Control flow: if statements

Ruth Anderson
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Making decisions

• How do we compute absolute value?
  Absolute value of 5 is
  Absolute value of 0 is
  Absolute value of -22 is

If the value is negative, negate it. Otherwise, use the original value.
Absolute value solution

If the value is negative, negate it.
Otherwise, use the original value.

val = -10

# calculate absolute value of val
if val < 0:
    result = -val
else:
    result = val

print result

In this example, result will always be assigned a value.

Condition must be a Boolean expression

Indentation is significant

else is not required
**Absolute value solution**

**If** the value is negative, negate it. **Otherwise**, use the original value.

```python
val = -10

# calculate absolute value of val
if val < 0:
    result = -val
else:
    result = val

print result
```

Another approach that does the same thing without using `result`:

```python
val = -10

if val < 0:
    print -val
else:
    print val
```

In this example, `result` will always be assigned a value.
As with loops, a sequence of statements could be used in place of a single statement:

```
val = -10

# calculate absolute value of val
if val < 0:
    result = -val
    print "val is negative!"
    print "I had to do extra work!"
else:
    result = val
    print "val is positive"
print result
```
val = 0

# calculate absolute value of val
if val < 0:
    print "val is negative"
    print val
    result = -val
elif val == 0:
    print "val is zero"
    print val
    result = val
else:
    print "val is positive"
    print val
    result = val

print result
Another absolute value solution

What happens here?

```python
val = 5

# calculate absolute value of val
if val < 0:
    result = -val
    print "val is negative!"
else:
    for i in range(val):
        print "val is positive!"
    result = val

print result
```

Another if

It is **not required that anything happens**...

```python
val = -10

if val < 0:
    print "negative value!"
```

What happens when val = 5?
The if body can be any statements

```python
# height is in km
if height > 100:
    print "space"
else:
    if height > 50:
        print "mesosphere"
    elif height > 20:
        print "stratosphere"
    else:
        print "troposphere"
```

Execution gets here only if "height > 100" is false

Execution gets here only if "height > 100" is false AND "height > 50" is true
# height is in km
if height > 100:
    print "space"
else:
    if height > 50:
        print "mesosphere"
    else:
        if height > 20:
            print "stratosphere"
        else:
            print "troposphere"
Version 1

# height is in km
if height > 100:
    print "space"
else:
    if height > 50:
        print "mesosphere"
    else:
        if height > 20:
            print "stratosphere"
        else:
            print "troposphere"
if height > 50:
    if height > 100:
        print "space"
    else:
        print "mesosphere"
else:
    if height > 20:
        print "stratosphere"
    else:
        print "troposphere"
Version 3 (Best)

```python
if height > 100:
    print "space"
elif height > 50:
    print "mesosphere"
elif height > 20:
    print "stratosphere"
else:
    print "troposphere"
```

ONE of the print statements is guaranteed to execute: whichever condition it encounters first that is true
Order Matters

# version 3
if height > 100:
    print "space"
elif height > 50:
    print "mesosphere"
elif height > 20:
    print "stratosphere"
else:
    print "troposphere"

# broken version 3
if height > 20:
    print "stratosphere"
elif height > 50:
    print "mesosphere"
elif height > 100:
    print "space"
else:
    print "troposphere"

Try height = 72 on both versions, what happens?
Incomplete Version 3

```python
# incomplete version 3
if height > 100:
    print "space"
elif height > 50:
    print "mesosphere"
elif height > 20:
    print "stratosphere"
```

In this case it is possible that nothing is printed at all, when?

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**Diagram:**
- `troposphere`: 0 to 20 km
- `stratosphere`: 20 to 50 km
- `mesosphere`: 50 to 90 km
- `space`: 90 to 100 km

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See in python tutor
What Happens Here?

```python
# height is in km
if height > 100:
    print "space"
if height > 50:
    print "mesosphere"
if height > 20:
    print "stratosphere"
else:
    print "troposphere"
```

Try height = 72
The then clause or the else clause is executed

speed = 54
limit = 55
if speed <= limit:
    print "Good job!"
else:
    print "You owe $", speed/fine

What if we change speed to 64?