

Introduction to SwiftData

Reena Thakkar

@ Swift Ahmedabad on Saturday 21st December 2024

Today

- Introduction to SwiftData
- Core Data
- SwiftData
- Final Thoughts

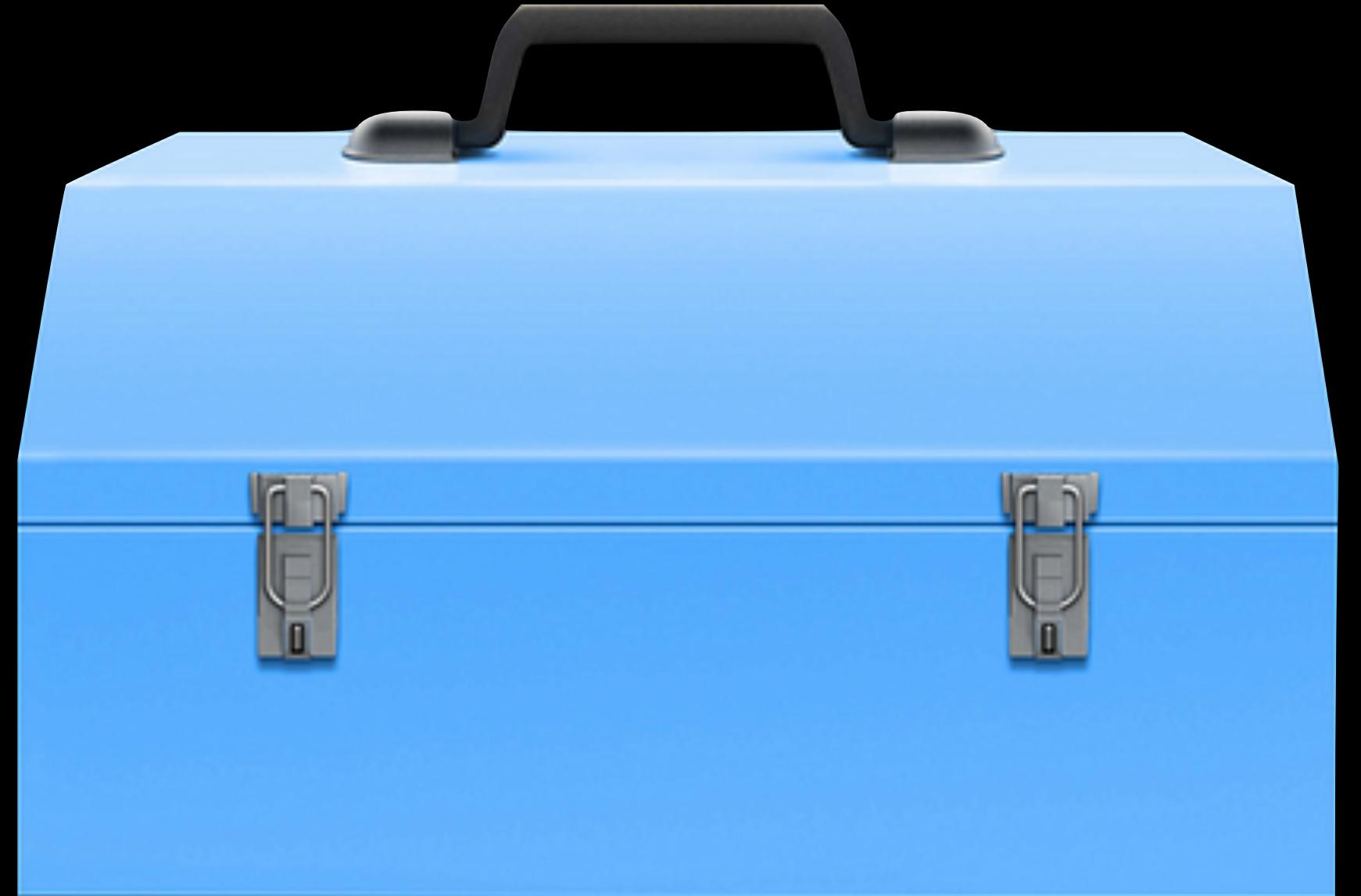
Introduction To SwiftData

- Introduced with iOS 17
- For below iOS 17
 - CoreData
 - Raw SQLite
 - GRDB
 - Other OpenSource Libraries



Introduction To SwiftData

- It is a Framework not Database
- Database used is “SQLite”
- It still uses “CoreData” internally
- Interoperate / Migrate to SwiftData Gradually



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WWDC 23: Migrate to SwiftData - <https://www.youtube.com/watch?v=olsjgo4Qb4A>

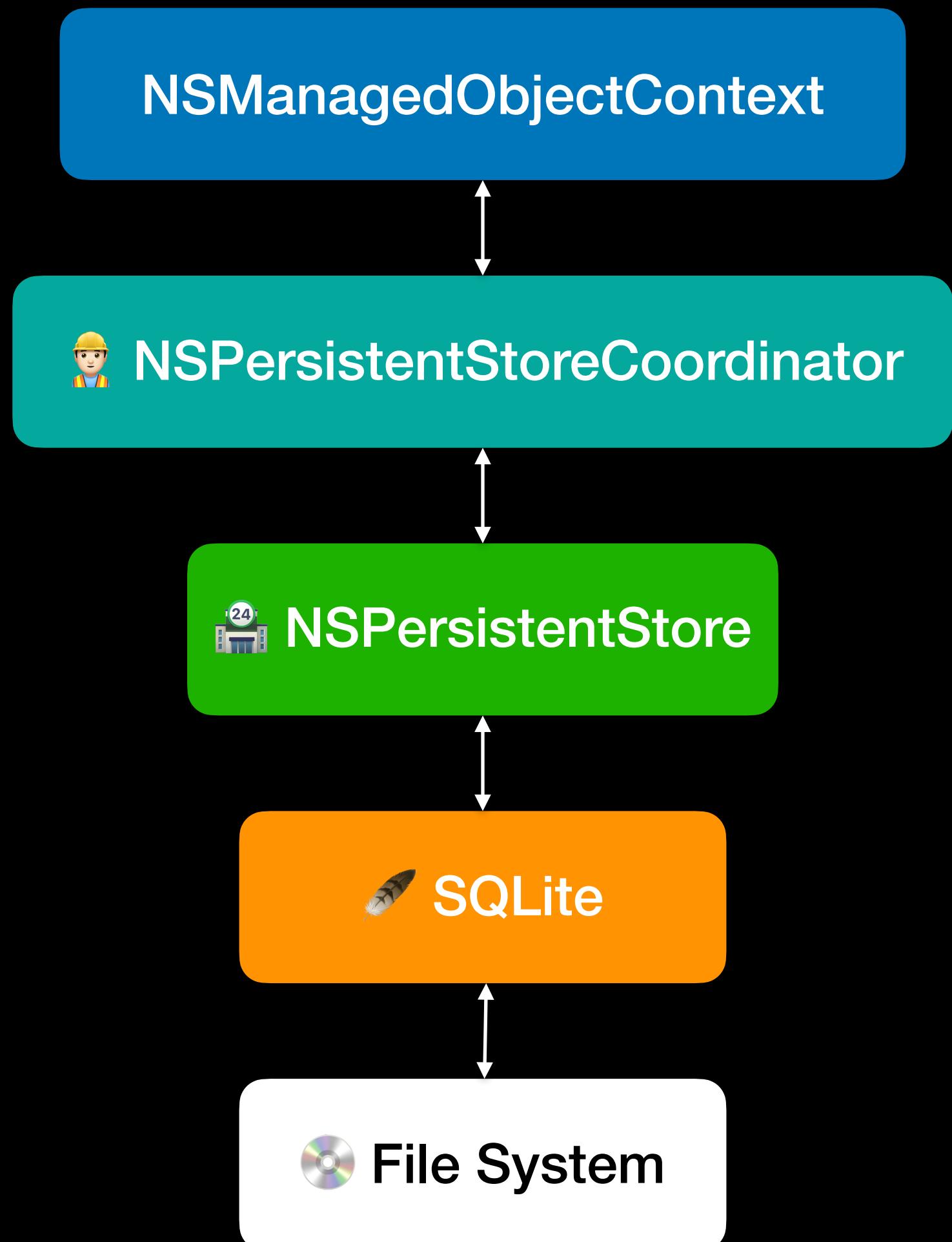
<https://www.hackingwithswift.com/quick-start/swiftdata/how-to-migrate-an-app-from-core-data-to-swiftdata>

Today

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- Final Thoughts

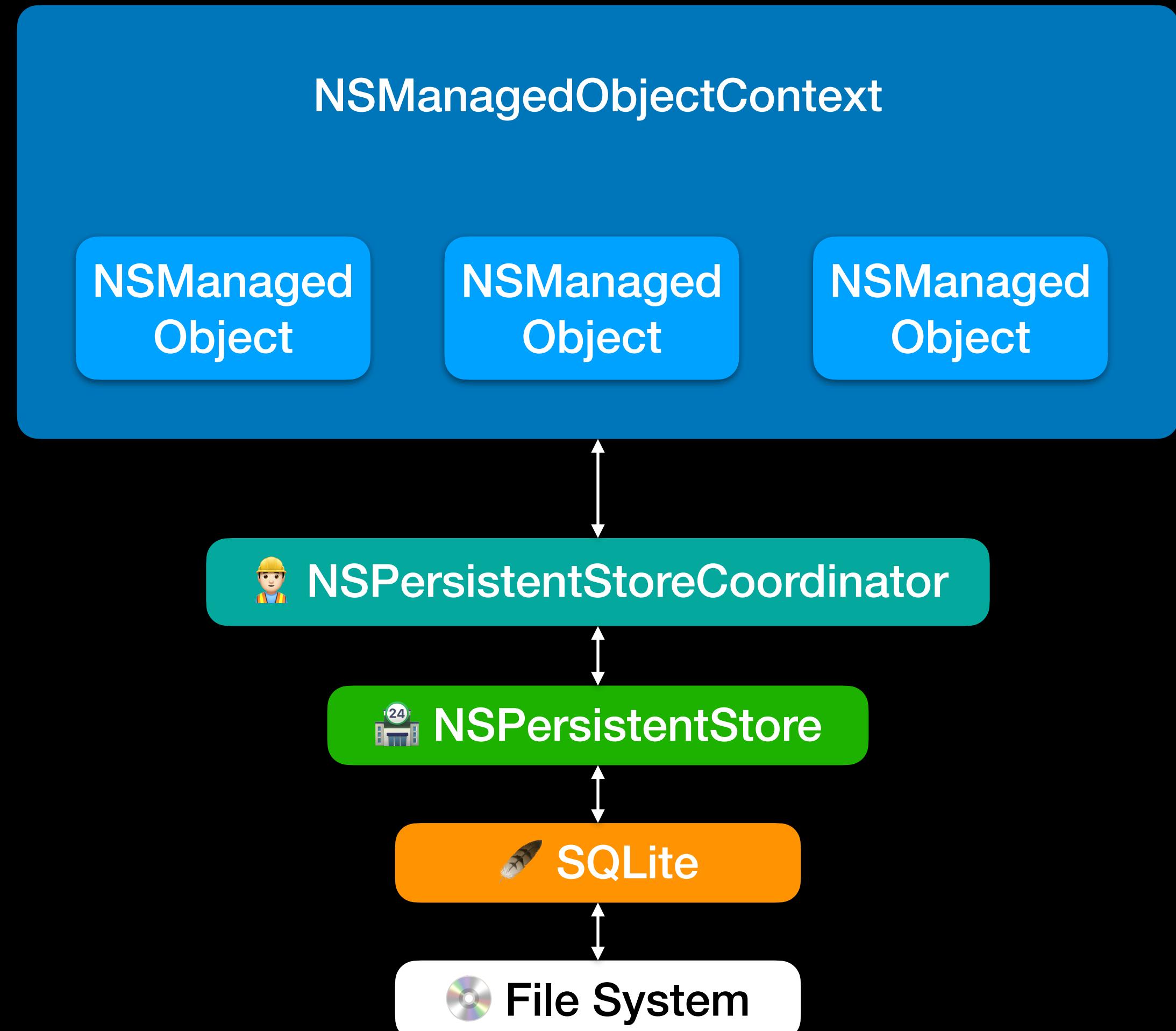
Core Data Stack

BEFORE iOS 9.0



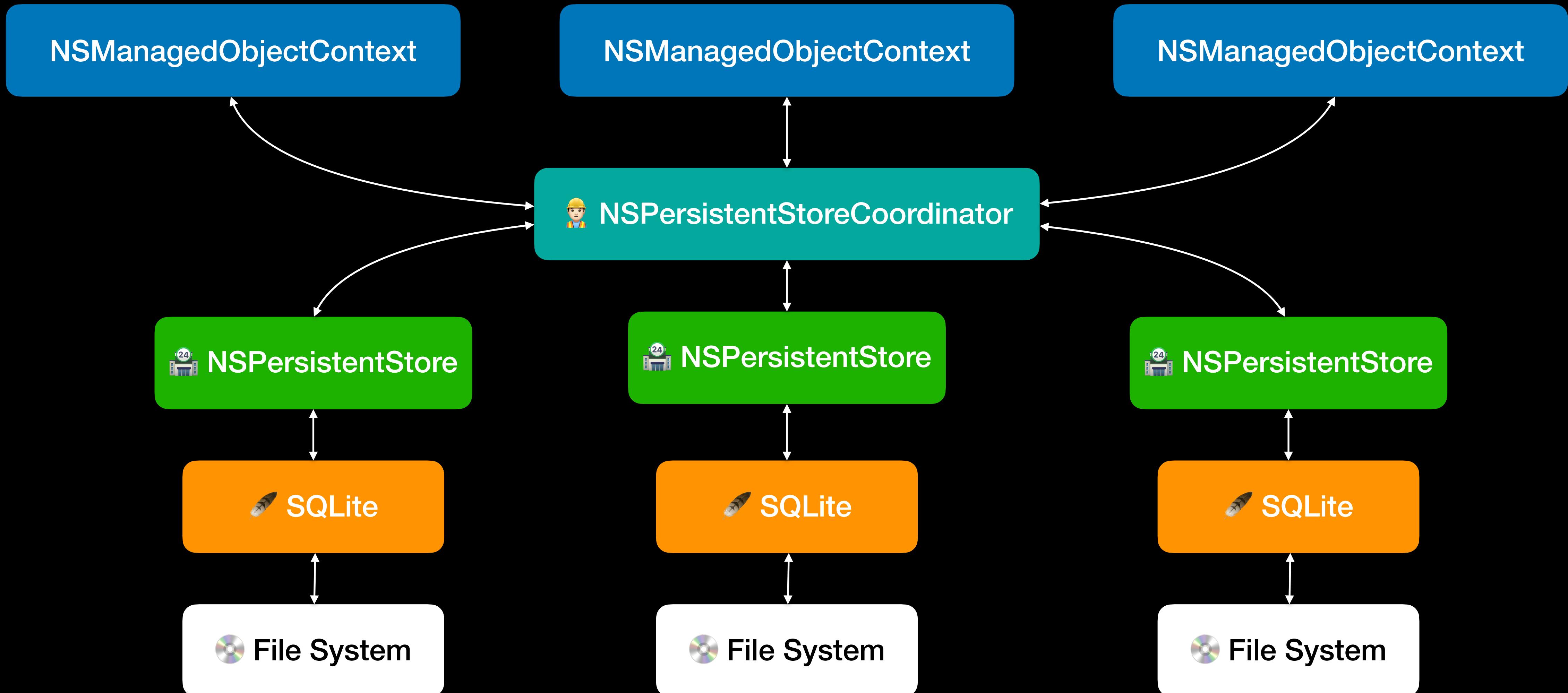
Core Data Stack

BEFORE iOS 9.0



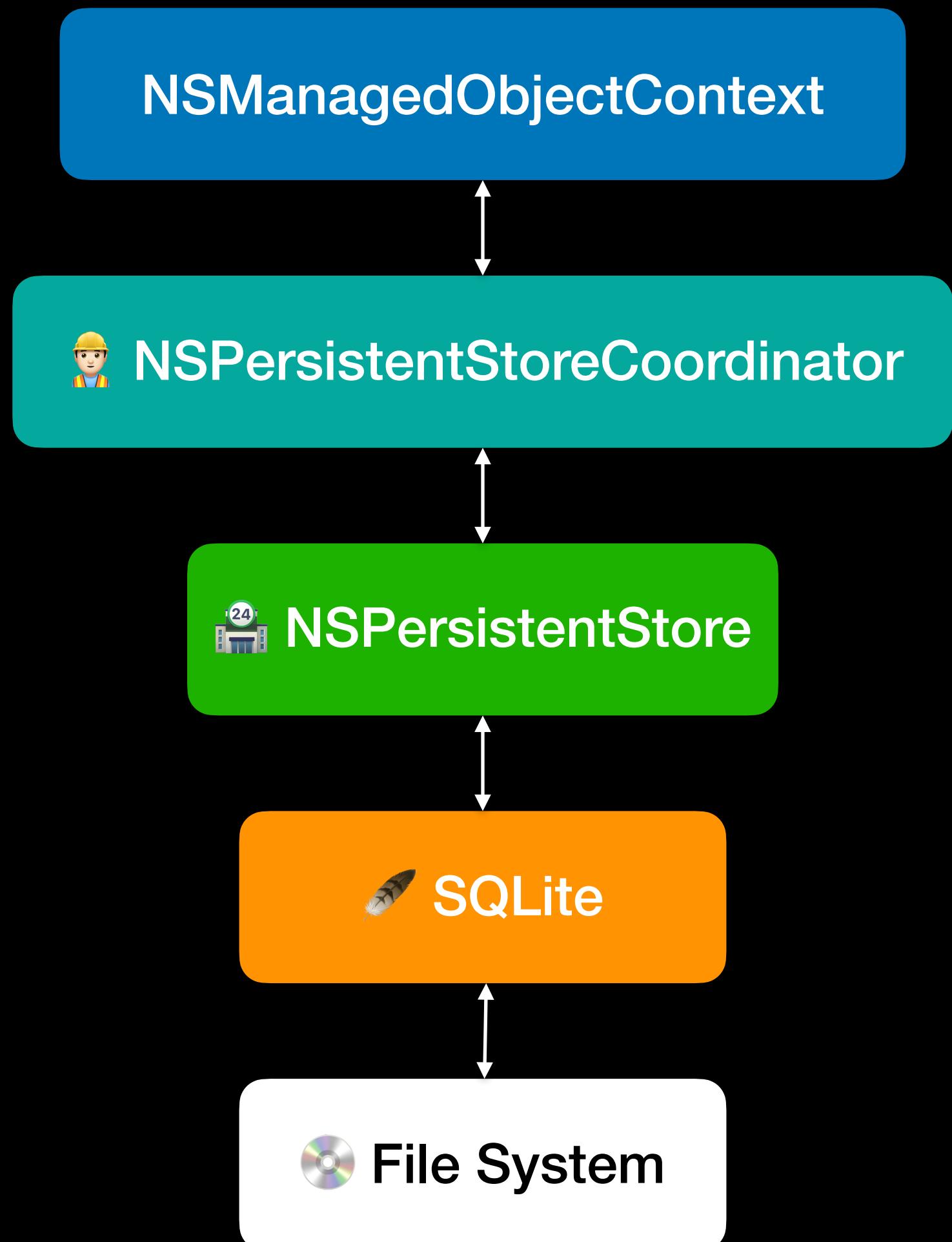
Core Data Stack

BEFORE iOS 9.0



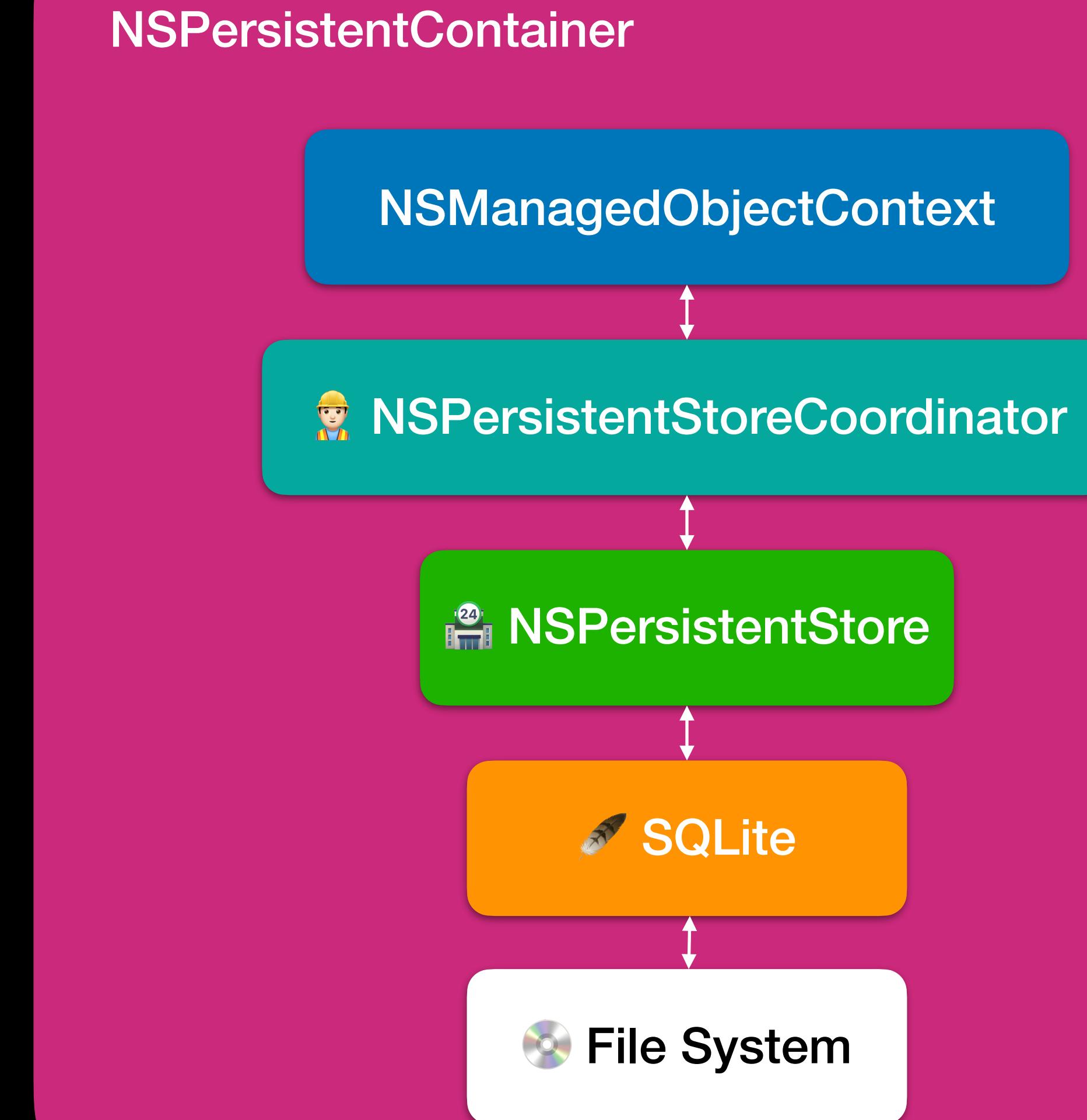
Core Data Stack

BEFORE iOS 9.0



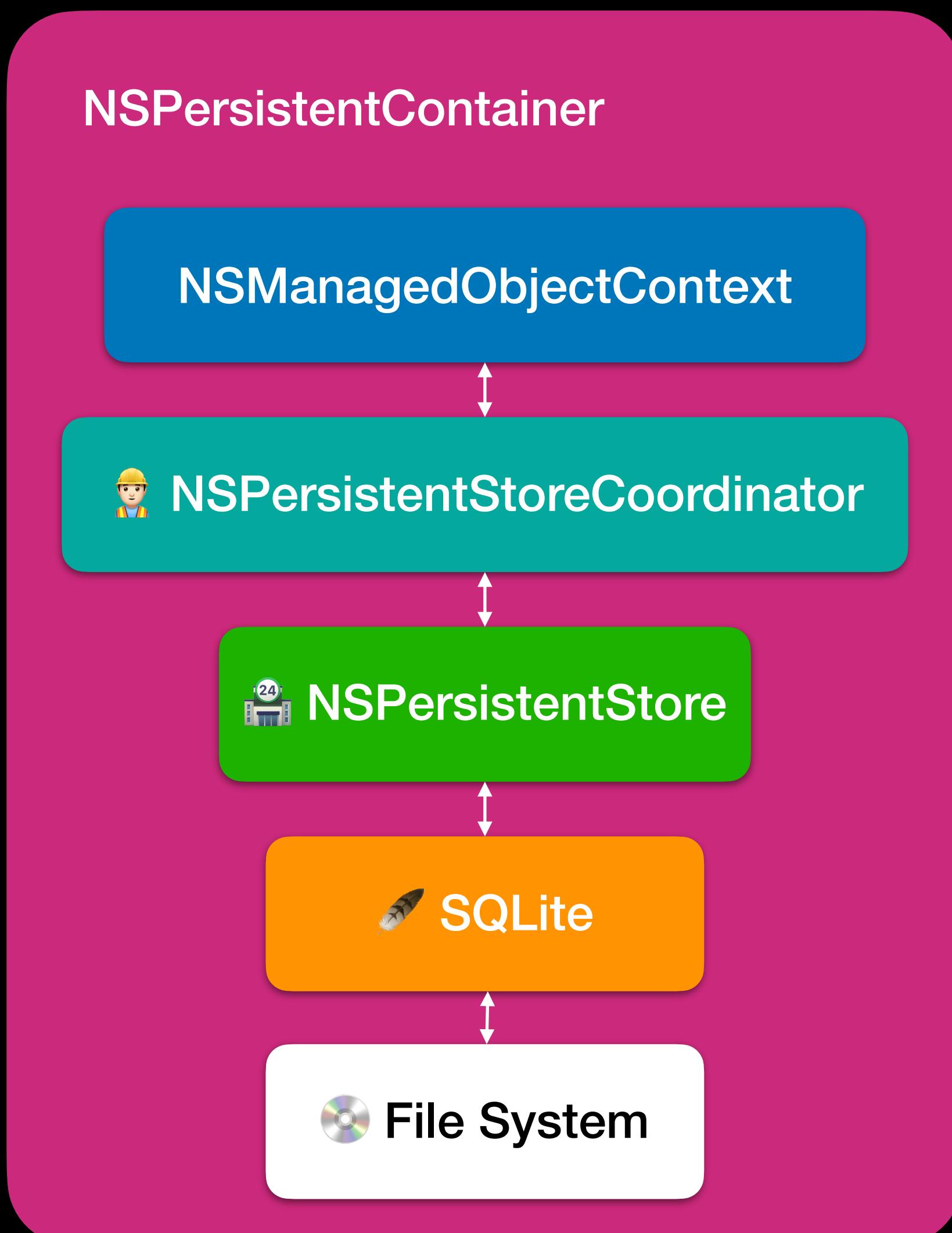
Core Data Stack

iOS 10.0



Core Data Stack

iOS 10.0



Let's Configure

Core Data Setup

iOS 10.0

```
public enum PersistentModelStore {  
    public static let container: NSPersistentContainer = {  
        guard let modelURL = Bundle.main.url(forResource: "PersistentModels", withExtension: "momd") else { fatalError() }  
        guard let model = NSManagedObjectModel(contentsOf: modelURL) else { fatalError() }  
        let container = NSPersistentContainer(name:"PersistentModels", managedObjectModel: model)  
        container.loadPersistentStores(completionHandler: { (storeDescription, error) in  
            if let error = error as NSError? {  
                print("Unresolved error \(error), \(error.userInfo)")  
            }  
        })  
        return container  
    }()  
}
```

Core Data Setup

iOS 10.0

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iOS 10.0

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            }
        })
        return container
    }()
}
```

Core Data Entities/Relationships/Indexing

The screenshot shows the Xcode Core Data Entity Editor with the following details:

Entity

- Name: Author
- Abstract Entity: Unchecked
- Parent Entity: No Parent Entity

Class

- Name: Author
- Module: Global namespace
- Codegen: Class Definition

Attributes

Attribute	Type
id	UUID
name	String

Relationships

Relationship	Destination	Inverse
books	Book	authors

Fetched Properties

Fetched Property	Predicate

UI Elements

- Outline Style button
- Add Entity button
- Add Attribute button

Core Data Entities/Relationships/Indexing

The screenshot shows the Xcode Core Data Entity Editor with the 'Author' entity selected. The interface is divided into several sections:

- Entities:** A sidebar on the left lists 'Author' and 'Book' under the 'ENTITIES' section.
- Attributes:** Under 'Attributes', the 'id' attribute is highlighted with a yellow box. It has a type of 'UUID'. Other attributes listed are 'name' (String).
- Relationships:** Under 'Relationships', there is one entry: 'books' (Destination: Book, Inverse: authors).
- Fetched Properties:** This section is currently empty.
- Entity (Main Panel):** This panel contains detailed configuration for the 'Author' entity:
 - Name:** Author
 - Abstract Entity:** Unchecked
 - Parent Entity:** No Parent Entity
 - Class:** Name: Author, Module: Global namespace, Codegen: Class Definition
 - Constraints:** No Content
 - Spotlight:** Display Name: Expression
 - User Info:** Key and Value fields are present but empty.
 - Versioning:** Hash Modifier: Version Hash Modifier, Renaming ID: Renaming Identifier.
- Bottom Navigation:** Buttons for 'Outline Style' (selected), 'Add Entity', 'Add Attribute', and 'Add Relationship'.

Core Data Entities/Relationships/Indexing

The screenshot shows the Xcode Core Data Entity Editor interface. On the left, a sidebar lists 'ENTITIES' (Author, Book), 'COMPOSITE TYPES', 'FETCH REQUESTS', 'CONFIGURATIONS' (Default), and navigation buttons ('Outline Style', '+ Add Entity'). The main area is divided into sections: 'Attributes' (id: UUID, name: String), 'Relationships' (books: Book, inverse: authors), and 'Fetched Properties'. The 'Relationships' section is highlighted with a yellow box. The right side displays detailed configuration for the 'Entity' (Name: Author, Abstract Entity: No Parent Entity), 'Class' (Name: Author, Module: Global namespace, Codegen: Class Definition), 'Constraints' (No Content), 'Spotlight' (Display Name: Expression), 'User Info' (Key: Value), and 'Versioning' (Hash Modifier: Version Hash Modifier, Renaming ID: Renaming Identifier). Buttons at the bottom include '+ Add Attribute'.

Entity

- Name
- Abstract Entity
- Parent Entity

Class

- Name
- Module
- Codegen

Constraints

- No Content

Spotlight

- Display Name

User Info

Key	Value

Versioning

- Hash Modifier
- Renaming ID

Attributes

Attribute	Type
<input type="text" value="id"/>	UUID
<input type="text" value="name"/>	String

Relationships

Relationship	Destination	Inverse
<input type="text" value="books"/>	<input type="text" value="Book"/>	<input type="text" value="authors"/>

Fetched Properties

Fetched Property	Predicate

Add Entity **Add Attribute**

Core Data Entities/Relationships/Indexing

The screenshot shows the Xcode Core Data Entity Editor with the Book entity selected. The left sidebar lists entities (Author, Book), composite types, fetch requests, configurations, and a default configuration. The main area is divided into three sections: Attributes, Relationships, and Fetched Properties. The Entity section on the right contains fields for Name (Book), Abstract Entity (unchecked), Parent Entity (No Parent Entity), Class (Name: Book, Module: Global namespace, Codegen: Class Definition), Constraints (No Content), Spotlight (Expression), User Info, and Versioning (Hash Modifier: Version Hash Modifier, Renaming ID: Renaming Identifier).

ENTITIES

- E Author
- E Book

COMPOSITE TYPES

FETCH REQUESTS

CONFIGURATIONS

- C Default

Attributes

Attribute	Type
S desc	String
N edition	Integer 16
I id	UUID
D publishedAt	Date
S title	String

Relationships

Relationship	Destination	Inverse
O authors	Author	books

Fetched Properties

Fetched Property	Predicate

Entity

Name: Book

Abstract Entity:

Parent Entity: No Parent Entity

Class

Name: Book

Module: Global namespace

Codegen: Class Definition

Constraints: No Content

Spotlight: Expression

User Info

Key	Value

Versioning

Hash Modifier: Version Hash Modifier

Renaming ID: Renaming Identifier

Outline Style

Add Entity

Add Attribute

Core Data Operations

```
private func performFetchRequest() {  
    let request = Book.fetchRequest()  
    let context = PersistentModelStore.container.viewContext  
    do {  
        let items = try context.fetch(request)  
        self.bookList = items  
    } catch {  
        print(error)  
    }  
}
```

Core Data Operations

```
private func performFetchRequest() {
    let request = Book.fetchRequest()
    let context = PersistentModelStore.container.viewContext
    do {
        let items = try context.fetch(request)
        self.bookList = items
    } catch {
        print(error)
    }
}

func createNew() throws {
    let context = PersistentModelStore.container.viewContext

    let author = Author(context: context)
    author.id = UUID()
    author.name = "The Author"

    let book = Book(context: context)
    book.id = UUID()
    book.title = "The Book"
    book.desc = "Authorization Book"
    book.edition = 1
    book.publishedAt = Date()
    book.authors = author
    try context.save()
}
```

Today

- Introduction to SwiftData
- Core Data
- SwiftData
- Final Thoughts

SwiftData

Declarative schema

@Attribute

@Relationship

@Transient

Versioning

@Query

Schema migration plan

History

#Index

#Expression

CloudKit Sync

#Predicate

Compound Predicates

#Unique

Relationship Management

Graph Management

Change tracking

ModalActor

Documents

SwiftData

```
class Book {  
    var id: UUID  
    var title: String  
    var author: Author  
  
    init(id: UUID = .init(), title: String, author: Author) {  
        self.id = id  
        self.title = title  
        self.author = author  
    }  
}
```

SwiftData

```
@Model
class Book {
    var id: UUID
    var title: String
    var author: Author

    init(id: UUID = .init(), title: String, author: Author) {
        self.id = id
        self.title = title
        self.author = author
    }
}
```

SwiftData

```
@Model
class Book: Identifiable {
    var id: UUID
    var title: String
    var author: Author

    init(id: UUID = .init(), title: String, author: Author) {
        self.id = id
        self.title = title
        self.author = author
    }
}
```

SwiftData

```
@Model
class Book: Identifiable {
    var id: UUID
    var title: String
    var author: Author

    init(id: UUID = .init(), title: String, author: Author) {
        self.id = id
        self.title = title
        self.author = author
    }
}

@Model
class Author: Identifiable {
    var id: UUID
    var name: String

    init(id: UUID, name: String) {
        self.id = id
        self.name = name
    }
}
```

SwiftData

```
import SwiftUI
import SwiftData

@main
struct SwiftDataStudyApp: App {
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
    }
}
```

SwiftData

```
import SwiftUI
import SwiftData

@main
struct SwiftDataStudyApp: App {
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(for: [Book.self, Author.self])
    }
}
```

SwiftData

```
import SwiftUI
import SwiftData

@main
struct SwiftDataStudyApp: App {
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(container: ModelContainer)
    }
}
```

SwiftData

```
import SwiftUI
import SwiftData

@main
struct SwiftDataStudyApp: App {
    var sharedModelContainer: ModelContainer = {
        let schema = Schema([Author.self, Book.self])
        let modelConfiguration = ModelConfiguration(schema: schema, isStoredInMemoryOnly: false)
        do {
            return try ModelContainer(for: schema, configurations: [modelConfiguration])
        } catch {
            fatalError("Could not create ModelContainer: \(error)")
        }
    }()
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(container: ModelContainer)
    }
}
```

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```
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        let schema = Schema([Author.self, Book.self])
        let modelConfiguration = ModelConfiguration(schema: schema, isStoredInMemoryOnly: false)
        do {
            return try ModelContainer(for: schema, configurations: [modelConfiguration])
        } catch {
            fatalError("Could not create ModelContainer: \(error)")
        }
    }()
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(sharedModelContainer)
    }
}
```

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@main
struct SwiftDataStudyApp: App {
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```
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struct SwiftDataStudyApp: App {
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(for: [Author.self, Book.self])
    }
}

#Preview {
    ContentView()
}
```

SwiftData

```
import SwiftUI
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@main
struct SwiftDataStudyApp: App {
    var body: some Scene {
        WindowGroup {
            ContentView()
        }
        .modelContainer(for: [Author.self, Book.self])
    }
}

#Preview {
    ContentView()
    .modelContainer(for: [Book.self, Author.self], inMemory: true)
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    var body: some View {
        List {
        }
    }
}

#Preview {
    ContentView()
        .modelContainer(for: [Book.self, Author.self], inMemory: true)
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    var body: some View {
        List {
            ...
        }
    }
}

#Preview {
    ContentView()
        .modelContainer(for: [Book.self, Author.self], inMemory: true)
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {

    var body: some View {
        List {

        }
    }
}

#Preview {
    ContentView()
        .modelContainer(for: [Book.self, Author.self], inMemory: true)
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    @Query private var items: [Book]

    var body: some View {
        List {
            ...
        }
    }
}

#Preview {
    ContentView()
        .modelContainer(for: [Book.self, Author.self], inMemory: true)
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    @Query private var items: [Book]

    var body: some View {
        List {
            ForEach(items) { item in
                Text(item.title)
            }
        }
    }
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    @Environment(\.modelContext) private var modelContext
    @Query private var items: [Book]

    var body: some View {
        List {
            ForEach(items) { item in
                Text(item.title)
            }
        }
    }

    private func addItem() {
        withAnimation {
            let newItem = Book(title: "New Book", author: Author(name: "A Author"))
            modelContext.insert(newItem)
        }
    }
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    @Environment(\.modelContext) private var modelContext
    @Query private var items: [Book]

    var body: some View {
        List {
            ForEach(items) { item in
                Text(item.title)
            }
        }
    }

    private func deleteItems(offsets: IndexSet) {
        withAnimation {
            for index in offsets {
                modelContext.delete(items[index])
            }
        }
    }
}
```

SwiftData View

```
import SwiftUI
import SwiftData

struct ContentView: View {
    @Environment(\.modelContext) private var modelContext
    @Query private var items: [Book]

    var body: some View {
        List {
            ForEach(items) { item in
                Text(item.title)
            }
            .onDelete(perform: deleteItems)
        }
    }

    private func deleteItems(offsets: IndexSet) {
        withAnimation {
            for index in offsets {
                modelContext.delete(items[index])
            }
        }
    }
}
```

SwiftData Macros

@Model

@Query

@Attribute

#Predicates

@Relationship

#Expression

@Transient

#Unique

#Index

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

Schema Macro

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

@Attribute(.unique, .spotlight)

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

Schema.Attribute.Option

@Query

.unique

#Predicates

.transformable(by:)

#Expression

.externalStorage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

.spotlight

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

Schema.Attribute.Option

@Query

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.transformable(by:)

#Predicates

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.externalStorage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

.spotlight

→ value is unique

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

Schema.Attribute.Option

@Query

.unique

#Predicates

.transformable(by:)

#Expression

→ b/n in-memory form and a persisted form

.externalStorage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

.spotlight

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

Schema.Attribute.Option

@Query

.unique

#Predicates

.transformable(by:)

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.externalStorage

→ binary data beside model storage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

.spotlight

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Schema.Attribute.Option

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.allowsCloudEncryption → Stored in encrypted form

.preserveValueOnDeletion

.ephemeral

.spotlight

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→ persistent history when deleted

.ephemeral

.spotlight

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#Unique

#Index

Schema.Attribute.Option

@Query

.unique

#Predicates

.transformable(by:)

#Expression

.externalStorage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

→ Track changes but not stored

.spotlight

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

Schema.Attribute.Option

@Query

.unique

#Predicates

.transformable(by:)

#Expression

.externalStorage

.allowsCloudEncryption

.preserveValueOnDeletion

.ephemeral

.spotlight

Indexes for spotlight search

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Relations with other models

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Track changes but not persist/store

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Avoids duplicate models

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Speed up queries

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Query using filter, sort &/or fetchDescription

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Rich & Optimised queries

SwiftData Macros

@Model

@Attribute

@Relationship

@Transient

#Unique

#Index

@Query

#Predicates

#Expression

- Express complex queries

Today

- Introduction to SwiftData
- Core Data
- SwiftData
- Final Thoughts

Final Thoughts

- Start using new tools/apis
- Think and ponder about why it was introduced
- Practice with study/demo projects
- Search for answers
- Ask for help
- Build it to learn it.

References (Highly Recommended)

- Pragmatic Core Data : by Florian Kugler (objc.io)

- <https://www.youtube.com/watch?v=pOSm-SDZl7A&t=279s>

- What's new in SwiftData: by Rishi Verma (WWDC 24: Apple)

- <https://www.youtube.com/watch?v=-lMOuvRQilc>

- Migrate to SwiftData: by Luvena Huo (WWDC 23: Apple)

- <https://www.youtube.com/watch?v=olsjgo4Qb4A>

- Migrate to SwiftData: by Paul Hudson (HackingWithSwift.com)

- <https://www.hackingwithswift.com/quick-start/swiftdata/how-to-migrate-an-app-from-core-data-to-swiftdata>

This was a brief Introduction to SwiftData

Reena Thakkar

@ Swift Ahmedabad on Saturday 21st December 2024

Thank you