

CUET · COMPUTER SCIENCE · CLASS XI · CODE 308

# Emerging Trends

CUET unit: Emerging Trends

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## Snapshot

- Six state-of-the-art technology domains — AI, Big Data, IoT, Cloud Computing, Grid Computing, and Blockchains — are reshaping the digital economy.
- Their conceptual foundations (definitions, sub-types, characteristics) drive CUET's direct-recall and application-based MCQs on emerging technologies.
- CUET regularly tests the 5 Vs of Big Data, the three cloud service models, the distinction between VR and AR, and blockchain's decentralised ledger concept.
- Each technology has real-world use cases (Sophia, MeghRaj, smart cities, digital currency), making example-based questions common in NTA papers.
- Understanding differences between similar-sounding concepts — Cloud vs. Grid, VR vs. AR, IoT vs. WoT, IaaS vs. PaaS vs. SaaS — is essential because NTA frequently uses these as distractors.



## Detailed Notes

### 2.1 Core concepts

- **Artificial Intelligence (AI):** AI endeavours to simulate the natural intelligence of human beings into machines, making them behave intelligently. An AI system builds a knowledge base (a store of facts, assumptions, and rules) and makes decisions based on it; it can also learn from past experiences. Digital assistants like Siri, Google Now, Cortana, and Alexa are powered by AI. (NCERT §3.2, p. 45)
- **Machine Learning (ML):** ML is a subsystem of AI wherein computers learn from data using statistical techniques without being explicitly programmed. Algorithms called **models** are trained on a training dataset and tested on a testing dataset; once accuracy is acceptable, they predict outcomes on new, unknown data. (NCERT §3.2.1, p. 46)
- **Natural Language Processing (NLP):** NLP deals with the interaction between humans and computers using human spoken languages (Hindi, English, etc.). Applications include predictive typing, spell-check, voice-based web search, text-to-speech, speech-to-text, machine translation, and automated customer service. (NCERT §3.2.2, p. 46)
- **Immersive Experiences — Virtual Reality (VR):** VR is a three-dimensional, computer-generated situation that simulates the real world, allowing the user to interact with and explore the environment. Achieved using VR Headsets; promotes

additional sensory inputs (sound, smell, motion, temperature). Applications: gaming, military training, medical procedures, entertainment, engineering simulation. (NCERT §3.2.3(A), p. 47)

- **Immersive Experiences — Augmented Reality (AR):** AR is the superimposition of computer-generated perceptual information over the existing physical surroundings, making the environment interactive and digitally manipulable. Unlike VR, AR does not create something new; it augments the existing physical world. Location-based AR apps let travellers access real-time information of historical places. (NCERT §3.2.3(B), p. 47)
- **Robotics:** A robot is a machine capable of carrying out tasks automatically with accuracy and precision; unlike other machines it is programmable by a computer. Types include wheeled robots, legged robots, manipulators, and humanoids (robots resembling humans). Sensors are prime components. Examples: NASA's Mars Exploration Rover (MER), Sophia (humanoid using AI and facial recognition), drones (unmanned aircraft using GPS and onboard sensors). (NCERT §3.2.4, p. 48)
- **Big Data:** Big Data refers to datasets of enormous volume and complexity that cannot be processed using traditional data-processing tools. Around 2.5 quintillion bytes of data are created daily (Figure 3.8). Big data is not only voluminous but also unstructured (posts, chats, photographs, tweets, etc.). (NCERT §3.3, p. 49)
- **Five Vs of Big Data:** Volume (enormous size, difficult to process with traditional DBMS), Velocity (exponentially higher generation rate than traditional datasets), Variety (structured, semi-structured, and unstructured data — text, images, videos, web pages), Veracity (trustworthiness of data; inconsistent or biased data gives wrong results), Value (hidden patterns of high business value; preliminary enquiry needed to assess value). (NCERT §3.3.1, p. 50)
- **Data Analytics:** The process of examining datasets to draw conclusions about the information they contain, using specialised systems and software. Used in commercial industries for business decisions, and by researchers to verify or disprove scientific models. Pandas is a Python library that simplifies data analysis. (NCERT §3.3.2, p. 50–51)
- **Internet of Things (IoT):** IoT is a network of devices that have embedded hardware and software to communicate (connect and exchange data) with other devices on the same network. IoT brings together devices to work in collaboration, creating an intelligent network of things (e.g., smart microwave ovens, air conditioners, CCTV cameras remotely controlled via smartphone). (NCERT §3.4, p. 51)
- **Web of Things (WoT):** WoT allows use of web services to connect anything in the physical world, besides human identities on the web. It enables smart homes, smart offices, and smart cities by providing one interface to connect all devices. (NCERT §3.4.1, p. 51–52)
- **Sensors in IoT:** Sensors observe and monitor elements in real-world applications. A smart sensor takes input from the physical environment and uses built-in computing

- resources to perform predefined functions upon detection of specific input, then processes data before passing it on. Examples: accelerometer (detects phone orientation) and gyroscope (tracks rotation/twist) in mobile phones. (NCERT §3.4.2, p. 52)
- **Smart Cities:** Use computer and communication technology along with IoT to manage and distribute resources efficiently (transportation, power, water, waste, law enforcement, schools, hospitals). Smart buildings use sensors for earthquake detection; smart bridges use wireless sensors to detect loose bolts. (NCERT §3.4.3, p. 52–53)
  - **Cloud Computing:** An emerging IT trend where computer-based services (software, hardware/servers, databases, storage) are delivered over the Internet, accessible from anywhere on any device. Cloud service providers charge on a pay-per-use basis. India's Government Cloud initiative is named **MeghRaj** (cloud.gov.in). (NCERT §3.5, p. 53–54)
  - **Cloud Service Models — IaaS:** Infrastructure as a Service — providers offer computing infrastructure (servers, virtual machines, storage, backup, network components, operating systems). Users configure and deploy any software on remote hardware, outsourcing setup and maintenance costs. (NCERT §3.5.1 (A), p. 54)
  - **Cloud Service Models — PaaS:** Platform as a Service — provides a platform/ environment to develop, test, and deliver software applications without worrying about underlying infrastructure. User has complete control over the deployed application and its configuration. (NCERT §3.5.1 (B), p. 54–55)
  - **Cloud Service Models — SaaS:** Software as a Service — provides on-demand access to application software, usually via licensing/subscription. Examples: Google Docs, Microsoft Office 365, Dropbox. User is not concerned with installation or configuration. (NCERT §3.5.1 (C), p. 55)
  - **Grid Computing:** A computer network of geographically dispersed and heterogeneous computational resources. Creates a sense of a virtual supercomputer with enormous processing power and storage. Constituent resources are called **nodes** that temporarily come together to solve a single large task. Two types: (i) Data grid — manages large distributed data with multi-user access; (ii) CPU/Processor grid — processing moved from one PC to another, or a large task divided into subtasks for parallel processing. The **Globus toolkit** is open-source software for building grids. (NCERT §3.6, p. 55–56)
  - **Grid vs. Cloud:** In IaaS cloud, a service provider rents infrastructure to users; in grid computing, multiple computing nodes join together to solve a common computational problem. Grid is more application-specific; cloud is service-oriented. (NCERT §3.6, p. 56)
  - **Blockchains:** A system that allows a group of connected computers to maintain a single updated and secure ledger. Each block is a secured chunk of data (a valid

transaction) with a header visible to all nodes; private data accessible only to the owner. Blocks form a chain — an 'append-only' open ledger updated only after all nodes authenticate the transaction. Each node holds a full copy; no single member can alter data. Most popular application: digital currency. Also used for transparency in governance, healthcare data sharing, land registration, and voting. (NCERT §3.7, p. 56–58)

## 2.2 Definitions to memorise

Term	Definition	Page
Artificial Intelligence	Simulation of the natural intelligence of human beings into machines, enabling them to learn, make decisions, and solve problems	45
Knowledge Base	A store of information consisting of facts, assumptions, and rules which an AI system can use for decision making	46
Machine Learning	A subsystem of AI wherein computers learn from data using statistical techniques without being explicitly programmed by a human	46
Natural Language Processing (NLP)	A field that deals with interaction between humans and computers using human spoken languages	46
Virtual Reality (VR)	A three-dimensional, computer-generated situation that simulates the real world, allowing the user to interact with and explore the environment	47
Augmented Reality (AR)	Superimposition of computer-generated perceptual information over existing physical surroundings, making the environment interactive and digitally manipulable	47
Humanoid	A robot that resembles a human being	48
Big Data	Datasets of enormous volume and complexity that cannot be processed and analysed using traditional data-processing tools	49
Veracity (Big Data)	Trustworthiness of data; refers to the consistency and quality of data, since inconsistent or biased data can give wrong results	50
Data Analytics	The process of examining datasets in order to draw conclusions about the information they contain, with the aid of specialised systems and software	50
Internet of Things (IoT)	A network of devices that have embedded hardware and software to communicate (connect and exchange data) with other devices on the same network	51
Smart Sensor	A device that takes input from the physical environment and uses built-in computing resources to perform predefined functions upon detection of specific input and then processes data before passing it on	52

Term	Definition	Page
Web of Things (WoT)	A system that allows use of web services to connect anything in the physical world, besides human identities, for creating smart homes, offices, and cities	52
Cloud Computing	An emerging IT trend where computer-based services are delivered over the Internet and are accessible from anywhere using any device	53
IaaS	Infrastructure as a Service — cloud model providing computing infrastructure such as servers, VMs, storage, and network components	54
PaaS	Platform as a Service — cloud model providing a platform/ environment to develop, test, and deliver software applications	54
SaaS	Software as a Service — cloud model providing on-demand access to application software, usually via licensing or subscription	55
MeghRaj	India's Government Cloud initiative (cloud.gov.in)	55
Grid Computing	A computer network of geographically dispersed and heterogeneous computational resources (nodes) that create a virtual supercomputer	55
Blockchain	A system allowing connected computers to maintain a single updated and secure 'append-only' ledger, updated only after all nodes authenticate each transaction	56–57
Training dataset	Dataset used to train an ML model so that it learns patterns and rules	46
Testing dataset	Dataset used to test the predictive accuracy of a trained ML model on unseen data	46
Sophia	Humanoid robot (Hanson Robotics) that uses AI and facial recognition	48
Drone	Unmanned aircraft, remotely controlled or autonomous, using onboard sensors and GPS	48
Accelerometer	Sensor that detects orientation of a mobile phone	52
Gyroscope	Sensor that tracks rotation or twist of a mobile phone	52
Node (Grid)	A constituent computational resource in a grid that temporarily joins to solve a large task	55–56
Globus toolkit	Open-source software used for building grids	56
Smart City	Urban area that uses IoT and ICT to manage transportation, power, water, waste, schools, and hospitals efficiently	52–53
Knowledge Base	Store of facts, assumptions and rules used by an AI system for decision-making	46

Term	Definition	Page
Ledger (Blockchain)	The append-only record of validated transactions maintained across all nodes	57
Pay-per-use model	Cloud billing approach where users are charged based on actual usage of services	53

### 2.3 Diagrams / processes to remember

- **Figure 3.1 (p. 46):** NLP enabling text-to-speech and speech-to-text conversion — key diagram showing bidirectional human–computer language interaction.
- **Figure 3.9 (p. 50):** Five Vs of Big Data (Volume, Velocity, Variety, Veracity, Value) shown as a petal/flower diagram — memorise all five labels and their meanings.
- **Figure 3.10 (p. 51):** IoT network showing diverse devices (appliances, vehicles, wearables, smartphones) connected through a central cloud — illustrates embedded communication.
- **Figure 3.12 (p. 54):** Cloud computing layers — IaaS at the bottom, PaaS in the middle, SaaS at the top — with user devices (laptops, phones, tablets, servers, desktops) on both sides.
- **Figure 3.13 (p. 55):** Grid computing showing users sharing resources through a Grid Resource Management System — distinguishes grid from cloud architecture.
- **Figure 3.14 (p. 57):** Blockchain transaction flow — request broadcast → nodes verify → block added to chain → transaction complete — illustrates the decentralised ledger process.

### 2.4 Common confusions / NTA trap points

- **VR vs. AR:** VR creates an entirely new computer-generated environment; AR only overlays digital information onto the real world. NTA may describe an application (e.g., a traveller pointing a camera at a monument) and ask which technology it is — that is AR, not VR.
- **Cloud vs. Grid:** Cloud is service-oriented (provider rents resources to users); Grid is application-specific (nodes collaborate as a virtual supercomputer). NTA may describe a scientific research setup where multiple PCs pool resources — that is Grid, not Cloud.
- **IaaS vs. PaaS vs. SaaS:** IaaS gives raw infrastructure (VMs, storage); PaaS gives a deployment platform (no hardware management); SaaS gives finished software (no installation). A question about "a user running Google Docs without installation" points to SaaS, not PaaS.
- **Five Vs of Big Data:** Students often confuse Veracity (data quality/trustworthiness) with Value (business worth of data). NTA uses both as options; remember — Veracity = trustworthiness; Value = business potential hidden in the data.

- **IoT vs. WoT (NCERT § 3.4, § 3.4.1, pp. 51-52):** IoT is the physical network of embedded devices; WoT uses web services as a single interface to connect those devices. WoT is a subset/extension of IoT that specifically leverages web protocols.
- **AI  $\supset$  ML, but ML  $\neq$  AI (NCERT § 3.2.1, p. 46).** All ML systems are AI systems, but not all AI systems are ML — rule-based expert systems are AI without learning. NTA may claim "AI is a subset of ML" — false.
- **NLP examples (NCERT § 3.2.2, p. 46).** Predictive typing, spell-check, voice-based web search, text-to-speech, speech-to-text, machine translation, and automated customer service all fall under NLP — not under general ML or robotics.
- **Quintillion bytes per day, not gigabytes (NCERT § 3.3, p. 49).** Around 2.5 quintillion bytes of data are created daily — NTA may swap quintillion with million/billion as distractor.
- **MeghRaj is government cloud, not a private cloud (NCERT § 3.5.1, p. 55).** MeghRaj is the Government of India's cloud (cloud.gov.in) — it is a public/government initiative, not a private corporate cloud.
- **Blockchain is append-only, not erasable (NCERT § 3.7, p. 57).** A blockchain ledger cannot be edited or deleted by any single member; all nodes must authenticate every transaction. NTA may suggest blockchain transactions are reversible — false.
- **Grid resources are heterogeneous (NCERT § 3.6, p. 55).** Grid computing uses heterogeneous (different OS, hardware) nodes; this is a key distinguishing property from a homogeneous cluster.
- **SaaS user does not install software (NCERT § 3.5.1(C), p. 55).** Google Docs, Office 365 are SaaS — accessed via browser/subscription, no local installation. NTA distractor: "SaaS requires user to manage updates" — false.
- **AR overlays do not replace reality (NCERT § 3.2.3(B), p. 47).** AR uses real surroundings as the canvas; only VR replaces reality entirely.
- **Humanoid examples (NCERT § 3.2.4, p. 48).** Sophia is the canonical humanoid example; Mars Rover (MER) is a wheeled robot, not a humanoid. NTA may mislabel the Mars Rover.

 **Practice MCQs**

**Q1. Which of the following best describes the function of a Knowledge Base in an Artificial Intelligence system?**

- A.** It is the processing unit that executes algorithms in real time
- B.** It is a store of information consisting of facts, assumptions, and rules that an AI system uses for decision making
- C.** It is a training dataset used exclusively by Machine Learning models
- D.** It is a natural language interface between the user and the AI system

**Q2. Consider the following statements about Big Data: 1. Velocity refers to the trustworthiness of data. 2. Variety asserts that a dataset has structured, semi-structured, and unstructured data. 3. Veracity refers to the rate at which data is generated and stored. 4. Value refers to the hidden patterns and useful knowledge of high business worth in the data. Which of the statements given above is/are correct?**

- A.** 1 and 3 only
- B.** 2 and 4 only
- C.** 2, 3, and 4 only
- D.** 1, 2, and 4 only

**Q3. Which cloud service model would best suit a software development team that wants to deploy a web application online without managing the underlying servers, operating systems, or network infrastructure?**

- A.** Infrastructure as a Service (IaaS)
- B.** Software as a Service (SaaS)
- C.** Platform as a Service (PaaS)
- D.** Grid as a Service (GaaS)

 **12 more MCQs + answer key**

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## PYQ Alignment

Chapter 3 (Emerging Trends) is one of the most frequently tested chapters in CUET Computer Science, consistently contributing 1–2 questions per year on topics such as the five characteristics of Big Data, cloud service models (IaaS/PaaS/SaaS), and distinguishing between AI sub-domains (ML, NLP). Blockchain, IoT, and the difference between cloud and grid computing have appeared as statement-based and match-the-column questions in recent NTA papers. Cross-link this with the [PYQ archive for Computer Science](#) for further practice.

