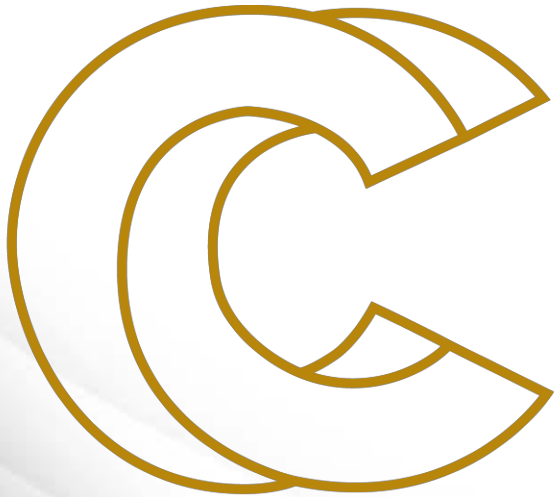
TÜBİTAK

Sabancı Üniversitesi



EURO^2

Performance Engineering on CPUs and GPUs:
- CPU and Memory: Things to be Careful for Performance -

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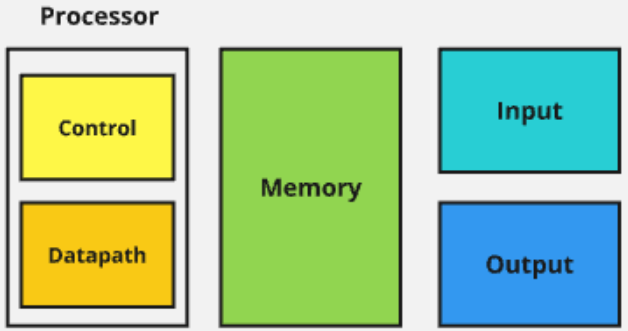
Introduction to Computers

- Conventional computers coarsely comprise of a **processor**, and a **memory system**.
  - Each of these components present significant performance bottlenecks.
- Computer = Processor + Memory system

  Processor = Control + Datapath
- Control can be considered as a finite state machine
- Datapath = Functional units (ALU, multipliers, dividers, etc.) +

  Registers (Program counters, shifters, storage) +

  Buses



Processor: Pipelining

- Pipelining overlaps various stages of instruction execution to achieve performance.

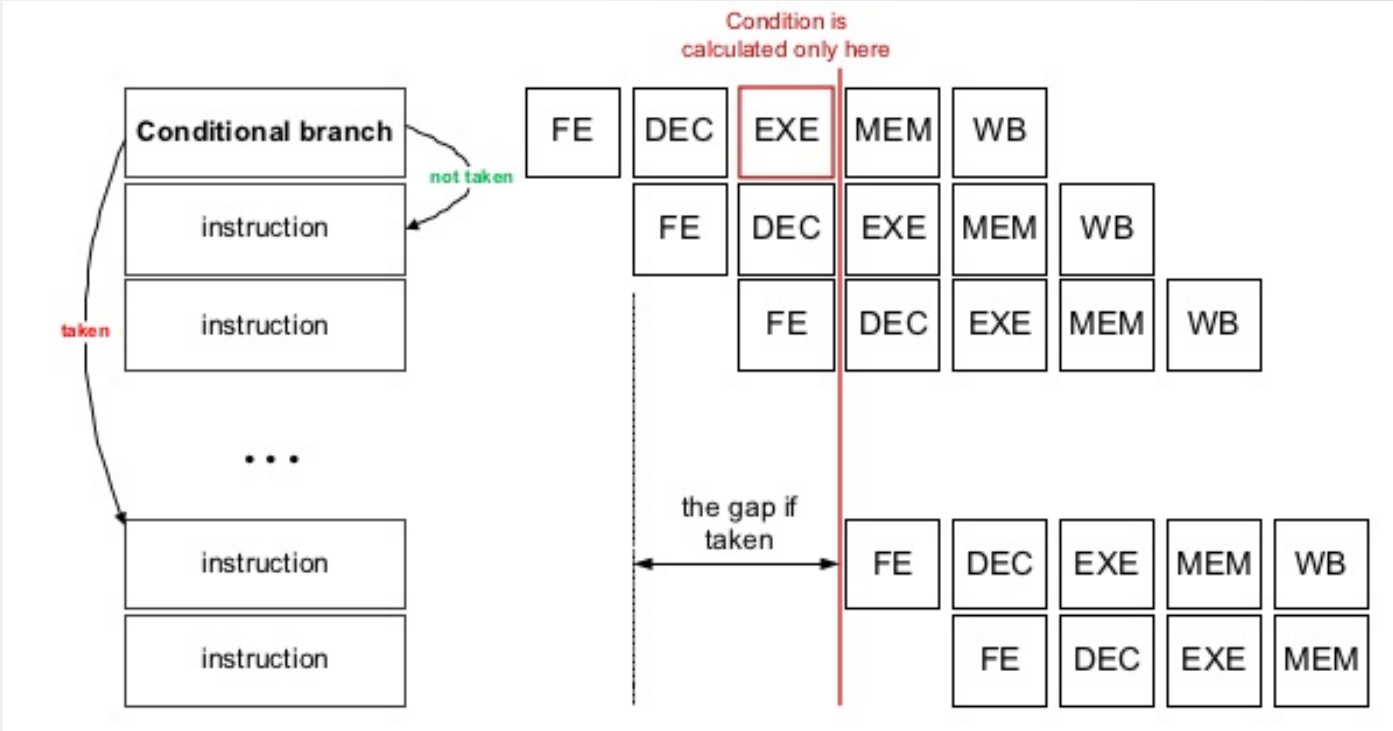
- At a high level of abstraction, an instruction can be executed while the next one is being decoded and the next one is being fetched.

Five stages of RISC pipeline

- **Fetch:** instruction is fetched from memory.
- **Decode:** we decode the instruction and fetch the source operands
- **Execute:** the computer performs the operation specified by the instruction
- **Memory:** if there is any data that needs to be accessed, it is done in the memory stage
- **Write:** if we need to store the result in the destination location, it is done during the writeback stage

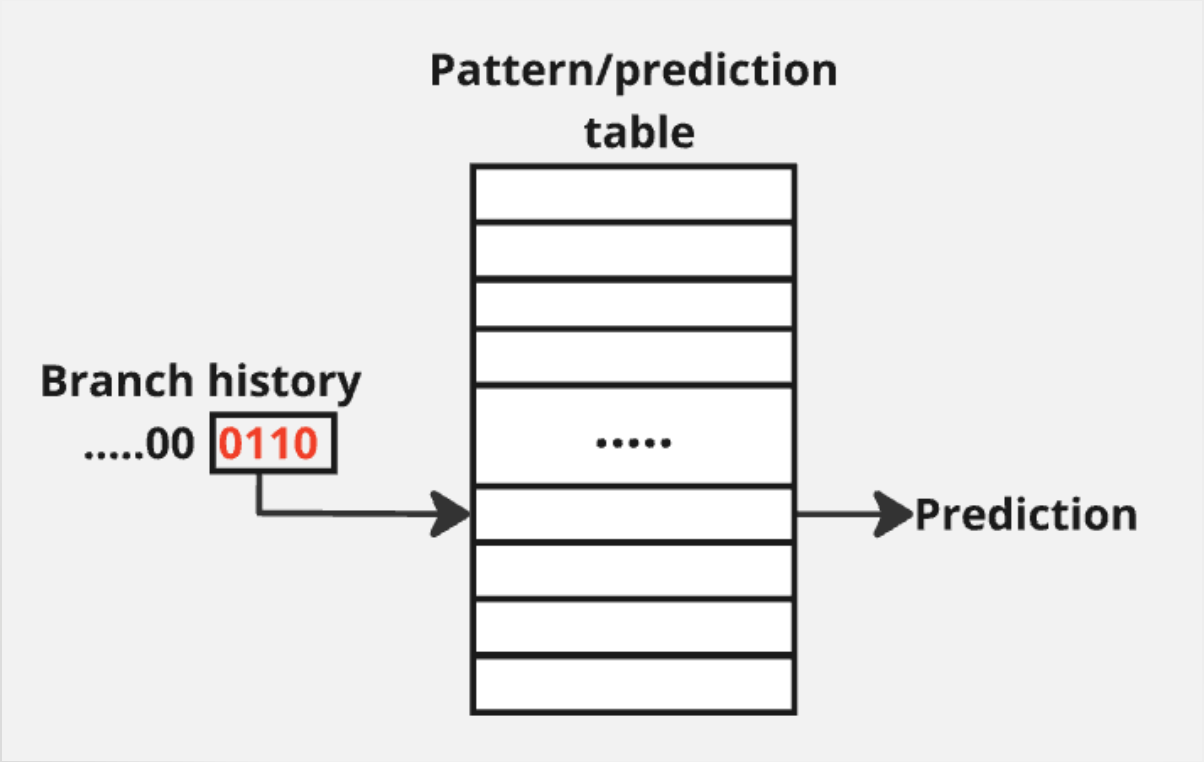
Processor: Branches

- In a typical program traces, every 5-6th instruction is a conditional jump! This requires very accurate branch prediction.



Processor: Branches

- A typical branch predictor



Processor: Branches

Let’s see some examples

Thanks

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