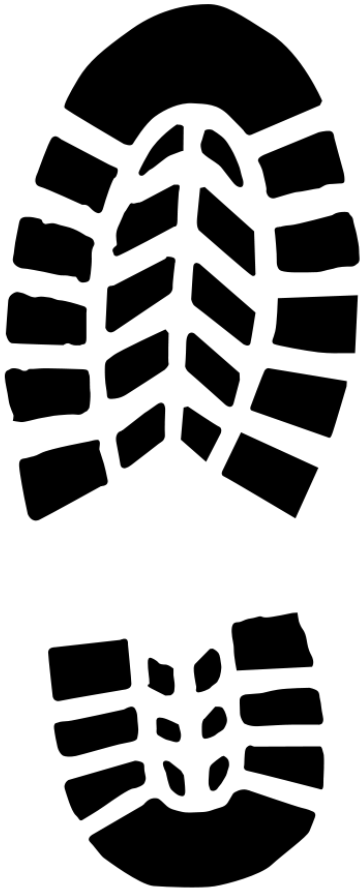

Welcome to Python 2

Session #6

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Problem 7: RNA Splicing

- After identifying the exons and introns of an RNA string, we only need to delete the introns and concatenate the exons to form a new string ready for translation.
- **Given:** A DNA string s and a collection of substrings of s acting as introns. (All strings are given in FASTA format.)
- **Return:** A protein string resulting from transcribing and translating the exons of s.
- **Note**: Only one solution will exist for the dataset provided.

Problem 7: RNA Splicing

```
from dna_sequence import DNASequence
from rna_sequence import RNAsequence
from fasta_file import FASTAfile

def run(fnp):
    fasta = FASTAfile(fnp)
    dnaAndIntrons = fasta.sequences()
    dna = dnaAndIntrons[0]
    introns = dnaAndIntrons[1:]
    rna = dna.transcribe()
    rna.splice(introns)
    return rna.translate()
```

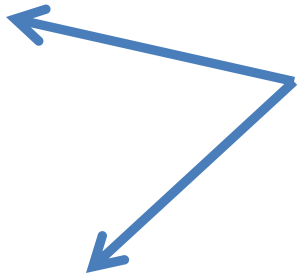
```
def test():
    t = run("splc.test.txt")
    out = "MVYIADKQHVASREAYGHMFKVCA"
    if out == t:
        print "SPLC: PASSED"
    else:
        print "SPLC: FAILED!"
        print "expected", out, "but got", t

test()
```

Building Blocks: list comprehension

- Quick way to build lists under certain situations

```
v = []
for i in range(10):
    v.append(i)
```



Do same thing!

```
v = [x for x in range(10)]
```

Building Blocks: list comprehension

- Quick way to build certain kinds of lists

```
a = [x for x in range(10)]
print a

b = [x*x for x in range(10)]
print b

c = [str(x) for x in range(10)]
print c

q = 5
d = [x+q for x in range(10)]
print d
```

Building Blocks: list comprehension

```
a = [x for x in range(10)]
print a
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

b = [x*x for x in range(10)]
print b
[0, 1, 4, 9, 16, 25, 36, 49, 64, 81]

c = [str(x) for x in range(10)]
print c
['0', '1', '2', '3', '4', '5', '6', '7', '8', '9']

q = 5
d = [x+q for x in range(10)]
print d
[5, 6, 7, 8, 9, 10, 11, 12, 13, 14]
```

Building Blocks: map

- Another way to build a list
- Applies a function to every element in a list

```
a = map(lambda x: x, range(10))
print a

b = map(lambda x: x*x, range(10))
print b

c = map(str, range(10))
print c

q = 5
d = map(lambda x: x+q, range(10))
print d
```

Building Blocks: map

- Another way to build a list
- Applies a function to every element in a list

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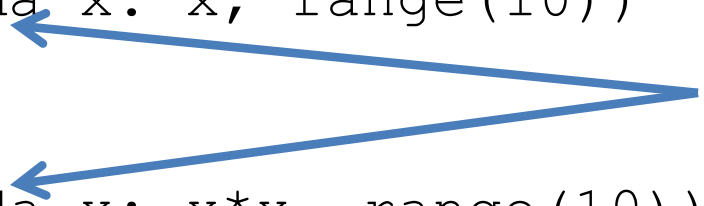
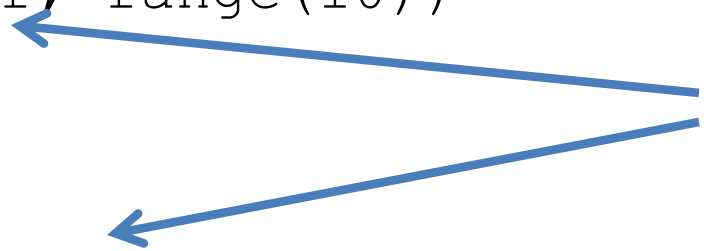


"anonymous" function!
➔ Function with no name



For examples on this slide, map assumes the function takes only 1 argument

Building Blocks: map

```
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print a
[0, 1, 2, 3, 4, 5, 6, 7, 8, 9]

b = map(lambda x: x*x, range(10))
print b
[0, 1, 4, 9, 16, 25, 36, 49, 64, 81]

c = map(str, range(10))
print c
['0', '1', '2', '3', '4', '5', '6', '7', '8', '9']

q = 5
d = map(lambda x: x+q, range(10))
print d
[5, 6, 7, 8, 9, 10, 11, 12, 13, 14]
```

Building Blocks: map

```
chrs = map(lambda x: int(x[3:]),
           ["chr1", "chr2", "chr3"])

print chrs
```

Building Blocks: map

```
chrs = map(lambda x: int(x[3:]),
           ["chr1", "chr2", "chr3"])

print chrs
[1, 2, 3]
```

Regular Expressions

- How would we extract 4-digit number from this sequence?

```
abcd1234dsfasdfa5643asdfasef
```

Try extracting the numbers; make sure the code also works for:

```
sadfaweqwe1235lkaf9843asdfaefaef
```

Regular Expressions

- An alternative way to extract the 4-digit number is to use regular expressions
  - We specify a **pattern** that we wish to match

Regular Expressions

- To match a digit (0-9)

  \d

- To match a non-digit

  \D

- To match any two letters

  \D\D

- To match any 1 letter and any 1 digit (0-9)

  \D\d

Regular Expressions

- To match any character

  .

- To match 0 or more times, add

  *

- To match 1 or more times, add

  +

- Example: to match any number of characters, then a digit

  .*\d

Regular Expressions

To find out if a string matches a pattern, you can do:

```
import re
if re.search(r"<your pattern", variableName):
      # Successful match
else:
      # Match attempt failed
```

For example, to see if the string has two letters, two digits, and then two letters:

```
if re.search(r"\D\D\d\d\D\D", "aa22aa"):
    print "matched 2 letters, 2 digits, 2 letters"
else:
    print "could not match the pattern"
```

Regular Expressions

- To denote what to copy out, surround with parenthesis

  \D\D(\d\d)\D\D

Extract the number:

```
match = re.search(r"\D\D(\d\d)\D\D", "aa22aa")
if match:
    print "found number!", int(match.group(1))
else:
    print "no number found!"
```

Regular Expressions

```
import re

s = "abcd1234dsfasdfa5643asdfasef"
```

Write the code to extract two numbers from the above string

Regular Expressions

```
import re

s = "abcd1234dsfasdfa5643asdfasef"

match = re.search(r"\D+(\d\d\d\d)\D+(\d\d\d\d)\D+", s)
if match:
    firstNum = int(match.group(1))
    secondNum = int(match.group(2))
    print firstNum, secondNum
else:
    print "no numbers found!"
```

Regular Expressions

```
import re

s = "the1234next5643word"
```

Write the code to extract the words from the above string

Regular Expressions

```
import re

s = "the1234next5643word"

match = re.search(r"(\D+)\d+(\D+)\d+(\D+)", s)
if match:
    firstWord = match.group(1)
    secondWord = match.group(2)
    thirdWord = match.group(3)
    print firstWord, secondWord, thirdWord
else:
    print "no words found!"
```

Regular Expressions

- Many other patterns possible!
  - See https://docs.python.org/2/library/re.html

Other Exercises and Info

Static Class Methods

- Methods that live in a class, but don't need any access to data (via `self`) in that class
- One use: organize miscellaneous functions together

```
class Utils:
    @staticmethod
    def mkdir_p(path):
...
@staticmethod
    def get_file_if_size_diff(url, path):
```

Called without using an object!

```
Utils.mkdir_p(path)
Utils.get_file_if_size_diff(url, path)
```

Extended Exercise 7

- Change the ChipseqData class to use Peak class:

```
class Peak:
    def __init__(self, line):
        toks = line.split()
        self.chr = toks[0]
        self.start = int(toks[1])
        self.end = int(toks[2])

    def length(self):
        return self.end - self.start
```

```
class ChipseqData:
    def __init__(self, paths, url):
        self.paths = paths
        self.url = url
        self.fnp =
Utils.get_file_if_size_diff(self.url,
paths.lectureFolder)

    def getPeaks(self, chr):
        peaks = []
        with open(self.fnp) as f:
            for line in f:
                peak = Peak(line)
                if chr != peak.chr:
                    continue
                peaks.append(peak)
        return peaks
```

```
def numPeaks(self, chr):
        return len(self.getPeaks(chr))

def computePercentageChromosomeCovered(self, chr,
                                       chromosomeLength):
        peaks = self.getPeaks(chr)
        numBases = 0
        for peak in peaks:
            numBases += peak.length()
        return "{0:.2f}%".format(float(numBases) /
                    chromosomeLength * 100)
```

Building Blocks: list comprehension

```
fnp = paths.makeFilePath("ENCFF002COQ.narrowPeak")

with open(fnp) as f:
    allPeaks = [Peak(x) for x in f]

print len(allPeaks)
```

Building Blocks: list comprehension

```
fnp = paths.makeFilePath("ENCFF002COQ.narrowPeak")

with open(fnp) as f:
    allPeaks = [Peak(x) for x in f]

print len(allPeaks)
55551
```

Building Blocks: map

```
fnp = paths.makeFilePath("ENCFF002COQ.narrowPeak")

with open(fnp) as f:
    allPeaks = map(Peak, f)

print len(allPeaks)
```

Building Blocks: map

```
fnp = paths.makeFilePath("ENCFF002COQ.narrowPeak")


with open(fnp) as f:
    allPeaks = map(Peak, f)


print len(allPeaks)
55551
```