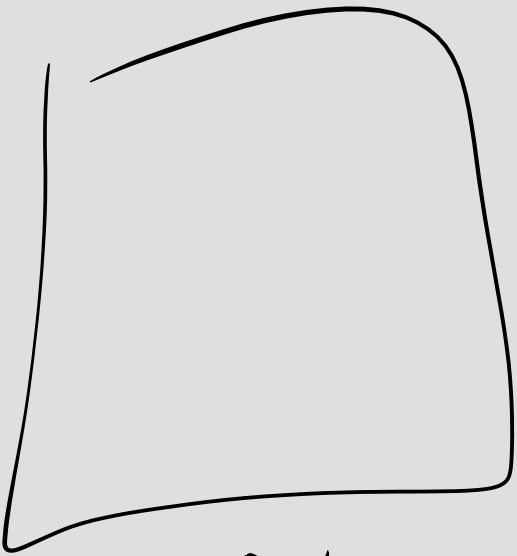


anything slow

- Pure
- no side effects
  - no non-arg dep

$F(x)$

RAM



CPU



Cache

SRAM

Transistors  
↳ wlog



RAM

DRAM

COST

Punch  
card

rey

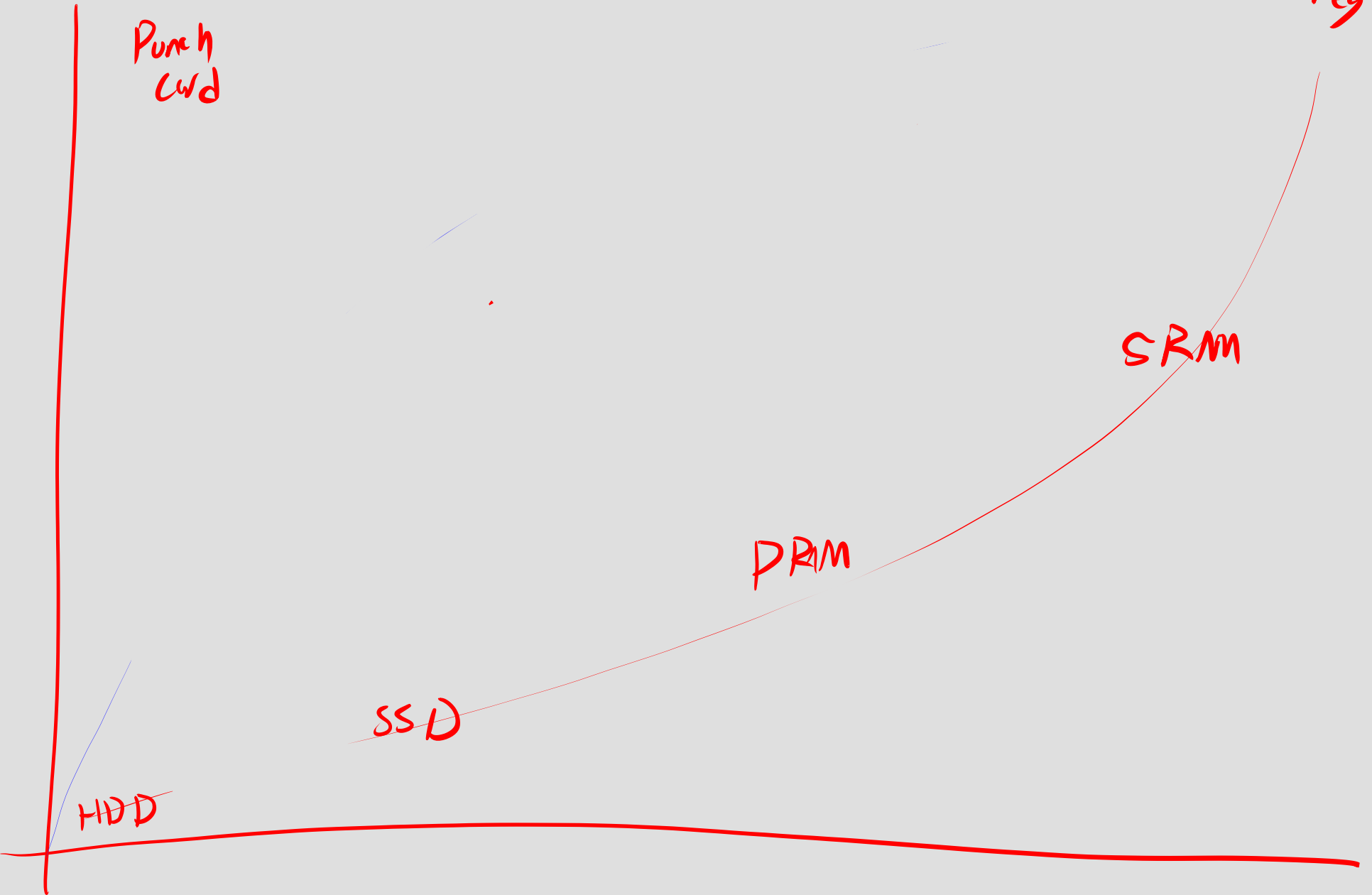
SRM

DRAM

SSD

HDD

Speed

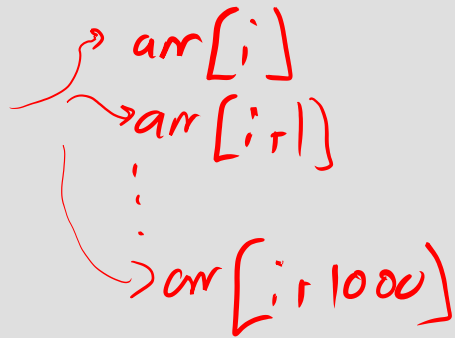


Speed  $\rightarrow$  Big = slow

# Locality

- Spatial
- Temporal

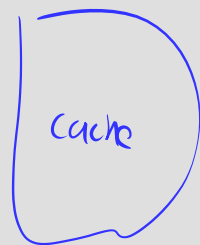
$x \neq x+3$



RAM

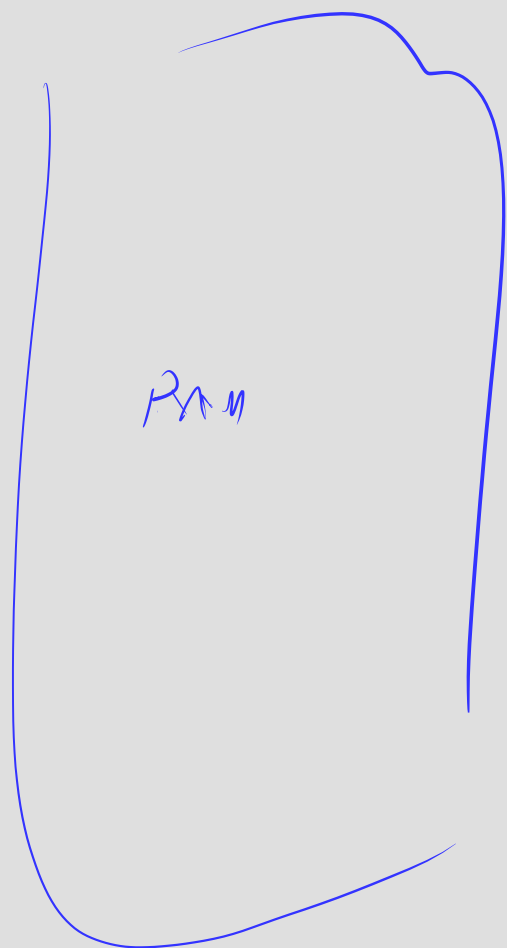
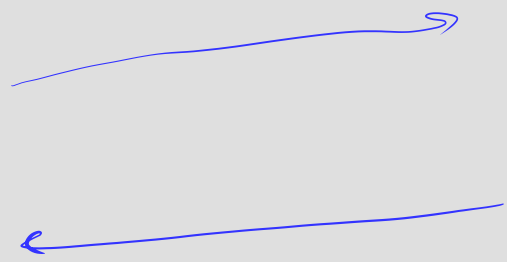
Spatial

read  
→  
0x12345678



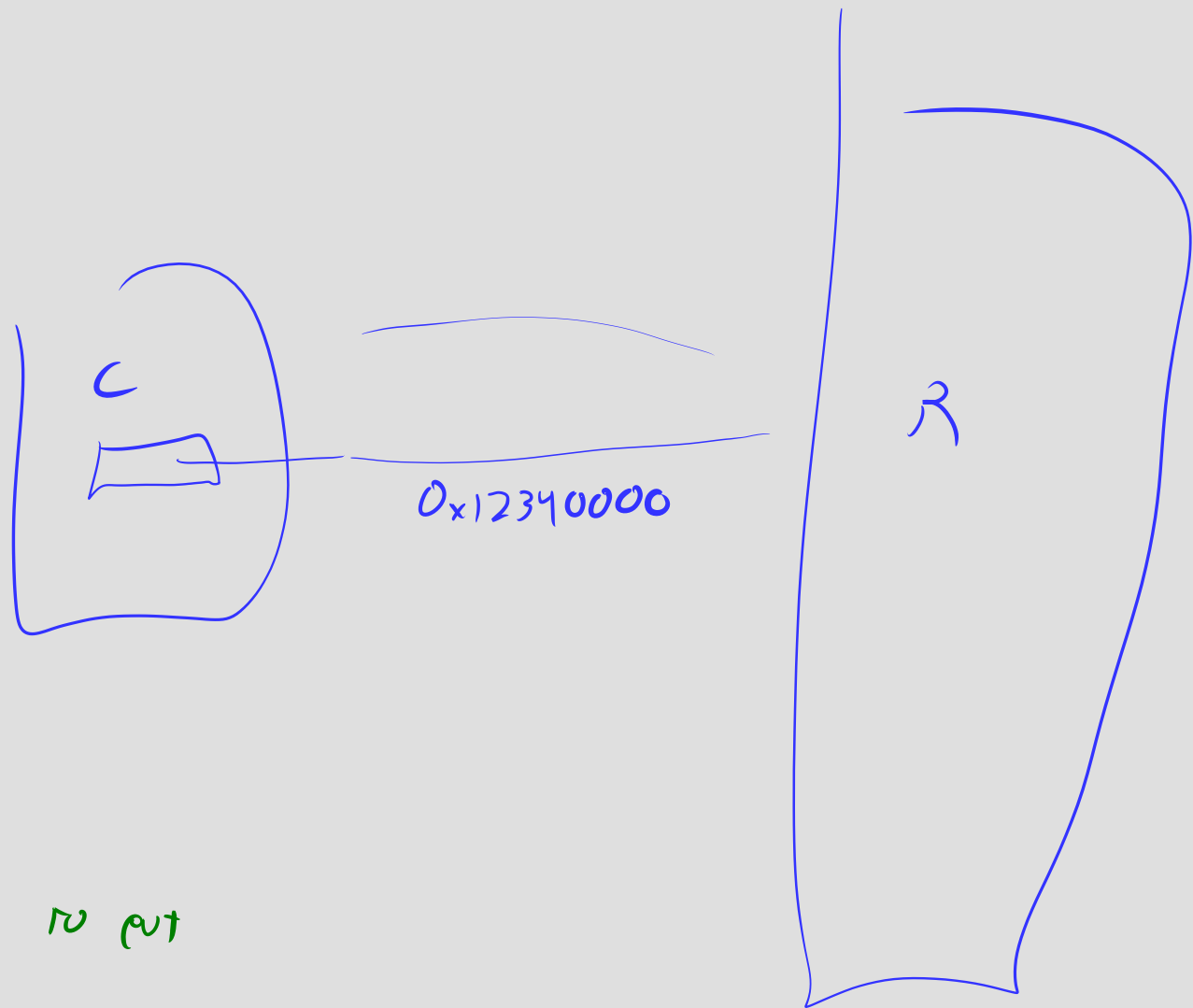
block

[ 0x12345678 ...  
0x1236000



Temoral

0x12340000  
→



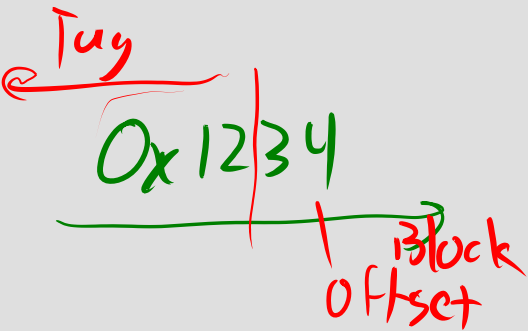
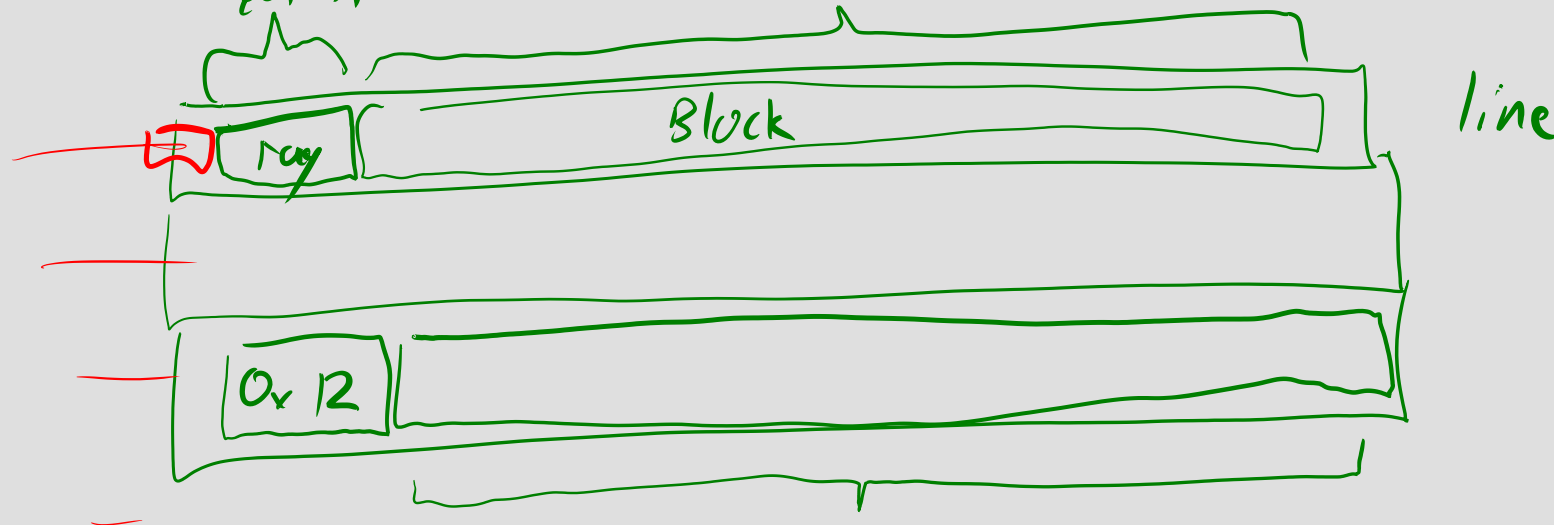
write  
eject - where to put



# Fully-associative Cache

where  
we  
get it

contents of RAM

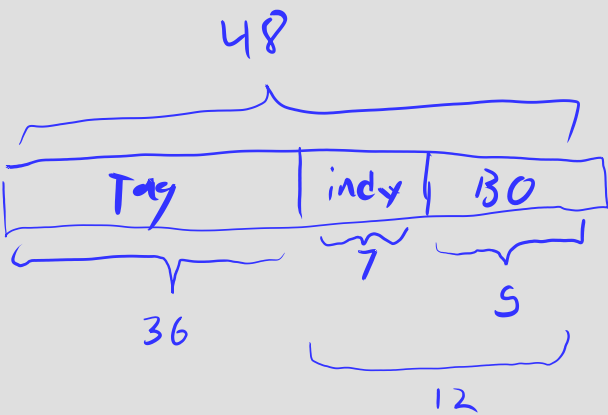


256 B  
1200 ... 12FF

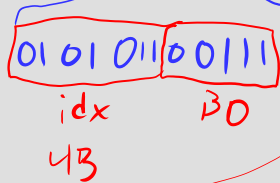
ever Least Recently Used

LRU

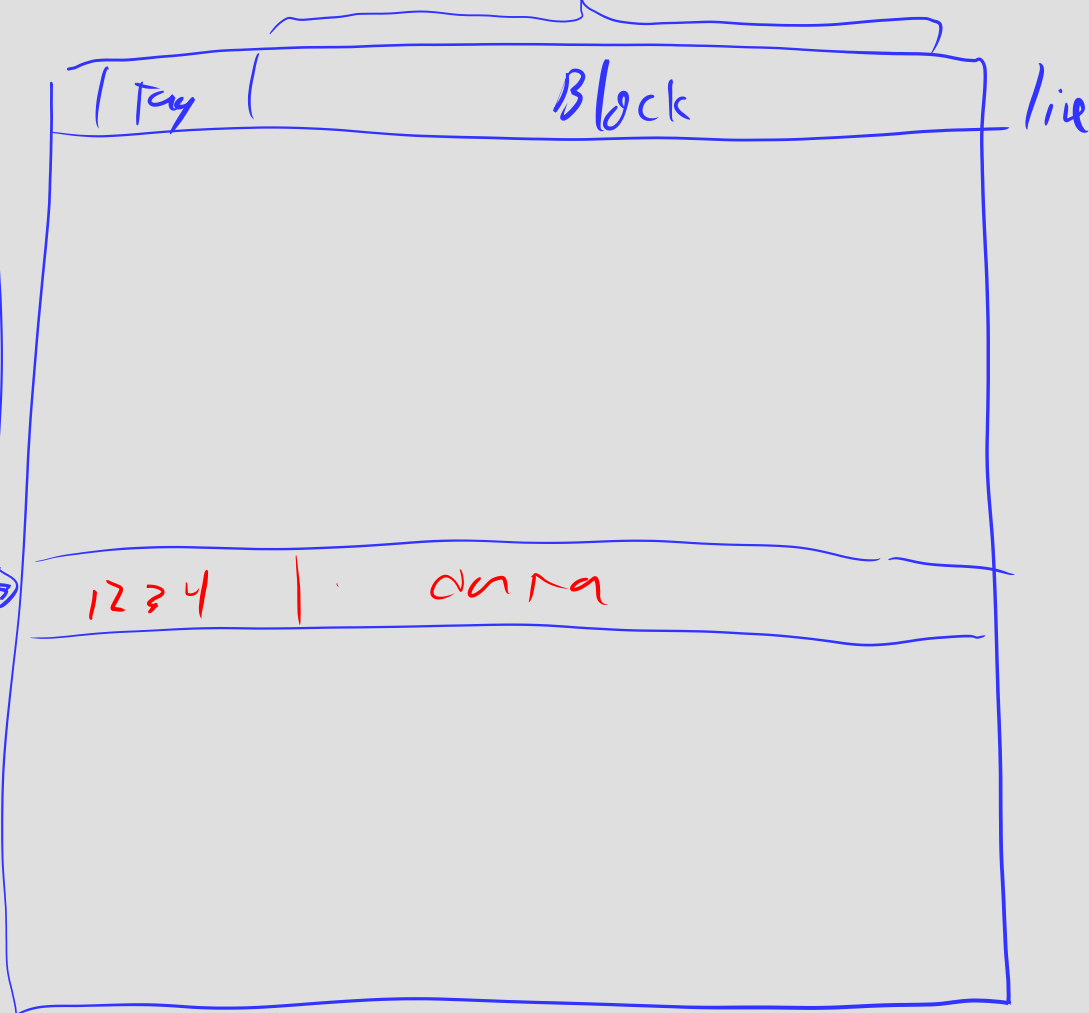
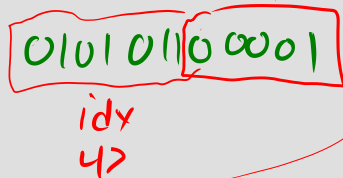
# Direct-mapped Cache



→ 0x1234567



0x1834561



$2^{12}$  B

4KB

128

idx

# Set-associative Cache

