Objectives

- More conditionals
- Boolean operators

Review

- How can we make Python code execute only under certain circumstances?
- How do we say "otherwise" in Python?

Review: Syntax of `if` statement: Simple Decision

```
if condition :
    statement1
    statement2
    …
    statementn
```

keyword

"then" Body
- Note indentation

English Examples:

if it is raining **:**
     I will wear a raincoat

if the PB is new **:**
     Remove the seal

Syntax of `if` statement: Two-Way Decision

```
if condition :
    statement1
    statement2
    …
    statementn
else :
    statement1
    statement2
    …
    statementn
```

keywords

"then" Body

"else" Body

English Example:

if it is Saturday or Sunday :
     I wake up at 10 a.m.
else :
     I wake up at 7 a.m.

Review: Relational Operators

- Syntax:
  - <expr> <relational_operator> <expr>

Relational Operator	Meaning
<	Less than?
<=	Less than or equal to?
>	Greater than?
>=	Greater than or equal to?
==	Equals?
!=	Not equals?

Low precedence

Review: Using Conditionals

- Determine if a number is even or odd

```
x = eval(input("Enter a number: "))
remainder = x%2
if remainder == 0:
    print(x, "is even")
if remainder == 1:
    print(x, "is odd")
```

```
x = eval(input("Enter a number: "))
remainder = x % 2
if remainder == 0:
    print(x, "is even")
else:
    print(x, "is odd")
```

This is the more efficient implementation. Why?

Using the building blocks:
Nesting `if-else` statements

```
if condition :
    if condition :
        statements
    else:
        statements
else:
    statements
```

`if-else` statement is **nested** inside the `if`

Review: Speeding Ticket Fines

- Any speed clocked over the limit results in a fine of at least $50, plus $5 for each mph over the limit, plus a penalty of $200 for any speed over 90mph.
- Our program
  - Input: speed limit and the clocked speed
  - Output: either (a) that the clocked speed was under the limit or (b) the appropriate fine

What should our test cases be?
Why should those be our test cases?

Testing Speeding Ticket Program

- Our test cases fell into two categories:
  - Data-related
    - Make sure we picked good numbers (clocked speed: 90, 91)
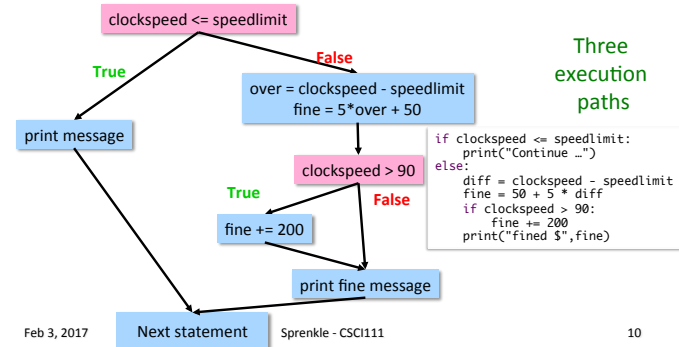 - Control-related

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Testing with `if` Statements

- Make sure *at least* have test cases that execute each branch in control flow diagram
  - i.e., Each execution path is "covered"

Three execution paths

```
if clockspeed <= speedlimit:
    print("Continue …")
else:
    diff = clockspeed - speedlimit
    fine = 50 + 5 * diff
    if clockspeed > 90:
        fine += 200
    print("fined $",fine)
```

Testing with `if` Statements

- Make sure have test cases that execute each branch in control flow diagram
  - i.e., Each execution path is "covered"

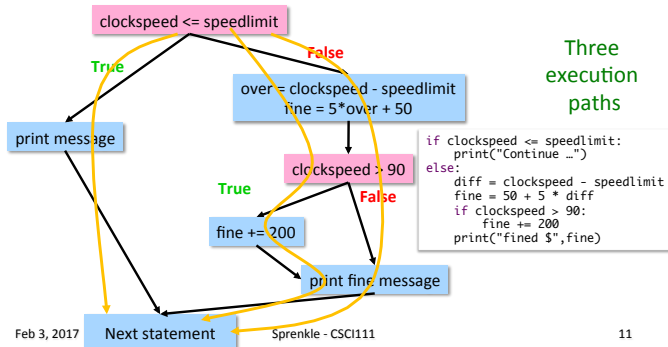Three execution paths

```
if clockspeed <= speedlimit:
    print("Continue …")
else:
    diff = clockspeed - speedlimit
    fine = 50 + 5 * diff
    if clockspeed > 90:
        fine += 200
    print("fined $",fine)
```

Practice: Numeric to Letter Grade

- Determine a numeric grade's letter grade (A, B, C, D, or F)

Numeric Grade	Letter Grade
90 and above	A
80 to below 90	B
70 to below 80	C
60 to below 70	D
Below 60	F

Syntax of **if** statement: Multi-Way Decision

```
if condition :
    <then-body1>
elif condition :
    <then-body2>
elif condition :
    <then-body3>
    …
else:
    <default-body>
```

keywords

English Example:

if it is Saturday**:**
    I wake up at 10 a.m.
elif it is Sunday**:**
    I wake up at 9 a.m.
else:
    I wake up at 7 a.m.

Using the building blocks: Nesting `if-else` statements

```
if condition :
    statements
else:
    if condition :
        statements
    else :
        statements
```

`if-else` statement is **nested** inside the `else`

This structure can be rewritten as an
if-elif-else statement

If-Else-If statements

Draw the control flow diagram

```
if x % 2 == 0 :
    print(x, "is a multiple of 2")
elif x % 3 == 0 :
    print(x, "is a multiple of 3")
else :
    print(x, "is not a multiple of 2 or 3")
```

If-Else-If statements

```
if x % 2 == 0 :
    print(x, "is a multiple of 2")
elif x % 3 == 0 :
    print(x, "is a multiple of 3")
else :
    print(x, "is not a multiple of 2 or 3")
```

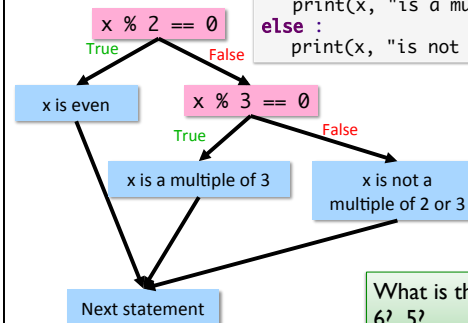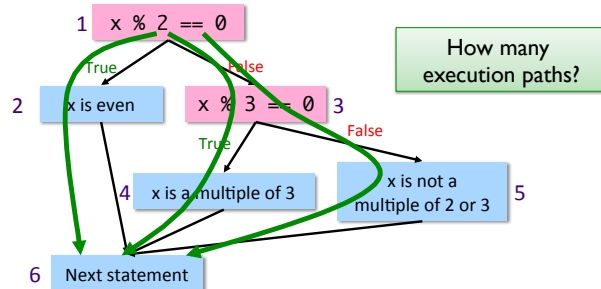x % 2 == 0
True   False

x is even

x % 3 == 0
True   False

x is a multiple of 3

x is not a multiple of 2 or 3

Next statement

What is the output if x is 4? 6? 5?

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Testing with If Statements

- Make sure have test cases that execute each branch in control flow diagram
  - i.e., Each execution path is "covered"

1 $x \% 2 == 0$

True   False

2 x is even $x \% 3 == 0$ 3

How many execution paths?

True   False

4 x is a multiple of 3   x is not a multiple of 2 or 3 5

6 Next statement

Modify to use `elif`

- Determine if a numeric grade is a letter grade (A, B, C, D, or F)

Numeric Grade	Letter Grade
90 and above	A
80 to below 90	B
70 to below 80	C
60 to below 70	D
Below 60	F

Broader Issue Groups

Charlotte George Josette Tony Zander	Alex Buddy Mike Mira Sarah	Austin Burke Lexi Molly Win	Anna Kate Ashley Jae John	Collin Leslie Robert Victor

Self-Driving Cars

- Will you feel safe (safer?) with an automated driver in the lane next to you?
- What guarantees about the cars would you want from the company/government?
- Are there situations that would be particularly difficult for software to handle that a person would be better equipped to handle?
- What algorithms might be used in a car? How are they implemented?
  - What would be the most difficult part about programming something like a car to run without human input?
- What should the next DARPA Challenge be?
  - In a year?
  - In 5 years?

Looking Ahead

- Exam Next Week

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