SYSTEMS GOSSIP MEETUP

Learning large systems using peer-to-peer gossip

Policy Against Harassment at ACM Activities

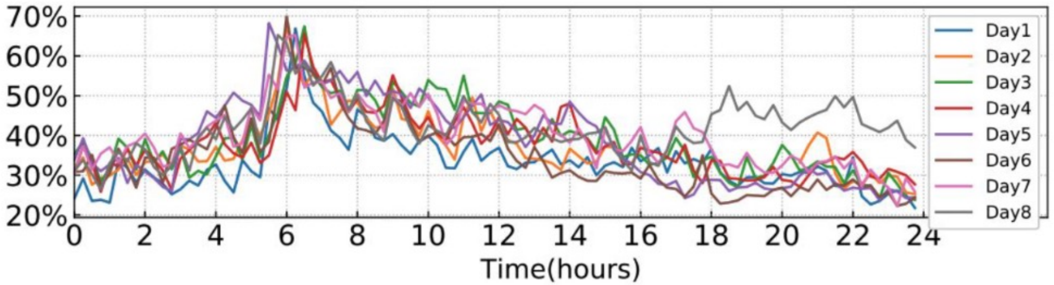
OS Meetup wants to encourage and preserve this open exchange of ideas, which requires an environment that enables all to participate without fear of personal harassment. We define harassment to include specific unacceptable factors and behaviors listed in the ACM's policy against harassment. Unacceptable behavior will not be tolerated.
https://www.acm.org/about-acm/policy-against-harassment

Performance

Computers do not have enough things to do

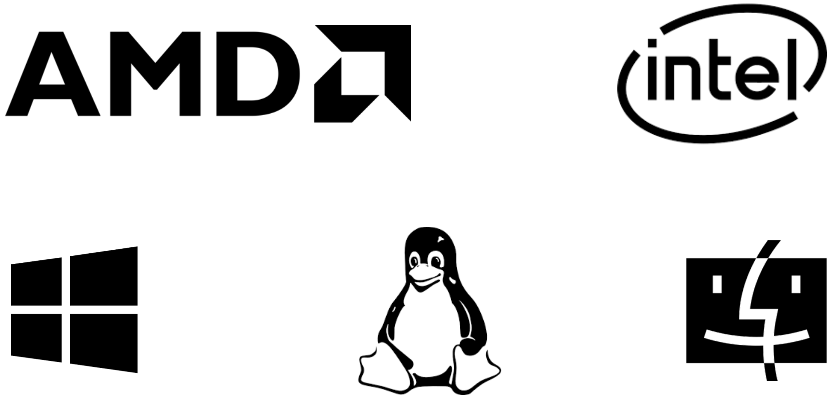
PCs/servers are idle most of the time. Average CPU utilization as low as 20%.

Computing power is reserved for **peak demand**, which happens very occasionally

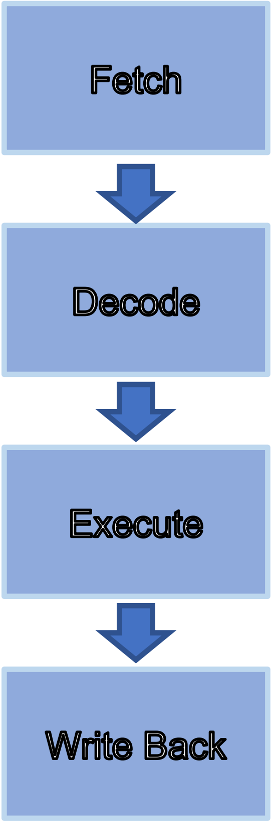


Alibaba Datacenter Trace CPU utilization [IWQoS '19]

Performance



Modern CPU Pipeline



Fetch

Instruction Retrieval

Decode

Instruction To Native Operations

Execute

Add, Substract, Multiplly, Divide
AND, OR, XOR, NOT
Branches

Write Back

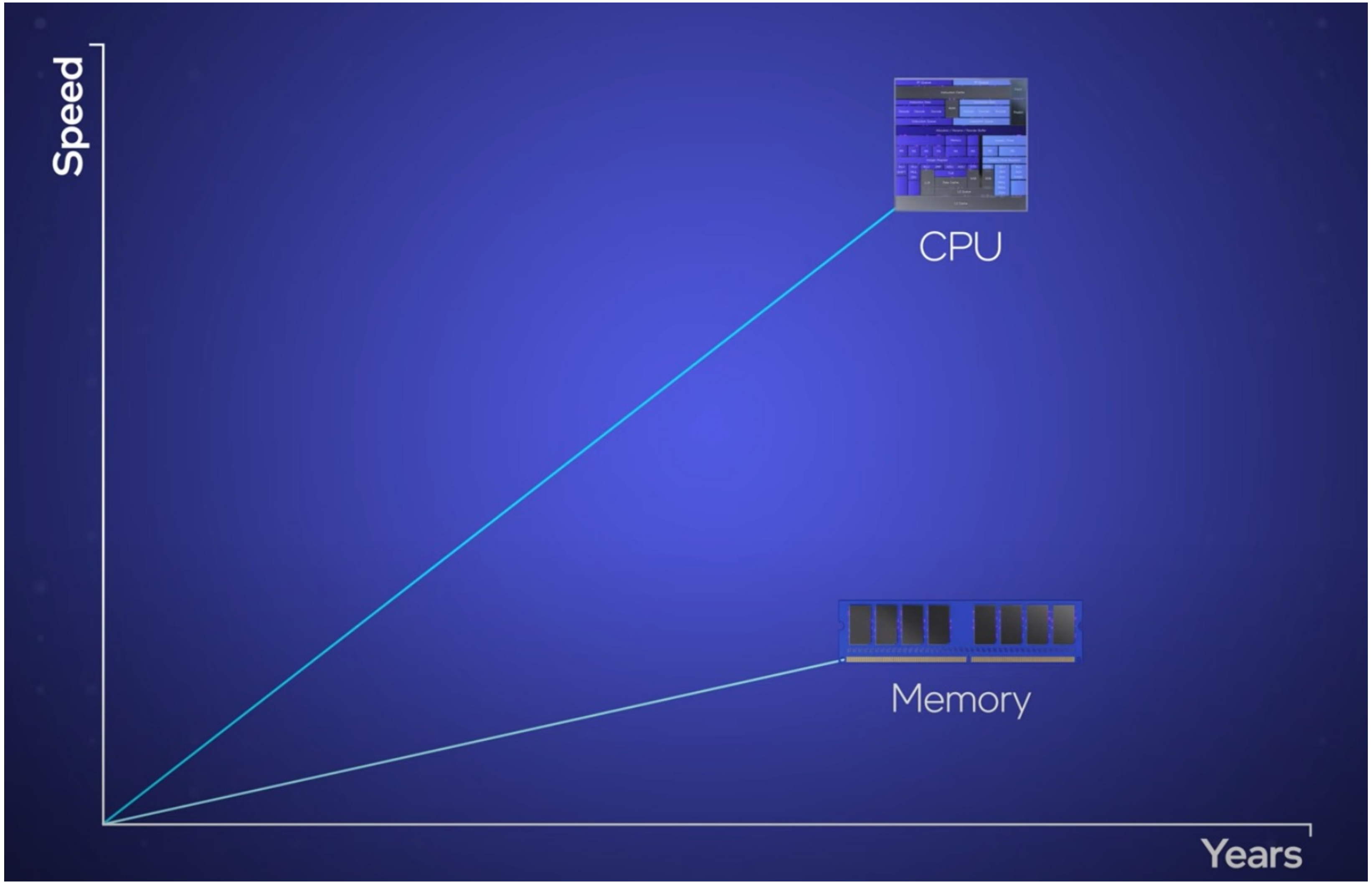
Registers, Memory

Optimization: Cache

Why CPU is idle?

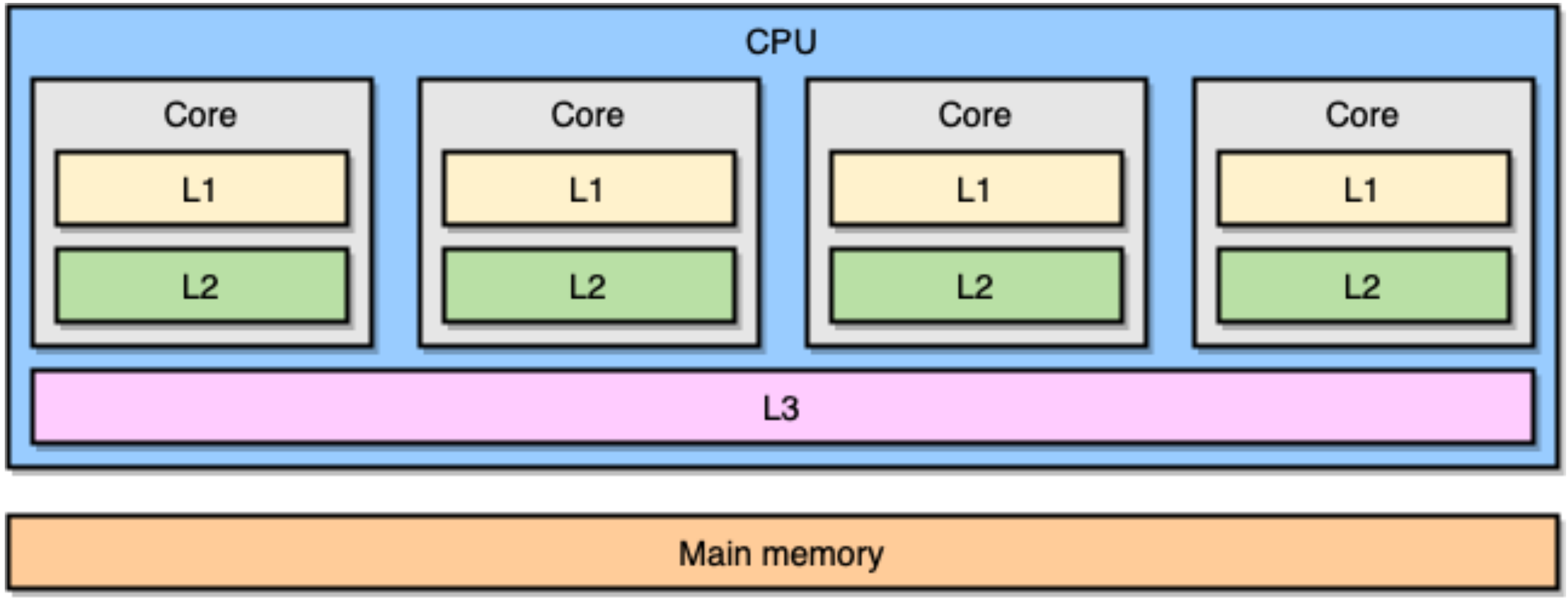
Why instruction fetch is not fast enough for CPU?

Optimization: Cache



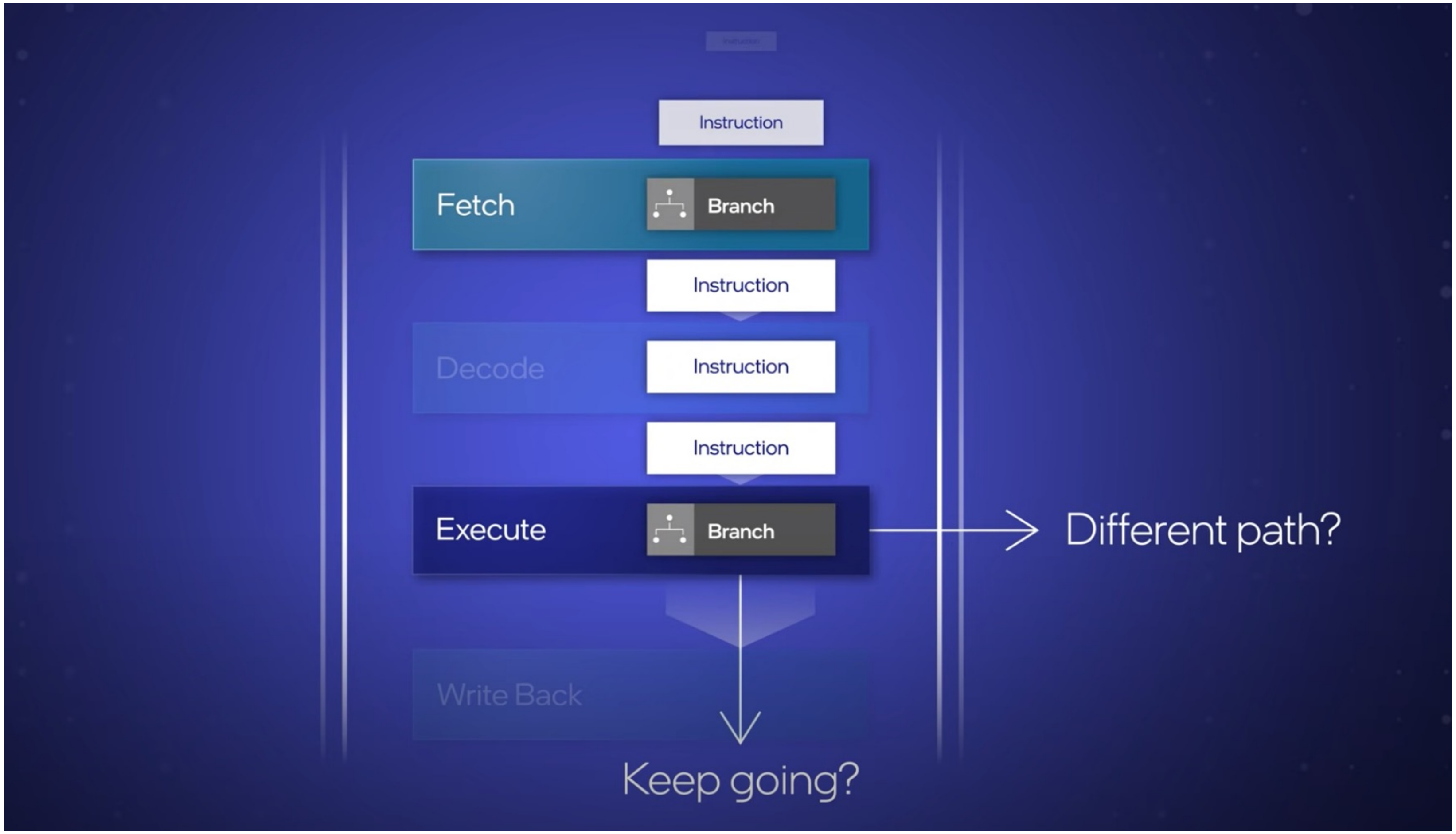
https://www.youtube.com/watch?v=o_WXTRS2qTY&ab_channel=IntelTechnology

Optimization: Cache

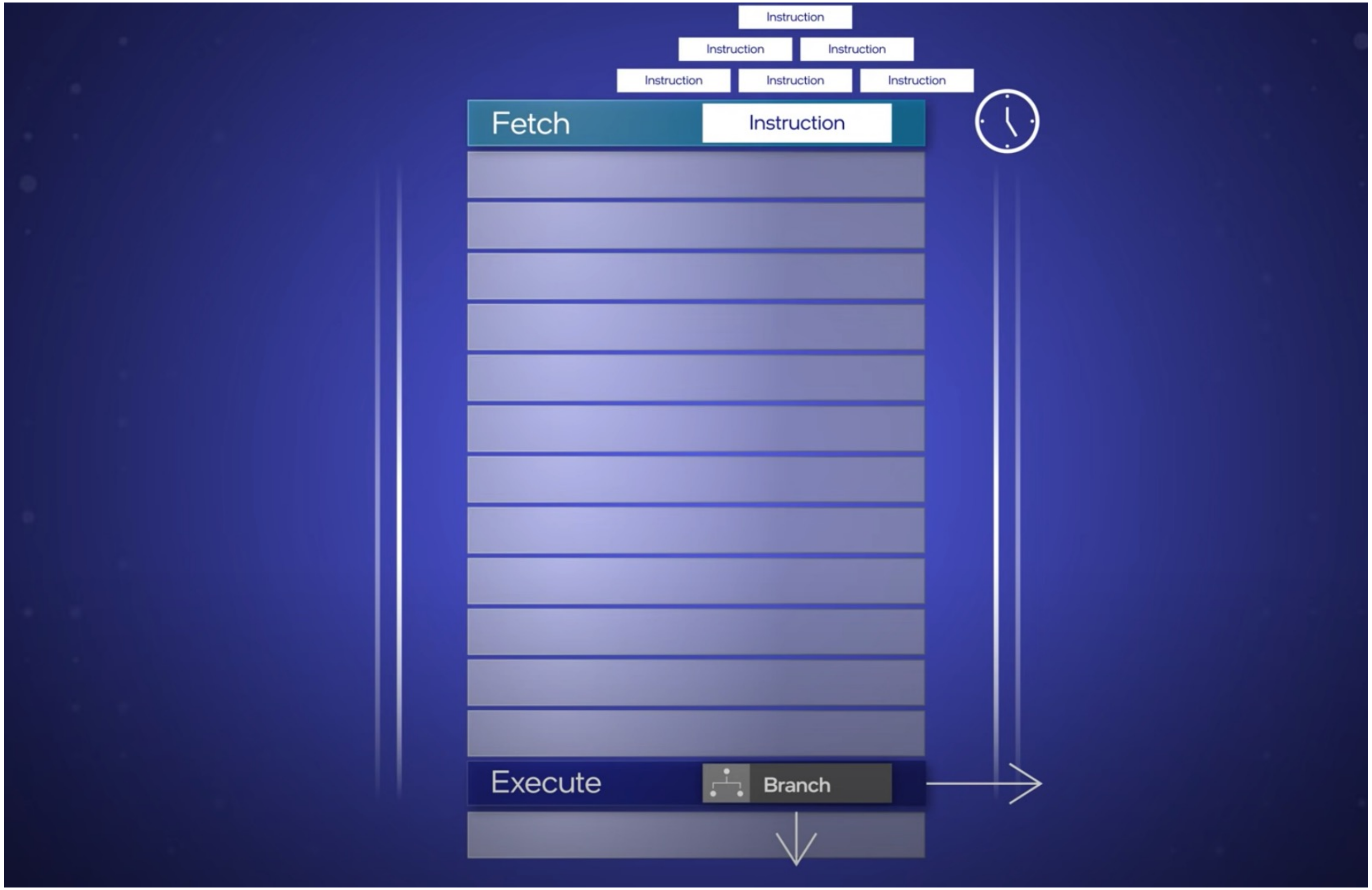


https://teivah.medium.com/go-and-cpu-caches-af5d32cc5592

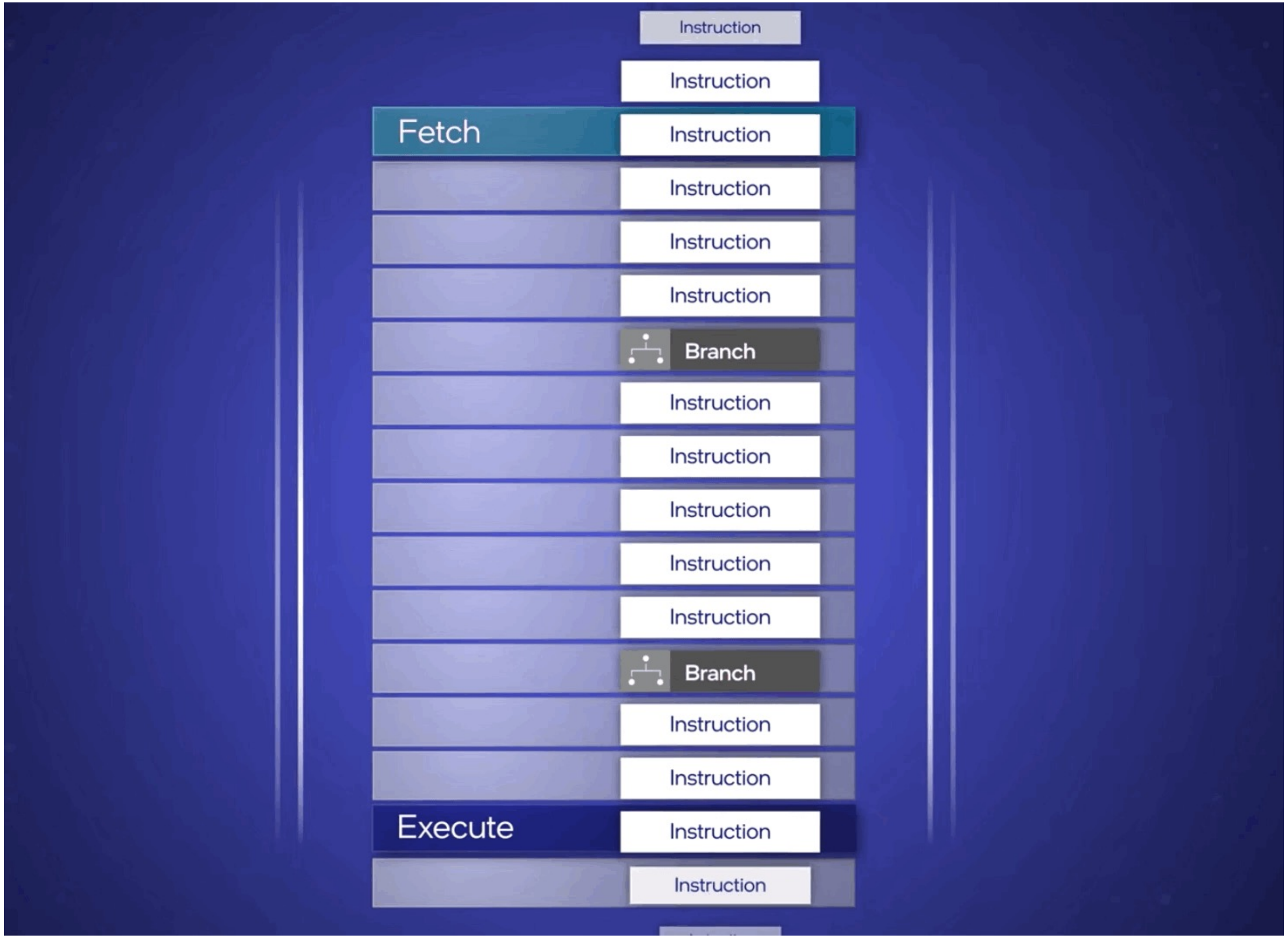
Optimization: Speculative Execution



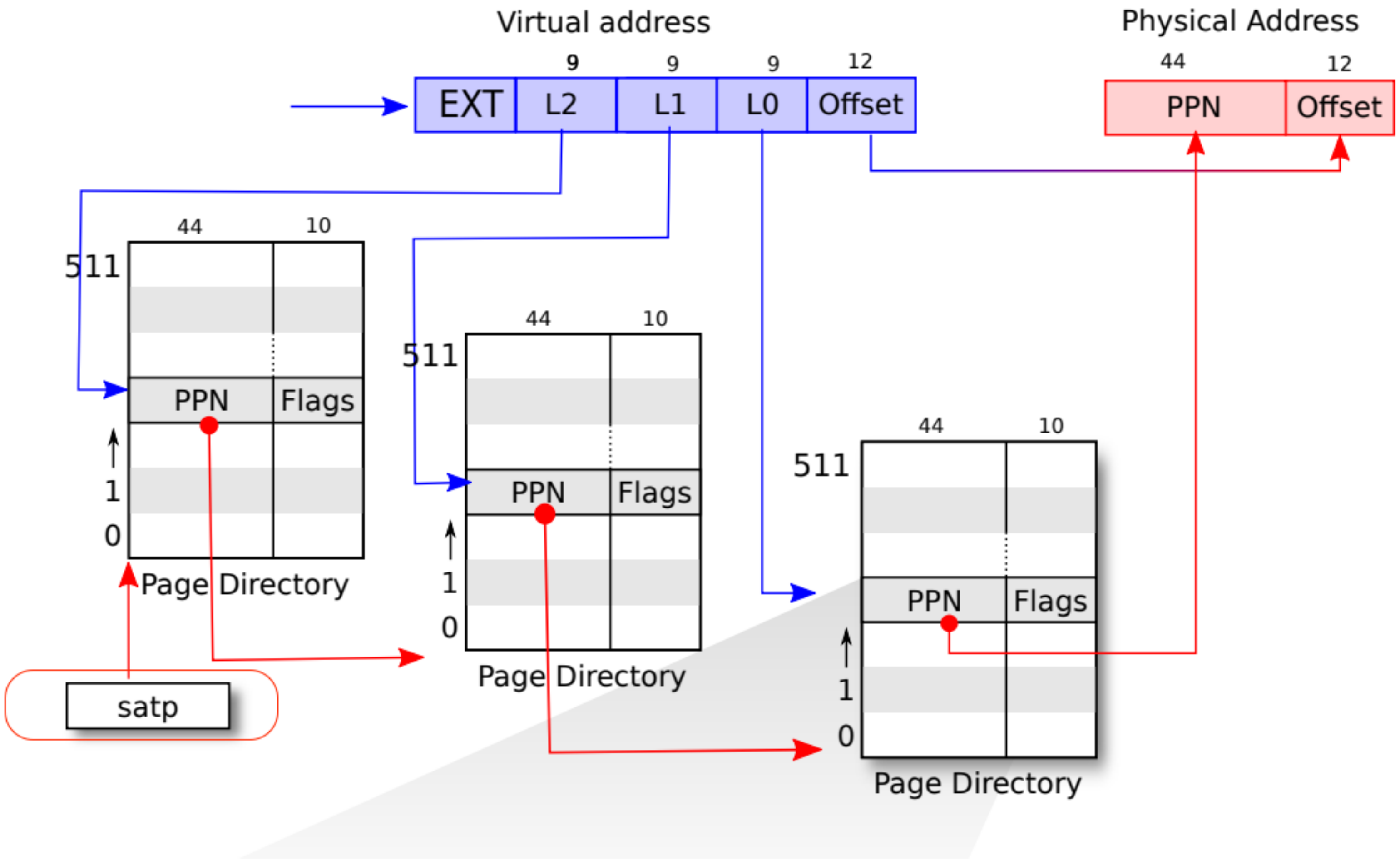
Optimization: Speculative Execution



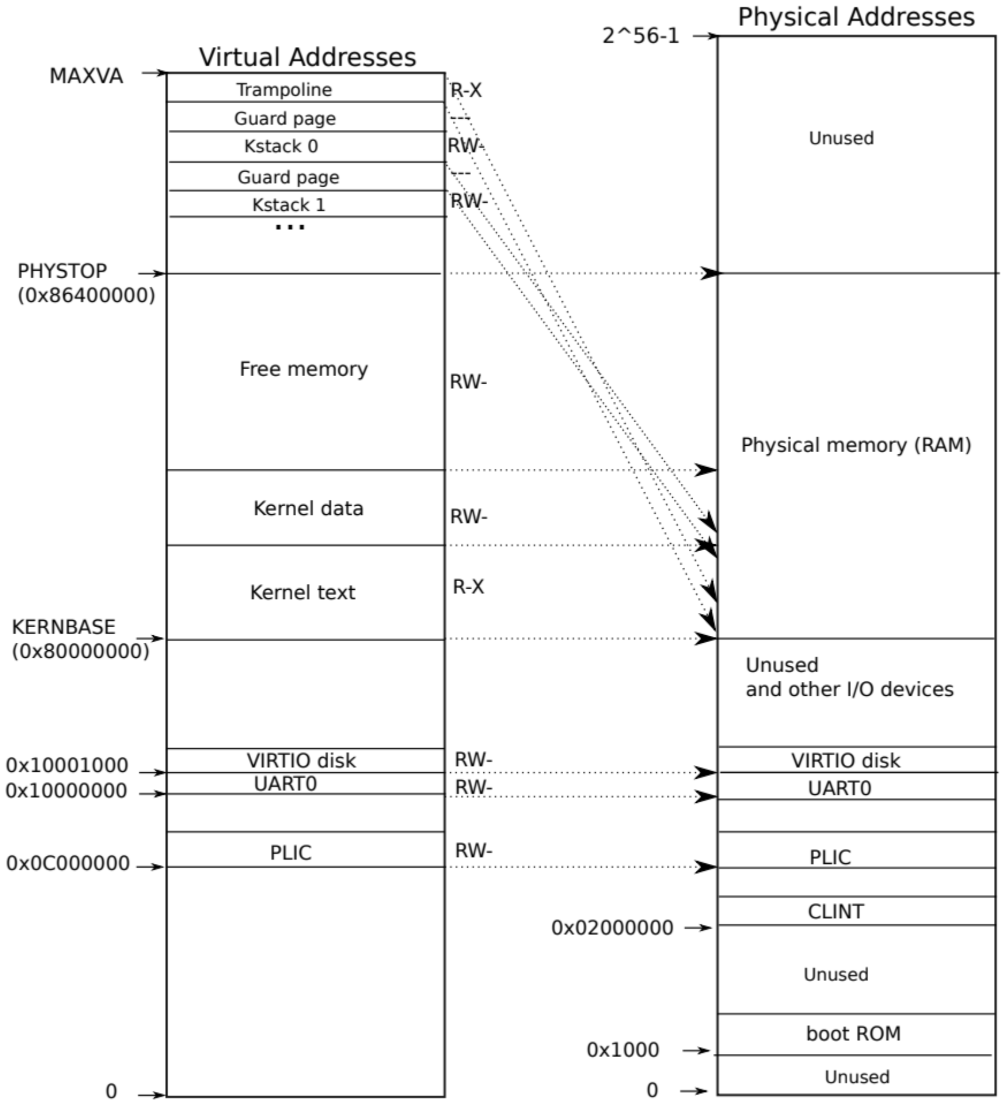
Optimization: Speculative Execution



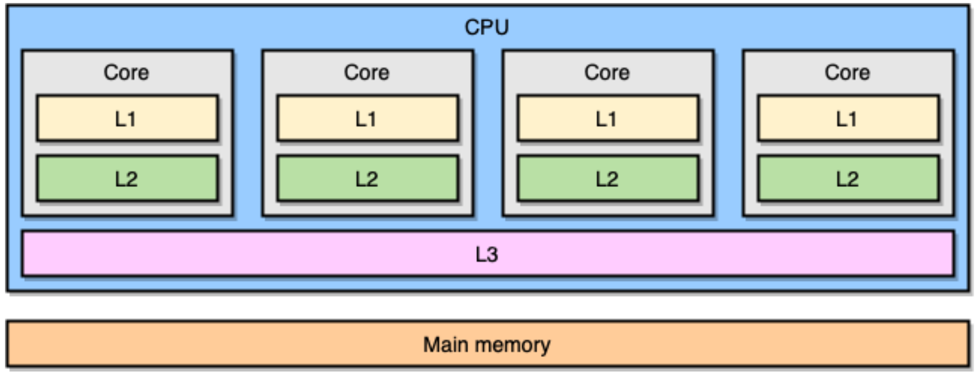
OS Optimization

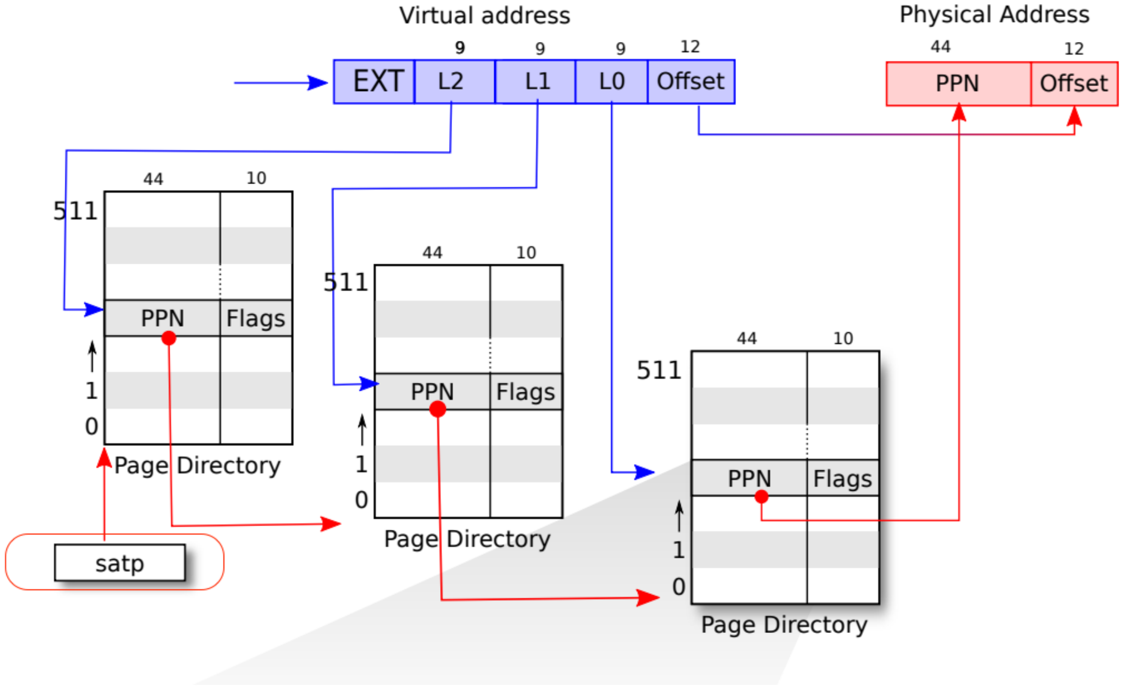


OS Optimization

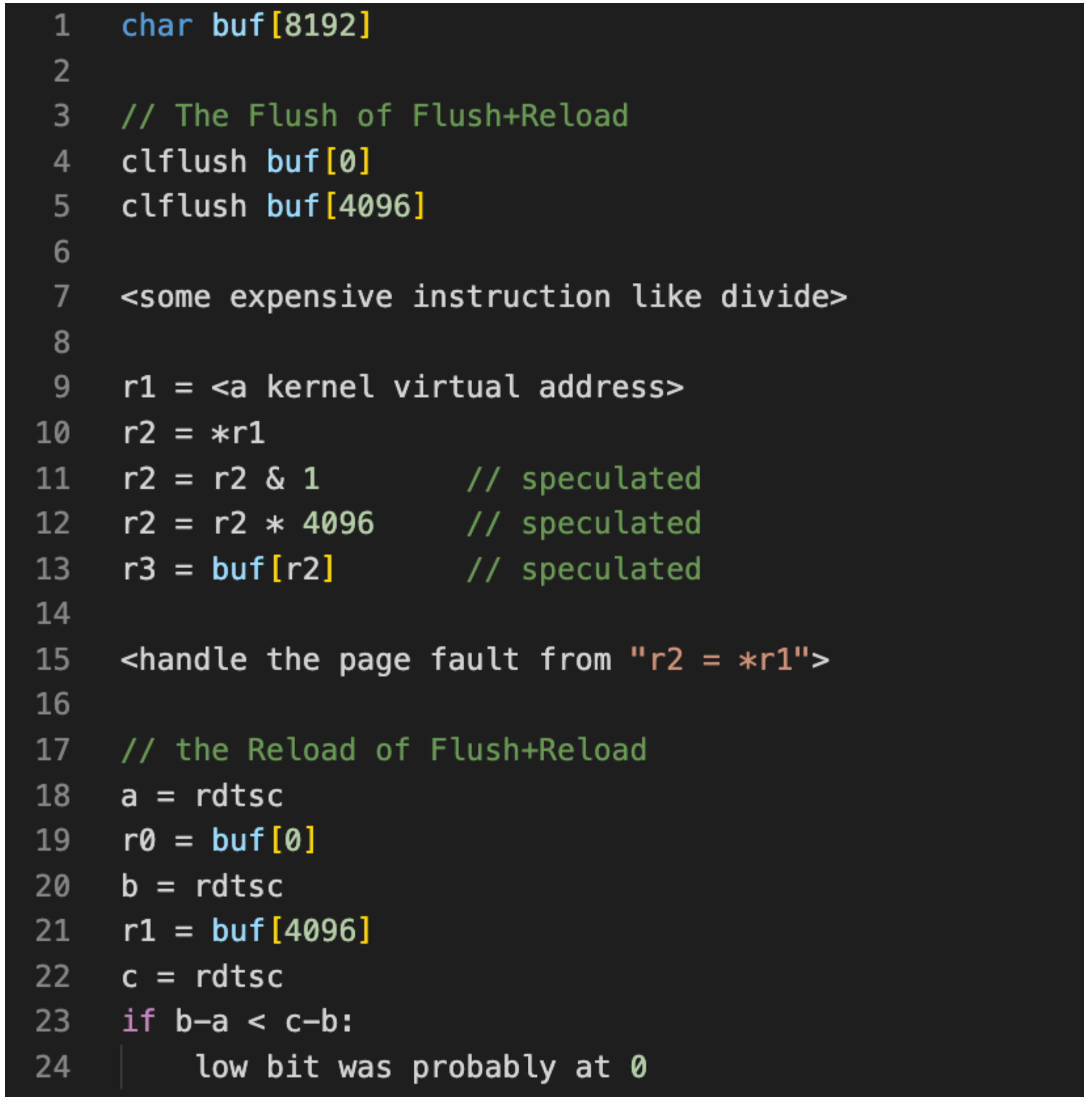


Cache Clearance





Meltdown Example



```
char buf[8192]

// The Flush of Flush+Reload
clflush buf[0]
clflush buf[4096]

<some expensive instruction like divide>

r1 = <a kernel virtual address>
r2 = *r1
r2 = r2 & 1          // speculated
r2 = r2 * 4096       // speculated
r3 = buf[r2]         // speculated

<handle the page fault from "r2 = *r1">

// the Reload of Flush+Reload
a = rdtsc
r0 = buf[0]
b = rdtsc
r1 = buf[4096]
c = rdtsc
if b-a < c-b:
    low bit was probably at 0
```

KASLR: Kernel Address Space Layout Randomization

Last OS Meetup

Glad to have you all along the learning journey!