CSCI 101 Midterm Sample Questions

Note: you may bring one 8.5"x11" double-sided sheet of notes for your use during the exam (handwritten or typed). Otherwise, no notes, computers, calculators, phones or other aids are allowed.

1. *Short answer*

(a) The following function is supposed to test whether a given word contains a given letter. It uses a recursive strategy. Unfortunately, there are three different problems with this function. Identify these problems and rewrite the corrected function.

```python
def contains(word, letter):
    if word[0] == letter:
        return True
    elif len(word) == 0:
        return False
    else:
        contains(word[1:], letter)
```

error 1: __order of base cases needs to be switched__

error 2: __if len(word) = 0 needs == instead of =__________

error 3: __last line is missing the word ‘return’__________

(b) What output do the following lines of Python produce?

```
x = 10
y = x * 3 + 5
x = 2 * y - 5
print("x=", x)
print("y=", y)
```

(c) Describe what makes a problem suitable for a recursive solution. What are the necessary components or characteristics of a recursive solution?

A problem might be suitable for a recursive solution if the solution to the entire problem can be expressed in terms of the solution to a smaller problem. For example, \( N! = N \times (N-1)! \)
The two necessary components of a recursive solution are (1) a base case that solves a trivial version of the problem, and (2) a recursive case that solves a smaller version of the problem while making progress towards a base case.
2. **True or False**

For each of the statements below state whether they are true or false. No justification required.

**False** If s='eat more kale' then s[1] == s[-1] would give True.

**True** Given an even-length string s, s[(len(s)//2):] would give the last half of the string.

**True** \(\frac{7}{2} + \frac{7}{2} + 7\%2\) evaluates to 7.5

**False** Given the function below, if we were to type \texttt{print(identity(3))}\ and hit enter in the Python console, we would only see 3 displayed.

```python
def identity(num):
    print(num)
    return num
```

**False** The function \texttt{rundown(n)} produces the even numbers from n down to 2.

```python
def rundown(n):
    if n>1:
        print(n)
        rundown(n//2)
```

3. **Understanding code**

(a) Consider the following Python program. What output will this code produce when run?

```python
def mystery1(a, b):
    return a+b

def mystery2(a, b):
    if a > b:
        return a
    else:
        return b

def mystery3(a, b):
    if a < b:
        print(a)
        a = a + 2
        mystery3(a, b)

y = mystery1(26, 8)
print(y)

y = mystery2(26, 8)
print(y)

mystery3(16, 22)
```
(b) Consider the following function definition.

```python
def mystery(side):
    if side > 0:
        turtle.forward(side)
        turtle.left(90)
        mystery(side - 50)
```

Draw what the function above would draw on the screen if run with command `mystery(250)`. Assume the turtle initially is at the center of the window facing right. You can assume the width and height of the window are about 600 pixels. Indicate the final position and orientation of the turtle with a small triangle.

4. **Writing functions**

(a) Complete the Python program `midterm1.py`. The program asks the user for input, then calls functions `test1` and `test2` and outputs their results. You should define the (non-recursive) functions `test1` and `test2` so that the provided main program (at the bottom of the box below) will work without any modification. Do not use any pre-defined mathematical functions, rather simply use multiplication, addition, conditionals, etc, to complete the code. Here is an example of how your program should work (the user’s input is the -7 in bold). Note: The function calls and input/output are done for you; you do not need to rewrite the main program, just write the function definitions for `test1()` and `test2()`.

```python
>>> runfile('midterm1.py')
Enter a number: -7
square of -7 is 49
absolute value of -7 is 7
```

```python
# midterm1.py

# define functions test1 and test2 here:

def test1(x):
    return x * x

def test2(x):
    if x < 0:
        return -x
    else:
        return x

# main program that calls test1 and test2:

x = int(input("Enter a number: "))
print("square of", x, "is", test1(x))
print("absolute value of", x, "is", test2(x))
```
(b) Write a recursive function called `every_other_letter` that takes a string parameter as input and returns a string that contains every other letter in the string starting with the first letter. For example:

```python
def every_other_letter(s):
    if len(s) < 2:
        return s
    else:
        return s[0] + every_other_letter(s[2:]),

>>> every_other_letter('banana')
'bnn'
>>> every_other_letter('computer')
'cmue'
>>> every_other_letter('kale')
'kl'
>>> every_other_letter('a')
'a'
```

[Note: a concise correct answer can be given in just 5 lines of code. Just give the function definition, not the main program, and do not use `print()` or `input()`.]

5. **Binary numbers**

For each of the following (a)-(c), perform the conversion. Use 16-bit *unsigned* binary numbers.

a. 372 from decimal to (unsigned) binary
   \[00000010110100\]

b. 1024 from decimal to (unsigned) binary
   \[00001000000000\]

c. 0000000000001111 from (unsigned) binary to decimal
   \[15\]

For each of the following (d)-(f), perform the conversion. Use 16-bit *two’s complement* numbers.

d. 000000000010101 from (two’s complement) binary to decimal
   \[2^4 + 2^2 + 2^0 = 21\]

e. 11111110111101 from (two’s complement) binary to decimal
   \[-(0000000010000011) = -(2^7 + 2^1 + 2^0) = -131\]

f. -1024 from decimal to (two’s complement) binary
   \[11111100000000\]

g. B8 from hexadecimal to (two’s complement) binary, then to decimal
   \[1111111111011000\]
   \[-(0000000000100100)\]
   \[-(2^6 + 2^3) = -(64+8) = -72\]