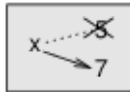# Think Python 2e, Chapter 7 Notes

Geoffrey Matthews

September 15, 2022

Reassignment

```
1  >>> x = 5
2  >>> x
3  5
4  >>> x = 7
5  >>> x
6  7
```


State diagram

Updating variables

```
1 >>> x = x + 1
2 NameError: name 'x' is not defined
```

Must be initialized first:

```
1 >>> x = 0
2 >>> x = x + 1
```

The while statement

```python
def countdown(n):
    while n > 0:
        print(n)
        n = n - 1
    print('Blastoff!')
```

The while statement

```python
def countdown(n):
    while n > 0:
        print(n)
        n = n - 1
    print('Blastoff!')
```

```python
def countdown(n):
    if n > 0:
        print(n)
        n = n - 1
    print('Blastoff!')
```

The Collatz Sequence

```python
def sequence(n):
    print('Collatz: ', end='')
    while n != 1:
        print(n, end=', ')
        if n % 2 == 0:          # n is even
            n = n // 2
        else:                   # n is odd
            n = n*3 + 1
    print(n)
```

```
Collatz: 3, 10, 5, 16, 8, 4, 2, 1
Collatz: 512, 256, 128, 64, 32, 16, 8, 4, 2, 1
Collatz: 513, 1540, 770, 385, 1156, 578, 289, 868,
    434, 217, 652, 326, 163, 490, 245, 736, 368, 184,
    92, 46, 23, 70, 35, 106, 53, 160, 80, 40, 20, 10,
    5, 16, 8, 4, 2, 1
```

break

```
1  while True:
2      line = input('> ')
3      if line == 'done':
4          break
5      print(line)
6
7  print('Done!')
```

Newton's Method

Find the square root of a number by iteration.

n	x	x^2	n/x	$\frac{x+n/x}{2}$	$\left(\frac{x+n/x}{2}\right)^2$
5	10	100	0.5	5.25	27.56
5	5.25	27.56	0.95	3.1	9.62
5	3.1	9.62	1.61	2.36	5.55
5	2.36	5.55	2.12	2.24	5.01
5	2.24	5.01	2.23	2.24	5.0

Final answer:

$$2.23607010853285^2 = 5.000009530274112$$

Newton's Method

n	x	x^2	n/x	$\frac{x+n/x}{2}$	$\left(\frac{x+n/x}{2}\right)^2$
5000	10	100	500.0	255.0	65025.0
5000	255.0	65025.0	19.61	137.3	18852.37
5000	137.3	18852.37	36.42	86.86	7544.62
5000	86.86	7544.62	57.56	72.21	5214.56
5000	72.21	5214.56	69.24	70.73	5002.21

Final answer:

$$70.72628275743688^2 = 5002.207072684913$$

Newton's Method

```python
1  def newton(n):
2      x = 10
3      while abs(x**2/n - 1) > 1e-5:
4          x = (x + n/x)/2
5      return x
```

Algorithms

- Newton's method is an **algorithm** for finding square roots.
- An algorithm is a method for solving a class of problems.
- There are other ways of finding square roots, using different algorithms.
    - long division
    - binary search
- Which algorithm is best for which problem is real computer science.

Debugging by bisection

- Divide the program roughly in half.
- Find an intermediate result there.
- Test to see if this result is correct.
    - If no, the problem is in the first half
    - If yes, the problem is in the second half
- Now divide the subset of the program in half, and repeat.

Vocabulary

reassignment: Assigning a new value to a variable that already exists.

update: An assignment where the new value of the variable depends on the old.

initialization: An assignment that gives an initial value to a variable that will be updated.

increment: An update that increases the value of a variable (often by one).

decrement: An update that decreases the value of a variable.

iteration: Repeated execution of a set of statements using either a recursive function call or a loop.

infinite loop: A loop in which the terminating condition is never satisfied.

algorithm: A general process for solving a category of problems.