

# Cache Content Duplication

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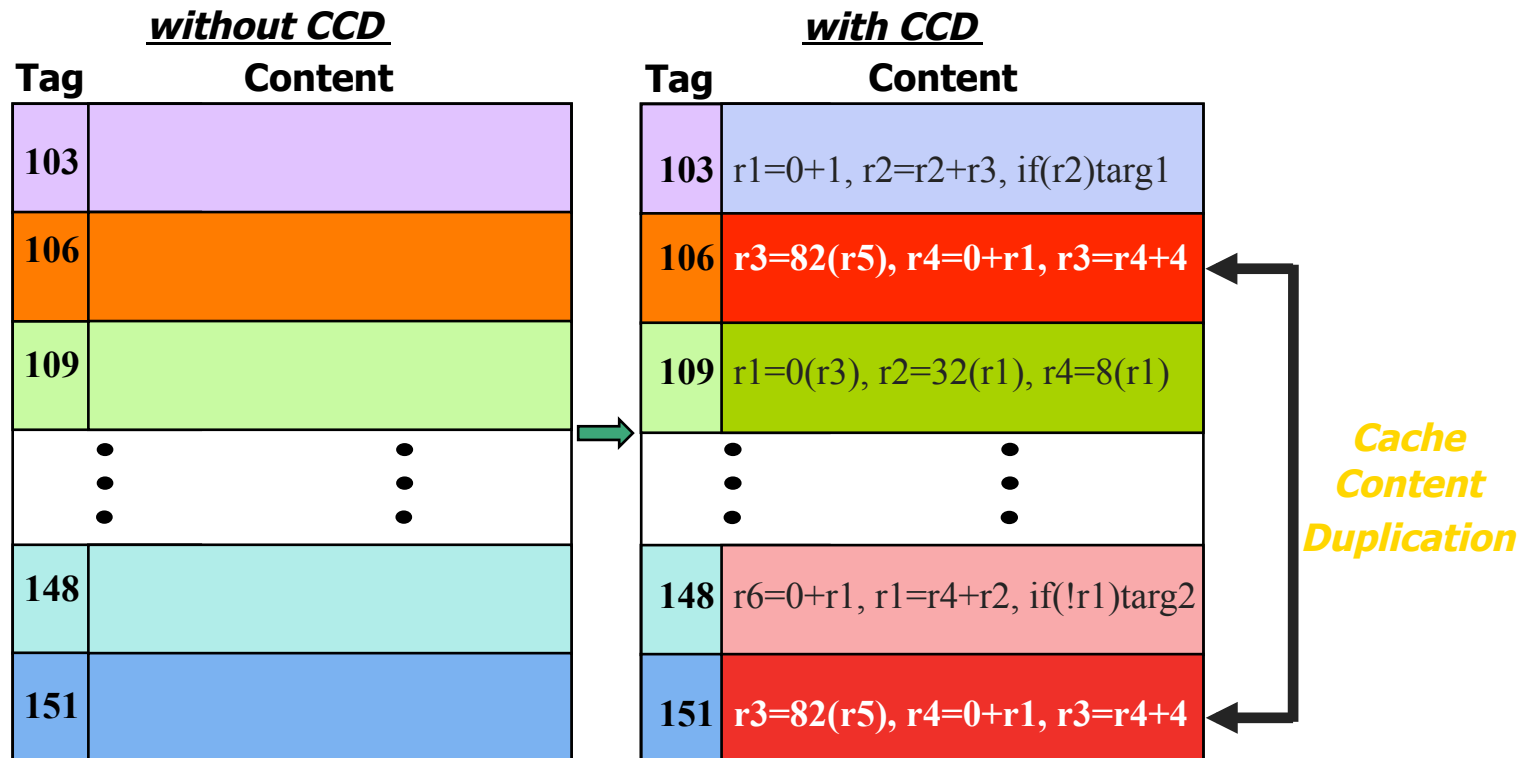


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# Cache-Content-Duplication (CCD)

- On a miss for a block in a cache, the required block of data may reside already in the cache under a different tag-index



# Why CCD happens

- An example from *twolf*

```
term_newpos_b( antrmptr , xcenter , ycenter , newaor )
{
  ...
  if (...)
  {
    ...
    rowsptr2[bblock]-- ;
    rowsptr2[ablock]++ ;
    dimptr->new_total = dimptr->old_total +
      ttermptr->newx - ttermptr->xpos ;
  }
  else
  {
    rowsptr2[bblock]-- ;
    rowsptr2[ablock]++ ;
    dimptr->new_total += ttermptr->newx - ttermptr->xpos ;
  }
  ...
  return ;
}
```

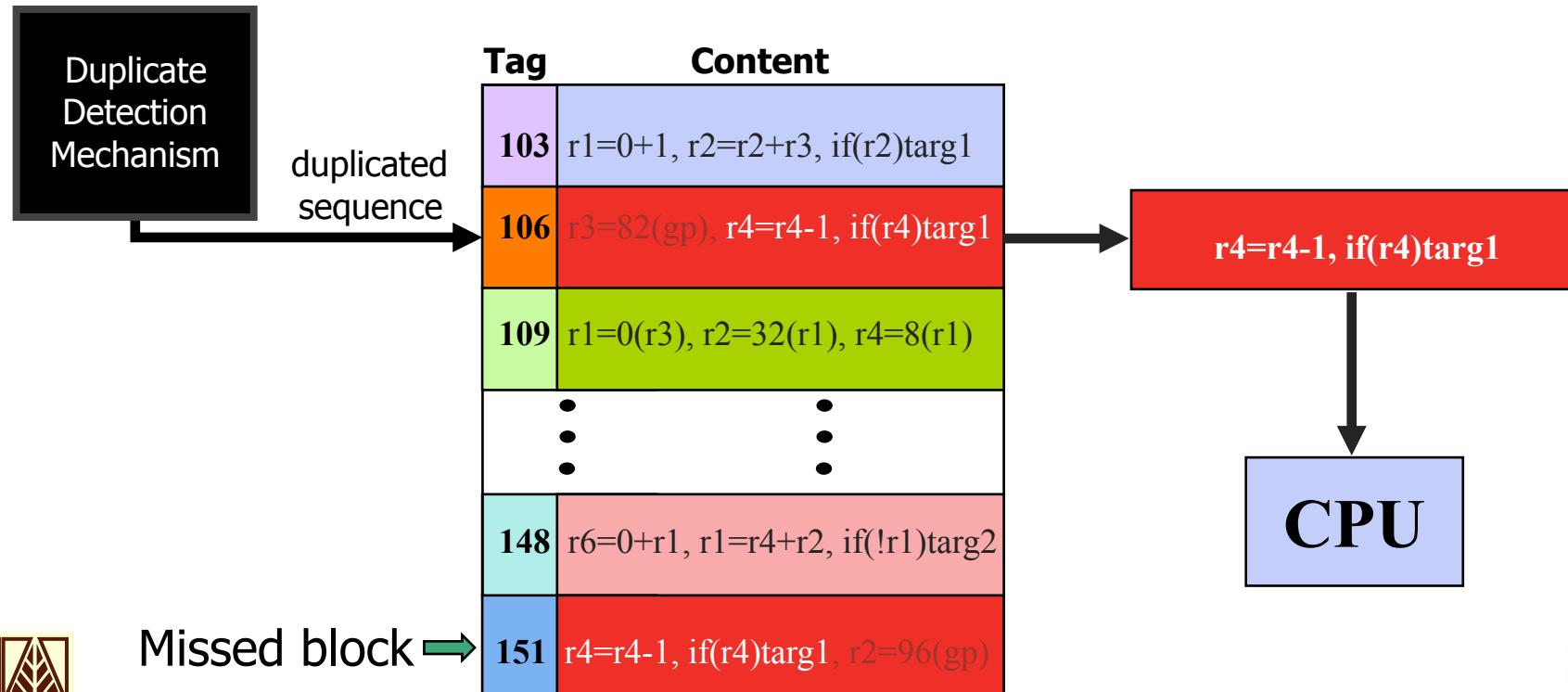
```
addu    r3,r7,r3
lbu     r2,0(r3)
addiu   r2,r2,-1
sb      r2,0(r3)
lw      r3,-28076(r28)
addu    r3,r7,r3
lbu     r2,0(r3)
addiu   r2,r2,1
```

Compiled with gcc 2.7 -O3 optimizations



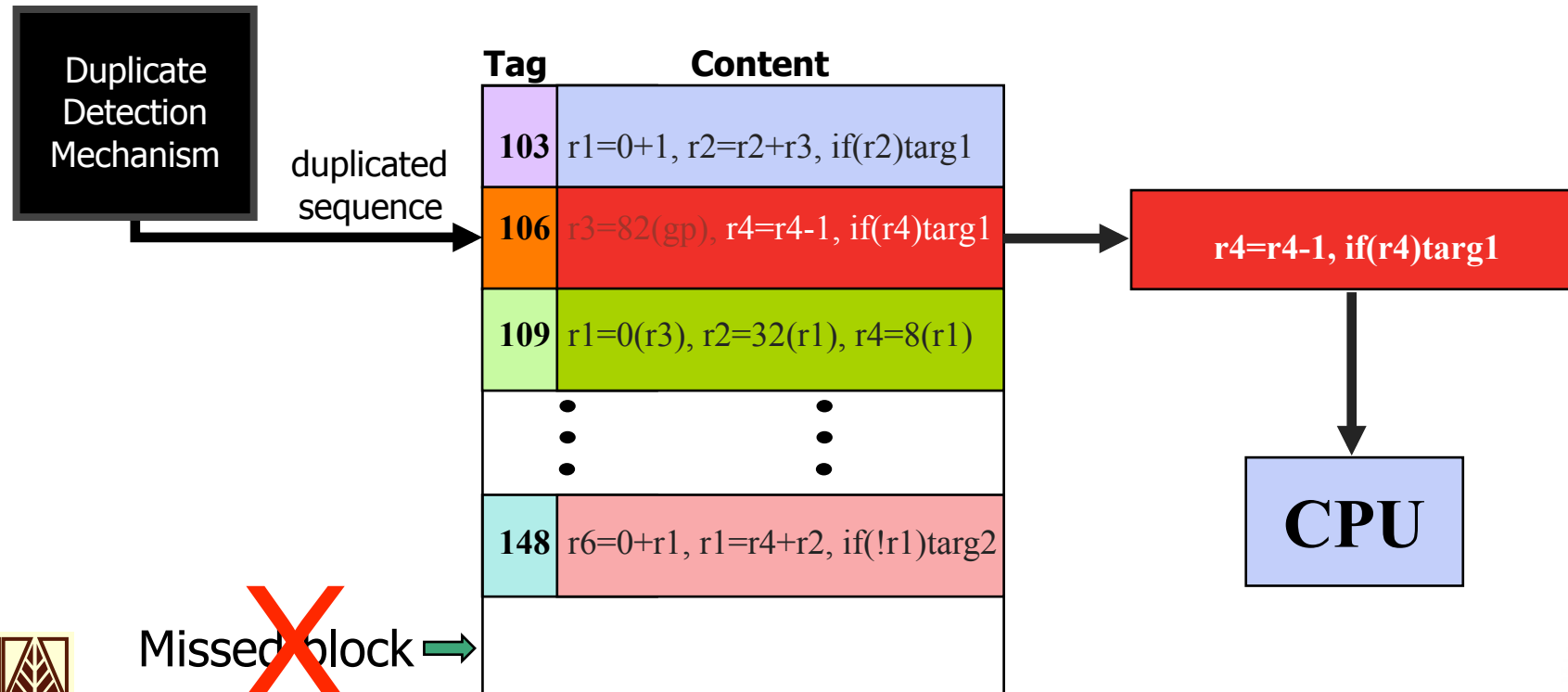
# How to exploit CCD

- Duplicate-Aware-Cache (DAC)
  - Detection of misses to blocks with a duplicate in the cache



# How to exploit CCD

- Unique-Content-Cache (UCC)
  - Detection of misses to blocks with a duplicate in the cache **and prevent duplicates to enter cache**



## Related work

- Cache Compression
  - Increase the effective cache size by keeping the stored data in a compressed form
  - Even different compressed blocks can be identical
- Code Compaction
  - Compiler factors out common sequences
  - Transformations to increase redundancy
  - May entail overhead, for example call and return instructions
  - CCD is a dynamic program behavior



## Future Work

- Optimizations to increase CCD frequency
  - Compiler transformations to facilitate CCD
- Consider CCD for:
  - SMT Processors
  - Chip Multiprocessors
  - Caches with Translated Sequences



Thank you. Questions?

