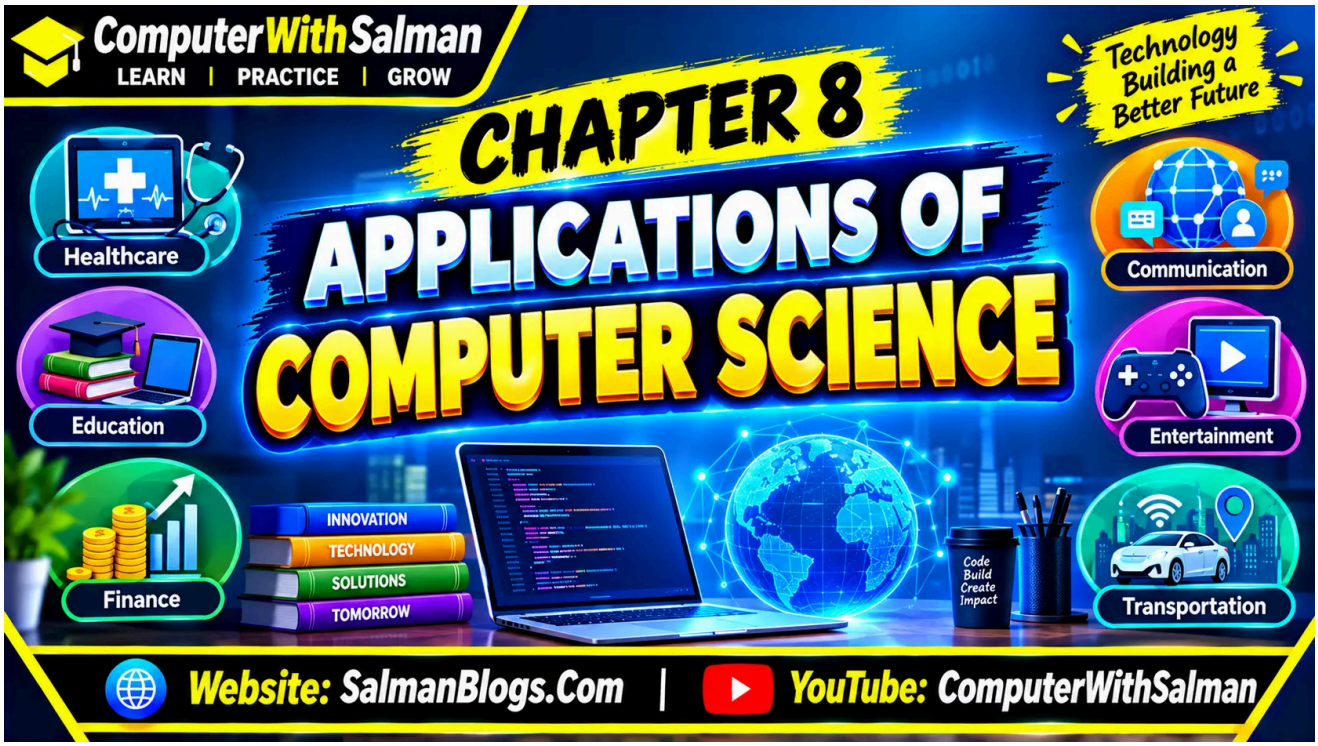
Computer Networks

Posted in **12 Computer Science**



These lecture notes are prepared by **Salman Ahmad**, who is both a **teacher** and a **web developer**. The purpose of this material is to make the topic clear and useful for students of Class 10 Computer Science.

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Emerging Technology

Emerging technology refers to new or developing technologies that have the potential to change how people live, work, communicate, and solve problems.
Examples: Artificial Intelligence (AI), Robotics, Virtual Reality (VR), Augmented Reality (AR), and the Internet of Things (IoT).
Example in Daily Life: AI-powered assistants can answer questions, understand voice commands, and help users perform tasks more efficiently.

Artificial Intelligence (AI)

Artificial Intelligence (AI) is a technology that allows computers and machines to learn from data, recognize patterns, understand information, and perform tasks that normally require human intelligence.
Example: AI can recognize faces in photos, translate languages, and recommend videos based on a user's interests.

Machine Learning (ML)

Machine Learning (ML) is a branch of Artificial Intelligence that enables computers to learn from data, identify patterns, and make predictions or decisions without being explicitly programmed for every task.

Examples or Uses [Mention any 1 or 2 Examples during writing exam]

1. **YouTube:** Machine learning algorithms recommend videos based on users' viewing histories and interests.
2. **Email:** Machine learning algorithms analyze incoming emails and identify spam messages based on suspicious words, links, and patterns.
3. **Online Shopping:** Machine learning systems suggest products based on users' previous purchases, searches, and interests.
4. **Banking:** Machine learning systems analyze transaction patterns to detect unusual activities that may indicate fraud.
5. **Healthcare:** Machine learning models analyze medical data and images to help doctors identify possible diseases.
6. **Weather Forecasting:** Machine learning models analyze past and current weather data to predict future weather conditions.

How Artificial Intelligence (AI) Works

Artificial Intelligence (AI) works by using data, algorithms, and computing power to learn patterns, understand information, and make predictions or decisions. Technologies such as **Neural Networks (NN)** and **Natural Language Processing (NLP)** help AI recognize images, understand human language, respond to questions, and solve complex problems.

Common AI Applications

- **Voice Assistants:** AI-powered assistants like Siri, Alexa, and Google Assistant understand spoken commands and respond with useful information or perform tasks.
- **Chatbots:** AI-powered chatbots on websites answer questions and help customers solve problems.
- **Image Recognition:** AI identifies faces, objects, and possible medical conditions from images and medical scans.
- **Recommendation Systems:** AI recommends videos or products based on users' interests and preferences. For example, YouTube suggests videos, while Daraz and Amazon recommend products.
- **Self-Driving Cars:** AI uses cameras and sensors to understand the surroundings, recognize obstacles, and make driving decisions to help vehicles travel safely.

Benefits of AI in Society

- **Increased Efficiency:** AI performs repetitive tasks faster than humans and saves time.
- **Improved Healthcare:** AI helps doctors diagnose diseases and predict health problems.
- **Better Agriculture:** AI helps farmers monitor crops and improve farming methods.
- **Customer Support:** AI chatbots answer customer questions, such as "Where is my order?" for many users at the same time.
- **Better Business Decisions:** AI analyses customer behaviour and predicts trends to help businesses make better decisions.
- **Personalized Education:** AI provides personalized learning and adaptive tutoring according to students' needs.

Challenges of AI in Society

- **Data Privacy:** AI systems may collect and process personal information, creating privacy risks.
- **Job Displacement:** AI can automate tasks previously performed by humans, reducing the need for some jobs.
- **Algorithmic Bias:** AI may produce unfair results if it is trained on biased or unbalanced data.
- **Ethical Issues:** AI decisions can affect people's lives, raising concerns about fairness and responsibility.
- **Lack of Transparency:** Some AI systems make decisions that are difficult for people to understand.

Conclusion

AI offers many benefits, but its challenges must be managed carefully. Responsible, fair, and ethical use of AI can help ensure that it benefits society.

Internet of Things (IoT)

Definition: The Internet of Things (IoT) is a technology that connects physical devices to the internet so they can collect, share, and exchange data.

- **Smart Watches:** IoT-enabled smartwatches collect information such as heart rate and physical activity and share it with connected applications.
- **Smart Cities:** IoT sensors monitor traffic and streetlights to improve traffic management and save energy.

  Must to do all the below points. These are mentioned in the book.

- **Smart Homes:** IoT connects devices such as smart lights, air conditioners, and security cameras to the internet. Users can control these devices using their smartphones, even when they are away from home.
- **Healthcare:** IoT connects devices such as smartwatches and health monitors to the internet. These devices measure health information, such as heart rate and blood pressure, and share it with doctors to help them monitor patients' health remotely.
- **Agriculture:** IoT uses sensors to monitor soil moisture, temperature, and crop conditions. It helps farmers decide when to water crops, check their growth, and estimate the right time to harvest. This helps farmers save water, improve crop production, and manage their fields more effectively.

Data Collection, Communication and Automation

How IoT Works

IoT works through three main processes:

1. **Data Collection:** IoT devices use sensors to collect different types of information from their surroundings, such as temperature, humidity, movement, air quality, soil moisture, and health information.
2. **Communication:** IoT devices send the collected data to other devices, computers, or applications through communication networks, such as the internet or Bluetooth.
3. **Automation:** IoT devices use the collected data to perform tasks automatically with little or no human involvement, making daily activities easier and more efficient.

Example: In smart agriculture, IoT sensors collect information about soil moisture and send it to a control system. If the soil becomes too dry, the system automatically turns on the water pump to water the crops.

Cloud Computing

Definition: Cloud computing is a technology that allows users to store data, use software, and access computing services over the internet instead of relying only on their own computers.

Example

- **Online Storage:** Google Drive and Dropbox allow users to store files online and access them from anywhere with an internet connection.

Examples from Textbook

- **Amazon Web Services (AWS):** AWS provides cloud services that allow users and businesses to store data, run applications, and use computing resources over the internet.
- **Microsoft Azure:** Microsoft Azure provides cloud services for storing files, hosting websites, running applications, and managing data over the internet.

Advantages of Cloud Computing

- **Scalability:** Cloud computing allows users to increase or decrease storage and computing resources according to their needs.
- **Accessibility:** Users can access their files, applications, and data from different devices and locations through the internet.
- **Cost-Effectiveness:** Cloud computing reduces the need to buy expensive hardware and maintain physical servers, helping users and businesses save money.

Blockchain Technology

Definition: Blockchain is a technology that stores information in blocks connected in a chain. The information is shared across multiple computers, making it difficult to change or delete recorded data without detection.

Examples or Uses [Mention any 1 or 2 Examples during writing exam]

1. **Cryptocurrency Transactions:** Blockchain is used to send and receive digital currencies such as Bitcoin and Ethereum without relying on a traditional bank to record each transaction.
2. **Banking and Finance:** Some banks and financial companies use blockchain to transfer money, settle payments, and maintain secure transaction records.
3. **Supply Chain Management:** Companies use blockchain to track products from manufacturers to shops and check where products come from.
4. **Digital Identity:** Blockchain can be used to verify identities and help protect digital identity records.
5. **Healthcare:** Hospitals and healthcare organizations can use blockchain to help maintain secure medical records and track access to information.
6. **Smart Contracts:** Blockchain can run programs called smart contracts that automatically perform agreed actions when specific conditions are met.
7. **Bitcoin:** Bitcoin is a digital currency that uses blockchain technology to record and verify transactions between users without requiring a traditional bank to process them.

Cultural and Ethical Implications of AI Systems

AI systems can affect people's culture, values, privacy, and daily lives. Therefore, AI should be developed and used fairly, responsibly, and respectfully.

Stakeholders in AI Systems

- **Developers:** Developers design and create AI systems. They should make sure AI works fairly, protects users' data, and does not produce biased results.
- **Users:** Users interact with AI systems in their daily lives. They should use AI responsibly and be careful when sharing personal information.
- **Government:** Governments make laws and rules to ensure AI is used safely, protects people's rights, and prevents misuse.
- **Communities:** Communities are groups of people affected by AI systems. AI should respect their cultures, traditions, and values and should not unfairly discriminate against any group.

Cultural Awareness and Diversity

Cultural awareness and diversity means understanding and respecting the different cultures, languages, traditions, and beliefs of people.
AI systems should respect different cultures and languages and treat people fairly. They should be designed to work well for people from different backgrounds without showing unfair preferences toward any group.

Example

AI Translation: An AI translation system should support different languages so that people from different countries can communicate easily.

Ethical Principles in AI

Fairness, Accountability, Transparency

- **Fairness:** AI systems should treat all people equally and should not discriminate against anyone based on their gender, culture, or background.
- **Accountability:** Developers and organizations should take responsibility for the decisions and actions of their AI systems.
- **Transparency:** AI systems should provide clear information about how they work and how they make decisions.

Avoiding Bias and Ensuring Inclusivity Design

AI systems should be designed to work fairly for people from different backgrounds, languages, and abilities. Developers should reduce bias so that no group is treated unfairly.

Conflicts of Interest Among Stakeholders

Definition: Conflicts of interest occur when different stakeholders have different goals or interests regarding the development and use of AI systems.

Examples or Conflicts [Mention any 1 or 2 Examples during writing exam]

- **Developers vs. Users:** Developers may want to collect more data to improve AI, while users want to protect their personal information.
- **Businesses vs. Communities:** Businesses may use AI to reduce costs, but this may lead to job losses in communities.
- **Government vs. Users:** Governments may use AI for security and monitoring, while users want to protect their privacy.
- **Businesses vs. Government:** Businesses may want fewer restrictions on AI, while governments want rules to ensure its safe and fair use.

Importance: These conflicts should be managed carefully to ensure that AI benefits society while respecting people's rights, privacy, and interests.

Policy and Legal Frameworks

Definition: Policy and legal frameworks are rules and guidelines that help ensure AI is developed and used safely, fairly, and responsibly.

Examples or Frameworks

1. **GDPR:** The General Data Protection Regulation (GDPR) protects personal data and gives people rights over how their information is collected and used.
2. **AI Ethics Guidelines:** These guidelines encourage fairness, transparency, accountability, and respect for human rights when developing and using AI systems.
3. **National AI Policies in Pakistan:** These policies help promote AI research, protect data, and encourage the responsible use of AI according to local needs.

Exercise: Short Questions and Answers

1. What is Artificial Intelligence (AI) and how is it used in daily life?

Artificial Intelligence (AI) is a technology that enables computers and machines to perform tasks that normally require human intelligence. It is used in voice assistants, chatbots, image recognition, video recommendations, and self-driving cars.

2. How does the Internet of Things (IoT) connect smart devices together?

The Internet of Things (IoT) connects physical devices through networks such as the internet. These devices collect and share data, allowing users to monitor and control them remotely.

Example: Smart lights and air conditioners can be controlled using a smartphone.

3. What are the main advantages of using Cloud Computing?

The main advantages of cloud computing are:

- **Scalability:** Resources can be increased or decreased according to needs.
- **Accessibility:** Files and applications can be accessed from different devices through the internet.
- **Cost-Effectiveness:** It reduces the need to buy expensive hardware and maintain physical servers.

4. How does Blockchain ensure security and transparency in transactions?

Blockchain stores transaction records in connected blocks shared across multiple computers. Cryptographic methods help protect these records, while authorized participants can view and verify transactions. Changes to recorded information are difficult to make without detection.

5. Why is it important to consider ethics while developing AI systems?

AI ethics is important because it helps ensure that AI systems are fair, protect people's privacy, avoid discrimination, and respect human rights. Ethical AI builds public trust and reduces the risk of harm.

6. What role do stakeholders play in the design and regulation of AI technologies?

Stakeholders help ensure that AI is developed and used responsibly.

- **Developers:** Design safe and fair AI systems.
- **Users:** Use AI responsibly and protect their personal information.
- **Government:** Creates laws and rules for AI.

- **Communities:** Help ensure that AI respects different cultures, values, and needs.

7. How can emerging technologies help solve national challenges in Pakistan?

Emerging technologies can help Pakistan improve healthcare, education, agriculture, transportation, and business. For example, AI can help doctors identify diseases, IoT can help farmers monitor crops, and cloud computing can make online education more accessible.

8. What is the importance of cultural awareness when designing technological solutions?

Cultural awareness helps developers create technologies that respect different languages, traditions, beliefs, and values. It makes technology more inclusive and useful for people from different backgrounds.

9. How can AI, IoT, and Cloud work together to improve agriculture?

IoT sensors collect information about soil moisture, temperature, and crop conditions. AI analyses this information to help farmers make better decisions, while cloud computing stores the data and makes it accessible online. Together, these technologies help farmers manage crops, save water, and improve production.

10. Why are laws and policies necessary for the responsible and safe use of technology?

Laws and policies protect people's privacy and rights, prevent the misuse of technology, and encourage fairness and accountability. They help ensure that technologies are developed and used safely and responsibly.

Exercise: Long Questions and Answers

1. Explain how AI, IoT, Cloud Computing, and Blockchain are transforming modern industries. Give suitable examples for each technology.

Modern technologies are improving the way businesses, industries, and people work.

1. Artificial Intelligence (AI)

Artificial Intelligence (AI) enables computers to perform tasks that normally require human intelligence. It helps businesses make decisions, doctors diagnose diseases,

and websites recommend products.

Example: YouTube uses AI to recommend videos based on users' interests.

2. Internet of Things (IoT)

The Internet of Things (IoT) connects physical devices to networks so they can collect and share data. It allows devices to be monitored and controlled remotely.

Example: Smart agriculture uses IoT sensors to monitor soil moisture and help farmers decide when to water crops.

3. Cloud Computing

Cloud computing allows users to store data, run applications, and access computing resources over the internet.

Example: Google Drive allows users to store files online and access them from different devices.

4. Blockchain

Blockchain stores information in connected blocks, making recorded information difficult to change without detection.

Example: Bitcoin uses blockchain to record financial transactions securely.

These technologies improve efficiency, save time, support better decisions, and help solve problems in different industries.

2. Discuss the benefits and challenges of AI in society. How can ethical principles ensure fair and responsible use of AI?

Artificial Intelligence (AI) provides many benefits to society, but it also creates challenges that must be managed carefully.

Benefits of AI

- **Increased Efficiency:** AI performs repetitive tasks quickly and saves time.
- **Improved Healthcare:** AI helps doctors identify diseases and analyse medical information.
- **Better Education:** AI supports personalized learning according to students' needs.
- **Business Improvement:** AI analyses customer behaviour and helps businesses make better decisions.

Challenges of AI

- **Data Privacy:** AI may collect and process personal information, creating privacy risks.
- **Job Displacement:** Automation may reduce the need for workers in some jobs.
- **Bias:** AI may produce unfair results if trained on biased data.
- **Ethical Issues:** AI decisions may affect people's lives and rights.

Role of Ethical Principles

- **Fairness:** AI should treat people equally and avoid discrimination.
- **Accountability:** Developers and organizations should take responsibility for AI decisions.
- **Transparency:** AI decisions should be understandable wherever possible.
- **Privacy:** AI systems should protect people's personal information.

Following these principles helps make AI safer, fairer, and more trustworthy.

3. Describe how IoT devices collect and communicate data for automation. How is IoT improving healthcare, agriculture, and smart homes?

The Internet of Things (IoT) connects physical devices through networks, allowing them to collect and share data and perform tasks automatically.

How IoT Works

1. **Data Collection:** Sensors collect information from the surroundings, such as temperature, movement, humidity, and soil moisture.
2. **Communication:** Devices send collected data to other devices or applications through networks such as the internet.
3. **Automation:** A device or control system uses the data to perform actions automatically.

Uses of IoT [Mention any 1 or 2 Examples during writing exam]

- **Healthcare:** Smartwatches and health monitors measure information such as heart rate and blood pressure and share it with healthcare professionals.
- **Agriculture:** Sensors monitor soil moisture and crop conditions, helping farmers decide when to water crops and estimate the right time to harvest.
- **Smart Homes:** Connected lights, air conditioners, and security cameras can be monitored and controlled remotely using smartphones.

IoT improves convenience, saves resources, and helps people make decisions using real-time information.

4. Explain how Cloud Computing supports scalability, accessibility, and collaboration. Compare Google Drive, AWS, and Microsoft Azure.

Cloud computing provides storage, software, and computing resources over the internet instead of relying entirely on local computers.

Advantages of Cloud Computing

- **Scalability:** Users can increase or decrease computing resources according to their needs.

- **Accessibility:** Users can access files and services from different devices and locations through the internet.
- **Collaboration:** Multiple users can work on shared files and documents online.

Comparison of Cloud Platforms

Platform	Main Purpose	Example
Google Drive	Online file storage and sharing	Students share assignments and documents.
Amazon Web Services (AWS)	Cloud computing, storage, and application hosting	Businesses run websites and applications.
Microsoft Azure	Cloud computing, data storage, and application development	Organizations host applications and manage business data.

Google Drive mainly helps individuals and teams store and share files, while AWS and Microsoft Azure provide a wider range of computing services for developers and organizations.

5. What is Blockchain technology? Discuss how its decentralized nature improves transparency and security in financial and non-financial applications.

Blockchain is a technology that stores information in blocks connected in a chain. Copies of these records can be stored across multiple computers, making unauthorized changes difficult to make without detection.

How Blockchain Improves Security and Transparency

- **Decentralization:** Records are shared across multiple computers instead of being controlled by a single central authority.
- **Security:** Cryptographic methods help protect recorded information from unauthorized changes.
- **Transparency:** Participants can view and verify transactions recorded on the blockchain.
- **Data Integrity:** Changes to previous records are difficult to make without detection.

Financial Applications [Mention any 1 or 2 Examples during writing exam]

- **Cryptocurrency:** Bitcoin uses blockchain to record financial transactions between users.
- **Banking:** Blockchain can help record and verify financial transactions securely.

Non-Financial Applications [Mention any 1 or 2 Examples during writing exam]

- **Supply Chain Management:** Blockchain helps track products from manufacturers to customers.
- **Digital Records:** Blockchain can maintain verifiable records of important information, such as certificates and documents.

Multiple Choice Questions (MCQs) on Applications of Computer Science

1. What is emerging technology?

a. Technology that is no longer used
b. New or developing technology with the potential to bring changes
c. A type of computer hardware only
d. A traditional method of communication

> **Answer: b. New or developing technology with the potential to bring changes**

2. What does AI stand for?

a. Automated Internet
b. Artificial Intelligence
c. Advanced Information
d. Automatic Integration

> **Answer: b. Artificial Intelligence**

3. What is the main purpose of Artificial Intelligence?

a. To perform tasks that normally require human intelligence
b. To increase the size of computer monitors
c. To replace all computer hardware
d. To store files without processing them

> **Answer: a. To perform tasks that normally require human intelligence**