



COMPUTING Higher 2

9569/02

Paper 2 (Lab-based)

3 hours

1. A message is encrypted and passed between two parties. To decrypt the message, a “key” is applied. Both the sending and receiving parties hold the key which enables them to encrypt and decrypt the message.

An approach of cryptography is the simple substitution cipher, a method of encryption by which each letter of a message is substituted with another letter. The receiving party deciphers the text by performing an inverse substitution.

The substitution system is created by first writing out a *phrase*. The *key* is then derived from the *phrase* by removing all the repeated letters. The *cipher text* alphabet is then constructed starting with the letters of the *key* and then followed by all the remaining letters in the alphabet.

Using this system, the phrase "apple" gives us the *key* as "APPLE" and the following substitution scheme:

Plain text alphabet:

abcdefghijklmnopqrstuvwxyz



.....



is substituted by

Cipher text alphabet:

A P L E B C D F G H I J K M N O Q R S T U V W X Y Z

'a' will be substituted by 'A', 'b' will be substituted by 'P', 'c' will be substituted by 'L', 'd' will be substituted by 'E', 'e' will be substituted by 'B', and so on.

Task 1.1

Write program code for a function to create cipher text using the following specification:

```
FUNCTION CreateCipher (phrase: STRING): STRING
```

The function `CreateCipher` has a single parameter `phrase` and returns the cipher text alphabet as a string.

Evidence 1.1

Your program code for Task 1.1

[8]

Task 1.2

Write program code for a procedure `CreateCipherTest` which does the following:

- read the phrases from file `PHRASES.txt`
- create cipher text for each of the phrases
- display each phrase and cipher text on the screen as follows:

```
Phrase: apple
Cipher text: APLEBCDFGHIJKMNOQRSTUVWXYZ
... ..
... ..
```

Evidence 1.2:

Your program code for Task 1.2.

[3]

Screenshot for running Task 1.2.

[1]

Task 1.3

Write program code for a function to decrypt a message using the following specification:

```
FUNCTION Decrypt(enc_message: STRING, cipher: STRING): STRING
```

The function `Decrypt` accepts parameters `enc_message` and `cipher`, and returns the decrypted message as a string. Parameter `enc_message` is the encrypted message, and parameter `cipher` is the cipher text alphabet.

Evidence 1.3

Your program code for Task 1.3.

[6]

Task 1.4

Write program code which does the following:

- read the phrase and encrypted message from file `CIPHER.txt`
- cipher text is generated from `CreateCipher` function
- message is decrypted from `Decrypt` function
- display decrypted message on the screen together with the phrase and encrypted message

```
Phrase: ...
Encrypted message: ...
Decrypted message: ...
```

Evidence 1.4:

Your program code for Task 1.4:

[3]

Screenshot for running Task 1.4:

[1]

Task 1.5

Write program code for a function to encrypt a message using the following specification:

```
FUNCTION Encrypt(message: STRING, cipher: STRING): STRING
```

The function `Encrypt` accepts parameters `message` and `cipher`, and returns the encrypted message as a string. Parameter `message` is the message to be encrypted while parameter `cipher` is the cipher text.

Evidence 1.5:

Your program code for Task 1.5

[4]

Task 1.6

Write program code which does the following:

- encrypt the message: "do not give up!"
- use the phrase: "skyhigh"
- generate cipher text from `CreateCipher` function
- message is encrypted using `Encrypt` function
- encrypted message is displayed on screen as follows:

```
Phrase: skyhigh  
Encrypted Message: ...
```

Evidence 1.6

Your program code for Task 1.6.

[3]

Screenshot for running Task 1.6

[1]

2 A school library stores the following data in a file named story.csv:

Field	Format
book_title	text
subject	text
author_name	text
Published	'YYYY' (year)

Merge sort is an efficient sorting algorithm which falls under divide and conquer paradigm and produces a stable sort. It operates by dividing a large array into two smaller subarrays and then recursively sorting the subarrays.

For each of the sub-tasks, add a comment statement at the beginning of the code using the hash symbol '#', to indicate the sub-task the program code belongs to, for example:

In [1]:

```
#Task 2.1
Program code
```

Output:

In [2]:

```
#Task 2.2
Program code
```

Task 2.1

Write program code to:

- read data from `story.csv` into an array of records.
- ask user to input in which field to sort the records by.
- validate that the choice must be 'B', 'S', 'A', or 'P' representing `book_title`, `subject`, `author_name` and `published` fields.
- implement a `MergeSort(ArrayData, Sortby)` function that takes in two parameters, `ArrayData` (array of records) and `Sortby`, and sorts the records in ascending order according to the specified field. `MergeSort(ArrayData, Sortby)` will return the sorted `ArrayData` using a mergesort algorithm to do the sorting.
- display `ArrayData`.
- test your program twice and show your output for sorting by `subject` and by `author_name`. [12]

Task 2.2

Write program code to:

- implement a `QuickSort(ArrayData)` function that uses the quicksort algorithm to sort the `ArrayData` by `book_title` in descending order. [8]

Design 2 test cases to test your `QuickSort(ArrayData)` function and explain the purpose of the test data. Show the output of your test cases. [4]

3.

A large company keeps records on paper of all the computing equipment it owns. Every computer device has its information recorded when it is purchased.

The company has decided to store this information electronically in the future. The company will trial two methods of storing this information.

The first method to be trialed is the use of object-oriented programming (OOP) to manage a sample of these records.

When a computer device is purchased the following information is recorded.

- `serial_number` – unique serial number of device
- `make` – make of device
- `model` – model of device
- `location` – where the device is used
- `date of purchase` – date of purchase
- `written_off` – device is still in use – True or
device is still not in use – False

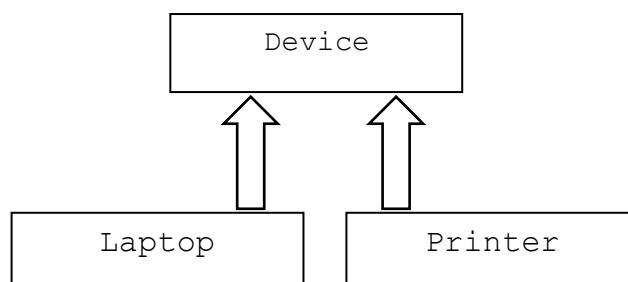
For laptops, the following extra information is recorded.

- `weight_kg` – the weight in kilograms

For printers, the following extra information is recorded.

- `toner` – type of toner required
- `date_changed` – the last date the toner cartridge was changed

The program design uses two classes as follows:



Task 3.1

Write program code only for the base class and the **two** sub-classes to illustrate encapsulation, inheritance and polymorphism.

Evidence 3.1

Save your program as `TASK3_1.py`

[8]

Task 3.2

Write program code to:

- Find all the printers, still in use, that have not had their toner changed for over three months, display the number of printers found
- Find all the laptops that are over a year old, display: the serial number make whether they have been written off the number of months to the nearest month since the device was purchased
- Test your program with the following test data files `PRINTERS.txt` and `LAPTOPS.txt`.

Evidence 3.2

Save your program as `TASK3_2.py`

[8]

Place screenshots of your testing in your evidence document.

[6]

4.

The company has now decided to trial a database to manage an extended sample, including monitors, of the computing equipment records described in **Question 3**.

When a computer device is purchased, the following information is recorded:

- `SerialNumber` – unique serial number of device
- `Type` – type of device
- `Make` – make of device
- `Model` – model of device
- `Location` – where the device is used
- `DateOfPurchase` – date of purchase
- `WrittenOff` – device is still in use - True, or
device is not in use – False

For monitors, the following extra information is recorded:

- `DateCleaned` -the last date the monitor was cleaned

For laptops. the following extra information is recorded:

- `WeightKg` -the weight in kilograms

For printers, the following extra information is recorded:

- `Toner` -type of toner required
- `DateChanged` -the last date the toner cartridge was changed

The information is to be stored in four different tables:

`Device`

`MonitorExtra`

`LaptopExtra`

`PrinterExtra`

Task 4.1

Write SQL code to create the database `Equipment` with the four tables. The table, `Device`, must use `SerialNumber` as its **primary key**. The other tables must use `SerialNumber` **as a foreign key**.

Evidence 4.1

Save your SQL code as `TASK4_1.sql` [10]

Task 4.2

Write SQL code to show the make and model of each monitor with the location and the date it was last cleaned. Run this query.

Evidence 4.2

Save your SQL code as `TASK4_2.sql` [4]

Task 4.3

The company wants to be able to show the results of the query in a web browser.

Write a Python/CSS routine to show the results of the query from `Task 4.2`. Run this query.

Evidence 4.3

Save your SQL code as `TASK4_4.sql`

Place screenshots showing this query working in a web browser in your evidence document.

[10]