CS193P - Lecture 2

iPhone Application Development

Objective-C
Foundation Framework

Announcements

- Enrollment process is complete!
- Contact *cs193p@cs.stanford.edu* if you are unsure of your status
- Please drop the class in Axess if you were not enrolled.

Office Hours

- Troy Brant
  - Tuesdays 12-2pm: 4th floor of Gates 463
- Paul Salzman
  - Mondays 12-2: Gates B26A
  - Wednesday 4/8 (one-time only) 12-2pm: Gates 24A

Apple Design Awards

- Student categories for iPhone & Leopard apps

- Winners receive plenty of Apple-schwag:
  - 15" MacBook Pro
  - 30" Cinema Display
  - 16GB iPhone 3G
  - 16GB iPod touch
  - ADC 2009 Student Membership
  - Reimbursement of 2009 WWDC ticket

- http://developer.apple.com/wwdc/ada

iPhone SDK

- Enrolled students have been invited to developer program
  - Login to Program Portal
  - Request a Certificate
  - Download and install the SDK
- Will need your Device UDIDs - details to come
- Auditors will need to sign up for Developer Program independently
  - Free for Simulator development
  - $99 for on-device development

Assignments

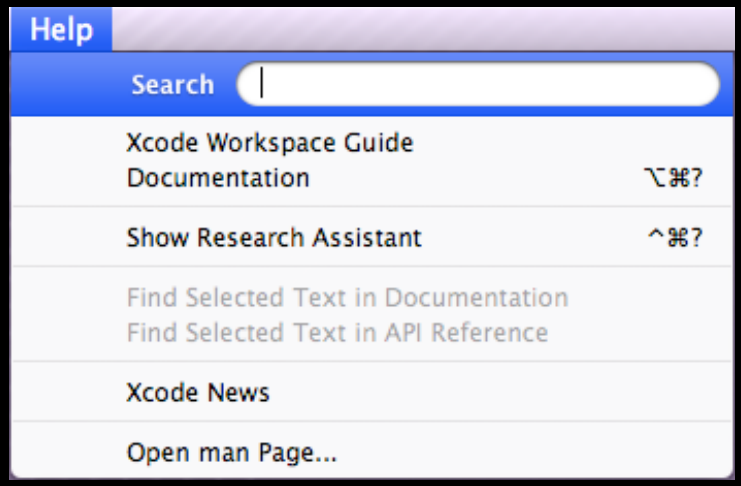
- Assignment schedule:
  - Handed out on Mondays *(correction from lecture)*
  - Due the following Tuesdays, by 11:59pm *(correction from lecture)*

- This week is an exception:
  - Both Assignment 1A and 1B are due this Thursday (4/9)

- Submitting Assignments:
  - Click on 'Submissions' tab on class website
  - Follow instructions
  - If someone finishes early, *please submit early!*

Getting Help

- The assignment walks you through it
- Key spots to look
  - API & Conceptual Docs in Xcode
  - Class header files
  - Docs, sample code, tech notes on Apple Developer Connection (ADC) site
    - http://developer.apple.com
    - Dev site uses Google search



Today's Topics

- Questions from Tuesday or Assignments?
- Object Oriented Programming Overview
- Objective-C Language
- Common Foundation Classes

Object Basics

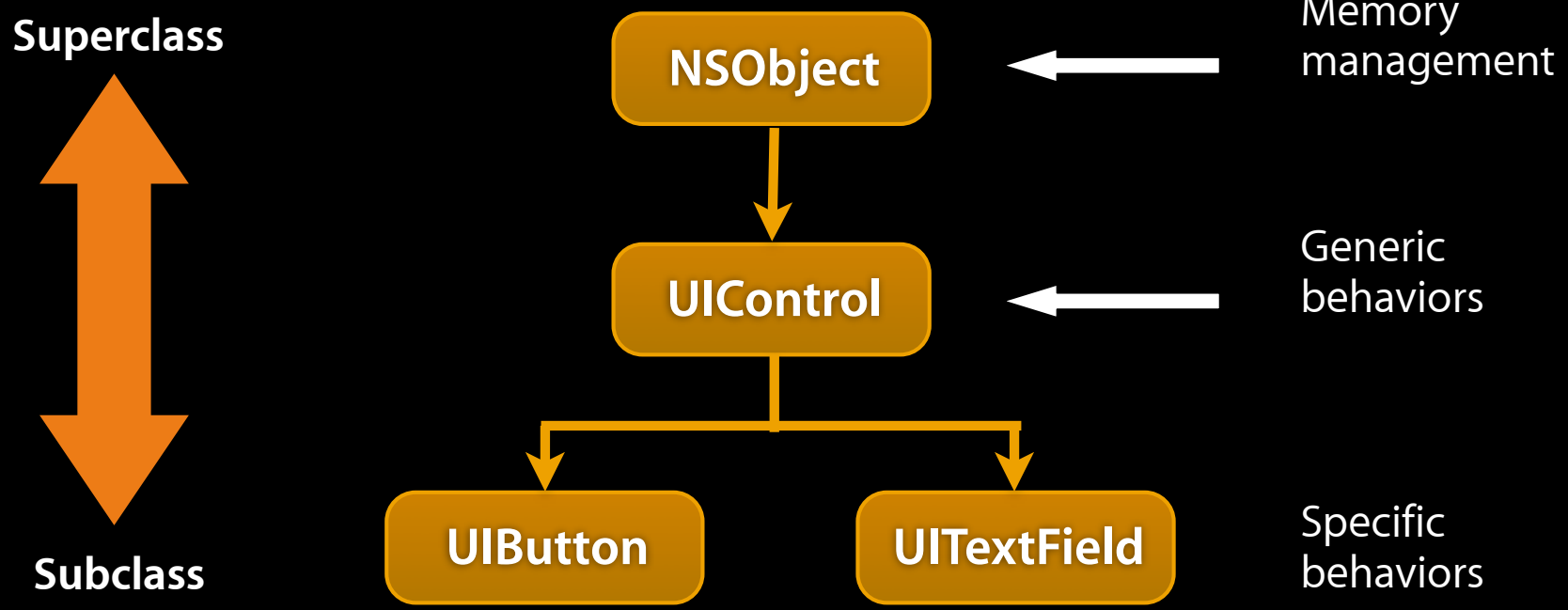
OOP Vocabulary

- **Class**: defines the grouping of data and code, the "type" of an object
- **Instance**: a specific allocation of a class
- **Method**: a "function" that an object knows how to perform
- **Instance Variable (or "ivar")**: a specific piece of data belonging to an object

OOP Vocabulary

- Encapsulation
  - keep implementation private and separate from interface
- Polymorphism
  - different objects, same interface
- Inheritance
  - hierarchical organization, share code, customize or extend behaviors

Inheritance



- Hierarchical relation between classes
- Subclass "inherit" behavior and data from superclass
- Subclasses can use, augment or replace superclass methods

More OOP Info?

- Drop by office hours to talk about basics of OOP
- Tons of books and articles on OOP
- Most Java or C++ book have OOP introductions
- Objective-C 2.0 Programming Language
  - http://developer.apple.com/documentation/Cocoa/Conceptual/ObjectiveC

Objective-C

Objective-C

- Strict superset of C
  - Mix C with ObjC
  - Or even C++ with ObjC (usually referred to as ObjC++)
- A very simple language, but some new syntax
- Single inheritance, classes inherit from one and only one superclass
- Protocols define behavior that cross classes
- Dynamic runtime
- Loosely typed, if you'd like

Syntax Additions

- Small number of additions
- Some new types
  - Anonymous object
  - Class
  - Selectors
- Syntax for defining classes
- Syntax for message expressions

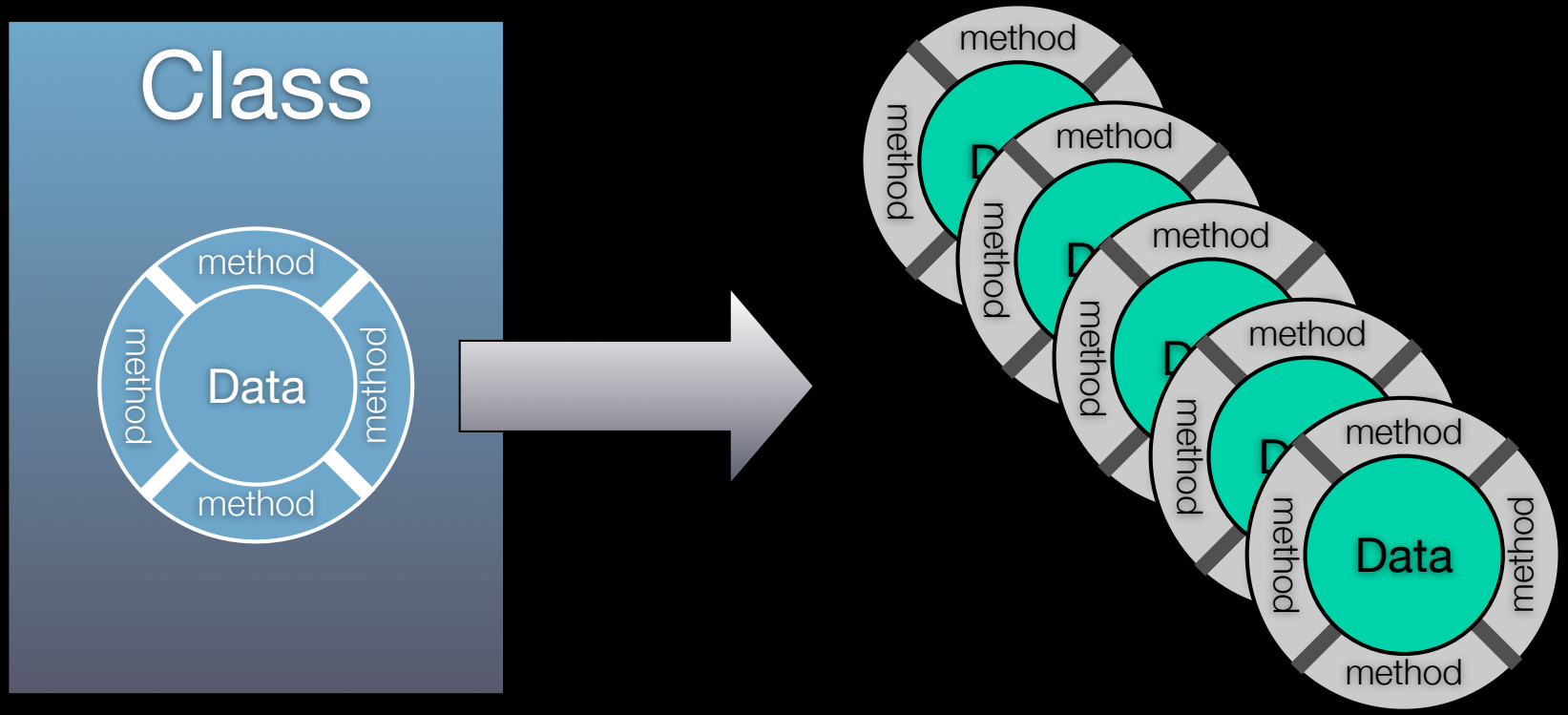
Dynamic Runtime

- Object creation
  - All objects allocated out of the heap
  - No stack based objects
- Message dispatch
- Introspection

OOP with ObjC

Classes and Instances

- In Objective-C, classes and instances are both objects
- Class is the blueprint to create instances



Classes and Objects

- Classes declare state and behavior
- State (data) is maintained using instance variables
- Behavior is implemented using methods
- Instance variables typically hidden
  - Accessible only using getter/setter methods

OOP From ObjC Perspective

- Everybody has their own spin on OOP
  - Apple is no different
- For the spin on OOP from an ObjC perspective:
  - Read the "Object-Oriented Programming with Objective-C" document
  - http://developer.apple.com/iphone/library/documentation/Cocoa/Conceptual/OOP_ObjC

Messaging syntax

Class and Instance Methods

- Instances respond to instance methods
  - (id)init;
  - (float)height;
  - (void)walk;

- Classes respond to class methods
  + (id)alloc;
  + (id)person;
  + (Person *)sharedPerson;

Message syntax

```
[receiver message]

[receiver message:argument]

[receiver message:arg1 andArg:arg2]
```

Message examples

```
Person *voter; //assume this exists

[voter castBallot];

int theAge = [voter age];

[voter setAge:21];

if ([voter canLegallyVote]) {
   // do something voter-y
}

[voter registerForState:@"CA" party:@"Independant"];

NSString *name = [[voter spouse] name];
```

Terminology

- Message expression

  [receiver method: argument]

- Message

  [receiver method: argument]

- Selector

  [receiver method: argument]

- Method

  The code selected by a message

Dot Syntax

- Objective-C 2.0 introduced dot syntax
- Convenient shorthand for invoking accessor methods

```
float height = [person height];
float height = person.height;

[person setHeight:newHeight];
person.height = newHeight;
```

- Follows the dots...

```
[[person child] setHeight:newHeight];

// exactly the same as
person.child.height = newHeight;
```

Objective-C Types

Dynamic and static typing

- Dynamically-typed object

```
id anObject
```

  - Just id
  - Not id * (unless you really, really mean it...)
- Statically-typed object

```
Person *anObject
```

- Objective-C provides compile-time, not runtime, type checking
- Objective-C always uses dynamic binding

The null object pointer

- Test for nil explicitly

```
if (person == nil) return;
```

- Or implicitly

```
if (!person) return;
```

- Can use in assignments and as arguments if expected

```
person = nil;
[button setTarget: nil];
```

- Sending a message to nil?

```
person = nil;
[person castBallot];
```

BOOL typedef

- When ObjC was developed, C had no boolean type (C99 introduced one)
- ObjC uses a typedef to define BOOL as a type

```
BOOL flag = NO;
```

- Macros included for initialization and comparison: YES and NO

```
if (flag == YES)
if (flag)
if (!flag)
if (flag != YES)
flag = YES;
flag = 1;
```

Selectors identify methods by name

- A selector has type SEL

```
SEL action = [button action];
[button setAction:@selector(start:)];
```

- Conceptually similar to function pointer

- Selectors include the name and all colons, for example:

```
-(void)setName:(NSString *)name age:(int)age;
```

would have a selector:

```
SEL sel = @selector(setName:age:);
```

Working with selectors

- You can determine if an object responds to a given selector

```
id obj;
SEL sel = @selector(start:);
if ([obj respondsToSelector:sel]) {
  [obj performSelector:sel withObject:self]
}
```

- This sort of introspection and dynamic messaging underlies many Cocoa design patterns

```
-(void)setTarget:(id)target;
-(void)setAction:(SEL)action;
```

Working with Classes

Class Introspection

- You can ask an object about its class

```
Class myClass = [myObject class];
NSLog(@"My class is %@", [myObject className]);
```

- Testing for general class membership (subclasses included):

```
if ([myObject isKindOfClass:[UIControl class]]) {
  // something
}
```

- Testing for specific class membership (subclasses excluded):

```
if ([myObject isMemberOfClass:[NSString class]]) {
  // something string specific
}
```

Working with Objects

Identity versus Equality

- Identity—testing equality of the pointer values

```
if (object1 == object2) {
  NSLog(@"Same exact object instance");
}
```

- Equality—testing object attributes

```
if ([object1 isEqual: object2]) {
  NSLog(@"Logically equivalent, but may
         be different object instances");
}
```

-description

- NSObject implements -description

```
- (NSString *)description;
```

- Objects represented in format strings using %@
- When an object appears in a format string, it is asked for its description

```
[NSString stringWithFormat: @"The answer is: %@", myObject];
```

- You can log an object's description with:

```
NSLog([anObject description]);
```

- Your custom subclasses can override description to return more specific information

Foundation Classes

Foundation Framework

- Value and collection classes
- User defaults
- Archiving
- Notifications
- Undo manager
- Tasks, timers, threads
- File system, pipes, I/O, bundles

NSObject

- Root class
- Implements many basics
  - Memory management
  - Introspection
  - Object equality

NSString

- General-purpose Unicode string support
  - Unicode is a coding system which represents all of the world's languages
- Consistently used throughout Cocoa Touch instead of "char *"
- Without doubt the most commonly used class
- Easy to support any language in the world with Cocoa

String Constants

- In C constant strings are

```
"simple"
```

- In ObjC, constant strings are

```
@"just as simple"
```

- Constant strings are NSString instances

```
NSString *aString = @"Hello World!";
```

Format Strings

- Similar to printf, but with %@ added for objects

```
NSString *aString = @"Johnny";
NSString *log = [NSString stringWithFormat: @"It's '%@'", aString];
```

log would be set to `It's Johnny`

- Also used for logging

```
NSLog(@"I am a %@, I have %d items", [array className], [array count]);
```

would log something like:

```
I am a NSArray, I have 5 items
```

NSString

- Often ask an existing string for a new string with modifications

```
- (NSString *)stringByAppendingString:(NSString *)string;
- (NSString *)stringByAppendingFormat:(NSString *)string;
- (NSString *)stringByDeletingPathComponent;
```

- Example:

```
NSString *myString = @"Hello";
NSString *fullString;
fullString = [myString stringByAppendingString:@" world!"];
```

fullString would be set to `Hello world!`

NSString

- Common NSString methods

```
- (BOOL)isEqualToString:(NSString *)string;
- (BOOL)hasPrefix:(NSString *)string;
- (int)intValue;
- (double)doubleValue;
```

- Example:

```
NSString *myString = @"Hello";
NSString *otherString = @"449";
if ([myString hasPrefix:@"He"]) {
      // will make it here
}
if ([otherString intValue] > 500) {
      // won't make it here
}
```

NSMutableString

- NSMutableString subclasses NSString
- Allows a string to be modified
- Common NSMutableString methods

```
+ (id)string;
- (void)appendString:(NSString *)string;
- (void)appendFormat:(NSString *)format, ...;

NSMutableString *newString = [NSMutableString string];
[newString appendString:@"Hi"];
[newString appendFormat:@", my favorite number is: %d",
   [self favoriteNumber]];
```

Collections

- Array - ordered collection of objects
- Dictionary - collection of key-value pairs
- Set - unordered collection of unique objects
- Common enumeration mechanism
- Immutable and mutable versions
  - Immutable collections can be shared without side effect
  - Prevents unexpected changes
  - Mutable objects typically carry a performance overhead

NSArray

- Common NSArray methods

```
+ arrayWithObjects:(id)firstObj, ...;  // nil terminated!!!
- (unsigned)count;
- (id)objectAtIndex:(unsigned)index;
- (unsigned)indexOfObject:(id)object;
```

- NSNotFound returned for index if not found

```
NSArray *array = [NSArray arrayWithObjects:@"Red", @"Blue",
@"Green", nil];
if ([array indexOfObject:@"Purple"] == NSNotFound) {
      NSLog (@"No color purple");
}
```

- Be careful of the nil termination!!!

NSMutableArray

- NSMutableArray subclasses NSArray
- So, everything in NSArray
- Common NSMutableArray Methods

```
+ (NSMutableArray *)array;
- (void)addObject:(id)object;
- (void)removeObject:(id)object;
- (void)removeAllObjects;
- (void)insertObject:(id)object atIndex:(unsigned)index;
```

```
NSMutableArray *array = [NSMutableArray array];
[array addObject:@"Red"];
[array addObject:@"Green"];
[array addObject:@"Blue"];
[array removeObjectAtIndex:1];
```

NSDictionary

- Common NSDictionary methods

```
+ dictionaryWithObjectsAndKeys: (id)firstObject, ...;
- (unsigned)count;
- (id)objectForKey:(id)key;
```

- nil returned if no object found for given key

```
NSDictionary *colors = [NSDictionary
      dictionaryWithObjectsAndKeys:@"Red", @"Color 1",
      @"Green", @"Color 2", @"Blue", @"Color 3", nil];
NSString *firstColor = [colors objectForKey:@"Color 1"];


if ([colors objectForKey:@"Color 8"]) {
    // won't make it here
}
```

NSMutableDictionary

- NSMutableDictionary subclasses NSDictionary
- Common NSMutableDictionary methods

```
+ (NSMutableDictionary *)dictionary;
- (void)setObject:(id)object forKey:(id)key;
- (void)removeObjectForKey:(id)key;
- (void)removeAllObjects;
```

```
NSMutableDictionary *colors = [NSMutableDictionary dictionary];

[colors setObject:@"Orange" forKey:@"HighlightColor"];
```

NSSet

- Unordered collection of objects
- Common NSSet methods

```
+ setWithObjects:(id)firstObj, ...;   // nil terminated
- (unsigned)count;
- (BOOL)containsObject:(id)object;
```

NSMutableSet

- NSMutableSet subclasses NSSet
- Common NSMutableSet methods

```
+ (NSMutableSet *)set;
- (void)addObject:(id)object;
- (void)removeObject:(id)object;
- (void)removeAllObjects;
- (void)intersectSet:(NSSet *)otherSet;
- (void)minusSet:(NSSet *)otherSet;
```

Enumeration

- Consistent way of enumerating over objects in collections
- Use with NSArray, NSDictionary, NSSet, etc.

```
NSArray *array = ... ; // assume an array of People objects

// old school
Person *person;
int count = [array count];
for (i = 0; i < count; i++) {
    person = [array objectAtIndex:i];
    NSLog([person description]);
}

// new school
for (Person *person in array) {
   NSLog([person description]);
}
```

NSNumber

- In Objective-C, you typically use standard C number types
- NSNumber is used to wrap C number types as objects
- Subclass of NSValue
- No mutable equivalent!
- Common NSNumber methods

```
+ (NSNumber *)numberWithInt:(int)value;
+ (NSNumber *)numberWithDouble:(double)value;
- (int)intValue;
- (double)doubleValue;
```

Other Classes

- NSData / NSMutableData
  - Arbitrary sets of bytes
- NSDate / NSCalendarDate
  - Times and dates

Getting some objects

- Until we talk about memory management:
  - Use class factory methods
    - NSString's +stringWithFormat:
    - NSArray's +array
    - NSDictionary's +dictionary
  - Or any method that returns an object except alloc/init or copy.

More ObjC Info?

- http://developer.apple.com/documentation/Cocoa/Conceptual/ObjectiveC
- Concepts in Objective C are applicable to any other OOP language

Questions?