

Get Your Code Under Control

Code Coverage & Xcode Server

Renaissance 2014

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About Me

- Co-founder & Engineering Lead at AppOrchard
- Worked at Apple (at the turn of the century)
- Latest Author of More iOS 6 Development



Overview

- Why Code Coverage?
- Why Continuous Integration?
- Xcode 5 and Code Coverage
- Xcode Server and Code Coverage
- More Xcode Server

Why Code Coverage?

- Measure code execution via tests
- Guide test improvement
- 100% Coverage \neq 100% tested

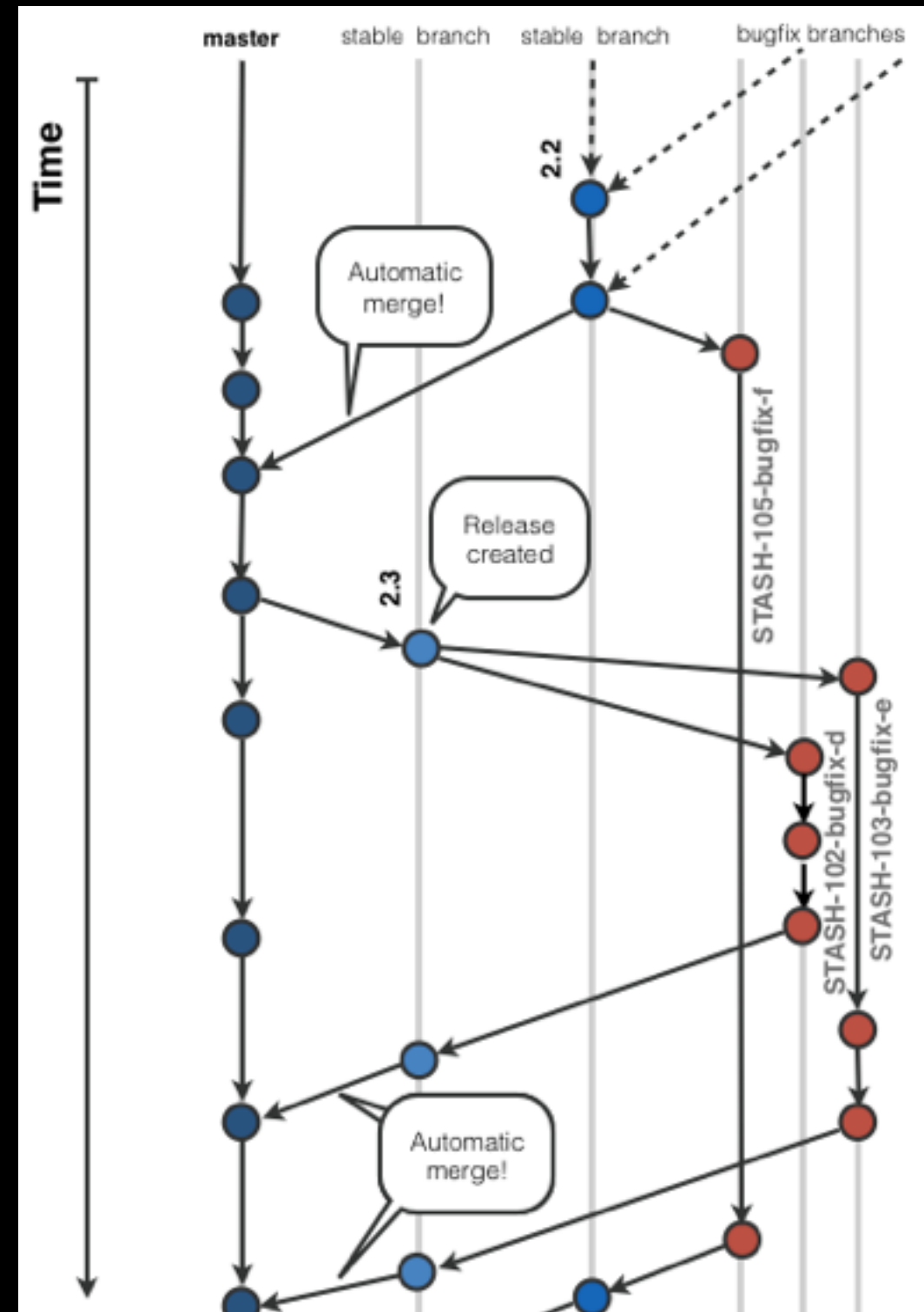
*“Testing never proves the absence of faults,
it only show their presence.”*

- Edsger Dijkstra



Why Continuous Integration?

- Merge code early and often
- Avoid “Integration” Hell
- Automatic test execution
- Catch problems early



Xcode 5 and Code Coverage

- Coverage files:
 - **.gcno** - generated on compilation
 - **.gcda** - generated on execution
- **gcov** - GCC coverage tool
- **lcov** - gcov wrapper and report generator



Code Coverage in Xcode 5

- Set some Xcode Build Settings
- “Fix” Xcode 5
- Generate coverage reports

method		block	
65.0%	<div><div>2812/4325</div></div>	60.0%	<div><div>92077/153347</div></div>
	method		bl
<div><div></div></div>	0.0% <div><div>0/0</div></div>	0.0%	<div><div></div></div>
<div><div></div></div>	0.0% <div><div>0/0</div></div>	0.0%	<div><div></div></div>
<div><div></div></div>	40.0% <div><div>2/5</div></div>	58.1%	<div><div></div></div>
<div><div></div></div>	49.4% <div><div>41/83</div></div>	48.5%	<div><div>11</div></div>
<div><div></div></div>	58.6% <div><div>310/529</div></div>	59.9%	<div><div>105</div></div>
<div><div></div></div>	74.6% <div><div>521/698</div></div>	66.0%	<div><div>197</div></div>
<div><div></div></div>	81.4% <div><div>92/113</div></div>	70.5%	<div><div>47</div></div>
<div><div></div></div>	25.0% <div><div>3/12</div></div>	40.5%	<div><div>30</div></div>
<div><div></div></div>	61.0% <div><div>242/397</div></div>	53.6%	<div><div>30</div></div>
<div><div></div></div>	59.8% <div><div>134/224</div></div>	54.2%	<div><div>27</div></div>
<div><div></div></div>	67.8% <div><div>101/149</div></div>	66.8%	<div><div>17</div></div>
<div><div></div></div>	27.3% <div><div>3/11</div></div>	38.3%	<div><div>1</div></div>
<div><div></div></div>	65.0% <div><div>13/20</div></div>	51.8%	<div><div>1</div></div>
<div><div></div></div>	8.3% <div><div>1/12</div></div>	1.0%	<div><div></div></div>
<div><div></div></div>	25.0% <div><div>1/4</div></div>	25.0%	<div><div></div></div>
<div><div></div></div>	60.0% <div><div>3/5</div></div>	90.1%	<div><div></div></div>
<div><div></div></div>	0.0% <div><div>0/2</div></div>	0.0%	<div><div></div></div>

Xcode Build Settings

Under **Apple LLVM 5.0 Code Generation**

- **Generate Test Coverage Files** (-ftest-coverage)
This generates .gcno files

Generate Position-Dependent Code	No ▴ ▾
▼ Generate Test Coverage Files	<Multiple values> ▴ ▾
Debug	+ Yes ▴ ▾
Release	No ▴ ▾
Inline Methods Hidden	Yes ▴ ▾

- **Instrument Program Flow** (-fprofile-arcs)
This generates .gcda files

► Inline Methods Hidden	Yes ▴ ▾
▼ Instrument Program Flow	<Multiple values> ▴ ▾
Debug	+ Yes ▴ ▾
Release	No ▴ ▾
Kernel Development Mode	No ▴ ▾

“Fix” Xcode

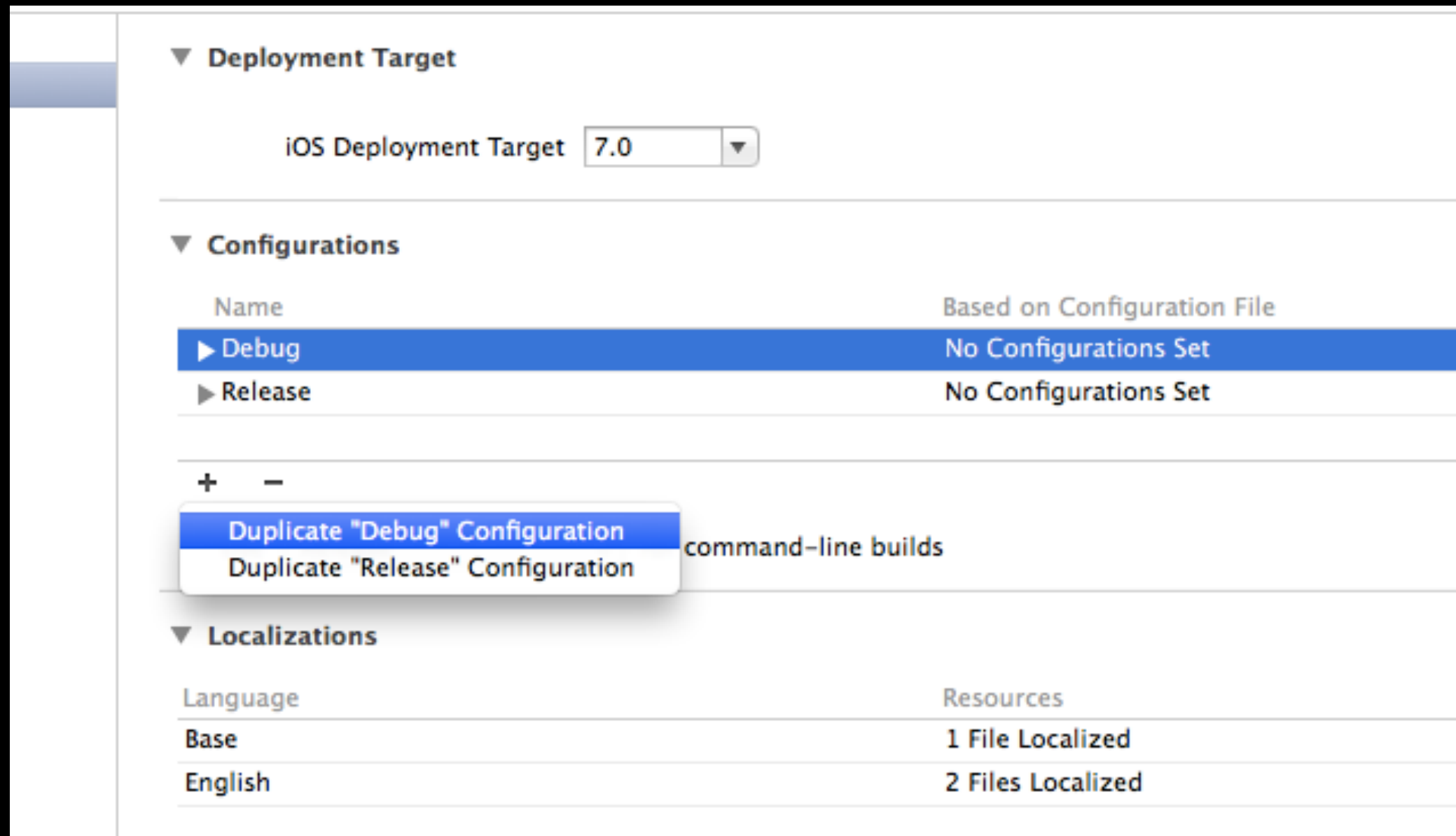
- “Set it and forget it”
“It just works”
- Broken in Xcode 5
.gcda files not generated
- **__gcov_flush()** function
needs to be called
manually



Fix Code Coverage

Step 1

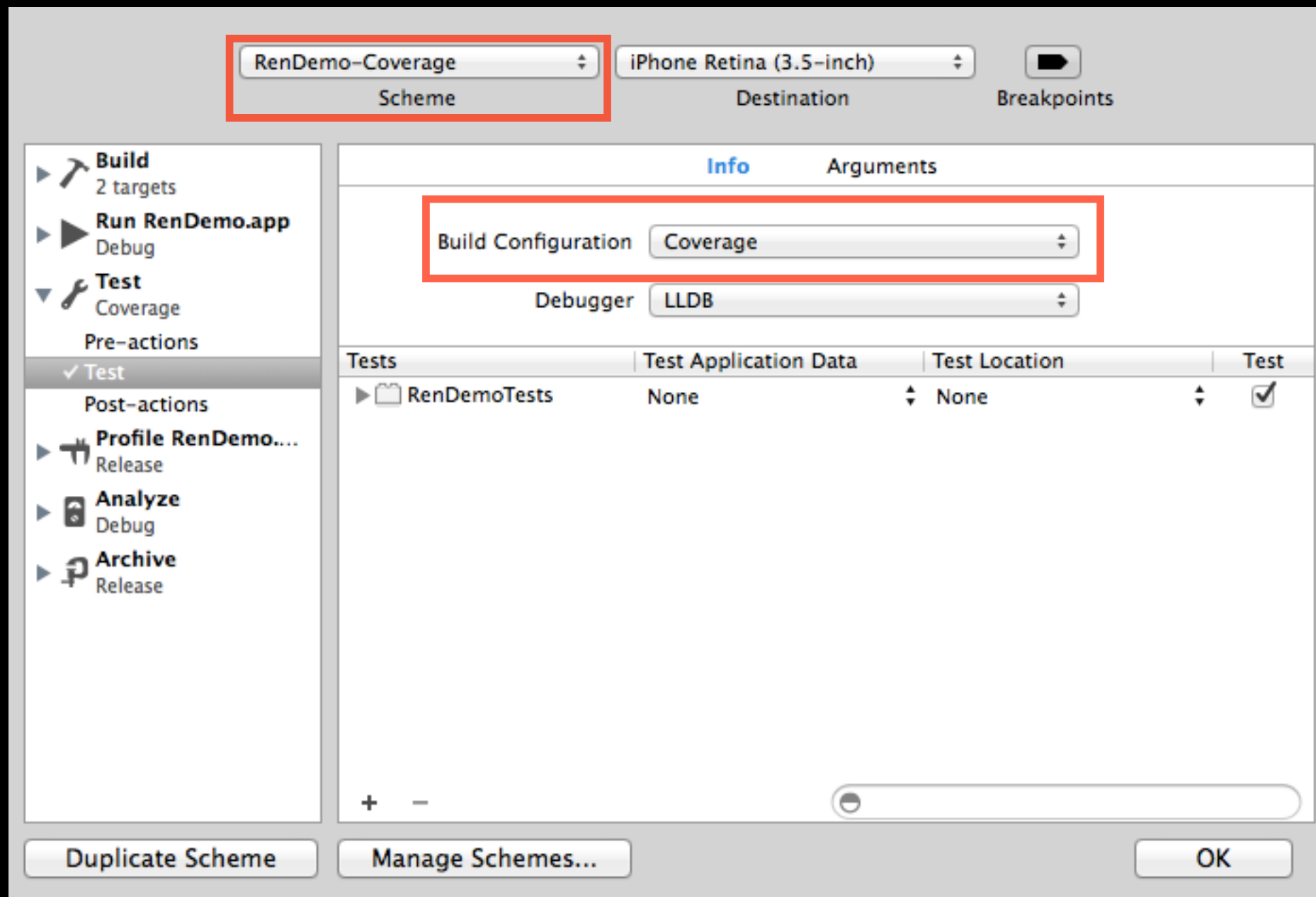
Create a new Build Configuration



Fix Code Coverage

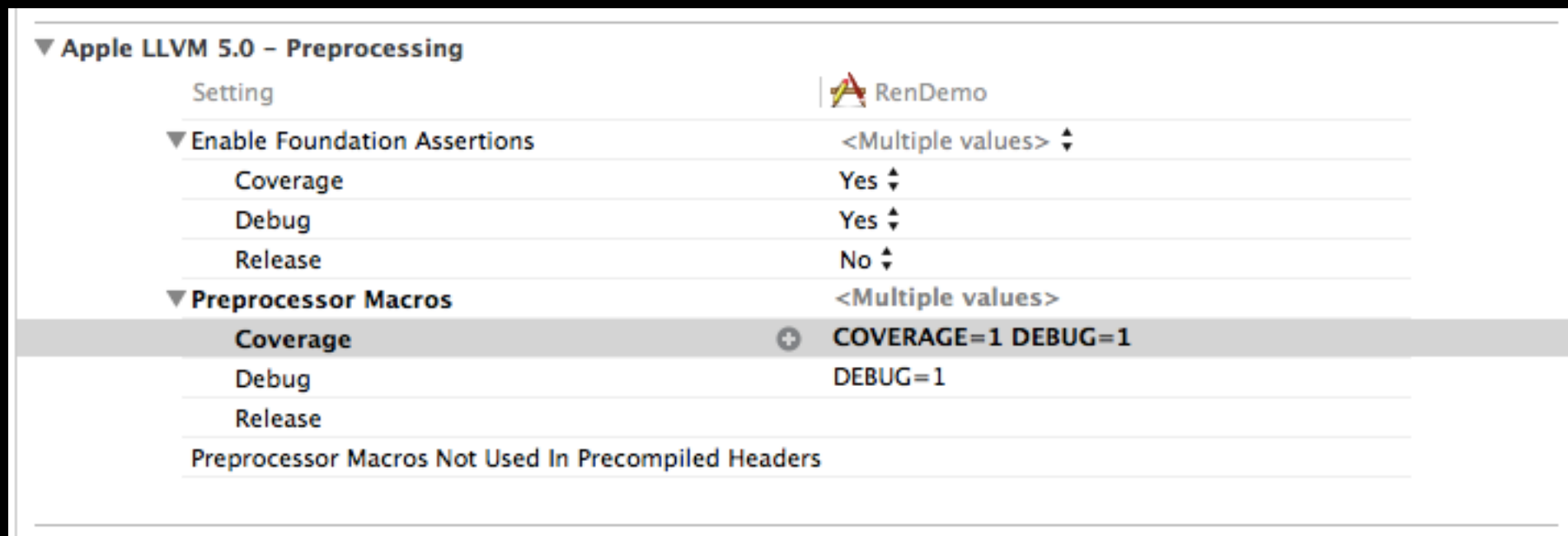
Step 2

Create a new Scheme



Fix Code Coverage Step 3

Create a new Preprocessor Macro
Add to both Application and Test Targets!



Fix Code Coverage

Step 4

Create a custom XCTestObserver

```
#ifdef COVERAGE

#import <XCTest/XCTest.h>

@interface RenDemoTestObserver : XCTestObserver

@end

@implementation RenDemoTestObserver

+ (void)load
{
    [[NSUserDefaults standardUserDefaults] setValue:@"XCTestLog,RenDemoTestObserver"
                                                    forKey:XCTestObserverClassKey];
}

- (void)stopObserving
{
    [super stopObserving];
    UIApplication *application = [UIApplication sharedApplication];
    id <UIApplicationDelegate> delegate = [application delegate];
    [delegate applicationWillResignActive:application];
}

@end

#endif
```

Fix Code Coverage Step 5

Call **__gcov_flush()** from
AppDelegate -applicationWillResignActive:

```
#import "AppDelegate.h"

#ifdef COVERAGE
extern void    __gcov_flush();
#endif

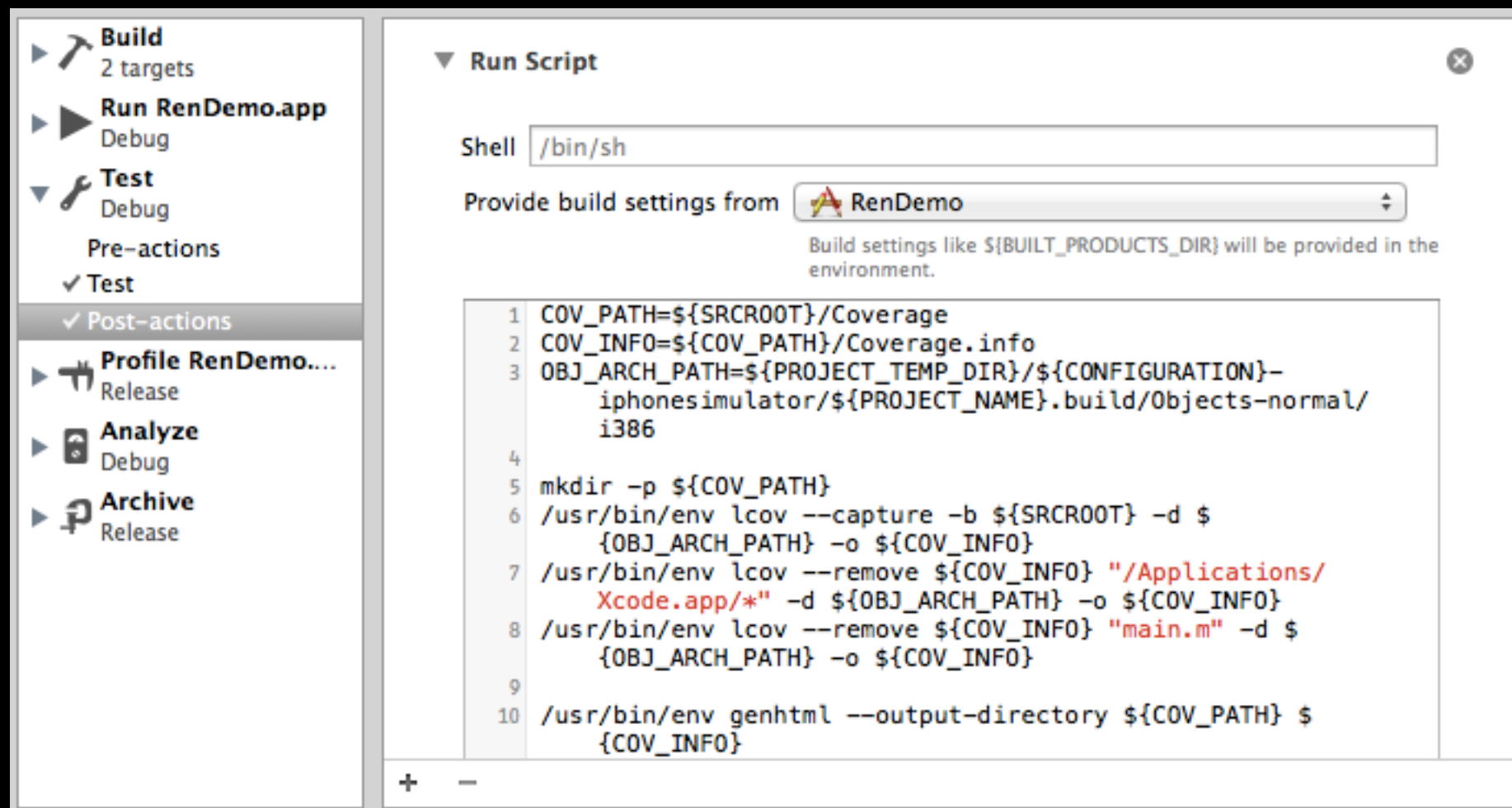
@implementation AppDelegate

- (BOOL)application:(UIApplication *)application didFinishLaunchingWithOptions:(NSDictionary *)launchOptions
{
    // Override point for customization after application launch.
    return YES;
}

- (void)applicationWillResignActive:(UIApplication *)application
{
#ifdef COVERAGE
    __gcov_flush();
#endif
}
```


Generate Coverage Reports

Generate reports via **gcov/lcov** using
Xcode Scheme Test Post-Action



Test Post-Action Script

```
OBJ_ARCH_PATH=${PROJECT_TEMP_DIR}/${CONFIGURATION}-iphonesimulator/${PROJECT_NAME}.build/Objects-normal/i386

COV_PATH=${SRCROOT}/Coverage
COV_INFO=${COV_PATH}/Coverage.info

mkdir -p ${COV_PATH}
/usr/local/bin/lcov --capture -b ${SRCROOT} -d ${OBJ_ARCH_PATH} -o ${COV_INFO}
/usr/local/bin/lcov --remove ${COV_INFO} "/Applications/Xcode.app/*" -d ${OBJ_ARCH_PATH} -o ${COV_INFO}
/usr/local/bin/lcov --remove ${COV_INFO} "main.m" -d ${OBJ_ARCH_PATH} -o ${COV_INFO}

/usr/local/bin/genhtml --output-directory ${COV_PATH} ${COV_INFO}
```


LCOV - code coverage report

Current view: [top level](#)

Test: [Coverage.info](#)

Date: [2014-01-27](#)

	Hit	Total	Coverage
Lines:	21	87	24.1 %
Functions:	8	28	28.6 %

Directory	Line Coverage ↕	Functions ↕
RenDemo	 24.1 % 21 / 87	28.6 % 8 / 28

Generated by: [LCOV version 1.10](#)


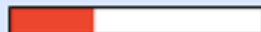



LCOV - code coverage report

Current view: [top level](#) - [RenDemo](#)

Test: [Coverage.info](#)

Date: [2014-01-27](#)

	Hit	Total	Coverage
Lines:	21	87	24.1 %
Functions:	8	28	28.6 %

Filename	Line Coverage ↕	Functions ↕
AppDelegate.h	 100.0 % 1 / 1	100.0 % 2 / 2
AppDelegate.m	 33.3 % 5 / 15	28.6 % 2 / 7
DetailViewController.h	 0.0 % 0 / 2	0.0 % 0 / 3
DetailViewController.m	 0.0 % 0 / 19	0.0 % 0 / 5
MasterViewController.m	 30.0 % 15 / 50	36.4 % 4 / 11

Generated by: [LCOV version 1.10](#)

LCOV - code coverage report

Current view: [top level](#) - [RenDemo](#) - [MasterViewController.m](#) (source / [functions](#))

Test: [Coverage.info](#)

Date: 2014-01-27

	Hit	Total	Coverage
Lines:	15	50	30.0 %
Functions:	4	11	36.4 %

Line data	Source code
1	: //
2	: // MasterViewController.m
3	: // RenDemo
4	: //
5	: // Created by Kevin Y. Kim on 1/27/14.
6	: // Copyright (c) 2014 kykim, inc. All rights reserved.
7	: //
8	:
9	: #import "MasterViewController.h"
10	:
11	: #import "DetailViewController.h"
12	:
13	: @interface MasterViewController () {
14	: NSMutableArray *_objects;
15	: }
16	: @end
17	:
18	0 : @implementation MasterViewController
19	:
20	1 : - (void)awakeFromNib
21	: {
22	1 : [super awakeFromNib];
23	1 : }
24	:
25	1 : - (void)viewDidLoad
26	: {
27	1 : [super viewDidLoad];
28	: // Do any additional setup after loading the view, typically from a nib.
29	1 : self.navigationItem.leftBarButtonItem = self.editButtonItem;
30	:
31	1 : UIBarButtonItem *addButton = [[UIBarButtonItem alloc] initWithBarButtonSystemItem:UIBarButtonSystemItemAdd target:nil];
32	1 : self.navigationItem.rightBarButtonItem = addButton;
33	1 : }
34	:
35	0 : - (void)didReceiveMemoryWarning
36	: {
37	0 : [super didReceiveMemoryWarning];
38	: // Dispose of any resources that can be recreated.
39	0 : }
40	:

Xcode Server

- Apple's Continuous Integration Server
- Integrated with Xcode 5
I prefer to use the Server.app and Web Application
- Lots of other issues
which I won't get into :-)



Xcode Server Concepts

- Schemes
- Bots
- Integrations



Xcode Server Web Home Page

Xcode

Bots

+

Latest Integration

XcodeServerArchs...

Integration 2

View Summary

0

0

0

Errors

Warnings

Analysis

Next Integration

No Scheduled Integrations

Latest Downloads

No Downloads Available

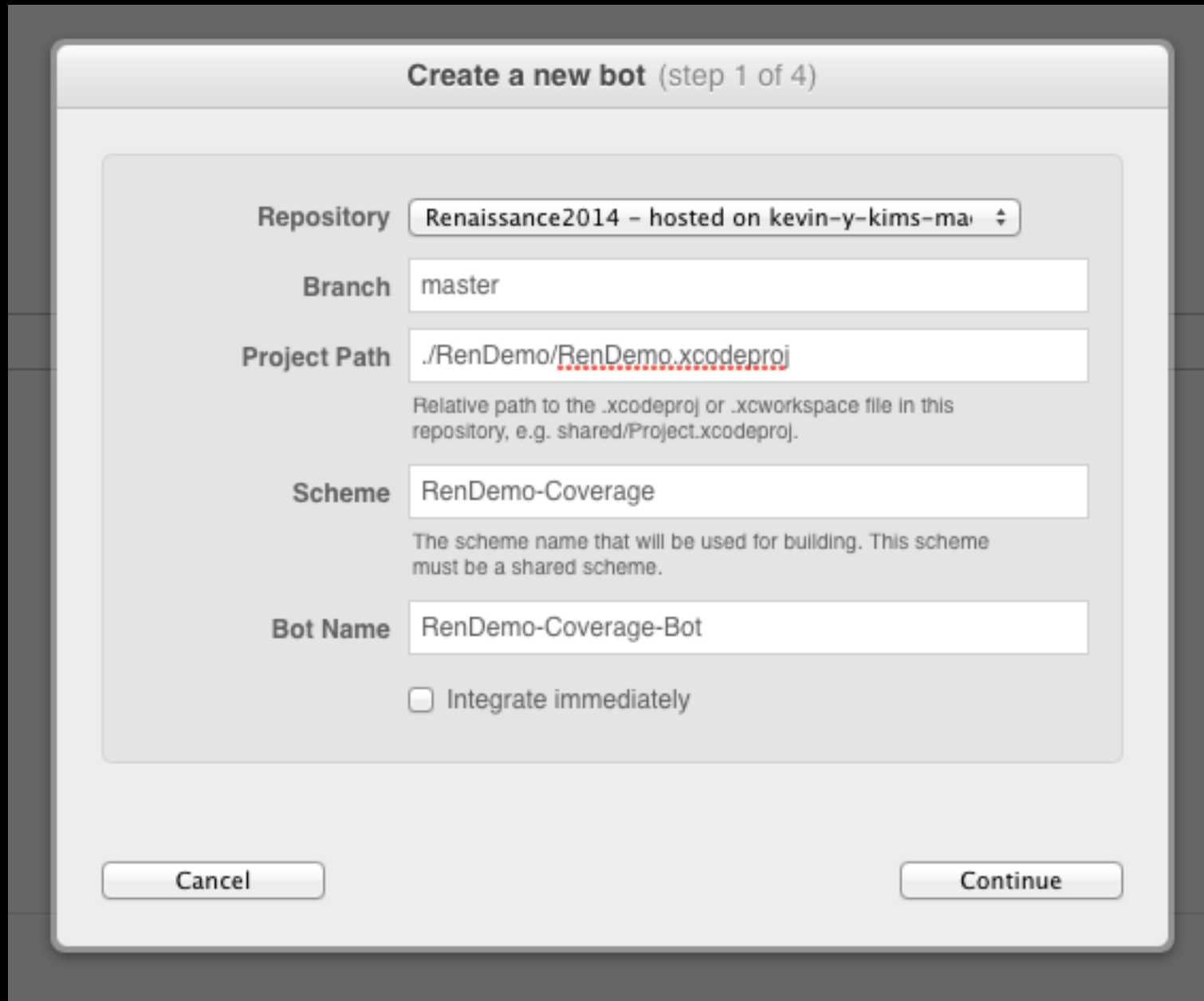
AllFailedPassed

Filter

Name	Status	Next	Last	
RenDemo-Coverage-Bot	Finished with test failures	--	January 27 at 10:20 PM	Integrate
XcodeServerArchs-Coverage-Bot	Finished with test failures	--	Yesterday at 3:18 PM	Integrate

Bot Creation

Step 1



The screenshot shows a macOS-style dialog box titled "Create a new bot (step 1 of 4)". It contains several input fields for configuring a new bot:

- Repository:** A dropdown menu showing "Renaissance2014 - hosted on kevin-y-kims-ma".
- Branch:** A text field containing "master".
- Project Path:** A text field containing ".RenDemo/RenDemo.xcodeproj". Below this field is a small text description: "Relative path to the .xcodeproj or .xcworkspace file in this repository, e.g. shared/Project.xcodeproj."
- Scheme:** A text field containing "RenDemo-Coverage". Below this field is a small text description: "The scheme name that will be used for building. This scheme must be a shared scheme."
- Bot Name:** A text field containing "RenDemo-Coverage-Bot".

At the bottom of the form area, there is a checkbox labeled "Integrate immediately" which is currently unchecked.

At the bottom of the dialog box, there are two buttons: "Cancel" on the left and "Continue" on the right.

Bot Creation Step 2

Create a new bot (step 2 of 4)

Schedule Run manually ▾

Actions

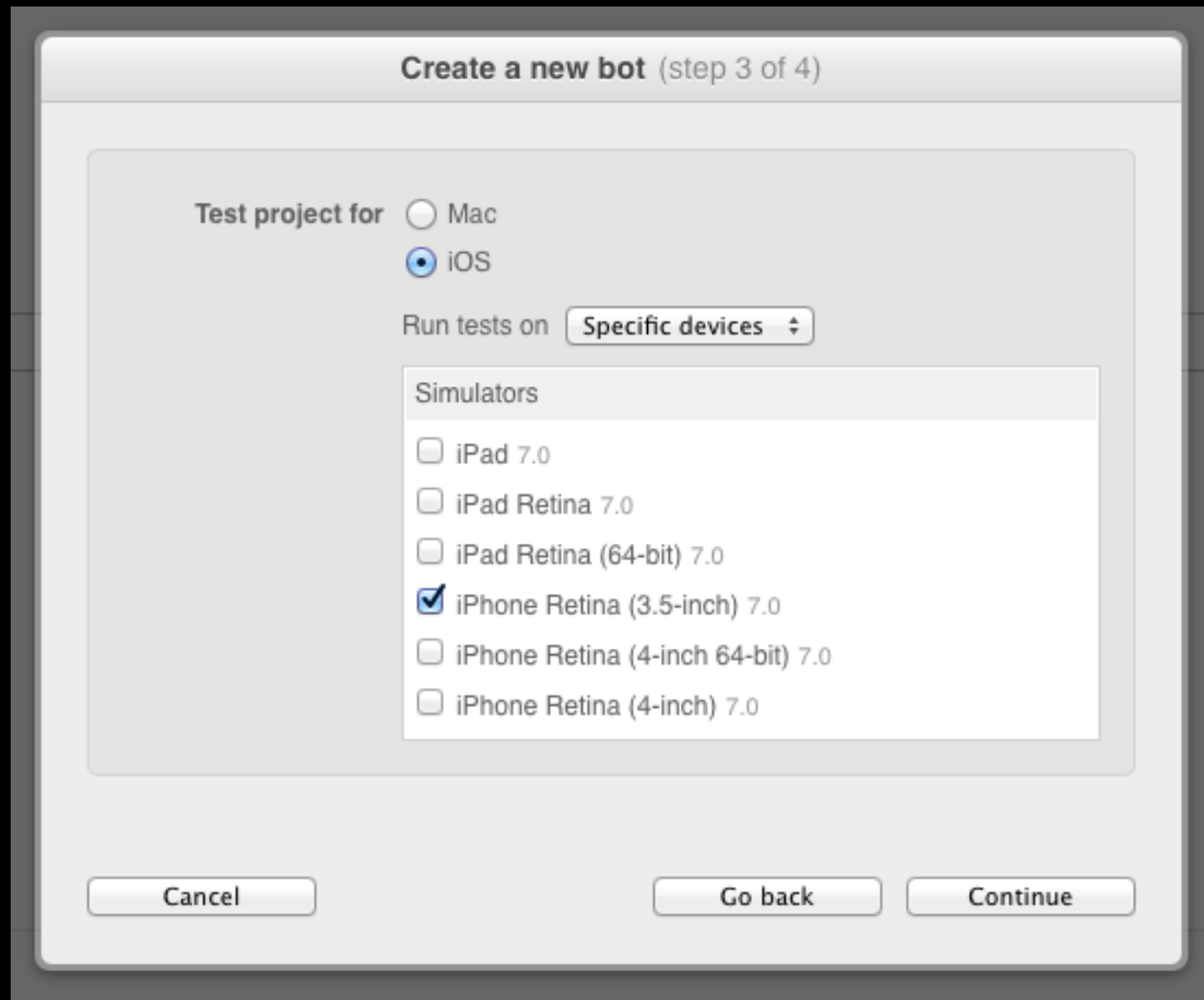
- ☐ Perform analyze action
- ☒ Perform test action
- ☐ Perform archive action

Options ☒ Clean before each integration

Cancel Go back Continue

Bot Creation

Step 3



Bot Creation

Step 4

Create a new bot (step 4 of 4)

On Success ☐ Email all committers

Add additional email addresses seperated by commas:

Type one or more valid email addresses here

On Failure ☒ Email all committers

Add additional email addresses seperated by commas:

Type one or more valid email addresses here

Cancel Go back Create

Xcode Server Operation

What's the problem?



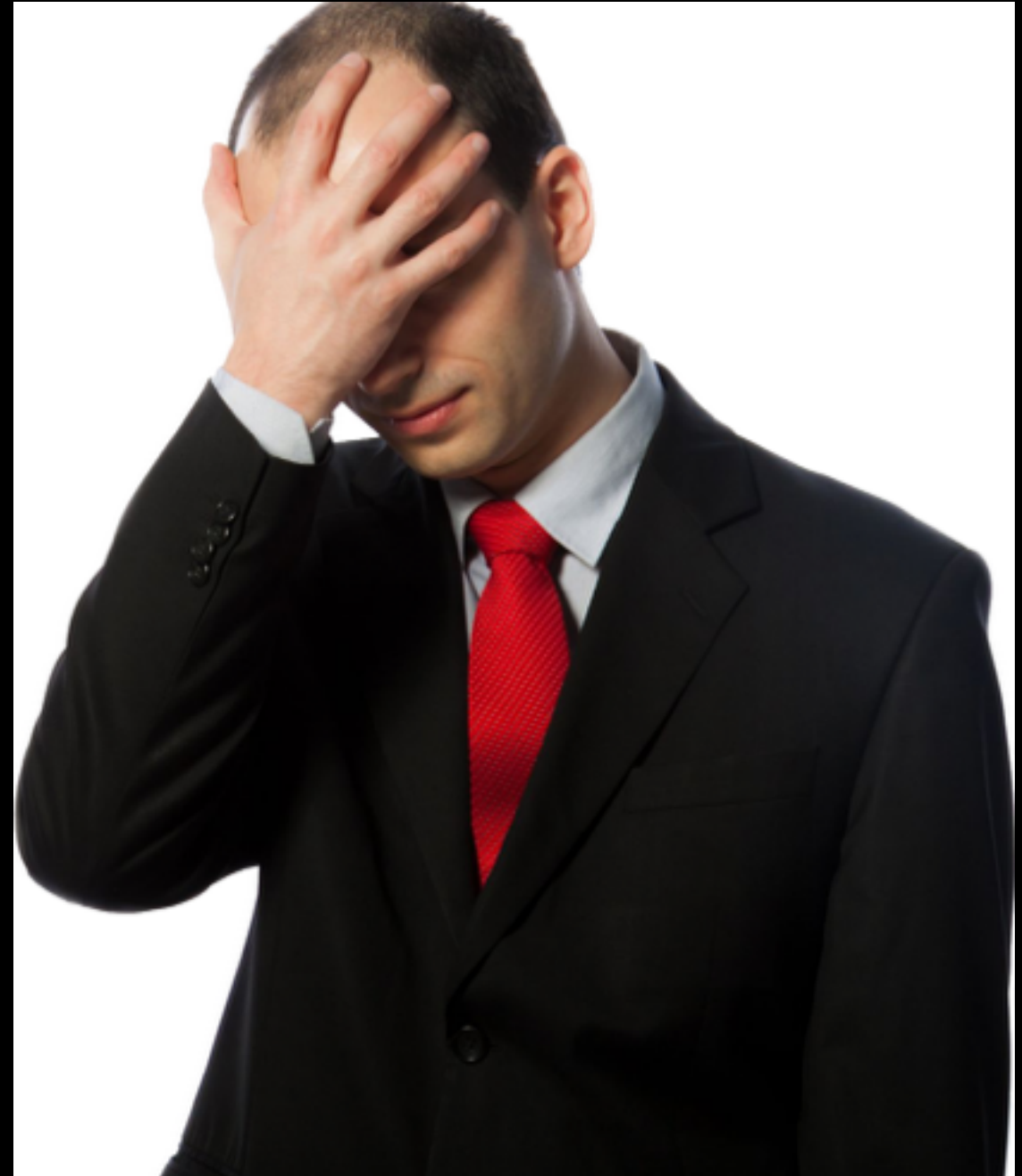
Xcode Server
_teamsserver

Xcode Build
_teamsserver

Xcode Test
_xcstest

Damn DerivedData

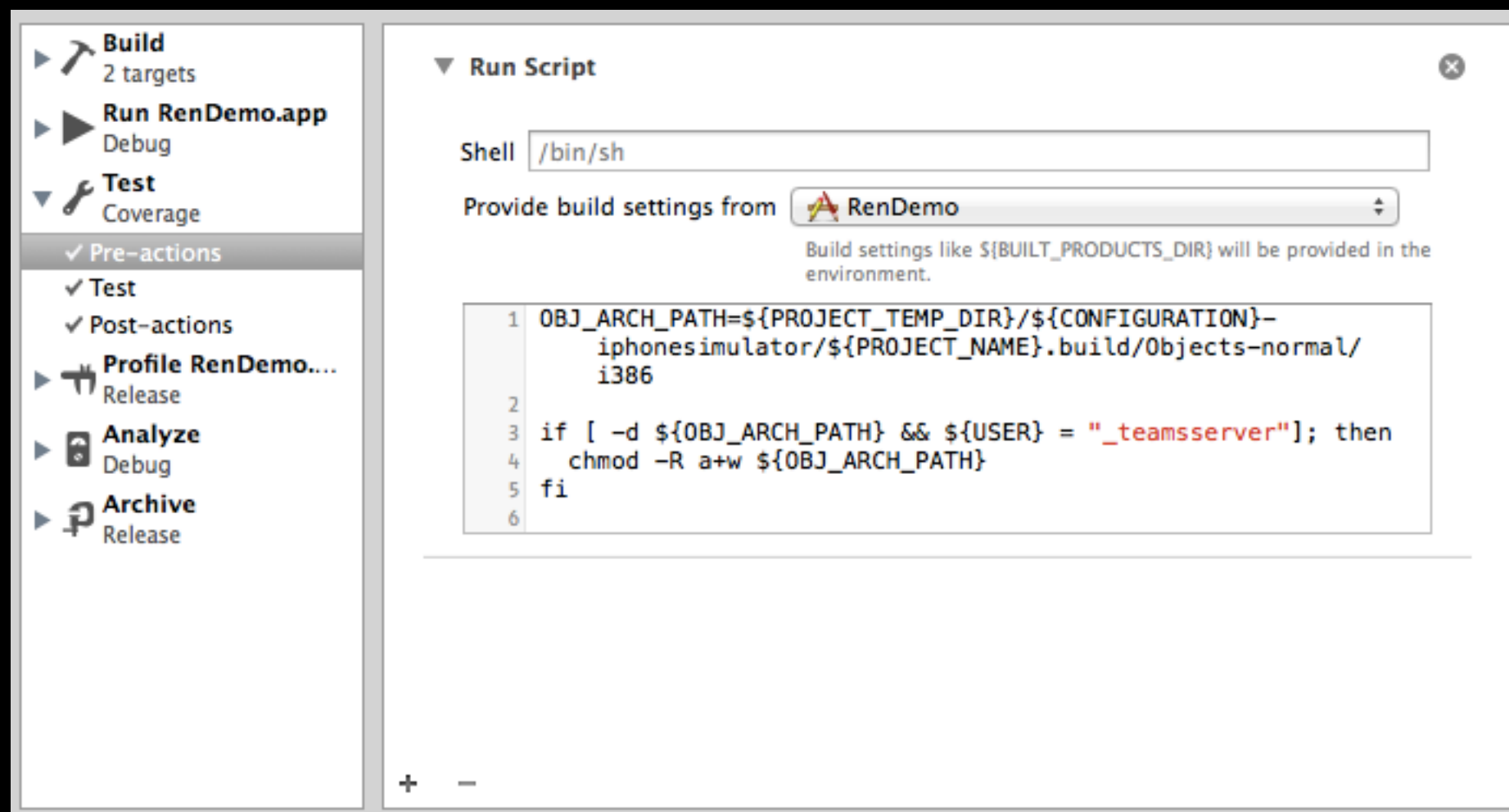
- Xcode 5:
`~/Library/Developer/
Xcode/DerivedData/...`
- Xcode Server:
`/Library/Server/Xcode/
Data/BotRuns/Cache/...`



Fix Code Coverage *Again*

Step 1

Fix permissions via Xcode Scheme Pre-Action



Fix Code Coverage *Again*

Step 2

Adjust Coverage Report location in Test Post-Action

```
OBJ_ARCH_PATH=${PROJECT_TEMP_DIR}/${CONFIGURATION}-iphonesimulator/${PROJECT_NAME}.build/Objects-normal/i386
```

```
if [ $USER = "_teamsserver" ]; then
    COVERAGE_OBJ_DIR=$(mktemp -d -t Coverage)
    mkdir -p ${COVERAGE_OBJ_DIR}
    cp -r ${OBJ_ARCH_PATH}/* ${COVERAGE_OBJ_DIR}
    OBJ_ARCH_PATH=${COVERAGE_OBJ_DIR}
    COV_PATH=/Library/Server/Xcode/Data/Coverage/${PROJECT_NAME}/${date +%Y%m%d%H%M%S}
else
    COV_PATH=${SRCROOT}/Coverage
fi
```

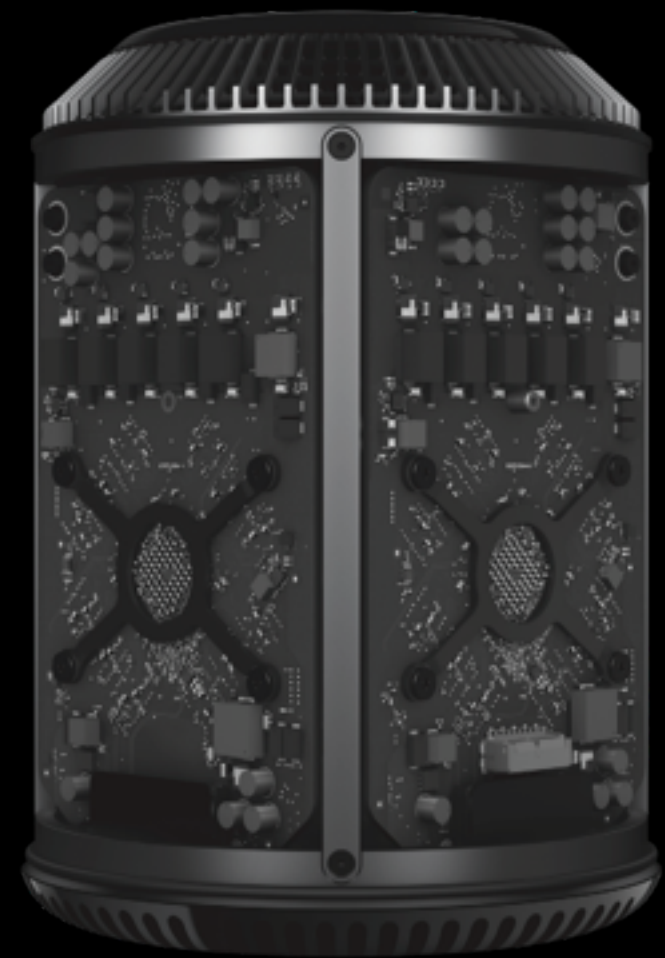
```
COV_INFO=${COV_PATH}/Coverage.info
```

```
mkdir -p ${COV_PATH}
/usr/local/bin/lcov --capture -b ${SRCROOT} -d ${OBJ_ARCH_PATH} -o ${COV_INFO}
/usr/local/bin/lcov --remove ${COV_INFO} "/Applications/Xcode.app/*" -d ${OBJ_ARCH_PATH} -o ${COV_INFO}
/usr/local/bin/lcov --remove ${COV_INFO} "main.m" -d ${OBJ_ARCH_PATH} -o ${COV_INFO}

/usr/local/bin/genhtml --output-directory ${COV_PATH} ${COV_INFO}
```


More Xcode Server

- Server Processes
- Server Application Bundle
- Server Data
- PostgreSQL Database



Xcode Server Processes

- Apache Server modules
git server, XCS web app
- Xcode Build Daemon
xcsbuildd
- Credentials Service
xcscredd, xcscredhandler
- Device Monitor xcsdevicesnifferd
- Other xcsxcodeappwatcher



Server.app bundle

```
/Applications/Server.app/  
  Contents/ServerRoot/  
    System/Library/  
      LaunchDaemons  
      ServerSetup  
    usr/libexec  
    usr/sbin
```



Server Data

`/Library/Server/Xcode/`

`Data/BotRuns`

`Logs`

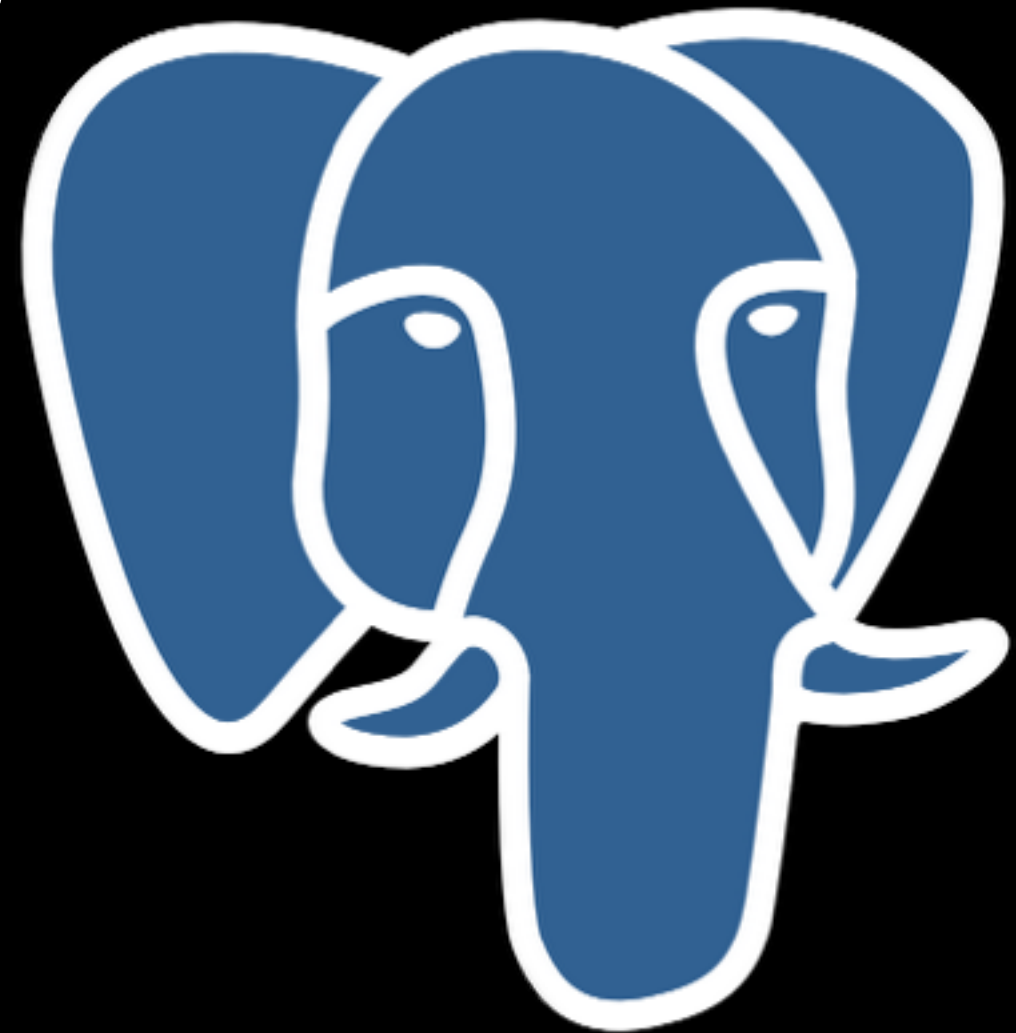
`Repositories`

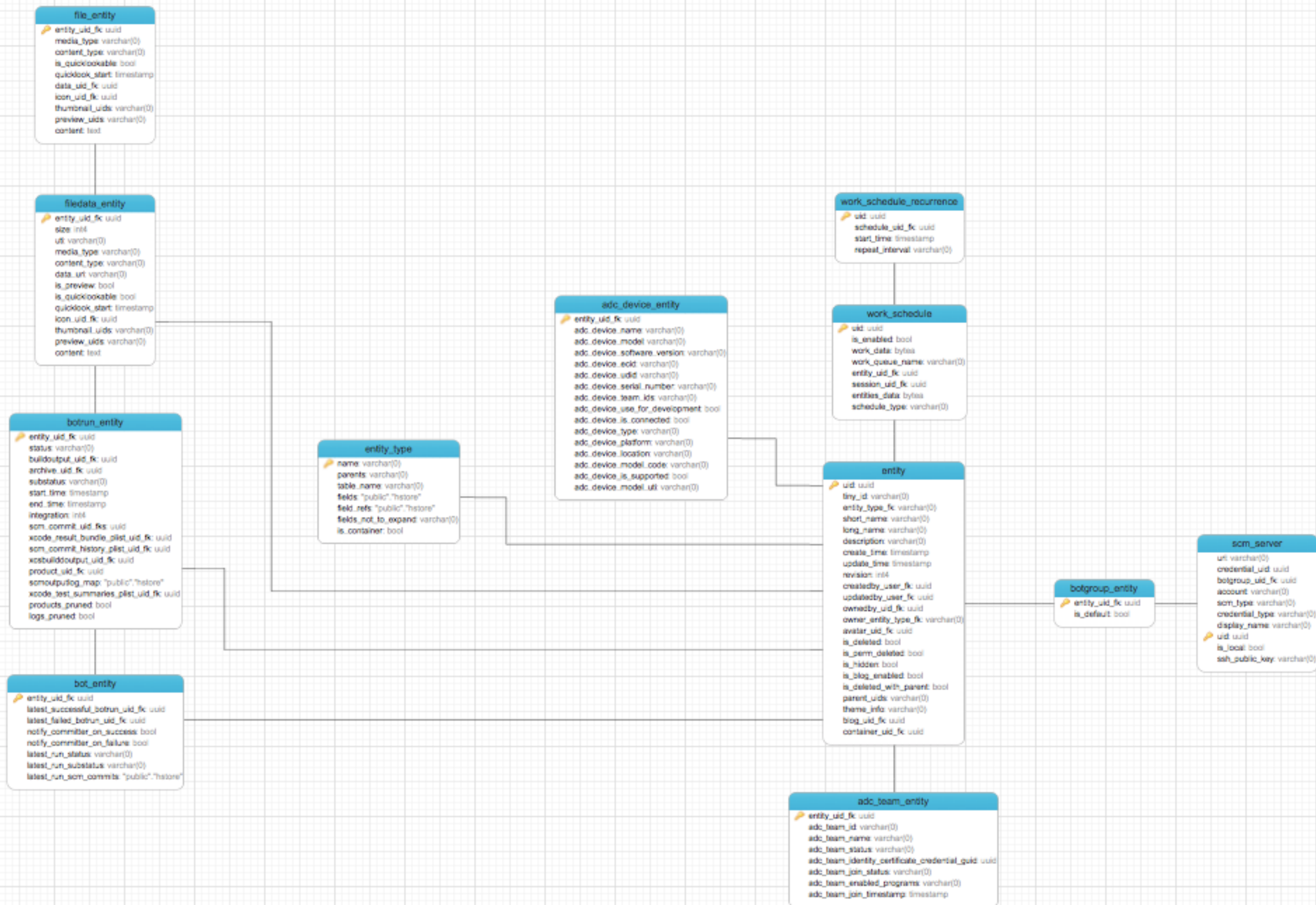


PostgreSQL Database

```
> psql  
  -h /Library/Server/Wiki/PostgresSocket  
  -U _teamserver  
collab
```

(sudo as root)





More Information

- WWDC 2013
412: Continuous Integration with Xcode 5
- gcov - GCC coverage tool
<http://gcc.gnu.org/onlinedocs/gcc/Gcov.html>
- lcov - gcov wrapper and report generator
<http://ltp.sourceforge.net/coverage/lcov.php>
- Martin Fowler
<http://martinfowler.com/bliki/TestCoverage.html>
<http://martinfowler.com/articles/continuousIntegration.html>
- The Way of Testivus
<http://www.artima.com/weblogs/viewpost.jsp?thread=203994>