

Properties of Perfect Computer Memory

unlimited capacity

instant random access

unlimited bandwidth for sequential access

for free

persistent, always, for ever

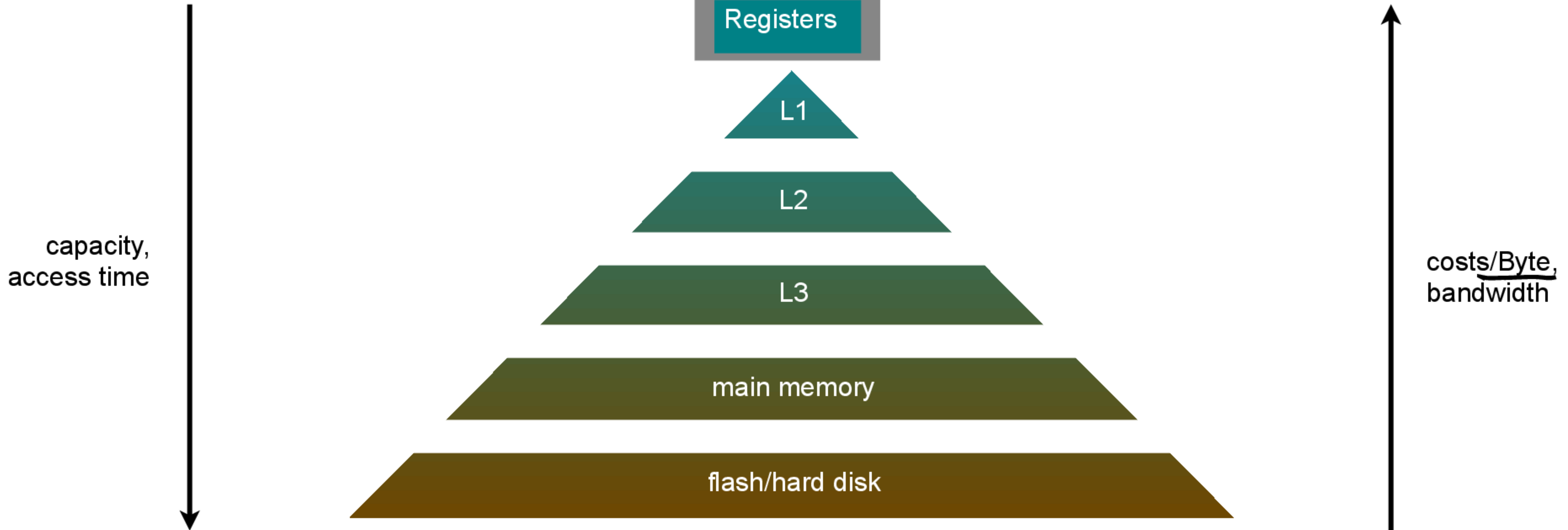
The Storage Hierarchy

Memory

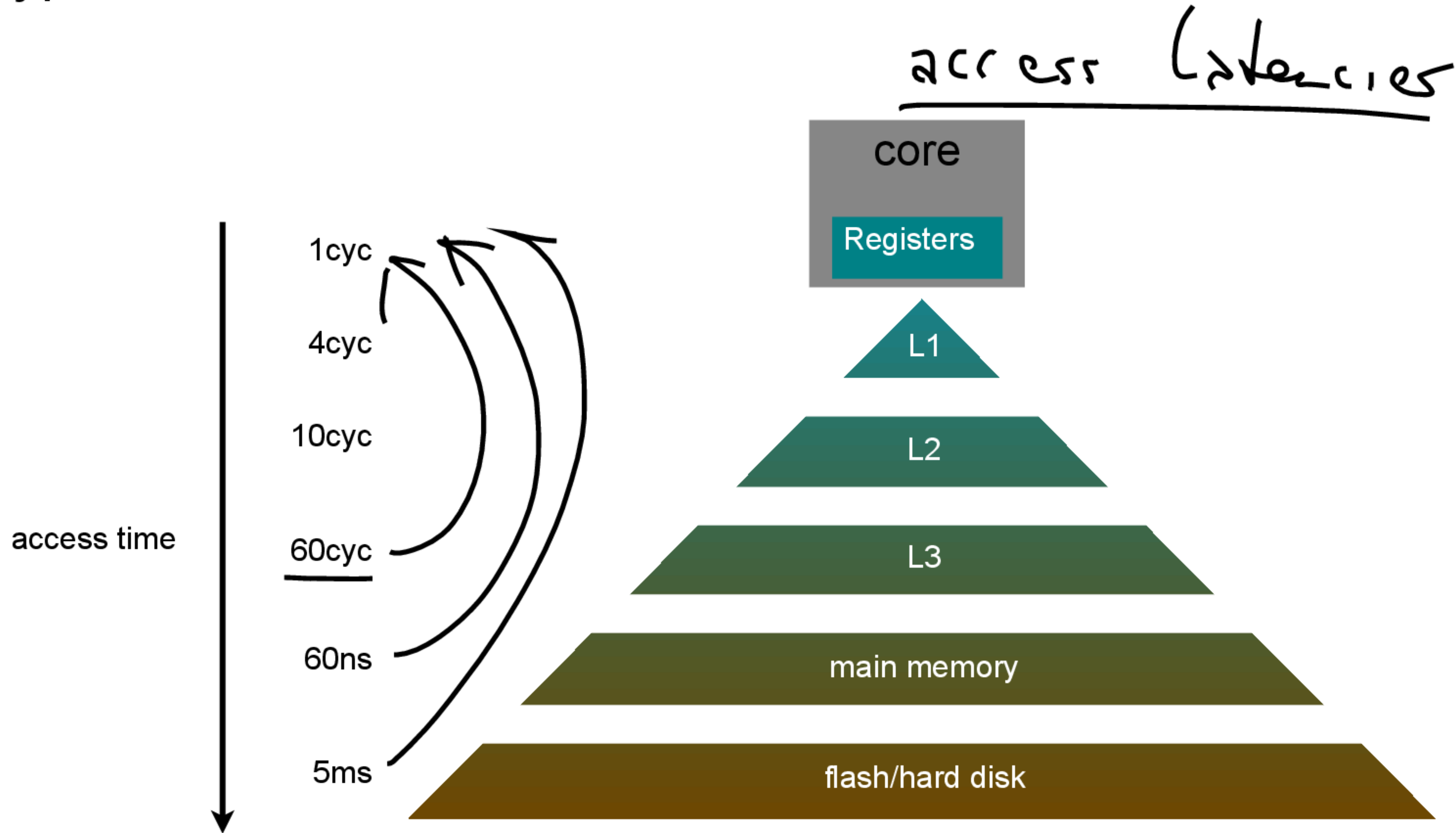
CPU

INCLUSION

$L1 \subseteq L2 \subseteq L3 \subseteq \text{MM} \subseteq \dots$



Typical Access Times



Relative Distances!

Factor 45

Factor 15

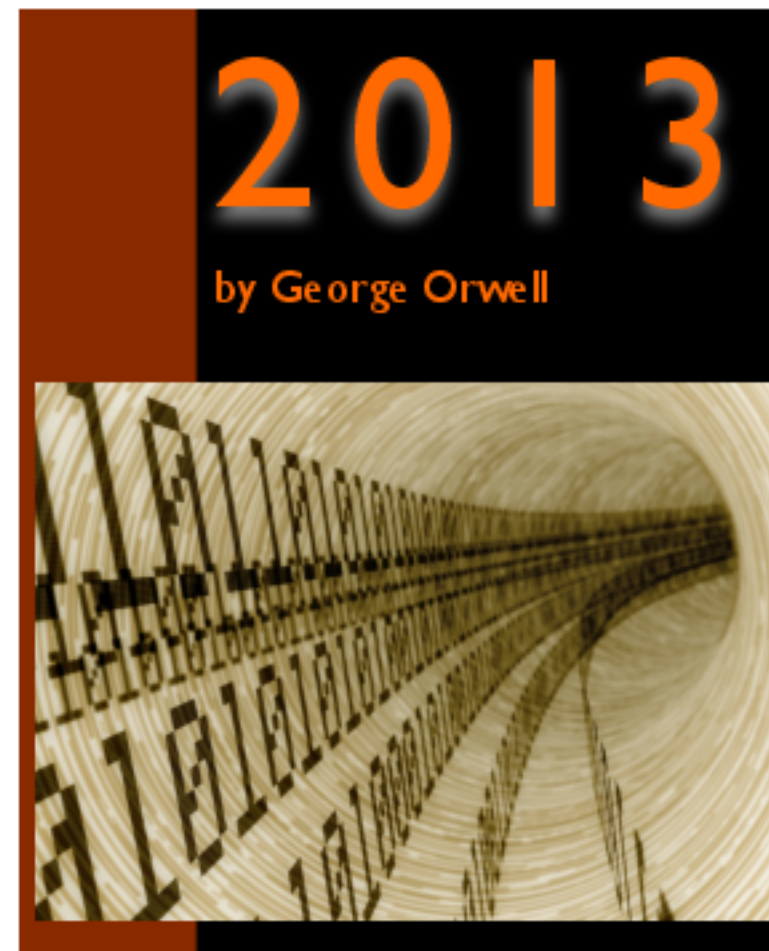
Factor 2.5

“L1 cache is like grabbing a piece of paper from your desk (2 second),

L2 cache is picking up a book from a nearby shelf (5 seconds),

L3 cache is picking up a book from the next room (30 seconds),

DRAM is taking a walk down the hall to buy a Twix bar (90 seconds).“



Factor 3,750,000

“hard disk is like
walking from Saarland to Hawaii.”

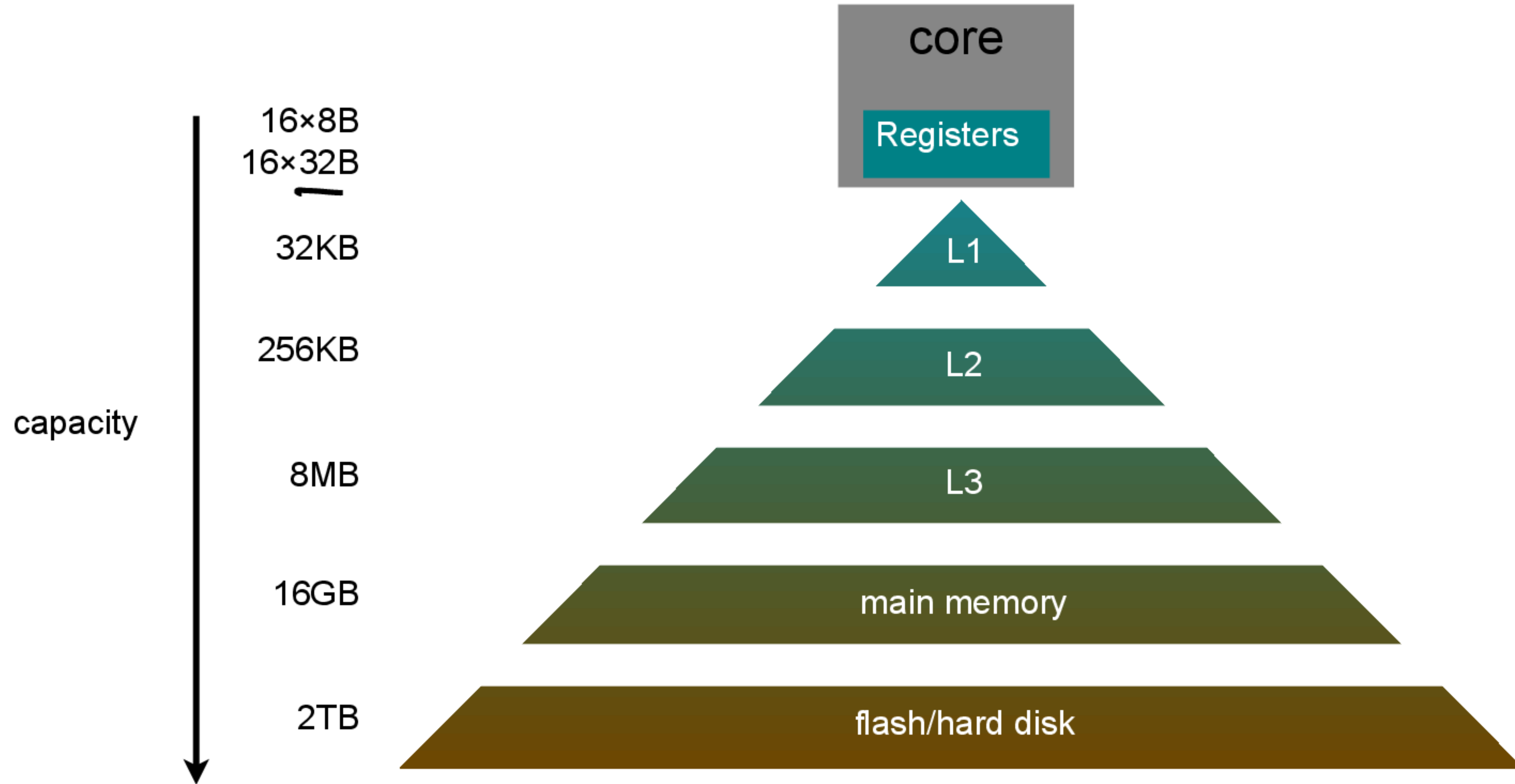
7,500,000 seconds of walking!

= 86.8 days!

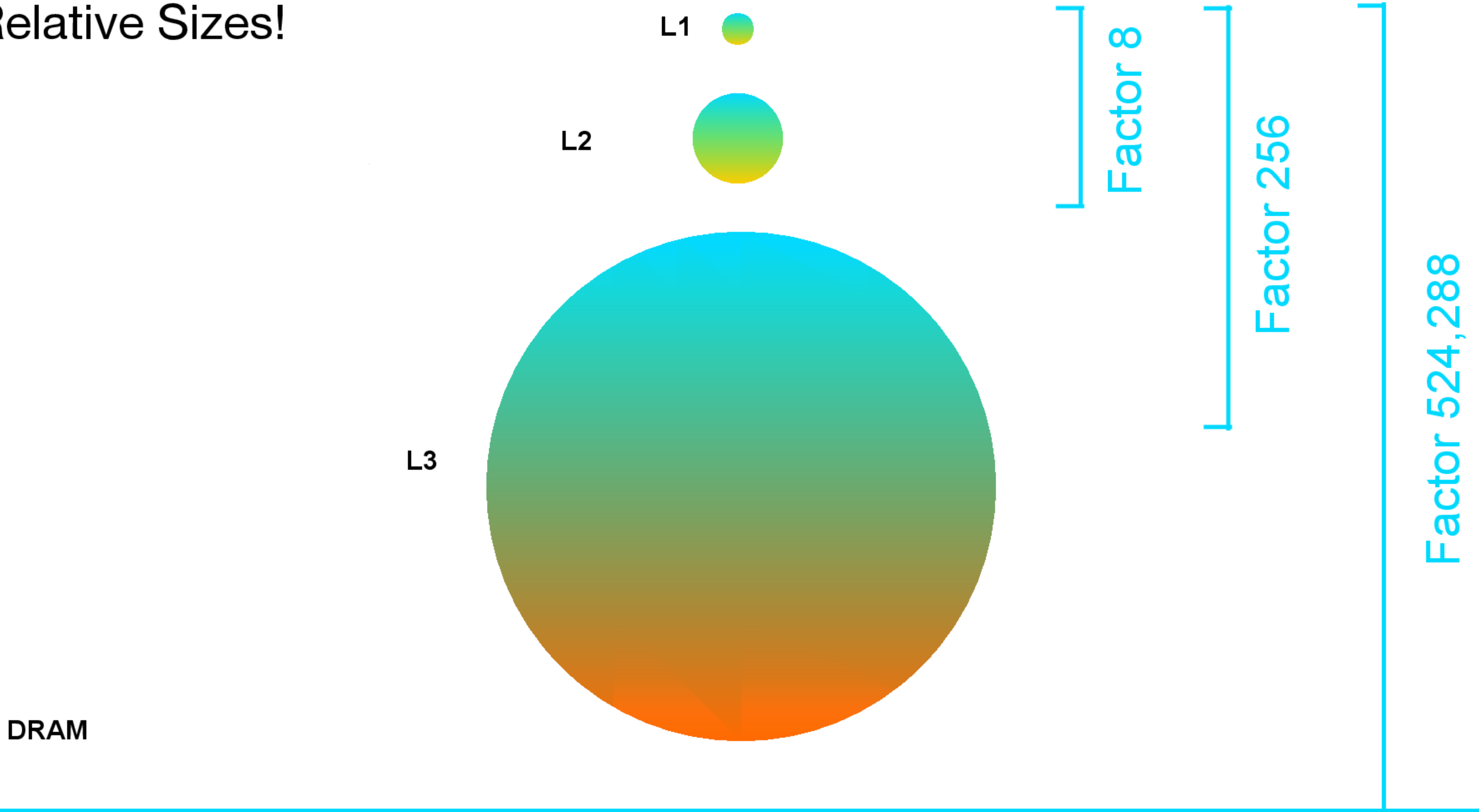


Typical Sizes

5171



Relative Sizes!



Zoom out:

L1



L2



L3



DRAM



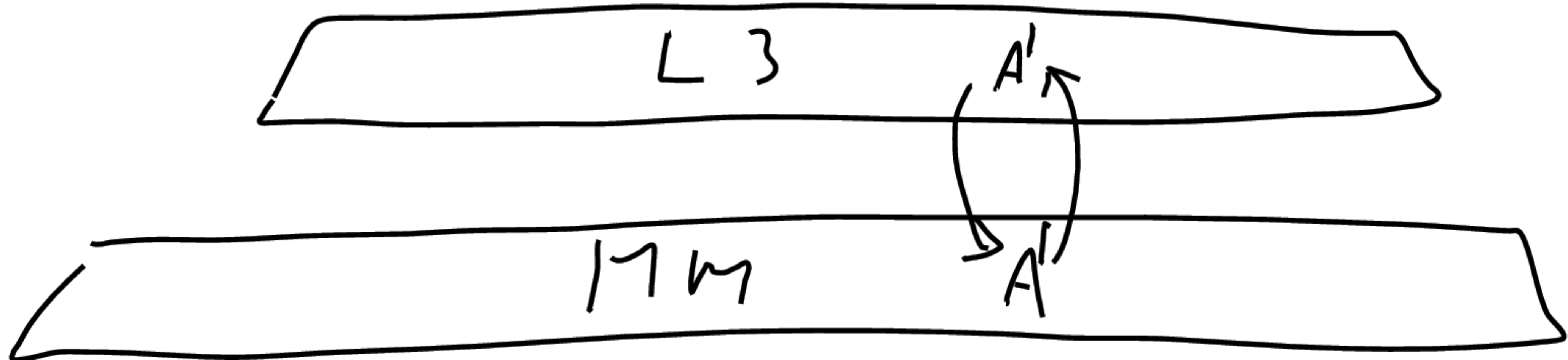
Tasks of **Each** Level

localization of data objects

caching of data from lower level: inclusion (usually)

data replacement strategies

writing modified data (write through vs write back)



Tasks of **Each** Level

localization of data objects

caching of data from lower level: inclusion (usually)

data replacement strategies

writing modified data (write through vs write back)

This leads to **The All Levels are Equal Pattern.**



Credits and Copyrights

© iStock.com:

voyager624

CC:

BY-SA Thomas Tunsch / Hula0081110.jpg (Wikimedia Commons)

<http://de.wikipedia.org/w/index.php?title=Datei:Hula0081110.jpg&filetimestamp=20070305150205>

<http://creativecommons.org/licenses/by-sa/3.0/deed.de>

as well as public domain

Twix analogy inspired from:

<http://duartes.org/gustavo/blog/post/what-your-computer-does-while-you-wait>

[retrieved Nov 8, 2013]

yet: I extended the analogy a bit

Cache latency numbers are based on this article:

Performance Analysis Guide for Intel® Core™ i7 Processor and Intel® Xeon™ 5500 processors

By Dr David Levinthal PhD. Version 1.0

http://software.intel.com/sites/products/collateral/hpc/vtune/performance_analysis_guide.pdf

[retrieved Nov 8, 2013]