CS 111 Fall 2025 Review Guide for the In-class Midterm 1

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On **Friday, October 10** you will take the first midterm exam during your CS111 lecture. **You will have the entire 75 minutes of the lecture to complete the exam.** Students with exam time accommodations will be contacted by their instructors with details about how to take the exam.

In this exam, you will write your answers by hand on the hardcopy exam. Each question has boxes where you will be asked to write your answer. Only write inside the boxes. We will scan your exam into Gradescope and will grade what you write within the boxes only (so do not write in the margins or outside the boxes).

In the exam you could be asked to:

1. Read Python programs and explain what they do. What values do they print or return?
2. Modify existing Python programs.
3. Write Python programs that satisfy a specification.

The exam is open notes in the sense that you can bring with you any **printed and handwritten materials**, such as your written notes, printouts of slides and web pages from our website you think are important. We strongly recommend against printing large numbers of pages, since most students don't have time during the exam to consult them. **To prepare for the exam, it's better for you to write a few pages of your own notes of what you think is important and might forget**.

You are **not** allowed to use any electronic devices during the exam, including but not limited to computers, calculators or smartphones. You are **not** allowed to browse the web during the exam nor use a Python interpreter during the exam.

Here are some things we encourage you to do to prepare for the exam:

- **Practice solving lots of problems involving Python concepts and coding.** Where can you find such problems?
    - This document has **many** problems from past midterms and quizzes
    - Redownload Exercises notebooks from prior weeks and redo the problem, preferably on paper
    - Problems in the lecture notebooks.
    - Problems in the slides
    - Redo problems from quizzes and projects
- Review the quiz guides and corresponding solutions
- Review the posted solutions for all exercises and projects on Potluck. Often, the posted solutions may show you how to solve a problem in a better way than you did on your own.
- Review all course lecture slides, notebooks and lab materials. Write down anything you're confused about and ask an instructor/tutor.

Concepts for Midterm Exam 1

The topics covered by Midterm Exam 1 are listed here.

Midterm Exam 1 Practice Problems

This section contains **many** practice problems. Most of these problems have been part of either midterm exams or quizzes in past semesters. In some cases they have been modified to satisfy the concept coverage of the Fall 2025 midterm.

A typical 75-minute midterm will have **6 to 8 problems** like those in this section. Some problems will have multiple subproblems. **This is *not* a practice exam.** That is, you would ***not*** be expected to finish all of the practice problems in 75 minutes! Completing all of the practice problems will take most students **many** hours. Indeed, some students will simply not have the time to solve all practice problems, in which case they should focus on the problems that seem most beneficial. We provide many problems just to give you more practice.

In a 75-minute midterm, we expect all students to do almost all problems. If you are spending more than 10 to 15 minutes on an exam problem, move on, and return to the problem later if time allows.

Solutions to all of the problems in this section are provided here, but you are strongly encouraged to completely solve a problem before you study its solution.

Table of Contents for Midterm 1 Review Problems

Python Basics

Python Basics 1: Python Calisthenics

Part 1a: Examine each snippet of code below to find the value of the variable **a** and state its type. Write the value in the second column and the type in the third column. If the code evaluates to an error, write the kind of error and use the third column to briefly explain the error. *The first two have been done as examples for you.*

Please write only within the table below:

Code:	**What is the value of a (or Error)?**	**What type is a? (or Error explanation)**
`a = 3 + 4`	7	int
`a = float('3.4.5')`	Value Error	Although `float` can work on some strings, it doesn't work on `'3.4.5'`
`a = (17 // 3) * 3 + 17 % 3`		
`b = 'cat'` `a = b[2] + b[3]`		
`b = 'dog'` `a = b[-1] + b[1]`		
`b = len('3.5' * 3)` `a = b * 2`		

`def joy():`
`  print(3)`
`a = joy() + 17`		

Part 1b: In the box below to the right, show what is printed by the following code. Note that the `sing` function is nonsense and should **not** be assumed to produce a meaningful result.

```
def sing(coda):
    song = 3.1
    print(round(song) % 2)
    lyric = str(song)
    for i in lyric:
        print(i)
    lyric = lyric + coda
    print(lyric)

print(sing("hello"))
```

Show printed output here

Python Basics 2: Python basics

Part 2a For each program, show the **printed output** from the final program statement. If executing the program causes an error, write (1) the kind of error and (2) why it occurs (briefly!).

```
a = 4
b = str(a) * a
b + '!'
print(b)
```

Printed output:

```
x = 4
y = 2 * x
z = y + 1
x = 5
print(x, y, z)
```

Printed output:

```
animal = "cat"
print(animal[1], animal[3])
```

Printed output:

```
i = int(5.9)
f = float("3")
print(i * f)
```

Printed output:

```
s= "watermelon"
print(s[:3] + s[-1:-5:-2])
```

Printed output:

```
c = 8
d = 3
r = round(c / d)
print(r, (c // d))
```

Printed output:

Part 2b: In the box below to the right, show the **printed output** from the following code.

```
num = 4

def show(num):
    saved = num
    double = num * 2
    num = 12
    half = num / 2
    both = double + half
    print('n', num)
    print('dtb', double, half, both)
    print('s', saved)

show(10)
print('z', num)
```

Show printed output here

Python Basics 3: Python built-in functions

Part 3a For each program, show the output **printed** by the final program statement. If executing the program causes an error, write (1) the kind of error and (2) why it occurs (briefly!).

```
a = "23"
b = int(a) - len(a)
b*2
print(b)
```

Printed output:

```
s1 = "a"
s2 = "b"
s3 = s1 + s2*3
s1 = "c"
print(s3 + s1)
```

Printed output:

```
city = "Newton"
print(city[3], city[6])
```

Printed output:

```
i = int(3.7)
f = float("5")
print(i + f)
```

Printed output:

```
s = "4.9"
print(int(s) + float(s))
```

Printed output:

```
c = 14
d = 5
print(c//d, c%d,
      int(c/d), round(c/d))
```

Printed output:

Part 3b: In the box below to the right, show what is printed by the following code. Note that the `mystery` function is nonsense and should **not** be assumed to produce a meaningful result.

```
string = 'ABC'

def mystery(s):
    n = len(s)/2
    print(n)
    chars = str(n)
    i = int(chars[2])
    string = s.lower() + (s[1]*i)
    return string

print(mystery('DEF'))
print(string)
```

Show printed output here

Python Basics 4: Python built-in functions

Part 4a For each program, show the output printed by the final program statement. If executing the program causes an error, write (1) the kind of error and (2) why it occurs (briefly!).

```
a = 11
b = 2
print(a//b, a/b)
```

Printed output:

```
f = float("five")
print(f+5)
```

Printed output:

```
v1 = ""
v2 = " "
v3 = "cat"
print(len(v3+v2+v1))
```

Printed output:

```
a = "b"
c = "d"
print(a+b+c)
```

Printed output:

```
line1 = "a,b"
line2 = line1+"c"
print(line2)
```

Printed output:

Part 4b: Professor Anderson is cutting strips of fabric to make a border around a quilt. In the box below, write a program (not a function) that uses the input function (twice) to ask her for the height and width of the quilt, and then prints out the total length of the fabric that she needs. Below is a sample execution of the program:

```
Enter height in feet: 8
Enter width in feet: 6
You will need 28 feet of fabric.
```

The program calculates that 28 feet will be needed to cover all sides of the quilt (8+8+6+6).

You may assume that Professor Anderson enters valid dimensions when asked.

Write your Part 1b program in this box:

Python Basics 5: Python built-in functions

Part 5a: For each program, show the output printed by the final program statement. If executing the program causes an error, write (1) the kind of error and (2) why it occurs (briefly!).

```
a = 23
b = 4
print(a//b, a%b,
round(a/b))
```

Printed output:

```
f = float("5.6")
i = str(37)
print(f + i)
```

Printed output:

```
x = "12"
y = int(x) - len(x)
y*2
print(y)
```

Printed output:

```
color1 = "blue"
color2 = "red"
color3 = 2 * color1 +
color2
color1 = "cyan"
print(color3 + color1)
```

Printed output:

```
val1 = "one"
val2 = "two"
sum = int(val1) + int(val2)
print(sum)
```

Printed output:

Part 5b: The **harmonic mean** of two numbers is calculated through the formula:

$$h = \frac{2ab}{a+b}$$ in other words, *h* is (2 times a times b), divided by (a plus b)

In the box below, write a program (**not** a function) that uses the `input` function (twice) to prompt the user to enter numbers for **a** and **b**, calculates the harmonic mean and stores it in a variable **h**, and then prints out the message:

`The harmonic mean for` *a* `and` *b* `is` *h*

where *a* and *b* are the values of the two numbers entered by the user and *h* is the calculated harmonic mean. Below is a sample execution of this program:

```
Enter number a: 10
Enter number b: 2.5
The harmonic mean of 10.0 and 2.5 is 4.0
```

You may assume that all inputs are numbers.

Write your harmonic mean program in this box:

Simple Functions

Simple Functions 1: Defining a `repeatIt` function

In the box below, define a function named `repeatIt` that takes a single parameter that is a string, calls the `input` function to get an integer from the user, and **return**s the string repeated as many times as the user specified. You may assume that the user will always enter an integer. You may also assume that when the function `repeatIt` is called that the argument passed is a string.

Simple Functions 2: Functions with return and print

```
def red(word):
    newWord =  'red' + word
    print(word) # this is the only function with print in it
    return newWord

def blue(word):
    newWord = 'blue' + word
    return newWord

def green(word):
    newWord = 'green' + word
    return newWord
```

Part 5a. Given the function definitions above, what is printed by the following code?

```
newWord = 'grouch'
print(green(red(blue('oscar'))))
print(newWord)
```

Write what is printed in the box below

Part 5b. Suppose we remove the **print** invocation in the `red` function. Then all three functions above are very similar. Write a function called `addColor` that captures the pattern in the `red`, `blue` and `green` functions above. Your `addColor` function should have two string arguments and return a string (see examples below):

```
addColor('orange','cake') ⇒ 'orangecake'
addColor('purple','eyes') ⇒ 'purpleeyes'
```

Define your function in the box below

Simple Functions 3: Custom Functions

Part 3a Vocabulary

```
# line 1   def swift(anti, hero):
# line 2       greet = "hi!" * anti
# line 3       refrain = "it's me"
# line 4       return refrain + greet + hero
# line 5
# line 6   swift(3,"I")
# line 7   swift(5,"you")
```

3a(i): Identify all **function parameters** above:

Parameter	Line #

3a(ii): Identify all **function arguments** above:

Argument	Line #

3a(iii) What is the difference between a parameter and an argument? (1-3 sentences)

Part 3b Define the nameRow function

In the box below, define a function called `nameRow` that has no parameters and does not return anything. It should call the `input` function twice: once to get the user's name, and once to get a number indicating how many times the name should be repeated. It should print the name on one line the requested number of times.

Assume that the user will enter a positive integer when prompted. **For full credit, your solution must not use any loops.** Example printed output when the user's name is Carolyn and the user requests a row of length 2:
`CarolynCarolyn`

Simple Functions 4: Custom Functions

```
def someLaughter():
      print('LAUGHTER')
      print('LAUGHTER')
      print('LAUGHTER')
      print('LAUGHTER')
      print('LAUGHTER')
```

You are given the function `someLaughter` above that prints `'LAUGHTER'` five (5) times. You must define two **zero-parameter** functions, one of which is named `megaLaughter` and a helper function whose name you choose. When called on zero arguments, `megaLaughter` should print `'LAUGHTER'` one hundred (100) times.
For full credit, your solution must meet all these criteria:

- Define another helper function that calls `someLaughter`
- `megaLaughter` does not call `someLaughter` directly
- Neither `megaLaughter` nor the helper function may call `print` directly
- `megaLaughter` contains no more than 5 lines of code in the function body (not counting the `def` line)
- There are no loops anywhere in your solution, including in your helper function

You will receive partial credit if your code prints `'LAUGHTER'` one hundred (100) times even if it doesn't meet all of the criteria above.

Write your solution in this box

Simple Functions 5: Defining and calling functions

Part 5a: Consider the following three functions:

`def a():` `  return 'a'`	`def b(s):` `  return s + 'b'`	`def c(s):` `  return s + 'c' + s`

In the table below, fill in the results for each expression (write your answers as quoted strings).

Expression consisting only of calls to the three functions above	String that is the value of the expression
`b(c(a()))`	
`c(b(b(a())))`	

Part 5b: You are given the following function definition for `printCombinations`:

```
def printCombinations(x, y, z):
    plus = x + y
    times = y * z
    print(plus, y, times)
```

In the box below, fill in the missing arguments to the `printCombinations` function calls so that `printNums()` **prints** this output:

```
5 4 12
7 2 8
```

```
def printNums():
    printCombinations(                    )
    printCombinations(                    )
```

Part 5c : Define a function named pickNums that takes three **integers** and **prints** them right-justified with brackets to their left as shown in these examples:

`pickNums(3, 4, 15)` **prints**
`[ ]  3`
`[ ]  4`
`[ ] 15`
	`pickNums(9231, 2, 950)` **prints**
	`[ ] 9231`
	`[ ]    2`
	`[ ]  950`

Your definition **must not** include any conditionals or loops and **must** include **three** invocations of the following `optRow` function (in addition to other function calls):

```
def optRow(num, indent):
      return '[ ] ' + (' ' * indent) + str(num)
```

Define your **pickNums** *function in this box:*

Simple Functions 6: Defining and calling functions

Part 6a: Consider the following three functions:

```
def one():
    return 1
```

```
def dbl(n):
    return 2*n
```

```
def incDbl(n):
    return 1 + (2*n)
```

It turns out that any positive integer can be expressed using nested calls to just these three functions. In the table below, fill in the missing parts.

Expression consisting only of calls to the three functions one, dbl, and incDbl	**Positive integer that is the value of the expression**
`incDbl(dbl(dbl(one())))`	
`dbl(incDbl(incDbl(one())))`	

Part 6b: You are given the following function definition for `printPatternLine`:

```
def printPatternLine(char1, char1Repeat, char2, chunkWidth, chunkRepeat):
    chunk = (char1*char1Repeat) + (char2*(chunkWidth - char1Repeat))
    print(chunk*chunkRepeat)
```

In the box below, fill in the missing arguments to the `printPatternLine` function calls so that `printPattern()` **prints** this output:

```
Y.....Y.....Y.....
ZZZZ-----ZZZZ-----
```

```
def printPattern():

    printPatternLine(                                    )

    printPatternLine(                                    )
```

Part 6c: In the box below, define a function named box3 that takes three strings and **prints** them left-justified inside a rectangular box made of +, -, and | characters, as shown in these examples:

box3('apple', 'banana', 'pear') **prints**	box3('two', 'roads', 'diverged') **prints**
+------+ |apple | |banana| |pear | +------+	+--------+ |two | |roads | |diverged| +--------+

Your definition **must not** include any conditionals and **must** include **three** invocations of the following `printBoxLine` function (in addition to invocations of `print`):

```
def printBoxLine(word, numSpaces):
     print('|' + word + (' '*numSpaces) + '|')
```

Define your **box3** *function in this box:*

Simple Functions 7: Defining and calling functions

Part 7a: Define a function `rectangle` that takes four parameters — two strings that are characters (a border character and a filler character) and two integers (the width and the height of the rectangle) — and **prints** rectangles like the ones shown below.

- Assume that each of the width and the height is 2 or greater.
- Recall that * can be used to repeat a string.
- For **full credit**, your function **must** use a **`while`** loop (but **substantial partial credit** will be awarded if it uses a correct **`for`** loop).

`rectangle('#', '.', 5, 4)`	`rectangle('@', '-', 6, 3)`	`rectangle('&', '+', 4, 6)`

`#####`
`#...#`
`#...#`
`#####`
	`@@@@@@`
	`@----@`
	`@@@@@@`
		`&&&&`
		`&++&`
		`&++&`
		`&++&`
		`&++&`
		`&&&&`

Define your `rectangle` function in this box.

Part 7b: (You do not have to define `rectangle` correctly in part 3a in order to answer this part.) In the box below, write an invocation of the `rectangle` function that will display the pattern shown in the box to the left (assuming `rectangle` is correctly defined).

```
????????
?      ?
?      ?
?      ?
????????
```

Write your invocation of rectangle in this box:

Simple Functions 8: Defining and calling functions

Define a function `buildSandwich` that takes three parameters: bread (a string), filling (a string), and layers (an integer). Your function should **print** lines of text to form a sandwich: the bread string appears on the top and bottom with the filling word in the middle. The total number of lines should be the number of layers requested by the user. Your function should use the printFilling helper function defined below to do this, and should NOT include any loops.

```
def printFilling(f,n):
   for i in range(n):
      print(f)
```

`> buildSandwich('pita','falafel',3)`	`> buildSandwich('toast','butter',5)`	`> buildSandwich('rye','tuna',4)`
pita falafel pita	toast butter butter butter toast	rye tuna tuna rye

Define your `buildSandwich` *function in this box.*

Booleans and Predicates

Booleans and Predicates 1: `exactlyTwoEqual` predicate

In the box below, define a function named `exactlyTwoEqual` that takes three numbers and returns `True` if exactly two or them are equal and `False` otherwise. For example:

```
exactlyTwoEqual(6, 8, 6) ⇒ True    exactlyTwoEqual(6, 8, 5) ⇒ False
exactlyTwoEqual(7, 7, 4) ⇒ True    exactlyTwoEqual(5, 5, 5) ⇒ False
exactlyTwoEqual(8, 9, 9) ⇒ True
```

Booleans and Predicates 2: Age Predicates

In this problem you will define and use **predicates**, which are functions that return booleans. **You are NOT allowed to use `if/else` statements in any of your definitions. Instead, you should combine booleans with `and/or/not`.**

Part 7a: Define a predicate `isTeenager` that has one parameter for age (an integer) and returns true when the age is in the teen years (thirteen to nineteen). For example, `isTeenager(13)` and `isTeenager(19)` should both return `True`, but `isTeenager(12)` and `isTeenager(20)` should both return `False`.

Part 7b:: Assume that you have been given correct definitions for the following two predicates:

- `isMinor(age)`: returns `True` if `age` <= 15, and `False` otherwise.
- `canRetire(age)`: returns `True` if `age` >= 67, and `False` otherwise.

Define a predicate `isWorkingAge` that has one parameter for age and returns `True` if a person with that age is of working age (between the ages of 16 and 66, inclusive) and `False` otherwise. Your definition **must not contain any numbers**. Instead, it **must call both the `isMinor` and `canRetire` functions to determine the answer**. For example, `isWorkingAge(16)` and `isWorkingAge(66)` should both return `True`, but `isWorkingAge(15)` and `isWorkingAge(67)` should both return `False`.

Part 7c:: Define a predicate `isNonWorkingAge` that has one parameter for the age and returns `True` if a person with that age is **not** of working age (as defined above) and `False` otherwise. Your definition **must not contain any numbers and must *not* call `isWorkingAge`**. Instead **must call both the `isMinor` and `canRetire` functions to determine the answer**. For example, `isNonWorkingAge(15)` and `isNonWorkingAge(67)` should both return `True`, but `isNonWorkingAge(16)` and `isNonWorkingAge(66)` should both return `False`.

Part 7d: Define a predicate `isWorkingTeenager` that has one parameter for the age and returns `True` if a person with that age is a teenager who is of working age and `False` otherwise. Your definition **must not contain any numbers and must *not* call `isMinor` or `canRetire`.** Instead it **must call both `isTeenager` and `isWorkingAge`** (which you can assume are correct). For example, `isWorkingTeenager(16)` and `isWorkingTeenager(19)` should both return `True`, but `isWorkingTeenager(15)` and `isWorkingTeenager(20)` should both return `False`.

Booleans and Predicates 3: Understanding and Defining Predicates

Part 3a: The following mysteryPred predicate takes three boolean arguments and returns a boolean result.

```
def mysteryPred(bool1, bool2, bool3):
    return ((bool1 or bool2 or bool3)
            and (not (bool1 and bool2 and bool3))
```

Fill in the following table to show the results of calls to the `mysteryPred` function:

Function call	Result		Function call	Result
`mysteryPred(False, False, False)`			`mysteryPred(True, False, True)`	
`mysteryPred(True, False, False)`			`mysteryPred(True, True, True)`	

Part 3b: Define a predicate named `isShortIn` that takes two string arguments `s1` and `s2` and returns `True` only if all **three** of the following conditions are satisfied:

1. `s1` is a substring in `s2`
2. `s1` has at most three characters.
3. `s2` does not begin with the substring `s1`. (You can use **string slicing** to test this!)

For example:

Function call	Result		Function call	Result
`isShortIn('war', 'toward')`	`True`		`isShortIn('it', 'kitty')`	`True`
`isShortIn('ward', 'toward')`	`False`		`isShortIn('kit', 'kitty')`	`False`
`isShortIn('to', 'toward')`	`False`		`isShortIn('dog', 'kitty')`	`False`

For **full** credit, your definition should not use any conditionals (`if` statements).

Define your isShortIn predicate in this box:

Booleans and Predicates 4: Predicates

Part 4a: Define a predicate named `outsideRange` that takes three numbers (`num`, `lo`, and `hi`), where you may assume that `lo` is less than or equal to `hi`. It **returns** `True` when `num` is outside the range between `lo` and `hi` (inclusive) and `False` otherwise. For example:

```
outsideRange(1, 3, 5) ⇒ True   outsideRange(2, 3, 5) ⇒ True   outsideRange(3, 3, 5) ⇒ False
outsideRange(4, 3, 5) ⇒ False  outsideRange(5, 3, 5) ⇒ False  outsideRange(6, 3, 5) ⇒ True
```

Below, complete the two different function definitions for `outsideRange` so that they both behave correctly.

```
def outsideRange(num, lo, hi):
    return                  or
```

```
def outsideRange(num, lo, hi):
    return not (                    and                    )
```

Part 4b(i): The three most frequent letters in English texts are `e`, `t`, and `a`. In the box below, define a predicate named `isFrequentLetter` that takes a single string argument. It **returns** `True` if the string is a lower-case or upper-case version of one of these three letters, and `False` otherwise. For example:

```
isFrequentLetter('e') ⇒ True   isFrequentLetter('T') ⇒ True   isFrequentLetter('a') ⇒ True
isFrequentLetter('x') ⇒ False  isFrequentLetter('B') ⇒ False  isFrequentLetter('eta') ⇒ False
```

Recall that if `s` is a string, then `s.lower()` returns the lower-case version of the string.

```
# In this definition, you must *not* use any conditional (if/else) statements
```

Part 4b(ii): In the box below, define a predicate named `containsAllFrequentLetters` that takes a single string argument. It **returns** `True` if the string contains **all** of the letters `e`, `t`, and `a` in any case (lower or upper) and `False` otherwise. For example:

```
containsAllFrequentLetters('cattle') ⇒ True   containsAllFrequentLetters('eagle') ⇒ False
containsAllFrequentLetters('TEAM') ⇒ True     containsAllFrequentLetters('CS111') ⇒ False
```

```
# In this definition, you must *not* use any conditional (if/else) statements
```

Booleans and Predicates 5: Predicates

In this problem you will define and use **predicates**, which are functions that return booleans. **You are NOT allowed to use `if/else` statements in any of your definitions. Instead, you should combine booleans with `and/or/not`.**

Part 5a [2 pts]: Define a predicate `isCurrentStudent` that has one parameter for class year (an integer) and returns `True` when the year is the graduation date of a current college student (2024-2027). For example, `isCurrentStudent(2023)` and `isCurrentStudent(2028)` should both return `False`, but `isCurrentStudent(2024)` and `isCurrentStudent(2027)` should both return `True`.

Part 5b [2 pts]: Define a predicate `isRedClass` that has one parameter for class year and returns `True` if that class year's color is red and `False` otherwise. The class color of 2024 is red; class colors rotate on a 4 year cycle.
For example, `isRedClass(2020), isRedClass(2024)` and `isRedClass(2028)` should all return `True`, but `isRedClass(2025)` should return `False`.

Part 5c [4 pts]: Assume that you have been given correct definitions for the following two predicates:

- `isPurpleClass(year)`: returns `True` if the class year was a purple class (2014, 2018, 2022, 2026 …) and `False` otherwise.
- `isAlum(year)`: returns `True` if the graduation year is before 2024 and `False` otherwise.

Define a predicate `isPurpleAlum` that has one parameter for year and returns `True` if a person with that graduation year is an alum from a purple class and `False` otherwise. Your definition **must not contain any numbers**. Instead, it **must call both the `isPurpleClass` and `isAlum` functions to determine the answer**. For example, `isPurpleAlum(2022)` and `isPurpleAlum(2018)` should both return `True`. `isPurpleAlum(2026)` and `isPurpleAlum(2023)` should both return `False`.

Part 5d [2 pts]: Define a predicate `isNotPurpleAlum` that has one parameter for the class year and returns `True` if a person with that class year is **not** of a purple class alum and `False` otherwise. Your definition **must not contain any numbers and must *not* call `isPurpleAlum`**. It **must call both the `isAlum` and `isPurpleClass` functions to determine the answer**. For example, `isNotPurpleAlum(2026)` and `isNotPurpleAlum(2023)` should both return `True`, but `isNotPurpleAlum(2022)` and `isNotPurpleAlum(2018)` should both return `False`.

Conditionals

Conditionals 1: Understanding conditionals

In the table below, show what is printed for various calls of this **`analyze`** function:

```
def analyze(word):
    if len(word) <= 4:
        print('S')
    else:
        print('L')
    if isVowel(word[0]):
        print('V0')
        if not isVowel(word[1]):
            print('C1')
    elif isVowel(word[1]):
        print('V1')
    else:
        print('C01')
    if isVowel(word[-1]): # last letter of word
        print('VU')
        if not isVowel(word[-2]): # next to last letter of word
            print('CP')
```

```
def isVowel(char):
    return len(char) == 1 and char.lower() in 'aeiou'
```

Function call	Printed Output		Function call	Printed Output
`analyze('cat')`			`analyze('spree')`	
`analyze('oats')`			`analyze('apple')`	

Conditionals 2: Conditionals with `whichName`

Define a function named `whichName`, which takes two parameters that represent potential cat names and returns which one is best. The function `whichName` must **return** the best cat name indicated as the string `'#1'` or `'#2'` given the following rules:

- Names with titles ("Mr. Biggles") are the best. Any string that includes a period contains a title.
- If both names have a title or neither name has a title, the longer name is best.
- If the length of the names are the same, choose the name that is alphabetically last.

Examples:

```
In[]: whichName("Ms. Piggy","Whiskers")
Out[]: '#1'

In[]: whichName("Fancy Feast","Giganotosaurus")
Out[]: '#2'

In[]: whichName("Tuna","Foxy")
Out[]: '#1'

In[]: whichName("Ms. Piggy","Ms. Puffy")
Out[]: '#2'
```

You must not use loops for this problem. Hint: < and > can be used to compare strings.

```
# Define your whichName function in this box
```

Conditionals 3: Printing Time (Function with Conditionals & Booleans)

In the box at the bottom of this problem, define a function **`printTime`** that takes three arguments:

1. **`day`**: a day of the week, which is one of the strings **`'Sun'`**, **`'Mon'`**, **`'Tue'`**, **`'Wed'`**, **`'Thu'`**, **`'Fri'`**, **`'Sat'`**
2. **`hour`**: an integer between 1 and 12, inclusive
3. **`ampm`**: one of the strings **`'AM'`** or **`'PM'`**

printTime prints *exactly one word* as specified below. It does not return anything.

- For a weekend day (Sat or Sun), it prints **`weekend`**.
- For a weekday (Mon through Fri):
    - It prints **`evening`** from 5PM up to and including 11PM
    - It prints **`sleep`** from midnight (12AM) up to and including 8AM.
      Note that midnight is considered the beginning of a new day, not the end of a previous day.
    - It prints **`class`** for all other times — i.e., from 9AM up to and including 4PM.
      This range includes noon (12PM).

Here are some examples:

Function call	**Printed Output**		**Function call**	**Printed Output**
`printTime('Sat',12,'AM')`	`weekend`		`printTime('Mon',12,'AM')`	`sleep`
`printTime('Sat',10,'AM')`	`weekend`		`printTime('Wed',3,'AM')`	`sleep`
`printTime('Sun',11,'PM')`	`weekend`		`printTime('Fri',8,'AM')`	`sleep`
`printTime('Mon',5,'PM')`	`evening`		`printTime('Tue',9,'AM')`	`class`
`printTime('Thu',8,'PM')`	`evening`		`printTime('Wed',12,'PM')`	`class`
`printTime('Fri',11,'PM')`	`evening`		`printTime('Thu',4,'PM')`	`class`

In your definition you do **not** need to handle cases where an input is an unexpected value (e.g., an invalid day or ampm string or an hour that is not an integer in the range 1 to 12 inclusive).

`(Please keep all your code within the box)`

Conditionals 4: `lmnop`

Define a function named `lmnop` that takes a single letter and returns an integer according to these rules:

- If the letter is one of the five letters in `l`, `m`, `n`, `o`, or `p` (either lower or upper case) then 5 is returned
- If the letter comes before the `l` in the alphabet (letter "el", not the digit 1!) in the alphabet, 1 is returned
- If the letter comes after `p` in the alphabet, then 3 is returned

`lmnop` should treat upper and lower case letters the same way. You may assume the input is a string consisting of a single alphabetic letter; you should **not** handle input strings whose length is not 1, nor nonalphabetic characters like digits, punctuation or spaces. Below are some sample invocations. Recall that characters can be compared alphabetically using < and >, e.g. `('a' < 'b')` is `True` because `'a'` comes before `'b'` in the alphabet.

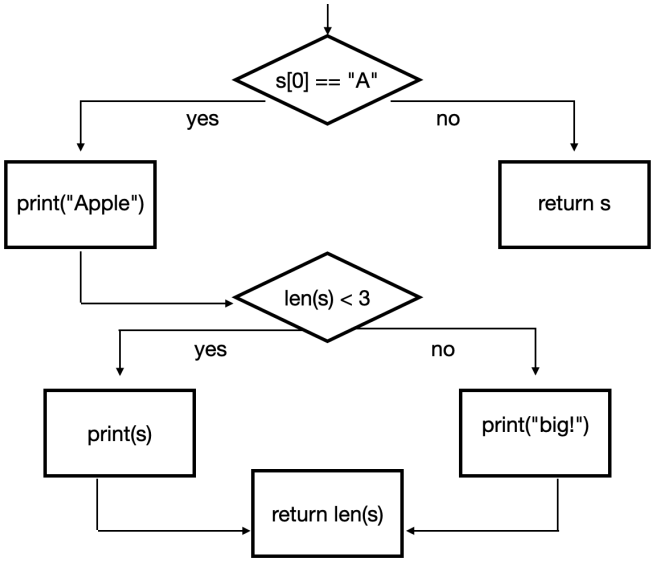
```
 In[]: lmnop('a')
Out[]: 1
 In[]: lmnop('p')
Out[]: 5
 In[]: lmnop('L')
Out[]: 5
 In[]: lmnop('T')
Out[]: 3
 In[]: lmnop('C')
Out[]: 1
```

```
Define your lmnop function in this box
```

Conditionals 5: Implementing a program based on a flow chart

Define a function called `stringExplorer` that implements the flow chart shown to the right. Your function should have one parameter, s.

Define your `stringExplorer` *function in this box:*



Understanding `while` Loops

Understanding while Loops 1: mystery while loop

Study the **`mystery`** function below, which uses the provided **`isVowel`** function.

```
def isVowel(char):
    return len(char) == 1 and char.lower() in 'aeiou'

def mystery(word, bound):
    """Docstring withheld."""
    result = ''
    i = 0

    while len(result) < bound and i < len(word):
        if (not isVowel(word[i])) and word[i] not in result:
            result += word[i]
        i += 1

    if result == '':
        return 'No result'

    return result
```

Predict the outcome of the following invocations of the **`mystery`** function:

Function call	Value returned by function call
`mystery('pineapple', 1)`	
`mystery('pineapple', 4)`	
`mystery('guava', 2)`	
`mystery('oooooh', 2)`	
`mystery('ooooo', 2)`	

Understanding while Loops 2: While Loops with user input

Consider this **askForFruit** function:

```
def askForFruit():
  name = ''
  while len(name) <= 6:
    name = input('Fruit? ')
  print('Done')
```

Select **all** the valid possible outcomes consistent with executing `askForFruit()`

☐ Choice A Fruit? Apple Fruit? Strawberry Done	☐ Choice B Fruit? LightBlue Done
☐ Choice C Fruit? Apple Done	☐ Choice D Fruit? Banana Fruit? Fofana Done
☐ Choice E Fruit? Watermelon Fruit? Apple Fruit? Grapes Done	☐ Choice F Fruit? Apple Fruit? Orange Fruit? Cantaloupe Done

Understanding while Loops 3: Using an iteration table to understand a loop

You are given this definition of a `mysteryLines` function.

```
def mysteryLines(c, h):
    i = 1
    while i < h + 1:
        s = h - i
        if i == 1 or i == h:
            m = 2 * i - 1
            line = ('-' * s) + (c * m) + ('-' * s)
        else:
            m = 2 * i - 3
            line = ('-' * s) + c + ('-' * m) + c + ('-' * s)
        # In the iteration table, show the values of state variables at this point
        print(line)
        i += 1
```

For the invocation **`mysteryLines('*', 4)`**, in each row of the iteration table below, show the values of the state variables in each execution of the **body** of the **`for`** loop **right before the call to `print`**.

- The iteration table has more rows than needed, so at least one will be blank
- Unlike some other iteration tables you have seen in class, this iteration table **should not** have any row containing the values of state variables **before** the loop is entered.

Fill in this iteration table for ***`mysteryLines('*', 4)`***

i	h	s	m	line

Understanding while Loops 4: Tracing loops and conditionals

Below is a function `doSomething` that contains a `while` loop and conditional statements. Trace the execution of invoking the `doSomething` function with different arguments by showing what is **printed** and what is **returned** for each invocation.

```
def doSomething(n):
    # n is an *integer*
    answer = ''
    # answer is a *string*
    while n > 2:
        answer = answer + str(n)
        if n%2 == 0:
            print(n, 'E')
        elif n % 9 == 0:
            print(n, 'T')
            # early return
            return answer

        if n == 10:
            print(n, 'R')
        elif n >= 7:
            print(n, 'H')
            if n <= 12:
                print(n, 'L')
            else:
                print(n, 'M')
        else:
            print(n, 'S')
        # update n in loop:
        n = n - 4
    # return result after loop
    if len(answer) >= 3:
        return '#' + answer
    else:
        return '!' + answer
```

```
>>> doSomething(10)
```

Show what is **printed**:	Show what is **returned**:

```
>>> doSomething(13)
```

Show what is **printed**:	Show what is **returned**:

```
>>> doSomething(7)
```

Show what is **printed**:	Show what is **returned**:

Understanding while Loops 5: Tracing loops and conditionals

Below is a function `process` that contains a `while` loop and conditional statements. Trace the execution of invoking the `process` function with different arguments by showing what is **printed** and what is **returned** for each invocation.

```
def process(n):
    # n is an *integer*
    answer = ''
    # answer is a *string*
    while n > 0:
        answer = answer + str(n)
        if n%2 == 0:
            print(n, 'E')
        if n > 9:
            print(n, 'G')
        elif n == 8:
            print(n, 'R')
            # early return
            return answer
        elif n >= 5:
            print(n, 'H')
            if n <= 7:
                print(n, 'L')
            else:
                print(n, 'M')
        else:
            print(n, 'S')
        # update n in loop:
        n = n - 5
    # return result after loop
    if len(answer) >= 3:
        return '#' + answer
    else:
        return '!' + answer
```

```
>>> process(10)
```

Show what is **printed**:	Show what is **returned**:

```
>>> process(9)
```

Show what is **printed**:	Show what is **returned**:

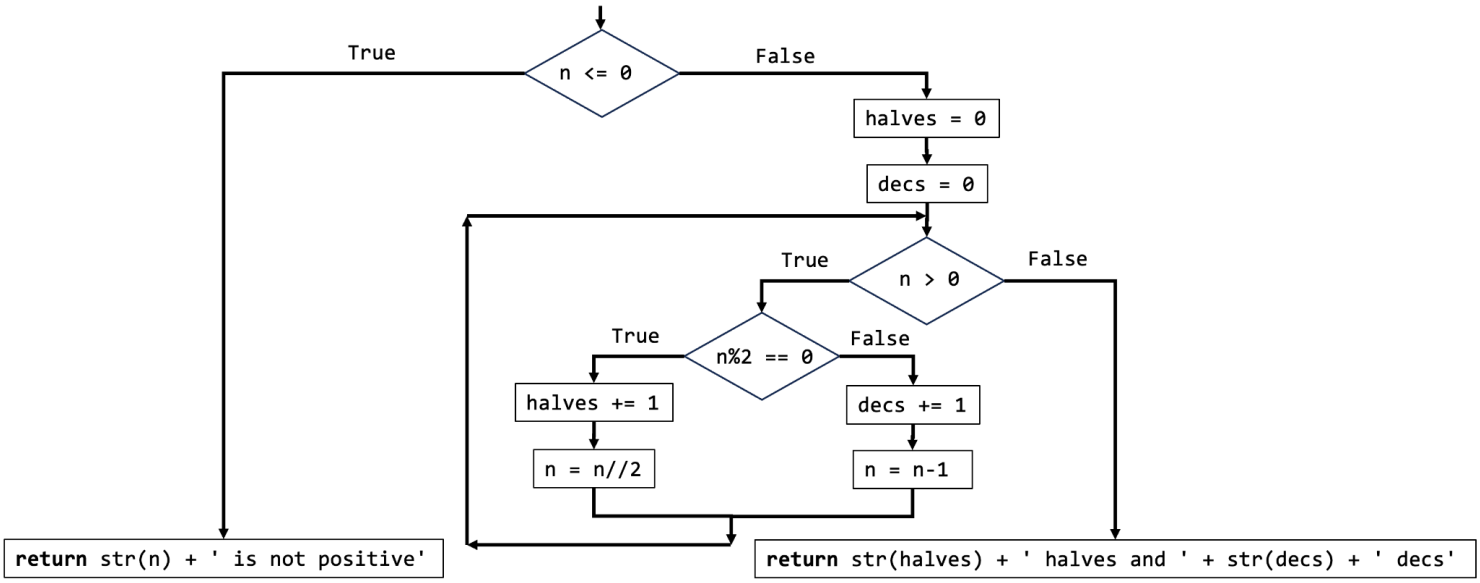
```
>>> process(8)
```

Show what is **printed**:	Show what is **returned**:

Understanding while Loops 6: Flow diagrams, iteration tables, and while loops

This problem involves a function named `halvesAndDecs`, which has a single integer parameter `n` and returns a string. The function counts the number of **halves** (n//2 operations) and **decs** (n-1 operations) performed in a loop within the body of the function. ("dec" is short for "decrement", which means to subtract 1 from a number.)

The body of the `halvesAndDecs` function is expressed by this flow diagram:



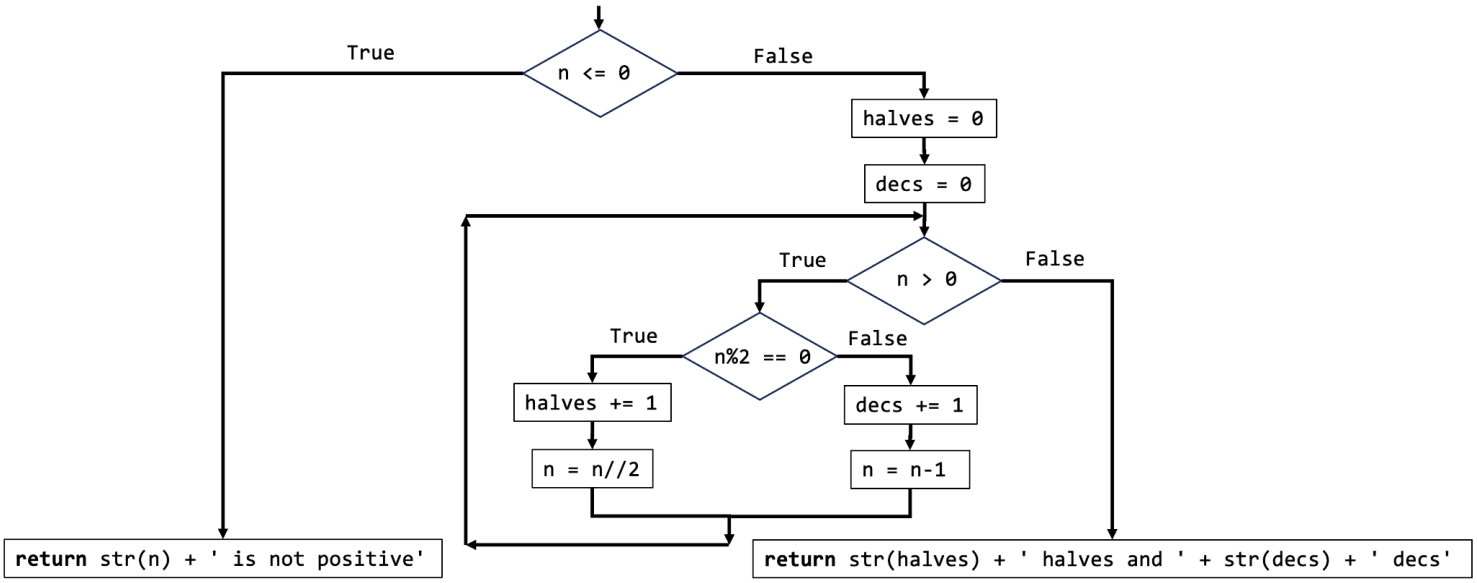
Part 6a [10 pts]: For the function invocation `halvesAndDecs(10)` , fill in the missing values in the rows of the iteration table below. Each row shows the values of the variables n, halves, and decs right before the loop condition `n > 0` is tested. **The iteration table has more rows than needed, so at least one will be blank**.

Number of times loop body has been executed	**n**	**halves**	**decs**
0	**10**	**0**	**0**
1			
2			
3			
4			
5			

Part 6b [8 pts]: In the box below, complete the body of the `halvesAndDecs` function in Python so that it correctly expresses the meaning of the flow diagram (copied below). **Make sure that your indentation is clear!**

```
def halvesAndDecs(n):
```

Here is a copy of the flow diagram for reference:



Understanding for Loops

Understanding for loops 1: Tracing conditionals

Given the function `calcPoints` below, show what is (1) returned and (2) printed by the following invocations. Assume that `lmnop` works correctly, as described above in Conditionals 4: `lmnop`.

```
def calcPoints(word):
    points = 0
    for char in word:
        if char == 'y':
            points = 10  # =, not +=
        elif char in 'aeiou':
            points = points * 2
        elif char in '0123456789':
            # early return
            return points + int(char)
        points += lmnop(char)
        print(char, points)
    return points
```

`In[]: calcPoints('bye')` `Out[]:` *Show what is returned:*	*Show what is printed:*

`In[]: calcPoints('iou')` `Out[]:` *Show what is returned:*	*Show what is printed:*

`In[]: calcPoints('R45ot')` `Out[]:` *Show what is returned:*	*Show what is printed:*

Understanding for loop 2: Conditionals in loops in `getScore`

This problem involves the following `getScore` function:

```
def getScore(word):
    score = 0
    for char in word:
        if char.isdigit():
            score = score + int(char)
            print(char, 'return1', score)
            return score
        elif char == 't':
            score = 10 # note: this uses =, not +=
        elif char in 'aeiou':
            score = score * 2
        else:
            score = score + 1
        print(char, 'if1', score)
        if char < 'i':  # compare by dictionary order
            if char > 'c':  # compare by dictionary order
                score += 5
            score += 3
        print(char, 'if2', score)
    print(char, 'return2', score)
    return score
```

For each of the following calls of `getScore`, show the output of all the print statements and what is returned.

Call	What is printed	What is returned
`getScore("show")`		
`getScore("pots")`		
`getScore("cat32")`		

Understanding for loops 3: Tracing for loops and conditionals

Given the function `wordScore`, show what is (1) returned and (2) printed by the following function calls.
If nothing is printed, write "nothing."

The predicate `isVowel` returns `True` for vowels (any letter in the string "aAeEiIoOuU") and `False` otherwise.

```
def wordScore(word):
    result = 0
    if word[1] == word[0]:
        result += 1
    for char in word:
        if char in "!?":
            result += 100
            return result
        if isVowel(char):
            print('+',char)
            result += 2
        else:
            print('++', char)
    print('Finished!')
    return result
```

`In[]: wordScore('et&c')` `Out[]:` *Show what is returned:*	*Show what is printed:*

`In[]: wordScore('eek')` `Out[]:` *Show what is returned:*	*Show what is printed:*

`In[]: wordScore('z?y!')` `Out[]:` *Show what is returned:*	*Show what is printed:*

Understanding for loops 4: Tracing for loops and conditionals

You are given the function `string_inspector` that contains conditional statements. Trace the execution of invoking this function with different arguments by showing what is **printed** and what is **returned** for each invocation.

- `char.upper()` returns the uppercase version of `char` if it's a letter; otherwise it just returns `char`.
- `char.isupper()` returns `True` if `char` is an uppercase letter and `False` otherwise

```
def string_inspector(s):
    result = '$'
    for char in s:
        result += char.upper()

        if char.isupper():
            print("P")

        if char == 'a':
            if 'd' in s:
                print("Q")
            else:
                print("R")
        elif char == 'b':
            if s[-1] == 'd':
                print("S")
            else:
                print("T")
        elif char in 'cdef':
            print("U")
            if s[0] == 'z':
                return result
        else:
            print("W")

    if len(s) >= 4:
        return result + "!"
    else:
        return result + "*"
```

```
>>> string_inspector("Abba")
```

Show what is **printed**:	Show what is **returned**:

```
>>> string_inspector("zemor")
```

Show what is **printed**:	Show what is **returned**:

```
>>> string_inspector("bad")
```

Show what is **printed**:	Show what is **returned**:

Understanding for Loops 5: Tracking variables

This problem involves the following function definition that uses the **tracking variable** `prev` to keep track of the previous letter in the word while the **`for`** loop is executed. You may assume that `isVowel` correctly returns `True` if its string argument is a lower or upper case version of the letters `a`, `e`, `o`, `i`, `u`, and is otherwise `False`.

```
def process(word):   # line 1
    newWord = ''         # line 2
    prev = ''            # line 3
    for letter in word:  # line 4
        if isVowel(letter) or isVowel(prev):  # line 5
            newWord += letter                 # line 6
        # print('prev', prev, 'letter', letter, 'newWord', newWord) # line 7
        prev = letter    # line 8
    return newWord       # line 9
```

Part a: [6 pts] Suppose the debugging `print` on line 7 is uncommented. Fill in the underlined parts in the following printed output to show what is printed when `process('purple')` is called. if the empty string is printed, leave the underlined part blank.

```
prev ____ letter ____ newWord _______________
prev ____ letter ____ newWord _______________
prev ____ letter ____ newWord _______________
prev ____ letter ____ newWord _______________
prev ____ letter ____ newWord _______________
prev ____ letter ____ newWord _______________
```

Part b: [3 pts] Show the **result** returned by the following three calls to `process`. Assume that line 7 is commented out, so that nothing is printed. Write the result value after the arrow ⇒, remembering to quote all string values.

`process('length')` ⇒ `process('odious')` ⇒ `process('bcd')` ⇒

Understanding for loops 6: Debugging a loop

This problem involves a function `hasThreeConsecutiveVowels` that should return `True` when called on a string that contains at least three consecutive vowels and `False` for any other string. For example, it should return `True` for strings like `"bureau"`, `"precious"` , and `"queue"` and `False` for strings like `"cat"`, `"nation"`, and `"evoke"`.

Below is a buggy version of `hasThreeConsecutiveVowels` that does not work correctly.

```
def buggyHasThreeConsecutiveVowels(string):  # line 1
    counter = 0                              # line 2
    for letter in string:                    # line 3
        if isVowel(letter):                  # line 4
            counter += 1                     # line 5
            if counter == 3:                 # line 6
                return True                  # line 7
    return False                             # line 8
```

Assume that the function `isVowel` correctly returns `True` when its single argument is a vowel (a single letter in `aeiouAEIOU`) and `False` otherwise.

Part 3a Are there any counterexample strings for which `buggyHasThreeConsecutiveVowels` returns `True` when `hasThreeConsecutiveVowels` returns `False`?

- If yes, give an example of such a counterexample string, and explain in English the structure of such counterexample strings.
- If no, explain why such counterexample strings are not possible.=

Part 3b Are there any counterexample strings for which `buggyHasThreeConsecutiveVowels` returns `False` when `hasThreeConsecutiveVowels` returns `True`?

- If yes, give an example of such a counterexample string, and explain in English the structure of such counterexample strings.
- If no, explain why such counterexample strings are not possible.

Part 3c It is possible to add code between two consecutive lines of `buggyHasThreeConsecutiveVowels` so that the modified function behaves like the correct `hasThreeConsecutiveVowels`. Specify the two lines between which the new code should be added and what the new code is.

Defining functions with loops

Defining functions with loops 1: Hiding characters

Define a function named `hide` that takes a string and replaces certain characters with a `'*'`. The `hide` function will take two parameters: (1) a string and (2) a string of characters such that if any of them occur in the first string parameter, they are to be hidden (replaced) by a `'*'`. For full credit, `hide` should contain one `for` loop.
Below are some sample invocations.

Invocation	Result
`hide('apple', 'p')`	`'a**le'`
`hide('apple', 'pa')`	`'***le'`
`hide('coffee', 'oe')`	`'c*ff**'`
`hide('coffee', 'xyz')`	`'coffee'`
`hide('winter is coming', 'coming')`	`'w**ter *s ******'`

Define your `hide` function in the box below:

Defining functions with loops 2: Duplicating odd characters

Define a function `duplicateOddChars` that takes a string as its single argument and returns a string containing all the characters of the given string in order **except** that each character at an **odd index** is duplicated.

- Recall that indexing starts at 0.
- For **full credit**, your function **must** use a **while** loop (but **substantial partial credit** will be awarded if it uses a correct **for** loop).

Below are shown some examples of invoking the function.

```
>>> duplicateOddChars('Omaha, NE')
'Ommahha,, NNE'

>>> duplicateOddChars('ba')
'baa'

>>> duplicateOddChars('yes!')
'yees!!'
```

```
>>> duplicateOddChars('I')
'I'

>>> duplicateOddChars('')
''
```

Define your `duplicateOddChars` function in this box.

Defining functions with loops 3: Shouting a string

Define a function `shout` that takes a string as its single argument and **returns** a version of the string in which

- all alphabetic characters **and spaces** are kept but all other non-space non-alphabetic characters have been removed;
- all alphabetic characters have been capitalized.

Below are some sample invocations of `shout`:

```
>>> shout('{one}, (two), [three]')
'ONE TWO THREE'

>>> shout('!@Foo#$BAR%^baz&*')
'FOOBARBAZ'
```

```
>>> shout('You say "Goodbye!", and I say "Hello!"')
'YOU SAY GOODBYE AND I SAY HELLO'

>>> shout('')
''
```

- In your `shout` definition, you may use either a **`for`** loop or a **`while`** loop, whichever you find easier.
- If s is a string, then `s.isalpha()` returns `True` if all the characters in s are alphabetic, and False otherwise.
- You can test for a space character using `==`.
- If s is a string, then `s.upper()` returns a version of s in which all alphabetic characters are capitalized.

Define your **`shout`** *function in this box.* ***Make sure that your indentation is clear!***

Defining functions with loops 4: Swapping case in a string

Define a function `swapCase` that takes a string as its single argument and **returns** a version of the string in which

- all alphabetic characters **and spaces** are kept, but all other non-space non-alphabetic characters have been removed;
- all lower-case alphabetic characters have been upper-cased and all upper-cased alphabetic characters have been lower-cased. (An upper-case letter is just a capital letter; a lower-case letter is not a capital.)

Below are some sample invocations of `swapCase`:

```
>>> swapCase('lower Capitalized UPPER')
'LOWER cAPITALIZED upper'

>>> swapCase('I am NOT shouting but TALKING!')
'i AM not SHOUTING BUT talking'

>>> swapCase('Happy Birthday! You're the *BEST*') =>
'hAPPY bIRTHDAY yOURE THE best'
```

- In your `swapCase` definition, you should use a **`for`** loop to get full credit
- If s is a string, then
  - `s.isalpha()` returns `True` if **all** the characters in s are alphabetic, and `False` otherwise.
  - `s.islower()` returns `True` if **all** the alphabetic characters in s are lower case, and `False` otherwise. (`s.isupper()` is similar for upper case , but it's not necessary in this problem.)
  - `s.lower()` returns a version of s in which all letters are lower-cased.
  - `s.upper()` returns a version of s in which all letters are upper-cased.
- You can test for a space character using `==`.

Define your `swapCase` *function in this box.* ***Make sure that your indentation is clear!***

Defining functions with loops 5: Laughing strings

Part 8a: Define a function named `laughStretch` with four parameters — two strings (a word and a filler character) and two integers (maxReps and length) — that **prints** stretched words like the ones shown below. The function repeats the word until it reaches the target length or runs out of allowed repetitions, and then fills any leftover space with the filler character.

- `maxReps` is the maximum number of times that word can be repeated in the final string
- `length` is the minimum length of the final string
- You can assume that the `filler` argument will contain a single character.
- Recall that * can be used to repeat a string.
- For **full credit**, your function **must** use a **`while`** loop (but **substantial partial credit** will be awarded if it uses a correct **`for`** loop).

Below are shown some examples of invoking the function.

```
>>> laughStretch("ha","~",10,6)
hahaha

>>> laughStretch("ha","~",2,6)
haha~~

>>> laughStretch("teehee","!",1,10)
teehee!!!!
```

```
>>> laughStretch("ha","w",2,7)
hahawww

>>> laughStretch("ha","w",4,7)
hahahaha
```

Define your `laughStretch` *function in this box.*

Part 8b: (You do not have to define `laughStretch` correctly in part 4a in order to answer this part.) In the box below, write an invocation of the `laughStretch` function that will display the pattern below if `laughStretch` is correctly defined:

```
teehee!teehee!!!
```

Write your invocation of `laughStretch` *in this box:*

Defining functions with loops 6: Converting a tracking variable to an index loop

This problem is related to the one in Understanding for Loops 5: Tracking variables. It involves the following function definition that uses the **tracking variable** `prev` to keep track of the previous letter in the word while the **`for`** loop is executed. You may assume that `isVowel` correctly returns `True` if its string argument is a lower or upper case version of the letters `a`, `e`, `o`, `i`, `u`, and is otherwise `False`.

```
def process(word):   # line 1
    newWord = ''         # line 2
    prev = ''            # line 3
    for letter in word:  # line 4
        if isVowel(letter) or isVowel(prev):  # line 5
            newWord += letter                 # line 6
        # print('prev', prev, 'letter', letter, 'newWord', newWord) # line 7
        prev = letter    # line 8
    return newWord       # line 9
```

Below, show how to define an alternative version of `process` that uses an **index loop** expressed with a **`while`** loop rather than a tracking variable expressed with a **`for`** loop to handle accessing the previous letter. The definition has been started for you; you must complete it. You should ***not*** include the commented debugging print from line 7 in your definition.

```
def process(word):
    """version of process with an index loop using while"""
    index = 0
    while                          :
```

Defining functions with loops 7: `replaceVowelSequences` *[tests writing a complex loop]*

Because vowels are more likely to change over time than consonants, linguists sometimes describe words in terms of just their consonants, putting in a star (asterisk) for a sequence of consecutive vowels. So `'dog'` would be written `'d*g'` and `'seafood'` would be written as `'s*f*d'`.

In this problem you will write a function `replaceVowelSequences` that takes a word and returns a string that replaces each **sequence** of vowels in the word with a single asterisk. Here are iteration tables that show the function working on some examples:

Iteration Tables

Example 1: `'dog'`

char	**result**	**inVowelSequence**
	`''`	`False`
`d`	`'d'`	`False`
`o`	`'d*'`	`True`
`g`	`'d*g'`	`False`

Example 2: `'seafood'`

char	**result**	**inVowelSequence**
	`''`	`False`
`s`	`'s'`	`False`
`e`	`'s*'`	`True`
`a`	`'s*'`	`True`
`f`	`'s*f'`	`False`
`o`	`'s*f*'`	`True`
`o`	`'s*f*'`	`True`
`d`	`'s*f*d'`	`False`

Define `replaceVowelSequences` in the box below using a **for** loop with the state variables shown in the above iteration tables. Assume there is a correct `isVowel` predicate that you can use without defining it.

Defining functions with loops 8: firstDigits *[tests writing a complex loop]*

Define a function named `firstDigits` that takes a string containing only spaces and digits and returns a string containing the first digits from each group of digits. `firstDigits` has a single string parameter and returns a string.

If the string passed into `firstDigits` is not empty, it will always begin with a digit and end with a digit. If the string is empty, the function should return the string "NOTHING!" You can assume the groups of digits are separated by single spaces.

For full credit, `firstDigits` must contain exactly one while loop or `for` loop, and cannot use .split().
Here are some sample function calls:

Invocation	Result
`firstDigits('19 500 0')`	`'150'`
`firstDigits('')`	`'NOTHING!'`
`firstDigits('34 34 34 34')`	`'3333'`
`firstDigits('1 2 3')`	`'123'`

Write your `firstDigits` function in the box below: