Exam 2 on Monday, November 10
Loops

Repetition structures
Introduce nonlinearity into programs
Repeatedly execute blocks of code
Loops fall into two general categories
• Condition-controlled loops
• Count-controlled loops
While-Loops

Repeat a block of code while a condition is True

Must initialize variable and set incrementation

```python
i = 0
while i < 10:
    print(i)
    i = i + 1
```
For-Loops

Repeat a block of code a specified number of times

Assumptions are built into for-loops so it is not necessary to initialize variables and set incrementation

```python
for i in range(n):
    print(i)
```
Break Statement

`break`

**Let's you jump out of a loop from within the loop body**

**Allows you to skip over unnecessary statements**

**Should only be used when it makes your code simpler**
**Continue Statement**

`continue`

Related to `break` statement

- Lets you jump to the next iteration of a currently-executing loop
- Good for when you want to continue with the loop without doing anything
Functions
Encapsulating Logic
Functions

Groups of statements that can be run more than once in a program

Reusable chunks of code

Take input, provide output

Can be reused in a variety of contexts

Maximize code reuse, minimize code redundancy

Encapsulate logic, splitting complex systems into manageable parts
Calling Functions

\texttt{type(3.7)}

- Function name
- Arguments passed into function
- Return Value

( ) tells Python to execute the function

Even if a function takes no input, the brackets are still required

Some functions do not return a value
Defining Functions

Just like writing a Python program but with some extra syntax

Function header:

• Begins with `def`
• Followed by name of function
• Function parameter list
• Ends with a `:`
Functions
Encapsulating Logic

**Documentation String**

- **Doc String**
- Optionally follows function header
- Explains what function will do
- May include example(s)
- Almost always good to include for clarity and as a reminder
Function Body

All the code that follows the header

Simply an indented block of code with necessary statements

This code can use the variables from the function header

Function should return a value with the keyword return

After return, Python jumps out of the function and back to the program
Function Syntax

def name(parameters):
    statements

A return value is not required

return None

Anything besides return are called “side effects”

A print() statement is an example of a side effect
Variables
Local and Global

Variable scope is something we must pay attention to when using functions.

When and where is a variable accessible to your program?

Local variables are only usable within the function they are local to.

Global variables are usable by any function or code within your program.
Local Variables

```python
def area(rad):
    import math
    return math.pi * rad ** 2
```

When this function ends, `rad` is automatically deleted because it is local.
Global Variables

rad = 5

def area():
    import math
    return math.pi * rad ** 2

def change_rad(new_rad):
    global rad
    rad = new_rad

This program will not allow rad to be changed because it is global

To change the radius variable:
global rad
Main Function

main()

It is both common and a good idea to use a main function in your programs.

This is usually the starting point of a program and is run by typing: main()

This simplifies rerunning programs and as well as passing input values.
Function Parameters

Used to pass input into a function

Python passes values by reference

Default values can be set for parameters

def name(parameter = 'default')
Introduction to Computer Programming
CSCI-UA 2

Functions
Functions and Modules
Modules

A module is a group of related functions.

Different from a regular Python program in that it acts like a toolbox.

A module usually does not have a `main()` function.

To use a module, simply import it.
Importing Modules and Calling Functions

Calling function after importing module:

```python
import module_name

module_name.function()
```

Calling function after importing module along with all of its functions:

```python
from module_name import *

function()
```
Module Namespaces

Functions within a module are available when you import them.

Modules form namespaces.

Different modules with the same function name will not clash in the same program.

module1.function(parameter)

module2.function(parameter)

The only time functions may conflict is when you import all using `*`.
Strings

Strings and Characters

s[i]
Strings are one of Python’s primary data types.

Strings can be used to represent anything that can be encoded as text.

Examples: symbols, words, text files, Python programs, and Web pages.

We’ve already been using strings quite a bit and will now focus on accessing and processing them.
Indexing

\[ s[i] \]

Strings are defined as ordered collections of characters.

Therefore, we can access these characters by position with “indexing.”

Offsets start at 0 and end at one less than the length of the string.

Offset can also be specified negatively.
<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>p</td>
<td>y</td>
<td>t</td>
<td>h</td>
<td>o</td>
<td>n</td>
</tr>
<tr>
<td>-6</td>
<td>-5</td>
<td>-4</td>
<td>-3</td>
<td>-2</td>
<td>-1</td>
<td></td>
</tr>
</tbody>
</table>
Characters

\texttt{ord('a')} 

All characters have a corresponding character code.

Python uses Unicode to assign character codes.

Unicode is a common standard for encoding thousands of symbols and characters from many languages.

The \texttt{ord()} function can be used to get the Unicode number for any character.

The \texttt{chr()} function can be used to get the character for any Unicode number.
# Strings

## Strings and Characters

<table>
<thead>
<tr>
<th>Decimal</th>
<th>Hex</th>
<th>Char</th>
<th>Decimal</th>
<th>Hex</th>
<th>Char</th>
<th>Decimal</th>
<th>Hex</th>
<th>Char</th>
<th>Decimal</th>
<th>Hex</th>
<th>Char</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
<td>[NULL]</td>
<td>32</td>
<td>20</td>
<td>[SPACE]</td>
<td>64</td>
<td>40</td>
<td>@</td>
<td>96</td>
<td>60</td>
<td>`</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>[START OF HEADING]</td>
<td>33</td>
<td>21</td>
<td>!</td>
<td>65</td>
<td>41</td>
<td>A</td>
<td>97</td>
<td>61</td>
<td>a</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>[START OF TEXT]</td>
<td>34</td>
<td>22</td>
<td>&quot;</td>
<td>66</td>
<td>42</td>
<td>B</td>
<td>98</td>
<td>62</td>
<td>b</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>[END OF TEXT]</td>
<td>35</td>
<td>23</td>
<td>#</td>
<td>67</td>
<td>43</td>
<td>C</td>
<td>99</td>
<td>63</td>
<td>c</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>[END OF TRANSMISSION]</td>
<td>36</td>
<td>24</td>
<td>$</td>
<td>68</td>
<td>44</td>
<td>D</td>
<td>100</td>
<td>64</td>
<td>d</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>[ENQUIRY]</td>
<td>37</td>
<td>25</td>
<td>%</td>
<td>69</td>
<td>45</td>
<td>E</td>
<td>101</td>
<td>65</td>
<td>e</td>
</tr>
<tr>
<td>6</td>
<td>6</td>
<td>[ACKNOWLEDGE]</td>
<td>38</td>
<td>26</td>
<td>&amp;</td>
<td>70</td>
<td>46</td>
<td>F</td>
<td>102</td>
<td>66</td>
<td>f</td>
</tr>
<tr>
<td>7</td>
<td>7</td>
<td>[BEL]</td>
<td>39</td>
<td>27</td>
<td>'</td>
<td>71</td>
<td>47</td>
<td>G</td>
<td>103</td>
<td>67</td>
<td>g</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>[BACKSPACE]</td>
<td>40</td>
<td>28</td>
<td>(</td>
<td>72</td>
<td>48</td>
<td>H</td>
<td>104</td>
<td>68</td>
<td>h</td>
</tr>
<tr>
<td>9</td>
<td>9</td>
<td>[HORIZONTAL TAB]</td>
<td>41</td>
<td>29</td>
<td>)</td>
<td>73</td>
<td>49</td>
<td>I</td>
<td>105</td>
<td>69</td>
<td>i</td>
</tr>
<tr>
<td>11</td>
<td>B</td>
<td>[VERTICAL TAB]</td>
<td>43</td>
<td>2B</td>
<td>+</td>
<td>75</td>
<td>4B</td>
<td>K</td>
<td>107</td>
<td>6B</td>
<td>k</td>
</tr>
<tr>
<td>12</td>
<td>C</td>
<td>[FORM FEED]</td>
<td>44</td>
<td>2C</td>
<td>,</td>
<td>76</td>
<td>4C</td>
<td>L</td>
<td>108</td>
<td>6C</td>
<td>l</td>
</tr>
<tr>
<td>13</td>
<td>D</td>
<td>[CARRIAGE RETURN]</td>
<td>45</td>
<td>2D</td>
<td>-</td>
<td>77</td>
<td>4D</td>
<td>M</td>
<td>109</td>
<td>6D</td>
<td>m</td>
</tr>
<tr>
<td>14</td>
<td>E</td>
<td>[SHIFT OUT]</td>
<td>46</td>
<td>2E</td>
<td>.</td>
<td>78</td>
<td>4E</td>
<td>N</td>
<td>110</td>
<td>6E</td>
<td>n</td>
</tr>
<tr>
<td>15</td>
<td>F</td>
<td>[SHIFT IN]</td>
<td>47</td>
<td>2F</td>
<td>/</td>
<td>79</td>
<td>4F</td>
<td>O</td>
<td>111</td>
<td>6F</td>
<td>o</td>
</tr>
<tr>
<td>16</td>
<td>10</td>
<td>[DATA LINK ESCAPE]</td>
<td>48</td>
<td>30</td>
<td>0</td>
<td>80</td>
<td>50</td>
<td>P</td>
<td>112</td>
<td>70</td>
<td>p</td>
</tr>
<tr>
<td>17</td>
<td>11</td>
<td>[DEVICE CONTROL 1]</td>
<td>49</td>
<td>31</td>
<td>1</td>
<td>81</td>
<td>51</td>
<td>Q</td>
<td>113</td>
<td>71</td>
<td>q</td>
</tr>
<tr>
<td>18</td>
<td>12</td>
<td>[DEVICE CONTROL 2]</td>
<td>50</td>
<td>32</td>
<td>2</td>
<td>82</td>
<td>52</td>
<td>R</td>
<td>114</td>
<td>72</td>
<td>r</td>
</tr>
<tr>
<td>19</td>
<td>13</td>
<td>[DEVICE CONTROL 3]</td>
<td>51</td>
<td>33</td>
<td>3</td>
<td>83</td>
<td>53</td>
<td>S</td>
<td>115</td>
<td>73</td>
<td>s</td>
</tr>
<tr>
<td>20</td>
<td>14</td>
<td>[DEVICE CONTROL 4]</td>
<td>52</td>
<td>34</td>
<td>4</td>
<td>84</td>
<td>54</td>
<td>T</td>
<td>116</td>
<td>74</td>
<td>t</td>
</tr>
<tr>
<td>21</td>
<td>15</td>
<td>[NEGATIVE ACKNOWLEDGE]</td>
<td>53</td>
<td>35</td>
<td>5</td>
<td>85</td>
<td>55</td>
<td>U</td>
<td>117</td>
<td>75</td>
<td>u</td>
</tr>
<tr>
<td>22</td>
<td>16</td>
<td>[SYNCHRONOUS IDLE]</td>
<td>54</td>
<td>36</td>
<td>6</td>
<td>86</td>
<td>56</td>
<td>V</td>
<td>118</td>
<td>76</td>
<td>v</td>
</tr>
<tr>
<td>23</td>
<td>17</td>
<td>[ENG OF TRANS. BLOCK]</td>
<td>55</td>
<td>37</td>
<td>7</td>
<td>87</td>
<td>57</td>
<td>W</td>
<td>119</td>
<td>77</td>
<td>w</td>
</tr>
<tr>
<td>24</td>
<td>18</td>
<td>[CANCEL]</td>
<td>56</td>
<td>38</td>
<td>8</td>
<td>88</td>
<td>58</td>
<td>X</td>
<td>120</td>
<td>78</td>
<td>x</td>
</tr>
<tr>
<td>25</td>
<td>19</td>
<td>[END OF MEDIUM]</td>
<td>57</td>
<td>39</td>
<td>9</td>
<td>89</td>
<td>59</td>
<td>Y</td>
<td>121</td>
<td>79</td>
<td>y</td>
</tr>
<tr>
<td>26</td>
<td>1A</td>
<td>[SUBSTITUTE]</td>
<td>58</td>
<td>3A</td>
<td>:</td>
<td>90</td>
<td>5A</td>
<td>Z</td>
<td>122</td>
<td>7A</td>
<td>z</td>
</tr>
<tr>
<td>27</td>
<td>1B</td>
<td>[ESCAPE]</td>
<td>59</td>
<td>3B</td>
<td>;</td>
<td>91</td>
<td>5B</td>
<td>[</td>
<td>123</td>
<td>7B</td>
<td>{</td>
</tr>
<tr>
<td>28</td>
<td>1C</td>
<td>[FILE SEPARATOR]</td>
<td>60</td>
<td>3C</td>
<td>&lt;</td>
<td>92</td>
<td>5C</td>
<td>\</td>
<td>124</td>
<td>7C</td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>1D</td>
<td>[GROUP SEPARATOR]</td>
<td>61</td>
<td>3D</td>
<td>=</td>
<td>93</td>
<td>5D</td>
<td>]</td>
<td>125</td>
<td>7D</td>
<td>}</td>
</tr>
<tr>
<td>30</td>
<td>1E</td>
<td>[RECORD SEPARATOR]</td>
<td>62</td>
<td>3E</td>
<td>&gt;</td>
<td>94</td>
<td>5E</td>
<td>^</td>
<td>126</td>
<td>7E</td>
<td>~</td>
</tr>
<tr>
<td>31</td>
<td>1F</td>
<td>[UNIT SEPARATOR]</td>
<td>63</td>
<td>3F</td>
<td>?</td>
<td>95</td>
<td>5F</td>
<td>_</td>
<td>127</td>
<td>7F</td>
<td>[DEL]</td>
</tr>
</tbody>
</table>
Escape Characters

“Escape characters” are a special notation for whitespace and other unprintable characters.

Used for characters without a standard symbol or symbols Python sets aside.

Escape characters begin with a backslash.

Escape sequences are considered one character.
**Slicing Strings**

`s[begin:end]`

Slicing is for extracting substrings from a string.

To slice a string, indicate the first character you want and one past the last character.

First index location is always 0.

Last index location is always the length of the string minus one.
String Functions

s.function()
String Formatting Expressions

Python defines the % operator to work on strings

When applied to strings, % provides a compact way to code multiple string substitutions

Operator on left is conversion target

On the right, provide the object you want Python to insert in its place

print('%d %s' % (i, 'str'))

Most common: %s %d %f
Exam 2 on Monday, November 10