15-112 Fundamentals of Programming

What are we doing today?

❑ *map*, *filter*, and *reduce*.

Functional Programming

- ❑Three main classes of data transformation
  - Mapping: One-to-One transformation: each element in the source is converted to a new value
  - Filtering: Filtering out values that don’t meet a criteria, or retaining only those values that meet a specific criteria
  - Reduction: Applying a binary function to each value of list in a cumulative fashion.

Mapping Example

- ❑Take a list of values and produce a list of squares of each value

```
def square(x):
    return x*x

squares = map(square,a)
print squares
```

With Lambda function

```
squares = map(lambda x: x*x ,a)
print squares
```

Filtering Example

- ❑Given a list, print all the odd numbers
- ❑Imperative Approach

```
a = [1,2,3,4,5,6]
for i in a:
    if i %2 == 1:
        print i
```

- ❑Functional Approach

```
a = [1,2,3,4,5,6]
print filter(lambda x: x%2==1,a)
```

Reduction Example

- ❑Find the sum of all values in a list
- ❑Imperative Approach

```
a = [1,2,3,4,5,6]
Sum = 0
for i in a:
    Sum = Sum + i
print Sum
```

- ❑Functional Approach

```
print reduce(lambda x,y: x+y, a)
```

Print the sum of all numbers that are odd

```
a = [3,6,3,5,6,7,5,4,6,7,8]
print reduce(lambda x,y:x+y,
filter(lambda x: x%2==1,a))
```

Finding common elements

- Find a list of elements common in lists a and b?
- Imperative Approach?
- Functional Approach?

Exercises

❑Write a function that takes a list as input and returns a list containing the cubes of those numbers that are divisible by 3.

  - Write an imperative form of this function
  - Write a functional form of this function using map and filter.

❑Using reduce, find the average of a list of numbers.

Caesar Cipher

- ❑Given a string and offset n, calculate the Caesar cipher for the string.

Remove vowels

- Given a list of characters, remove all the vowels from the list

Count values

❑Count how many times a specific value occurs in a list

a = [1,1,2,3,0,0,0,0,6,3,7,1,2,8,7,1,9,3,6,1]

Count how many times 1 occurs in a?

Word Count

- ❑Count the number of times a word appears in a file

List comprehensions

❑Used for creating lists in a concise way

Examples:

```
a = [i for i in range(2,5)]

a = [i for i in range(1,20) if i%2 ==1]
```

Format:

```
[ expression(x) for x in someList if filter ]
```