CSC343
Course Wrap-Up

csc343, Introduction to Databases
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Fall 2015

UNIVERSITY OF TORONTO

DCS50

Database Design – Recap & Comments

- Closure +
- Projection
- Minimal Cover
- Finding Keys for R
- BCNF Decomposition
- 3NF Decomposition

Bogdan's section (L0101) used a slightly different algorithm. It's ok if you use either approach!
Just get it right :-)

Tutorial examples posted on course website are important. If you only rely on course slides, you don't get the full picture!

Minimal Cover

- Step 1: Reduce RHS to Singletons
- Step 2: Remove redundant FDs
- Step 3: Reduce LHS whenever possible
- Step 4: Repeat steps 2, 3 until no changes occur

✓ In the other approach, reverse steps 2, 3, eliminate 4.

✓ Both are cited as valid Minimal Cover algorithms.

✓ This one (above) since is consistent with the text book we're using for this course.

Database Design – Recap & Comments

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There are *techniques* to help you limit the scope of attributes you use to find a relation's Keys

Finding Keys from FDs – Helping techniques

- *Prime* attribute: if it's part of any *key*
- Example #1: R(ABC), FDs = {A→B, B→C}
- A is clearly a key

=> A is prime, B and C are non-prime

- Example #2: R(ABC), FDs = {AB→C, C→A}
- AB and BC are the keys (Check: closure test!)

=> A, B, and C are prime (but not *keys* alone!)

- How do I know AB and BC are keys?

Keys from FDs – Helping technique (Example 1)

- R(ABC), FDs = {A→B, B→C}
- Table of where attributes appear in FDs

```
Only Left | Middle (appears both left/right)| Only Right
-------------------------------------------------------
     A    |               B                 |    C
```

✓Only on Left => *must* be part of any key

✓Only on Right => *cannot* be part of any key

✓Middle => maybe (*in combination with LEFT atts*); maybe not.

- In this case: A
- A+ = ABC => A is the key
- A is part of any key, and it happens to be a key

=> no need to look at B

Keys from FDs – Helping technique (Example 2)

- R(ABC), FDs = {AB→C, C→B, C→D}
- Table of where attributes appear in FDs:

```
Left   | Middle   | Right
-------------------------------
 A     |   B, C   |  D
```

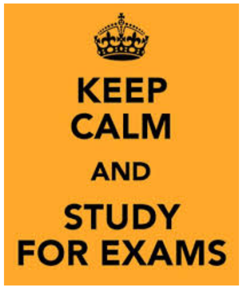
- A must be part of any key; might be a key on its own, might not (test!)
- => A+ = A
- Add one from Middle: AB
- => AB+ = ABCD
- Must try it with the other Middles too: AC
- => AC+ = ACBD

=> both AB, AC are keys!

◆What if *all* attributes of a relation were in the *middle*?

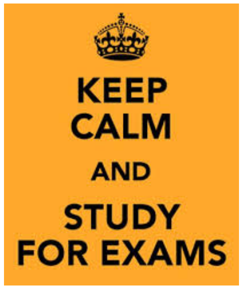
◆ Try one at a time, then combinations of two, etc.

The Final



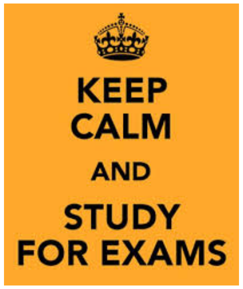
- Comprehensive (covers the whole term), including:
  - RA
  - SQL (DDL, DML); JDBC
  - DTDs, XML, XQuery
  - FD theory and normalization
  - ER modelling and DB design

Preparing for the exam



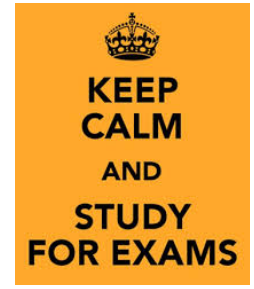
- Re-solve parts of the assignments where you didn't get full marks.
- For topics you aren't fully confident in, re-do the lecture prep and in-class exercises.
- Go over solutions for in-class exercises
- Make up your own queries in RA, SQL, XQuery to hit on query types and language features you need practice in.
- Solve old tests and finals.

The Final



- You need to know the syntax of each language.
- You don't need to memorize function/method APIs. We will provide what you need and/or be forgiving when marking those details.
- SQL: views are always welcome, as long as correct.
- Comments are never necessary unless we say otherwise.
- Questions may be similar to previous tests and final exams, but don't count on that!

The Final



- It's about 24 pages long, but
  - A page towards the end is empty (for rough work)
  - Last 2 pages: the schemas for reference (you can detach this last sheet, for convenience – do not detach anything else though)
  - Page 1 is the cover
  - Lots of empty space to fill in your answers
- So it's really 20 pages, with lots of white space
- You need 40% on the final to pass the course, regardless of the rest of the term marks

Final Exam – Logistics

- When and where:
- http://www.artsci.utoronto.ca/current/exams/dec15

CSC343H1F	A - MC	TUE 15 DEC	EV 7:00 - 10:00	BN 2N
CSC343H1F	ME - Z	TUE 15 DEC	EV 7:00 - 10:00	BN 2S
CSC369H1F	A - T	FRI 11 DEC	EV 7:00 - 10:00	BN 3
CSC369H1F	U - Z	FRI 11 DEC	EV 7:00 - 10:00	ST VLAD
CSC373H1F		THU 17 DEC	EV 7:00 - 10:00	BN 3

- Clara Benson Building (BN), 320 Huron Street
- Next to Athletic Centre!
- EV == evening! So, it's at 7-10PM, not AM!

Course wrap-up - Lessons learned

- What do I take away from this course?
  - Data models are important
  - Relational model: concept of relation/table
  - Schema vs. instance!
  - Keys, integrity constraints
  - RA: foundation of SQL
  - SQL: DML, DDL, expressive power/limitations
  - Embedded SQL: more control, addresses SQL limitations by combining it with a conventional language
  - XML/DTD + Xpath/Xquery – not all data fits a rigid schema; unstructured data needs another representation
  - Database design theory:
    client requirements => E/R diagram => relational schema.
  - FD theory helps bring schema into a normal form

Why should I care?

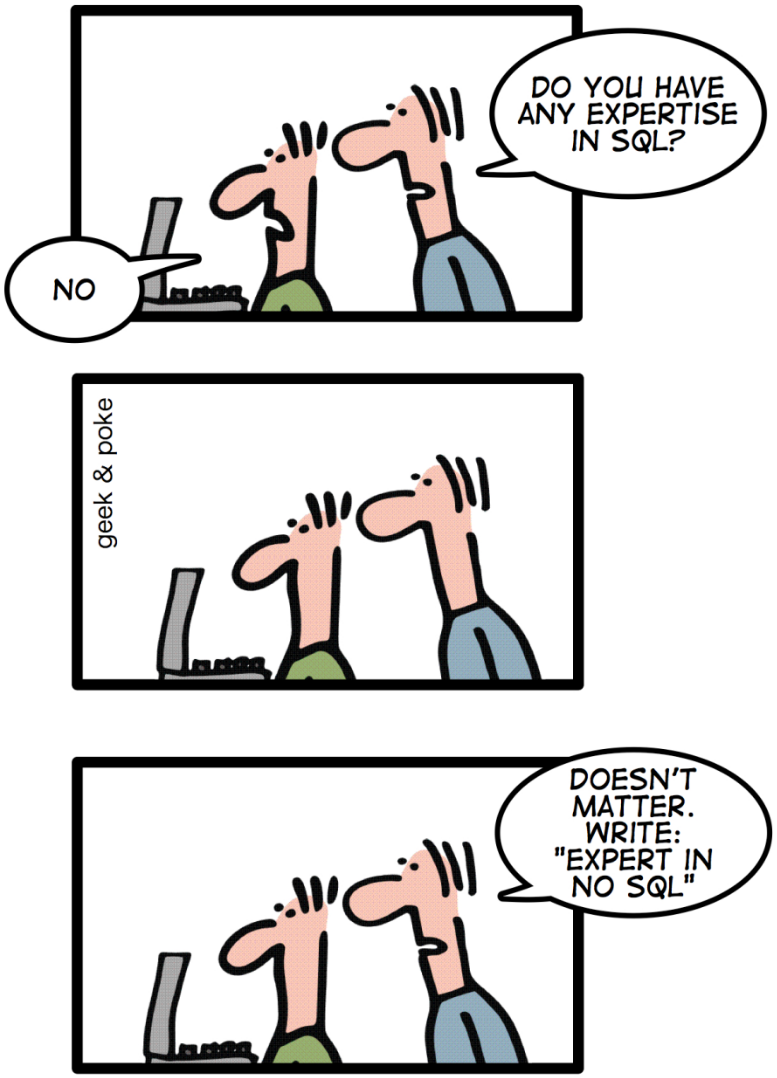
- In the era of Big Data, having knowledge of database systems is really important! E.g.,
  - What type of data do I have? Structured vs. unstructured
  - How do I start designing a database?
  - How do I optimize my design?
  - How do I use a database system?
- Database systems are all part of a bigger picture

Trends in DB Research

- Managing huge amounts of data: approximate querying, statistical methods, self-tuning, power management
- NoSQL technologies
- Stream processing
- Data mining
- Data privacy and security
- Different *kinds* of data, e.g., spatial, temporal, data from sensors, social network data, graph databases
- Visualization of data

- Top-tier database conferences: VLDB, SIGMOD, ICDE, EDBT, CIDR, CIKM, SIGSPATIAL GIS, IEEE BigData

NoSQL – why should I check it out?



Leverage the NoSQL boom

BigData – no "one-size fits all"

- Relational databases are not always a good fit

- No "one-size fits all"
  - Typical relational database: less than 1TB of data
  - Google: 900 TB of search engine data (mostly unstructured!)
  - Youtube: 80PB video data/year
  - Scientific data
    - US department of energy: 3.5PB

Need for flexible data model

- Relational schema: too rigid
  - No way to change dynamically
  - Need a DB admin to "stop the world" and change the schema, migrate the data in the new structures, etc.

- Many applications' data: no fixed structure
  - Log processing
  - Stream processing
  - Graph processing
    (e.g. think Google Maps)

NoSQL advantages

- Data is replicated to multiple nodes (availability and fault-tolerance) and can be partitioned
  - Down nodes easily replaced
  - No single point of failure
- Can scale up and down
- Doesn't require a schema
  - Not really.. :)

What are we sacrificing instead?

- Decades of database optimizations (carefully-designed query optimizers, indexing, etc.)

- Joins

- ACID Transactions

- SQL, powerful expressive query language (mostly)

- Easy integration with other applications that support SQL

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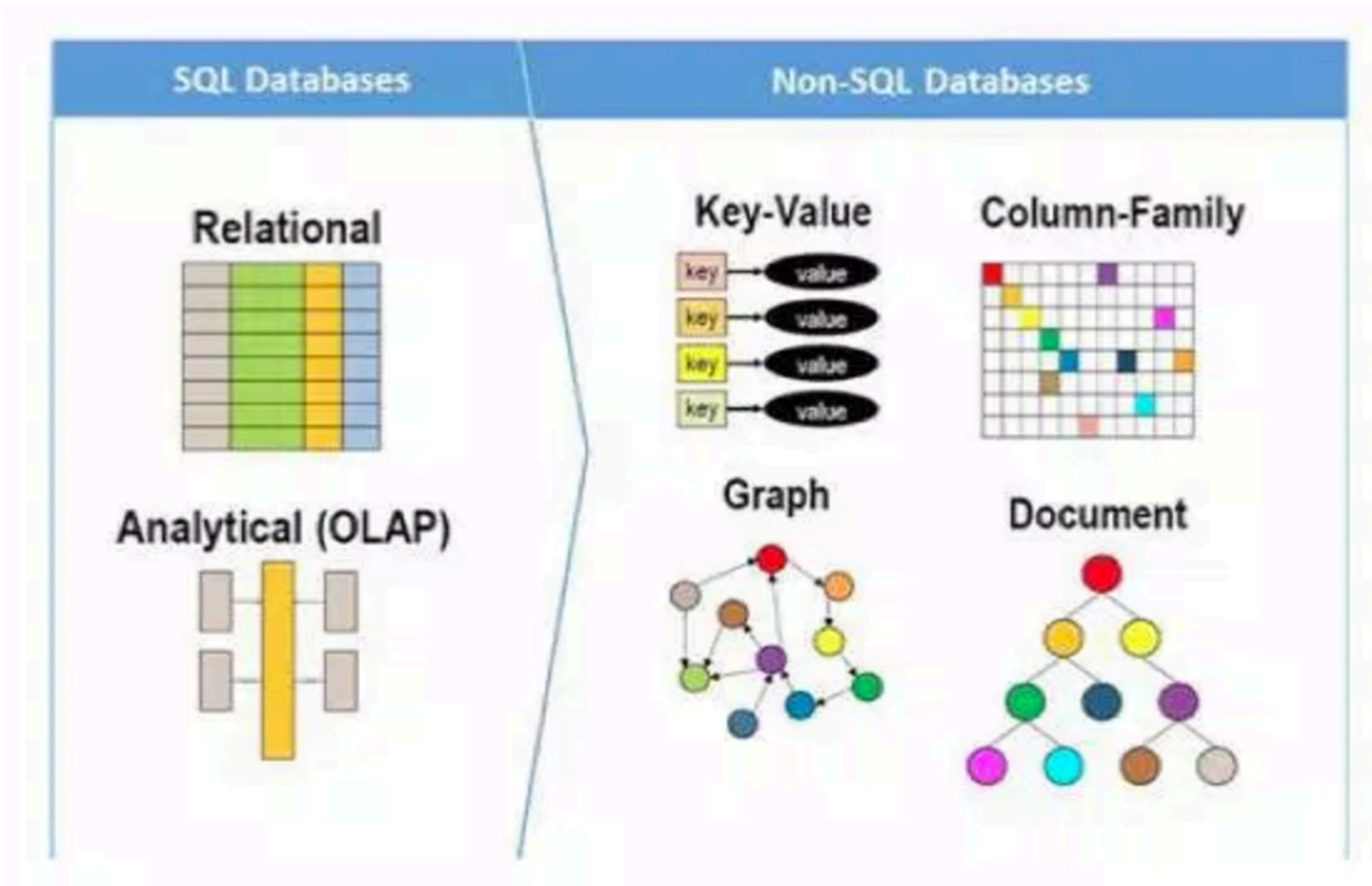
Should I be using NoSQL Databases?

- NoSQL data storage systems makes sense for applications that need to deal with very large semi-structured data
  - Log Analysis
  - Social Networking Feeds

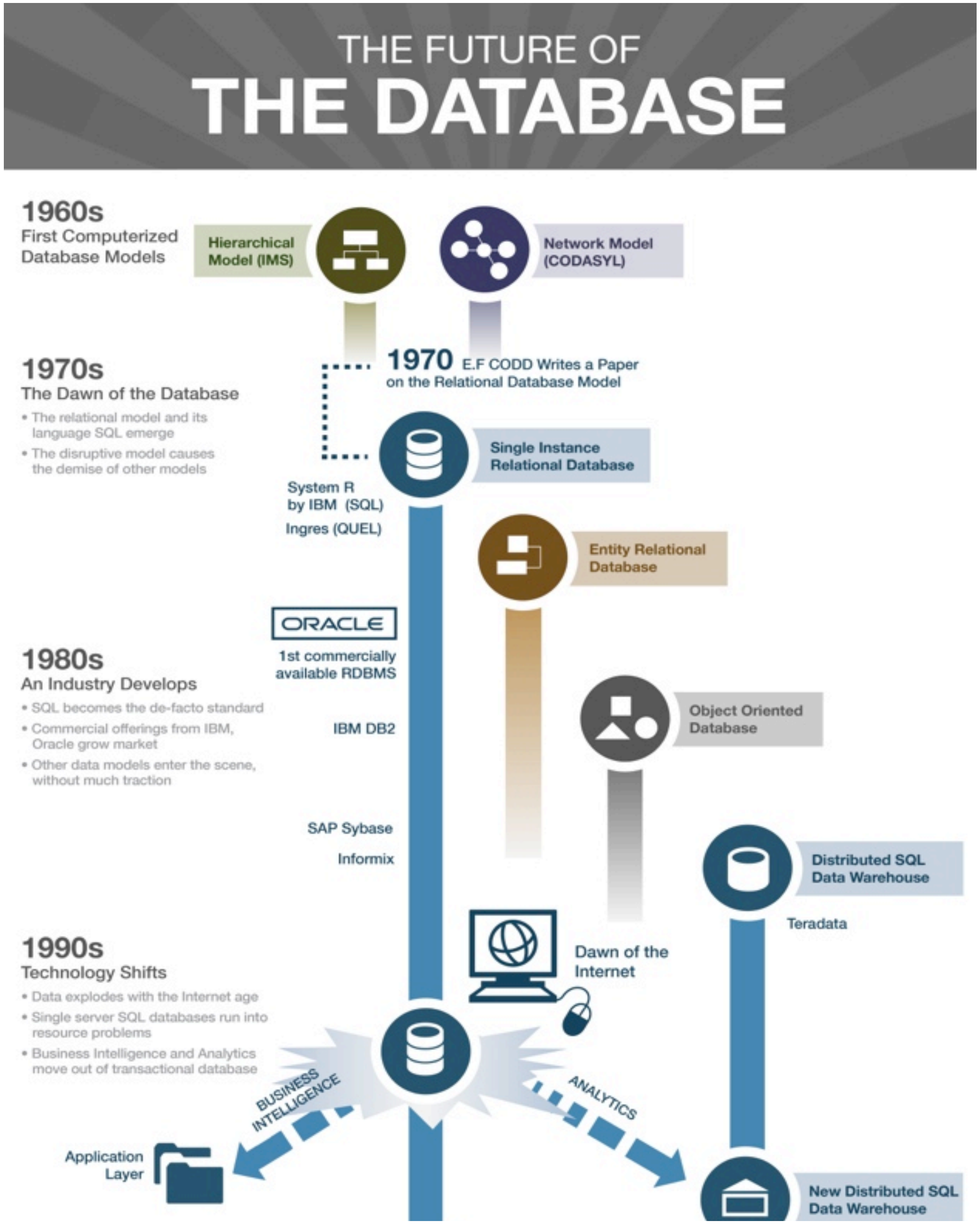
- Most of us work on organizational databases, which are not that large and have low update/query rates
  - Regular relational databases are the right solution for most such applications



Source:

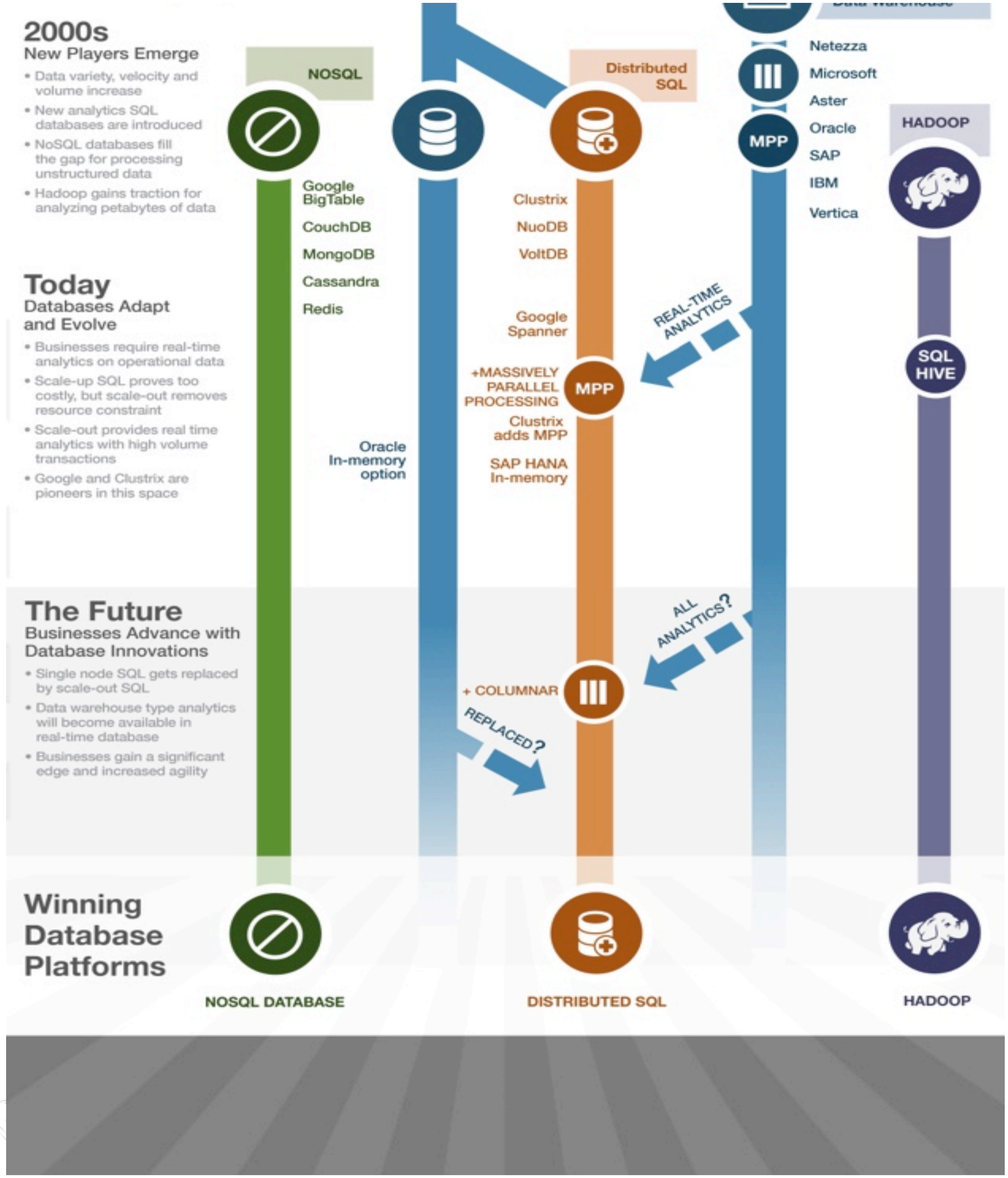
https://kvaes.wordpress.com/2015/01/21/database-variants-explained-sql-or-nosql-is-that-really-the-question/

Big Picture
What next?



Source: *wired.com*

Google



YAHOO!

facebook

Source:
wired.com

CSC443

- "Database System Technology"
- Takes the perspective of building a DBMS.
- Internals of a DBMS
- Topics like:
  - Memory management – bufferpool
  - Query optimization – produce good query plans
  - Managing storage – row-oriented, column-oriented, etc.
  - Concurrency control
  - Tuning for performance
  - Types of workloads: OLTP, OLAP, etc.
  - Data mining

Thank you!

Hope you found this course interesting; good luck using what you learned in your future career prospects!

Good luck with the final exam :-)