LECTURER: NGHIA DUONG-TRUNG

DATA SCIENCE

TOPIC OUTLINE

Introduction to Data Science	1
Use Cases and Performance Evaluation	2
Data Preprocessing	3
Processing of Data	4
Selected Mathematical Techniques	5
Selected Artificial Intelligence Techniques	6

UNIT 4

PROCESSING OF DATA

STUDY GOALS

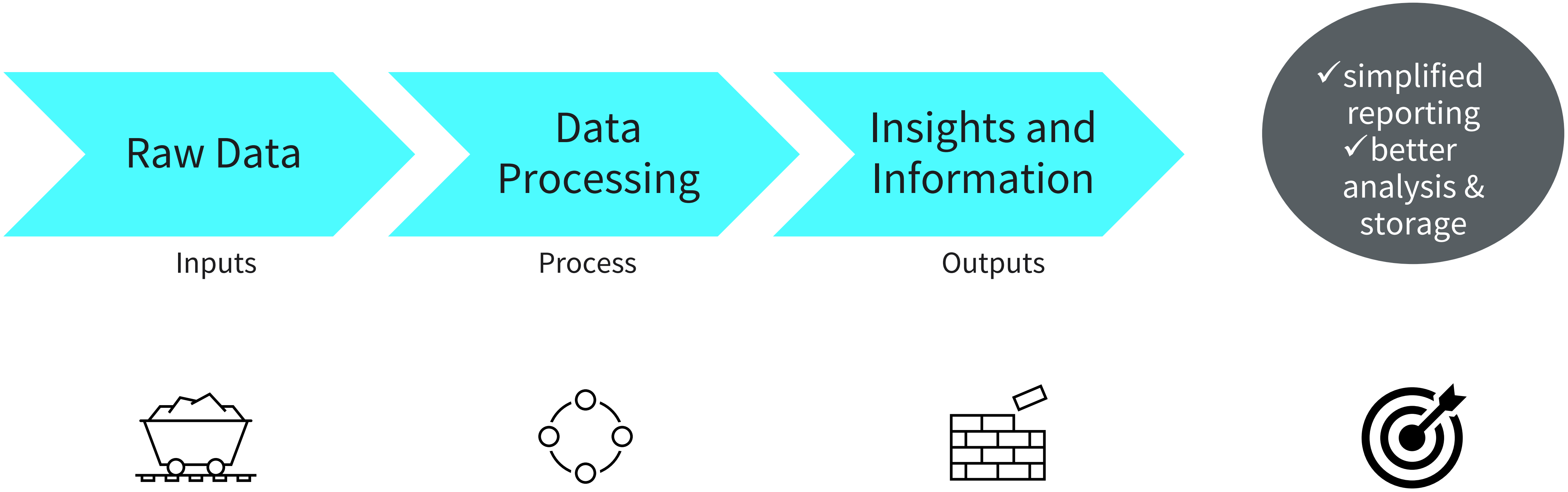
On completion of this unit, you will have learned …

- the concepts of data, information, and data processing.
- the stages and cycles of data processing.
- the different methods and types of data processing.
- the output forms and file formats for processed data.

EXPLAIN SIMPLY

1. Explain why data processing is important.
2. In what way benefit data science projects from data processing.
3. Describe the five types of electronic data processing.

DATA PROCESSING INTRODUCTION



Raw Data

Inputs

Data Processing

Process

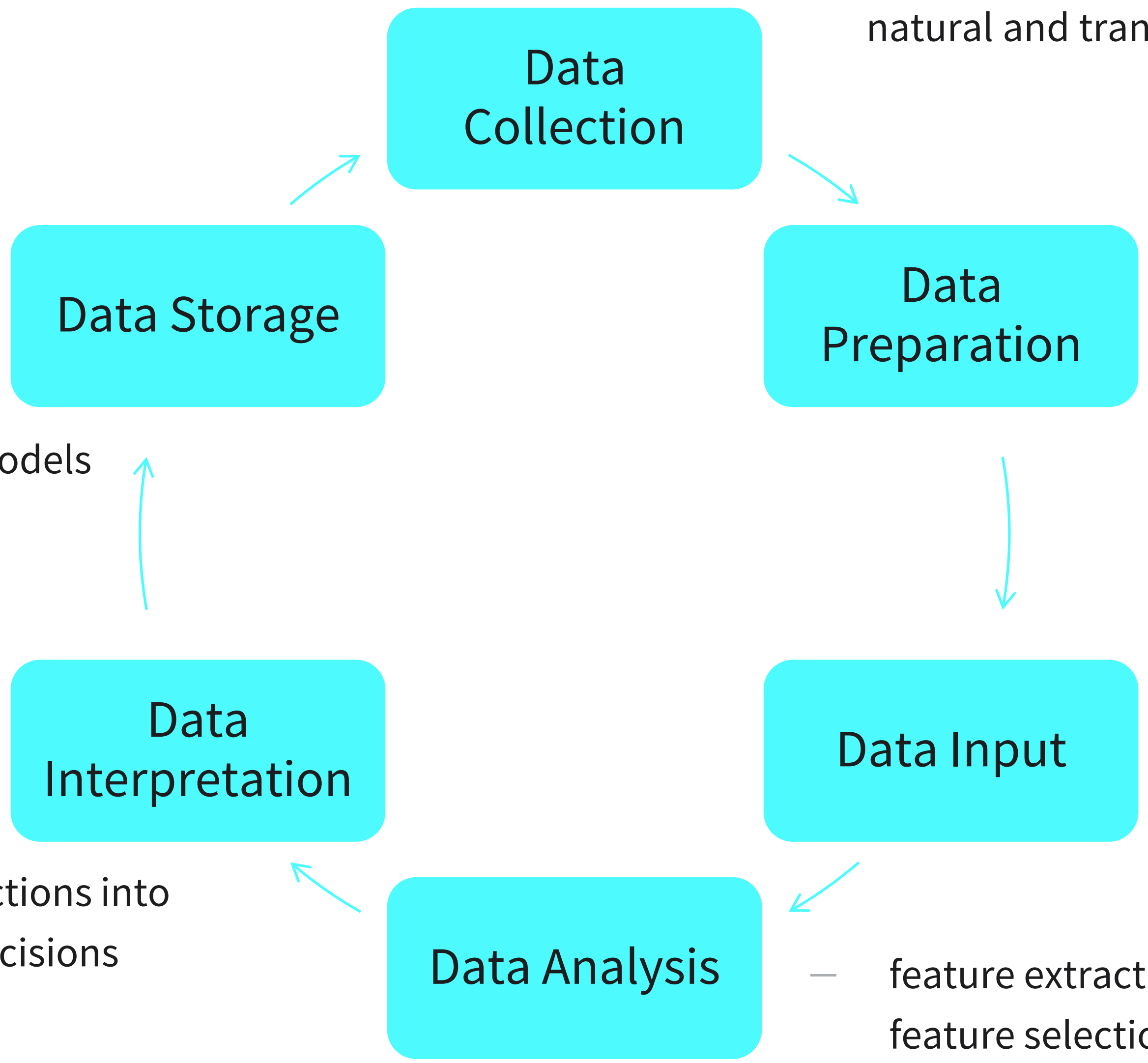
Insights and Information

Outputs

✓simplified reporting
✓better analysis & storage

Source of the graphic: IU International University, Course Book DLMBDSA01.

DATA PROCESSING CYCLE



Data Collection
- Creation of a **data lake** (Storage of natural and transformed data)

Data Preparation
- Preprocess raw data (outliers, missing values etc.)

Data Input
- Update **data warehouse**

Data Analysis
- feature extraction, correlation analysis, feature selection, machine learning & extracting valuable insights

Data Interpretation
- Translate model predictions into actionable business decisions

Data Storage
- Documentation of processes, models and information for future use

Source of the graphic: IU International University, Course Book DLMBDSA01.

ELECTRONICAL DATA PROCESSING

Batch

split data into batches to permit sequential processing (mostly offline)

Online

make use of internet connections

Real-time

immediate response to requests

Distributed

multiple remote workstations connected to a large server

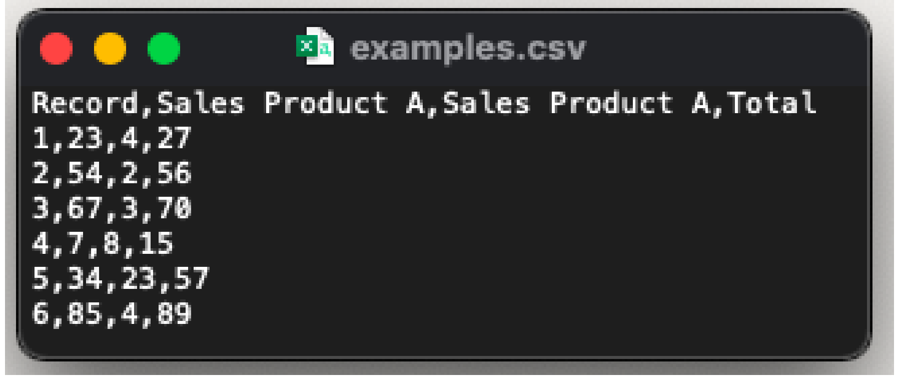
Time-sharing

computing unit is utilized by multiple users

OUTPUT FORMATS OF PROCESSED DATA

CSV (comma-separated-value)

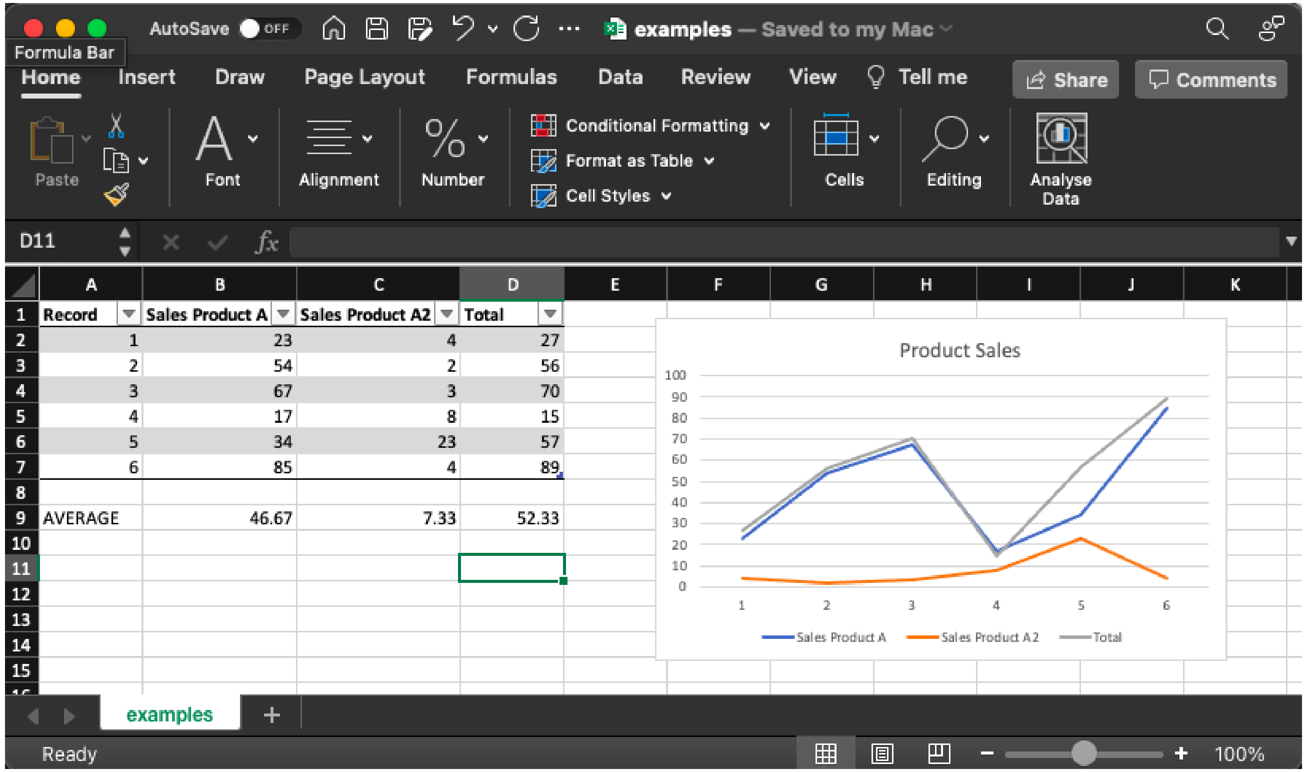
- row-based: every line represents one record
- features are separated by comma



```
Record,Sales Product A,Sales Product A,Total
1,23,4,27
2,54,2,56
3,67,3,70
4,7,8,15
5,34,23,57
6,85,4,89
```

XLS (Excel spreadsheet)

- tabular format of records and features
- possibility to add graphs, computations



Record	Sales Product A	Sales Product A2	Total
1	23	4	27
2	54	2	56
3	67	3	70
4	17	8	15
5	34	23	57
6	85	4	89
AVERAGE	46.67	7.33	52.33

Source of the graphics: Antonia Schulze, 2021.

OUTPUT FORMATS OF PROCESSED DATA

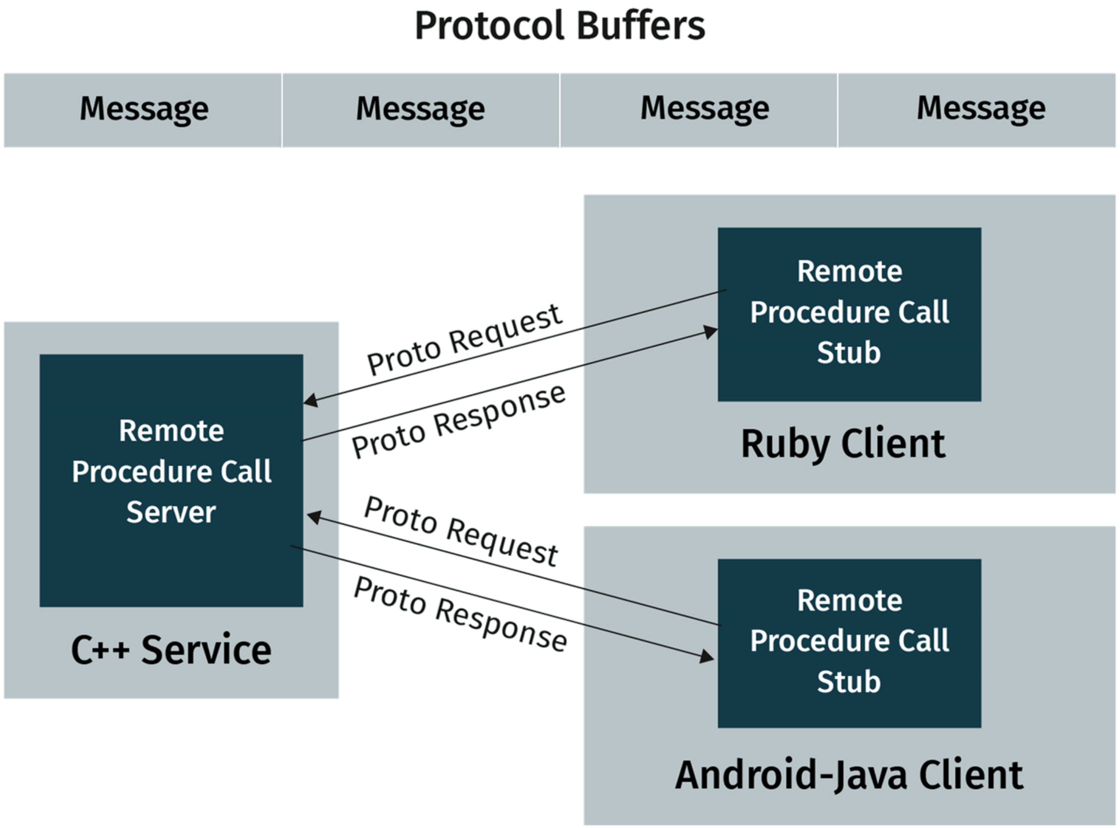
XML (extensible markup language)

- structured, non-tabular data written as text with annotations

```
<student>
  <name>
      <firstname> John </firstname>
      <lastname> Miller</lastname>
  </name>
  <birthdate> 1999-12-12</birthdate>
</student>
<student>
  <name>
      <firstname> Alice </firstname>
      <lastname> Doe</lastname>
  </name>
  <birthdate> 1987-01-06</birthdate>
</student>
```

Protobuf (protocol buffers)

- reduced XML version

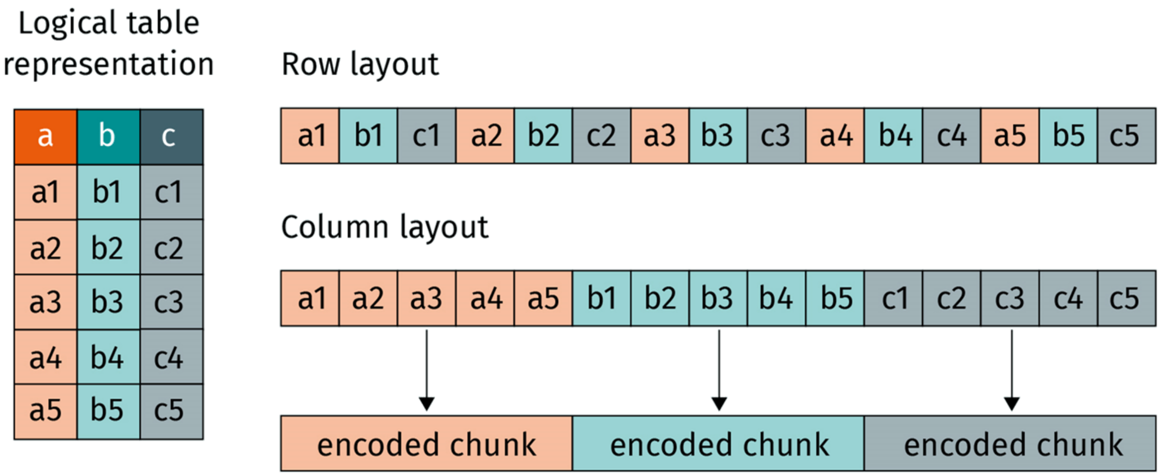


Source of the graphic: IU International University, Course Book DLMBDSA01.

OUTPUT FORMATS OF PROCESSED DATA

Apache Parquet

- column-based file format



Logical table representation

a	b	c
a1	b1	c1
a2	b2	c2
a3	b3	c3
a4	b4	c4
a5	b5	c5

Row layout

a1 b1 c1 a2 b2 c2 a3 b3 c3 a4 b4 c4 a5 b5 c5

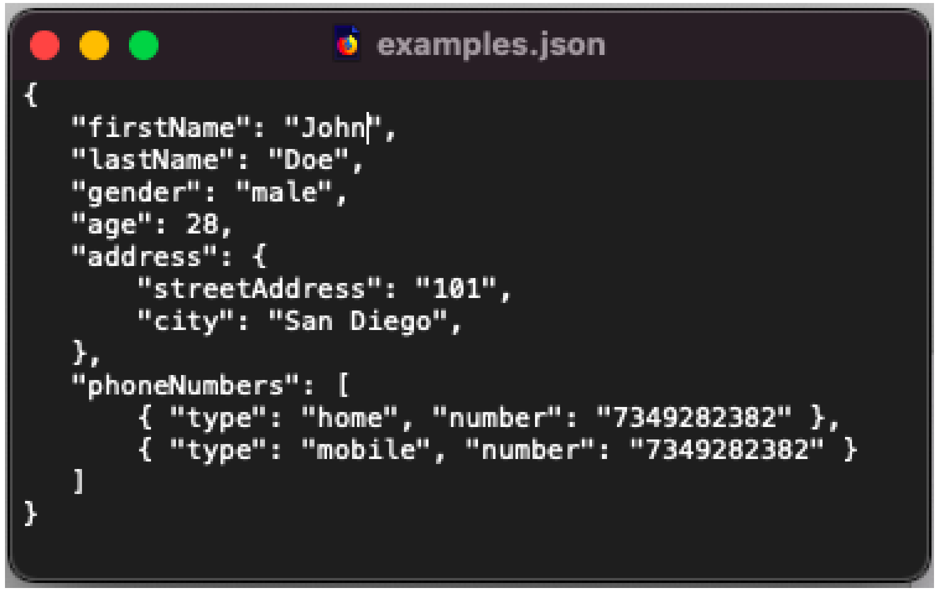
Column layout

a1 a2 a3 a4 a5 b1 b2 b3 b4 b5 c1 c2 c3 c4 c5

encoded chunk | encoded chunk | encoded chunk

JSON (Java script object notation)

- a list of key-value pairs



```
{
   "firstName": "John",
   "lastName": "Doe",
   "gender": "male",
   "age": 28,
   "address": {
       "streetAddress": "101",
       "city": "San Diego",
   },
   "phoneNumbers": [
       { "type": "home", "number": "7349282382" },
       { "type": "mobile", "number": "7349282382" }
   ]
}
```

Source of the graphics: IU International University, Course Book DLMBDSA01; Antonia Schulze, 2021.

REVIEW STUDY GOALSSTUDY GOALS

You have learned …

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SESSION 4

TRANSFER TASK

TRANSFER TASK

Create a framework that helps data practitioners to choose the best sub-type of electronic data processing.
Which questions should they ask themselves?

TRANSFER TASK
PRESENTATION OF THE RESULTS

Please present your results.

The results will be discussed in plenary.

LEARNING CONTROL QUESTIONS

1. In which step is data with missing values handled?

   a) feature selection
   b) machine learning
   c) correlation analysis
   d) data pre-processing

LEARNING CONTROL QUESTIONS

2. The data provided in this format, <img fig=”Alice.jpg” tag=”Alice” /> , represents the…

   a) SQL data format.
   b) XLS data format.
   c) XML data format.
   d) CSV data format.

LEARNING CONTROL QUESTIONS

3. The patterns and relationships among data elements are defined as …

a) data.
b) properties.
c) information.
d) features.