Big Data Analysis

Lecture 3

2019/11/29

A Real Big Data Case in Finance

- Quantitative Trading
- Cover stocks (3600+), ETFs(250), futures(55*120), bonds(different types), options(tenors*strikes), funds(7000+), etc.
- Since 2011 or the first listed dates, around 2160 business days
- Various data types: prices (OHLC), volume, amount, news, …
- Derived data information such as dividend adjusted prices, returns, consensus, etc.

Actually Available Data

lev2_lz_201712130400.zip	2017/12/23 11:06	WinRAR ZIP archive	5,813,602 KB	2018/7/22 21:40
lev2_lz_201712131510.zip	2017/12/23 11:07	WinRAR ZIP archive	5,530,698 KB	2018/7/22 21:47
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lev2_lz_201712180400.zip	2017/12/23 11:29	WinRAR ZIP archive	5,922,013 KB	2018/7/22 20:19
lev2_lz_201712181510.zip	2017/12/23 11:28	WinRAR ZIP archive	5,352,670 KB	2018/7/22 20:27
lev2_lz_201712190400.zip	2017/12/23 11:36	WinRAR ZIP archive	6,291,980 KB	2018/7/22 20:35
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lev2_lz_201712200400.zip	2017/12/23 11:43	WinRAR ZIP archive	5,714,756 KB	2018/7/22 20:52
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lev2_lz_201712221510.zip	2017/12/23 11:57	WinRAR ZIP archive	5,161,314 KB	2018/7/22 21:32

lev2_lz_201712221510.zip\logs - ZIP64 archive, unpacked size 42,661,117,642 bytes

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Selected 201,423,834 bytes in 1 file

Total 42,661,117,642 bytes in 216 files

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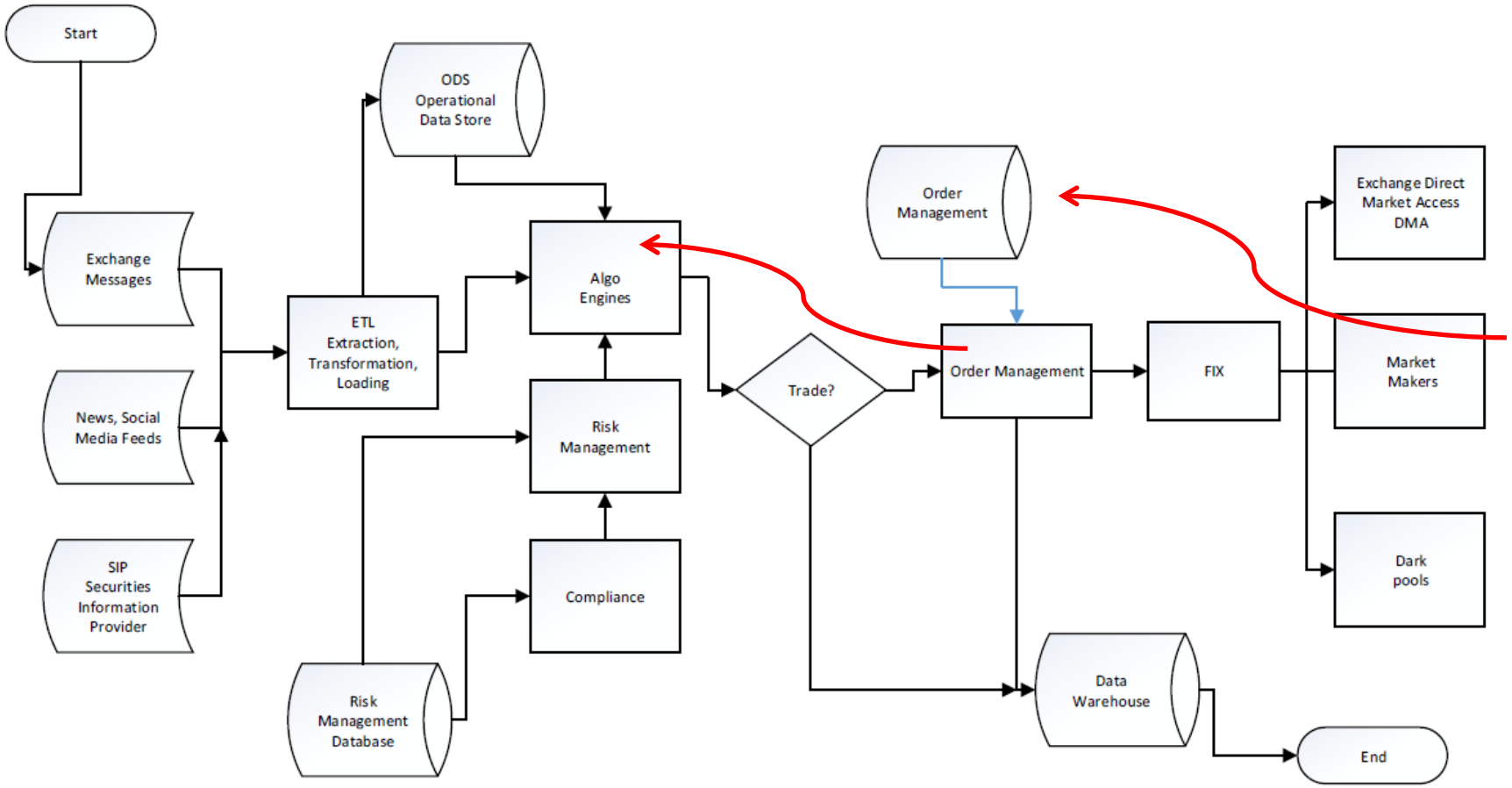
```

Objectives

- Predict the price movements of securities
- Construct a portfolio of selected securities
- Manage the risks of the portfolio

Workflow



Big Data, Fast: Database Requirements for High Frequency Trading, Ramesh K. Karne, 2017

Big Data is Perfect for Quant Strategies

- Central Limit Theorem
- https://nypost.com/2014/04/18/schneiderman-to-probe-virtus-htf-practices/

Strategy Categories

- Constraints
  - AUM
  - Research capabilities
  - Trading system, especially IT infrastructure

Frequency	High	Middle	Low
Upper limit of AUM	small	between	large
Expected Alpha Return	high	between	low
System Requirement	high	between	low

Multi Strategies

- No strategy works forever
- Each strategy has its good and bad times
- Most institutional investors diversify their investment portfolios with multi strategies
- Strategies with portable alphas can work together

Raw Data Treatment

- Slice and group data from raw data into different frequencies
- Typical example is the daily stock price time series
- Choices of how to summarize the discarded information between sample points
- Irregular and regular information handling
- Data cleaning

Data Storage Choices

- Relational databases
- NoSQL databases
- Time Series Databases

Relational databases

- Database engine supports concurrent transactions
- Relational model and schema
- Structured Query Languages (SQL)

Concurrent Transactions

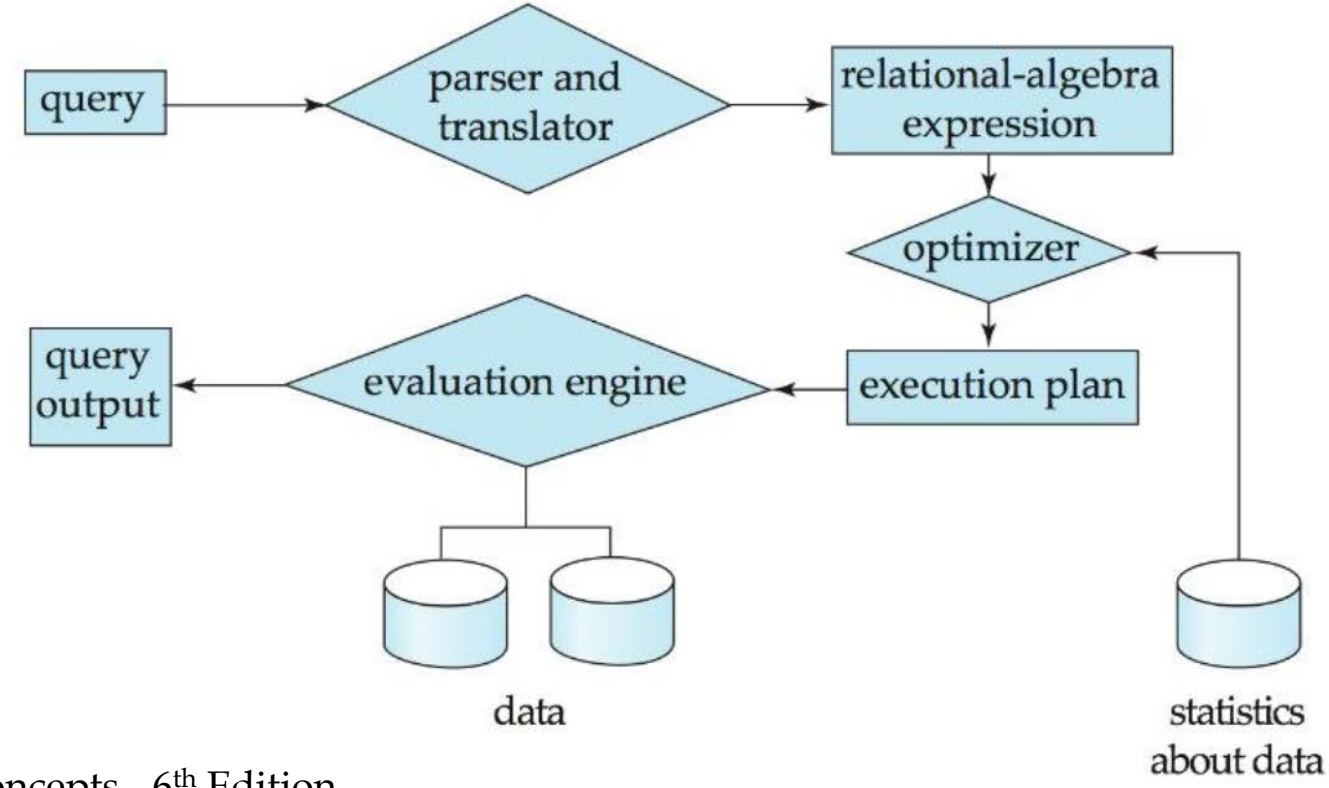
- Properties known as ACID:
  - **Atomicity**: No inconsistent state with partial updates of transactions.
  - **Consistency**: No illegal transactions.
  - **Isolation**: Concurrently executed transactions need to be isolated.
  - **Durability**: Committed transactions will stay.

Database Engine Components

- Storage manager
  - the interface between the database and the operating system
  - responsible for authorization, interaction with the OS file system (accessing storage and organizing files), and efficient data storage/modification (indexing, hashing, buffer management).
- Transaction manager
  - ensures the database is consistent (if a failure occurs) and ACID properties

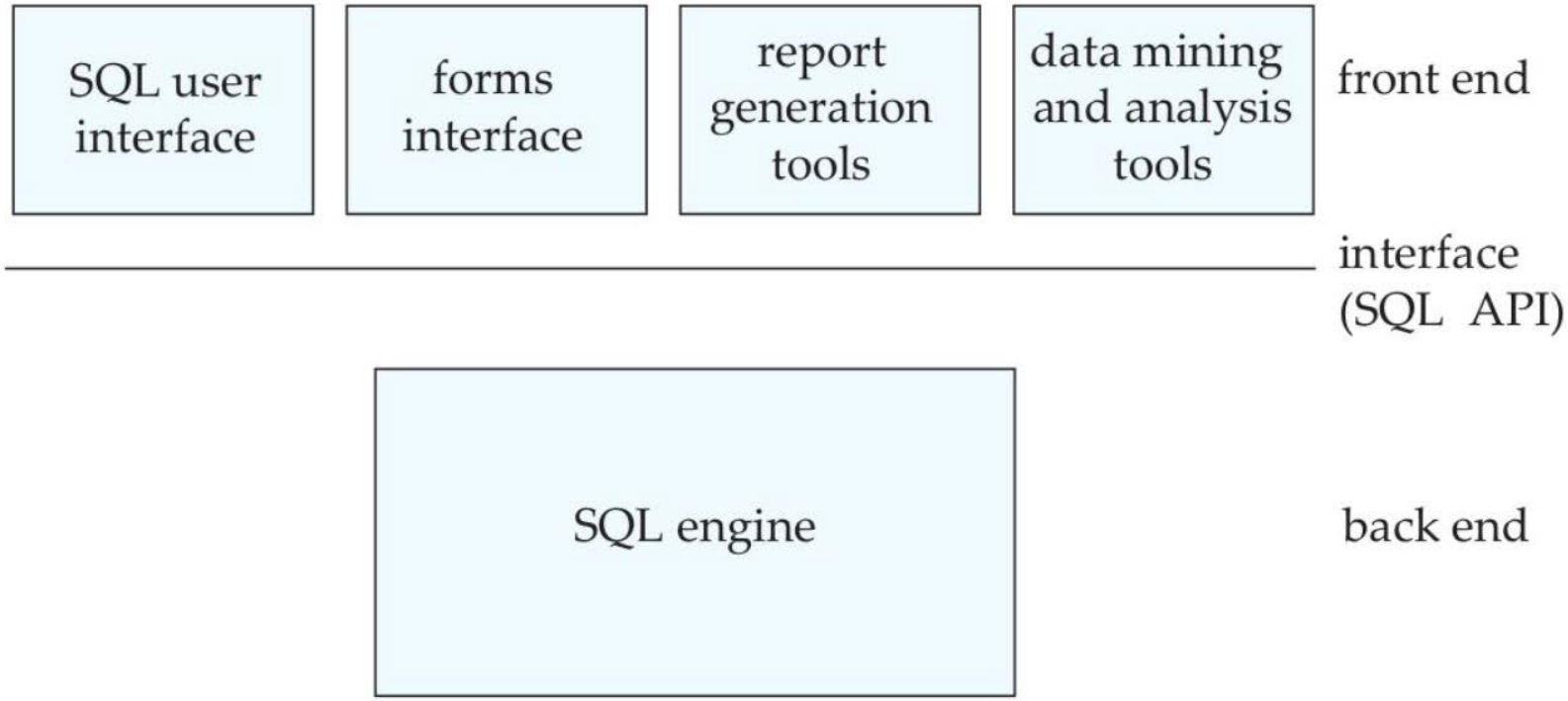
Query Processor

- Three major jobs: parsing and translation, optimization, and evaluation



Database System Concepts - 6th Edition

SQL API as Interface



Database System Concepts - 6th Edition

Relation Example: Instructor

attributes
(or columns)

ID	*name*	*dept_name*	*salary*
10101	Srinivasan	Comp. Sci.	65000
12121	Wu	Finance	90000
15151	Mozart	Music	40000
22222	Einstein	Physics	95000
32343	El Said	History	60000
33456	Gold	Physics	87000
45565	Katz	Comp. Sci.	75000
58583	Califieri	History	62000
76543	Singh	Finance	80000
76766	Crick	Biology	72000
83821	Brandt	Comp. Sci.	92000
98345	Kim	Elec. Eng.	80000

tuples
(or rows)

Schema Example: Instructor

- Database schema -- is the logical structure of the database.
- Database instance -- is a snapshot of the data in the database at a given instant in time.
- Example:
  - schema: *instructor* (*ID, name, dept_name, salary*)
  - Instance:

ID	*name*	*dept_name*	*salary*
22222	Einstein	Physics	95000
12121	Wu	Finance	90000
32343	El Said	History	60000
45565	Katz	Comp. Sci.	75000
98345	Kim	Elec. Eng.	80000
76766	Crick	Biology	72000
10101	Srinivasan	Comp. Sci.	65000
58583	Califieri	History	62000
83821	Brandt	Comp. Sci.	92000
15151	Mozart	Music	40000
33456	Gold	Physics	87000
76543	Singh	Finance	80000

SQL Query Example

- The **where** clause specifies conditions that the result must satisfy
  - Corresponds to the selection predicate of the relational algebra.
- To find all instructors in Comp. Sci. dept

```
select name
from instructor
where dept_name = 'Comp. Sci.'
```

- SQL allows the use of the logical connectives **and, or,** and **not**
- The operands of the logical connectives can be expressions involving the comparison operators <, <=, >, >=, =, and <>.
- Comparisons can be applied to results of arithmetic expressions
- To find all instructors in Comp. Sci. dept with salary > 80000

```
select name
from instructor
where dept_name = 'Comp. Sci.'  and salary > 80000
```