External-memory model [Aggarwal & Vitter - CACM 1988]

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L14.4
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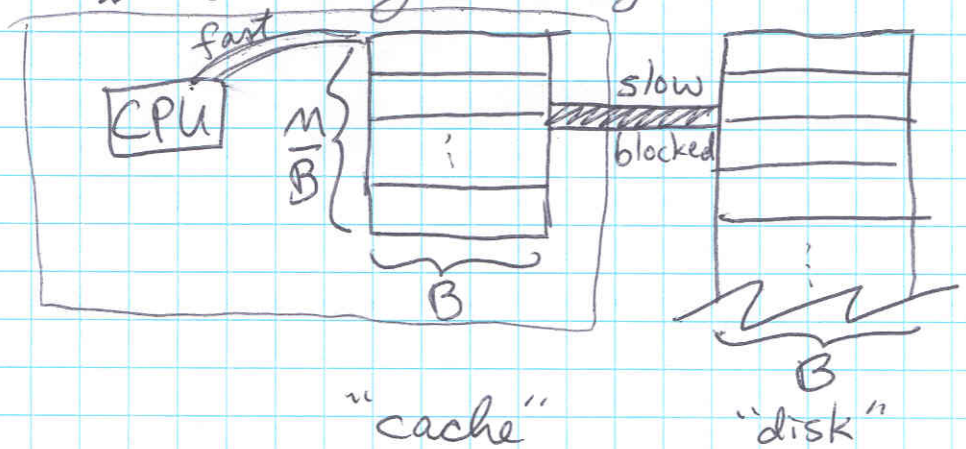
- two-level memory hierarchy



Charge for memory transfers between cache & disk.

Simple examples:

- scanning N elements in order costs $\lceil N/B \rceil$ memory transfers
- searching in a B-tree with branching factor B costs $O(\log_B N)$ memory transfers
  (& this is optimal — learn $\lg B$ bits/memory transfer — where fit in B)

Cache-oblivious model [Frigo, Leiserson, Prokop, Ramachandran - FOCS 1999]

- similar, but...
- algorithm/data structure doesn't know B or M (!)
- automatic block transfers triggered by element accesses
  - with optimal block-replacement strategy

Simple examples:

- scanning still $\leq \lceil N/B \rceil + 1$ memory transfers
- B-trees without knowing B?!

Why cache-oblivious?

- self-tuning
- multilevel memory hierarchies (but design for 2 levels)
- clean
- easy-to-use (program like a RAM)
- often possible!

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