Intro. to Computing Name:_____

1. Read sections 6.1 and 6.2 of the textbook. A *function* is a procedural abstract, i.e., a named body of code that performs some task when it is called/invoked. Often a function will have one or more parameter that allows it to perform a more general (variable) task. For example, we used the "input" function several times, e.g., the wageCalc.py program:

```
hoursWorked = input("Enter number of hours worked: ")
payRate = input("Enter hourly pay rate: ")
grossPay = hoursWorked * payRate
print "Gross pay earned = $", grossPay
print '"Formatted" Gross pay earned = $ %.2f' % grossPay
```

The string parameter of the input function allows the function to behave differently (print an appropriate prompt) for each value to be entered by the user.

Likewise, the cube function below (in file lec7\cube.py)can be called with any numeric value with the corresponding cube of that number being returned.

```
# Function to calculate the cube of a number
def cube(num):
    num_squared = num * num
    return num_squared * num

# call the function
value = 2
print 'The value', value, 'raised to the power 3 is', cube(value)
print 'The value 3 raised to the power 3 is', cube(3)
```

Terminology:

- a *formal parameter* is the name of the variable used in the function definition which receives a value when the function is called. In the function cube, `num` is the formal parameter. Formal parameters are only known inside of the function definition. The section of a program where a variable is known is called its *scope*, so the scope of a formal parameter (and other *local variable* defined in the function such as num_squared) is limited to the function in which it is defined.
- an *actual parameter/argument* is the value used in the function call that is sent to the function. In the call to function cube, the variable `value` supplies the actual parameter value of 2.
- a *global variable* is created outside all functions and is known throughout the whole program file, e.g. `value`.

a) Write a function that takes as a parameter the Celsius temperature and returns the corresponding Fahrenheit temperature. Recall the formula for the conversion is $F = \frac{9}{5}C + 32$

2. a) Trace the following program and predict the output.

```
# Program to demonstrate function calls
def main():
    value = 99   # local variable
    print 'In main before call: value is', value
    change_me(value)
    print 'Back in main: value is', value

def change_me(arg):
    value = 10   # local variable
    print 'In change_me: arg is', arg
    arg = 3
    print 'In change_me: arg is', arg, 'and value is', value
    value = more_change(value, arg)
    print 'Back in change_me: arg is', arg, 'and value is', value

def more_change(arg, arg2):
    print 'In more_change: value is', value
    print 'In more_change: arg is', arg, 'and arg2 is', arg2
    arg = arg2
    print 'In more_change: arg is', arg,'and arg2 is', arg2
    return arg2 * 5

#Global variable
value = 5
# Call the main  function.
main()
print 'Here, value is',value
```

Predicted Output	
Actual Output	

b) It is helpful to understand the "rules of the game" when a function is called. Memory is used to store the current program and the data associated with it. The memory used to store the data is divided as shown below.

- Global memory is used to store the global variables (and constants).
- The *heap* is used to store dynamically allocated objects as the program runs.
- The *run-time stack* is used to store *call-frames* (or *activation records*) that get *pushed* on the stack when a function is called, and *popped* off the stack when a function returns.

When a function is called the section of code doing the calling is temporarily suspended, and a new call-frames gets pushed on top of the stack before execution of the function body. The call-frame contains the following information about the function being called:

- the *return address* -- the spot in code where the call to the function occurred. This is needed so execution (control) can return there when the function returns.
- room to store the formal parameters used by the function. In Python parameters are *passed-by-value* which means that the value of each actual parameter in the function call is assigned to the corresponding formal parameter in the function definition before the function starts executing.
- room to store the local variables defined in the function.

When a function returns, execution resumes at the function call (which is specified by the return address). A function typically sends back a value to the call by specifying an expression after `return` in the return statement. In Python if no expression is specified returned, then the special object `None` is returned. **Below, complete the trace of the same program by building the run-time stack.**

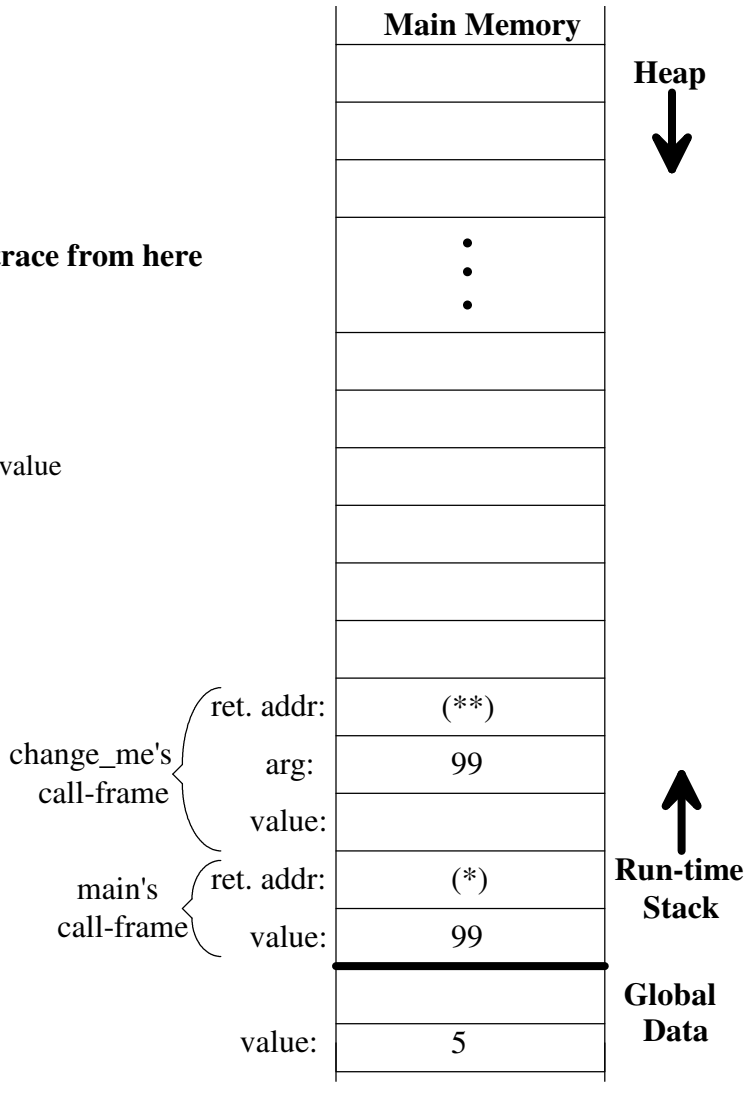
```
# Program to demonstrate function calls
def main():
    value = 99   # local variable
    print 'In main before call: value is', value
    change_me(value)     # location (**)
    print 'Back in main: value is', value

def change_me(arg):
    value = 10   # local variable
    print 'In change_me: arg is', arg
    arg = 3
    print 'In change_me: arg is', arg, 'and value is', value
    value = more_change(value, arg)
    print 'Back in change_me: arg is', arg, 'and value is', value

def more_change(arg, arg2):
    print 'In more_change: value is', value
    print 'In more_change: arg is', arg, 'and arg2 is', arg2
    arg = arg2
    print 'In more_change: arg is', arg, 'and arg2 is', arg2
    return arg2 * 5

#Global variable
value = 5
# Call the main  function.
main()   # location (*)
print 'Here, value', value
```

Continue trace from here



3. Lets work together to design a program to solve the following program (Project 11 from Chapter 3.)

In the game of Lucky Sevens, the player rolls a pair of dice. If the dice add up to 7, the player wins $4; otherwise, the player loses $1. Suppose that, to entice the gullible, a casino tells players that there are lots of ways to win: (1, 6), (2, 5), etc. A little mathematical analysis reveals that there are not enough ways to win to make the game worthwhile; however, because many people's eyes glaze over at the first mention of mathematics, your challenge is to write a program that demonstrates the futility of playing the game. Your program should take as input the amount of money that the player wants to put into the pot, and play the game until the pot is empty. At that point, the program should print the number of rolls it took to break the player, as well as maximum amount of money in the pot.

Read the specifications carefully. Try to identify:

a) What would the user's interaction with the program look like?

b) We want the `main` function to act as an outline of the program and contain at most:

- the "main loop": What would be the main loop for this program?

- function calls to perform difficult subproblems. What high-level subproblems does our program need to perform? (Think about what arguments each subprogram needs to be passed or user input needed, and what type of information is returned to the caller)

Actual Output of Program:

```
IDLE 1.2.1      ==== No Subprocess ====
>>>
In main before call: value is 99
In change_me: arg is 99
In change_me: arg is 3 and value is 10
In more_change: value is 5
In more_change: arg is 10 and arg2 is 3
in more_change: arg is 3 and arg2 is 3
Back in change_me: arg is 3 and value is 15
Back in main: value is 99
Here, value is 5
>>>
```