1 While loop

In addition to the for loop, there is something called a while loop. The while loop is very simple and flexible (but can be trickier to use!). Here is an example.

```python
num = 2
while num < 50:
    print(num),
    num = num * 2
```

The while condition, num < 50, is evaluated, and if it is True the statements in the loop body are executed. The loop condition is rechecked and if found to be True, the body executes again. This continues until the loop condition is checked and is False. In the example above, there are five iterations: the loop body executes five times. It prints 2 4 8 16 32.

In general, the while loop has this form:

```python
while boolean_expression:
    statements (called the body)
```

It is similar in form to an if statement, but the behavior is very different. In an if statement, when the boolean expression is True the body is executed once; in a while statement, when the boolean expression is True the body is executed repeatedly until the expression becomes False.

2 While loops are more general

The while loop is more general, meaning that you can do more with a while loop than with a for loop. Any for loop can be translated into a while loop. For example, this for loop:

```python
s = "abcxyz"
for ch in s:
    print(ch),
```

can be translated into a while loop:

```python
s = "abcxyz"
i = 0 # initialize before loop
while i < len(s): # check for end
    ch = s[i]
    print(ch),
i += 1 # increment
```

On the other hand, there are while loops that cannot be easily translated to for loops. Consider the loop shown below: it is hard to predict how many times it loops. A mathematician, Lothar Collatz, conjectured this program terminates – that is, stops looping – for every positive n, but no one knows for sure!
n = int(input("Enter a positive number: "))
while n != 1:
    print n,
    if n % 2 == 0:
        n = n / 2
    else:
        n = n * 3 + 1

3 While loops vs. for loops

When should you use a for loop and when should you use a while loop? Use a for loop if you can easily determine, before you start looping, the maximum number of times that you’ll need to execute the body. Use a while loop when you don’t know. Here are some general cases when a while loop is appropriate:

- You ask the user for a particular kind of input (say, a positive number) and keep asking until you receive an acceptable input.
- You have a random process (say flipping a coin) that you want to repeat until a certain event happens (say 10 heads in a row).
- You want to loop over a sequence (say a list or string) but stop when a certain item is found.
- You want to step through a sequence but take different size steps in each iteration. (For example, suppose you want to skip ahead three characters every time you see the letter “x.”)

4 Exercises

Solutions are presented in class and also included in the moodle version of this handout.

1. Ask the user for a lowercase string and print each letter up to but not including the first vowel.

   Solution:
   ```python
   s = raw_input("Gimme a string: ")
i = 0
   while i < len(s) and s[i] not in 'aeiou':
       print s[i],
i += 1
   ```

2. Translate this for loop into a while loop.
```python
for i in range(5):
    print 2*(i + 1),
```

**Solution:**

```python
i = 2
while i <= 10:
    print i,
    i += 2
```

3. Suppose \( n \) refers to some int. Print out each digit of \( n \) from least to most significant. Example: if \( n = 4982 \), the program should print 2 8 9 4. You cannot use the `str` function.

**Solution:**

```python
n = int(input("Enter a number: "))
while n > 0:
    last_digit = n % 10
    print last_digit,
    n = n/10
```

4. Translate this for loop into a while loop.

```python
L = ['a', 'b', 'c', 'd', 'e']
for i in range(len(L)):
    print L[-(i+1)],
```

**Solution:**

```python
i = len(L)-1
while i >= 0:
    print L[i],
    i -= 1
```

Adapted from materials by Gries and Campbell.