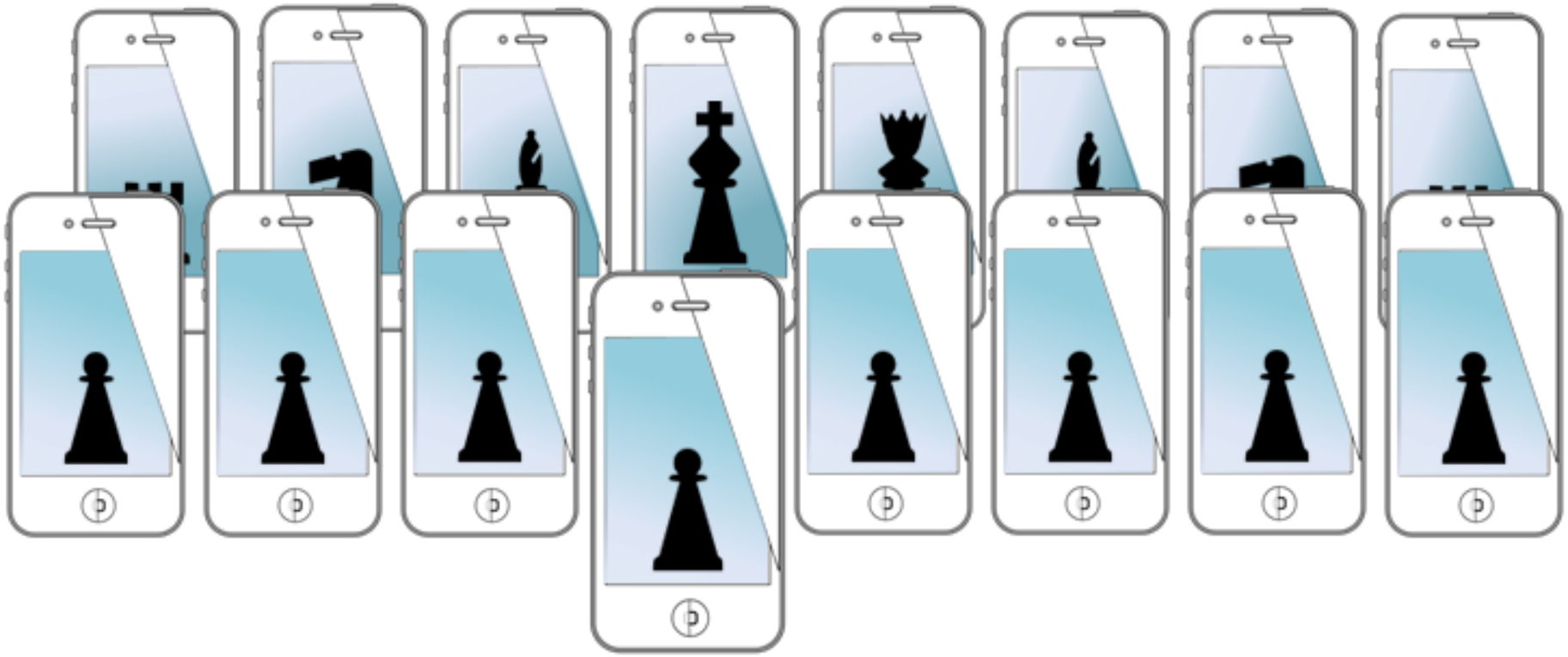
MOBILE SENSING LEARNING & CONTROL



CSE5323 & 7323

Mobile Sensing, Learning, and Control

lecture four: page controllers & core data

Eric C. Larson, Lyle School of Engineering,
Computer Science and Engineering, Southern Methodist University

course logistics

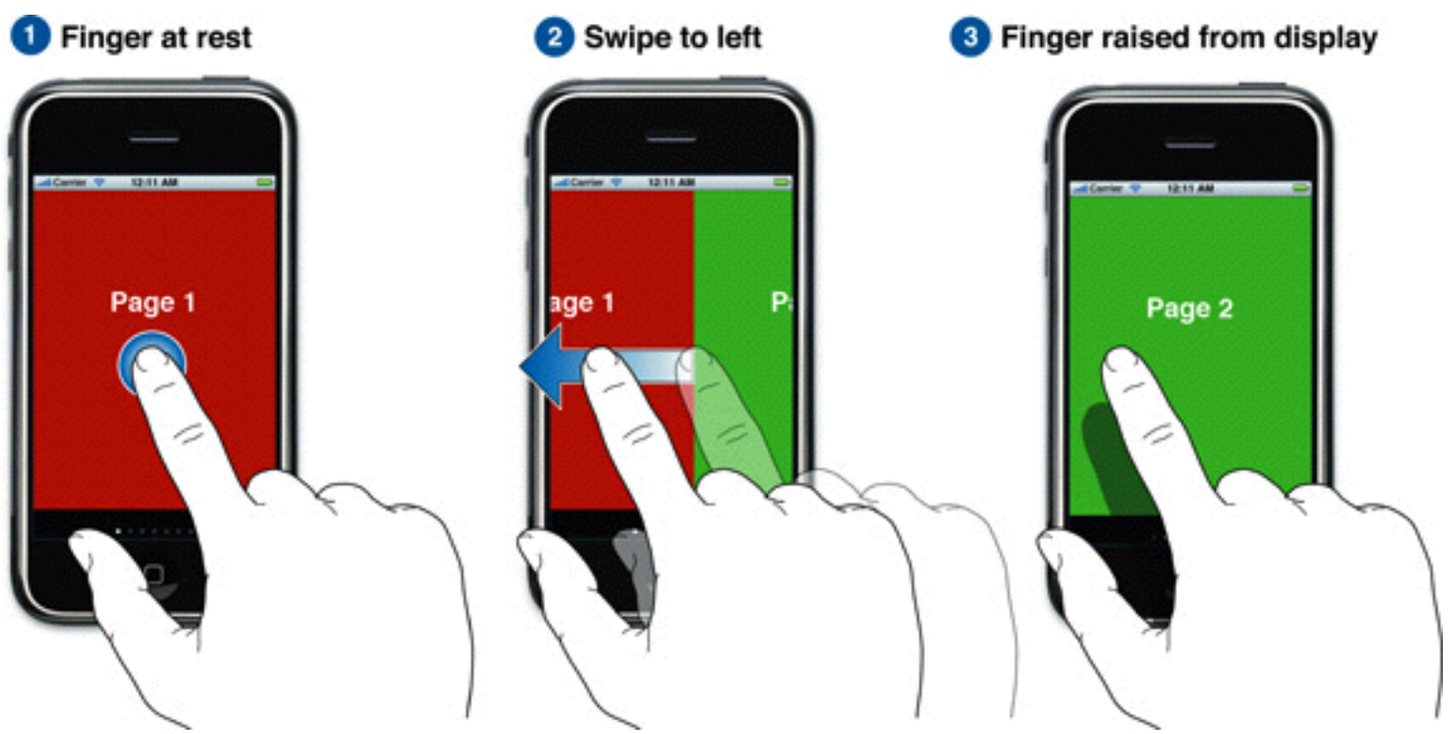
- A1 due this Friday
- I have 20 people on teams, and 2 unassigned
    - correct?

agenda

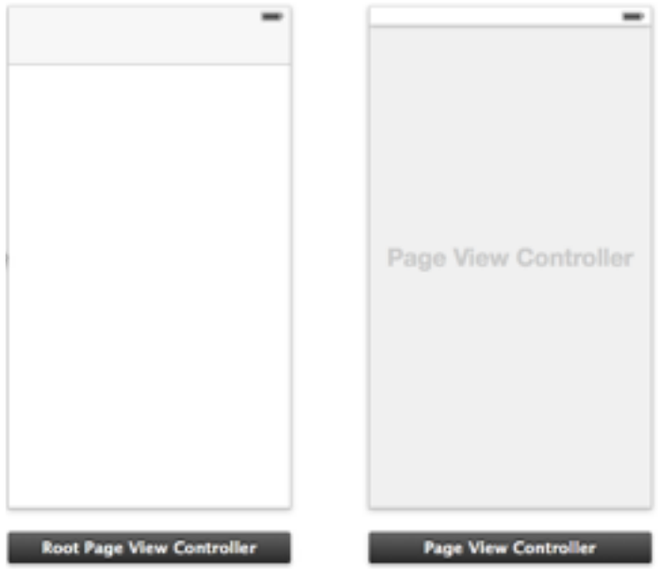
- page view controllers
- timers / segmented control
- persistent storage
  - core data for creating and using database schema
- blocks and multi-threading
- objective c++

page view controller

- place UIPageViewController in storyboard
- place a “root controller” for the page
  - adopt <UIPageViewControllerDataSource>
  - instantiate pageViewController from “root”
  - instantiate views to be paged in “root”

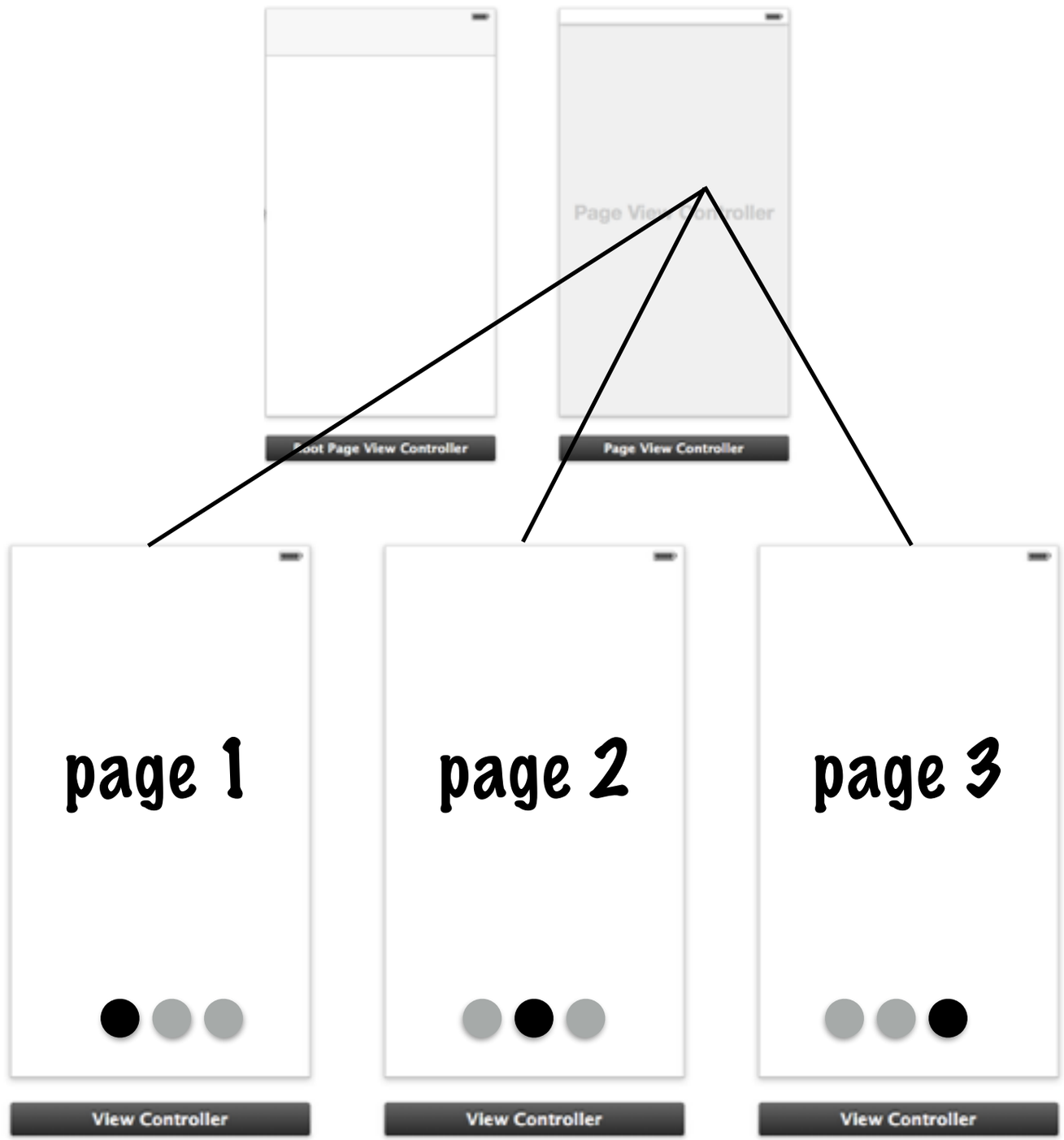


page view controller



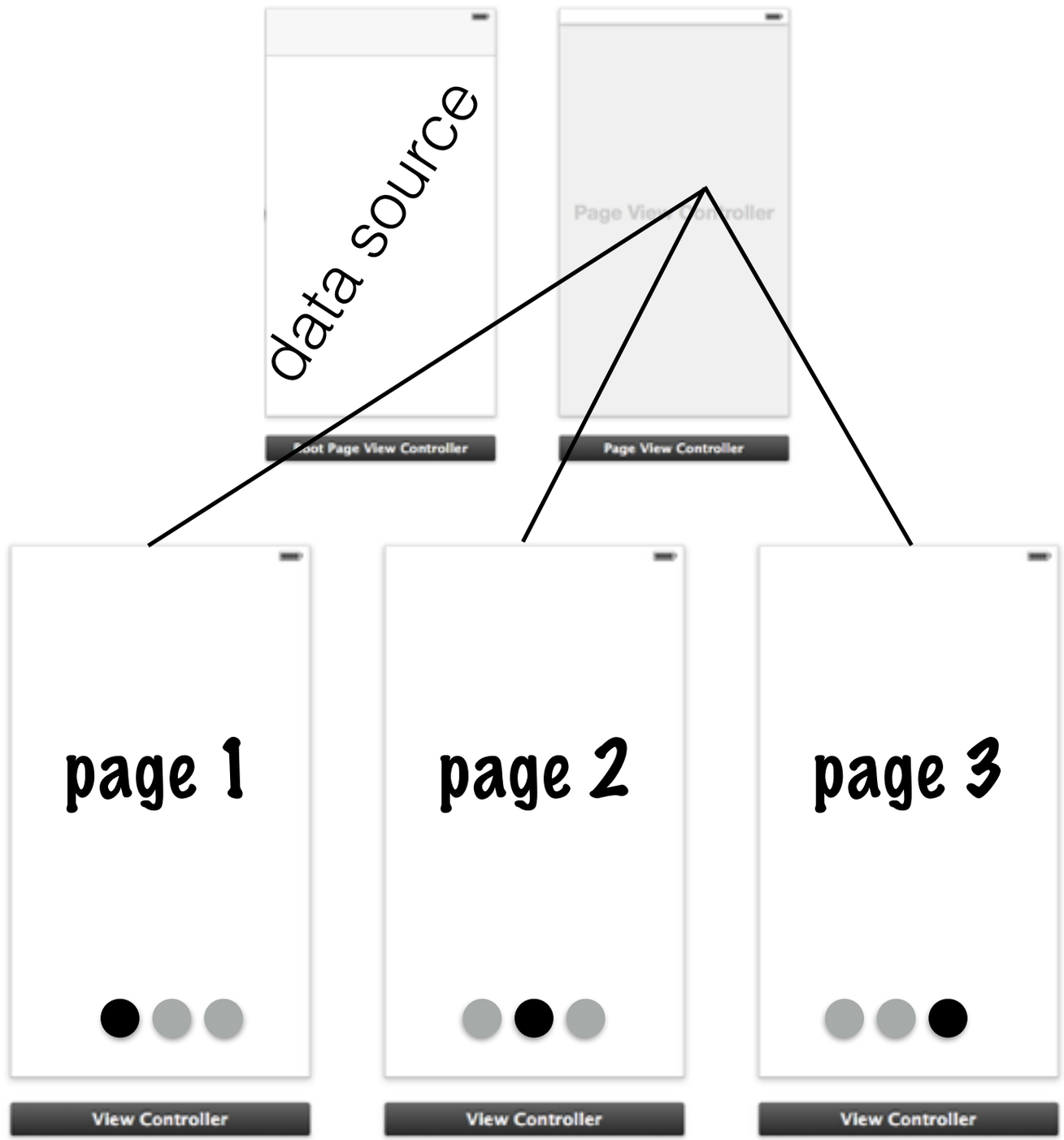
different instantiations of view controller

page view controller



different instantiations of view controller

page view controller



different instantiations of view controller

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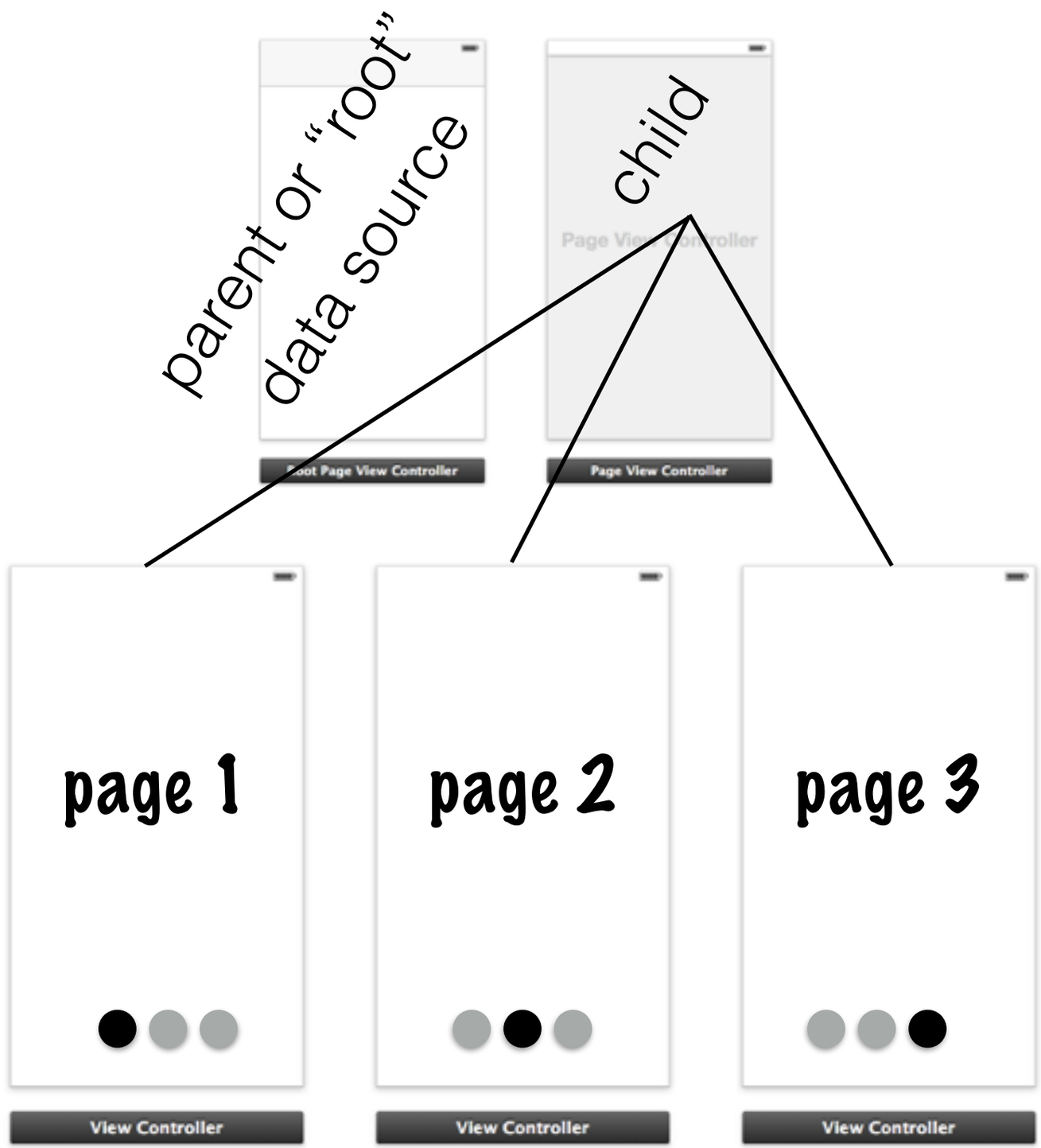

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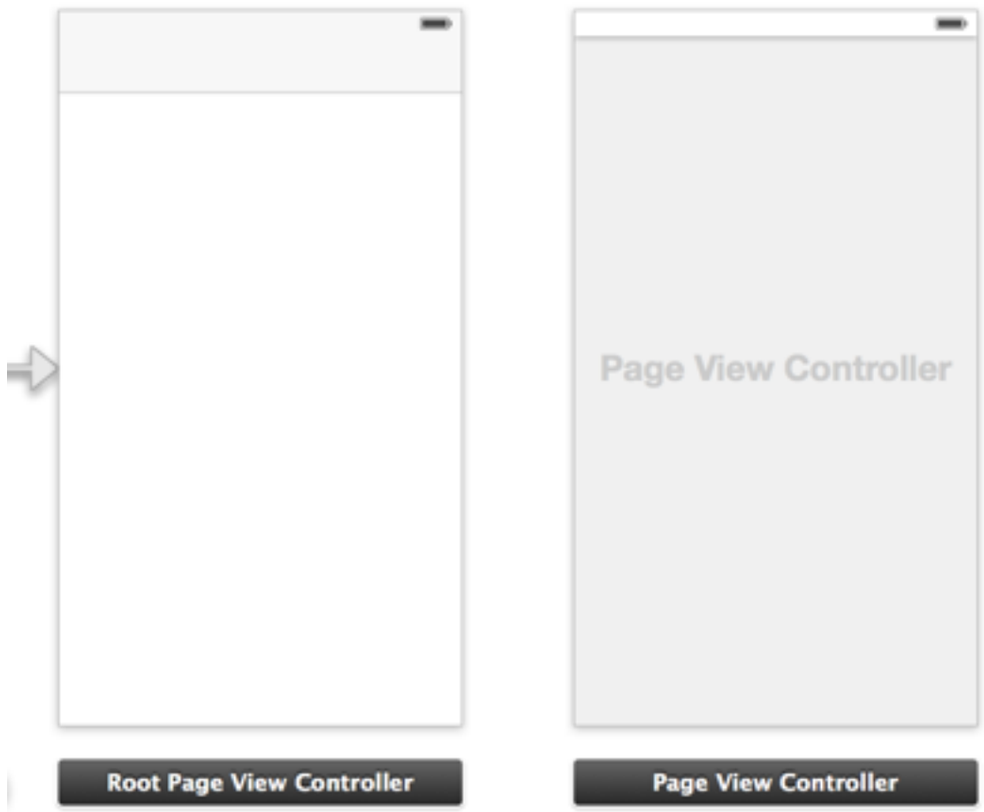
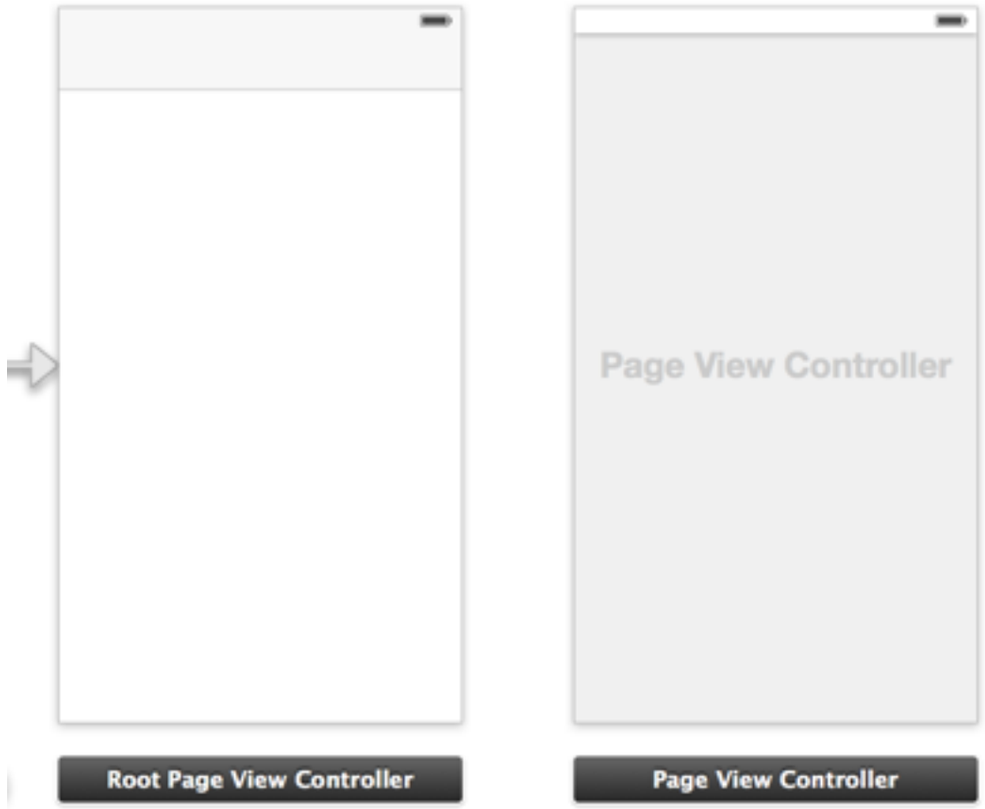
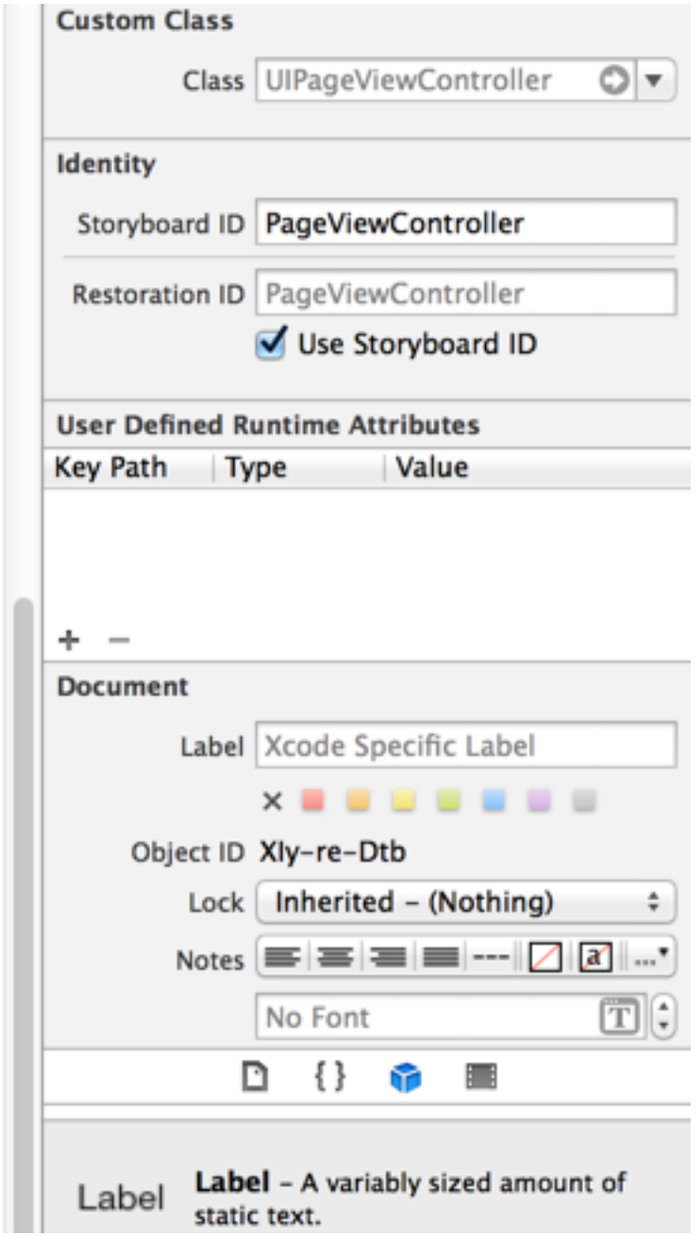
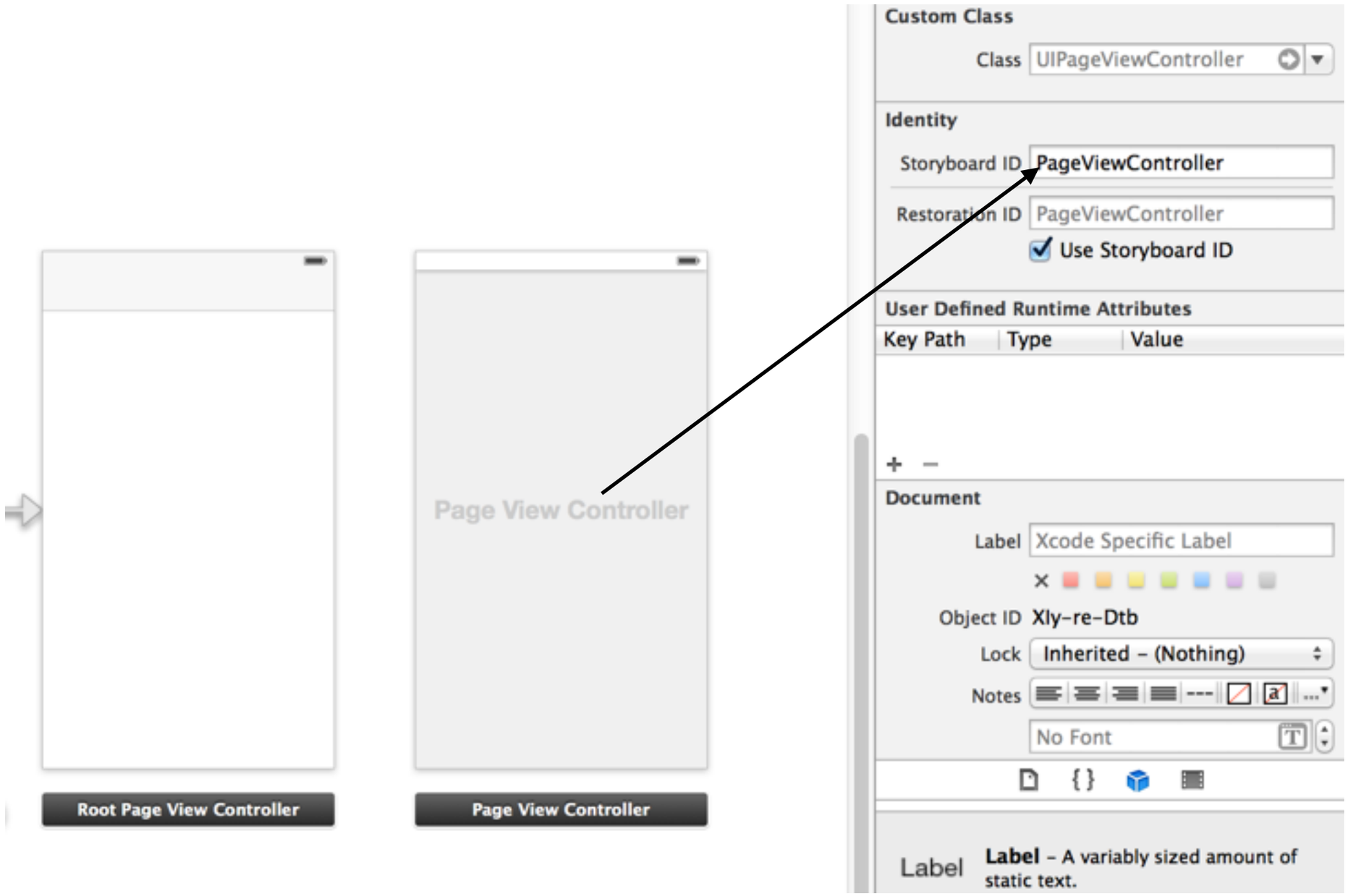


page view controller



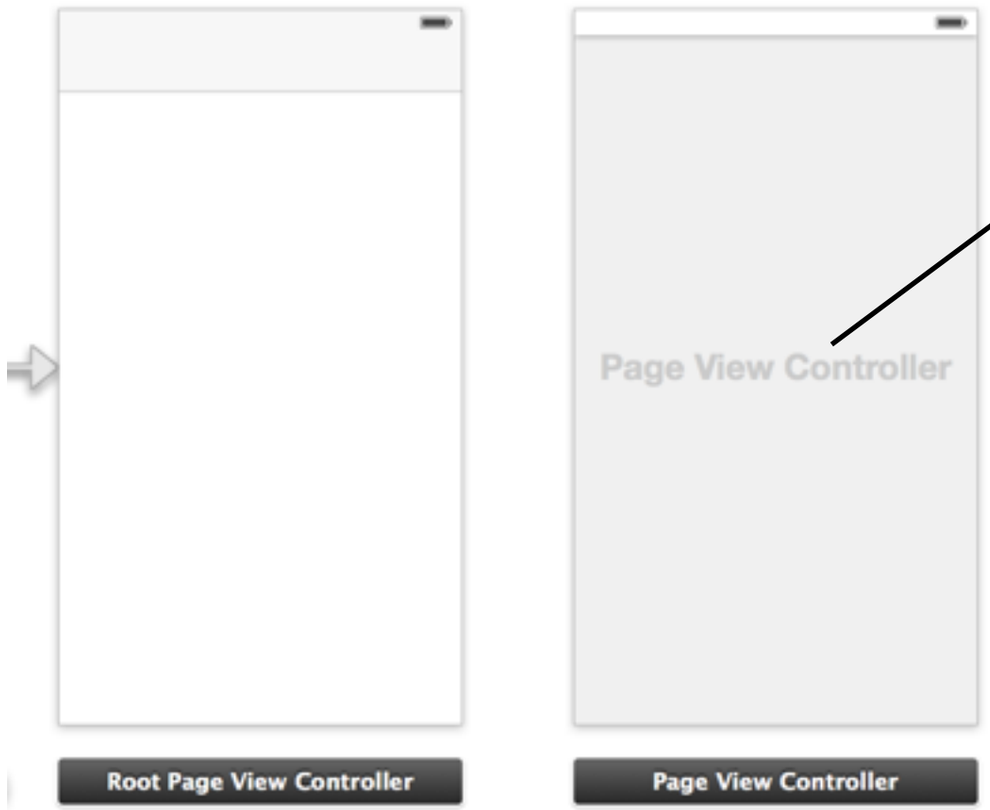


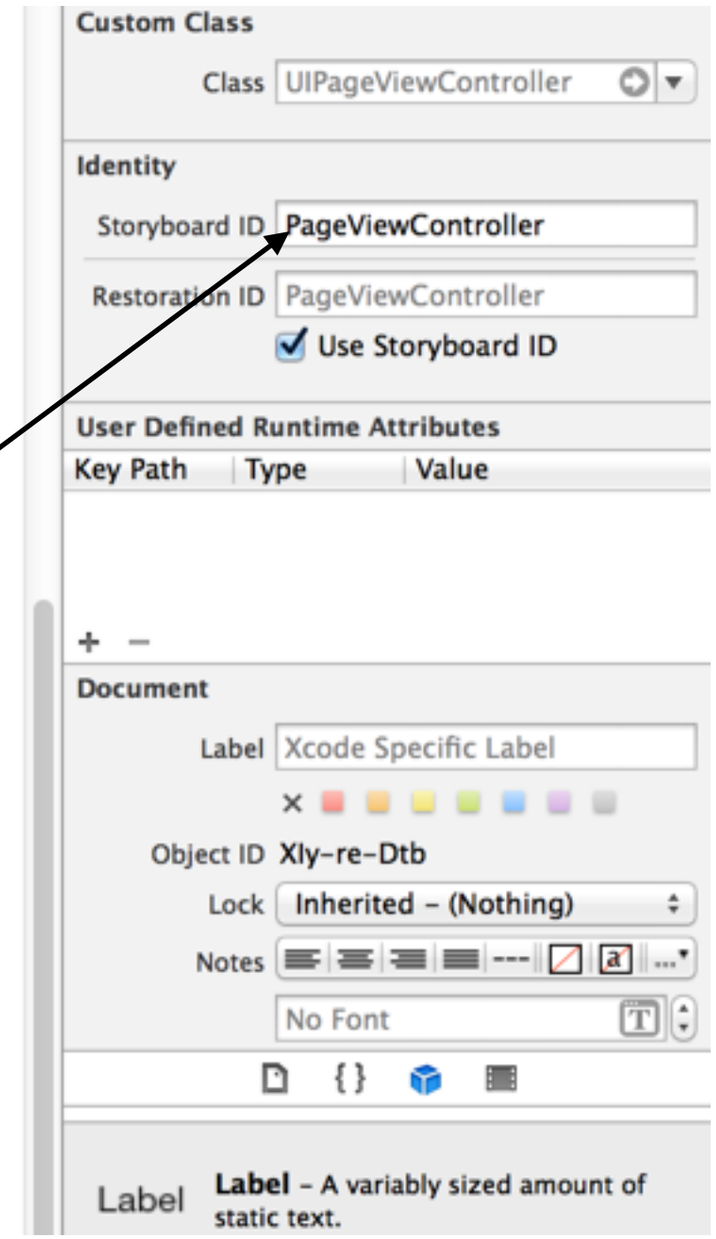
page view controller



page view controller

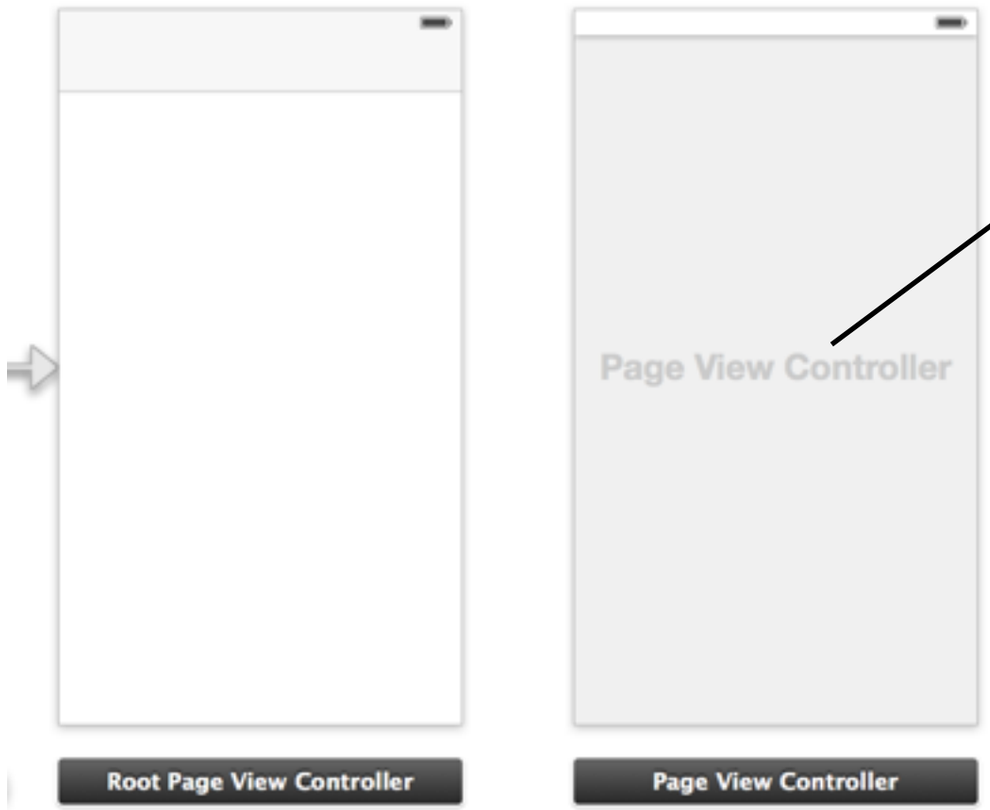
no need to subclass the page controller!

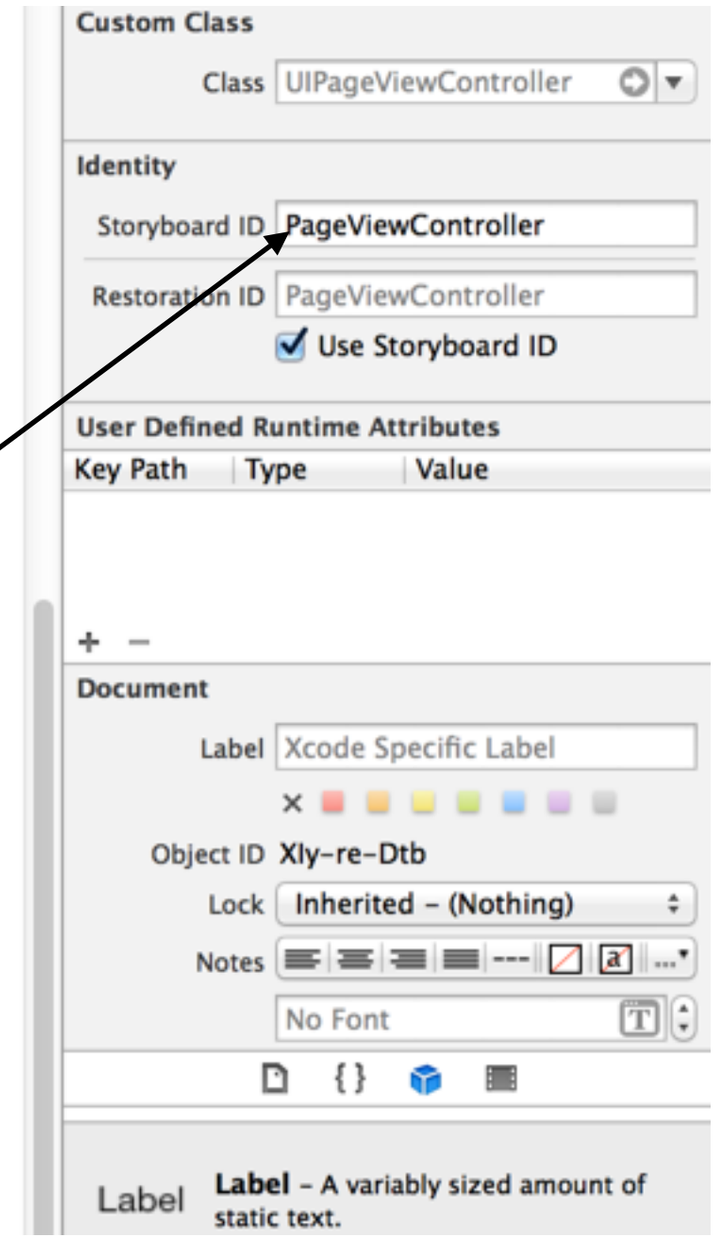




page view controller

no need to subclass the page controller!





but root of the page controller must be the data source…

root page view controller

root page view controller

instantiation in root view controller

```
@property (strong, nonatomic) UIPageViewController * pageViewController;
@property (strong, nonatomic) NSArray *pageContent;

_pageViewController = [self.storyboard instantiateViewControllerWithIdentifier:@"PageViewController"];
_pageViewController.dataSource = self;
```

root page view controller

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instantiate!

in viewDidLoad

```
[self.pageViewController setViewControllers:firstPageToDisplay // the page is a view controller!
                                  direction:UIPageViewControllerNavigationDirectionForward
                                   animated:NO
                                 completion:nil];

[self addChildViewController:_pageViewController];
[self.view addSubview:_pageViewController.view];
[self.pageViewController didMoveToParentViewController:self];
```

root page view controller

instantiation in root view controller

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set first page

instantiate!

in viewDidLoad

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apple says do this, in order

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```

apple says do this, in order

some datasource protocol methods

```
- (NSInteger)presentationCountForPageViewController:(UIPageViewController *)pageViewController
{
    return [self.pageContent count];
}

- (NSInteger)presentationIndexForPageViewController:(UIPageViewController *)pageViewController
{
    return 0;
}
```

root page view controller

some datasource protocol methods (cont.)

```
- (NSInteger)presentationCountForPageViewController:(UIPageViewController *)pageViewController
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    return 0;
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root page view controller

some datasource protocol methods (cont.)

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    return 0;
}

-(UIViewController*)pageViewController:(UIPageViewController *)pageViewController
viewControllerBeforeViewController:(UIViewController *)viewController
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```

root page view controller

some datasource protocol methods (cont.)

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root page view controller

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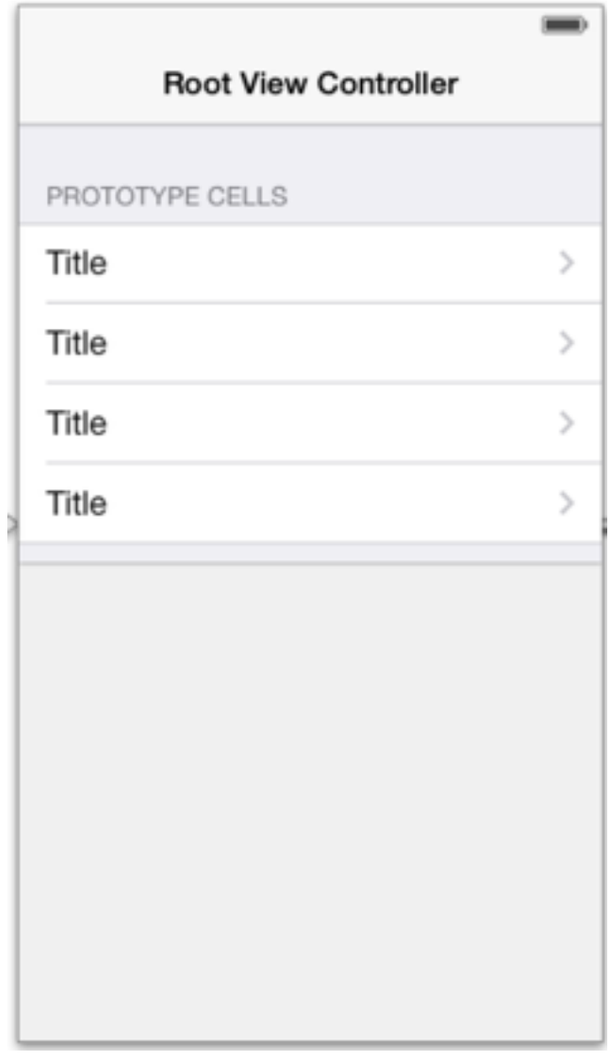
```

1. create pages (VCs)
2. set any information for loading
3. return the instantiated VC

page view demo

assignment one

- Automatic Layout (storyboard and programmatically)
- UIButtons (created in storyboard and programmatically)
- Sliders (created in storyboard and programmatically)
- Labels (created in storyboard and programmatically)
- Stepper
- Switch
- Picker (Date or otherwise)
- UINavigationController
- **UISegmentedControl**
- **NSTimer** (which should repeat and somehow update the UIView)
- UIScrollView (with scrollable, zoomable content)
- UIPageViewController
- UIImageView
- **(optional) Persistent storage via CoreData**



due Friday, Feb. 7

timers, segmented control

```
- (IBAction)updateFromSegmentedControl:(UISegmentedControl *)sender {

    NSString *selectedText = [sender titleForSegmentAtIndex: [sender selectedSegmentIndex]];

    YOUR_CODE
}
```

timers, segmented control

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get title from control

timers, segmented control

```
- (IBAction)updateFromSegmentedControl:(UISegmentedControl *)sender {

    NSString *selectedText = [sender titleForSegmentAtIndex: [sender selectedSegmentIndex]];

    YOUR_CODE
}
```

get title from control


```
NSTimer *timer = [NSTimer scheduledTimerWithTimeInterval:someIntervalInSeconds
                                                  target:self
                                                selector:@selector(someFunction:)
                                                userInfo:nil
                                                 repeats:YES];

// don't get blocked by the main thread
[[NSRunLoop mainRunLoop] addTimer:timer forMode:NSRunLoopCommonModes];
```

core data databases

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- allows access to SQLite database

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- integrated deeply into Xcode and into iOS

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- excellent for storing persistent table data

core data databases

- allows access to SQLite database
- integrated deeply into Xcode and into iOS
- highly optimized
- excellent for storing persistent table data
  - but usable for most anything

core data schema

ENTITIES
- Student
- Teams

FETCH REQUESTS

CONFIGURATIONS
- Default

Attributes

Attribute	Type
hardware	String
name	String

+ −

ENTITIES
- Student
- Teams

FETCH REQUESTS

CONFIGURATIONS
- Default

Attributes

Attribute	Type
major	String
name	String

+ −

core data schema

ENTITIES
- Student
- Teams

FETCH REQUESTS

CONFIGURATIONS
- Default

Attributes

Attribute	Type
hardware	String
name	String

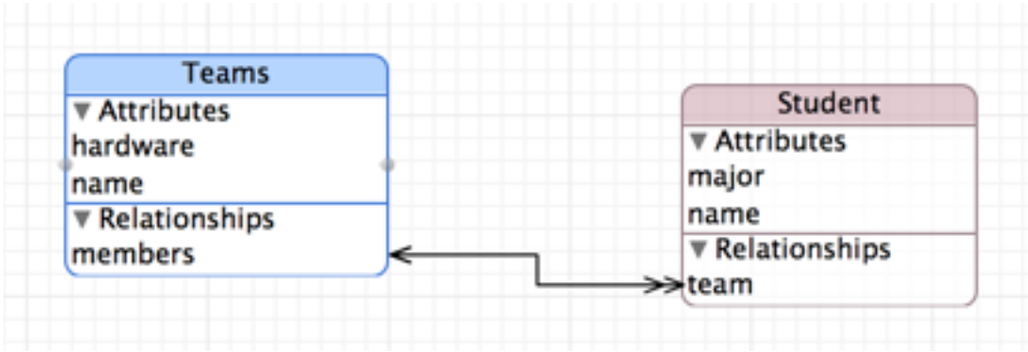
ENTITIES
- Student
- Teams

FETCH REQUESTS

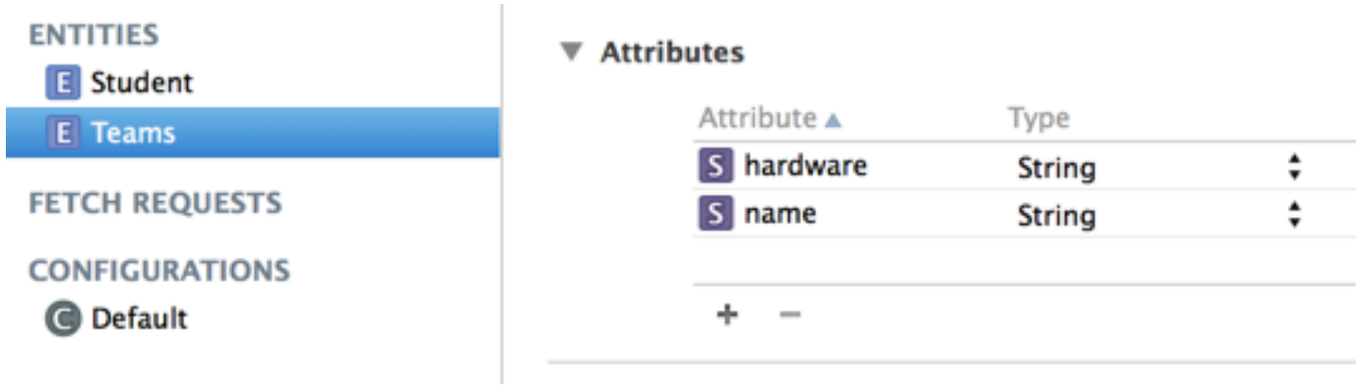
CONFIGURATIONS
- Default

Attributes

Attribute	Type
major	String
name	String



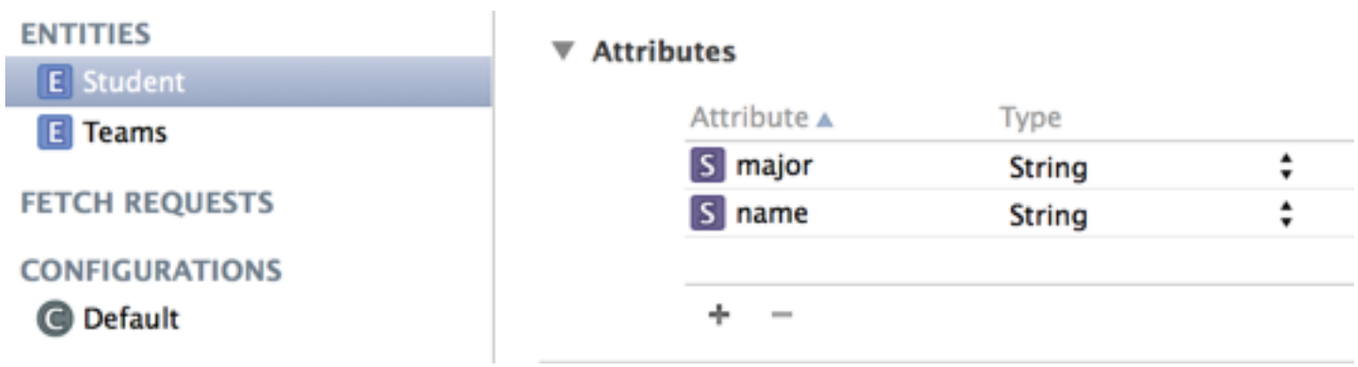
core data schema

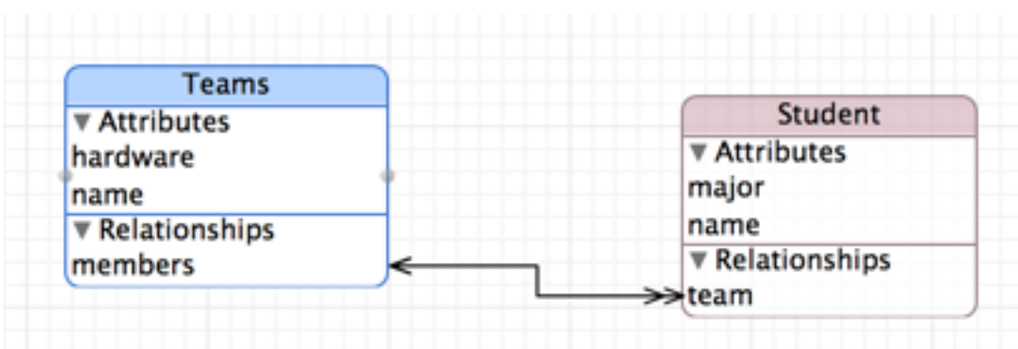



```
@interface Teams : NSManagedObject

@property (nonatomic, retain) NSString * name;
@property (nonatomic, retain) NSString * hardware;
@property (nonatomic, retain) NSSet *members;

@end
```





core data schema

ENTITIES
- Student
- Teams

FETCH REQUESTS

CONFIGURATIONS
- Default

Attributes

Attribute	Type
hardware	String
name	String

```
@interface Teams : NSManagedObject

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```

ENTITIES
- Student
- Teams

FETCH REQUESTS

CONFIGURATIONS
- Default

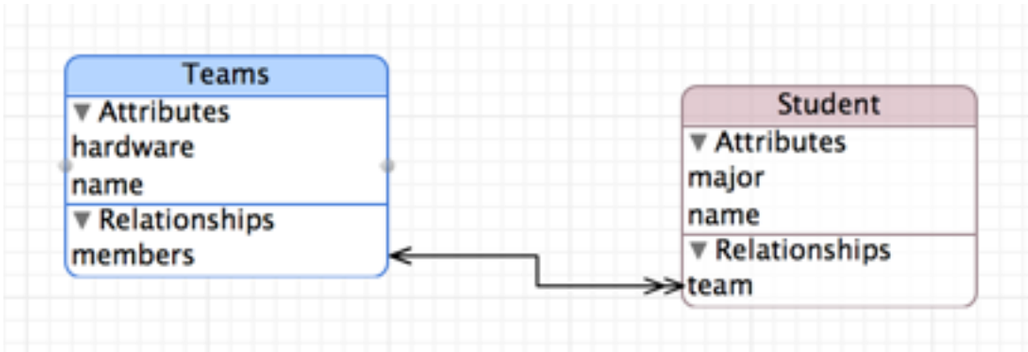
Attributes

Attribute	Type
major	String
name	String

```
@interface Student : NSManagedObject

@property (nonatomic, retain) NSString * name;
@property (nonatomic, retain) NSString * major;
@property (nonatomic, retain) Teams *team;

@end
```



core data

- schema creation
  - automatic subclassing
- NSManagedObject
- NSManagedObjectContext
- NSPersistentStore
- NSFetchRequest

core data

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create SQLite Database on phone

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create SQLite Database on phone

enable access through properties

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create SQLite Database on phone

enable access through properties

bundle “data models”

core data

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create SQLite Database on phone

enable access through properties

bundle “data models”

get “context” for using data model

core data

- schema creation
  - automatic subclassing
- NSManagedObject
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create SQLite Database on phone

enable access through properties

bundle “data models”

get “context” for using data model

coordinate access to the data model

core data

- schema creation
  - automatic subclassing
- NSManagedObject
- NSManagedObjectContext
- NSPersistentStore
- NSFetchRequest

create SQLite Database on phone

enable access through properties

bundle “data models”

get “context” for using data model

coordinate access to the data model

create and execute queries

core data setup

```
// Getter for managed context
- (NSManagedObjectContext *) managedObjectContext {

    if(!_managedObjectContext){
        // create the storage coordinator
        NSPersistentStoreCoordinator *coordinator = [self persistentStoreCoordinator];
        if (coordinator != nil) {
            _managedObjectContext = [[NSManagedObjectContext alloc] init];
            [_managedObjectContext setPersistentStoreCoordinator: coordinator];
        }
    }

    return _managedObjectContext;
}
```

core data setup

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            _managedObjectContext = [[NSManagedObjectContext alloc] init];
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        }
    }

    return _managedObjectContext;
}

// getter for the storage coordinator
- (NSPersistentStoreCoordinator *)persistentStoreCoordinator {
    if (!_persistentStoreCoordinator) {

        // this points to our model
        NSURL *storeUrl = [NSURL fileURLWithPath: [[self applicationDocumentsDirectory]
                                                    stringByAppendingPathComponent: @"ModelName.sqlite"]];
        NSError *error = nil;
        _persistentStoreCoordinator = [[NSPersistentStoreCoordinator alloc]
                                        initWithManagedObjectModel:[self managedObjectModel]];

        if(![_persistentStoreCoordinator addPersistentStoreWithType:NSSQLiteStoreType
                                configuration:nil URL:storeUrl options:nil error:&error]) {
            // exit gracefully if you need the database to function in the UI
        }
    }
    return _persistentStoreCoordinator;
}
```

core data setup

```
// getter for the storage coordinator
- (NSPersistentStoreCoordinator *)persistentStoreCoordinator {
    if (!_persistentStoreCoordinator) {

        // this points to our model
        NSURL *storeUrl = [NSURL fileURLWithPath: [[self applicationDocumentsDirectory]
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        NSError *error = nil;
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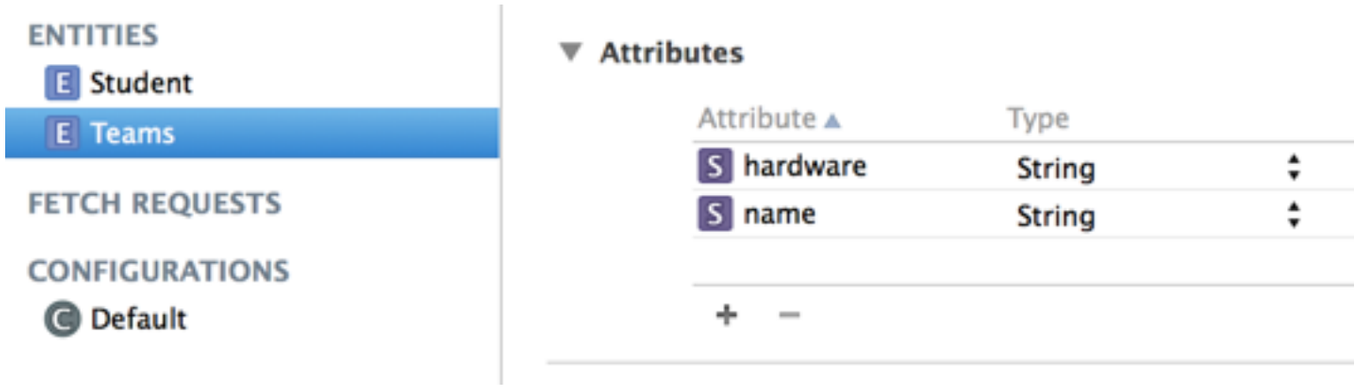
        if(![_persistentStoreCoordinator addPersistentStoreWithType:NSSQLiteStoreType
                                configuration:nil URL:storeUrl options:nil error:&error]) {
            // exit gracefully if you need the database to function in the UI
        }
    }
    return _persistentStoreCoordinator;
}


// getter for the object model, create if needed
- (NSManagedObjectModel *)managedObjectModel {
    if (!_managedObjectModel) {
        _managedObjectModel = [NSManagedObjectModel mergedModelFromBundles:nil];
    }
    return _managedObjectModel;
}
```

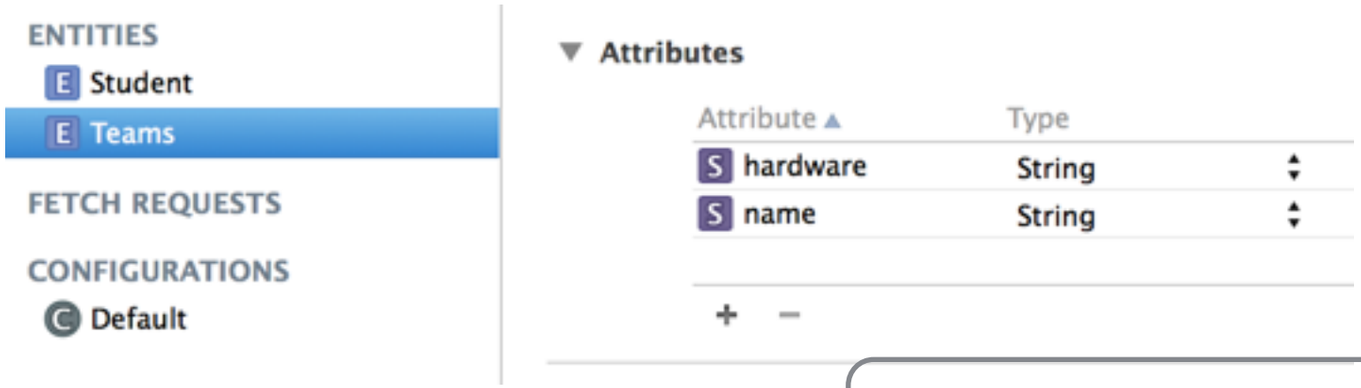
entering data




```
//  get a new entry
 team = [NSEntityDescription insertNewObjectForEntityForName:@"Teams"
                                        inManagedObjectContext:self.managedObjectContext];
 // save the attributes
 team.name = self.teamNameTextField.text;
 team.hardware = [self assignHardware];

 //  save into the database
 NSError *error;
 if (![self.managedObjectContext save:&error]) {
     NSLog(@"save database failed: %@", [error localizedDescription]);
 }
```

entering data



create a new entity from model

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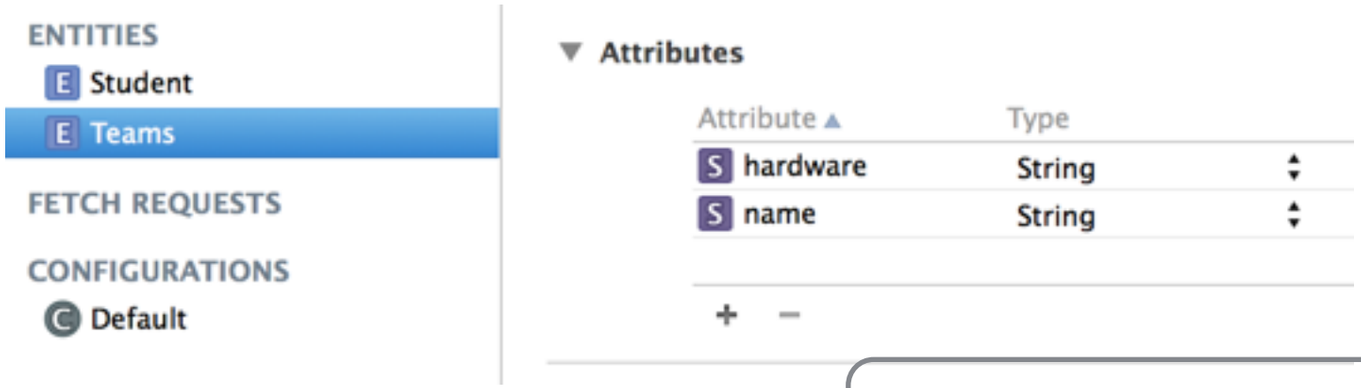
entering data



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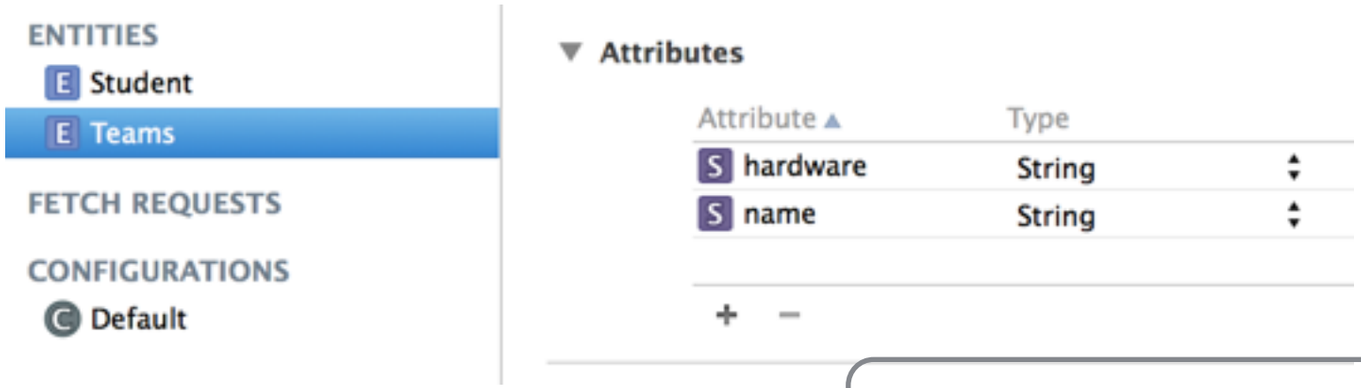
set attributes

entering data



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 NSError *error;
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     NSLog(@"save database failed: %@", [error localizedDescription]);
 }
```

set attributes

not saved in database until here

queries in core data

```
-(NSArray*)getAllTeamsFromDatabase
{
    // initializing NSFetchRequest
    NSFetchRequest *fetchRequest = [[NSFetchRequest alloc] init];

    //Setting Entity to be Queried
    NSEntityDescription *entity = [NSEntityDescription entityForName:@"Teams"
                                                inManagedObjectContext:self.managedObjectContext];
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}
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queries in core data

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-(NSArray*)getAllTeamsFromDatabase
{
    // initializing NSFetchRequest
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request

fetch

entity to request from

array of results, even if size=0

```
-(NSArray*)getTeamFromDatabase:(NSString*)teamName
{
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   fetchRequest.predicate =
        [NSPredicate predicateWithFormat:@"name = %@",teamName];

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queries in core data

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set predicate

queries in core data

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}
```

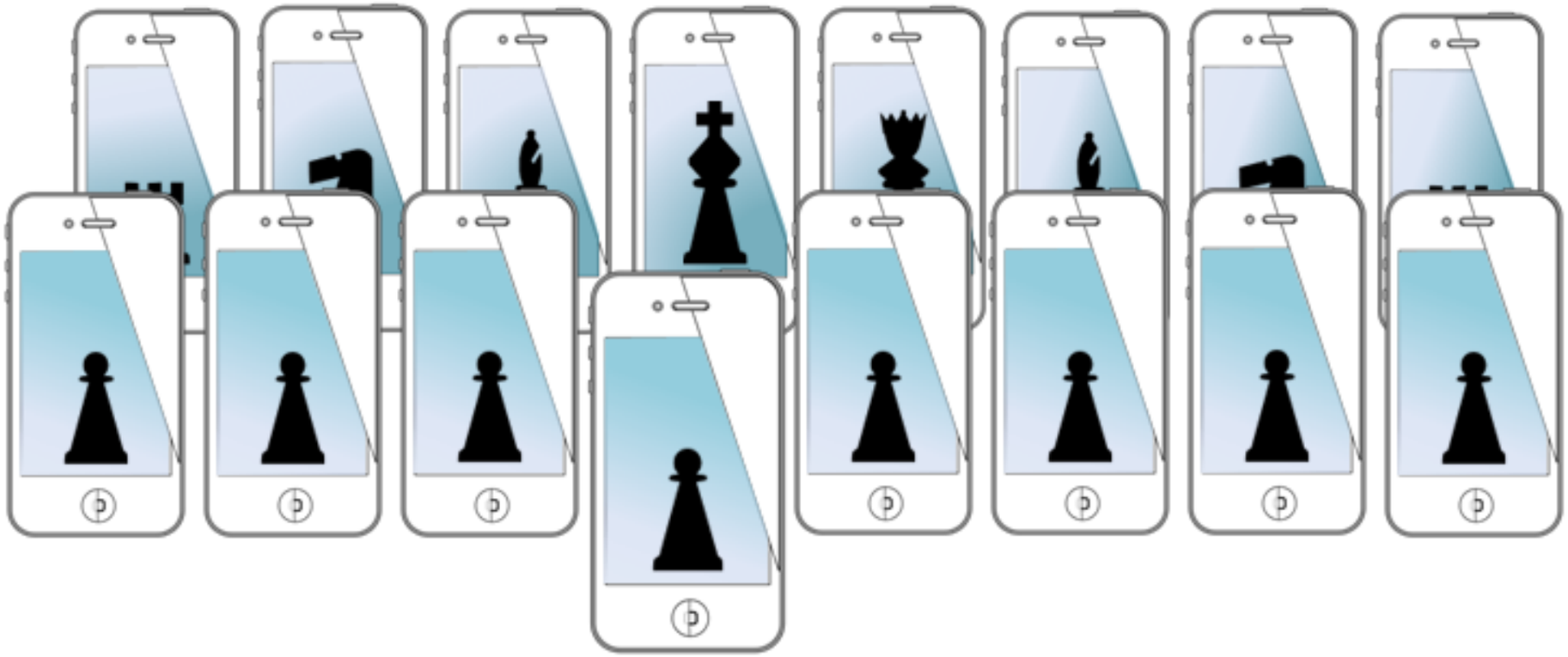
set predicate

```
@"name = %@“
@"name contains[c] %@“
@"value > 7“
@“team.name = %@“
@“any student.name contains %@“
```

core data demo

- Who Was In That!
- Class Teams! will make available on website

MOBILE SENSING LEARNING & CONTROL



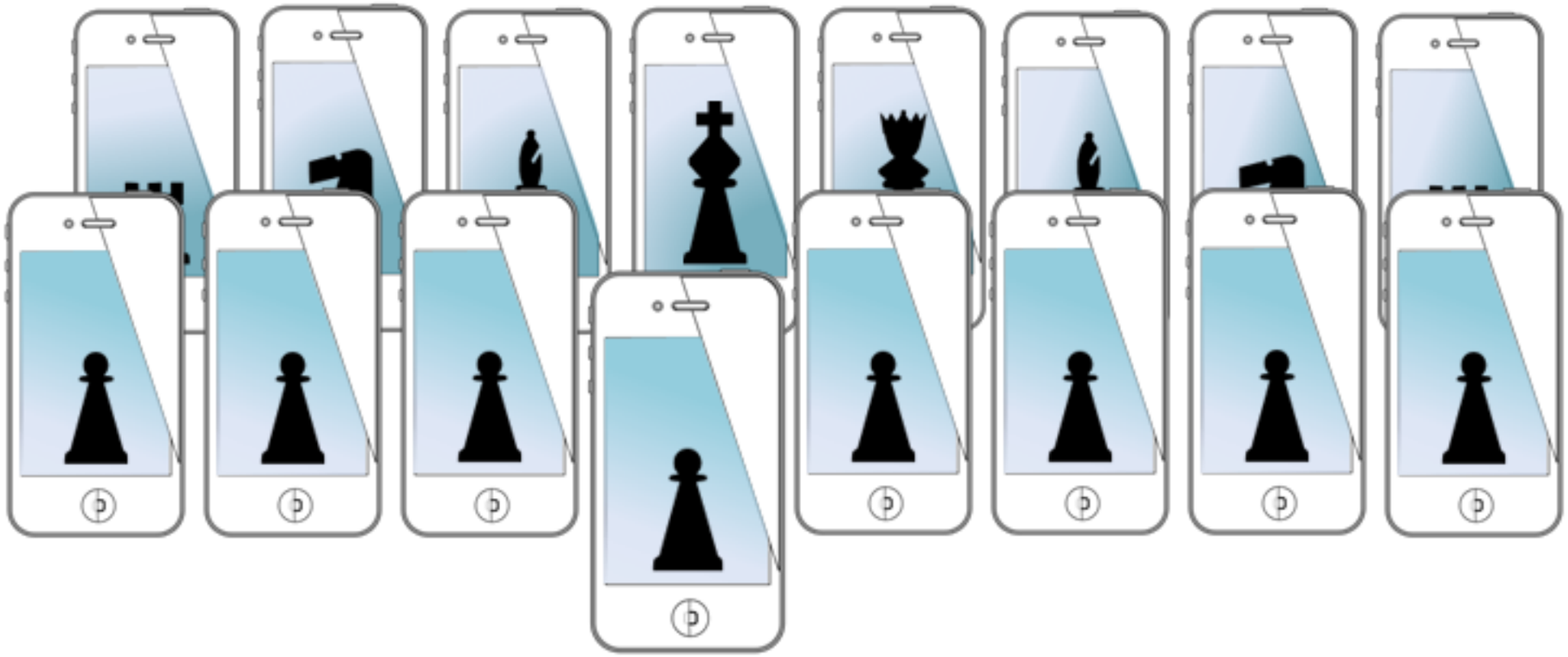
CSE5323 & 7323

Mobile Sensing, Learning, and Control

lecture four: page controllers & core data

Eric C. Larson, Lyle School of Engineering,
Computer Science and Engineering, Southern Methodist University

MOBILE SENSING LEARNING & CONTROL



CSE5323 & 7323

Mobile Sensing, Learning, and Control

lecture five: queues, blocks, c++, audio session

Eric C. Larson, Lyle School of Engineering,
Computer Science and Engineering, Southern Methodist University

agenda

- questions about core data?
- notifications
- blocks and multi-threading
- objective c++
- core audio intro
  - demo if time

notifications

- NotificationCenter - a radio station for which any method can tune in on

```
MCDAppDelegate* appDelegate = [UIApplication sharedApplication].delegate;

    [[NSNotificationCenter defaultCenter] addObserver:self
                                              selector:@selector(tableDataDidChange)
                                                  name:NSManagedObjectContextDidSaveNotification
                                                object:appDelegate.managedObjectContext];
```

notifications

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access notification center

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when this happens

from this context

lets add notifications to WhoWasInThat!

blocks

- not callback functions (but similar)
  - created at runtime
  - can access data from scope when defined
  - syntax is ^(…)
- not a lambda (but similar)
  - but it acts like an object that can be passed as an argument or created on the fly

block syntax

```
//create a block on the fly
 float (^onTheFlyBlockThatAddsTwoInts)(int,int); // declare the block, try not to make unclear
 // define the behavior of the block
 onTheFlyBlockThatAddsTwoInts =^(int a, int b){
     return (float)(a+b);
 };
 // use the block
 NSLog(@" On the fly value: %.4f",onTheFlyBlockThatAddsTwoInts(5,6));
```

block syntax

block name

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typedef float(^TypeDefinedBlock)(float,float);

TypeDefinedBlock blockAsObject = ^(float arg1, float arg2){
    return arg1 / arg2;
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    //-------------------------------
    //execute the block from typedef
    float value = blockAsObject(22.0,44.0);
    NSLog(@" Val = %.4f",value);
```

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syntax to call block

```
//-------------------------------
//enumerate an Array with a block
NSArray *myArray = @[@34.5,@56.4567,@(M_PI)];

// here the block is created on the fly for the enumeration
[myArray enumerateObjectsUsingBlock:^(NSNumber *obj, NSUInteger idx, BOOL *stop) {
    // print the value of the NSNumber in a variety of ways
    NSLog(@"Float Value = %.2f, Int Value = %d",[obj floatValue],[obj integerValue]);
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block syntax

return type

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enumerate with block

some semantics

- variables from same scope where block is defined are read only
  - __block float someVariable; // this is now readwrite
- blocks hold a **strong** pointer from where there defined
  - so using “self” would create a retain cycle

concurrency in iOS

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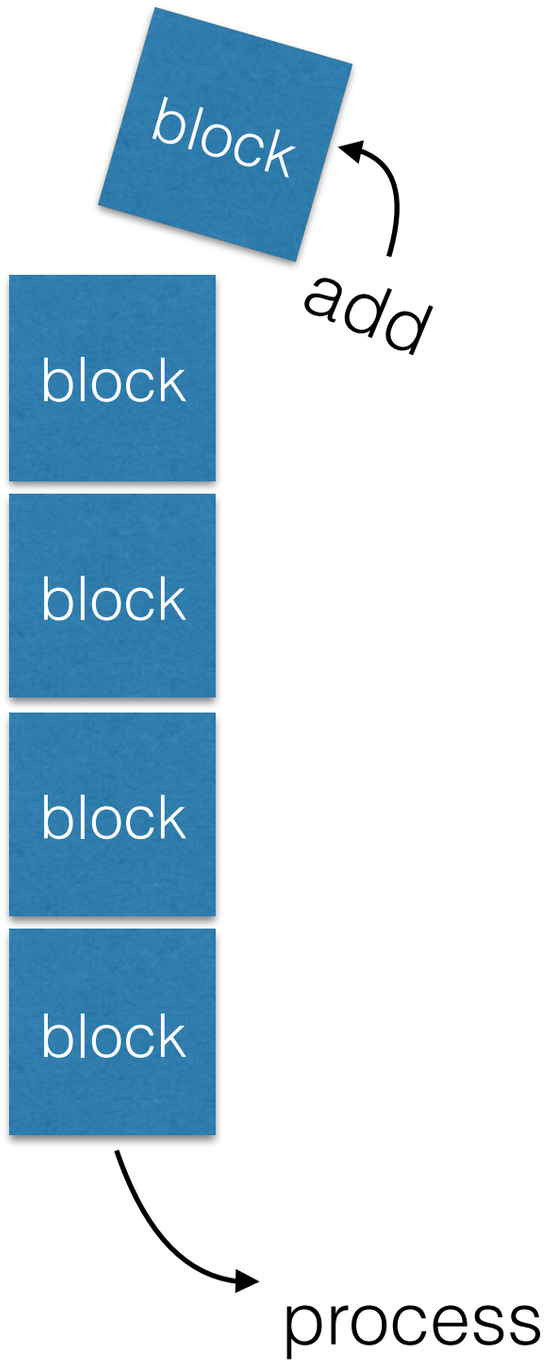
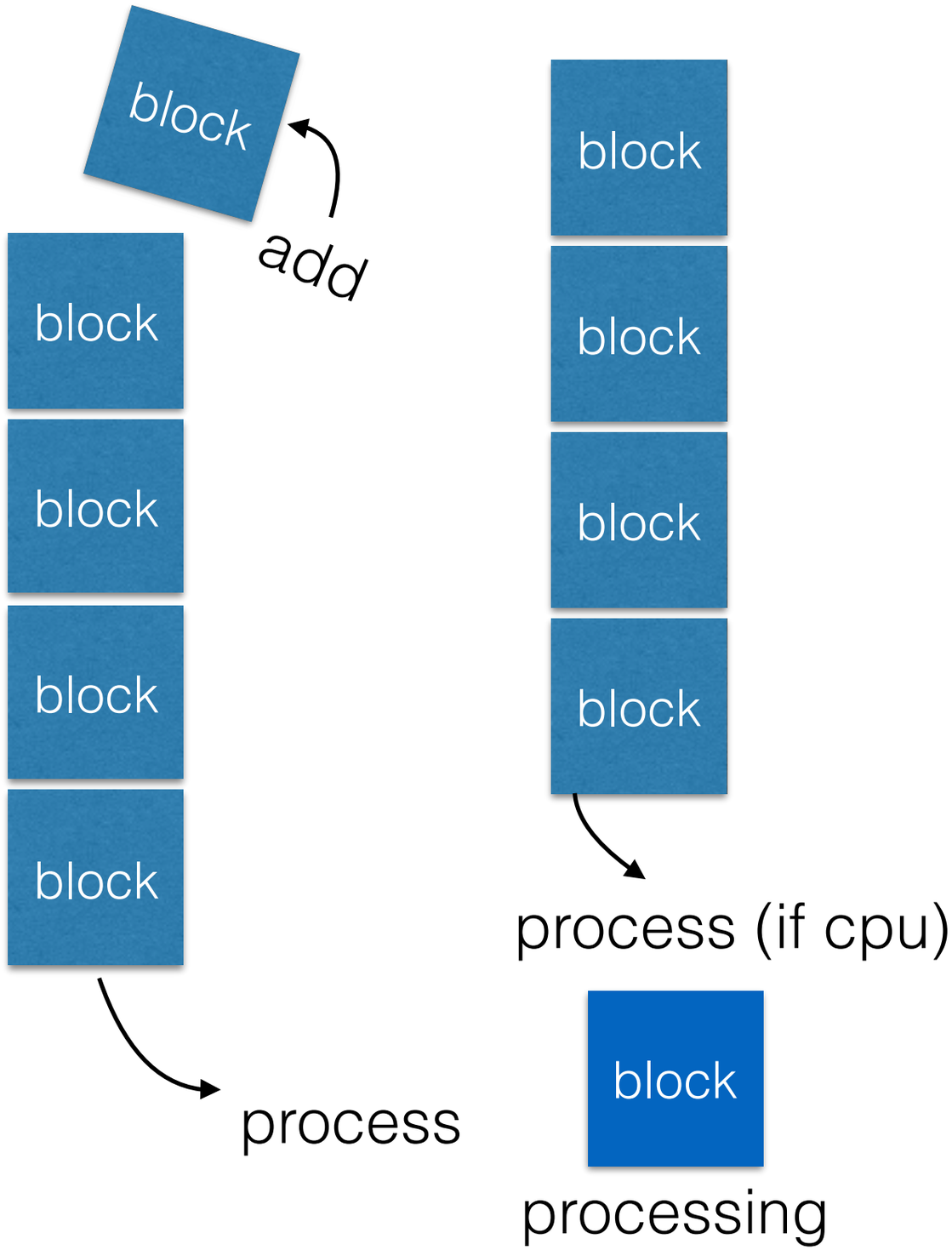
    - if CPU is available, then the next block is also dequeued, but could finish any time
- the main queue handles all UI operations (and no other queue should generate UI changes!!)
  - so, no updating of the views, labels, buttons, (image views*) except from the main queue

concurrent queues



concurrent queues



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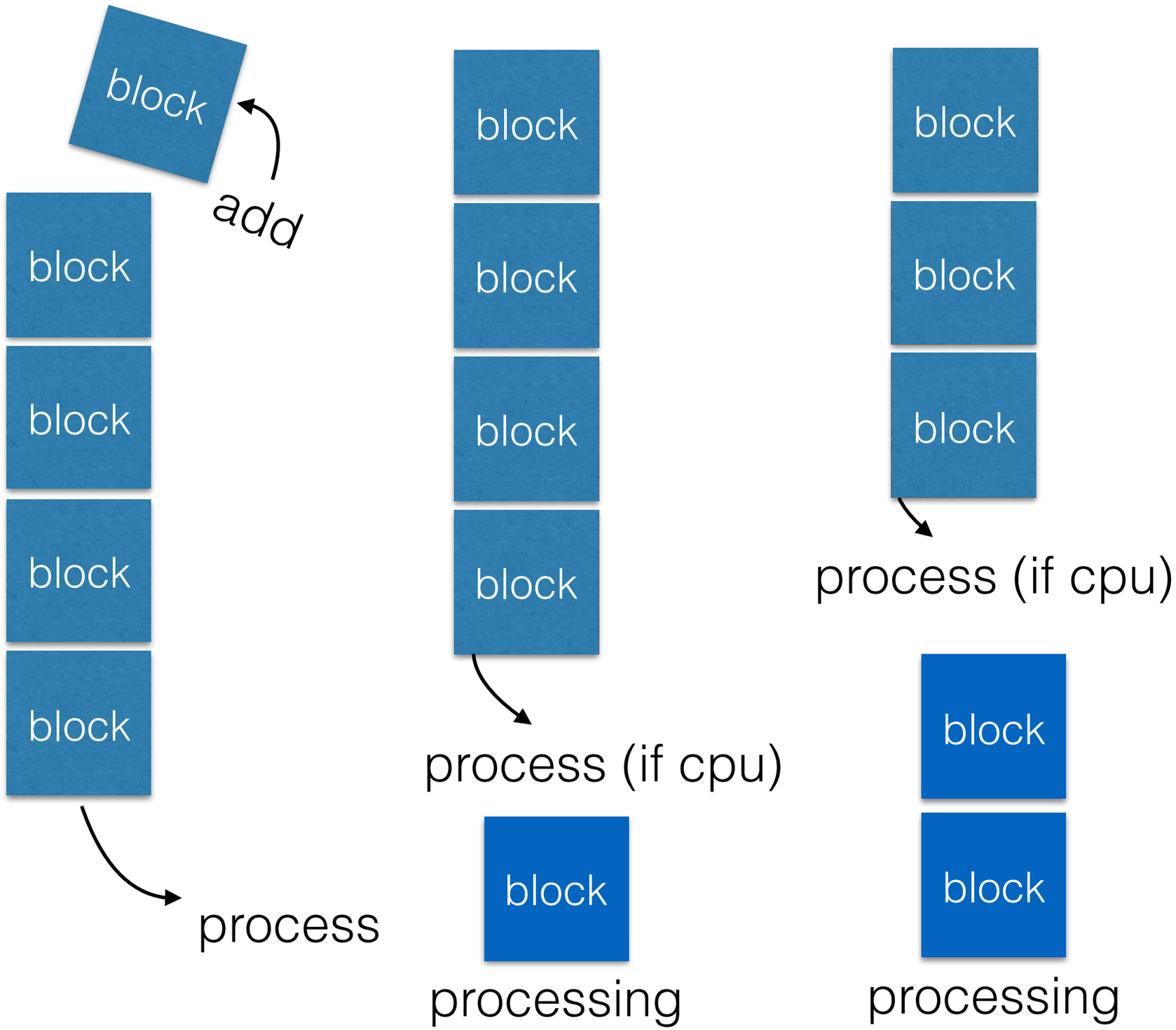

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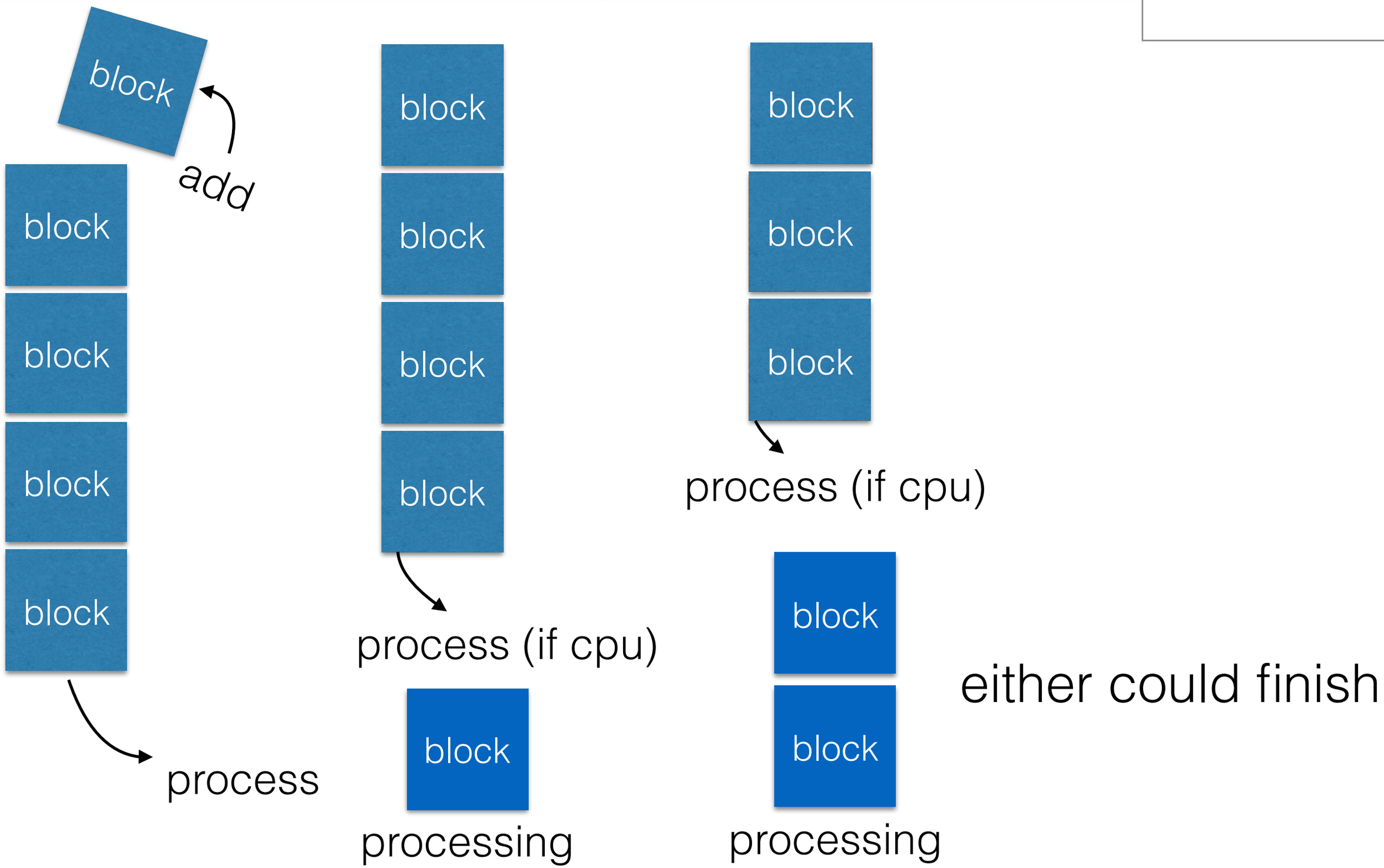

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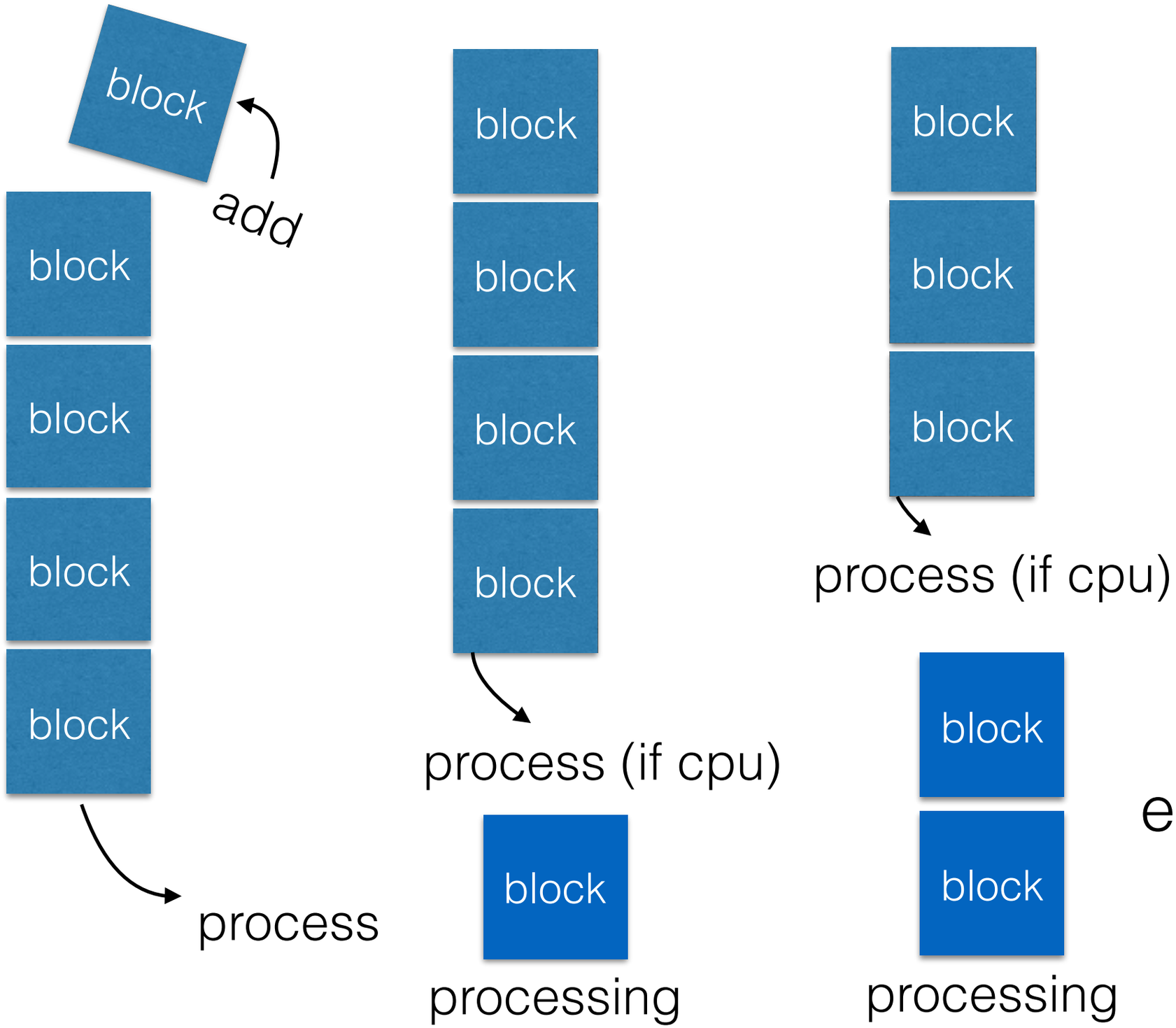
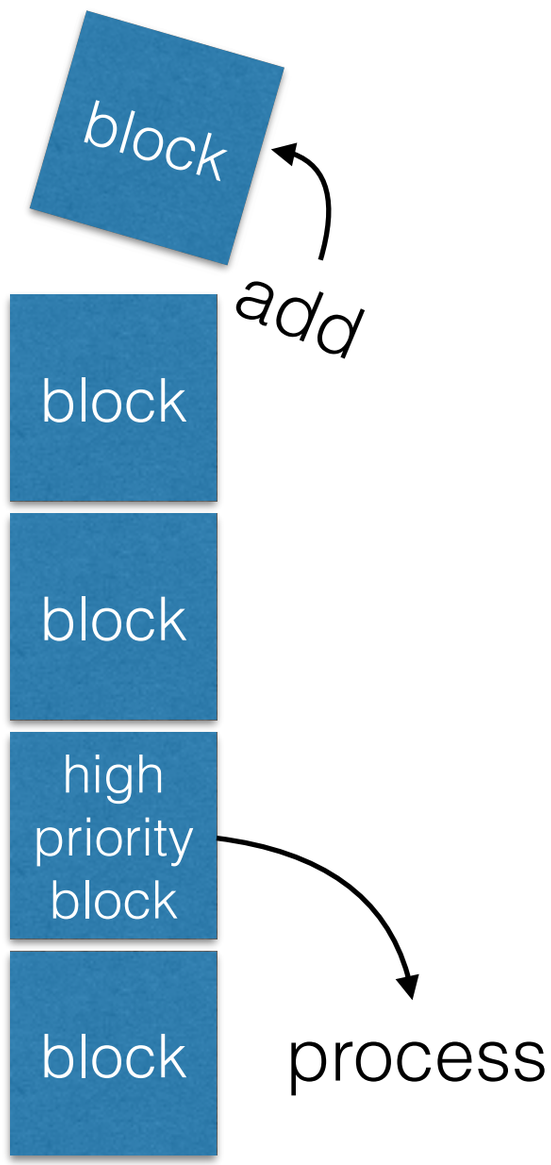


threads?

either could finish

the main queue



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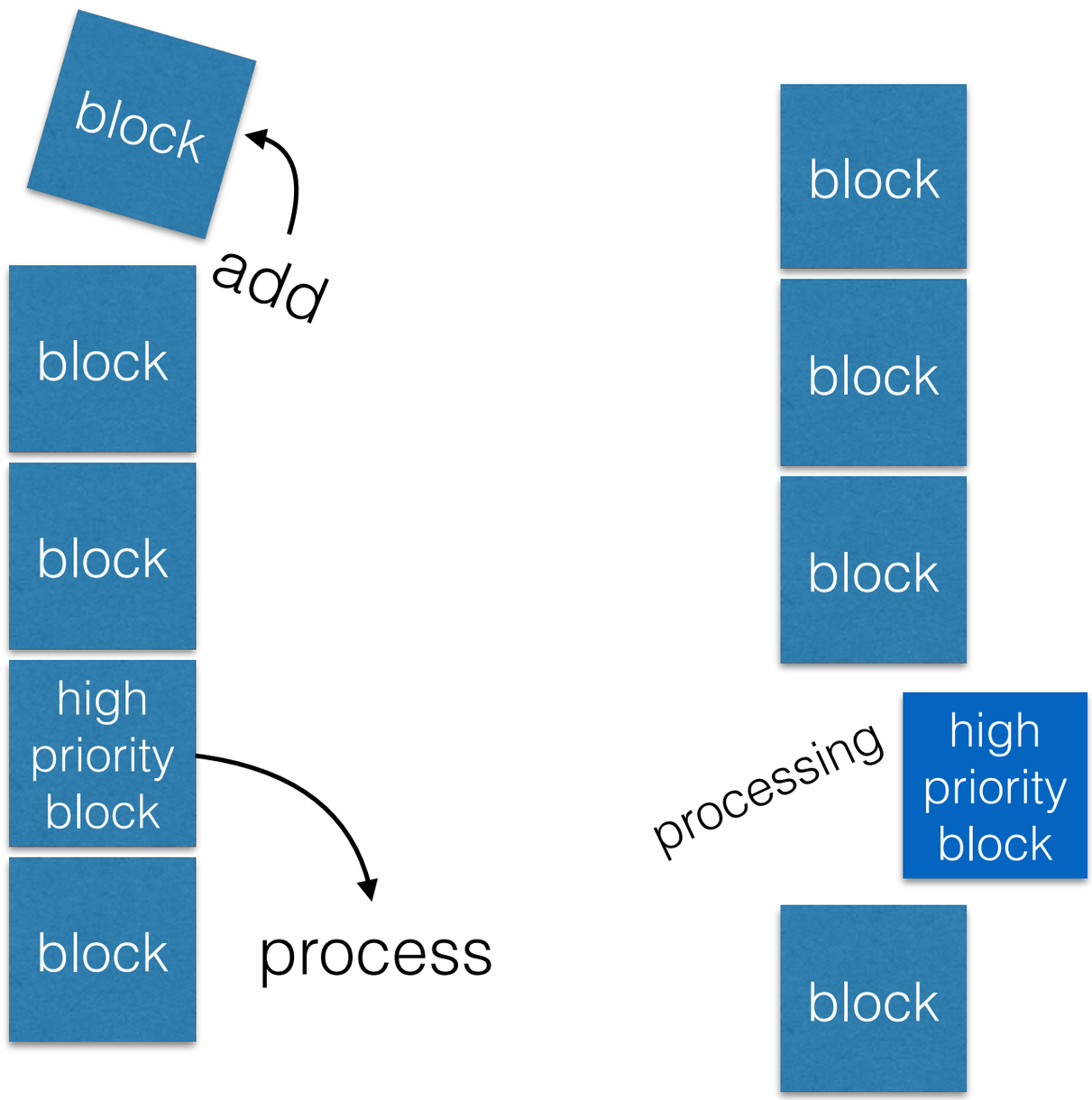

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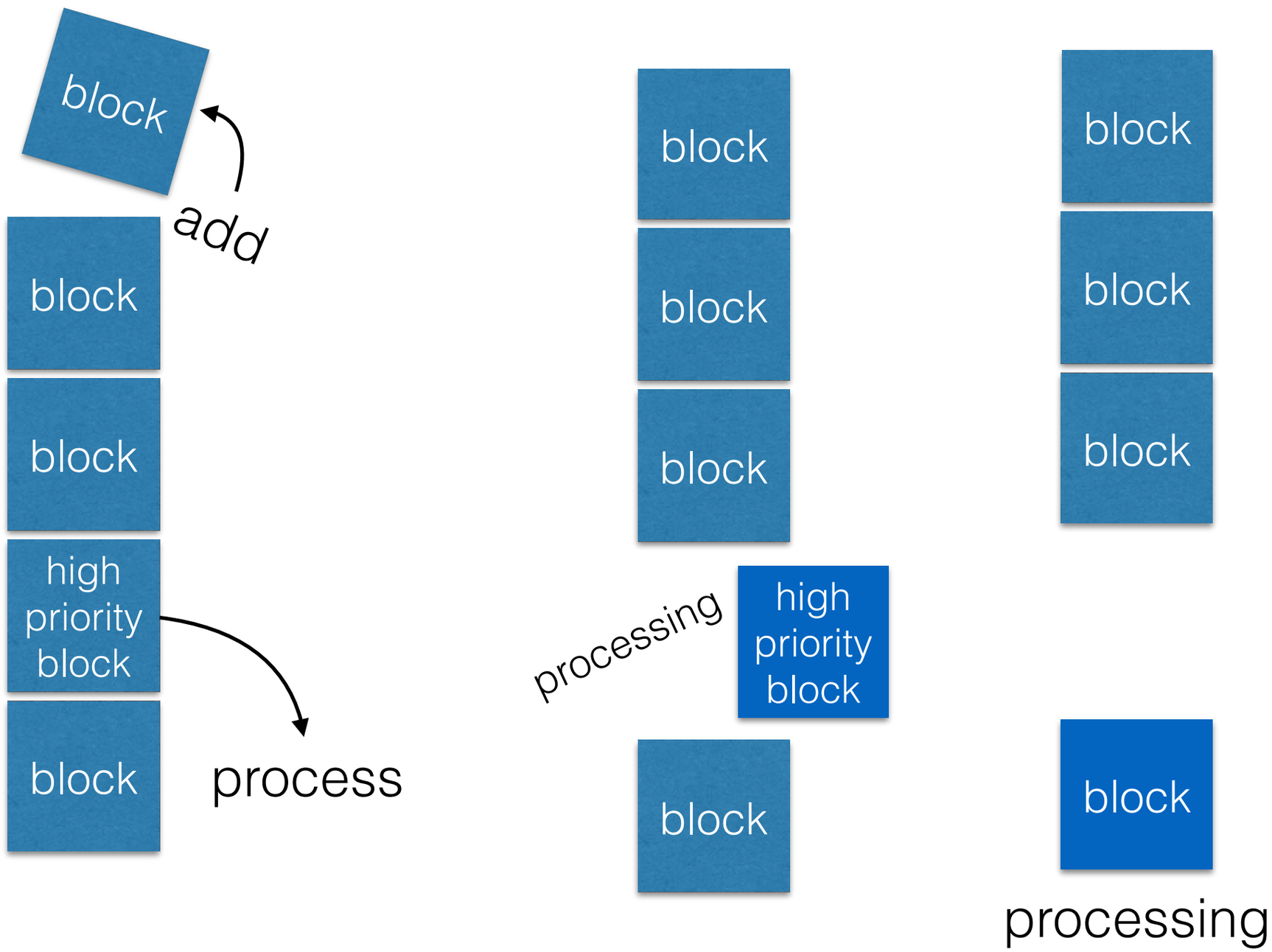

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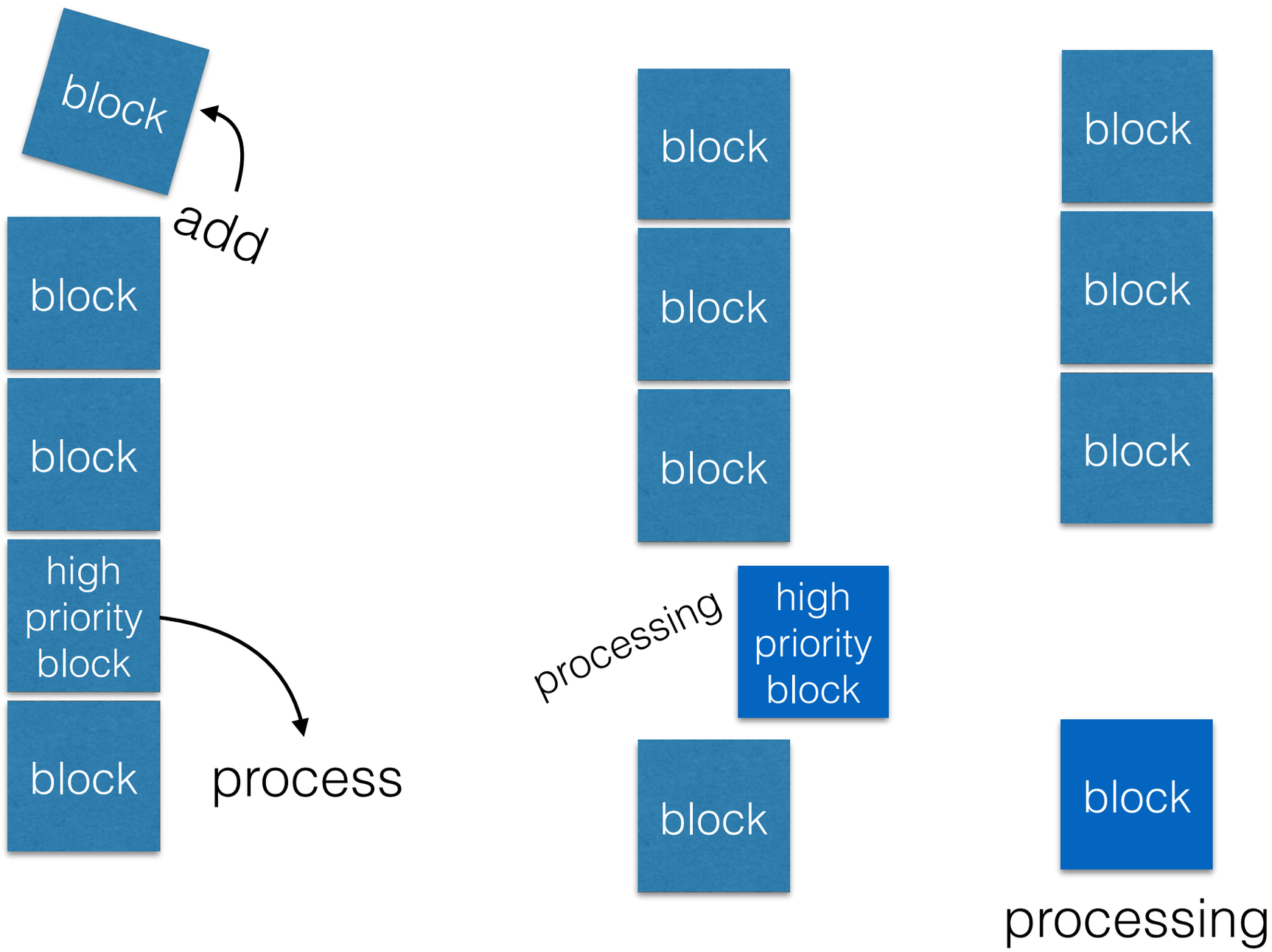

one thread
UI is in sync

queue syntax

```
// using c code:
 dispatch_queue_t someQueue = dispatch_queue_create("myCreatedQueue", DISPATCH_QUEUE_CONCURRENT );
 dispatch_async(someQueue, ^{
     // your code to execute
     for(int i=0;i<3;i++)
         NSLog(@"I am being executed from a dispatched queue");

     // now I need to set something in the UI, but I am not in the main thread!
     // call from main thread
     dispatch_async(dispatch_get_main_queue(), ^{
         self.label.text = [NSString stringWithFormat:@"Finished running %d times, Safe",3];
     });


 }); // this operation adds the block to the queue in a single clock cycle, then returns
```

queue syntax

create new queue

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define block

update UI, main thread

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// using c code:
 dispatch_queue_t someQueue = dispatch_queue_create("myCreatedQueue", DISPATCH_QUEUE_CONCURRENT );
 dispatch_async(someQueue, ^{
     // your code to execute
     for(int i=0;i<3;i++)
         NSLog(@"I am being executed from a dispatched queue");

     // now I need to set something in the UI, but I am not in the main thread!
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     dispatch_async(dispatch_get_main_queue(), ^{
         self.label.text = [NSString stringWithFormat:@"Finished running %d times, Safe",3];
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 }); // this operation adds the block to the queue in a single clock cycle, then returns
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define block

update UI, main thread

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NSOperationQueue *newQueue = [[NSOperationQueue alloc] init];
    newQueue.name = @"ObjCQueue";
    [newQueue addOperationWithBlock:^{
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        for(int i=0;i<3;i++)
            NSLog(@"I am being executed from a dispatched queue, from objective-c");

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        [self performSelectorOnMainThread:@selector(setMyLabel)
                                withObject:nil
                             waitUntilDone:NO];


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queue syntax

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serial or concurrent

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create new queue

define block

update UI, main thread

queue syntax

- using global queues

queue syntax

- using global queues

```
// An example of using already available queues from GCD
dispatch_async(dispatch_get_global_queue(DISPATCH_QUEUE_PRIORITY_DEFAULT, 0), ^{
    // your code to execute
    for(int i=0;i<3;i++)
        NSLog(@"I am being executed from a global concurrent queue");

    // now I need to set something in the UI, but I am not in the main thread!

    // call from main thread
    dispatch_async(dispatch_get_main_queue(), ^{
        self.label.text = @"Finished running from GCD global";
    });
```

queue syntax

- using global queues

access a global queue

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```
DISPATCH_QUEUE_PRIORITY_LOW
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so let's add a c++ class to our multi-tasking code

Core Audio

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- Audio Sessions (completely overhauled for iOS7)

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  - shared instance (for all applications)

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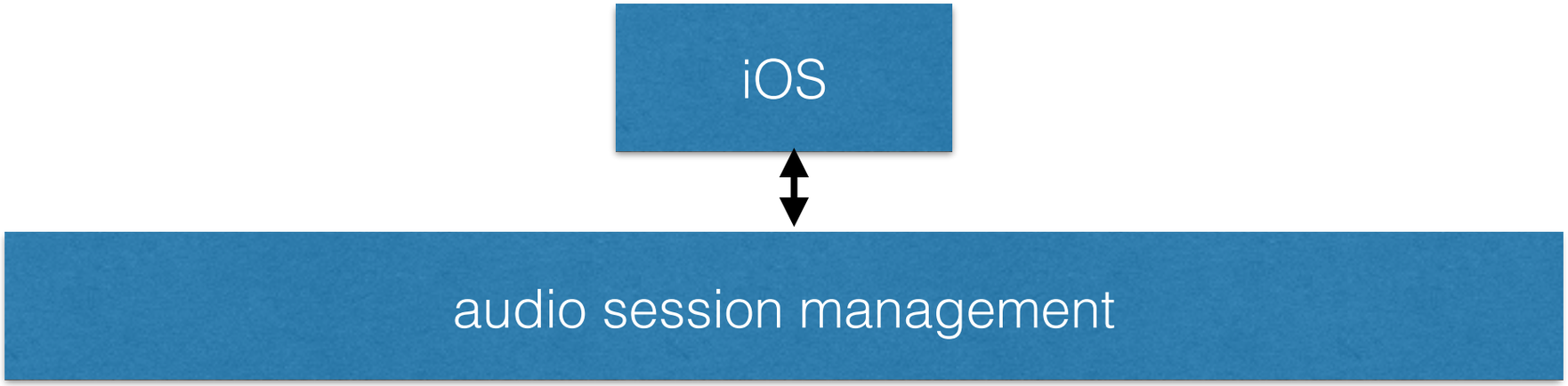
  - initialize memory for audio buffers
  - set callback rendering procedure

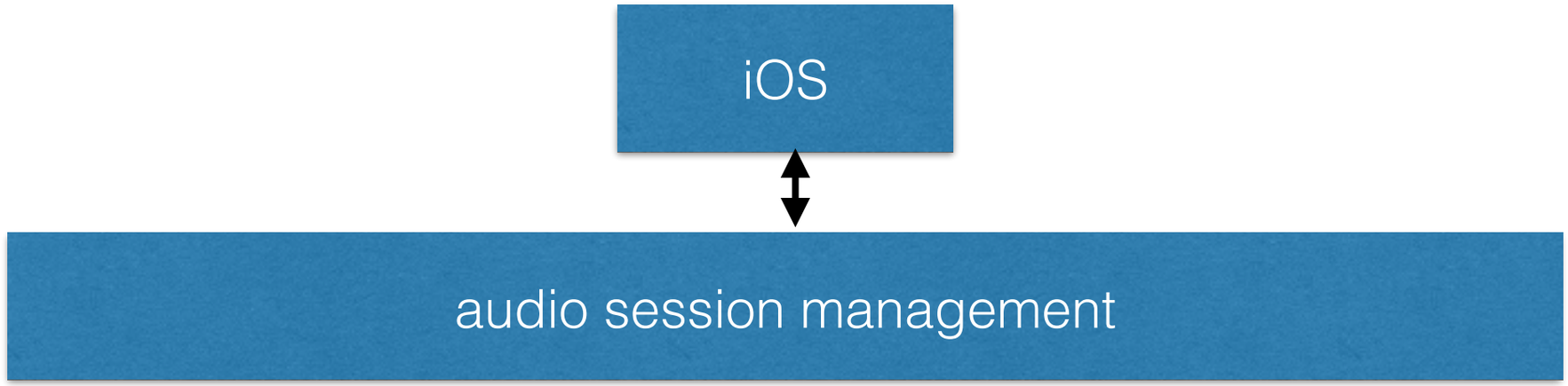
audio sessions

iOS

audio sessions

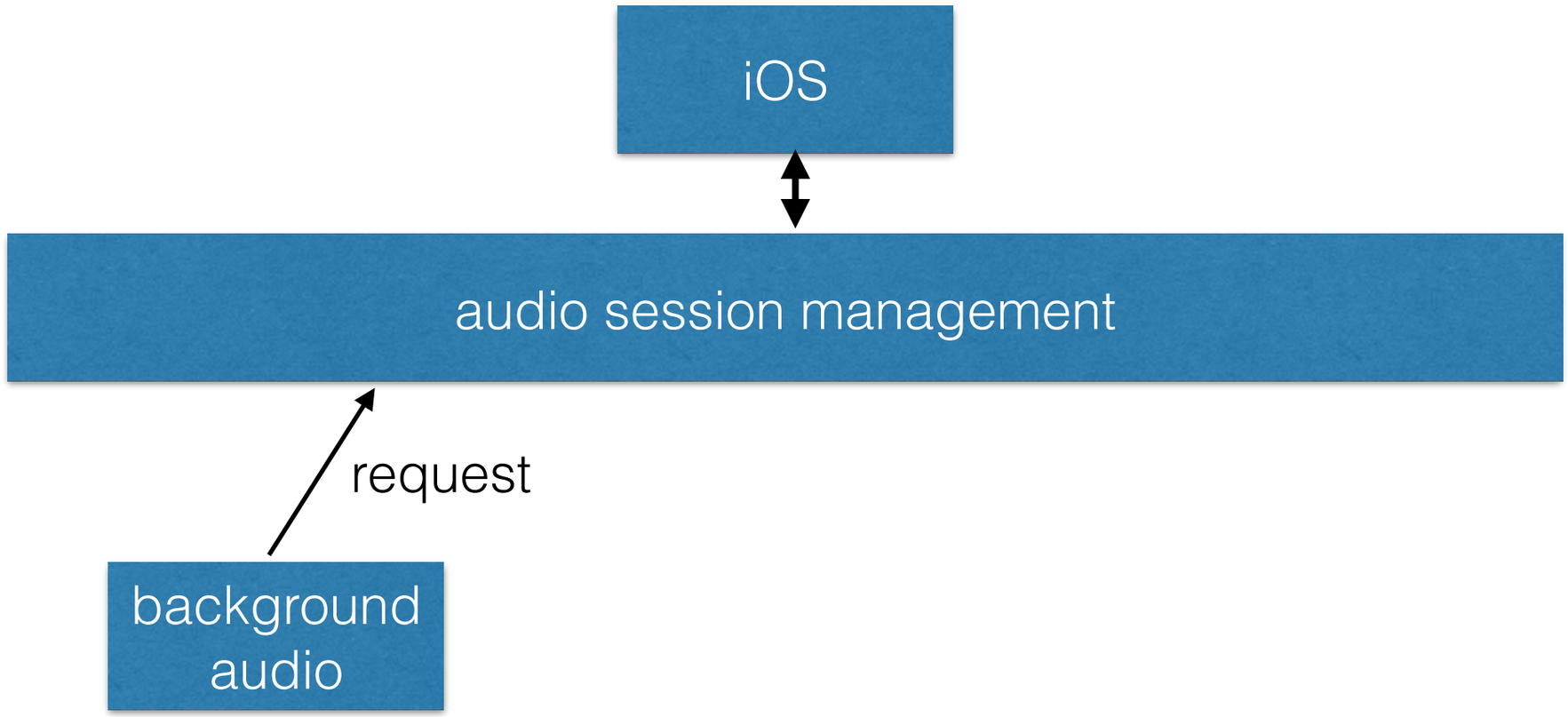


audio sessions

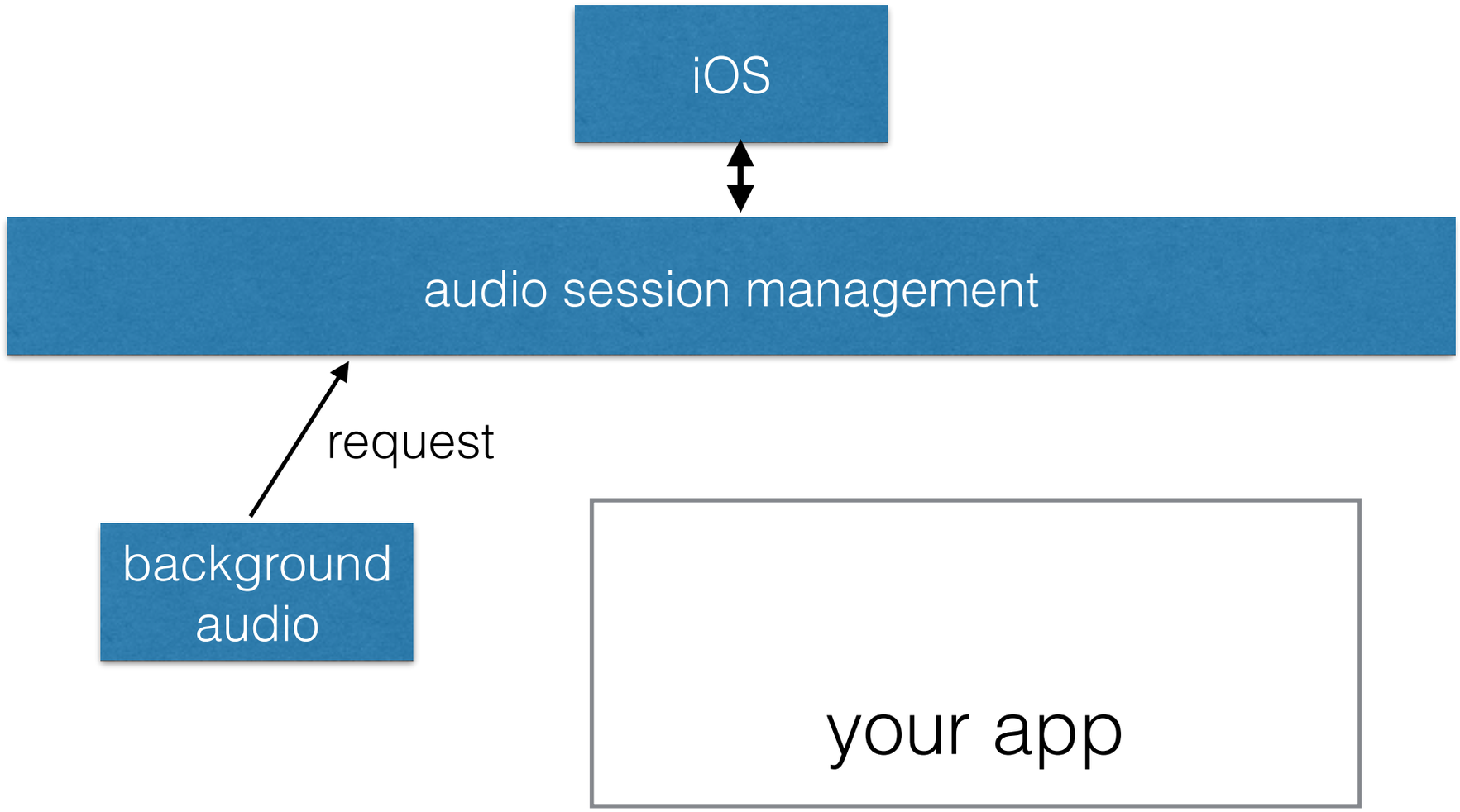


background audio

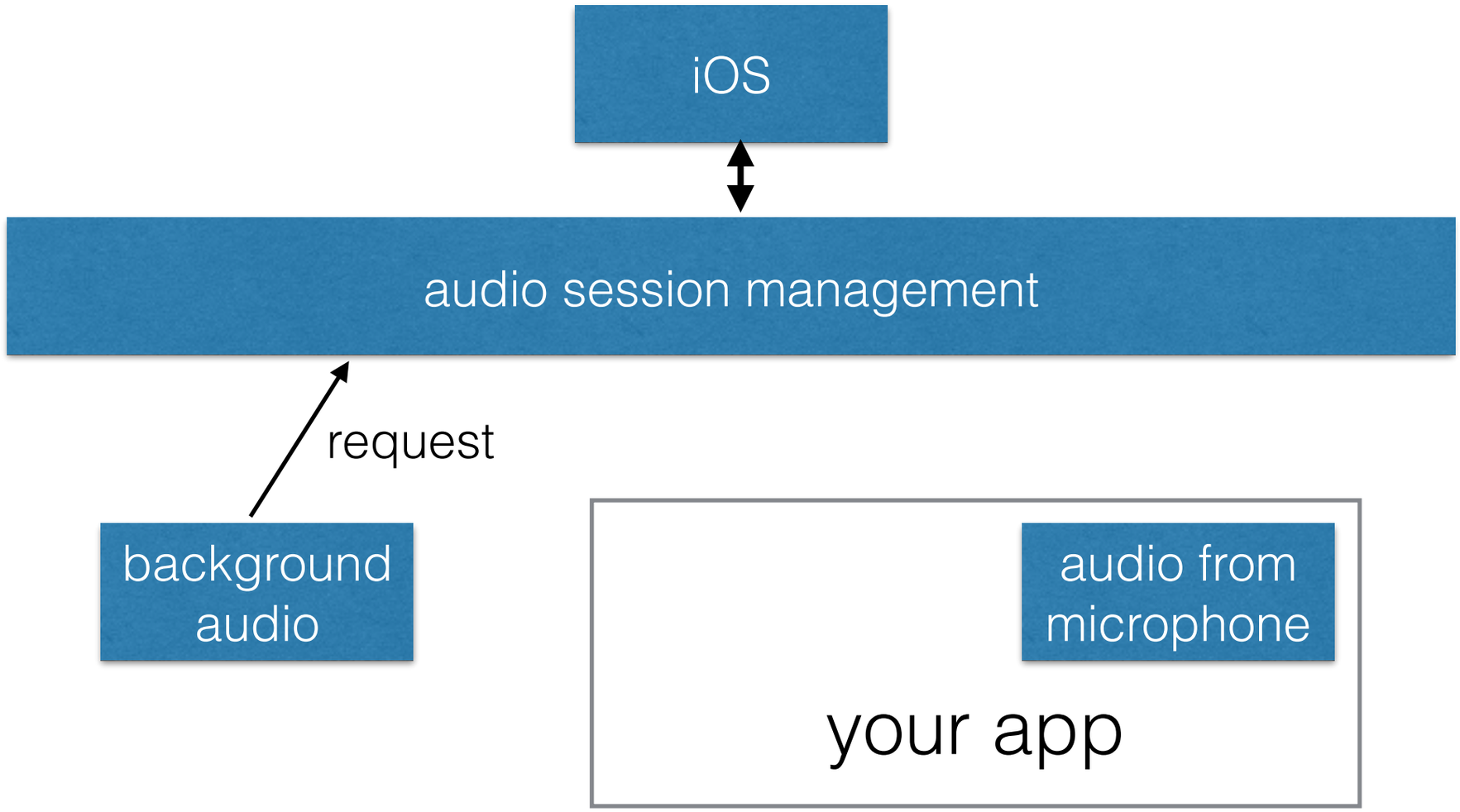
audio sessions



audio sessions



audio sessions



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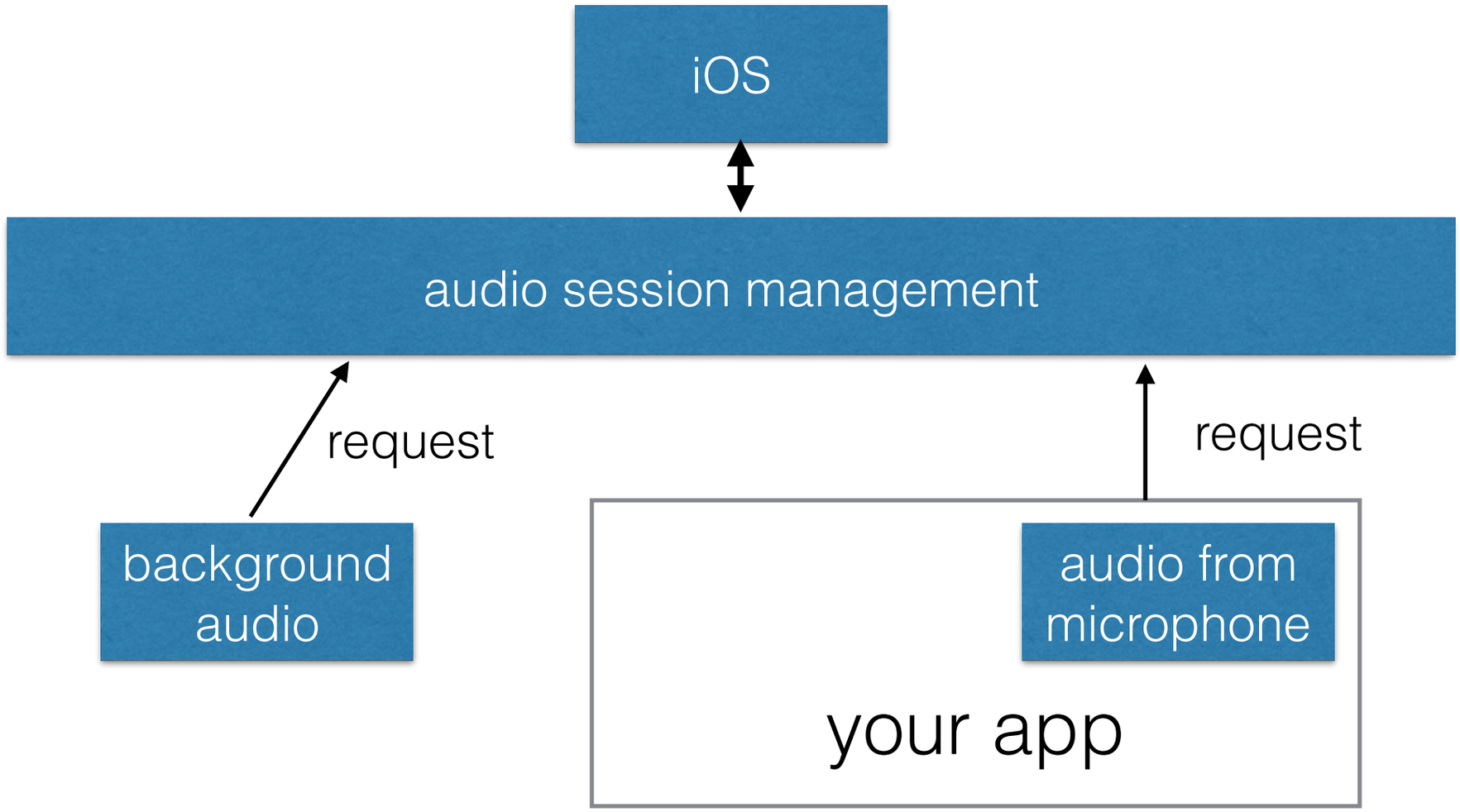

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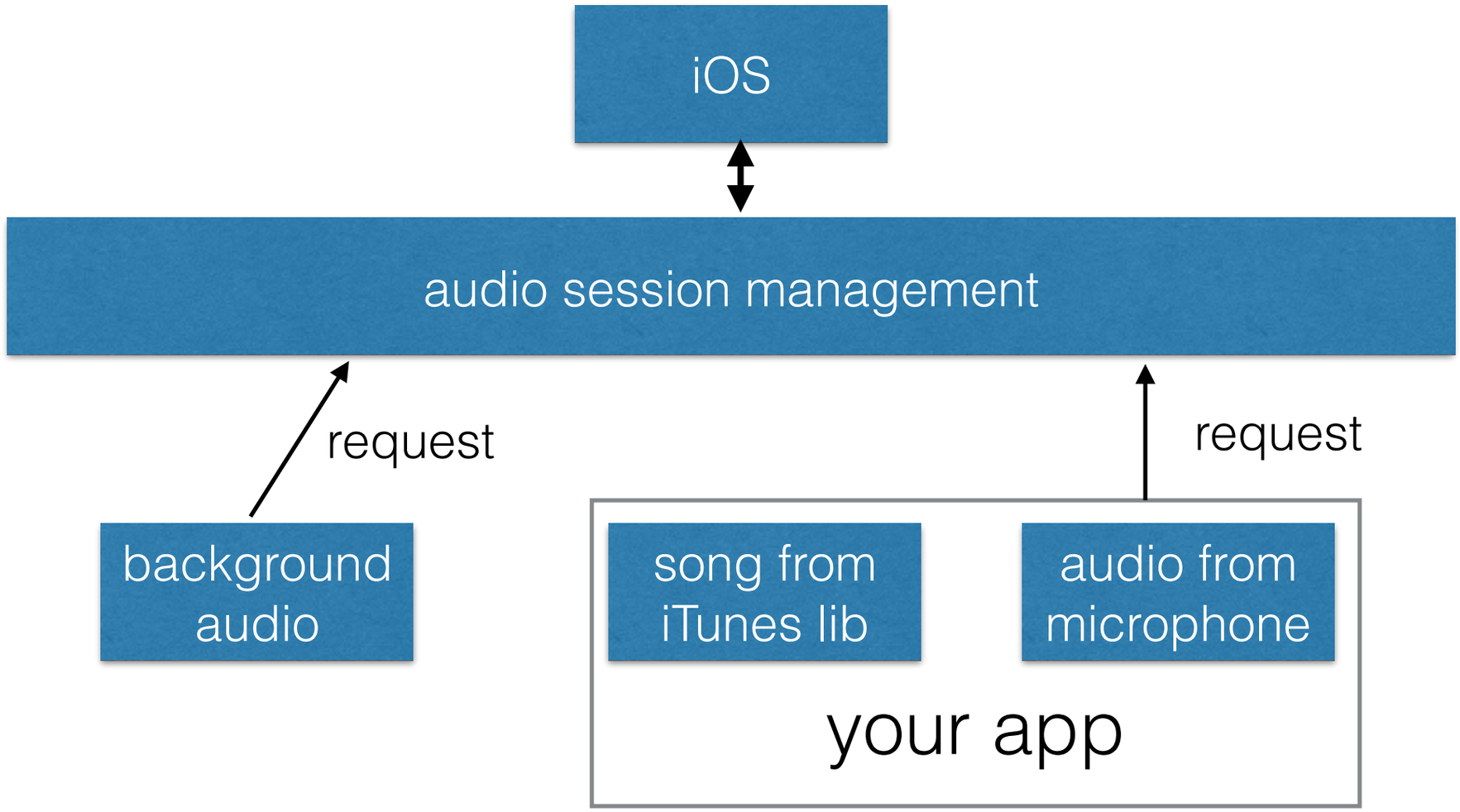

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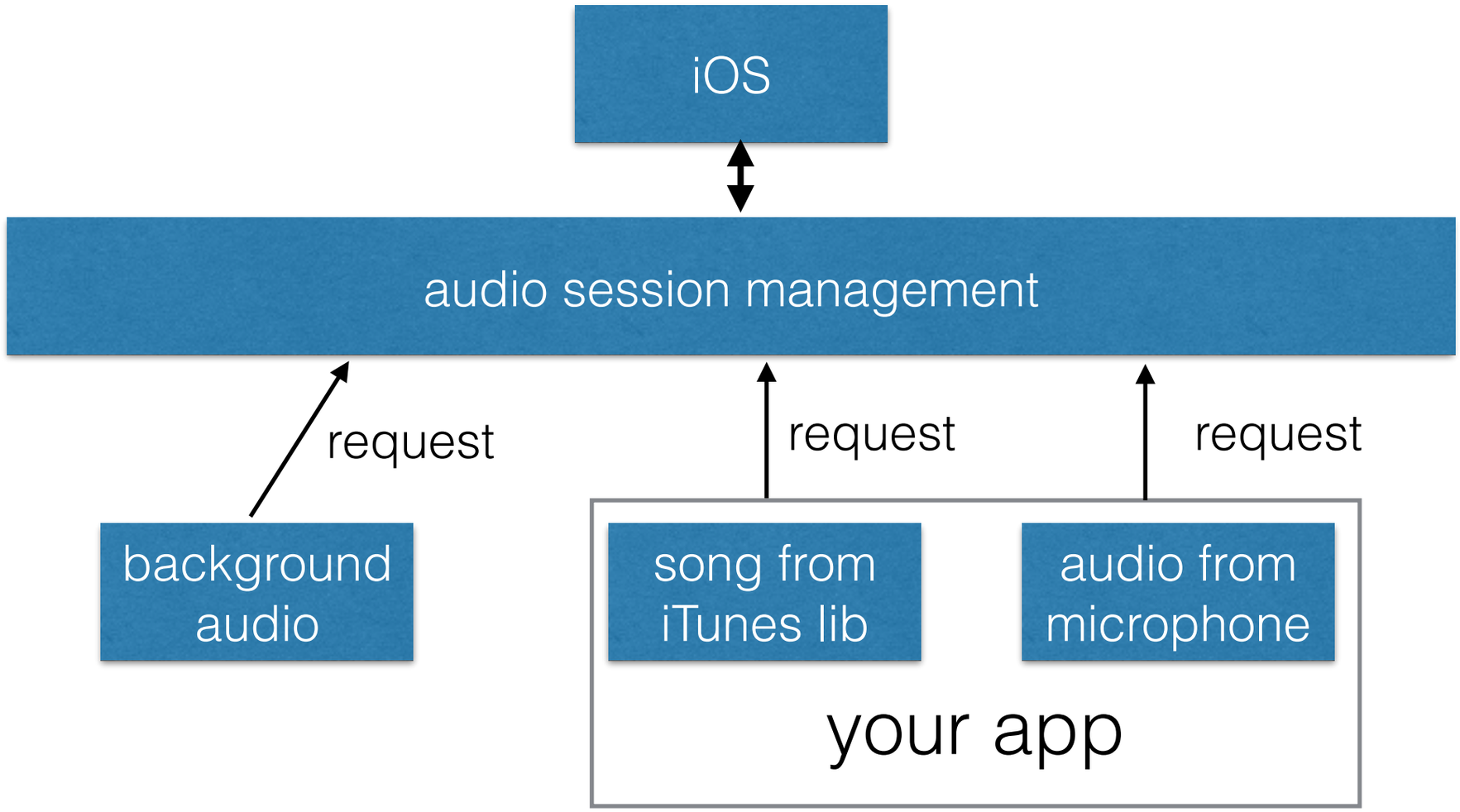

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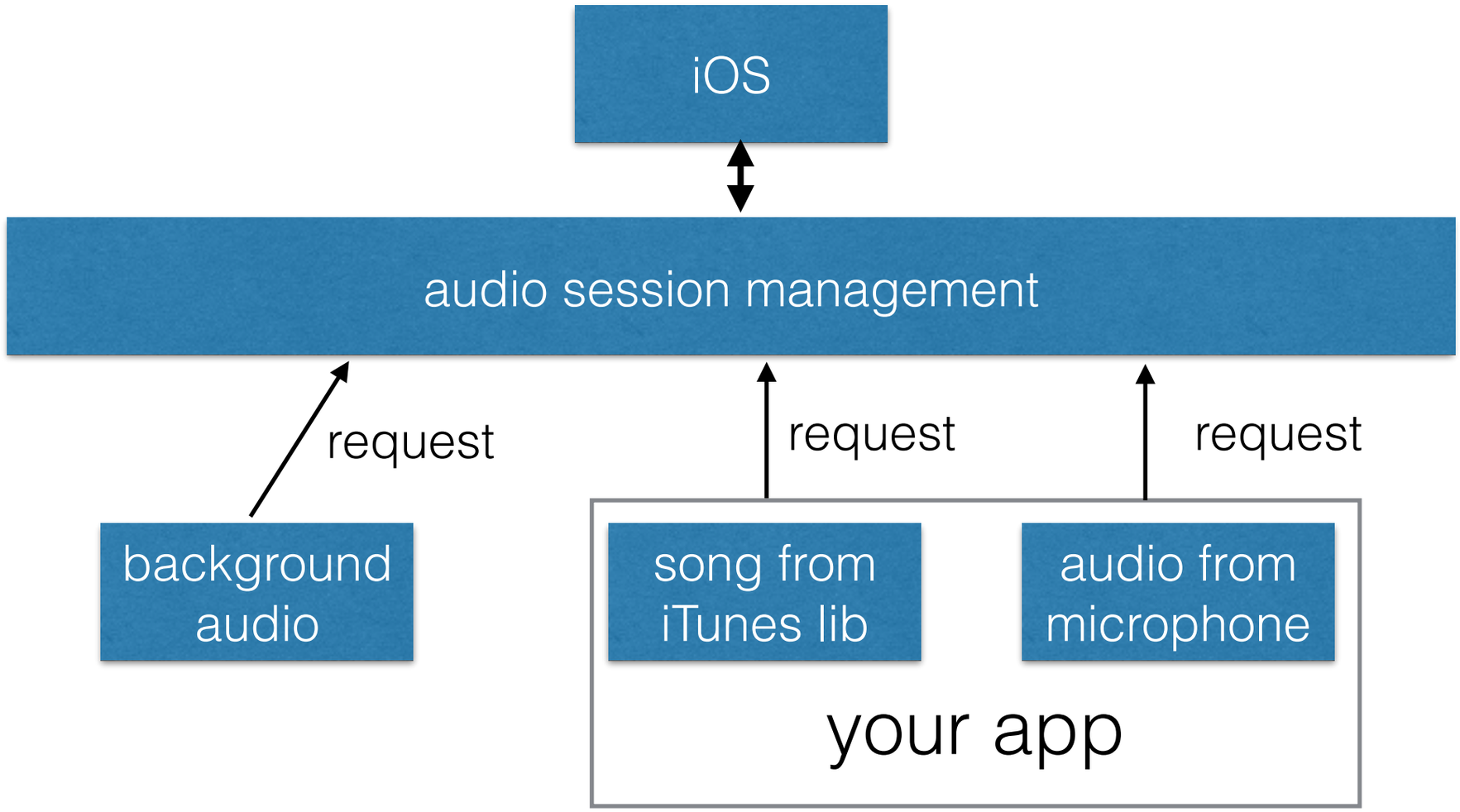

any request can alter management of other audio requests

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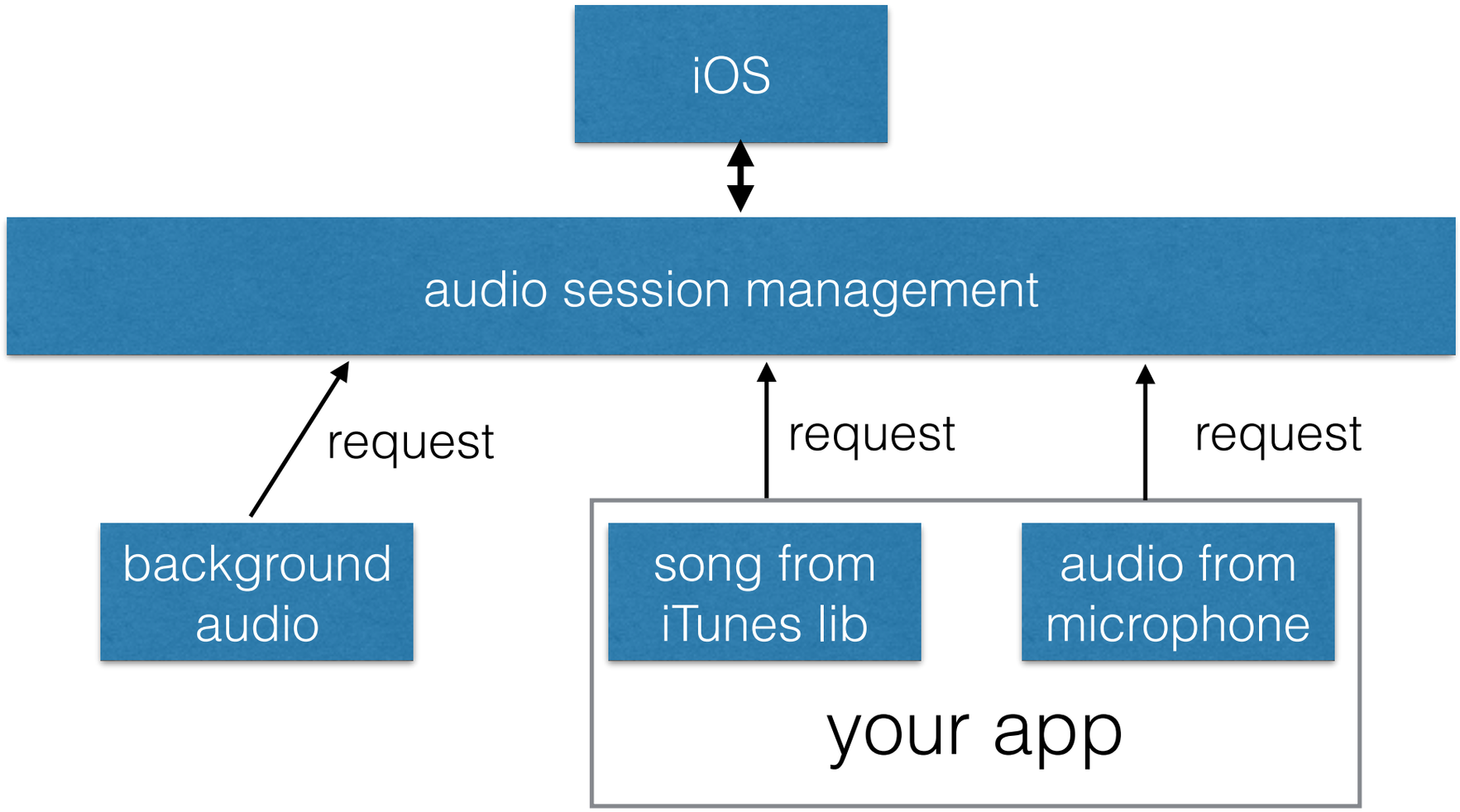

any request can alter management of other audio requests

mixing can be automatic — this is impressive

audio units

audio input buffer

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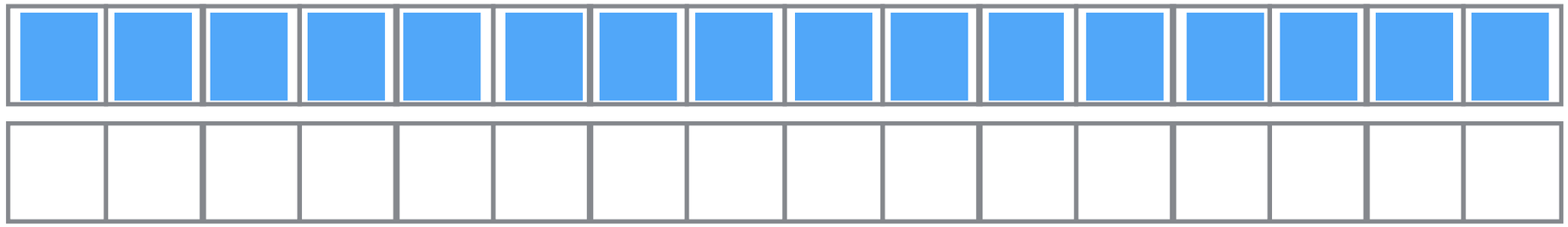

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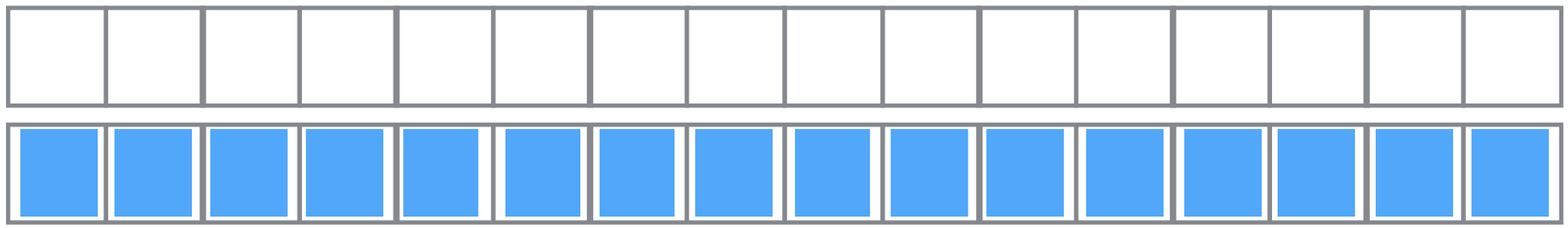

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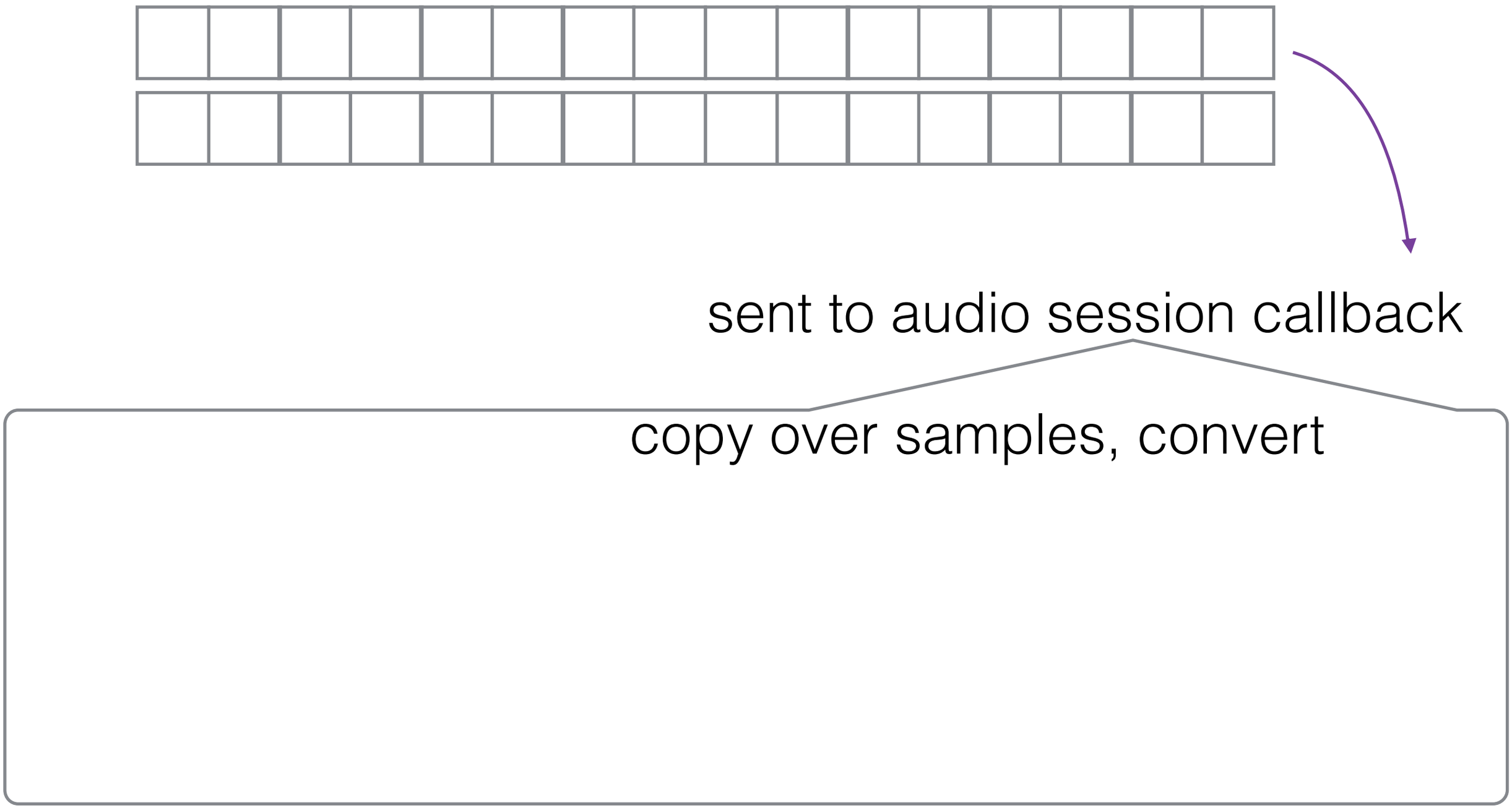

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exit from call as soon as possible!

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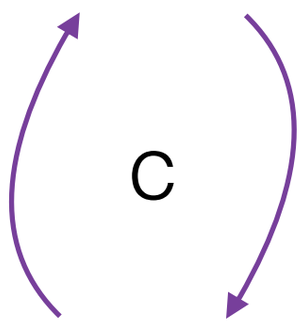

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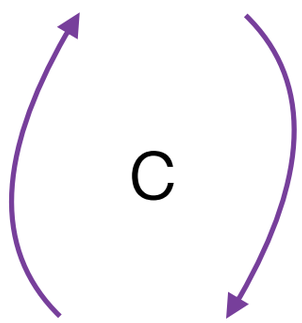

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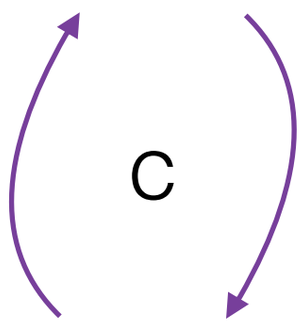

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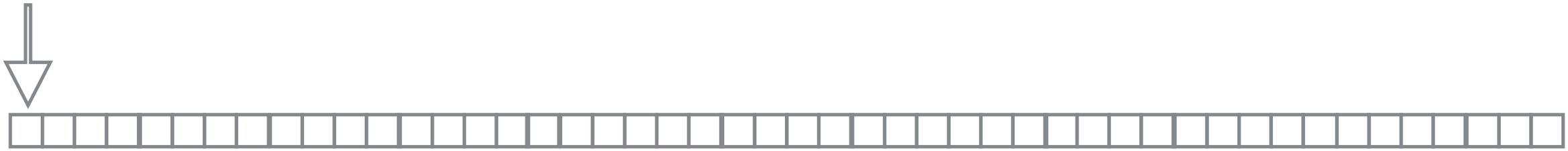

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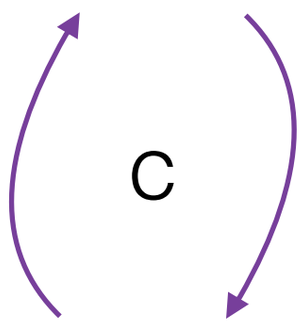

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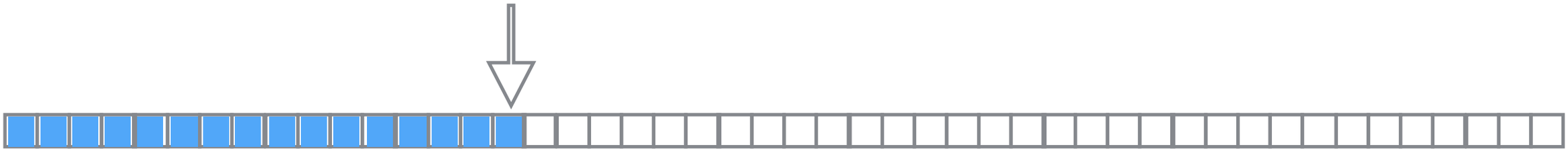

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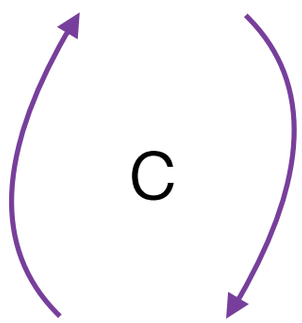

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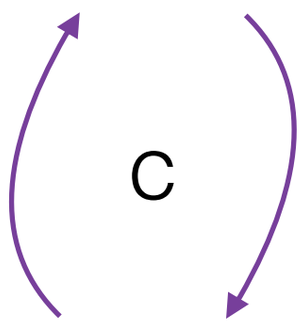

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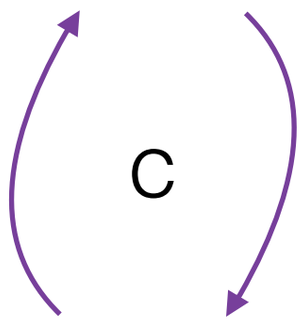

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audio unit formats

microphone

audio unit formats

microphone

stereo is interleaved

audio unit formats

microphone

stereo is interleaved

audio unit formats

microphone

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32 bits

audio made easy

- Novocaine (I mean real easy!!)

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RingBuffer       *ringBuffer;

- (void)viewDidLoad

   audioManager = [Novocaine audioManager];
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   -(void)viewWillAppear:(BOOL)animated{

      [audioManager setInputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels) {



      }];



      [audioManager setOutputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels)
       {



       }];
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      [audioManager setOutputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels)
       {



       }];
```

microphone samples as float array

audio made easy

- Novocaine (I mean real easy!!)

```
Novocaine        *audioManager;
RingBuffer       *ringBuffer;
```

declare class

```
- (void)viewDidLoad

   audioManager = [Novocaine audioManager];
   ringBuffer = new RingBuffer(kBufferLength,1);
```

setup audio and init buffer

```
   -(void)viewWillAppear:(BOOL)animated{

      [audioManager setInputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels) {



      }];
```

microphone samples as float array

```
      [audioManager setOutputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels)
       {



       }];
```

data to write to speakers

audio made easy

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declare class

```
- (void)viewDidLoad

   audioManager = [Novocaine audioManager];
   ringBuffer = new RingBuffer(kBufferLength,1);
```

setup audio and init buffer

```
   -(void)viewWillAppear:(BOOL)animated{

      [audioManager setInputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels) {

          ringBuffer->AddNewInterleavedFloatData(data, numFrames, numChannels);

      }];
```

microphone samples as float array

```
      [audioManager setOutputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels)
       {




       }];
```

data to write to speakers

audio made easy

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```
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          ringBuffer->AddNewInterleavedFloatData(data, numFrames, numChannels);

      }];
```

microphone samples as float array

data to write to speakers

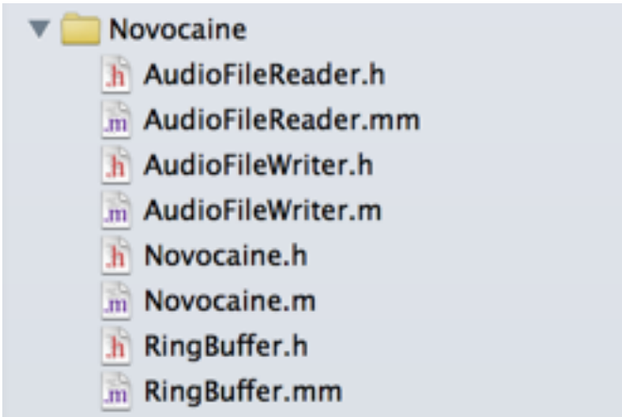
```
      [audioManager setOutputBlock:^(float *data, UInt32 numFrames, UInt32 numChannels)
       {

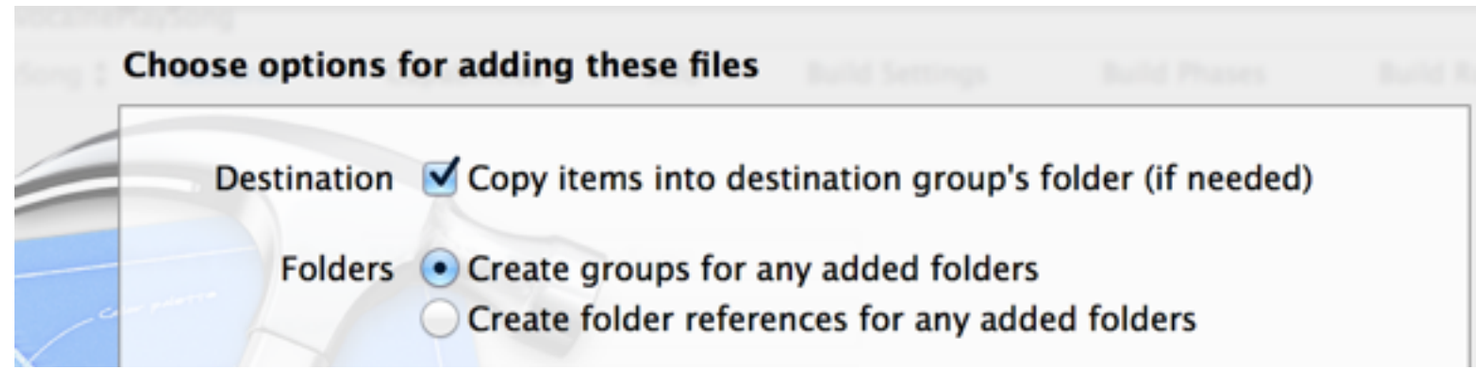
          ringBuffer->FetchInterleavedData(data, numFrames, numChannels);

       }];
```

novocaine uses c++

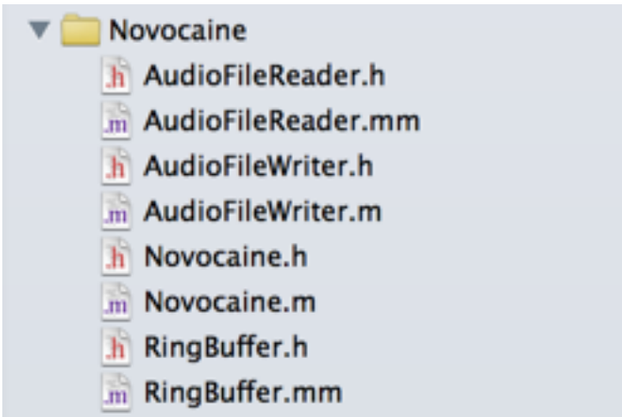
drag into project

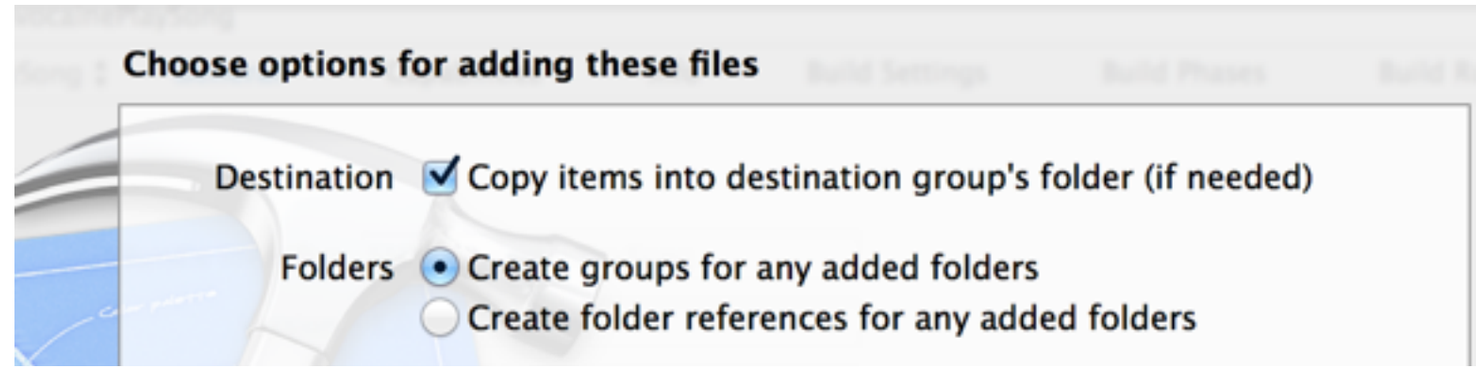


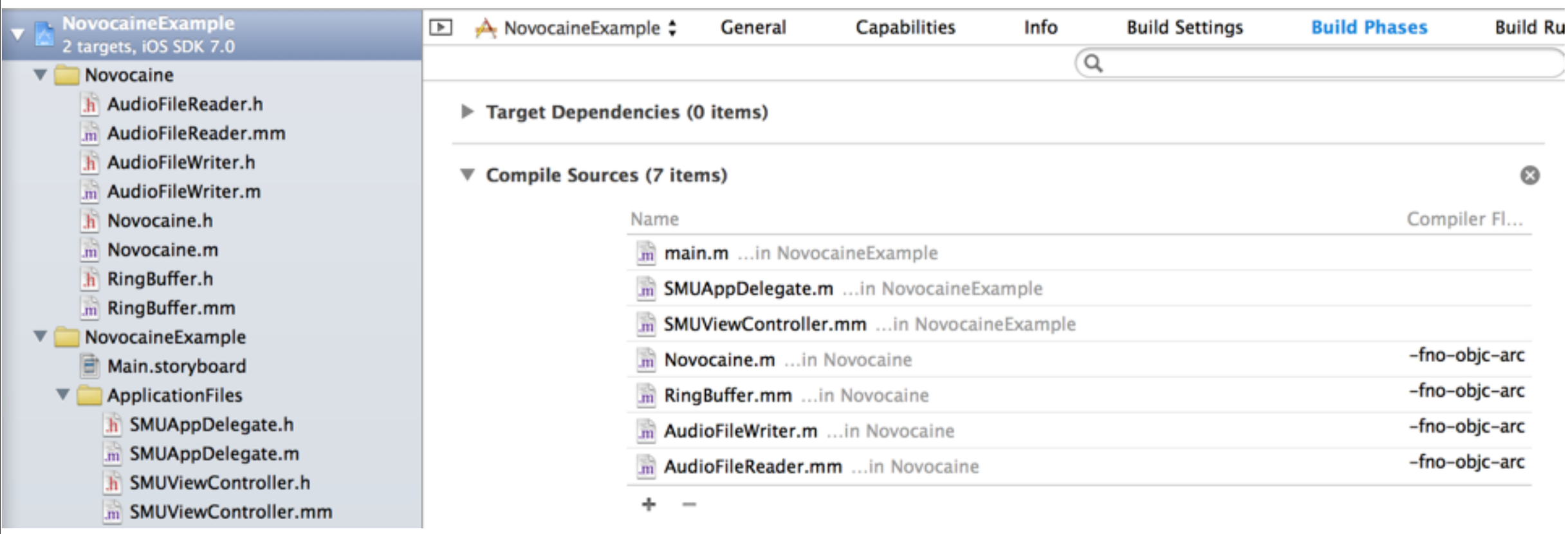


novocaine uses c++

drag into project

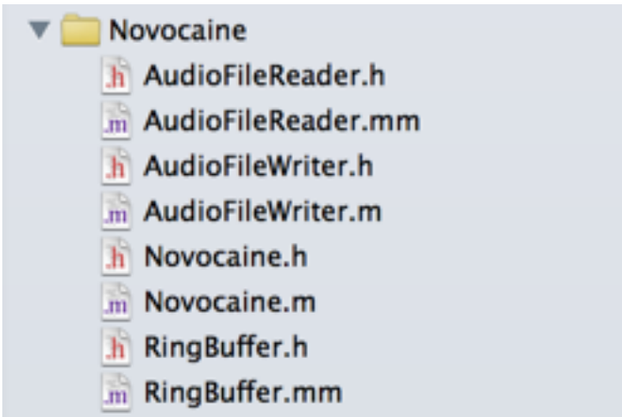


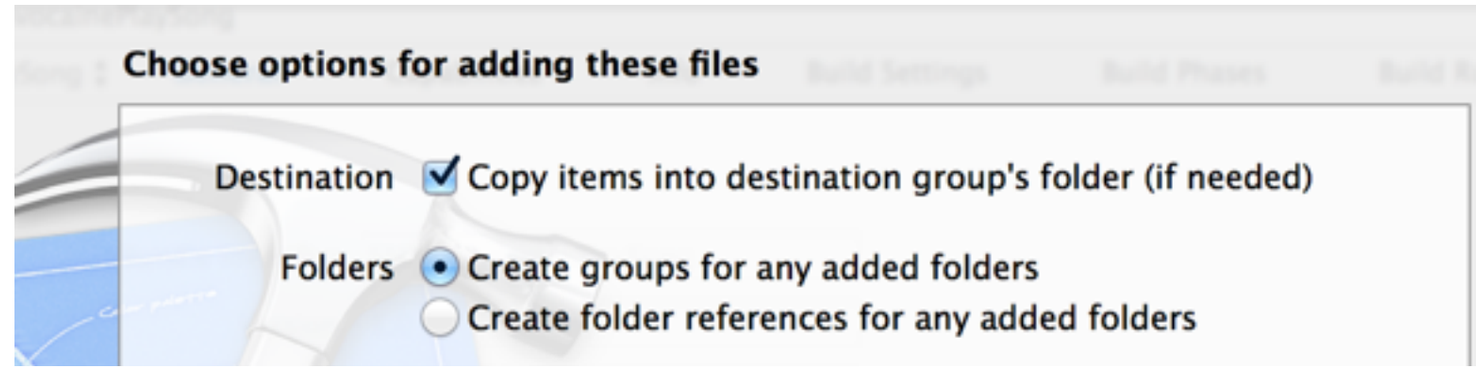




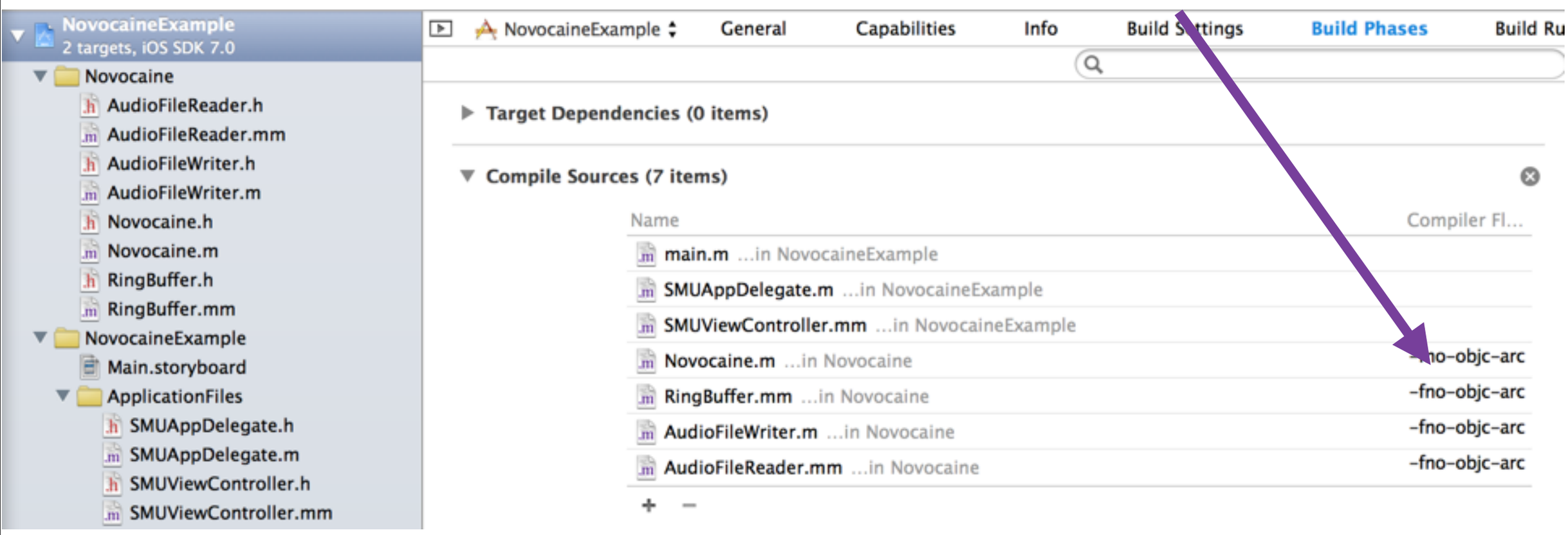
novocaine uses c++

drag into project



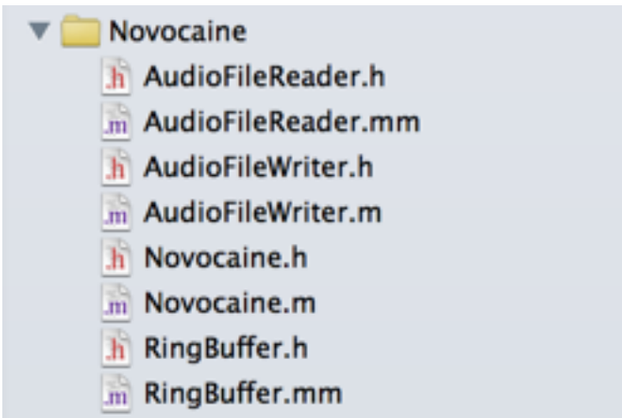


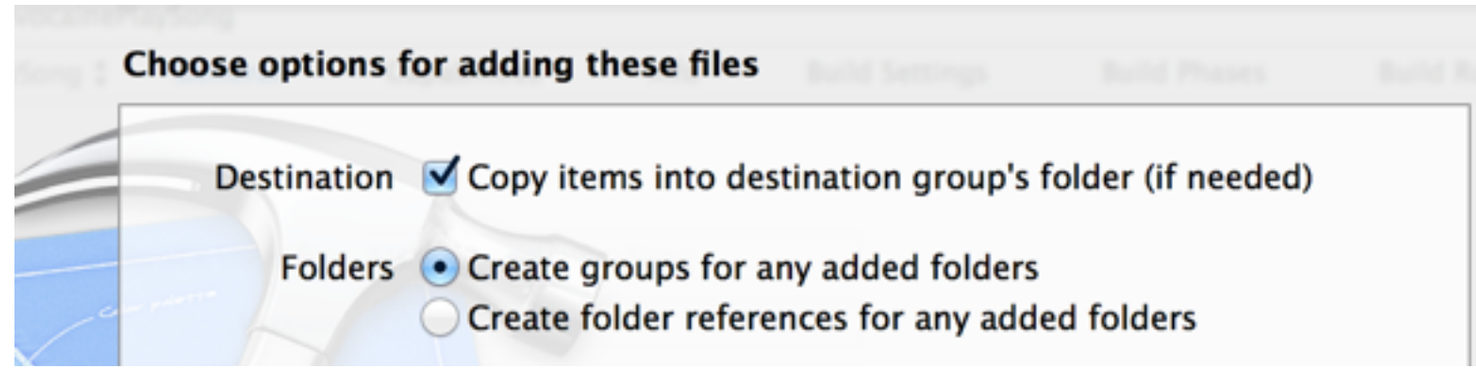
disable arc for these files



novocaine uses c++

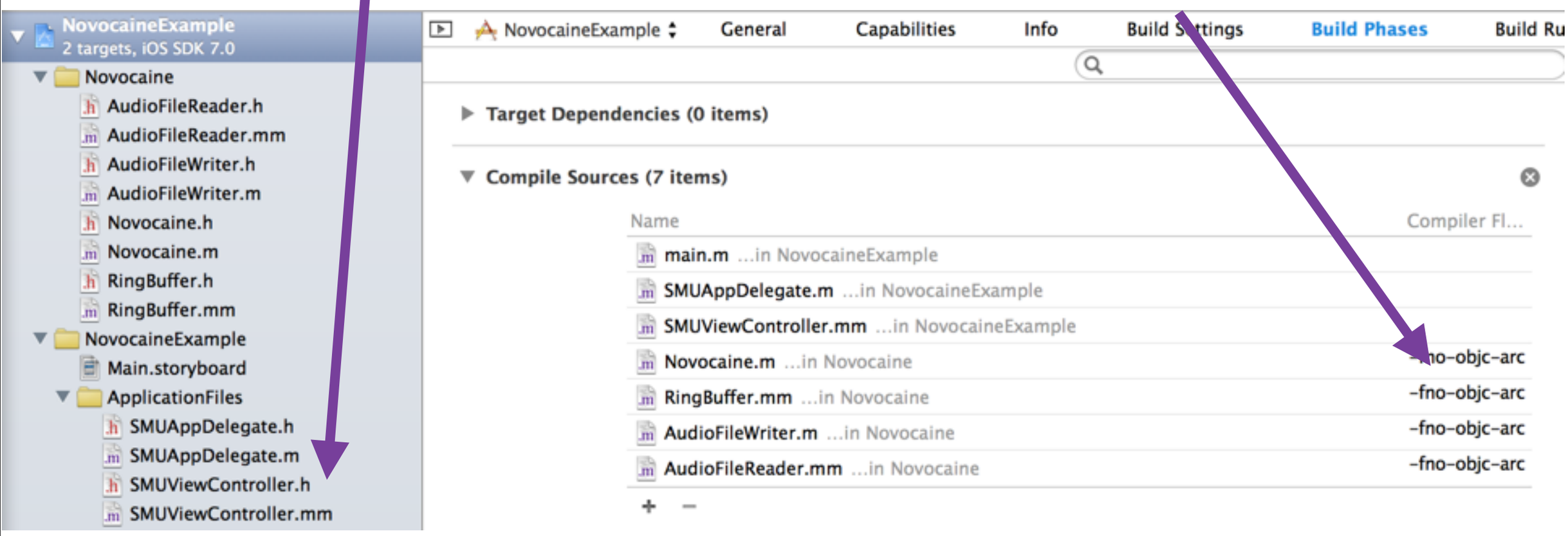
drag into project





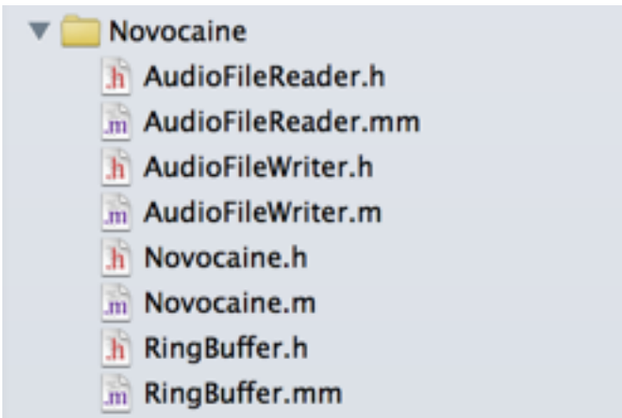
rename method to use c++

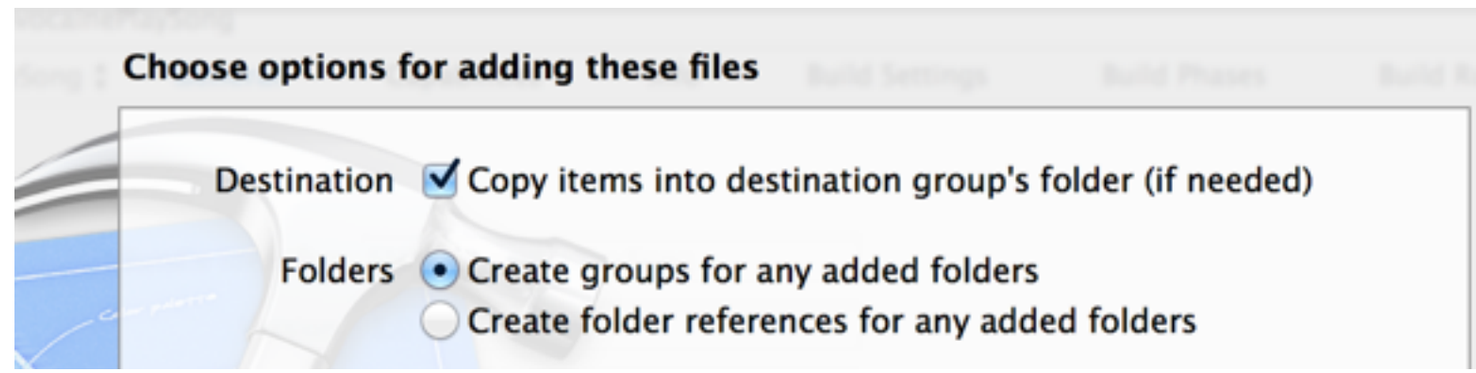
disable arc for these files



novocaine uses c++

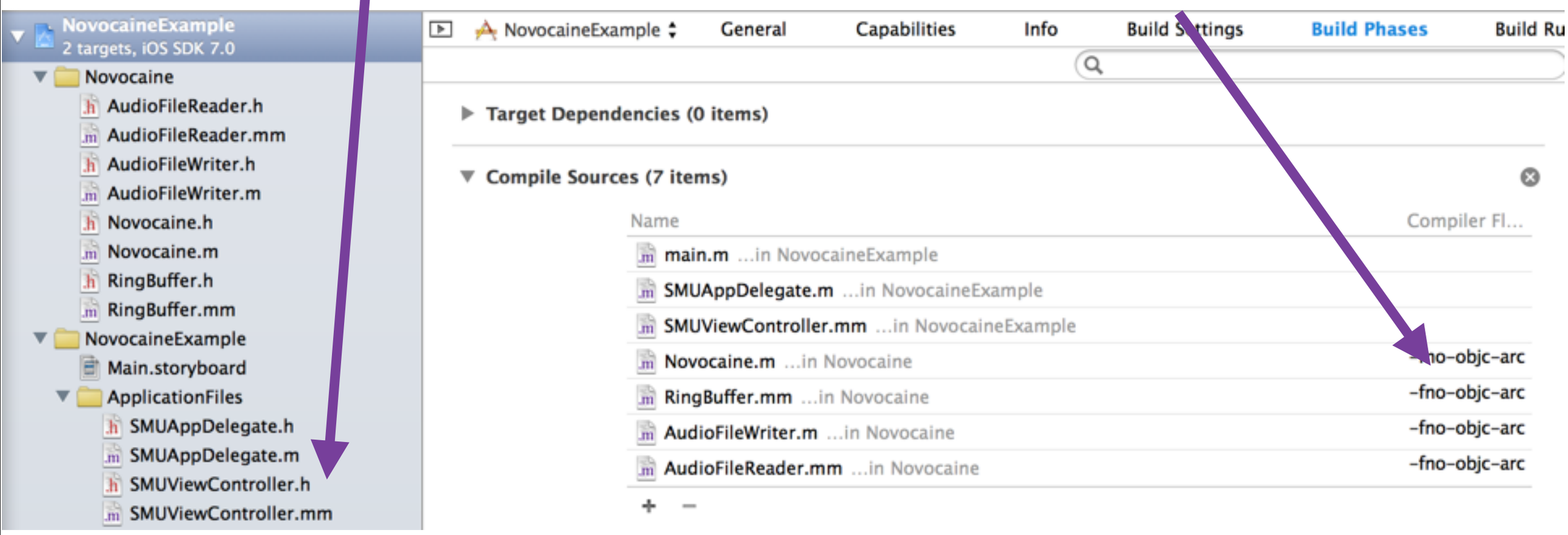
drag into project





rename method to use c++

disable arc for these files



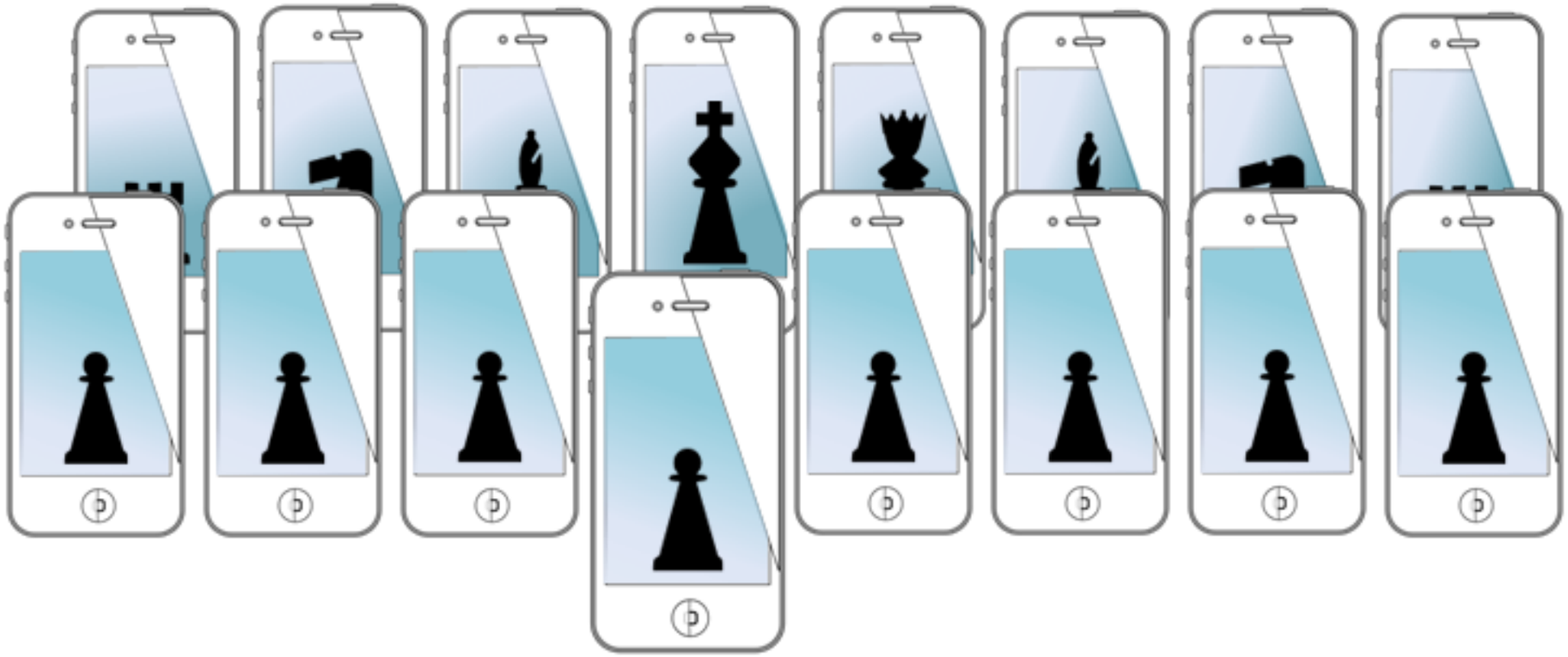
get source from blackboard!!

novocaine setup demo

for next time...

- more core audio
  - playing songs
  - getting samples from microphone
    - showing samples with OpenGL
  - working with sampled data
  - the accelerate framework

MOBILE SENSING LEARNING & CONTROL



CSE5323 & 7323

Mobile Sensing, Learning, and Control

lecture five: queues, blocks, c++, audio session

Eric C. Larson, Lyle School of Engineering,
Computer Science and Engineering, Southern Methodist University