CSc 110, Spring 2017

Lecture 8: `input`; `if/else`

Adapted from slides by Marty Stepp and Stuart Reges

Returning a value (review)

```
def name(parameters):
    statements
    ...
    return expression
```

- When Python reaches a return statement:
  - it evaluates the expression
  - it substitutes the return value in place of the call
  - it goes back to the caller and continues after the function call

Functions that return values (review)

- Consider a function that prints the square of an integer

```
def square(n):
    sq = n * n
    print(sq)
```

- Python also allow functions to *return values*

```
def square(n):
    sq = n * n
    return sq
```

- The program runs the function, computes the answer, and then "replaces" the function call with its computed result value.

- To see the result, we must print it or store it in a variable.
  - `result = square(8)`
  - `print(result)` `# 64`

Interactive programs

interactive program: Reads input from the console.

- While the program runs, it asks the user to type input.
- The input typed by the user is stored in variables in the code.

- Can be tricky; users are unpredictable and misbehave.

`input`

- **`input`**: A function that reads input from the user.
- **`input`**: Returns a value of type string

- Using the `input` function to read console input:

  name `= input(`**prompt**`)`

  - Example:

    ```
    user_name = input("What is your name? ")
    ```

  The string the user types in is assigned to the variable `user_name`

input example

```
def main():
    age = input("How old are you? ")

    years = 65 - age
    print(years + " years until retirement!")
```

age | 29

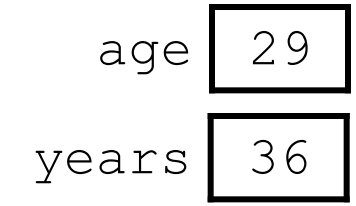
- Console (user input underlined):

```
How old are you? 29
```

```
Traceback (most recent call last):
  File "<pyshell#13>", line 1, in <module>
    print(65 - age)
TypeError: unsupported operand type(s) for -:
'int' and 'str'
```

input example

```
def main():
    age = int(input("How old are you? "))

    years = 65 - age
    print(str(years) + " years until retirement!")
```



- Console (user input underlined):

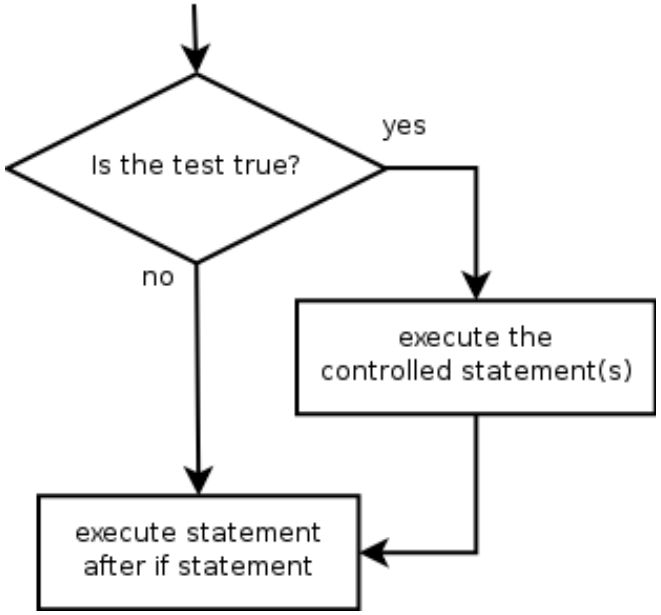
```
How old are you? 29
36 years until retirement!
```

The `if/else` statement

The `if` statement

Executes a block of statements only if a test is true

```
if (test):
    statement
    ...
    statement
```



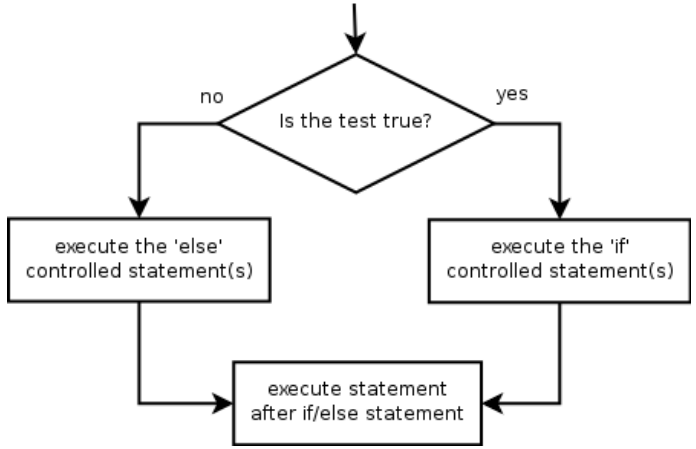
- Example:

```
gpa = float(input("gpa? "))
if (gpa >= 2.0):
    print("Application accepted.")
```

The `if/else` statement

Executes one block if a test is true, another if false

```
if (test):
    statement(s)
else:
    statement(s)
```



- Example:

```
gpa = float(input("gpa? "))
if (gpa >= 2.0):
    print("Welcome to Mars University!")
else:
    print("Application denied.")
```

Relational Operators

- `if` statements use logical tests.

```
if (test): ...
```

  - **`Test`** is a `boolean` expression that produces a literal value of True or False

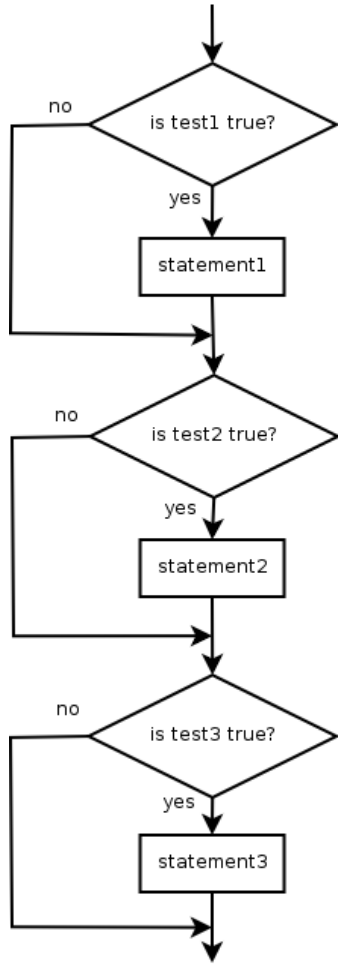
- Tests use *relational operators* Note the equals "==" !!

Operator	Meaning	Example	Value
==	equals	1 + 1 == 2	True
!=	does not equal	3.2 != 2.5	True
<	less than	10 < 5	False
>	greater than	10 > 5	True
<=	less than or equal to	126 <= 100	False
>=	greater than or equal to	5.0 >= 5.0	True

Misuse of `if`

- What's wrong with the following code?

```
percent = float(input("What percentage did you earn? "))

if (percent >= 90):
    print("You got an A!")

if (percent >= 80):
    print("You got a B!")

if (percent >= 70):
    print("You got a C!")

if (percent >= 60):
    print("You got a D!")

if (percent < 60):
    print("You got an F!")

...
```



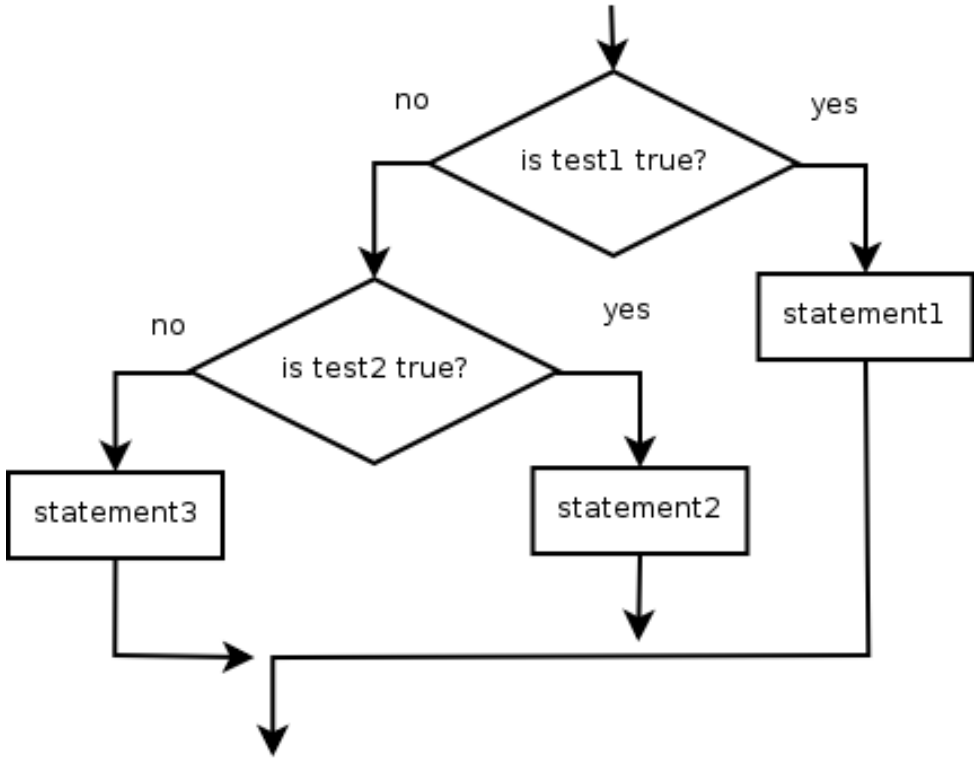
Nested `if/else`

Chooses between outcomes using many tests

```
if (test):
    statement(s)
elif (test):
    statement(s)
else:
    statement(s)
```

- Example:

```
if (x > 0):
    print("Positive")
elif (x < 0):
    print("Negative")
else:
    print("Zero")
```



Corrected using nested `if/else`

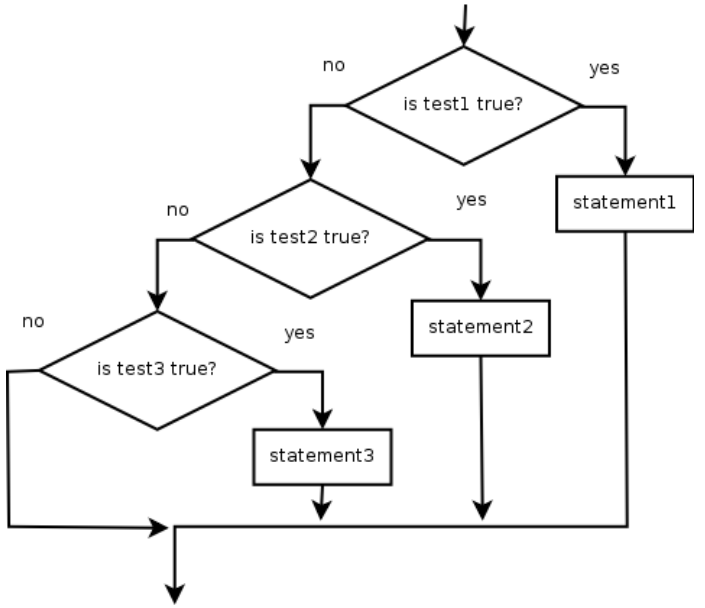
- Now only 1 path is taken

```
percent = float(input("What percentage did you earn? "))

if (percent >= 90):
    print("You got an A!")

elif (percent >= 80):
    print("You got a B!")

elif (percent >= 70):
    print("You got a C!")

elif (percent >= 60):
    print("You got a D!")

else (percent < 60):
    print("You got an F!")
```

Nested `if/else/if`

- If it ends with `else`, exactly one path must be taken.
- If it ends with `if`, the code might not execute any path.

```
if (test):
    statement(s)
elif (test):
    statement(s)
elif (test):
    statement(s)
```



- Example:

```
if (place == 1):
    print("Gold medal!")
elif (place == 2):
    print("Silver medal!")
elif (place == 3):
    print("Bronze medal.")
```

Nested `if` structures

- exactly 1 path *(mutually exclusive)*

```
if (test):
    statement(s)
elif (test):
    statement(s)
else:
    statement(s)
```

- 0 or 1 path *(mutually exclusive)*

```
if (test):
    statement(s)
elif (test):
    statement(s)
elif (test):
    statement(s)
```

- 0, 1, or many paths *(independent tests; not exclusive)*

```
if (test):
    statement(s)

if (test):
    statement(s)

if (test):
    statement(s)
```

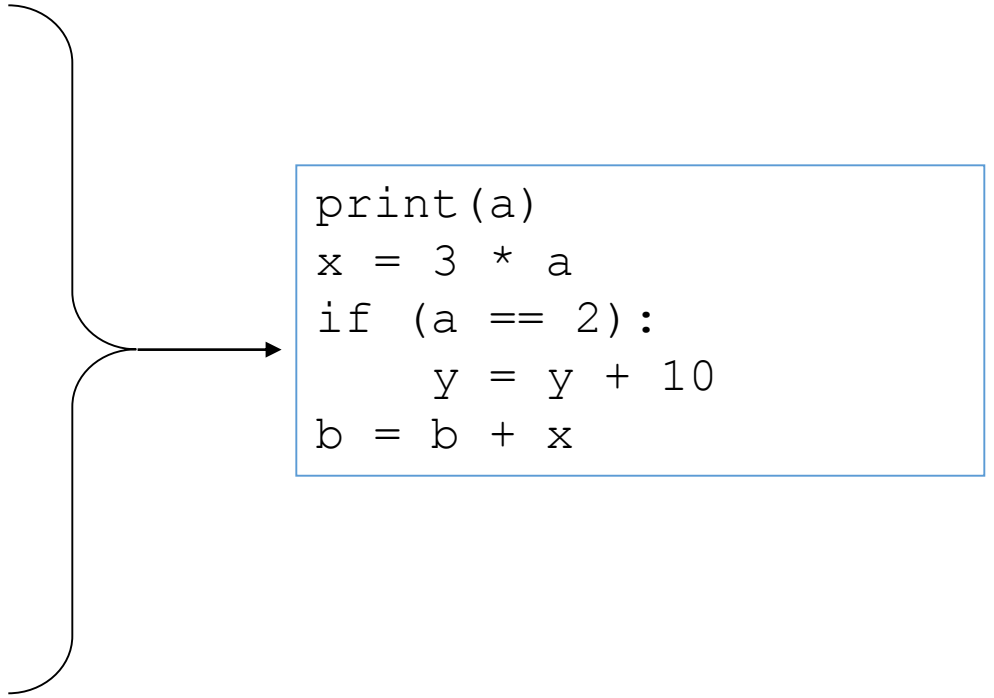
Which nested `if/else`?

- **(1) if/if/if (2) nested if/else (3) nested if/else/if**
  - Whether a user is lower, middle, or upper-class based on income.
    - **(2)** nested `if / else if / else`
  - Whether you made the dean's list (GPA ≥ 3.8) or honor roll (3.5-3.8).
    - **(3)** nested `if / else if`
  - Whether a number is divisible by 2, 3, and/or 5.
    - **(1)** sequential `if / if / if`
  - Computing a grade of A, B, C, D, or F based on a percentage.
    - **(2)** nested `if / else if / else if / else if / else`

Factoring `if/else` code

- **factoring**: Extracting common/repeated code.
  - Can reduce or eliminate repetition from `if/else` code.
- Example:

```
if (a == 1):
    print(a)
    x = 3
    b = b + x
elif (a == 2):
    print(a)
    x = 6
    y = y + 10
    b = b + x
else:          # a == 3
    print(a)
    x = 9
    b = b + x
```



```
print(a)
x = 3 * a
if (a == 2):
    y = y + 10
b = b + x
```

The "dangling if" problem

- What can be improved about the following code?

```
if (x < 0):
    print("x is negative")
elif (x >= 0):
    print("x is non-negative")
```

- The second if test is unnecessary and can be removed:

```
if (x < 0):
    print("x is negative")
else:
    print("x is non-negative")
```

  - This is also relevant in functions that use `if` with `return`...

`if/else` with `return`

```
# Returns the larger of the two given integers.
def max(a, b):
    if (a > b):
        return a
    else:
        return b
```

- Functions can return different values using `if/else`
  - Whichever path the code enters, it will return that value.
  - Returning a value causes a function to immediately exit.
  - All paths through the code should reach a `return` statement.

Nested `if/else` question

- Write a program that produces output like the following:

```
This program reads data for two students and
computes their Computer Science GPAs

Enter next person's information:
CS 110 grade? A
CS 120 grade? B

Enter next person's information:
CS 110 grade? B
CS 120 grade? B

Person 1 GPA = 3.5
accepted
Person 2 GPA = 3.0
accepted
Difference = 0.5
```

Grade	GPA
A	4.0
B	3.0
C	2.0
D	1.0