Big Data Management

After this video you will be able to..

- Describe what “data management” means
- Identify the primary issues involved in the management of “big data”

What is Data Management?

Must-Ask Questions about a Data Application

- How do we **ingest** the data?
- Where and how do we **store** it?
- How can we ensure **data quality**?
- What **operations** do we perform on the data?
- How can these operations be **efficient**?
- How to **scale up** data volume, variety, velocity and access?
- How to keep the data **secure**?

Ingestion Infrastructure

How many data sources?

How large are data items?

Will the number of data sources grow?

Rate of data ingestion?

What to do with bad data?

What to do when data is too little or too much?

An imaginary cloud database of personal information

Ingestion Infrastructure

How many data sources? ~20

How large are data items?
Avg. record size: 5KB, Avg. image size: 2GB, #records: 50 Million

Will the number of data sources grow? Not much

Rate of data ingestion? 3k/day

What to do with bad data?
Warn, flag and ingest

What to do when data is too little or too much?
Not likely

Ingestion policy

Ingestion Infrastructure

How many data sources? 2M

How large are data items?
Avg. record size: 3KB, Avg. image size: 2MB, #records: 200 Billion

Will the number of data sources grow?
Now 25 M, growing at 15% per year

Rate of data ingestion? peak 200k/hr

What to do with bad data?
Retry once, then discard

What to do when data is too little or too much?
Spill to auxiliary server for 10 TB, reclaim lazily, drop by 0.1% steps when > 85% full

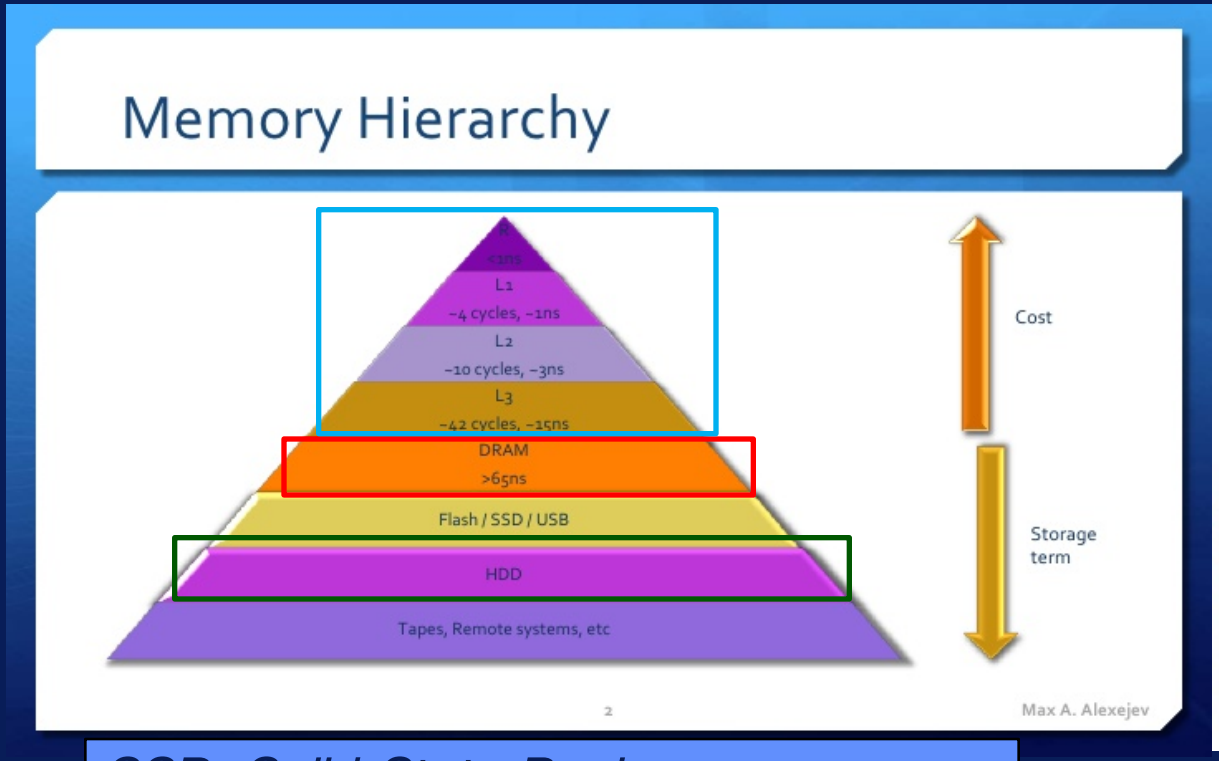
An imaginary cloud database of personal information

Storage Infrastructure

where hardware meets Data Management

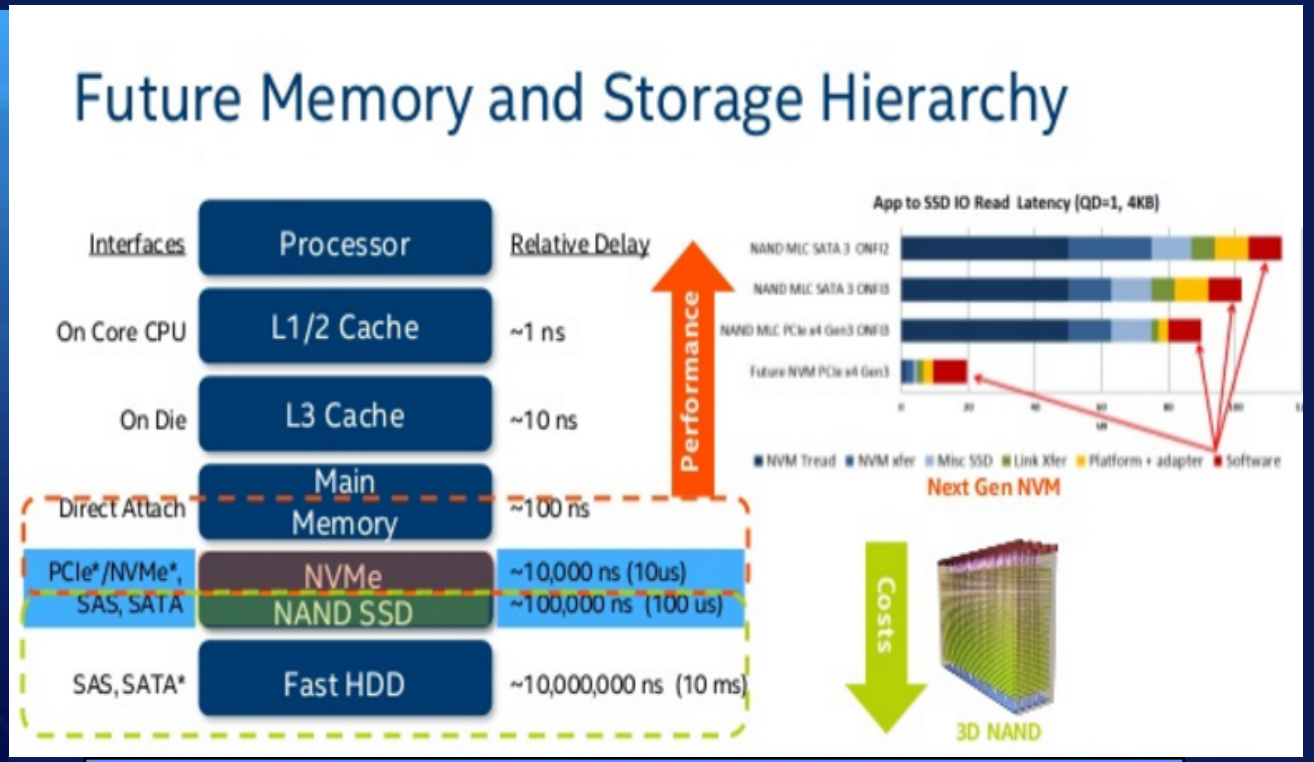
How much data to store?

Directly attached? Network attached?



SSD: Solid State Device

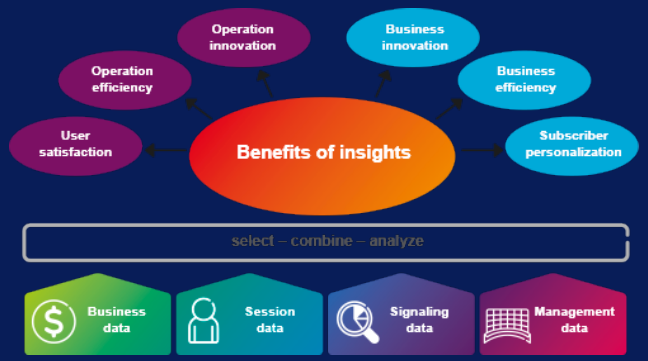
How fast do we need to read/write?



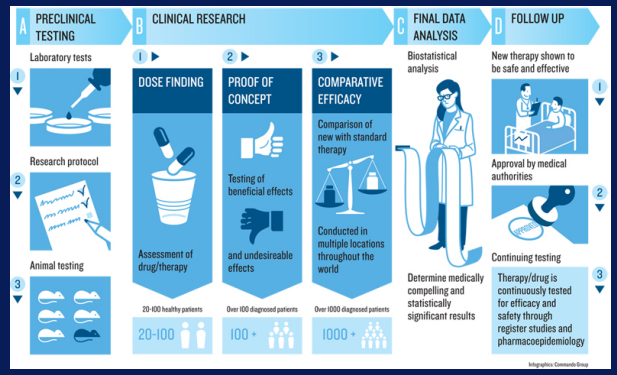
NVMe: Non-volatile Memory Express
For fast transfer between memory and SSD

Data Quality

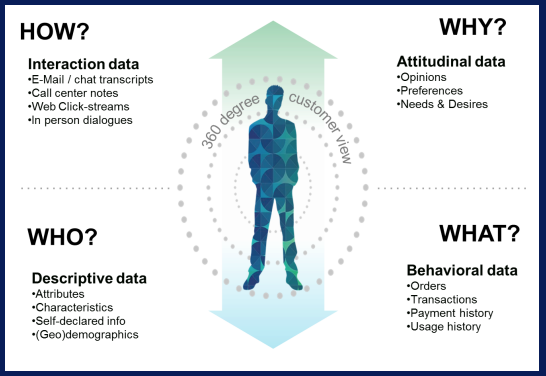
Why worry about data quality?



Better quality means better analytics and decision making



Quality assurance means needed for regulatory compliance



Quality leads to better engagement and interaction with external entities

Data Quality

Why worry about data quality?

Gartner

- **Data profiling and data quality measurement:** The analysis of data to capture statistics (metadata) that provide insight into the quality of data and help to identify data quality issues.
- **Parsing and standardization:** The decomposition of text fields into component parts and the formatting of values into consistent layouts, based on industry standards, local standards (for example, postal authority standards for address data), user-defined business rules, and knowledge bases of values and patterns.
- **Generalized "cleansing":** The modification of data values to meet domain restrictions, integrity constraints or other business rules that define when the quality of data is sufficient for an organization.
- **Matching:** The identifying, linking or merging of related entries within or across sets of data.
- **Monitoring:** The deployment of controls to ensure that data continues to conform to business rules that define data quality for an organization.
- **Issue resolution and workflow:** The identification, quarantining, escalation and resolution of data quality issues through processes and interfaces that enable collaboration with key roles, such as data steward.
- **Enrichment:** The enhancement of the value of internally held data by appending related attributes from external sources (for example, consumer demographic attributes and geographic descriptors).

Operations on Data

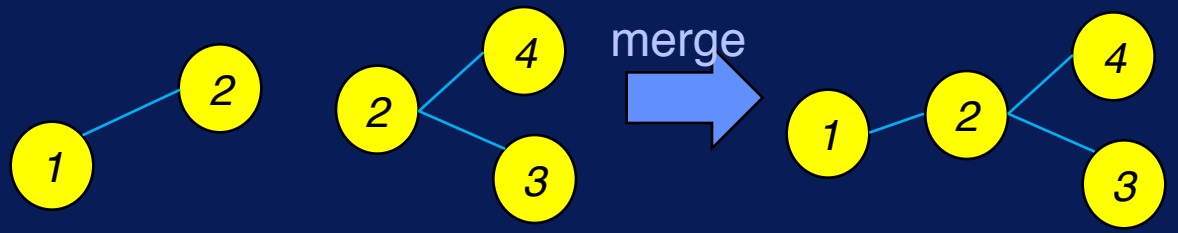
Operations on single data items that produce a sub-item

subarray

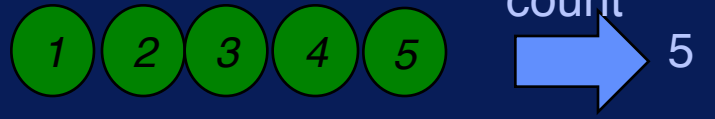
Operations on collections of data items

Operations that select a part of a collection

Operations that combine two collections



Operations that compute a function on a collection

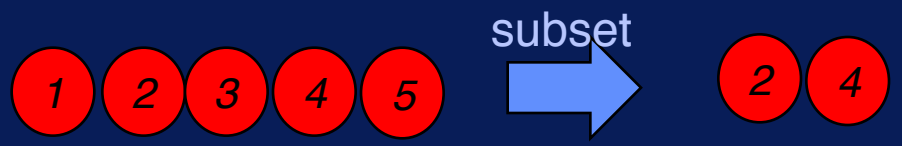


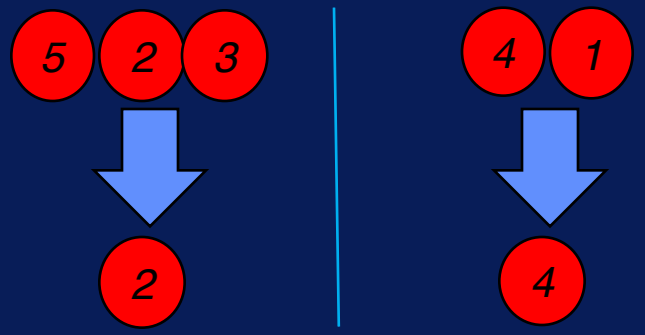
Efficiency of Data Operations

Measured by time and space

Should use parallelism

Selection





Achieving Scalability

Scaling up and Scaling Out

Vertical Scaling (Scale-up): Adding more processors and RAM, buying a more expensive and robust server

Horizontal Scaling (Scale-out): Adding more, possibly less powerful machines that interconnect over a network

Many operations perform better with more memory, more cores

Parallel operations will possibly be slower

Maintenance can be difficult, expensive

Easier in practice to add more machines

The Server industry has many solutions for scale-up/scale-out decisions

Keeping Data Secure

Data security – a must for sensitive data

Increasing the number of machines leads to more security risks

Data in transit must be secure

Encryption and decryption increase security but make data operations expensive