FUNCTIONS THAT RETURN RESULTS, DECISION STRUCTURES

CSSE 120—Rose Hulman Institute of Technology

Functions Can Return Values

- We've **written** functions that just do things
  - printFactorial(5)
  - printDistance(p1,p2)
- We've **used** functions that *return* values
  - abs(-1)
  - fn_root_1 = math.sqrt(b*b – 4*a*c)
- Define a function that returns a value
  - # Returns the square of x

```
def square(x):
    return x * x
```

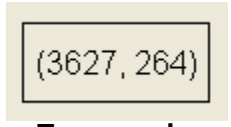
return statement

Multiple Value Return

- A function can return multiple values
  - **def powers(n):**
    return n2, n**3, n**4**
- What's the type of the value returned by this:
  powers(4)

Pair Programming: Three Squares

- Download threeSquares.py from Angel
- Run the program to be sure it works
- Add a function, **stats** that takes a Rectangle, **r**, as a parameter and returns the area of **r**
- Change the program to display the area of each rectangle inside the shape
- Finally, change **stats** to return the area and perimeter (see figure at right)
- Upload to threeSquares dropbox on Angel



Example Display

Modifying Parameters

- How do functions send information back?
  - Return statements
  - *Mutating* parameters
- Consider:

```
def awardEC(score, extra):
        newScore = score + extra
        score = newScore

earned = 87
bonus = 4
awardEC(earned, bonus)
print earned
```

Parameter Passing in Python

- Formal parameters only receive the **values** of the actual parameters
- Assigning a new value to a formal parameter does not affect the actual parameter
- Python passes parameters *by value*
- How should we fix **awardEC**?

Full Credit for Getting It Right

```
def awardEC(score, extra):
    newScore = score + extra
    return newScore

earned = 87
bonus = 4
earned = awardEC(earned, bonus)
print earned
```

Extra-Credit for Everyone!

```
def awardEC(scores, extras):
        for i in range(len(scores)):
                scores[i] = scores[i] + extras[i]
earned = [87, 63, 94]
bonuses = [3, 5, 0]
awardEC(earned, bonuses)
print earned
```

- Did the value of amounts change?
  - No, it refers to the same list
  - The list's *contents* changed
  - Functions can change state of *mutable* objects

Decision, Decisions

- Sometimes we have to alter the sequential flow of a program
  - What examples have we seen of this?
- Statements that alter the flow are called

  control structures
- *Decision structures* are control structures that allow programs to "choose" between different sequences of instructions

Simple Decisions

- The **if** statement
  - if <condition>:
    <body>
  - Semantics:
    "if the condition is true, run the body, otherwise skip it"
- Simple conditions
  - <expr> <relop> <expr>
  - Some relational operators:

Math	<	≤	=	≥	>	≠
Python	<	<=	==	>=	>	!=

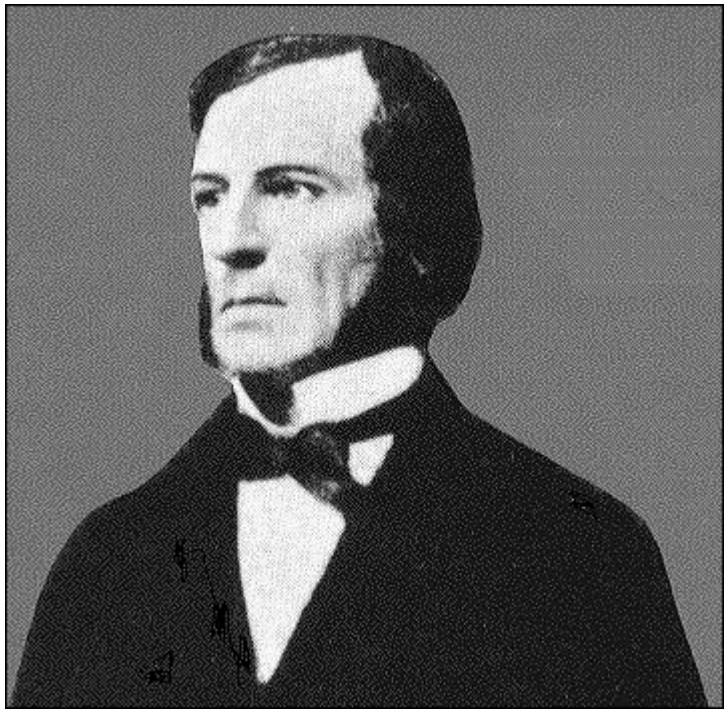
Class Exercise

- Define a function **grade(score)**
  - Where score is an exam score
  - and result is "perfect", "passing", or "failing" based on the score

More on Comparisons

- Conditions are *boolean expressions*
  - They evaluate to True or False
- Try:

```
>>> 3 < 4
>>> 42 > 7**2
>>> "ni" == "Ni"
>>> "A" < "B"
>>> "a" < "B"
```



George Boole

Having It Both Ways: if-else

- Syntax:

  if <condition>:

  <statementsForTrue>

  else:

  <statementsForFalse>

- Semantics:

  "If the condition is true, execute the statements for true, otherwise execute the statements for false"

Individual Exercise on Using if-else

- Define a function **countFailPass(scores)** that
  - takes a list of exam scores
  - returns two values:
    - the count of failing scores in the list (those less than 60), and
    - the count of passing scores in the list
- Examples:
  - **countFailPass([57, 100, 34, 87, 74])** returns **(2,3)**
  - **countFailPass([59])** returns **(1,0)**
  - **countFailPass([])** returns **(0,0)**
- Upload to countFailPass dropbox on Angel

A Mess of Nests

- Can we modify the **grade** function to return letter grades—A, B, C, D, and F?

Multi-way Decisions

- Syntax:

```
if <condition1>:
        <case 1 statements>
elif <condition2>:
        <case 2 statements>
elif <condition 3>:
        <case 3 statements>
…
else:
        <default statements>
```

reach here if condition1 is false

reach here if condition1 is false AND condition2 is true

reach here if BOTH condition1 AND condition2 are false

Cleaning the Bird Cage

- Advantages of **if-elif-else** vs. nesting
  - Number of cases is clear
  - Each parallel case is at same level in code
  - Less error-prone
- Fix **grade** function to use **if-elif-else** statement instead of nesting