ENGINEER 1D04 Midterm Test 1
McMaster University

Answer Key: Large arrow ($\Longleftarrow$) for correct, small ($\leftarrow$) for partially correct

Day Class 01, 02, **Version 1** Dr. S. Smith and Dr. W. Farmer

DURATION: 2 hours October 18, 2012

Please CLEARLY print:

NAME:

Student ID: | | | | | | | |

This examination paper includes 13 pages and 30 questions. You are responsible for ensuring that your copy of the examination paper is complete. Bring any discrepancy to the attention of your invigilator.

Special Instructions:

1. It is your responsibility to ensure that the answer sheet is properly completed. Your examination result depends upon proper attention to these instructions:
   - A heavy mark must be made, completely filling the circular bubble, with an HB pencil.
   - Print your name, student number, course name, course number and the date in the space provided on the top of Side 1 and fill in the corresponding bubbles underneath.
   - **Fill in the bubble corresponding to your version number.**
   - Mark only **ONE** choice from the alternatives (1, 2, 3, 4, 5 or A, B, C, D, E) provided for each question. If there is a True/False question, mark 1 (or A) for True, and 2 (or B) for False. The question number is to the left of the bubbles. Make sure that the number of the question on the scan sheet is the same as the number on the examination paper.
   - Pay particular attention to the "Marking Directions" given on the scan sheet.
   - Begin answering the questions using the first set of bubbles, marked "1." Answer all questions.
2. The use of notes and textbooks is **not** permitted.
3. Calculators, computers, cell phones, and all other electronic devices are **not** to be utilized.
4. Read each question carefully.
5. Try to allocate your time sensibly and divide it appropriately between the questions.
6. Select the **best** answer for each question.

Question 1 [1 mark]
When writing the requirements for a software program you should focus on *how* your program will be implemented, not on *what* your program should accomplish. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
The above statement is the opposite of how good software is developed. The first emphasis at the requirements stage is what needs to be accomplished. The "how" of implementation of the requirements comes later. This was discussed in Lecture 02 and in Zelle, Chapter 2 (page 26).

Question 2 [1 mark]
Ada Lovelace was the first person to construct the hardware for a Turing Machine. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
No Ada Lovelace did not implement a Turing machine, since a Turing machine is a hypothetical not a practical concept. Given the requirement for infinite memory, a Turing machine cannot be created. Moreover, Ada Lovelace's work was on the first algorithm intended for a machine (Babbage's analytical engine), but she never "ran" her algorithm since the technology of the time did not permit construction of the device. Furthermore, Ada Lovelace could not have constructed a design by Turing, since she died before he was born.

Question 3 [1 mark]
Which of the following statements are **not** valid in Python? You can assume that any variables used have been assigned a value of an admissible type and any libraries have been properly imported.

A. `x = (x == 1)`.

B. `True = False`.

C. `math.sqrt = abs`.

D. `s = "123" * "3"`. ⟸

ANSWER:
The first statement assigns `x` the value of `True` or `False` depending on the result of the equality test. The second redefines the variable `True` to have the value `False`. The third option is valid because functions are treated like any other type in Python. The last option is not valid because strings cannot be multiplied together.

Question 4 [1 mark]
In some cases, when `x` and `y` are Python expressions of type `int`, the value of `x / y` will be of type `long`. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
If `x` and `y` are of type `int` the result of their division cannot have a magnitude larger than `x` so it will always be possible to represent the result by an `int` value, with no need for a `long`.

Question 5 [1 mark]
Which of the following programs would **not** be naturally implemented following the "input process output" design pattern?

A. An operating system, like Windows, Linux or Max OS X. ⟸

B. A program that reads a table of values, calculates statistics on the values and outputs these statistics.

C. A program that takes the design of a structure and returns the forces inside the structural elements.

D. All of the above.

ANSWER:
Operating systems do not fit the "input process output" design pattern because they require concurrency, with multiple, unpredictable input events, and even the possibility of interruption of the process stage. Design patterns were discussed in Lecture 03.

Question 6 [1 mark]
A subset of the Unicode standard includes all of the ASCII characters. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
Unicode is a character scheme that can represent the graphemes from almost any writing system, including those present in the ASCII standard.

Question 7 [1 mark]
Neglecting cases of overflow, in Python for positive floating point numbers `x` and `y`, `x + y` is always greater than `x`. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
If `x` is much greater than `y`, then adding `y` to `x` may be evaluated to `x`. For instance `x = 1e30` plus `y = 1` is not greater than `x`

Question 8 [1 mark]
For any list `a` and number `s`, the value of `num` after the code executes

```
num = 0
for i in range(len(a)):
     num = num + s * a[i]
```

is the same as the value of `num` after the code executes

```
num = 0
for i in range(len(a)):
     num = num + a[i]
num = s * num
```

Is this statement true or false?

A. True. $\Longleftarrow$

B. False.

ANSWER:
This code shows the rule that $\sum_{i=0}^{n-1} sa_i = s\sum_{i=0}^{n-1} a_i$.

Question 9 [1 mark]
Given `cm` (the integer index, between 0 and 11, of the current month) and `n` (an integer), the following code is intended to print a message showing what month it will be `n` months from the current month.

```
year = ["jan", "feb", "mar", "apr", "may", "jun", "jul", "aug", "sep",
   "oct", "nov", "dec"]
nm = E
print str(n) + " months from " + year[cm] + " is " + year[nm]
```

Sample output would be:

```
0 months from jan is jan
1 months from jan is feb
12 months from jan is jan
25 months from jan is feb
-1 months from jan is dec
```

For this code to work, what should the value be for expression E?

A. E = `cm + n`.

B. E = `(cm + n) / 12`.

C. E = `(cm + n) % 11`.

D. E = `(cm + n) % 12`. $\Longleftarrow$

ANSWER:
Modulus arithmetic allows one to wrap around to the beginning of the next calendar year. The remainder, or modulus operator, is discussed in Zelle on page 54 and in Lecture 03.

Question 10 [1 mark]
What is the binary number 11001001110 in hexadecimal?

A. 1614.

B. 64E. $\Longleftarrow$

C. C9C

D. C96.

E. E4E.

ANSWER:
Conversion between number systems is discussed in Lecture 03 and Tutorial 04.

Question 11 [1 mark]
In Python, `range(m, n) = []` if `m` $\geq$ `n`. Why?

A. This behaviour for `range` makes it consistent with normal mathematical conventions, such as $\sum_{i=3}^{1} i = 0$. $\leftarrow$

B. This behaviour is consistent with the slice notation; that is, `x[m:n] = []` for `m` $\geq$ `n` . $\leftarrow$

C. The empty list is natural in many cases, avoiding the need for special exceptions or conditional checks. $\leftarrow$

D. There is no good reason. A better design would have `range(3,1)` equal to `[3, 2, 1]`.

E. A, B and C. $\Longleftarrow$

ANSWER:
In addition to other places, the `range` function was discussed in Tutorial 02.

Question 12 [1 mark]
Which of the following are **not** used in expressions?

A. variables.

B. statements. $\Longleftarrow$

C. operators.

D. literals.

ANSWER:
Expressions and statements are discussed in Chapter 2 of Zelle and in Lecture 02.

Question 13 [1 mark]
If we have a `Rectangle` class in Python, with two state variables: `width` and `height`. A method that returns the area (`width * height`) would be a mutator. Is this statement true or false?

A. True.

B. False. $\Longleftarrow$

ANSWER:
The method would be an accessor, not a mutator, since the method does not change the state of the object. See Lecture 05.

Question 14 [1 mark]
Concatenation of strings in Python is associative. That is, for strings `x`, `y` and `z`:
`(x + y) + z = x + (y + z)`.
Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
The grouping of the addition of the strings does not matter, although the order of addition does matter. That is, concatenation is associative, but not commutative (`x + y` $\neq$ `y + x`).

Question 15 [1 mark]
Assume you are given a variable `movieList` that consists of a list of movies, where each element of the list is itself a list. Each of these lists consists of three elements, in the following order: a string for the movie title, a string for the director and an integer for the year. The following code is intended to take `movieList` and build a string `mstring` of all of the movie titles, each separated by a newline.

```
mstring = ""
for m in movieList:
    S
```

To get the required behaviour what would you use for statement S?

A. `mstring = mstring + m[0] + "\n".` ⟸

B. `mstring = mstring + m[1] + "\n".`

C. `mstring = mstring + movieList[1][m] + "\n".`

D. `mstring = mstring + movieList[m][0] + "\n".`

ANSWER:
The loop goes through each movie and for each movie takes the title, which is at index 0 and concatenates it with the string that is being built. Sequences, including strings and lists, were discussed in Lecture 04.

Question 16 [1 mark]
If you double your computer's memory, what effect does this have on the maximum floating point number you can represent using the standard floating point numbers in Python?

A. Doubles the maximum.

B. Increases the maximum, but the specific results depend on the particular computer's architecture.

C. There is no change in the maximum. ⟸

D. The magnitude of the maximum stays the same, but the precision of the representation increases.

ANSWER:
The maximum floating point number is independent of a computer's memory. The maximum floating point number is defined by the standard used to representing floating point numbers in Pythyon. (Floating point numbers follow in Python follow the IEEE (Institute of Electrical and Electronics Engineers) standard.

Question 17 [1 mark]
The statement `myShape.move(10, 20)` moves `myShape` to the point `(10, 20)`. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
The `move` method changes the position by adding its arguments to the current coordinates of `myShape`. This method is discussed in Chapter 5 and in Lecture 05.

Question 18 [1 mark]
For Python lists `a` and `b`, if `a == b`, then `a is b` will always be `True`. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
See Lecture 04. It is possible to have two different objects (`a is b` is `False`) that are equal.

Question 19 [1 mark]
What is the value of `x` after the following code is executed, assuming `m` and `n` are greater or equal to `0`?

```
x = 0
for i in range(m):
  for j in range(n):
    x = x + 1
```

A. $\sum_{i=0}^{m-1} \sum_{j=0}^{n-1} x.$

B. $\sum_{i=0}^{m} \sum_{j=0}^{n} x.$

C. `m*n`. ⟸

D. `(m-1)*(n-1)`.

E. `m+n`.

ANSWER:
The code calculates $\sum_{\texttt{i=0}}^{\texttt{m-1}} \sum_{\texttt{j=0}}^{\texttt{n-1}} \texttt{1}$, which is equal to `m*n`.

Question 20 [1 mark]
If you define a class to represent a car, what should the type be for the field that represents whether the engine is on or off?

A. `int`.

B. `long`.

C. `float`.

D. `bool`. ⟸

E. `object`.

ANSWER:
There are two states for the engine, either on or off; therefore, `bool` makes the most sense.

Question 21 [1 mark]
Consider the following code to calculate the average (`avg`) of the entries in the list `a`, where `avg` = $(\sum_{i=0}^{\texttt{len(a)}-1} \texttt{a}_i)/\texttt{len(a)}$.

```
avg = 0
for x in a:
    avg = avg + x
avg = float(avg)/len(a)
```

For the above code to provide a correct answer and not generate a run time error, what minimal assumption(s) have to be true?

A. `a` is a list of integers or floats. ←

B. `a` is a list of floats.

C. `a` has at least one entry. ←

D. A and C. ⟸

E. B and C.

ANSWER:
To calculate the answer correctly the list has to have at least one element, or a zero division will occur. Since there is an explicit type cast to float, there is no problem with using a list of integers for `a`.

Question 22 [1 mark]
Assume that `w` is an expression of type `str`. What does the following code print?

```
v = ""
for i in range(len(w)):
    v = w[i] + v
print v
```

A. The string `w`.

B. The string `w + w`.

C. The reverse of the string `w`. ⟸

D. The reverse of the string `w + w`.

E. The string `w + w1` where `w1` is the reverse of `w`.

ANSWER:
Try it out on a sample string.

Question 23 [1 mark]
What is the decimal number 256 equal to in binary?

A. 10101010.

B. 11111111.

C. 100000000. ⟸

D. 100000001.

E. 101010101.

ANSWER:
Conversion between number systems is discussed in Lecture 02 and Tutorial 03.

Question 24 [1 mark]
Given strings `fileName` and `message`, one can write to a file using the statement `fileName.write(message)`. Is this statement true or false?

A. True.

B. False. ⟸

ANSWER:
To write to a file, one uses a file variable, not a string. A string representing the file name is used to associate the a file on disk with a file variable.

Question 25 [1 mark]
How many graphics objects are created by the following code?

```
from graphics import *
win = GraphWin("Window", 500,500)
win.setCoords(0,0,100,100)
p = Point(50,50)
circ1 = Circle(p,20)
circ1.draw(win)
circ1.setOutline("red")
circ2 = circ1
circ2.move(20, 30)
```

A. 0.

B. 1.

C. 2.

D. 3. ⟸

E. 4.

ANSWER:
In the code one object is created of each of the following types: `GraphWin`, `Point`, and `Circle`. The variable `circ2` does not create a new object; it simply references an existing object (`circ1`).

Question 26 [1 mark]
Mathematical objects, such as numbers, or sequences, have multiple potential representations within a programming language, as opposed to one unique representation. Is this statement true or false?

A. True. ⟸

B. False.

ANSWER:
Theme 2, from Lecture 02 states "There are various ways that common mathematical objects and other data are represented in programming languages."

Question 27 [1 mark]
Which of the following Python expressions is a literal?

A. `True`. ⟸

B. `int(3.14)`.

C. `math.sqrt(2)`.

D. `x`.

E. `"horse" + "show"`.

ANSWER:
Only the expression `True` literally tell you its value: the boolean `True`.

Question 28 [1 mark]
The following code reads a file and then prints out every `n`th line. You may assume that `n` is positive.

```
fname = raw_input("Please enter a file name: ")
n = input("Please enter the number of lines to skip: ")

f = open(fname, "r")
lst = f.readlines()

for i in range(0, len(lst), n):
    print lst[i]
```

What value should expression E have so that the following code can replace the above for loop and not change the program's behaviour?

```
for i in range(0, E):
    print lst[i*n]
```

A. $E =$ `len(lst)/n`.

B. $E =$ `(len(lst)-1)/n + 1`. ⟸

C. $E =$ `(len(lst)-1)/n`.

D. $E =$ `len(lst)/n + 1`.

ANSWER:
Although option A works some of the time, in some cases it will miss the last line of output. You can see this with a file with 5 lines and n = 3. The original code will print out lines 0 and 3 from the file. Option A will print line 0, while option B will print the required lines (0 and 3). The reason for the `-1` in the numerator of the expression E is that the first line of the file is always printed out.

Question 29 [**1 mark**]

```
infile = open("grades.txt", "r")
grade_points = [0]*13
for line in infile:
     grade = int(line)
     grade_points[grade] = grade_points[grade] + 1
infile.close()
```

You can assume that the file exists. What other minimal assumptions does the code make about the file located at `"grades.txt"` to avoid a run time error?

A. The file is not empty.

B. Each line contains one string representing a number. ←

C. Each number in the file must be between 0 and 12 inclusive. ←

D. B and C. ⇐

E. All of the above.

ANSWER:
Assumption A is not necessary because an empty file will simply leave `grade_points` unchanged.

Question 30 [**1 mark**]

```
x = []
for i in range(3):
    S
print x
```

What should the statement S be to guarantee that the program prints `[[[[0], 1], 2]]`?

A. `x = [i] + x`.

B. `x = [x + [i]]`. ⇐

C. `x = i + x`.

D. `x = [x, i]`.

E. `x = [[x], i]`.

ANSWER:
B adds the singleton list created with `i` to the current list `x` and puts this list inside of a list.

Please make sure your **version number** is clearly marked on your scan sheet!