

# PROFILING WITH INTEL VTUNE

Background: CPU Architecture

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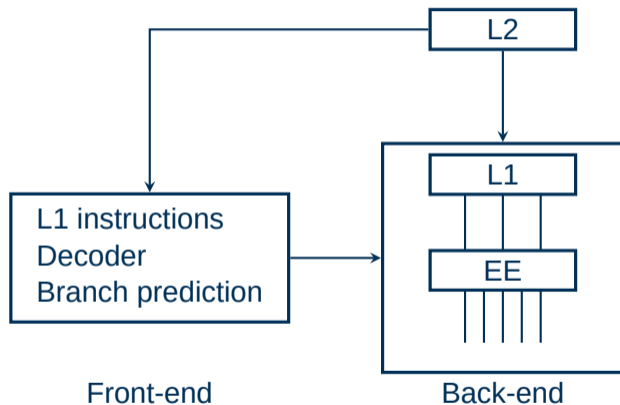
- VTune profile results often refer to CPU architecture concepts
- Overview of important concepts and terms
- The “Intel Optimization Reference Manual” is a very useful and detailed resource!

1. Front-end (instructions, predictions)
2. Back-end (caches, ports)
3. In-order and out-of-order execution
4. Retired instructions
5. (Hyper-)Threading
6. Vectorization (SIMD)

incomplete list

# SIMPLIFIED BLOCK DIAGRAM

Front-end



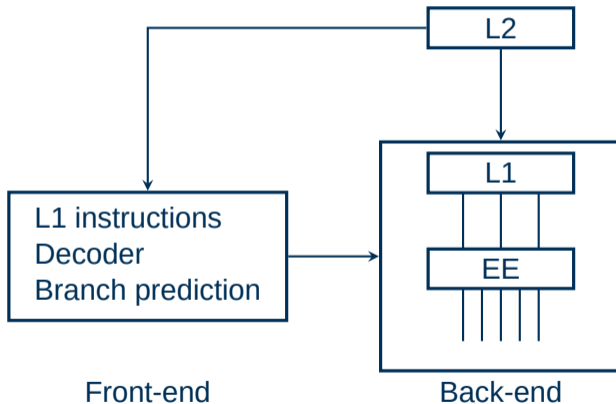
– Instruction cache



# SIMPLIFIED BLOCK DIAGRAM

## Back-end

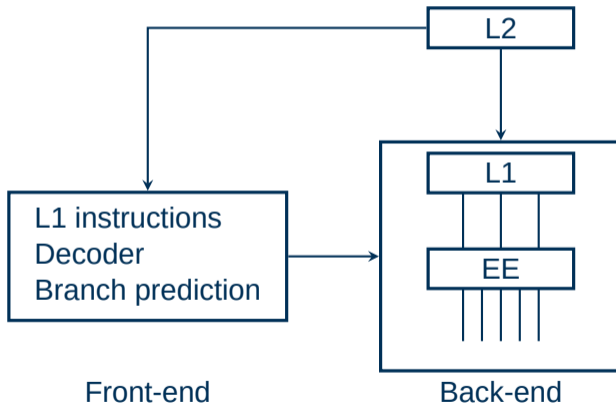
- Memory access
- “Out-of-order”:  
execution engine (EE)
- Multiple ports to  
available resources



# SIMPLIFIED BLOCK DIAGRAM

## Back-end

- Parallelism through pipeline, EE ports, decoders etc.
- Speculative execution, e.g. through branch prediction
- “Good” instructions are *retired*



- Each metric is affected by its own class of problems
  - ⇒ different approaches to resolve
    - Frequent branch reorders?
      - ⇒ improve predictability and speculative execution
    - Many cache misses?
      - ⇒ improve cache alignment of data and/or instructions
    - Poor utilization of CPU capabilities?
      - ⇒ look into ways for threading, vectorization and specialized instructions

- Special hardware counters to evaluate performance of CPU
- Count things like
  - Instruction Retired
  - Branch mis-predictions
  - UnHalted Core Cycles
  - Last Level Cache (LLC) misses
- Useful CPU metrics reference in the VTune user guide



- VTune profiling results are expressed in these terms!
- Have a rough understanding of CPU features and operation
- Read up on details as soon as you hit a real-world problem