Topic 5: Repetition

Are you saying that I am redundant? That I repeat myself? That I say the same thing over and over again?

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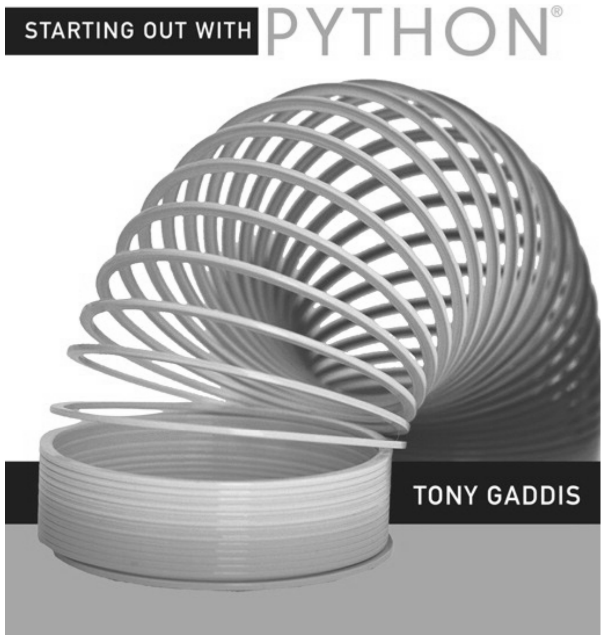
Recommended Readings



- Chapter 5

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Repetition

- So far, we have learned…
  - How to use variables
  - Read values from the user
  - Make decisions
  - Compute a result
  - Output a result

- What if we want to perform a task several times?

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Types of Loops

- Python includes two types of loops
  - While Loops
  - For Loops

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While Loops

- A while loop executes a statement as long as a condition is true
  - `while` condition`:`
    statement(s)
  - Statement may be simple or compound
    - Typically compound
    - Needs to change one of the values being tested in the condition

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Example

- How do we compute the average of several numbers

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Example

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While Loop Review

- Executes as long as some condition is true
- A pre-tested loop
  - loop condition is tested before the loop executes the first time
- General form:

```
while condition:
    statement(s)
```

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Loop Terminology

- Body of the Loop:
  - simple or compound statement that is repeated
- Loop Condition:
  - a Boolean expression
  - tested to determine if the loop will continue executing

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Loop Terminology

- Initialization:
  - the process of placing starting values in variables before the loop
- Termination:
  - the end of execution for the loop
- Pre-tested Loop:
  - any loop where the loop condition is checked before the loop executes the first time

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Loop Terminology

- Post-tested Loop:
  - – Any loop where the condition is not checked until the loop has executed once
- Infinite Loop:
  - – A loop that never terminates

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Another Example

- Using a while loop, compute n factorial

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Common Errors

- Initialization Errors
- Termination Errors
- Logic Errors

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Tracing

- Tracing code:
  - – Examine each statement in sequence
  - – Perform whatever tasks the statement requires, recording values of interest
    - Usually requires that the value of each variable is recorded
  - – Result of tracing could be the value of one or more variables, or the output generated

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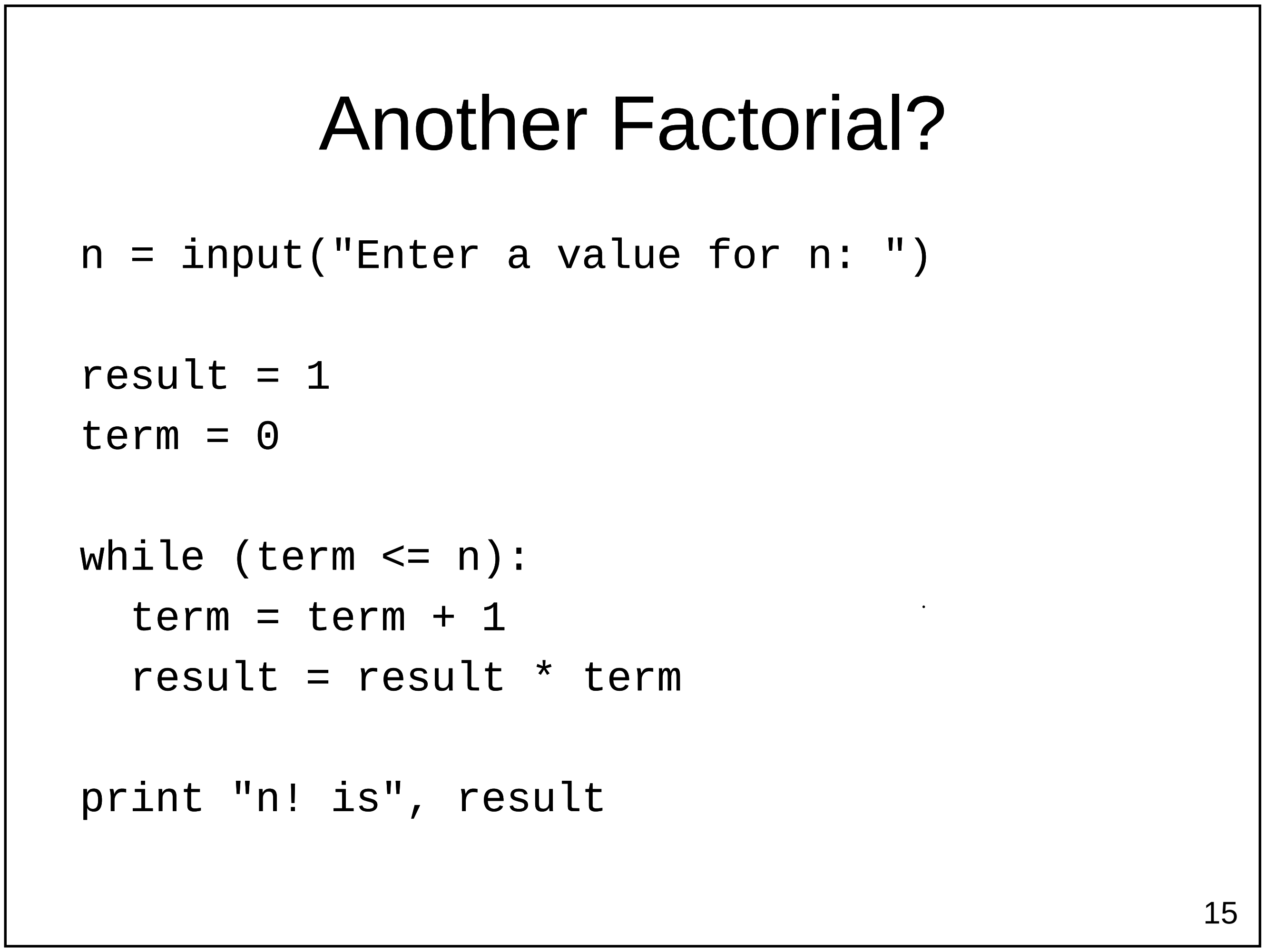

Another Factorial?

```
n = input("Enter a value for n: ")

result = 1
term = 0

while (term <= n):
  term = term + 1
  result = result * term

print "n! is", result
```

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While Loop Review

- Executes as long as some condition is True
  - Pre-tested
    - Executes zero or more times
  - Generally
    - need to initialize variables used in conditions before the loop
    - need to change the value of at least one of these variables in the loop body

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For Loop

- A counting loop
  - Typically used when we know how many times we need to perform a task in advance
  - A pre-tested loop
  - General form:

```
for variable in list:
    body
```

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Example

- Use a for loop to display the values from 3 to 10
  - For loop assigns a value from a list into a variable at the beginning of each loop iteration
  - Construct a list with the range function

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How Does a For Loop Work?

- List is examined
  - If every value has already been processed
    - loop body does not execute
    - control passes to statement after loop body
  - If unprocessed values remain
    - control variable is assigned next item in the list
    - body of the loop executes
    - control returns to the top of the loop
    - list is examined to see if the body should run again

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Example

- Rewrite the factorial program using a for loop

Step Values

- Range is flexible
  - With one parameter
    - Counts from 0 to the number provided - 1
  - With two parameters
    - Counts from the first number to the second number (exclusive), increasing by one each time
    - Generates the empty list if the second number is less than the first
  - With three parameters
    - Counts from the first number to the second (exclusive), increasing by the third

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Example

- Compute the sum of the even numbers from 0 to n

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For Loops vs. While Loops

- What kind of loop would you use if:
  - You know how many times the loop will execute
  - You want to loop until some event occurs
- Is it possible that the body of a for loop will never execute?
- Is it possible that the body of a while loop will never execute?

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Nested Loops

- The body of a loop can be
  - A simple statement
  - A compound statement

- The body of the loop can contain another loop

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Nested Loops

- Trace the output from the following program:

```
for i in range(1,6):
  print i
  j = i
  while j < 5:
    print j
    j = j + 1
```

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Break and Continue

- Allow a loop iteration to end prematurely
- `break`
  - Entire loop ends immediately
  - Execution continues at the first statement after the loop body
- `continue`
  - Current iteration ends immediately
  - Execution returns to the top of the loop
    - In a for loop, the next item in the list is used

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Bringing It All Together

- Write a simple number guessing game
  - The computer will randomly choose a number between 1 and 100
  - The user will be asked to guess a number
  - The computer will let the user know if the guess was too high or too low
  - Goal: guess the correct number in as few guesses as possible

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Bringing It All Together

- Improving our program:
  - Should try and protect the user from themselves
    - Don’t let them guess a number smaller than the lowest remaining value
    - Don’t let them guess a number larger than the largest remaining value
    - Don’t count an out of range value as a guess

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Wrapping Up

- Two types of loops available
  - While loops
  - For loops
- Both types are pre-tested
  - Will execute zero or more times
- Loops can be nested, mixed with other statement types

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Where Are We Going?

- Our number guessing game had a problem
  - Many lines of code in one place
  - Starting to become more difficult to enhance and debug
  - Solution?
    - Use functions to break our solution into pieces that each perform a specific task

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