
Introduction to Software Design

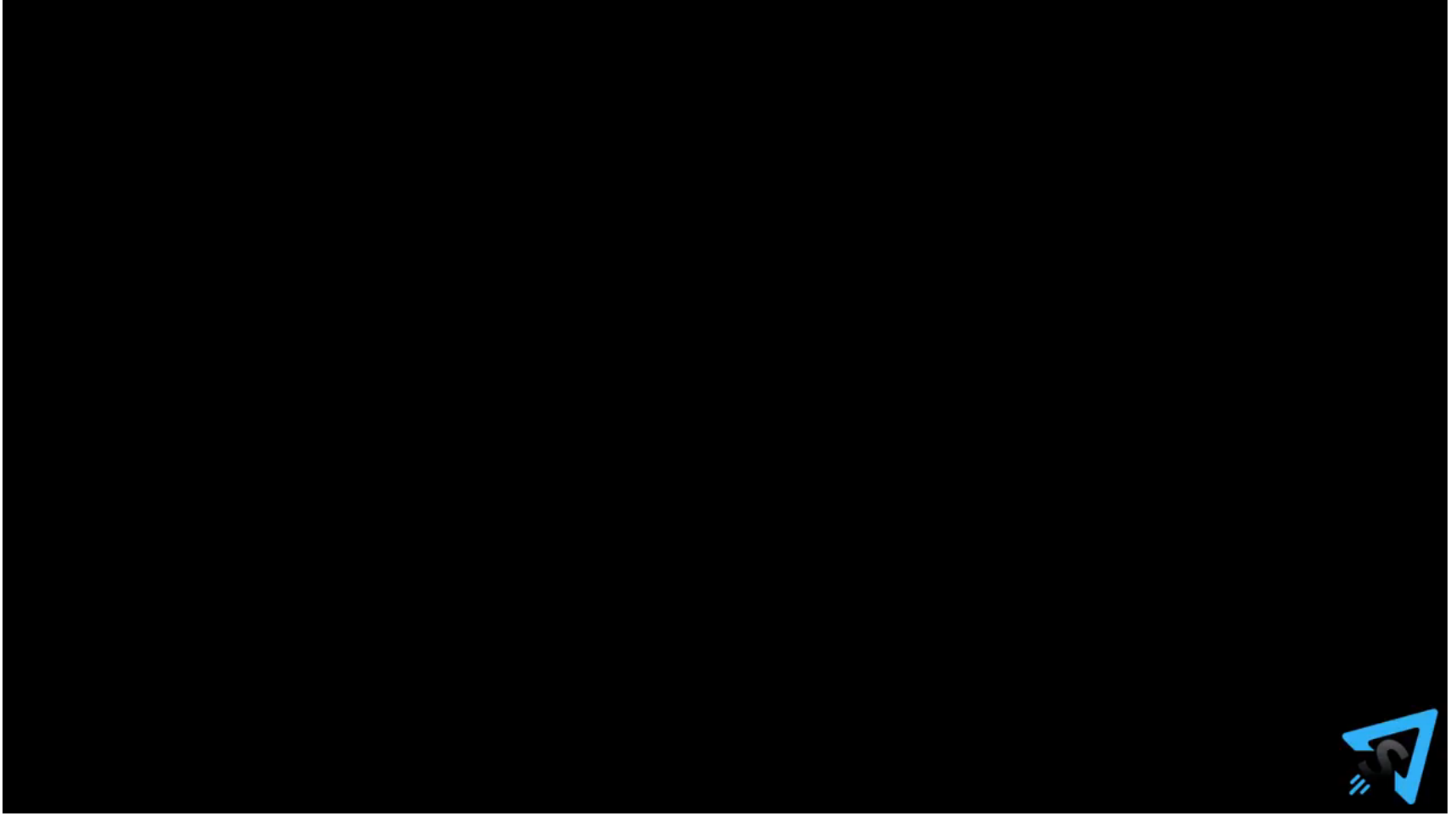
P04. Hangman

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Introduction

- “Hangman”
 - Sample Run
 - Source Code
- Designing the Program
- Code Explanation
- Things Covered In This Chapter

Hangman



“Hangman”

- Sample Run

H A N G M A N

```

+---+
|
|
|
=====
Missed letters:
_ _ _ a _
Guess a letter.
a
o
```

```

+---+
|
O
|
|
|
=====
Missed letters: o
_ a _
Guess a letter.
r
t
```

```

+---+
|
O
|
|
|
=====
Missed letters: or
_ a t
Guess a letter.
a
You have already guessed that letter. Choose again.
Guess a letter.
c
Yes! The secret word is "cat"! You have won!
Do you want to play again? (yes or no)
no
```

“Hangman”

- Source Code(1/4)

```

import random
HANGMAN_PICS = [ '''
  +---+
  |   |
      |
  ==='' , ...

  +---+
  | 0 |
      |
  ==='' , ...

  +---+
  | 0 |
  |  |
  ==='' , ...

  +---+
  | 0 |
  | / |
  ==='' , ...

  +---+
  | 0 |
  | / | W
  ==='' , ...

  +---+
  | 0 |
  | / | W
  | /
  ==='' , ...

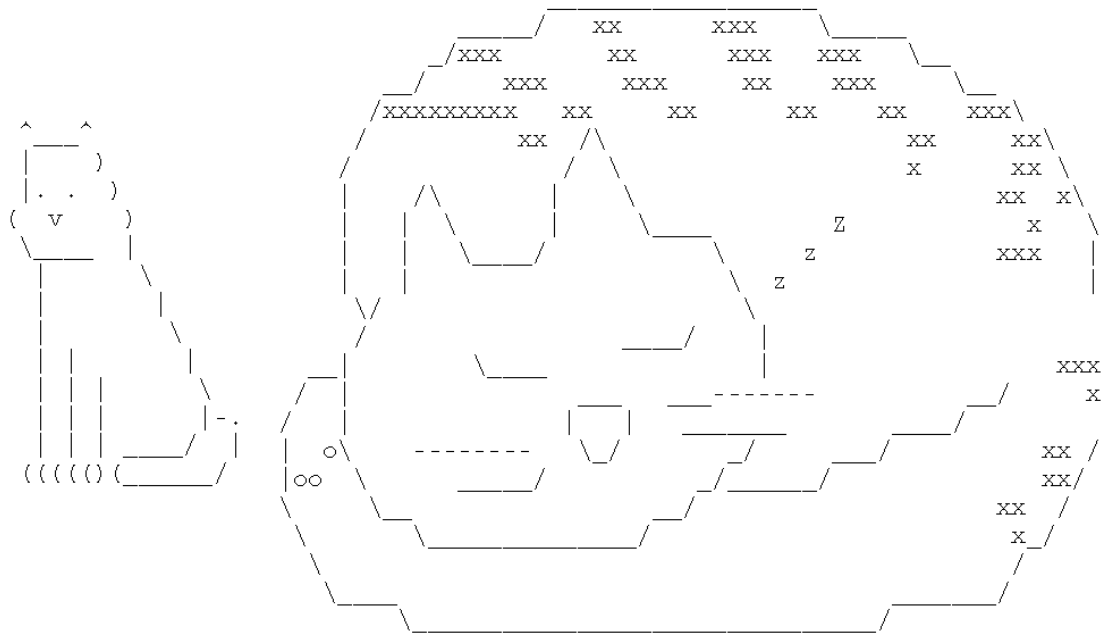
  +---+
  | 0 |
  | / | W
  | / W
  ==='' ]

words = 'ant baboon badger bat bear beaver camel cat clam cobra cougar W
coyote crow deer dog donkey duck eagle ferret fox frog goat goose hawk W
lion lizard llama mole monkey moose mouse mule newt otter owl panda W
parrot pigeon python rabbit ram rat raven rhino salmon seal shark sheep W
skunk sloth snake spider stork swan tiger toad trout turkey turtle weasel W
whale wolf wombat zebra'.split()

```

ASCII Art

- ASCII Art
 - Half of the lines of code in the Hangman **aren't really code at all**.
 - Multiline Strings that use **keyboard characters** to draw pictures.
 - **ASCII** stands for **American Standard Code for Information**



ASCII Table

ASCII code

Dec = Decimal Value
Char = Character

'5' has the int value 53

if we write '5'-'0' it evaluates to 53-48, or the int 5

if we write char c = 'B'+32; then c stores 'b'

- ASCII character table

Dec	Char	Dec	Char	Dec	Char	Dec	Char
0	NUL (null)	32	SPACE	64	@	96	`
1	SOH (start of heading)	33	!	65	A	97	a
2	STX (start of text)	34	"	66	B	98	b
3	ETX (end of text)	35	#	67	C	99	c
4	EOT (end of transmission)	36	\$	68	D	100	d
5	ENQ (enquiry)	37	%	69	E	101	e
6	ACK (acknowledge)	38	&	70	F	102	f
7	BEL (bell)	39	'	71	G	103	g
8	BS (backspace)	40	(	72	H	104	h
9	TAB (horizontal tab)	41	)	73	I	105	i
10	LF (NL line feed, new line)	42	*	74	J	106	j
11	VT (vertical tab)	43	+	75	K	107	k
12	FF (NP form feed, new page)	44	,	76	L	108	l
13	CR (carriage return)	45	-	77	M	109	m
14	SO (shift out)	46	.	78	N	110	n
15	SI (shift in)	47	/	79	O	111	o
16	DLE (data link escape)	48	0	80	P	112	p
17	DC1 (device control 1)	49	1	81	Q	113	q
18	DC2 (device control 2)	50	2	82	R	114	r
19	DC3 (device control 3)	51	3	83	S	115	s
20	DC4 (device control 4)	52	4	84	T	116	t
21	NAK (negative acknowledge)	53	5	85	U	117	u
22	SYN (synchronous idle)	54	6	86	V	118	v
23	ETB (end of trans. block)	55	7	87	W	119	w
24	CAN (cancel)	56	8	88	X	120	x
25	EM (end of medium)	57	9	89	Y	121	y
26	SUB (substitute)	58	:	90	Z	122	z
27	ESC (escape)	59	;	91	[	123	{
28	FS (file separator)	60	<	92	\	124	|
29	GS (group separator)	61	=	93	]	125	}
30	RS (record separator)	62	>	94	^	126	~
31	US (unit separator)	63	?	95	_	127	DEL

“Hangman”

- Source Code(2/4)

```
def getRandomWord(wordList):
    # This function returns a random string from the passed list of strings.
    wordIndex = random.randint(0, len(wordList) - 1)
    return wordList[wordIndex]

def displayBoard(missedLetters, correctLetters, secretWord):
    print(HANGMAN_PICS[len(missedLetters)])
    print()

    print('Missed letters:', end=' ')
    for letter in missedLetters:
        print(letter, end=' ')
    print()

    blanks = '_' * len(secretWord)

    for i in range(len(secretWord)): # replace blanks with correctly guessed letters
        if secretWord[i] in correctLetters:
            blanks = blanks[:i] + secretWord[i] + blanks[i+1:]

    for letter in blanks: # show the secret word with spaces in between each letter
        print(letter, end=' ')
    print()
```


“Hangman”

- Source Code(3/4)

```
def getGuess(alreadyGuessed):  
    # Returns the letter the player entered. This function makes sure the player  
    while True:  
        print('Guess a letter.')  
        guess = input()  
        guess = guess.lower()  
        if len(guess) != 1:  
            print('Please enter a single letter.')  
        elif guess in alreadyGuessed:  
            print('You have already guessed that letter. Choose again.')  
        elif guess not in 'abcdefghijklmnopqrstuvwxyz':  
            print('Please enter a LETTER.')  
        else:  
            return guess  
  
def playAgain():  
    # This function returns True if the player wants to play again; otherwise, i  
    print('Do you want to play again? (yes or no)')  
    return input().lower().startswith('y')  
  
print('H A N G M A N')  
missedLetters = ''  
correctLetters = ''  
secretWord = getRandomWord(words)  
gameIsDone = False
```

“Hangman”

- Source Code(4/4)

```
while True:
    displayBoard(missedLetters, correctLetters, secretWord)

    # Let the player enter a letter.
    guess = getGuess(missedLetters + correctLetters)

    if guess in secretWord:
        correctLetters = correctLetters + guess

        # Check if the player has won.
        foundAllLetters = True
        for i in range(len(secretWord)):
            if secretWord[i] not in correctLetters:
                foundAllLetters = False
                break
        if foundAllLetters:
            print('Yes! The secret word is "' + secretWord + '"! You have won!')
            gamelsDone = True
    else:
        missedLetters = missedLetters + guess

        # Check if player has guessed too many times and lost.
        if len(missedLetters) == len(HANGMAN_PICS) - 1:
            displayBoard(missedLetters, correctLetters, secretWord)
            print('You have run out of guesses!\nAfter ' + str(len(missedLetters)
            gamelsDone = True

        # Ask the player if they want to play again (but only if the game is done).
        if gamelsDone:
            if playAgain():
                missedLetters = ''
                correctLetters = ''
                gamelsDone = False
                secretWord = getRandomWord(words)
            else:
                break
```

Designing the Program

- Designing a Program with a Flowchart
 - Create a **flow chart** to help us visualize what this program will do.
 - A flow chart is a diagram that shows a series of steps as several boxes connected with arrows.
 - **Begin your flow chart with a Start and End box.**



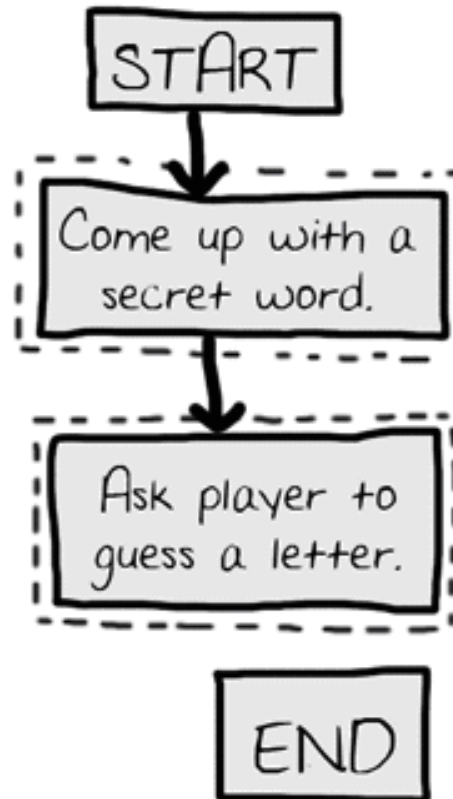
START



END

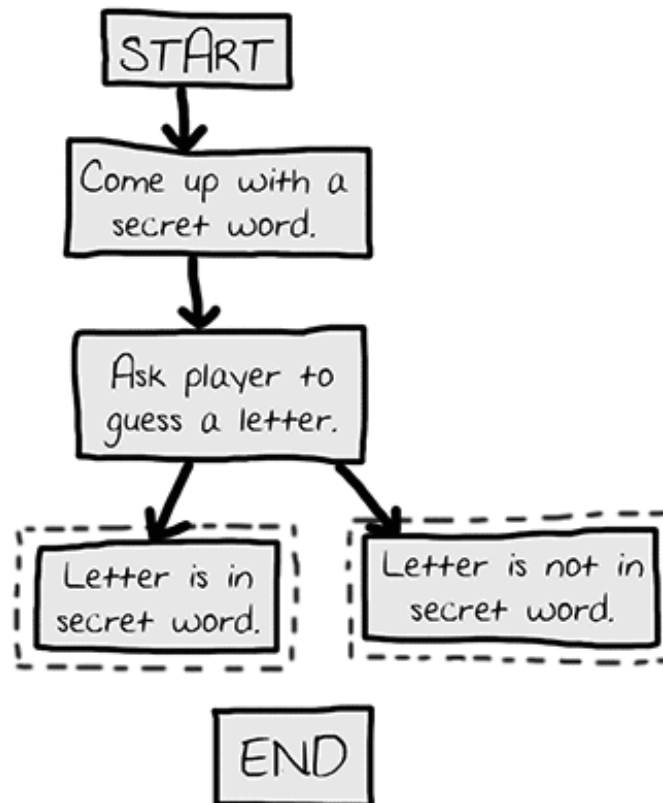
Designing the Program

- Designing a Program with a Flowchart
 - Draw out the first **two steps** of Hangman as boxes with descriptions.



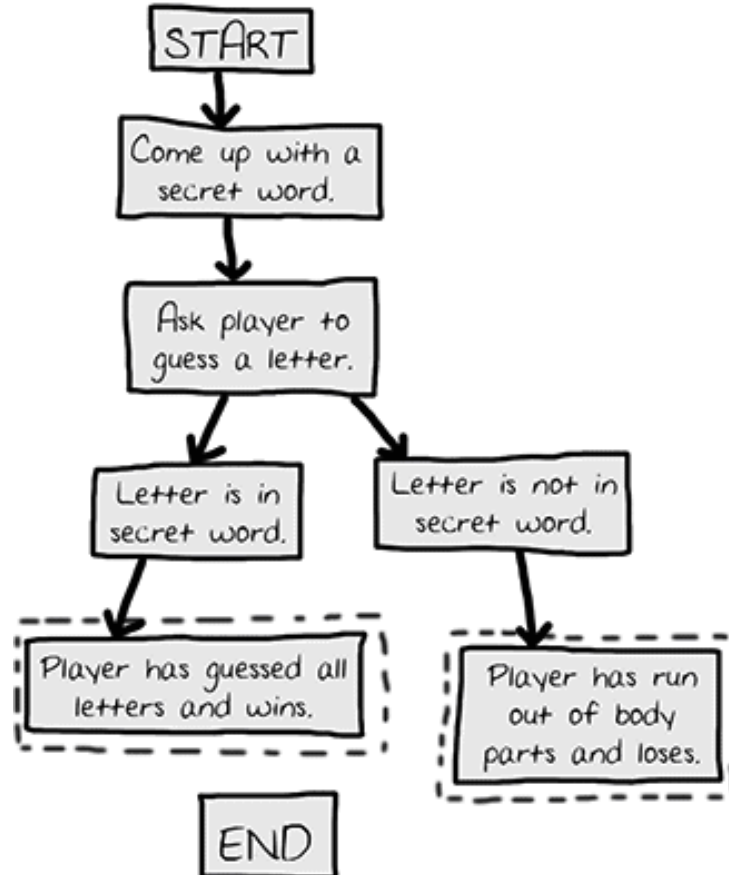
Designing the Program

- Designing a Program with a Flowchart
 - There are **two different things** that could happen after the player guesses, so have two arrows going to separate boxes.



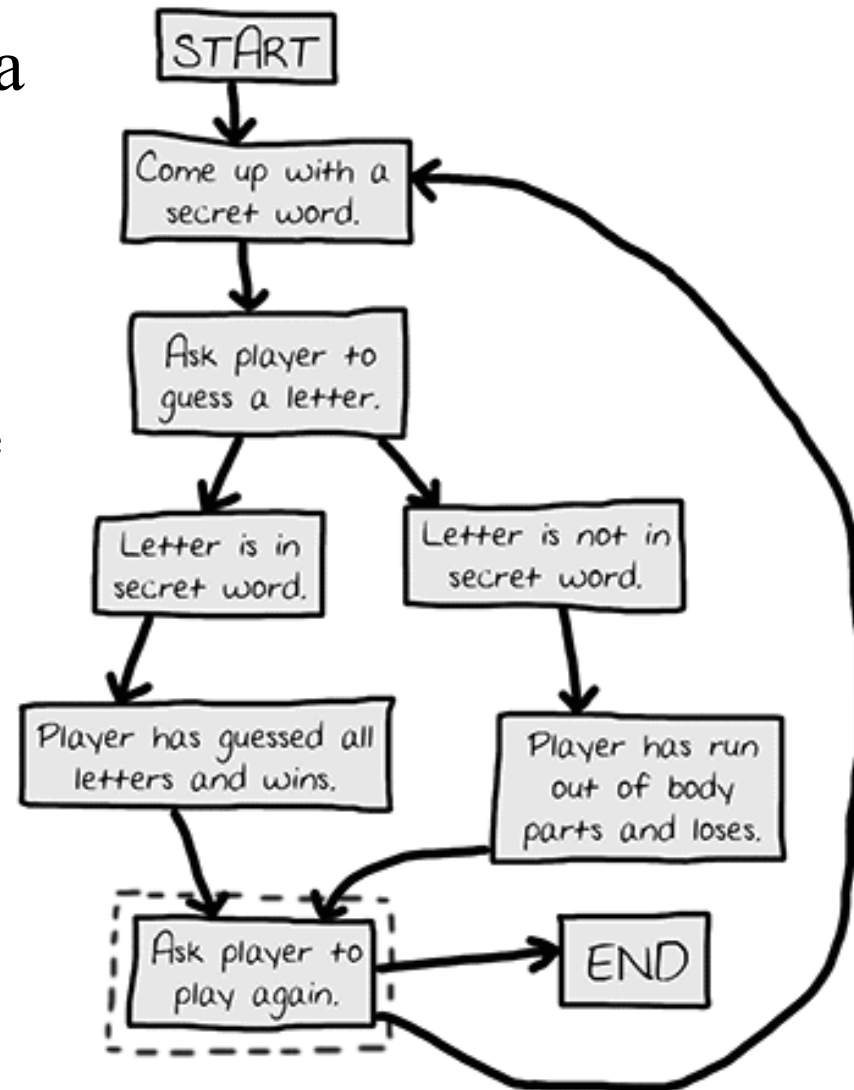
Designing the Program

- Designing a Program with a Flowchart
 - After the branch, the steps continue their separate paths.



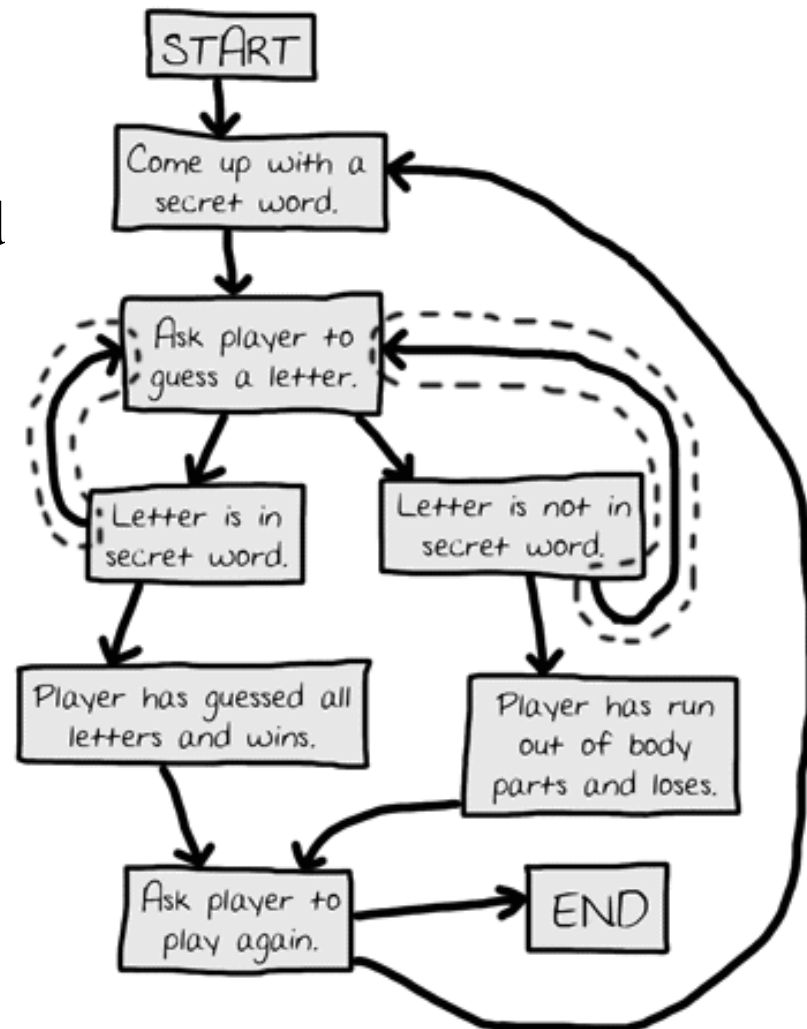
Designing the Program

- Designing a Program with a Flowchart
 - The game ends if the player doesn't want to play again, or the game goes back to the beginning.



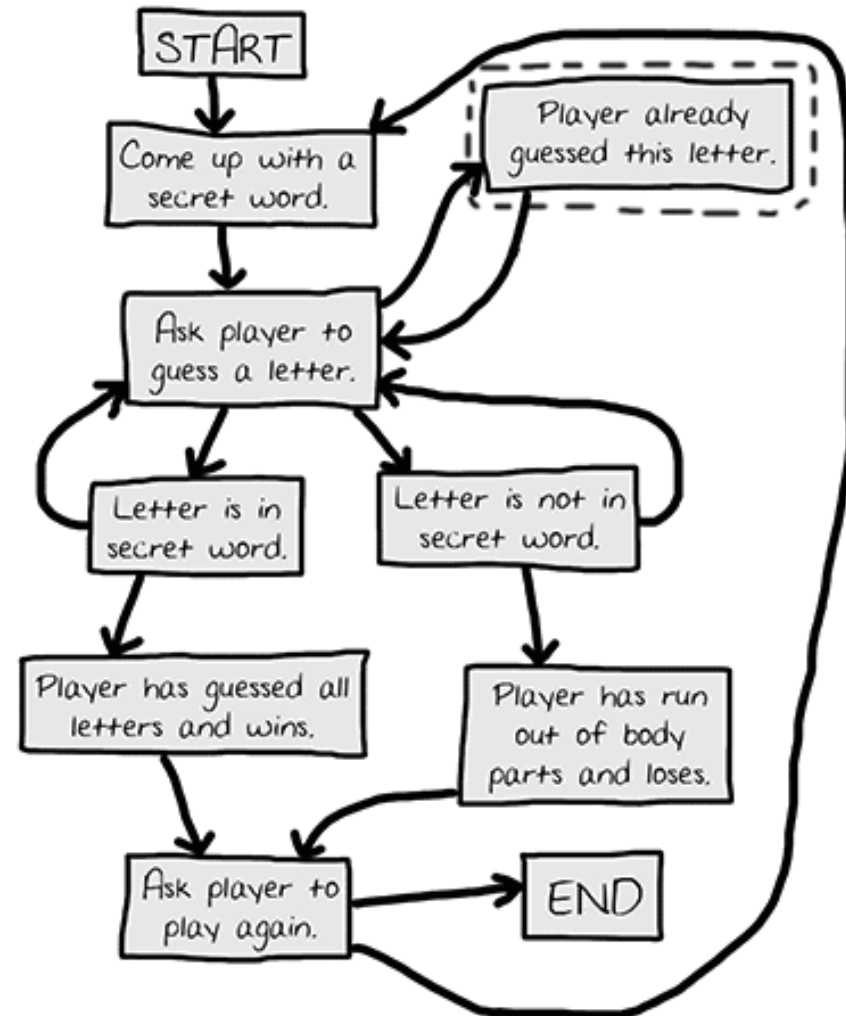
Designing the Program

- Designing a Program with a Flowchart
 - The game does not always end after a guess. The new arrows show that the player can guess again.



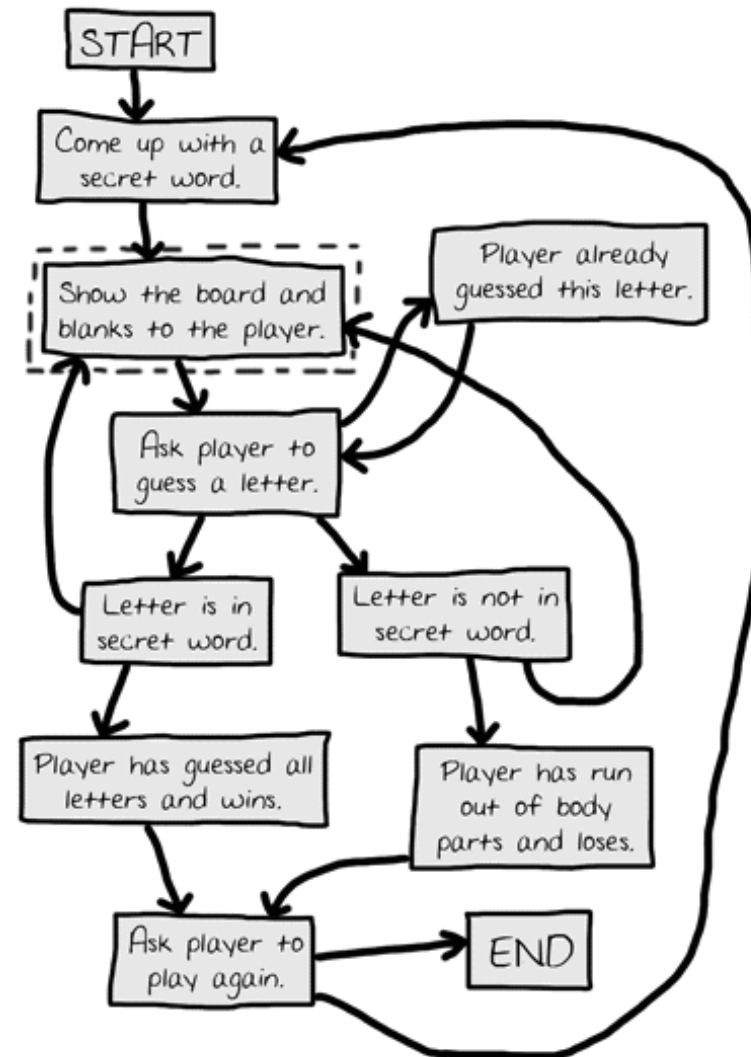
Designing the Program

- Designing a Program with a Flowchart
 - Adding a step if the player guesses a letter they already guessed.



Designing the Program

- Designing a Program with a Flowchart
 - Adding "Show the board and blanks to the player." to give the player feedback.



Code Explanation

- How the Code Works

```
import random
```

- The Hangman program is going to **randomly select** a secret word from a list of secret words.
- This means we will need the random module imported.

Code Explanation

- How the Code Works
 - This "line" of code is a simple variable creation.
 - Refer to page 6.

```
HANGMAN_PICS = [ '''  
  O  
  |  
--|  
    '''
```

```
...the rest of the code is too big to show here...
```

Code Explanation

- Multi-line Strings
 - if you use **three single-quotes** instead of one single-quote to begin and end the string, the string can be on several lines.

```
>>> fizz = '''Dear Alice,  
I will return home at the end of the month. I will see you then.  
Your friend,  
Bob'''  
>>> print(fizz)  
Dear Alice,  
I will return home at the end of the month. I will see you then.  
Your friend,  
Bob
```

Code Explanation

- Multi-line Strings
 - we would have to use the **\n escape character** to represent the new lines.
 - which can make the string **hard to read** in the source code.

```
>>> fizz = 'Dear Alice,\nI will return home at the end of the month.\nI will see you then.\nYour friend,\nBob'\n>>> print(fizz)\nDear Alice,\nI will return home at the end of the month. I will see you then.\nYour friend,\nBob
```

Code Explanation

- Multi-line Strings
 - Do not have to keep the same indentation to remain in the same block.
 - Within the multi-line string, Python **ignores the indentation rules** it normally has for where blocks end.

```
def writeLetter():  
    # inside the def-block  
    print('''Dear Alice,  
How are you? Write back to me soon.  
  
Sincerely,  
Bob''') # end of the multi-line string and print statement  
    print('P.S. I miss you.') # still inside the def-block  
  
writeLetter() # This is the first line outside the def-block.
```

Code Explanation

- Constant Variables
 - **HANGMAN_PICS**'s name is in all capitals.
 - This is the programming convention for constant variables.
 - Constants are variables whose values do not change throughout the program.

```
>>> eggs = 72
```

```
>>>
```

```
>>> DOZEN = 12
```

```
>>> eggs = DOZEN * 6
```

```
>>> eggs
```

```
72
```


Code Explanation

- Lists
 - A list value can contain several other values in it.
 - This is a list value that contains three string values.
 - Just like any other value, you can store this list in a variable.

```
>>> spam = ['apples', 'oranges', 'HELLO WORLD']  
>>> spam  
['apples', 'oranges', 'HELLO WORLD']
```

Code Explanation

- Lists
 - The individual values inside of a list are also called **items**.
 - **The square brackets** can also be used to get an item from a list.
 - The number between the square brackets is the **index**.

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']
>>> animals[0]
'aardvark'
>>> animals[1]
'anteater'
>>> animals[2]
'antelope'
>>> animals[3]
'albert'
```

Note that the list index starts from **0**, not 1

Code Explanation

- Lists
 - Lists are very good when we **deal with lots of values**.
 - Without using list, our code would be like this:

```
>>> animals1 = 'aardvark'  
>>> animals2 = 'anteater'  
>>> animals3 = 'antelope'  
>>> animals4 = 'albert'
```

Code Explanation

- Lists
 - Using the square brackets
 - you can treat items in the list just like any other value.
 - the expression `animals[0] + animals[2]` is the same as `'aardvark' + 'antelope'`.

```
>>> animals[0] + animals[2]  
'aardvarkantelope'
```

Code Explanation

- What happens if we enter an index that is larger than the list's largest index?

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']  
>>> animals[4]
```

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']  
>>> animals[99]
```

→ `IndexError: list index out of range`

Code Explanation

- Changing the Values of List Items with Index Assignment
 - Use the square brackets to **change the value** of an item in a list.
 - overwritten with a new string.

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']
>>> animals[1] = 'ANTEATER'
>>> animals
['aardvark', 'ANTEATER', 'antelope', 'albert']
```

Code Explanation

- List Concatenation
 - **Join lists** together into one list with the `+` operator.
 - this is known as **list concatenation**.

```
>>> [1, 2, 3, 4] + ['apples', 'oranges'] + ['Alice', 'Bob']  
[1, 2, 3, 4, 'apples', 'oranges', 'Alice', 'Bob']
```

Code Explanation

- The *in* Operator
 - Makes it easy to see if a value is inside a list or not.
 - Expressions that use the in operator return a **Boolean value**.
 - **True** if the value is in the list
 - **False** if the value is **not** in the list.

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']
>>> 'antelope' in animals
True
```


Code Explanation

- Removing Items from Lists with *del* Statements
 - You can remove items from a list with a `del` statement.

```
>>> spam = [2, 4, 6, 8, 10]
>>> del spam[1]
>>> spam
[2, 6, 8, 10]
>>> del spam[1]
>>> spam
[2, 8, 10]
>>> del spam[1]
>>> spam
[2, 10]
```

Code Explanation

- Lists of Lists
 - Lists are a data type that can contain other values as items in the list.
 - These items can also be a lists.

```
>>> groceries = ['eggs', 'milk', 'soup', 'apples', 'bread']
>>> chores = ['clean', 'mow the lawn', 'go grocery shopping']
>>> favoritePies = ['apple', 'frumleberry']
>>> listOfLists = [groceries, chores, favoritePies]
>>> listOfLists
[['eggs', 'milk', 'soup', 'apples', 'bread'], ['clean', 'mow
the lawn', 'go grocery shopping'], ['apple', 'frumleberry']]
```

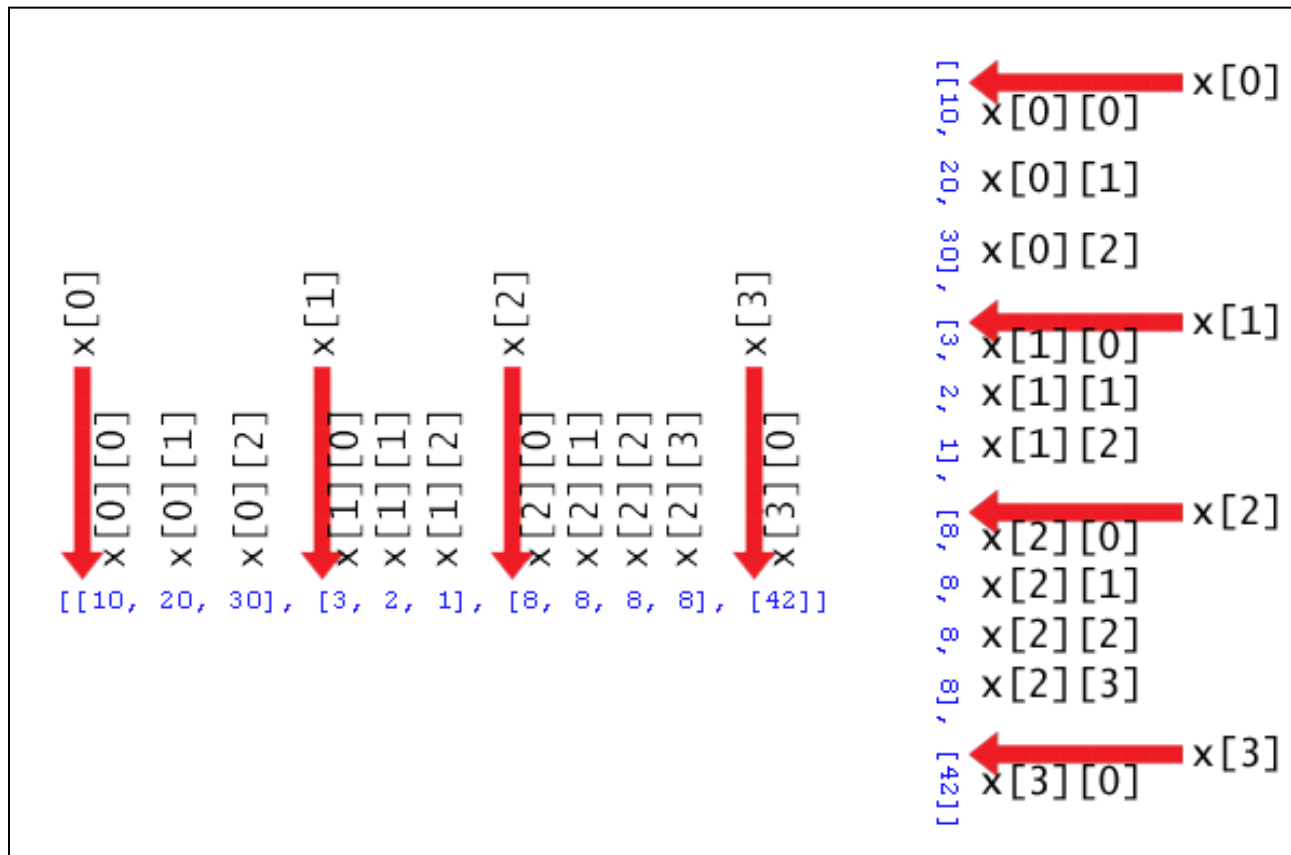
Code Explanation

- Lists of Lists
 - You could also type the following and get the same values for all four variables.

```
>>> listOfLists = [['eggs', 'milk', 'soup', 'apples', 'bread'],  
, ['clean', 'mow the lawn', 'go grocery shopping'], ['apple',  
'frumbleberry']]  
>>> groceries = listOfLists[0]  
>>> chores = listOfLists[1]  
>>> favoritePies = listOfLists[2]  
>>> groceries  
['eggs', 'milk', 'soup', 'apples', 'bread']  
>>> chores  
['clean', 'mow the lawn', 'go grocery shopping']  
>>> favoritePies  
['apple', 'frumbleberry']
```

Code Explanation

- Lists of Lists
 - The indexes of a list of lists.



Code Explanation

- List of multi-line strings
 - Assign a list to the variable `words` using the `split()` method.

```
words = 'ant baboon badger bat bear beaver camel cat  
clam cobra cougar coyote crow deer dog donkey duck  
eagle ferret fox frog goat goose hawk lion lizard ll  
ama mole monkey moose mouse mule newt otter owl pand  
a parrot pigeon python rabbit ram rat raven rhino sa  
lmon seal shark sheep skunk sloth snake spider stork  
swan tiger toad trout turkey turtle weasel whale wo  
lf wombat zebra'.split()
```

Code Explanation

- Methods
 - Methods are just like functions, but they are always attached to a value.
 - **The `lower()` and `upper()` String Methods**

```
>>> 'Hello world'.lower()  
'hello world'  
>>> 'Hello world'.upper()  
'HELLO WORLD'
```

- Can call a string method on that variable.

```
>>> fizz = 'Hello world'  
>>> fizz.upper()  
'HELLO WORLD'
```

Code Explanation

- Think about:

```
>>> 'Hello world'.upper().lower()
```

```
>>> 'Hello world'.lower().upper()
```

Code Explanation

- Methods
 - The **reverse()** List Method
 - reverse the order of the items in the list.

```
>>> spam = [1, 2, 3, 4, 5, 6, 'meow', 'woof']
>>> spam.reverse()
>>> spam
['woof', 'meow', 6, 5, 4, 3, 2, 1]
```


Code Explanation

- Methods
 - The **append()** List Method
 - add the value you pass as an argument to the end of the list.

```
>>> eggs = []
>>> eggs.append('hovercraft')
>>> eggs
['hovercraft']
>>> eggs.append('eels')
>>> eggs
['hovercraft', 'eels']
>>> eggs.append(42)
>>> eggs
['hovercraft', 'eels', 42]
```

Code Explanation

- Methods

- The **split()** string Method

- This line is just one very long string, full of words separated by spaces.
 - The `split()` method changes this long string into a list, with each word making up **a single list item**.

```
words = 'ant baboon badger bat bear beaver camel cat  
clam cobra cougar coyote crow deer dog donkey duck  
eagle ferret fox frog goat goose hawk lion lizard ll  
ama mole monkey moose mouse mule newt otter owl pand  
a parrot pigeon python rabbit ram rat raven rhino sa  
lmon seal shark sheep skunk sloth snake spider stork  
swan tiger toad trout turkey turtle weasel whale wo  
lf wombat zebra'.split()
```

Code Explanation

- Methods
 - The **split()** List Method
 - A string with words → a list of words

```
>>> 'My very energetic mother just served us nine pies'.split()  
['My', 'very', 'energetic', 'mother', 'just', 'served', 'us', '  
nine', 'pies']
```

Code Explanation

- The `len ()` Function
 - Argument = a list
 - Return = the number of items in the list.

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']
>>> len(animals)
4
>>> people = ['Alice', 'Bob']
>>> len(people)
2
>>> len(animals) + len(people)
6
```

Code Explanation

- The `len ()` function
 - The square brackets by themselves are also a list value known as the **empty list**.

```
>>> len ( [ ] )  
0  
>>> spam = [ ]  
>>> len (spam)  
0
```

Code Explanation

- The `getRandomWord()` Function
 - Gets a random item in `wordList` at `wordIndex`.
 - Does this by calling `randint()` with two arguments.
 - The reason we need the `- 1` is because the **indexes for lists start at 0**.

```
def getRandomWord(wordList):  
    # This function returns a random string from the  
    # passed list of strings.  
    wordIndex = random.randint(0, len(wordList) - 1)  
    return wordList[wordIndex]
```

Code Explanation

- The `displayBoard()` Function
 - This function has three parameters.

```
def displayBoard(missedLetters, correctLetters, secretWord):  
    print(HANGMAN_PICS[len(missedLetters)])  
    print()
```

missedLetters	a string made up of the letters the player has guessed that are not in the secret word.
correctLetters	a string made up of the letters the player has guessed that are in the secret word.
secretWord	the secret word that the player is trying to guess.

Code Explanation

- The `range()` Function
 - When called with one argument,
 - `range()` will return a range object of integers from 0 up to the argument.

```
>>> list(range(10))  
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]  
>>> list(range(10000))  
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15,...  
...The text here has been skipped for brevity...  
...9989, 9990, 9991, 9992, 9993, 9994, 9995, 9996, 9997,  
9998, 9999]
```


Code Explanation

- The `range ()` Function
 - The list is so huge, that it won't even all fit onto the screen.
 - But we can save the list into a variable just like any other list.

```
>>> spam = list(range(10000))
```

- If you pass **two arguments** to `range()`,
- The list of integers it returns is from the first argument up to **(but not including)** the second argument.

```
>>> list(range(10, 20))  
[10, 11, 12, 13, 14, 15, 16, 17, 18, 19]
```

Code Explanation

- `Revisit for` Loops

- The `for` loop is very good at looping over a list of values.
- begins with **`for`**, followed by a variable name, **`in`**, a sequence or a range object, and then `:`.
- Each time the program execution goes through the loop (on each **iteration** through the loop)
- Syntax

```
for index_variable in list_variable :  
    loop_body
```

```
for index_variable in string_variable :  
    loop_body
```

Code Explanation

- for Loops
 - we used the for statement with the **list** instead of `range()`.

```
>>> for i in [0, 1, 2, 3, 4, 5, 6, 7, 8, 9]:  
        print i  
  
0  
1  
2  
3  
4  
5  
6  
7  
8  
9
```

Code Explanation

- for Loops
 - For example

```
>>> for i in range(10):  
      print i
```

```
0  
1  
2  
3  
4  
5  
6  
7  
8  
9
```

for loop

- for Loops
 - For example

```
for i in range(10):  
    print(i)
```

0
1
2
3
4
5
6
7
8
9

```
for i in range(1,10):  
    print(i)
```

1
2
3
4
5
6
7
8
9

```
for i in range(10,0,-1):  
    print(i)
```

10
9
8
7
6
5
4
3
2
1

Code Explanation

- for Loop
 - A single character from the string can be displayed on each iteration.

```
>>> for i in 'Hello world!':  
        print i
```

```
H  
e  
l  
l  
o  
  
w  
o  
r  
l  
d  
!
```

Code Explanation

- for Loop
 - This for loop will display all the missed guesses that the player has made.
 - If missedLetters was 'ajtw', then this for loop would display a j t w.

```
print('Missed letters:', end=' ')\nfor letter in missedLetters:\n    print(letter, end=' ')\nprint()
```

Code Explanation

- A while Loop Equivalent of a for Loop
 - You can make a while loop that acts the same way as a for loop by adding extra code.

```
>>> sequence = ['cats', 'pasta', 'programming', 'spam']
>>> index = 0
>>> while (index < len(sequence)):
    thing = sequence[index]
    print 'I really like ' + thing
    index = index + 1
```

```
I really like cats
I really like pasta
I really like programming
I really like spam
```


Code Explanation

- Displaying the Secret Word with Blanks
 - Now we want to **print the secret word**, except we want **blank lines** for the letters.
 - We can use the **_ character** (called the underscore character) for this.

secret word	blanked string
otter	_____ (five _ characters)

correctLetters	blanked string
rt	_tt_r

Code Explanation

- Displaying the Secret Word with Blanks
 - * operator can also be used on a string and an integer.
 - so the expression 'hello' * 3 evaluates to 'hellohellohello'
 - This will make sure that blanks has the same number of underscores as secretWord has letters.

```
blanks = '_' * len(secretWord)

for i in range(len(secretWord)): # replace blanks with correctly guessed let
    if secretWord[i] in correctLetters:
        blanks = blanks[:i] + secretWord[i] + blanks[i+1:]
```

Code Explanation

- Strings Act Like Lists
 - Just think of strings as “list” of one-letter strings.

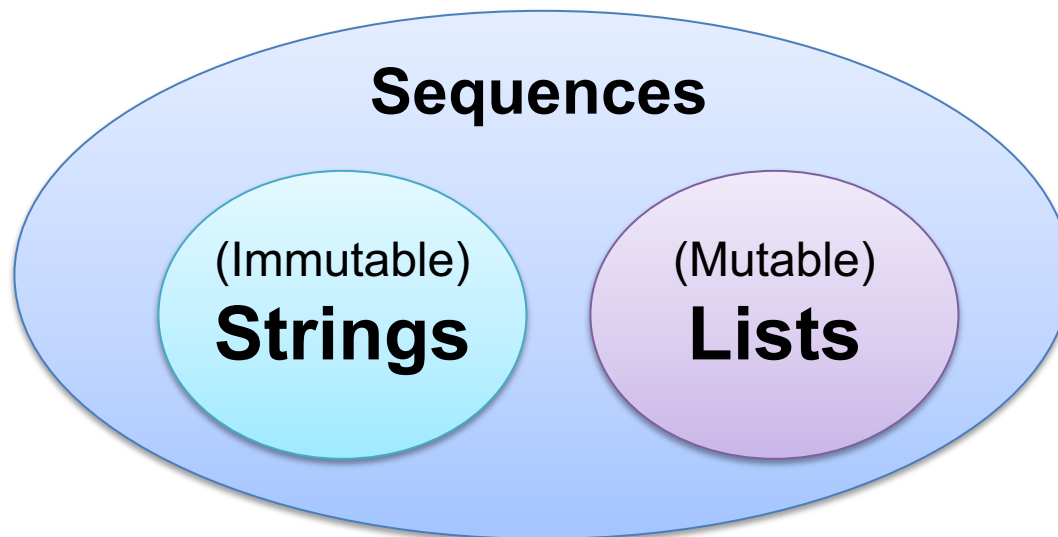
```
>>> fizz = 'Hello world!'
>>> fizz[0]
'H'
```

- You can also find out how many characters are in a string with the `len()` function.

```
>>> fizz = 'Hello world!'
>>> fizz[0]
'H'
>>> len(fizz)
12
```

Code Explanation

- Strings Act Like Lists
 - You **cannot change** a character in a string or **remove a character** with `del` statement.
 - List: **mutable** sequence (changeable)
 - String: **immutable** sequence (cannot be changed)



Code Explanation

- **List Slicing**
 - Like indexing with multiple indexes instead of just one.
 - `list[start : stop : steps]`
 - start element is included, but stop element is **not** included.

```
>>> animals = ['aardvark', 'anteater', 'antelope', 'albert']
>>> animals[0:3]
['aardvark', 'anteater', 'antelope']
>>> animals[2:4]
['antelope', 'albert']
```

Code Explanation

- **List Slicing**

- `list[start : stop : steps]`
- Default values of start is 0, stop is last index of list, and step is 1
- `[: stop]` will slice list from 0 to **stop-1**
- `[start :]` will slice list from start index till end
- `[: : -1]` prints list in reverse order
- You can use slicing for strings as well.

Sequence Types

1. Tuple `tu = (23, 'abc', 4.56, (2,3), 'def')`

- A simple ***immutable*** ordered sequence of items
- Items can be of mixed types, including collection types

2. Strings `st = 'Hello World'`

- ***Immutable***
- **Conceptually very much like a tuple**

3. List `li = ["abc", 34, 4.34, 23]`

- ***Mutable*** ordered sequence of items of mixed types

Sequence Types 2

- We can access individual members of a tuple, list, or string using square bracket “array” notation.
- *Note that all are 0 based...*

```
>>> tu = (23, 'abc', 4.56, (2,3), 'def')
>>> tu[1]      # Second item in the tuple.
'abc'
```

```
>>> li = ["abc", 34, 4.34, 23]
>>> li[1]      # Second item in the list.
34
```

```
>>> st = "Hello World"
>>> st[1]      # Second character in string.
'e'
```


Slicing: Return Copy of a Subset 2

```
>>> t = (23, 'abc', 4.56, (2,3), 'def')
```

Omit the first index to make a copy starting from the beginning of the container.

```
>>> t[:2]  
(23, 'abc')
```

Omit the second index to make a copy starting at the first index and going to the end of the container.

```
>>> t[2:]  
(4.56, (2,3), 'def')
```

The 'in' Operator

- **Boolean test whether a value is inside a container:**

```
>>> t = [1, 2, 4, 5]
>>> 3 in t
False
>>> 4 in t
True
>>> 4 not in t
False
```

- **For strings, tests for substrings**

```
>>> a = 'abcde'
>>> 'c' in a
True
>>> 'cd' in a
True
>>> 'ac' in a
False
```

- **Be careful: the *in* keyword is also used in the syntax of *for loops* and *list comprehensions*.**

The + Operator

- The + operator produces a *new* tuple, list, or string whose value is the concatenation of its arguments.

```
>>> (1, 2, 3) + (4, 5, 6)
(1, 2, 3, 4, 5, 6)
```

```
>>> [1, 2, 3] + [4, 5, 6]
[1, 2, 3, 4, 5, 6]
```

```
>>> "Hello" + " " + "World"
'Hello World'
```

The * Operator

- The * operator produces a *new* tuple, list, or string that “repeats” the original content.

```
>>> (1, 2, 3) * 3  
(1, 2, 3, 1, 2, 3, 1, 2, 3)
```

```
>>> [1, 2, 3] * 3  
[1, 2, 3, 1, 2, 3, 1, 2, 3]
```

```
>>> "Hello" * 3  
'HelloHelloHello'
```

Code Explanation

- Replacing the Underscores with Correctly Guessed Letters
 - Assume that
 - `secretWord` is **'otter'**
 - the value in `correctLetters` is **'tr'**
 - Then `len(secretWord)` will return 5.
 - Then `range(len(secretWord))` becomes `range(5)`, which in turn returns the list `[0, 1, 2, 3, 4]`.

```
for i in range(len(secretWord)) :  
    if secretWord[i] in correctLetters:  
        blanks = blanks[:i] + secretWord[i] + blanks[i+1:]
```

Code Explanation

- Replacing the Underscores with Correctly Guessed Letters
 - The value of **i** will take on each value in **[0, 1, 2, 3, 4]**
 - then the **for loop** code is equivalent to this (called **loop unrolling**).

```
if secretWord[0] in correctLetters:
    blanks = blanks[:0] + secretWord[0] + blanks[1:]
if secretWord[1] in correctLetters:
    blanks = blanks[:1] + secretWord[1] + blanks[2:]
if secretWord[2] in correctLetters:
    blanks = blanks[:2] + secretWord[2] + blanks[3:]
if secretWord[3] in correctLetters:
    blanks = blanks[:3] + secretWord[3] + blanks[4:]
if secretWord[4] in correctLetters:
    blanks = blanks[:4] + secretWord[4] + blanks[5:]
```

Code Explanation

- Replacing the Underscores with Correctly Guessed Letters
 - The following shows the values of the variable `secretWord` and `blanks`.
 - With the index for each letter in the string

blanks	<table><tr><td>—</td><td>—</td><td>—</td><td>—</td><td>—</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr></table>					—	—	—	—	—	0	1	2	3	4
	—	—	—	—	—										
0	1	2	3	4											
secretWord	<table><tr><td>o</td><td>t</td><td>t</td><td>e</td><td>r</td></tr><tr><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr></table>					o	t	t	e	r	0	1	2	3	4
	o	t	t	e	r										
0	1	2	3	4											

Code Explanation

- Replacing the Underscores with Correctly Guessed Letters
 - The **unrolled loop** code would be the same as this.

```
if 'o' in 'tr': # False, blanks == '_____'
    blanks = '' + 'o' + '_____' # This line is skipped.
if 't' in 'tr': # True, blanks == '_____'
    blanks = '_' + 't' + '_____' # This line is executed.
if 't' in 'tr': # True, blanks == '_t_____'
    blanks = '_t' + 't' + '_____' # This line is executed.
if 'e' in 'tr': # False, blanks == '_tt_____'
    blanks = '_tt' + 'e' + '_____' # This line is skipped.
if 'r' in 'tr': # True, blanks == '_tt_____'
    blanks = '_tt_' + 'r' + '_____' # This line is executed.
# blanks now has the value '_tt_r'
```


Code Explanation

- Replacing the Underscores with Correctly Guessed Letters
 - This `for` loop will print out each character in the string `blanks`.
 - Show the secret word with spaces in between each letter

```
for letter in blanks: # show the secret word with spaces in between each let
    print(letter, end=' ')
print()
```

Code Explanation

- Get the Player's Guess
 - The **getGuess()**
 - called whenever we want to let the player type in a letter to guess.
 - **while** loop
 - it will loop forever (unless it reaches a **break** statement).
 - Such a loop is called an **infinite loop**.

```
def getGuess(alreadyGuessed):  
    # Returns the letter the player entered. This function makes sure  
    while True:  
        print('Guess a letter.')  
        guess = input()  
        guess = guess.lower()
```

Code Explanation

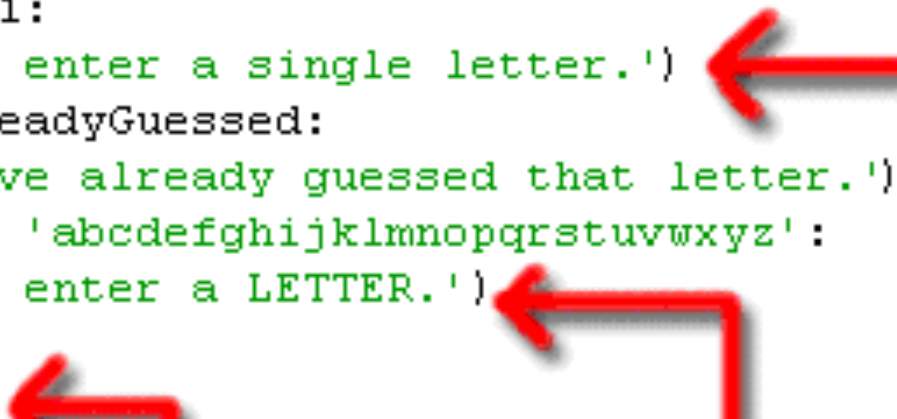
- Making Sure the Player Entered a Valid Guess
 - The guess variable contains the text the player typed in for their letter guess.
 - The `if` statement's condition checks that the text is one and only letter.

```
if len(guess) != 1:
    print 'Please enter a single letter.'
elif guess in alreadyGuessed:
    print 'You have already guessed that letter. Choose again.'
elif guess not in 'abcdefghijklmnopqrstuvwxyz':
    print 'Please enter a LETTER.'
else:
    return guess
```

Code Explanation

- Making Sure the Player Entered a Valid Guess
 - The `elif` statement.

```
if len(guess) != 1:  
    print('Please enter a single letter.')  
elif guess in alreadyGuessed:  
    print('You have already guessed that letter.')  
elif guess not in 'abcdefghijklmnopqrstuvwxyz':  
    print('Please enter a LETTER.')  
else:  
    return guess
```

A diagram consisting of four red arrows pointing to the right-hand side of each conditional block in the code. The arrows originate from the right and point left towards the end of each line: the first arrow points to the end of the first `if` block, the second to the end of the first `elif` block, the third to the end of the second `elif` block, and the fourth to the end of the `else` block. This visualizes that only one of these blocks will be executed.

One and only one of these blocks will execute.

Code Explanation

- Asking the Player to Play Again
 - The `playAgain()` function
 - just a `print()` function call and a return statement
 - The function call is `input()` and the method calls are `lower()` and `startswith('y')`

```
def playAgain():  
    # This function returns True if the player wants to play again;  
    print('Do you want to play again? (yes or no)')  
    return input().lower().startswith('y')
```

Code Explanation

- Asking the Player to Play Again
 - Here's a step by step look at how Python evaluates this expression if the user types in YES.

```
return input().lower().startswith('y')
```



```
return 'YES'.lower().startswith('y')
```



```
return 'yes'.startswith('y')
```



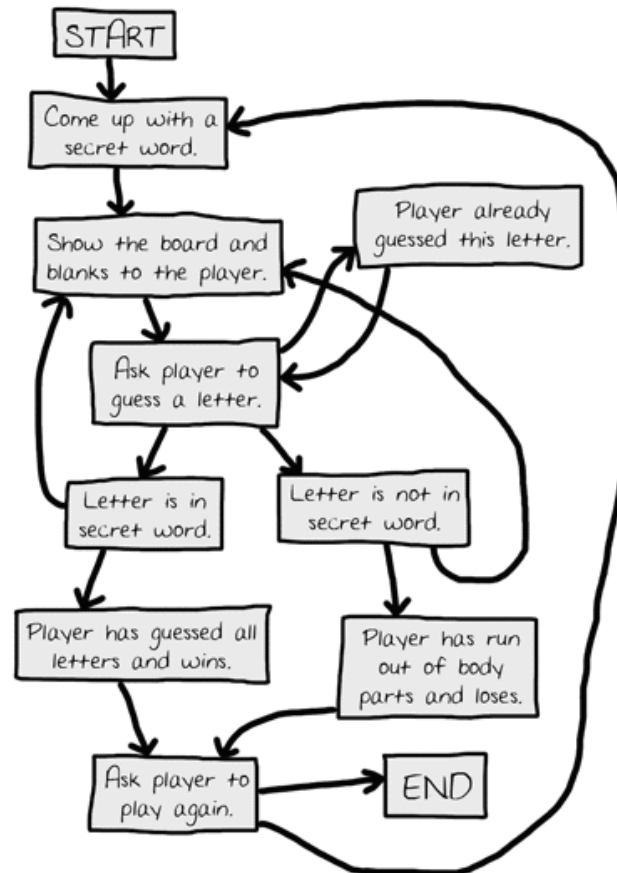
```
return True
```

Code Explanation

- Review of the Functions We Defined
 - `getRandomWord(wordList)`
 - `displayBoard(missedLetters, correctLetters, secretWord)`
 - `getGuess(alreadyGuessed)`
 - `playAgain()`

Code Explanation

- Review of the Functions We Defined
 - The complete flow chart of Hangman.



Code Explanation

- The Main Code for Hangman
 - Setting Up the Variables
 - This is where the program executes really starts.

```
print('H A N G M A N')  
missedLetters = ''  
correctLetters = ''  
secretWord = getRandomWord(words)  
gameIsDone = False
```

Code Explanation

- Displaying the Board to the Player
 - The `while` loop's condition is always `True`
 - The program loops forever until a `break` statement.
 - It executes a `break` statement, when the game is over.

```
while True:
    displayBoard(                missedLetters,
correctLetters, secretWord)
```

Code Explanation

- Letting the Player Enter Their Guess
 - Remember that the function needs all the letters in `missedLetters` and `correctLetters` combined.

```
# Let the player type in a letter.  
guess = getGuess(missedLetters + correctLetters)
```

- Checking if the Letter is in the Secret Word
 - It concatenate the letter in `guess` to the `correctLetters` string

```
if guess in secretWord:  
    correctLetters = correctLetters + guess
```

Code Explanation

- Checking if the Player has Won
 - The only way we can be sure the player won is
 - to go through each letter in `secretWord` and see if it exists in `correctLetters`.

```
# Check if the player has won
foundAllLetters = True
for i in range(len(secretWord)):
    if secretWord[i] not in correctLetters:
        foundAllLetters = False
        break
```

Code Explanation

- Checking if the Player has Won
 - This is a simple check to see if we found all the letters.
 - If we have found every letter in the secret word
 - we should tell the player that they have won.

```
if foundAllLetters:  
    print 'Yes! The secret word is "' + secretWord +  
    '"! You have won!'  
    gameIsDone = True
```

Code Explanation

- When the Player Guesses Incorrectly
 - This is the start of the `else`-block.
 - the code in this block will execute if the condition was `False`.

```
else:
```

- The player's guessed letter was wrong
- we add it to the `missedLetters` string.

```
missedLetters = missedLetters + guess
```

Code Explanation

- When the Player Guesses Incorrectly
 - How we know when the player has guessed too many times?
 - Remember that each time the **player guesses wrong**,
 - The program **add the wrong letter** to the string in missedLetters.
 - The length of missedLetters can tell us the number of wrong guesses.

```
# Check if player has guessed too many times and lost
if len(missedLetters) == len(HANGMANPICS) - 1:
    displayBoard(
        missedLetters, correctLetters,
secretWord)
    print 'You have run out of guesses!\nAfter ' + str(len(m
issedLetters)) + ' missed guesses and ' + str(len(correctLetters)) +
' correct guesses, the word was "' + secretWord + '"'
    gameIsDone = True
```

Code Explanation

- When the Player Guesses Incorrectly
 - `len(HANGMANPICS) - 1`
 - When we read the program code later, we should know why this program behaves the way it does.
 - Of course, it is a good idea to leave a comment to remind yourself and possibly others to use your code.

```
if len(missedLetters) == 6:  
    #6 is the last index in the HANGMANPICS list
```

- But it is better to use `len(HANGMANPICS) - 1` instead.

Code Explanation

- When the Player Guesses Incorrectly
 - If the player won or lost after guessing their letter
 - then our code would have set the `gameIsDone` variable to `True`.
 - If this is the case, we should ask the player if they want to play again.

```
# Ask the player if they want to play again
(but only if the game is done).
if gameIsDone:
    if playAgain():
        missedLetters = ''
        correctLetters = ''
        gameIsDone = False
        secretWord = getRandomWord(words)
```

Code Explanation

- When the Player Guesses Incorrectly
 - If the player typed in 'no'
 - return value of the call to the `playAgain()` function would be `False`
 - the `else`-block would have executed.

```
else:  
    break
```

Code Explanation

- Making New Changes to the Hangman Program
 - We can easily give the player more guesses
 - by **adding more multi-line strings** to the HANGMAN_PICS list.

```
===== ' ', ' '

+-----+
|
| [o
| /|\
| / \
|
|
===== ' ', ' '

+-----+
|
| [O]
| /|\
| / \
|
|
===== ' ' ]
```

Code Explanation

- Making New Changes to the Hangman Program
 - We can also change the list of words.
 - colors, shapes, fruits

```
words = 'red orange yellow green blue indigo  
violet white black brown'.split()
```

```
words = 'square triangle rectangle circle ell  
ipse rhombus trapazoid chevron pentagon hexag  
on septagon octagon'.split()
```

```
words = 'apple orange lemon lime pear waterme  
lon grape grapefruit cherry banana cantalope  
mango strawberry tomato'.split()
```

Code Explanation

- Dictionaries
 - A collection of many values.
 - Accessing the items with an index (the indexes are called **keys**) of any data type (most often **strings**).

```
>>> stuff = {'hello': 'Hello there, how are you?', 'chat': 'How is the weather?', 'goodbye': 'It was nice talking to you!'}
```

Code Explanation

- Dictionaries
 - Curly braces { and }
 - On the keyboard they are on the same key as the **square braces [and]**.
 - We use curly braces to type out a dictionary value in Python.
 - The values in between them are **key-value pairs**.

```
>>> stuff['hello']  
'Hello there, how are you?'  
>>> stuff['chat']  
'How is the weather?'  
>>> stuff['goodbye']  
'It was nice talking to you!'
```

Code Explanation

- Getting the Size of Dictionaries with `len ()`
 - You can get the size with the `len ()` function.

```
>>> len(stuff)
3
```

- The **list version** of this dictionary would have only the values.

```
>>> listStuff = ['Hello there, how are you?', 'How  
is the weather?', 'It was nice talking to you!']
```

Code Explanation

- The Difference Between Dictionaries and Lists
 - Dictionaries are **unordered**.
 - Dictionaries do not have any sort of order.

```
>>> favorites1 = {'fruit':'apples', 'number':42, 'animal':'cats'}  
>>> favorites2 = {'animal':'cats', 'number':42, 'fruit':'apples'}  
>>> favorites1 == favorites2  
True
```


Code Explanation

- The Difference Between Dictionaries and Lists
 - Lists are **ordered**.
 - list with the same values in them but in a different order are not the same.

```
>>> listFavs1 = ['apples', 'cats', 42]
>>> listFavs2 = ['cats', 42, 'apples']
>>> listFavs1 == listFavs2
False
```

Code Explanation

- The Difference Between Dictionaries and Lists
 - You can also use integers as the keys for dictionaries.
 - Dictionaries can have keys of any data type, not just strings.

```
>>> myDict = {'0': 'a string', 0: 'an integer'}
>>> myDict[0]
'an integer'
>>> myDict['0']
'a string'
```

Code Explanation

- The Difference Between Dictionaries and Lists
 - A dictionary can be used in a for loop

```
>>> favorites = {'fruit':'apples', 'animal':'cats', 'number':42}
>>> for i in favorites:
    print i
```

```
fruit
number
animal
```

```
>>> for i in favorites:
    print favorites[i]
```

```
apples
42
cats
```

Code Explanation

- The Difference Between Dictionaries and Lists
 - Dictionaries also have two useful methods
 - `keys()` and `values()`
 - They return values of a type called `dict_keys` and `dict_values`, respectively.

```
>>> favorites = {'fruit':'apples', 'animal':'cats', 'number':42}
>>> list(favorites.keys())
['fruit', 'number', 'animal']
>>> list(favorites.values())
['apples', 42, 'cats']
```

Code Explanation

- Sets of Words for Hangman
 - So how can we use dictionaries in our game?
 - First, let's **change the list words into a dictionary**
 - keys are strings
 - values are lists of strings

```
98. words = {'Colors': 'red orange yellow green blue indigo violet  
white black brown'.split(),  
99. 'Shapes': 'square triangle rectangle circle ellipse rhombus tra  
pazoid chevron pentagon hexagon septagon octagon'.split(),  
100. 'Fruits': 'apple orange lemon lime pear watermelon grape grapef  
ruit cherry banana cantalope mango strawberry tomato'.split(),  
101. 'Animals': 'bat bear beaver cat cougar crab deer dog donkey duc  
k eagle fish frog goat leech lion lizard monkey moose mouse o  
tter owl panda python rabbit rat shark sheep skunk squid tiger  
turkey turtle weasel whale wolf wombat zebra'.split() }
```

Code Explanation

- The `random.choice()` Function
 - Change our `getRandomWord()` function
 - it chooses a random word from a dictionary of lists of strings, instead of from a list of strings.
 - Here is what the function **originally** looked like:

```
def getRandomWord(wordList):  
    # This function returns a random string from the  
    passed list of strings.  
    wordIndex = random.randint(0, len(wordList) - 1)  
    return wordList[wordIndex]
```

Code Explanation

- The `random.choice()` Function
 - Change our `getRandomWord()` function
 - **Change** the code in this function so that it looks like this:

```
def getRandomWord(wordDict):  
    # This function returns a random string from the passed  
    # dictionary of lists of strings, and the key also.  
    # First, randomly select a key from the dictionary:  
    wordKey = random.choice(list(wordDict.keys()))  
  
    # Second, randomly select a word from the key's list in  
    # the dictionary:  
    wordIndex = random.randint(0, len(wordDict[wordKey]) - 1)  
  
    return [wordDict[wordKey][wordIndex], wordKey]
```

Code Explanation

- The `random.choice()` Function
 - `randint(a, b)`
 - return a random integer between the two integers `a` and `b`
 - `choice(a)` returns a random item from the list `a`

```
>>> random.randint(0, 9)
```

```
>>> random.choice(list(range(0, 10)))
```


Code Explanation

- Evaluating a Dictionary of Lists
 - `wordDict[wordKey][wordIndex]` may look kind of complicated
 - but it is just an expression you can evaluate one step at a time like anything else.

```
wordDict[wordKey][wordIndex]
```



```
wordDict['Fruits'][5]
```



```
['apple', 'orange', 'lemon', 'lime', 'pear', 'watermelon',  
, 'grape', 'grapefruit', 'cherry', 'banana', 'cantalope',  
'mango', 'strawberry', 'tomato'][5]
```



```
'watermelon'
```

Code Explanation

- Evaluating a Dictionary of Lists
 - There are just **three more changes** to make to our program.
 - The **first two** are on the lines that we call the **getRandomWord()** function.
 - The function is called on lines 148 and 184 in the original program

```
147.         correctLetters = ''
148.         secretWord = getRandomWord(words)
149.         gameIsDone = False
...

183.         gameIsDone = False
184.         secretWord = getRandomWord(words)
185.     else:
```

Code Explanation

- Evaluating a Dictionary of Lists
 - We would then have to change the code as follows

```
147. correctLetters = ''
148. secretWord = getRandomWord(words)
149. secretKey = secretWord[1]
150. secretWord = secretWord[0]
151. gameIsDone = False
...

182.         gameIsDone = False
183.         secretWord = getRandomWord(words)
184.         secretKey = secretWord[1]
185.         secretWord = secretWord[0]
186.     else:
```

Code Explanation

- Multiple Assignment
 - An easier way by doing a little trick with assignment statements.
 - to put the same number of variables on the left side of the = sign as are in the list on the right side.

```
>>> a, b, c = ['apples', 'cats', 42]
>>> a
'apples'
>>> b
'cats'
>>> c
42
```

Code Explanation



- Think about:

```
>>> a, b, c, d = ['apples', 'cats', 42]
```

```
>>> a, b, c, d = ['apples', 'cats']
```

Code Explanation

- Multiple Assignment
 - So we should change our code in Hangman to use this trick
 - end up with more compact code with fewer lines.

```
147. correctLetters = ''
148. secretWord, secretKey = getRandomWord(words)
149. gameIsDone = False
...

182.         gameIsDone = False
183.         secretWord, secretKey = getRandomWord
      (words)
184.     else:
```

Code Explanation

- Printing the Word Category for the Player
 - **The last change**
 - to add a simple print statement to tell the player which set of words they are trying to guess.
 - Here is the original code:

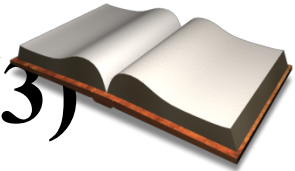
```
151. while True:
152.     displayBoard(                missedLetters,
correctLetters, secretWord)
```

Code Explanation

- Printing the Word Category for the Player
 - The last change
 - Add the line so your program looks like this:

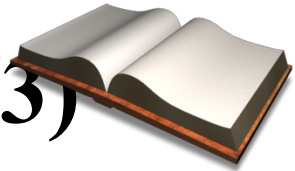
```
151. while True:
152.     print 'The secret word is in the set: ' +
secretKey
153.     displayBoard(                missedLetters,
correctLetters, secretWord)
```


Things Covered In This Chapter(1/3)



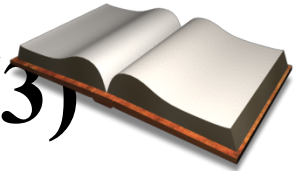
- Designing our game by drawing a flow chart before programming.
- ASCII Art
- Multi-line Strings
- Lists
- List indexes
- Index assignment
- List concatenation
- The `in` operator
- The `del` operator
- Methods

Things Covered In This Chapter(2/3)



- The `append ()` list method
- The `lower ()` and `upper ()` string methods
- The `reverse ()` list method
- The `split ()` list method
- The `len ()` function
- Empty lists
- The `range ()` function
- `for` loops
- Strings act like lists
- Mutable sequences(lists) and immutable sequences(strings)
- List slicing and substrings

Things Covered In This Chapter(3/3)



- The `startswith(someString)` and `endswith(someString)` string methods
- The **dictionary** data type(which is unordered, unlike list data type which is ordered)
- key-value pairs
- The `keys()` and `values()` dictionary methods.
- Multiple variable assignment, such as `a, b, c = [1, 2, 3]`