CS354: Machine Organization and Programming
Lecture 23
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Section 2
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Lecture Overview
1. Review of Caches
2. Example Problems

Generic Cache Organization

Looking up a memory address

Fully Associative
Cache Lookup

Three steps while determining whether a request is a hit or a miss:

- Set selection: Select the set where the address resides.
- Line matching: Select the cache line within the set.
- Word extraction: Extract the requested word from the right offset.

Types of Misses

- Compulsory or cold misses: Cache is empty to start with and will miss.
- Conflict misses: Cache has space but because objects map to the same cache block they keep missing.
- Capacity misses: Cache does not have space because size of the working set exceeds the size of the cache.

Cache Replacement Policies

- Which block to replace or evict to make space for new blocks?
  - Random Replacement Policy: chooses a random victim block.
  - Least Recently Used (LRU) Policy: chooses the block that was last accessed furthest in the past.
  - Least Frequently Used (LFU) Policy: chooses the block that was least frequently accessed in the past.
• Write Alloc: Load block in cache and update word (often used along with Write back)

• Write No-Alloc (a.k.a. Write around): Just update memory (often used along with Write through)
Analyze memory references 0x071A and 0x16E8
Strided Access Patterns

```c
int i, j, sum = 0;
for(i=0;i<16;i++)
    for(j=0;j<16;j++)
        sum += a[i][j]
```

What if: `sum += a[j][i]`?