DispatchQueue.sync するときのスレッド

DispatchQueueでありがちなデッドロック

```
class ViewController: UIViewController {
    override func viewDidLoad() {
        super.viewDidLoad()

        importantSet()
    }
}

var value: Int = 0
func importantSet() {
    DispatchQueue.main.sync {  Thread 1: EXC_BAD_INSTRUCTION (code=E.
        value = 1
    }
}
```

軽い気持ちで呼んだ関数が内部で `DispatchQueue.sync` を使っていた

便利関数が用意される

```
func runOnMainThread(closure: () -> ()) {
    if Thread.isMainThread {
        closure()
    } else {
        DispatchQueue.main.sync {
            closure()
        }
    }
}
```

これでクラッシュしない！

```
class ViewController: UIViewController {
    override func viewDidLoad() {
        super.viewDidLoad()

        importantSet()
    }
}

var value: Int = 0
func importantSet() {
    runOnMainThread {
        value = 1
    }
}
```

めでたしめでたし

しかしここで疑問が

次のようなコードを実行するとき

```
func runOnMainThread(closure: () -> ()) {
    if Thread.isMainThread {
        closure()
    } else {
        DispatchQueue.main.sync {
            closure()
        }
    }
}

class ViewController: UIViewController {
    override func viewDidLoad() {
        super.viewDidLoad()

        let queue = DispatchQueue(label: "my.queue")
        queue.sync {
            runOnMainThread {
                print("Hello")
            }
        }
```

```swift
func runOnMainThread(closure: () -> ()) {
    // 3. myqueueのスレッドにいるはずなのでelseに入るはず
    if Thread.isMainThread {
        closure()
    } else {
        // 4. myqueueはメインスレッドをロックしているのでデッドロック！？
        DispatchQueue.main.sync(execute: closure)
    }
}

class ViewController: UIViewController {
    override func viewDidLoad() {
        super.viewDidLoad()

        // 1. ここはメインスレッド
        let myqueue = DispatchQueue(label: "my.queue")
        myqueue.sync {
            // 2. ここはmyqueueのスレッド？
            runOnMainThread {
                print("Hello")
            }
        }
    }
}
```

しかしここで疑問が

- 実際に実行するとクラッシュしない
- この場合 `Thread.isMainThread` は `true` を返す
- `myqueue` の中から呼んでいるのに、なぜ？
- (この時点で僕は勘違いをしています)

apple/swift-corelibs-libdispatch

apple / **swift-corelibs-libdispatch**

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The libdispatch Project, (a.k.a. Grand Central Dispatch), for concurrency on multicore hardware http://swift.org

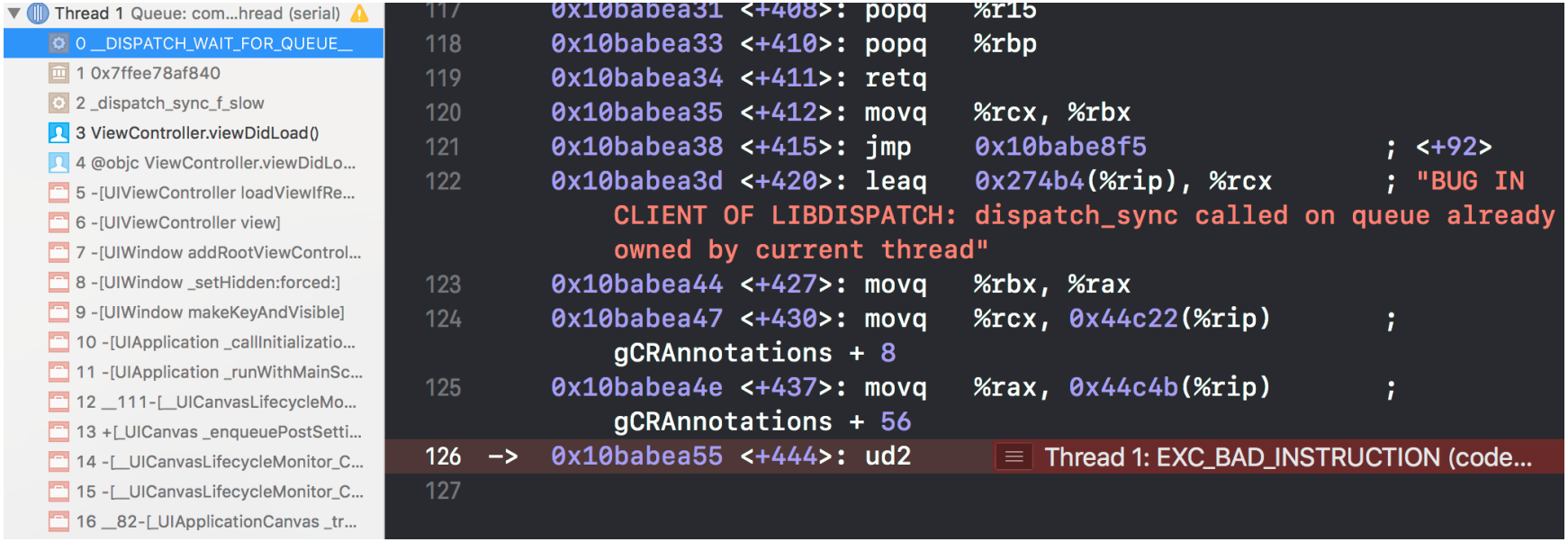
994 commits | **38** branches | **952** releases | **51** contributors | Apache-2.0

Branch: **master** | New pull request | Create new file | Upload files | Find file | Clone or download

ktopley-apple Merge pull request #406 from adierking/printflike ... Latest commit `f6376cb` 10 days ago

cmake	Linux i686 Build Support	14 days ago
dispatch	build: honour `BUILD_SHARED_LIBS`	24 days ago
libdispatch.xcodeproj	merge darwin/libdispatch-913.1.4	a year ago
man	build: remove autotools based build system	8 months ago
os	[gardening] Use https for swift.org links	7 months ago
private	Fix the signature of _dispatch_install_thread_detach_callback()	13 days ago
resolver	Import libdispatch-500.1.5	3 years ago
src	Merge pull request #397 from compnerd/static-stdlib	10 days ago
tests	Merge pull request #406 from adierking/printflike	10 days ago
tools	Merge libdispatch-913.1.4	a year ago
xcodeconfig	Merge libdispatch-913.1.4	a year ago
xcodescripts	Merge libdispatch-743	2 years ago

デッドロックを発生させてエラーからソースをたどる



- `dispatch_sync called on queue already owned by current thread` というエラー文をswift-corelibs-libdispatchからgrep
  - → 出ない

- あった（`_dispatch_sync_wait`）

```
static void
_dispatch_sync_wait(dispatch_queue_t top_dq, void *ctxt,
        dispatch_function_t func, uintptr_t top_dc_flags,
        dispatch_queue_t dq, uintptr_t dc_flags)
{
    pthread_priority_t pp = _dispatch_get_priority();
    dispatch_tid tid = _dispatch_tid_self();
    dispatch_qos_t qos;
    uint64_t dq_state;

    dq_state = _dispatch_sync_wait_prepare(dq);
    if (unlikely(_dq_state_drain_locked_by(dq_state, tid))) {
        DISPATCH_CLIENT_CRASH((uintptr_t)dq_state,
                "dispatch_sync called on queue "
                "already owned by current thread");
    }
```

- C++の文字列リテラルは空白や改行があれば結合されるので、そこで分かれていた

デッドロック判定処理をたどる

- `_dq_state_drain_locked_by` が判定しているっぽい

```
static inline bool
_dq_state_drain_locked_by(uint64_t dq_state, dispatch_tid tid)
{
    return _dispatch_lock_is_locked_by((dispatch_lock)dq_state, tid);
}
```

```
typedef uint32_t dispatch_tid;
typedef uint32_t dispatch_lock;
```

```
#define DLOCK_OWNER_MASK   ((dispatch_lock)0xfffffffc)
```

```
static inline bool
_dispatch_lock_is_locked_by(dispatch_lock lock_value, dispatch_tid tid)
{
    // equivalent to _dispatch_lock_owner(lock_value) == tid
    return ((lock_value ^ tid) & DLOCK_OWNER_MASK) == 0;
}
```

- C にありがちなビット演算
- `dq_state` と `tid` の下位3~32bitが同一かどうかで比較されてる
- `dq_state` は `DispatchQueue` が管理している値っぽいので、 `tid` が何か分かれば良さそう

_dispatch_sync_waitに戻る

```
static void
_dispatch_sync_wait(dispatch_queue_t top_dq, void *ctxt,
        dispatch_function_t func, uintptr_t top_dc_flags,
        dispatch_queue_t dq, uintptr_t dc_flags)
{
    pthread_priority_t pp = _dispatch_get_priority();
    dispatch_tid tid = _dispatch_tid_self();
    dispatch_qos_t qos;
    uint64_t dq_state;

    dq_state = _dispatch_sync_wait_prepare(dq);
    if (unlikely(_dq_state_drain_locked_by(dq_state, tid))) {
        DISPATCH_CLIENT_CRASH((uintptr_t)dq_state,
                "dispatch_sync called on queue "
                "already owned by current thread");
    }
```

- `tid` は `_dispatch_tid_self()` から来てるっぽい

```
#define _dispatch_tid_self()  \
          ((dispatch_tid)_dispatch_thread_port())
```

```
#define _dispatch_thread_port()  \
       pthread_mach_thread_np(_dispatch_thread_self())
```

```
#if defined(_WIN32)
#define _dispatch_thread_self() ((uintptr_t)GetCurrentThreadId())
#else
#if DISPATCH_USE_DIRECT_TSD
#define _dispatch_thread_self() ((uintptr_t)_dispatch_thread_getspecific( \
        _PTHREAD_TSD_SLOT_PTHREAD_SELF))
#else
#define _dispatch_thread_self() ((uintptr_t)pthread_self())
#endif
#endif
```

- ようやく見慣れた関数が出てくる (`pthread_self`)
- OSによって分岐しているが、実態はpthreadのスレッドID（あるいは同等にみなせる代物）っぽい

_dispatch_sync_waitに戻る

```
static void
_dispatch_sync_wait(dispatch_queue_t top_dq, void *ctxt,
        dispatch_function_t func, uintptr_t top_dc_flags,
        dispatch_queue_t dq, uintptr_t dc_flags)
{
    pthread_priority_t pp = _dispatch_get_priority();
    dispatch_tid tid = _dispatch_tid_self();
    dispatch_qos_t qos;
    uint64_t dq_state;

    dq_state = _dispatch_sync_wait_prepare(dq);
    if (unlikely(_dq_state_drain_locked_by(dq_state, tid))) {
        DISPATCH_CLIENT_CRASH((uintptr_t)dq_state,
                "dispatch_sync called on queue "
                "already owned by current thread");
    }
```

- sync処理を行う対象のスレッドが現在のスレッドならデッドロックと判定しクラッシュさせている

最初の疑問に戻り、なぜrunOnMainThreadは問題なさそうなのか

```swift
func runOnMainThread(closure: () -> ()) {
    // 3. myqueueのスレッドにいるはずなのでelseに入るはず
    //  → ではなく、メインスレッドのままなのでelseには入らない
    if Thread.isMainThread {
        closure() // 4. デッドロックしない
    } else {
        DispatchQueue.main.sync(execute: closure)
    }
}

class ViewController: UIViewController {
    override func viewDidLoad() {
        super.viewDidLoad()

        // 1. ここはメインスレッド
        let myqueue = DispatchQueue(label: "my.queue")
        myqueue.sync {
            // 2. ここはmyqueueのスレッド？
            //  → ではなく、myqueue側がメインスレッドで動作している
            runOnMainThread {
                print("Hello")
            }
        }
    }
}
```

そもそもの勘違い

- `DispatchQueue` はそれぞれが専用のスレッドを持っていてその中でのみ動作するものだと思いこんでいた
    - これだとconcurrent queueは何者やねん！ってなる

最後に

- 事の発端となった `DispatchQueue.main.sync` だが、そもそもこれをしなきゃいけない場面はほぼないはず
- 適切に `DispatchQueue` （や、Lock）を使っていこう