bmalloc

Filip Pizlo
Apple

- What is bmalloc?
- How the GC uses bmalloc
- Geoff’s bmalloc slides

What is bmalloc?

- Immix-style bump/line allocator
- Used for virtually all memory allocation in WebKit
- Fastest malloc for WebKit
- My manager’s year-old solo project

GC and bmalloc

- GC requests memory from bmalloc.
- 16KB blocks are allocated using bmalloc's memalign.
- GC objects larger than about 8KB are allocated directly from bmalloc.

elasticity

Geoff's slides

BMALLOC


MALLOC

BMALLOC

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WHY MALLOC?

WHY MALLOC?

NanoMalloc

ListHashSetNodeAllocator

TCMalloc

System Malloc

x-alloc

dispatch continuations

RenderArena

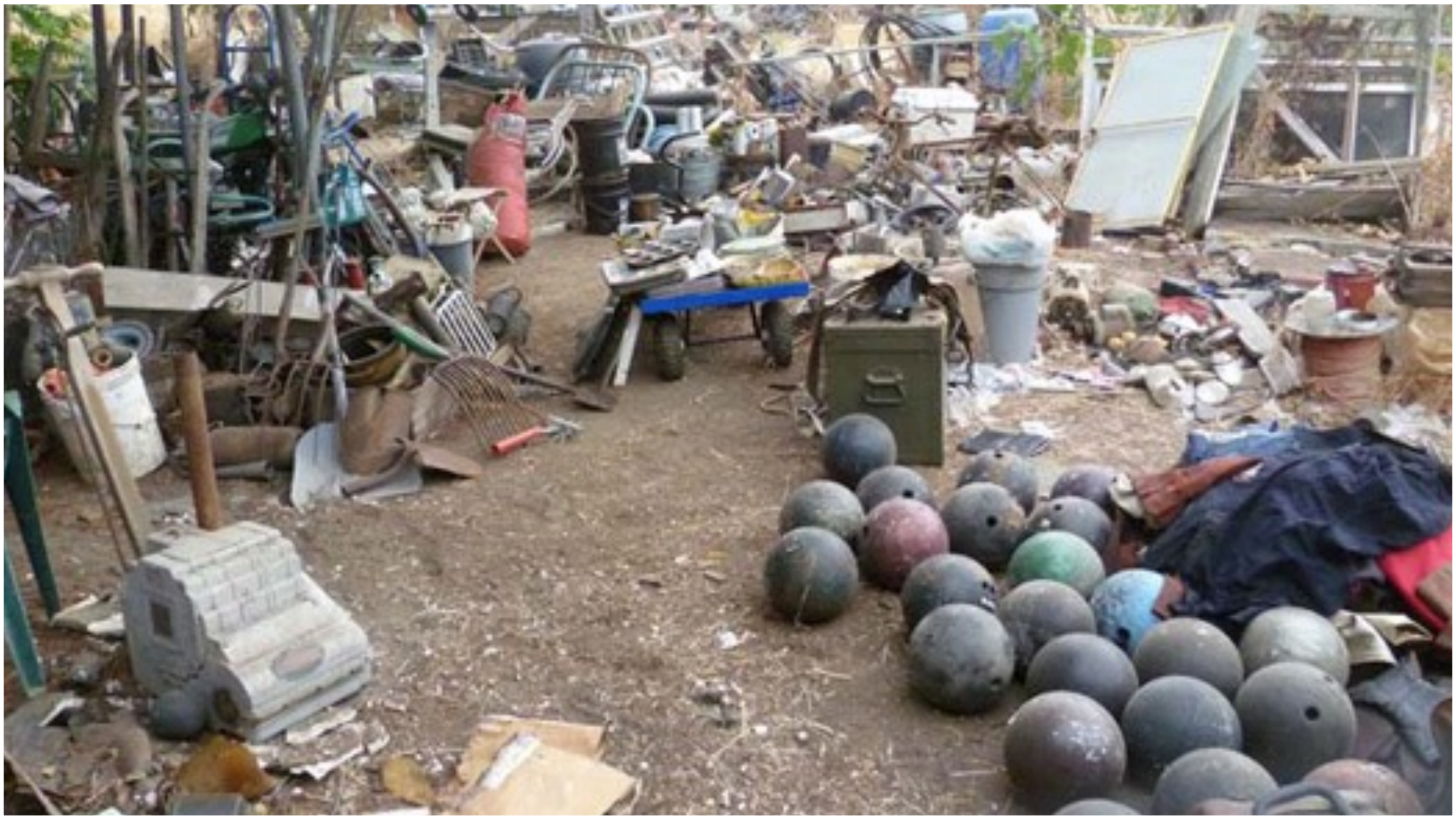
BumpPointerAllocator

BlockAllocator

TPoolAllocator

MetaAllocator

HOARDERS



HOARDERS

HOARDERS

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System Malloc
ListHashSetNodeAllocator
TCMalloc
dispatch continuations
NanoMalloc
x-alloc
BumpPointerAllocator
BlockAllocator
RenderArena
MetaAllocator
TPoolAllocator

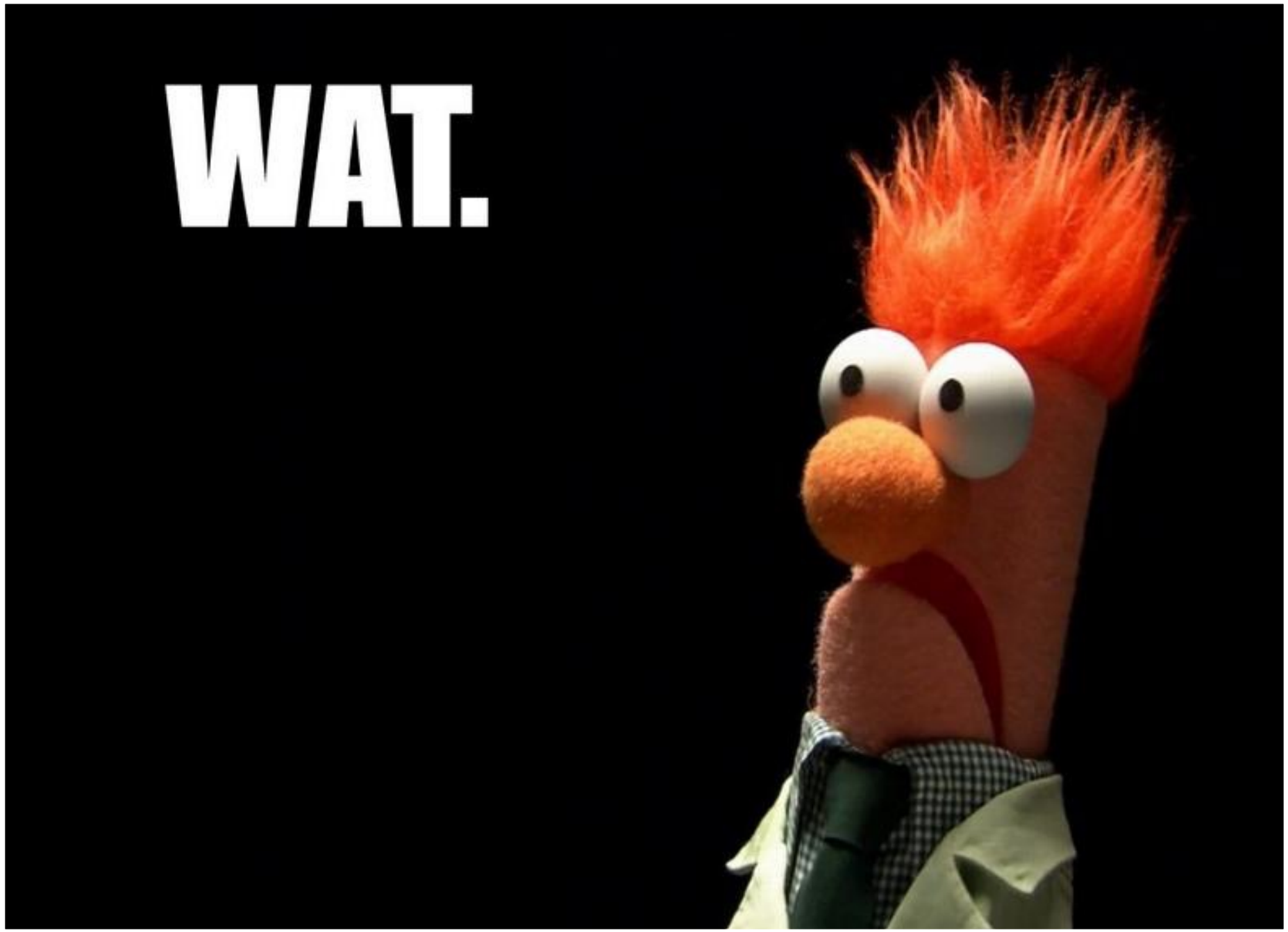
HOARDERS

GARBAGE COLLECTION

"Performance of the [garbage] collector is typically competitive with malloc/free… it may in some cases significantly outperform malloc/free."

–Hans Boehm

GARBAGE COLLECTION



GARBAGE COLLECTION

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TOPICS

- Memory allocation
- Traditional malloc
- bmalloc

MEMORY ALLOCATION

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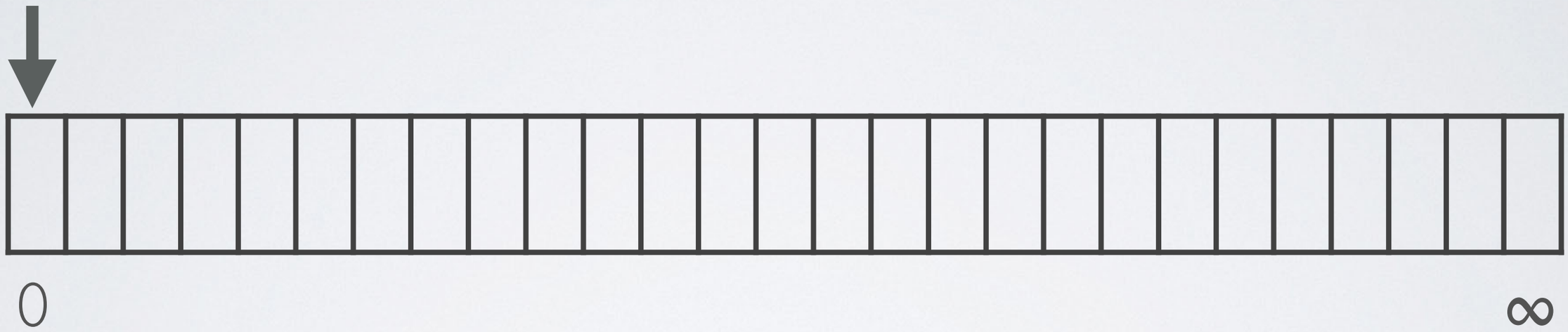
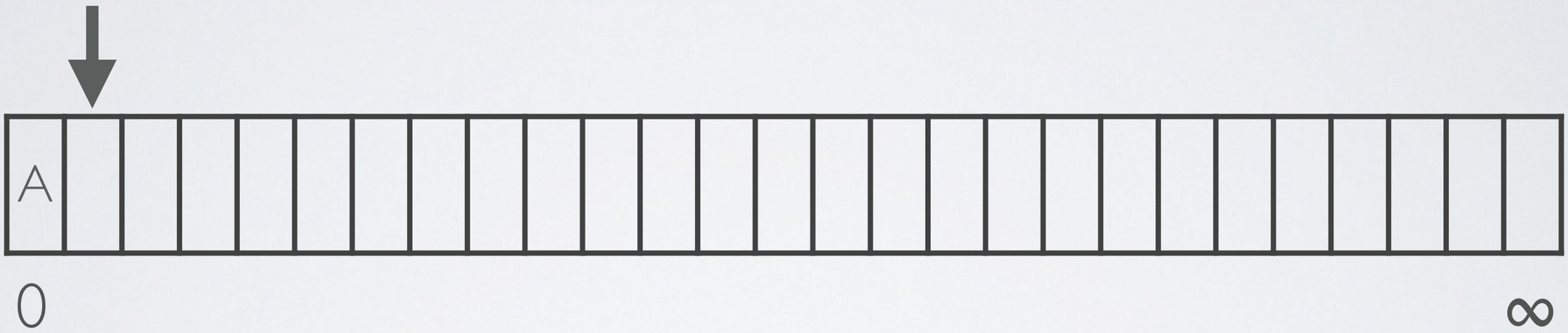
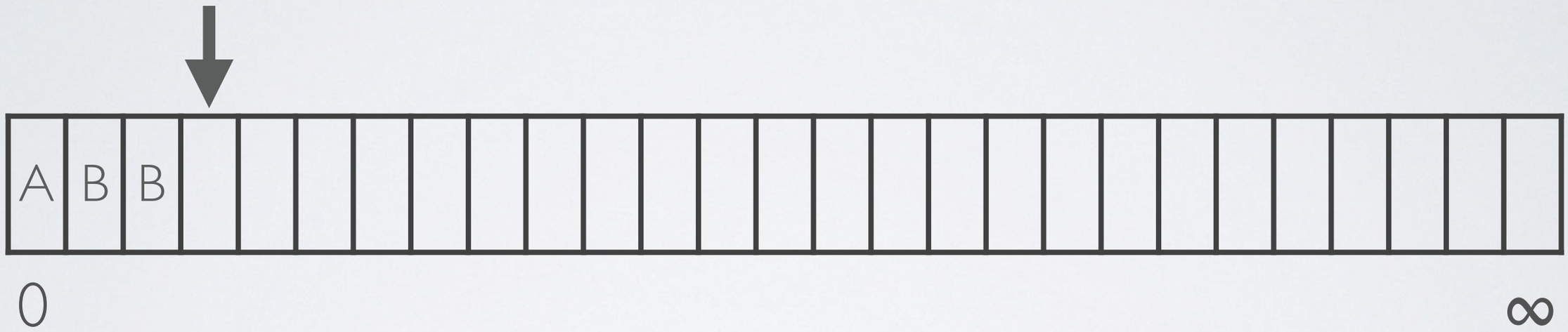


MEMORY ALLOCATION



MEMORY ALLOCATION



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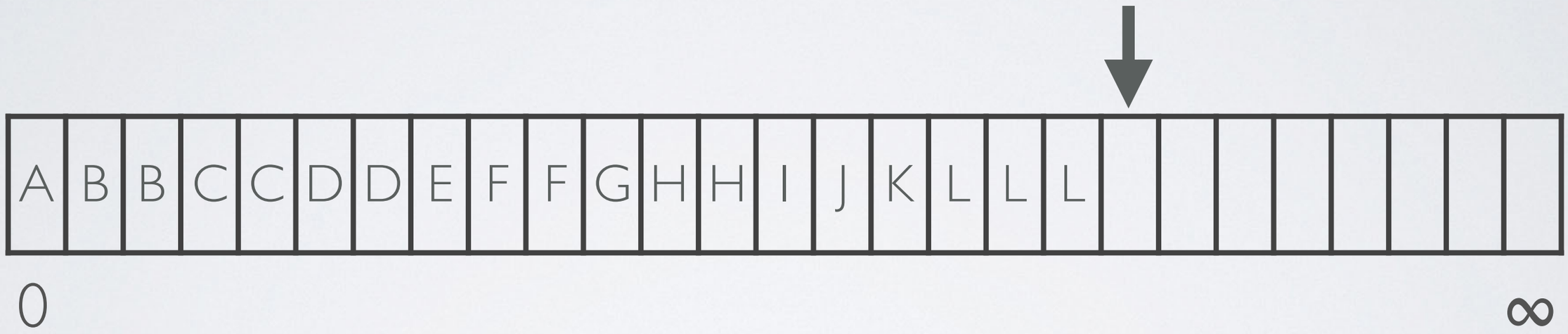

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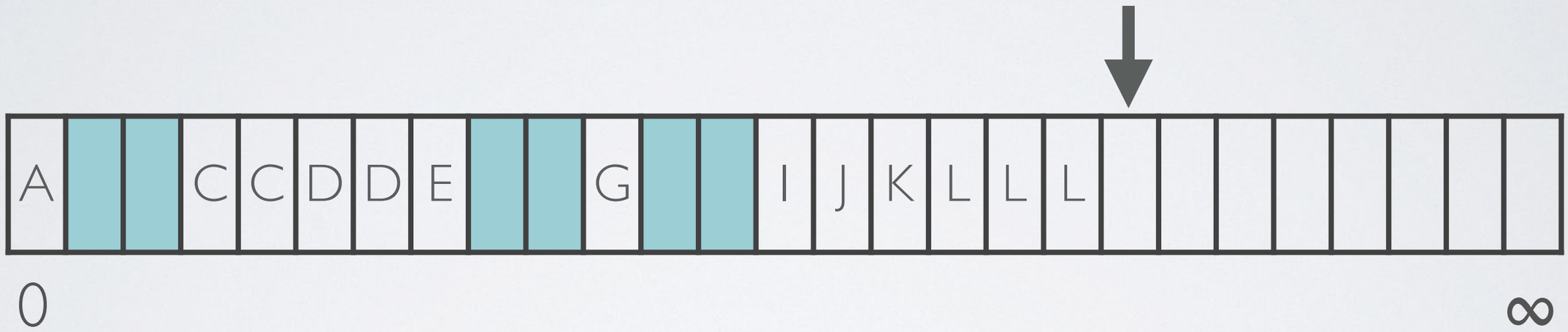

TRADITIONAL MALLOC

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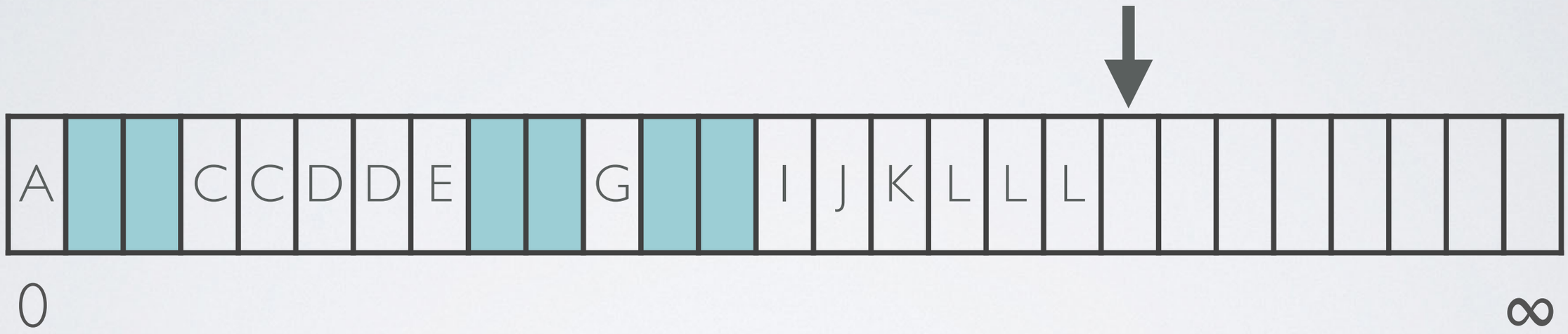
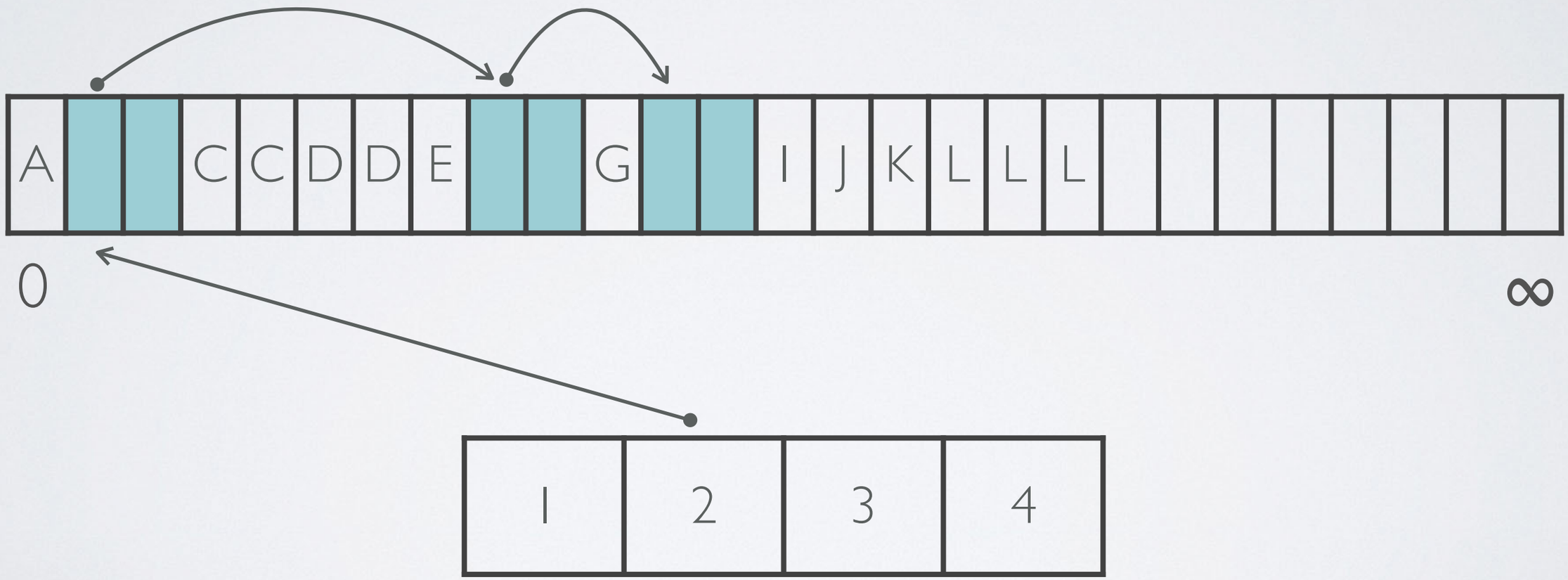


FREE LISTS



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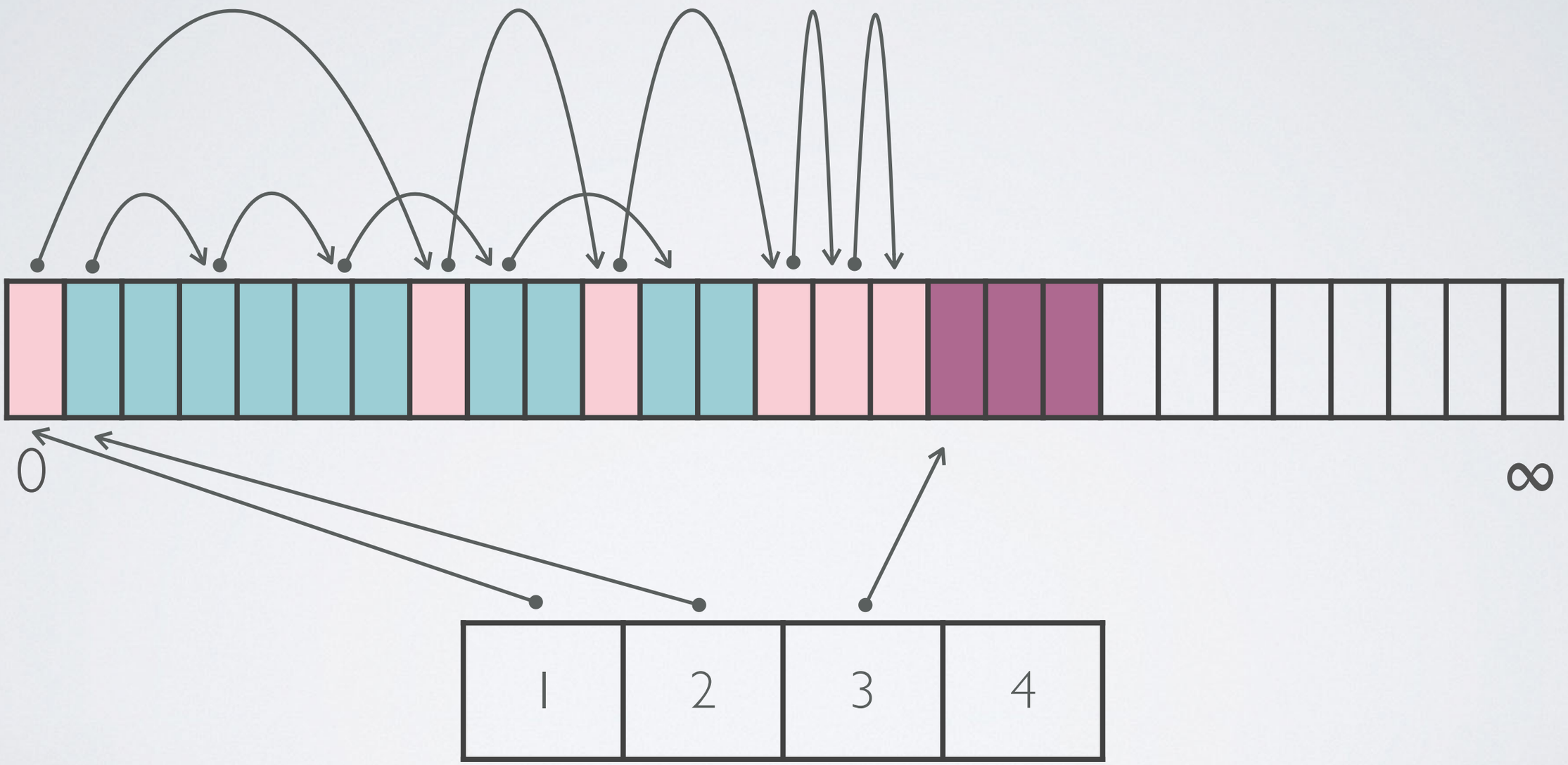
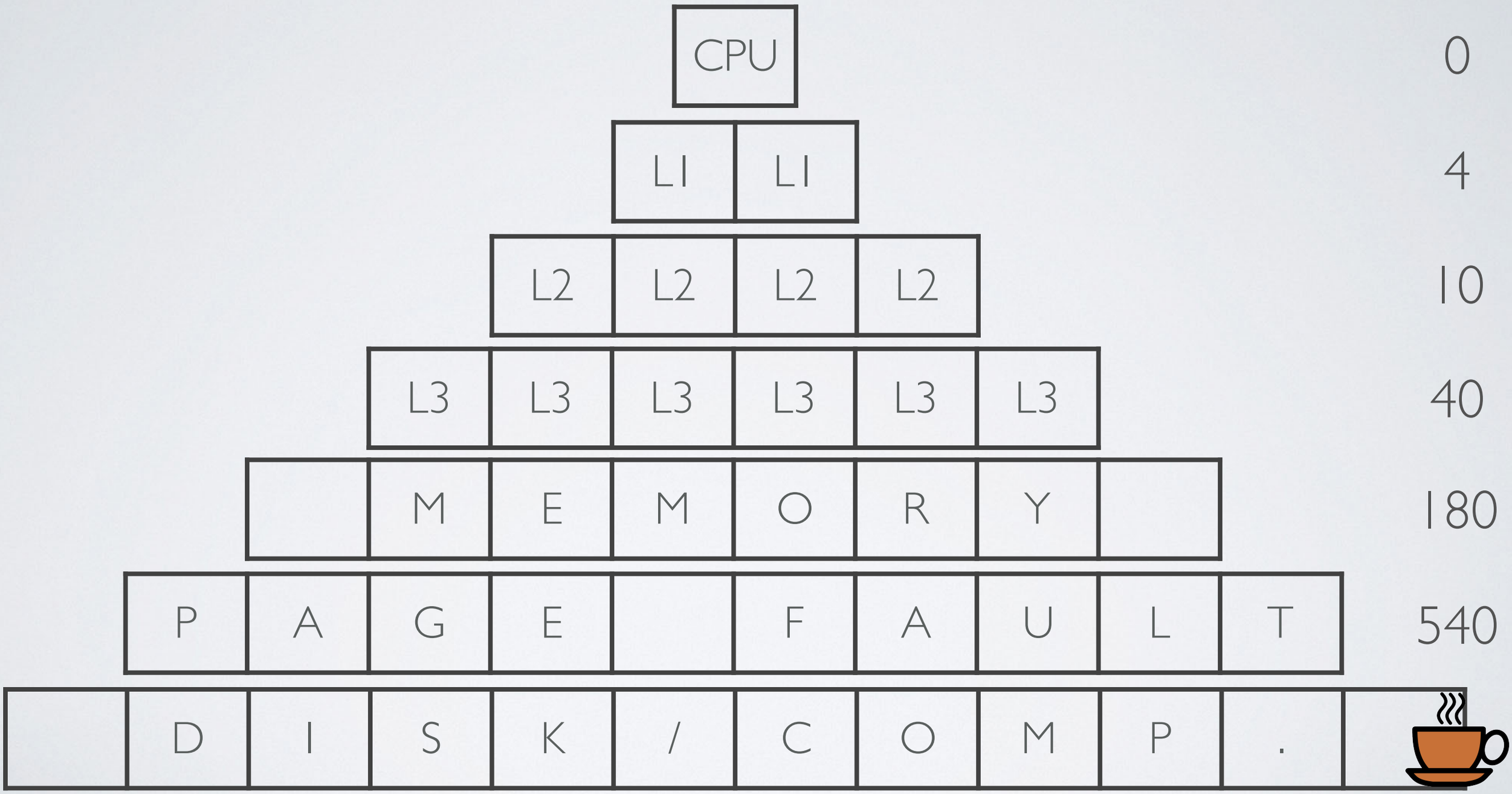


MEMORY MOUNTAIN



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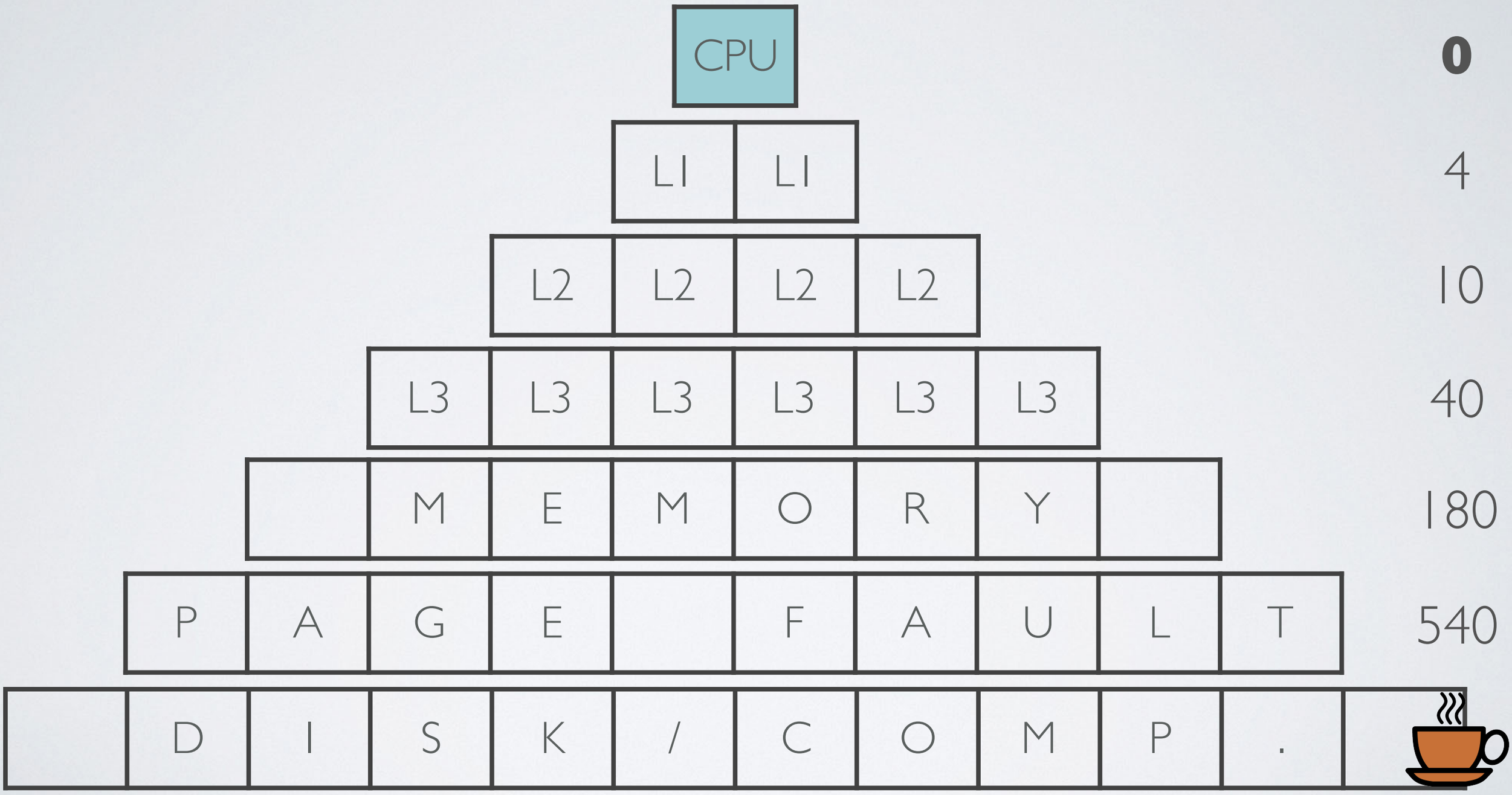

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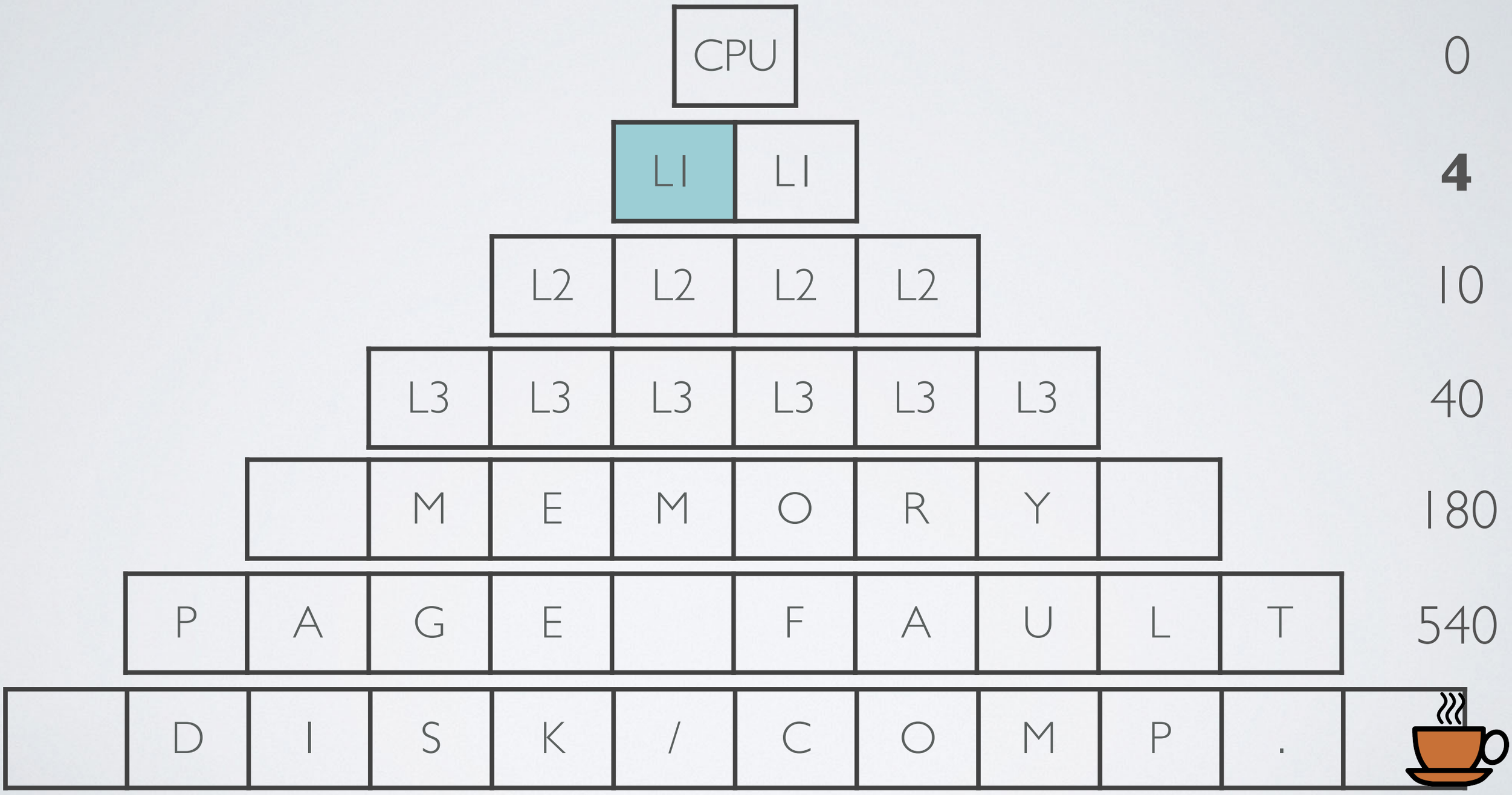

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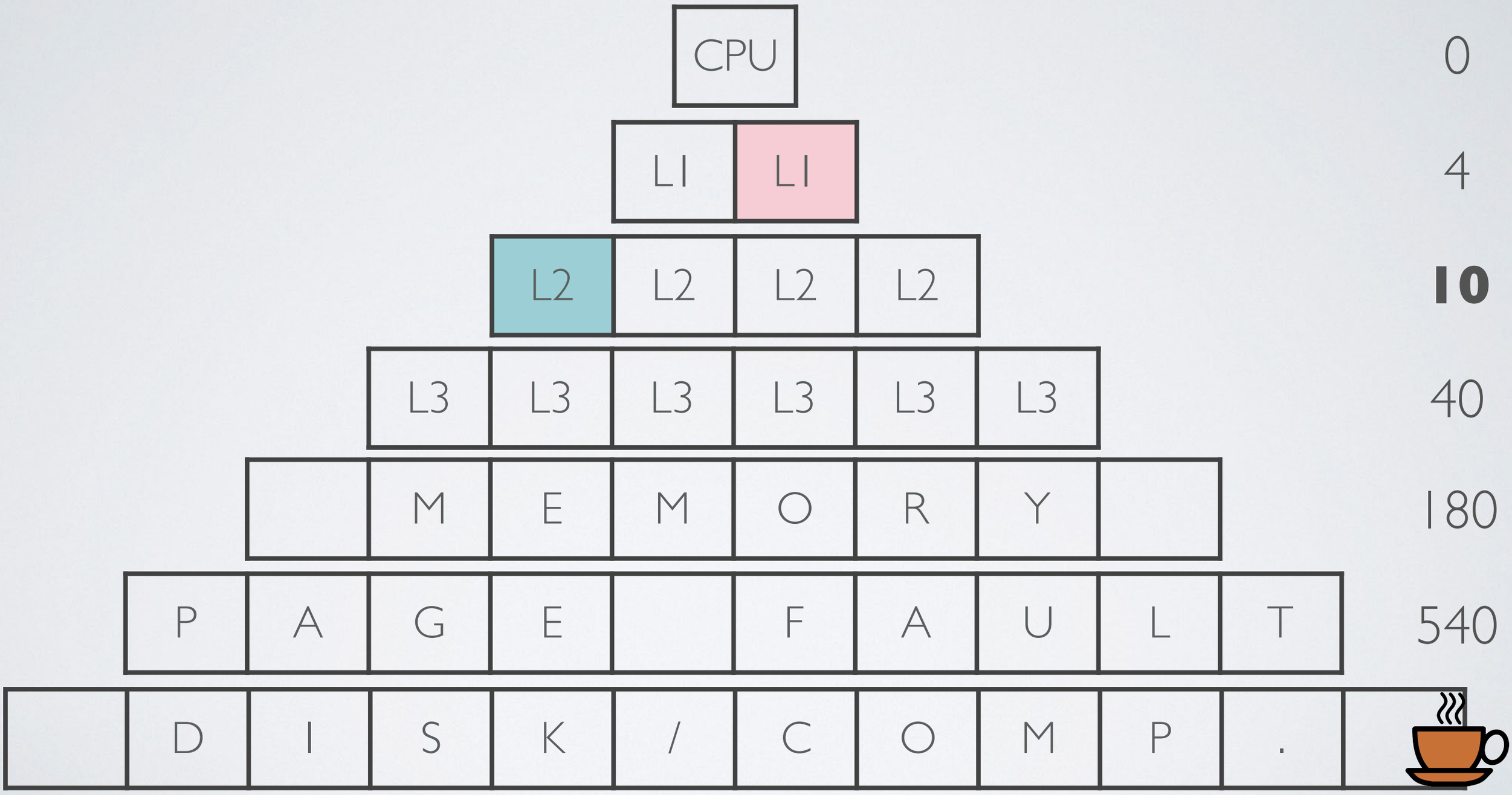

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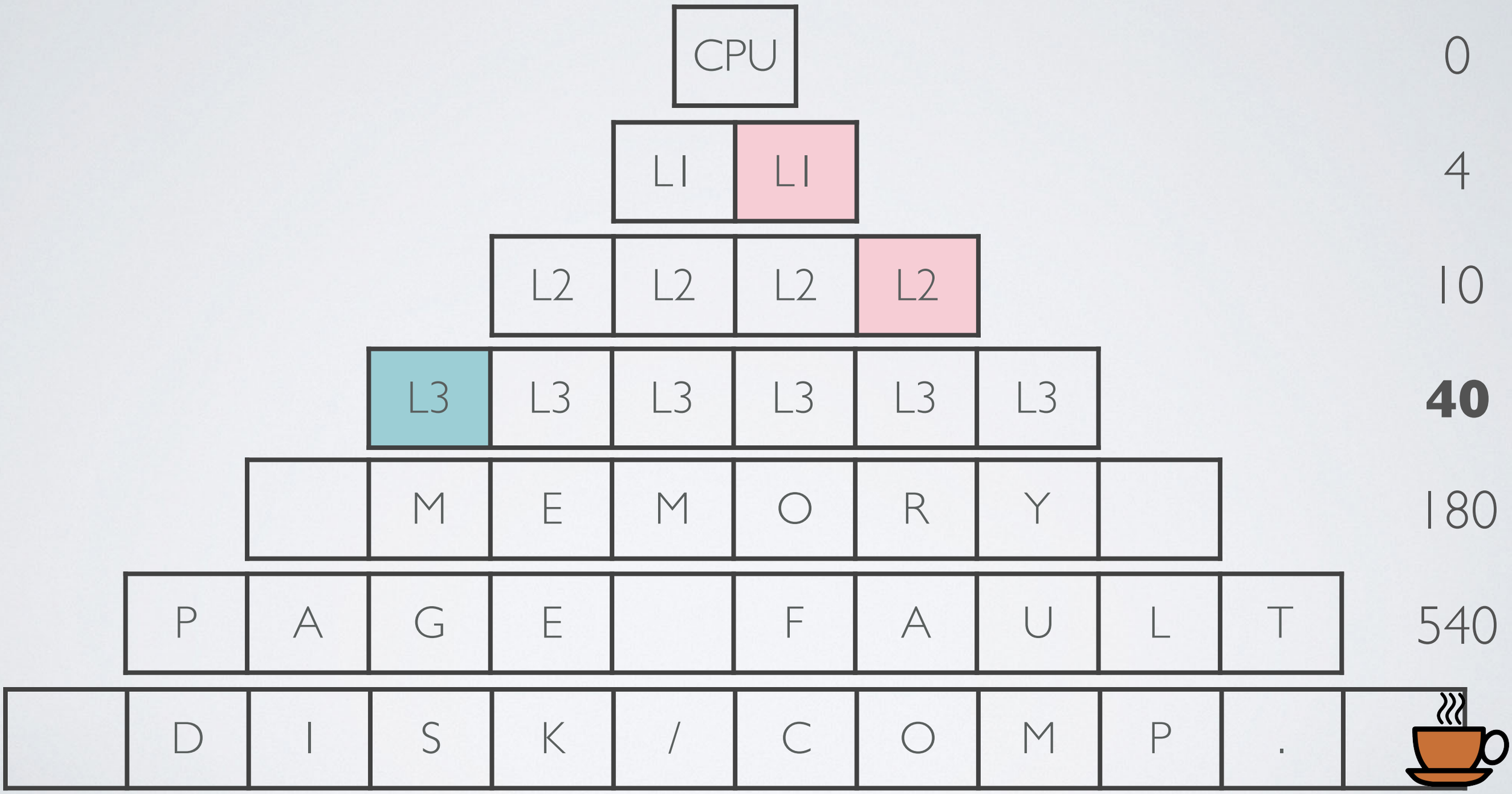
MEMORY MOUNTAIN



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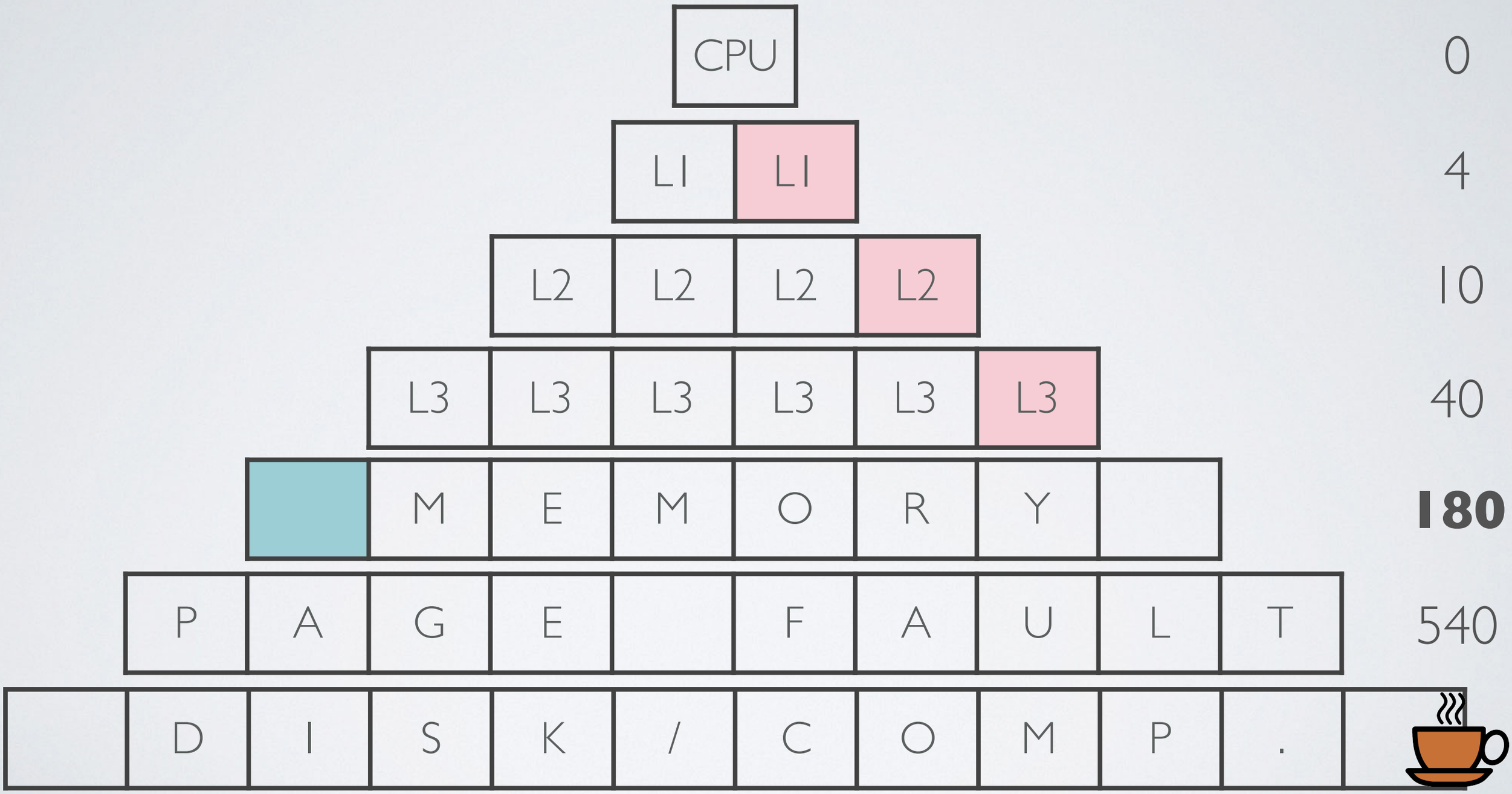

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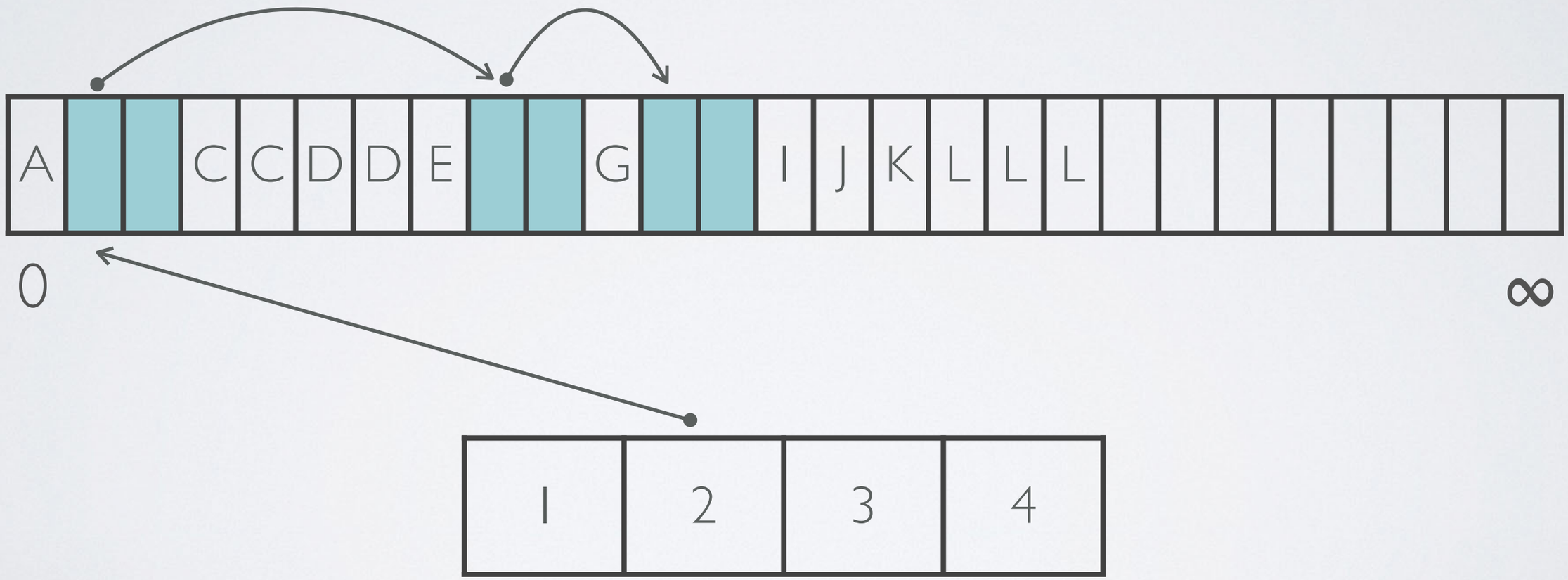

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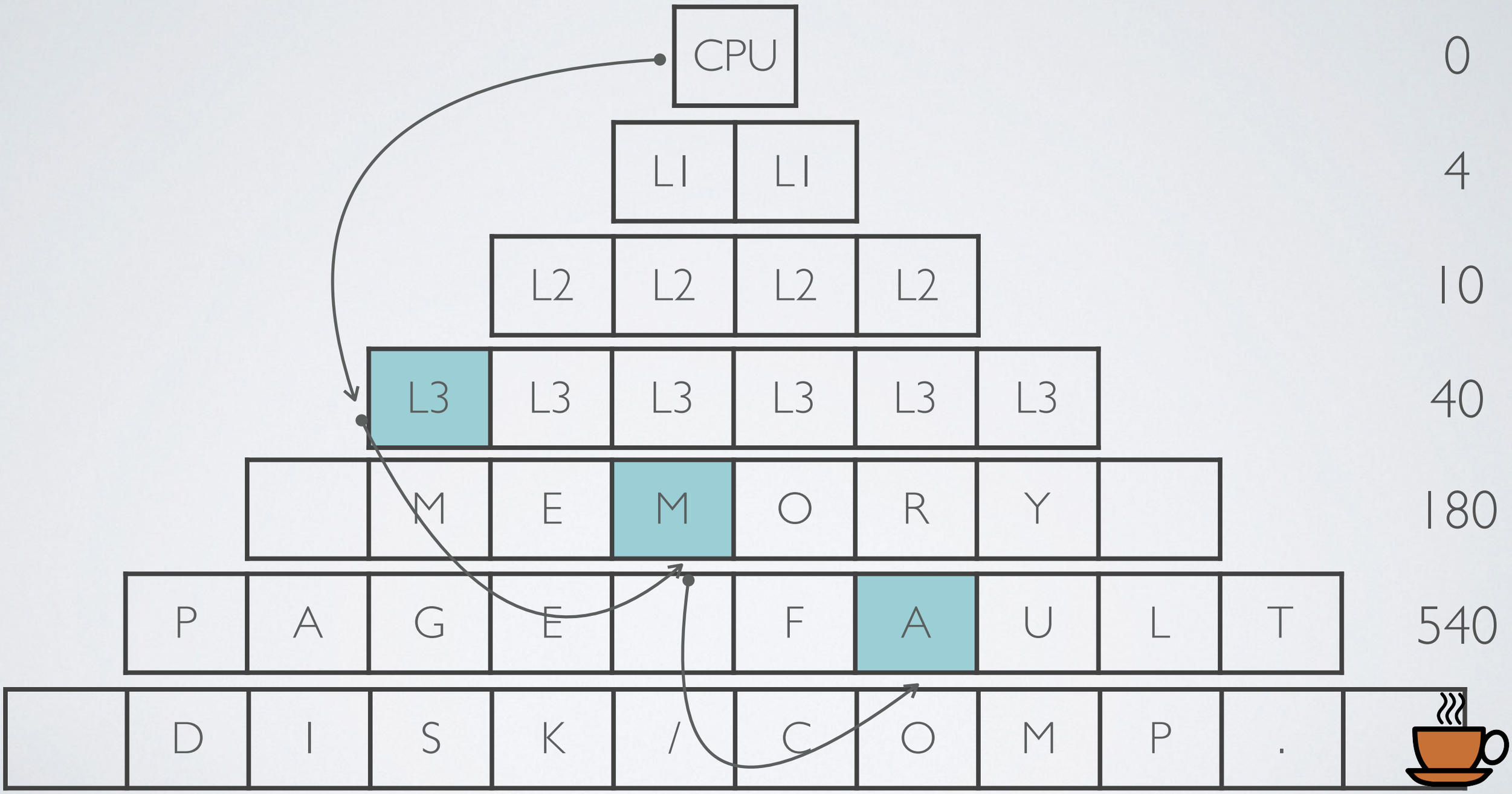
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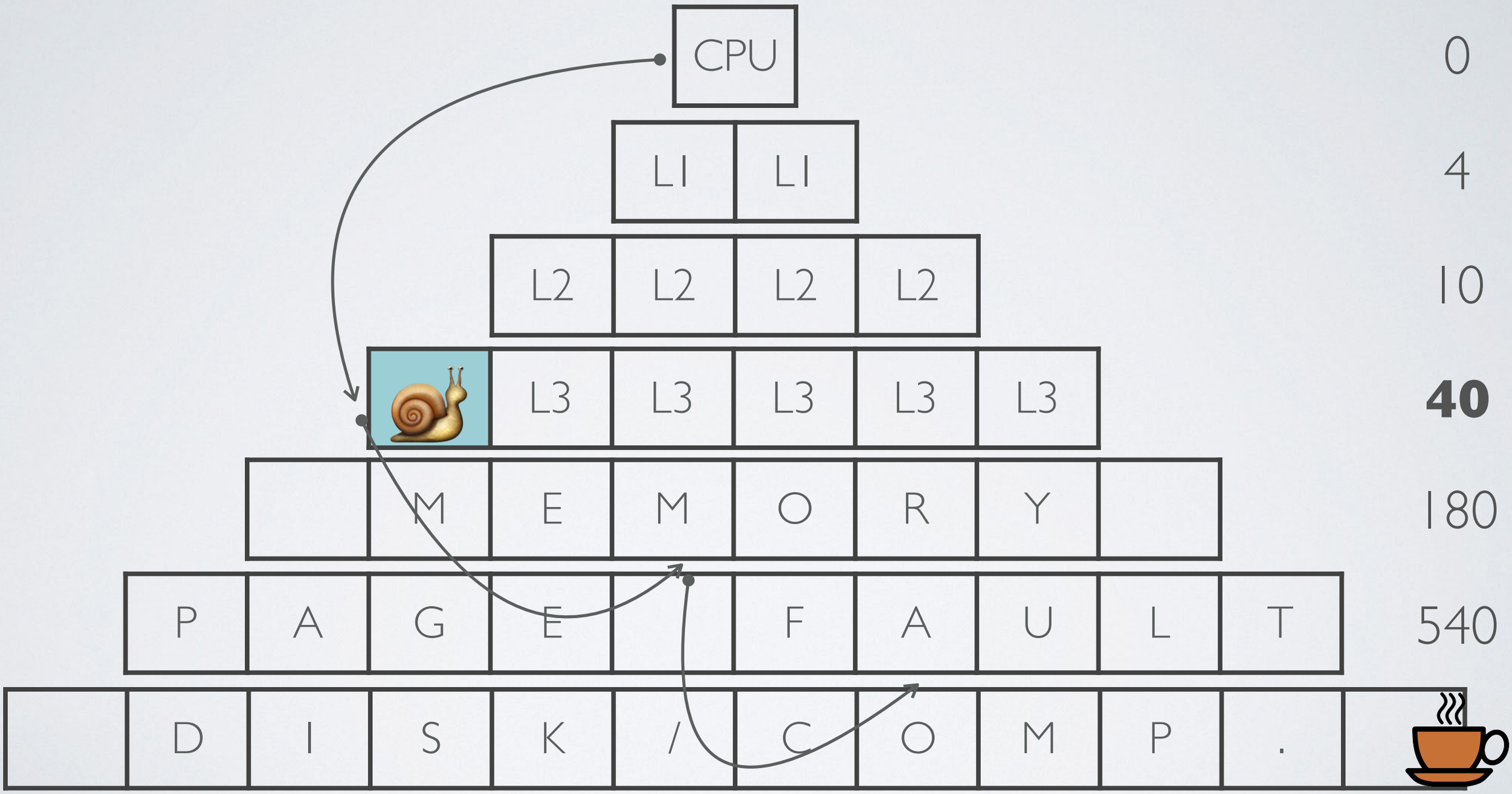
FREE LISTS



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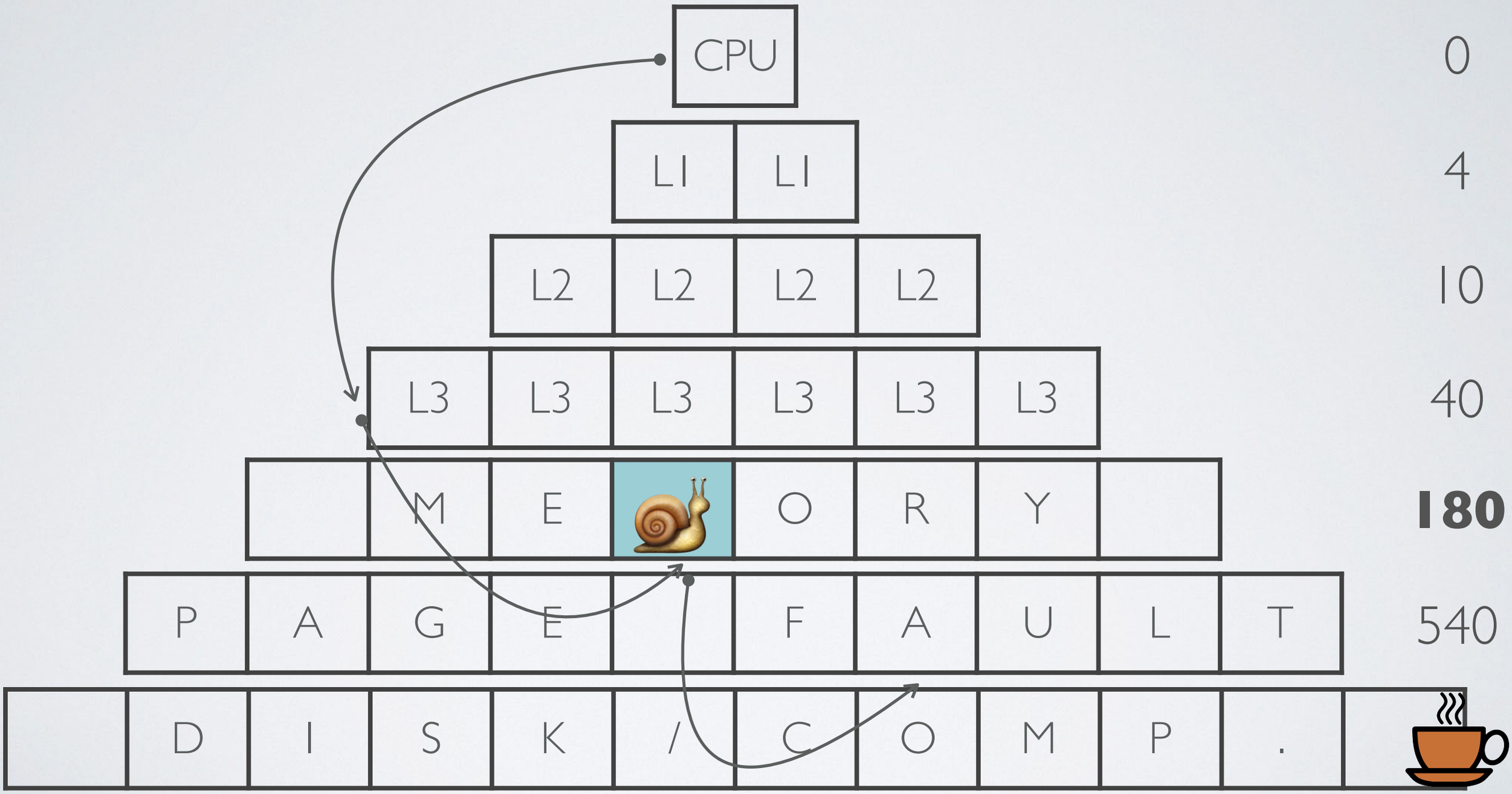

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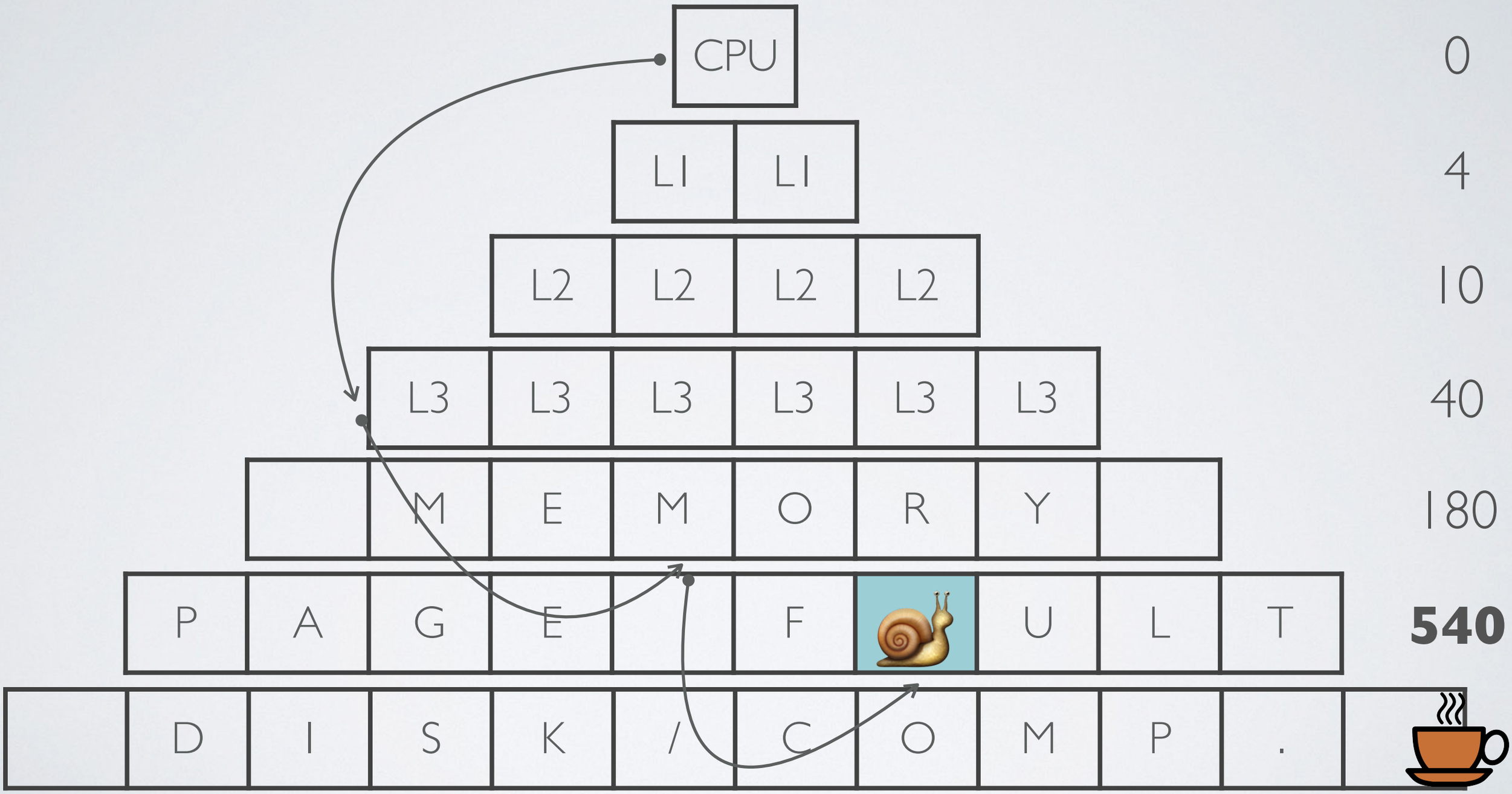

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GARBAGE COLLECTION

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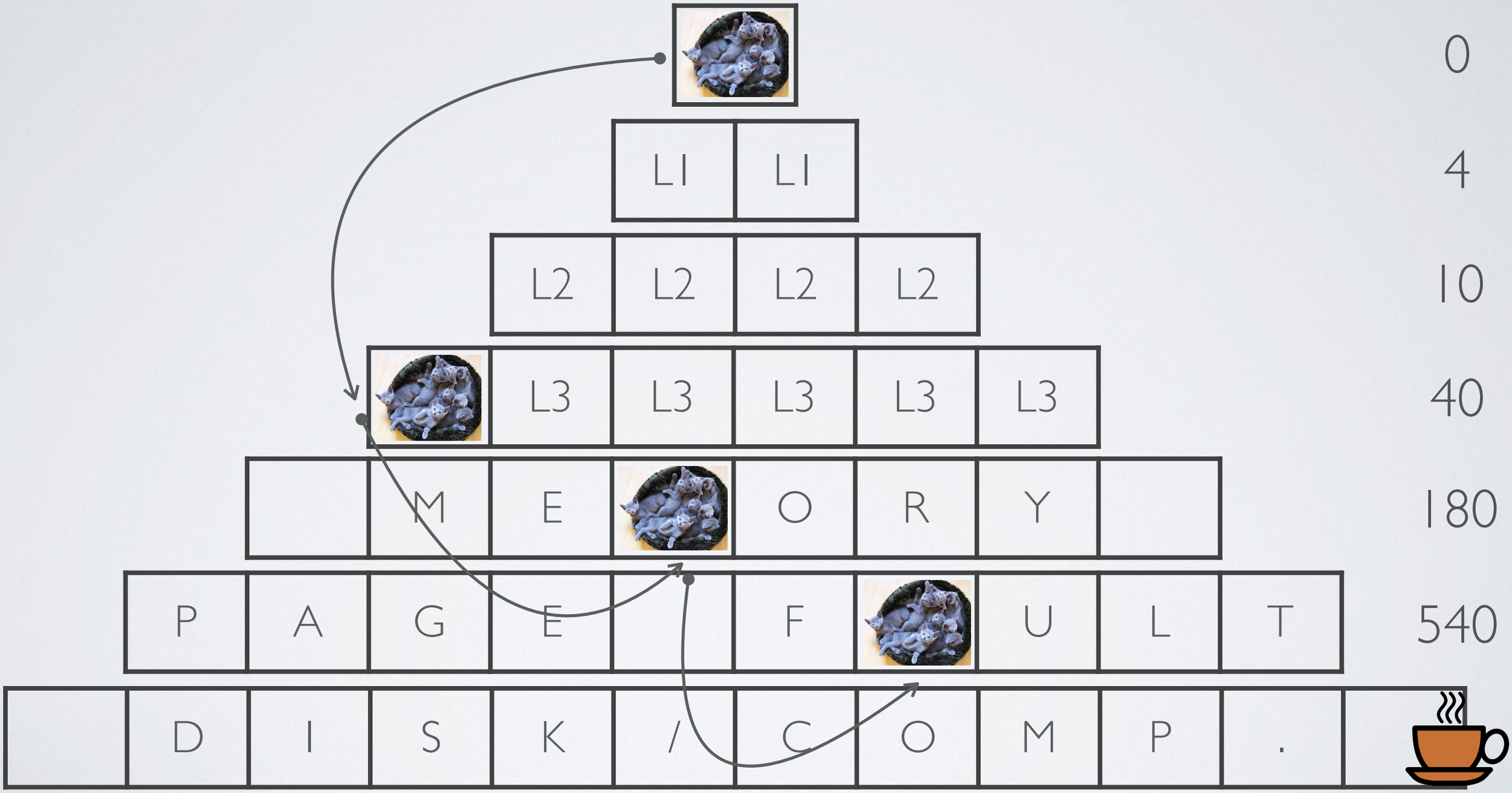

GARBAGE COLLECTION

BMALLOC

BMALLOC

BMALLOC

LINES

LINES

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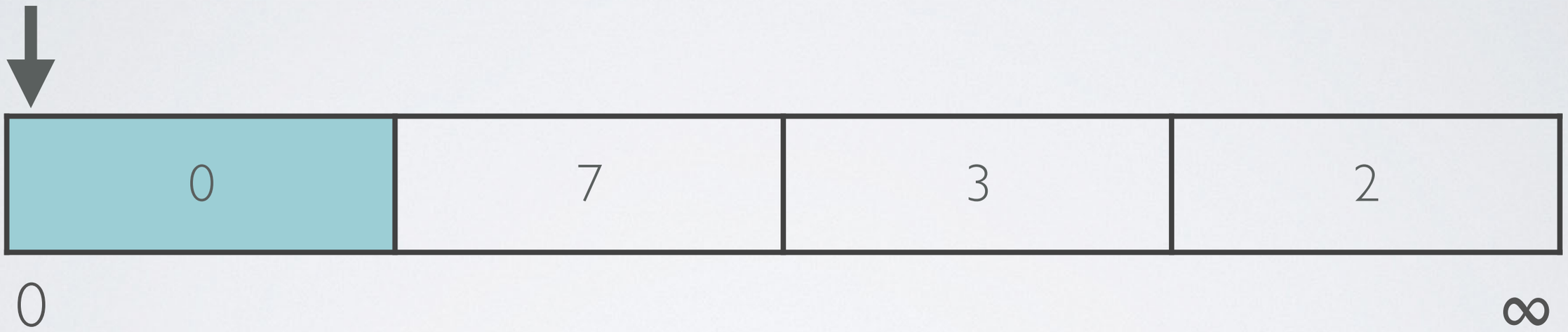
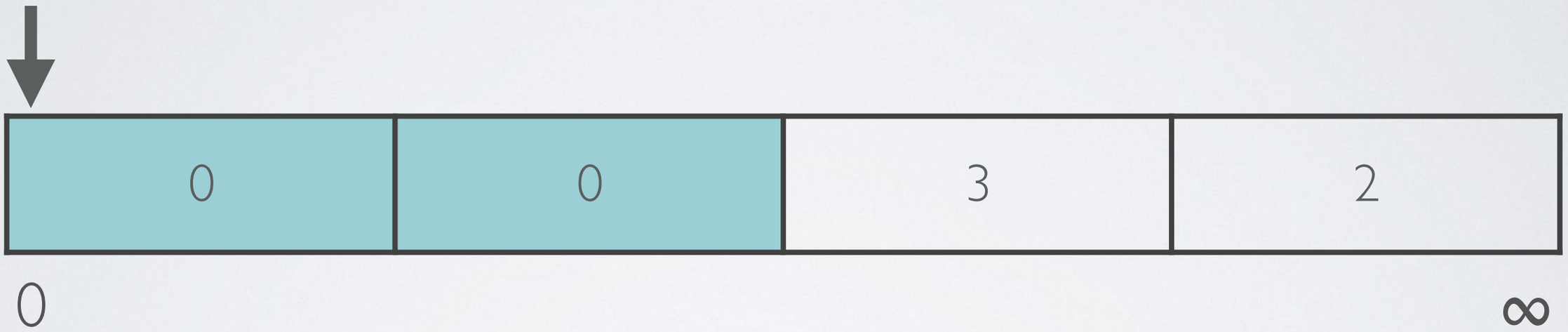


LINES

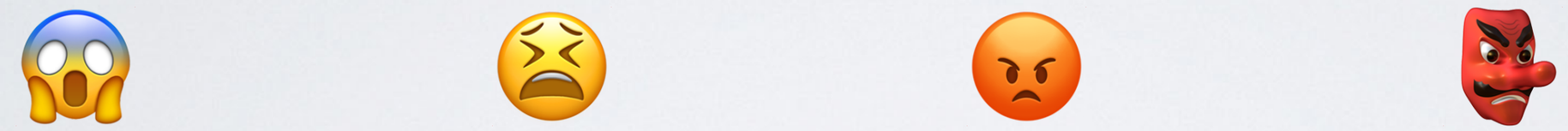


“But what about the crumbs?!”

–Everyone ever

CRUMBS

CRUMMY CRUMBS



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DON’T FEAR THE CRUMBS

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- Most objects die young

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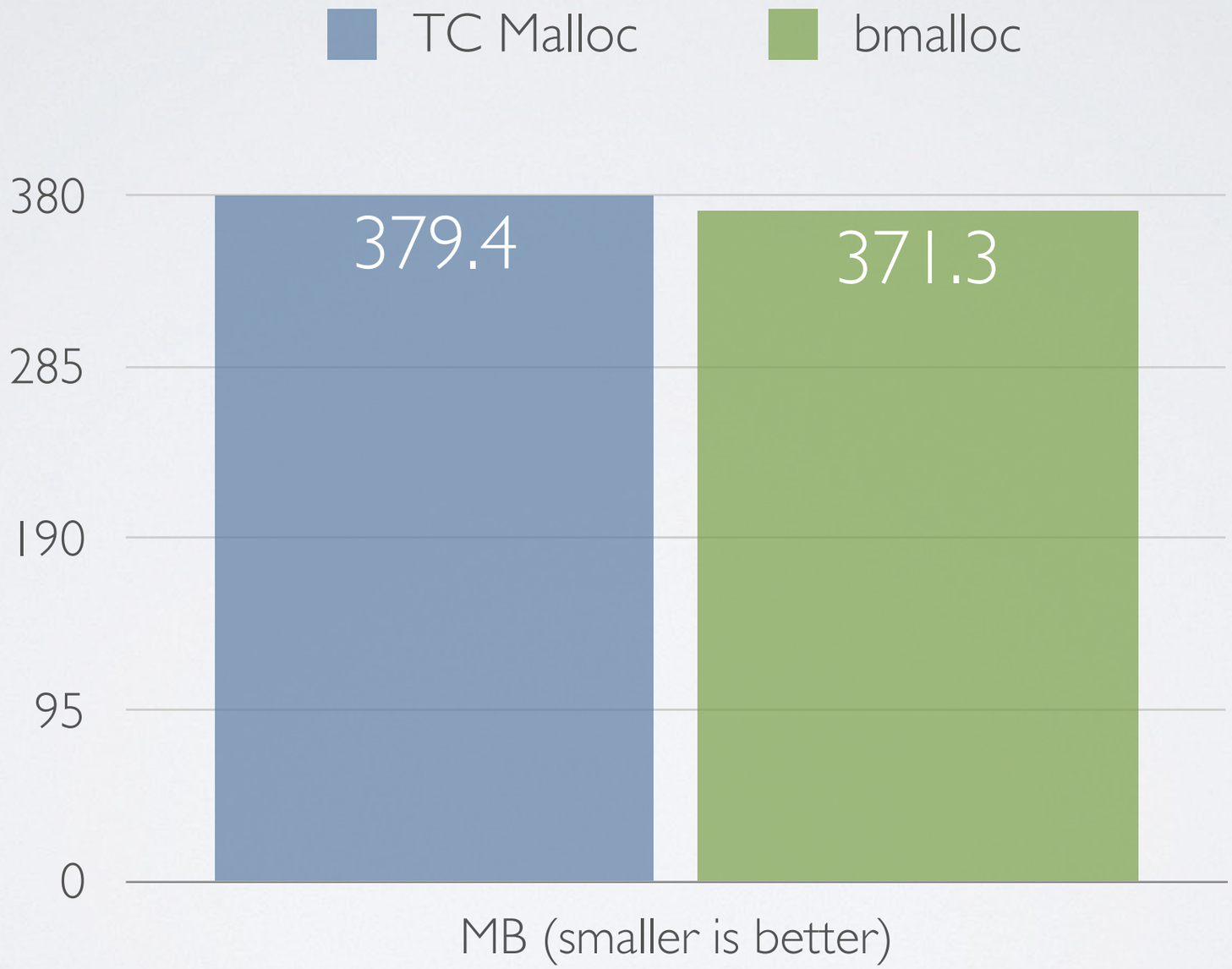
- Objects of the same type die together

DON'T FEAR THE CRUMBS

- Most objects die young
- Objects allocated together die together
- Objects of the same type die together
- Large objects matter most

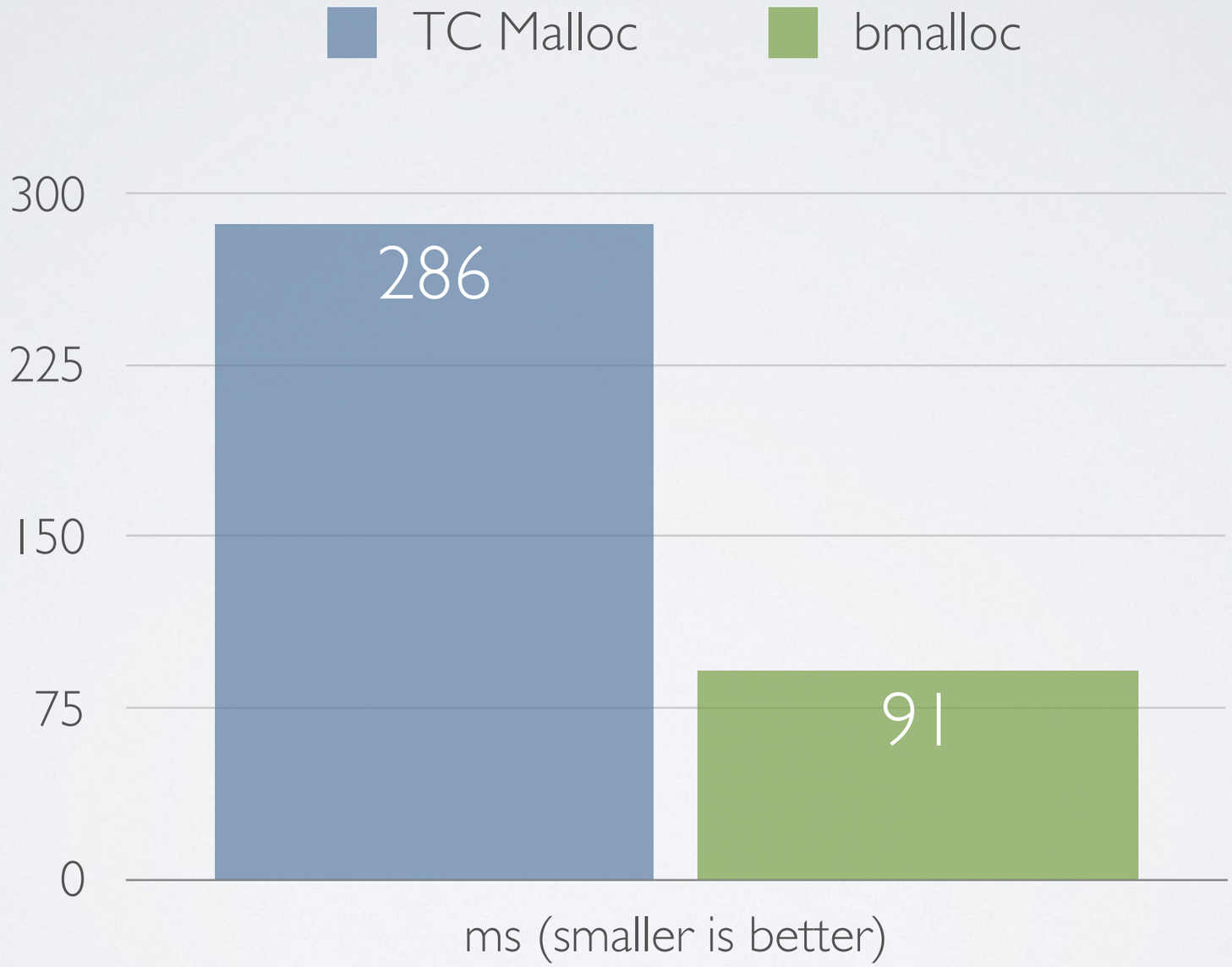
MEMBUSTER "POST"



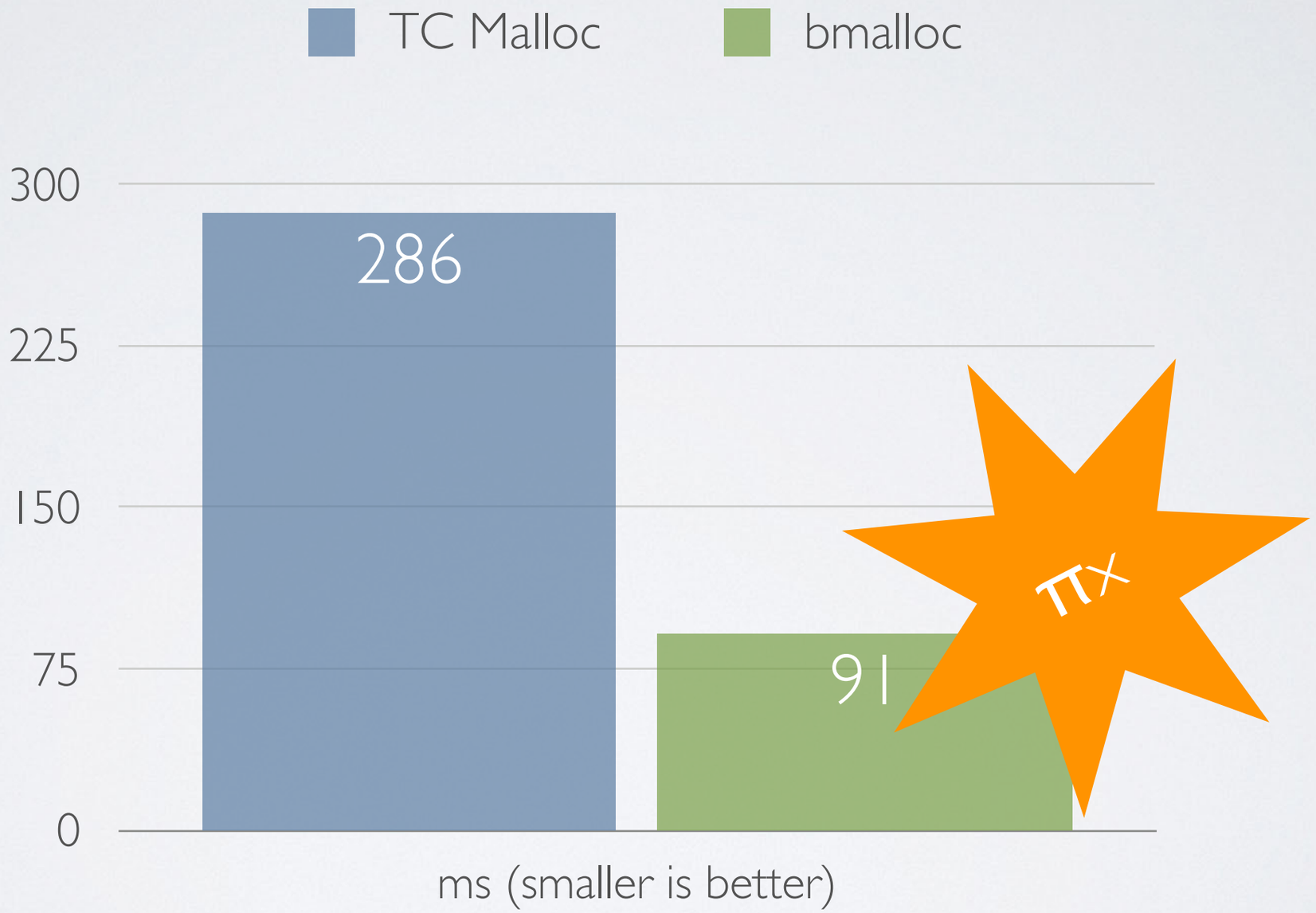
"But what about the **crumbs**?!"

–andersca

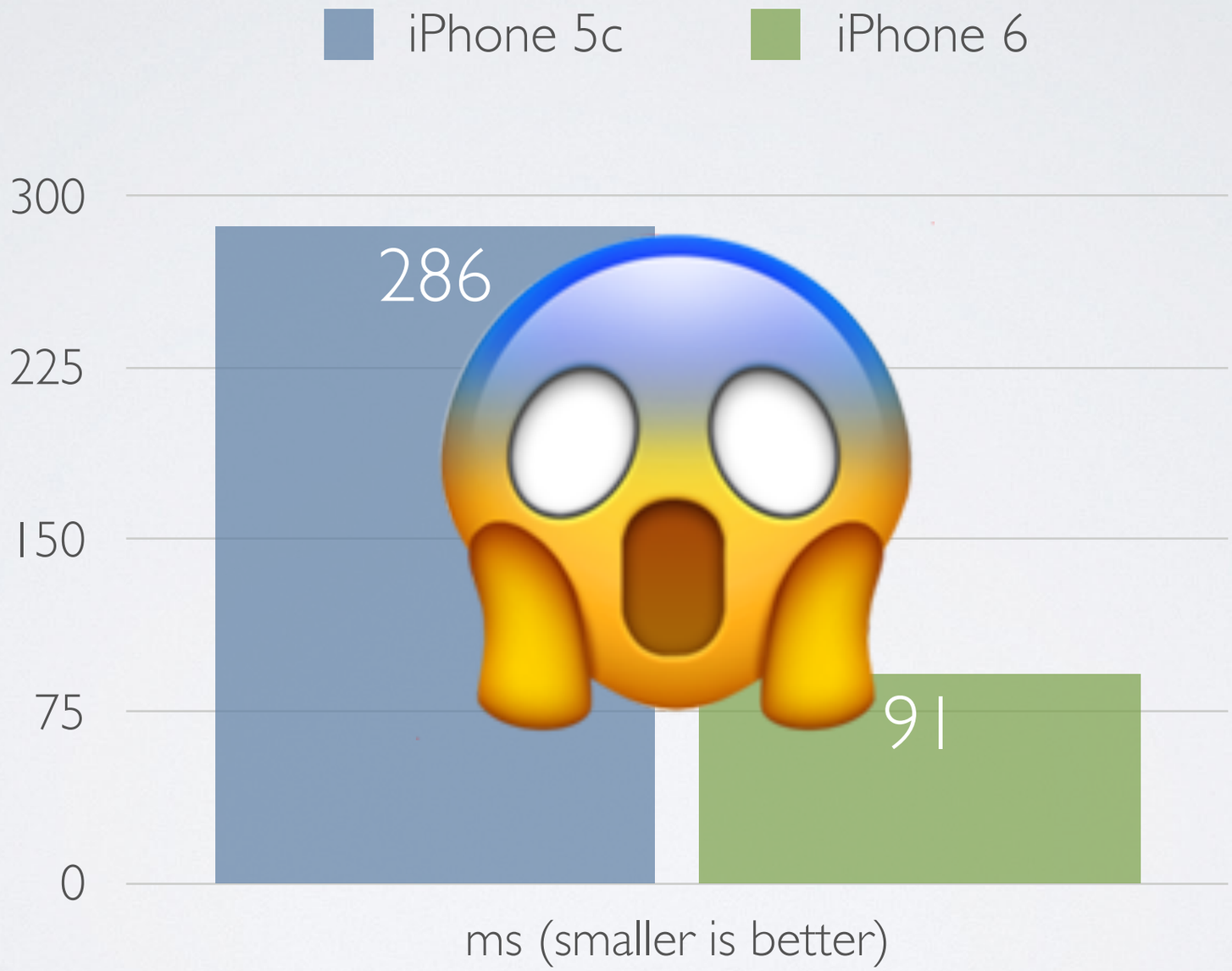
FRAGMENT_ITERATE



FRAGMENT_ITERATE



FRAGMENT_ITERATE



20 MALLOC BENCHMARKS

- churn
- list_allocate
- tree_allocate
- tree_churn
- fragment_iterate
- medium
- big
- facebook
- reddit
- flickr
- theverge
- message_one
- message_many
- churn (parallel)
- list_allocate (parallel)
- tree_allocate (parallel)
- tree_churn (parallel)
- fragment_iterate (parallel)
- medium (parallel)
- big (parallel)

20 MALLOC BENCHMARKS

Category	Speedup
reddit	1.65x
Average	2.11x
Max (list_allocate)	4.09x

30 WEBKIT BENCHMARKS

- DOM
- Page load
- JS frameworks
- CSS
- Layout
- Animation
- Parsing
- Window resize

30 WEBKIT BENCHMARKS

Category	Speedup
PLT	1.05x
Average	1.10x
Max (GetElement)	1.43x

DIDN’T WORK

DIDN'T WORK

- Threads

DIDN'T WORK

- Threads
- Atomics

DIDN'T WORK

- Threads
- Atomics
- Regions

DIDN'T WORK

- Threads
- Atomics
- Regions
- Bitvectors

DIDN'T WORK

- Threads
- Atomics
- Regions
- Bitvectors
- Trees

DIDN'T WORK

- Threads
- Atomics
- Regions
- Bitvectors
- Trees
- Sorting

DIDN'T WORK

- Threads
- Atomics
- Regions
- Bitvectors
- Trees
- Sorting
- Hashing

NEXT STEPS

NEXT STEPS

- Remove all the allocators!

NEXT STEPS

- Remove all the allocators!
- System tools

NEXT STEPS

- Remove all the allocators!
- System tools
- Moar clients

NEXT STEPS

- Remove all the allocators!
- System tools
- Moar clients
- Poor locality is a fixable bug

Agenda

- ~~Introduction~~
- ~~JavaScriptCore~~
- ~~Efficient Mark-Sweep~~

  - *30 minute break*

- ~~Concurrent GC~~
- ~~bmalloc~~
- WTF::Lock