

# Homework Assignment 4 of Computer Architecture

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1

(a)

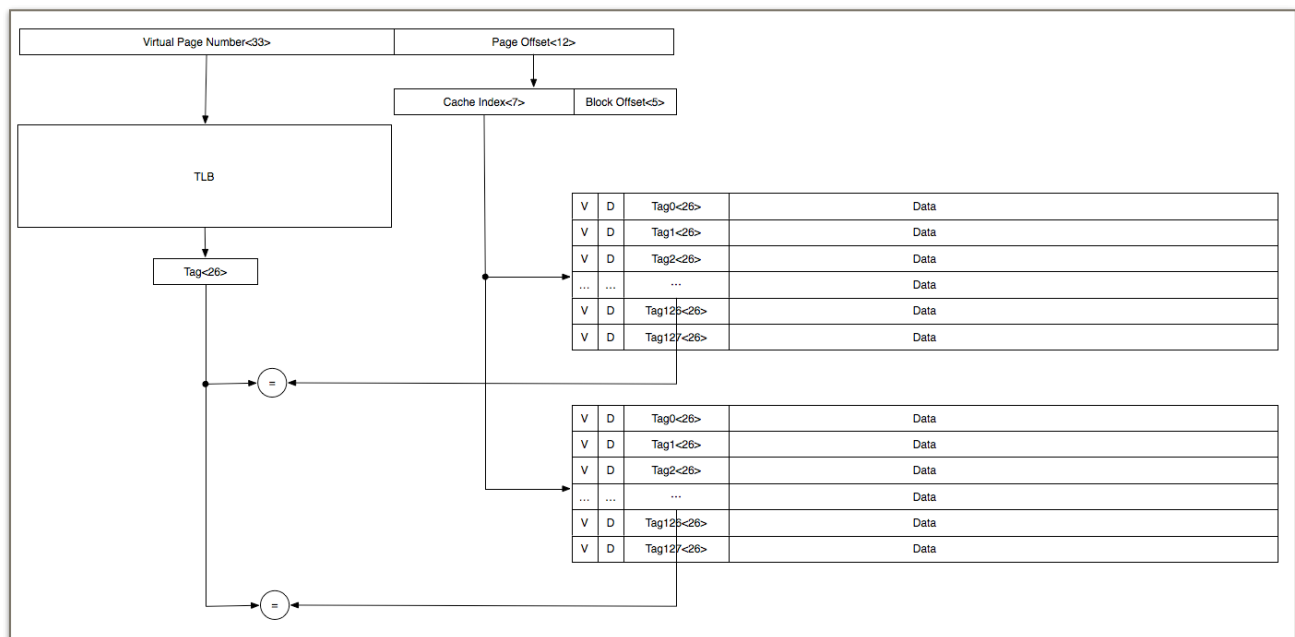
Block size is 32 Bytes, that means offset is 5 bits, cache is 2-way, so each part is 4KB, each 128 blocks, so the index is 7 bits, tag =  $38-5-7=26$ bits, so:

tag = 26 bits; index = 7 bits; offset = 5 bits;

(b)

V	D	Tag	Data
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(c)



(d)

The Virtual page part is used to find proper tag in TLB, and the index part of the virtual address is used to find tag and data in cache, then the two parts compare, if one of the tag in the cache is the same with the proper tag, and data is valid, then the data is what we want.

2

machine A:

$$8 + 0.08 \times 50 \text{ ns} = 12 \text{ ns}$$

machine B:

$$2 + 0.15 \times (20 + 0.1 \times 50) \text{ ns} = 5.75 \text{ ns}$$

So the machine B is the better.

3

The original CPI:

$$1 + 0.025 \times 80 + 0.3 \times 0.035 \times 80 = 3.84$$

Purchase A:

$$0.5 + 0.025 \times 80 + 0.3 \times 0.035 \times 80 = 3.34$$

Purchase B:

$$1 + 0.025 \times 0.6 \times 80 + 0.3 \times 0.035 \times 0.6 \times 80 = 2.704$$

So Purchase B.

4

(a)

L1 access : 0

L1 miss rate 2%

L2 access time : 15 ns

L2 transfer time :

$$32 \times 8 / 128 / (266 \times 10^6) = 7.52 \text{ ns}$$

L2 miss rate 20%

dirty rate 50%

memory access time 60 ns

memory transfer time:

$$64 \times 8 / 128 / (133 \times 10^6) = 30 \text{ ns}$$

total

$$2\% \times (15 + 7.52 + 20\% \times (60 + 30) + 20\% \times 50\% \times (60 + 30)) = 0.9904 \text{ ns}$$

(b)

L1 access : 0

L1 miss rate 5%

L2 access time : 15 ns

L2 transfer time :

$$16 \times 8 / 128 / (266 \times 10^6) = 3.76 \text{ ns}$$

L2 miss rate 20%

dirty rate 50%

memory access time 60 ns

memory transfer time:

$$64 \times 8 / 128 / (133 \times 10^6) = 30 \text{ ns}$$

total

$$5\% \times (15 + 3.76 + 20\% \times (60 + 30) + 20\% \times 50\% \times (60 + 30)) = 2.288 \text{ ns}$$

(c)

L1 access : 0

stall 5%

L2 access time : 15 ns

L2 transfer time :

$$16 \times 8 / 128 / (266 \times 10^6) = 3.76 \text{ ns}$$

L2 miss rate 20% (write back)

dirty rate 50%

memory access time 60 ns

memory transfer time:

$$64 \times 8 / 128 / (133 \times 10^6) = 30 \text{ ns}$$

total

$$5\% \times (15 + 3.76 + 20\% \times (60 + 30) + 20\% \times 50\% \times (60 + 30)) = 2.288 \text{ ns}$$

(d)

$$\text{cycle} = 1 / (1.1 \times 10^9) = 0.91 \text{ ns}$$

$$\text{CPI} = 0.7 + 0.9904 / 0.91 + 0.2 \times 2.29 / 0.91 + 5\% \times 2.29 / 0.91 = 2.43$$

(e)

$$\text{cycle} = 1/(2.1 \times 10^9) = 0.476$$

$$\text{CPI} = 0.7 + 0.9904/0.476 + 0.2 \times 2.29/0.476 + 5\% \times 2.29/0.476 = 3.98$$

$$\text{speedup} = (2.43 \times 0.91)/(3.98 \times 0.476) = 1.167$$

1.167 times faster