NANYANG JUNIOR COLLEGE

JC2 PRELIMINARY EXAMINATIONS

Higher 2

# COMPUTING 9569/01

Paper 1 Written **17th September 2025**

**3 hours**

**READ THESE INSTRUCTIONS FIRST**

An answer booklet will be provided with this question paper. You should follow the instructions on the front cover of the answer booklet. If you need additional answer paper ask the invigilator for a continuation booklet.

Answer **all** questions.
Approved calculators are allowed.

The number of marks is given in brackets [ ] at the end of each question or part question.
The total number of marks for this paper is 100.



© NYJC 2025 **[Turn over**

**1** A programmer is writing a program to manage and search for records. The records include phone numbers, which comprise 8 decimal digits.

**(a)** Convert the phone number `62842281` to:

**(i)** Hexadecimal representation [2]

**(ii)** ASCII values.
(`'0'` has an ASCII value of 48 and `'9'` has an ASCII value of 57.) [2]

**(b)** Determine the minimum number of bits required to store the phone number 62842281 as:

**(i)** an integer [2]

**(ii)** a string. [2]

**(c)** The programmer decides to store phone numbers in an array as integers instead of strings for binary search. Suggest two reasons for this. [2]

**(d)** The programmer's supervisor suggests a binary search tree instead of a sorted array for managing phone numbers instead. Suggest two reasons for the supervisor's advice. [3]

A function `Search(data, target, start, end)` takes in `data` an array of phone numbers, `target` a phone number to be searched, and two integers `start` and `end` representing the start and end indexes respectively. `Search` implements a recursive binary search and returns the index of the matching phone number, or `-1` if the phone number is not found.

`Contacts` is an array that has the following phone numbers:

[61625074, 90923657, 93197564, 93289273, 99108357, 99283918, 99561273]

**(e)** Complete the following table, expanding it as necessary to show each successive recursive call. [3]

| Function call | Return value |
|---|---|
| `Search(Contacts, 62842281, 0, 6)` | |
| | |

**(f)** Write the function `Search` using pseudocode. [5]

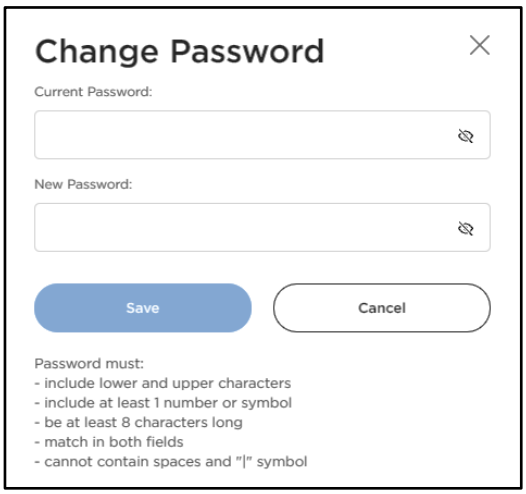
**(g)** Besides `62842281`, suggest 3 other suitable test values for `target` for the above array. [3]

**2** Validation and verification are used in data entry.

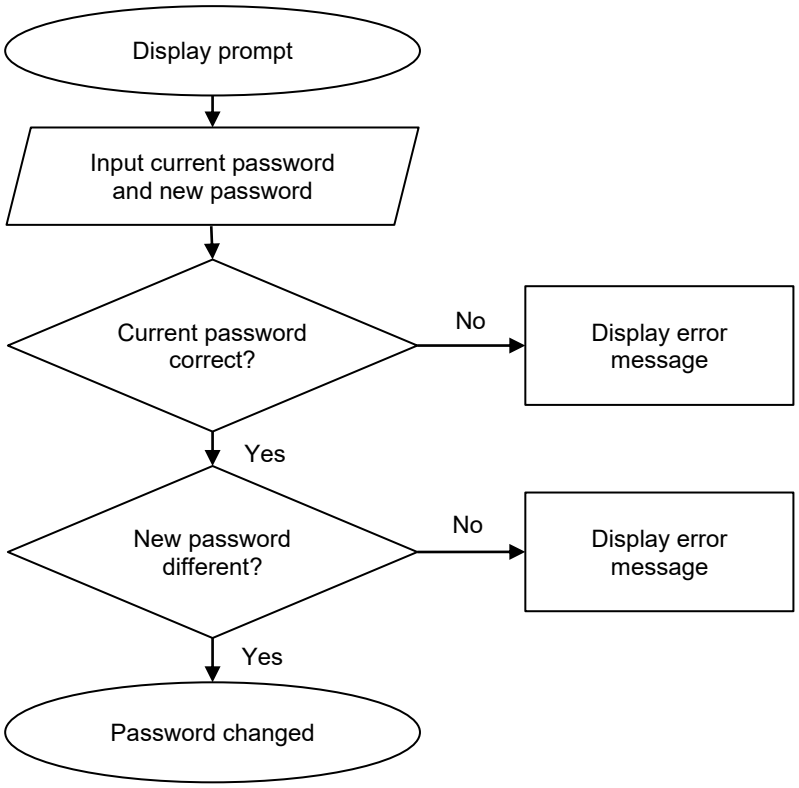
**(a) (i)** State the purpose of validation. [1]

**(ii)** State the purpose of verification. [1]

The image below shows the password change dialog box for a web application.




The flowchart below shows the process for changing a user's password.




**(b)** Redraw the flowchart to include, for the new password:

- one suitable validation technique
- one suitable verification technique. [6]

**(c)** State two ways the password change interface can be improved using suitable application design principles. [2]

**3** A company, ImageMaps, wishes to develop an application that scans a user's device for photographs, detect the associated location, and display the images on a map using the associated locations.

**(a)** State the actions ImageMaps must take to secure critical business data against catastrophic hardware failure. [4]

**(b)** State the consequences, should ImageMaps suffer such a hardware failure. [2]

**(c)** ImageMaps needs to store a large quantity of data that will not be frequently accessed. State how they can reduce costs while doing so. [2]

**(d)** State two actions the company must take regarding the collection and use of personal user data to comply with prevailing personal data protection laws. [4]

**(e)** State whether a native or web application is more suitable for ImageMaps's application. Explain your answer. [3]

**4** **(a)** Describe how a digital certificate is involved in producing a digital signature for a document. [4]

A CEO wishes to email a contract document to a customer. To prevent tampering with the contract document, he attaches his digital certificate to the email alongside the document.

**(b)** Explain why this is insufficient to ensure the integrity of the document. [2]

**5** A software company is writing a program for a vehicle hire business. Both cars and vans are available for hire.

For all vehicles, the data that will be stored include:

Vehicle Registration Number (VRN)
Total distance travelled (km)
Date hired
Date of return
Cost per day
Available for hire

For cars, the additional data stored include:

Fuel type (petrol, diesel, electric, hybrid)

For vans, the additional data stored include:

Maximum load (kg)

The odometer in the vehicle displays the total distance the vehicle has travelled since manufacture.

When a vehicle is hired:

- total distance travelled is set to the odometer's value
- date hired is set to the current date
- return date is set to the date the vehicle is expected to be returned
- available for hire is set to FALSE.

When a vehicle is returned:

- hire cost is returned as the cost per day multiplied by the number of days the vehicle was hired
- total distance travelled is set to the odometer value
- date returned is set to the current date
- available for hire is set to TRUE.

Object-oriented programming will be used to model vehicles.

**(a)** Draw a class diagram that shows the following for the situation described above.

- the superclass
- any subclasses
- inheritance
- properties
- appropriate methods.

[8]

**(b)** Explain how encapsulation helps to prevent inadvertent data modification. [2]

**(c)** Explain how inheritance promotes code reuse. [2]

The programmer uses a database to store vehicle hire data. Each row in the table represents a vehicle hire record. A vehicle must be hired for a minimum of one day.

Vehicle hire data is stored in the following table:

| VRN | TotalDistance | DateHired | DateReturned | CostPerDay | Available | FuelType | MaxLoad |
|---|---|---|---|---|---|---|---|
| | | | | | | | |

**(d) (i)** Identify a suitable primary key for the above table. [1]

**(ii)** Identify suitable SQL data types for the following columns:

**1.** DateHired [1]

**2.** Available [1]

**(e)** State whether the above table is in Third Normal Form (3NF). Explain your answer. [4]

A database consultant rewrites the above table into the following table descriptions:

Vehicle (<u>VRN</u>, Type, TotalDistance, CostPerDay, Available)
Hire (<u>VRN</u>, <u>DateHired</u>, DateReturned)
Car (<u>VRN</u>, FuelType)
Van (<u>VRN</u>, MaxLoad)

The vehicle type is stored as either `'Car'` or `'Van'`.

**(f)** Draw an entity-relationship (ER) diagram representing the four tables. [4]

**(g)** Write an SQL query to retrieve from the above tables the VRNs of hybrid cars and their latest date of hire. [6]

**6** **(a)** Describe how networking protocols address the following problems:

**(i)** Data packets may arrive out of order and require reassembly [2]

**(ii)** Data packets may be corrupted in transit [2]

**(b)** State the time complexity of the following operations:

**(i)** adding an item to an array [1]

**(ii)** adding an item to a BST. [1]

**(c)** A data structure is used to hold data packets that are being reassembled. Describe one advantage and one disadvantage of each data structure for packet reassembly.

**(i)** Statically allocated array [3]

**(ii)** Dynamically allocated BST. [3]

Not all data packets require reassembly; only data packets that are too large to be sent in a single packet will need to be split into multiple packets, which are then reassembled by the recipient.

A network router uses the following algorithm to process incoming data packets:

1. Allocate sufficient memory to hold data for the incoming packet.
2. If the data packet does not require reassembly, free the allocated memory and pass the data to the appropriate program.
3. If the data packet requires reassembly, instantiate an array with sufficient slots in the allocated memory to store data fragments as they arrive.
4. When all data fragments have been received, pass the data to the appropriate program.

The program passed initial user testing and ran successfully for a few weeks before the router suddenly crashes.

**(d)** State the type of error that occurred. [1]

**(e)** Explain why the error was not caught in initial user testing. [2]

**(f)** Describe the change(s) required in the algorithm to resolve the error. [1]

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