

Please fill in your Student Number and Name.

Student Number : _____

Name:

Student Number:

University of Cape Town ~ Department of Computer Science

Computer Science 1018F ~ 2009

June Exam

Question	Max	Internal	External	Question	Max	Internal	External
1	10			7	6		
2	8			8	14		
3	8			9	20		
4	12						
5	12						
6	10						
				TOTAL	100		

Marks : 100

Time : 180 minutes

Instructions:

- a) Answer all questions.
- b) Write your answers in pen in the spaces provided.
- c) Show all calculations where applicable.

Question 1 [10]

- a) Python has many strengths as a programming language but it does have some weaknesses. List (and explain) one of these weaknesses. [1]

- b) Describe three major ways in which Python is different from Java and also three ways in which it is similar. [6]

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- c) What is the difference between mutable and immutable datatypes? Provide two examples of each. [3]

[illegible]

Question 2 [8]

a) Given a list:

```
captains = ['Kirk', 'Picard', 'Sisko', 'Janeway', 'Archer',  
            'Kirk'].
```

What would the newcaptains list look like after each of the following operations: [5]

i. `newcaptains = captains[1:-1]`

ii. `newcaptains = captains`
`newcaptains.delete('Kirk')`

iii. `newcaptains = [captains.index(c) for c in captains]`

iv. `newcaptains = ', '.join(captains)`

v. `newcaptains = captains.insert(2, 'Pike')`

- b) Given a list of strings, called `inlist` (e.g., `inlist = ['I', 'you', 'we', 'she', 'them']`), write a code snippet that will check if each element is less than three characters in length and return a list, called `outlist`, with `true` (`len < 3`) or `false` (`len >= 3`) in the corresponding positions (e.g., `outlist = [True, False, True, False, False]`). Code this, using: [3]

i. a for loop

ii. list comprehension

- c) Write Python code to convert a nested list, called `inlist`, of the form: `inlist = [[key1, value1], [key2, value2], [key3, value3], ...]` into a dictionary, `outdict`, where the first element of each sublist is the key and the second element is the corresponding value. If a duplicate key occurs later in the list, its value should overwrite the existing value. [2]

Question 3 [12]

The following is the declaration for a class that implements a matrix:

```

class Matrix():
    """A standard two-dimensional array of floating point
    numbers, as used in Linear Algebra."""

```

- a) Write an initialisation function that creates a matrix of size $n \times m$ (where n and m are input parameters, both of which default to 1). All the elements of the matrix should be set to zero, initially. [4]

[illegible]

- b) Write a method for the Matrix class that will determine if the matrix is symmetric. This means that the element at position (x,y) is equal to the element at position (y,x). Your method should return a boolean value of True if the matrix is symmetric and False otherwise. Note: in order to be symmetric a matrix must first be square ($n == m$). [4]

[illegible]

- c) Write a method, `add`, for the `Matrix` class that takes two matrices as input, adds them together if they are of the same size, and places the result in the current object. This involves adding together the corresponding elements from both matrices. The method should exit without doing anything if the matrices are not of equal size. [4]

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Question 4 [12]

You are given a file that has been compressed using run-length compression. In this form of data compression repeated symbols in a sequence are encoded with the number of repetitions and the symbol being repeated. For instance, the stream of numbers ‘0 0 0 0 10 10 17’ would be encoded as ‘4 0 2 10 1 17’. Note that a single symbol still needs to be preceded by a ‘1’. Assuming that you have a file that has already been compressed (encoded), your task is to uncompress (decode) it.

- a) Write a method, called `DecodeLoad`, that takes a file name as parameter (with a default of `'decode.txt'`). The method should open the file and read the contents into a list of integers, called `stream`, which is then returned by the method. Hint: there is a space between each integer in the file and you can use this to split them. You should use exceptions to check for file IO errors and return an empty list if an error occurs. [5]

[illegible]

Question 5 [8]

You are provided with the following Visual Python code:

```
from visual import *

ball = sphere(pos=(-5,0,0), radius=0.5, color=color.red)
wallR = box(pos=(6,0,0), size=(0.2,4,4), color=color.green)
wallL = box(pos=(-6,0,0), size=(0.2,4,4), color=color.green)
dt = 0.05
ball.velocity = vector(2,0,0)
while (1==1):
    rate(100)
    ball.pos = ball.pos + ball.velocity*dt
    if ball.x > wallR.x:
        ball.velocity.x = -ball.velocity.x
    if ball.x < wallL.x:
        ball.velocity.x = -ball.velocity.x
```

- a) There is a semantic error in this algorithm. What is it and how would you fix it? [1]

- b) Describe the output produced by the correct (debugged) code. [3]

- c) Describe two ways in which the ball could be slowed down or sped up. [2]

d) How you would go about adding a trail behind the ball?

[2]

Question 6 [10]

- a) Black Box and Glass Box are two code testing methodologies. Explain the approach behind each scheme. [4]

- b) What is a unit test? Explain how unit tests can be combined with equivalence testing to define a (fairly robust) method for testing code. [4]

- c) Why do we need to 'test for failure' when composing test cases for our code? [2]

Question 7 [6]

Consider the following Python code:

```
import re
text = "It was a cold, blustery day. The wind whistled \
      through a crack in the attic wall, making the \
      candle gutter."
regExpression = r"\b[c|b]\w+\b"
r = re.compile(regExpression, re.MULTILINE)
```

- a) What is the function of the `re.MULTILINE` flag? [1]

- b) What output will the following statement yield: [3]

```
print r.findall(text)
```

- c) How would you modify the regular expression to match words which started with a lower case vowel? [2]

Question 8 [14]

a) Given the decimal number 212.63:

- i. Convert it to binary. Show full working and assume 8 bits for the integer part and 4 bits for the fractional part. [4]

- ii. Convert it to octal. [2]

b) What real number does the following IEEE 32-bit float represent? [3]

1 11011011 010001000000000000000000

c) Given the following Boolean algebra function F:

$$F = \overline{(A \cdot \bar{B} + \bar{B} \cdot C)}$$

i. Write down the Boolean truth table for the expression. [3]

ii. Use the rules of Boolean algebra to simplify this expression i.e reduce the number of Boolean operations required. [2]

Question 9 [20]

Bridging the Generation Gap

Teenagers communicate electronically using a language that adults often do not understand. You have been asked to investigate a solution to translate a message in SMS language into regular English. For example, “u r gr8 dude c u l8r” would be translated into “you are great dude see you later”. Assume there is no punctuation and words are separated by spaces.

You have decided that your solution will be based on the use of a translation table such as that shown below.

u	you
r	are
l8r	later
gr8	great
c	see

- a) Describe the algorithm you will use to perform the translation.

[4]

[illegible]

- b) Describe the data type you will use to store the translation table.

[2]

- c) Describe 2 classes that you could use in an object-oriented solution and what the purpose of each is. [4]

- d) Write the code for the **translate** method that performs the translation and returns the translated string. Assume the message to be translated is passed as a string parameter and the translation table is an instance variable that already contains the table listed above. [10]

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