Data Engineering Project

Module 3
Data Quality Assessment and Data Exploration

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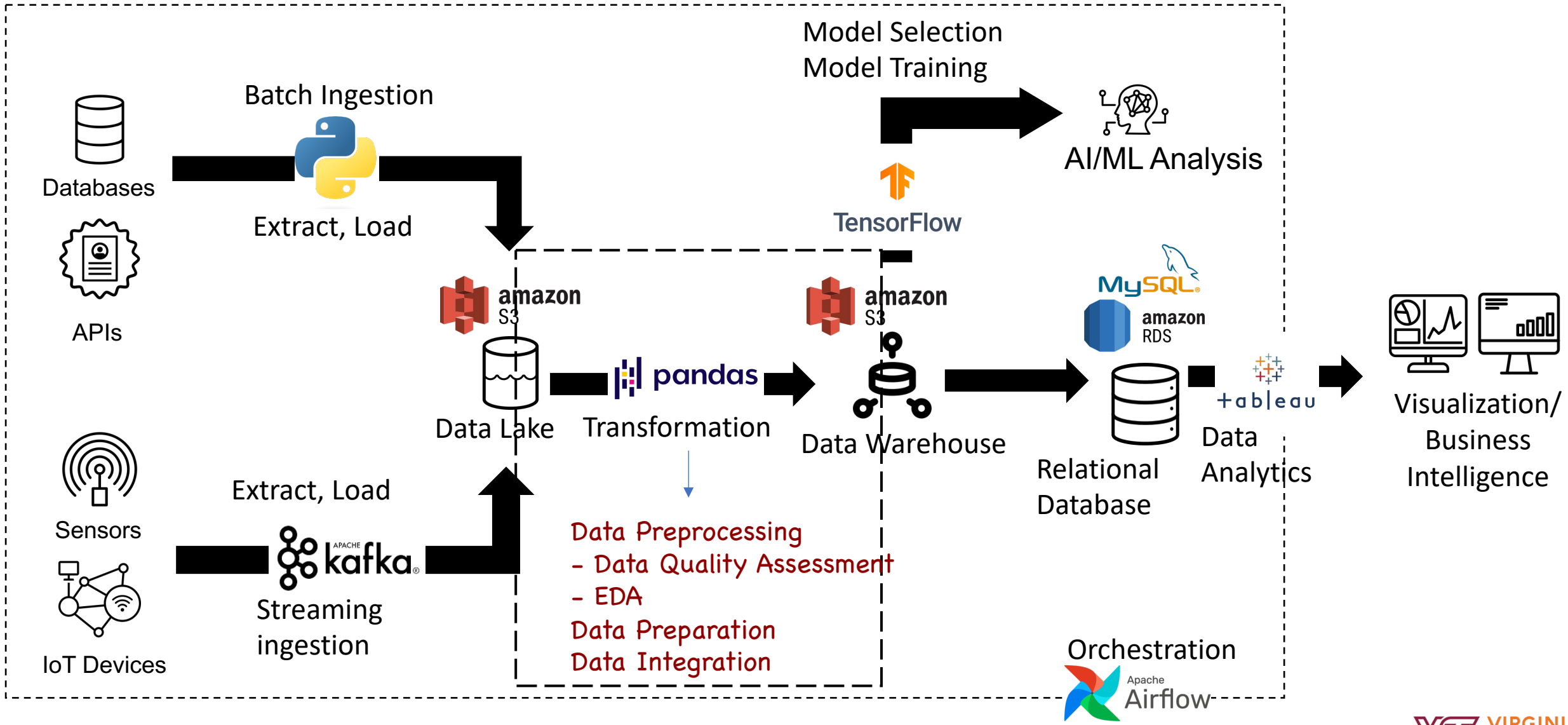
Objectives

- Data Quality Assessment
- Exploratory Data Analysis

Custom Data Engineering Pipeline



Data Quality Assessment

The Role of Data Quality in Data-intensive Tasks

Real-world data is noisy, incomplete, inconsistent:

- Noisy: errors/ outliers
  Erroneous values: e.g., salary= -10K
  Unexpected values: e.g., salary= 100K when the rest dataset lies in [30K-50K]

- Incomplete: missing data
  Missing values: e.g., occupation=“ ”
  Missing attributes of interest: e.g., no information on occupation

- Inconsistent: discrepancies in the data
  Example: student grade ranges differ across countries, in USA [A-F] and in GR [0-10]

“Garbage in, garbage out”

“Dirty” data → poor results

Data Quality Dimensions

Accuracy

The ages in the dataset match the actual ages of the individuals

Completeness

The dataset includes unique data on all the employees, include their names, ages, and addresses

Consistency

Data about a particular customer is the same across all the records in the dataset

Timeliness

The data in the dataset reflects the most recent sales information

Relevance

The data in the dataset is relevant to the products the user is interested in

Validity

The correct format for phone numbers, and does not contain any errors or invalid entries

Data Quality Dimensions (mostly in ML)

Amount of Training Data

Does the dataset include enough data for the model at hand?

Feature Relevance

Analyze relative importance of each feature with respect to the target variable or with other features

Bias

Is the dataset biased?

Outliers

How many outliers? The presence of outliers in data increases the misclassification

Exploratory Data Analysis (EDA)

getting to know our data

Exploratory Data Analysis (EDA)

Goal:

- analyze and investigate data sets
- summarize their main characteristics

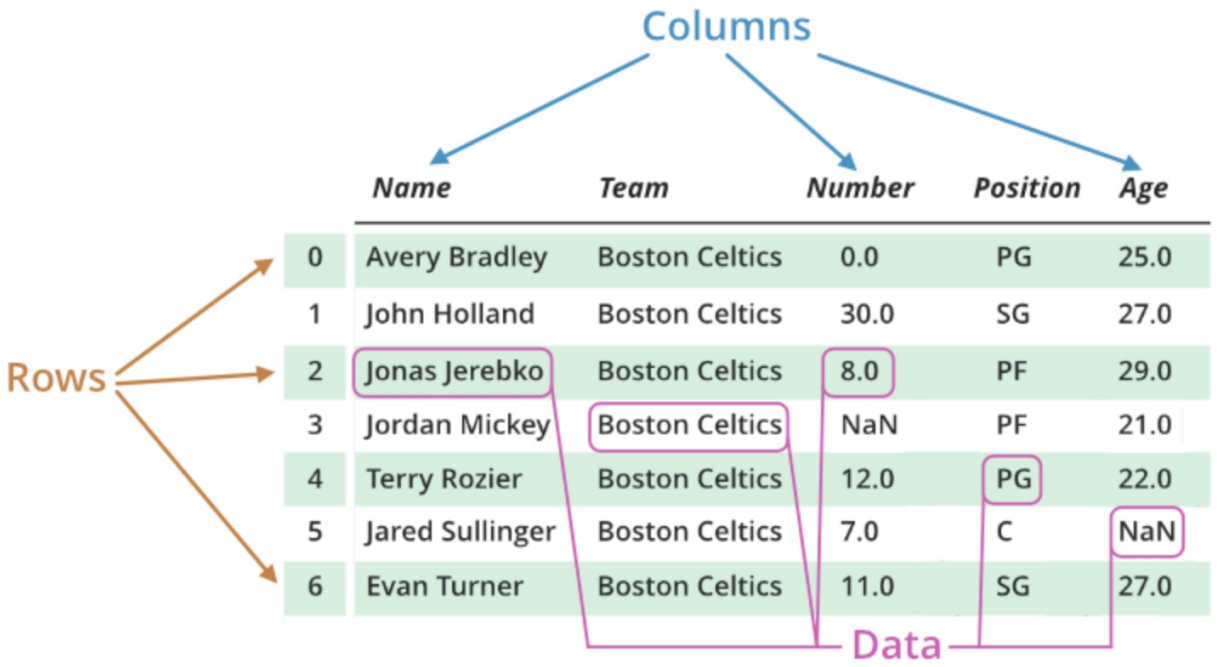
- determine how best to manipulate data sources to get the meaningful answers
- discover patterns, spot anomalies, test a hypothesis, or check assumptions

EDA with Pandas DataFrames

Pandas DataFrame is a two-dimensional data structure

- i.e., data is aligned in a tabular fashion in rows and columns

Pandas DataFrame consists of three principal components: **data**, **rows**, and **columns**



	Name	Team	Number	Position	Age
0	Avery Bradley	Boston Celtics	0.0	PG	25.0
1	John Holland	Boston Celtics	30.0	SG	27.0
2	Jonas Jerebko	Boston Celtics	8.0	PF	29.0
3	Jordan Mickey	Boston Celtics	NaN	PF	21.0
4	Terry Rozier	Boston Celtics	12.0	PG	22.0
5	Jared Sullinger	Boston Celtics	7.0	C	NaN
6	Evan Turner	Boston Celtics	11.0	SG	27.0

Basic EDA functions

Function: `df.info()`

Prints a concise summary of a DataFrame including the dtype and columns, non-null values, and memory usage

Example:

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 458 entries, 0 to 457
Data columns (total 9 columns):
Name        457 non-null object
Team        457 non-null object
Number      457 non-null float64
Position    457 non-null object
Age         457 non-null float64
Height      457 non-null object
Weight      457 non-null float64
College     373 non-null object
Salary      446 non-null float64
dtypes: float64(4), object(5)
memory usage: 32.3+ KB
```

	Name	Team	Number	Position	Age	Height	Weight	College	Salary
0	Avery Bradley	Boston Celtics	0.0	PG	25.0	6-2	180.0	Texas	7730337.0
1	Jae Crowder	Boston Celtics	99.0	SF	25.0	6-6	235.0	Marquette	6796117.0
2	John Holland	Boston Celtics	30.0	SG	27.0	6-5	205.0	Boston University	NaN
3	R.J. Hunter	Boston Celtics	28.0	SG	22.0	6-5	185.0	Georgia State	1148640.0
4	Jonas Jerebko	Boston Celtics	8.0	PF	29.0	6-10	231.0	NaN	5000000.0
5	Amir Johnson	Boston Celtics	90.0	PF	29.0	6-9	240.0	NaN	12000000.0
6	Jordan Mickey	Boston Celtics	55.0	PF	21.0	6-8	235.0	LSU	1170960.0
7	Kelly Olynyk	Boston Celtics	41.0	C	25.0	7-0	238.0	Gonzaga	2165160.0
8	Terry Rozier	Boston Celtics	12.0	PG	22.0	6-2	190.0	Louisville	1824360.0
9	Marcus Smart	Boston Celtics	36.0	PG	22.0	6-4	220.0	Oklahoma State	3431040.0
10	Jared Sullinger	Boston Celtics	7.0	C	24.0	6-9	260.0	Ohio State	2569260.0
11	Isaiah Thomas	Boston Celtics	4.0	PG	27.0	5-9	185.0	Washington	6912869.0
12	Evan Turner	Boston Celtics	11.0	SG	27.0	6-7	220.0	Ohio State	3425510.0
13	James Young	Boston Celtics	13.0	SG	20.0	6-6	215.0	Kentucky	1749840.0
14	Tyler Zeller	Boston Celtics	44.0	C	26.0	7-0	253.0	North Carolina	2616975.0
15	Bojan Bogdanovic	Brooklyn Nets	44.0	SG	27.0	6-8	216.0	NaN	3425510.0

DataFrame Example

Basic EDA functions

Function: `df.describe()`

Generates descriptive statistics including those that summarize the central tendency, dispersion and shape of a dataset's distribution, excluding NaN (Not a Number) values

Example:

	Number	Age	Weight	Salary
count	457.000000	457.000000	457.000000	4.460000e+02
mean	17.678337	26.938731	221.522976	4.842684e+06
std	15.966090	4.404016	26.368343	5.229238e+06
min	0.000000	19.000000	161.000000	3.088800e+04
25%	5.000000	24.000000	200.000000	1.044792e+06
50%	13.000000	26.000000	220.000000	2.839073e+06
75%	25.000000	30.000000	240.000000	6.500000e+06
max	99.000000	40.000000	307.000000	2.500000e+07

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DataFrame Example

Basic EDA functions

Function: `df.isnull()`

Detects missing values. Returns a boolean same-sized object indicating if the values are empty (or missing)

For example, the following command displays the number of empty values for each column in descending order

```
df.isnull().sum().sort_values(ascending = False)
```

Example:

```
College     85
Salary      12
Name         1
Team         1
Number       1
Position     1
Age          1
Height       1
Weight       1
dtype: int64
```

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DataFrame Example

Basic EDA functions

Function: `df.apply(pd.Series.nunique)`

Counts the number of unique values in each column of a DataFrame

Example:

```
Name        457
Team         30
Number       53
Position      5
Age          22
Height       18
Weight       87
College     118
Salary      309
dtype: int64
```

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DataFrame Example

Basic EDA functions

Function: `df.duplicated()`

Returns Boolean Series denoting duplicate rows

Example:

```
0      False
1      False
2      False
3      False
4      False
       ...
453    False
454    False
455    False
456    False
457    False
Length: 458, dtype: bool
```

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DataFrame Example

https://pandas.pydata.org/docs/

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