## 61A Lecture 11

Friday, September 21

## Midterm 1 Recap

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should

```
1X vs WX
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two

if first_tens(p)==1:
return second_tens(p)!=1

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two

return second_tens(p)!=1

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two


X0 vs Y0

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should
twelve twenty-two

zero twenty
X0 vs Y0

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


```
zero twenty
twenty zero
    X0 vs Y0
if first_tens(p)==0:
    return second_tens(p)!=0
else:
                                return second_tens(p)==0
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


```
zero twenty
twenty zero
    X0 vs Y0
if first_tens(p)==0:
    return second_tens(p)!=0
else:
                                return second_tens(p)==0
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


```
\(\begin{array}{ll}\text { zero } & \text { twenty } \sqrt{ } \\ \text { twenty } & \text { zero } \\ \end{array}\)
    X0 vs Y0
if first_tens(p)==0:
    return second_tens(p)!=0
else:
                                return second_tens \((p)==0\)
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


```
twenty-two twelve
    WX vs 1X
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should


```
twenty-two twelve
    WX vs 1X
```


## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should

twenty-two twelve
"You may not use boolean operator or"

## Midterm 1 Recap

The exam was more difficult than the Fall 2011 Midterm 1
Typically, more than $75 \%$ of students receive A's \& B's in 61A
Problem 4(c): through doesn't rhyme with cough, and 20 (twenty) doesn't rhyme with 10 (ten)
Sight rhyme: A pair of words that don't rhyme, but look like they should

if first_tens(p)==0: return second_tens(p)!=0 else:
return second_tens $(p)==0$
twenty-two twelve
WX vs $1 X$
"You may not use boolean operator or" Demo

## Mapping a Function over a Sequence

Apply a function to each element of the sequence

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))
(1, 2, 3, 4, 5)

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))
(1, 2, 3, 4, 5)

The returned value of map is an iterable map object

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))
(1, 2, 3, 4, 5)

The returned value of map is an iterable map object

A constructor for the built-in map type

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))
(1, 2, 3, 4, 5)

The returned value of map is an iterable map object

A constructor for the built-in map type

The returned value of filter is an iterable filter object

## Mapping a Function over a Sequence

Apply a function to each element of the sequence
>>> alternates $=(-1,2,-3,4,-5)$
>>> tuple(map(abs, alternates))
(1, 2, 3, 4, 5)

The returned value of map is an iterable map object

A constructor for the built-in map type

The returned value of filter is an iterable filter object

Demo

## Accumulation and Iterable Values

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!
Many built-in functions take iterable objects as argument.

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!
Many built-in functions take iterable objects as argument.
tuple Return a tuple containing the elements

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!
Many built-in functions take iterable objects as argument.

| tuple | Return a tuple containing the elements |
| :--- | :--- |
| sum | Return the sum of the elements |

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!
Many built-in functions take iterable objects as argument.

| tuple | Return a tuple containing the elements |
| :--- | :--- |
| sum | Return the sum of the elements |
| min | Return the minimum of the elements |

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!
Many built-in functions take iterable objects as argument.

| tuple | Return a tuple containing the elements |
| :--- | :--- |
| sum | Return the sum of the elements |
| min | Return the minimum of the elements |
| $\max$ | Return the maximum of the elements |

## Accumulation and Iterable Values

Iterable objects give access to some elements in order.
However, you may only be able to access the elements once!

Many built-in functions take iterable objects as argument.

| tuple | Return a tuple containing the elements |
| :--- | :--- |
| sum | Return the sum of the elements |
| min | Return the minimum of the elements |
| $\max$ | Return the maximum of the elements |

For statements also operate on iterable values.

Reducing a Sequence

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.
>>> from operator import mul

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.
>>> from operator import mul
>>> from functools import reduce

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.

```
>>> from operator import mul
>>> from functools import reduce
>>> reduce(mul, (1, 2, 3, 4, 5))
```


## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.

```
>>> from operator import mul
>>> from functools import reduce
>>> reduce(mul, (1, 2, 3, 4, 5))
120
```


## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.
>>> from operator import mul
>>> from functools import reduce
>>> reduce(mul, (1, 2, 3, 4, 5))
120
First argument:
A two-argument function

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.
>>> from operator import mul
>>> from functools import reduce
>>> reduce(mul, (1, 2, 3, 4, 5))
120
First argument:
A two-argument function

Second argument: an iterable object

## Reducing a Sequence

Reduce is a higher-order generalization of max, min, \& sum.

```
>>> from operator import mul
>>> from functools import reduce
>>> reduce(mul, (1, 2, 3, 4, 5))
120
First argument:
A two-argument
    function
```

Second argument: an iterable object

Like accumulate from Homework 2, but with iterable objects

## Generator Expressions

One large expression that evaluates to an iterable object

## Generator Expressions

One large expression that evaluates to an iterable object

```
(<map exp> for <name> in <iter exp> if <filter exp>)
```


## Generator Expressions

One large expression that evaluates to an iterable object

```
(<map exp> for <name> in <iter exp> if <filter exp>)
```

- Evaluates to an iterable object.


## Generator Expressions

One large expression that evaluates to an iterable object
(<map exp> for <name> in <iter exp> if <filter exp>)

- Evaluates to an iterable object.
- <iter exp> is evaluated when the generator expression is evaluated.


## Generator Expressions

One large expression that evaluates to an iterable object
(<map exp> for <name> in <iter exp> if <filter exp>)

- Evaluates to an iterable object.
- <iter exp> is evaluated when the generator expression is evaluated.
- Remaining expressions are evaluated when elements are accessed.


## Generator Expressions

One large expression that evaluates to an iterable object
(<map exp> for <name> in <iter exp> if <filter exp>)

- Evaluates to an iterable object.
- <iter exp> is evaluated when the generator expression is evaluated.
- Remaining expressions are evaluated when elements are accessed.
Short version: (<map exp> for <name> in <iter exp>)


## Generator Expressions

One large expression that evaluates to an iterable object
(<map exp> for <name> in <iter exp> if <filter exp>)

- Evaluates to an iterable object.
- <iter exp> is evaluated when the generator expression is evaluated.
- Remaining expressions are evaluated when elements are accessed.
Short version: (<map exp> for <name> in <iter exp>)

Precise evaluation rule introduced in Chapter 4.

## Generator Expressions

One large expression that evaluates to an iterable object
(<map exp> for <name> in <iter exp> if <filter exp>)

- Evaluates to an iterable object.
- <iter exp> is evaluated when the generator expression is evaluated.
- Remaining expressions are evaluated when elements are accessed.
Short version: (<map exp> for <name> in <iter exp>)

Precise evaluation rule introduced in Chapter 4.

## Python Lists

['Demo']

## List Comprehensions

## List Comprehensions

[<map exp> for <name> in <iter exp> if <filter exp>]

## List Comprehensions

[<map exp> for <name> in <iter exp> if <filter exp>]

Short version: [<map exp> for <name> in <iter exp>]

## List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
```

Short version: [<map exp> for <name> in <iter exp>]

Unlike generator expressions, the map expression is evaluated when the list comprehension is evaluated.

## List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
```

Short version: [<map exp> for <name> in <iter exp>]

Unlike generator expressions, the map expression is evaluated when the list comprehension is evaluated.
>>> suits = ['heart', 'diamond', 'spade', 'club']

## List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
Short version: [<map exp> for <name> in <iter exp>]
```

Unlike generator expressions, the map expression is evaluated when the list comprehension is evaluated.
>>> suits = ['heart', 'diamond', 'spade', 'club']
>>> from unicodedata import lookup

## List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
```

Short version: [<map exp> for <name> in <iter exp>]

Unlike generator expressions, the map expression is evaluated when the list comprehension is evaluated.

```
>>> suits = ['heart', 'diamond', 'spade', 'club']
>>> from unicodedata import lookup
>>> [lookup('WHITE ' + s.upper() + ' SUIT') for s in suits]
```


## List Comprehensions

```
[<map exp> for <name> in <iter exp> if <filter exp>]
```

Short version: [<map exp> for <name> in <iter exp>]

Unlike generator expressions, the map expression is evaluated when the list comprehension is evaluated.

```
>>> suits = ['heart', 'diamond', 'spade', 'club']
>>> from unicodedata import lookup
>>> [lookup('WHITE ' + s.upper() + ' SUIT') for s in suits]
    ||`|
        |
```



```
\(\square\)
```



Dictionaries
\{'Dem': 0\}

Limitations on Dictionaries

## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:

## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:

- A key of a dictionary cannot be an object of a mutable built-in type.


## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:

- A key of a dictionary cannot be an object of a mutable built-in type.
- Two keys cannot be equal. There can be at most one value for a given key.


## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:

- A key of a dictionary cannot be an object of a mutable built-in type.
- Two keys cannot be equal. There can be at most one value for a given key.

This first restriction is tied to Python's underlying implementation of dictionaries.

## Limitations on Dictionaries

Dictionaries are unordered collections of key-value pairs.

Dictionary keys do have two restrictions:

- A key of a dictionary cannot be an object of a mutable built-in type.
- Two keys cannot be equal. There can be at most one value for a given key.

This first restriction is tied to Python's underlying implementation of dictionaries.

The second restriction is an intentional consequence of the dictionary abstraction.

