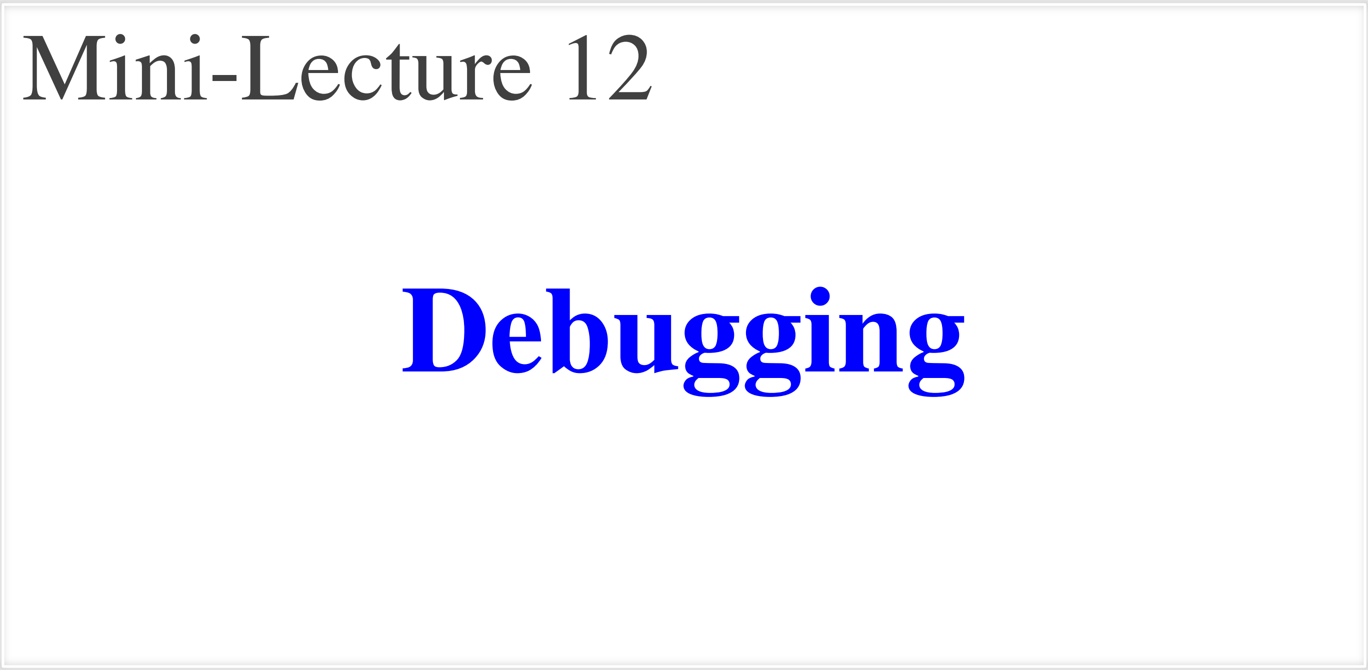


Mini-Lecture 12

# Debugging

# Testing last_name_first(n)

```
# test procedure
def test_last_name_first():
    """Test procedure for last_name_first(n)"""
    result = name.last_name_first('Walker White')
    introcs.assert_equals('White, Walker', result)
    result = name.last_name_first('Walker       White')
    introcs.assert_equals('White, Walker', result)

# Script code
test_last_name_first()
print('Module name is working correctly')
```

Call function on test input

Compare to expected output

Call test procedure to activate the test

# Types of Testing

## Black Box Testing

- Function is “opaque”
  - Test looks at what it does
  - **Fruitful**: what it returns
  - **Procedure**: what changes
- **Example**: Unit tests
- **Problems**:
  - Are the tests everything?
  - What caused the error?

## White Box Testing

- Function is “transparent”
  - Tests/debugging takes place inside of function
  - Focuses on where error is
- **Example**: Use of `print`
- **Problems**:
  - Much harder to do
  - Must remove when done

# Finding the Error

- Unit tests cannot find the source of an error
- Idea: “Visualize” the program with print statements

```
def last_name_first(n):
    """Returns: copy of <n> in form <last>, <first>"""
    end_first = n.find(' ')
    print(end_first)
    first = n[:end_first]
    print('first is '+str(first))
    last  = n[end_first+1:]
    print('last is '+str(last))
    return last+', '+first
```

Print variable after each assignment

**Optional**: Annotate value to make it easier to identify

# Conditionals and Debugging

- Must understand which branch caused the error
  - Unit test produces error
  - Visualization tools show the current flow for error
- Visualization tools?
  - print statements
  - Advanced tools in IDEs (Integrated Dev. Environ.)

```
# Put max of x, y in z
 print('before if')
 if x > y:
     print('if x>y')
     z  = x
 else:
     print('else x<=y')
     z  = y
 print('after if')
```

# Conditionals and Debugging

- Call these tools **traces**
- No requirements on how to implement your traces
  - Less print statements ok
  - Do not need to word them exactly like we do
  - Do what ever is easiest for you to see the flow
- **Example**: flow.py

```
# Put max of x, y in z
print('before if')
if x > y:
    print('if x>y')
    z = x
else:
    print('else x<=y')
    z = y
print('after if')
```

Traces

# Watches vs. Traces

## Watch

- Visualization tool (e.g. print statement)
- Looks at **variable value**
- Often after an assignment
- What you did in lab

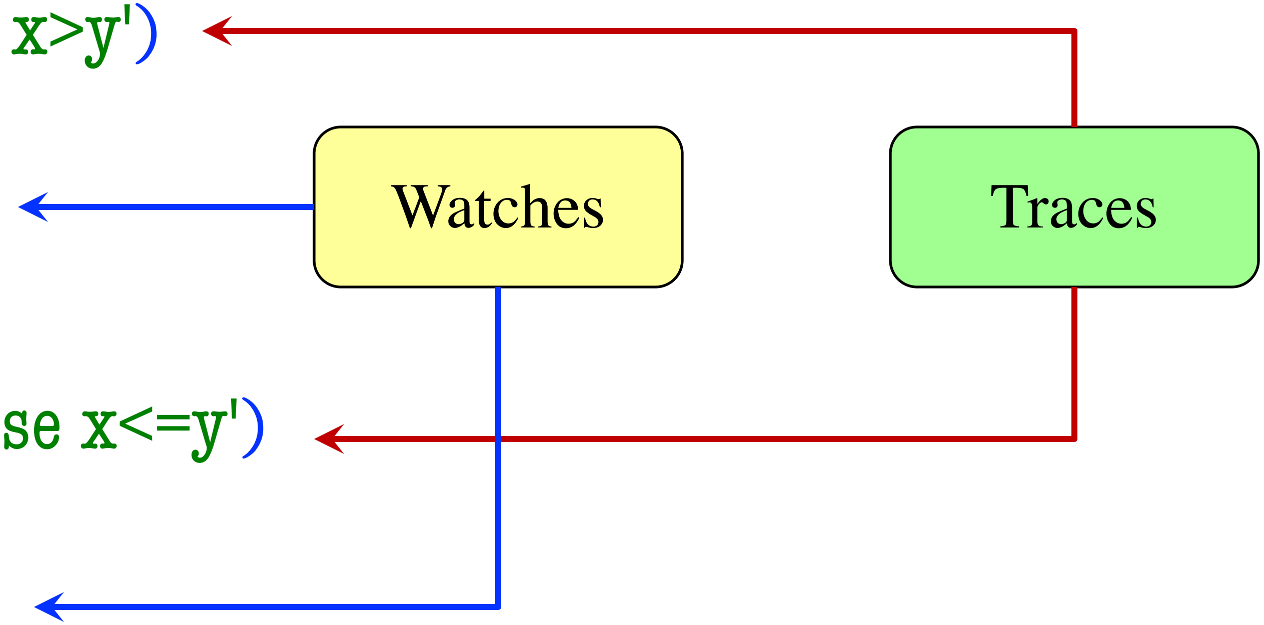
## Trace

- Visualization tool (e.g. print statement)
- Looks at **program flow**
- Before/after any point where flow can change

# Traces and Functions

**Example**: flow.py

```
print('before if')
    if x > y:
        print('if x>y')
        z  = y
        print(z)
    else:
        print('else x<=y')
        z  = y
        print(z)
    print('after if')
```


Watches
Traces