MCS 260 Exam 1 14 October 2015

Name: _____

- Do not start until instructed to do so.
- In order to get full credit, you need to show your work.
- You have 50 minutes to complete the exam.
- Good Luck!

Problem 1 _____/15
Problem 2 _____/15
Problem 3 _____/17
Problem 4 _____/20
Problem 5 _____/25
Problem 6 _____/8

Total _____/100

Problem 1 *(15 points)* Briefly describe (in at most four-five sentences and capturing only the main ideas) what is operating system scheduling.

Answer. The CPU can only be fetch-decode-executing a single program at once, so the operating system kernel must alternate between programs to give the appearance that multiple programs run at once. The kernel does this by running a program for a short time and then interrupting it. The kernel then schedules, which means it decides which program to run next and causes the CPU to jump into the program to pick up where it left off. By keeping the time each program runs short and making sure the scheduling rotates through all programs, the kernel gives the appearance that multiple programs are running at once.

Problem 2 *(15 points)* Convert the following binary number to decimal: 100101. For full credit you must show your work.

Answer. Expanding the binary number, we obtain

$$1 \times 2^5 + 0 \times 2^4 + 0 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$$
$$32 + 0 + 0 + 4 + 0 + 1 = 37.$$

Problem 3 *(17 points)* Compute the truth table of the following boolean expression.

$$(not(x) \text{ and } not(y)) \text{ or } (x \text{ and } not(z))$$

Answer. The truth table is:

x	y	z	not(x) and not(y)	x and not(z)	result
T	T	T	F	F	F
T	T	F	F	T	T
T	F	T	F	F	F
T	F	F	F	T	T
F	T	T	F	F	F
F	T	F	F	F	F
F	F	T	T	F	T
F	F	F	T	F	T

Problem 4 *(20 points)* Write a python function which takes as input a list of strings and returns the sum of the lengths of all the strings. For example, if `["Hello", "World!"]` is passed to your function, your function should return 11 (which is $5 + 6$ since "Hello" has length 5 and "World!" has length 6). Your function must work for all lists of strings, not just this example.

Answer.

```
def answer(lst):
    count = 0
    for x in lst:
        count += len(x)
    return count
```

Problem 5 *(25 points)* Consider the following python function.

```
def somefunction(d1):
    d2 = {}
    for x in d1.keys():
        if d1[x] > 0:
            d2[x] = d1[x] * d1[x]
    return d2
```

What does the following code print? (You don't need to exactly match the spaces/order that python would print, just show what data value will be printed.)

```
someval = { "luke": 5, "vader": -12, "c-3po": 3, "leia": -22 }
print(somefunction(someval))
```

Answer. The code prints

```
{ "luke": 25, "c-3po": 9 }
```

Describe in words what `somefunction` does. What is the input? What is the output?

Answer. `somefunction` takes as input a dictionary `d1` and computes a new dictionary `d2`. For each entry in the input dictionary, if the value of the entry is positive, an entry in the new dictionary is created with the same key and with value is the square of the original value.

Problem 6 *(8 points, 2 points each)* Mark whether each statement below is True or False and add one sentence of explanation why it is True or False. **You must have a correct explanation to get full credit!!!**

(a) The semantics of a programming language describe which sequences of ASCII characters constitute a valid program.

Answer. False, the syntax describes the proper sequence of ASCII characters.

(b) It is possible to exactly represent all fractions using python floating point numbers.

Answer. False, floating point numbers are rounded. For example, $\frac{1}{3}$ can't be represented.

(c) Modern general purpose operating system kernels protect memory so that different programs cannot access each other's memory.

Answer. True, the kernel (with the help of the CPU) makes sure the program can only access memory which the kernel has given to the program to use.

(d) Say Alice and Bob want to communicate using the substitution cipher and Carol wants to eavesdrop by breaking their encryption using frequency analysis. Alice and Bob can be secure against Carol by being extra careful in how they choose the secret key for the substitution cipher.

Answer. False, frequency analysis works without knowing the secret key and in fact works for any secret key, since it is just concerned with frequencies of letters.