#WWDC18

Core Data Best Practices

Session 224

Scott Perry, Engineer
Nick Gillett, Engineer

Modernizing Core Data

Evolving containers

Matching models with views

Managing growth

Potpourri

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Let’s Build an App

Let’s Manage Some Data

Let’s Manage Some Data

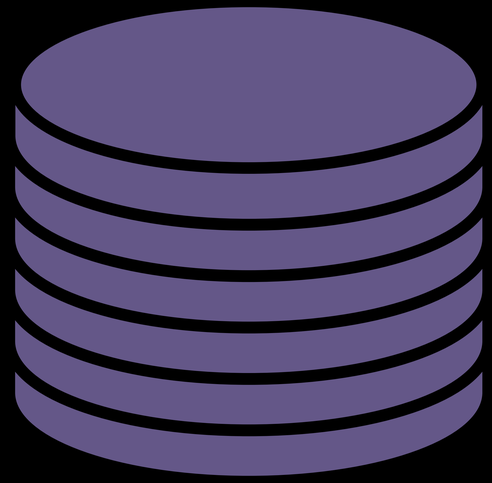
Where does the data live?

- Online

Let’s Manage Some Data

Where does the data live?

- Online
- On device



Object Graph

Object Graph Persistence

Core Data

Core Data Manages Persistence

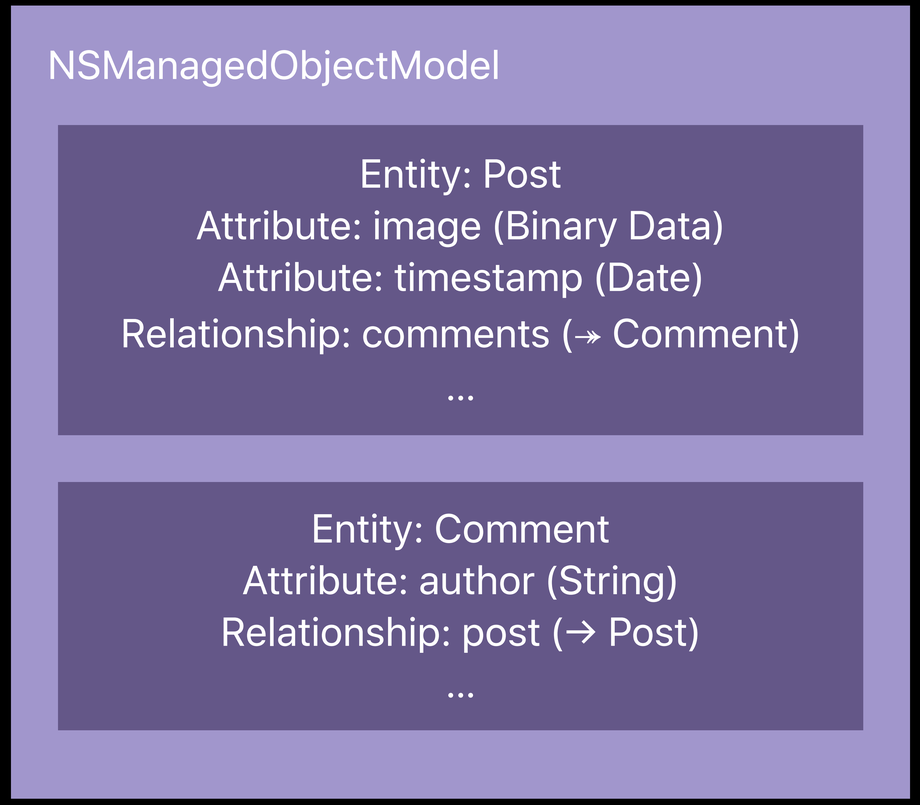
Core Data Manages Persistence

NSManagedObjectModel

Entity: Post
Attribute: image (Binary Data)
Attribute: timestamp (Date)
Relationship: comments (↠ Comment)
…

Entity: Comment
Attribute: author (String)
Relationship: post (→ Post)
…

Core Data Manages Persistence



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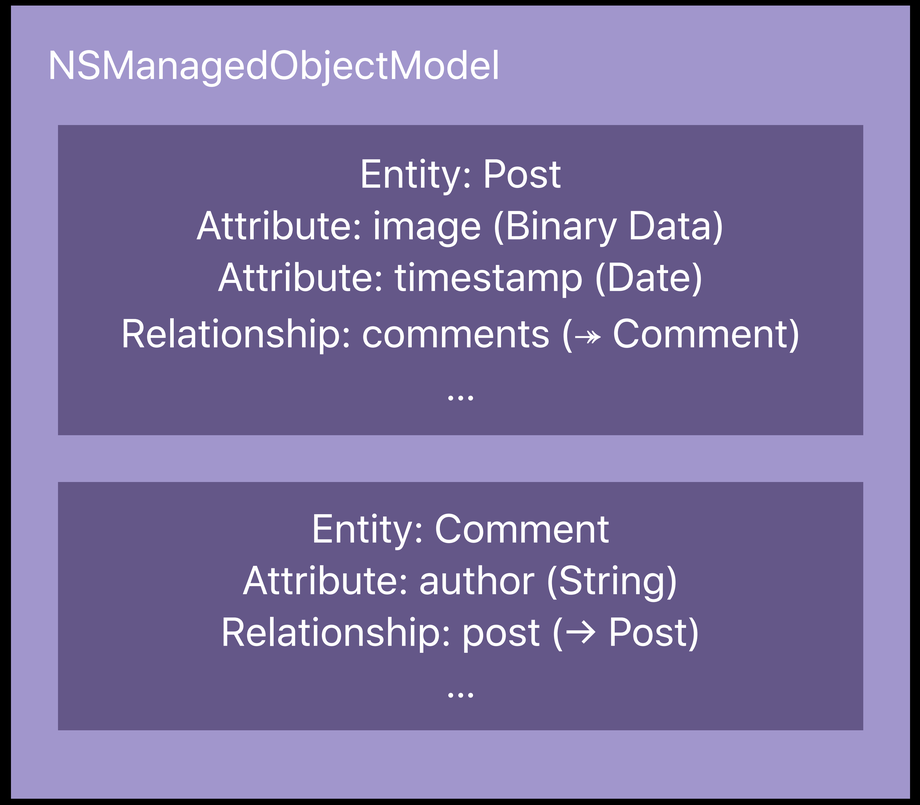

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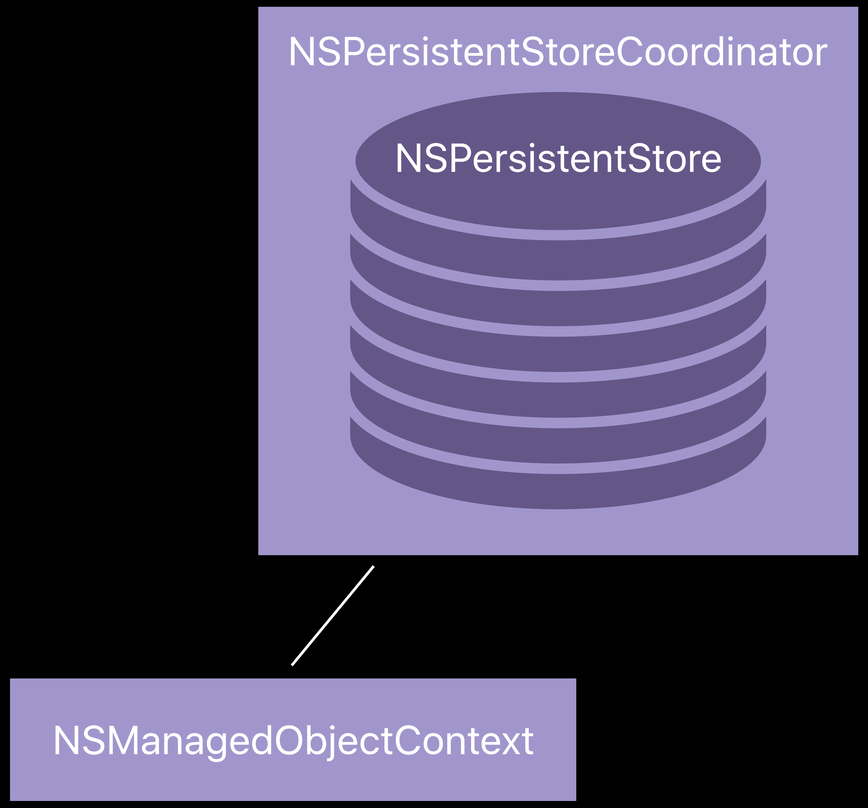

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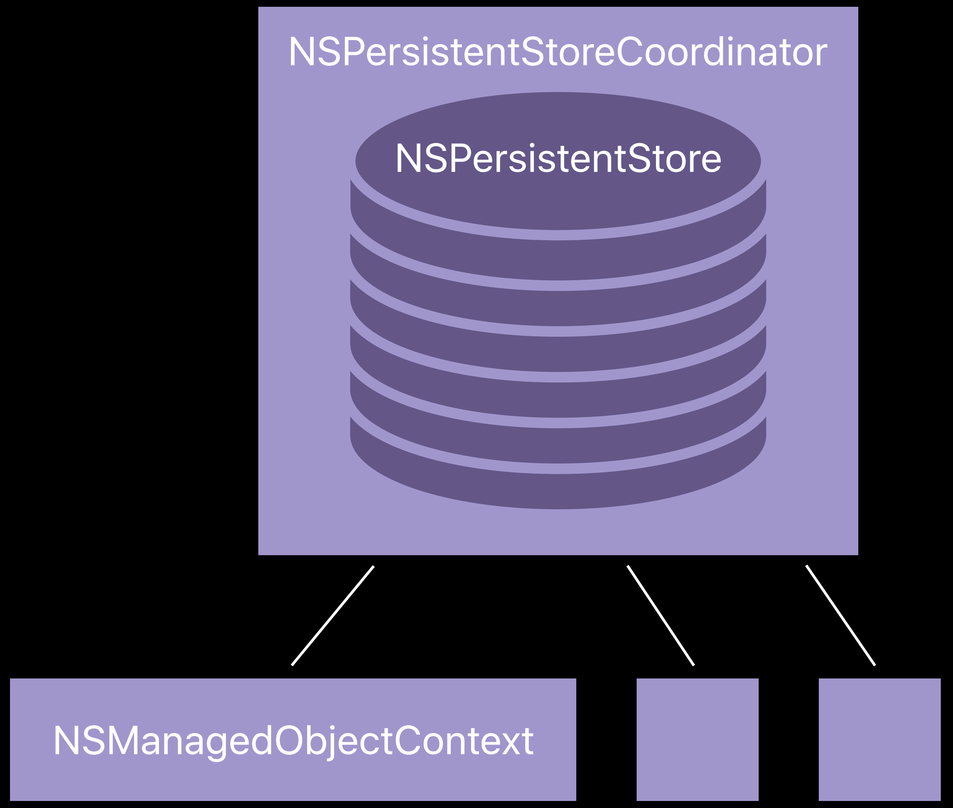

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Entity: Post
Attribute: image (Binary Data)
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Relationship: comments (↠ Comment)
...

Entity: Comment
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Relationship: post (→ Post)
...

```
let storeURL = FileManager.default
                          .urls(for: .documentDirectory, in: .userDomainMask)[0]
                          .appendingPathComponent("Postings")

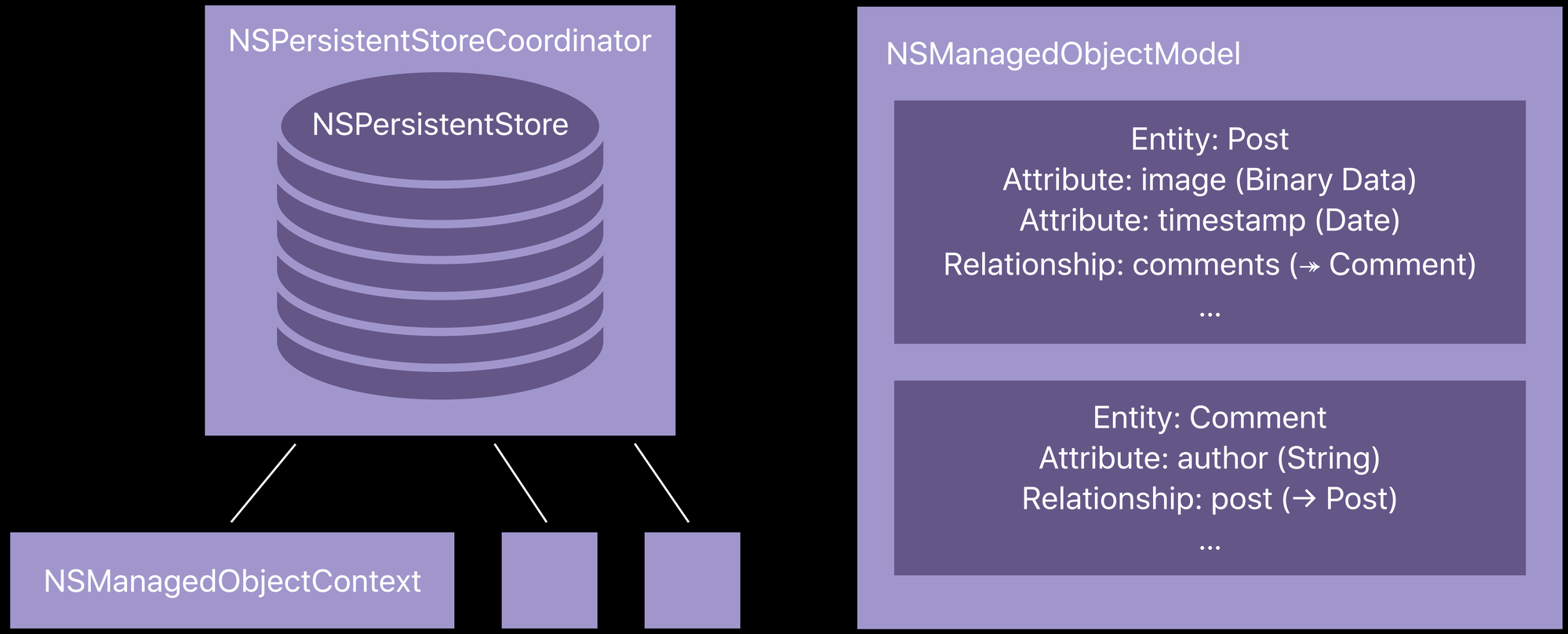

guard let modelURL = Bundle.main.url(forResource: "Postings", withExtension: "momd"),
      let model = NSManagedObjectModel(contentsOf: modelURL) else {
    print("error")
    return
}

let psc = NSPersistentStoreCoordinator(managedObjectModel: model)
var success = false
do {
    try psc.addPersistentStore(ofType: NSSQLiteStoreType, configurationName: nil,
                               at: storeURL,
                               options: [NSInferMappingModelAutomaticallyOption: true,
                                         NSMigratePersistentStoresAutomaticallyOption: true])
    success = true
} catch {
    print("error loading store: \(error)")
    return
}

if success {
    print("ready!")
}
```

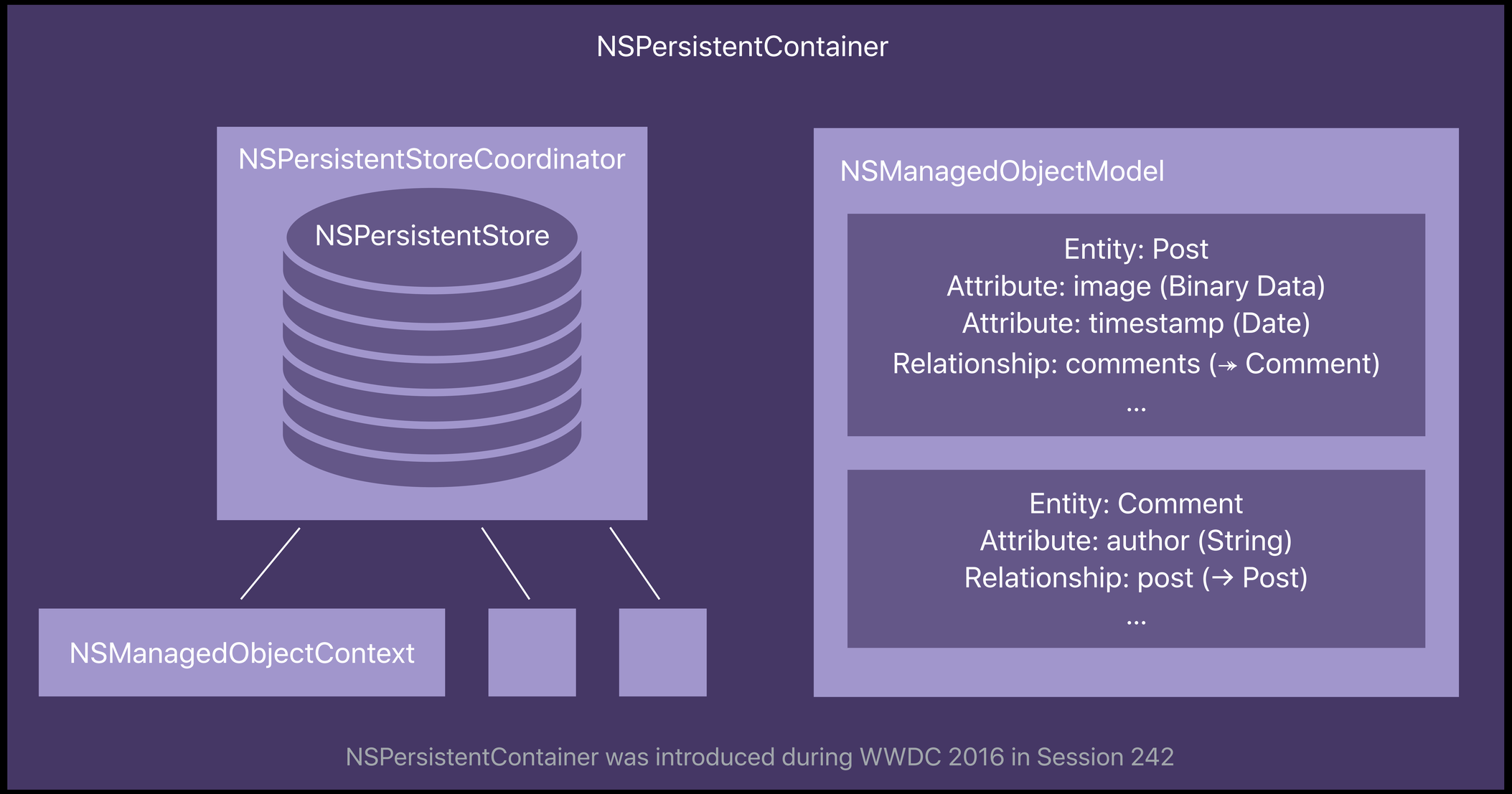
```
let container = NSPersistentContainer(name: "Postings")
container.loadPersistentStores { (desc, err) in
    if let err = err {
        print("error loading store \(desc): \(err)")
        return
    }
    print("ready!")
}
```

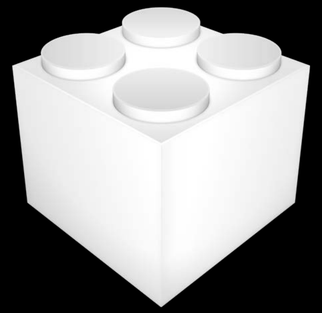
Core Data Manages Persistence

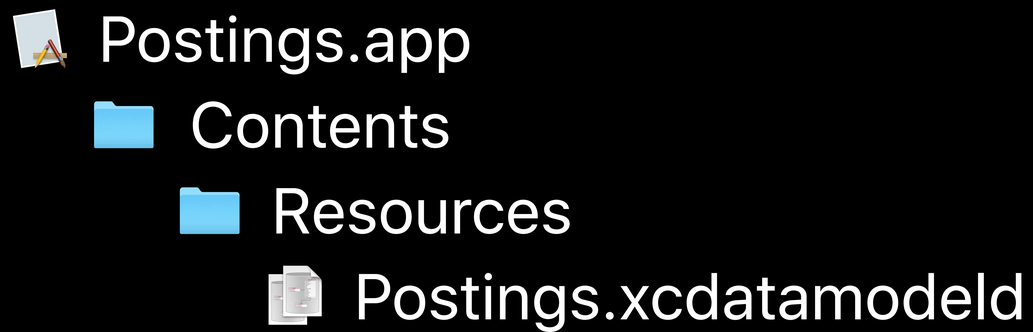


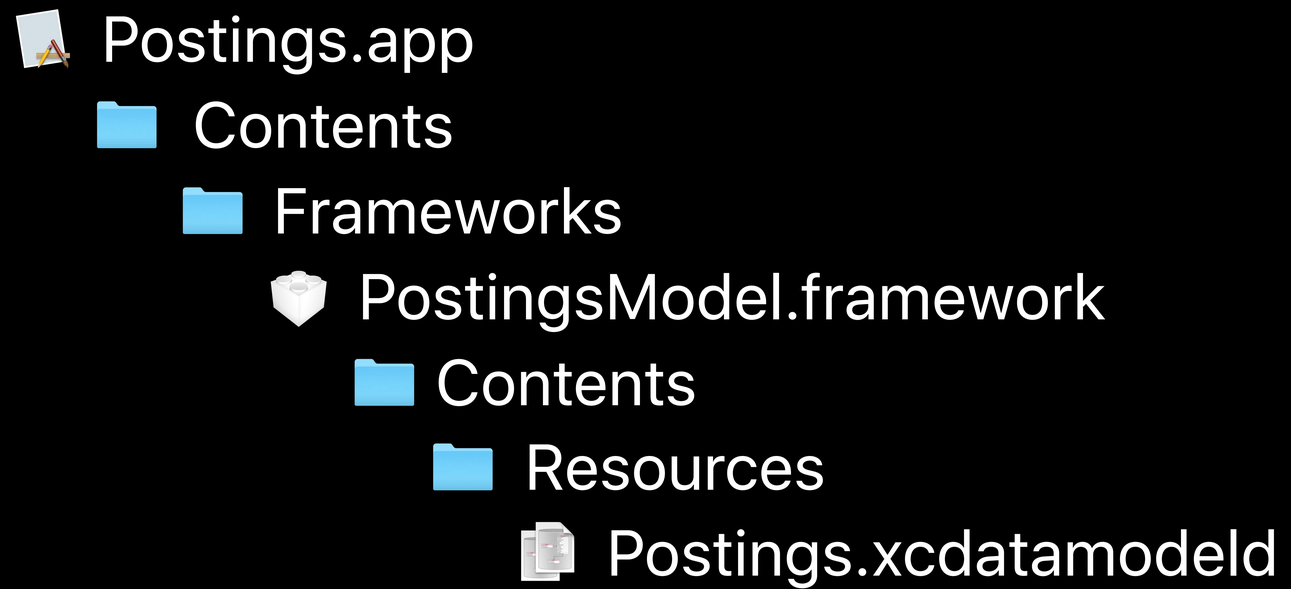
NSPersistentContainer was introduced during WWDC 2016 in Session 242

Core Data Manages Persistence






Postings.app
Contents
Resources
Postings.xcdatamodeld


Postings.app
Contents
Frameworks
PostingsModel.framework
Contents
Resources
Postings.xcdatamodeld

How the Container Finds Models

```
guard let modelURL = Bundle.main.url(forResource: "Postings", withExtension: "momd"),
      let model = NSManagedObjectModel(contentsOf: modelURL) else {
    print("error")
    return
}

let container = NSPersistentContainer(name: "Postings", managedObjectModel: model)
container.loadPersistentStores { (desc, err) in
    if let err = err {
        print("error loading store \(desc): \(err)")
        return
    }
    print("ready!")
}
```

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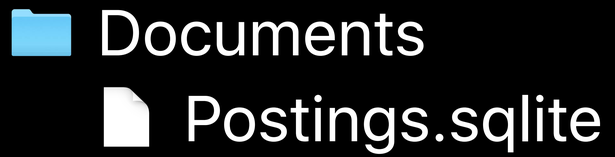
Postings.sqlite


Documents
Postings.sqlite


Documents
PostingsModel
Postings.sqlite

More Container Tricks

Customizing where stores are—stored

```
let storeName = container.persistentStoreDescriptions[0].url?.lastPathComponent
                ?? container.name

let container = PMPersistentContainer(name: "Postings")

container.persistentStoreDescriptions[0].url = storeStorage.appendingPathComponent(storeName)

container.loadPersistentStores { (desc, err) in
    if let err = err {
        print("error loading store \(desc): \(err)")
        return
    }
    print("ready!")
}
```

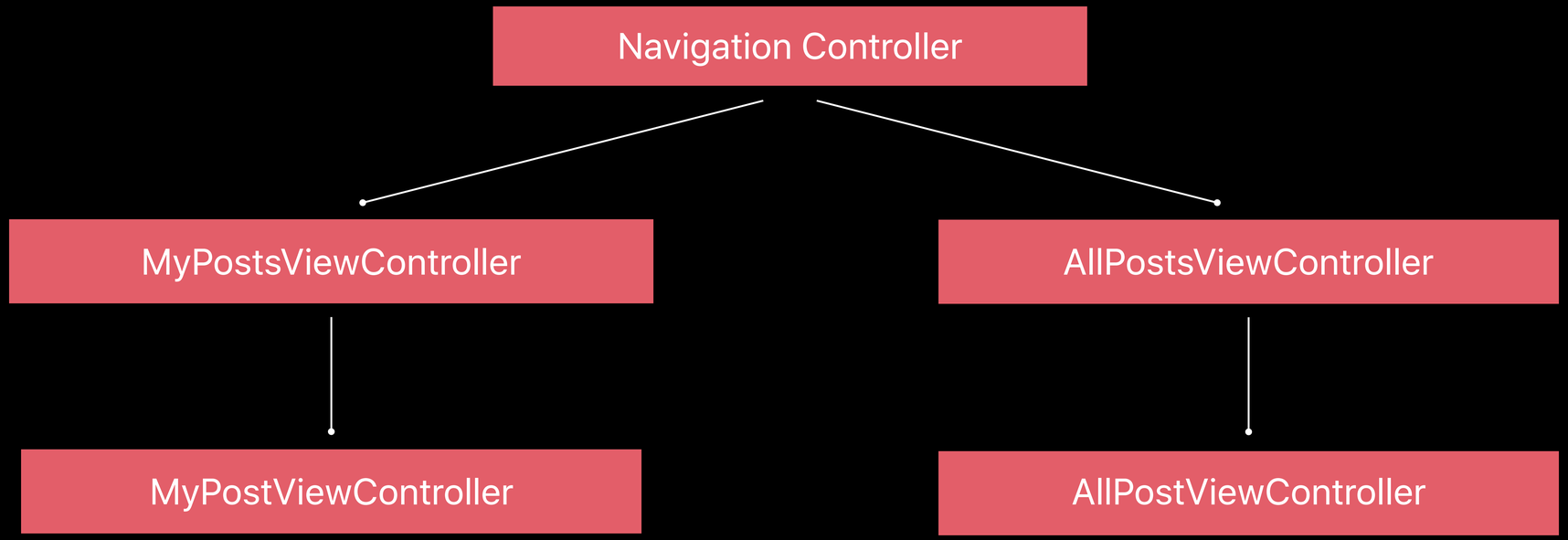
More Container Tricks

Customizing where stores are—stored

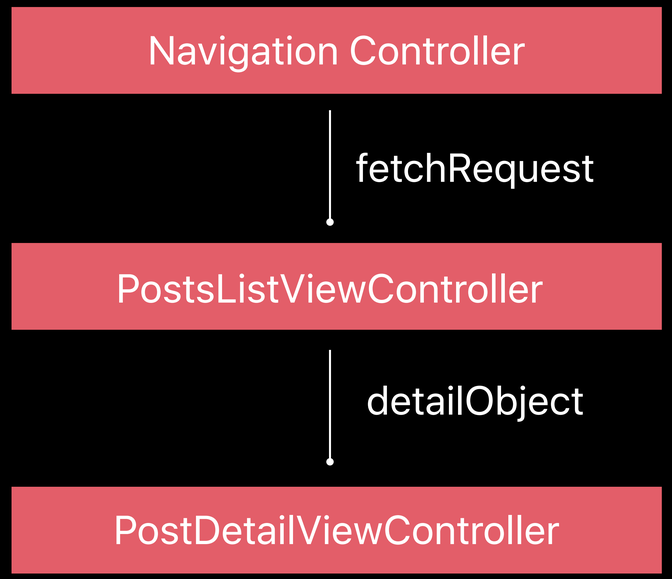
```
class PMPersistentContainer: NSPersistentContainer {
    override class func defaultDirectoryURL() -> URL {
        return super.defaultDirectoryURL().appendingPathComponent("PostingsModel")
    }
}
```

Generalizing Controllers

Generalizing Controllers



Generalizing Controllers



Generalizing Controllers

Controllers using Core Data should have

- Data
  - Managed object
  - Fetch request

Generalizing Controllers

Controllers using Core Data should have

- Data
  - Managed object
  - Fetch request
- Managed object context

Generalizing Workers

Workers using Core Data should have

- Data
  - URL
  - Property list
- Managed object context

Generalizing Controllers

Getting view controllers what they need when using

Generalizing Controllers

Getting view controllers what they need when using

- Segues

```
override func prepare(for segue: UIStoryboardSegue, sender: Any?) {
    let fetchRequest = NSFetchRequest<Post>(entityName: "Post")
    // …
    if let destinationViewController = segue.destination as? PostsListViewController {
        destinationViewController.context = self.context
        destinationViewController.fetchRequest = fetchRequest
    }
}
```

Generalizing Controllers

Getting view controllers what they need when using

- Segues
- Storyboards

```
let fetchRequest = NSFetchRequest<Post>(entityName: "Post")
// …
let destinationViewController = PostsListViewController(nibName: "…", bundle: nil)
destinationViewController.context = self.context
destinationViewController.fetchRequest = fetchRequest
present(destinationViewController, animated: true, completion: nil)
```

Generalizing Controllers

Getting view controllers what they need when using

- Segues
- Storyboards
- Code

```
let fetchRequest = NSFetchRequest<Post>(entityName: "Post")
// …
let destinationViewController = PostsListViewController(context: self.context,
                                                        fetchRequest: fetchRequest)
present(destinationViewController, animated: true, completion: nil)
```

Turning Fetch Requests Into List Views

Configure the results’ behaviour

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- Fetch limit
- Batch size

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Use the fetched results controller!

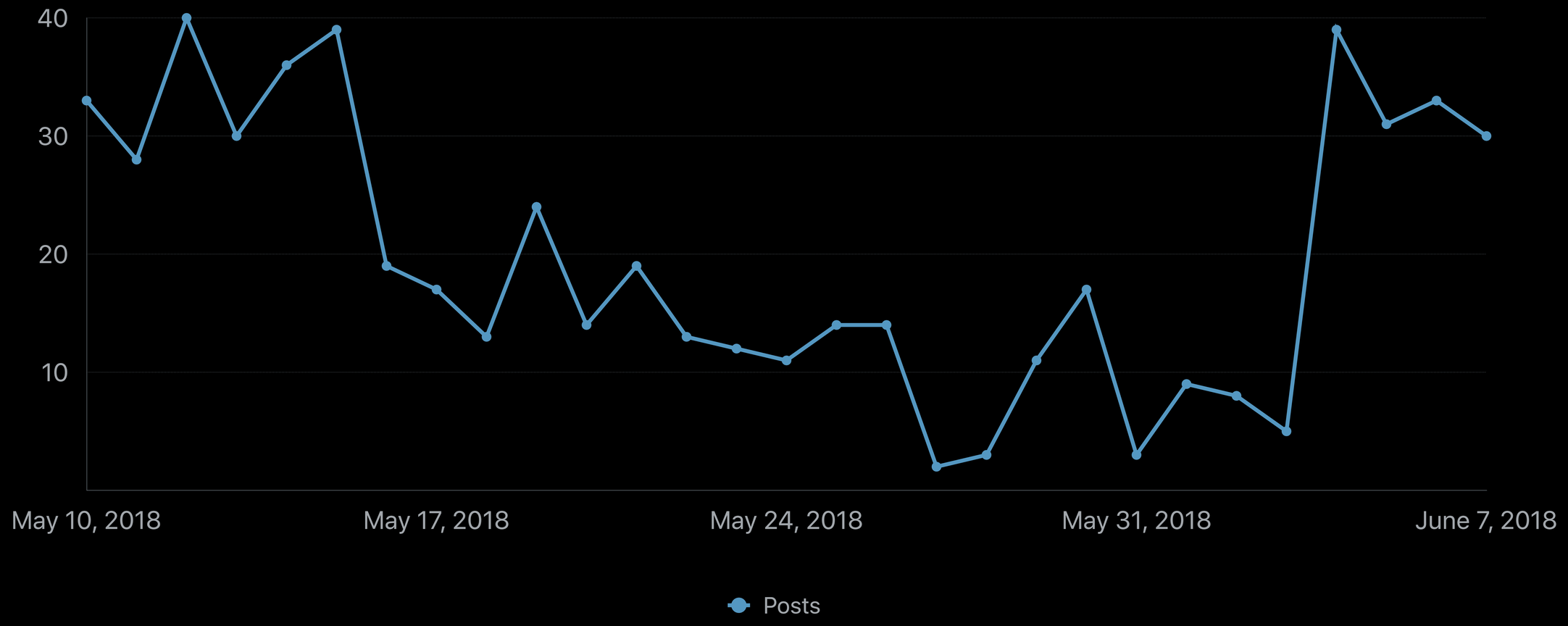
Turning Fetch Requests Into List Views

Use the fetched results controller!

```
extension Post {
    @objc var day: String {
        let components = Calendar.current.dateComponents([Calendar.Component.year,
                                                          Calendar.Component.month,
                                                          Calendar.Component.day],
                                                         from: self.timestamp!)
        return "\(components.year!)-\(components.month!)-\(components.day!)"
    }
}
```

Matching UIs to the Model

ChartViewController



Matching UIs to the Model

Complex fetch requests

```
let fr = NSFetchRequest<NSDictionary>(entityName: "Post")

let end = Date()
let start = Calendar.current.date(byAdding: DateComponents(day: -30), to: end)!
fr.predicate = NSPredicate(format: "timestamp > %@ AND timestamp <= %@",
                           argumentArray: [start, end])

fr.propertiesToGroupBy = ["day"]
fr.resultType = .dictionaryResultType

let ced = NSExpressionDescription()
ced.expression = NSExpression(forFunction: "count:",
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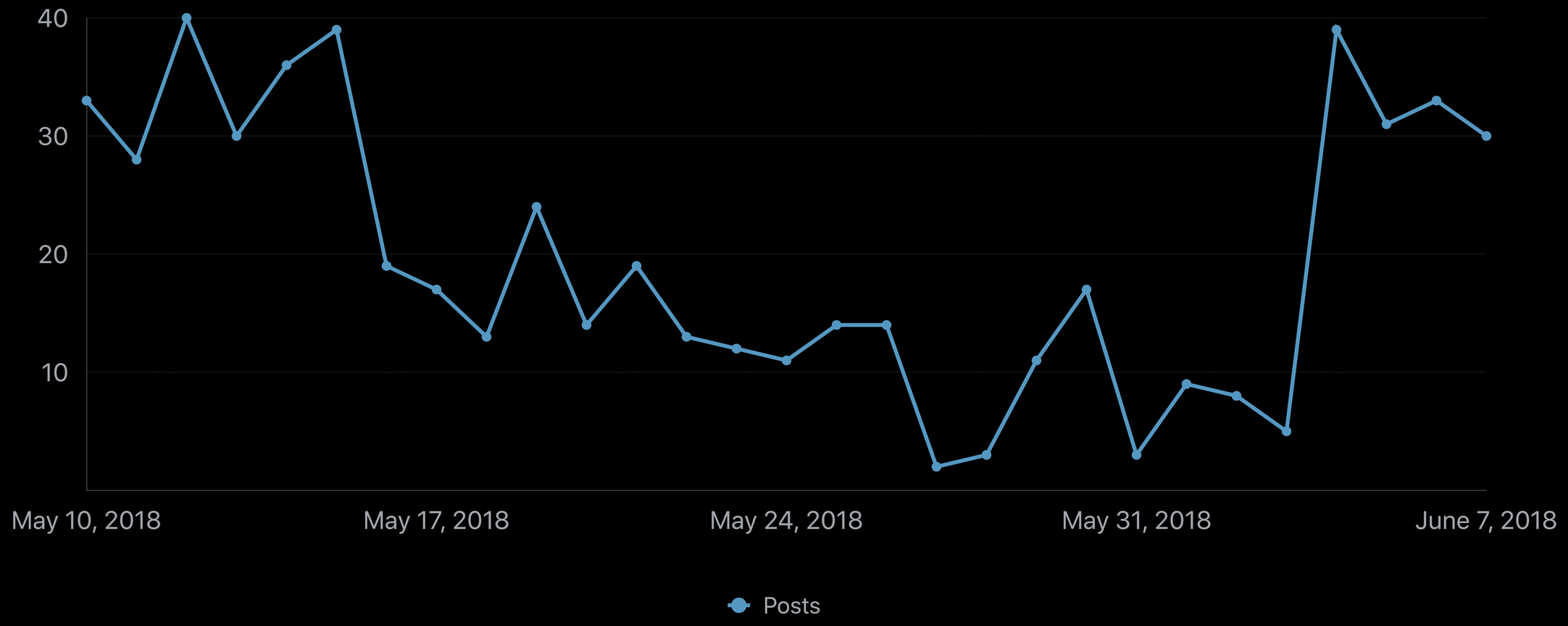
Matching UIs to the Model

ChartViewController



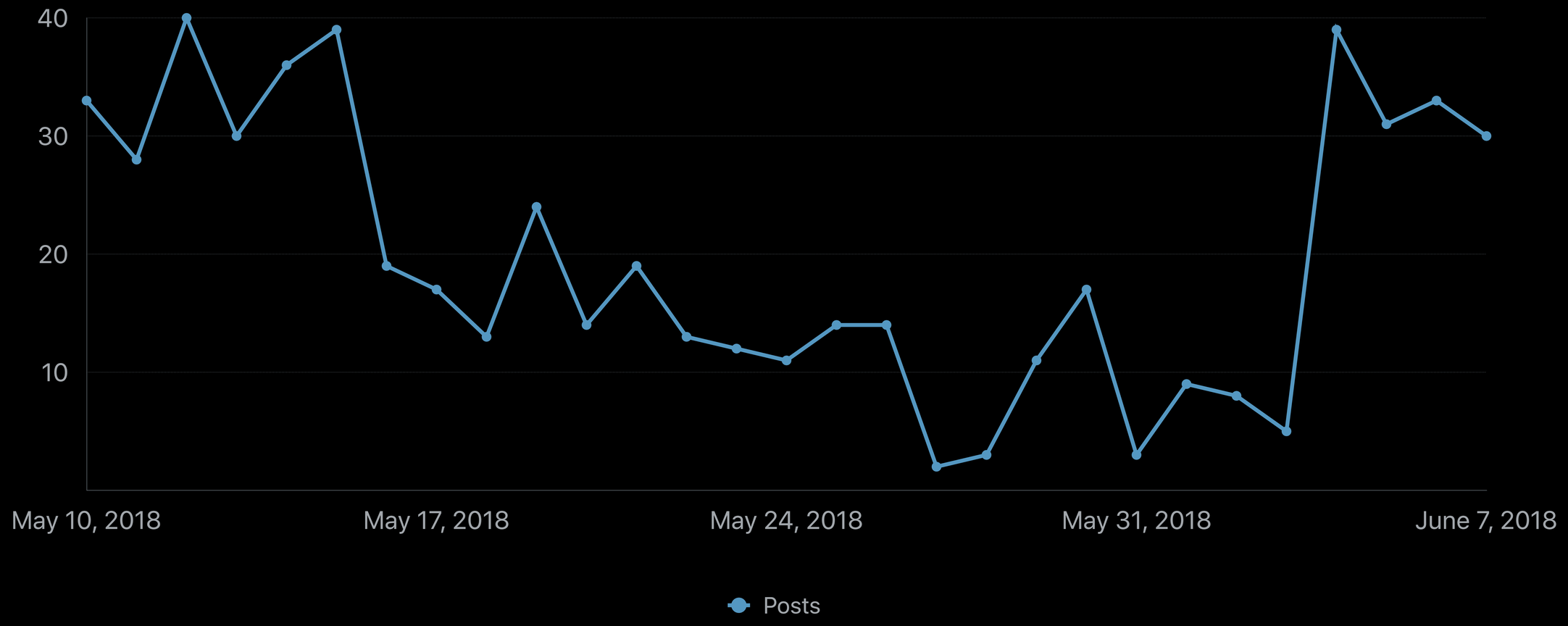
Matching UIs to the Model

Complex fetch requests

```
SELECT t0.ZDAY, COUNT( t0.ZDAY)
FROM ZPOST t0
WHERE ( t0.ZTIMESTAMP > ? AND  t0.ZTIMESTAMP <= ?)
GROUP BY  t0.ZDAY
```

Matching UIs to the Model

ChartViewController



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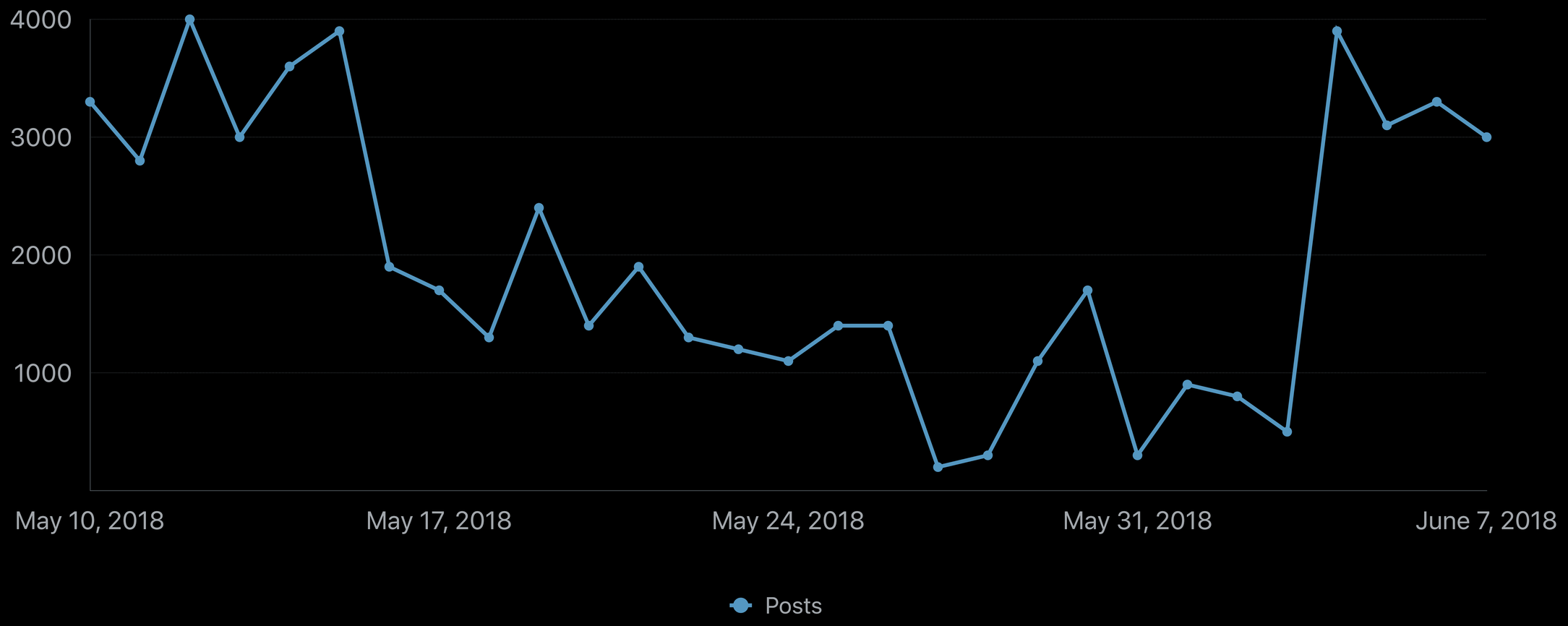

Denormalization

Matching UIs to the Model

ChartViewController

New entity

- PublishedPostCountPerDay
  - day (Date)
  - count (UInt)

Matching UIs to the Model

ChartViewController

```
let endDate = Date()

let startDate = Calendar.current.date(byAdding: DateComponents(day: -30), to: endDate)!

let fetchRequest = NSFetchRequest<PublishedPostCountPerDay>(entityName: "PublishedPostCountPerDay")
fetchRequest.predicate = NSPredicate(format: "day > %@ AND day <= %@",
                                     argumentArray: [startDate, endDate])
```

Matching UIs to the Model

ChartViewController

New entity

Maintained as needed

- When publishing a post
- When deleting a post

```
@objc func contextWillSave(_ notification: Notification) {
    guard let context = notification.object as? NSManagedObjectContext else { return }

    context.performAndWait {
        for case let post as Post in context.insertedObjects {
            let countObj = PublishedPostCountPerDay(dayOf: post.timestamp, context: context)
            countObj.count += 1
        }
        for case let post as Post in context.deletedObjects {
            let countObj = PublishedPostCountPerDay(dayOf: post.timestamp, context: context)
            countObj.count -= 1
        }
    }
}
```

Managing Growth

Nick Gillett

Managing Growth

Managing Growth

We want your application to grow

Managing Growth

We want your application to grow

- Specific to your app

Managing Growth

We want your application to grow

- Specific to your app
- Dependent on customer experience

Managing Growth

We want your application to grow

- Specific to your app
- Dependent on customer experience
- Tends toward chaos

Managing Growth

Managing Growth

Give structure to the chaos

Managing Growth

Give structure to the chaos

- Predictable behaviors

Managing Growth

Give structure to the chaos

- Predictable behaviors
- Build tunable containers

Managing Growth

Give structure to the chaos

- Predictable behaviors
- Build tunable containers
- Align performance with experience

Managing Growth

Managing Growth

Customer Aligned Metrics

Managing Growth

Customer Aligned Metrics

- Consistent UI

Managing Growth

Customer Aligned Metrics

- Consistent UI
- Responsive scrolling

Managing Growth

Customer Aligned Metrics

- Consistent UI
- Responsive scrolling
- Customer Delight

Managing Growth

Managing Growth

Engineering Metrics

Managing Growth

Engineering Metrics

- Peak memory consumption

Managing Growth

Engineering Metrics

- Peak memory consumption
- Battery drain

Managing Growth

Engineering Metrics

- Peak memory consumption
- Battery drain
- CPU time

Managing Growth

Engineering Metrics

- Peak memory consumption
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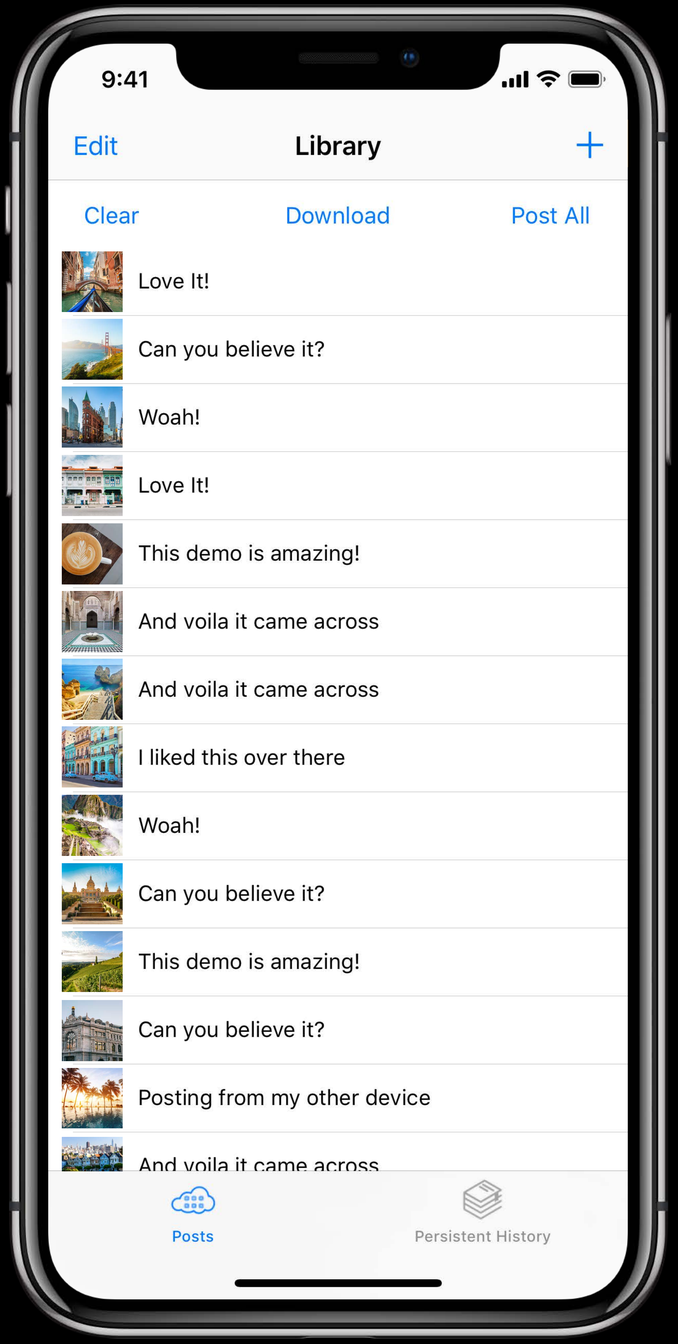
- CPU time
- I/O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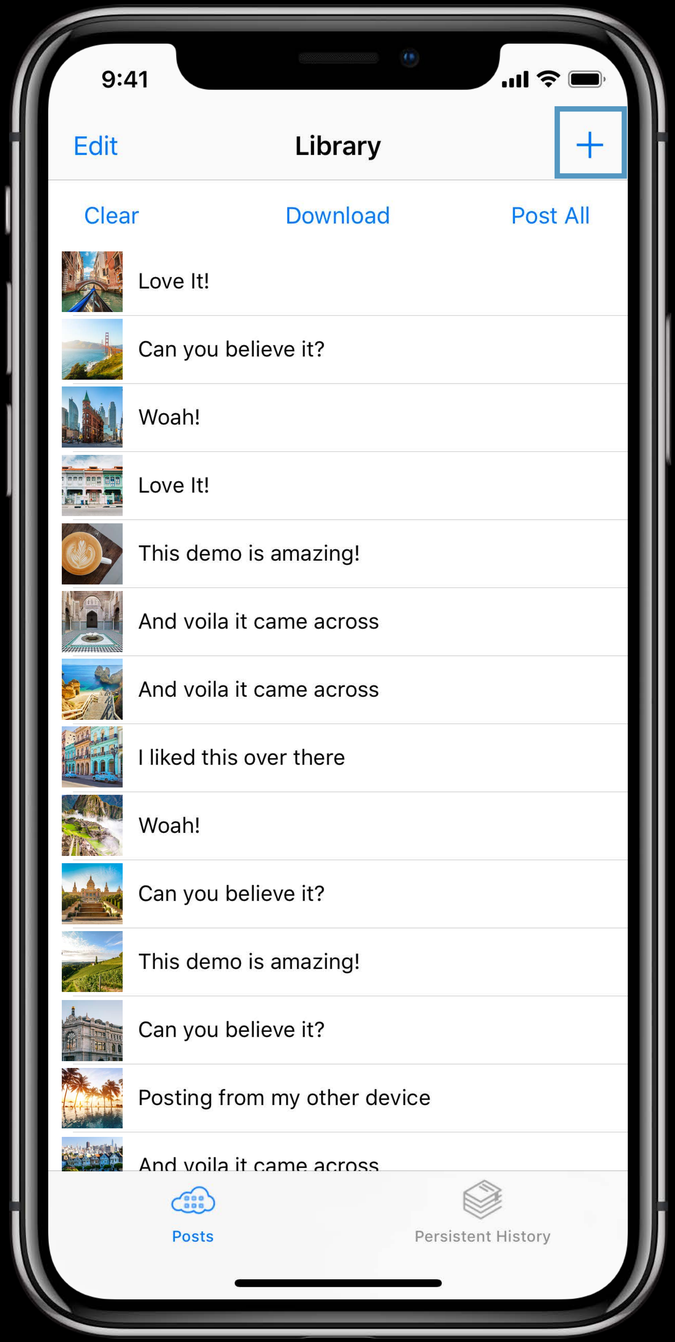
Posts
Persistent History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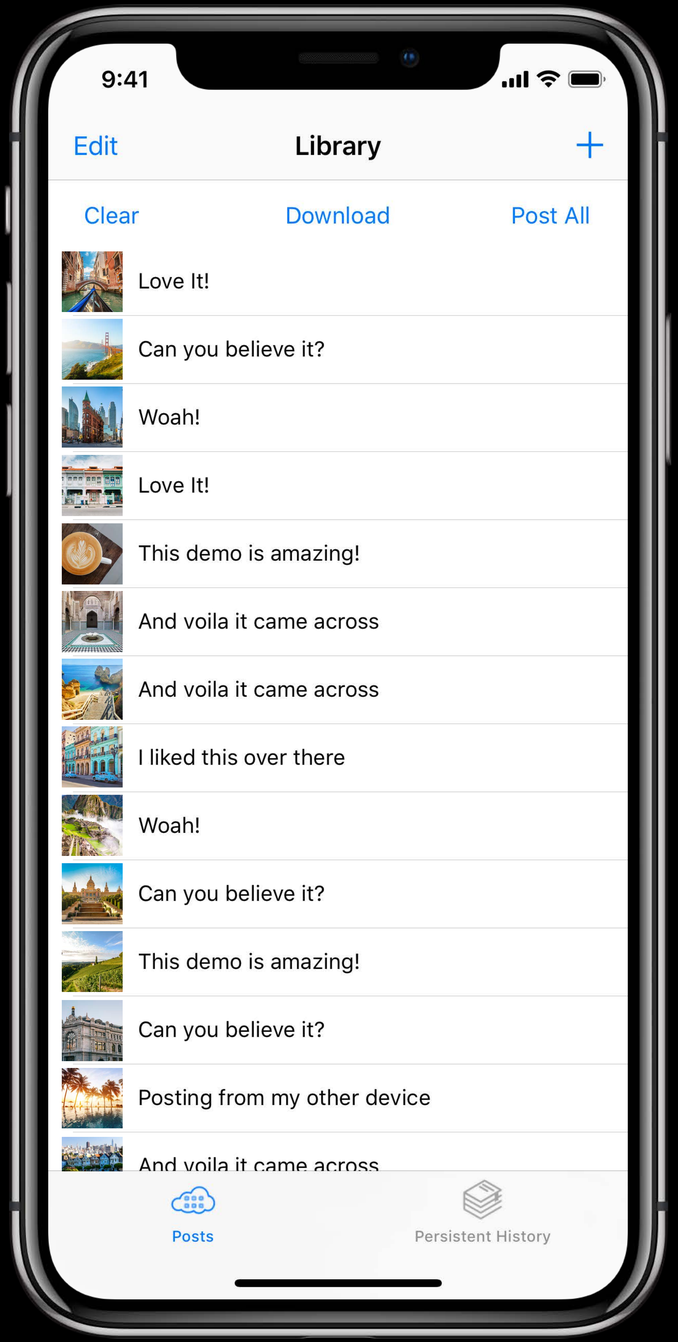
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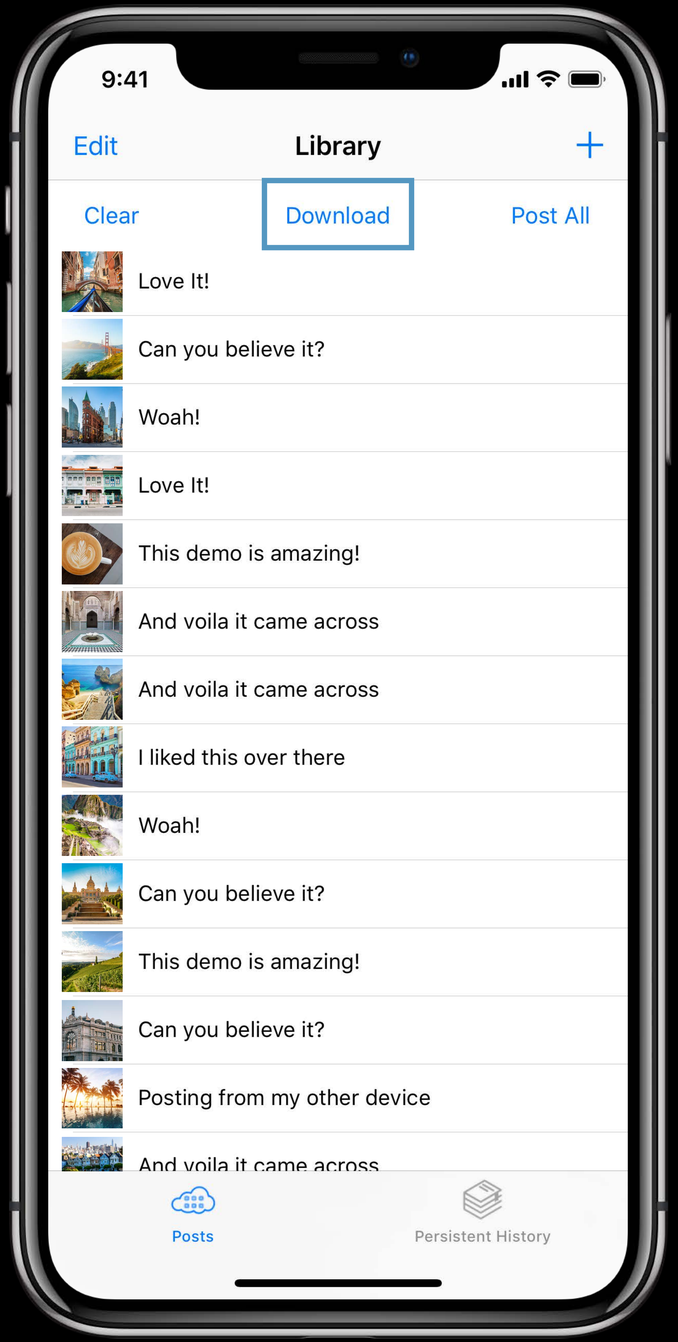
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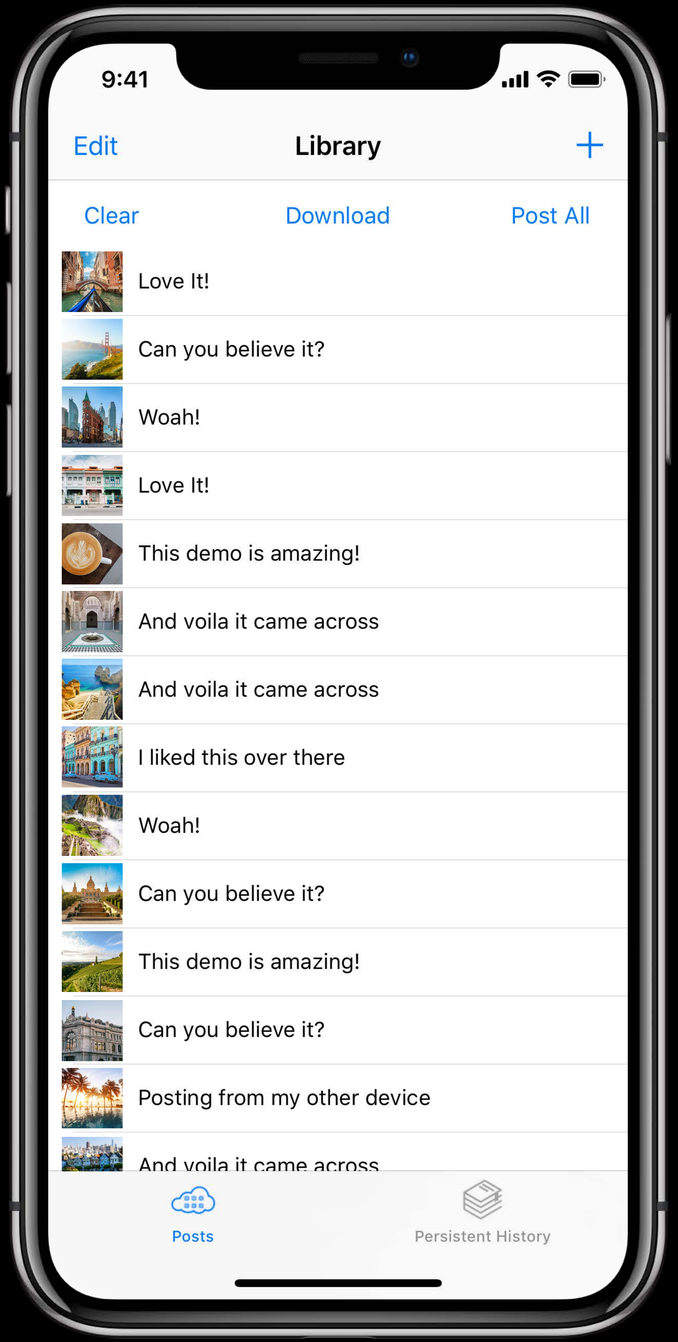
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Posts
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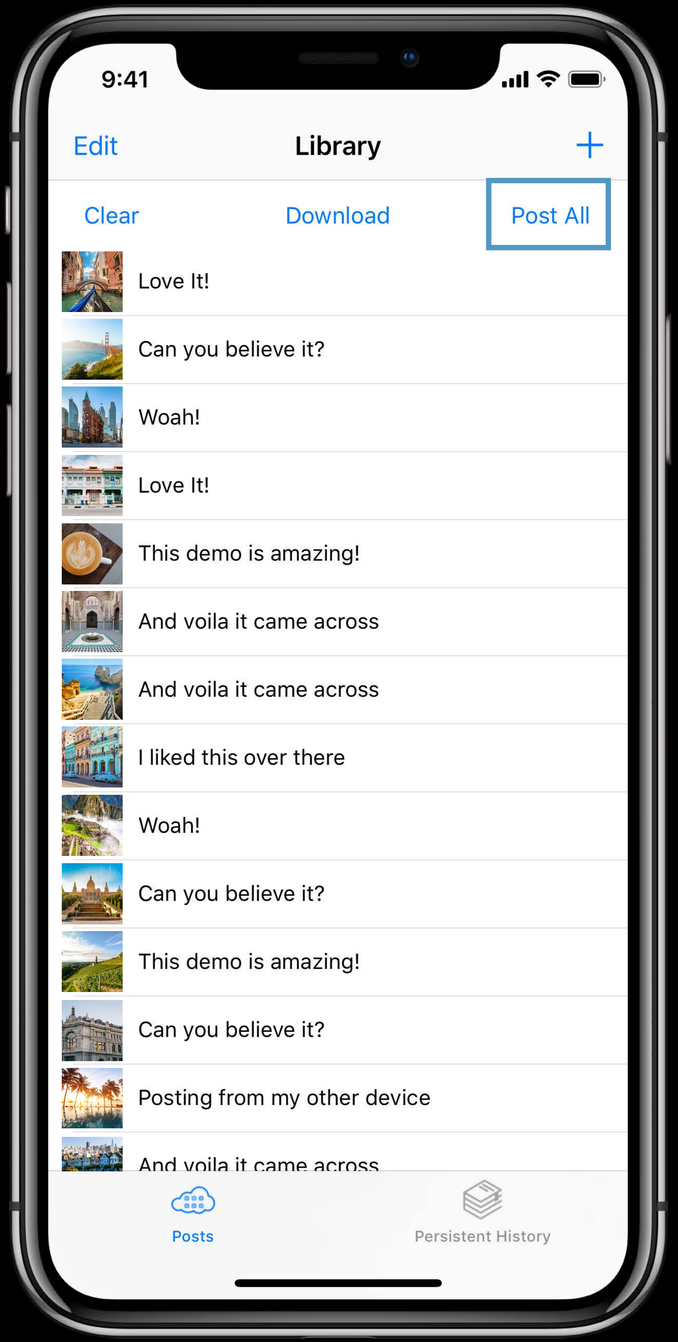
9:41
Edit
Library
Clear
Download
Post All
Love It!
Can you believe it?
Woah!
Love It!
This demo is amazing!
And voila it came across
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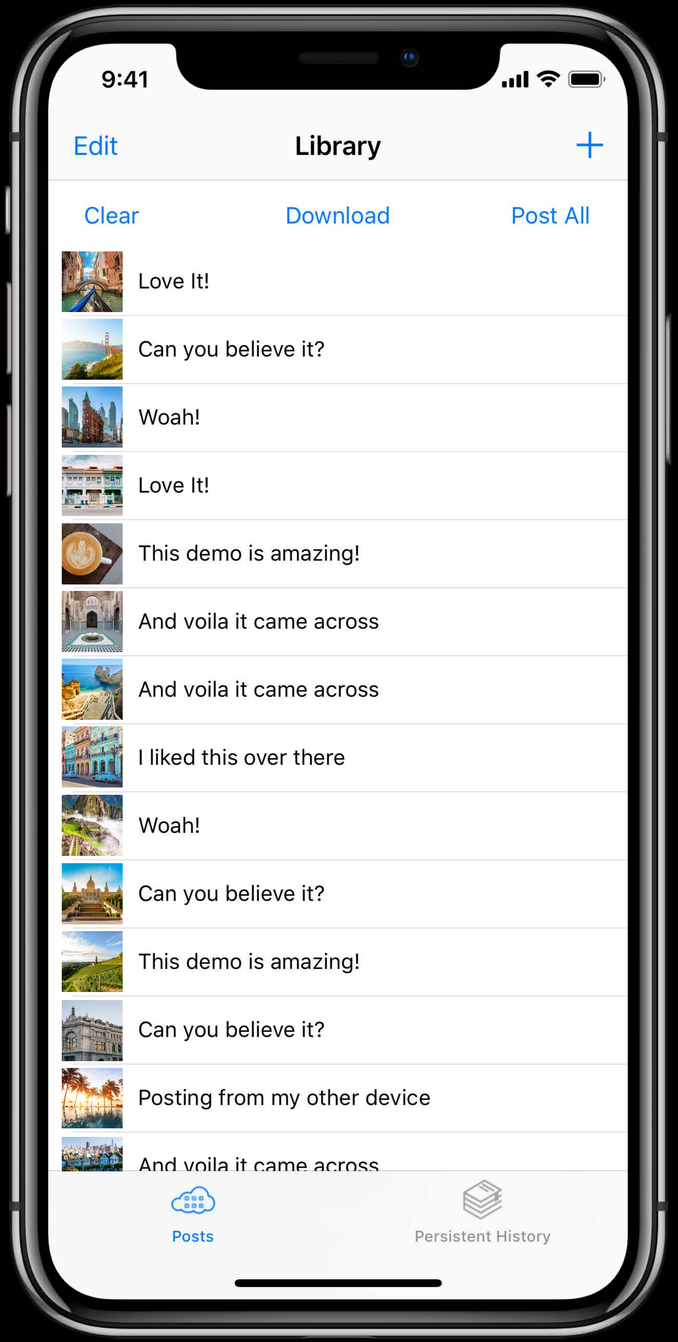
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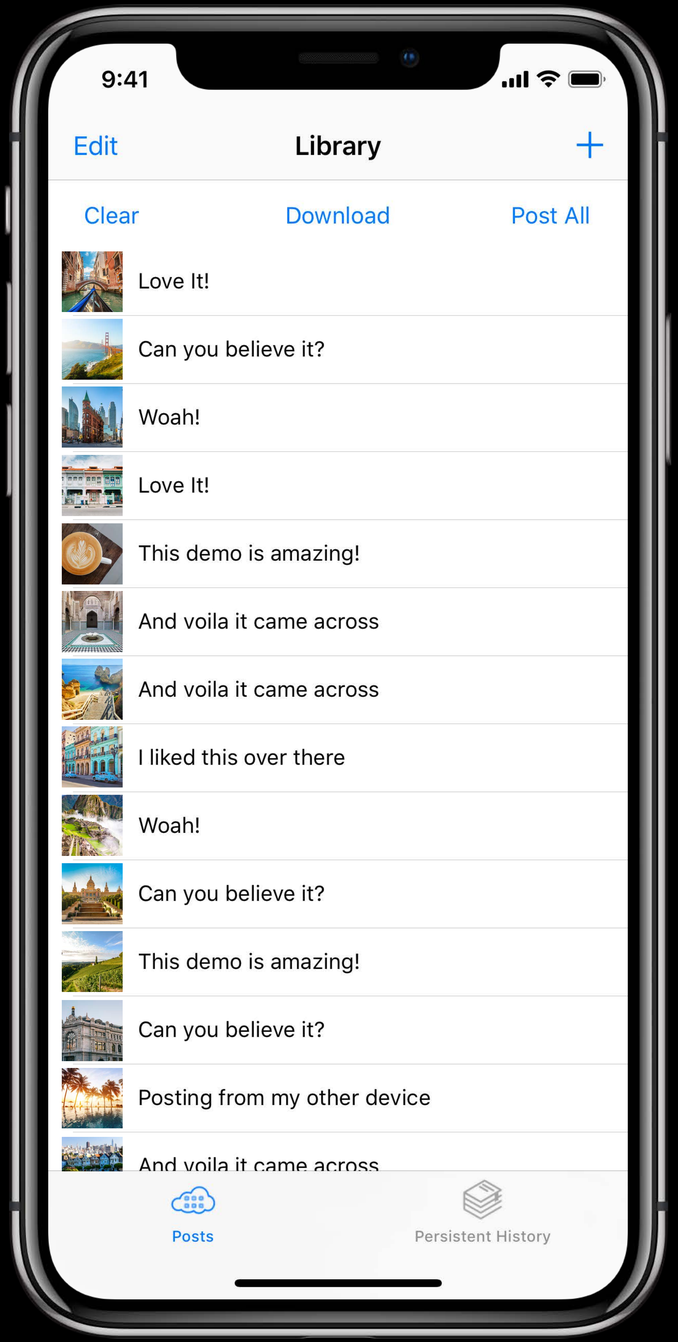
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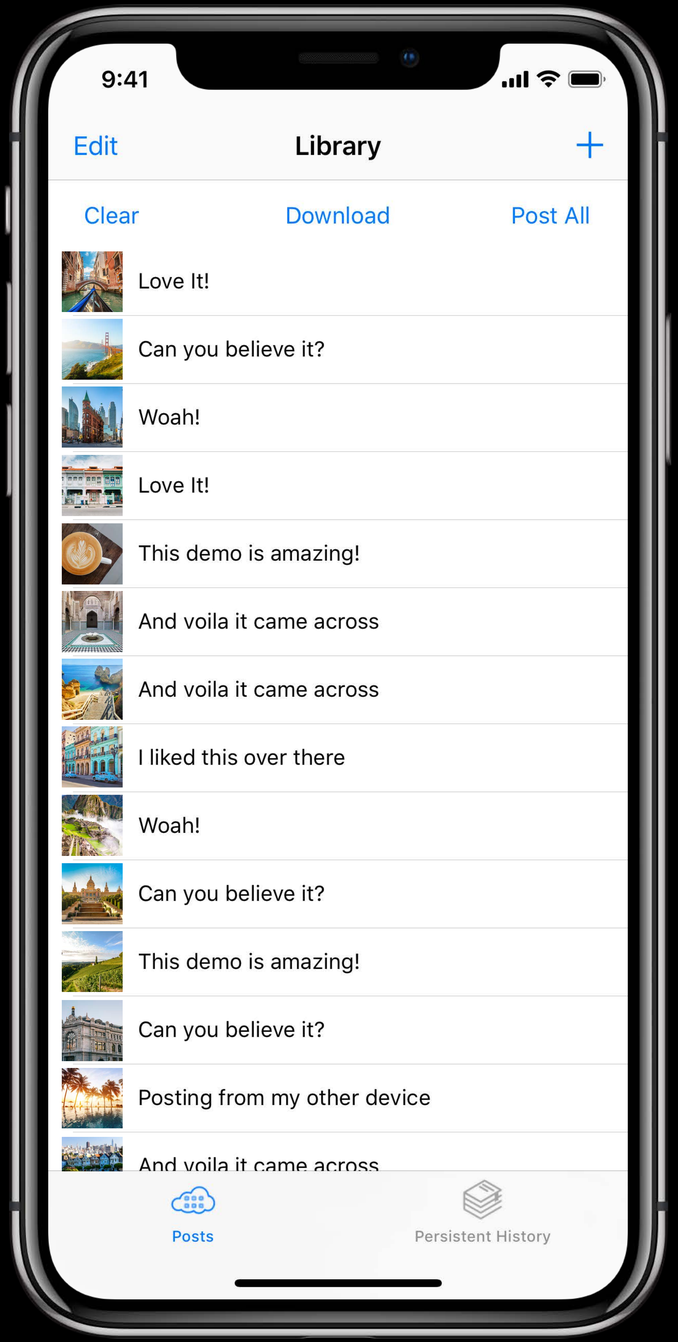
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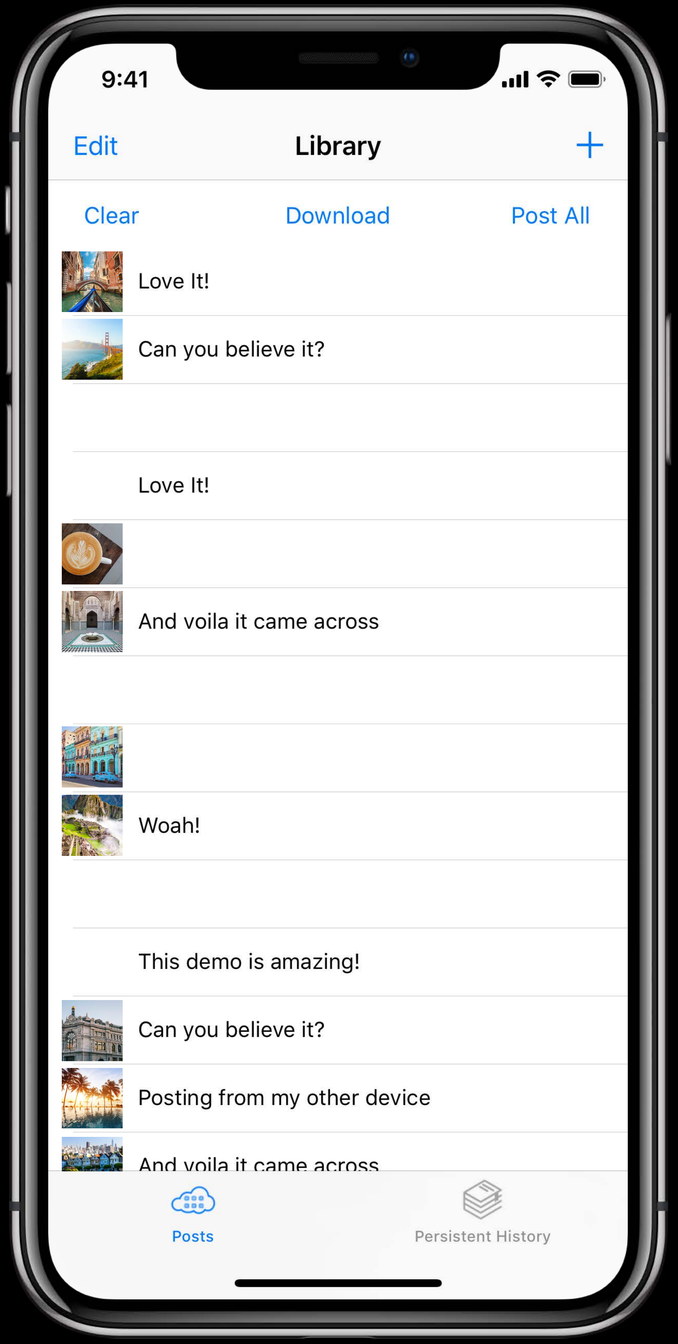
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Consistent Experiences with Query Generations

Consistent Experiences with Query Generations

CoreData is here to help

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- Query generations

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- Query generations
  - Isolate contexts from competing work

Consistent Experiences with Query Generations

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- Query generations
  - Isolate contexts from competing work
  - Provide a consistent, durable view of the database

Consistent Experiences with Query Generations

CoreData is here to help

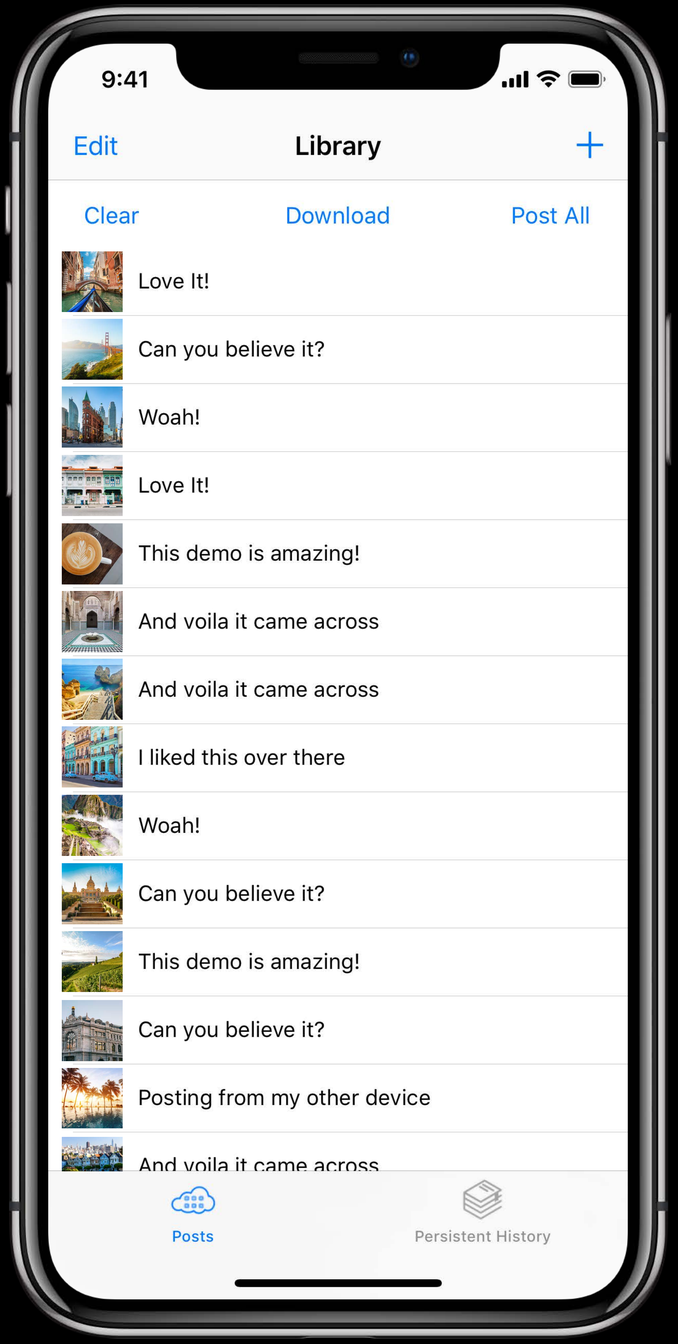
- Query generations
  - Isolate contexts from competing work
  - Provide a consistent, durable view of the database
  - Requires WAL journal mode

```
let context = container.viewContext
context.performAndWait {
    try context.setQueryGenerationFrom(NSQueryGenerationToken.current)
    try self.fetchedResultsController.performFetch()
}
self.tableView.reloadData()
```

```
let context = container.viewContext
context.performAndWait {
    try context.setQueryGenerationFrom(NSQueryGenerationToken.current)
    try self.fetchedResultsController.performFetch()
}
self.tableView.reloadData()
```

```
@objc func contextDidSave(notification: Notification) {
    let context = self.viewContext
    context.perform {
        context.mergeChanges(fromContextDidSave: notification)
    }
}
```

```
@objc func contextDidSave(notification: Notification) {
    let context = self.viewContext
    context.perform {
        context.mergeChanges(fromContextDidSave: notification)
    }
}
```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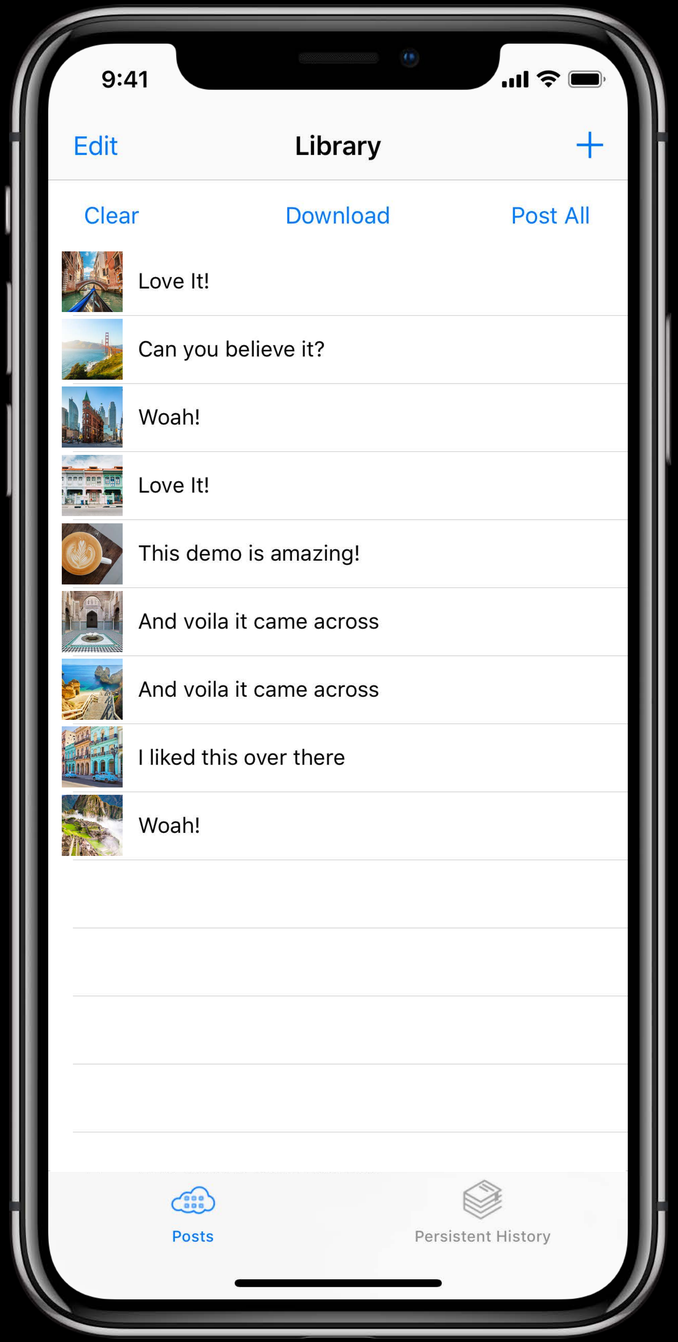
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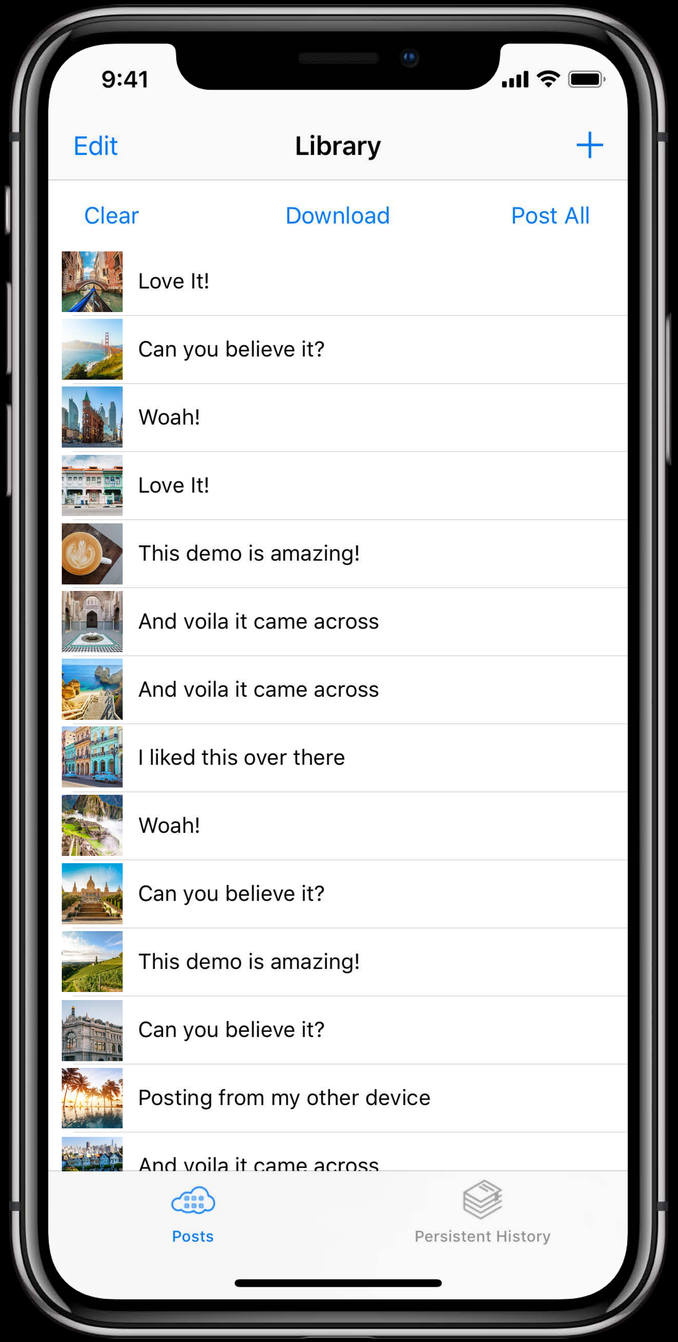
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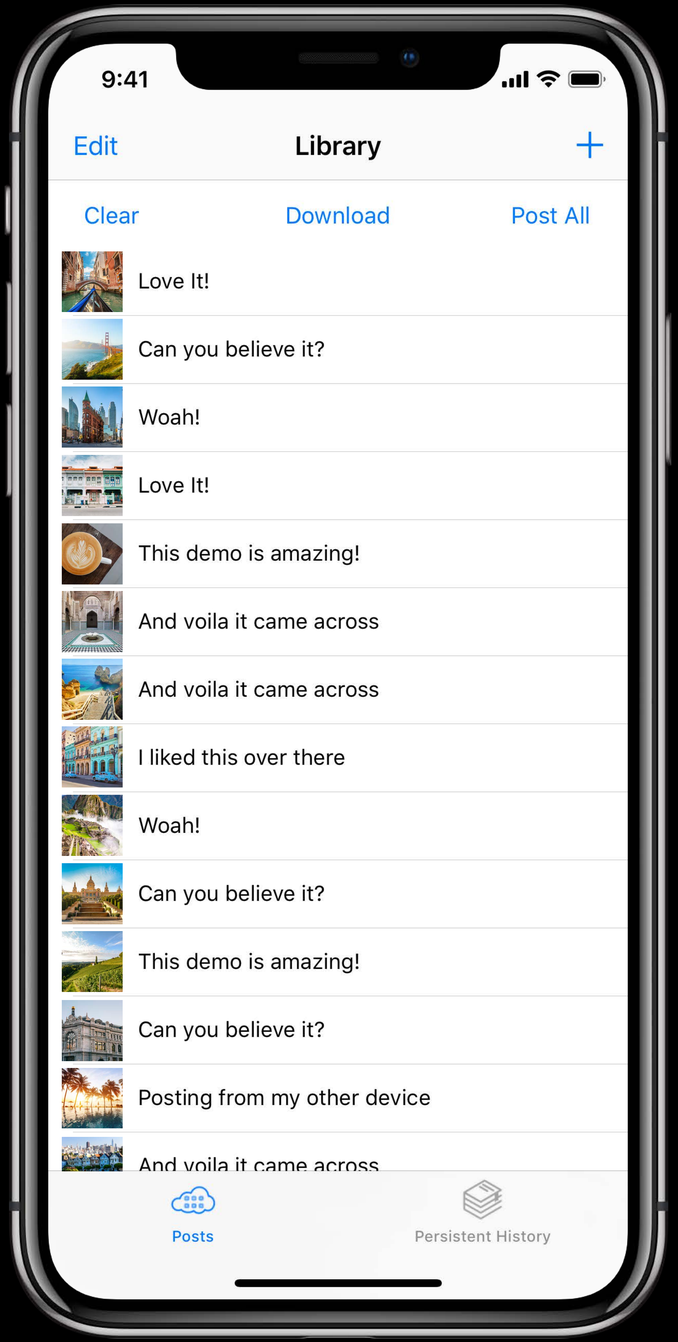
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Filtering Updates with Persistent History Tracking

Filtering Updates with Persistent History Tracking

New in iOS 11 and macOS 10.13

Filtering Updates with Persistent History Tracking

New in iOS 11 and macOS 10.13

Persisted record of each transaction

```swift
@available(iOS 11.0, *)
open class NSPersistentHistoryChange : NSObject, NSCopying {
    @NSCopying open var changedObjectID: NSManagedObjectID { get }
    open var updatedProperties: Set<NSPropertyDescription>? { get }
    //...
}
```

```swift
@available(iOS 11.0, *)
open class NSPersistentHistoryChange : NSObject, NSCopying {
    @NSCopying open var changedObjectID: NSManagedObjectID { get }
    open var updatedProperties: Set<NSPropertyDescription>? { get }
    //...
}


@available(iOS 11.0, *)
open class NSPersistentHistoryTransaction : NSObject, NSCopying {
    open var changes: [NSPersistentHistoryChange]? { get }
    //...
    open func objectIDNotification() -> Notification
}
```

Filtering Updates with Persistent History Tracking

Filtering Updates with Persistent History Tracking

changedObjectID	type
Post/p1	insert
Post/p2	insert
Post/p3	insert
Post/p4	insert
Post/p5	insert

```
let context = self.viewContext
let transaction: NSPersistentHistoryTransaction = //...
context.perform {
    context.mergeChanges(fromContextDidSave: transaction.objectIDNotification())
}
```

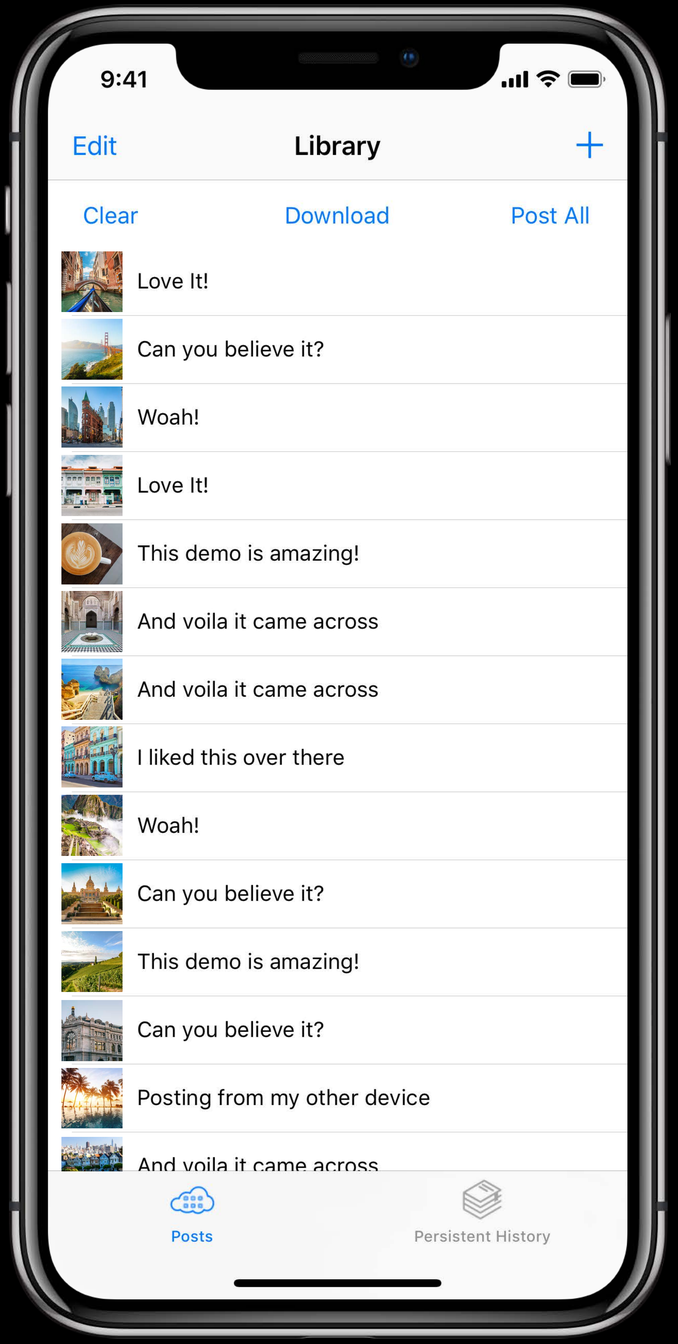
```
let context = self.viewContext
let transaction: NSPersistentHistoryTransaction = //...
context.perform {
    context.mergeChanges(fromContextDidSave: transaction.objectIDNotification())
}
```

Filtering Updates with Persistent History Tracking

changedObjectID	type
Comment/p1	insert
Comment/p2	insert
Comment/p3	insert
Comment/p4	insert
Comment/p5	insert

```
var changes = [] as Array<NSPersistentHistoryChange>
//…
for transaction in transactions {
    let filteredChanges = transaction.changes!.filter({ (change) -> Bool in
        return Post.entity().name == change.changedObjectID.entity.name
    })
    changes.append(contentsOf: filteredChanges)
}
```

```
var changes = [] as Array<NSPersistentHistoryChange>
//…
for transaction in transactions {
    let filteredChanges = transaction.changes!.filter({ (change) -> Bool in
        return Post.entity().name == change.changedObjectID.entity.name
    })
    changes.append(contentsOf: filteredChanges)
}
```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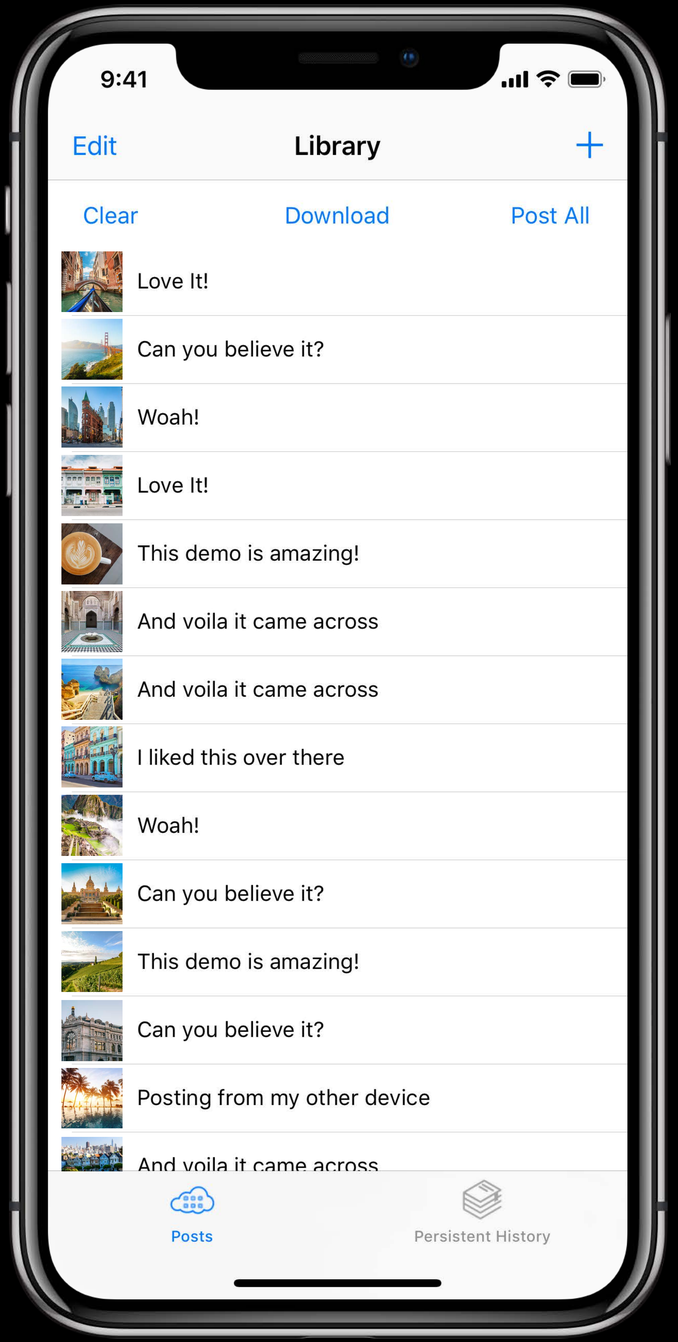
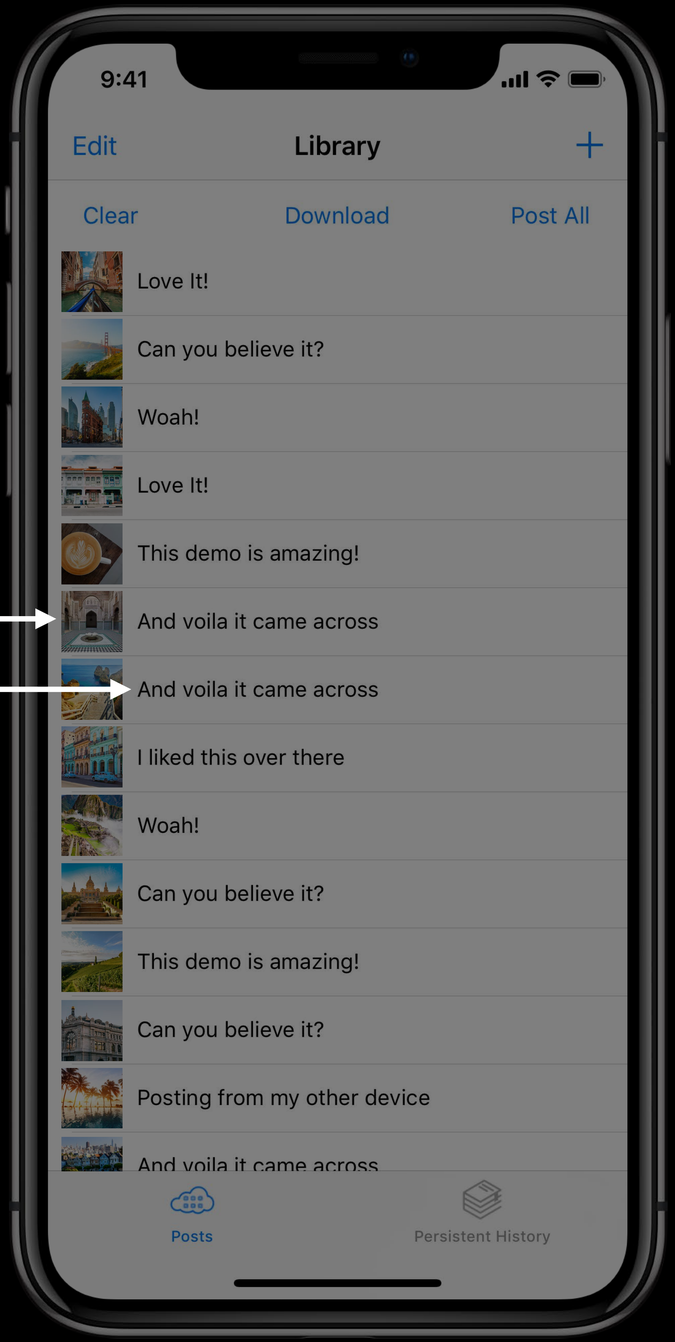
```
extension Post {
    @NSManaged public var image: Data?
    @NSManaged public var title: String?
    //...
}
```



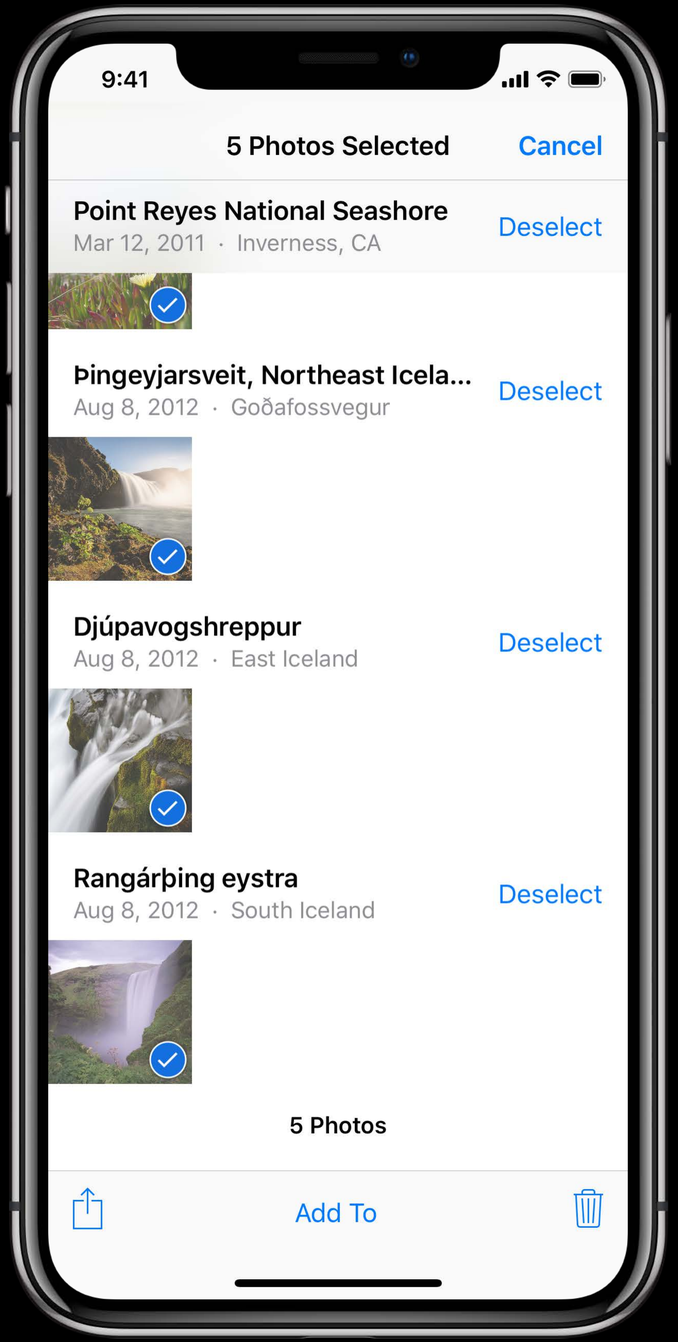
```
extension Post {
    @NSManaged public var image: Data?
    @NSManaged public var title: String?
    //...
}
```



```
var changes = [] as Array<NSPersistentHistoryChange>
//…
for transaction in transactions {
    let filteredChanges = transaction.changes!.filter({ (change) -> Bool in
        if let updatedProperties = change.updatedProperties {
            return updatedProperties.contains(where: { (property) -> Bool in
                return property.name == "image" ||
                       property.name == "title"
            })
        } else {
            return false;
        }
    })
    changes.append(contentsOf: filteredChanges)
}
```

```
var changes = [] as Array<NSPersistentHistoryChange>
//…
for transaction in transactions {
    let filteredChanges = transaction.changes!.filter({ (change) -> Bool in
        if let updatedProperties = change.updatedProperties {
            return updatedProperties.contains(where: { (property) -> Bool in
                return property.name == "image" ||
                       property.name == "title"
            })
        } else {
            return false;
        }
    })
    changes.append(contentsOf: filteredChanges)
}
```

Bulk Editing with Batch Operations


9:41
5 Photos Selected
Cancel
Point Reyes National Seashore
Mar 12, 2011 · Inverness, CA
Deselect
Þingeyjarsveit, Northeast Icela...
Aug 8, 2012 · Goðafossvegur
Deselect
Djúpavogshreppur
Aug 8, 2012 · East Iceland
Deselect
Rangárþing eystra
Aug 8, 2012 · South Iceland
Deselect
5 Photos
Add To

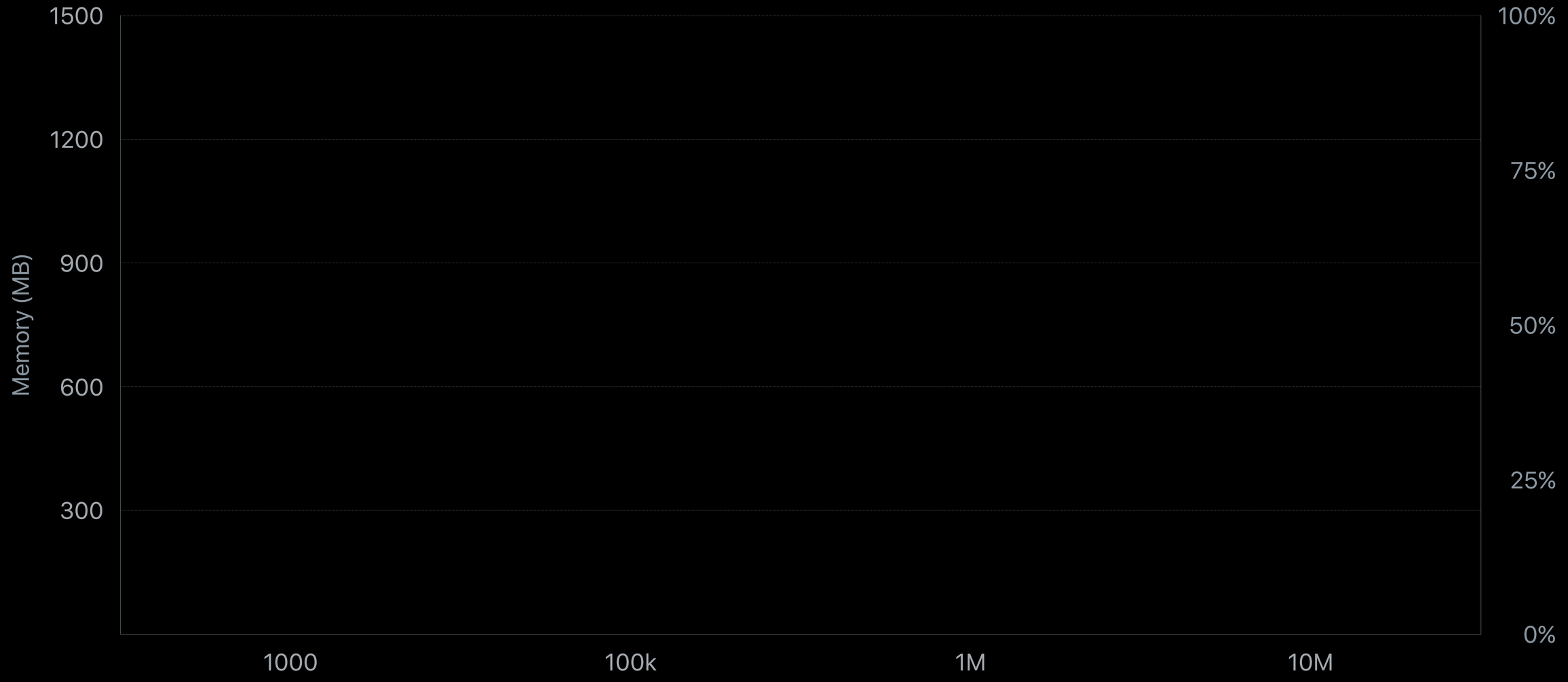
```swift
let context = self.container.newBackgroundContext()
context.perform {
    let bur = NSBatchUpdateRequest(entity: Photo.entity())
    bur.propertiesToUpdate = ["favorite": NSExpression(forConstantValue: 1)]
    try context.execute(bur)
}
```

```swift
let context = self.container.newBackgroundContext()
context.perform {
    let bur = NSBatchUpdateRequest(entity: Photo.entity())
    bur.propertiesToUpdate = ["favorite": NSExpression(forConstantValue: 1)]
    try context.execute(bur)
}
```

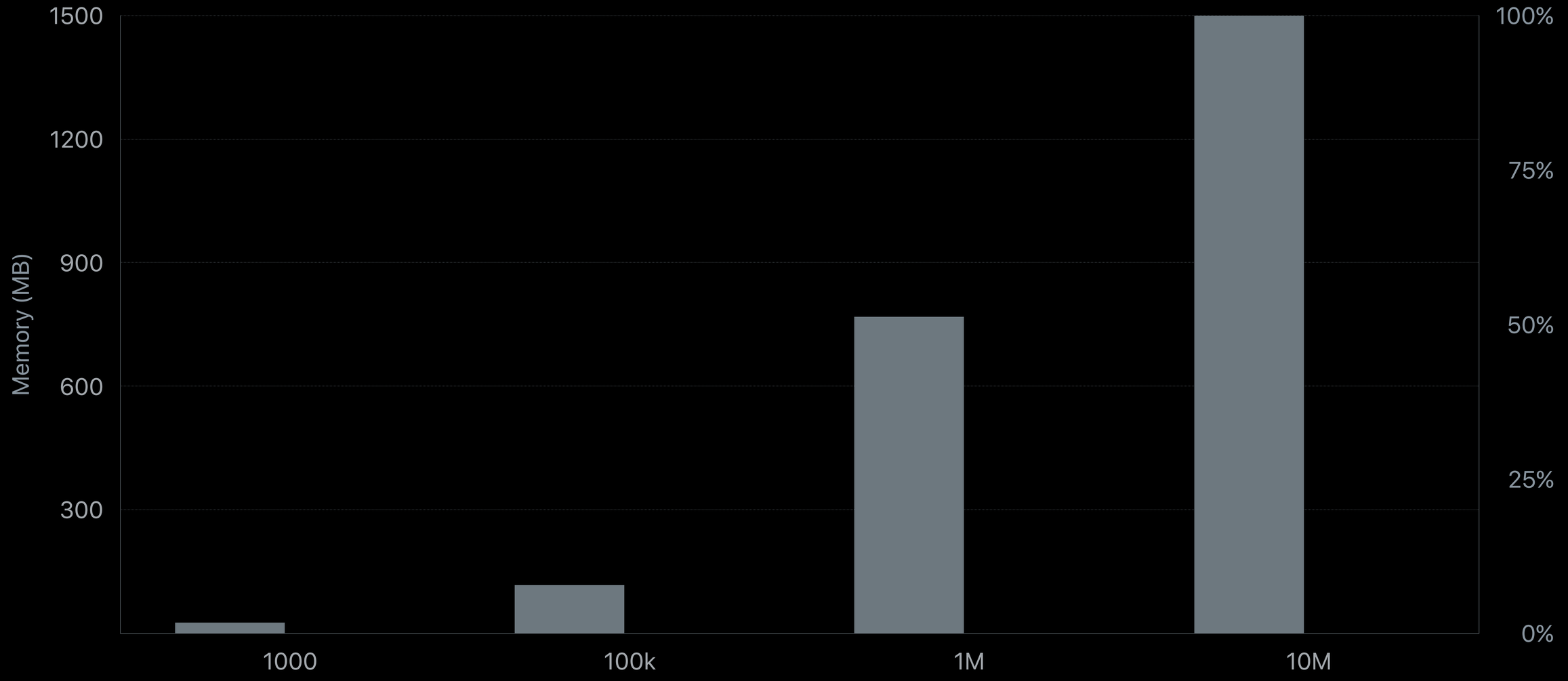
```
let context = self.container.newBackgroundContext()
context.perform {
    let bdr = NSBatchDeleteRequest(entity: Photo.entity())
    try context.execute(bdr)
}
```

NSManagedObject.delete vs NSBatchDeleteRequest

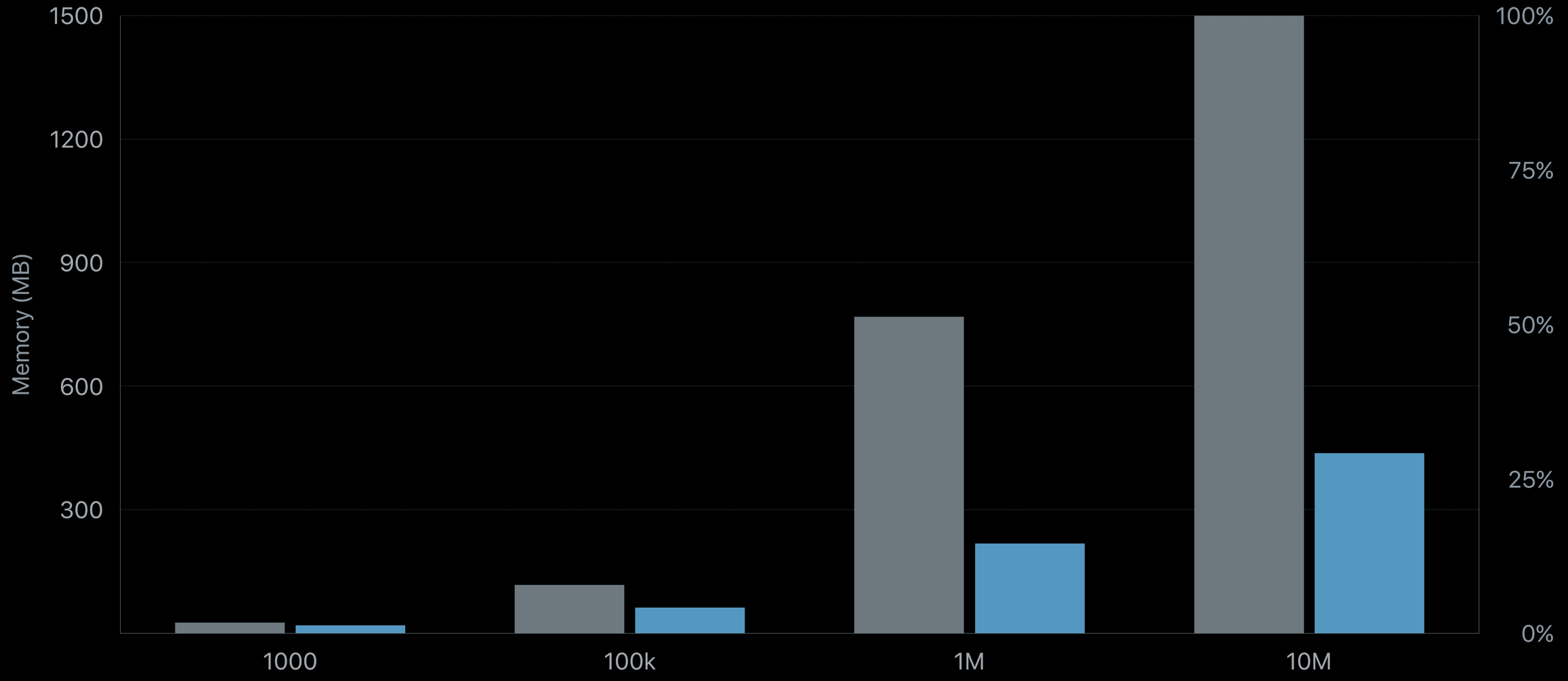
NSManagedObject.delete vs NSBatchDeleteRequest



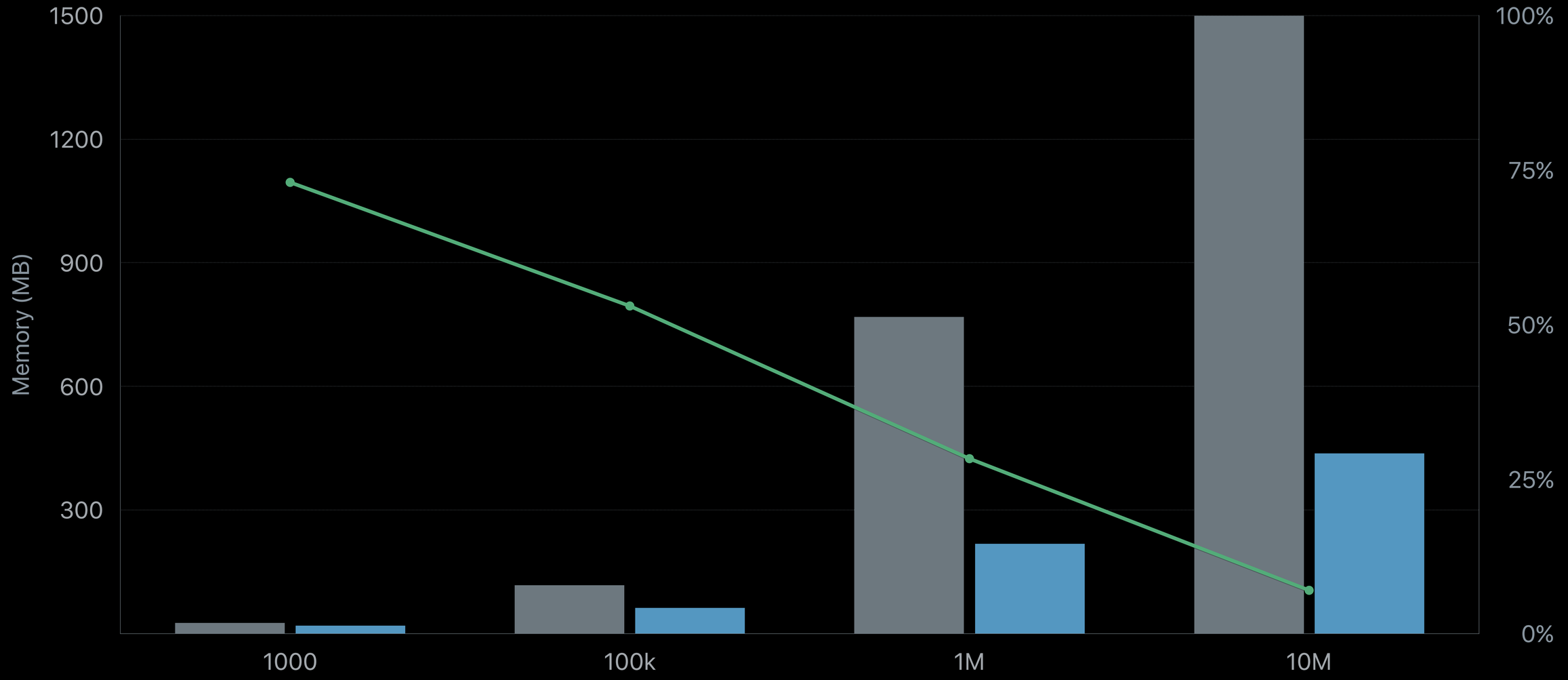
NSManagedObject.delete vs NSBatchDeleteRequest



NSManagedObject.delete vs NSBatchDeleteRequest



NSManagedObject.delete vs NSBatchDeleteRequest



```swift
let context = container.viewContext
context.performAndWait {
    let request = NSPersistentHistoryChangeRequest()
    request.resultType = .transactionsAndChanges
    do {
        let result = try context.execute(request) as! NSPersistentHistoryResult
        let transactions = result.result as! Array<NSPersistentHistoryTransaction>
        for transaction in transactions {
            context.mergeChanges(fromContextDidSave: transaction.objectIDNotification())
        }
    } catch {
        //...
    }
}
```

```swift
let context = container.viewContext
context.performAndWait {
    let request = NSPersistentHistoryChangeRequest()
    request.resultType = .transactionsAndChanges
    do {
        let result = try context.execute(request) as! NSPersistentHistoryResult
        let transactions = result.result as! Array<NSPersistentHistoryTransaction>
        for transaction in transactions {
            context.mergeChanges(fromContextDidSave: transaction.objectIDNotification())
        }
    } catch {
        //...
    }
}
```

```
let context = container.viewContext
context.performAndWait {
    let request = NSPersistentHistoryChangeRequest()
    request.resultType = .transactionsAndChanges
    do {
        let result = try context.execute(request) as! NSPersistentHistoryResult
        let transactions = result.result as! Array<NSPersistentHistoryTransaction>
        for transaction in transactions {
            context.mergeChanges(fromContextDidSave: transaction.objectIDNotification())
        }
    } catch {
        //...
    }
}
```

Working Efficiently with CoreData

Help Future You

Help Future You

NSKeyedArchiver API is changing

Help Future You

NSKeyedArchiver API is changing

Default value transformer

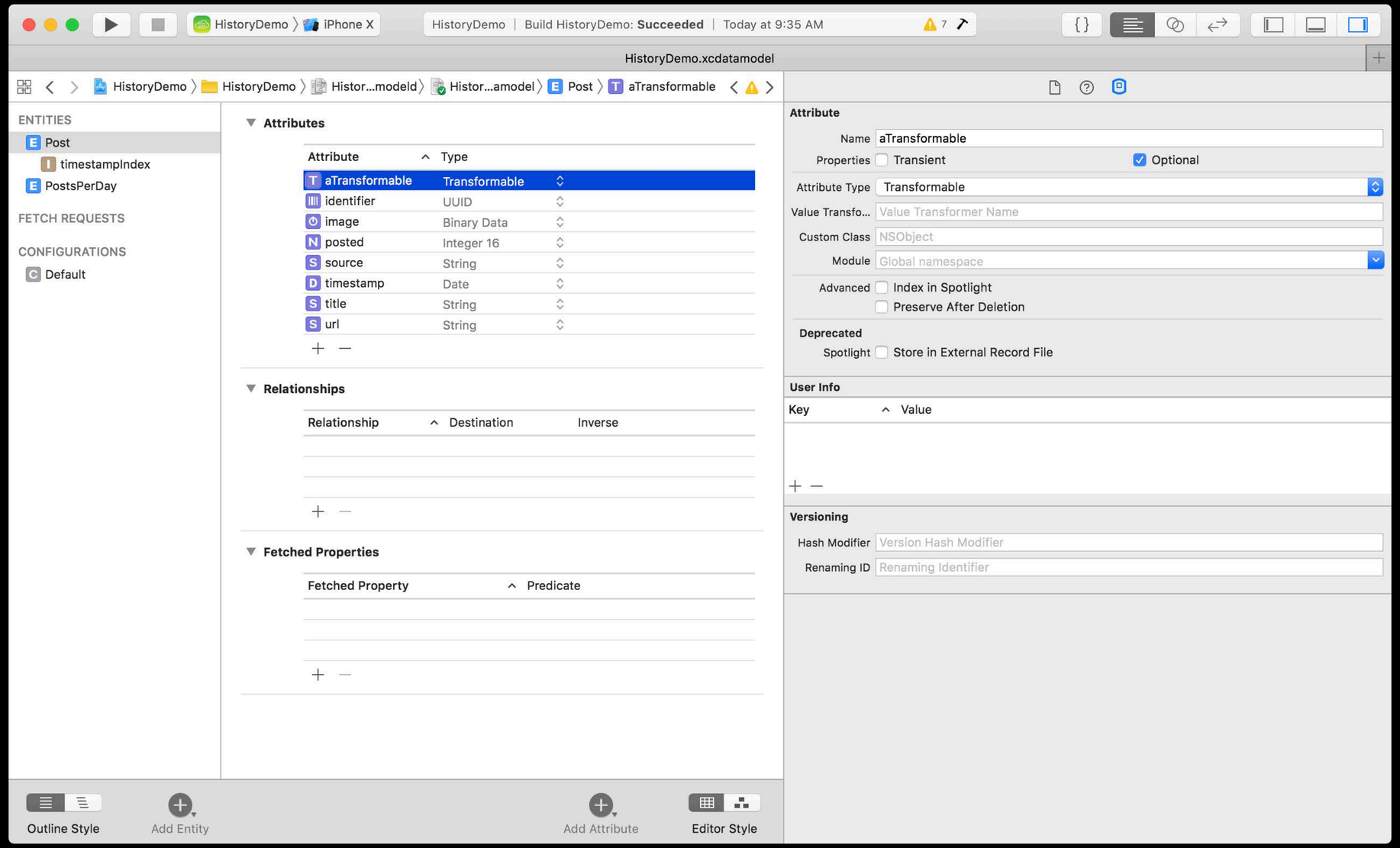
Help Future You

NSKeyedArchiver API is changing

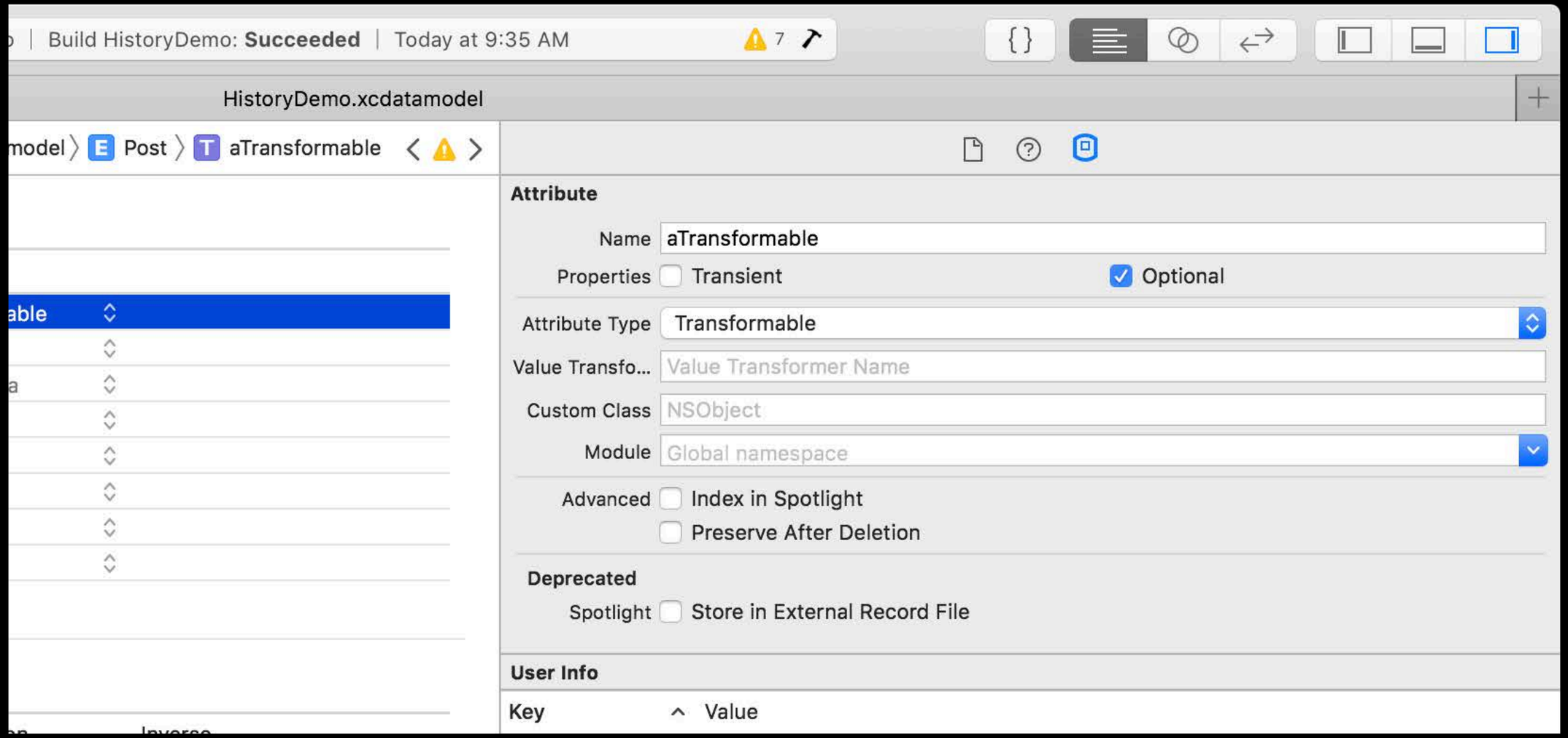
Default value transformer

- Old—nil or NSKeyedUnarchiveFromDataTransformerName
- New—NSSecureUnarchiveFromDataTransformerName

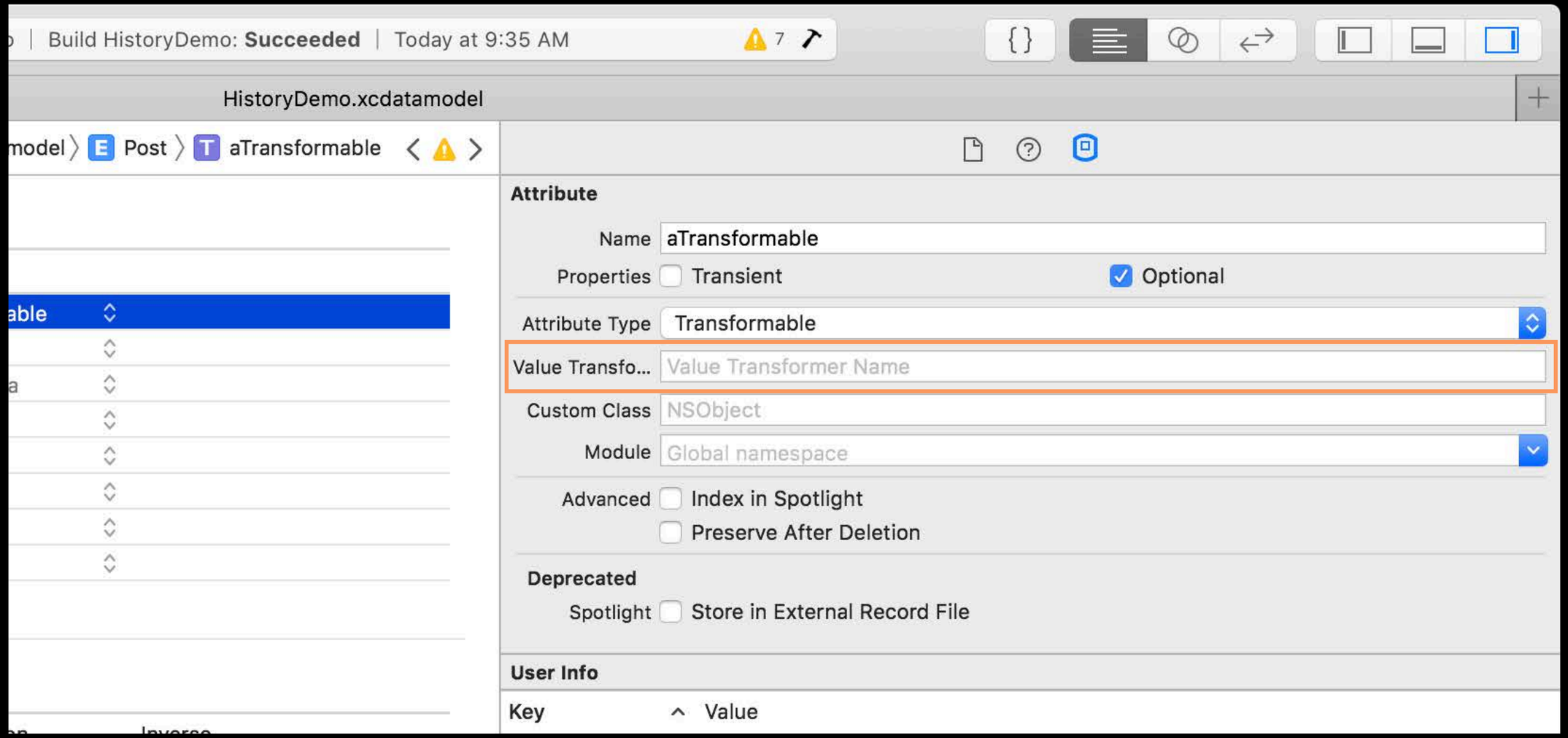
Adopt NSSecureUnarchiveFromDataTransformerName



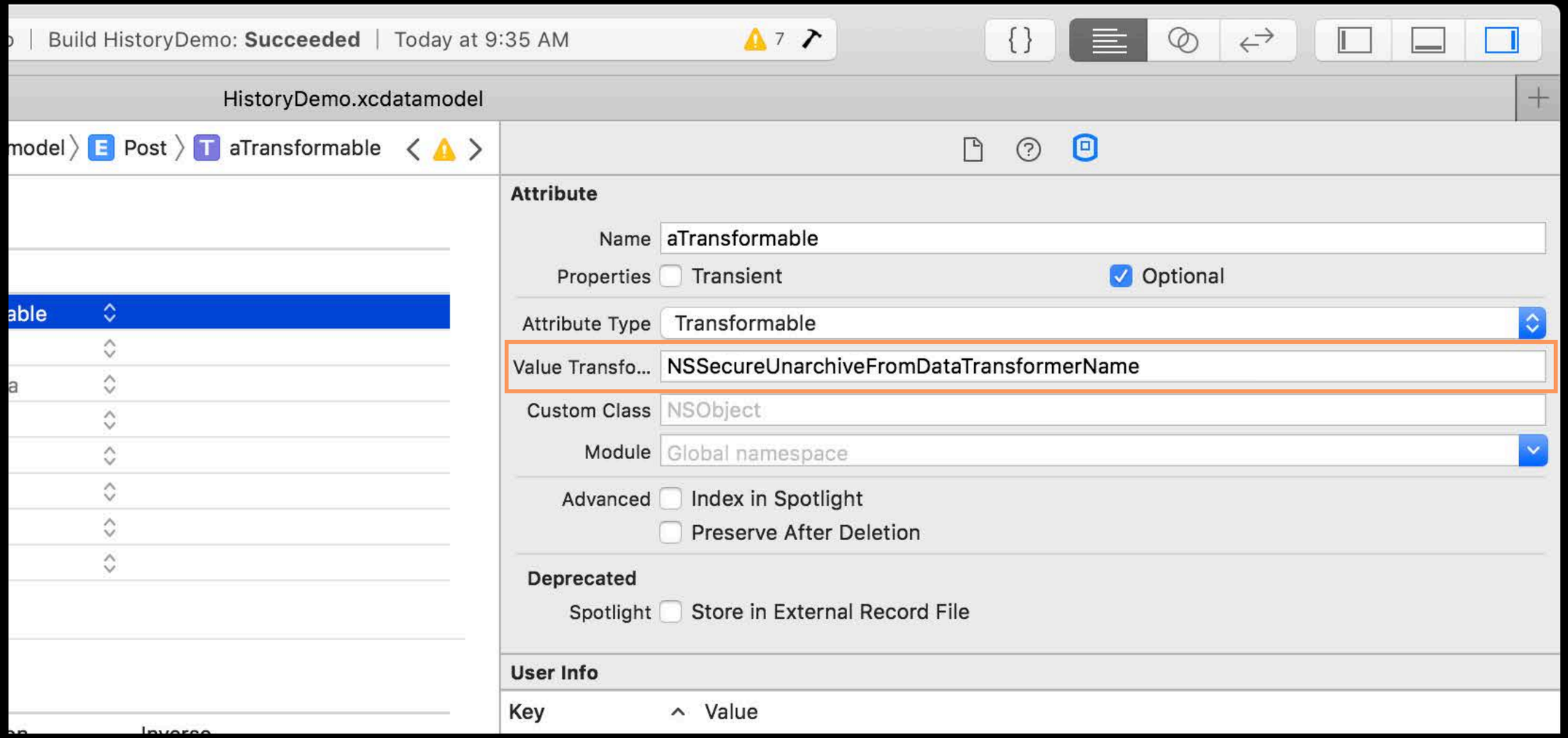
Adopt NSSecureUnarchiveFromDataTransformerName



Adopt NSSecureUnarchiveFromDataTransformerName



Adopt NSSecureUnarchiveFromDataTransformerName



```
if let transformableAttribute = model.entitiesByName["Post"]?.attributesByName["aTransformable"] {
    transformableAttribute.valueTransformerName = NSSecureUnarchiveFromDataTransformerName
}
```

```
if let transformableAttribute = model.entitiesByName["Post"]?.attributesByName["aTransformable"] {
    transformableAttribute.valueTransformerName = NSSecureUnarchiveFromDataTransformerName
}
```

Help Future You

NSKeyedArchiver API is changing

Default Value Transformer

- Old—nil or NSKeyedUnarchiveFromDataTransformerName
- New—NSSecureUnarchiveFromDataTransformerName

Help Future You

NSKeyedArchiver API is changing

Default Value Transformer

- Old—nil or NSKeyedUnarchiveFromDataTransformerName
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Transparent for plist types

Help Future You

NSKeyedArchiver API is changing

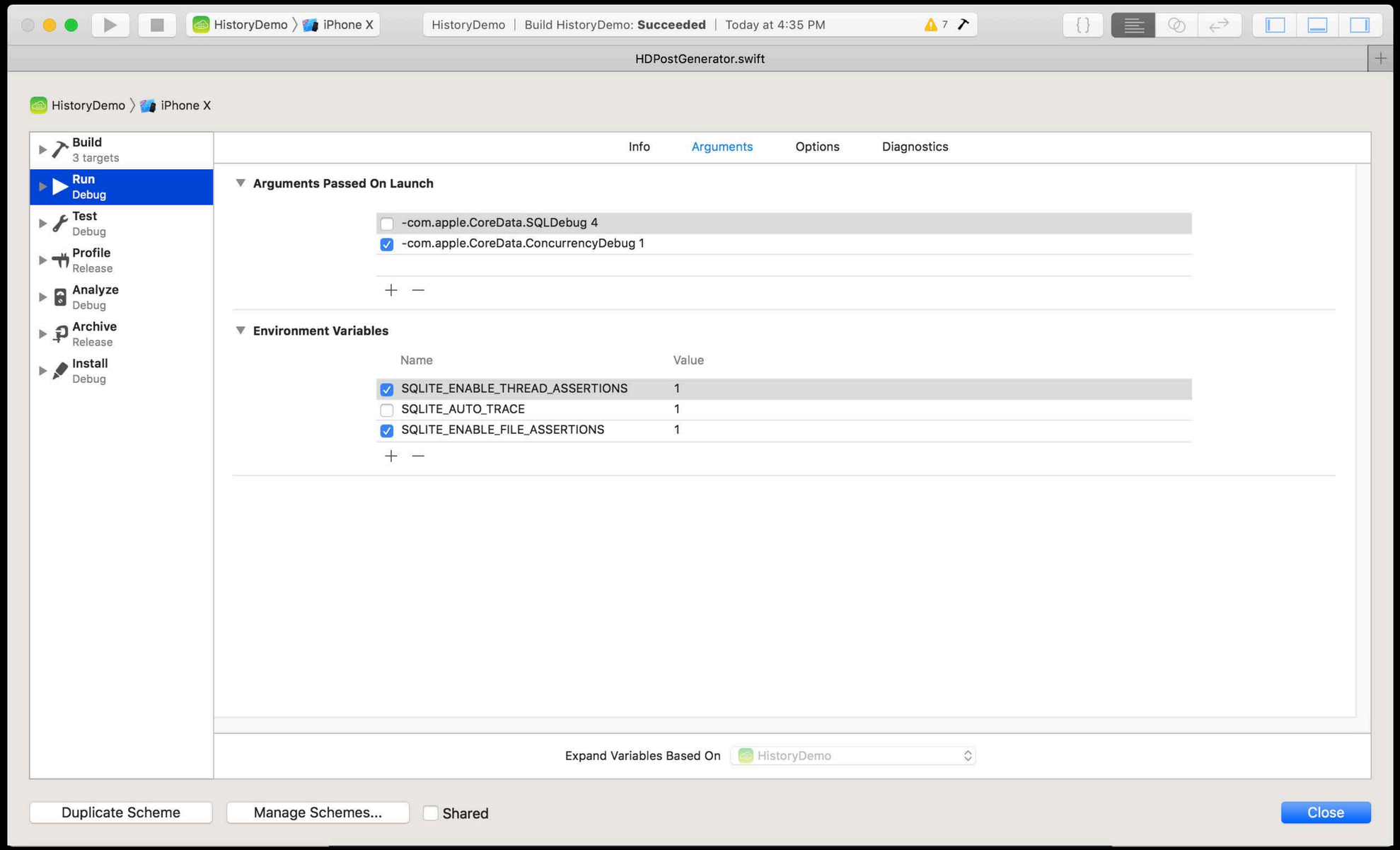
Default Value Transformer

- Old—nil or NSKeyedUnarchiveFromDataTransformerName
- New—NSSecureUnarchiveFromDataTransformerName

Transparent for plist types

- Custom classes need a custom transformer
- Come see us in lab!

Help Us Help You



```
CoreData: annotation: Core Data multi-threading assertions enabled.
CoreData: annotation: Connecting to sqlite database file at “/path/to/db.sqlite”
```

```
CoreData: annotation: Core Data multi-threading assertions enabled.
CoreData: annotation: Connecting to sqlite database file at “/path/to/db.sqlite”
//...
CoreData: annotation: fetch using NSSQLiteStatement <0x600003aae0d0> on entity 'Post' with sql text 'SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC' returned 100000 rows with values: (
//...
)
CoreData: annotation: total fetch execution time: 17.6644s for 100000 rows.
```

```
CoreData: annotation: Core Data multi-threading assertions enabled.
CoreData: annotation: Connecting to sqlite database file at “/path/to/db.sqlite”
//...
CoreData: annotation: fetch using NSSQLiteStatement <0x600003aae0d0> on entity 'Post' with sql text 'SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC' returned 100000 rows with values: (
//...
)
CoreData: annotation: total fetch execution time: 17.6644s for 100000 rows.
CoreData: details: SQLite: EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC
      0 0 0 SCAN TABLE ZPOST AS t0
      0 0 0 USE TEMP B-TREE FOR ORDER BY
```

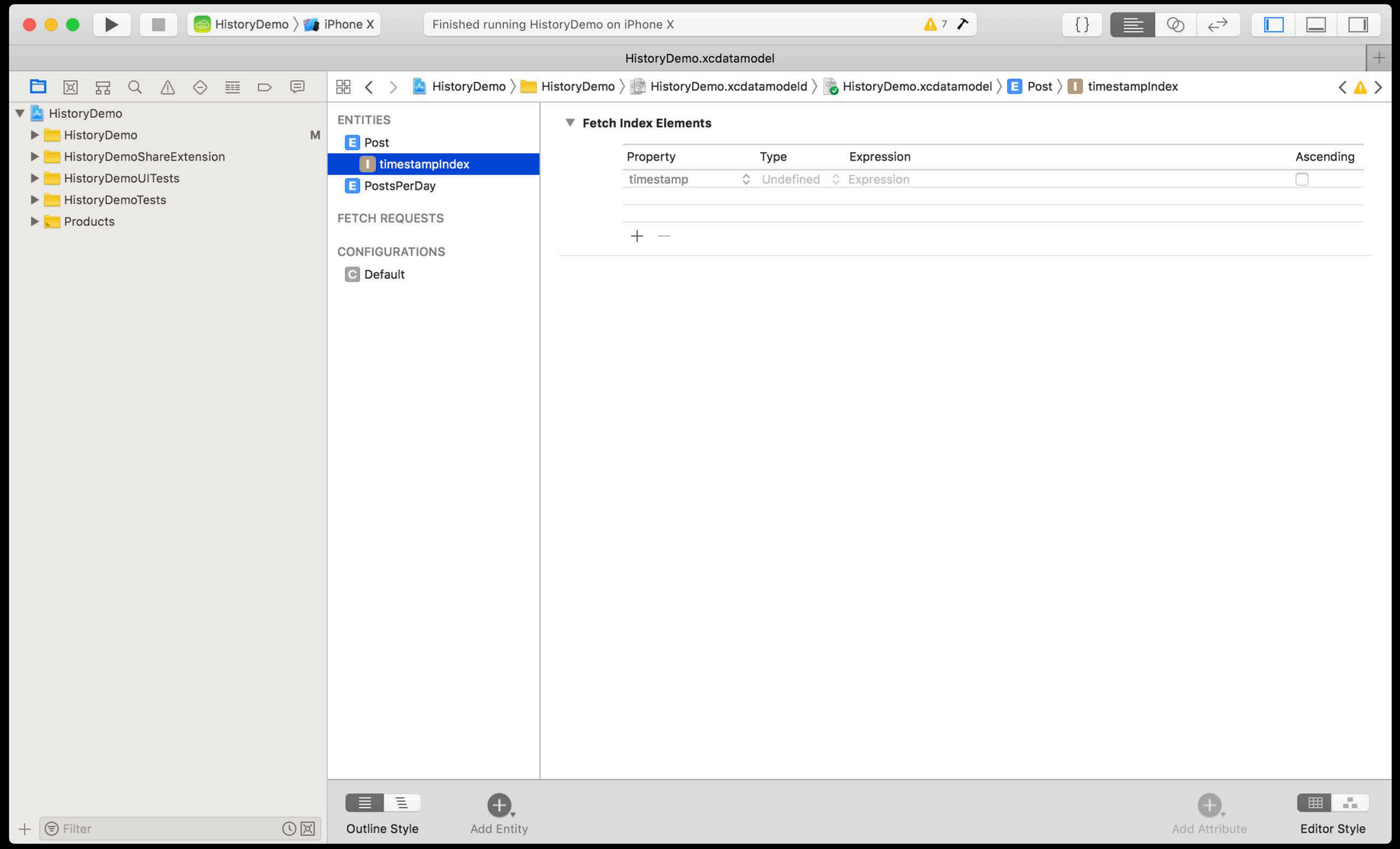
```
$ sqlite3 /path/to/db.sqlite
sqlite> EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
QUERY PLAN
|--SCAN TABLE ZPOST AS t0
`--USE TEMP B-TREE FOR ORDER BY

sqlite> .expert
sqlite> SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
CREATE INDEX ZPOST_idx_43b4963d ON ZPOST(ZTIMESTAMP DESC);

SCAN TABLE ZPOST AS t0 USING COVERING INDEX ZPOST_idx_43b4963d
```

```
$ sqlite3 /path/to/db.sqlite
sqlite> EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
QUERY PLAN
|--SCAN TABLE ZPOST AS t0
`--USE TEMP B-TREE FOR ORDER BY

sqlite> .expert
sqlite> SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
CREATE INDEX ZPOST_idx_43b4963d ON ZPOST(ZTIMESTAMP DESC);

SCAN TABLE ZPOST AS t0 USING COVERING INDEX ZPOST_idx_43b4963d
```

```
$ sqlite3 /path/to/db.sqlite
sqlite> EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
QUERY PLAN
|--SCAN TABLE ZPOST AS t0
`--USE TEMP B-TREE FOR ORDER BY

sqlite> .expert
sqlite> SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
CREATE INDEX ZPOST_idx_43b4963d ON ZPOST(ZTIMESTAMP DESC);

SCAN TABLE ZPOST AS t0 USING COVERING INDEX ZPOST_idx_43b4963d
```

```
$ sqlite3 /path/to/db.sqlite
sqlite> EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
QUERY PLAN
|--SCAN TABLE ZPOST AS t0
`--USE TEMP B-TREE FOR ORDER BY

sqlite> .expert
sqlite> SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC;
CREATE INDEX ZPOST_idx_43b4963d ON ZPOST(ZTIMESTAMP DESC);

SCAN TABLE ZPOST AS t0 USING COVERING INDEX ZPOST_idx_43b4963d
```

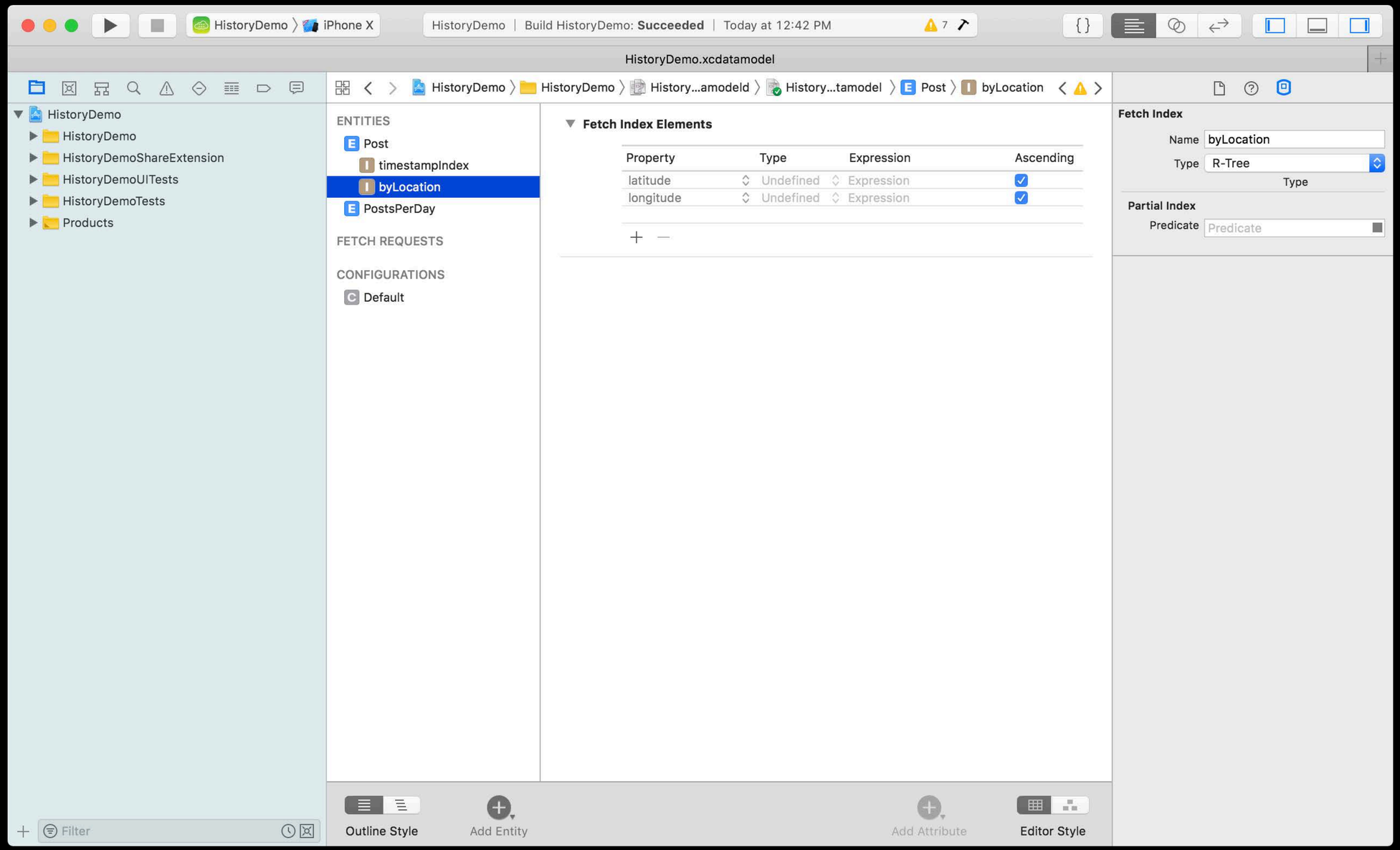
Performance Analysis with sqlite3



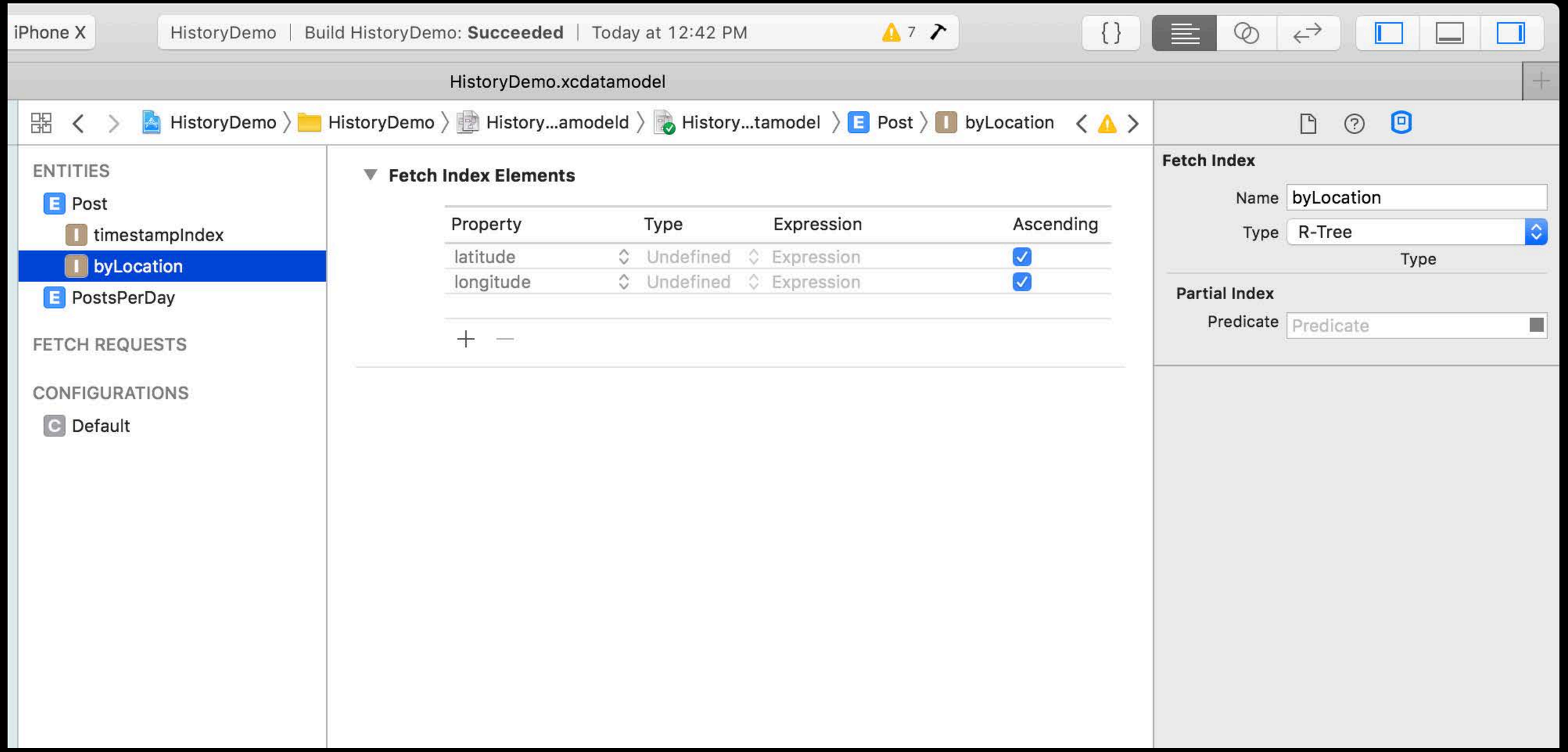
```
CoreData: sql: SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC
TraceSQL(0x7fac11f0c200): SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC
```

```
CoreData: sql: SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC
TraceSQL(0x7fac11f0c200): SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY t0.ZTIMESTAMP DESC
//…
CoreData: details: SQLite: EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 ORDER BY
t0.ZTIMESTAMP DESC
      0 0 0 SCAN TABLE ZPOST AS t0 USING COVERING INDEX Z_Post_timestampIndex
```

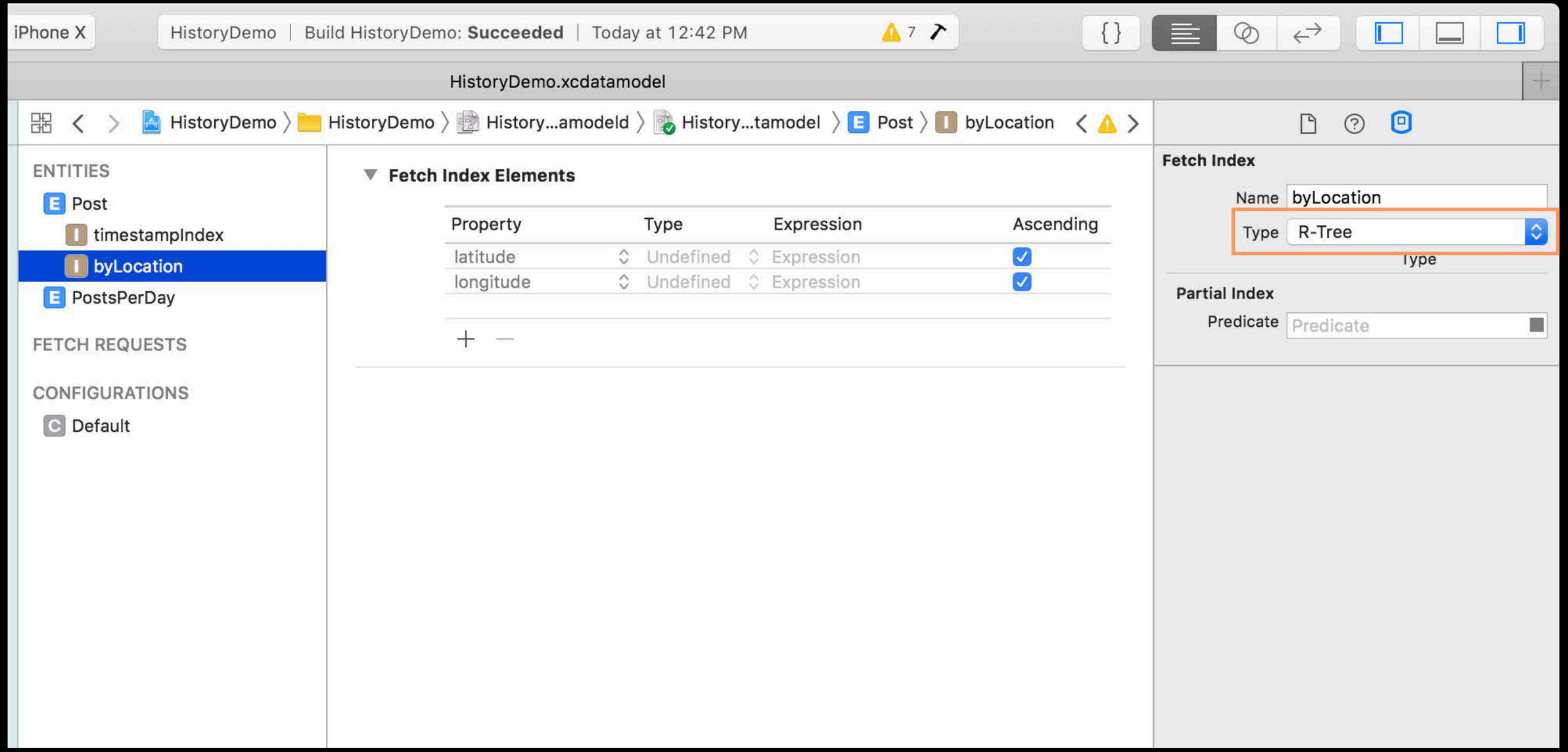
Better Indexing



Better Indexing



Better Indexing



```
let longPredicate = NSPredicate(format: "indexed:by:(longitude, \"byLocation\") between { %@, %@ }",
                                argumentArray: [ 109.93333333333334, 134.75 ])
let latPredicate = NSPredicate(format: "indexed:by:(latitude, \"byLocation\") between { %@, %@ }",
                               argumentArray: [ 20.233333333333334, 53.55 ])

fetchRequest.predicate = NSCompoundPredicate(type: NSCompoundPredicate.LogicalType.and,
                                             subpredicates: [ latPredicate, longPredicate])
```

```
CoreData: details: SQLite: EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 WHERE
(( t0.ZLATITUDE BETWEEN ? AND ?) AND ( t0.ZLONGITUDE BETWEEN ? AND ?)) ORDER BY t0.ZTIMESTAMP
DESC
     0 0 0 SCAN TABLE ZPOST AS t0 USING INDEX Z_Post_timestampIndex
```

```
CoreData: details: SQLite: EXPLAIN QUERY PLAN SELECT 0, t0.Z_PK FROM ZPOST t0 WHERE ( t0.Z_PK
IN (SELECT n1_t0.Z_PK FROM Z_Post_byLocation n1_t0 WHERE (? <= n1_t0.ZLONGITUDE_MIN AND
n1_t0.ZLONGITUDE_MAX <= ?)) AND  t0.Z_PK IN (SELECT n1_t0.Z_PK FROM Z_Post_byLocation n1_t0
WHERE (? <= n1_t0.ZLATITUDE_MIN AND n1_t0.ZLATITUDE_MAX <= ?))) ORDER BY t0.ZTIMESTAMP DESC
     0 0 0 SEARCH TABLE ZPOST AS t0 USING INTEGER PRIMARY KEY (rowid=?)
     0 0 0 EXECUTE LIST SUBQUERY 1
     1 0 0 SCAN TABLE Z_Post_byLocation AS n1_t0 VIRTUAL TABLE INDEX 2:D2B3
     0 0 0 EXECUTE LIST SUBQUERY 2
     2 0 0 SCAN TABLE Z_Post_byLocation AS n1_t0 VIRTUAL TABLE INDEX 2:D0B1
     0 0 0 USE TEMP B-TREE FOR ORDER BY
```

```
Test Case '-[HistoryDemoTests.TestFetchPerformance testLibraryFetchWithLocation]' measured
[Time, seconds] average: 0.434, relative standard deviation: 2.792%
```

```
Test Case '-[HistoryDemoTests.TestFetchPerformance testLibraryFetchWithLocation]' measured
[Time, seconds] average: 0.434, relative standard deviation: 2.792%

Test Case '-[HistoryDemoTests.TestFetchPerformance testLibraryFetchWithLocationIndex]'
measured
[Time, seconds] average: 0.306, relative standard deviation: 3.255%
```

Testing With CoreData

Testing With CoreData

Tests are great!

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Tests are great!

- Learn CoreData

Testing With CoreData

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- Learn CoreData
- Verify assumptions

Testing With CoreData

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- Learn CoreData
- Verify assumptions
- Capture product requirements

Testing With CoreData

Tests are great!

- Learn CoreData
- Verify assumptions
- Capture product requirements
- Communicate your expectations

```
class CoreDataTestCase: XCTestCase {
    override func setUp() {
        super.setUp()
        container = NSPersistentContainer(name: "HistoryDemo")
        container.persistentStoreDescriptions[0].url = URL(fileURLWithPath: "/dev/null")
        container.loadPersistentStores { (description, error) in
            XCTAssertNil(error)
        }
    }

    override func tearDown() {
        container = nil
        super.tearDown()
    }
}
```

```
class CoreDataTestCase: XCTestCase {
    override func setUp() {
        super.setUp()
        container = NSPersistentContainer(name: "HistoryDemo")
        container.persistentStoreDescriptions[0].url = URL(fileURLWithPath: "/dev/null")
        container.loadPersistentStores { (description, error) in
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        }
    }

    override func tearDown() {
        container = nil
        super.tearDown()
    }
}
```

```
class CoreDataTestCase: XCTestCase {
    override func setUp() {
        super.setUp()
        container = NSPersistentContainer(name: "HistoryDemo")
        container.persistentStoreDescriptions[0].url = URL(fileURLWithPath: "/path/to/db.sqlite")
        container.loadPersistentStores { (description, error) in
            XCTAssertNil(error)
        }
    }

    override func tearDown() {
        container = nil
        super.tearDown()
    }
}
```

```
class AppDatabaseTestCase: XCTestCase {
    override func setUp() {
        super.setUp()
        let delegate = UIApplication.shared.delegate
        XCTAssertNotNil(delegate)
        container = (delegate as! AppDelegate).persistentContainer
    }
}
```

```
class AppDatabaseTestCase: XCTestCase {
    override func setUp() {
        super.setUp()
        let delegate = UIApplication.shared.delegate
        XCTAssertNotNil(delegate)
        container = (delegate as! AppDelegate).persistentContainer
    }
}
```

```swift
public func insertSamplePosts(into managedObjectContext: NSManagedObjectContext) {
    for _ in 0 ..< 100000 {
        self.insertSamplePost(into: managedObjectContext)
    }
    XCTAssertNoThrow(try managedObjectContext.save())
}
```

```
 public func insertSamplePosts(into managedObjectContext: NSManagedObjectContext) {
     for _ in 0 ..< 100000 {
         self.insertSamplePost(into: managedObjectContext)
     }
     XCTAssertNoThrow(try managedObjectContext.save())
 }
```

```
public func insertSamplePost(into managedObjectContext:NSManagedObjectContext) {
    let newPost = Post(context: managedObjectContext)
    newPost.timestamp = Date()
    newPost.identifier = UUID()
    newPost.url = URL("http://store.apple.com”)
    newPost.title = self.sampleTitles[arc4random() % self.sampleTitles.count]
    newPost.source = "User"
}
```

```swift
func testLibraryFetchPerformance() {
    let fetchRequest: NSFetchRequest<Post> = Post.fetchRequest()
    fetchRequest.fetchBatchSize = 200
    fetchRequest.sortDescriptors = [ NSSortDescriptor(key: "timestamp", ascending: false) ]

    self.measure {
        do {
            let context = self.newContainer().newBackgroundContext()
            let frc = self.newFetchedResultsController(with: fetchRequest, context: context)
            try frc.performFetch()
        } catch {
            XCTFail("performFetch threw: \(error)")
        }
    }
}
```

```
func testLibraryFetchPerformance() {
    let fetchRequest: NSFetchRequest<Post> = Post.fetchRequest()
    fetchRequest.fetchBatchSize = 200
    fetchRequest.sortDescriptors = [ NSSortDescriptor(key: "timestamp", ascending: false) ]

    self.measure {
        do {
            let context = self.newContainer().newBackgroundContext()
            let frc = self.newFetchedResultsController(with: fetchRequest, context: context)
            try frc.performFetch()
        } catch {
            XCTFail("performFetch threw: \(error)")
        }
    }
}
```

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More Information

https://developer.apple.com/wwdc18/224

CoreData Lab	Technology Lab 7	Friday 1:30PM
Testing Tips and Tricks	Hall 2	Friday 3:20PM


WWDC18