



# CodexScan

Book Collection Manager for iPhone & iPad

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## Developer README

Architecture & Technical Reference

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A native iOS app for managing your personal book collection. Scan barcodes or NFC tags, track reading status, manage loans across multiple copies, and sync across devices via CloudKit.

## Features

- **Barcode scanning** — Camera-based ISBN scanning (EAN-13, EAN-8, Code-128)
- **OCR text scanning** — Vision-based OCR detects ISBNs from printed text when a barcode is unavailable
- **NFC/RFID** — Read ISBNs from NFC NDEF tags; write ISBNs to writable NFC tags
- **Automatic metadata** — Fetches title, author, genre, cover art, publish year, and page count from Open Library and Google Books
- **Multiple copies per ISBN** — Each physical copy tracked independently with its own UUID (`copyID`) and `copyNumber`; averaged star rating shared across all copies
- **Reading status** — Track books as Unread, Reading, Finished, or Wishlist
- **Circulation tracking** — Check individual copies in/out with borrower names, due dates, and full loan history
- **Due-date notifications** — Local notifications fire the day before and on the due date for overdue loans
- **Cover Wall** — Visual mosaic of book covers on the home screen (6 columns portrait, 8 landscape)
- **Category filter bar** — Quick-filter pills in the library: All, Out, Favorite, Rating, Wishlist
- **Smart Collections** — Saved filter presets combining status, genre, location, and keyword search
- **Multiple named libraries** — Separate SQLite databases per library; switch instantly from the Home screen
- **CloudKit sync** — Record-level CloudKit sync with auto-sync, conflict resolution, and incremental change tracking
- **iCloud Documents** — Optional file-level sync that stores SQLite databases in iCloud Drive
- **Shelf QR codes** — Generate and scan QR codes for shelf locations; batch-assign location to scanned books
- **Widgets** — Home screen widgets (Small/Medium/Large) showing library stats and last scanned book
- **iPad layout** — `NavigationSplitView` with scanner sidebar and two-column library detail
- **Export** — PDF catalogs, single-book PDFs, CSV export (optionally with embedded cover images), printable barcode label sheets
- **Import** — CSV import into the active library or as a brand-new named library
- **Backup & restore** — Timestamped `.codexbackup` files shareable via Files/AirDrop

## Architecture

Pure SwiftUI + UIKit (scanner/NFC) app with no third-party dependencies. Data layer uses SQLite3 via the native C API. CloudKit sync uses the native CloudKit framework.

```
ISBNScanner/
|-- Models/           Book, LoanRecord, ReadingStatus, CirculationStatus
|-- Managers/        DatabaseManager, LibraryManager, AppSettingsManager,
|                    iCloudSyncManager, BackupManager, SmartCollectionManager,
|                    ScanHistoryManager, NotificationManager
|-- Sync/            LibraryRepository, LibrarySyncCoordinator,
|                    CloudKitLibraryStore, CloudKitRecordCoding,
|                    LibrarySyncModels, LibrarySyncMetadataStore
|-- Services/        OpenLibraryService
|-- Views/           HomeView, LibrarySheetView, BookDetailView,
|                    SettingsView, ShelfQRCodeView, SetActiveShelfView, ...
|-- Components/     BookCardView, CoverWallCardView, ScannerView,
|                    TextScannerView, CheckInSheet, BulkEditSheet, ...
|-- NFC/             RFIDReader, RFIDWriter
|-- Export/          PDFExporter, BarcodeLabelExporter, CSVManager
`-- Widgets/        ISBNScannerWidget (Small / Medium / Large)
```

## Data Storage

- **Books** — SQLite3 table; primary key is `copyID` (UUID per physical copy); `isbn + copyNumber` identify a logical title group
- **Loans** — Separate table tracking full checkout/check-in history; keyed by `bookRecordName` for CloudKit-aware copy-level matching
- **Smart Collections** — JSON in `UserDefaults`
- **Settings** — `UserDefaults` (30+ keys)
- **Widget data** — Shared via App Group (`group.com.izipx.ISBNScanner`)

## Multiple Copies

When a barcode or NFC scan matches an ISBN that already exists in the library, a dialog offers to add another copy. Each copy receives a unique `copyID` (UUID) as its database primary key and a stable 1-based `copyNumber` within the ISBN group. Circulation state (checked in/out, borrower, due date) is tracked independently per copy. Star rating is a book-level aggregate — when any copy is rated, the average of all rated copies is computed and written back to every copy.

## CloudKit Sync

`LibrarySyncCoordinator` orchestrates record-level sync via `CloudKitLibraryStore`:

- **Incremental sync** — Uses `CKServerChangeToken` to fetch only changed records since the last sync
- **Auto-sync** — Fires automatically 30 seconds after any local mutation
- **Conflict resolution** — Prefers the record with the most recent `updatedAt` timestamp; pending local changes win on ties
- **Multi-copy aware** — Copy 1 uses an ISBN-based CloudKit record name; Copy 2+ use copyID-based names, preventing cross-copy state contamination during sync reconciliation
- **Full refresh fallback** — Falls back to a full zone fetch if the change token expires

## iCloud Documents Sync

`iCloudSyncManager` moves the active SQLite file(s) into the app's iCloud ubiquity container. All devices signed into the same Apple ID share the file via iCloud Drive. This is a separate, simpler mechanism than the CloudKit record sync above.

## CSV Import & Export

Direction	Feature	Detail
Export	Share CSV Catalog	13 core fields; optional base64 cover images
Import	Import CSV Catalog	Adds books to active library; skips existing ISBNs
Import	Import CSV as New Library	Validates format, prompts for name, creates and switches to new library

Required import columns: `isbn`, `title`, `author`, `category`, `genre`.

## External APIs

Service	Purpose
Open Library	Primary metadata and cover art lookup by ISBN
Google Books	Cover image and publish year fallback

No API keys required.

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## Requirements

- iOS 16+
- Xcode 15+
- iCloud account (optional, for sync)
- NFC-capable device (optional, for RFID read/write)

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