

Lecture 2: 调试与性能分析

Debugging & Profiling

调试系统

日志系统

调试器

行为级跟踪

静态分析

“The most effective debugging tool is still careful thought, coupled with judiciously placed print statements”

— Brian Kernighan, *Unix for Beginners*.

Logger

- You can log to files, sockets or even remote servers instead of standard output.
- Logging supports severity levels (such as INFO, DEBUG, WARN, ERROR), that allow you to filter the output accordingly.
- For new issues, there's a fair chance that your logs will contain enough information to detect what is going wrong.
- `/var/log`

Debugger

- Halt execution of the program when it reaches a certain line.
- Step through the program one instruction at a time.
- Inspect values of variables after the program crashed.
- Conditionally halt the execution when a given condition is met.
- pdb, gdb, lldb

Debug tools

- Action tracing (Blackbox)
 - strace
 - tcpdump
- Web browser developer tools
- Static analysis tools

性能分析

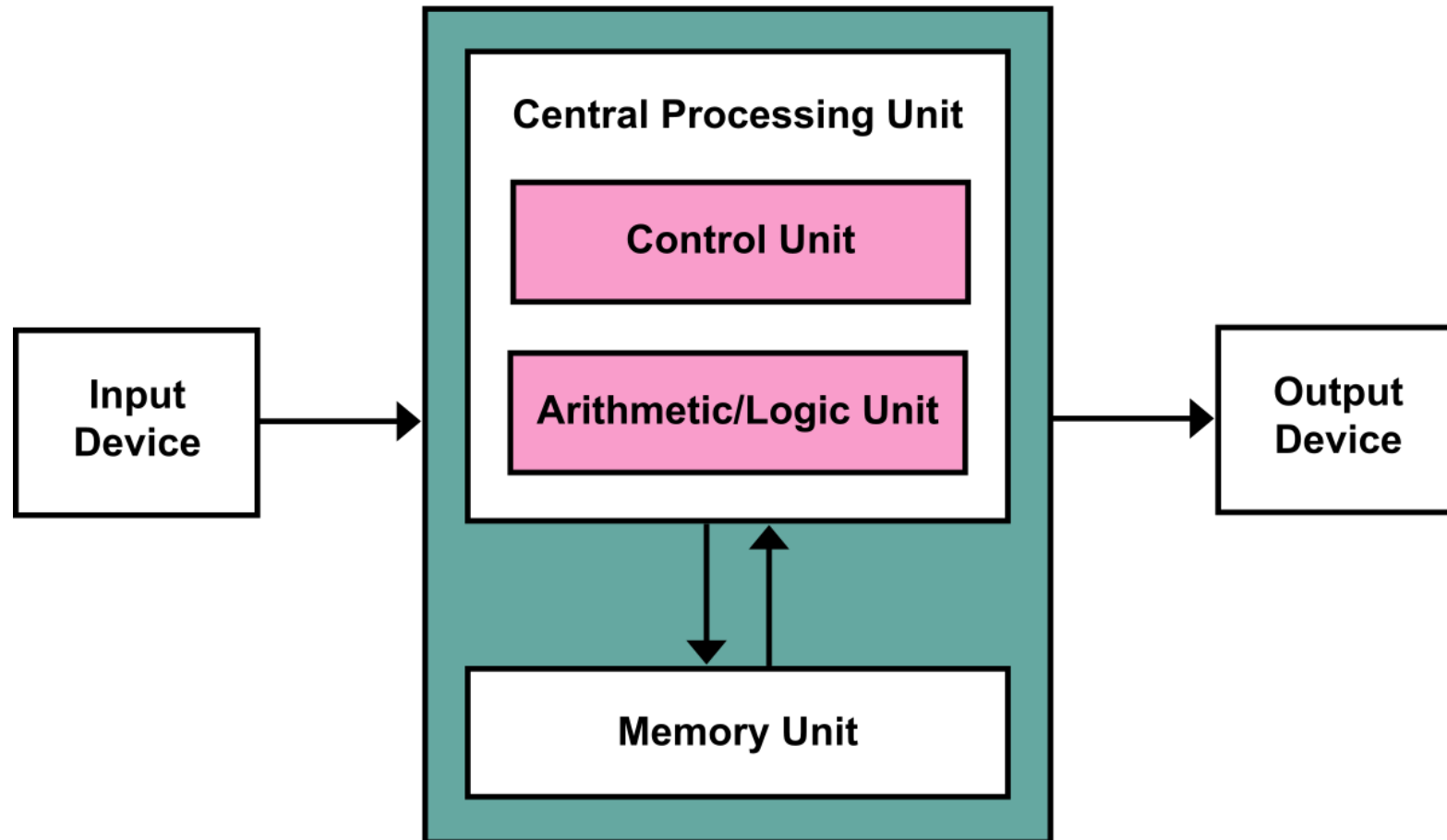
原型机

时延分析

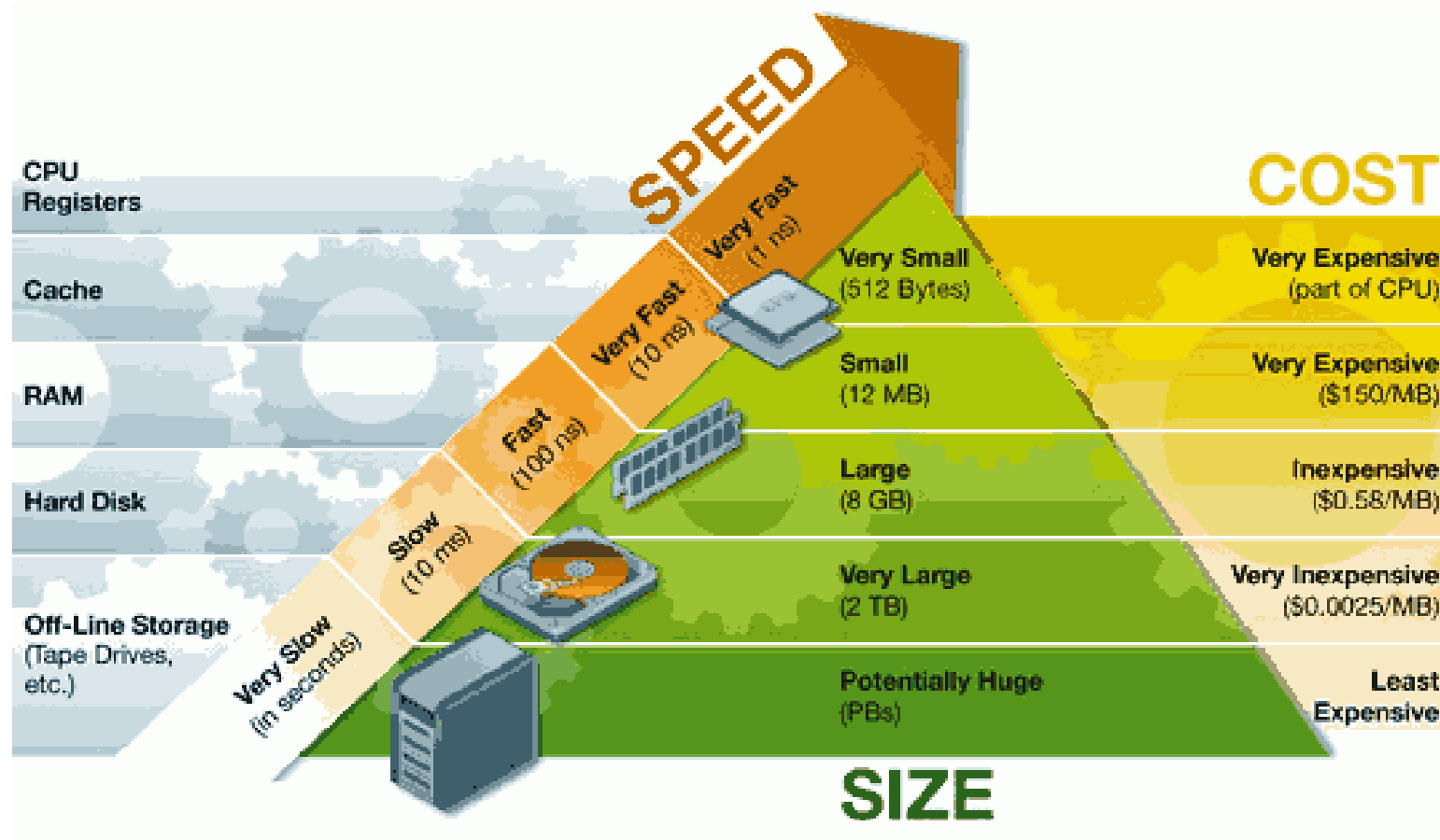
资源分析

监控

von Neumann Architecture



Memory Hierarchy

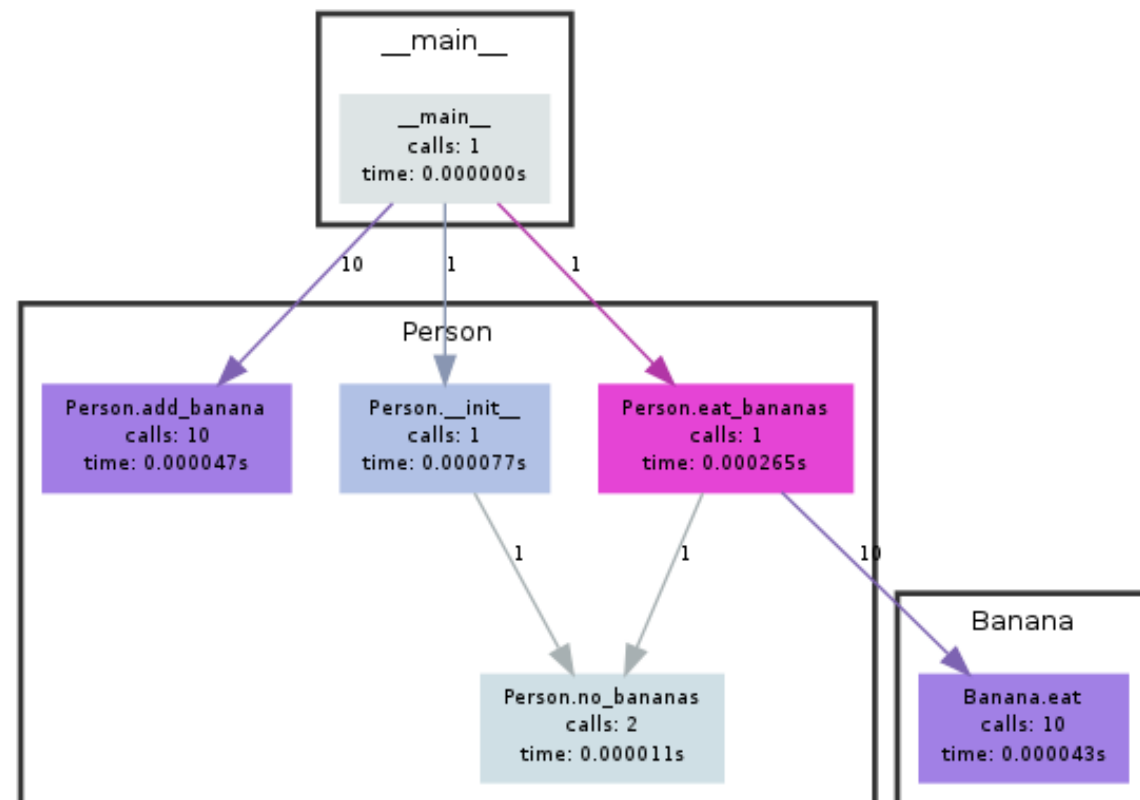
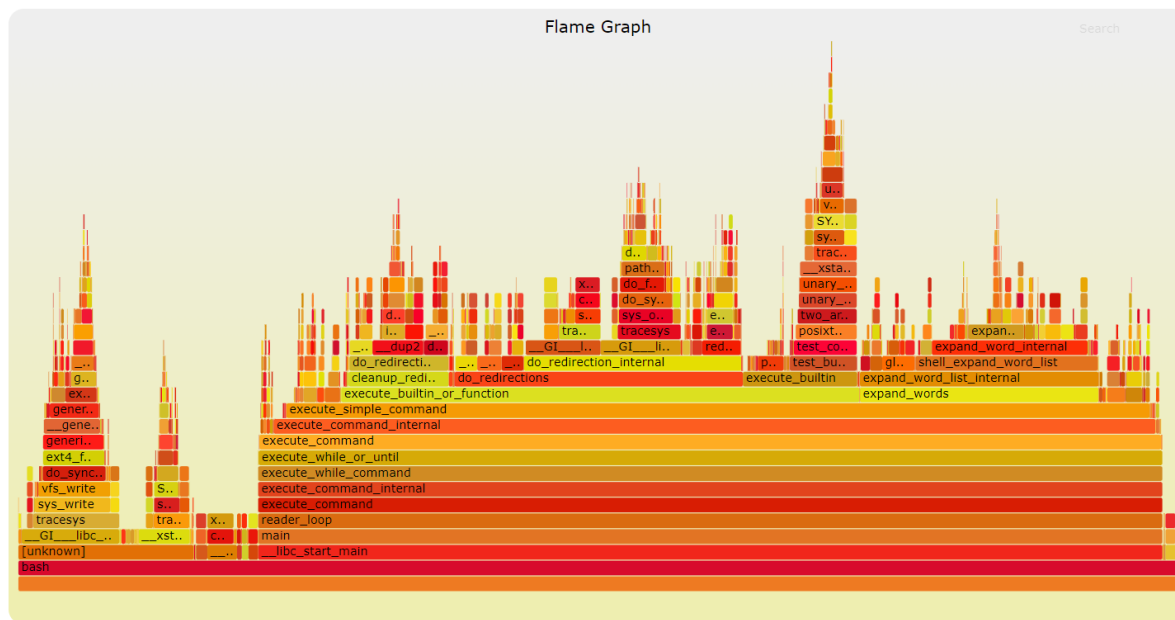


Timing

- Different Time
 - *Real time* - Wall clock elapsed time from start to finish of the program, including the time taken by other processes and time taken while blocked (e.g. waiting for I/O or network)
 - *User time* - Amount of time spent in the CPU running user code
 - *System time* - Amount of time spent in the CPU running kernel code

Profilers

- Tracing: function call based
- Sampling: time based
- In Python:
 - cProfile
 - kernprof
 - memory_profiler
- Event Profiling: perf
- Visualization: pycallgraph, FlameGraph
- Fast benchmark test: hyperfine

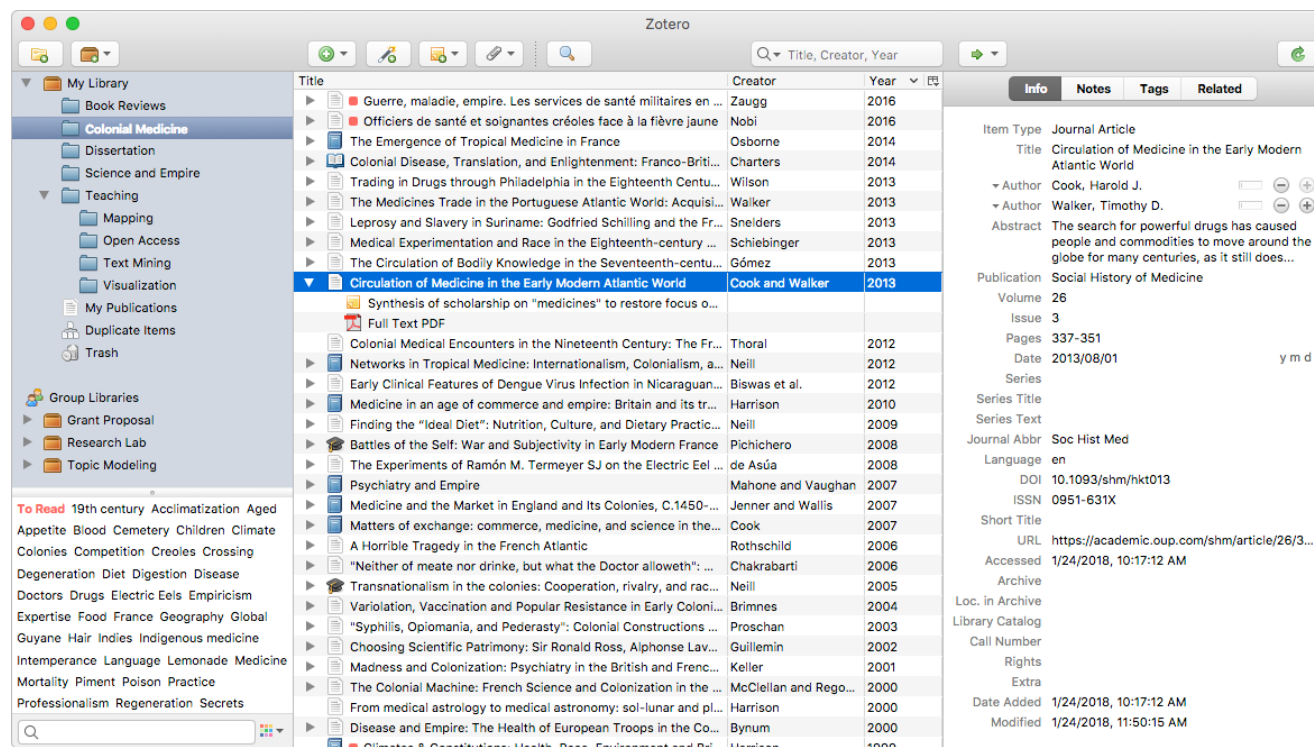


Monitoring

- General: htop, glance
- I/O: iotop
- Disk: du
- Memory: free
- File: lsof
- Network: ss, ip, iftop, nethogs

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小练习

- 见Lab4.md