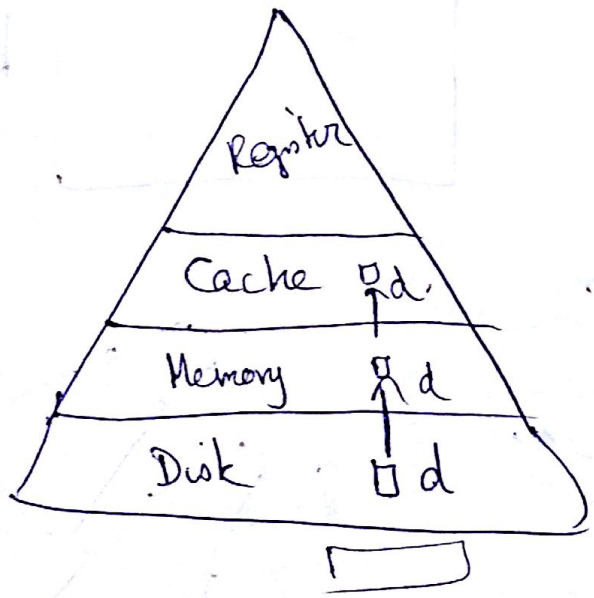
Topics

1) Memory Hierarchy
2) Locality → Temporal
   ↘ Spatial

Temporal Locality.



d → a [0]

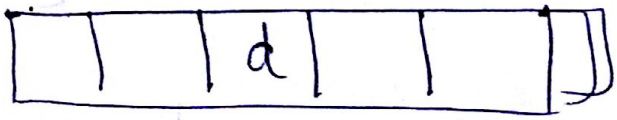
Linked list does not have good Spatial locality.

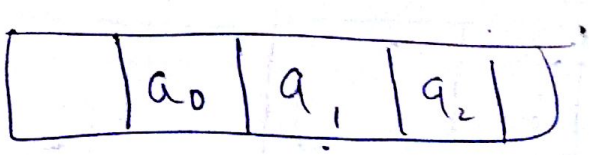
Spatial locality.

Same idea!

Data item d, when it is being read, is not read alone.

A chunk of memory gets read.





Locality also → applies to Instructions

for ( )
{

}

Label

movl

jmp Label.

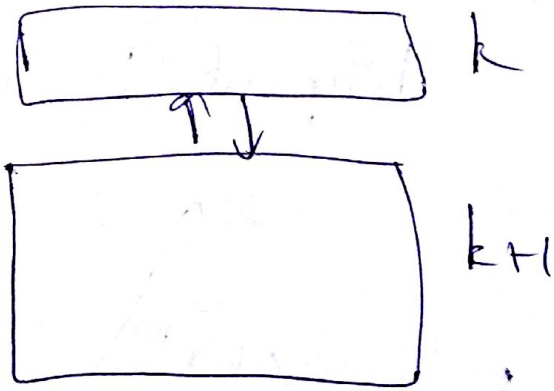
These instructions will get executed sequentially → spatial locality.

good temporal locality!

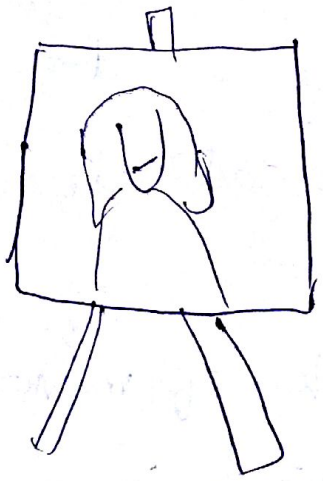
↳ because it gets executed repeatedly!

3) Caching (Idea)

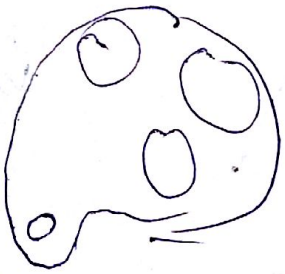
Use a smaller, faster memory as a staging area for a larger, slower memory.



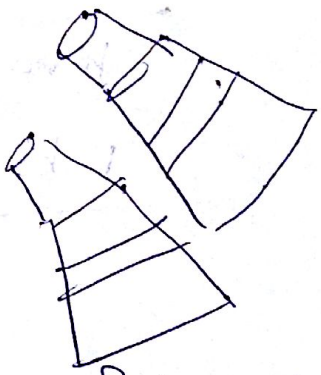
Analogy,

① 

Canvas.



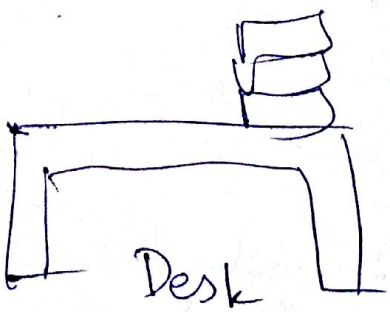
Palette
(Staging area)



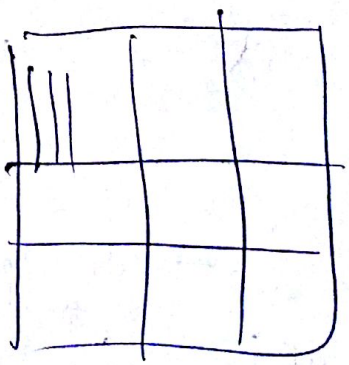
Paint tube

②

Reading area



Desk



Library.

Cache Hit

Last Lecture Notes

Cache miss

If d is not in k, level k goes and fetches it from k+1 and stores it

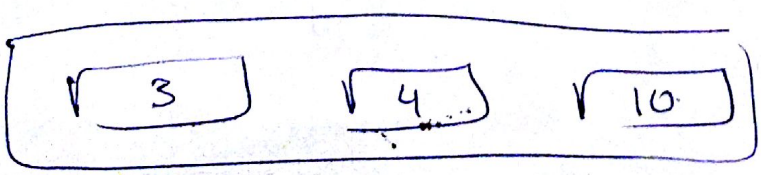
① If k has a free space, no problems.

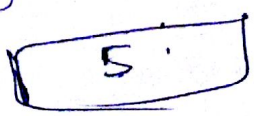
② If k is already full.

we replace a block → victim block

(or) evicting a block.

How is this block chosen?





① Randomly.

② Least Recently Used //

} Examples of Cache Replacement policies.

Kinds of Cache Misses

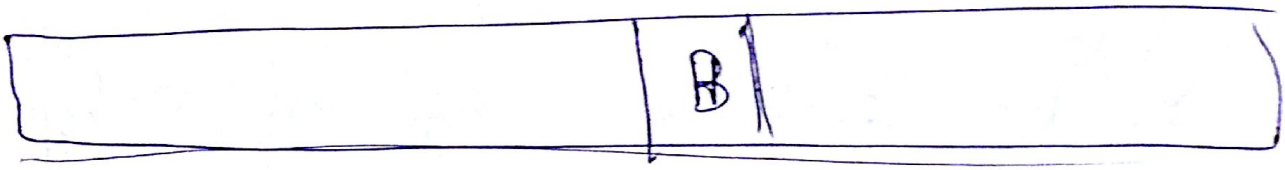
① Cold miss → If cache at level k is empty. (cold → empty).

② Conflict Miss

Placement Policy → Where the the retreived block is placed in k?

ⓐ No restriction → Place any block from k+1 anywhere in k.

Drawbacks.



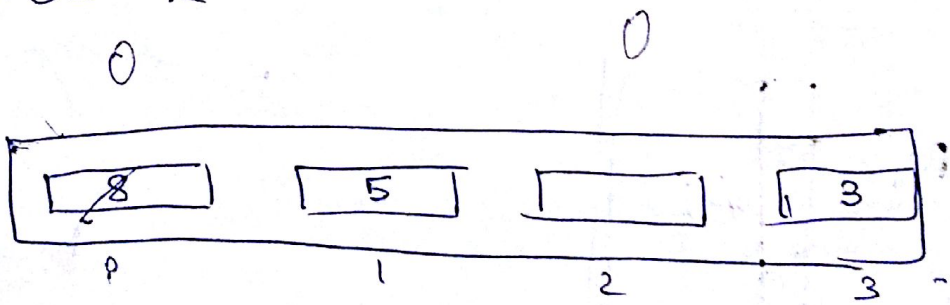
Million locations.

To retreive block B, linear search is expensive!

We speed it up!

(b) Restrictive Placement.

Example: Block i at level (k+1) must be stored at Block (i mod 4) on level k.



If i request Block 5 => look at index 1

If request Block 0 => look at index 0

We already have Block 8 at index 0.

⇒ cache miss!

⇓

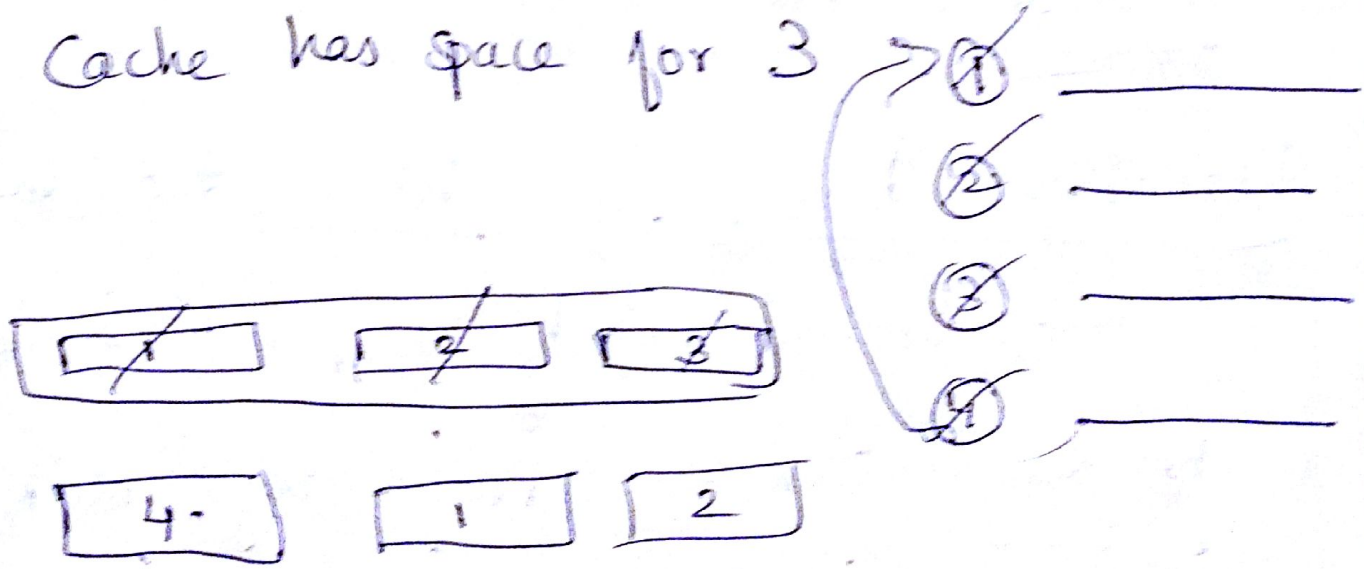
due to some restrictive placement policy is called conflict miss.

③ Capacity Miss

Suppose → we have a loop.

⇒ 4 instructions in the body

⇒ Cache has space for 3

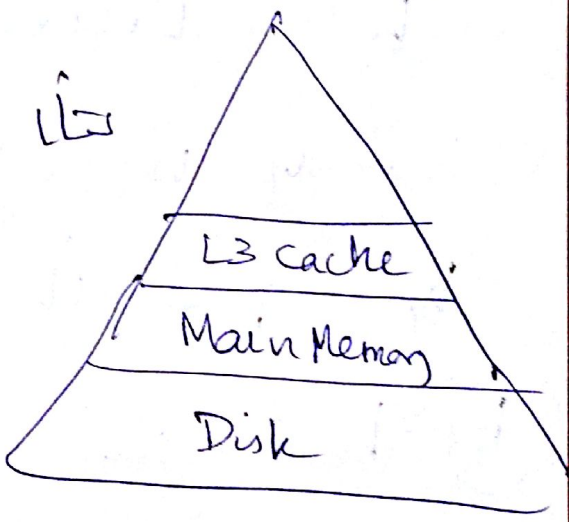


which happen when the cache size is too small ⇒ capacity misses.

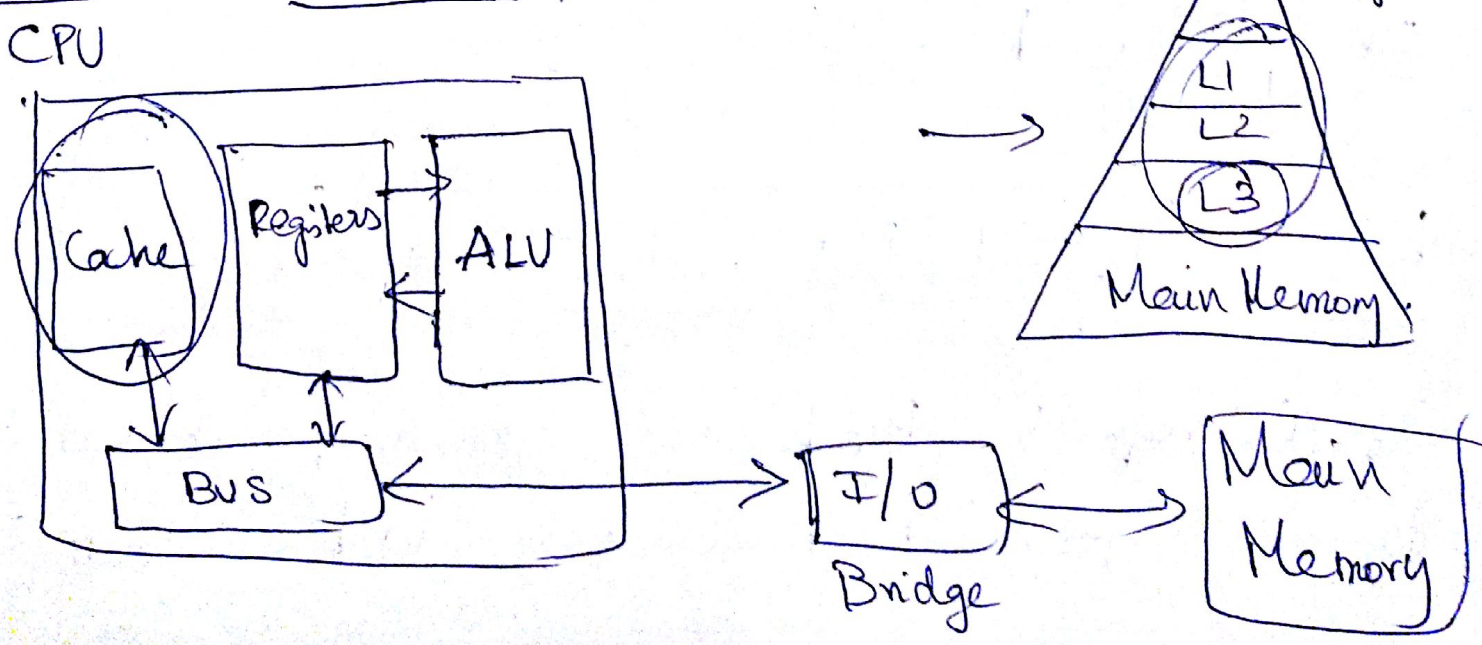
To takeway

→ each level in the hierarchy is a cache for its lower level.

→ each level manages its own blocks. using its own policies (replacement, placements).



6.4 Cache.



Cache Memory Organization.

Check next lecture's notes