CS 1110

Lecture 18: While loops

Announcements

Prelim 2 conflicts

If you have a conflict you need to submit the information in CMS. We need a little more information than for Prelim 1—please see the Exams page of the CS1110 website.

Slides by D. Gries, L. Lee, S. Marschner, W. White

Recall: For Loops

```
# Print contents of seq
x = seq[0]
print x
x = seq[1]
print x
…
x = seq[len(seq)-1]
print x
```

The for-loop:

```
for x in seq:
    print x
```

- Key Concepts
  - **loop sequence:** seq
  - **loop variable:** x
  - **body:** print x
  - Also called **repetend**

Iteration: Doing things repeatedly

1. Process each item in a sequence
   - Compute aggregate statistics for a dataset, such as the mean, median, standard deviation, etc.
   - Send everyone in a Facebook group an appointment time

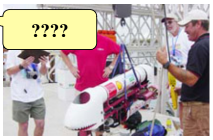
```
for x in sequence:
    process x
```

2. Perform *n* trials or get *n* samples
   - Draw *n* cards to make a poker hand
   - Run a protein-folding simulation for 10^6 time steps

```
for x in range(n):
    do next thing
```

3. Do something an unknown number of times
   - CUAUV team, vehicle keeps moving until reached its goal

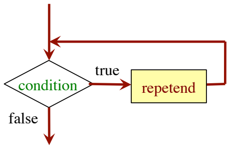
????



Beyond Sequences: The while-loop

```
while <condition>:
    statement 1
    …
    statement n
```

repetend or **body**



- Relationship to **for** loop
  - Broader notion of "still stuff to do"
  - Must ensure condition eventually becomes false
  - *You* explicitly manage what changes per iteration

while Versus for

```
# process range b..c-1
for k in range(b,c)
    process k
```

```
# process range b..c-1
k = b
while k < c:
    process k
    k = k+1
```

Must remember to increment

```
# process range b..c
for k in range(b,c+1)
    process k
```

```
# process range b..c
k = b
while k <= c:
    process k
    k = k+1
```

Note on Ranges

- m..n is a range containing n+1-m values

2..5	contains 2, 3, 4, 5.	Contains 5+1 – 2 = 4 values
2..4	contains 2, 3, 4.	Contains 4+1 – 2 = 3 values
2..3	contains 2, 3.	Contains 3+1 – 2 = 2 values
2..2	contains 2.	Contains 2+1 – 2 = 1 values
2..1	contains ???	

What does 2..1 contain?

A: nothing
B: 2,1
C: 1
D: 2
E: something else

Note on Ranges

- m..n is a range containing n+1-m values
  - 2..5 contains 2, 3, 4, 5. Contains 5+1 – 2 = 4 values
  - 2..4 contains 2, 3, 4. Contains 4+1 – 2 = 3 values
  - 2..3 contains 2, 3. Contains 3+1 – 2 = 2 values
  - 2..2 contains 2. Contains 2+1 – 2 = 1 values
  - 2..1 contains ???
- The notation m..n, always implies that m <= n+1
  - So you can assume that even if we do not say it
  - If m = n+1, the range has 0 values

while Versus for

Have to know in advance where to stop

```
#  ble of squares to N
n = floor(sqrt(N)) + 1
for k in range(n):
    seq[k] = k*k
```

```
# table of squares to N
k = 0
while k*k < N:
    seq[k] = k*k
    k = k+1
```

while is more flexible, but is *tricker* to use

while Versus for

Sometimes you don't use the loop variable at all

```
# Table of n Fibonacci nums
fib = [1, 1]
for k in range(2,n):
    fib.append(fib[-1] + fib[-2])
```

Don't need to have a loop variable if you don't need one

```
# Fibonacci table up to N
fib = [1, 1]
while fib[-1] + fib[-2] < N:
    fib.append(fib[-1] + fib[-2])
```

A numerical iteration

```
def sqrt(c):
    x = c/2
    while abs(x*x - c) > 1e-6:
        x = x / 2 + c / (2*x)
        print x
    return x
```

Patterns for Processing Integers

range a..b-1

```
i = a
while i < b:
    process integer I
    i = i + 1
```

```
# store in count # of '/'s in  String s
count = 0
i = 0
while i < len(s):
    if s[i] == '/':
        count= count + 1
    i= i +1
# count is # of  '/'s in s[0..s.length()-1]
```

range c..d

```
i= c
while i <= d:
    process integer I
    i= i + 1
```

```
# Store in double var. v the sum
# 1/1   + 1/2 + ...+ 1/n
v = 0;    # call this 1/0 for today
i = 0
while i <= n:
    v = v + 1.0 / i
    i= i +1
# v= 1/1   + 1/2 + ...+ 1/n
```

While-Loops and Flow

```
print 'Before while'
count = 0
i = 0
while i < 3:
    print 'Start loop '+`i`
    count = count + I
    i = i + 1
    print 'End loop '
print 'After while'
```

Output:

```
Before while
Start loop 0
End loop
Start loop 1
End loop
Start loop 2
End loop
After while
```