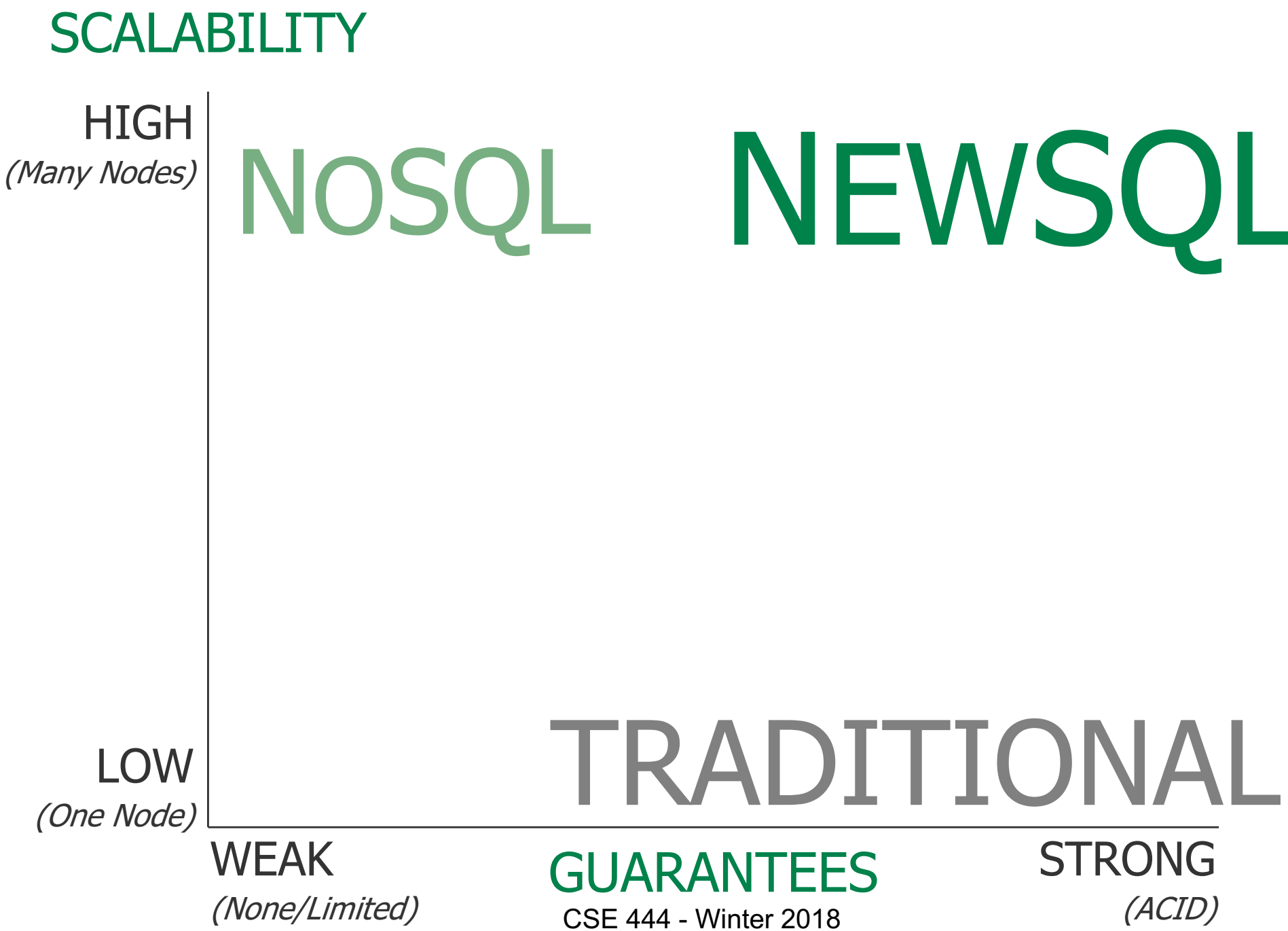
CSE 444: Database Internals

Lecture 27

NewSQL



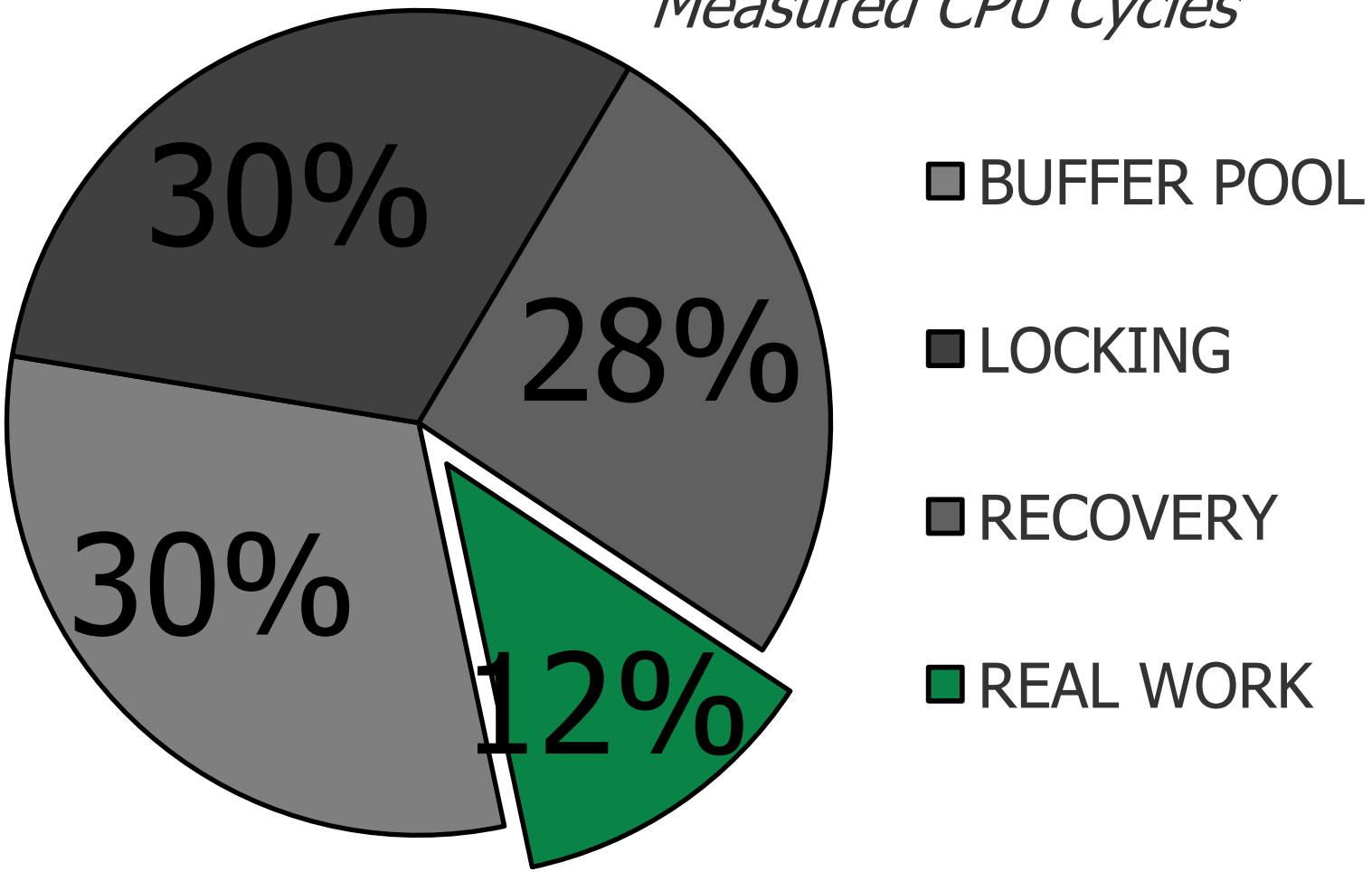
Slide from Andy Pavlo @ CMU

Some Popular NewSQL Systems

- H-Store
  - Research system from Brown U., MIT, CMU, and Yale
  - Commercialized as VoltDB
- Hekaton
  - Microsoft
  - Fully integrated into SQL Server
- Hyper
  - Hybrid OLTP/OLAP
  - Research system from TU Munich. Bought by Tableau
- Spanner
  - Google

H-STORE INSIGHT

TRADITIONAL DBMS:



OLTP THROUGH THE LOOKING GLASS, AND WHAT WE FOUND THERE
SIGMOD, pp. 981-992, 2008.

Slide from Andy Pavlo @ CMU

H-Store Key Ideas

- Main-memory storage
  - Avoids disk IO costs / buffer pool costs
  - Durability through snapshots + cmd log
  - Replication
- Serial execution
  - One database partition per thread on one core
  - Avoid overheads related to locking
- All transactions are stored procedures
  - Command logging avoids heavy recovery overheads
- Avoid distributed transactions
  - But when needed, run 2PC

STORED PROCEDURE

VoteCount:

```
SELECT COUNT(*)
 FROM votes
WHERE phone_num = ?;
```

InsertVote:

```
INSERT INTO votes
 VALUES (?, ?, ?);
```

```
run(phoneNum, contestantId, currentTime) {
        result = execute(VoteCount, phoneNum);
        if (result > MAX_VOTES) {
                return (ERROR);
        }
        execute(InsertVote, phoneNum,
                contestantId,
                currentTime);
        return (SUCCESS);
}
```

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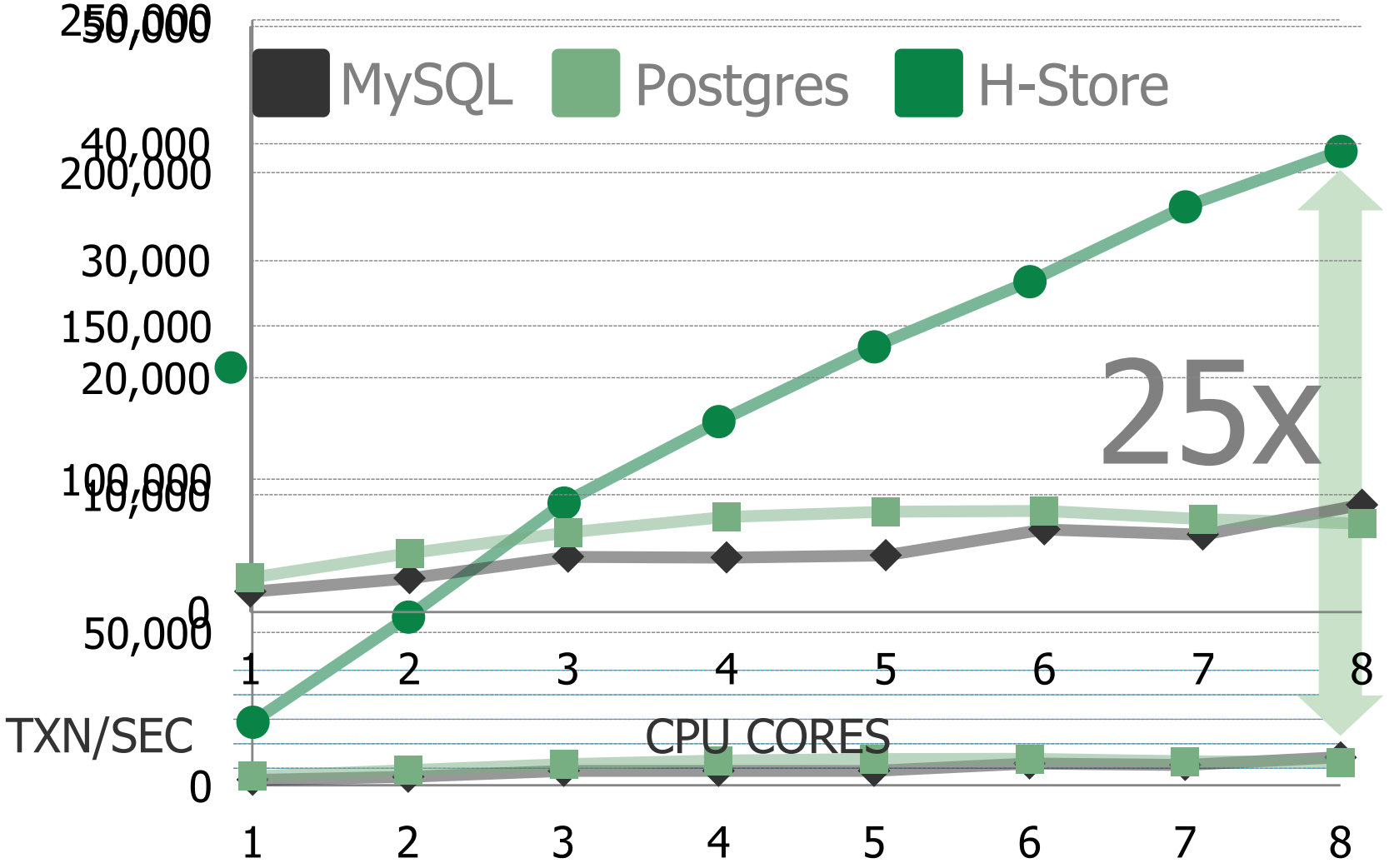
VOTER BENCHMARK

Japanese "American Idol"



H-Store

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Hekaton

- Focus: DBMS with large main memories and many core CPUs
- Integrated with SQL Server
- Key user-visible features
  - Simply declare a table “memory resident”
  - Hekaton tables are fully durable and transactional, though non-durable tables are also supported
  - Query can touch both Hekaton and regular tables

Hekaton Key Details

- Idea: To increase transaction throughput must decrease number of instructions / transaction
- Main-memory DBMS
  - Optimize indexes for memory-resident data
  - Durability by logging and checkpointing records to external storage
- No partitioning
  - Any thread can touch any row of any table
- No locking
  - Uses a new MVCC method for isolation

Hekaton More Details

- Optimized stored procedures
  - Compile statements and stored procedures into customized, highly efficient machine code

Hyper

- Hybrid OLTP and OLAP
- In-memory data management
  - Including optimized indexes for memory-resident data
  - Data compression for cold data
- Data-centric code generation
  - SQL translated to LLVM
- OLAP separated from OLTP using MVCC
- Exploits hardware transactional memory
- Data shuffling and distribution optimizations

Conclusion

- Many innovations recently in
  - Big data analytics
  - Transaction processing at very large scale
- Many more problems remain open
- This course teaches foundations
- Innovate with an open mind!