Computer Architecture - Homework #4

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5.8

5.8.1 [10] <§§5.4, 5.8>

(1) miss rate = 6.25%

(2) The miss rate doesn't change with the size of the cache or the working set.

(3) These misses are compulsory misses based only on the access pattern and the block size.

5.8.2 [5] <§§5.1, 5.8>

(1) 16 bytes: 12.5%/64 bytes: 3.125%/128 bytes: 1.5625%

(2) This workload exploits spatial locality.

5.8.3 [10] <§5.13>

The miss rate will be near 0%.

5.13

5.13.1 [5] <§5.5>

MTBF = MTTF + MTTR = 3 years + 1 day = 1096 days#

5.13.2 [5] <§5.5>

$$Availability = \frac{MTTF}{MTTF + MTTR} = \frac{1095\ days}{1095\ days + 1\ day} = 99.91\%\#$$

5.13.3 [5] <§5.5>

$$Availability = \frac{MTTF}{MTTF + MTTR} \approx \frac{3\ years}{3\ years + 0} \approx 100\,\%$$, if MTTR approaches 0.

No. Despite the fact that people try their best to make MTTR as close to zero as possible by switching in redundant components for failed components as fast as it can, a failure might not be observable at all by a client of the service. If it's not observable by the client, it is impossible to happen in some sense.

5.13.4 [5] <§5.5>

$$Availability = \frac{MTTF}{MTTF + MTTR} \approx \frac{3\ years}{3\ years + \infty} \approx 0$$, if MTTR is very high.

Yes, the device might have very low availability.

5.16

5.16.1 [10] <§5.7>

0x123d (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xb	12	5
1	0x7	4	2
1	0x3	6	4
1	0x1	13	1

0x08b3 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	1
1	0x7	4	3
1	0x3	6	5
1	0x1	13	2

0x365c (hit in the TLB/don’t care in the page table/don’t care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	2
1	0x7	4	4
1	0x3	6	1
1	0x1	13	3

0x871b (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	3
1	0x8	14	1
1	0x3	6	2
1	0x1	13	4

0xbee6 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	4
1	0x8	14	2

1	0x3	6	3
1	0xb	12	1

0x3140 (hit in the TLB/don’t care in the page table/don’t care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	5
1	0x8	14	3
1	0x3	6	1
1	0xb	12	2

0xc049 (miss in the TLB/miss in the page table)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xc	15	1
1	0x8	14	4
1	0x3	6	2
1	0xb	12	3

5.16.2 [15] <§5.7>

0x123d (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xb	12	5
1	0x7	4	2
1	0x3	6	4
1	0x0	5	1

0x08b3 (hit in the TLB/don’t care in the page table/don’t care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xb	12	6
1	0x7	4	3
1	0x3	6	5
1	0x0	5	1

0x365c (hit in the TLB/don’t care in the page table/don’t care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access

1	0xb	12	7
1	0x7	4	4
1	0x3	6	6
1	0x0	5	1

0x871b (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x2	13	1
1	0x7	4	5
1	0x3	6	7
1	0x0	5	2

0xbee6 (hit in the TLB/don't care in the page table/don't care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x2	13	1
1	0x7	4	6
1	0x3	6	8
1	0x0	5	3

0x3140 (hit in the TLB/don't care in the page table/don't care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x2	13	2
1	0x7	4	7
1	0x3	6	9
1	0x0	5	1

0xc049 (hit in the TLB/don't care in the page table/don't care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x2	13	3
1	0x7	4	8
1	0x3	6	1
1	0x0	5	2

The advantages of having a larger page size are less page faults and smaller page tables.

The disadvantages are more fragment, longer disk transfer and more page faults if no locality.

5.16.3 [15] <§5.7>

0x123d (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xb	12	5
1	0x7	4	2
1	0x3	6	4
1	0x1	13	1

0x08b3 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	1
1	0x7	4	3
1	0x3	6	5
1	0x1	13	2

0x365c (hit in the TLB/don’t care in the page table/don’t care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	2
1	0x7	4	4
1	0x3	6	1
1	0x1	13	3

0x871b (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	3
1	0x8	14	1
1	0x3	6	2
1	0x1	13	4

0xbee6 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	4
1	0x8	14	2
1	0x3	6	3

1	0xb	12	1

0x3140 (hit in the TLB/don't care in the page table/don't care page fault or not)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	5
1	0x8	14	3
1	0x3	6	1
1	0xb	12	2

0xc049 (miss in the TLB/miss in the page table)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xc	15	1
1	0x8	14	4
1	0x3	6	2
1	0xb	12	3

5.16.4 [15] <§5.7>

0x123d (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0xb	12	5
1	0x1	13	1
1	0x3	6	4
1	0x4	9	8

0x08b3 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	1
1	0x1	13	2
1	0x3	6	5
1	0x4	9	9

0x365c (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x0	5	2

1	0x1	13	**3**
1	0x3	6	**6**
1	**0x3**	**6**	**1**

0x871b (miss in the TLB/hit in the page table/page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	**0x8**	**14**	**1**
1	0x1	13	**4**
1	0x3	6	**7**
1	0x3	6	**2**

0xbee6 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x8	14	**2**
1	0x1	13	**5**
1	0x3	6	**8**
1	**0xb**	**12**	**1**

0x3140 (miss in the TLB/hit in the page table/not page fault)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	0x8	14	**3**
1	0x1	13	**6**
1	0x3	6	**9**
1	**0x3**	**6**	**1**

0xc049 (miss in the TLB/miss in the page table)

Valid	Tag	Physical Page Number	TIme Since Last Access
1	**0xc**	**15**	**1**
1	0x1	13	**7**
1	0x3	6	**10**
1	0x3	6	**2**

5.16.5 [10] <§§5.4, 5.7>

Because TLB helps maintain a smaller cache which contains addresses recently used, it can make it faster to search and translate virtual page number to physical page number. Therefore,

CPU performs better. If there were no TLB, each memory lookup needs to go through the page table whose size is much bigger than the size of TLB, and then leads to longer memory access time.

5.23

5.23 [10] <§5.6>

The difficulty involved in this kind of virtualization is the time to transfer the commands. Seeing that the commands for guest OS are different from the commands for host, it needs emulator to transfer the commands and deliver them to run on the host. Thus, it's difficult to run faster on non-native ISA than on native ISA.

5.27

5.27.1 [5] <§5.15>

(1) `srcIP` and `refTime` fields will be accessed for the given log processing function.

(2) The given function incurs two cache misses per entry on average.

5.27.2 [5] <§5.15>

Make a new structure only contain `srcIP` and `refTime` fields.

5.27.3 [10] <§5.15>

```
peak_status (int srcIP);  //peak the status of a given srcIP
```

Make a new structure contain `srcIP`, `refTime` and `status`.