BI694
Bioinformatics & Phylogenetics

Winter Semester 2017

WEEK 6

Homework review

Basics of Python Programming

Review of Assignment 1

```
#!/bin/bash


# retrieve data from github repository
wget https://raw.githubusercontent.com/bastodian/2017_BioinformaticsPhylogenetics/master/Week_3/Assignment_1/Hydrozoa.fst
# take last 40 sequences and copy them into another fasta file
tail -n 80 Hydrozoa.fst  > Hydrozoa_Last40-Seqs.fst
# make file read only
chmod 444 Hydrozoa_Last40-Seqs.fst
# align the last 40 sequences using MUSCLE and CLUSTAL
muscle -in Hydrozoa_Last40-Seqs.fst -out Hydrozoa_Last40-Seqs.MUSCLE.fst
clustalo -i Hydrozoa_Last40-Seqs.fst -o Hydrozoa_Last40-Seqs.CLUSTAL.fst
# open the alignments in Seaview and put Seaview into the background using &
seaview Hydrozoa_Last40-Seqs.MUSCLE.fst &
seaview Hydrozoa_Last40-Seqs.CLUSTAL.fst &
```

Let’s check our BLAST runs…

Connect to the server again using ssh

Connect to your screen session:

- screen -ls
- screen -r BLAST

Are we done yet? If not why not?

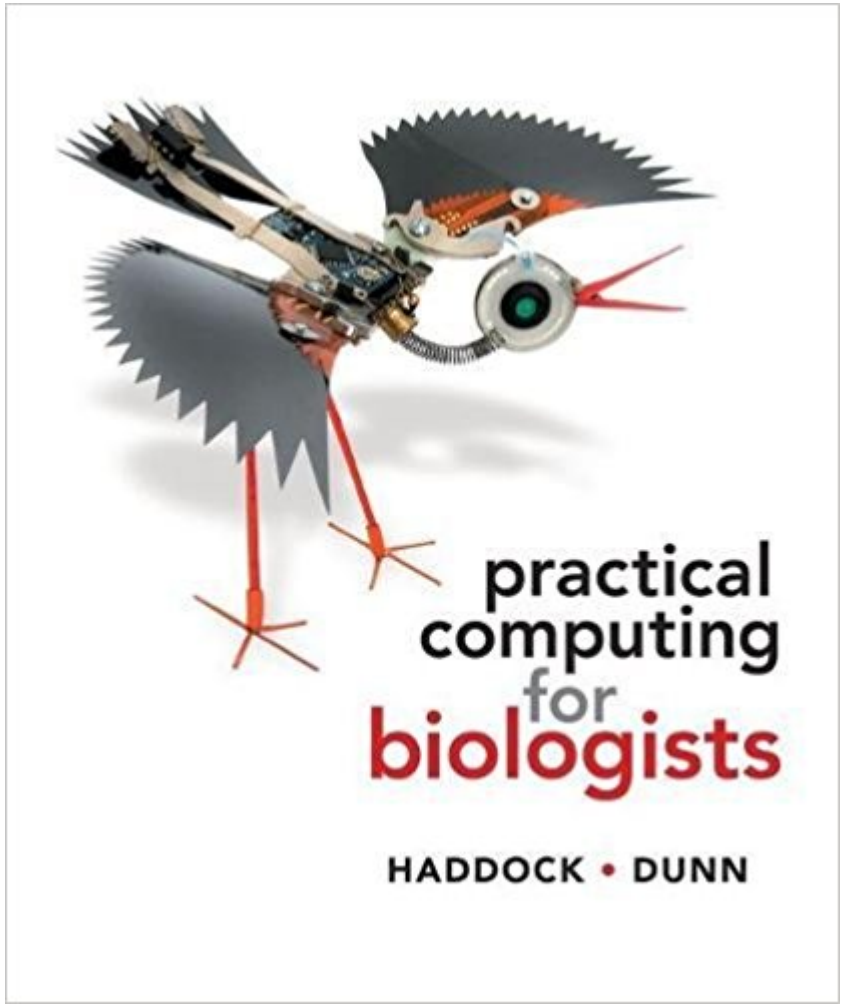
Parsing BLAST output

- Parsing tabular BLAST output using grep and awk
  - Keep only selected rows
  - Extract select columns
- We can do this more elegantly with Python
  - Python is an interpreted language like Bash
  - Python is easy to read and intuitive (in my opinion)
  - Python has lots of add-on features specifically targeted to bioinformatics

Install Some Additional Software

```
$ sudo apt-get install ipython      # interactive python shell
$ sudo apt-get install geany        # Integrated Development Environment (IDE)
```

Components of Programming



Chapters 7 through 13 cover Programming in Python.

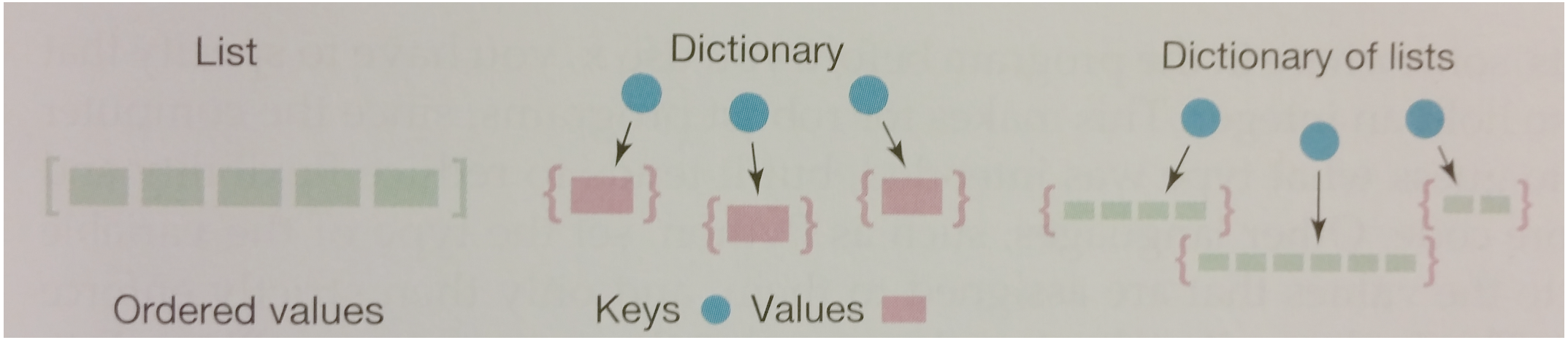
Components of Programming

- Arguments
  - Values that are sent to the program at the time it is run
- Code
  - Noun: a program or line of a program, also called source code
  - Verb: the act of writing a program
- Execute/Run
  - To begin and carry out the operation of a program
- Parse
  - To extract particular data elements from a larger block of text

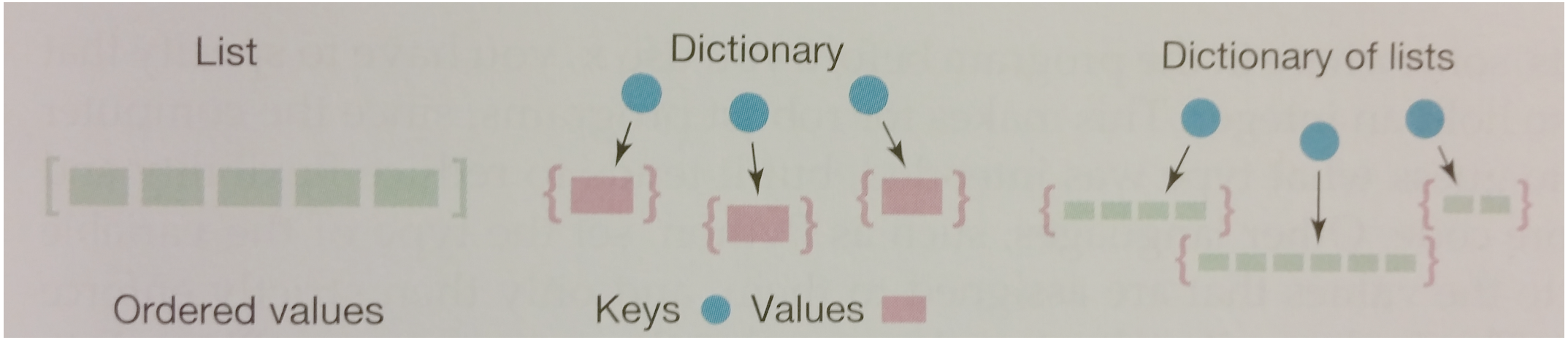
Components of Programming – Variable types

Type	Example	Python Function
Integer	98	int()
Float	98.6	float()
Boolean	False	bool()
String	‘Acropora digitifera’	str()

Components of Programming – Lists, Dictionaries, Tuples, Sets



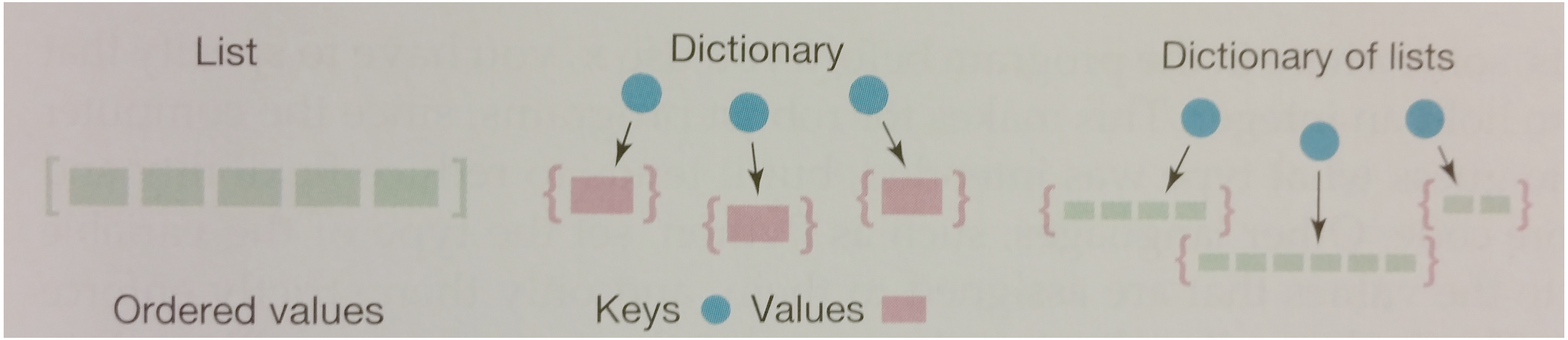
Components of Programming – Lists, Dictionaries, Tuples, Sets



$ ListOfIntegers = [1, 2, 4, 5] # ordered collection of values, indexed starting at 0

$ ListOfStrings = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]

Components of Programming – Lists, Dictionaries, Tuples, Sets



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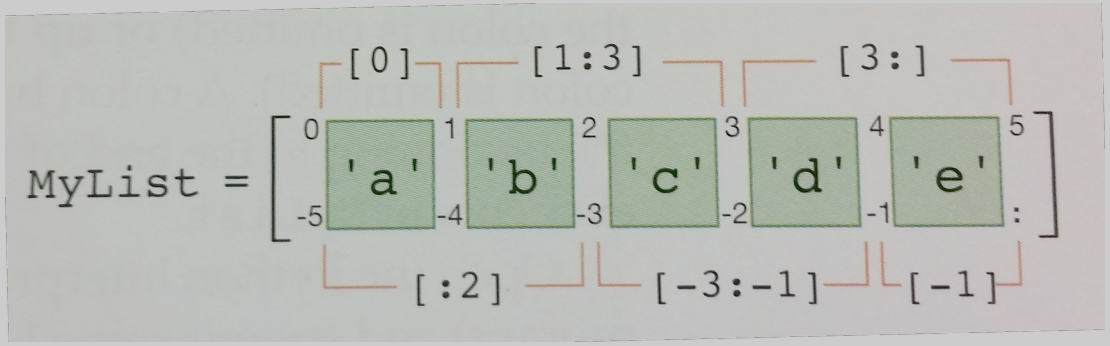

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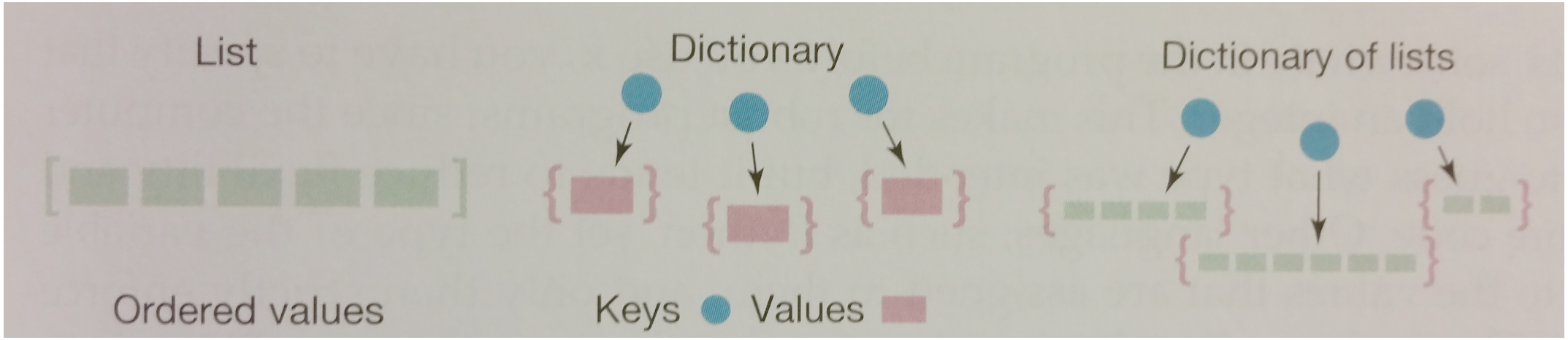


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$ ListOfIntegers = [1, 2, 4, 5]              # ordered collection of values, indexed starting at 0
$ ListOfStrings = [‘a’, ‘b’, ‘c’, ‘d’, ‘e’]
$ DictionaryOfIntegers = {‘A’: 1, ‘B’: 2}    # also known as a hastable; indexed using keys
$ DictionaryOfLists = {‘A’: [1, 2, 3], ‘B’: [3, 4, 5]}
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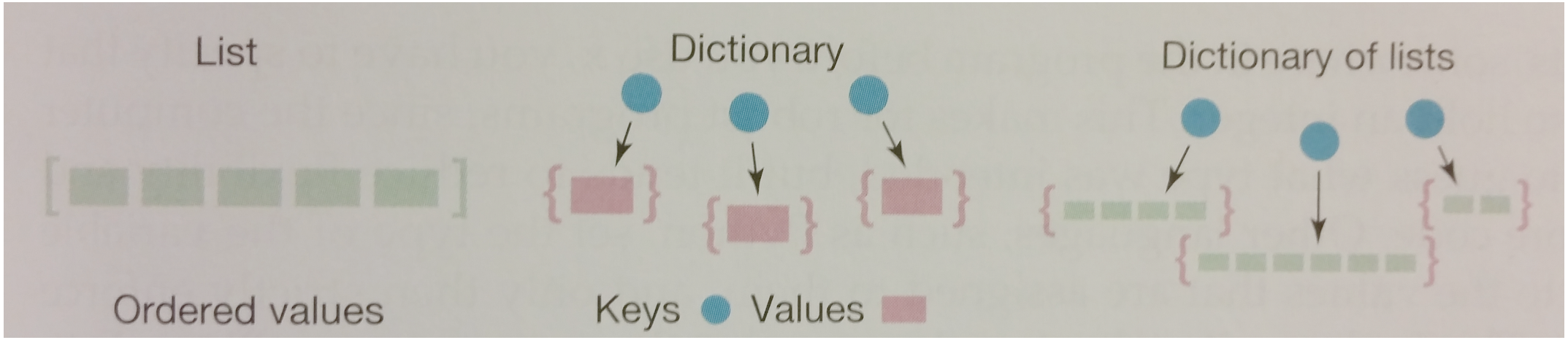
Components of Programming – Lists, Dictionaries, Tuples, Sets

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Components of Programming – Lists, Dictionaries, Tuples, Sets

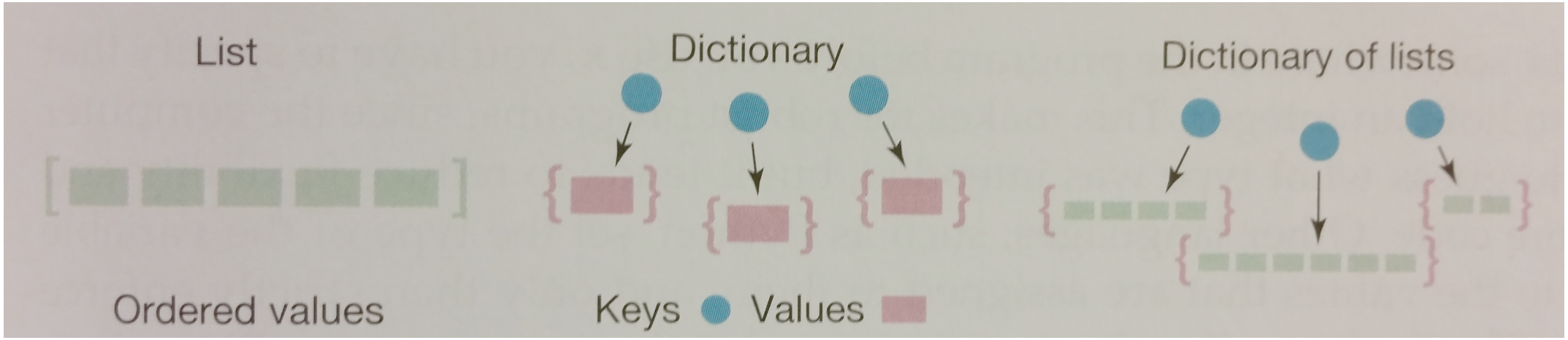
Create a dictionary and add data to it. Here, the keys are strings of specimens names and the values in the dictionary are floating point numbers (latitude and longitude).

```
$ TreeStat = {}          # creates an empty dictionary

$ TreeStat['Kodiak'] = [57.8, -152.5]

$ TreeStat['Juneau'] = [58.3, -134.5]
```

Components of Programming – Lists, Dictionaries, Tuples, Sets

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$ DictionaryOfLists = {‘A’: [1, 2, 3], ‘B’: [3, 4, 5]}
$ TupleOfIntegers = (1, 2, 3)                  # ordered, immutable list
$ SetOfIntegers = {1, 2, 3}                        # unordered collection of unique elements
```

Components of Programming – Objects and Functions (Methods)

What can we do with sets?

For example, we can find the intersection between two lists…

```
$ dir(set)          # lists the functions associated with set
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Consider **set** as an object. Set has many properties associated with it, which can be listed using **dir**.

These attributes can be accessed using the **dot notation**.

```
$ set(A).intersection(set(B))
```

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```

```
$ SetOfIntegers_A = {1, 2, 3, 7, 10}
$ SetOfIntegers_B = {1, 2, 3, 4, 5, 11}
$ SetOfIntegers_A.intersection(SetOfIntegers_B)          # what does .union produce?
```

Components of Programming – Objects and Functions (Methods)

An example of functions associated with string objects:

```
$ DNASeq = ‘ATGCAC’
$ dir(DNASeq)
$ DNASeq.isdigit()
$ DNASeq.lower()
$ DNASeq.startswith(‘ATG’)
$ DNASeq.endswith(‘cac’)       # case sensitive!!
```

Components of Programming – Converting Between Variables

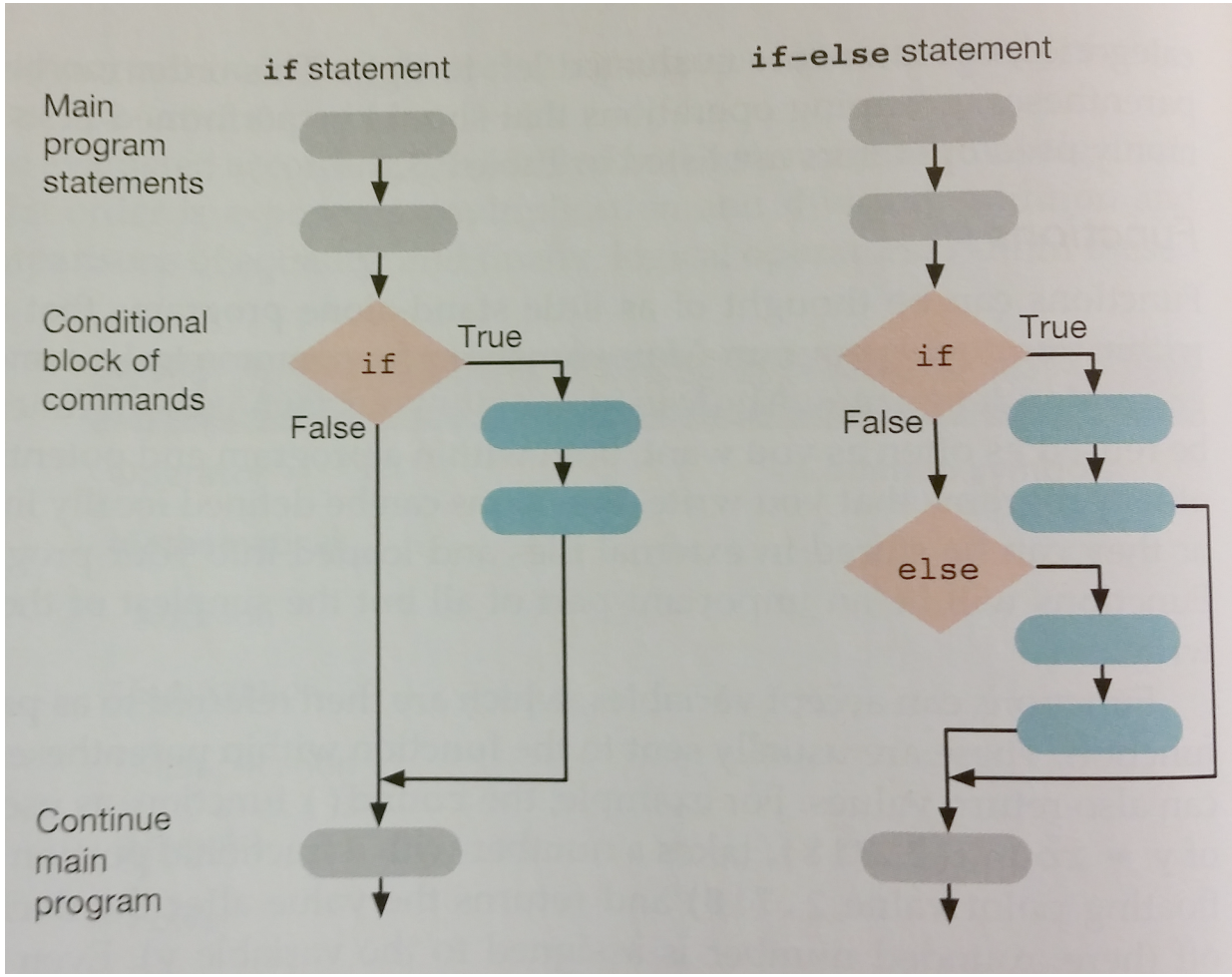
Variables an be converted into each other. Example: **str()**, **int()**, and **float()**

```
$ print ‘7’ + str(3*2)
$ print 7 + str(3*2)          # does this work?
$ print 7 + 3*2
$ print float(7) + 3*2
```

Components of Programming – Operators

Mathematical		
Addition	+	
Subraction	-	
Multiplication	*	
Division	/	
Power	**	
Modulo	%	# remainder after division
Truncated Division	//	
Comparative		
Equal to	==	
Not equal to	!=, <>, ~=	
Greater than	>	
Less than	<	
Greater or equal	>=	
Less or equal	<=	
Logical		
And	and, &, &&	
Or	or, |, ||	
Not	not, !, ~	

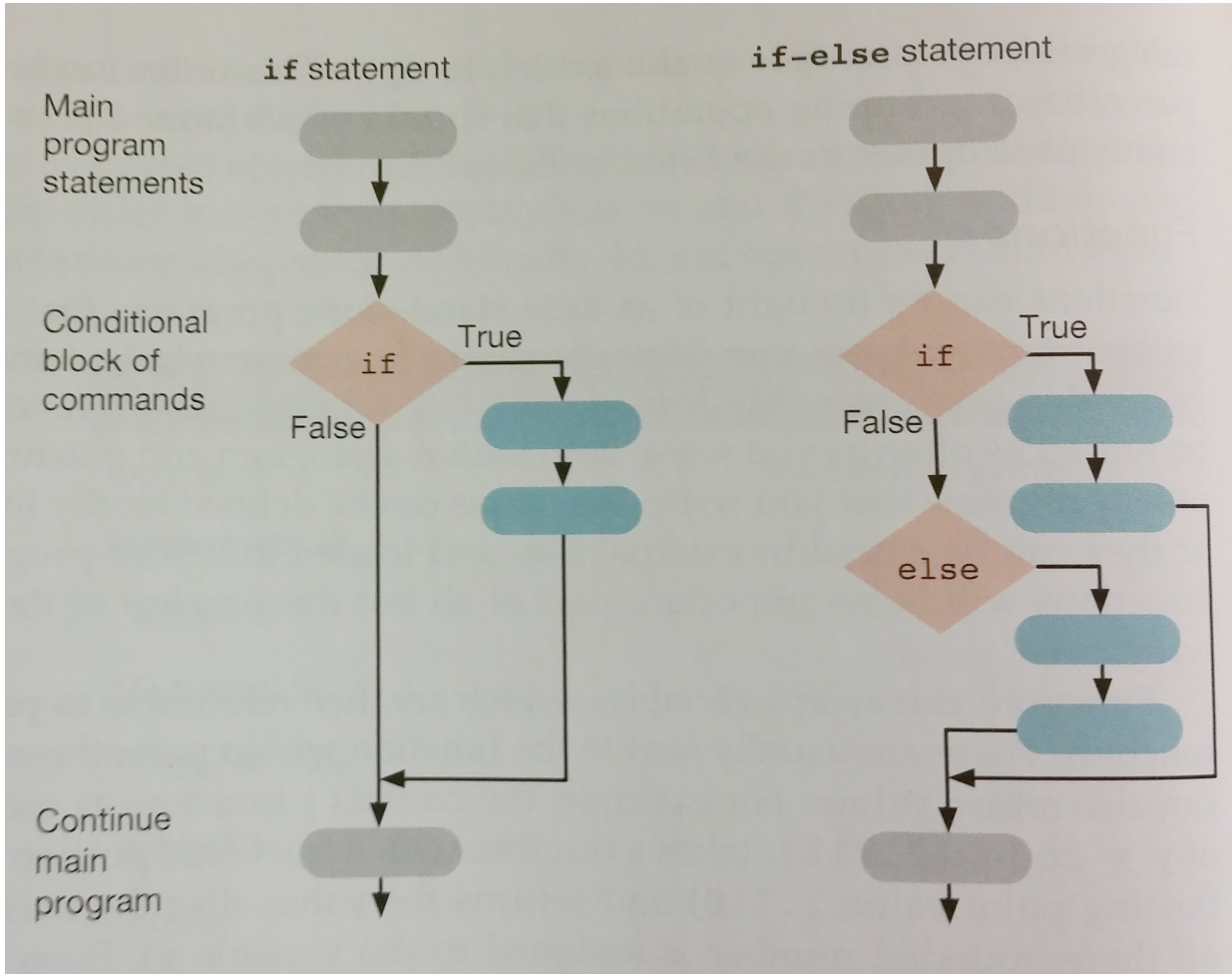
Components of Programming – Conditionals




```
A = 5

if A < 0:
        print “Negative Number”
else:
        print “Zero or positive number”
```

Components of Programming – Conditionals

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```
if A < 0:
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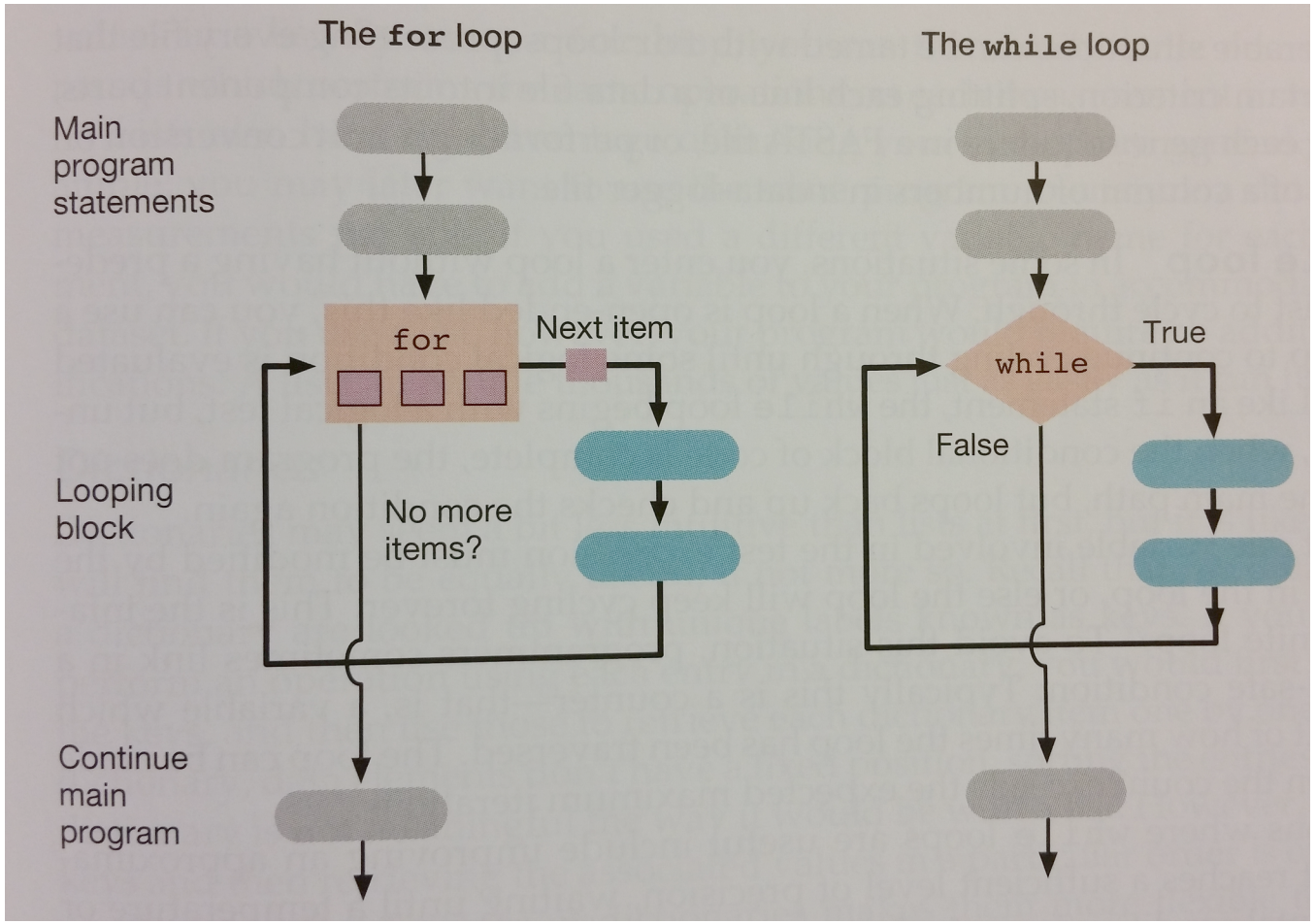
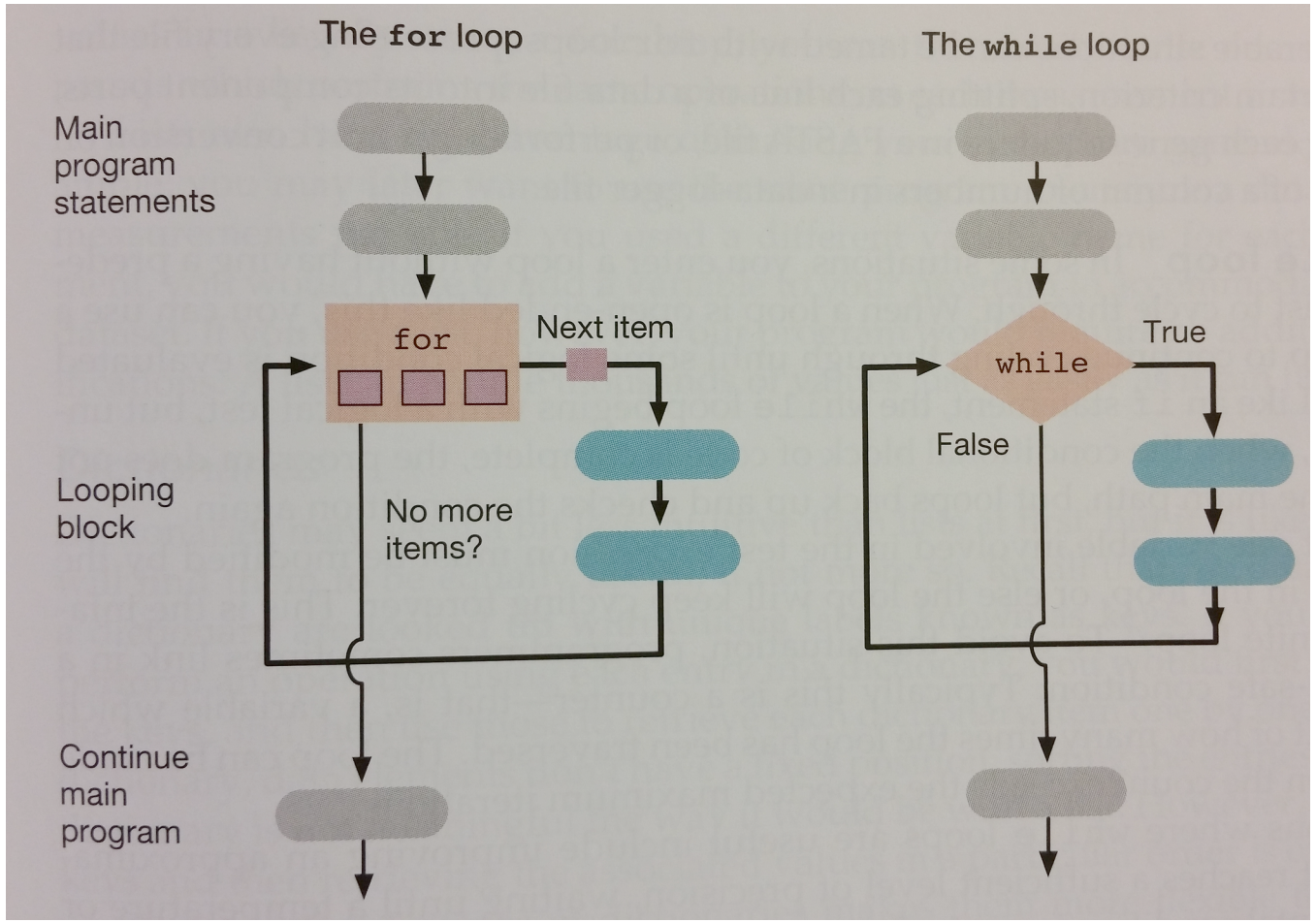
elif A > 0:
        print “Positive number”
else:
        print “Zero”
```

Components of Programming – Loops




```
for Num in range(10):
    print Num
```

Components of Programming – Loops




```
for Num in range(10):
        print Num

Num = -1

while Num <= 9:
        Num += 1
        print Num
```

Components of Programming – Reading/Writing Files

```
BLAST = open('Acropora_genes.blastn', 'r')
for Line in BLAST:
        print Line
BLAST.close()
```

Components of Programming – Reading/Writing Files

```
BLAST = open('Acropora_genes.blastn', 'r')
for Line in BLAST:
    print Line
BLAST.close()


with open('Acopora_genes.blastn', 'r') as BLAST:
    with open('Temp.txt', 'w') as TEMP:
        for Line in BLAST:
            TEMP.write(Line)
```

Components of Programming – Parsing Data From Files