NANYANG TECHNOLOGICAL UNIVERSITY

SEMESTER 2 EXAMINATION 2015-2016

CE1003/CZ1003 – INTRODUCTION TO COMPUTATIONAL THINKING

Apr/May 2016 Time Allowed: 2 hours

INSTRUCTIONS

1. This paper contains 4 questions and comprises 4 pages.
2. Answer **ALL** questions.
3. This is a closed-book examination.
4. All questions carry equal marks.

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1. (a) What are the differences between an algorithm and a program?

(2 marks)

(b) What is a machine language? Briefly elaborate on its properties.

(3 marks)

(c) An algorithm is needed to search for prime numbers. A prime number is a positive integer greater than 1 that has no positive divisors other than 1 and itself.

(i) Use a flowchart to describe an algorithm that prints out prime numbers starting from 1 to k (the upper bound of the search for prime numbers).

(8 marks)

(ii) Write a pseudo-code of the algorithm described in Q1(c)(i). Your pseudo-code should read the upper bound, k, from the user.

(7 marks)

Note: Question No. 1 continues on Page 2

(iii) A Mersenne prime is a prime number that is one less than a power of two. They can be written in the form of $M^n = 2^n - 1$ for some integer n. Modify your pseudo code in Q1(c)(ii) to indicate if the prime number found is also a Mersenne prime.

(5 marks)

2. (a) (i) What is a namespace? Briefly elaborate on the Local, Enclosed, Global, Built-in (LEGB) rule.

(3 marks)

(ii) What is duck-typing? How is it used by Python?

(2 marks)

(b) (i) `Float` is an approximation to the real number. Explain with an example how the limited precision of `float` results in inexact computation.

(5 marks)

(ii) Describe a method of comparing two `float` numbers to determine if they are equivalent. Elaborate on the design consideration and limitations of your method. Write this in Python code.

(6 marks)

(iii) Given a constraint of using only integers, describe a method of approximating the division of 2 numbers up to 3 decimal places. Describe the limitations of your method. Write this in a pseudo code.

(4 marks)

(c) In the following Python code segment, where we define a loop to count up to 42, there are a number of syntactical errors. Describe the errors and suggest fixes.

```
spam == 0
print('I start with  ' + spam + ' number of spam(s).)

while (spam < 42)
spam++
print('Spam exceeds 41')

// Program ends
```

(5 marks)

3. (a) An integer number is *palindromic* if it is positive and has digits that read the same backwards and forwards. For example, `3773` is palindromic. Using `string`, write a Python program to check if an integer `N` is palindromic. Your program must obtain `N` as input from the user, and print out `True` if the integer is palindromic, and `False` otherwise.

(8 marks)

(b) Describe two differences between the `string` and `set` data structures.

(4 marks)

(c) Write a Python function that takes an eight-digit phone number (stored as a string with a hyphen separator in the center, e.g., `'1053-4000'`) as input, and returns the number of unique digits. For example, the phone number `'1053-4000'` has `5` unique digits, while `'9999-1211'` has only `3`.

(8 marks)

(d) Determine the printed output of the following program, and briefly explain the functionality of the program.

```
C = {0.5:'Fifty', 0.2:'Twenty', 0.1:'Ten', \
     0.05:'Five', 1.0:'Dollar'}
N = 3.25
while N > 0:
     if N >= 1.0:
          N = N - 1.0
          print(C[1.0])
     elif N >= 0.5:
          N = N - 0.5
          print(C[0.5])
     elif N >= 0.2:
          N = N - 0.2
          print(C[0.2])
     elif N >= 0.1:
          N = N - 0.1
          print(C[0.1])
     else:
          N = N- 0.05
          print(C[0.05])
```

(5 marks)

4. (a) What is the output of the following Python program? Explain your answer. For clarity, indicate a space character with "_" (underscore) in your answer(s) if necessary.

```
str = "A python is a constricting snake"
print(str[::-1][-3:-9:-1])
```

(4 marks)

(b) What happens to the contents of an existing file when it is opened for writing by using `open('filename','w')`? What about for appending by using `open('filename','a')`?

(4 marks)

(c) What is a user-defined module? What are the differences between a function and a user-defined module?

(3 marks)

(d) Describe the two common approaches to handle exceptions in Python. Discuss their differences.

(6 marks)

(e) What is the printed output of the script in Figure Q4, if the inputs are `X=10`, `Y=0`, and `Z=4`?

```
def div(A,B):
      return A//B

X=int(input('X='))
Y=int(input('Y='))
Z=int(input('Z='))
try:
      print('X div Z is ',div(X,Z))
      print('Y div X is ',div(Y,X))
      print('X div Y is ',div(X,Y))
      print('Z div X is ',div(Z,X))
except:
      print('Something failed!')

print('All done')
```

Figure Q4

(8 marks)

END OF PAPER

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Please read the following instructions carefully:

1. **Please do not turn over the question paper until you are told to do so. Disciplinary action may be taken against you if you do so.**

2. You are not allowed to leave the examination hall unless accompanied by an invigilator. You may raise your hand if you need to communicate with the invigilator.

3. Please write your Matriculation Number on the front of the answer book.

4. Please indicate clearly in the answer book (at the appropriate place) if you are continuing the answer to a question elsewhere in the book.