THE UNIVERSITY OF MANITOBA
COMP1012: Computer Programming for Scientists & Engineers
Midterm In Class Exam (A02—Boyer)
2016 March 2, 11:30 am

Name	Student Number

Time: 50 minutes

Instructions:

1. Answer all questions on this paper. For multiple choice questions, circle the letter of the ***best*** or most complete choice. For short answer questions, write your answer in the space provided.
2. Extra work space is available on page 3.
3. You will find a Python Guide along with your midterm; ask if you don't have one. You may ***not*** use your own copy. No other aids (such as calculators or cell phones) are permitted.
4. You have 50 minutes to complete the exam.

Marks for Part 1	Part 2A	Part 2B	Part 3	Total
/ 4	/ 4	/ 4	/ 4	/16

Part 1: Predict the output [4 x 1 mark]

In each row of the table below, mentally execute the code on the left and enter the expected output in the box on the right. Each table row is separate. Use the space below for scrap work.

	Code Fragment	*Expected output*

A.	What is printed by
	`print(('Sun', 'Mon', 'Tue', 'Wed',`
	`'Thu', 'Fri', 'Sat')[-5:-1]) ?`
		`('Tue', 'Wed', 'Thu', 'Fri')`

B.	What is printed by `print(list(range (-2,-4,-1))) ?`	`[-2, -3]`
C.	What is printed by `print(3 // 1 <= 5 and 2**4) ?`	`16`
D.	What is printed by `print(1 / 4 < 2 == 2 // 2) ?`	`False`

Work space:

Part 2: Write a program [Total 8 marks]

2. [8 marks] The hyperbolic cosine function, cosh(x), is defined as follows:

$$\cosh(x) = \frac{1}{2}(\exp(x) + \exp(-x))$$

where

$$\exp(x) = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \frac{x^4}{4!} + \frac{x^5}{5!} + \ldots$$

$$\exp(-x) = 1 - \frac{x}{1!} + \frac{x^2}{2!} - \frac{x^3}{3!} + \frac{x^4}{4!} - \frac{x^5}{5!} + \ldots$$

```
TESTING COSH SERIES
x     math.cosh(x)     series cosh(x)  Equal
0.4    1.08107237184    1.08107237184  True
0.8     1.3374349463     1.3374349463  True
1.2    1.81065556732    1.81065556732  True
1.6    2.57746447119    2.57746447119  True
2.0    3.76219569108    3.76219569108  True
2.4    5.55694716697    5.55694716697  True
2.8    8.25272841686    8.25272841686  True
3.2    12.2866462005    12.2866462005  True
3.6    18.3127790831    18.3127790831  True
3.6   18.28545536062   18.28545536062  True
```

Write a full program with a single function definition, for cosh(x), that prints out a table of values as shown above right with ***12 significant figures*** for the cosh columns. There does exist a function `math.cosh`. Use it to provide values to compare to the series solutions. Use `EPS1` to check terms for series convergence, and `EPS2` as a comparison tolerance. ***Do not calculate a factorial separately!***

```
# put imports here
import math

# global constants here
EPS1 = 1.e-16
EPS2 = 1.e-12

def cosh(xx) : # your code to evaluate this function
    totalPos = 0. # sum of +x terms so far

    totalNeg = 0. # sum of -x terms so far

    count = 0  # number of terms included in total

    term = 1  # first term

    while abs(term) > EPS1 :

        count += 1

        totalPos += abs(term)

        totalNeg += term

        term = -term * xx / count

    return 0.5 * (totalPos + totalNeg)


# put your main code for the table here
print("TESTING COSH SERIES")
print(" x     math.cosh(x)    series cosh(x)  Equal" )
for num in range(1,10) :
    xx = num * 0.4
    coshX = math.cosh(xx)
    seriesX = cosh(xx)
    equal = abs(coshX - seriesX) <= EPS2 * max(abs(coshX), abs(seriesX))
    print("%3g %16.13f %16.13f %5s" % (xx, coshX, seriesX, equal))
```

`MAIN`

A. [1] import, headings
B. [1] for loop, *x* values
C. [1] math.sinh, sinh, comparison
D. [1] print result, format

`SINH`

A. [1] initializations
B. [1] while loop, abs, use of EPS1
C. [1] updates, dealing with -term
D. [1] function evaluation, return
E. bad indentation, variables

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Part 3: Circle the letter of the *best* answer, or provide the required answer [4 x 1 mark]

A. Given the following lines have just been executed, which of the options below creates a list of all numbers from `seq1` that are negative even numbers, and only those numbers?

```
seq1 = [-3,  4, -4, -5,  4,  0,  1, -4,  3, -3]
seq2 = []
```

a) `for num in seq1:  seq2.append((num % 2 == 1) * (num < 0) * num)`
b) `for num in seq1:  seq2 += [num] * (num % 2 == 0) * (num < 0)` THIS ONE
c) `for num in seq1:  seq2 =  [num] * (num % 2 == 0) * (num < 0)`
d) `for num in seq1:  seq2 +=  num  * (num % 2 == 0) * (num < 0)`
e) `for num in seq1:  seq2  = [num] * (num % 2 == 0) + (num < 0)`

B. As a general rule, a Python operation between two integer-valued variables `aa` and `bb` will produce an integer-valued result. Which of the following operations violates that rule?

a) `aa / bb` THIS ONE
b) `aa - bb`
c) `aa * bb`
d) `aa // bb`
e) `aa % bb`

C. Given **`value = 4.6`**, which of the following will produce a result with value rounded to the nearest integer ***and*** **`int`** type?

a) **`round(value)`**
b) **`int(value)`**
c) **`round(int(value))`**
d) **`int(round(value))`** This is the one
e) **`int(value // 1)`**

D. Using good coding practices and the same rules as QuizMaster, write a Python expression to evaluate this math expression, assuming math has already been imported:

$$\left\lceil \frac{\ln(\pi)}{3 \cdot \sin(y) - \tan(4 \cdot 10)} \right\rceil$$

Put expression here

math.ceil(math.log(math.pi) / (3. * math.sin(yy) - math.tan(4. * 10.)))

or

math.ceil(math.log(math.pi) / (3. * math.sin(yy) - math.tan(40.)))