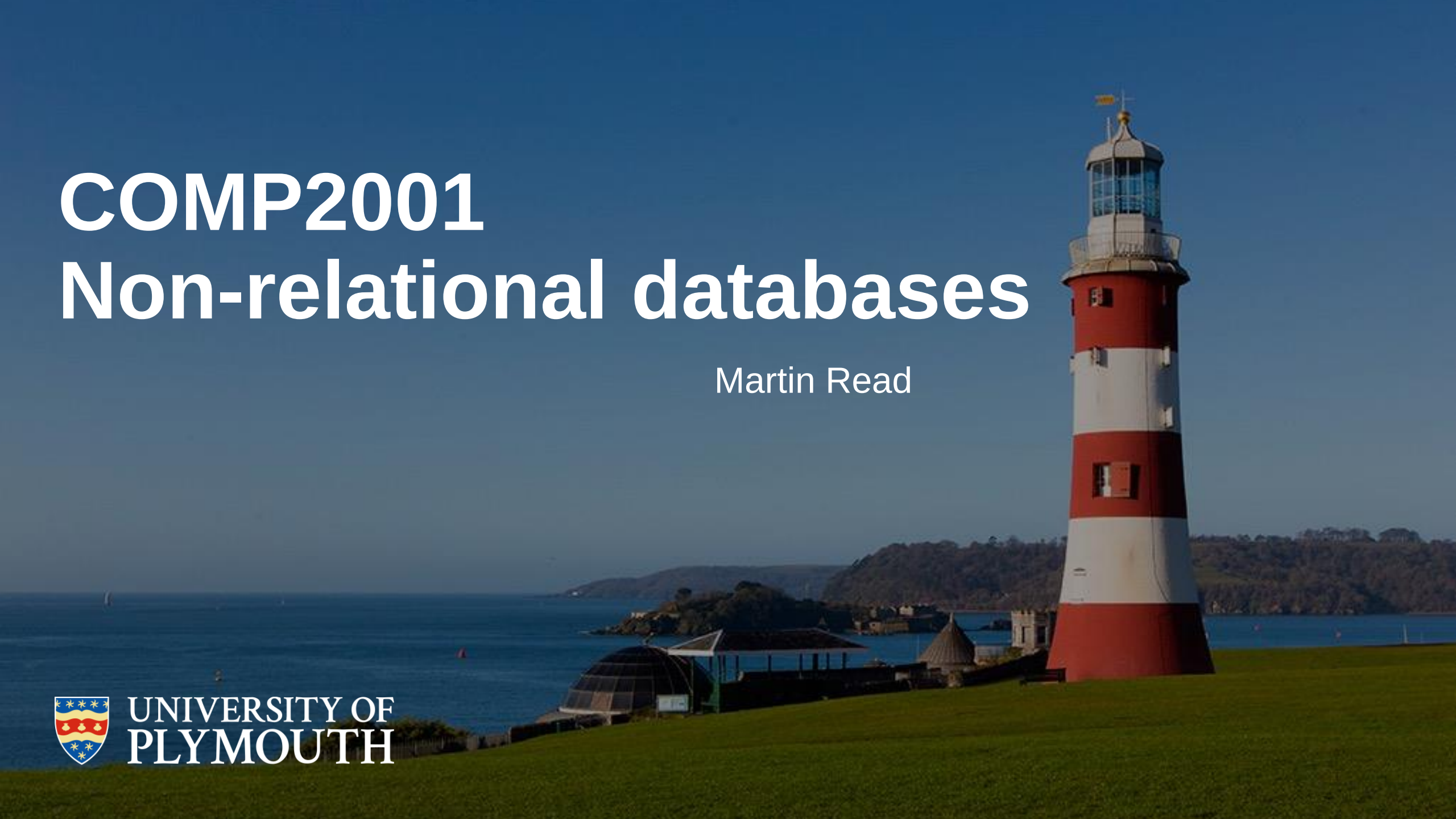

COMP2001
Non-relational databases

Martin Read

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Session outline

- To introduce landscape for advanced database concepts and information retrieval
- Summarise major approaches of the NoSQL data model and how they differ from the relational model

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Databases

“A database is a collection of information that exists over a long period of time, often many years. ”

– *Garcia-Molina et al. Database Systems: The Complete Book*

Databases are powerful tools for doing exactly what computers do best:

- store
- manipulate
- display information

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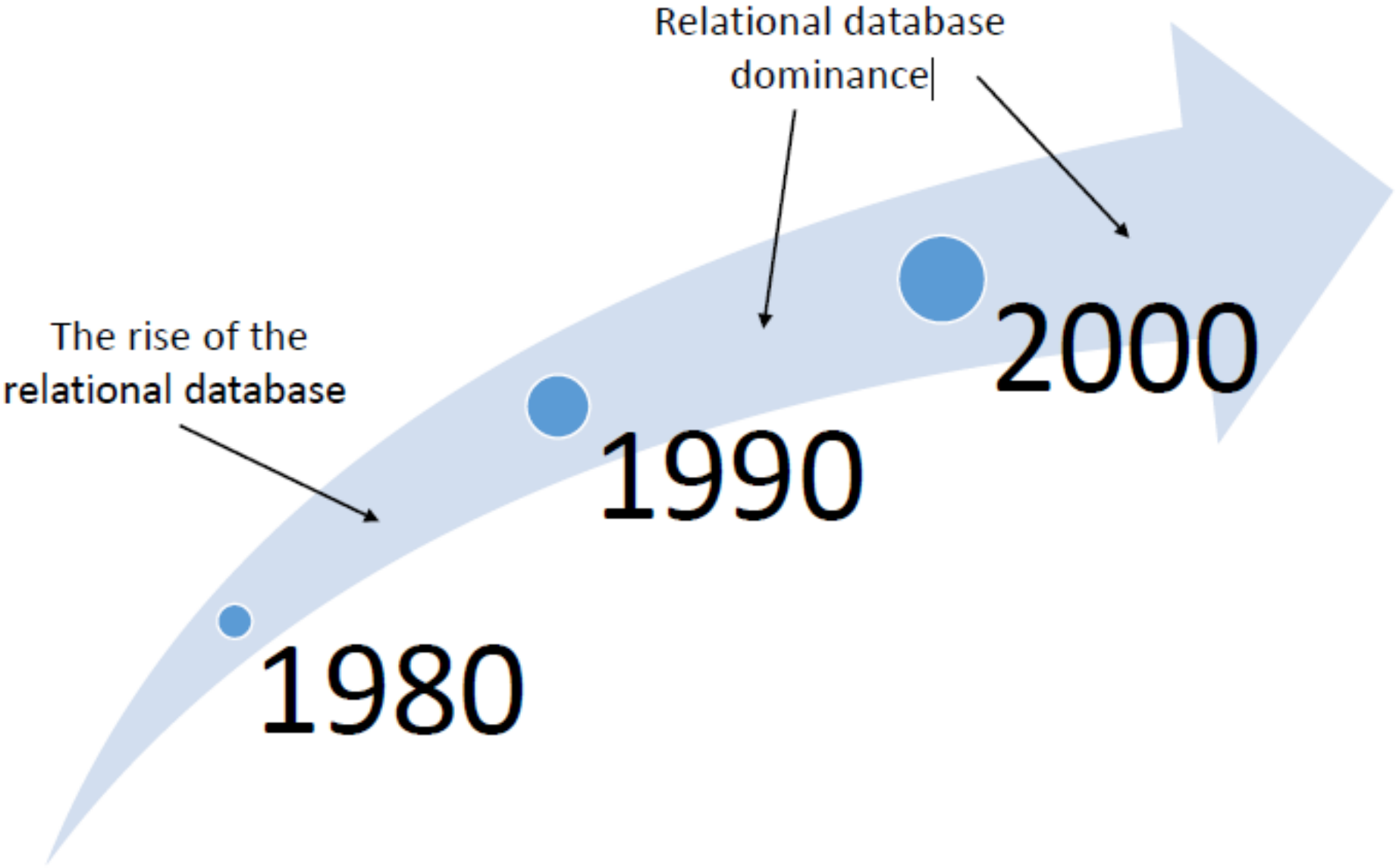
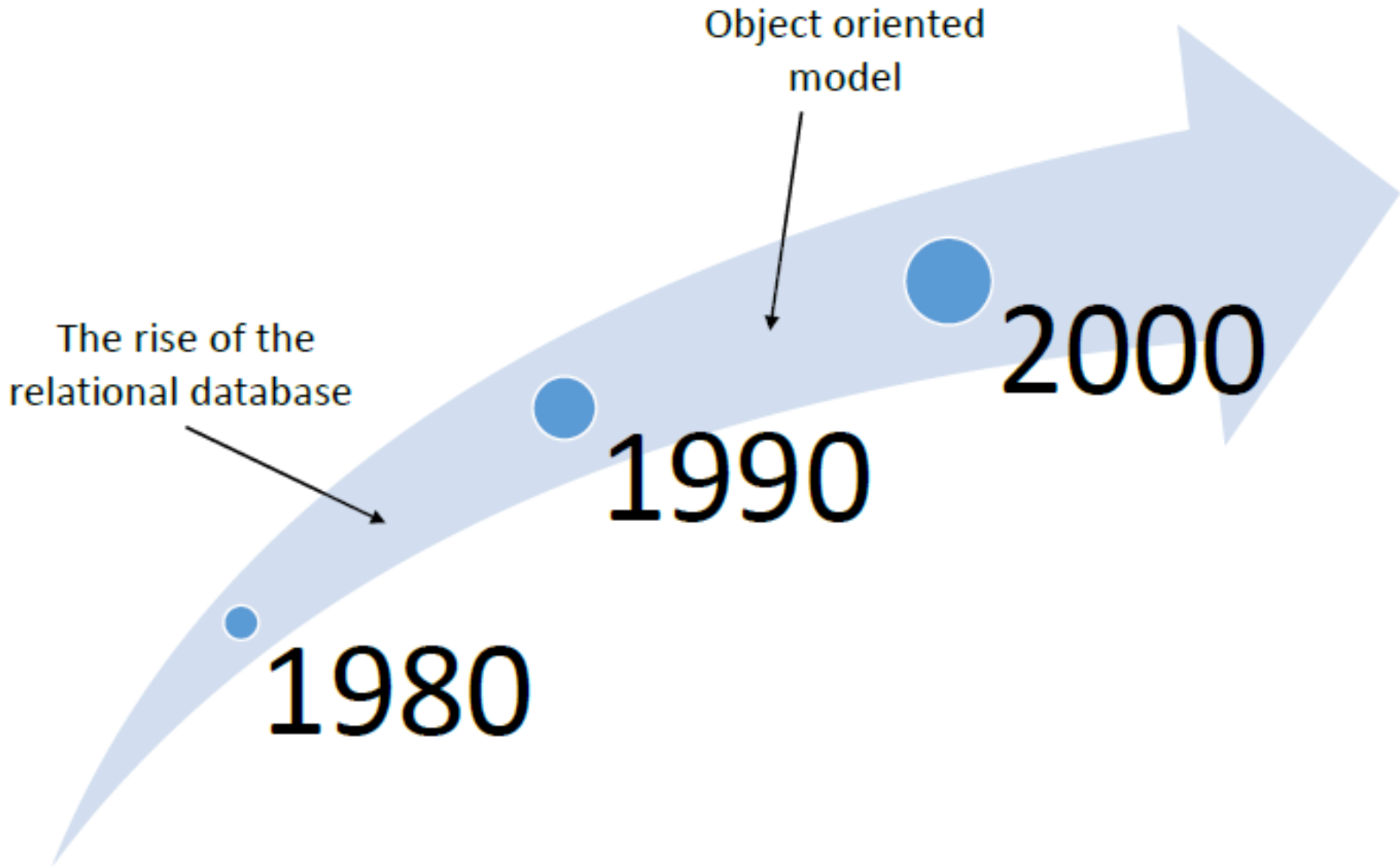
Background (history)



Background (history)



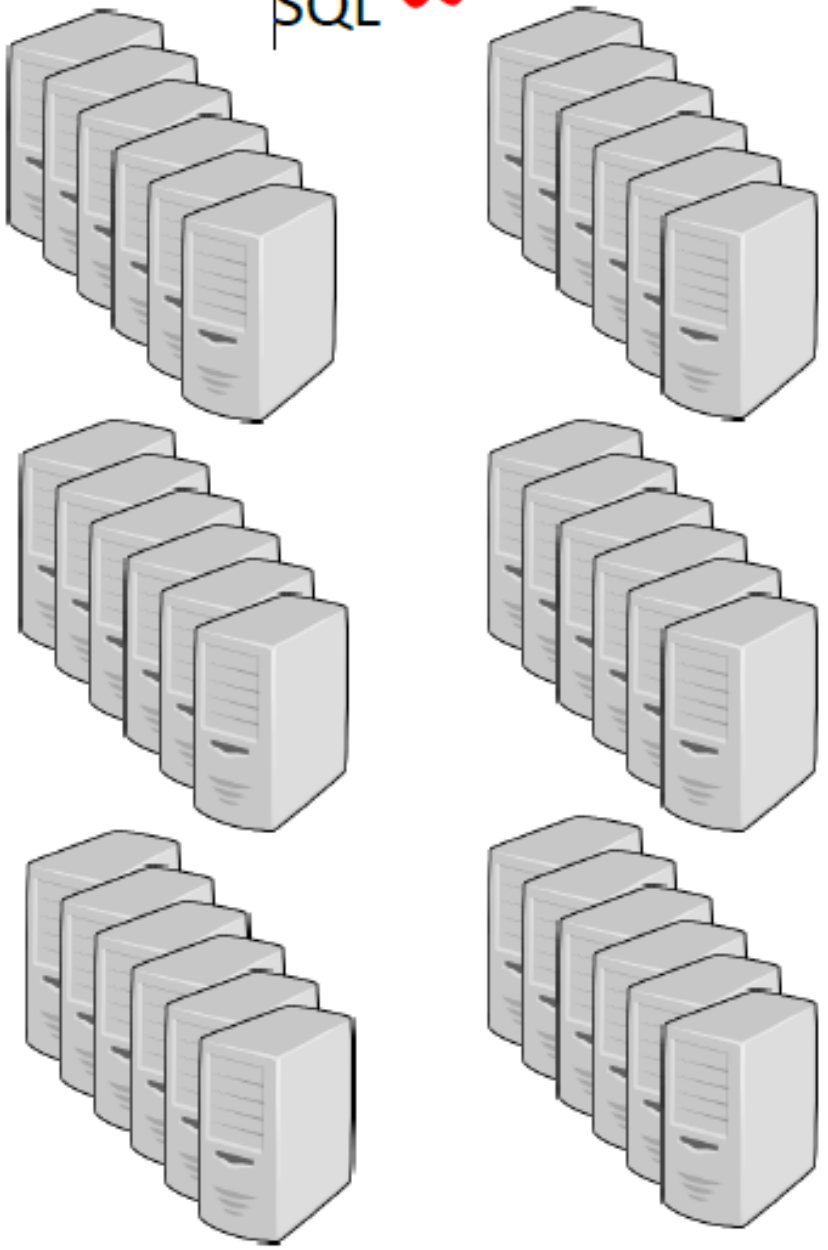
Internet traffic

Servers

SQL ✓

Unnatural acts...

SQL ✗



New data storage systems

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Origins

Google	Apache Software Foundation
Google File System (GFS)	Hadoop Distributed File System (HDFS)
Google MapReduce	MapReduce
Google BigTable	Apache HBase

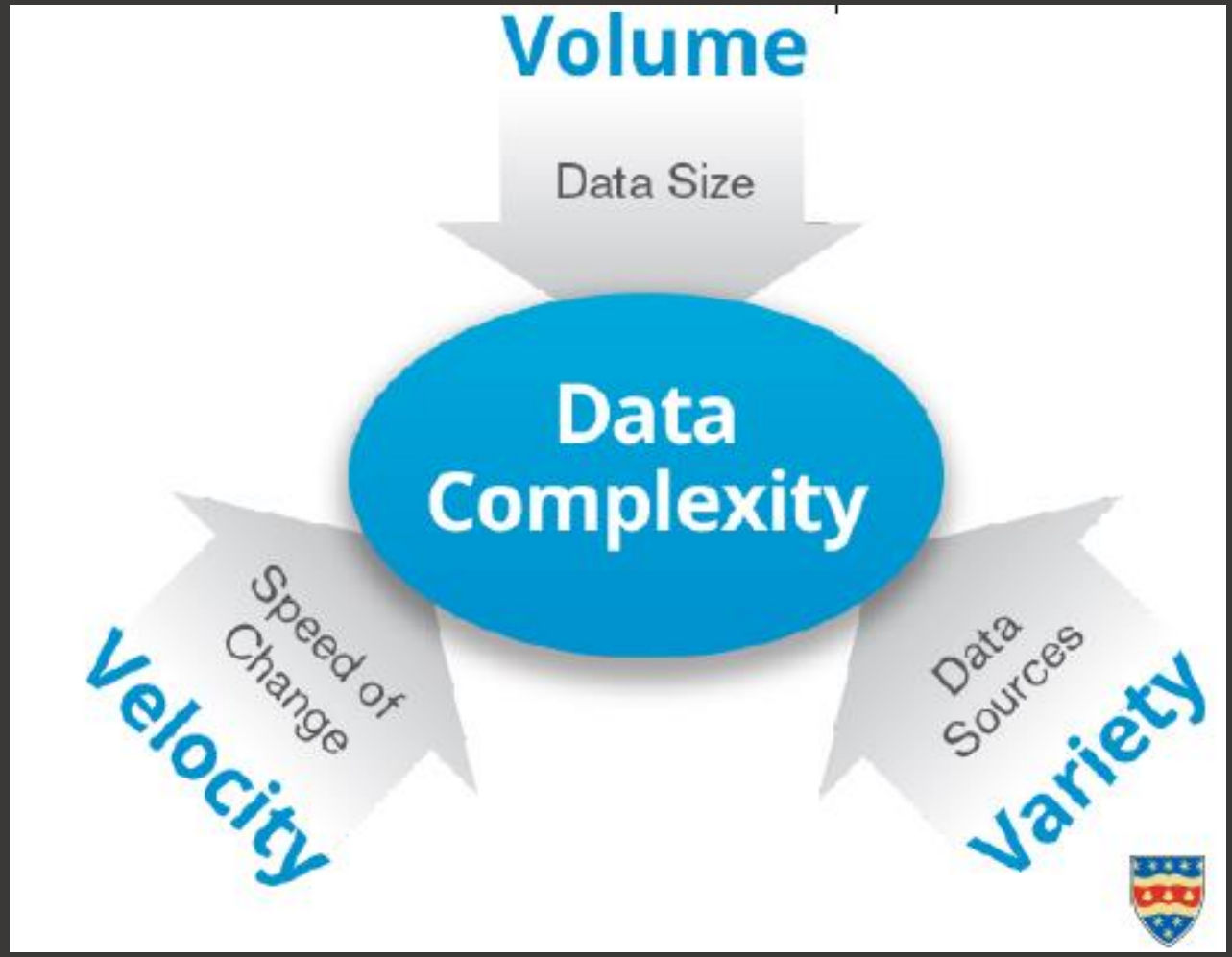
Google whitepapers

The origins of non-relational databases can be traced back to 3 Google whitepapers:

- Sanjay Ghemawat, Howard Gobioff, and Shun-TakLeung. 2003. **The Google file system**. In Proceedings of the 19th ACM symposium on Operating systems principles(SOSP '03). ACM, New York, NY, 29-43.
- Jeffrey Dean and Sanjay Ghemawat. 2010. **MapReduce: A flexible data processing tool**.Commun. ACM53, 72-77.
- Fay Chang, *et al*. 2008. **Bigtable: A Distributed Storage System for Structured Data**. ACM Trans. Comput. Syst.26, 2

Big Data

- Big data is often described using the three Vs: **volume**, **velocity** and **variety**



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Four Vs

Sometimes big data is described using four Vs:

- Volume
- Velocity
- Variety
- **Veracity**

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Veracity

Refers to the messiness or trustworthiness of the data

- **With many forms of big data, quality and accuracy are less controllable**
- Estimated that poor data quality costs the US economy 3.1 trillion US dollars per year
  - consider Twitter posts, abbreviations, typos & colloquial speech
  - reliability and accuracy of content
- technology now allows us to work with this type of data

Five Vs

Sometimes big data is described using five Vs:

- Volume
- Velocity
- Variety
- Veracity
- **Value**

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Value

- Value refers to the ability to **achieve greater value through insights from the analysis of big data**

- Aircraft engine manufacturers make use of big data analysis to predict engine events that lead to costly airline disruptions with 97% accuracy. This could save millions

Criticism

- **Big data** is an ill-defined term
- There is a lack of precision in the definition of big data, which leads to ambiguity

- **NoSQL** is an accidental neologism
- a term with no prescriptive definition. All you can make is an observation of common characteristics

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New data storage systems

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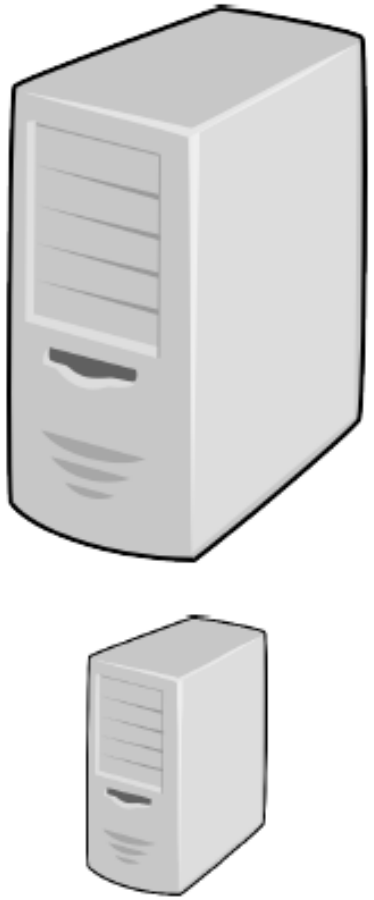
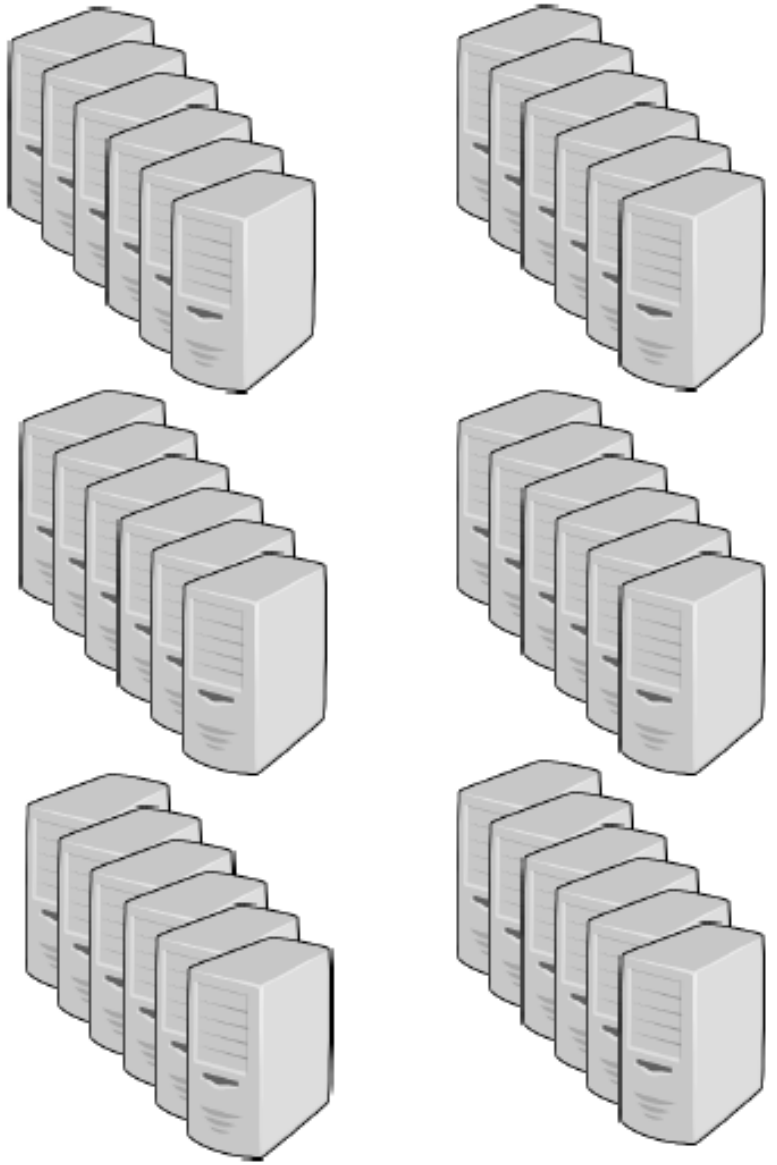
Scaling



Scale up

Scale out



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Emerging data models

- **Bigtable:** Google Bigtable
- **Key-value store**, or **key-value database:** Redis, MemcacheDB, Berkeley DB (BDB), HamsterDB...
- **Document-oriented database**, or **document store**: MongoDB, CouchDB, OrientDB, RavenDB, Lotus Notes....
- **Graph database**: Neo4j, HyperGraphDB...

NoSQL... ?

- NoSQL was a Twitter hashtag (#nosql) chosen for a meetup organised by **Johan Oskarsson**in San Francisco in 2009 to discuss new databases

- “NoSQL is an accidental term with no precise definition”. [Sadalage& Fowler: NoSQL Distilled, 2012]

NoSQL

- **NoSQL**means **Not Only SQL**
- implying that when designing a software solution or product, there is more than one storage mechanism that could be used

NoSQL features

- Non-relational
- Cluster friendly
- Open source
- 21st Century Web

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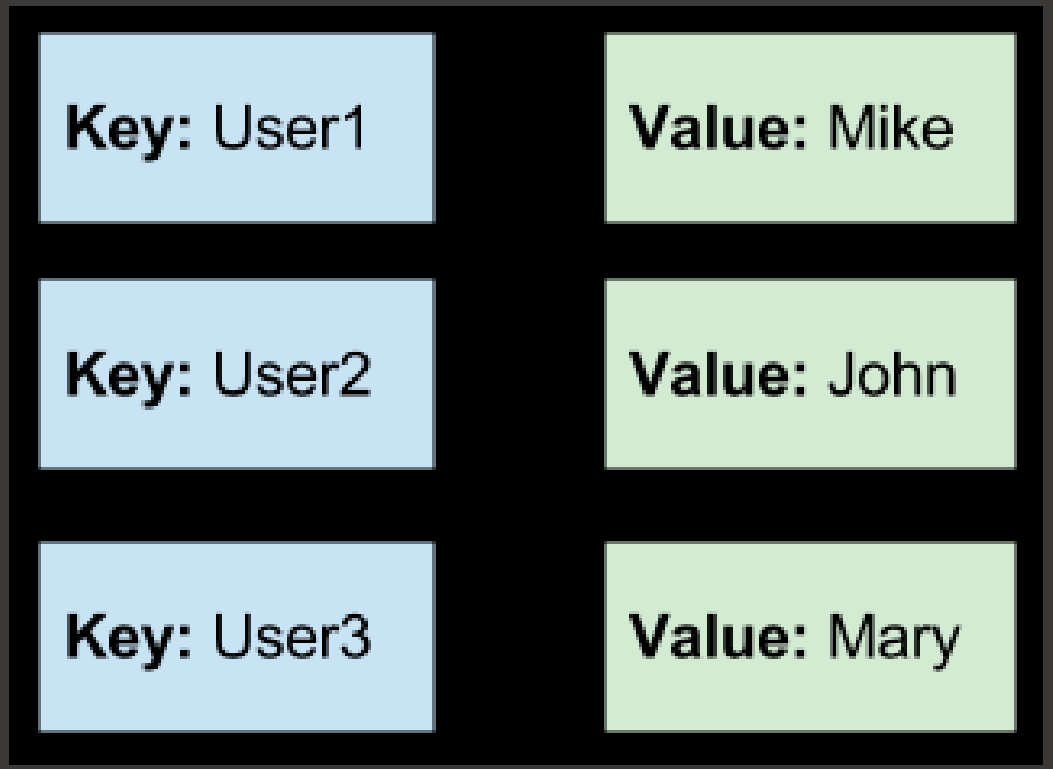
Key-value store

- Key-value pairs are similar to a table
  - key serves as an index to find an associated value
- Key-value pairs are similar to accessing data in memory
  - the key is a **memory location** & the value is the **data stored at the location**, making key-value pairs a good data model for **in-memory databases**




Any Questions?
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