

# Introduction to Database Systems (CS 4320 @ Cornell)

Immanuel Trummer

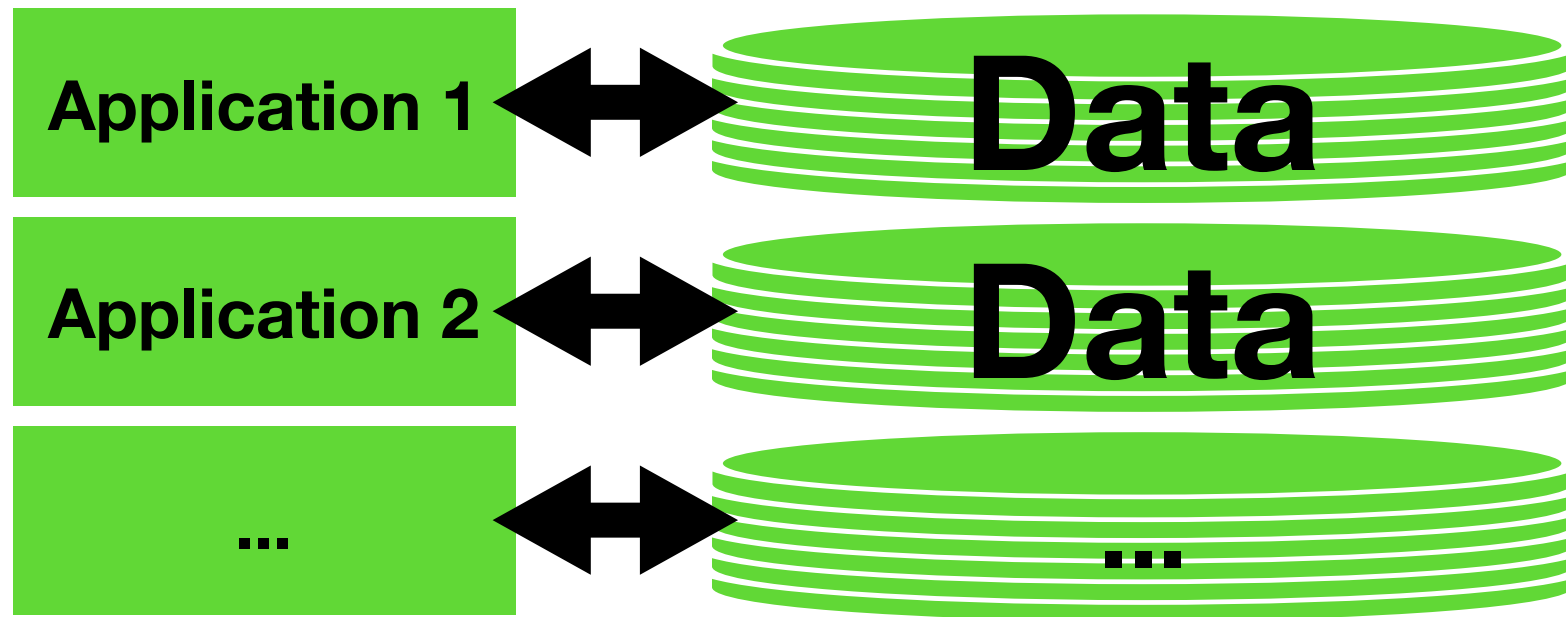
@[ImmanuelTrummer](#)

[www.itrummer.org](http://www.itrummer.org)

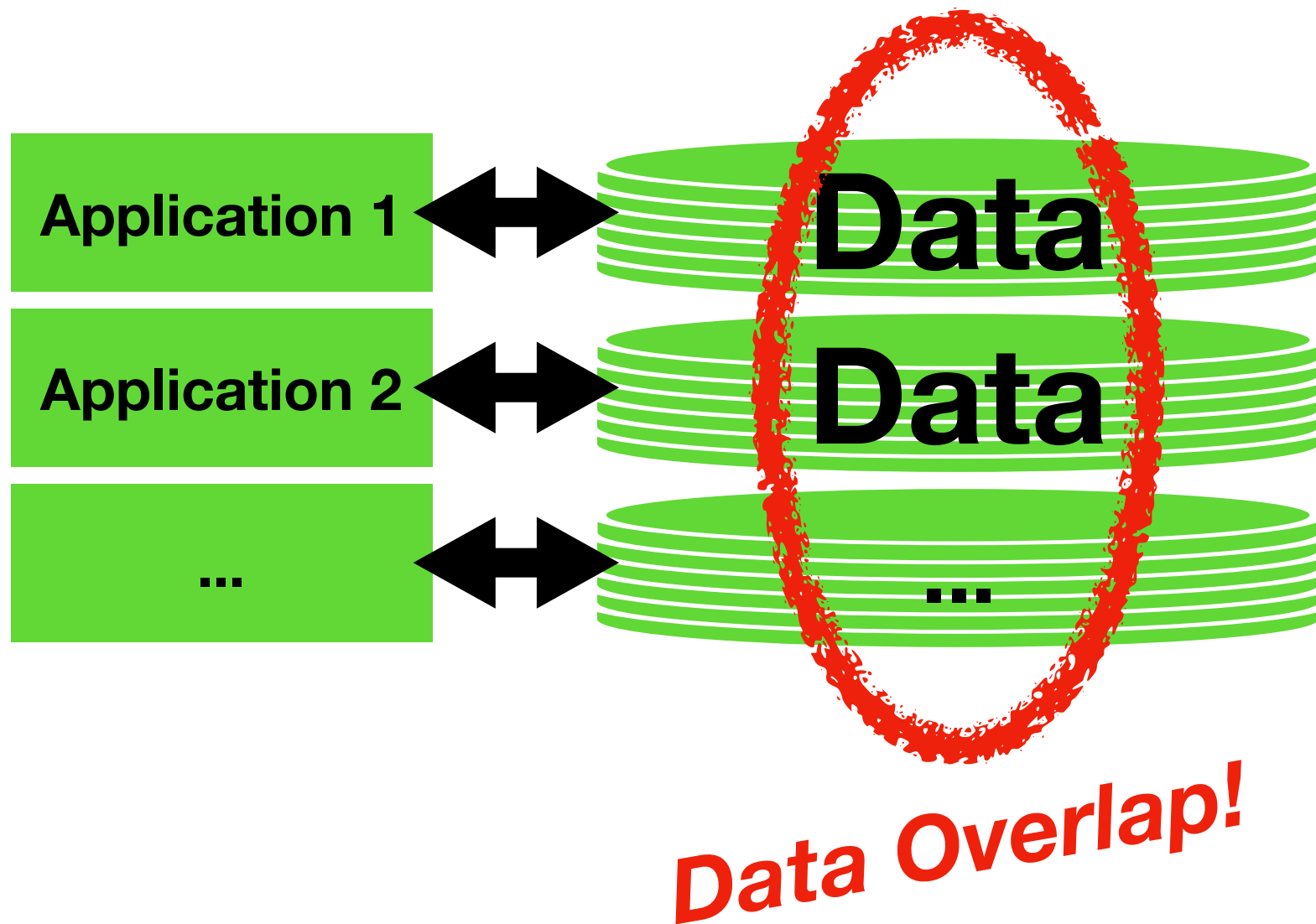
# Databases Are Everywhere

- You're using a **Database System** if you ...
  - **Enroll** in a course
  - **Transfer** money
  - **Shop** on Amazon
  - ...

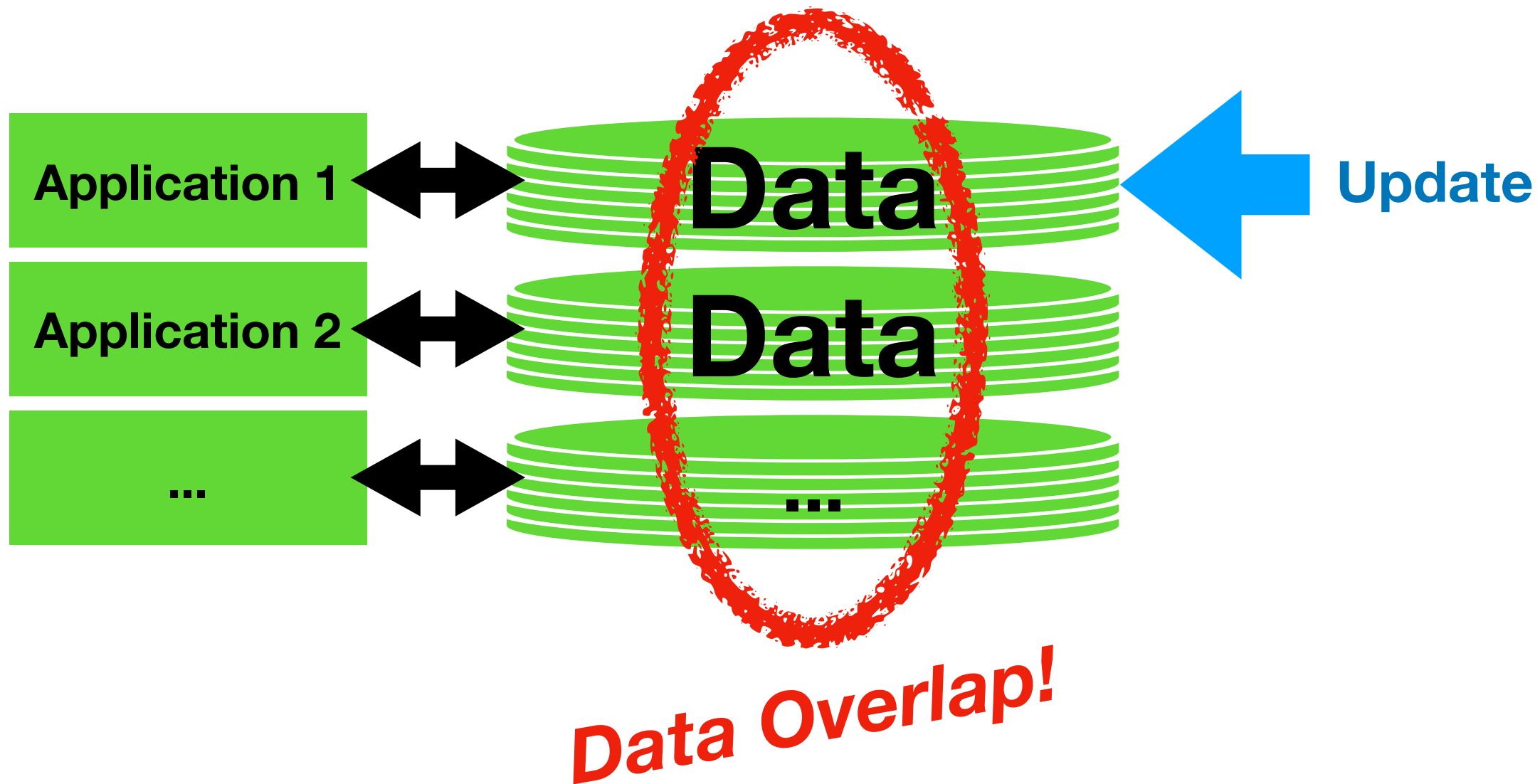
# File-Based Approach



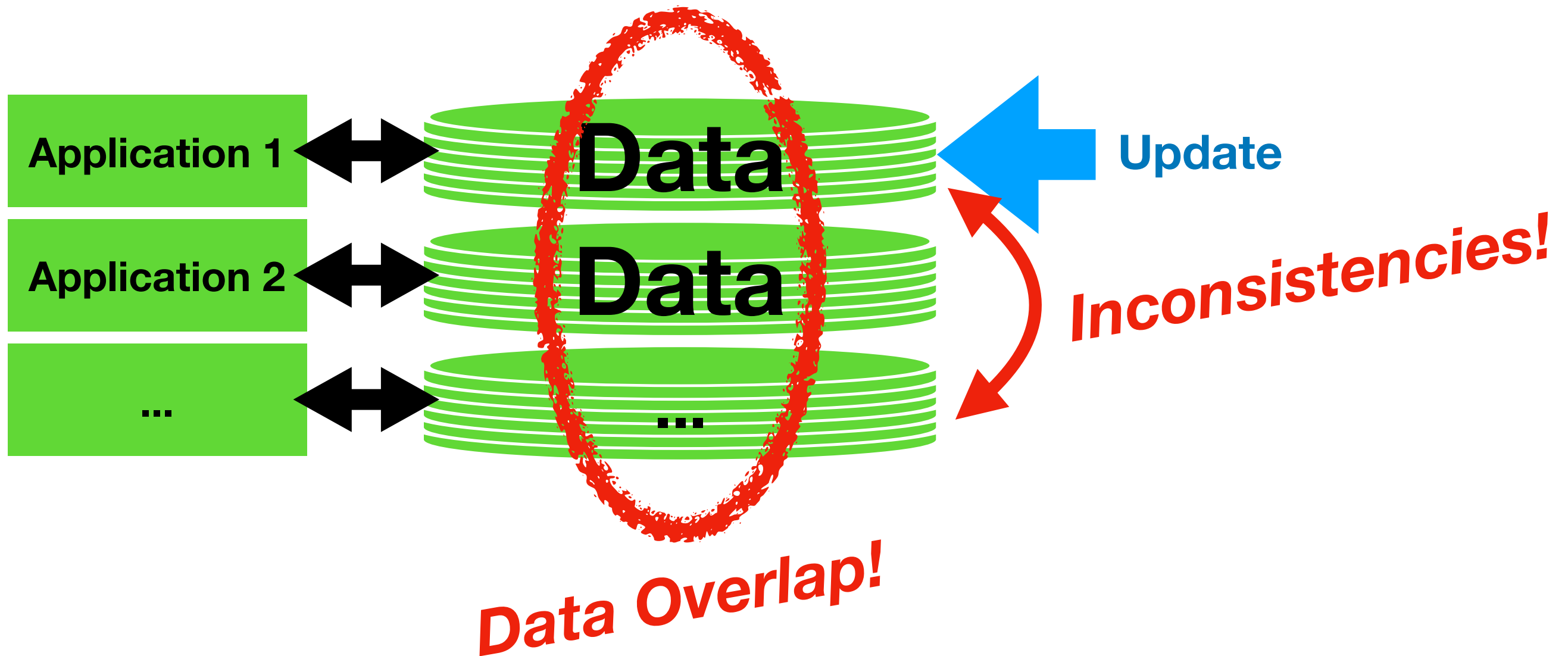
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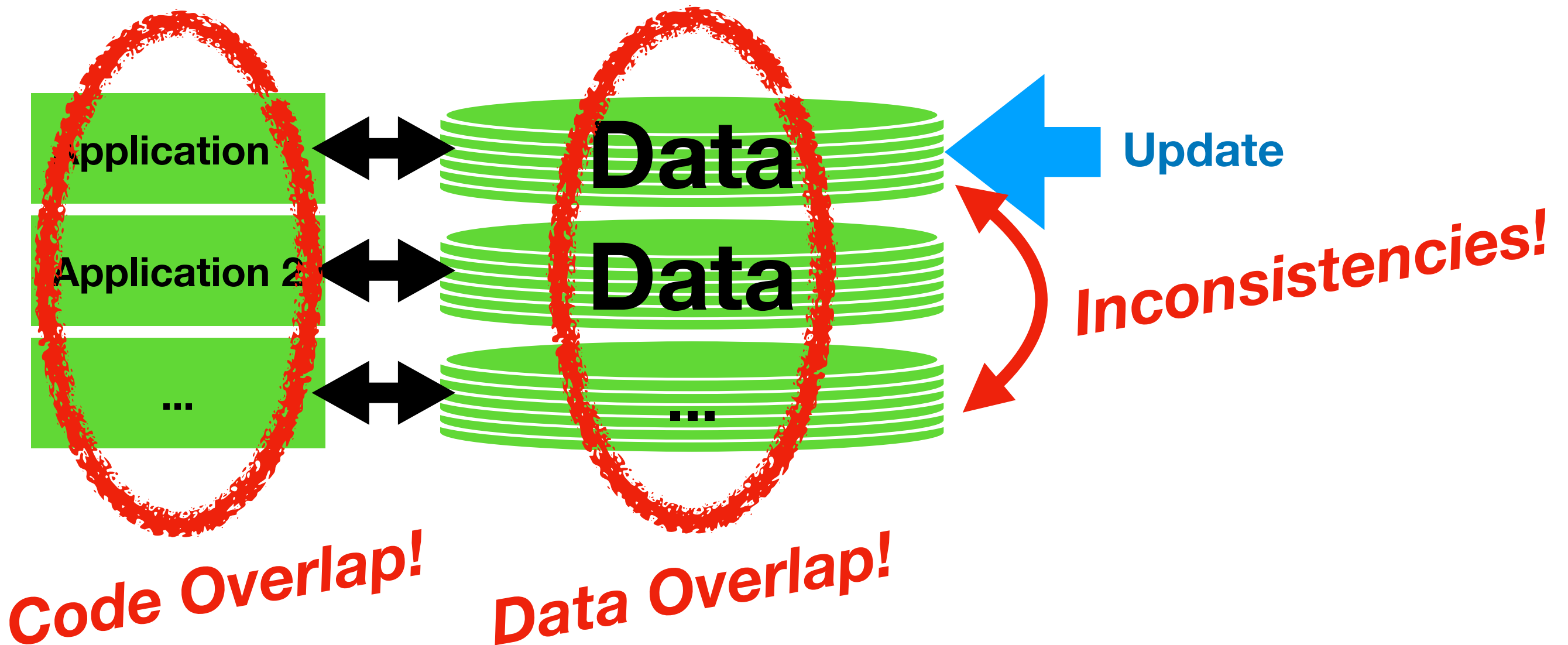
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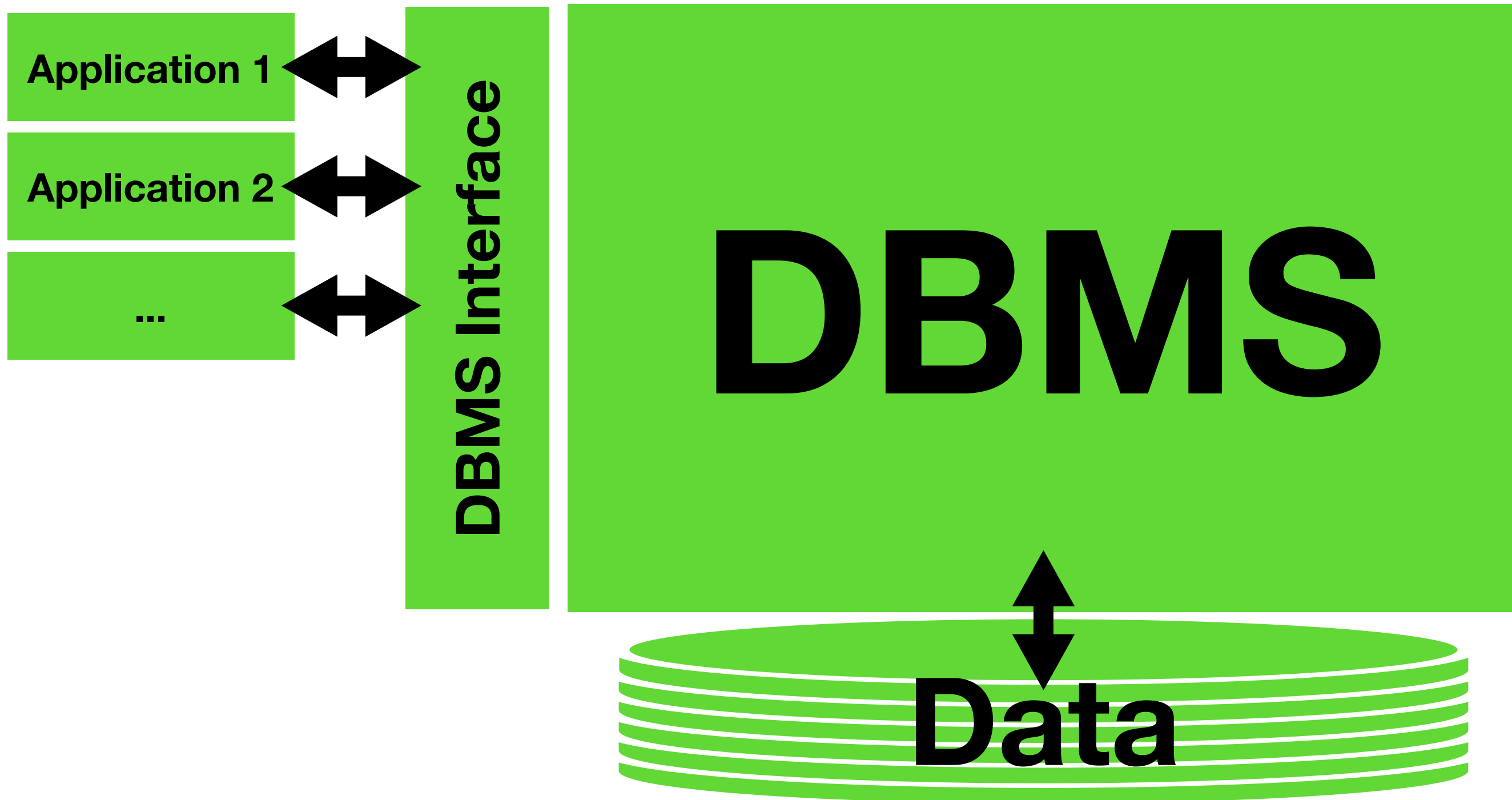
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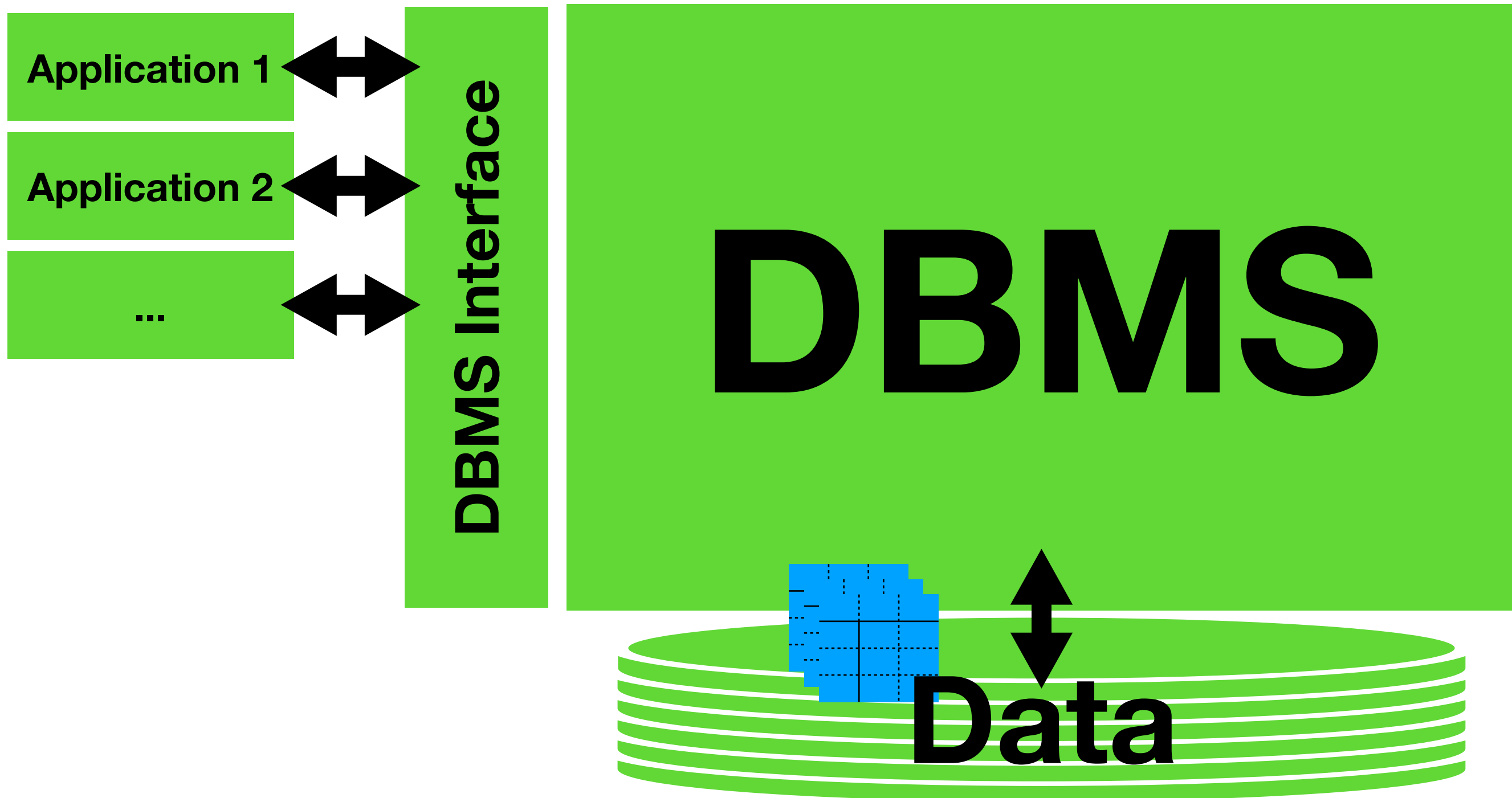


# Database Management Systems (DBMS)

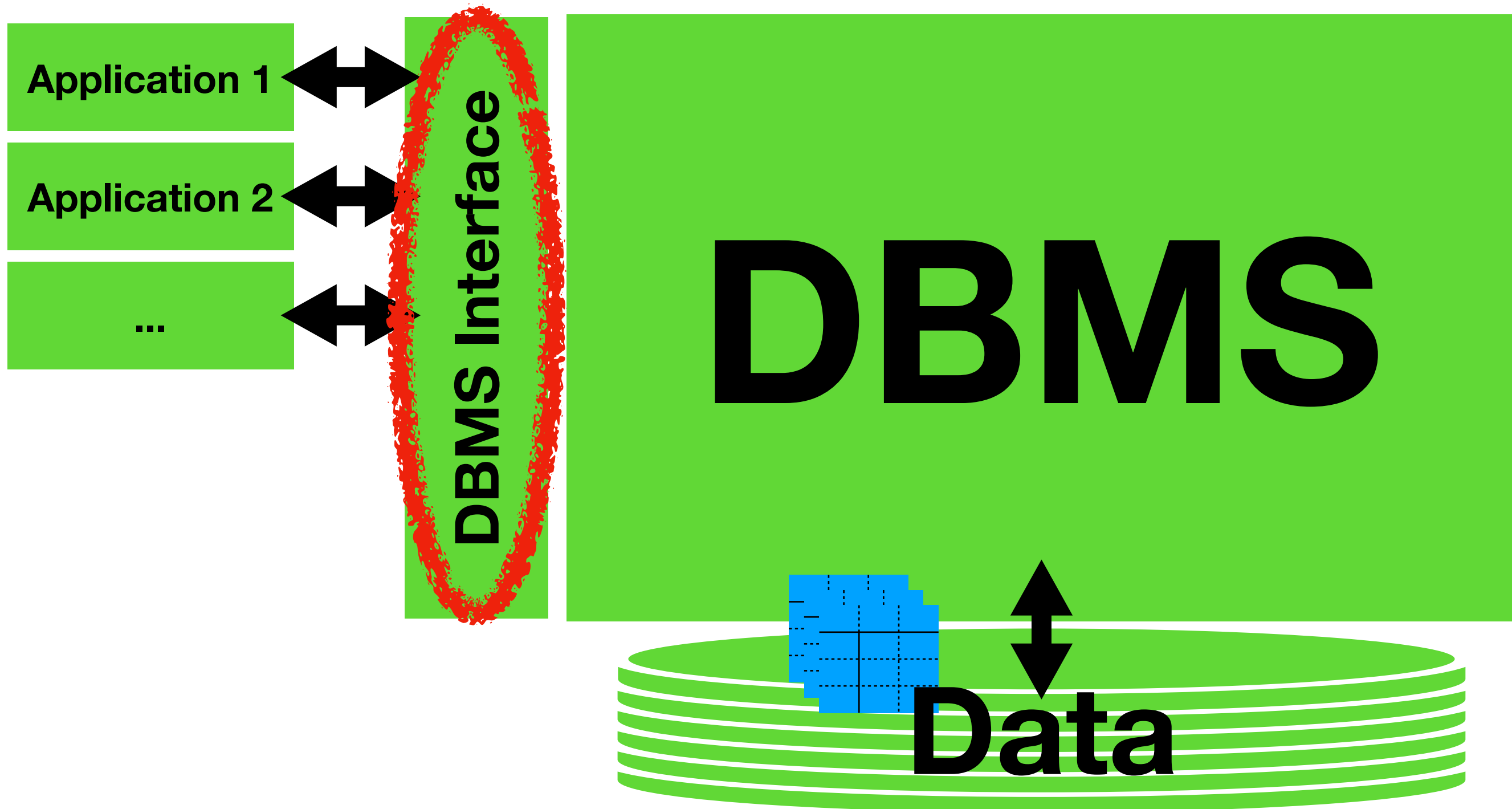




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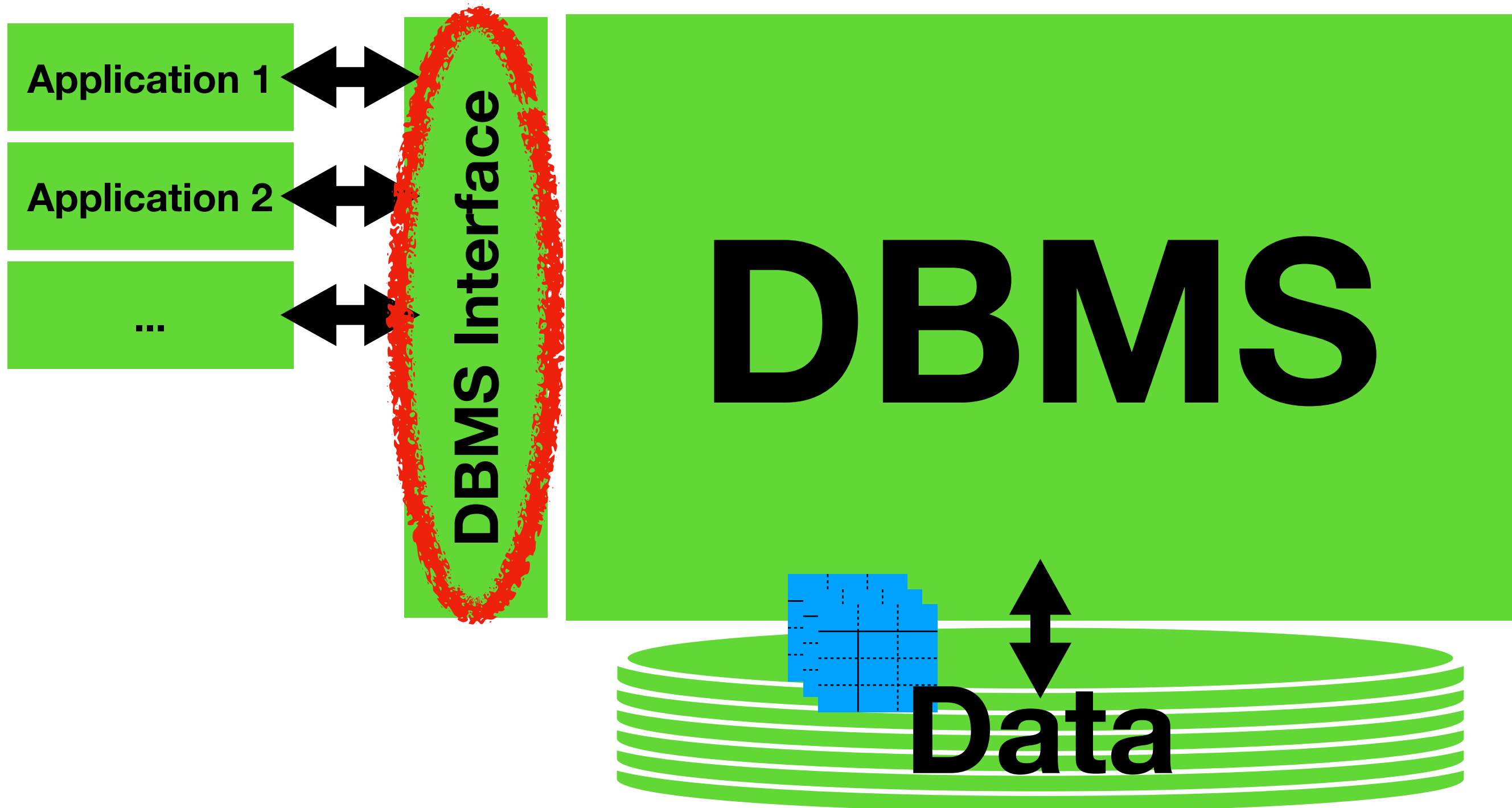


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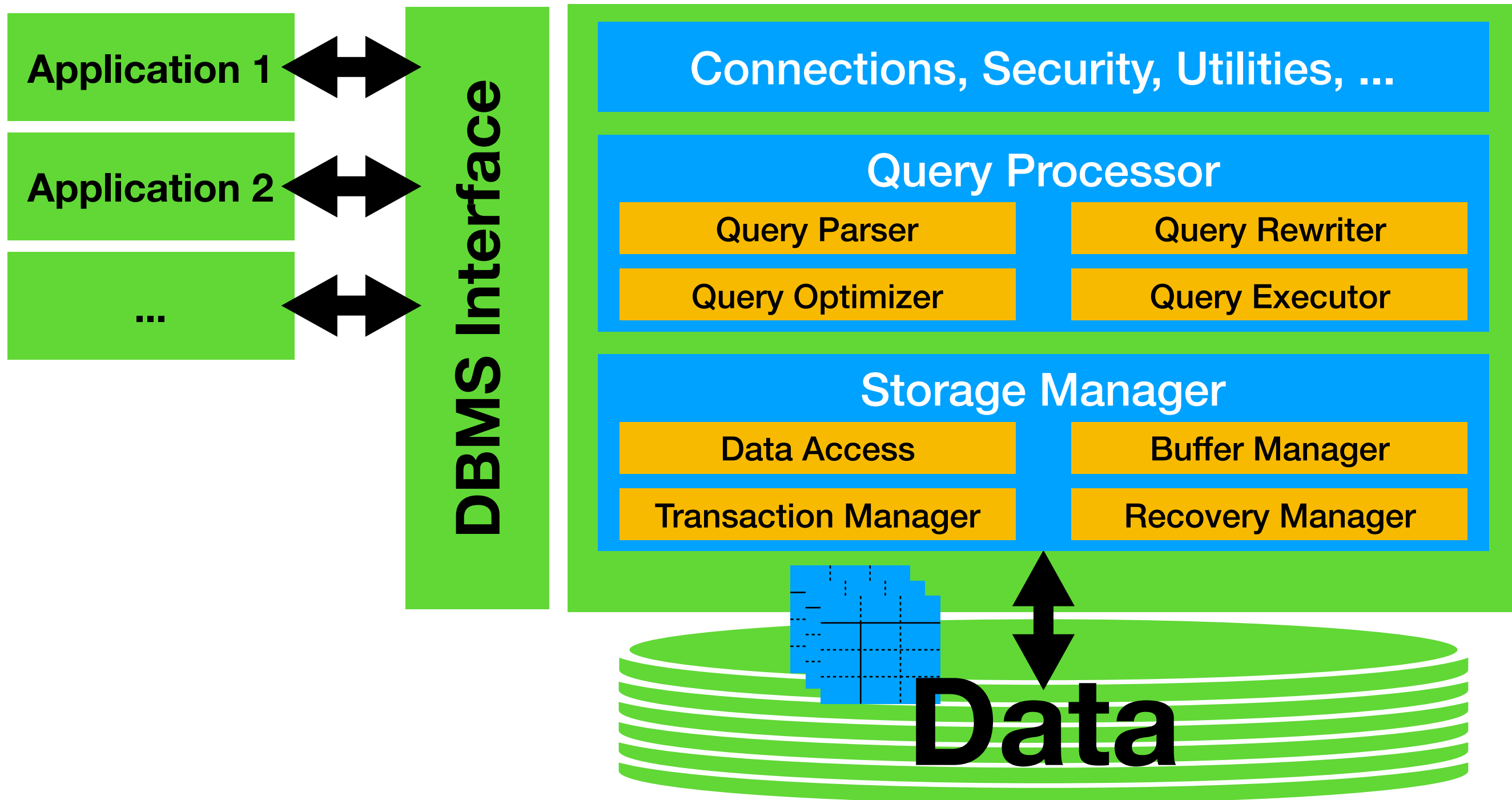


# Structured Query Language

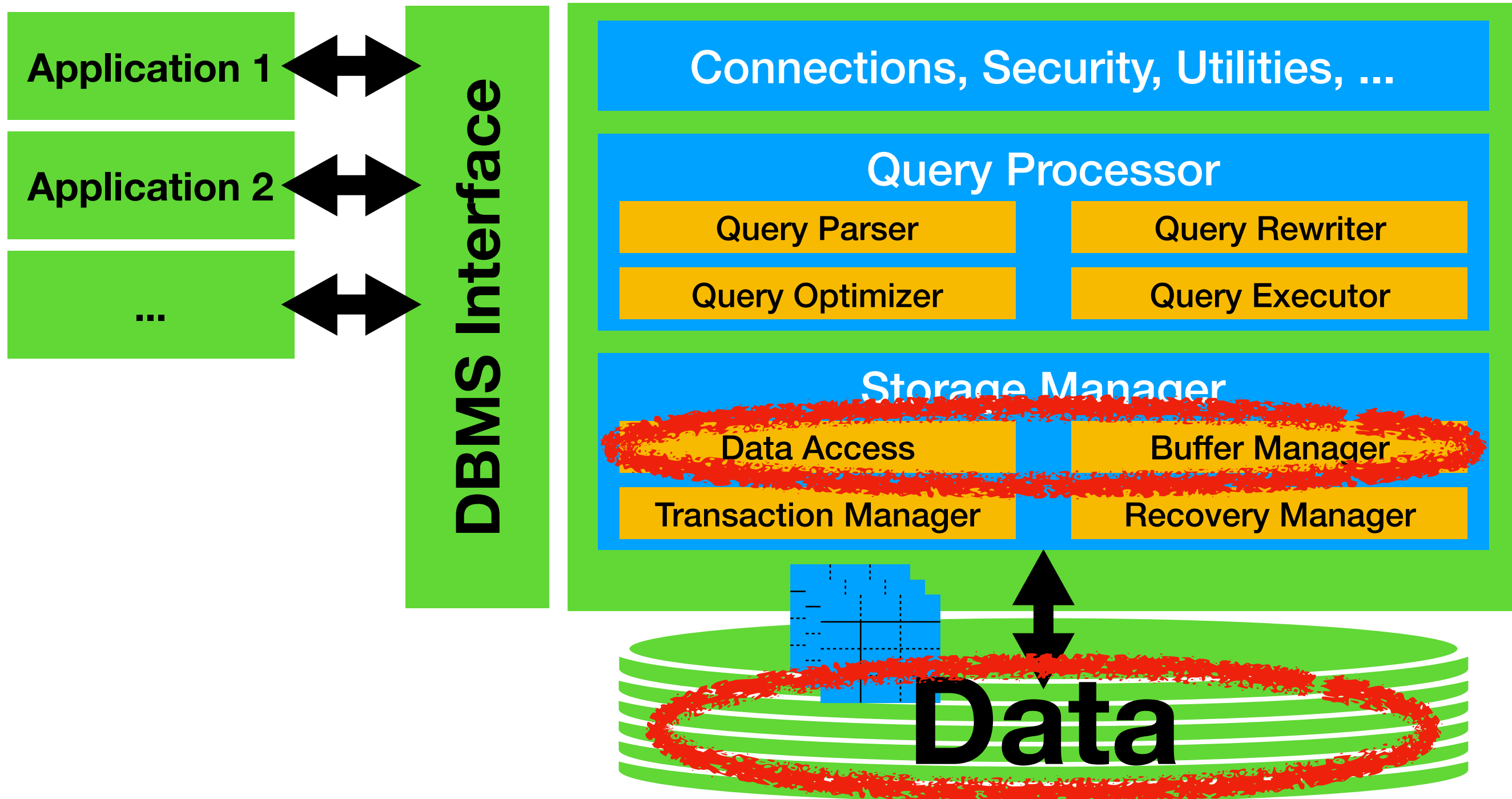
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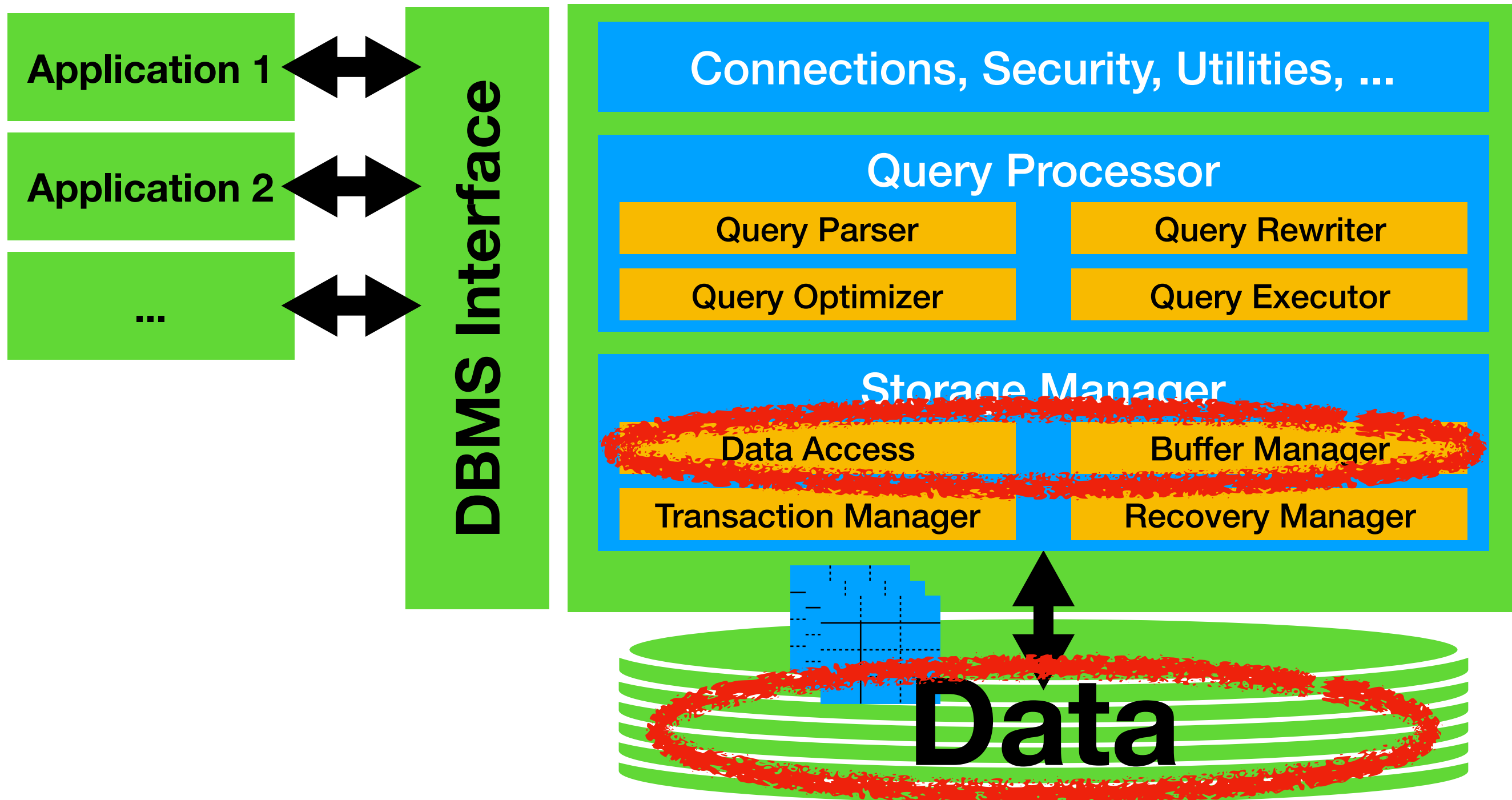


# **Storage Media**

## **Data Layout**

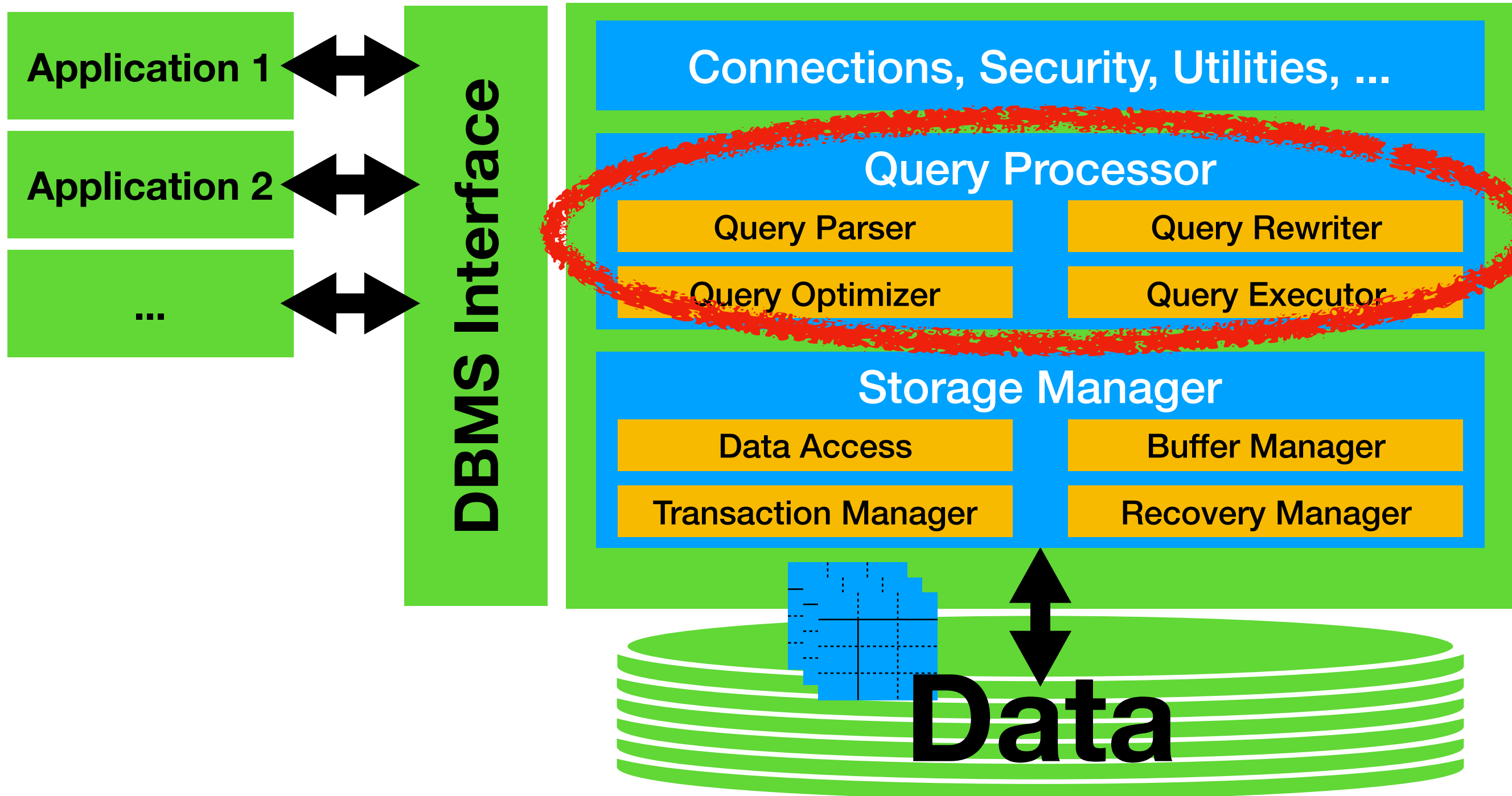
### **Files and Indexes**

# Database Management Systems (DBMS)





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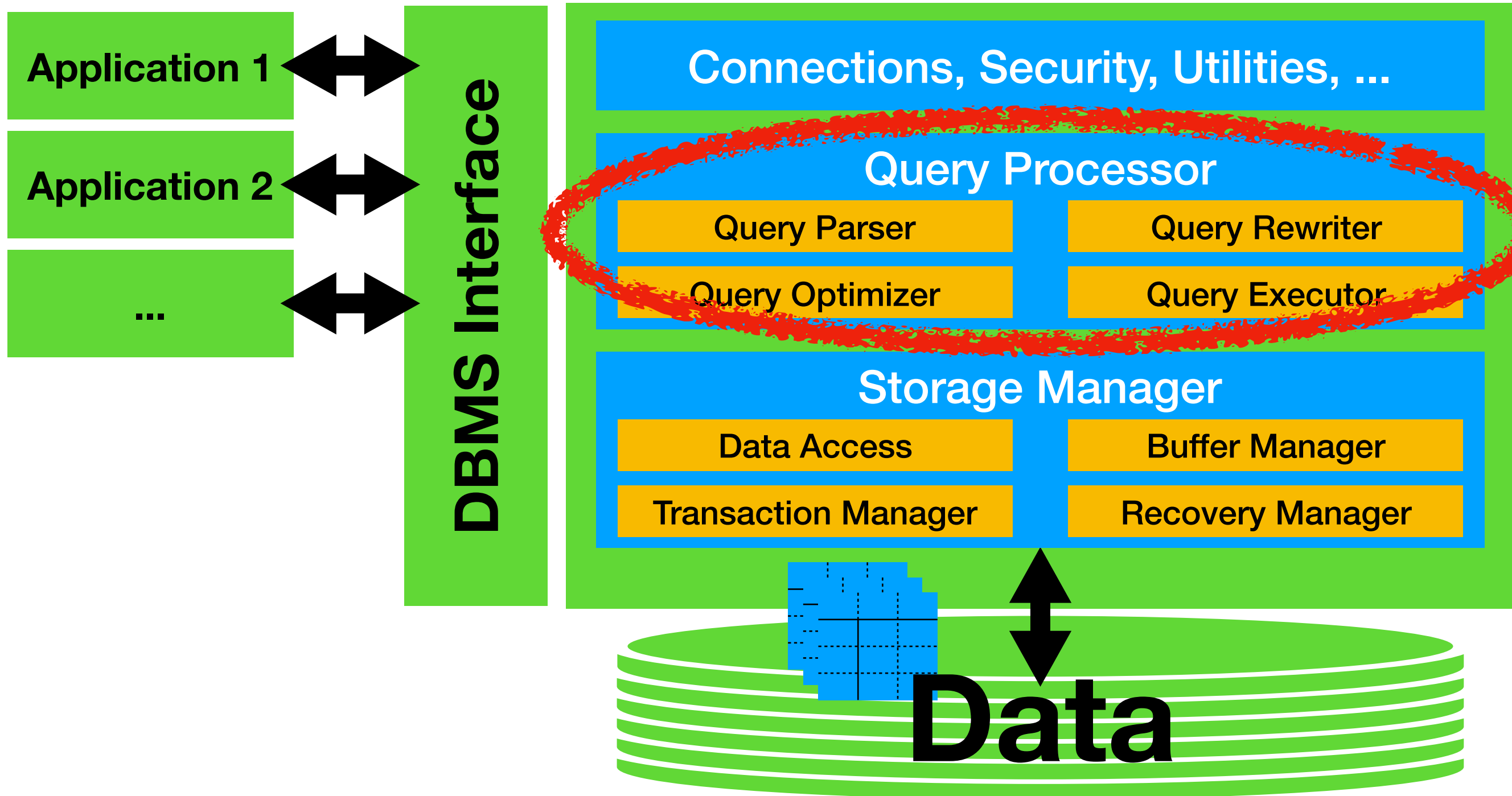


# Operators

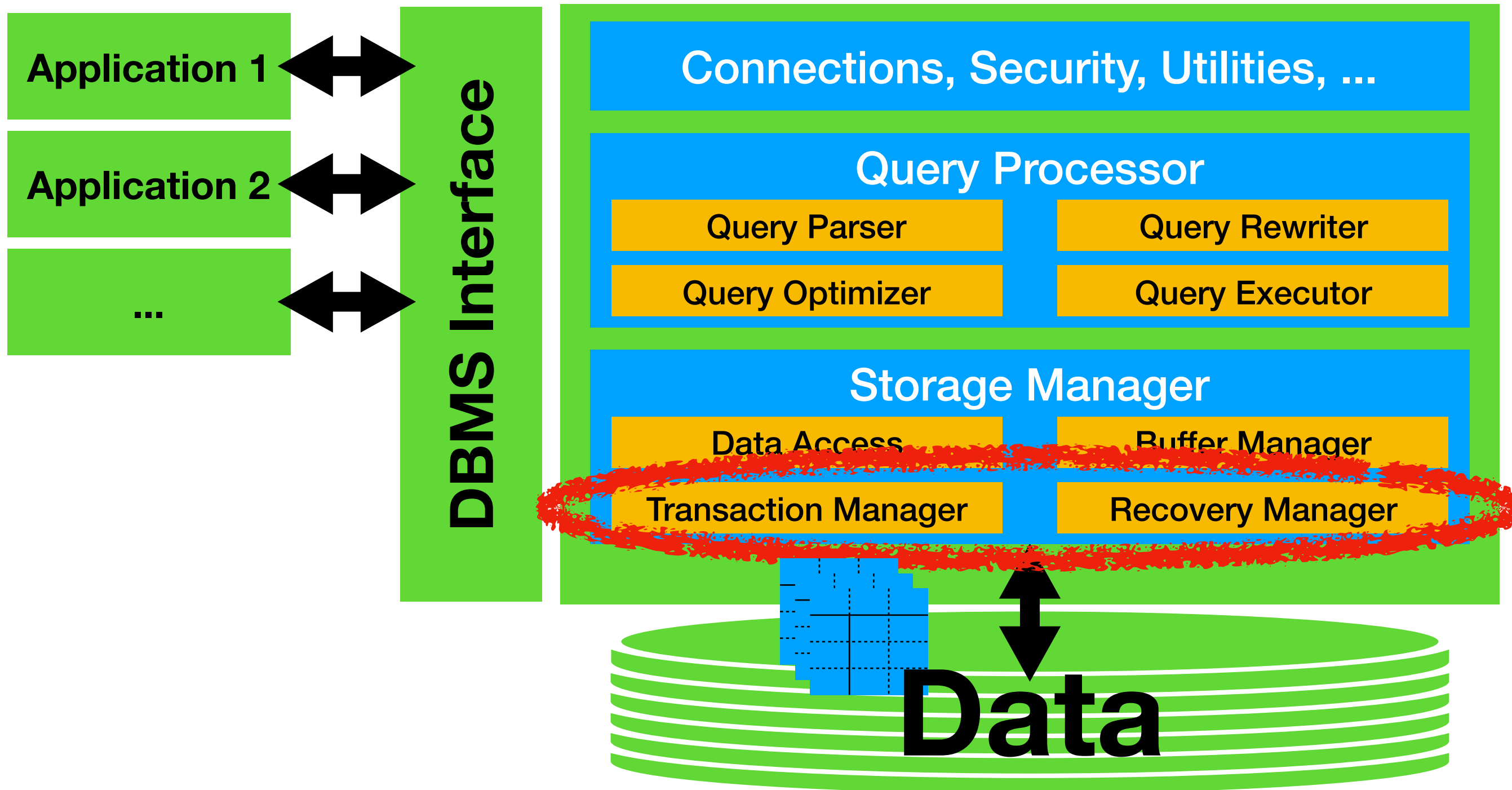
# Cost Estimation

# Query Optimization

# Database Management Systems (DBMS)



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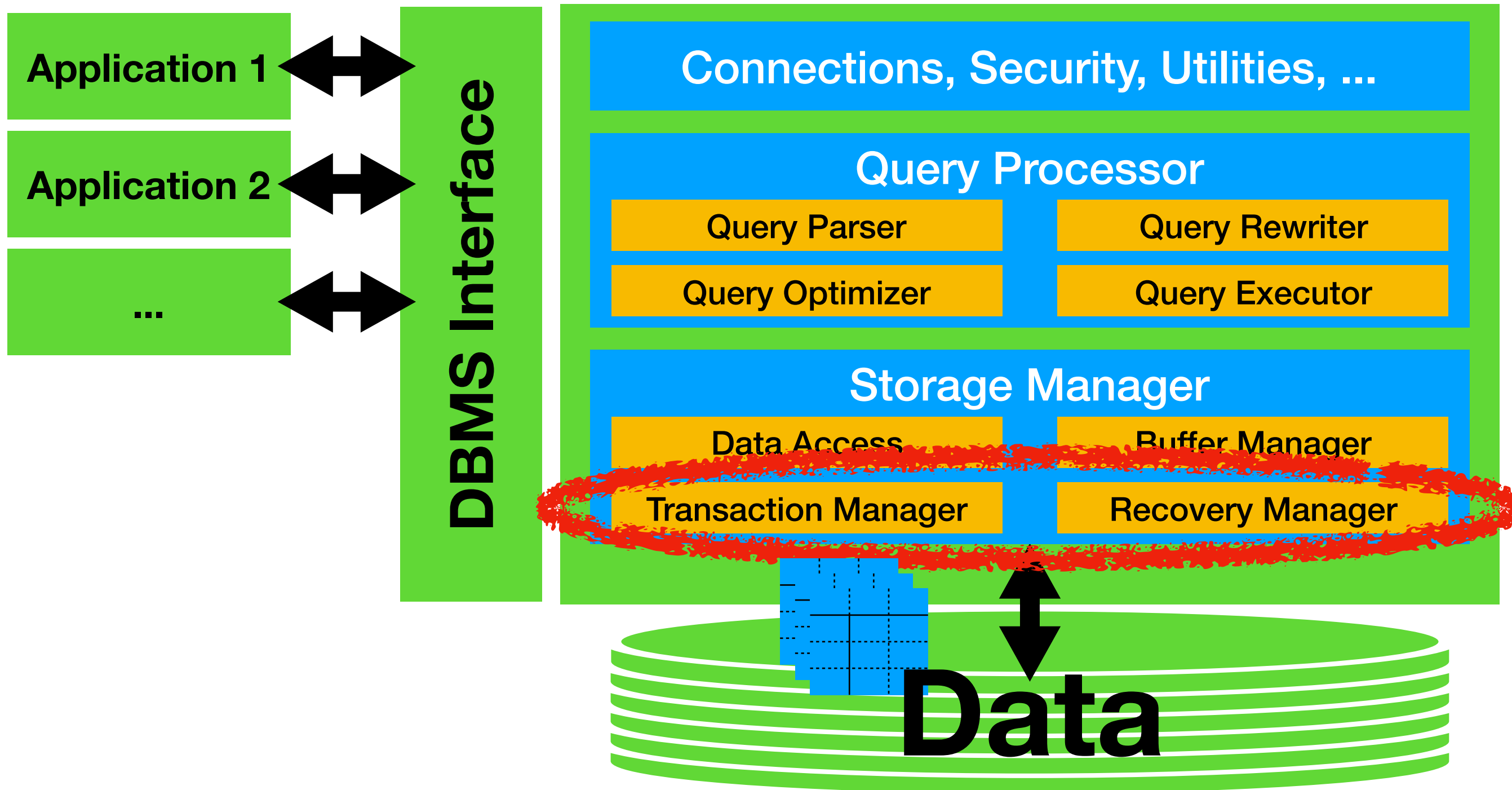


# Transaction Processing

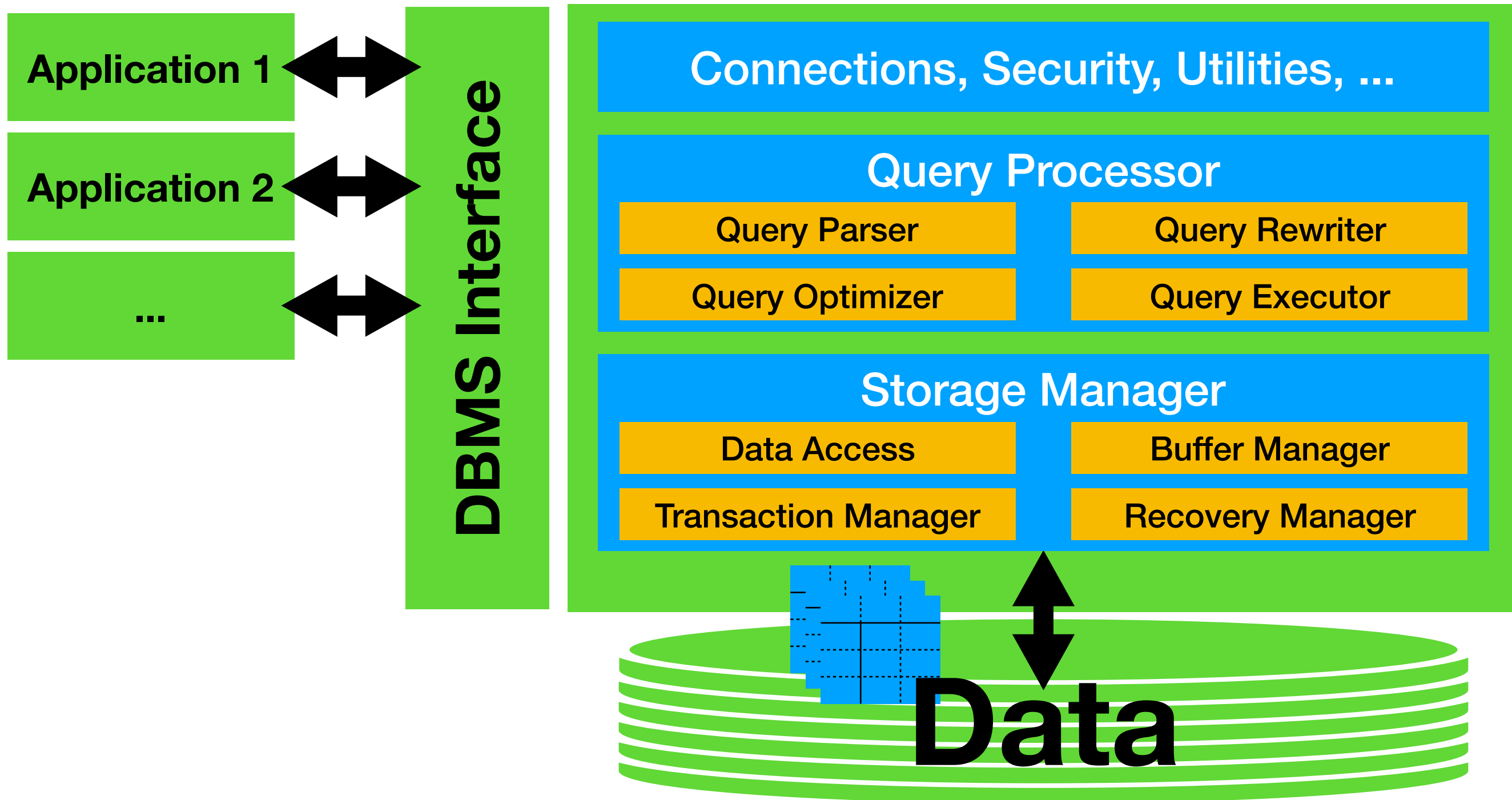
## Concurrency Control

## Crash Recovery

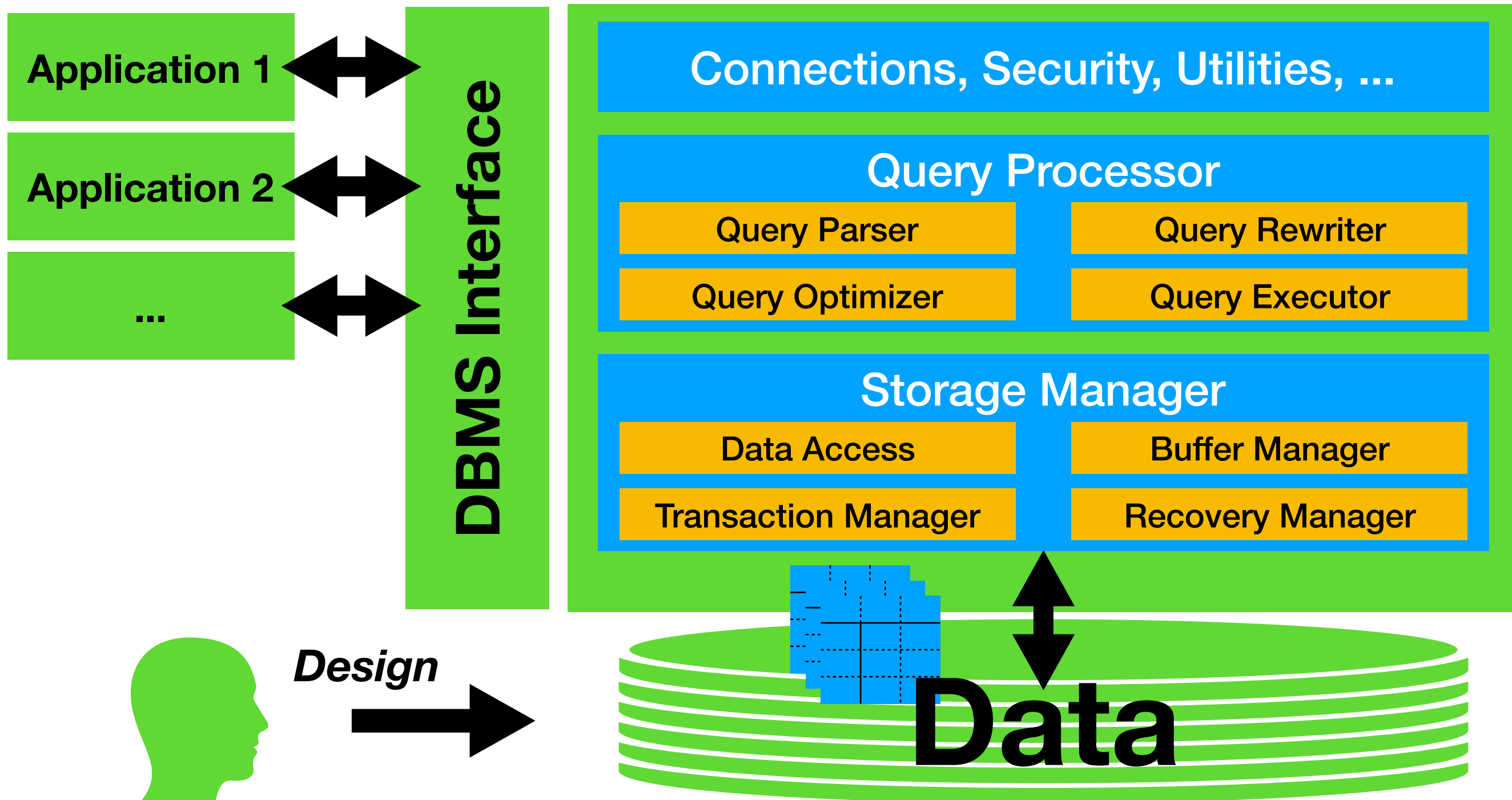
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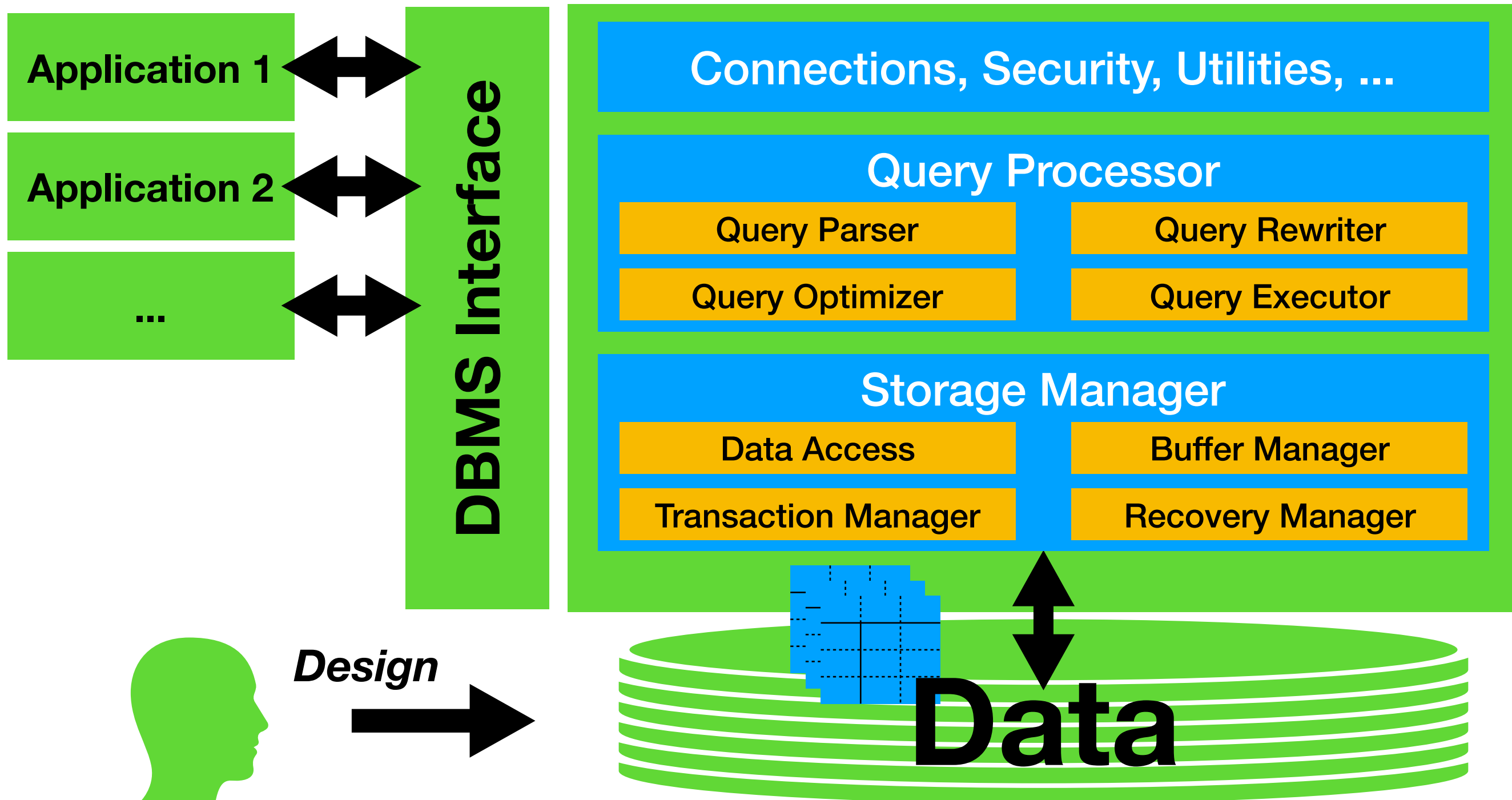


# Schema Design

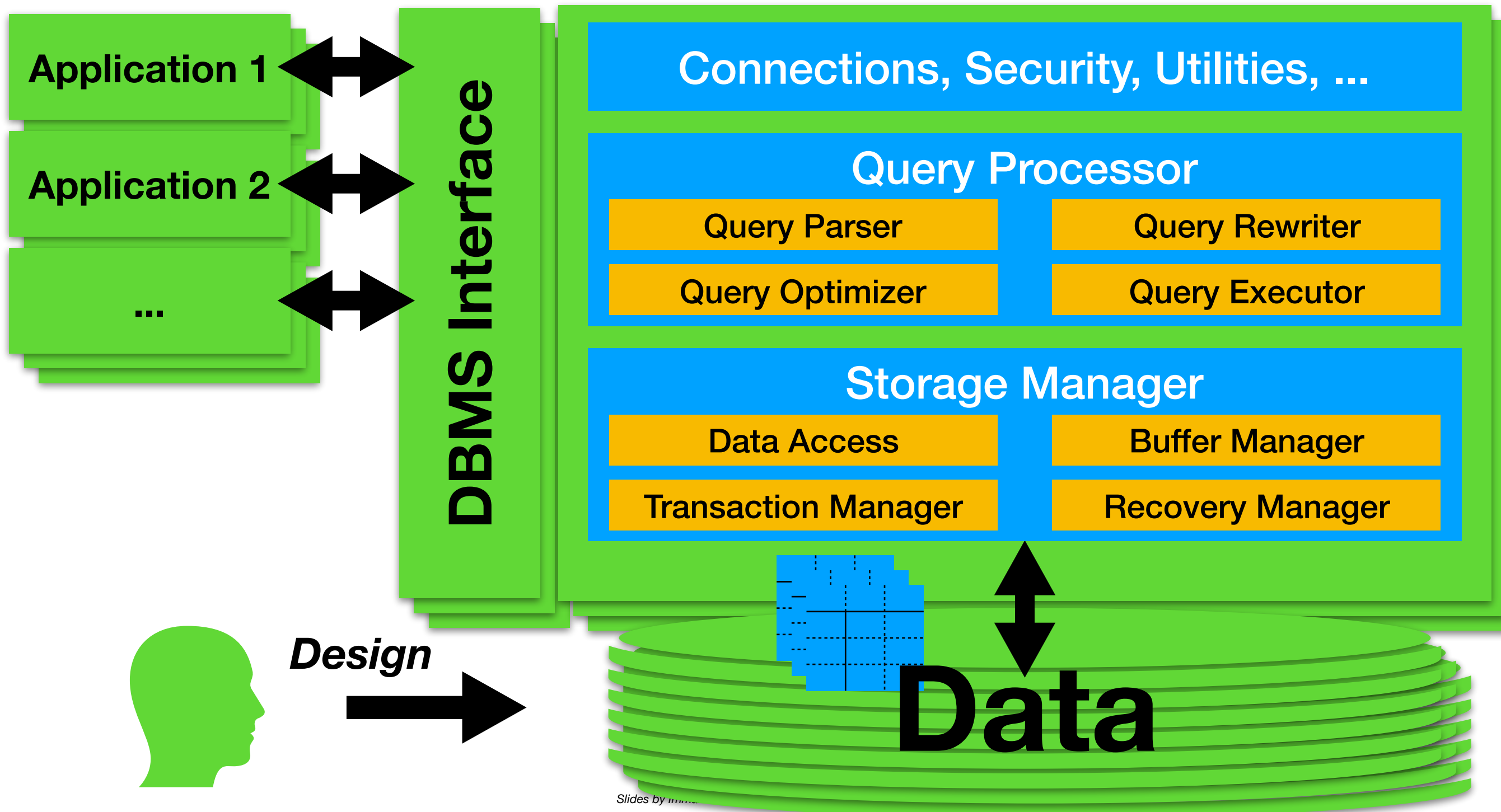
## Detecting Redundancy

## Schema Normalization

# Database Management Systems (DBMS)



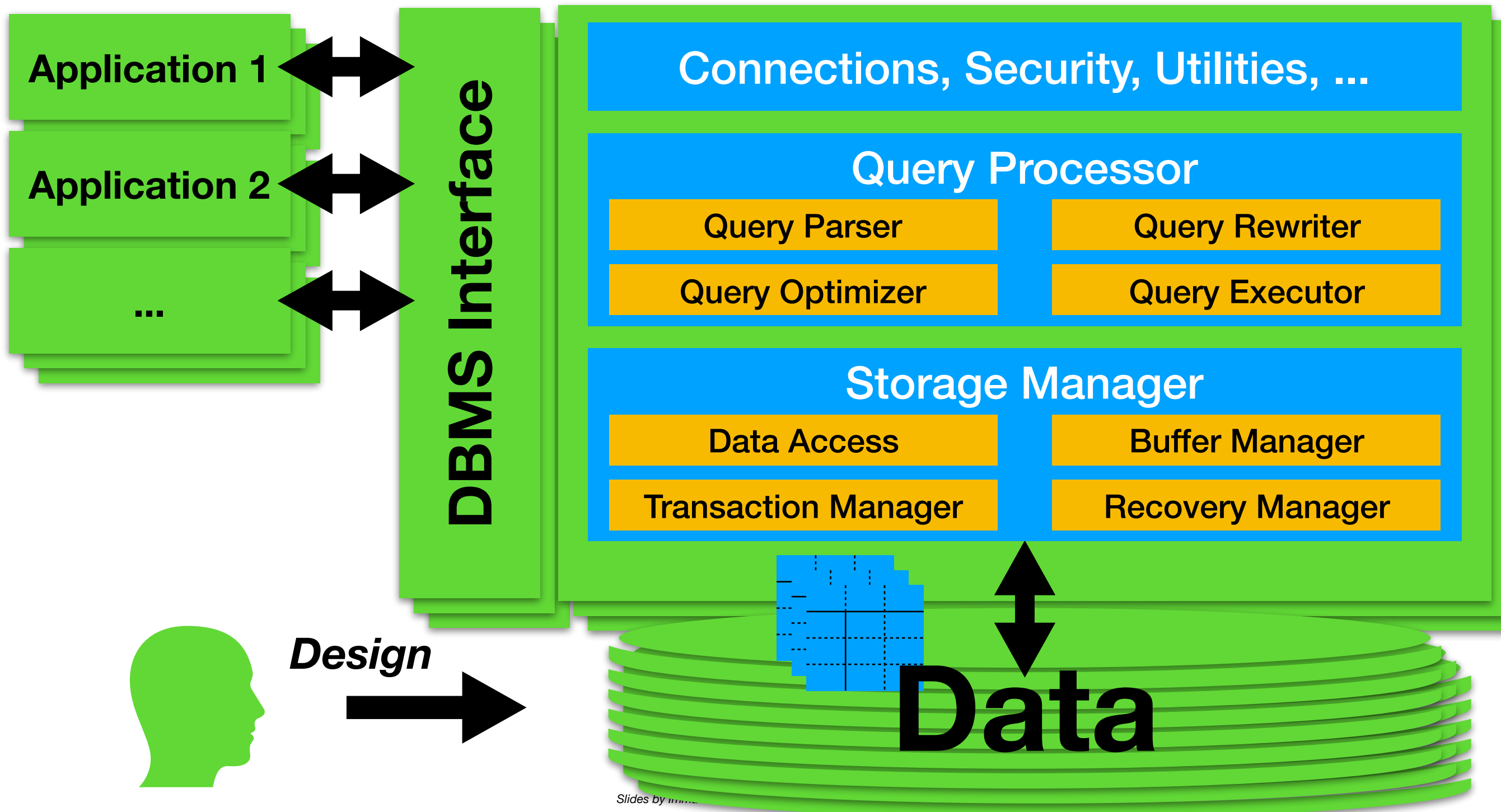
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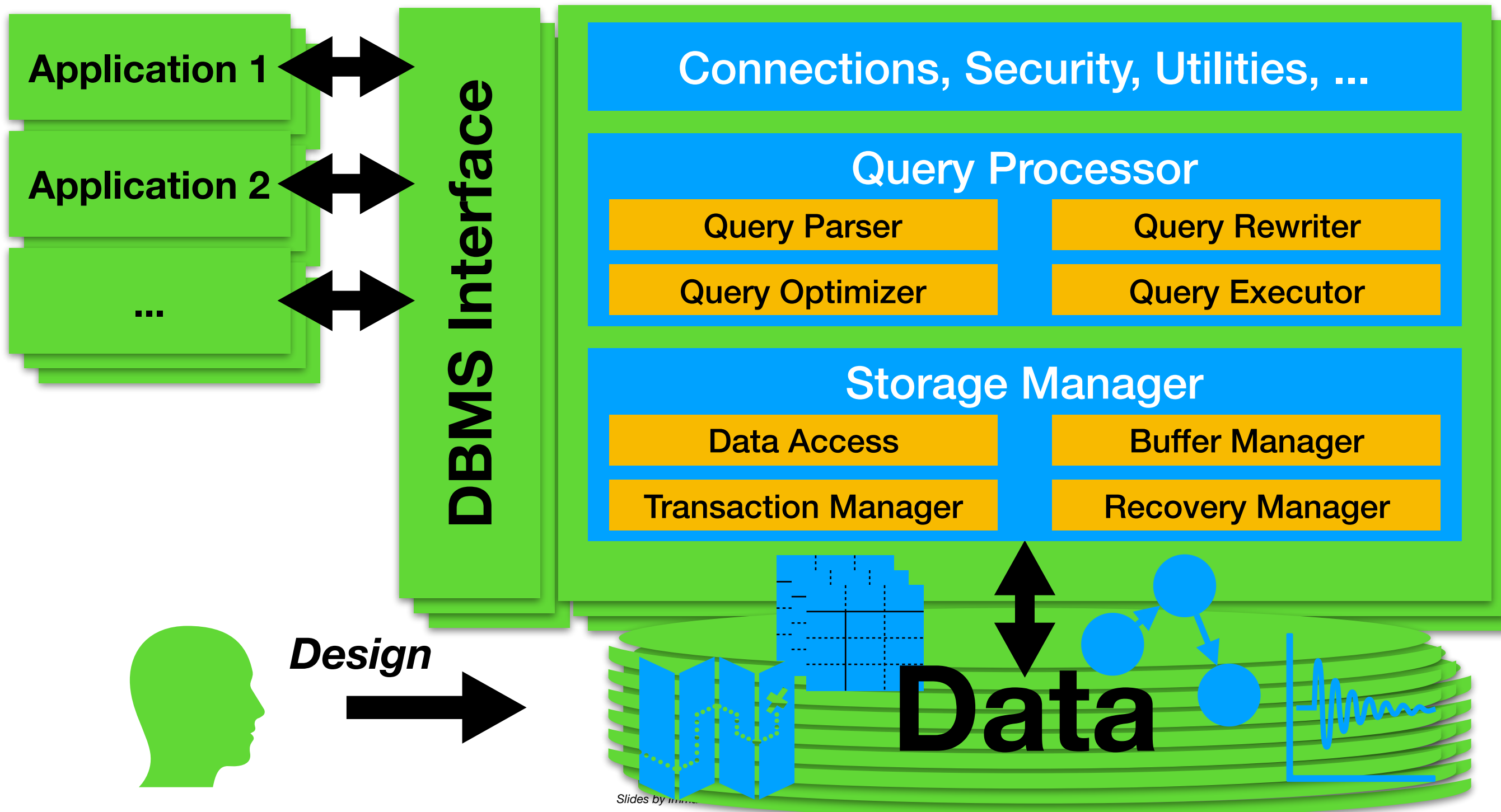
# Distributed Processing

## NoSQL and NewSQL

# Database Management Systems (DBMS)



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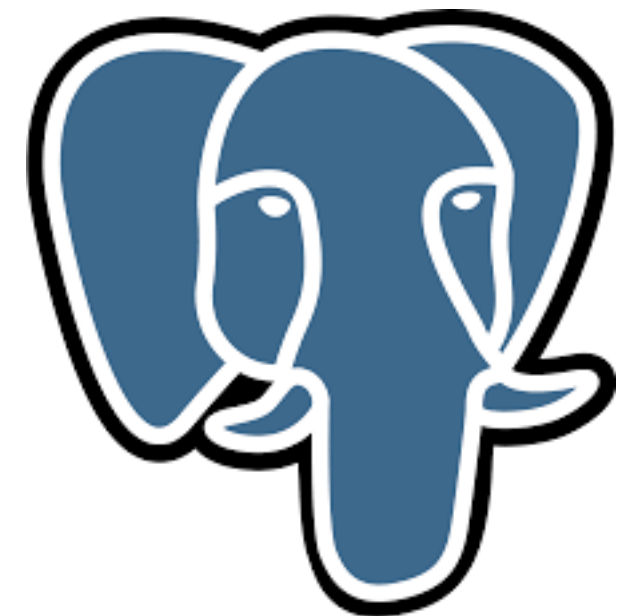
# **Graph Data**

# **Data Streams**

# **Spatial Data**

# Other Resources

- "*Database Management Systems*" by Ramakrishnan & Gehrke
- Papers - see "*Reading Material*" slides
- PostgreSQL - [www.postgresql.org/](http://www.postgresql.org/)







<https://www.cs.cornell.edu/database/>