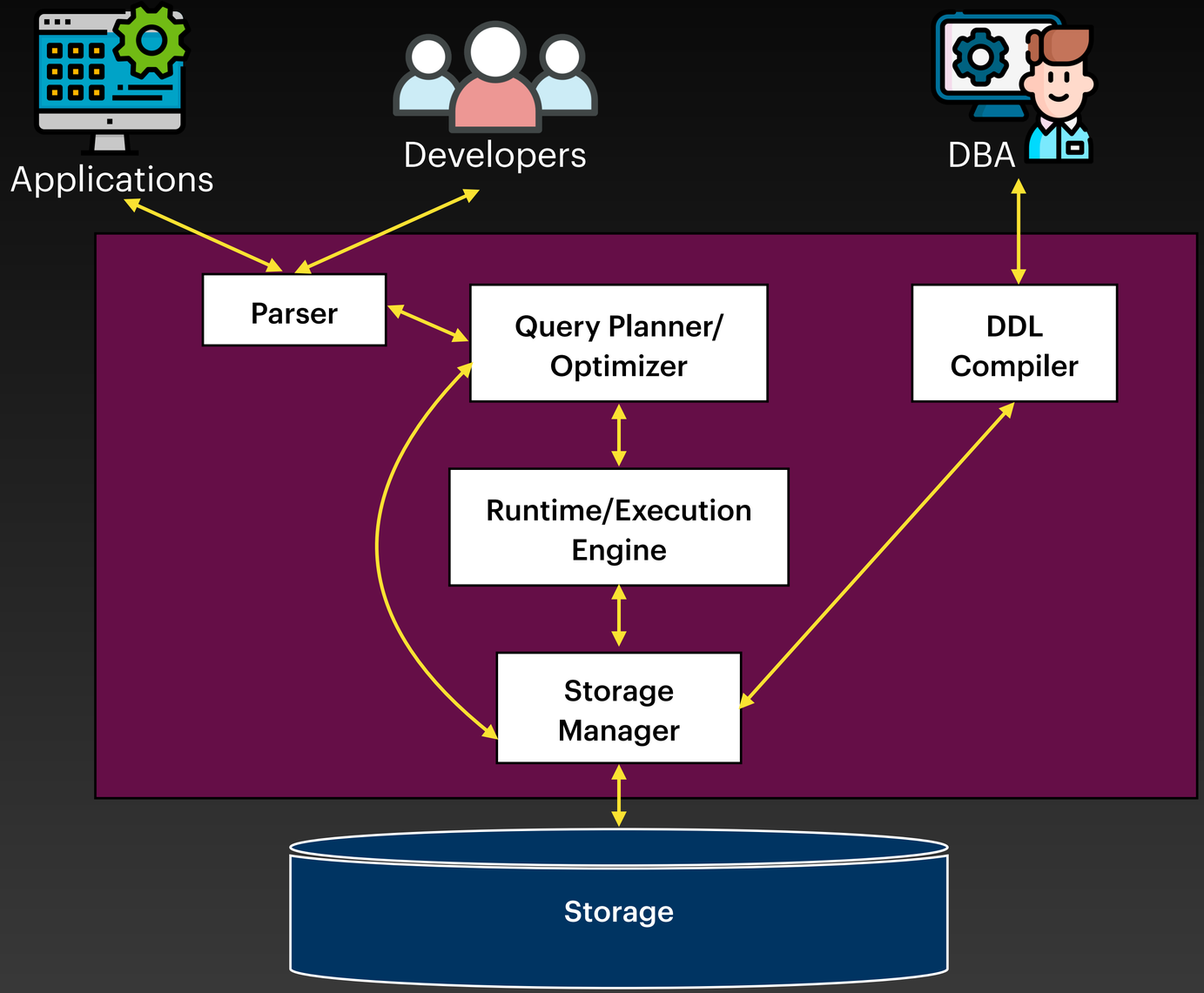
Amr Elhelw's

TECH VAULT

# DATABASE STORAGE PART 1

# DBMS Structure



# Storage Types

Volatile

Random access optimized for this

Bytes read per byte

CPU Registers

CPU Cache

DRAM

Non-volatile

Sequential access mechanical

Blocks/Pages read per page

SSD

HDD

Network Storage

Smaller
Faster
More Expensive

Larger
Slower
Cheaper

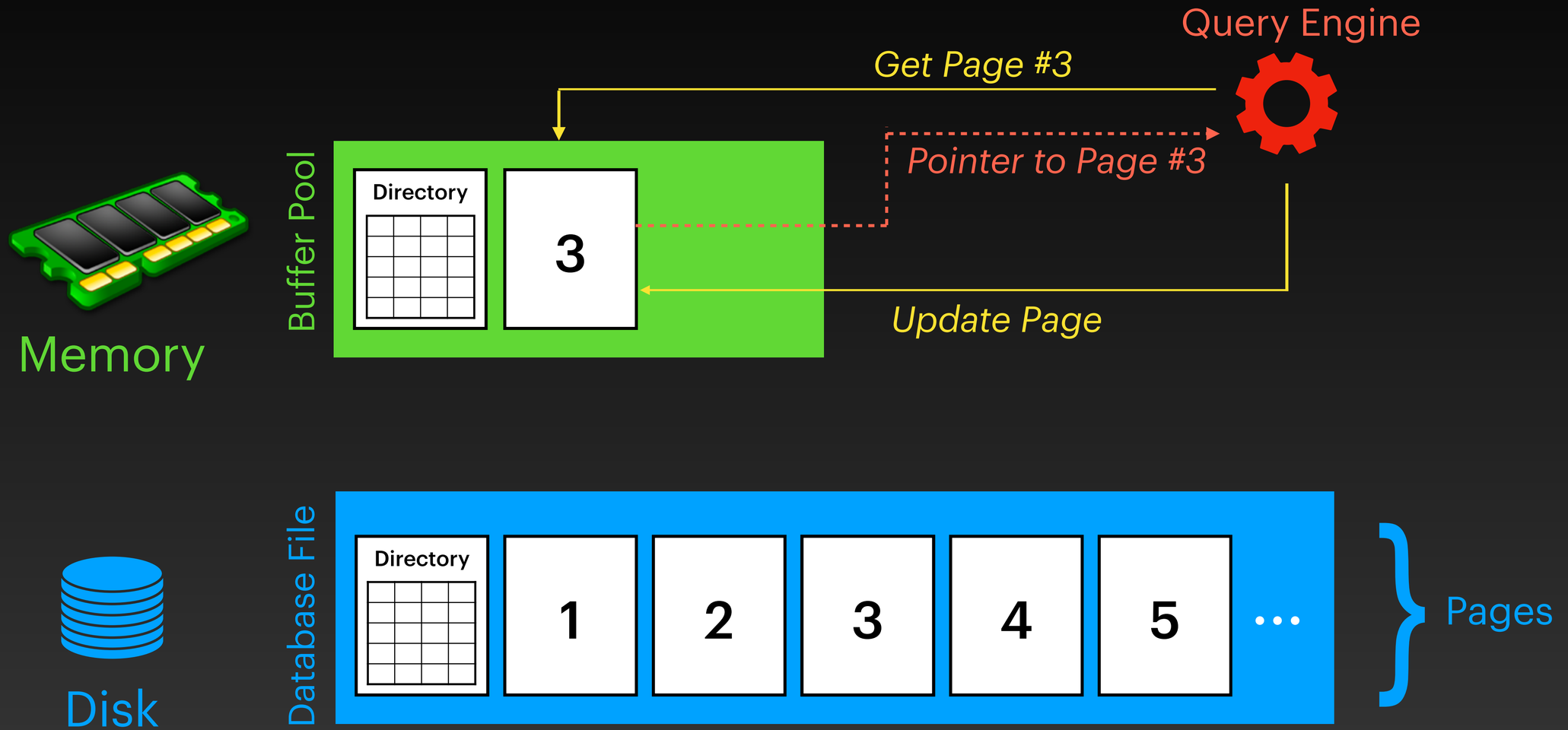
# Access Times

| | |
|---|---|
| L1 Cache | 1 ns |
| L2 Cache | 4 ns |
| DRAM | 100 ns |
| SSD | 16,000 ns |
| HDD | 2,000,000 ns |
| Network Storage | ~50,000,000 ns |

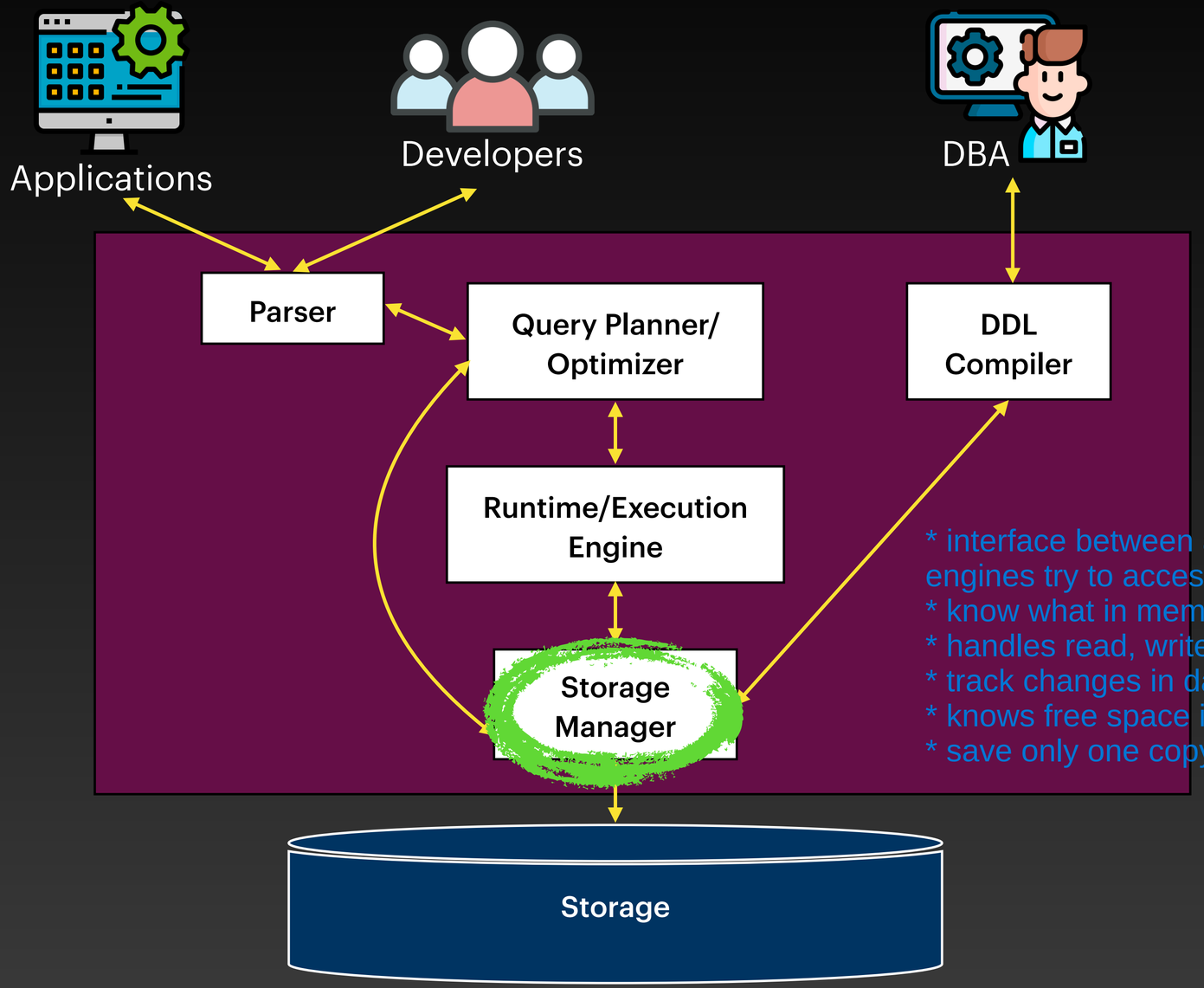
# Design Goals for DB

- Manage data that exceed the available memory
- Minimize reading/writing to disk (expensive)
- When accessing data on disk, try to maximize sequential access

# Disk-based DBMS



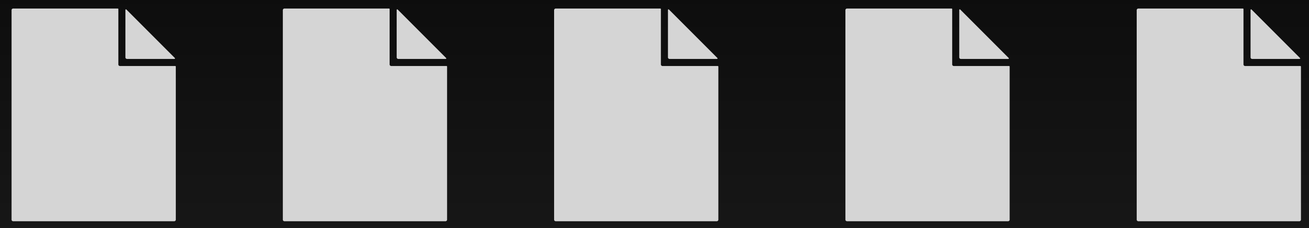
# DBMS Structure




* interface between actual storage and other engines try to access data
* know what in memorey, what in storage.. etc
* handles read, write. etc
* track changes in data
* knows free space in each page
* save only one copy for each page

# Database Storage

Database Files

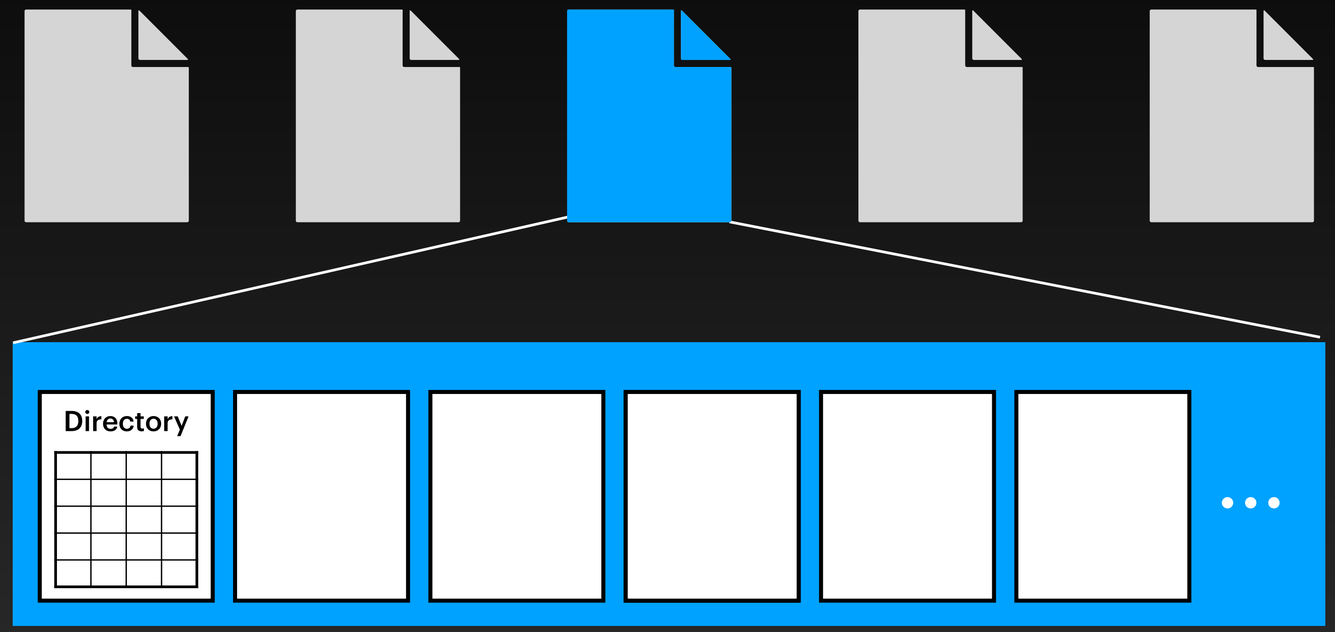


- System-specific file format different formats between sql serve, mysql.. etc
- OS does not understand the contents
- Single file/multiple files according to data size

# Database Storage

Database Files

Pages



# What is a Page?

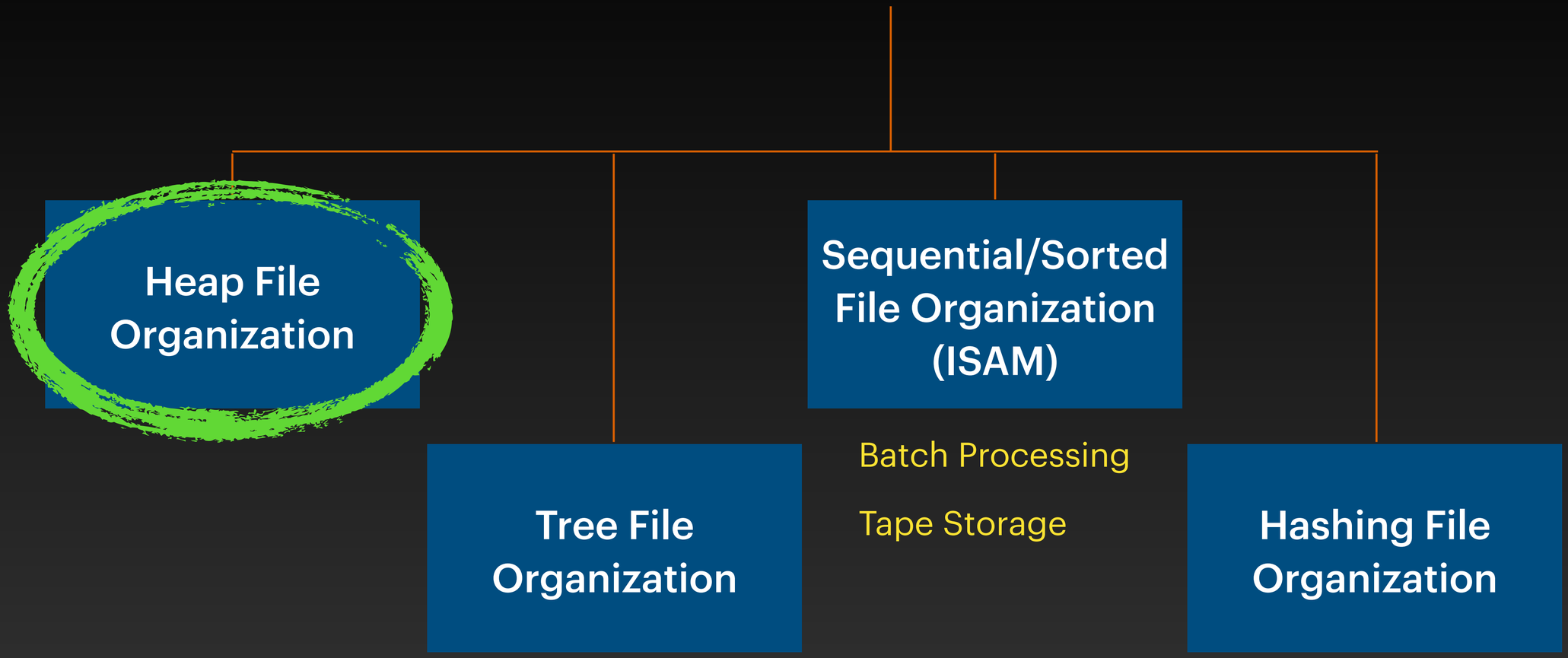
- Fixed-size block of data

- Can contain anything
  - Tuples, meta-data, indexes, log records, ...

- Unique ID for each page
  - DBMS can map a page id to a physical location whetere in memory or in disk

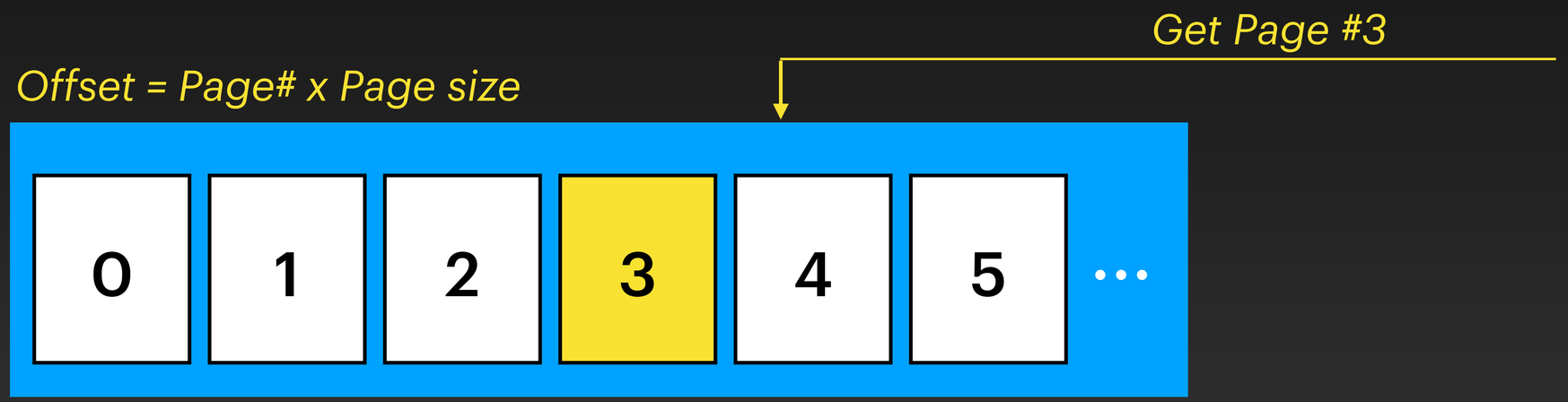
each page contains data of the same table and of the same type
no multiple tables in the same page, no multiple types of data (indexing, data ...etc)

# File Organization



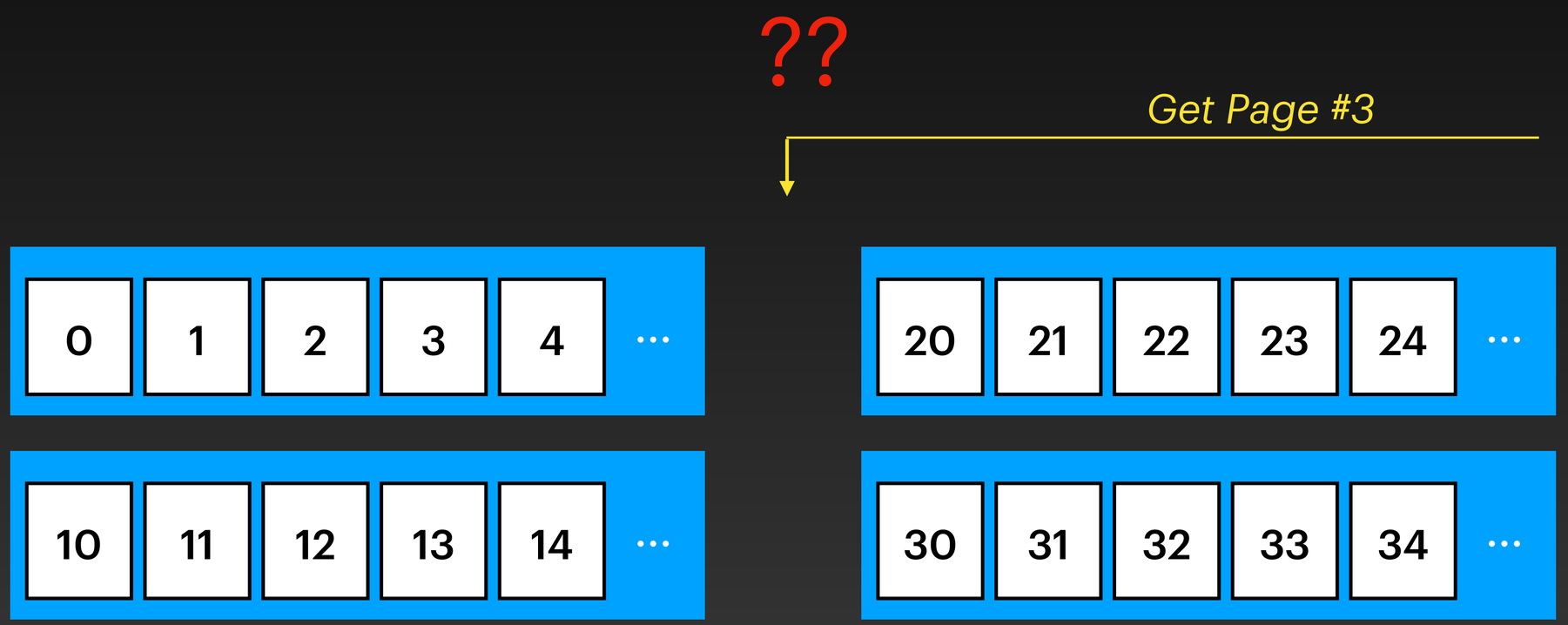
# Heap File

- Single ordered file not ncesseray to be ordered pages or ordered tuples in a page



# Heap File

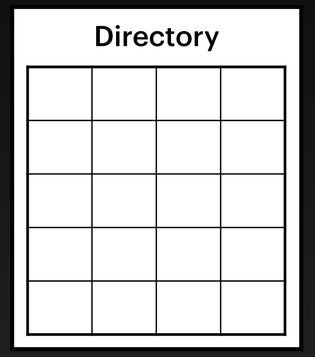
- Multiple files



# Heap File - Page Directory

because pages not sorted in the file

- Special page(s) within each file
  - Location of each data page in the file
  - Number of free “slots” per page
  - List of free/empty pages




- Must be kept in sync with data pages

any update in any page happens inside a transaction of (the update itself, the update of the directory)

# Heap File

- Multiple files