions.

RBA & BPA

Robotic Process Automation (RPA) uses software "robots" to automate repetitive, rule-based tasks across different applications.

- Optical Character Recognition
- Image recognition
- Automation of file saving
- Phishing/Spam mail processing

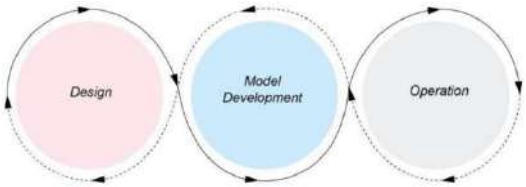
Business Process Automation (BPA) utilises technology to automate repetitive tasks and workflows within a business, aiming to streamline operations, increase efficiency, and reduce errors.

- Email marketing
- Inventory management
- Employee/customer onboarding
- Online order automation

DEVOps & MLOps

DevOps is a software development methodology that promotes collaboration and automation between development (Dev) and operations (Ops) teams.

MLOps, short for Machine Learning Operations, is a set of practices that aims to streamline and automate the process of developing, deploying, and maintaining machine learning models in production.



MLOps – Course Specifications

Design:

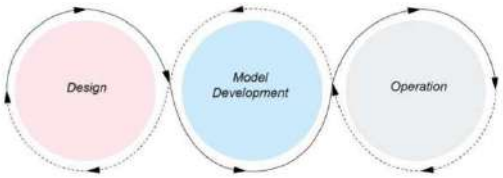
- defining the business problem to be solved
- refactoring the business problem into a ML problem
- defining success metrics
- researching available data

Model development:

- data wrangling
- feature engineering
- model training
- model testing and validation.

Operations:

- model deployment
- supporting operations/use
- monitoring model performance.



Algorithms in machine learning

- Know the algorithm
- Know the function form
- Know the use cases
- You will not have to code any models

- Describe types of algorithms associated with ML

  Including:

  - linear regression
  - logistic regression
  - K-nearest neighbour

- Research models used by software engineers to design and analyse ML

  Including:

  - decision trees
  - neural networks

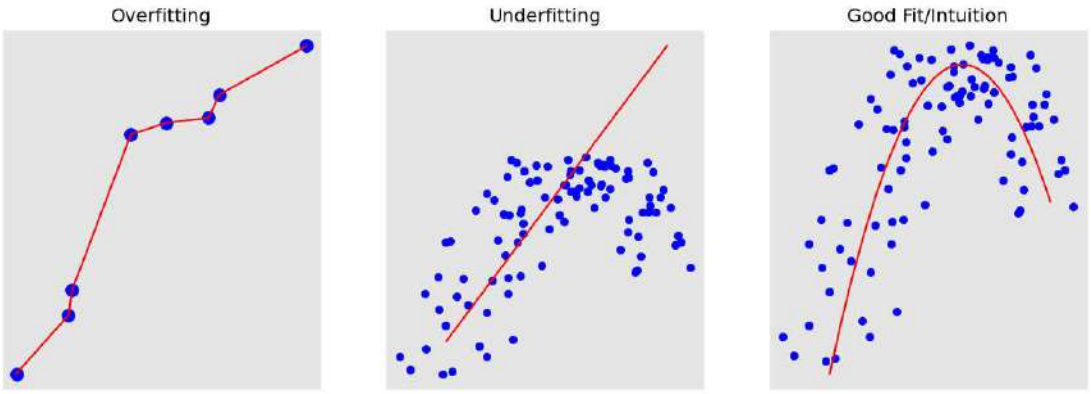
- Design, develop and apply ML regression models using an OOP to predict numeric values

  Including:

  - linear regression
  - polynomial regression
  - logistic regression

- Apply neural network models using an OOP to make predictions

Fitting/Intuition/Generalisation



Linear Regression

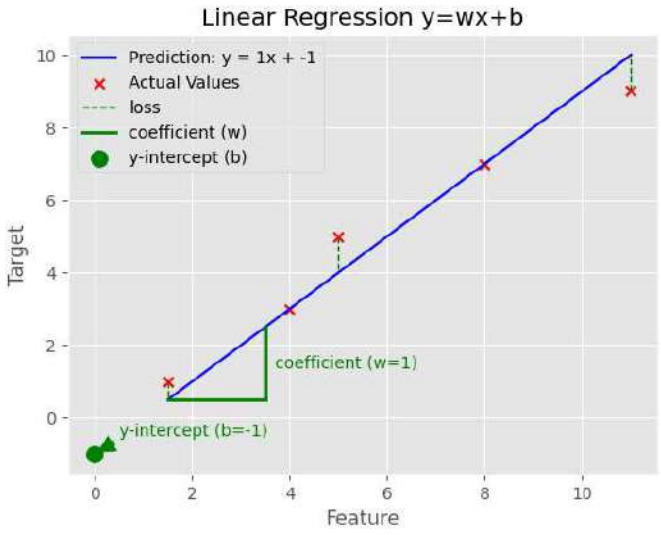
y = wx+b

Algorithm:

- Cost function: takes *w* & *b* parameters then calculates loss for each data poin and returns the (mean square error MSE) cost.
- Gradient descent optimises *w (weight)* and *b (bias)* parameters for the model, returning *w,b* with the lowest cost.

Assumes a linear relationship

Outputs a numerical prediction based or an input feature(s)



Polynomial Linear Regression

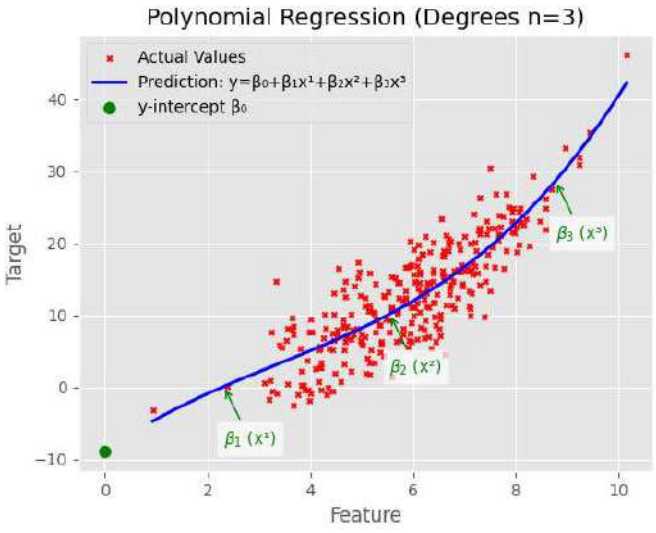
$y = \beta_0 + \beta_1 x + \beta_2 x^2 + \beta_3 x^3$

Algorithm:

- Cost function: takes β_0 *and* β_n *(*coefficients parameters then calculates loss for each data point and returns the (mean square error MSE) cost.
- Gradient descent optimises β_0, β_n parameters for the model, returning β_0, β_n *(*coefficients*)* with the lowest cost.

Assumes a curvilinear relationship

Outputs a numerical prediction based on an input feature(s)



Logistic Regression

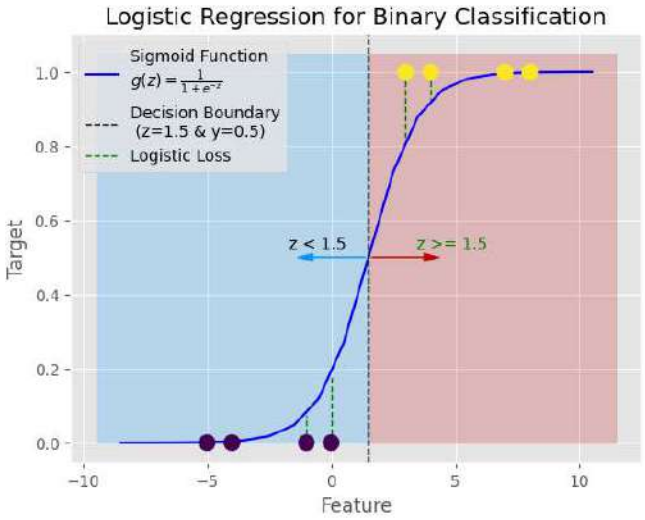
$f_{w,b}(x^{(i)})=g(w \cdot x^{(i)}+b)$ *where* $g(z) \frac{1}{1+e^{-z}}$

Algorithm:

- Logistic cost function: calculates logistic loss for each data point and returns model logistic cost (probability cost).
- Gradient descent optimises *w (weight)* and *b (bias)* parameters for the model, returning *w,b* with the lowest logistic cost.

Assumes a classification problem

Outputs a numerical value between 0-1 that is a probabilistic prediction that it is not class *0*.

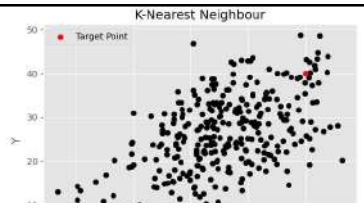


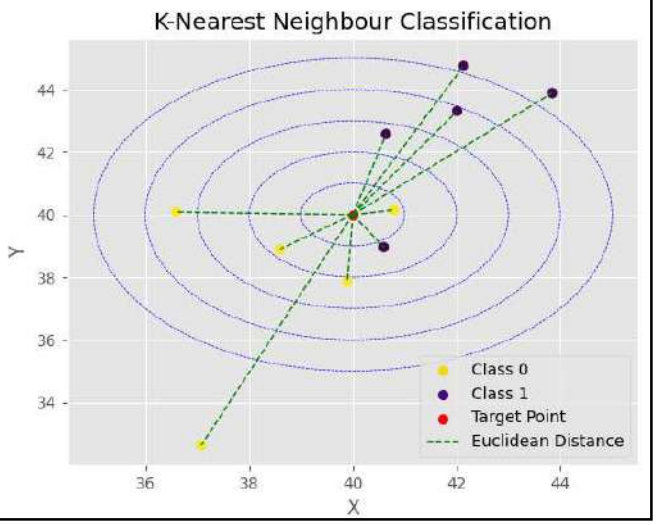
K Nearest Neighbour

k = sample size of neighbours to consider

Algorithm:

- Measure distance from new data point to all data points (Euclidean or Manhattan distance)
- Search for the closest k samples
  - **Regression** is the mean of *X,Y* coordinates of *k* samples.
  - **Classification** is the mode class of *k* samples.





Neural Networks – Course Specifciations

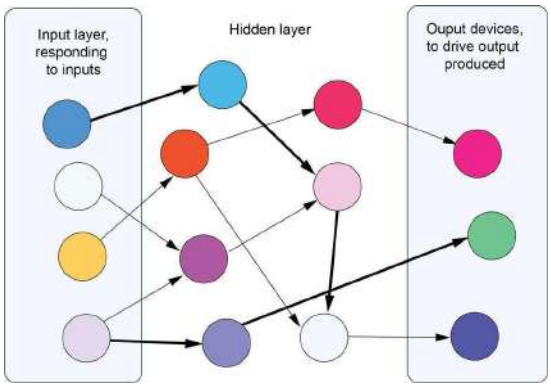
Neural networks were designed to mimic the processing inside the human brain.

Training cycle

Linear regression with backward chaining is used to iteratively determine the set of unique bias and weight values required for output. Regular exposure to the training cycle results in improved accuracy and pattern matching.

Execution cycle

The execution cycle follows the training cycle and utilises the internal values developed during the training cycle to determine the output.



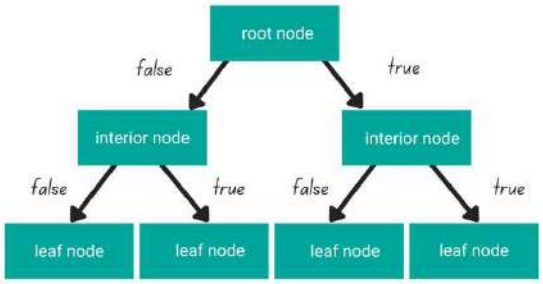
Example Implementation

Decision Tree

Algorithm:

- Using Gini Impurity to measure node purity (probability the node is pure, 0 indicates a pure node and 1 indicates classes are equally distributed).
- The process starts at the top with the root node, which represents the entire dataset.
- Recursively split notes into smaller subsets based on features, minimising node impurity.
- Splitting continues until a stopping criterion is met, such as a maximum depth, minimum number of samples or node purity is achieved
- Ends with leaf nodes that are the final classification

Assumes a classification problem with classification data.



Example Implementation

Exam

HSC Software Engineering Sample Examination – Reading Time

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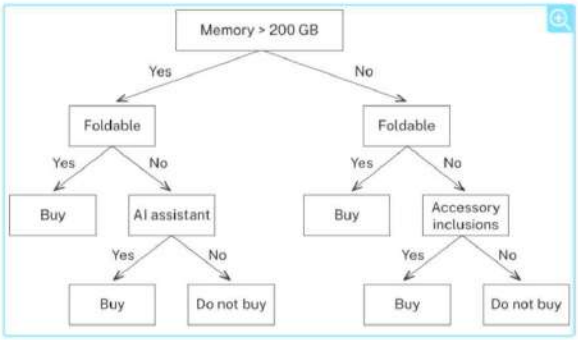
Question 20 (4 marks)

Consider the following decision tree of a trained machine learning model that determines whether to purchase a mobile phone.



(a) **Using the decision tree, determine the outcome of each of the following situations. (1 mark)** hide

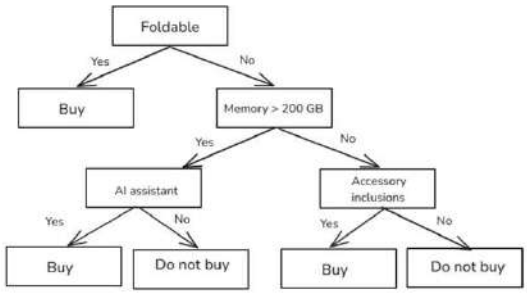
	Buy	Do not buy
Memory = 256 GB, AI Assistant = Yes, Accessory inclusions = No	○	○
Memory = 128 GB, AI Assistant = No, Accessory inclusions = Yes	○	○
Foldable = Yes, AI Assistant = No, Accessory inclusions = No	○	○

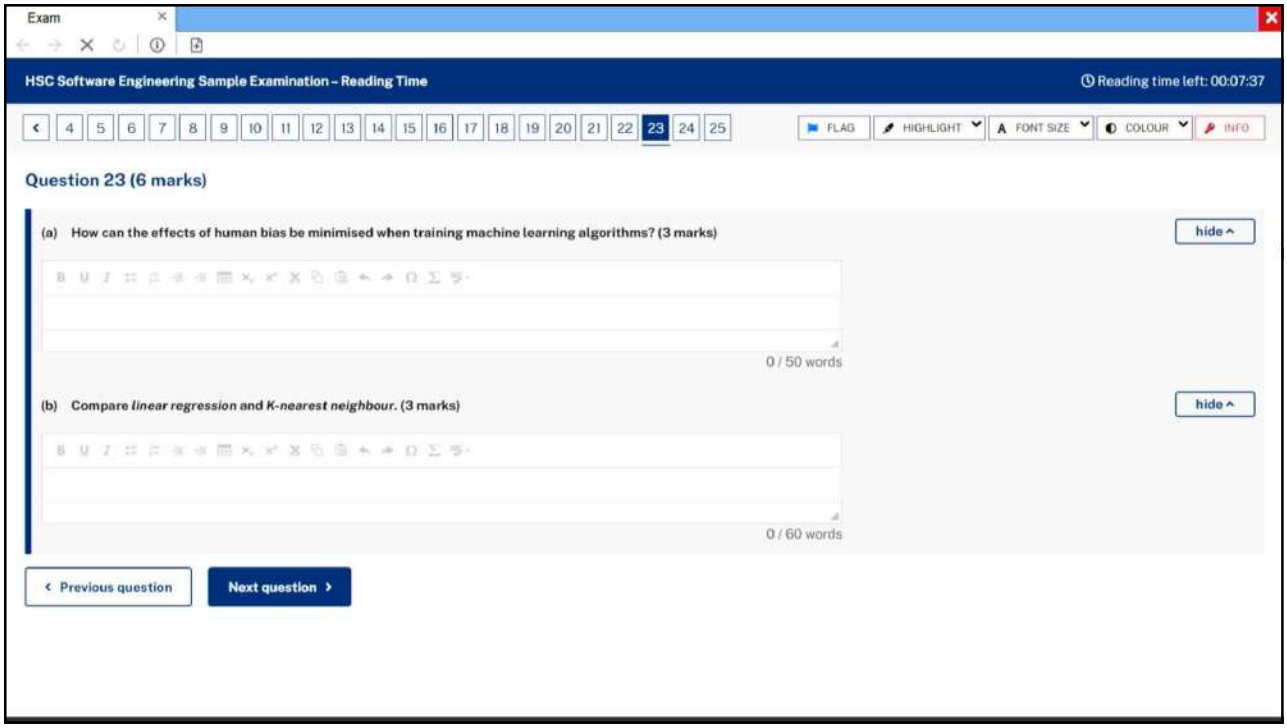
(b) **The decision tree can be simplified without compromising its logic. Redraw the decision tree to reduce the number of branches. (3 marks)** Full screen Reset hide

Question 20 (b)

Criteria	Marks
• Draws a correctly simplified decision tree	3
• Draws a simplified decision tree with most of the logic	2
• Shows some understanding of the requirement	1

Sample answer:

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Question 23 (6 marks)
(a) How can the effects of human bias be minimised when training machine learning algorithms? (3 marks)
hide
0 / 50 words
(b) Compare linear regression and K-nearest neighbour. (3 marks)
hide
0 / 60 words
Previous question
Next question

Question 23 (a)

Criteria	Marks
• Shows thorough understanding of how the effects of human bias on the training of machine learning algorithms can be minimised	3
• Outlines some effects of human bias on machine learning OR • Outlines some features of the training of machine learning algorithms	2
• Provides some relevant information	1

Sample answer:

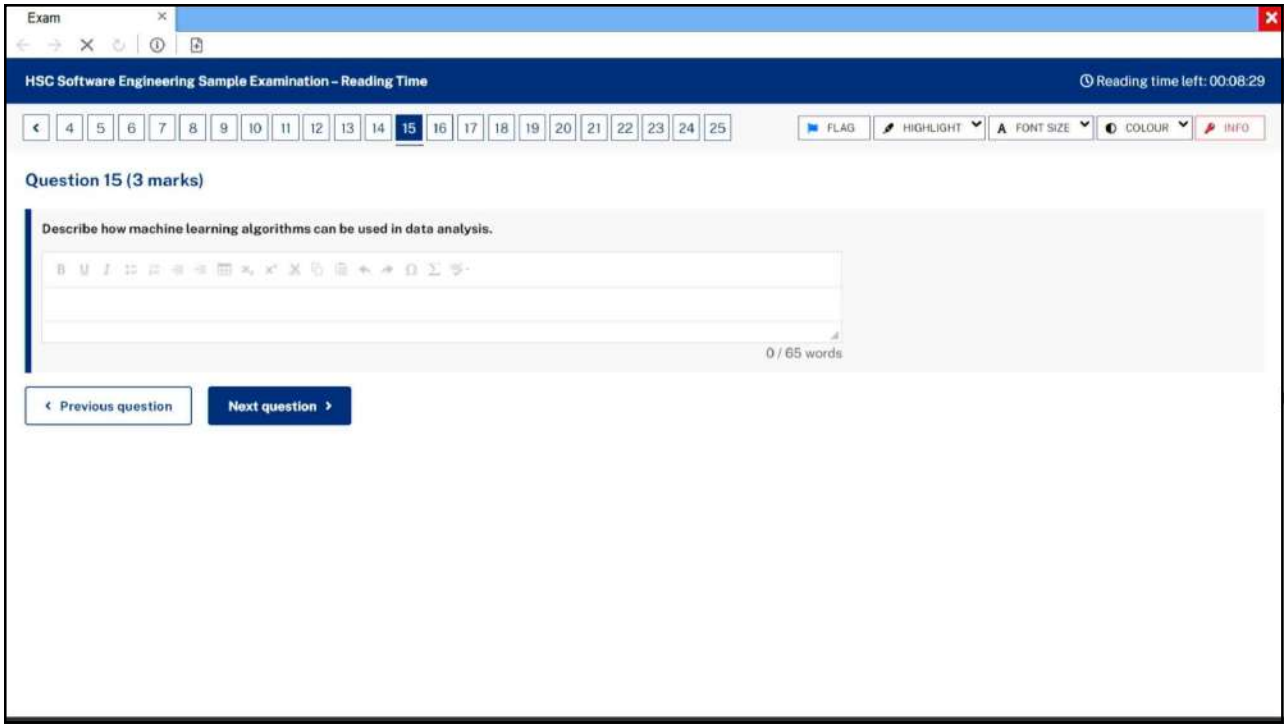
Training data is initially selected by humans, who may unintentionally introduce their own biases. To minimise this, ensure that training data is representative of the problem the ML model will address. Reviewing data by individuals from diverse backgrounds could identify and reduce potential biases, ensuring fairer and accurate model performance.

Question 23 (b)

Criteria	Marks
• Compares linear regression and K-nearest neighbour	3
• Outlines features of linear regression and/or K-nearest neighbour	2
• Provides some relevant information	1

Sample answer:

Linear regression and K-nearest neighbours (KNN) are both supervised learning algorithms that make predictions from labelled data. The key difference is how they handle data: linear regression assumes a linear relationship between input features and the target variable, while KNN makes predictions based on the closest 'K' training examples, allowing it to handle more complex, non-linear patterns. However, KNN can be more computationally expensive than linear regression and is usually slower.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Question 15 (3 marks)
Describe how machine learning algorithms can be used in data analysis.
0 / 65 words
Previous question
Next question

Question 15

Criteria	Marks
• Describes how machine learning algorithms can be used in data analysis	3
• Outlines some features of machine learning algorithms relevant to data analysis	2
• Provides some relevant information	1

Sample answer:

Machine learning algorithms can be trained with a subset of the data to automatically identify patterns and trends within large datasets. The algorithms can handle complex relationships and nonlinearities present in the data allowing for efficient and comprehensive analysis. Machine learning can also be used for predictions and forecasting. These models can learn from new data over time, continuously improving their analysis and predictive accuracy and performance.

Significance and impact of ML and AI

- Understand the difference between bias/variance, bias in the model and dataset bias.
- Understand and recall 3x types of dataset bias.
- Understand how BIAS enters the MLOps cycle.
- Investigate the effect of human and dataset source bias in the development of ML and AI solutions

Significance and impact of ML and AI

Know a range of positive and negative impacts that automation can have on individuals, society and the environment.

Be able to analyse (identify components and the relationship between them, draw out and relate implications) the impact.

- Assess the impact of automation on the individual, society and the environment

Including:

- safety of workers
- people with disability
- the nature and skills required for employment
- production efficiency, waste and the environment
- the economy and distribution of wealth

Significance and impact of ML and AI

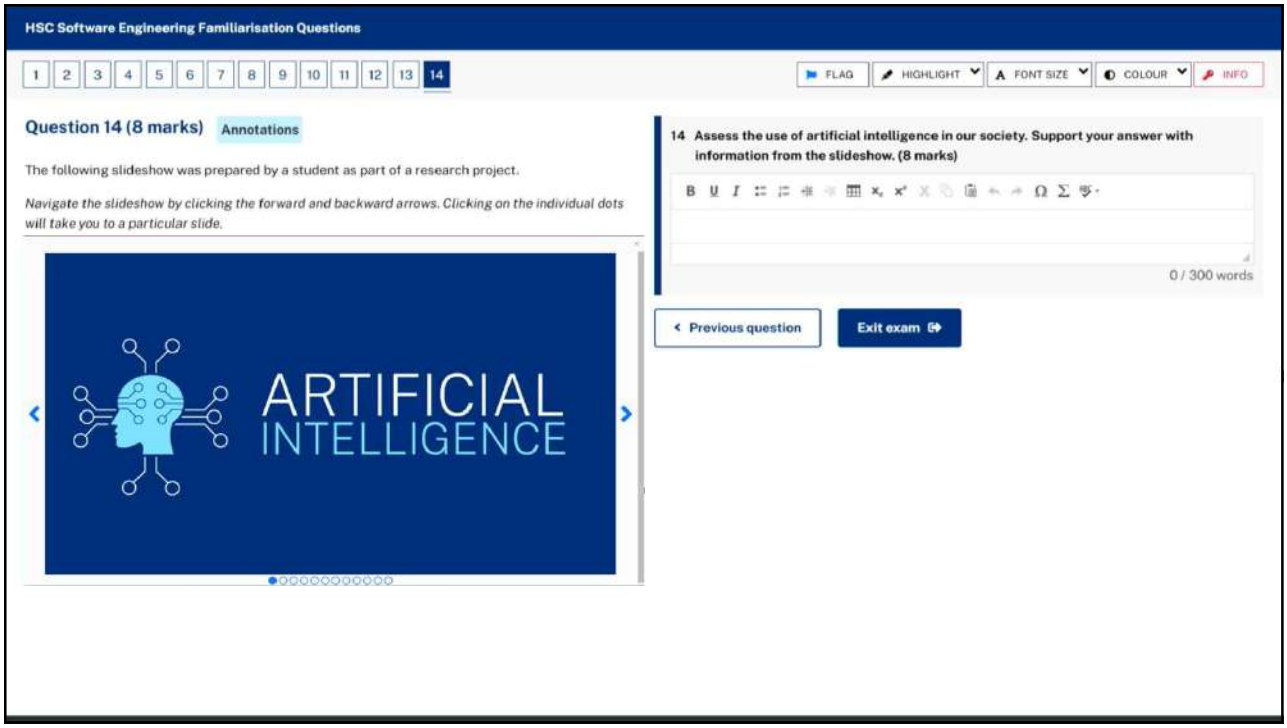
Understand that Automation is influence by human behaviour in all stages of the MLOps cycle.

Be able to analyse (identify components and the relationship between them, draw out and relate implications) the patterns.

- Explore by implementation how patterns in human behaviour influence ML and AI software development

Including:

- psychological responses
- patterns related to acute stress response
- cultural protocols
- belief systems


HSC Software Engineering Familiarisation Questions
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Question 14 (8 marks)
Annotations
The following slideshow was prepared by a student as part of a research project.
Navigate the slideshow by clicking the forward and backward arrows. Clicking on the individual dots will take you to a particular slide.
ARTIFICIAL
INTELLIGENCE
14 Assess the use of artificial intelligence in our society. Support your answer with information from the slideshow. (8 marks)
0 / 300 words
Previous question
Exit exam

Question 14

Criteria	Marks
• Makes an informed judgement about the use of artificial intelligence in our society, demonstrating comprehensive understanding of its use and effects • Supports answer with information from the slideshow	8
• Shows a broad understanding of the use of artificial intelligence and its advantages and disadvantages • Includes some information from the slideshow	6–7
• Shows a sound understanding of the use of artificial intelligence • Outlines some of its advantages and/or disadvantages	4–5
• Shows some understanding of artificial intelligence	2–3
• Provides some relevant information	1

- explore models of training Machine Learning (ML), including:
  - supervised learning
  - unsupervised learning
  - semi-supervised learning
  - reinforcement learning.
- investigate common applications of key Machine Learning (ML) algorithms, including:
  - data analysis and forecasting
  - virtual personal assistants
  - image recognition.
- assess the impact of automation on the individual, society and the environment, including:
  - safety of workers
  - people with disability
  - the nature and skills required for employment
  - production efficiency, waste and the environment
  - the economy and distribution of wealth.
- explore by implementation how patterns in human behaviour influence ML and AI software development, including:
  - psychological responses
  - patterns related to acute stress response
  - cultural protocols
  - belief systems.
- investigate the effect of human and data set source bias in the development of ML and AI solutions
- apply security features incorporated into software including data protection, security, privacy and regulatory compliance
- use and explain the 'privacy by design' approach in the development of software solutions, including:
  - proactive not reactive
  - embed privacy into design
  - respect for user privacy.
- evaluate the social, ethical, and legal issues and ramifications that affect people and enterprises resulting from the development and implementation of software, including:
  - employment
  - privacy
  - digital disruption.
- data mining
- streaming service management.

Exam

HSC Software Engineering Sample Examination – Reading Time

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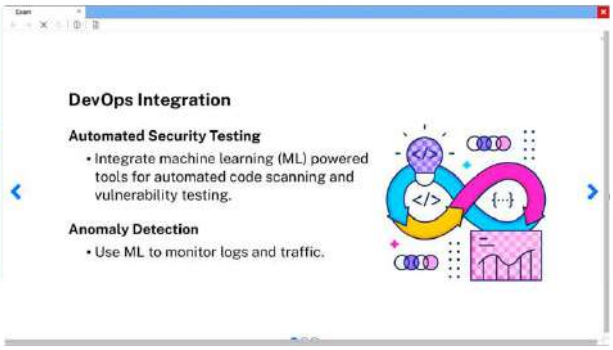
Question 25 (8 marks)

A telecommunications company had a recent security breach which prompted a review to improve the security of its systems.

It has contracted QuidantCon to propose security enhancements to its systems.

QuidantCon's Proposal



Discuss QuidantCon's proposal for security enhancements to the company's systems.

0 / 250 words

Previous question

Question 25

Criteria	Marks
• Discusses the proposal for security enhancements to the company's systems, with reference to machine learning (ML) in DevOps, robotic process automation (RPA) and business process automation (BPA) from the slideshow	8
• Outlines advantages and disadvantages of the proposal, with reference to at least TWO of these areas: machine learning (ML) in DevOps, robotic process automation (RPA), business process automation (BPA)	6–7
• Outlines some advantages and/or disadvantages of the proposal, with reference to machine learning (ML) in DevOps and/or robotic process automation (RPA) and/or business process automation (BPA)	4–5
• Shows some understanding of the features of the proposal	2–3
• Provides some relevant information	1

QuidantCon's proposal for the company suggests leveraging machine learning (ML) and automation to bolster security measures. One key benefit is the automation of security testing and vulnerability scanning, facilitated by integrating ML-powered tools into the DevOps pipeline. This approach ensures continuous security testing and provides rapid feedback to developers, allowing for early detection of security issues and reducing the risk of vulnerabilities being exploited. The frequent and automated testing improves the overall security position and enhances compliance with industry standards. Additionally, ML algorithms can analyse vast amounts of data to detect patterns and anomalies, which is crucial for proactive threat identification. This capability enables the company to identify security risks proactively, learn from past incidents, and predict future attacks, thereby enhancing their overall security measures.

QuidantCon's proposal for the company also raises some concerns. One key issue is the need for high-quality data for ML algorithms to work effectively. If the data is inconsistent or incomplete, the ML models may not perform well, leading to false positives or missed threats. Another concern is the complexity of implementing ML solutions, which can be challenging and may require specialised skills and training. This complexity could result in integration challenges, higher costs, and delays. Additionally, ML systems can be biased, potentially affecting security decisions. Security and privacy are also critical, as handling sensitive data requires protection against unauthorised access and breaches. These concerns emphasise the need for a careful and balanced approach when considering ML and automation in security practices.

Automation of security testing and vulnerability scanning:

- Automation of security testing including the use software tools to automatically test the security of an application or system
- Conducting scans for vulnerabilities, misconfigurations, and potential threats
- Automation helps in detecting security issues early in the development lifecycle, reducing the risk of vulnerabilities being exploited
- Automation also enables more frequent testing, improving overall security posture and compliance with security standards
- Integration of automation into the DevOps pipeline, allowing for continuous security testing and rapid feedback to developers.

Use of machine learning powered tools to enhance security practices:

- Machine learning helps in identifying security risks by analysing vast amounts of data to detect patterns and anomalies that may indicate a potential threat
- Machine learning algorithms can learn from past security incidents and use this knowledge to predict and prevent future attacks
- Machine learning can automate the analysis of security logs and events, providing real time insights
- Machine learning can assist in automating incident response in RPA, enabling faster and more effective mitigation of security risks.

Safe and efficient operation of Robotic Process Automation (RPA) bots:

- Machine learning algorithms for real-time detection and response to security threats
- Machine learning algorithms can continuously monitor RPA bot behaviour to detect any anomalies or deviations from normal operation
- By analysing data on bot performance and interactions, machine learning can identify potential security threats or operational issues
- Machine learning can optimise the performance of RPA bots by identifying areas for improvement and suggesting enhancements.

Protection of Business Process Automation workflows from cyber threats

- Machine learning algorithms can analyse BPA workflows to identify potential vulnerabilities
- By continuously monitoring BPA processes, machine learning can detect and respond to cyber threats in real-time
- Machine learning can automate the implementation of security controls and policies
- Machine learning can enhance BPA workflows by predicting and preventing potential security breaches.

Additional benefits of machine learning in security:

- Improved efficiency and accuracy in detecting security threats
- Enhanced ability to respond to security incidents in real-time
- Ensuring security and compliance while automating business processes.

Disadvantages of ML in Security:

- Complexity and learning curve
- Dependency on data quality
- Potential for bias
- Security and privacy concerns
- Integration challenges
- Cost considerations.

MY NOTES

HSC STUDY DAY SERIES

2025

SOFTWARE ENGINEERING STUDENT BOOKLET

Software Engineering Project

AURORA COLLEGE

IGNITING NEW WAYS OF LEARNING: CELEBRATING 10 YEARS

https://aurora.schools.nsw.gov.au

SOFTWARE ENGINEERING PROJECT

Mr. Raymond Montalban
Arthur Phillip High School

Aurora College HSC Study Day Series 2025

1

OVERVIEW

1. Approach of this workshop
2. Scenario
3. Software Engineering Project components
   - Identifying and defining
   - Research and planning
   - Producing and implementing
   - Testing and evaluating
4. Example HSC-style questions

2

1. APPROACH

This workshop will use a scenario, through which all syllabus content skills and knowledge dot points for Software Engineering Project will be covered.

Salient syllabus teaching outcomes will also be highlighted where necessary.

Example HSC-style questions will be shown to you and how to answer them.

3

2. SCENARIO

An app is being developed for use in a school. It will allow teachers to upload and assign work and track student homework. Students can download work and upload their completed responses for marking.

This app must be ready to demonstrate to the school administration in six weeks. There is only $500 available for subscriptions to required software programs for software development.

4

3A. Identifying and defining

Define and analyse the requirements of a problem

- *Need:* requirement that must be met by the software solution.
- *Feasibility:* how possible it is to complete a task.
  - Schedule feasibility: how possible it is to complete it within a given time.
  - Financial feasibility: how possible it is to complete it with the money allocated.
  - Organisational feasibility: how possible it is for the target organisation to use it given it workforce
  - Technical feasibility: how possible it is for their hardware and software to use the solution

5

3A. Identifying and defining

Define and analyse the requirements of a problem

- *Requirement:* quality, characteristic or component of a software solution that should be included
  - Functionality requirement: a specific function or task that the software should be able to do do
  - Performance requirement: a specific speed at which the software should operate
- *Data structure:* arrangement of data in memory e.g. variable, dictionary, tree, tuple etc
- *Boundary:* limit within which software solution must operate

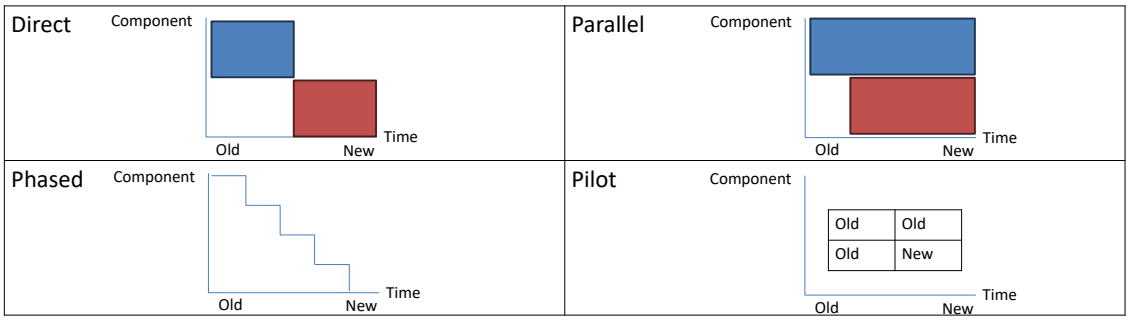
6

3A. Identifying and defining

Explore tools used to develop ideas and generate solutions

- **Tools are usually pieces of software or project methodologies used to either create software or do specific tasks.**

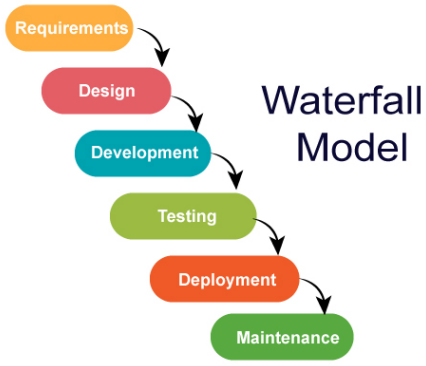
Investigate types of software implementation methods



7

3B. Researching and planning

Research and use the Waterfall, Agile and WAgile software development approaches.



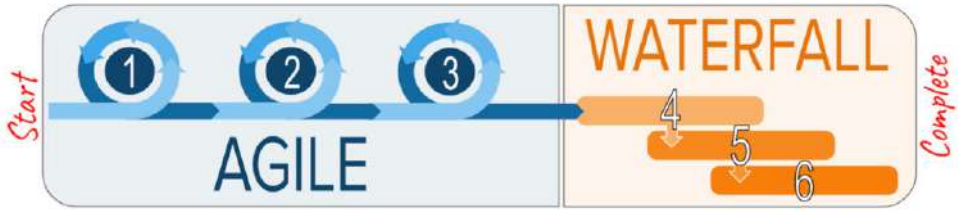
(https://medium.com/@chathmini96/waterfall-vs-agile-methodology-28001a9ca487)

(https://medium.com/@chathmini96/agile-methodology-30ec4cdf3fc)

8

3B. Researching and planning

Research and use the Waterfall, Agile and WAgile software development approaches.



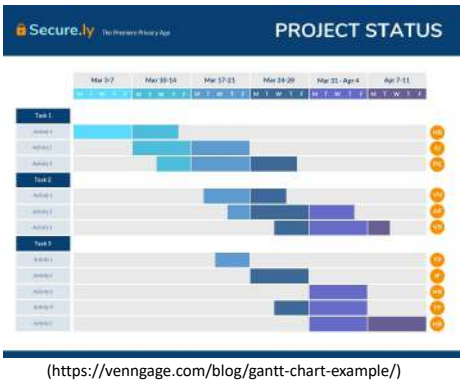
(https://cloudcoach.com/blog/what-is-wagile-project-management/)

9

3B. Researching and planning

Apply project management to plan and conduct the development and implementation of a project and software engineering solution

- **scheduling and tracking using a software tool including Gantt charts**
- **using collaboration tools**



(https://venngage.com/blog/gantt-chart-example/)

10

3B. Researching and planning

Explore social and ethical issues associated with project work, including working individually, collaboratively and responding to stakeholders

- Ethical issues include data privacy, accuracy, validation and security.
- Social issues include inclusion for disabilities, cultures, languages, lifestyles, changing nature of work (e.g. work from home versus in-person) etc.

Explore communication issues associated with project work

- involving and empowering the client
- enabling feedback
- negotiating

11

3B. Researching and planning

Investigate how software engineering solutions are quality assured

- defining quality criteria
- ensuring requirements are met by continually checking
- addressing compliance and legislative issues

Demonstrate the use of modelling tools

- data dictionaries
- Data Flow Diagrams (DFDs)
- flowcharts/pseudocode
- structure charts
- class diagrams
- screen designs/storyboards/wireframes/UI designs

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And now, it's your turn ...

Click on the link or scan the QR codes below to do the quiz on researching and planning.

HSC Study Day Quiz 1 – Investigating and Defining + Researching and Planning

13

Modelling tools: data dictionaries

Need							
1. Display which faculty has which spaces on what days.							
Variable	Data type	Format for display	Size in bytes	Size for display	Description	Example	Validation
student_name	String	Xxxxxxxxxxxx	128	60	Student name	John	Name > 1 character

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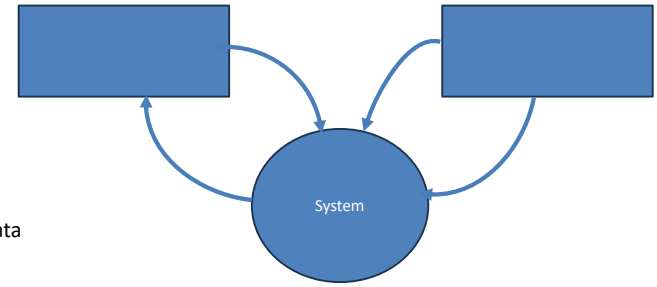
Modelling tools: Data Flow Diagrams (DFDs)

External entity
People or group of people

Process
Indicator of subprogram or component that transforms data

Data flow
Indicates data items and direction of data movement

Data store
Indicates a file or database where data are kept.



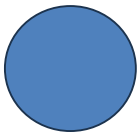
Level 0 Data Flow Diagram (DFD)

This shows a bird's eye view of the movement of data around a system. There is only one process on a Level 0 DFD. It usually has the word 'system' in its label. The data flow labels should correspond to variables/attributes in your code.

15

Modelling tools: Data Flow Diagrams (DFDs)

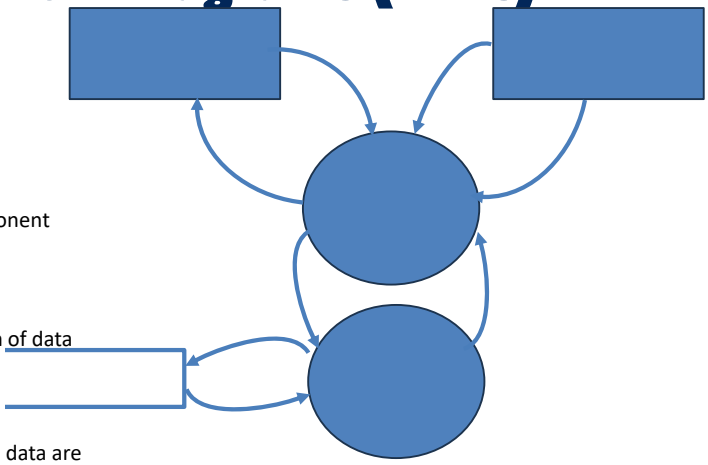
External entity
People or group of people



Process
Indicator of subprogram or component that transforms data

Data flow
Indicates data items and direction of data movement

Data store
Indicates a file or database where data are kept.



Level 1 Data Flow Diagram (DFD)

This shows data movement in more detail. The process labels should ideally correspond to function/subroutine/method names and should start with a verb. There is also a data store. The data flow labels should correspond to variable/attribute names in code.

16

Modelling tools: flowcharts vs pseudocode

Pseudocode

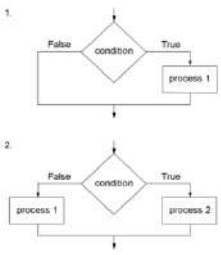
```
process 1
process 2
...
...
process n
```

Flowchart

Pseudocode

```
1. IF condition THEN
       process 1
   ENDIF

2. IF condition THEN
       process 2
   ELSE
       process 1
   ENDIF
```

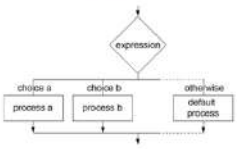
Flowchart



Pseudocode

```
CASEWHERE expression evaluates to
    choice a: process a
    choice b: process b
    ...
    OTHERWISE: default process
END CASE
```

Flowchart



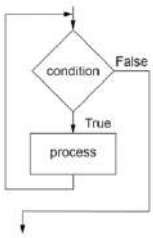
17

Modelling tools: flowcharts vs pseudocode

Pseudocode

```
WHILE condition is true
    process
ENDWHILE
```

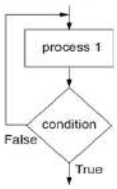
Flowchart



Pseudocode

```
REPEAT
    process
UNTIL condition is true
```

Flowchart



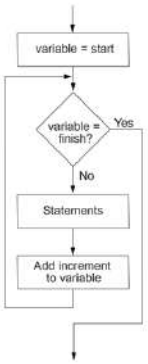
18

Modelling tools: flowcharts vs pseudocode

Pseudocode

```
FOR variable = start TO finish STEP increment
      statements
NEXT variable
```

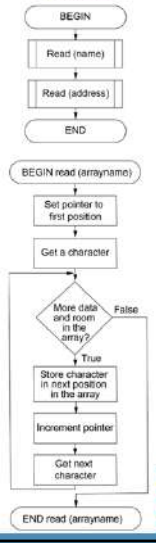
Flowchart



Pseudocode

```
BEGIN
      read (name)
      read (address)
END


BEGIN read (arrayname)
      Set pointer to first position
      Get a character
      WHILE more data AND space in array
            Store data in arrayname at the
            position given by the pointer
            Increment the pointer
            Get next character
      ENDWHILE
END read (arrayname)
```

Flowcharts



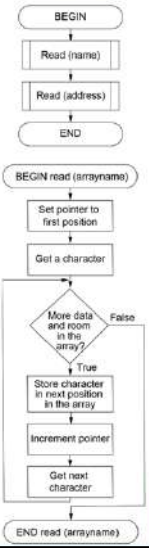
19

Modelling tools: flowcharts vs pseudocode

Pseudocode

```
BEGIN
      read (name)
      read (address)
END


BEGIN read (arrayname)
      Set pointer to first position
      Get a character
      WHILE more data AND space in array
            Store data in arrayname at the
            position given by the pointer
            Increment the pointer
            Get next character
      ENDWHILE
END read (arrayname)
```

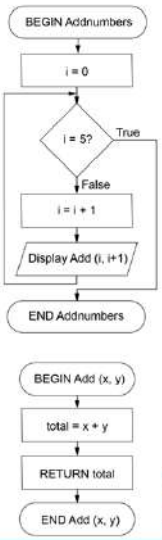
Flowcharts



Pseudocode

```
BEGIN Addnumbers
   FOR i = 1 to 5
      Display Add (i, i + 1)
   NEXT i
END Addnumbers


BEGIN Add (x, y)
   total = x + y
   RETURN total
END Add (x, y)
```

Flowcharts



20

Modelling tools: structure charts

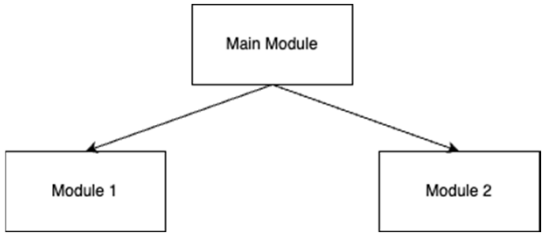
Data movement
Indicates a parameter

Control variable (flag)
Indicates a Boolean parameter

Decision
Branch or option

Repetition
Indicates a module or branch being done multiple times.

Module
Subroutine or function



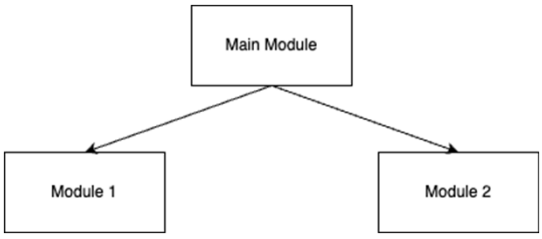
Structure Chart

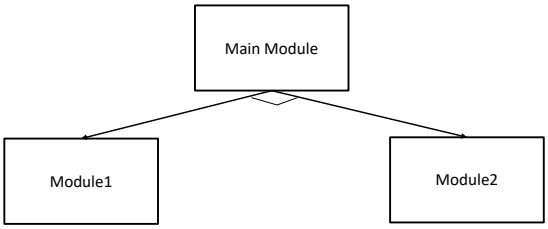
This structure chart shows a system with three modules. These modules represent subroutines or functions.

In object-oriented programming, these represent methods. If your object-oriented program has multiple classes, you may choose to have one structure chart per class.

21

Modelling tools: structure charts



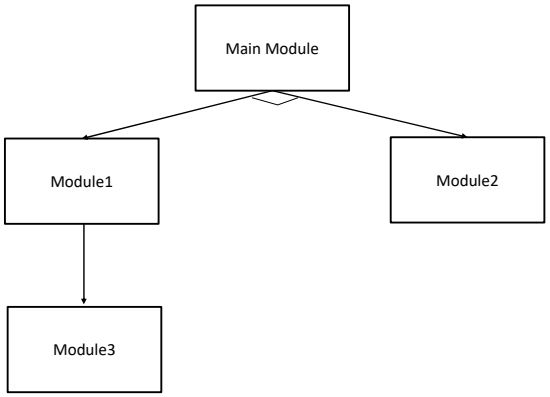



```
def module1():
    # some code here

def module2():
    # some more code here

def main():
    module1()
    module2()

main()
```

```
def module1():
    # some code here

def module2():
    # some more code here

def main():
    choice = "A"
    if choice == "A":
        module1()
    else:
        module2()

main()
```

22

Modelling tools: structure charts




```
def module2():
    # some more code here

def module3():
    # even more code

def module1():
    # some code here
    module3()


def main():
    choice = "A"
    if choice == "A":
        module1()
    else:
        module2()

main()
```

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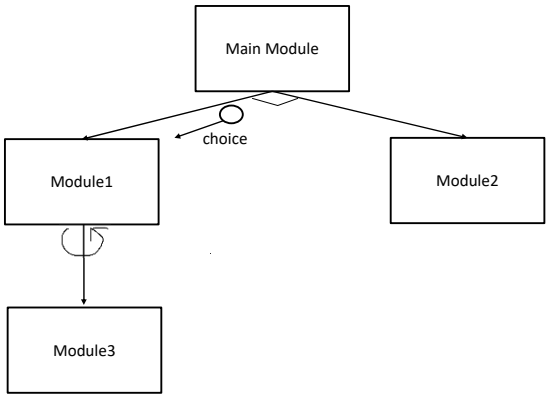
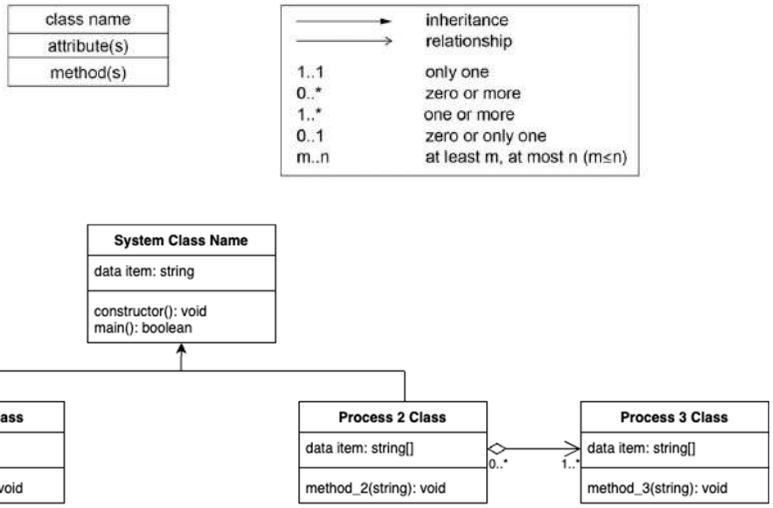
Modelling tools: structure charts




```
def module2():
    # some more code here

def module3():
    # even more code

def module1(choice):
    # some code here
    while True:
        module3()

def main():
    choice = "A"
    if choice == "A":
        module1(choice)
    else:
        module2()

main()
```

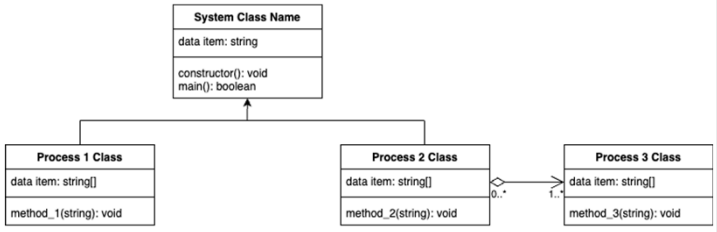
24

Modelling tools: class diagram



25

Modelling tools: class diagram




```
class SystemClassName:
    data_item = ""

    def __init__():
        # Code

    def main():
        # Code

class Process1Class(SystemClassName):
    data_item = [""]

    def method_1(string1):
        # Code

class Process2Class(SystemClassName):
    data_item = ["something", "more", "less"]
    process3 = Process3Class()

    def method_2(string2):
        # Code
        if not data_item:
            for i in data_item:
                data_item[i] = process3.method3(i)

class Process3Class:
    data_item = [""]

    def method_3(string3):
        # Code
```

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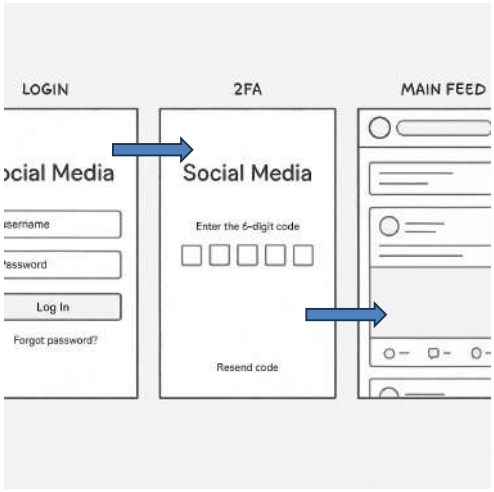
Modelling tools: storyboards/UI/wireframes



Storyboards

Storyboards are a visual representation of the User Interface (UI) and thus the type of User Experience (UX) that you want your user to have. Storyboards should ideally contain data items (variables or attributes) that are present on your Level 0 and/or 1 DFDs.

Each screen should correlate to a process in a DFD, module in a structure chart and/or class on a class diagram. Buttons, scroll bars and other navigation elements should be present. These should correspond to subroutines/functions/methods where possible.

27

And now, it's your turn ...

Click on the link or scan the QR codes below to do these quizzes.

HSC Study Day Quiz 1 – Investigating and Defining + Researching and Planning

HSC Study Day Quiz 2 – Systems Modelling Tools

28

3B. Researching and planning

Explain the contribution of back-end engineering to the success and ease of software development

- technology used
- error handling
- interfacing with front end
- security engineering

29

3C. Producing and implementing

- Design, construct and implement a solution to a software problem using appropriate development approach(es)
- Present a software engineering solution using presentation software
- Develop, construct and document algorithms
- Allocate resources to support the development of a software engineering solution
- Demonstrate the use of programmed data backup
- Implement version control when developing a software engineering solution
- Explore strategies to respond to difficulties when developing a software engineering solution
- Propose an additional innovative solution using a prototype and user interface (UI) design

30

3D. Testing and evaluating

- Apply methodologies to test and evaluate code
- Use a language-dependent code optimisation technique
- Analyse and respond to feedback
- Evaluate the effectiveness of a software engineering solution

  Including:
  - developing a report to synthesise feedback
  - developing a test plan
  - testing data used/generated based on path and boundary testing
  - comparing actual output with expected output

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Path testing

1. Create a path testing diagram.
2. Calculate complexity using the formula CC = E – N + 2.
3. Generate values for variables that activate each branch of the path testing diagram.

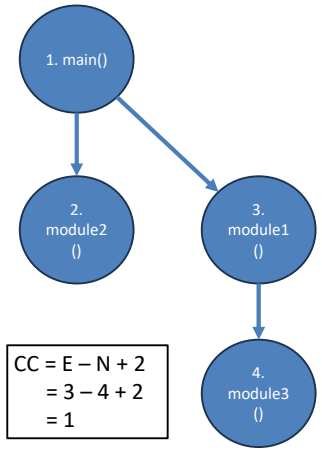
```
def module2():
    # some more code here

def module3():
    # even more code

def module1(choice):
    # some code here
    while True:
        module3()

def main():
    choice = "A"
    if choice == "A":
        module1(choice)
    else:
        module2()

main()
```



CC = E – N + 2
= 3 – 4 + 2
= 1

Variable	Value	Expected	Actual
choice	A	goes to module1() goes to module3()	goes to module1() goes to module3()
choice	B	goes to module2()	goes to module2()

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Boundary testing

1. Create a table with all the variables, their minimum and maximum values to test whether the program will break or not.
2. Put them into the program and noting what happens.

```
def module2():
    # some more code here

def module3():
    # even more code

def module1(choice):
    # some code here
    while True:
        module3()

def main():
    choice = "A"
    if choice == "A":
        module1(choice)
    else:
        module2()

main()
```

Variable	Maximum	Minimum	Default value	Expected output	Actual output	Reason for inclusion
choice	A	-	"A"	goes to module1()	goes to module1()	

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4. HSC Style Questions

- Software Engineering is an electronic exam. You will need to be familiar with the following types of questions:
  - Objective-response: radio button and tick box type multiple choice questions
  - Short answer: text boxes with white backgrounds in which you can type in sentences and paragraphs
  - Text editor: text boxes with black backgrounds in which you type in text e.g. pseudocode, regular expressions etc.
  - Code: an internal Integrated Development Environment (IDE) will be used for you type in Python code. You will then need to run it and see if it meets specification.

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4. HSC Style Questions

- Remember your NESA command verbs:
  - State
  - Define
  - Describe
  - Explain
  - Analyse
  - Justify
  - Evaluate
- Word limits on short answer questions are ***suggestions***. The exam will not stop you entering more words nor cut off your responses.

35

And now, it's your turn ...

Click on the link or scan the QR codes below to do these quizzes and HSC style questions.

HSC Study Day Quiz 1 – Investigating and Defining + Researching and Planning

HSC Study Day Quiz 2 – Systems Modelling Tools

HSC Study Day Quiz 3 – HSC Style Questions

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MY NOTES