



**YILDIZ TEKNİK ÜNİVERSİTESİ
ELEKTRİK-ELEKTRONİK FAKÜLTESİ
BİLGİSAYAR MÜHENDİSLİĞİ BÖLÜMÜ**

BLM 2022 BİLGİSAYAR DONANIMI

ÖDEV 2

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CEVAP -1

-1 KB Page Büyüklüğü 2^{10} B eşittir.

Bu nedenle PPO = 10 ve VPO = 10 olarak hesaplanır.

-VPN için Sanal Adress Genişliği – 10 = 20 – 10 = 10 olarak hesaplanır.

-PPN için Fiziksel Adress Genişliği – 10 = 18 – 10 = 8 olarak hesaplanır.

-L1 Cache 512 Byte / (8 set * 8 word/set) = 8 satır olarak hesaplanır.

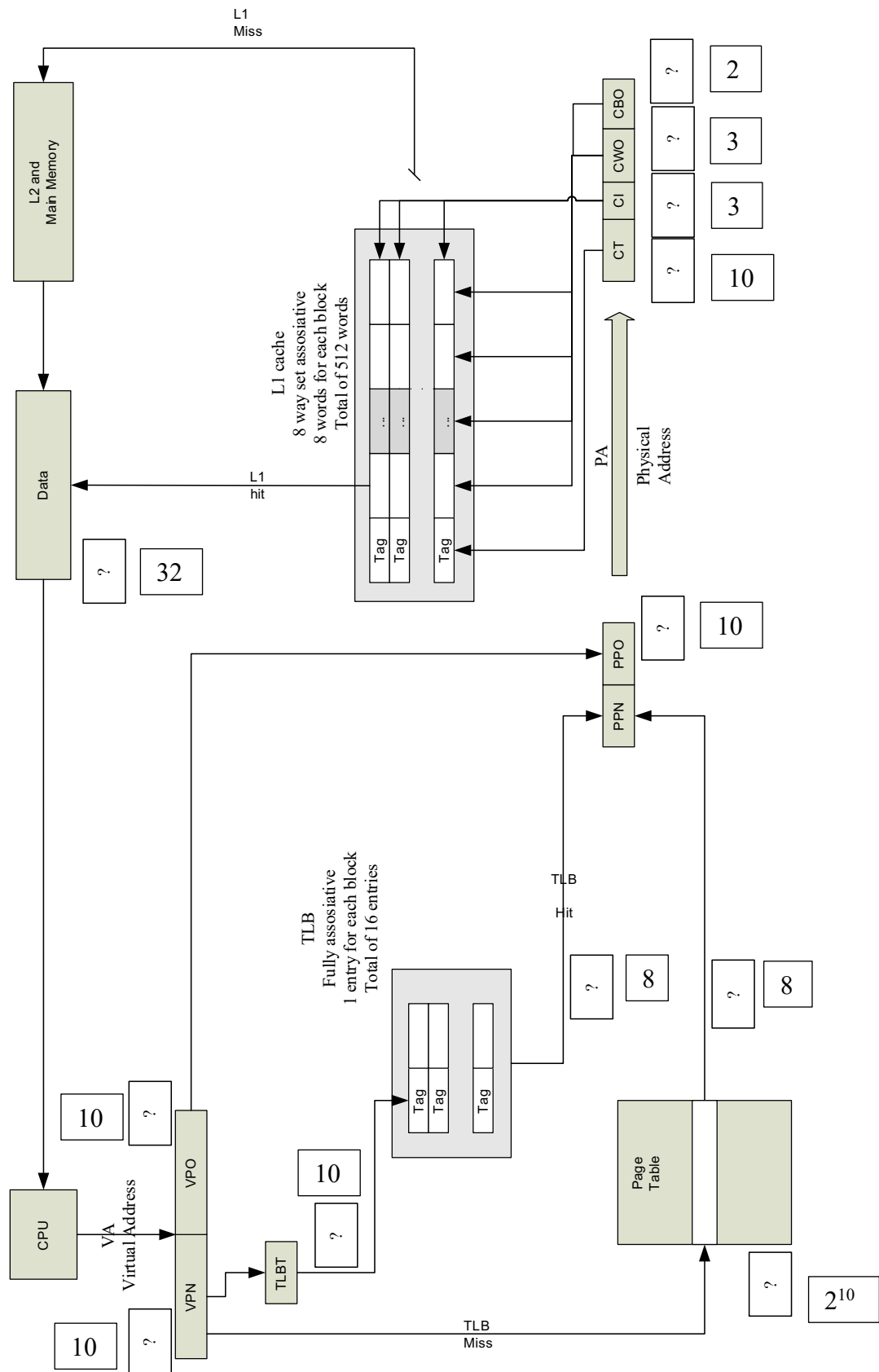
-CI 3 bit olur.

-32 bit / 8 bit = 4 byte /Word olarak hesaplanır.

-CBO 2 bit olur.

-8 word/block olursa CWO 3 bit olarak hesaplanır.

-CT = 18-2-3-3 = 10 bit olarak hesaplanır.



CEVAP -2



MacBook Pro (15-inch Mid 2012) Benchmarks

Benchmark results for the MacBook Pro (15-inch Mid 2012) with an Intel Core i7-3720QM processor can be found below. The data on this chart is gathered from user-submitted Geekbench 5 results from the Geekbench Browser.

Geekbench 5 scores are calibrated against a baseline score of 1000 (which is the score of an Intel Core i3-8100). Higher scores are better, with double the score indicating double the performance.

General information				
Vendor:	GenuineIntel			
Processor name (BIOS):	Intel(R) Core(TM) i7-3720QM CPU @ 2.60GHz			
Cores:	4			
Logical processors:	8			
Processor type:	Original OEM Processor			
CPUID signature:	306A9			
Family:	6 (06h)			
Model:	58 (03Ah)			
Stepping:	9 (09h)			
TLB/Cache details:	64-byte Prefetching Data TLB0: 2-MB or 4-MB pages, 4-way set associative, 32 entries Data TLB: 4-KB Pages, 4-way set associative, 64 entries Instruction TLB: 4-KB pages, 4-way set associative, 64 entries L2 TLB: 1-MB, 4-way set associative, 64-byte line size Shared 2nd-level TLB: 4 KB pages, 4-way set associative, 512 entries			
Cache details				
Cache:	L1 data	L1 instruction	L2	L3
Size:	4 x 32 KB	4 x 32 KB	4 x 256 KB	6 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 64B / 8B(Double) = 8 her line a karşılık gelir.

Cache Size / Line Size = 128KB / 64B = 2^{11} satır.

Ubuntu Üzerinde

1.c dosyası (dimension 256) çalıştırıldığında valgrind üzerinde %5.5 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip...
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$ g
cc 1.c -o 1.out
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$ v
algrind --tool=cachegrind ./1.out
==3844== Cachegrind, a cache and branch-prediction profiler
==3844== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==3844== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==3844== Command: ./1.out
==3844==
--3844-- warning: L3 cache found, using its data for the LL simulation.

secs:3.352384
==3844==
==3844== I refs:      783,500,008
==3844== I1 misses:    1,214
==3844== LLi misses:    1,192
==3844== I1 miss rate:  0.00%
==3844== LLi miss rate: 0.00%
==3844==
==3844== D refs:      306,774,944 (288,804,245 rd + 17,970,699 wr)
==3844== D1 misses:    16,895,710 ( 16,870,463 rd +   25,247 wr)
==3844== LLd misses:    27,265 (   2,095 rd +   25,170 wr)
==3844== D1 miss rate:   5.5% (   5.8% +   0.1% )
==3844== LLd miss rate:  0.0% (   0.0% +   0.1% )
==3844==
==3844== LL refs:      16,896,924 ( 16,871,677 rd +   25,247 wr)
==3844== LL misses:     28,457 (   3,287 rd +   25,170 wr)
==3844== LL miss rate:   0.0% (   0.0% +   0.1% )
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$
```

Dimension 256 = 2⁸ her iterasyonda miss

Miss - 0 C₁ ⇒ 2⁸ · 2⁵ = 2¹³

Miss - 12,5 A ⇒ 2⁸ · 2⁵ · 2⁸ · $\frac{1}{8}$ = 2¹⁸

Miss - 100 B ⇒ 2⁸ · 2⁵ · 2⁸ = 2²¹

Toplam = $\frac{2^{21} + 2^{13} + 2^{18}}{3 \cdot 2^8 \cdot 2^5 \cdot 2^8} = 4,8\%$

2.c dosyası (dimension 256) çalıştırıldığında valgrind üzerinde %0.7 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$ gcc 2.c
-o 2.out
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$ valgrind
--tool=cachegrind ./2.out
==40120== Cachegrind, a cache and branch-prediction profiler
==40120== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==40120== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==40120== Command: ./2.out
==40120== warning: L3 cache found, using its data for the LL simulation.

secs:5.622658
==40120==
==40120== I refs:      783,500,003
==40120== I1 misses:    1,211
==40120== L1i misses:    1,189
==40120== I1 miss rate:  0.00%
==40120== L1i miss rate: 0.00%
==40120==
==40120== D refs:      306,774,942 (288,804,244 rd + 17,970,698 wr)
==40120== D1 misses:    2,141,662 ( 2,116,415 rd +   25,247 wr)
==40120== L1d misses:    27,265 (   2,095 rd +   25,170 wr)
==40120== D1 miss rate:   0.7% (   0.7% +   0.1% )
==40120== L1d miss rate: 0.0% (   0.0% +   0.1% )
==40120==
==40120== LL refs:      2,142,873 ( 2,117,626 rd +   25,247 wr)
==40120== LL misses:    28,454 (   3,284 rd +   25,170 wr)
==40120== LL miss rate:  0.0% (   0.0% +   0.1% )
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$
```

Dimension 256 = 2^8

Miss - 12,5 - C $2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$

Miss - 0 - A $2^8 \cdot 2^5 = 2^{13}$

Miss - 12,5 - B $2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18}$

Total = $\frac{2^{18} \cdot 2^{13} \cdot 2^{18}}{3 \cdot 2^8 \cdot 2^6 \cdot 2^8} = 1,05\%$

3.c dosyası (dimension 256) çalıştırıldığında valgrind üzerinde %6.2 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files) $ gcc 3.c -o 3.out
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files) $ valgrind --tool=cachegrind ./3.out
==40214== Cachegrind, a cache and branch-prediction profiler
==40214== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==40214== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==40214== Command: ./3.out
==40214== warning: L3 cache found, using its data for the LL simulation.

secs:5.466731
==40214==
==40214== I refs:      783,500,003
==40214== I1 misses:    1,211
==40214== L1i misses:   1,189
==40214== I1 miss rate: 0.00%
==40214== L1i miss rate: 0.00%
==40214==
==40214== D refs:      306,774,942 (288,804,244 rd + 17,970,698 wr)
==40214== D1 misses:    18,968,028 ( 18,942,781 rd +   25,247 wr)
==40214== L1d misses:    27,265 (   2,095 rd +   25,170 wr)
==40214== D1 miss rate:   6.2% (   6.6% +   0.1% )
==40214== L1d miss rate:  0.0% (   0.0% +   0.1% )
==40214==
==40214== LL refs:      18,969,239 ( 18,943,992 rd +   25,247 wr)
==40214== LL misses:     28,454 (   3,284 rd +   25,170 wr)
==40214== LL miss rate:   0.0% (   0.0% +   0.1% )
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files) $
```

$$\begin{aligned} \text{Miss} - 12,5 - C &\Rightarrow 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18} \\ \text{Miss} - 12,5 - A &\Rightarrow 2^8 \cdot 2^5 \cdot 2^8 \cdot \frac{1}{8} = 2^{18} \\ \text{Miss} - 100 - B &\Rightarrow 2^8 \cdot 2^5 \cdot 2^8 = 2^{21} \\ \text{Toplam} &= \frac{2^{18} + 2^{18} + 2^{21}}{3 \cdot 2^8 \cdot 2^8 \cdot 2^8} = 5,2\% \end{aligned}$$

1.c dosyası (dimension 64) çalıştırıldığında valgrind üzerinde %1.1 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev...
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)
$ gcc 1.c -o 1_1.out
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)
$ valgrind --tool=cachegrind ./1_1.out
==40482== Cachegrind, a cache and branch-prediction profiler
==40482== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==40482== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==40482== Command: ./1_1.out
==40482==
--40482-- warning: L3 cache found, using its data for the LL simulation.

secs:0.059484
==40482==
==40482== I refs:      13,005,900
==40482== I1 misses:    1,238
==40482== L1i misses:    1,212
==40482== I1 miss rate:    0.01%
==40482== L1i miss rate:    0.01%
==40482==
==40482== D refs:      5,078,505 (4,729,153 rd + 349,352 wr)
==40482== D1 misses:    53,671 ( 51,464 rd + 2,207 wr)
==40482== L1d misses:    4,230 ( 2,102 rd + 2,128 wr)
==40482== D1 miss rate:    1.1% ( 1.1% + 0.6% )
==40482== L1d miss rate:    0.1% ( 0.0% + 0.6% )
==40482==
==40482== LL refs:      54,909 ( 52,702 rd + 2,207 wr)
==40482== LL misses:    5,442 ( 3,314 rd + 2,128 wr)
==40482== LL miss rate:    0.0% ( 0.0% + 0.6% )
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)$
```

Dimension 64 = 2^3 her iterasyondaki miss

Miss - O - C $\Rightarrow 2^1 \cdot 2^3 = 2^9$

Miss - O - A $\Rightarrow 2^6 \cdot 2^3 = 2^9$

Miss - 12.5 - B $\Rightarrow 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{2^3} = 2^{12}$

Toplam $= \frac{2^9 + 2^9 + 2^{12}}{8 \cdot 2^1 \cdot 2^6 \cdot 2^6} = 0.05\%$

2.c dosyası (dimension 64) çalıştırıldığında valgrind üzerinde %0.3 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/o...
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Fil
es)$ gcc 2.c -o 2_1.out
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Fil
es)$ valgrind --tool=cachegrind ./2_1.out
==40636== Cachegrind, a cache and branch-prediction profiler
==40636== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==40636== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==40636== Command: ./2_1.out
==40636==
--40636-- warning: L3 cache found, using its data for the LL simulation.

secs:0.056817
==40636==
==40636== I refs:      13,005,903
==40636== I1 misses:    1,241
==40636== LLi misses:    1,215
==40636== I1 miss rate:  0.01%
==40636== LLi miss rate: 0.01%
==40636==
==40636== D refs:      5,078,506 (4,729,153 rd + 349,353 wr)
==40636== D1 misses:    15,232 ( 13,025 rd + 2,207 wr)
==40636== LLd misses:    4,230 ( 2,102 rd + 2,128 wr)
==40636== D1 miss rate:  0.3% ( 0.3% + 0.6% )
==40636== LLd miss rate: 0.1% ( 0.0% + 0.6% )
==40636==
==40636== LL refs:      16,473 ( 14,266 rd + 2,207 wr)
==40636== LL misses:    5,445 ( 3,317 rd + 2,128 wr)
==40636== LL miss rate:  0.0% ( 0.0% + 0.6% )
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/oooooooooooooooooooo
odev2.zip (Unzipped Files)$
```

Dimension $\frac{2^6}{8} = 2^3$

Miss - 0 - C $\Rightarrow 2^6 \cdot 2^3 = 2^9$

Miss - 0 - A $\Rightarrow 2^6 \cdot 2^3 = 2^9$

Miss - 0 - B $\Rightarrow 2^6 \cdot 2^3 = 2^9$

Toplam = $\frac{2^9 + 2^9 + 2^9}{3 \cdot 2^6 \cdot 2^6} = \boxed{6,19 \frac{6}{10}}$

3.c dosyası (dimension 64) çalıştırıldığında valgrind üzerinde %1.5 miss rate oranı görülmektedir.

```
ubu@ubu-Mashen: ~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev...
$ gcc 3.c -o 3_1.out
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)
$ valgrind --tool=cachegrind ./3_1.out
==40745== Cachegrind, a cache and branch-prediction profiler
==40745== Copyright (C) 2002-2017, and GNU GPL'd, by Nicholas Nethercote et al.
==40745== Using Valgrind-3.15.0 and LibVEX; rerun with -h for copyright info
==40745== Command: ./3_1.out
==40745==
--40745-- warning: L3 cache found, using its data for the LL simulation.

secs:0.061826
==40745==
==40745== I refs:      13,005,901
==40745== I1 misses:    1,241
==40745== L1i misses:    1,215
==40745== I1 miss rate:    0.01%
==40745== L1i miss rate:    0.01%
==40745==
==40745== D refs:      5,078,506 (4,729,153 rd + 349,353 wr)
==40745== D1 misses:    77,835 ( 75,628 rd + 2,207 wr)
==40745== L1d misses:    4,230 ( 2,102 rd + 2,128 wr)
==40745== D1 miss rate:    1.5% ( 1.6% + 0.6% )
==40745== L1d miss rate:    0.1% ( 0.0% + 0.6% )
==40745==
==40745== LL refs:      79,076 ( 76,869 rd + 2,207 wr)
==40745== LL misses:    5,445 ( 3,317 rd + 2,128 wr)
==40745== LL miss rate:    0.0% ( 0.0% + 0.6% )
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001/odev2.zip (Unzipped Files)
ubu@ubu-Mashen:~/Desktop/BilDon/odev2.zip (Unzipped Files)-20220603T144010Z-001//
odev2.zip (Unzipped Files)$
```

Dimension $\frac{2^6}{8} = 2^3$

Miss - 12,5 - C $\Rightarrow 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{2^3} = 2^{12}$

Miss - 0 - B $\Rightarrow 2^6 \cdot 2^3 = 2^9$

Miss - 12,5 - A $\Rightarrow 2^6 \cdot 2^3 \cdot 2^6 \cdot \frac{1}{2^3} = 2^{12}$

Toplam = $\frac{2^{12} + 2^9 + 2^{12}}{3 \cdot 2^6 \cdot 2^3 \cdot 2^6} = 1,1\%$

Hocam yaptığım hesaplamaları da fotoğraf olarak ekledim.

Yapılan tüm hesaplamalar sonucunda valgrind çıktısında yer alan sonuçlara ulaşılammıştır. Set associative cache yapısına uygun şekilde bir çok farklı çözüm denenmiş ancak terminal çıktısında yer alan sonuçlara yakın sonuçlar elde edilememiştir.