CSc 110, Autumn 2017

Lecture 17: `while` Loops and Sentinel Loops

Adapted from slides by Marty Stepp and Stuart Reges

```
while (mahself.stillAwake())
{
    sheep++;
}
```

Categories of loops

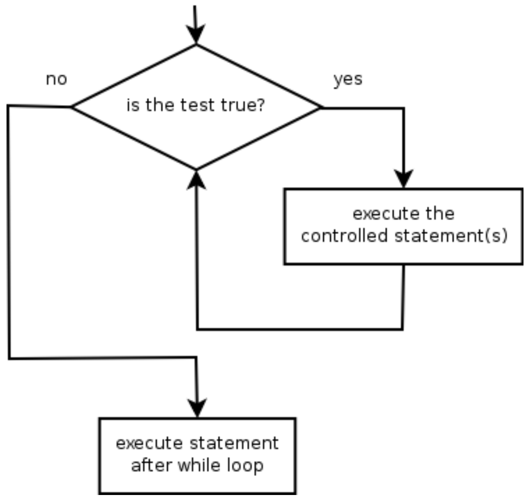
- **definite loop**: Executes a known number of times.
  - The `for` loops we have seen are definite loops.
    - Print "hello" 10 times.
    - Find all the prime numbers up to an integer *n*.
    - Print each odd number between 5 and 127.

- **indefinite loop**: One where the number of times its body repeats is not known in advance.
    - Prompt the user until they type a non-negative number.
    - Print random numbers until a prime number is printed.
    - Repeat until the user has typed "q" to quit.

The `while` loop

- **`while` loop**: Repeatedly executes its body as long as a logical test is true.

```
while test:
    statement(s)
```


no
yes
is the test true?
execute the controlled statement(s)
execute statement after while loop

- Example:

```
num = 1                                 # initialization
while num <= 200:                       # test
    print(str(num) + " ", end='')
    num = num * 2                       # update

# output:  1 2 4 8 16 32 64 128
```

Example while loop

```
# finds the first factor of 91, other than 1
n = 91
factor = 2
while n % factor != 0:
    factor += 1
print("First factor is", factor)

# output:  First factor is 7
```

- `while` is better than `for` because we don't know how many times we will need to increment to find the factor.

Sentinel values

- **sentinel**: A value that signals the end of user input.
  - **sentinel loop**: Repeats until a sentinel value is seen.

- Example: Write a program that prompts the user for text until the user types "quit", then output the total number of characters typed.
  - (In this case, "quit" is the sentinel value.)

```
Type a word (or "quit" to exit): hello
Type a word (or "quit" to exit): yay
Type a word (or "quit" to exit): quit
You typed a total of 8 characters.
```

Solution?

```
sum = 0
response = "dummy"   # "dummy" value, anything but "quit"

while response != "quit":
    response = input("Type a word (or \"quit\" to exit): ")
    sum += len(response)

print("You typed a total of " + str(sum) + " characters.")
```

- This solution produces the wrong output. Why?

```
You typed a total of 12 characters.
```

The problem with our code

- Our code uses a pattern like this:

```
sum = 0
while input is not the sentinel:
    prompt for input; read input.
    add input length to the sum.
```

- On the last pass, the sentinel's length (4) is added to the sum:

```
    prompt for input; read input ("quit").
    add input length (4) to the sum.
```

- This is a fencepost problem.
  - Must read *N* lines, but only sum the lengths of the first *N*-1.

A fencepost solution

```
sum = 0.
prompt for input; read input.                # place a "post"

while (input is not the sentinel):
    add input length to the sum.             # place a "wire"
    prompt for input; read input.            # place a "post"
```

- Sentinel loops often utilize a fencepost "loop-and-a-half" style solution by pulling some code out of the loop.

Correct code

```
sum = 0

# pull one prompt/read ("post") out of the loop
response = input("Type a word (or \"quit\" to exit): ")

while (response != "quit"):
    sum += len(response)     # moved to top of loop
    response = input("Type a word (or \"quit\" to exit): ")

print("You typed a total of " + str(sum) + " characters.")
```

Sentinel as a constant

```
SENTINEL = "quit"
...

sum = 0

# pull one prompt/read ("post") out of the loop
response = input("Type a word (or \"" + SENTINEL + "\" to exit): ")

while response != SENTINEL:
    sum += len(response)     # moved to top of loop
    response = input("Type a word (or \"" + SENTINEL + "\" to exit): ")

print("You typed a total of " + str(sum) + " characters.")
```