

Multithread programming

Multithread programming in GLib/GTK+ applications

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Introduction

- Concurrent programming based on threads
- Thread: independent execution flow inside a process.
- Multiple threads can run simultaneously (or pseudo-simultaneously)
- Creating a new thread is lighter than creating a new process

Advantages

- Avoiding blocks in applications that do I/O operations
- Improving feedback in GUI applications
- Communication among threads in the same process is quite easy and fast
- Taking advantage of the hardware parallelism in SMP systems

Disadvantages

- Concurrent programming is hard
- Non determinism execution
- Debugging is more difficult
- Typical concurrent issues: dead blocks, performance, and so on

¿Why alternatives?

- Disadvantages might be enough worth not to use threads
- General advice: use threads only when it's absolutely needed
- Many situations can be addressed in an easy way without using threads

Alternatives

- Use of `g_idle_add` functions to quickly finish a callback
- Explicitly dispatch pending work in the main loop
- Use of async API when it's available: `gnome_vfs_async_*`, `g_spawn_async_*`, etc.

GLib

- GLib provides an API that, in UNIX systems, is a wrapper of `p_thread` (POSIX threads)
- Threads management functions:
 - `g_thread_create`
 - `g_thread_create_full`
 - `g_thread_exit`
 - `g_thread_join`
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- Concurrency functions:
 - `g_mutex_*`
 - `g_cond_*`

Multithread programming in GLib/GTK+

- GLib is thread-safety when `g_thread_init` is used
- GDK provides `gdk_threads_init` too that has to be used in addition to `g_thread_init`, but it's not always recommendable
- Two options:
 - Using `gdk_threads_init`, `gdk_threads_enter()` and `gdk_threads_leave`
 - Accessing the program GUI exclusively from the main thread (where the gtk main loop is running)
- The second options is preferable in most of the cases

Threads communication

- Main thread
- One or more threads that perform the hard work
- `g_idle` or `g_timeout` functions to send tasks to the main thread from others

Design Patterns

- Boss/Workers: tasks are assigned by the boss to the workers. There are several variations of this model
- Pipeline model: a task is split into several steps so that there is a thread for every step

Debugging

Xlib: unexpected async reply (sequence 0x1421)!

¿What to do?

- Look for X error handlers in the intermediate layers
 - Bonobo: `bonobo_x_error_handler`
 - GDK: `gdk_x_error`
 - Cairo: `_noop_error_handler`
- Set a break point in gdb for every handler
- Run the program in gdb with the `-sync` modifier (so that the X window calls will be synchronous)
- Once you are stopped in the break point you can just get a backtrace like if it were a crash
- In order to get a backtrace for every running thread use the following command in gdb:

thread apply all bt
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