

# **Announcements for Today**

#### Reading

- Chapter 4 today
- Reread Chapter 3 for Thurs
  - Will review call frames
  - "Convert" his frames to ours

#### **More Assignments**

- A2 due next week (Tues)
- A3 posted this Thursday
  - Due in 1.5 weeks

#### Assignment 1

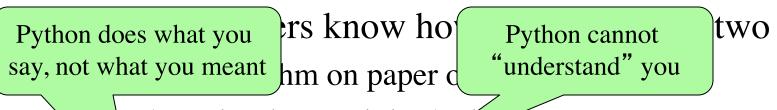
- We have started grading!
  - Should have your grade tomorrow morning
  - Resubmit until correct
- If you were **close**...
  - Will get feedback in CMS
  - Fix your assignment
- If you were very **wrong**...
  - Will be contacted tonight!
  - Will hold one-on-ones Wed

# **Algorithms: Heart of Computer Science**

- Algorithm: A step-by-step procedure for how to do something (usually a calculation).
- **Implementation**: How to write an algorithm in a specific programming language
- Good programmers know how to separate the two
  - Work out algorithm on paper or in head
  - Once done, implement it in the language
  - Limits errors to syntax errors (easy to find), not conceptual errors (much, much harder to find)
- Key to designing algorithms: **stepwise refinement**

# **Algorithms: Heart of Computer Science**

- Algorithm: A step-by-step procedure for how to do something (usually a calculation).
- **Implementation**: How to write an algorithm in a specific programming language



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- Lin ts errors to syntax errors (easy to find), not conceptual errors (much, much harder to find)
- Key to designing algorithms: stepwise refinement

# **Stepwise Refinement: Basic Principles**

- Write Specifications First Write a function specification before writing its body
- **Take Small Steps** Do a little at a time; follow the **Mañana Principle**
- Run as Often as You Can This can catch syntax errors
- Separate Concerns Focus on one step at a time
- Intersperse Programming and Testing When you finish a step, test it immediately

# **Mañana Principle**

- If not in current step, delay to "tomorrow"
  - Use comments to write steps in English
  - Add "stubs" to allow you to run program often
  - Slowly replace stubs/comments with real code
- Only create new local variables if you have to
- Sometimes results in creation of more functions
  - Replace the step with a function call
  - But leave the *function definition* empty for now
  - This is called top-down design

#### **Function Stubs**

#### **Procedure Stubs**

- Single statement: pass
  - Body cannot be empty
  - This command does nothing
- Example:
  - **def** foo():

pass

#### **Fruitful Stubs**

- Single return statement
  - Type should match spec.
  - Return a "default value"

#### • Example:

**def** first\_four\_letters(s):

return ' ' # empty string

#### **Purpose of Stubs**

Create a program that may not be correct, but does not crash.

# **Example: Reordering a String**

last\_name\_first('Walker White') is 'White, Walker'

```
def last_name_first(s):
```

"""Returns: copy of s in form <last-name>, <first-name>

Precondition: s is in the form <first-name> <last-name> with one blank between the two names"""

```
# Find the first name
```

# Find the last name

# Put them together with a comma

return ' ' # Currently a stub

# **Example: Reordering a String**

last\_name\_first('Walker White') is 'White, Walker'

```
def last_name_first(s):
```

"""Returns: copy of s in form <last-name>, <first-name>

```
Precondition: s is in the form <first-name> <last-name> with one blank between the two names"""
```

```
end_first = s.find(' ')
```

```
first_name = s[:end_first]
```

# Find the last name

```
# Put them together with a comma
```

return first\_name # Still a stub

# **Refinement: Creating Helper Methods**

**def** last\_name\_first(s):

"""Returns: copy of s in the form
<last-name>, <first-name>
Precondition: s is in the form
<first-name> <last-name> with
with one blank between names"""
first = first\_name(s)

# Find the last name

**#** Put together with comma

return first **# Stub** 

#### **def** first\_name(s):

"""Returns: first name in s
Precondition: s is in the form
<first-name> <last-name> with
one blank between names"""
end = s.find(' ')
return s[:end]

## **Refinement: Creating Helper Methods**

**def** last\_name\_first(s):

"""Returns: copy of s in the form
<last-name>, <first-name>
Precondition: s is in the form
<first-name> <last-name> with
with one blank between names"""
first = first\_name(s)

# Find the last name

**# Put together with comma** 

return first **# Stub** 

#### **def** first\_name(s):

"""**Returns**: first name in s **Precondition**: s is in the form <first-name> <last-name> with one blank between names""" end = s.find(' ')

return s[:end]

#### **Do This Sparingly**

- If you might use this step in **another** function later
- If implementation is rather long and complicated

# **Example: Reordering a String**

last\_name\_first('Walker White') is 'White, Walker'

```
def last_name_first(s):
```

"""Returns: copy of s in form <last-name>, <first-name>

Precondition: s is in the form <first-name> <last-name> with one or more blanks between the two names"""

```
# Find the first name
```

```
# Find the last name
```

```
# Put them together with a comma
```

```
return ' ' # Currently a stub
```

- anglicize(1) is "one"
- anglicize(15) is "fifteen"
- anglicize(123) is "one hundred twenty three"
- anglicize(10570) is "ten thousand five hundred

```
def anglicize(n):
```

```
"""Returns: the anglicization of int n.
Precondition: 0 < n < 1,000,000"""
pass # ???</pre>
```

**def** anglicize(n):

```
"""Returns: the anglicization of int n.
Precondition: 0 < n < 1,000,000"""
# if < 1000, provide an answer</pre>
```

```
# if > 1000, break into hundreds, thousands parts
# use the < 1000 answer for each part , and glue
# together with "thousands" in between
return " # empty string</pre>
```

```
def anglicize(n):
```

```
"""Returns: the anglicization of int n.
Precondition: 0 < n < 1,000,000"""
if n < 1000: # no thousands place
   return anglicize1000(n)
if n \% 1000 == 0: # no hundreds, only thousands
   return anglicize1000(n/1000) + ' thousand'
else:
                   # mix the two
   return (anglicize1000(n/1000) + ' thousand '+
            anglicize1000(n))
```

#### **def** anglicize(n):

