

# How to Think Like a Computer Scientist: Theoretical Exercises

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## Chapter 1

1. Incorrect syntax: “Pyton is a intresting programing Language”  
Correct would be: “Python is an interesting programming language”.
- Semantic errors: “He is thinking on his cat.” Here, “on” should read “about”. The person is not on top of his cat while in the act of thinking, but is thinking about his cat.
3. Entering `a` produces “NameError: name 'a' is not defined”. Entering `1a` produces “SyntaxError: invalid decimal literal”.
4. Entering `print("hello")` will return `hello`. Entering `"hello"` will return `'hello'` and entering `'hello'` will also return `'hello'`.
6. Typing `6+4*9` in the console yields `42`. Putting `6+4*9` in a script and running it will not display anything in the output. Changing this to `print(6+4*9)` will yield `42`.

## Chapter 2

3. When placing a comment before a line of code that works, the line of code will no longer be executed. It has been turned into a comment and is thus ignored by the compiler.
6. Evaluating `7%0` gives an error and thus cannot be computed. The reason why is because  $x \bmod 0$  does not exist for any  $x$ .
7. A normal clock works in modulo 24. If it is 2 pm, then it is  $14 \bmod 24$ . In 51 hours, it would be  $(14 + 51) \bmod 24 = 65 \bmod 24 = 17 \bmod 24$ . Hence it would be 5 pm.

## Chapter 3

2. Three attributes of my cell-phone: the phone screen, the phone battery, the charging port. Three methods of my cell-phone: turn the screen on, turn its flashlight on, make a sound.
4. If Tess starts out facing eastwards at 0 degrees and moves left 3645 degrees, then she is moving  $3645 \bmod 360 = 45 \bmod 360$  degrees after moving in a full circle 10 times. Her final heading would then be north-east.
9. If the regular polygon has 18 sides, then the sum of its angles should be 360 degrees. Since there are 18 sides, each angle will have to be  $\frac{360}{18} = 20$  degrees.
13. We get `<class 'turtle.Turtle'>`

## Chapter 5

3. (a) `a <= b` (b) `a < b` (c) `a < 18 or day != 3` (d) `a < 18 or day == 3`
4. (a) True (b) False (c) False (d) False
5. T, T, T, T, T, T, F, T

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## Chapter 6

10. `test(3 % 4 == 0)` fails because in modulo 4, zero has to be a multiple of 4 which 3 is not.  
`test(3 / 4 == 0)` fails because  $3 / 4 = 0.75 \neq 0$ .  
`test(4-2+2 == 0)` fails because  $4-2+2 = 4 \neq 0$ .

## Chapter 7

14. `num_digits(0)` returns 0. `num_digits(-24)` is an infinite loop because dividing and rounding down a negative number with a positive number will always result in a negative number. As such, the number itself will never reach zero causing an infinite loop.

## Chapter 8

1.

- `"Python"[1]` gives `y`.
- `"Strings are sequences of characters."[5]` gives `g`.
- `len("wonderful")` gives 9.
- `"Mystery"[:4]` gives `Myst`.
- `"p" in "Pineapple"` gives `True`.
- `"apple" in "Pineapple"` gives `True`.
- `"pear" not in "Pineapple"` gives `True`.
- `"apple" > "pineapple"` gives `False`.
- `"pineapple" < "Peach"` gives `False`.

## Chapter 9

1. See program. It is possible pass tuples as an argument in a function.
2. A tuple is a generalization of a pair. A pair is a tuple with two elements. A tuple itself can have any amount of elements.
3. A pair is a kind of tuple, since a pair is a tuple with two elements.

## Chapter 11

1. `list(range(10, 0, -2))` gives `[10, 8, 6, 4, 2]`. If `start < stop` and `step < 0`, it returns an empty list `[]`. A rule for the relationship is, `start < stop` iff `step > 0`.
2. The fragment creates one turtle. We first create an object `tess`. We then store this object into a variable `alex`. This means that if we call our variable `alex`, we will be accessing the object `tess`. Changing the color of `alex` means that we change the color of what is stored inside this variable, which is `tess`. In other words, we are assigning our object `tess` to `alex`, not a new turtle, and so there is only one turtle instance created.
3. N/A
4. The first print function will yield `False` because we are creating two identical lists and are assigning each of them to their own variable. This means that when we are checking whether the two variables are the same, we will get `false`, because even though both variables store identical lists, they are two different lists nonetheless. The second print function will yield `True` because we create one list and assigning it to a variable `this`, which is consequently stored in another variable `that`. So when accessing `that`, we are accessing `this` and consequently accessing the one list that has been created. Hence both variables are the same and the second print will return `True`.

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9. `" ".join(song.split())` will split place divide each word (separated by a space) in `song` over one list and then join each word back together using the same space. This works for all strings who are joined back together by the same separator. An instance where this would not work, however, is where each word in `song` is separated by more than one space. For example, if we set `song = "The rain in Spain"`, then each word is separated by four spaces. Applying `" ".join(song.split())` will then yield `"The rain in Spain"`, because the `split()` treats the four spaces in `song` as if it were one space.

## Chapter 12

2. (a) There are 53 functions.  
(b) `math.ceil(x)` and `math.floor(x)` round the argument `x` respectively up and down to the closest integer.  
(c) Python has a standard exponentiation operation, given by `**`. Since the square root of a number `x` is the same as raising `x` to the power 0.5, we can compute the square root of `x` by computing `x**0.5`.  
(d) They're `math.pi`, `math.e`, `math.tau` and `math.inf`  
3.  
5.