Direct mapped cache simulations

Digital Fundamentals and Computer Architecture

Simulation Design

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Objective

- To simulate Direct Mapped Cache mapping tech
- To analyze cache hits and misses
- To display cache content after each memory access
- To calculate hit ratio

Direct Mapped Cache

- In direct mapped cache, each memory block is mapped to exactly one cache line.
- The mapping between memory block and cache line is fixed.
- This technique is simple and fast but may cause more cache misses due to conflicts.

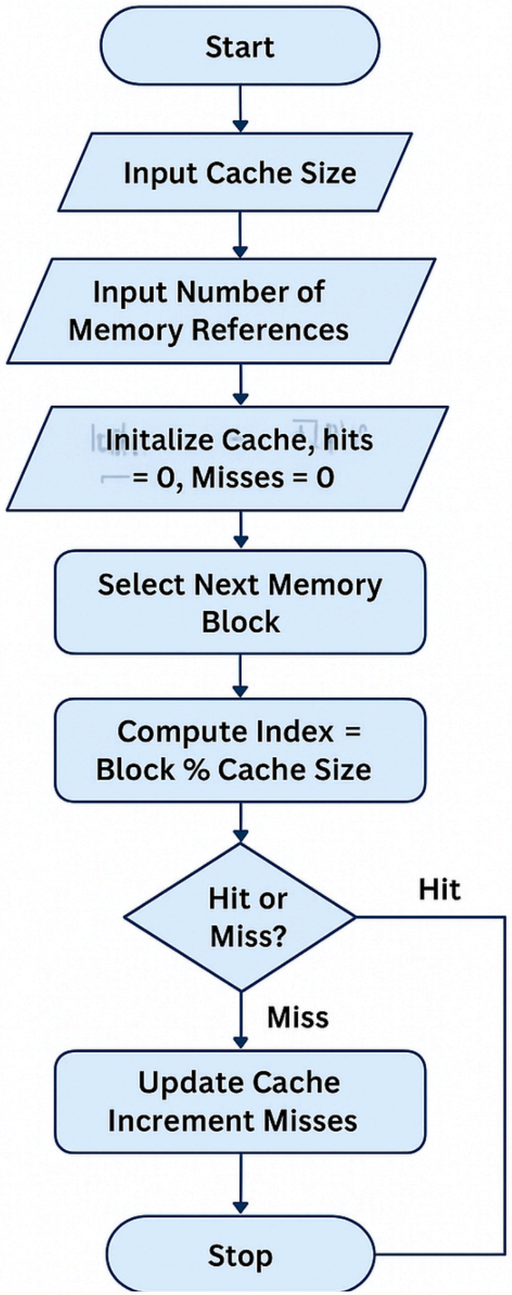
Mapping Formula:

Cache Index = Block Number mod Cache Size

Algorithm – Direct Mapped Cache

1. Start
2. Read Cache Size
3. Read memory block reference sequence
4. Initialize cache with empty values
5. For each memory block:
   - Compute index = block % cache size
   - If block is found → Hit
   - Else → Miss and replace block
6. Display cache after each access
7. Calculate hit ratio
8. Stop

Flow Diagram



Sample input

Input Details:

Cache Size:

4

Memory Block Reference Sequence:

1 2 3 1 4 2 1

Cache Access Workflow

Block	Index	Hit/Miss	Cache State
1	1	Miss	[-1, 1, -1, -1]
2	2	Miss	[-1, 1, 2, -1]
3	3	Hit	[4, 1, 2, 3]
1	4	Hit	[4, 1, 2, 3]
4	0	Miss	[4, 1, 2, 3]
1	1	Hit	[4, 1, 2, 3]

Cache Access Workflow (Continued)

Block	Index	Hit/Miss	Cache State
1	1	Hit	[4, 1, 2, 3]
4	0	Miss	[4, 1, 2, 3]
2	2	Hit	[4, 1, 2, 3]
1	1	Miss	[4, 1, 2, 3]

Final Result

- Total Hits = 3
- Total Misses = 4
- Hit Ratio = 3 / 7 = 0.43

Conclusion

- Direct Mapping is simple and fast
- Each block has a fixed cache location
- Cache performance depends on access pattern
- Simulation helps understand cache behavior