iCloud:
Lessons Learned

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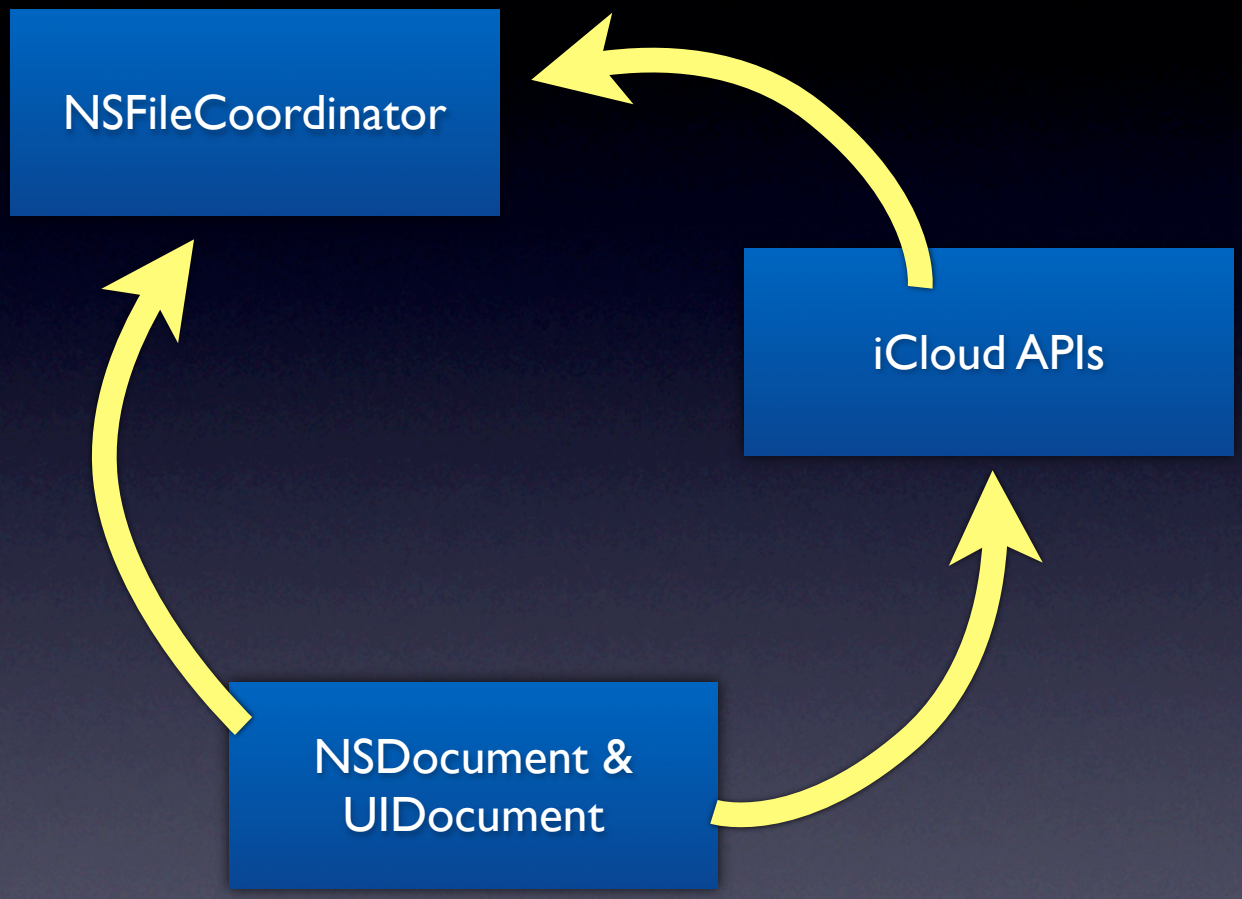
The Omni Group


NSFileCoordinator
iCloud APIs
NSDocument &
UIDocument

NSFileCoordinator

Using NSFileCoordinator

- The file system changes constantly
- Not always under your control (esp. on Mac)
  - User can rename files using Finder, edit attachments in Preview…
- You can’t coordinate on entire directories

Using NSFileCoordinator

- Adopt an optimistic locking approach
  - Determine the operation you want to perform
  - Start coordination on relevant URLs
  - If preconditions are no longer met, fail gracefully
  - Otherwise, attempt the operation

File Coordination != Serialization

- File operations might happen in parallel
- Presenter notifications might be enqueued in any order
- Impose your own order on coordinated operations
- Interface with {NS,UI}Document synchronization
- Use a serial `presentedItemOperationQueue`
  - Don't return `[NSOperationQueue mainQueue]`

iCloud APIs

Finding Out About iCloud Docs

- Scan the Ubiquity Container
- NSMetadataQuery
- Treat the filesystem as authoritative
  - NSMetadataQuery might return items that you just deleted
  - NSMetadataQuery returns ancillary information
- Resolving conflicts can wedge NSMetadataQuery

Finding Out About iCloud Docs

- Renamed directories are synced as delete/add
  - You don't get `-presentedItemDidMoveToURL:`
  - Think hard about using document packages
- Be sure to standardize your paths before comparing
  - No other way to keep track of NSFilePresenters

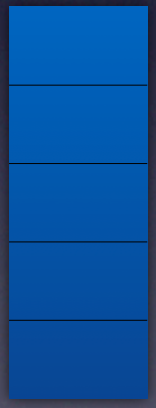
Moving Files To iCloud

- `-[NSFileManager setUbiquitous:itemAtURL:…]`
  - There's nothing special about it… yet
  - Performs a coordinated move to the ubiquity container
  - Must be called on a background thread
- `-[NSFileManager moveItemAtURL:…]`
  - iCloud will eventually notice the file
  - Not guaranteed
  - The only way to provide a file presenter to the NSFileCoordinator
- Use `-setUbiquitous…` unless absolutely necessary

NSDocument & UIDocument

NSDocument Synchronization

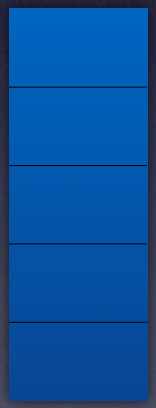
Activities



File Access

NSDocument Synchronization

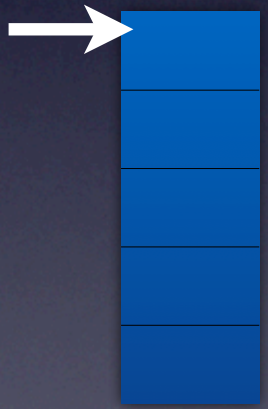
Activities



File Access

NSDocument Synchronization

Activities



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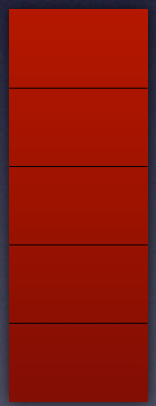
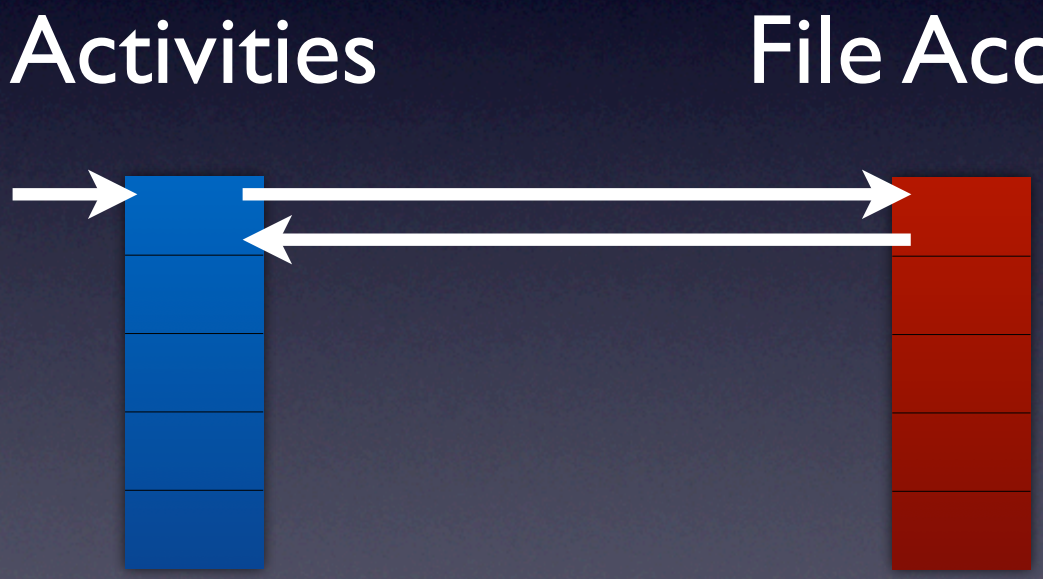


NSDocument Synchronization



NSDocument Synchronization

Activities

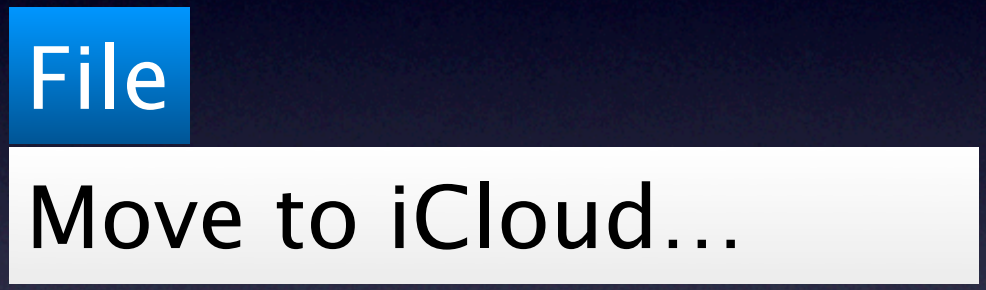
File Access

NSDocument Synchronization

- `-perform(A)SynchronousFileAccess`
- `-performActivityWithSynchronousWaiting:`
- Uses blocks—terms get confusing!
- You need to worry about this even if you don't support concurrent saving

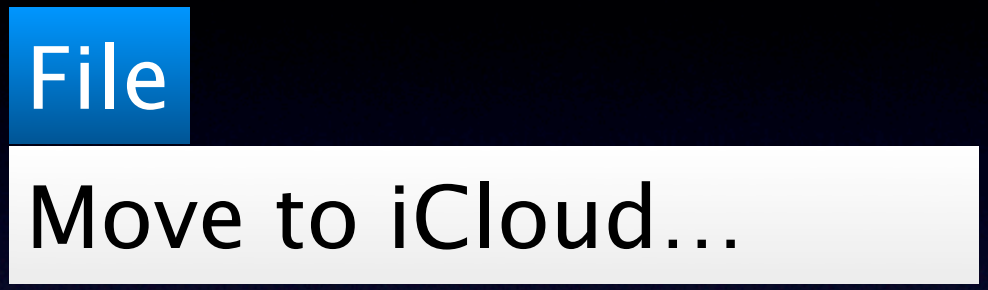
NSDocument Synchronization

- `-performActivity...` is main-thread only
- `-performFileAccess` can be called on any thread
- Block arguments are invoked on calling thread
- For async versions, you hold the "lock" until you invoke the completion handler
- You cannot transfer file access to another thread (r. 10365156)


File
Move to iCloud…

What do we need?

- Single menu item for in/out
  - Need to consult `fileURL`
  - Must be done in file access
  - Can’t block main thread
- Moving to iCloud uses NSFileCoordinator
  - Item must be disabled while move is in flight

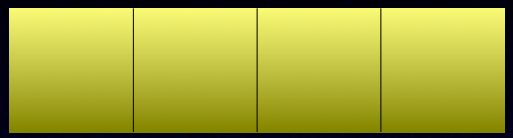


File

Main

File Access

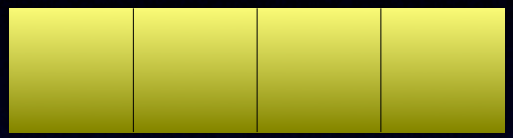
File



Main

File Access

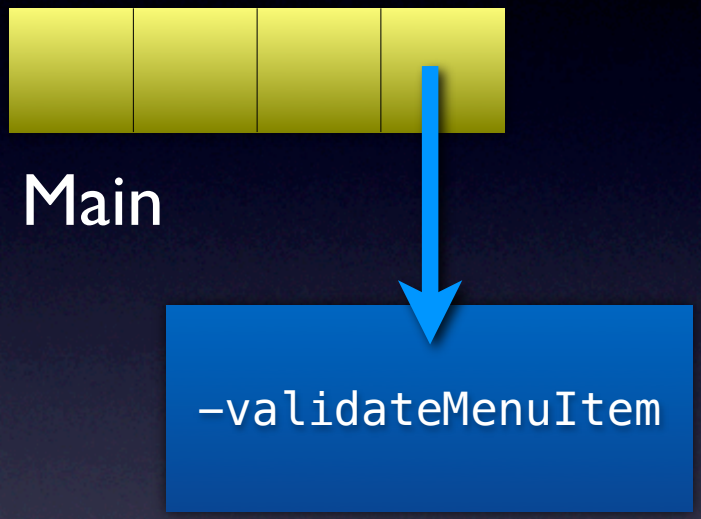
File



Main

File Access

File



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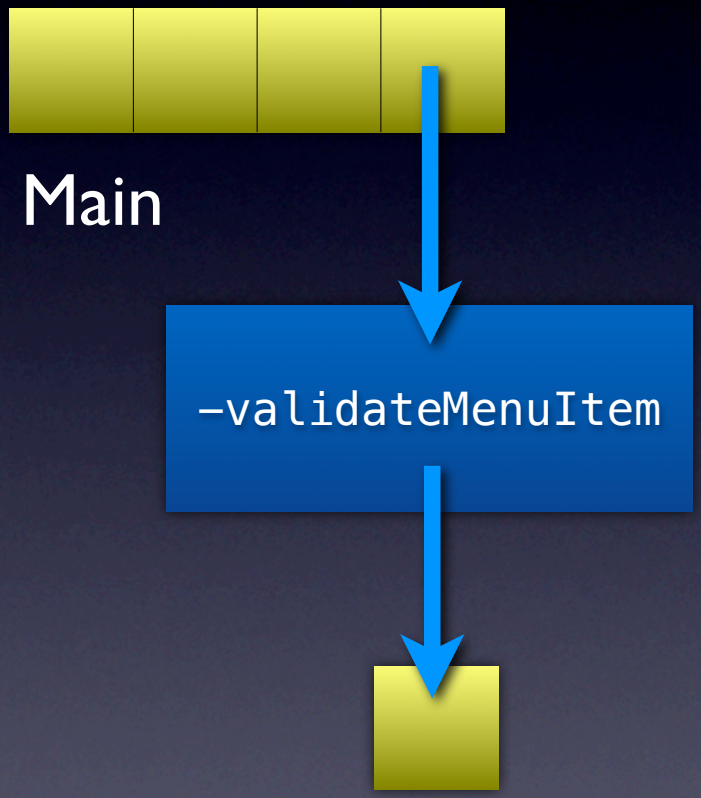
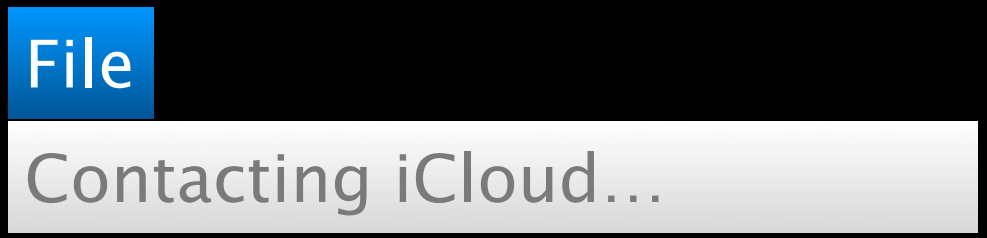




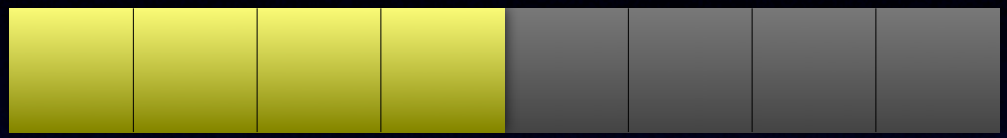
Main

`-validateMenuItem`

File Access

File

Contacting iCloud…



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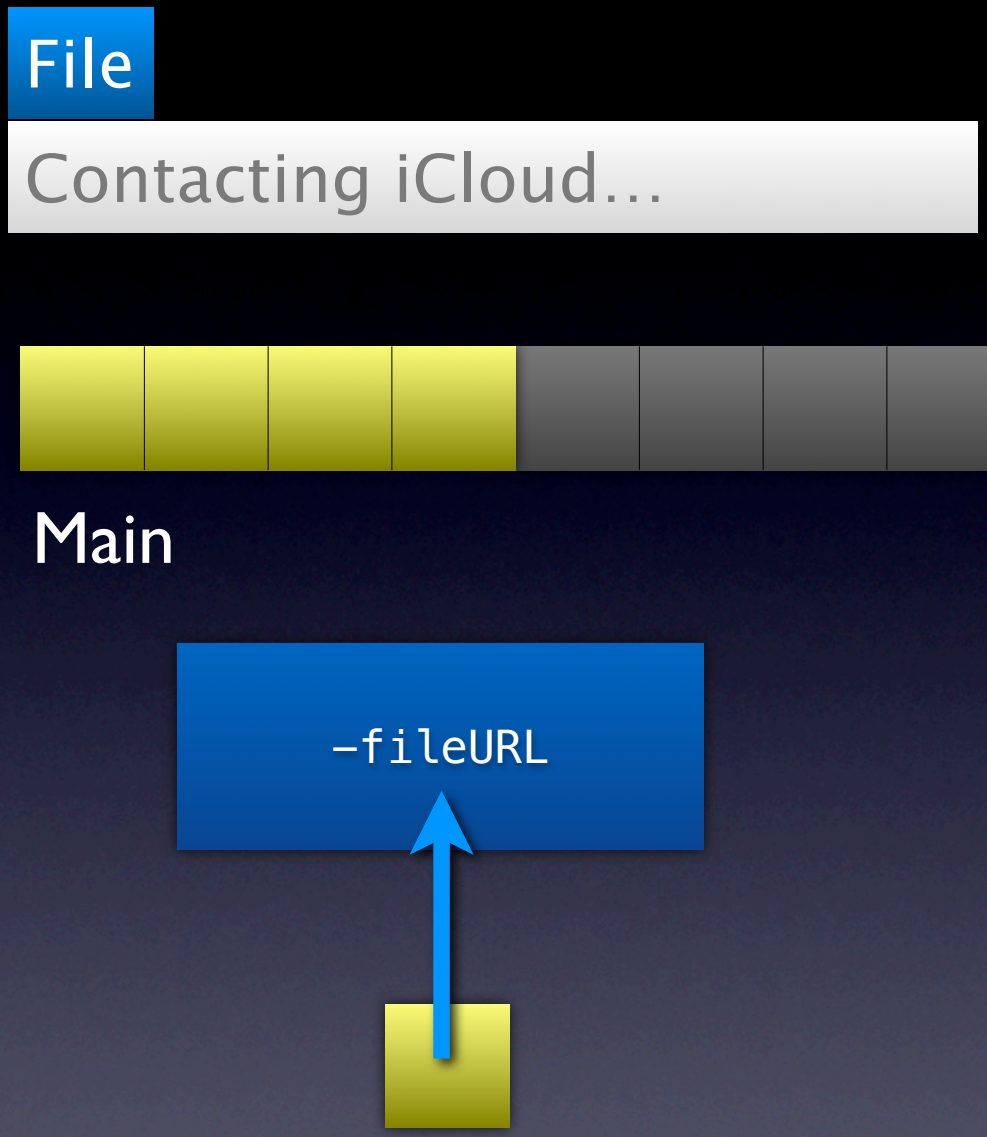
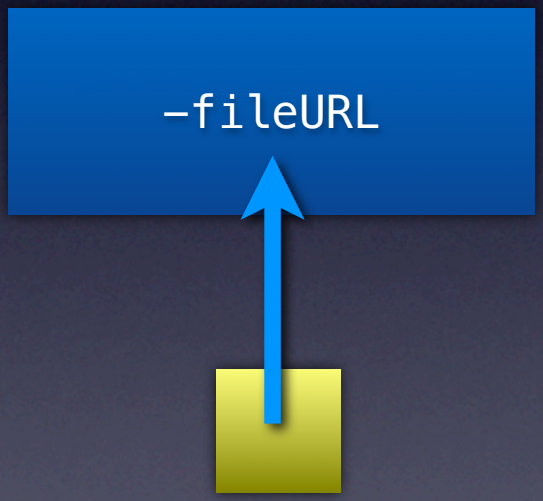

File
Contacting iCloud…
Main
-fileURL
File Access

File

Move to iCloud

Main



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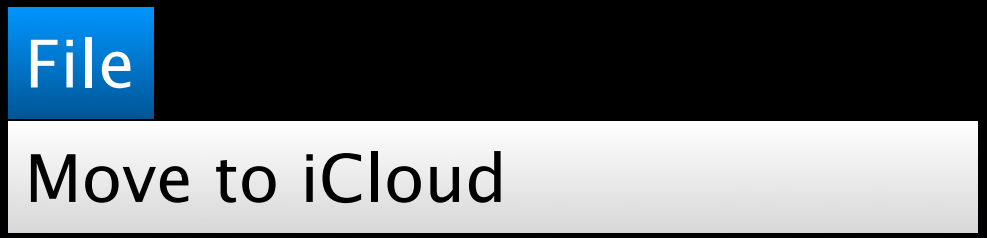

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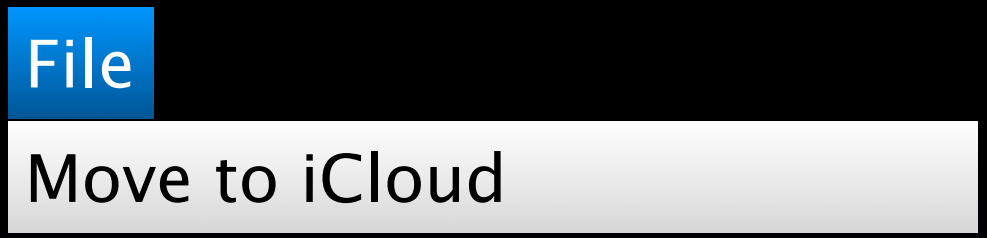

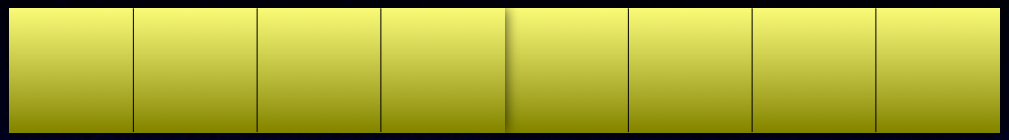

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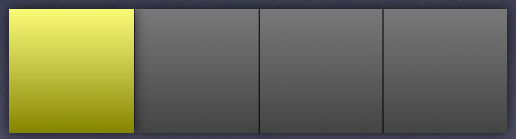
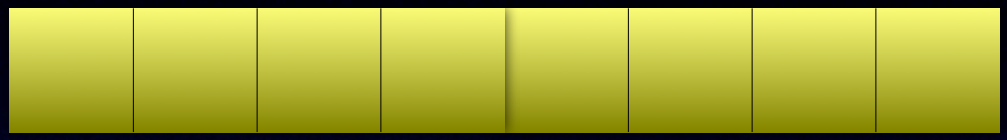


File Access

File

Move to iCloud



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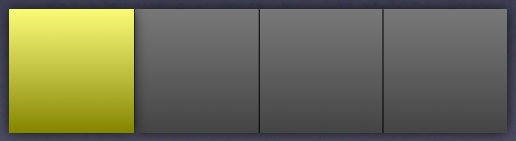

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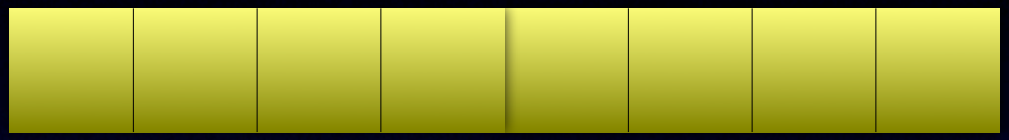

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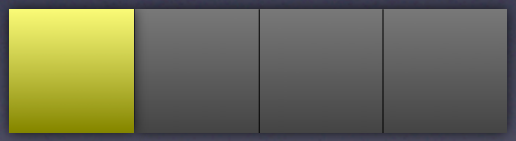
Activity



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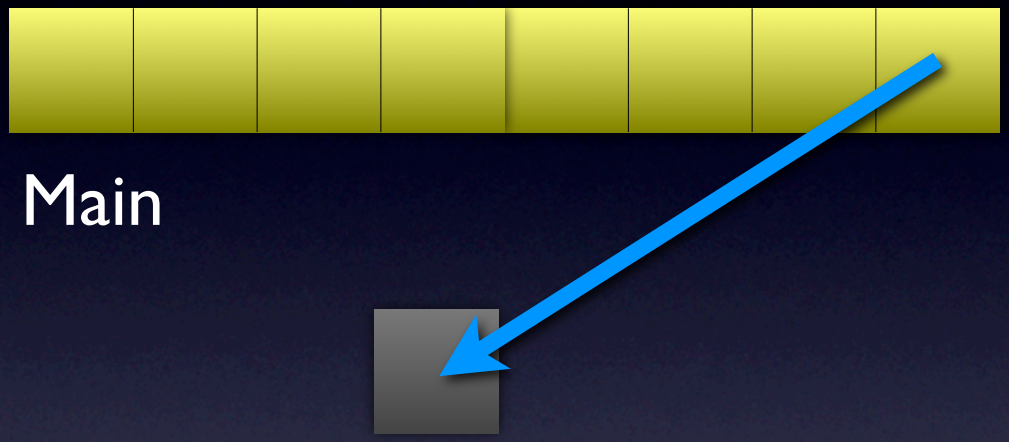
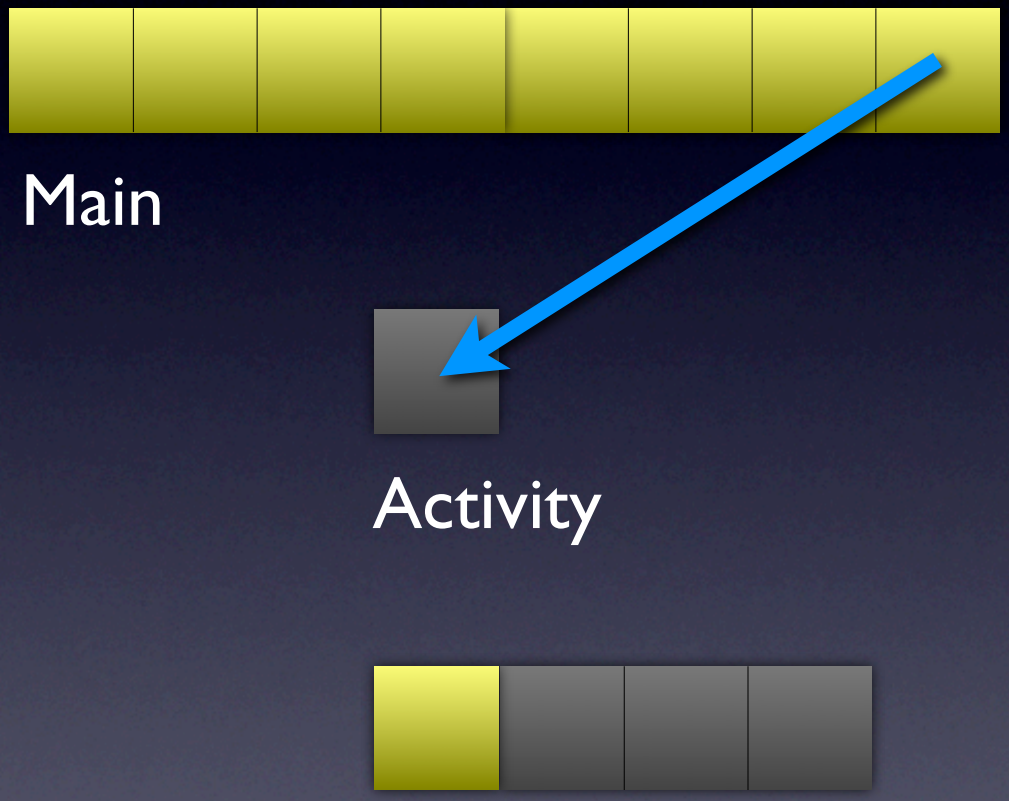
Move to iCloud

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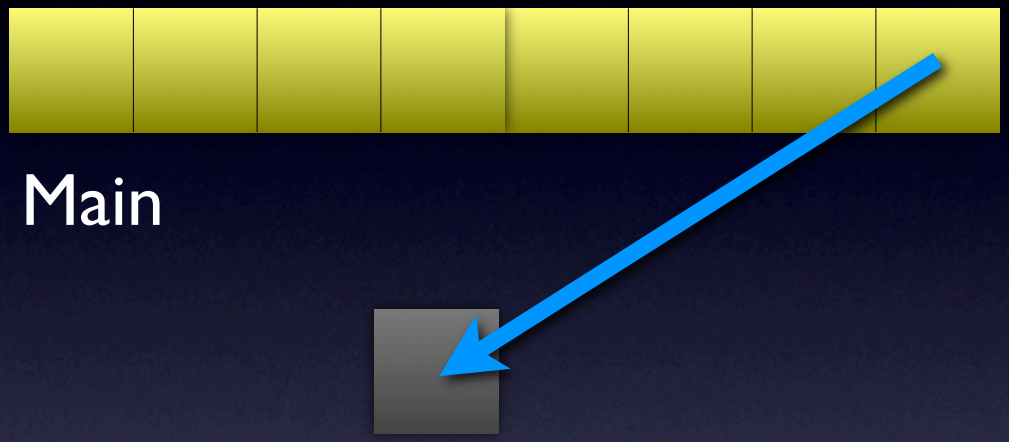
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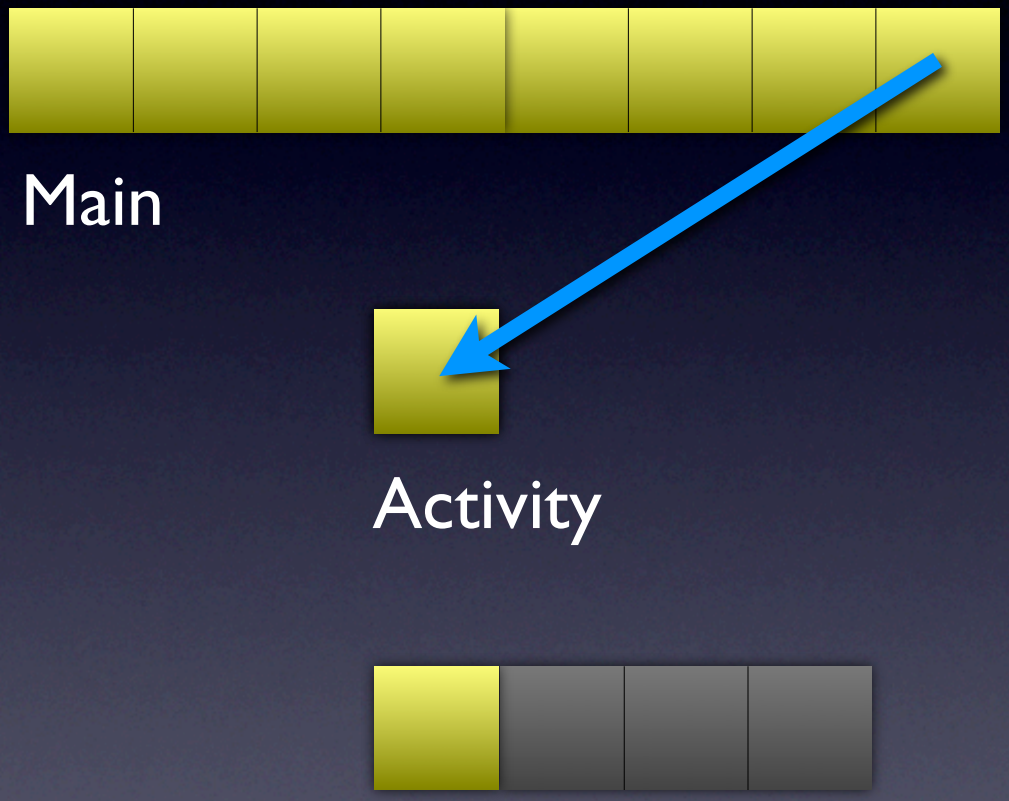
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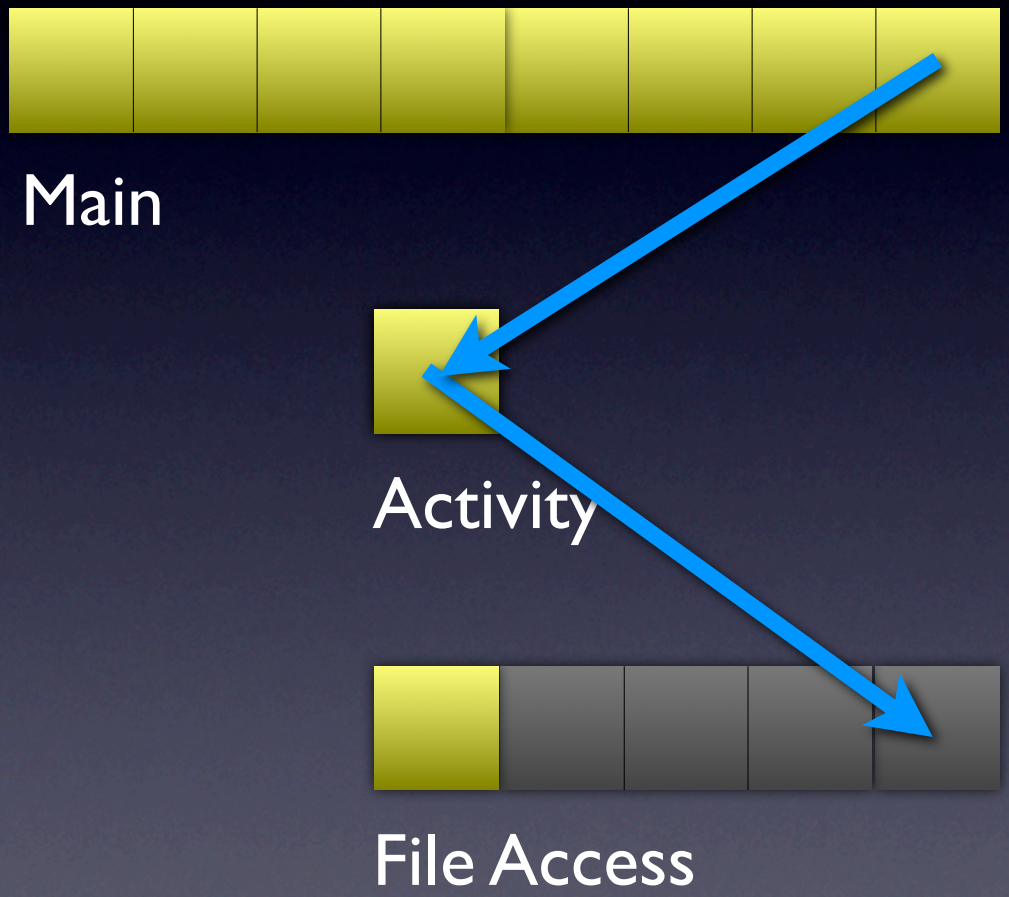
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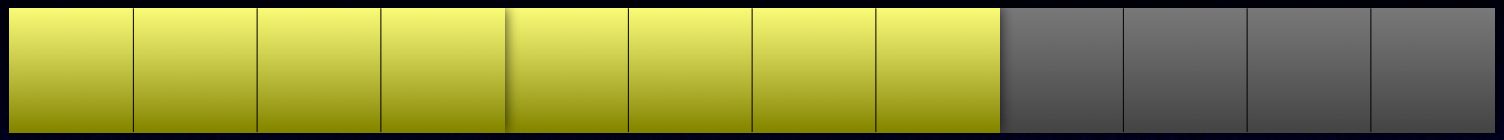

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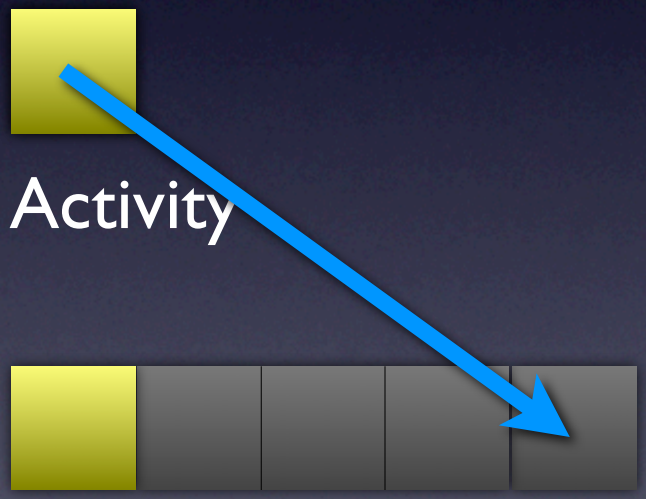

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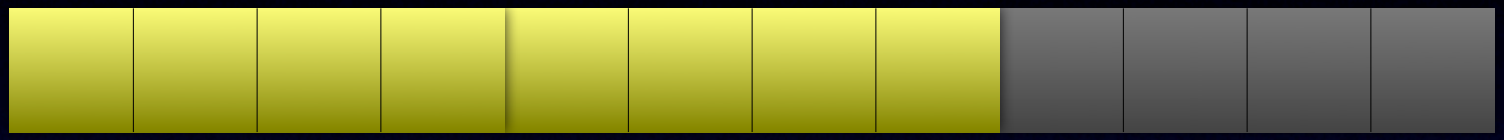

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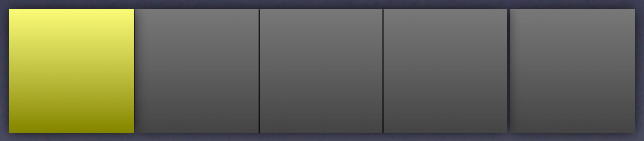

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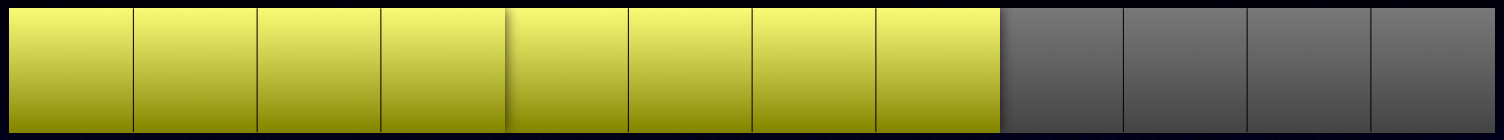

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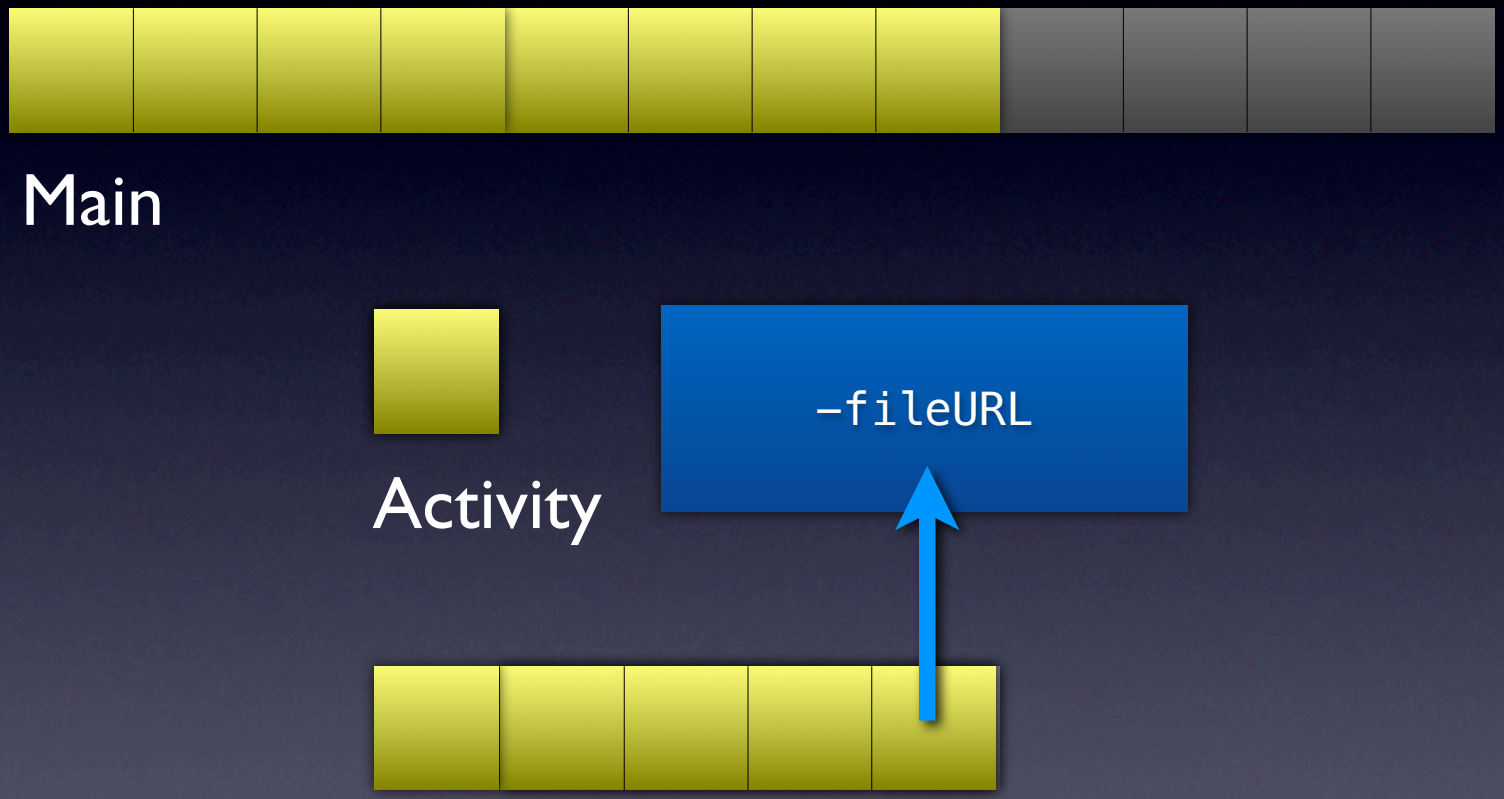
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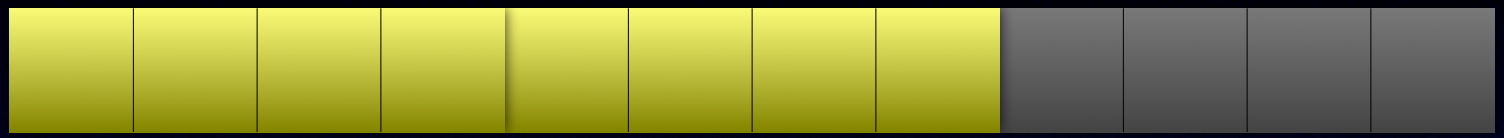

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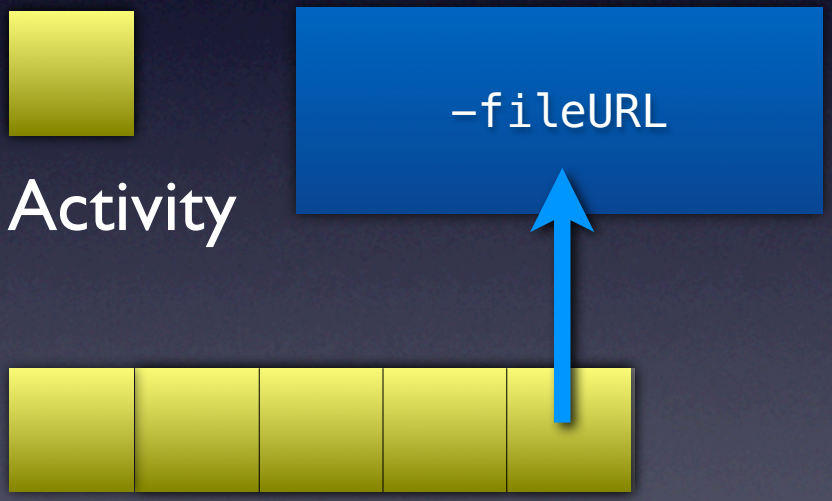

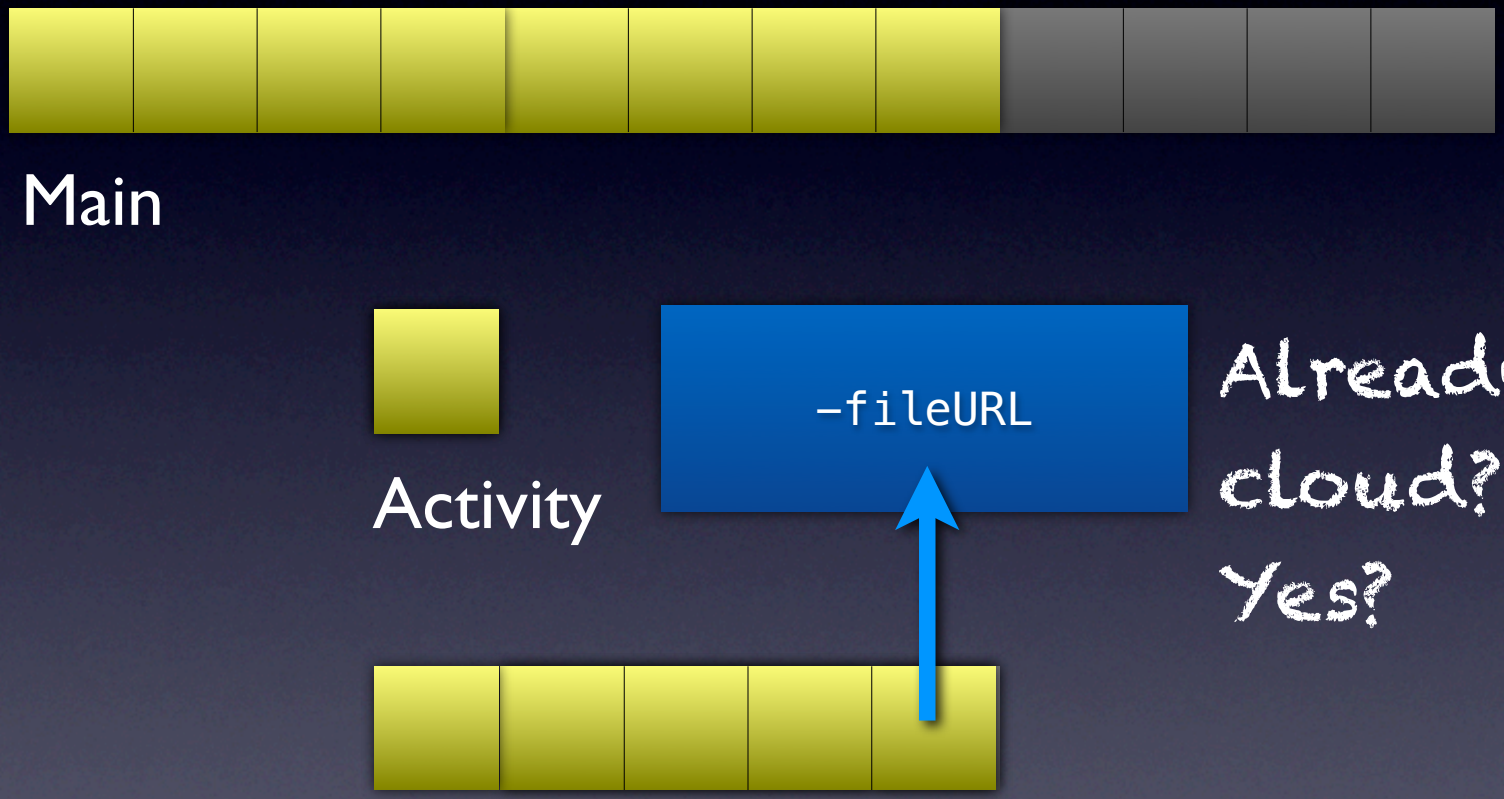
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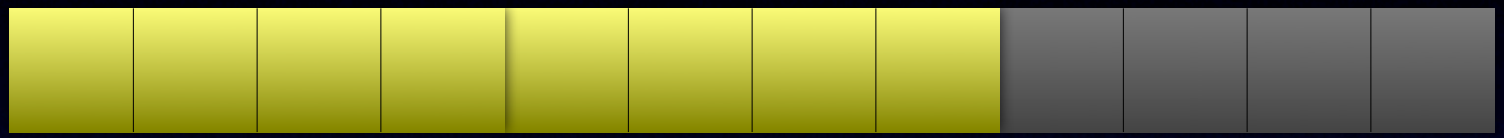
Activity
-fileURL
Already in cloud?
Yes?
File Access



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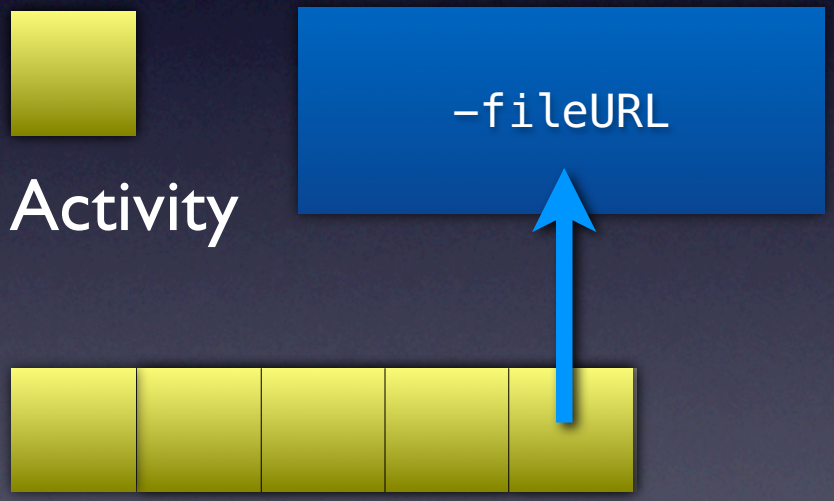


Activity

File Access

Already in cloud?

Yes?

Fail silently

A Race Condition Appears!

- Want to perform move to iCloud within file access
- NSDocument's file presenter methods use –`performFileAccess` and –`performActivity`
  - Which one(s) they use isn't documented

Main

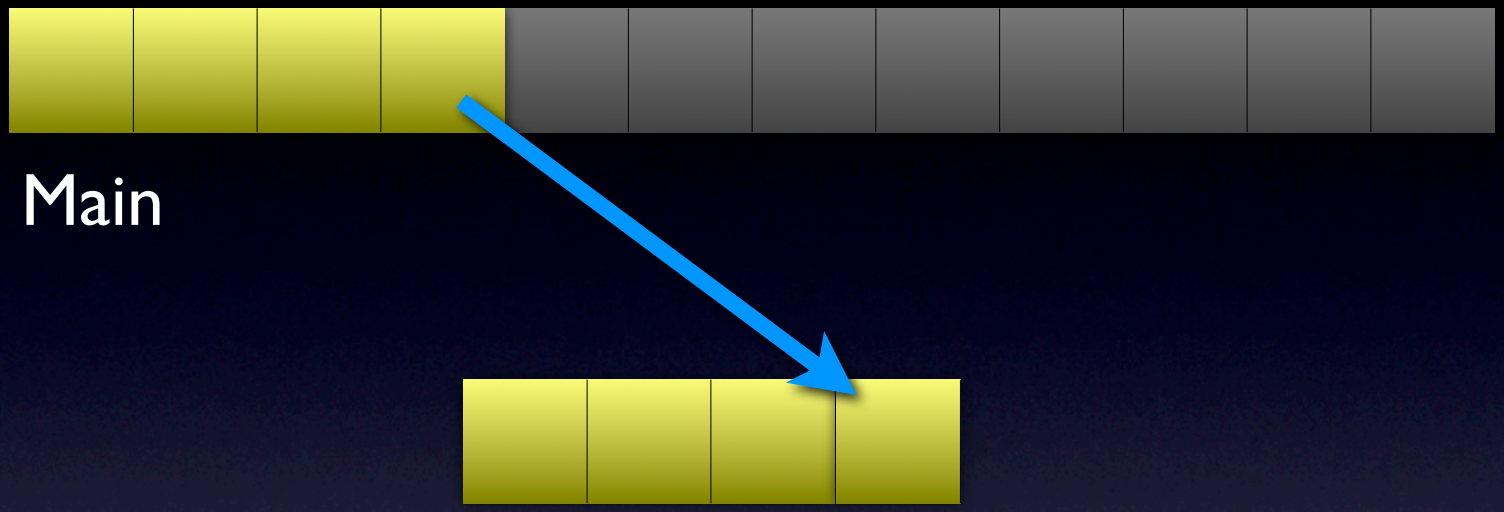
File Access

Main

File Access

Main

File Access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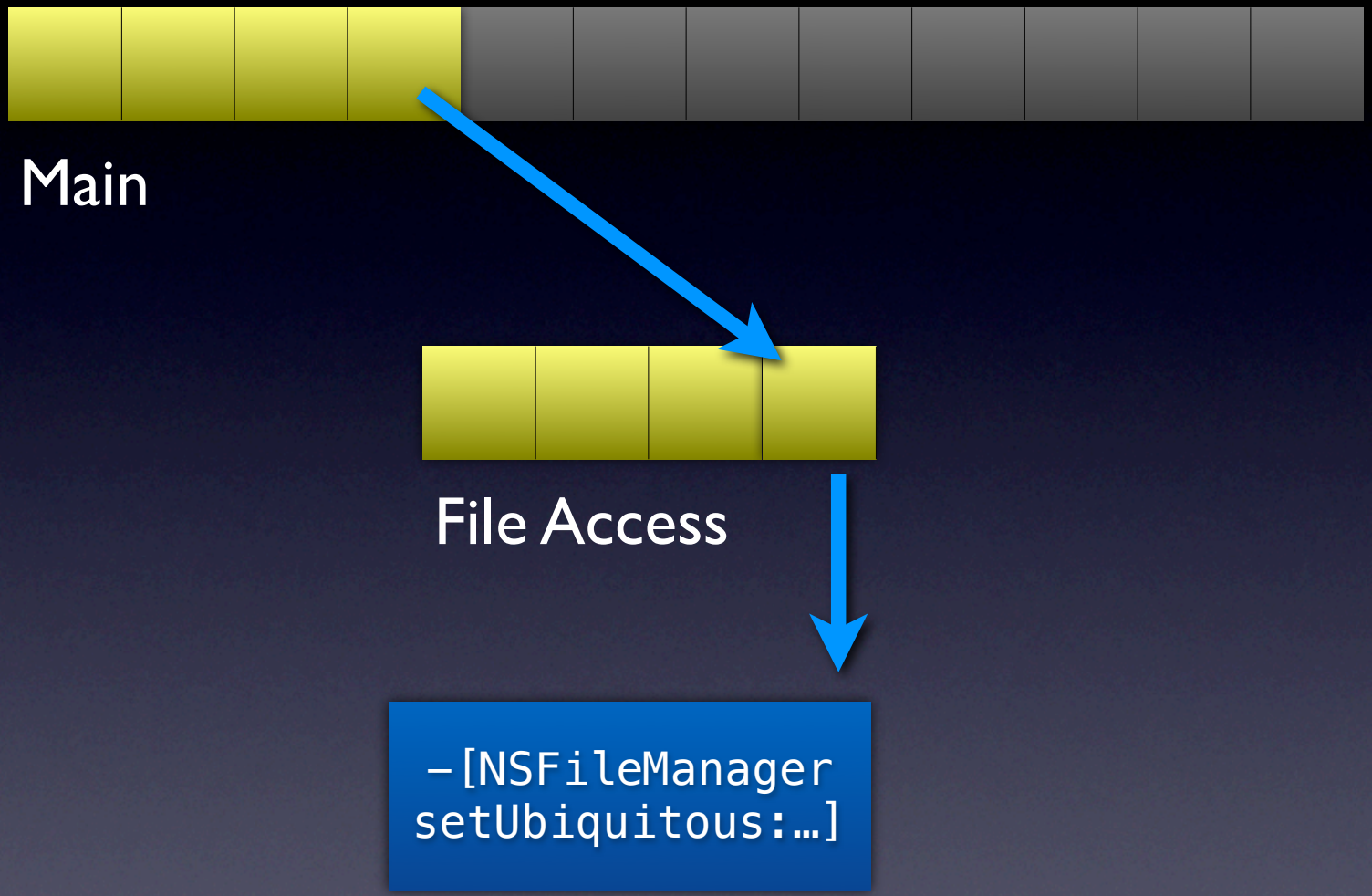
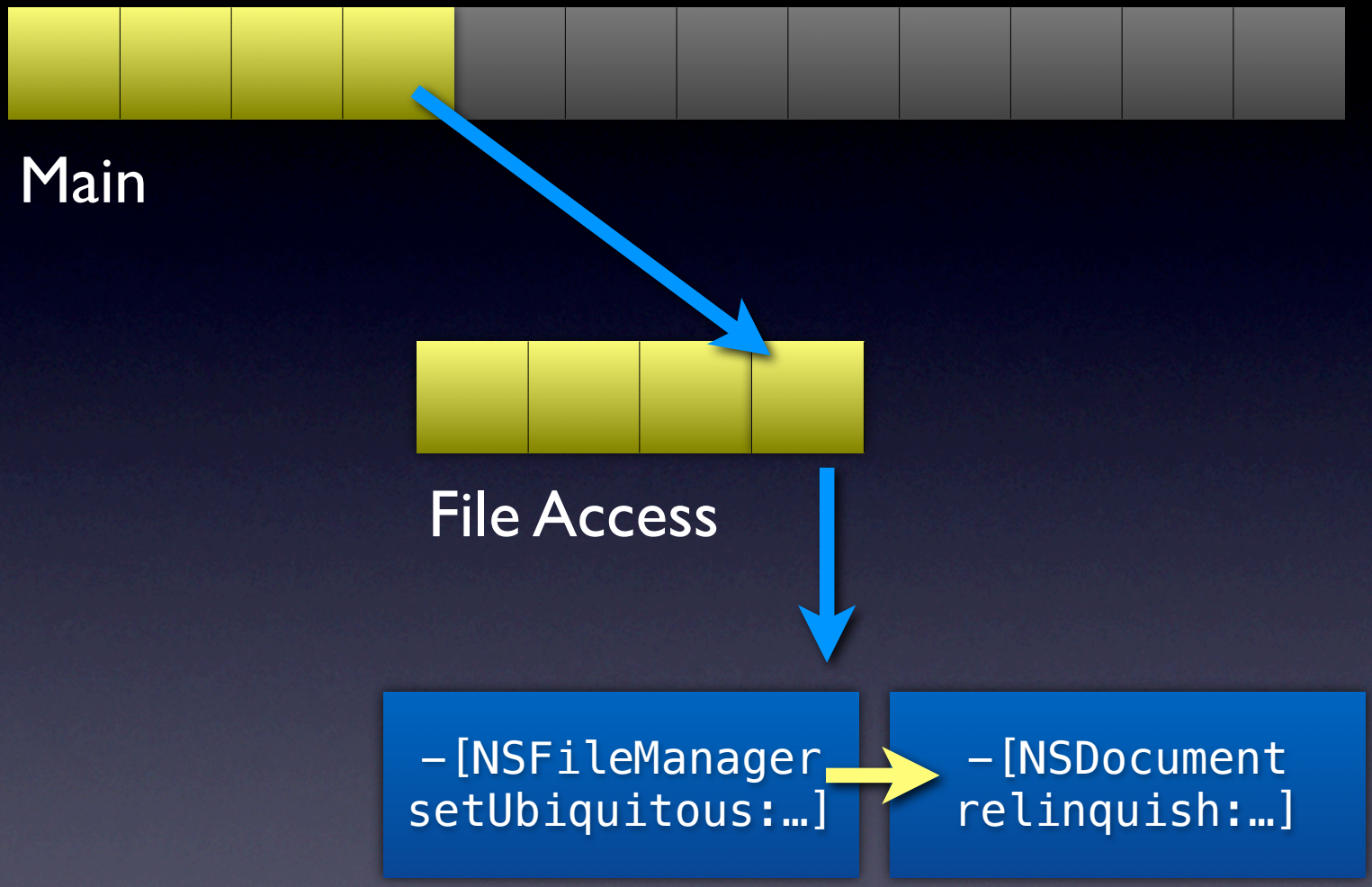
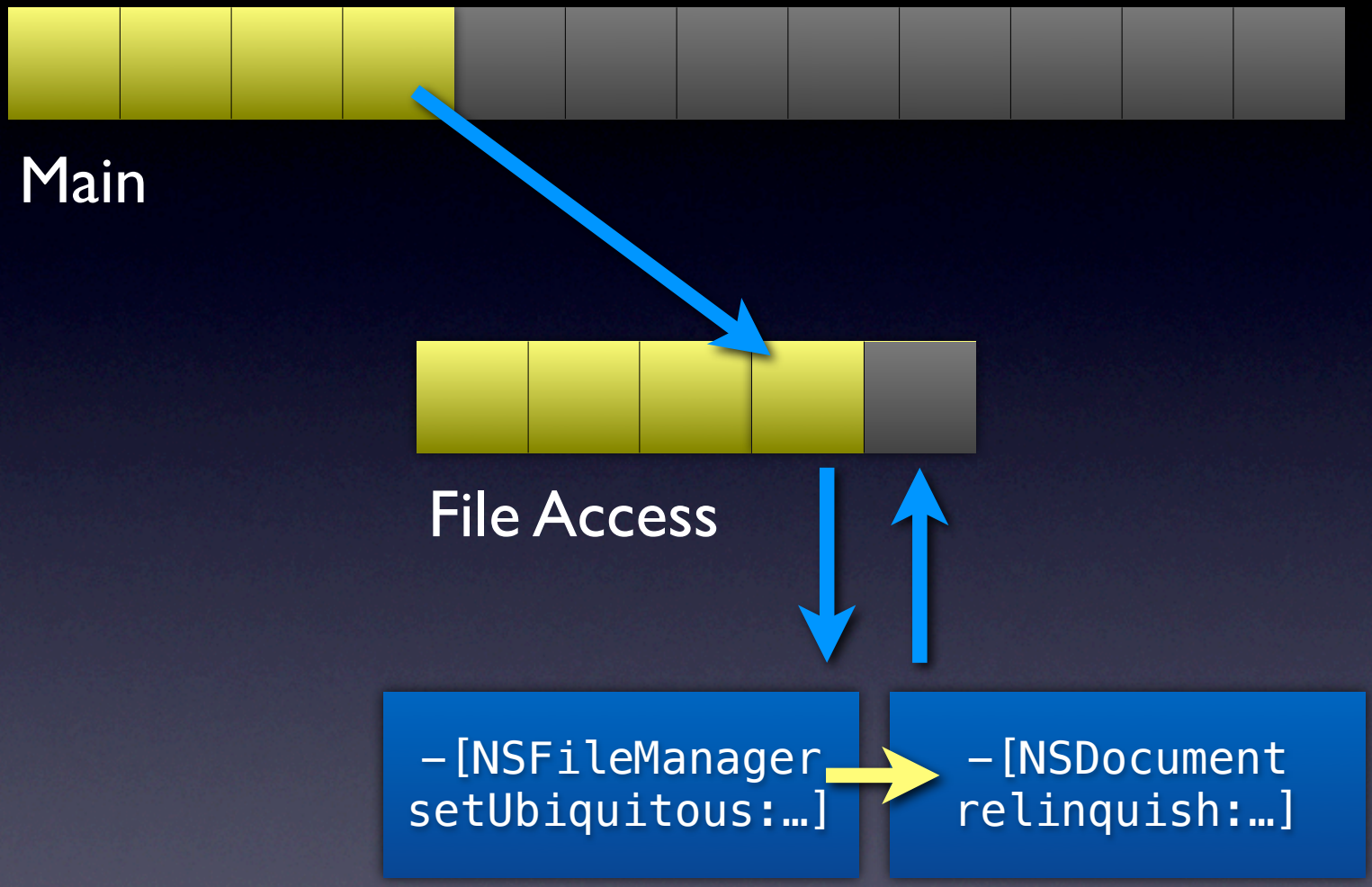
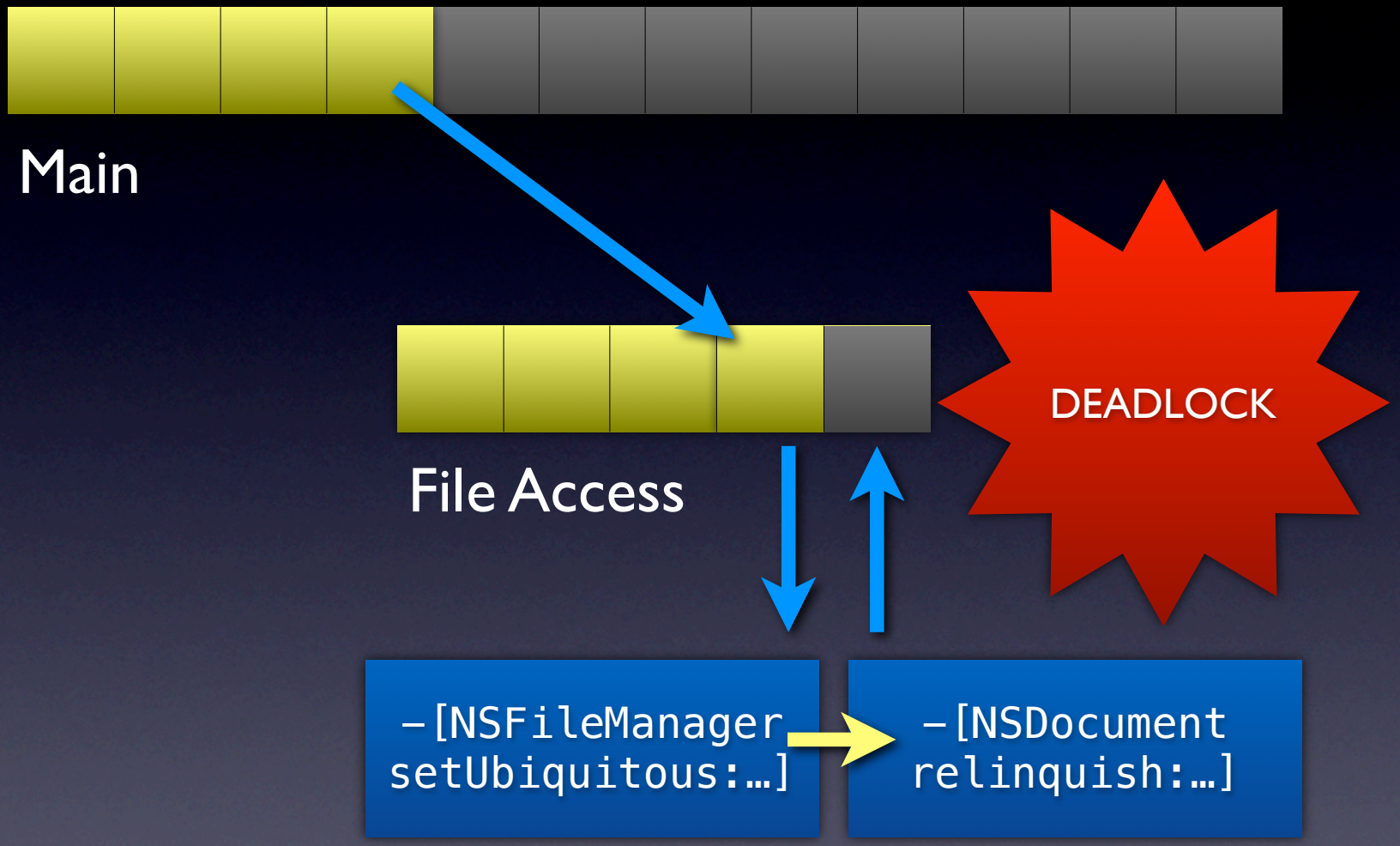
File Access


Main
File Access
-[NSFileManager
setUbiquitous:…]


Main
File Access
-[NSFileManager setUbiquitous:…]
-[NSDocument relinquish:…]


Main
File Access
-[NSFileManager setUbiquitous:…]
-[NSDocument relinquish:…]


Main
File Access
DEADLOCK
-[NSFileManager setUbiquitous:…]
-[NSDocument relinquish:…]

Main

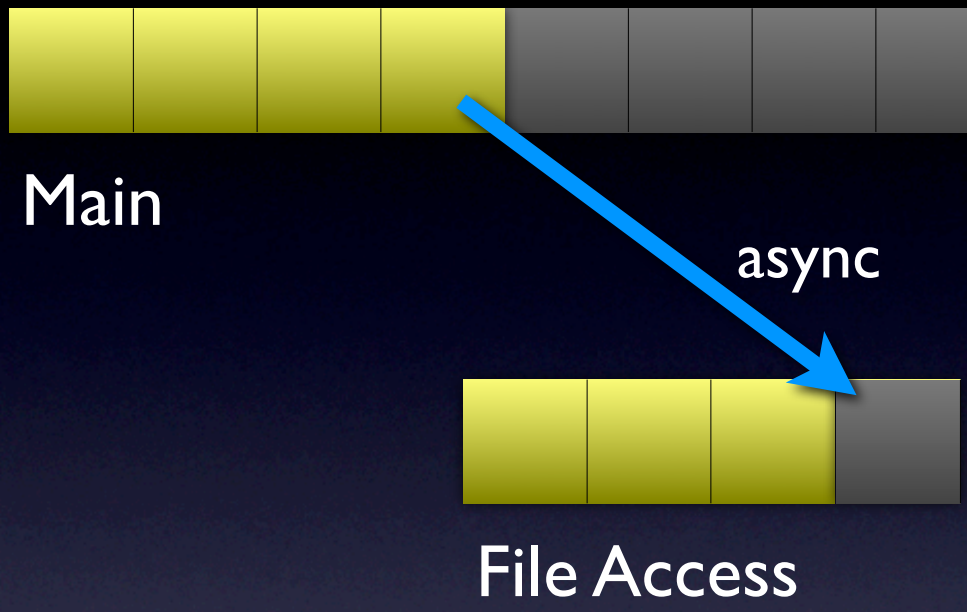
File Access

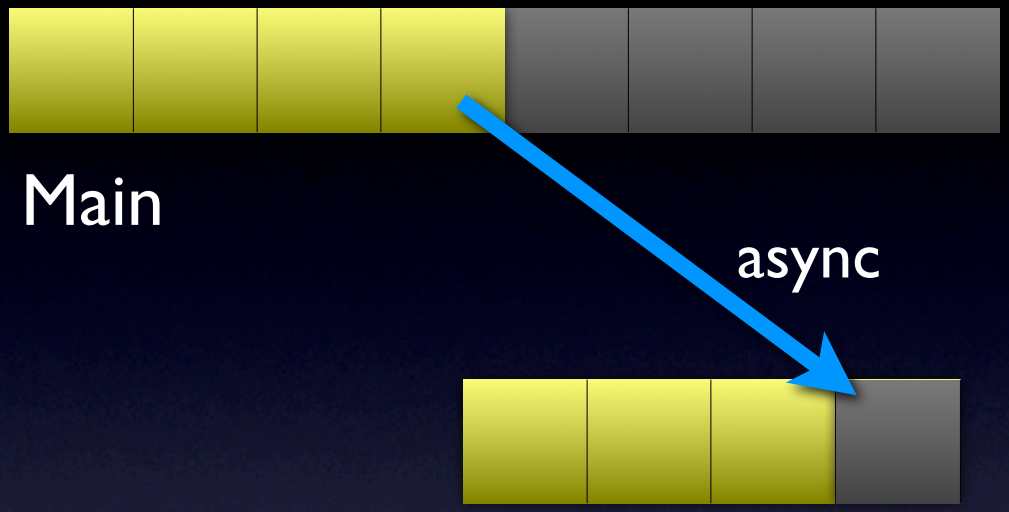
Main

File Access

Main

File Access


Main
async
File Access




```
-[NSDocument
relinquish:…]
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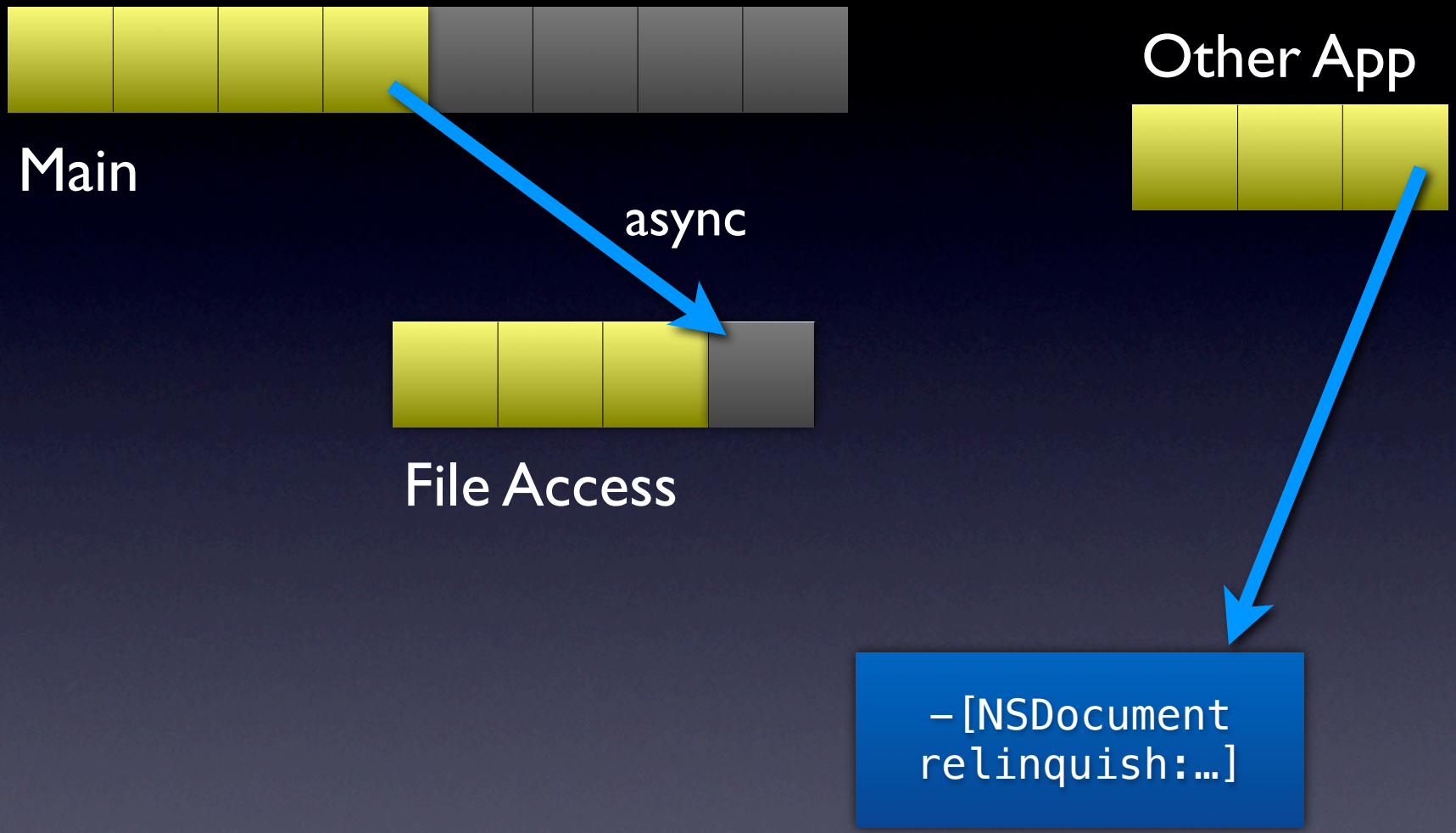
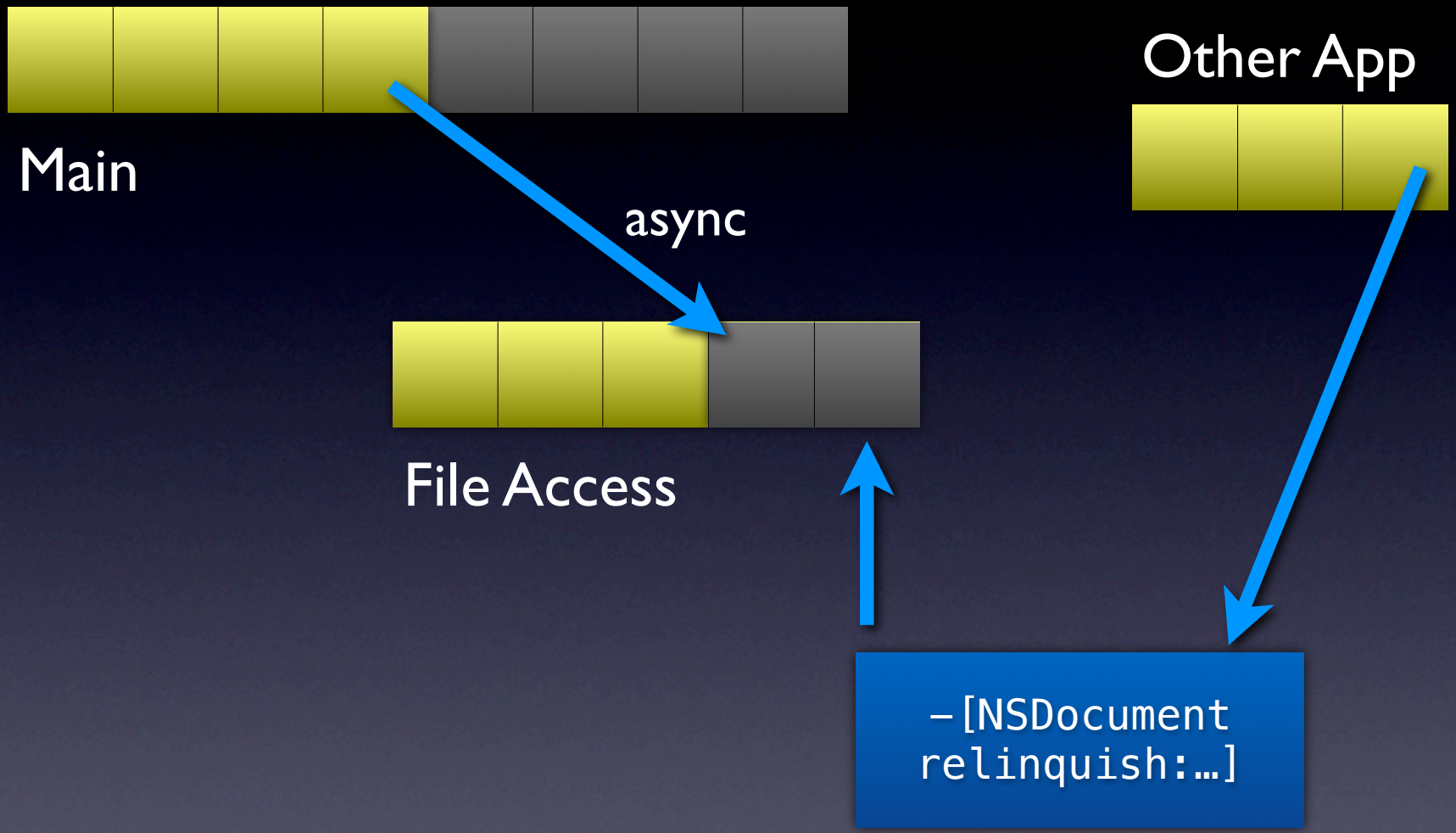
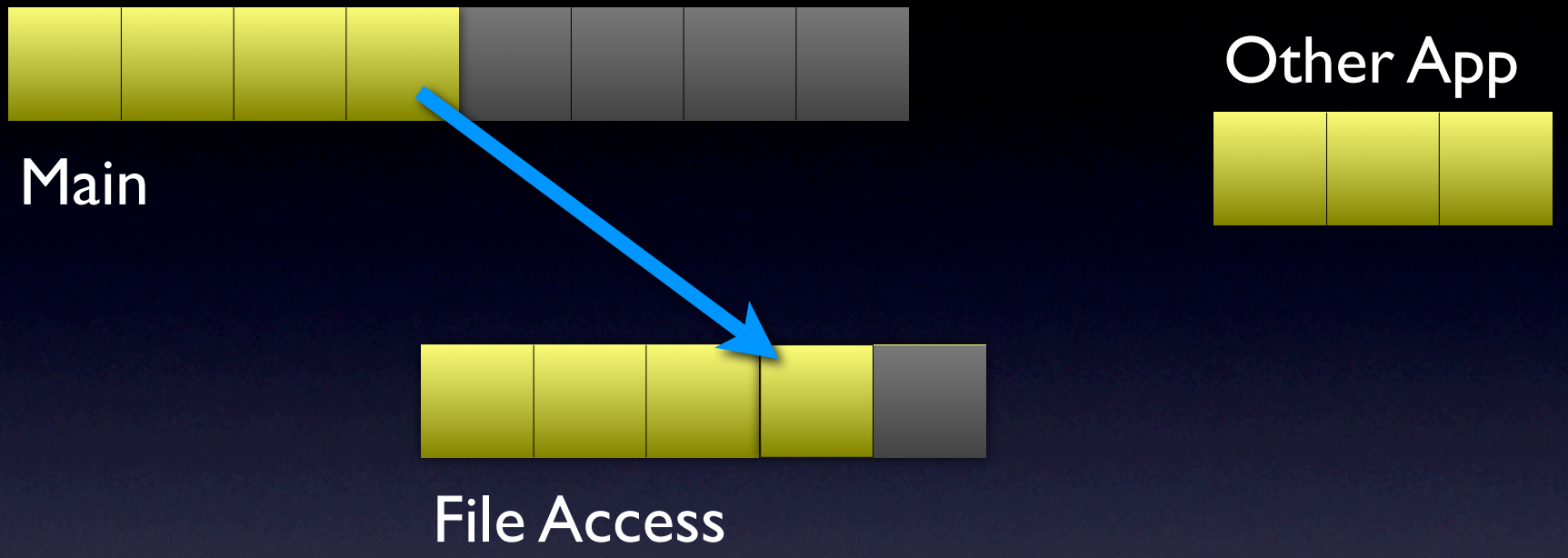
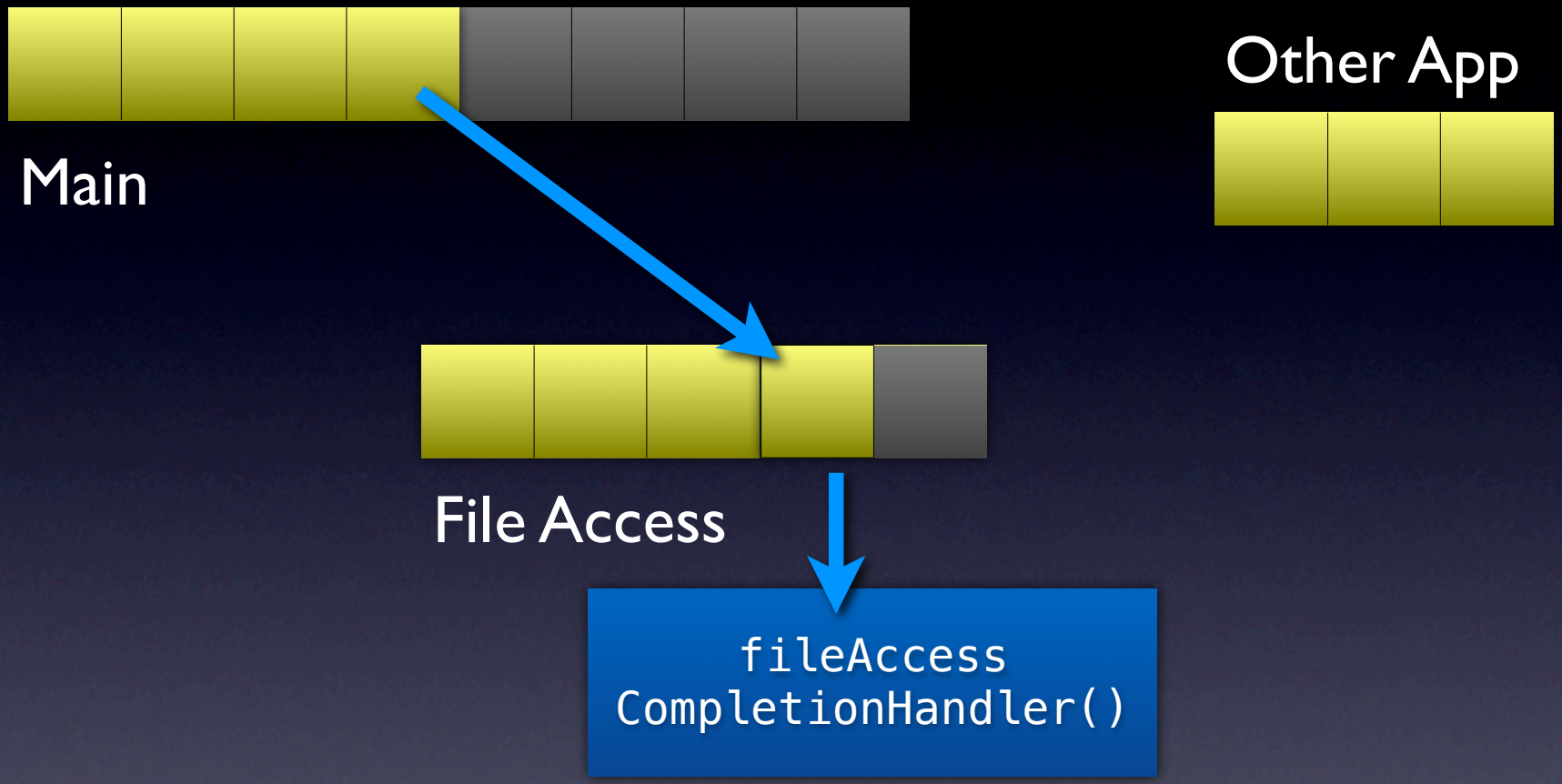
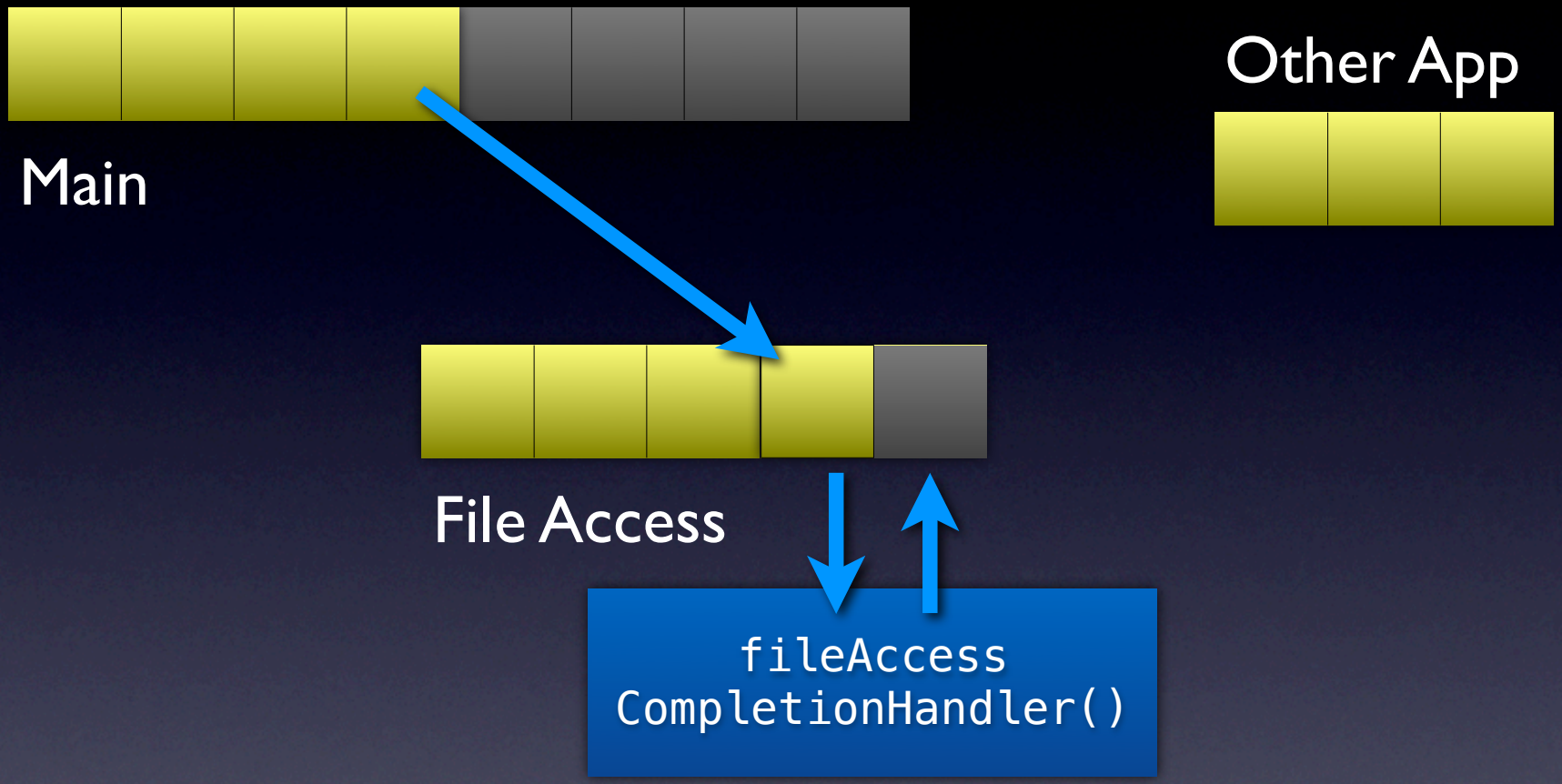
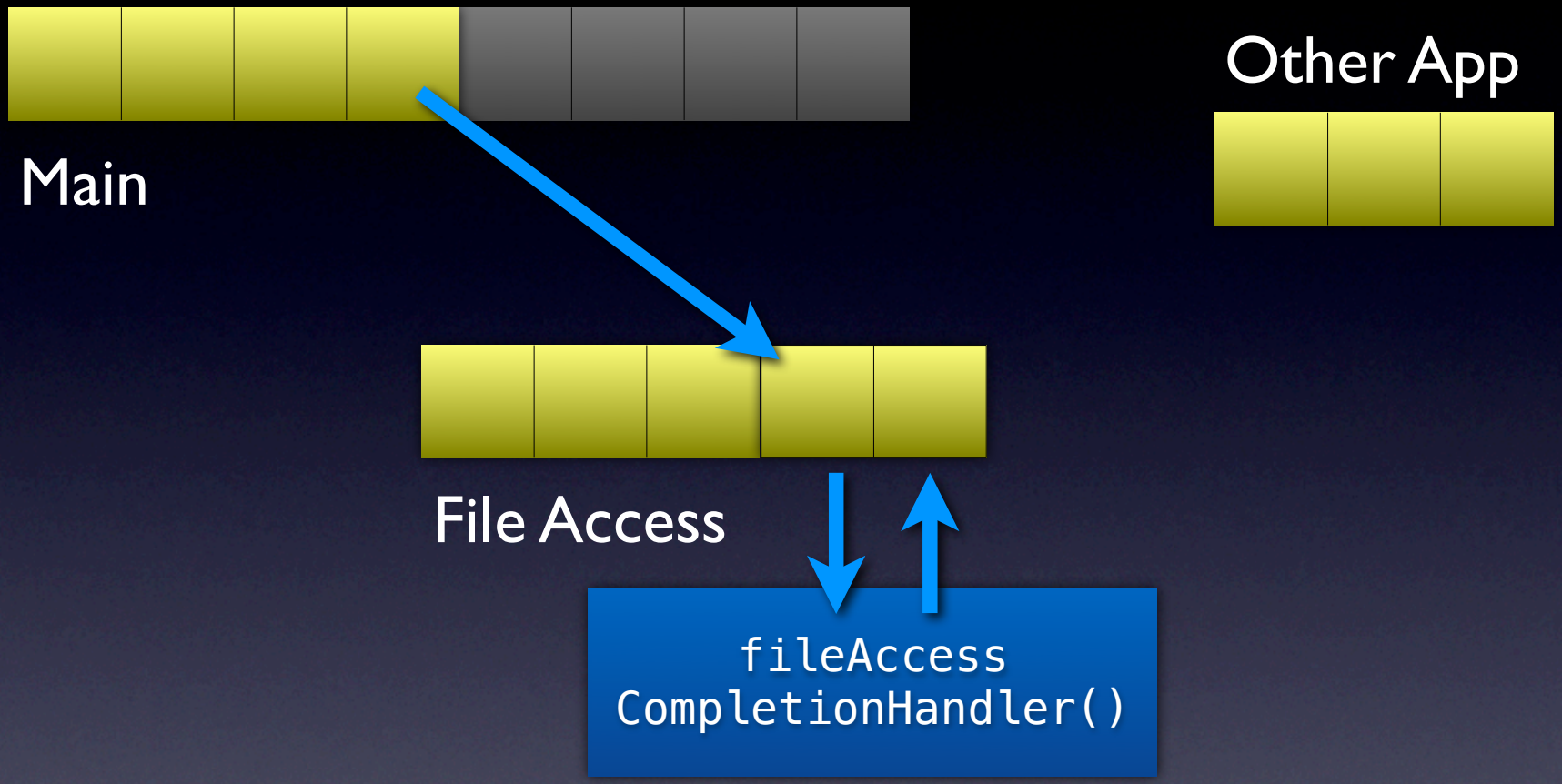

Main
async
File Access
Other App
-[NSDocument
relinquish:…]


Main
async
File Access
Other App
-[NSDocument relinquish:…]


Other App
Main
File Access


Main
Other App
File Access
fileAccess
CompletionHandler()


Other App
Main
File Access
fileAccess
CompletionHandler()


Other App
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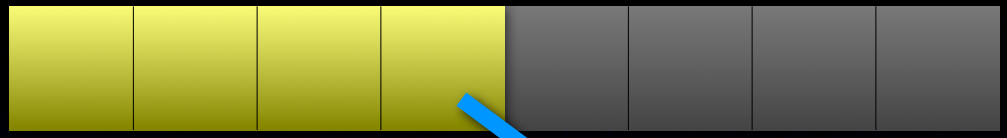
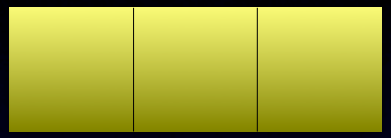


Main

Other App



File Access

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fileAccess
CompletionHandler()
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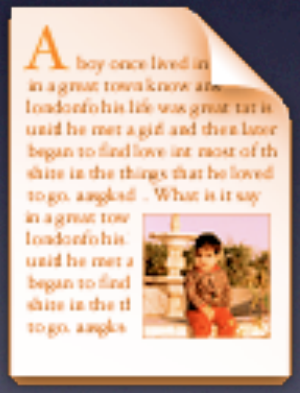
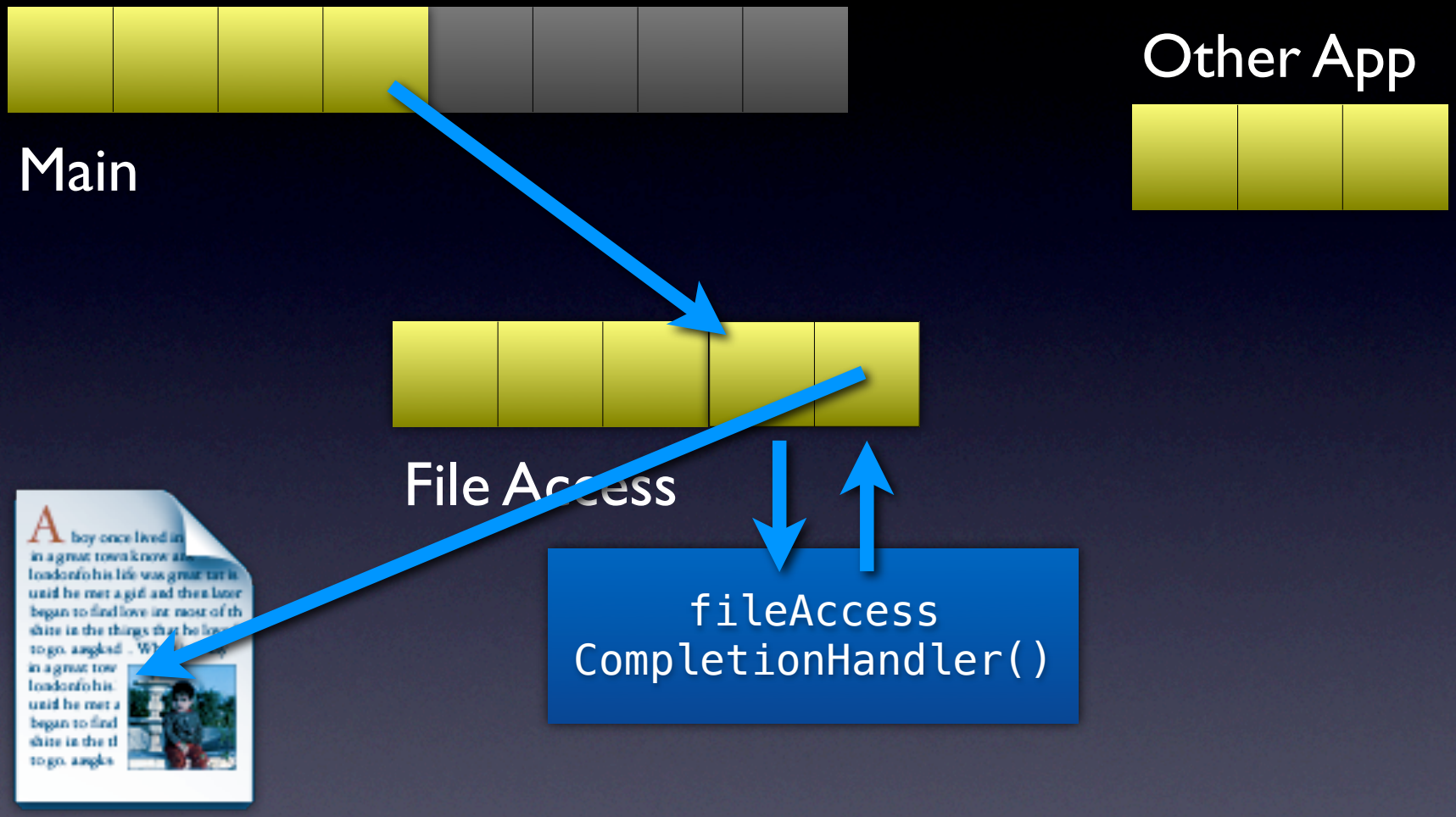


My Document


Other App
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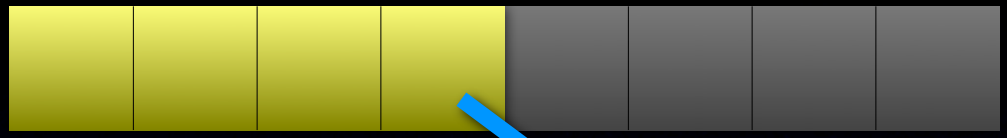
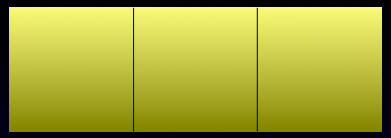
File Access
fileAccess
CompletionHandler()
My Document



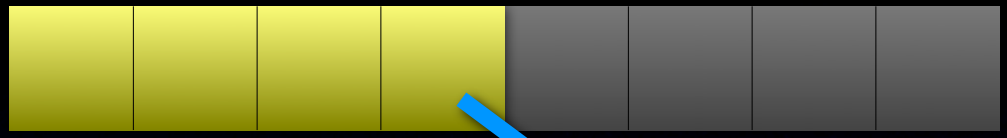
Main

Other App



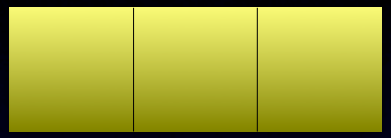
File Access

My Document



Main

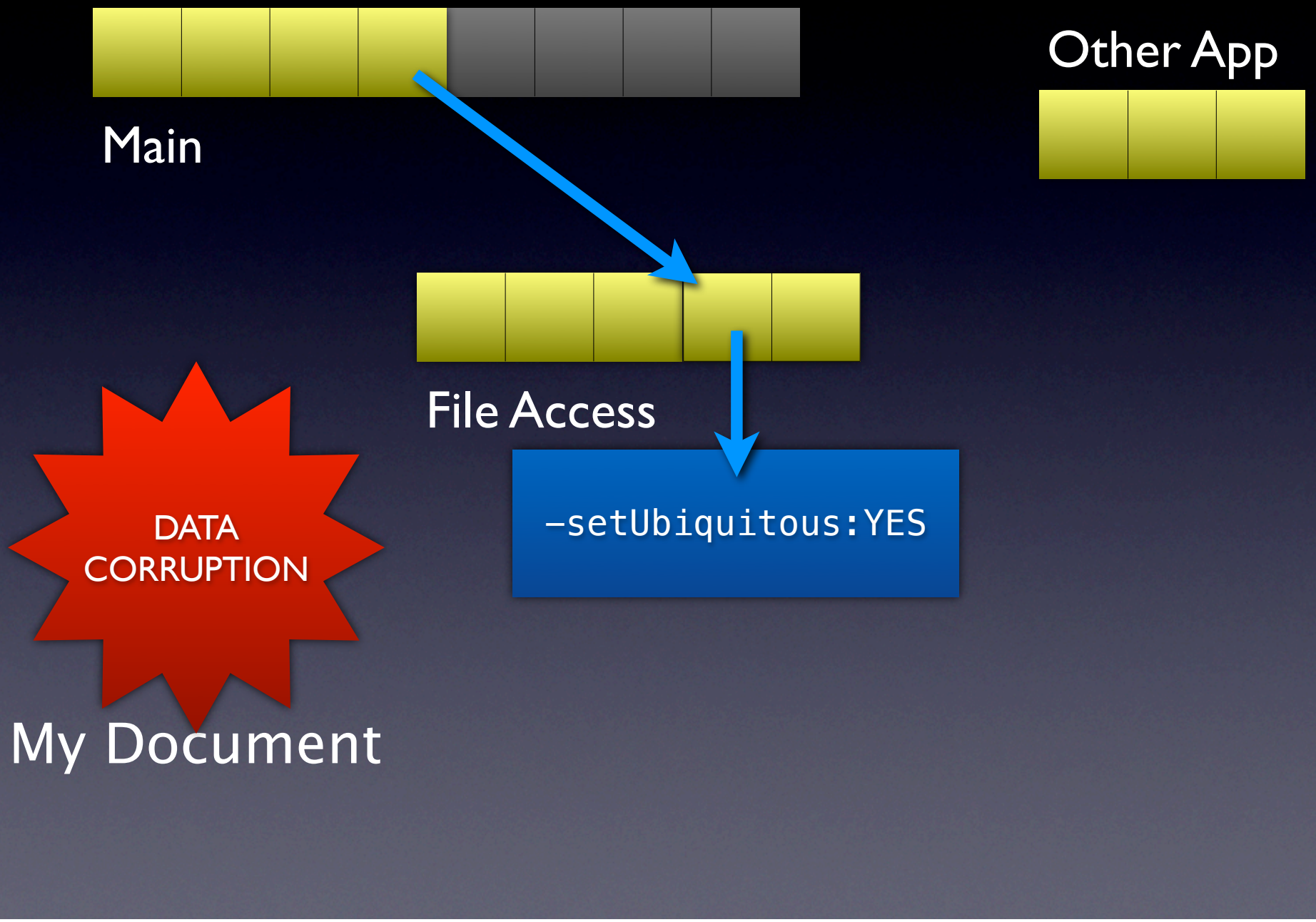
Other App



File Access

```
-setUbiquitous:YES
```

My Document


Main
Other App
File Access
-setUbiquitous:YES
DATA
CORRUPTION
My Document

UIDocument: It's Different!

- `-performAsynchronousFileAccess:` block is *always executed on a background thread*
- No concept of activities; use `-setUserInteractionEnabled:` instead
- No synchronous version of file access API

UIDocument: It's Broken!

- iTunes doesn't use NSFileCoordinator when accessing ~/Documents (r.10260542)
- `-accommodatePresentedItemDeletion` is broken

Handling UIDocument Deletion

- You get `-presentedItemDidMoveToURL:` with a URL in the (undocumented) "dead zone"
- Remember this URL, return it from `-presentedItemURL`, but *don't* call super
- You get `-accommodatePresentedItemDeletion`
- Call super with a wrapper completion block
  - Invoke the original completion handler
  - Attempt to salvage the file in case the user wants it
  - We haven't succeeded at that part yet

Speaking of Deletion…

- Put a file in a folder inside the ubiquity container
- Start editing the file on Client A
- Delete the folder on Client B
- Save your changes on Client A
- Save completes, then iCloud immediately deletes the folder (r.10247769)

iCloud: Lessons Learned

- Maintain a small set of serial queues
- Take care to interface with framework queues
- Be mindful of what thread you're executing on
- Be mindful of other processes touching your files
- Treat the filesystem as authoritative
- Directories suck
- File Radars!

Resources

- github.com/OmniGroup (OFSDocumentStore.m)
- cocoa-dev mailing list (lists.apple.com)
- Developer Forums (devforums.apple.com)
- @optshiftk
- optshiftk.com
- kyle.sluder@gmail.com

Thank You