CS61A Lecture 13
Object-Oriented Programming

Jom Magrotker
UC Berkeley EECS
July 10, 2012

Thoughts on the Midterm?

Using thumbs up/thumbs down...

What did everyone think of the midterm?

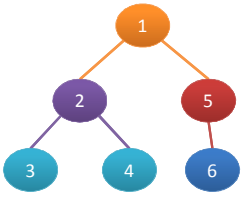
Computer Science in the News

Today

- Review: Binary Search Trees
- Demo: Project 2
- Object-Oriented Programming
  - Defining our own data types!
  - Data with functions!
  - State!

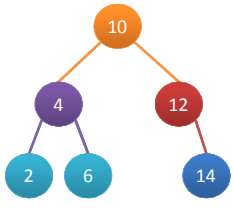
Review: Binary Trees

Trees where each node has *at most* two children are known as ***binary trees***.



Review: Binary Search Trees

Binary search trees are binary trees where all of the items to the ***left*** of a node are ***smaller***, and the items to the ***right*** are ***larger***.



Review: BST ADT

```
empty_bst = None
def make_bst(datum, left=empty_bst,
                    right=empty_bst):
    return (left, datum, right)

def bst_datum(b):
    return b[1]
def bst_left(b):
    return b[0]
def bst_right(b):
    return b[2]
```

Constructor

Selectors

Review: Searching with BSTs

```
def bst_find(b, item):
    if b == empty_bst:
        return False
    elif bst_datum(b) == item:
        return True
    elif bst_datum(b) > item:
        return bst_find(bst_left(b),
                        item)
    return bst_find(bst_right(b),
                    item)
```


Announcements

- Homework 6 is due today, **July 10**.
  - Starting with the next homework, we will mark questions as *core* and *reinforcement*.
  - The *core* questions are ones that we suggest you work on to understand the idea better.
  - The *reinforcement* questions are extra problems that you can practice with, but are not as critical.
- Homework 7 is due ***Saturday***, **July 14.**
  - It will be released this afternoon.
- Make sure you fill out a survey!
  - You must give us a completed survey to get back your exam once it has been graded.

Project 2 Demo

Get started if you haven't already!

Defining our Own Data Types

So far, we've been defining new data types like this:

```
def make_account(owner, balance):
    """Makes a bank account for the given owner with
    balance dollars
    """
    return (owner, balance)

def account_balance(acct):
    """Return acct's balance"""
    return acct[1]

def account_owner(acct):
    """Return acct's owner"""
    return acct[0]
```

Constructor

Can we group all of this into a single description of the data type?

Selectors

Defining our Own Data Types

```
class Account:
    def __init__(self, owner, balance):
        self.__owner = owner
        self.__balance = balance

    def get_owner(self):
        return self.__owner

    def get_balance(self):
        return self.__balance
```

Define the new data type Account

Constructor

`self` refers to the specific ***instance*** of a class that we're manipulating.

Selectors

Methods are operations that are associated with a class or object.

Two underscores at the beginning of an instance variable means that the variable should only be accessed inside the class definition.

Object-Oriented Programming: Creating Objects

We say that `toms_account` is an ***instance*** of the Account class.

```
>>> toms_account = Account("Tom", 50)
```

We call the process of creating an instance of a class ***instantiation.***

Using Our New Data Type

So how do we use it?

```
>>> toms_account = Account("Tom", 50)
>>> toms_account
<__main__.Account object at 0x01...>
>>> type(toms_account)
<class '__main__.Account'>
>>> Account.get_balance(toms_account)
50
>>> toms_account.get_balance()
50
>>> toms_account.get_owner()
"Tom"
```


Dot Notation

"Dot Notation" is used for referring to the data that is associated with a specific object.

```
self.__balance
```

Object

Attribute

```
toms_account.get_balance()
```

As we saw on the previous slide, the dot notation also allows us to call an object's associated functions without having to pass the object itself as the first argument.

Operating on our Data

How would we have implemented `withdraw` and `deposit` operations before?

```
def acct_withdraw(acct, amount):
    new_balance = acct.get_balance() - amount
    return Account(acct.get_owner(), new_balance)

def acct_deposit(acct, amount):
    new_balance = acct.get_balance() + amount
    return Account(acct.get_owner(), new_balance)
```

Can we associate the ***operations*** on our data type with the ***definition*** of the data type?

Operating on our Data

```
class Account:
    def __init__(self, owner, balance):
        self.__owner = owner
        self.__balance = balance
    def get_owner(self):
        return self.__owner
    def get_balance(self):
        return self.__balance
    def withdraw(self, amount):
        self.__balance -= amount
    def deposit(self, amount):
        self.__balance += amount
```


Operating on our Data

Using our operations for our accounts:

```
>>> toms_account = Account("Tom", 50)
>>> toms_account.get_balance()
50
>>> toms_account.withdraw(25)
>>> toms_account.get_balance()
25
>>> toms_account.deposit(500)
>>> toms_account.get_balance()
525
```

Object-Oriented Programming

We now have a new ***programming paradigm!***

Before – Functional Programming:
- Think of our program as a series of functions.
- Think in terms of inputs and outputs of each function.
- There is no change over time, no ***state.***

Now – Object-Oriented Programming:
- Think of our program as a series of objects.
- Think in terms of the ways in which objects interact with each other using methods.
- Objects can change over time in our program. They have ***state.***

19

Conclusion

- Object-oriented programming: a brand new paradigm.
- ***Preview:*** Classes that inherit traits from other classes and variables shared by all data of the same class.

20