Relevant Formulae: Caches

Nomenclature Note

- Line == Set == Row
- Ratio == Rate

Cache Information

- Blocksize = $2^{\text{\# Bits in Offset}}$
- \# Sets = $2^{\text{\# Bits in Index}}$

- \# Entries = Cache Size (without metadata) / Blocksize
- \# Bits in Address = \# Bits in Tag + \# Bits in Index + \# Bits in Offset

- Cache Size (without metadata) = \# Sets • Associativity • Blocksize in bits
- Cache Size (with metadata) = \# Sets • Associativity • (Blocksize in bits + Valid Bit + \# Bits in Tag)

- Hit Ratio = \# Hits / (\# Hits + \# Misses)
- Miss Ratio = 1 - Hit Ratio
- Average Memory Access Time = Hit Time + Miss Ratio * Miss Penalty

For Access

- BlockID = Address // Blocksize
- Set = BlockID % \# Set
- Tag = BlockID // \# Set

Cache Access

- Hit = Same Set; Same Block
- Miss = Block empty
- Miss & Evict = Same Set; Different Block

Relevant Formulae: Virtual Memory

Information

- Page Size = $2^{\text{\# Bits in offset}}$
- Offset = Address % Page Size

- Virtual Memory Size = $2^{\text{\# Bits in Virtual Address}}$
- Physical Memory Size = $2^{\text{\# Bits in Physical Address}}$

- \# Virtual Pages = Virtual Memory Size / Page Size
- \# Physical Pages = Physical Memory Size / Page Size

For Access

- Virtual Page Number = Address // Page Size
- Physical Page Number = Look up from the page table

- Physical Address = PPN • Page Size + Offset
- \# Bits in PPN = Physical Address Size - Offset

- \# Entries = \# Virtual Pages
- Page Table Entry Size = Valid Bit + Dirty Bit + Protect Bit + \# Bits in PPN
- Page Table Size = \# Entries • Page Table Entry Size

Useful Conversions

- 1 Byte = 8 bits
- 1 MB = 2^{20} Bytes
- 1 GB = 2^{30} Bytes