COL380

Introduction to
Parallel & Distributed Programming

2-0-2

Subodh Kumar

Agenda

- Cache behavior, false sharing
- Flavors of parallelism
- Memory bottleneck
- Intro to architecture

Matrix Multiplication


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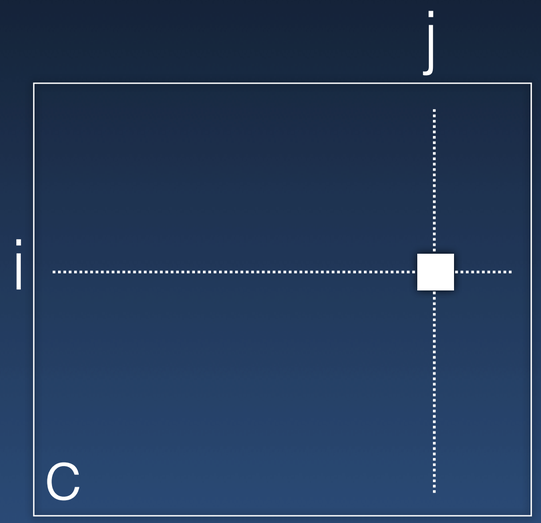

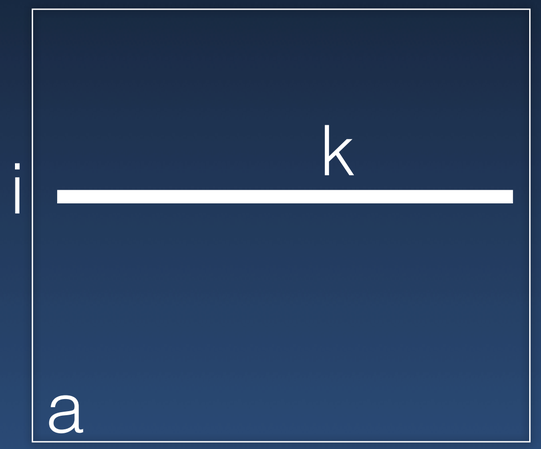

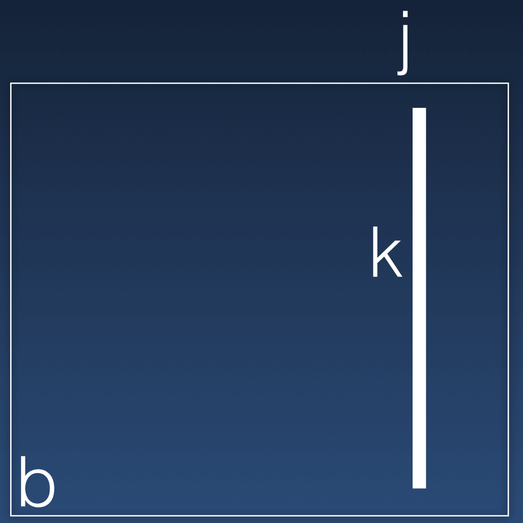


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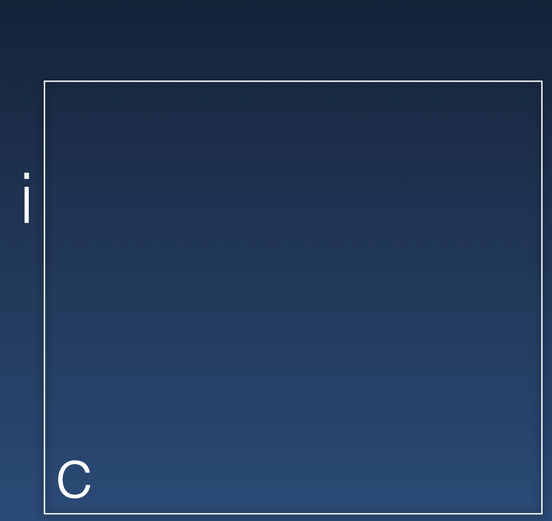

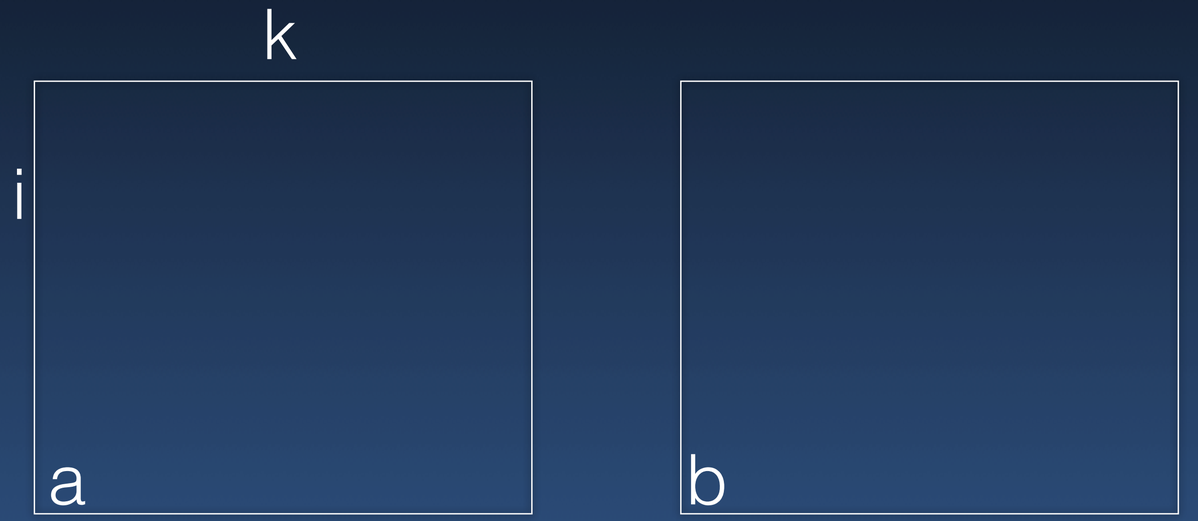


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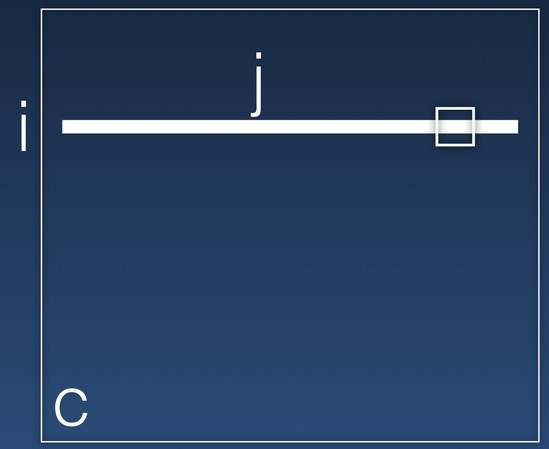

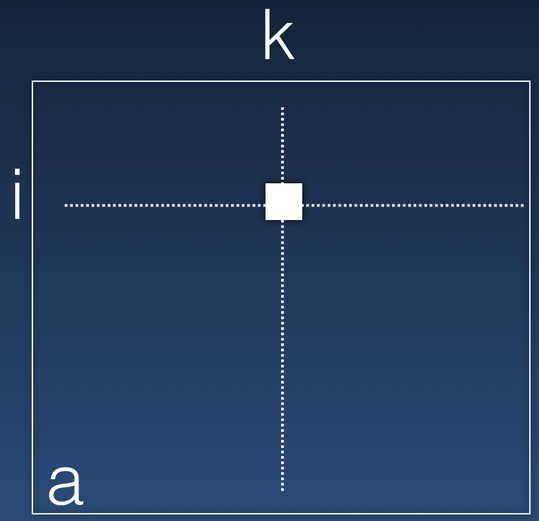

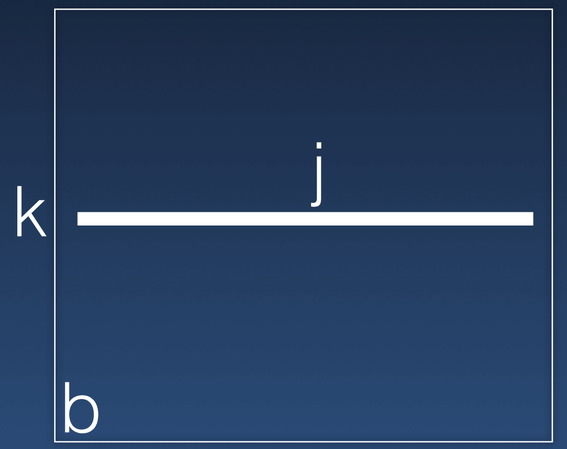


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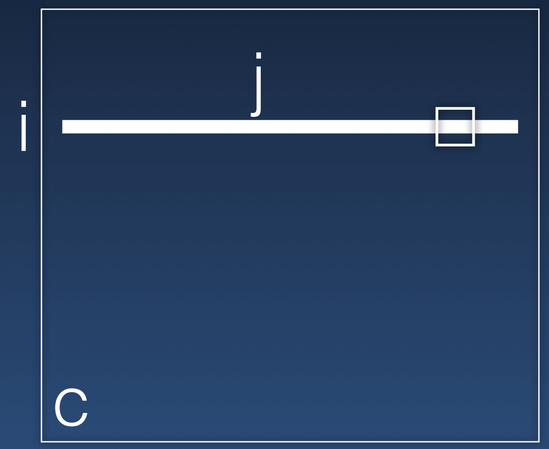

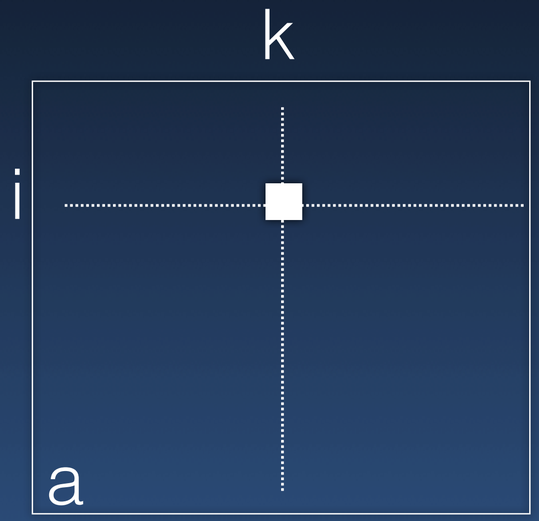

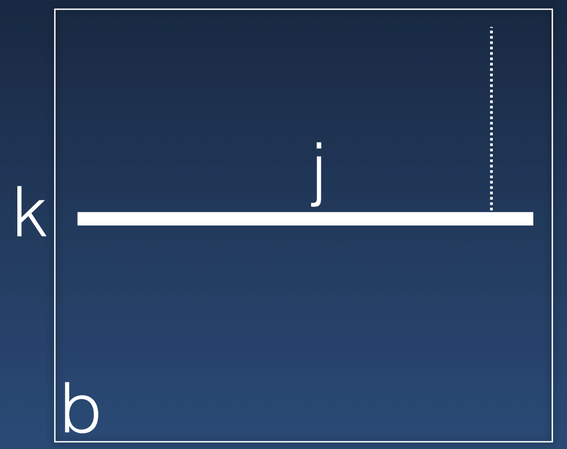


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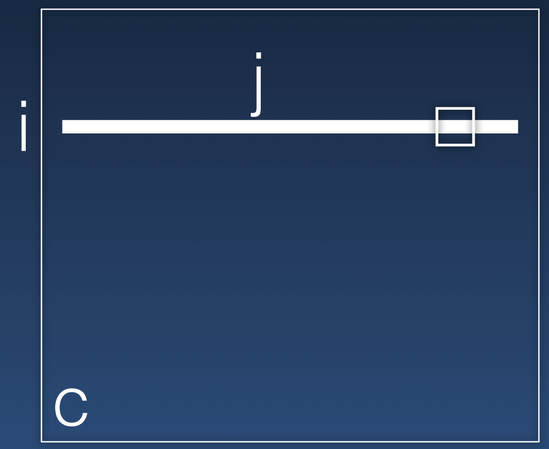

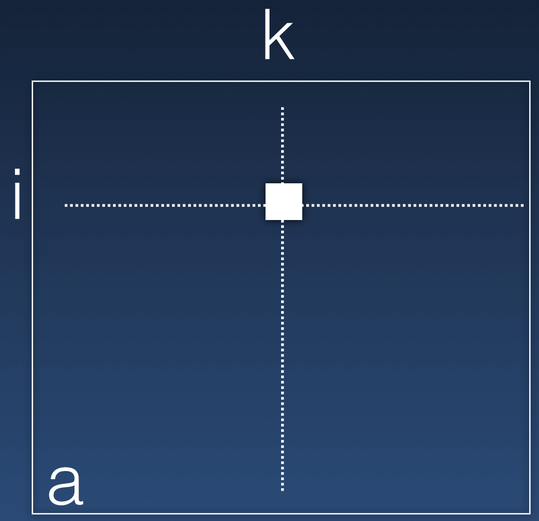

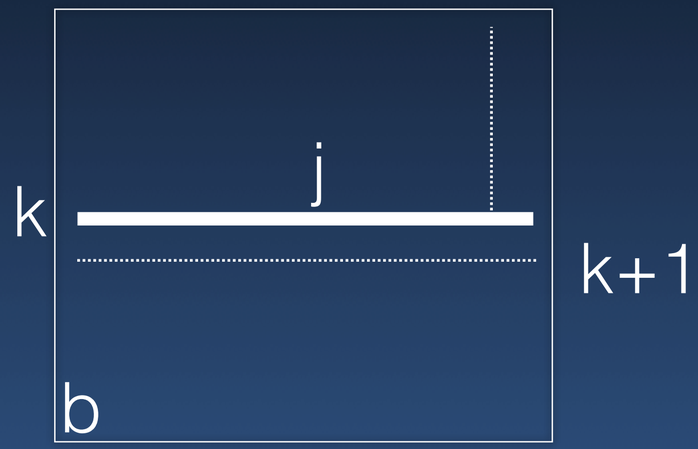


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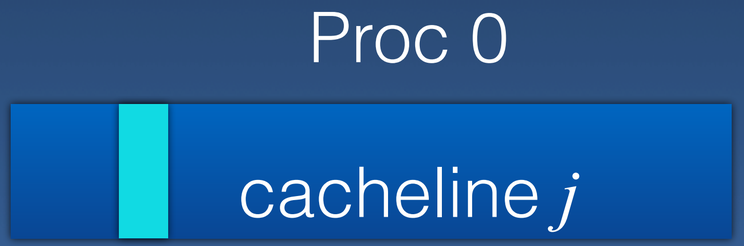

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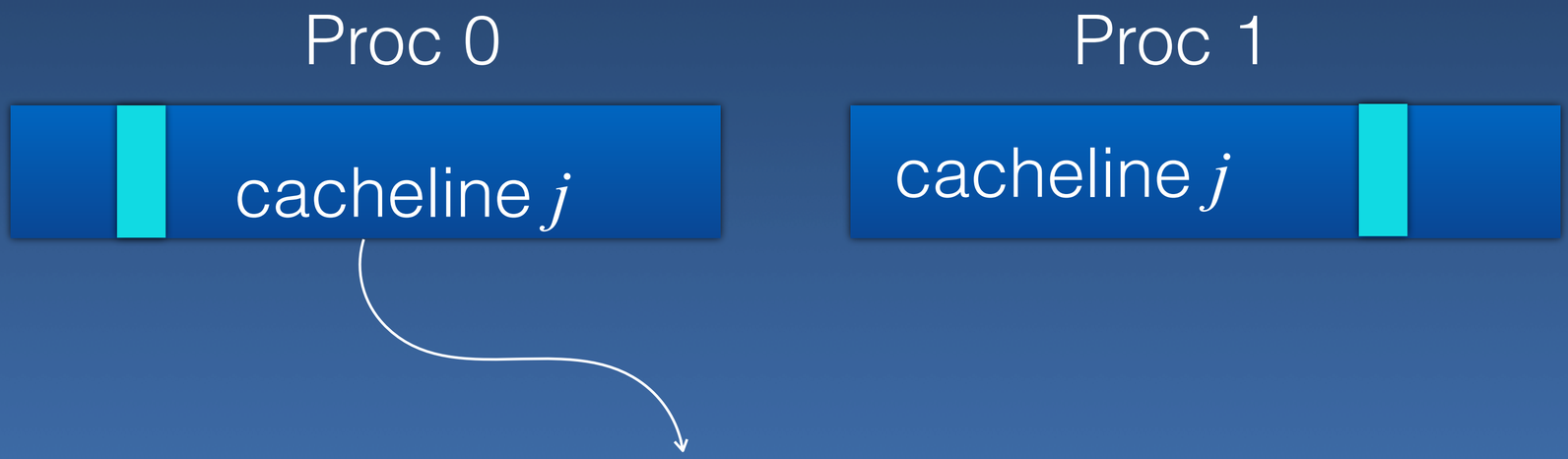

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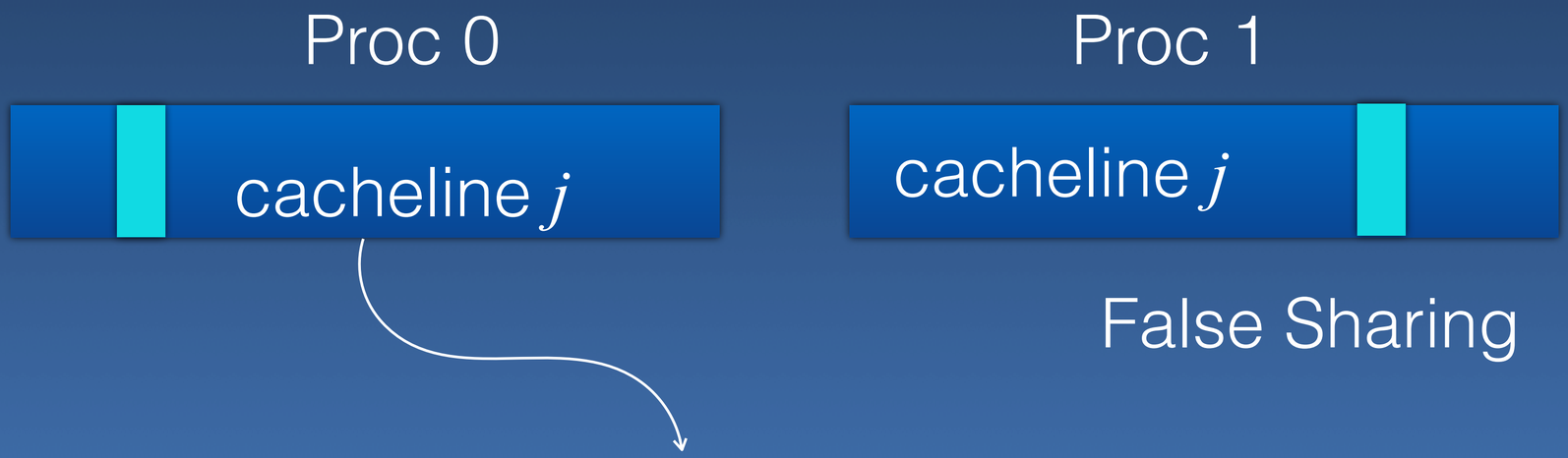

Parallelize Version 0

- Compiler flag
  - gcc -O2 -ftree-vectorize ### -mavx512f -fopt-info-vec-optimized
  - Or, gcc -O3
- Embarrassingly Parallel
  - Subdivide work in p equal parts, given p processors
  - forall i in [0,p)
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```
make -j

#!/bin/bash
for ((i=0; i< $count; i++));
do
      grep $pattern file$i &
done
```

Can files be read in parallel?

Hello OpenMP

```
#include <omp.h>

#pragma omp parallel // num_threads(8)
{
    tid = omp_get_thread_num();
    dowork(input, tid);
}
```

```
> g++ file.c -fopenmp
```

Sequential

OP operands
OP operands
OP operands
OP operands
OP operands
OP operands
OP operands
OP operands

Parallel

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Threads of Execution: Instructions executed in order

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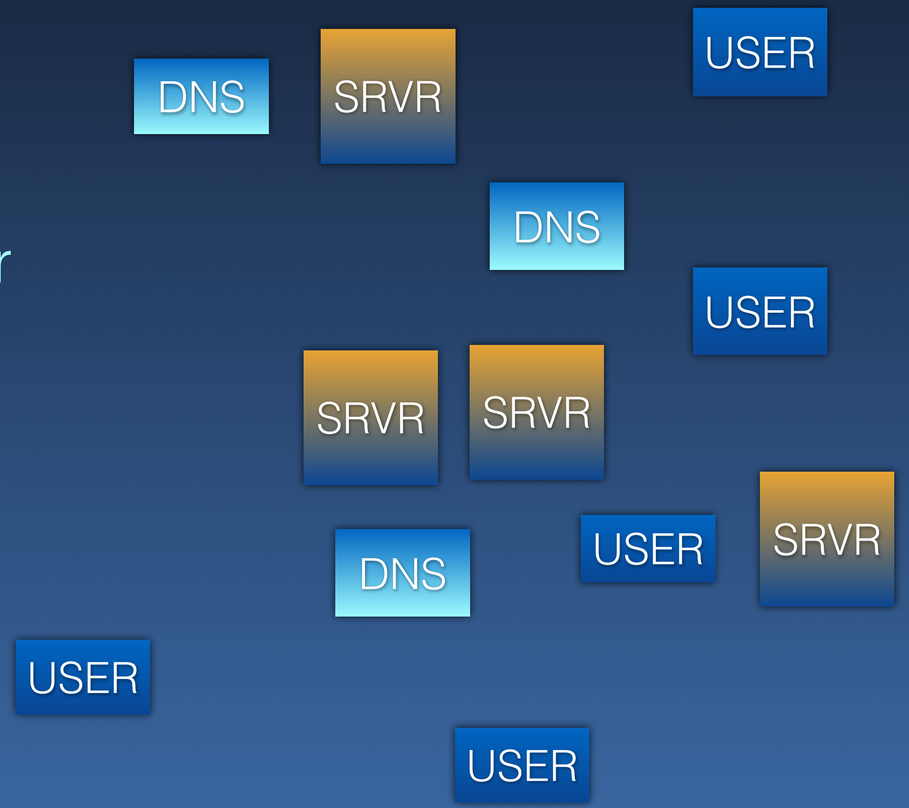

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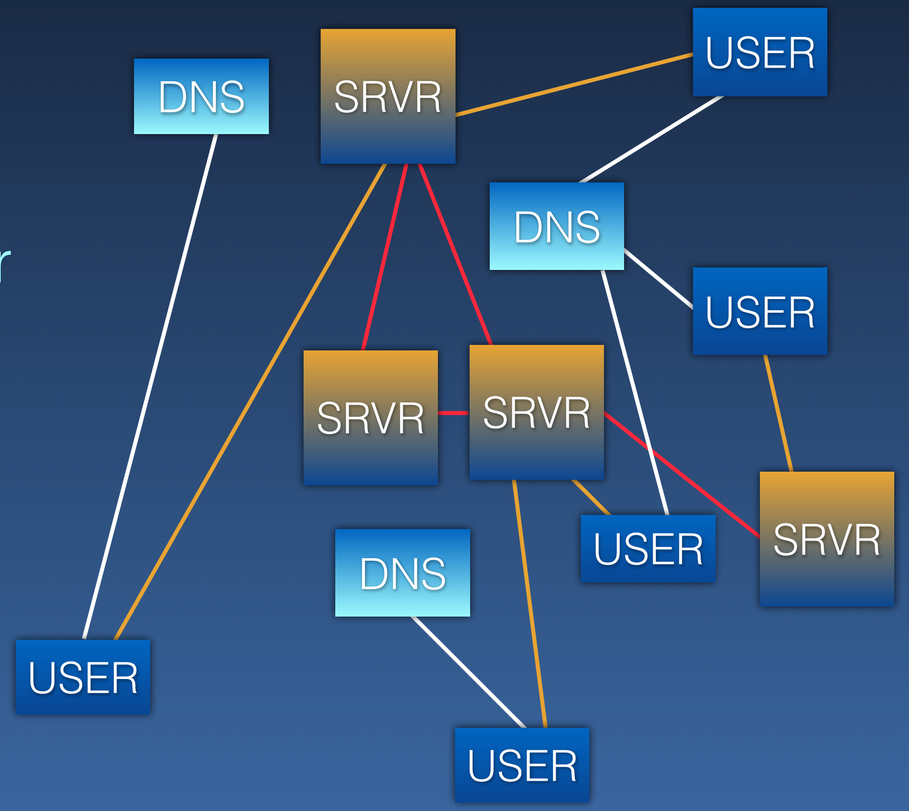

Review

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- Memory bottleneck
- Intro to architecture