Functions

• A **function** is a piece of code you can use over and over again
  • Treat it like a black box
• You pass it (optional) values, it does some work, and it (optionally) returns values
• You “call it”, ”invoke it”, or “use it” by using its name and parentheses
  • The things you pass it go inside the parentheses
  • `function(input) => output`
Using Simple Functions

- Functions that interact with the robot
  - forward (speed, duration)
  - beep(time, frequency)
- Pass in arguments
- Execute in sequential order
  - flow of execution

forward(1,1)
beep(1, 440)
Writing Simple Functions

- **Defining functions**
  - Creates function
  - Does not execute/run them
- Indenting indicates a “block” of code
- Call functions from top-level or other functions

```python
def nudge():
    print "going forward"
    forward(1,1)
    print "now stopped"
```
Format of a function definition

def function-name():
    statement
    statement
    statement
    ...
    statement
def function-name(series, of, params):
    statement
    statement
    ...
    statement

function-name(series, of, params)
def nudge(speed):
    print "Going forward with speed", speed
    forward(speed, 1)
    print "stopped"
    stop()

nudge(0.2)
nudge(0.9)
nudge(1)
Parameters are Variables

- When you pass values into functions as parameters, they get assigned to the variable names declared in the definition line of the function.

- For example, when you call `nudge(0.2)`
  The speed variable is assigned (points to) the value 0.2

- When the code in the function refers to the speed variable, it evaluates to the number 0.2

- So, when you call `nudge(0.2)` and the nudge function calls `forward(speed, 1)`, it's the same as if it called `forward(0.2, 1)`
Passing variables to a functions

• If you pass a variable to a function, the function gets the value that the variable is pointing at

userInput = raw_input("Enter a Name")
setName(userInput)
print "The Robots new Name is: ", userInput
def beepA(length, octave):
    beep(length, 440 * (2**octave))

beepA(1,0)  # A4
beepA(2,1)  # A5
beepA(3,2)  # A6

A4 : 440 Hz
A5:  880 Hz
A6: 1760 Hz
A7: 3520 Hz
Using Functions that Return Values

We've already seen examples:

name = getName()
print "Hello, your robot is", name

print "Robot battery voltage", getBattery()

p = takePicture()
show(p)
def function-name(series, of, params):
    statement
    statement
    ...
    statement
    return value

output = function-name(series, of, params)
Return Statements

- The return statement is used to return a value from a function.

- The return statement also affects the flow of execution:
  - Whenever the flow of execution hits a return statement it jumps back to the place where the function was called.

- All functions have an implicit return statement at the end of the block of indented code, even if you do not specifically place one at the end of your function.
def area(radius):
    return 3.14 * radius**2

def circumference(diameter):
    return 3.14 * diameter

print "Area of a 3 ft circle", area(3)
print "Circumference", circumference(2*3)
Local Variables

• Local variables are variables which are defined inside a function.
• These variables exist only inside the function.
• We refer to this concept as the “scope” in which a variable is defined.
Functions with Local Variables

def area(radius):
    a = 3.14 * radius**2
    return a

def circumference(diameter):
    c = 3.14 * diameter
    return c

print "Area of a 3 ft circle", area(3)
print "Circumference", circumference(2*3)
Variables in a Function are Local

- Variables in a function are private
  - Including the parameters
  - Means other code can't "touch" them
- Each function has its own variables
  - Even when the names are the same
- Allows you to write functions independently without worrying about using the same name
Different Variables - Same Name

def area(radius):
    a = 3.14 * radius**2
    return a

def circumference(radius):
    a = 3.14 * 2 * radius
    return a

a = 20
print "Area of a 3 ft circle", area(3)
print "Circumference", circumference(3)
print a
Composing/Composite Functions

• You can use the output (return value) of one function as the input (parameter) to another function.

show( takePicture() )

• In this example, the takePicture() function executes first (things inside parenthesis execute before things outside parenthesis)

• The takePicture() function returns a picture, which is then given to the show() function as a parameter.