

Structured and Unstructured Data – Smart Agriculture

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Questions:

1. Choose an industry or application area such as healthcare, automotive or finance.
2. Describe one example of structured data and one example of unstructured data generated or used in that domain.
3. Explain how each type of data is stored and processed technically.
4. Discuss the engineering challenges involved in integrating and analyzing these two types of data.
5. Suggest technologies, algorithms, or architectures to overcome these challenges.

1. Smart Agriculture / Precision Farming

2. **Structured Data:** Sensor readings such as soil moisture level, temperature, humidity, rainfall, and fertilizer usage collected at fixed time intervals.

Unstructured Data: Drone images of crops, satellite images, and farmer feedback in text or voice form.

3. Storage and Processing:

Structured Data: Stored in relational databases (MySQL, PostgreSQL) or time-series databases like InfluxDB. This data is processed using SQL queries and analytics pipelines to detect trends and threshold violations.

Unstructured Data: Stored in data lakes or distributed storage systems such as HDFS or cloud storage (AWS S3). Image data is processed using computer vision pipelines, while text feedback is processed using NLP techniques.

4. Engineering Challenges:

Data Integration: Combining numerical sensor data with image-based crop health analysis is complex due to different formats and time resolutions.

Scalability: Large farms generate massive data continuously, requiring scalable storage and processing systems.

Latency: Real-time decision-making (irrigation or pest control) demands low-latency data processing.

5. Technologies and Solutions:

- (a) SQL and time-series databases for sensor data analysis
- (b) Hadoop and Spark for large-scale agricultural data processing
- (c) Computer Vision and CNNs for crop disease detection from images
- (d) NLP models to analyze farmer feedback and advisory text
- (e) IoT architectures combined with AI/ML for automated irrigation and yield prediction