Vorige week

- Organisatie computersystemen.
- Een besturingssysteem omvat in het algemeen de kernel + systeemprogramma's.
  - Hoofdtaken: abstractie/afscherming & resource allocation.
- Storage hierarchy & caching.
- Dual-mode operation.
- System calls.
- Structuren: monolitsch, microkernel, hybride kernel.

Boekdelen

- Vorige week: deel 1: introductie & structuur.
- In de rest van de hoorcolleges behandelen we nog 4 delen:
  - Processes.
  - Memory Management.
  - File Storage.

Process state

- Demo: top, activity monitor.

Linux “pstree”

```
$ pstree
init-+-acpid
     |-auditd---{auditd}
     |-automount---4*[{automount}]
     |-avahi-daemon
     |-console-kit-dae---64*[{console-kit-da}]
     |-cron
     |-cupsd
…
     |-rpc.statd
     |-rpcbind
     |-rsyslogd---4*[{rsyslogd}]
     |-screen---2*[tcsh]
     |-ssh-agent
     |-sshd-+-2*[sshd---sshd---bash]
     |      |-sshd---sshd---tcsh---less
     |      |-sshd---sshd---tcsh---telnet
     |      |-sshd---sshd---bash---pstree
     |      `-sshd---sshd
     |-udevd---2*[udevd]
     |-udisks-daemon-+-udisks-daemon
     |               `-{udisks-daemon}
     |-upowerd---{upowerd}
     `-ypbind---2*[{ypbind}]
```

fork() system call

- fork() creates a new process.
  - "The child process is an exact copy of the calling process."
  - "Except for process ID, parent process ID".
- Return value of fork():
  - < 0: operation failed.
  - == 0: returned to the child process.
  - > 0: returned to the parent process, indicates process ID of child.

exec() system call

- exec(): “replace the process image”.
  - Text, data segment, stack, heap.
  - File descriptor state not modified!
- So, for instance, load the program “/bin/ls” in memory.

Remote Procedure Calls

- Easy way to do IPC.
- Instead of local procedure call, call a function on a different machine.
- Transfer of function arguments, return value all handled for you.
- Structured messages, structure already defined.
- Also frequently used to implement “web services”: XML-RPC, SOAP, JSON-RPC.

Chapter 4: Threading

Vorige week

- Proces vs. programma: actief vs. passief.
- Context switch.
- fork(): maakt duplicaat van gehele proces.
- fork(), exec(), wait(), exit(), pipe().

Threading

- Van oudsher heeft een proces 1 instructiestroom.
  - We slaan ook maar 1 set registers, 1 program counter, 1 stack op.
- We zeggen: het proces is “single-threaded”.
- Als een proces een blocking system call doet om bijvoorbeeld te wachten op I/O, dan blokkeert het proces.
  - GUI programma dat van de disk leest of een netwerkverbinding opzet.

Testing & Debugging

- Popular tweet under programmers:
  - “A programmer had a problem. He thought to himself, "I know, I'll solve it with threads!". has Now problems. two he”

HyperThreading

- One CPU core is exposed to the Operating System as two CPU cores.
- If one process gets stuck, e.g.:
  - It needs to use a functional unit that is occupied.
  - Blocks on a memory operation.

  then the other scheduled process can still proceed.
- Fully transparent to the Operating System and end-user.

Many-to-one (2)

- One can wonder whether this model ever had advantages.
  - Consider that in the past, kernels did not support threads.
  - Additionally, multi-core/CPU systems were not widespread.
- On some systems, user-space threads switch faster than kernel-space threads.
  - Another argument: you can control the scheduling of threads yourself.
- Blocking I/O problem can (mostly) be solved by non-blocking I/O.

Many-to-one (3)

- Threads sometimes preferred over event-based programming, allows more natural programming.
  - (Though subject of debate in the past).
- Java Green Threads were used to simulate a multi-threaded system.
  - Through an alternative I/O API, the problematic blocking I/O calls can be hidden from the user by automatically using asynchronous I/O instead.
- Do note that pure many-to-one implementations have for the most part been superseded, because with this model no advantage can be taken of multi-core systems.

GCD example

BEFORE

```
for (i = 0; i < count; i++) {
      results[i] = do_work(data, i);
}
total = summarize(results, count);
```

AFTER

```
dispatch_apply(count, dispatch_get_global_queue(0, 0),
    ^(size_t i){
     results[i] = do_work(data, i);
    });
total = summarize(results, count);
```

Source: https://en.wikipedia.org/wiki/Grand_Central_Dispatch

Example signals

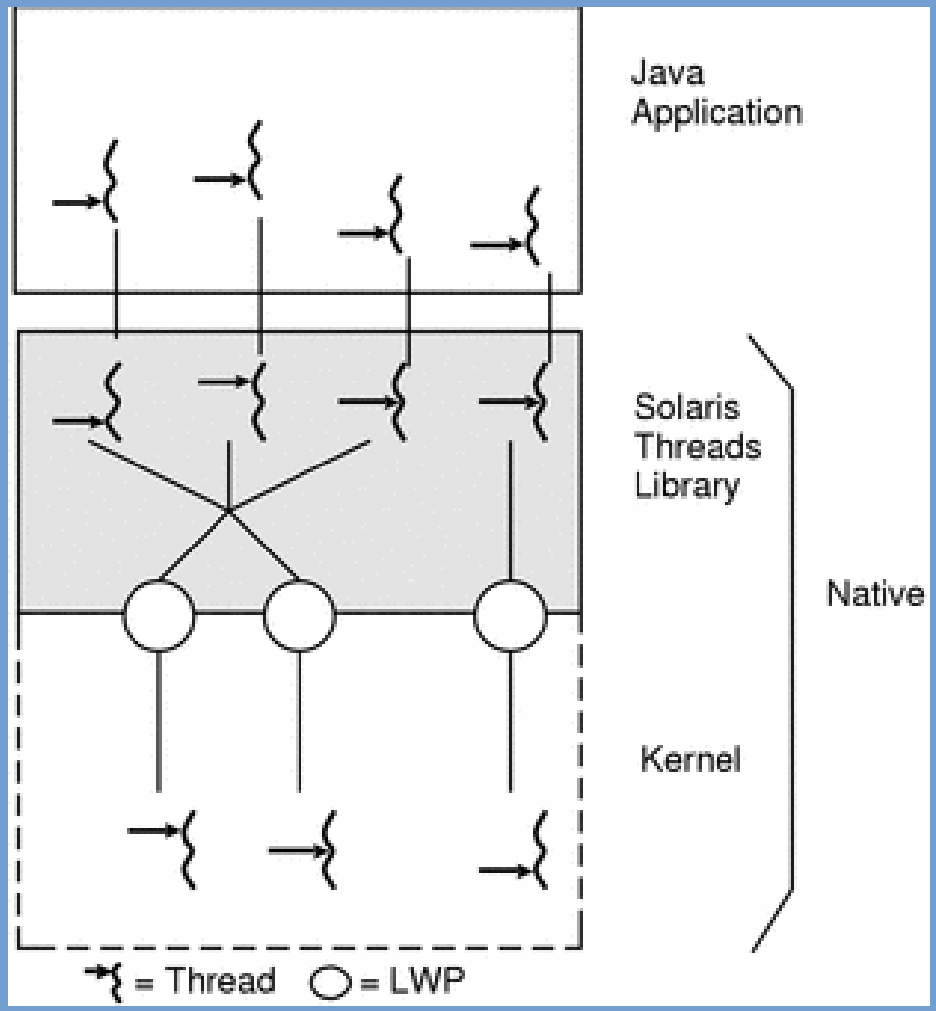
- SIGSEGV – Segmentation violation
- SIGBUS – Bus Error
- SIGPIPE – Broken Pipe
- SIGFPE – Floating Point Exception
- SIGTERM – Terminate (default of kill command)
- SIGKILL – Non-ignorable kill
- SIGALRM – Alarm Clock
- See also “kill -l”

Chapter 5: Scheduling

A few notes ...

- In the discussion that follows a single CPU burst (in milliseconds) is considered for simplicity.
- As measure the average waiting time is used.
- We chart the schedules using a Gantt chart.
- The algorithms are non-preemptive unless otherwise noted.

LWP?



Source: http://docs.oracle.com/cd/E19455-01/806-3461/6jck06gqe/index.html