19MCT401 Data Analytics in Automation Systems: Unit I Systems: Unit I - Evolution of Big Data

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Focus: Understanding the historical progression and foundational concepts of Big Data impacting automation.

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What is Big Data? Redefining Data Data Management

Traditional data processing systems struggle with new data scale, speed, and diversity. diversity.

Definition: Extremely large datasets analyzed computationally to reveal patterns, trends, and associations.

Relevance to Automation: Critical for optimizing performance, predictive maintenance, and maintenance, and autonomous decision-making.

2.5
Quintillion Bytes
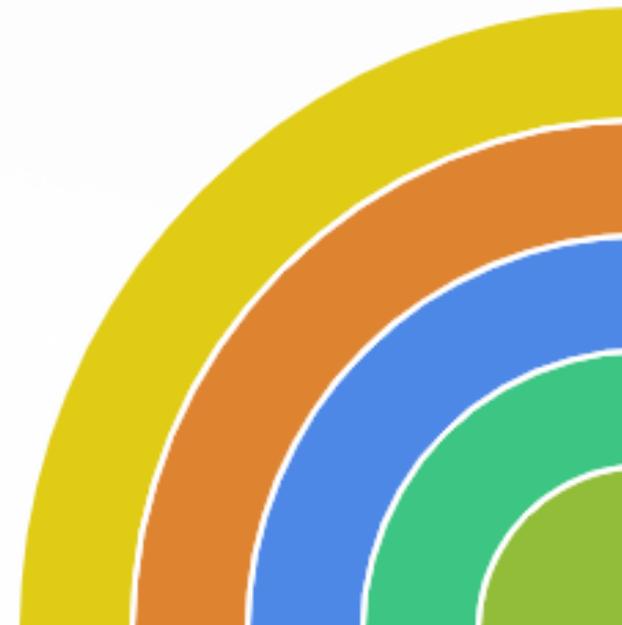Data created daily.

90%
World's Data
Generated in last two years.

175
Zettabytes
Expected by 2025.

Big Data's Impact on Organizations

Strategic Initiatives
Outcomes driving organizational success

Deeper Insights
Enhanced understanding from data analysis

Innovative Approaches
New methods to harness Big Data

Volume, Velocity, Variety
Key dimensions challenging traditional practices

Big Data
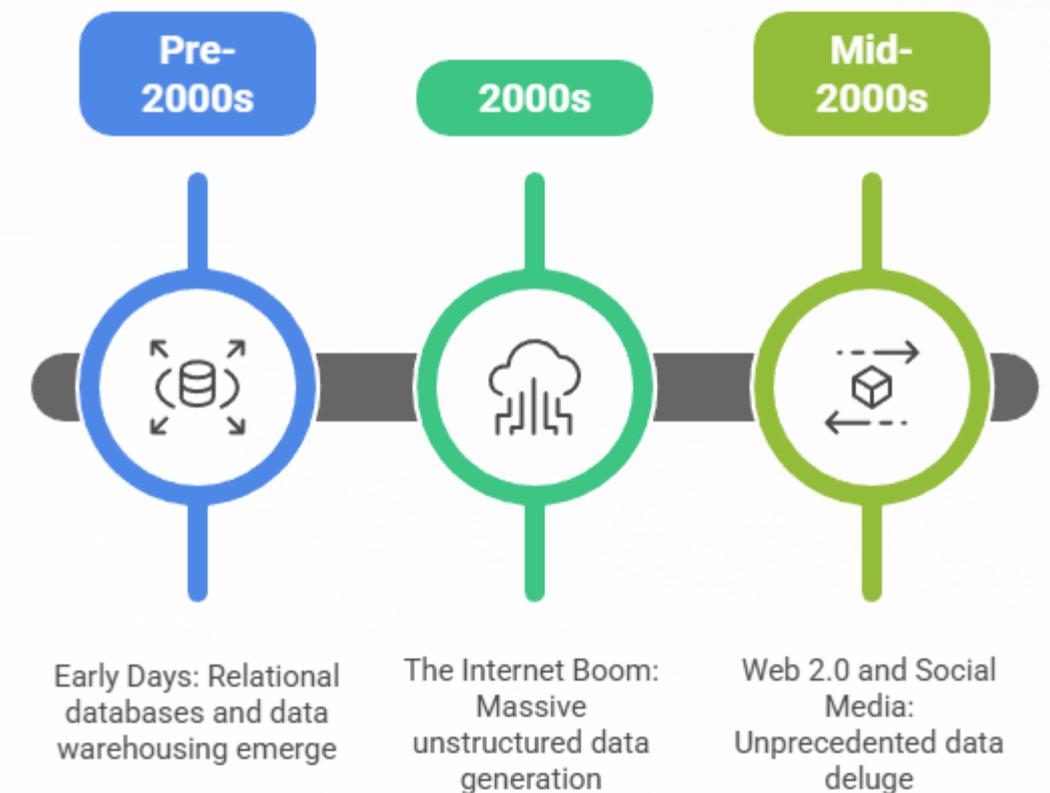The core concept of large and complex data sets

The Genesis of Big Data: A Data Deluge

•**Early Days (Pre-2000s):** The seeds of Big Data were sown in the pre-internet era with the rise of relational databases and data warehousing. Companies began collecting and storing transactional data, primarily for reporting and basic analysis. However, the scale was relatively limited, and data was largely structured.

•**The Internet Boom (2000s):** The explosion of the internet marked a turning point. Websites, e-commerce platforms, and search engines began generating massive amounts of unstructured data, including text, images, and user behavior logs. This data was too large and complex to be efficiently processed using traditional methods.

•**Web 2.0 and Social Media (Mid-2000s):** The advent of Web 2.0 and social media platforms like Facebook, Twitter, and YouTube further accelerated data generation. User-generated content, social interactions, and real-time updates created an unprecedented data deluge.

The Evolution of Big Data: Key Milestones

Pre-2000s — Early Days: Relational databases and data warehousing emerge

2000s — The Internet Boom: Massive unstructured data generation

Mid-2000s — Web 2.0 and Social Media: Unprecedented data deluge

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Early Data Challenges (Pre-2000s): The Foundation

Data Warehousing (1980s-1990s): Centralized repositories for structured data, primarily for.
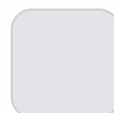
Relational Databases (SQL): Efficient for structured, transactional data; limitations in scalability and handling varied data types.

Early Internet Growth: Explosion of web content, but tools limited to process unstructured text/images effectively.

Emerging Need: Lack of tools to process vast, disparate, rapidly generated data.

Overcoming Early Data Challenges

Limited Data Handling
Inefficient data management practices

Technology Advancement
Improved data collection and storage

Standardization
Development of standardized data practices

Enhanced Analysis
Effective data processing and analysis

Data-Driven Decisions
Meaningful insights for decision-making

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Structured Focus
Dominated by rigid schemas.

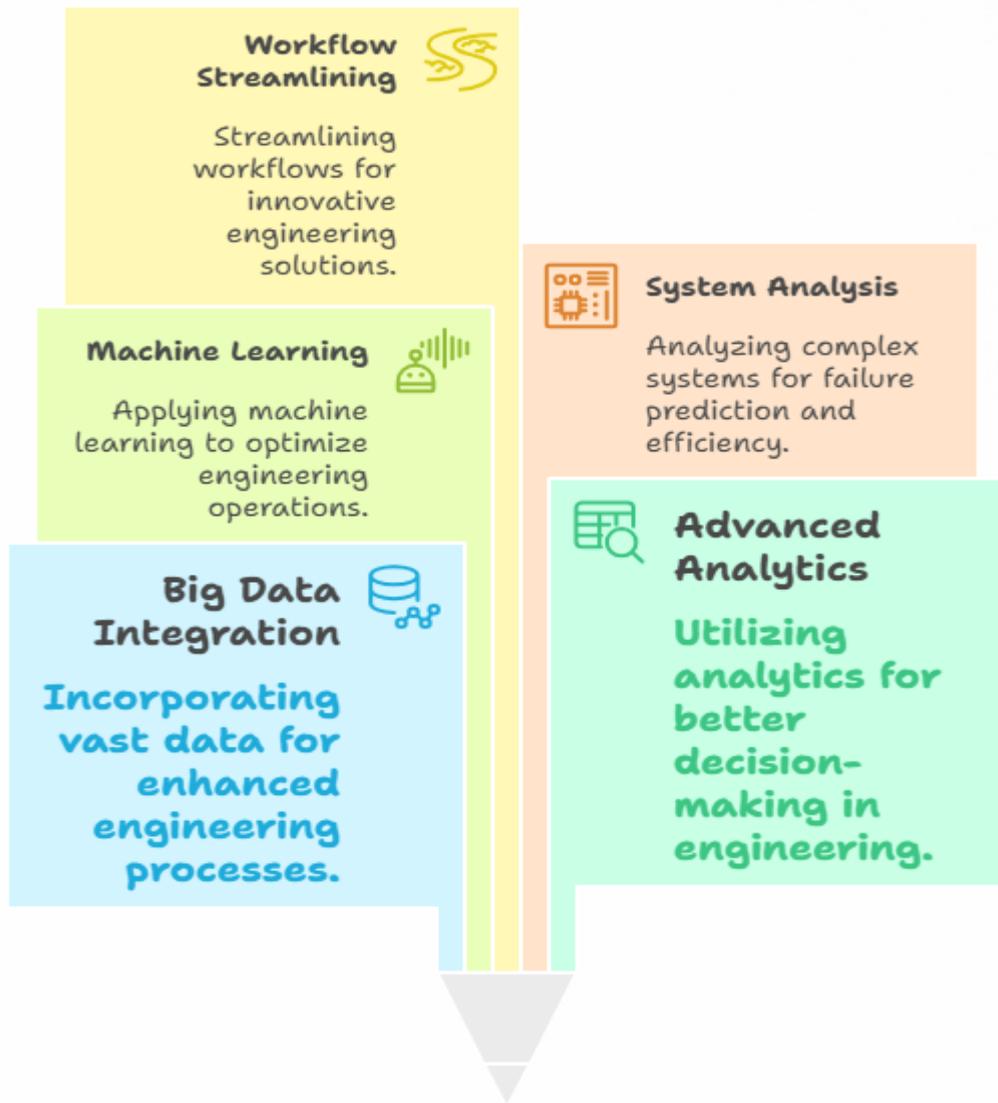## Scalability Limits
Struggled with growing data volumes. volumes.
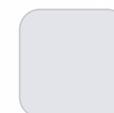
Batch Processing
Mostly offline, periodic analysis.

Big Data in Automation Systems: Engineering Applications

Transforming Engineering with Big Data

Big Data is fundamental for optimizing and enabling next-generation automation.

From predictive insights to real-time control, data fuels intelligent systems.

Workflow Streamlining
Streamlining workflows for innovative engineering solutions.

Machine Learning
Applying machine learning to optimize engineering operations.

System Analysis
Analyzing complex systems for failure prediction and efficiency.

Big Data Integration
Incorporating vast data for enhanced engineering processes.

Advanced Analytics
Utilizing analytics for better decision-making in engineering.

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Predictive Maintenance
Analyzing sensor data to predict machinery failures (e.g., aircraft engines).

Process Optimization
Real-time analysis to improve factory efficiency (e.g., smart factories).

Autonomous Systems
Enabling self-driving vehicles and robots with vast environmental data.

Quality Control
Image processing for automated defect detection in manufacturing.
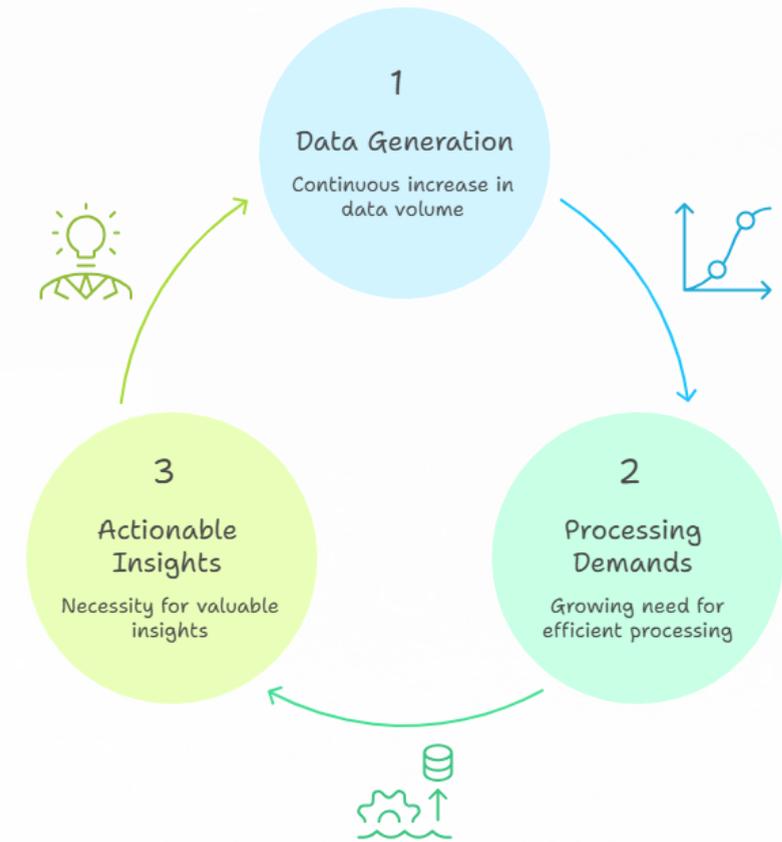
Conclusion & References

Big Data's evolution is driven by increasing data generation, processing needs, and needs, and actionable insights.

It is fundamental to the advancement and efficiency of modern automation systems.

Understanding this evolution is crucial for developing robust and intelligent intelligent automated solutions.

Loshin, David. "Big Data Analytics: From Strategic Planning to Enterprise Integration with Tools, Techniques, NoSQL, and Graph." Morgan Kaufmann, 2013.

Big Data Evolution Cycle

1
Data Generation
Continuous increase in data volume

2
Processing Demands
Growing need for efficient processing

3
Actionable Insights
Necessity for valuable insights

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