Bilgisayar Donanımı

2. ÖDEV

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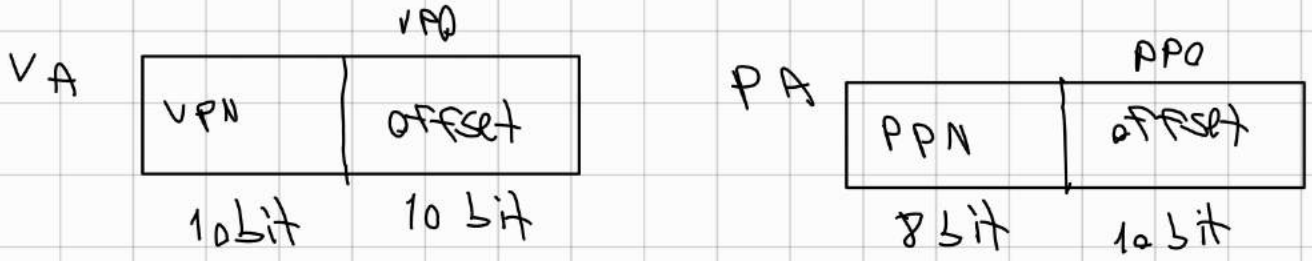
Soru 1

Page → 1 kB offset genişliği = $\log_2 2^{10} = 10$ bit

$1kB = 2^{10}$ Byte



satır sayısı = 512 word / 8 set x 8 word/set = 8

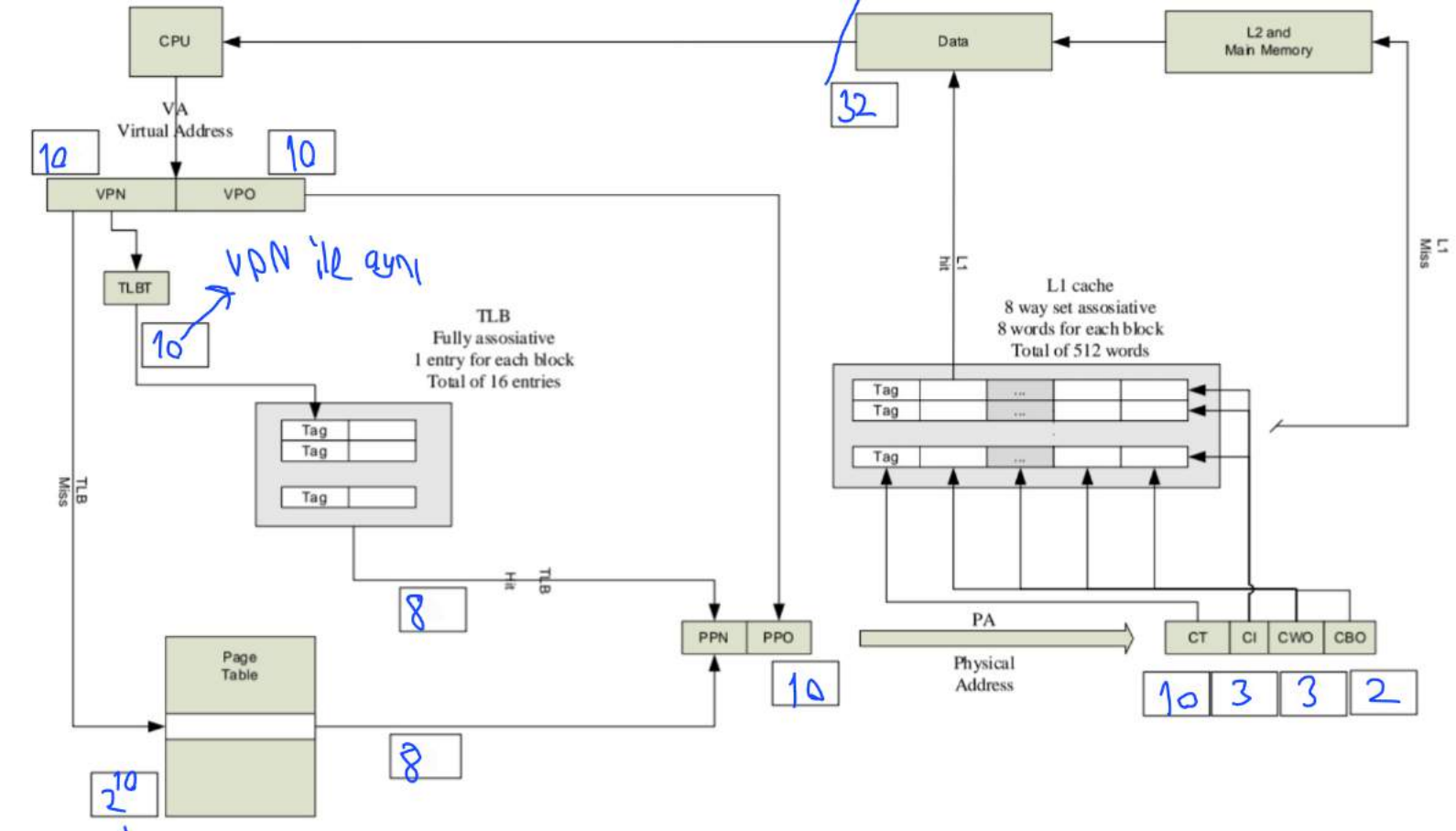
cache index = $\log_2 8 = 3$ bit

cache byte offset = 32/8 = 4 ⇒ $\log_2 4 = 2$ bit

cache word offset = her blokta 8 word → $\log_2 8 = 3$ bit

cache tag = 18 − 2 − 3 − 3 = 10 bit

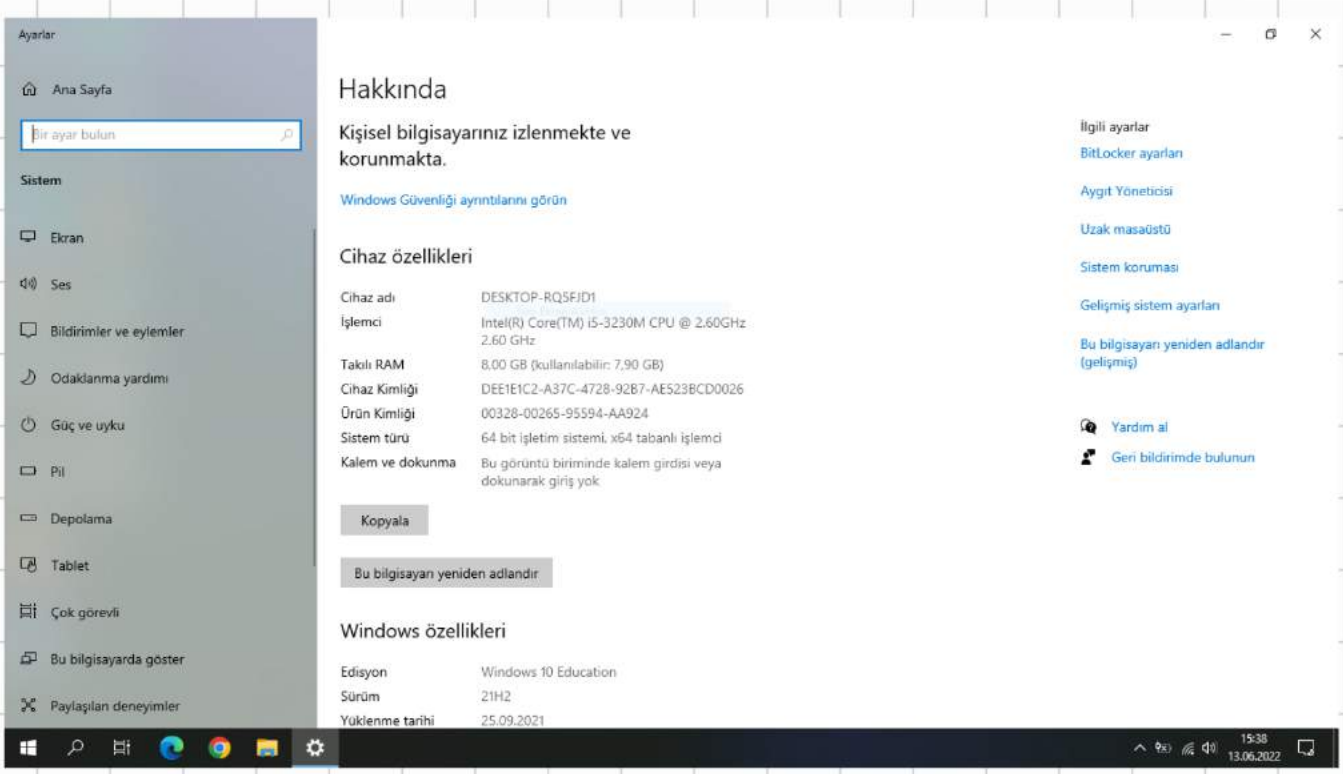
veri yolu genişliği 32 bit olduğu için



VPN 10 bit
olduğu için

Soru 2

İşletim Tipi:



Cache detayları:

Cache details				
Cache:	L1 data	L1 instruction	L2	L3
Size:	2 x 32 KB	2 x 32 KB	2 x 256 KB	3 MB
Associativity:	8-way set associative	8-way set associative	8-way set associative	12-way set associative
Line size:	64 bytes	64 bytes	64 bytes	64 bytes
Comments:	Direct-mapped	Direct-mapped	Non-inclusive Direct-mapped	Inclusive Shared between all cores

line size 64 B / 8 B(double size) = her line'da 8 adet değer var.

Cache size: $\frac{64\ kB}{64\ B} = 2^{10}$ satır.

Line size: 64 B

Case1:

dimension = 256

ijk formu

PC çıktısı:

```
secs:1.798717
==74==
==74== I   refs:      783,287,031
==74== I1  misses:          1,444
==74== LLi misses:          1,414
==74== I1  miss rate:        0.00%
==74== LLi miss rate:        0.00%
==74==
==74== D   refs:      306,628,504  (288,656,908 rd   + 17,971,596 wr)
==74== D1  misses:     16,894,159  ( 16,868,936 rd   +     25,223 wr)
==74== LLd misses:         26,480  (      1,311 rd   +     25,169 wr)
==74== D1  miss rate:         5.5% (        5.8%     +        0.1%  )
==74== LLd miss rate:         0.0% (        0.0%     +        0.1%  )
==74==
==74== LL refs:        16,895,603  ( 16,870,380 rd   +     25,223 wr)
==74== LL misses:          27,894  (      2,725 rd   +     25,169 wr)
==74== LL miss rate:          0.0% (        0.0%     +        0.1%  )
```

Çözüm:

$\frac{\text{dimension}}{\text{8 adet değer}} = \frac{2^8}{2^3} = 2^5$ = her 8 iterasyonda bir miss yapması durumu

C → her iç loopda miss oranı 0

$$miss = 2^8 \cdot 2^5 = 2^{13}$$

A → her iç loopda miss oranı 12,5

$$miss = 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$$

B → her iç loopda miss oranı 100

$$miss = 2^8 \cdot 2^5 \cdot 2^8 = 2^{21}$$

$$\text{Total miss rate} = \frac{2^{21} + 2^{18} + 2^{13}}{3 \cdot (2^8 \cdot 2^8 \cdot 2^8)} = 0,047 \rightarrow \%4,7 \quad //$$

Case 2:

dimension = 256

iki formu

PC çıktısı:

```
secs:1.408654
==103==
==103== I   refs:      783,287,031
==103== I1  misses:          1,444
==103== LLi misses:          1,414
==103== I1  miss rate:        0.00%
==103== LLi miss rate:        0.00%
==103==
==103== D   refs:      306,628,504  (288,656,908 rd   + 17,971,596 wr)
==103== D1  misses:      2,140,623  (  2,115,400 rd   +     25,223 wr)
==103== LLd misses:         26,480  (      1,311 rd   +     25,169 wr)
==103== D1  miss rate:         0.7% (        0.7%     +        0.1%  )
==103== LLd miss rate:         0.0% (        0.0%     +        0.1%  )
==103==
==103== LL refs:         2,142,067  (  2,116,844 rd   +     25,223 wr)
==103== LL misses:          27,894  (      2,725 rd   +     25,169 wr)
==103== LL miss rate:          0.0% (        0.0%     +        0.1%  )
```

Çözüm:

dimension 2^8 2^5

8 adet değer $\frac{2}{2^3} = 2$ = her 8 iterasyonda bir miss sapması oluyor

→ her i'ye loopda miss oranı 12.5

$$miss = 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$$

A → her i'ye loopda miss oranı 0

$$miss = 2^8 \cdot 2^5 = 2^{13}$$

B → her i'ye loopda miss oranı 12.5

$$miss = 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$$

$$\text{total miss rate} = \frac{2^{18} + 2^{18} + 2^{13}}{3 \cdot (2^8 \cdot 2^8 \cdot 2^8)} = 0,0105 \rightarrow \%\ 1,05 //$$

Case 3:

dimension = 256

jik formu

PC çıktısı:

```
secs:1.553624
==104==
==104== I   refs:      783,287,013
==104== I1  misses:          1,441
==104== LLi misses:          1,411
==104== I1  miss rate:        0.00%
==104== LLi miss rate:        0.00%
==104==
==104== D   refs:      306,628,498  (288,656,903 rd   + 17,971,595 wr)
==104== D1  misses:     18,966,989  ( 18,941,766 rd   +     25,223 wr)
==104== LLd misses:         26,480  (      1,311 rd   +     25,169 wr)
==104== D1  miss rate:         6.2% (        6.6%     +        0.1%  )
==104== LLd miss rate:         0.0% (        0.0%     +        0.1%  )
==104==
==104== LL refs:        18,968,430  ( 18,943,207 rd   +     25,223 wr)
==104== LL misses:          27,891  (      2,722 rd   +     25,169 wr)
==104== LL miss rate:          0.0% (        0.0%     +        0.1%  )
```

Çözüm:

$\frac{\text{dimension}}{\text{8 adet değer}} = \frac{2^8}{2^3} = 2^5$ = her 8 iterasyonda bir miss yapması durumu

C → her iç loopda miss oranı 12,5

$miss = 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$

A → her iç loopda miss oranı 12,5

$miss = 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$

B → her iç loopda miss oranı 100

$miss = 2^8 \cdot 2^5 \cdot 2^8 = 2^{21}$

$\text{total miss rate} = \frac{2^{18} + 2^{18} + 2^{21}}{3 \cdot (2^8 \cdot 2^8 \cdot 2^8)} = 0,052 \rightarrow \%\ 5,2$ //

Case 4:

dimension = 64

ijk formu

Pc çıktısı:

```
secs:0.060006
==91==
==91== I   refs:      12,914,365
==91== I1  misses:         1,459
==91== LLi misses:         1,427
==91== I1  miss rate:       0.01%
==91== LLi miss rate:       0.01%
==91==
==91== D   refs:       5,054,662  (4,704,477 rd   + 350,185 wr)
==91== D1  misses:        52,698  (   50,499 rd   +   2,199 wr)
==91== LLd misses:         3,441  (    1,311 rd   +   2,130 wr)
==91== D1  miss rate:        1.0% (      1.1%     +     0.6%  )
==91== LLd miss rate:        0.1% (      0.0%     +     0.6%  )
==91==
==91== LL refs:           54,157  (   51,958 rd   +   2,199 wr)
```

```
==91== LL misses:          4,868  (     2,738 rd   +     2,130 wr)
==91== LL miss rate:         0.0% (       0.0%     +       0.6%  )
```

Çözüm:

$\frac{\text{dimension}}{\text{8 adet değer}} = \frac{2^6}{2^3} = 2^3 =$ her 8 iterasyonda bir miss yapması durumu

C → her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

A → her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

B → her iç loopda miss oranı 12,5

$miss = 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{8} = 2^{12}$

$\text{total miss rate} = \frac{2^9 + 2^9 + 2^{12}}{3 \cdot (2^6 \cdot 2^6 \cdot 2^6)} = 0,0005 \rightarrow \%0,05$ //

Case 5:

dimension = 64

ikj formu

PC çıktısı:

```
secs:0.070269
==92==
==92== I   refs:      12,914,365
==92== I1  misses:         1,459
==92== LLi misses:         1,427
==92== I1  miss rate:       0.01%
==92== LLi miss rate:       0.01%
==92==
```

```
==92== D   refs:       5,054,662  (4,704,477 rd   + 350,185 wr)
==92== D1  misses:        14,259  (    12,060 rd   +   2,199 wr)
==92== LLd misses:         3,441  (     1,311 rd   +   2,130 wr)
==92== D1  miss rate:        0.3% (       0.3%     +     0.6%  )
==92== LLd miss rate:        0.1% (       0.0%     +     0.6%  )
==92==
==92== LL refs:           15,718  (    13,519 rd   +   2,199 wr)
==92== LL misses:          4,868  (     2,738 rd   +   2,130 wr)
==92== LL miss rate:         0.0% (       0.0%     +     0.6%  )
```

Çözüm:

$\frac{\text{dimension}}{\text{8 adet değer}} = \frac{2^6}{2^3} = 2^3$ = her 8 iterasyonda bir miss yapması durumu

→ her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

A → her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

B → her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

$\text{Total miss rate} = \frac{2^9 + 2^9 + 2^9}{3 \cdot (2^6 \cdot 2^6 \cdot 2^6)} = 0,010 \rightarrow \%\,0,19$ //

Case 6:

dimension = 64

jik formu

PC çıktısı:

```
secs:0.073944
```

```
==93==
==93== I   refs:      12,914,358
==93== I1  misses:         1,457
==93== LLi misses:         1,425
==93== I1  miss rate:       0.01%
==93== LLi miss rate:       0.01%
==93==
==93== D   refs:       5,054,660  (4,704,476 rd   + 350,184 wr)
==93== D1  misses:        76,868  (   74,669 rd   +   2,199 wr)
==93== LLd misses:         3,441  (    1,311 rd   +   2,130 wr)
==93== D1  miss rate:        1.5% (      1.6%     +     0.6%  )
==93== LLd miss rate:        0.1% (      0.0%     +     0.6%  )
==93==
==93== LL refs:           78,325  (   76,126 rd   +   2,199 wr)
==93== LL misses:          4,866  (    2,736 rd   +   2,130 wr)
==93== LL miss rate:         0.0% (      0.0%     +     0.6%  )
```

Çözüm:

$\frac{\text{dimension}}{\text{8 adet değer}} = \frac{2^6}{2^3} = 2^3 =$ her 8 iterasyonda bir miss yapması durumu

C → her iç loopda miss oranı 12,5

$miss = 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{8} = 2^{12}$

A → her iç loopda miss oranı 0

$miss = 2^6 \cdot 2^3 = 2^9$

B → her iç loopda miss oranı 12,5

$miss = 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{8} = 2^{12}$

$\text{Total miss rate} = \frac{2^{12} + 2^9 + 2^{12}}{3 \cdot (2^6 \cdot 2^6 \cdot 2^6)} = 0,011 \rightarrow \%1,1$ //