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# Introduction

This report uses a variety of specialized terminology and abbreviations. Explanations are defined in the Glossary.

# Database Technologies

**Relational Database Management Systems (RDBMS):**

Inferred from the name, the RDBMS uses a structure based on the relational model proposed by E.F. Codd in 1970 (Connolly 2015), to allow us to identify and access data attributes via table-based (Appendix B - Figure 1) relations using primary and foreign keys.

A screenshot of a computer

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Figure 1 Example RDBMS SQL Table Relations (W3Resource 2022)

They are designed to represent complex data schemas and minimize data redundancy through normalization whilst offering performant transactions using SQL[[1]](#endnote-1).

RDBMS vendors, such as *PostgreSQL, MySQL & SQLite* are amongst the most common databases used by professional developers, evidenced below.

A screenshot of a graph

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Figure 2 - Database Environments used by Professional Developers - Stack Overflow Survey 2023

An excellent reason to use an RDBMS’ is when your transactions must adhere to the ACID principles[[2]](#endnote-2) which most vendors support implicitly, and if your organisation has complex querying requirements.

A screenshot of a computer

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Figure 3 - ACID Principles

Any system that prefers reliable and consistent data storage with complex structure over performance will favour an RDBMS, such as:

* Banking systems
* Education sector systems
* Complex online stores

While RDMS’ advantages give them the number 1 spot in industry, their pros can be their greatest limitation for certain requirements:

* ACID inherently reduces performance, limiting their adoption by platforms like YouTube (Shivang, 2019).
* Unsuited for unstructured/semi-unstructured data such as JSON [[3]](#endnote-3)documents.
* Extreme complexity can lead to a poor representation of “real-world” entities & challenging schema updates (Connolly 2015).

**NoSQL – Not Only SQL**

**Hierarchical Databases:**

As one of the most straightforward database types, data is presented in a tree-like [[4]](#endnote-4)form resembling a single JSON Object. Relationships form a unidirectional parent-child hierarchy, where each record uniquely links to a single parent (Appendix B - Figure 2).

A diagram of a network

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Figure 4 - Hierarchical Data Structure - MariaDB 2015

Due to their tree-like structure, they are highly performant for read/write actions. They have exceptional use cases where entities are only in explicitly hierarchical relationships, such as File Systems (MariaDB, 2015).

However, they cannot support multi-dimensional or many-to-many relationships, so they are limited in their ability.

**Document Database**

Graph

Key-Value

Wide-Column

Object Oriented Databases

Time Series Databases

# Appendices

## Appendix A:

### Figure 1 – RDBMS Table

A simple representation of a table in a Relational Database Management System.

Adapted from “RDBMS Table Terminologies”, a blogpost by Wentz Wu. 8/07/2019.

### Figure 2 – Stack Overflow Database Environments Survey:

A chart displaying database environments used by professional developers (60,369 respondents). Answers are multiple choice to encapsulate total usage rather than the greatest usage of a specific vender.

Adapted from the 2023 Developer Survey by Stack Overflow.

### Figure 3 – ACID Principles:

A graphic showing an overview of the ACID Principles and their definitions.

Adapted from an independent blogpost by Dave Pinal. 9/12/2007.

### Figure 4 – Hierarchical Data Tree

A simple graphic showing the tree-like structure of hierarchical databases.

Adapted from an article from MariaDB. 06/06/2015.

## Appendix B:

### Figure 1 – RDBMS Table:

A diagram of a table

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A simple example of an RDBMS table and a visual representation of definitions associated with them.

Adapted from an example from W3Resource’s website. 19/08/2022.

### Figure 2 – Hierarchical Data Example:

A screenshot of a computer screen

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A visual representation of a Hierarchical data structure.

Organization is the Root of the hierarchy, with Departments & Employees as nested child entities. This demonstrates the limitation of the hierarchical data structure, as children can only have a single parent node.

# References

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# Glossary

1. SQL – Structured Query Language

   The standard language of accessing and manipulating Relational Database Management Systems. [↑](#endnote-ref-1)
2. ACID Principles:

   Atomicity, Consistency, Isolation & Durability. A set of principles applied to database transactions to enhance the reliability of data, avoid stateful concurrency issues in transactions and eliminate data loss through critical outages. [↑](#endnote-ref-2)
3. JSON – JavaScript Object Notation

   A lightweight format of data often sent across HTTP requests back and forth between a browser and server. Heavily adopted due to the format matching that of Object-Oriented Programming Languages, such as C# and JavaScript, making serialization of data easy for communication. [↑](#endnote-ref-3)
4. Tree Structure

   A data structure that contains a single root node that can have a recursive number of child elements with only one parent. Called a “Tree” due to its triangular visual representation and because each child node can be referred to as a branch, where each branch has it’s own branches. [↑](#endnote-ref-4)