CSCI 150: Exam 1 Practice

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Read all questions carefully before beginning. You will have 50 minutes to complete this exam. You are not allowed to use your notes, textbook, phone, calculator, or computer. Show all your work for full credit.

1. The color Cornflower Blue is defined as the hexadecimal number #6495ED. Find the amount of blue in this color, written as a number between 0 and 255.

2. September 13th is World Programmers Day, because it is the 256th day of the year. What is the binary representation of 92 (the 92nd day of the year is April 1st)?

3. You are given the following Python definitions:

```
a = 2
b = 3
c = 23.8
d = True
e = False
```

Evaluate the truth value of each Python expression below:

- `e or c > a`

- `(d and e) or (not d and not e)`

- `(a / b) > 0 and d`

- `((a * b) - 12) == 9`

4. Two trains a and b are on a collision course heading down the same track. If you know the speed of the two trains and how far apart they are, you can calculate when they will collide by the following formula:

$$collision = \frac{distance}{speed_a + speed_b}.$$

Write a program that asks the user for the speed of the two trains and their distance, calculates how long before the trains collide using the above formula, and prints the result to the screen. Be sure to include an informative message with the result, for example, `Time until the trains collide: 3.862049`.

5. You want to write a program that will tell you when to set your alarm clock. You have the input section already written, such that there is an integer variable for `day` according to 0=Sun, 1=Mon, 2=Tue, ..., 6=Sat, and a boolean variable `vacation` indicating if you are on vacation.

   Now you are writing the logic, so that the program will print a string of the form `7:00` indicating when the alarm clock should ring. Normally, on weekdays (Monday through Friday) the alarm should print `7:00` and on the weekend (Saturday or Sunday) it should print `10:00`. Unless you are on vacation—then on weekdays it should print `10:00` and weekends it should print `off`.

   This is your first attempt and it is wrong. Show **two** examples of values for `day` and `vacation` that produce incorrect output and clearly state the **semantic** errors with the code.

```
if vacation and day > 5:
    print("off")
else:
    if day > 0 or day < 6:
        print("7:00")
    else:
        print("10:00")
```

6. Trace the execution of the following Python program, by writing down the values of all variables and any output produced by the program. Make sure to clearly separate values of variables from output, and make sure to clearly indicate what values the variables have at the end of the program.

   Showing your work (*e.g.* evaluation of expressions) is not required but makes it much easier to give partial credit if you make a mistake.

```
i = 3
animal = 'cat'
if i < 1 or (animal == 'cat' and i > 1):
    i = i + 1
    animal = 'dog'
    print("yay")
elif animal == 'dog' and i > 1:
    i = i + 1
    animal = 'pig'
    print("boo")
if i > 5:
    i = i * 3
    print(animal)
else:
    i = i - 2
    print("no " + animal)
```

Extra practice

Distance bewteen two points

The shortest distance between two points is usually a straight line. However, the shortest distance between two locations on Earth is calculated with the great circle distance. Given two locations, this distance in kilometers is

$$6371.01 \operatorname{acos}(\sin(\phi_s)\sin(\phi_f) + \cos(\phi_s)\cos(\phi_f)\cos(\lambda_s - \lambda_f)),$$

where

- ϕ_s is the latitude of the starting point,
- λ_s is the longitude of the starting point,
- ϕ_f is the latitude of the final point, and
- λ_f is the longitude of the final point.

Write a program that asks the user for the latitude and longitude of two locations in decimal form, calculates the distance between them using the above formula, and prints the result to the screen.

Mercator projection

The Mercator Projection, formulated in 1569 by Gerardus Mercator, is the most commonly used 2D map projection of the globe and is seen on school walls across America. It has the property that compass bearings are accurately displayed, and is extremely useful for nautical purposes. Given a latitude ϕ and longitude λ, and using the Prime Meridian as the center of the map, we can find the x, y coordinate projection by:

$$\begin{aligned} x &= \lambda \\ y &= \frac{1}{2}\ln\left(\frac{1+\sin(\phi)}{1-\sin(\phi)}\right) \end{aligned}$$

Write a Python program to prompt the user for input of floating-point numbers for phi (ϕ) and lambda (λ), perform the above calculations, and then display the corresponding x, y coordinates to the user. Note, ln is the natural logarithm with base e.

Shoe sizes

European and American shoe sizes differ by a standard amount. You can approximate the European shoe size by using the following formulas.

For men:

$$euroSize = \frac{9}{7} americanSize + 30.5$$

For women:

$$euroSize = \frac{9}{7} americanSize + 29$$

Write a program that asks the user for the American shoe size and gender, calculates the European shoe size using the above formula, and prints the result to the screen.