# Review (1)

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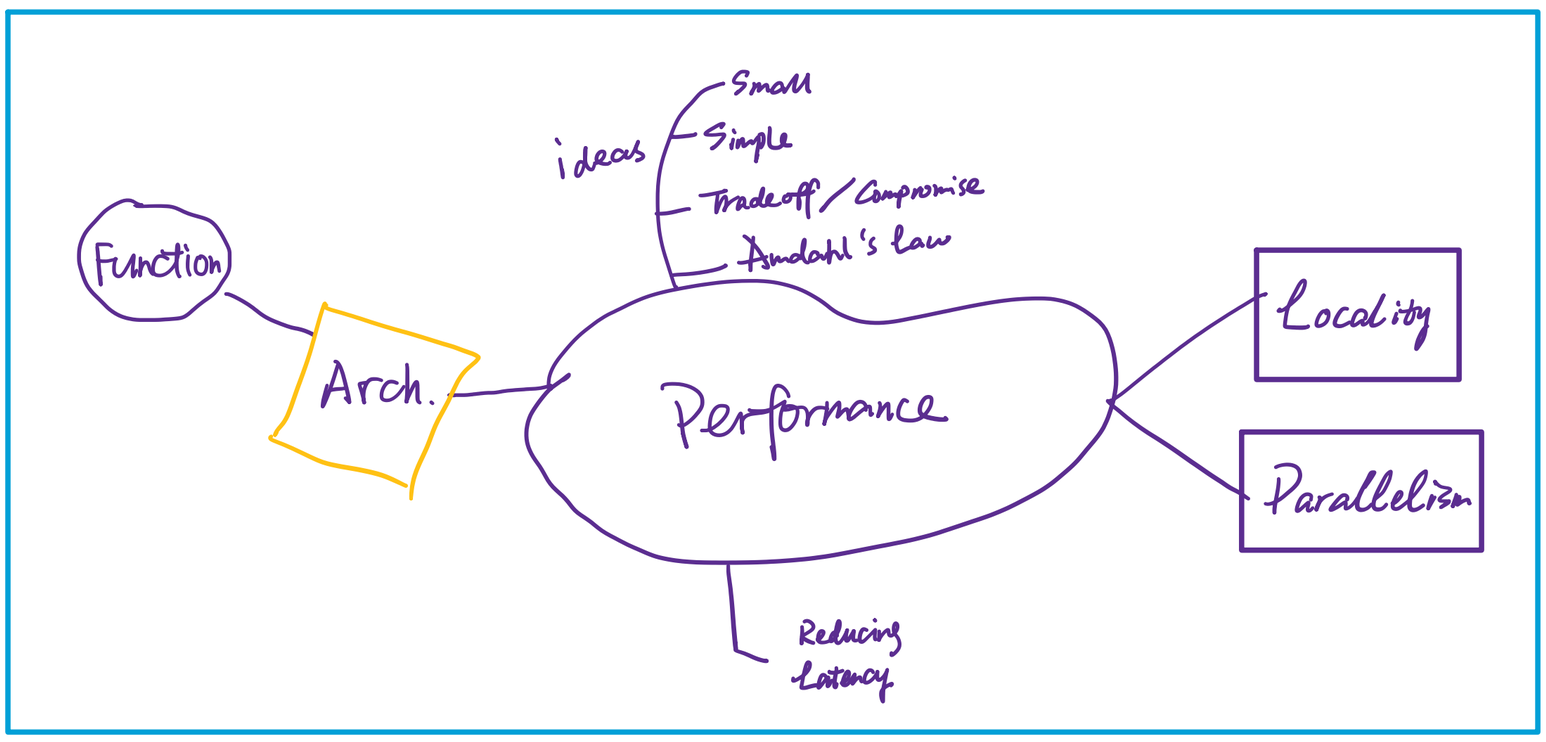
To assess an Architecture:

- Functions → Von Neumann.
- Performance.
  - Reduce Latency.
  - Parallelism
    - Pipeline
    - SuperScalar
  - Locality
    - Cache

Ideas:
- Small (fast)
- Simple (Simplify Inst Structure)
- Trade-off (don't go extreme)

Amdahl's Law: $S_p = \frac{1}{1-\eta+\frac{\eta}{s}}$

Make the most common faster.




< Main Structure >.

## Parallelism:

Pipeline (ILP).
(Instr)

Basic Principle:
- Balance (stage-stage).
- SpeedUp = N-Stages (Potential)

Hazard — Structural / Data / Control
- Stalls
- Distance

① Structural Hazard
e.g. Mem-Conflict
LD's 4th Stage (MEM)
$I_x$'s 1st Stage (IF).
Solution: I-Cache / D-Cache.
Duplicating.

② Data-Hazard
- True { Small Inst — forwarding; Large Inst — Out Of Order (Tomasulo).
- Pseudo. Renaming Regs.

③. Control Hazard.
- Early decision
- Prediction (Speculation)
- Calculate Target
- Delay Slot.
- KillBr

## Locality: Cache

$$AMAT = T_{hit} + \eta_{miss\ rate} \times T_{penalty}$$

Reduction Method
- Direct Mapping (it's fast!)
- Higher Associativity
- Mem.. Wider Bus / Multi Bank

## DM Cache Structure