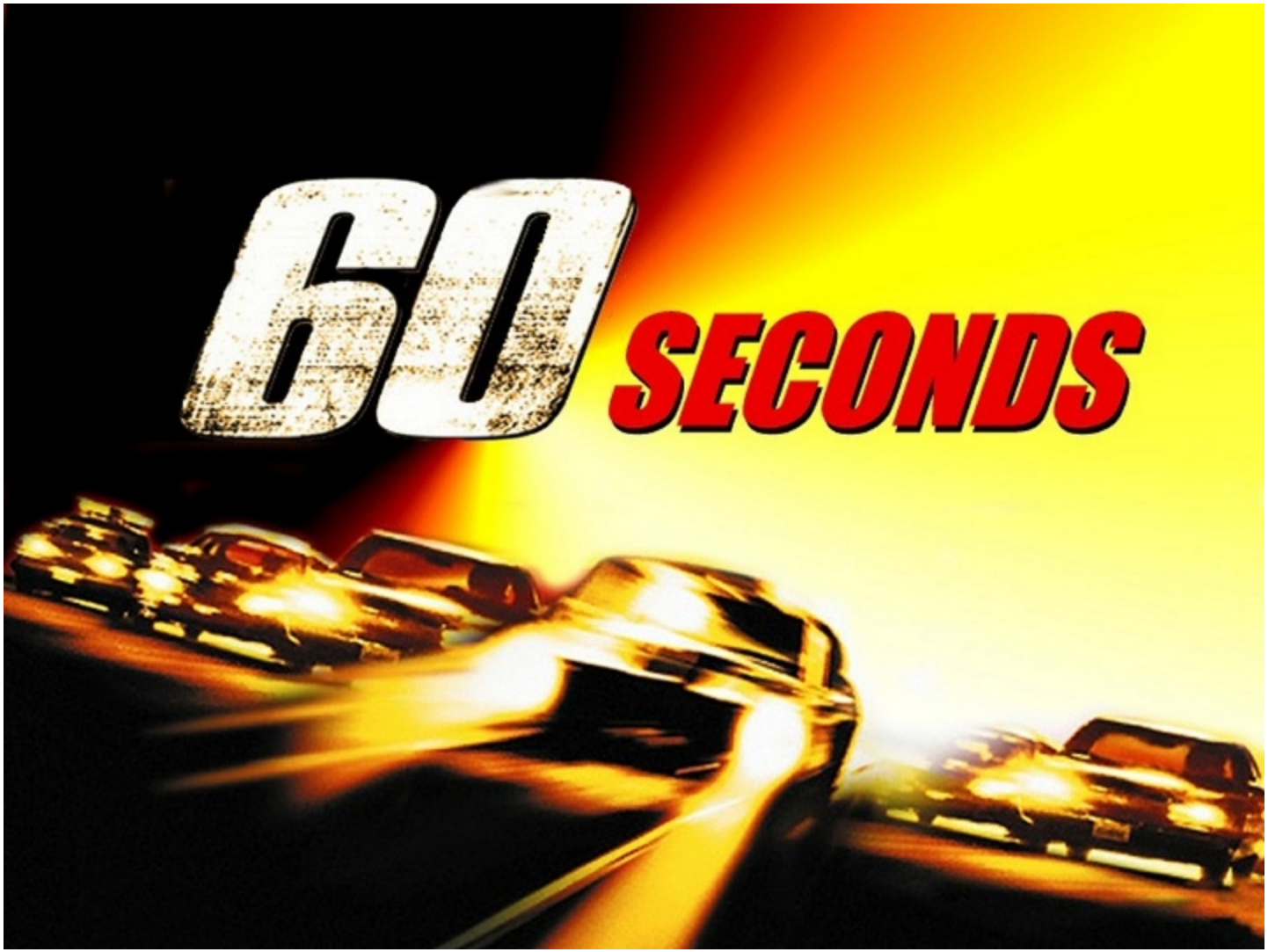
Minute Sort

What is Minute Sort?

- Simple task
- Sort as much as you can in **60 seconds** .


60
SECONDS

What is Minute Sort?

- Current World Record - 1353 GiB in 60 seconds (*Triton Sort*, 2011)
- **22.5 GiB/s**
- Disk Read Speed: ~ 50 MiB/s

Architecture

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- We will use Lonestar and Ranger

	Triton Sort	Our Configuration
# of Nodes	52	4
# of Cores / Node	2 Quadcores = 8	12
Total # of Cores	416	48
Disk Space	52 x 16 x 500 GiB ≈ **416 TiB**	250 GiB ($WORK)
Memory / Node	24 GiB	24 GiB
Total Memory	**1248 GiB**	96 GiB

Back of the Envelope Calculations

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Triton Sort

- 52 nodes, each have 16 disks
- A total of 832 disks
- A conservative esimate: 60 MB/s R/W speed => ~ **50 GiB/s** of bandwidth

Back of the Envelope Calculations

Triton Sort

- Their sorting speed => **22.5 GiB/s**
- = 22.5 GiB/s Reading + 22.5 GiB/s Writing
- = 45 GiB/s
- They are operating at close to disk bandwidth

Architecture

- Use **OpenMPI** for inter-machine parallelism
- Use **Cilk** for intra-machine parallelism

Basic Algorithm

Basic Algorithm - Inter Machine

- As discussed in class, we use over-sampling to choose *k* good pivots, and hence divide the input into *k* roughly equal parts.
- Each machine then works on an independent partition.
- When all the machines have independently sorted their partition, we can stitch the independent paritions without needing to merge them.

Basic Algorithm - Intra Machine

- Use a Merge-Sort based algorithm to sort the relevant parition on each node.
- Use Cilk for this purpose
- Try various optimizations to reduce buffer copying in Merge-Sort.

Challenges

Challenges

- We are practically limited by the disk I/O bandwidth. If the disk can only read / write 50 MB/s, we cannot sort more than (50*60)/2 = 1.5 GB in a minute. Potentially use compression before writing.
- Network Bandwidth might be limited. Potentially use compression.
- Certain optimizations like ensuring the file is in the cache might help (by reading the file just before the program is run).

Thank You