Concurrency (computer science) +3

What are the best languages for writing highly concurrent programs?

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Ulf Wiger, Specializing in massively concurrent, distributed, high-availability programming
Answered Apr 26, 2016

There are different flavors of concurrency, and (unsurprisingly) different languages address these differently. Note that there are middleware and cloud environments that address these areas, esp. for mainstream languages. I will leave them aside and focus on languages that have

- Embarrassingly parallel code. This is where lots of tasks are executed in parallel with no interaction between them and no (or minimal) synchronization required. Here, languages like Erlang and Haskell and Clojure work well, and also make use of multiple cores. From what I can tell, Go also works well here.
- Data parallelism, where you use parallelization to speed up e.g. computation jobs; the concurrent tasks have to synchronize at various points in a problem-specific fashion. Erlang is a bit hit-and-miss here, since it isn't the fastest computation language, and also doesn't thrive on data sharing. Haskell is at the forefront of language and compiler support in this area, and Clojure has some very nice data structures and constructs for shared-memory concurrency. However, in the exotic niche of huge computation clusters, Erlang is attractive due to its native support for distributed processing and fault tolerance. I would imagine that Go suffers a bit similarly to Erlang, in that the robust way to approach the problem - channels - is a bit too inefficient. While it lets you use e.g. semaphores for synchronization, so do most mainstream languages; I consider that fairly primitive support.
- Orchestration logic, where the concurrent tasks need to coordinate with each other in a stateful manner, is the domain of Erlang. Cloud Haskell and Akka are modeled after Erlang, and Akka has a considerable commercial user base. Elixir is a Ruby-like language that runs on the Erlang VM and has the same expressive power for concurrency as Erlang. Go has a solid CSP-like concurrency model, but lacks Erlang's error handling support (i.e. built-in logic for recovering from process crashes)

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The Actors programming model gives a good background to design concurrent, parallel and distributed systems. And the Erlang language was especially done to achieve it in production use in real.

If you can implement the Actor model as a library (say Akka), you also will have good chances to get its features in any language even in single-threaded language implementations (via RPC and cross-node messaging).

On the other side, this model will force you to change your programming style from the roots, and not all tasks can be done well in it. So the tasks you are solving can limit its acceptance.

and classical book on implementation:

Agha, Gul Abdulnabi
ACTORS: A Model of Concurrent Computation in Distributed Systems
MIT Press, 1985
AITR-844

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Just saying concurrent is not enough. For choosing which is the best language, need to know whats the degree of parallelism and what type of things are you trying to achieve.

For customer owned devices, that are typically multicore NUMA machines, you'd most likely do application specific things. And for these types best languages are asm, C, C++, java in that order.

For tasks that need to be parallelized at like multi- machine scale, and have some sort of distribution wide state, it makes more sense to use something like erlang, since it inherently supports the distributed communications.

Per Ounce performance , no functional language will ever beat C or C++. But, the flip side is that the code is hard to maintain, and not very intuitive.

On the other side of the story, functional languages are elegant to write code in, and you don't need to worry about details that much. Whether it will work in practice is highly dependent on the run time supported by those languages.

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Erlang and Haskell have pretty good reputations in this area.

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More like a weird coding...habit? I don't even know how to describe it. It boggles my mind to this day. When I was 18 years old at my first internship I worked with a senior developer on a number of p... (more)

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