**EXPERIMENT - 5**

**AIM:** To simulates a direct-mapped cache

**Submission Sheet**

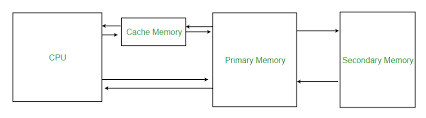
| **SAP ID** | **Name of Student** | **Date of Experiment** | **Date of Submission** | **Remarks** |
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| **60004190057** | **Junaid Girkar** | **30-10-2021** | **30-10-2021** |  |

**THEORY:**

cache memory, also called cache, supplementary memory system that temporarily stores frequently used instructions and data for quicker processing by the central processing unit (CPU) of a computer. The cache augments, and is an extension of, a computer’s main memory. Both main memory and cache are internal random-access memories (RAMs) that use semiconductor-based transistor circuits. Cache holds a copy of only the most frequently used information or program codes stored in the main memory. The smaller capacity of the cache reduces the time required to locate data within it and provide it to the CPU for processing.

When a computer’s CPU accesses its internal memory, it first checks to see if the information it needs is stored in the cache. If it is, the cache returns the data to the CPU. If the information is not in the cache, the CPU retrieves it from the main memory. Disk cache memory operates similarly, but the cache is used to hold data that have recently been written on, or retrieved from, a magnetic disk or other external storage device.

| Hit ratio = hit / (hit + miss) = no. of hits/total accesses. |
| --- |



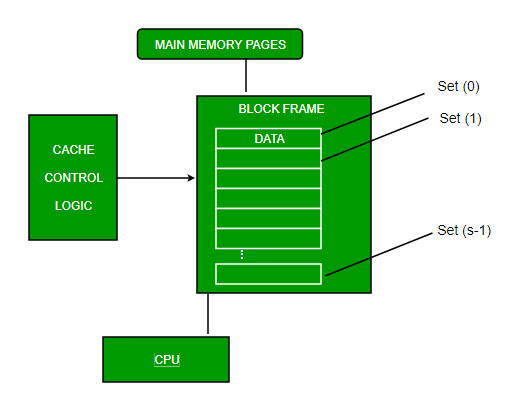
**DIRECT CACHE MAPPING:**

The simplest technique, known as direct mapping, maps each block of main memory into only one possible cache line. or

In Direct mapping, assign each memory block to a specific line in the cache. If a line is previously taken up by a memory block when a new block needs to be loaded, the old block is trashed. An address space is split into two parts: index field and a tag field. The cache is used to store the tag field whereas the rest is stored in the main memory. Direct mapping`s performance is directly proportional to the Hit ratio.

| i = j modulo m where i=cache line number j= main memory block number m=number of lines in the cache |
| --- |

For purposes of cache access, each main memory address can be viewed as consisting of three fields. The least significant w bits identify a unique word or byte within a block of main memory. In most contemporary machines, the address is at the byte level. The remaining s bits specify one of the 2s blocks of main memory. The cache logic interprets these s bits as a tag of s-r bits (most significant portion) and a line field of r bits. This latter field identifies one of the m=2r lines of the cache.



**8 Bit:**

CODE:

| **#include <stdio.h>  int tag[8];  int main( ) {  int addr;  int i, j, t;  int hits, accesses;  FILE \*fp;   fp = fopen("trace.txt", "r");  hits = 0;  accesses = 0;  while (fscanf(fp, "%x", &addr) > 0) {  /\* simulate a direct-mapped cache with 8 words \*/  accesses += 1;  printf("%3d: 0x%08x ", accesses, addr);  i = (addr >> 2) & 7;  t = addr | 0x1f;  if (tag[i] == t) {  hits += 1;  printf("Hit%d ", i);  } else {  /\* allocate entry \*/  printf("Miss ");  tag[i] = t;  }  for (i = 0; i < 8; i++)  printf("0x%08x ", tag[i]);  printf("\n");  }  printf("Hits = %d, Accesses = %d, Hit ratio = %f\n", hits, accesses, ((float)hits)/accesses);  close(fp); }** |
| --- |

**OUTPUT:**

| 1: 0x80000000 Miss 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   2: 0x80000004 Miss 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   3: 0x80000008 Miss 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   4: 0x8000000c Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000   5: 0x00000020 Miss 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000   6: 0x80000010 Miss 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000   7: 0x80000014 Miss 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000   8: 0x80000018 Miss 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   9: 0x8000000c Hit3 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   10: 0x00000024 Miss 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   11: 0x80000010 Hit4 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   12: 0x80000014 Hit5 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   13: 0x80000018 Hit6 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   14: 0x8000000c Hit3 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   15: 0x00000028 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   16: 0x80000010 Hit4 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   17: 0x80000014 Hit5 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   18: 0x80000018 Hit6 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   19: 0x8000000c Hit3 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   20: 0x0000002c Miss 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x00000000   21: 0x80000010 Hit4 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x00000000   22: 0x80000014 Hit5 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x00000000   23: 0x80000018 Hit6 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x00000000   24: 0x8000000c Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   25: 0x00000030 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x0000003f 0x8000001f 0x8000001f 0x00000000   26: 0x80000010 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   27: 0x80000014 Hit5 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   28: 0x80000018 Hit6 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   29: 0x8000000c Hit3 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   30: 0x00000034 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x0000003f 0x8000001f 0x00000000   31: 0x80000010 Hit4 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x0000003f 0x8000001f 0x00000000   32: 0x80000014 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   33: 0x80000018 Hit6 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   34: 0x8000000c Hit3 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000   35: 0x00000038 Miss 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x0000003f 0x00000000   36: 0x80000010 Hit4 0x0000003f 0x0000003f 0x0000003f 0x8000001f 0x8000001f 0x8000001f 0x0000003f 0x00000000   37: 0x80000014 Hit5 0x0000003f 0x0000003f 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0x8000001f 0x8000001f 0x0000003f   65: 0x00000050 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x0000005f 0x8000001f 0x8000001f 0x0000003f   66: 0x80000010 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000003f   67: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000003f   68: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000003f   69: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000003f   70: 0x00000054 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x0000005f 0x8000001f 0x0000003f   71: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x0000005f 0x8000001f 0x0000003f   72: 0x80000014 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000003f   73: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 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0x0000005f   83: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   84: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   85: 0x00000060 Miss 0x0000007f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   86: 0x80000010 Hit4 0x0000007f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   87: 0x80000014 Hit5 0x0000007f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   88: 0x80000018 Hit6 0x0000007f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   89: 0x8000000c Hit3 0x0000007f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   90: 0x00000064 Miss 0x0000007f 0x0000007f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   91: 0x80000010 Hit4 0x0000007f 0x0000007f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   92: 0x80000014 Hit5 0x0000007f 0x0000007f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   93: 0x80000018 Hit6 0x0000007f 0x0000007f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   94: 0x8000000c Hit3 0x0000007f 0x0000007f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   95: 0x00000068 Miss 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   96: 0x80000010 Hit4 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   97: 0x80000014 Hit5 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   98: 0x80000018 Hit6 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f   99: 0x8000000c Hit3 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f  100: 0x0000006c Miss 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x0000005f  101: 0x80000010 Hit4 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x0000005f  102: 0x80000014 Hit5 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x0000005f  103: 0x80000018 Hit6 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x8000001f 0x8000001f 0x8000001f 0x0000005f  Hits = 68, Accesses = 103, Hit ratio = 0.660194 |
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**16 Bit:**

CODE:

| **#include <stdio.h>   int tag[16];   int main( ) {  int addr;  int i, j, t;  int hits, accesses;  FILE \*fp;    fp = fopen("trace.txt", "r");  hits = 0;  accesses = 0;  while (fscanf(fp, "%x", &addr) > 0) {  /\* simulate a direct-mapped cache with 8 words \*/  accesses += 1;  printf("%3d: 0x%08x ", accesses, addr);  i = (addr >> 2) & 15;  t = addr | 0x1f;  if (tag[i] == t) {  hits += 1;  printf("Hit%d ", i);  } else {  /\* allocate entry \*/  printf("Miss ");  tag[i] = t;  }  for (i = 0; i < 16; i++)  printf("0x%08x ", tag[i]);  printf("\n");  }  printf("Hits = %d, Accesses = %d, Hit ratio = %f\n", hits, accesses, ((float)hits)/accesses);  close(fp); }** |
| --- |

**OUTPUT:**

| 1: 0x80000000 Miss 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   2: 0x80000004 Miss 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   3: 0x80000008 Miss 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   4: 0x8000000c Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   5: 0x00000020 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   6: 0x80000010 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   7: 0x80000014 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   8: 0x80000018 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   9: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   10: 0x00000024 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   11: 0x80000010 Hit4 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   12: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   13: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   14: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   15: 0x00000028 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   16: 0x80000010 Hit4 0x8000001f 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0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000   22: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000   23: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000   24: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000 0x00000000   25: 0x00000030 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000   26: 0x80000010 Hit4 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000   27: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000   28: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000   29: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000 0x00000000   30: 0x00000034 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000   31: 0x80000010 Hit4 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000   32: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000   33: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000   34: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000 0x00000000   35: 0x00000038 Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000   36: 0x80000010 Hit4 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000   37: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000   38: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000   39: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x00000000   40: 0x0000003c Miss 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   41: 0x80000010 Hit4 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   42: 0x80000014 Hit5 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   43: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   44: 0x8000000c Hit3 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   45: 0x00000040 Miss 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   46: 0x80000010 Hit4 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   47: 0x80000014 Hit5 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   48: 0x80000018 Hit6 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   49: 0x8000000c Hit3 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   50: 0x00000044 Miss 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   51: 0x80000010 Hit4 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   52: 0x80000014 Hit5 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   53: 0x80000018 Hit6 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   54: 0x8000000c Hit3 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   55: 0x00000048 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   56: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   57: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   58: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   59: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   60: 0x0000004c Miss 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   61: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   62: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   63: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   64: 0x8000000c Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   65: 0x00000050 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x0000005f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   66: 0x80000010 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   67: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   68: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   69: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   70: 0x00000054 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x0000005f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   71: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x0000005f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   72: 0x80000014 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   73: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   74: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   75: 0x00000058 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   76: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   77: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   78: 0x80000018 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   79: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   80: 0x0000005c Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   81: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   82: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   83: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   84: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   85: 0x00000060 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   86: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   87: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   88: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   89: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   90: 0x00000064 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   91: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   92: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   93: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   94: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   95: 0x00000068 Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   96: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   97: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   98: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f   99: 0x8000000c Hit3 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f  100: 0x0000006c Miss 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f  101: 0x80000010 Hit4 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f  102: 0x80000014 Hit5 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f  103: 0x80000018 Hit6 0x0000005f 0x0000005f 0x0000005f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x0000003f 0x0000003f 0x0000003f 0x0000003f  Hits = 72, Accesses = 103, Hit ratio = 0.699029 |
| --- |

**32 Bit:**

CODE:

| **#include <stdio.h> #include <stdio.h> int tag[32];  int main( ) {  int addr;  int i, j, t;  int hits, accesses;  FILE \*fp;    fp = fopen("trace.txt", "r");  hits = 0;  accesses = 0;  while (fscanf(fp, "%x", &addr) > 0) {  /\* simulate a direct-mapped cache with 8 words \*/  accesses += 1;  printf("%3d: 0x%08x ", accesses, addr);  i = (addr >> 2) & 31;  t = addr | 0x1f;  if (tag[i] == t) {  hits += 1;  printf("Hit%d ", i);  } else {  /\* allocate entry \*/  printf("Miss ");  tag[i] = t;  }  for (i = 0; i < 32; i++)  printf("0x%08x ", tag[i]);  printf("\n");  }  printf("Hits = %d, Accesses = %d, Hit ratio = %f\n", hits, accesses, ((float)hits)/accesses);  close(fp); }** |
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**OUTPUT:**

| 1: 0x80000000 Miss 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   2: 0x80000004 Miss 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000   3: 0x80000008 Miss 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 0x00000000 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0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x00000000 0x00000000 0x00000000 0x00000000  103: 0x80000018 Hit6 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x8000001f 0x00000000 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000003f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000005f 0x0000007f 0x0000007f 0x0000007f 0x0000007f 0x00000000 0x00000000 0x00000000 0x00000000  Hits = 76, Accesses = 103, Hit ratio = 0.737864 |
| --- |

**Comparison Table**

| **Number of Bits** | **Hits** | **Accesses** | **Hit Ratio** |
| --- | --- | --- | --- |
| 8 | 68 | 103 | 0.660194 |
| 16 | 72 | 103 | 0.699029 |
| 32 | 76 | 103 | 0.737864 |

**CONCLUSION:**

Cache memory is the closest to the CPU, it reduces the access time from Main Memory. There are 3 ways to map cache to Main memory: Direct mapping, Associative mapping, and Set-Associative mapping. In Direct mapping, each memory block is assigned to a specific line in the cache. It is a simple way to map blocks but it has a lower cache hit ratio, as there is only one cache line available in a set. Every time a new memory is referenced to the same set, the cache line is replaced, this is the drawback of Direct Mapping.

As seen from the comparison table above which is derived from our program output, as we go on increasing the number of bits in cache memory, the hit ratio also increases.