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9TH CLASS • CHAPTER 10

Emerging Technologies in Computer Science

Complete Exercise Solutions

Computer Science and Entrepreneurship

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MCQs

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Short Qs

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Long Qs

Answers • Explanations • Step by Step

Chapter 10 - Exercise Overview

This beautifully organized guide contains every exercise question of **Emerging Technologies in Computer Science**, solved step by step:

1. Multiple Choice Questions – answer ticked and highlighted, with a clear explanation.
2. Short Questions – crisp, exam-ready answers.
3. Long Questions – detailed, point-wise answers.

Tip: Read each explanation – it helps you understand *why* an answer is correct, not just *what* it is.

Section A - Multiple Choice Questions

1 Which of the following is not a subfield of AI?

- a) Machine Learning
- b) Natural Language Processing
- c) Computer Vision

✓ **d) Robotics**

Explanation: While Robotics heavily utilizes Artificial Intelligence to function, it is technically an interdisciplinary field that combines mechanical engineering, electrical engineering, and computer science. Machine Learning, Natural Language Processing (NLP), and Computer Vision are considered core, purely algorithmic subfields of AI.

2

Which of these AI algorithms is considered an "explainable" model?

a) Neural Networks

✓ **b) Decision Trees**

c) Random Forests

d) Convolutional Neural Networks

Explanation: Decision Trees are considered "white-box" or explainable models because their decision-making process can be easily traced and understood by humans through a series of clear if-then rules. Neural Networks, Random Forests, and CNNs are considered "black-box" models because their internal workings are highly complex and difficult to interpret.

3

Which of these is a security concern in IoT deployments?

- a) Device vulnerability
- b) Data privacy
- c) Lack of standardization

✓ **d) All of the above**

Explanation: IoT devices often lack robust security features (device vulnerability), transmit sensitive personal data (data privacy), and are manufactured by various companies without unified security protocols (lack of standardization). Therefore, all these factors pose significant security concerns.

4

Which of the following is an application of AI in healthcare?

- a) Personalized drug development
- b) Automated diagnosis
- c) Remote patient monitoring

✓ **d) All of the above**

Explanation: AI is revolutionizing healthcare across all these areas. It accelerates drug discovery by predicting molecular interactions, assists doctors in diagnosing diseases from medical imaging, and enables continuous health tracking through wearable IoT devices.

5

What is the primary purpose of using AI techniques in machine learning models?

- ✓ **a) To improve accuracy**
- b) To enhance interpretability
- c) To reduce computational complexity
- d) All of the above

Explanation: The primary and most fundamental purpose of applying advanced AI techniques (like deep learning) to machine learning models is to improve their accuracy and predictive performance on complex tasks. While enhancing interpretability and reducing complexity are secondary goals, accuracy is the main driving force behind AI advancements.

6

What is the key difference between explainable (whitebox) and unexplainable (blackbox) AI models?

a) The complexity of the model

✓ **b) The ability to understand the decision-making process**

c) The performance of the model

d) The training data used

Explanation: The defining characteristic that separates whitebox from blackbox models is transparency. Whitebox models allow users to understand *how* a decision was reached, whereas blackbox models provide outputs without revealing the internal logic or reasoning behind them.

7

Which of the following is an application of IoT in the transportation domain?

- a) Smart traffic management
- b) Vehicle-to-Vehicle (V2V) communication
- c) Predictive maintenance of vehicles

✓ **d) All of the above**

Explanation: IoT is heavily integrated into modern transportation. It enables smart traffic lights to reduce congestion, allows vehicles to communicate with each other for safety (V2V), and uses sensor data to predict when a vehicle needs maintenance before it breaks down.

8

Which of these is a potential impact of AI and IoT on the job market?

- a) Job displacement due to automation
- b) Increased demand for specialized skills
- c) Transformation of job roles and responsibilities

✓ **d) All of the above**

Explanation: The integration of AI and IoT automates routine tasks (displacing some jobs), creates a high demand for skilled professionals who can manage and develop these technologies, and fundamentally transforms existing job roles to require digital literacy and human-AI collaboration.

9

What is the key concern associated with algorithmic bias in AI-powered decision-making processes?

- a) Lack of transparency
- b) Perpetuation of existing societal biases
- c) Reduced accuracy of the model

✓ **d) All of the above**

Explanation: Algorithmic bias occurs when AI systems reflect the unconscious biases of their human creators or training data. This leads to a lack of transparency, perpetuates systemic societal discrimination (e.g., in hiring or lending), and results in reduced accuracy for marginalized groups.

10

Which of the following is an ethical principle that should be considered in the development and deployment of AI and IoT technologies?

- a) Transparency and accountability
- b) Respect for privacy and data rights
- c) Fairness and non-discrimination

✓ **d) All of the above**

Explanation: Ethical AI and IoT development requires a holistic approach. Developers must ensure transparency (explaining how systems work), respect user privacy (protecting data), and ensure fairness (avoiding discrimination) to build trust and prevent harm.

Section B - Short Questions

1 Define Artificial Intelligence (AI).

Artificial Intelligence (AI) is the branch of computer science dedicated to creating machines and software capable of performing tasks that typically require human intelligence. These tasks include learning, reasoning, problem-solving, perception, and natural language understanding.

2 What is the historical context and evolution of AI?

The evolution of AI began in the mid-20th century. Key milestones include Alan Turing's foundational work in the 1950s, the Dartmouth Workshop in 1956 (where the term "AI" was coined), followed by periods of optimism and subsequent "AI Winters" due to unmet expectations. The field resurged in the 1990s and 2000s with advancements in machine learning, big data, and computational power, leading to the current era of deep learning and generative AI.

3**Provide two examples of AI applications in healthcare.**

- 1. Medical Imaging Diagnosis:** AI algorithms analyze X-rays, MRIs, and CT scans to detect early signs of diseases like cancer or pneumonia with high accuracy.
- 2. Personalized Medicine:** AI analyzes a patient's genetic makeup and lifestyle to recommend tailored drug treatments and therapies, optimizing efficacy and reducing side effects.

4**Explain the role of AI techniques in advancing machine learning models.**

AI techniques provide the mathematical and algorithmic frameworks (such as neural networks, gradient descent, and reinforcement learning) that allow machine learning models to automatically learn patterns from vast datasets. AI drives the optimization of these models, enabling them to improve accuracy, handle unstructured data (like images and text), and make complex predictions without explicit programming.

5 Define the Internet of Things (IoT).

The Internet of Things (IoT) refers to the vast network of physical objects ("things") that are embedded with sensors, software, and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

6 Describe the significance of IoT in connecting devices and systems.

IoT is significant because it bridges the gap between the physical and digital worlds. It enables real-time data collection, remote monitoring, and automated control of devices. This connectivity leads to increased operational efficiency, reduced human intervention, and the creation of smart environments (like smart homes and smart cities).

7 What are the potential risks associated with AI and IoT?

Potential risks include:

- **Security Vulnerabilities:** IoT devices can be hacked, leading to data breaches or physical harm.
- **Privacy Erosion:** Constant data collection by AI and IoT can lead to invasive surveillance.

- **Algorithmic Bias:** AI can perpetuate societal discrimination if trained on biased data.
- **Job Displacement:** Automation can lead to economic instability for certain workers.

8**Discuss the societal impact of AI and IoT on daily life.**

AI and IoT have profoundly impacted daily life by making tasks more convenient and efficient. They power smart homes (thermostats, security), personalized entertainment (recommendation algorithms), and efficient navigation (GPS traffic routing). However, they also raise concerns about data privacy, screen addiction, and the digital divide between those who have access to these technologies and those who do not.

9**Explain the concept of algorithmic bias.**

Algorithmic bias refers to systematic and repeatable errors in a computer system that create unfair outcomes, such as privileging one arbitrary group of users over others. It occurs when AI models are trained on data that contains historical prejudices or lacks diversity, causing the AI to amplify and perpetuate those same biases in its decision-making.

10**Outline the importance of ethical considerations in AI and IoT.**

Ethical considerations are crucial to ensure that AI and IoT technologies serve humanity positively. They prevent harm, protect fundamental human rights (like privacy and autonomy), promote fairness, and build public trust. Without ethics, these technologies could be used to manipulate, discriminate, or endanger individuals and societies.

Section C - Long Questions

1

Discuss the various applications of AI in the field of education. Provide specific examples and explain how AI can enhance the educational experience.

AI is transforming education through personalized learning, automated administration, and intelligent tutoring.

- **Personalized Learning:** AI algorithms analyze a student's strengths and weaknesses to adapt the curriculum in real-time. For example, platforms like *Duolingo* use AI to adjust language lessons based on the learner's performance.
- **Intelligent Tutoring Systems:** AI-powered tutors, such as *Carnegie Learning*, provide one-on-one assistance, answering questions and offering hints tailored to the student's specific misconceptions.
- **Automated Grading:** AI can instantly grade multiple-choice questions and even provide feedback on essays, freeing up teachers to focus on lesson planning and individualized student support.
- **Predictive Analytics:** AI can analyze student data to identify those at risk of dropping out, allowing educators to intervene early.

These applications enhance the educational experience by making it more engaging, accessible, and tailored to individual needs, ultimately improving learning outcomes.

2

Differentiate between explainable (whitebox) and unexplainable (blackbox) AI models.

The core difference lies in the interpretability of the decision-making process.

- **Explainable (Whitebox) Models:** These are models whose internal logic and decision-making processes are transparent and easily understood by humans. Examples include Decision Trees and Linear Regression. If a decision tree denies a loan, you can trace exactly which rule (e.g., "income < \$30k") caused the rejection. This builds trust and allows for easy debugging.
- **Unexplainable (Blackbox) Models:** These models operate with complex, opaque internal mechanisms that are impossible for humans to interpret. Examples include Deep Neural Networks. While they often achieve higher accuracy on complex tasks (like image recognition), they cannot explain *why* they made a specific decision. This lack of transparency raises ethical and accountability concerns, especially in critical fields like healthcare or criminal justice.

3

Describe the components of an IoT system. Explain how these components work together to enable IoT applications.

An IoT system consists of four main components:

- 1. Sensors/Actuators:** Sensors collect data from the environment (e.g., temperature, motion), while actuators perform actions (e.g., locking a door, turning on a light).
- 2. Connectivity:** This includes the network protocols (Wi-Fi, Bluetooth, 5G) that transmit the data from the physical devices to the cloud or central servers.
- 3. Data Processing:** This involves cloud computing or edge computing where the collected data is analyzed, filtered, and processed. AI algorithms are often used here to derive insights.
- 4. User Interface:** This is the front-end application (mobile app, web dashboard) that allows users to monitor the system and control the devices.

How they work together: A sensor detects a change (e.g., room temperature drops), sends the data via the network to the cloud, the cloud processes the data and triggers an action (e.g., turning on the heater via an actuator), and the user is notified through the interface.

4

Explore the applications of IoT in the transportation domain.

IoT is revolutionizing transportation through improved safety, efficiency, and automation.

- **Smart Traffic Management:** IoT sensors embedded in roads and traffic lights monitor traffic flow in real-time. This data is used to dynamically adjust signal timings to reduce congestion and emissions.
- **Vehicle-to-Vehicle (V2V) Communication:** Cars equipped with IoT technology can communicate with each other, sharing data about speed, location, and braking. This helps prevent accidents by warning drivers of impending collisions.
- **Predictive Maintenance:** Sensors in vehicles monitor the health of engine components, brakes, and tires. This data is transmitted to manufacturers or fleet managers, who can schedule maintenance before a breakdown occurs, reducing downtime and costs.
- **Autonomous Vehicles:** Self-driving cars rely entirely on IoT sensors (LiDAR, cameras, radar) to perceive their surroundings and navigate safely without human intervention.

5

Analyze the potential privacy concerns associated with IoT deployments.

IoT deployments raise significant privacy concerns due to the massive scale of data collection and the intimate nature of the data collected.

- **Ubiquitous Surveillance:** IoT devices like smart speakers, cameras, and wearables are often always on, continuously collecting data about user behavior, conversations, and even health metrics. This creates a detailed digital profile of individuals.
- **Lack of User Control:** Many IoT devices have poor privacy settings, and users often do not know what data is being collected, who it is being shared with, or how long it is stored.
- **Data Breaches:** Because IoT devices often have weak security, they are prime targets for hackers. A breach could expose sensitive personal information, such as medical records or home security footage.
- **Secondary Use of Data:** Companies may sell user data to third parties, such as insurance companies or advertisers, without explicit consent, leading to discrimination or manipulation.

6

Evaluate the impact of AI and IoT on the job market and work environments.

The impact of AI and IoT on the job market is multifaceted, creating both disruption and opportunity.

- **Job Displacement:** Routine, manual, and repetitive jobs (e.g., assembly line work, basic data entry) are highly susceptible to automation, leading to displacement for some workers.
- **Creation of New Roles:** There is a surge in demand for highly specialized skills. New roles include IoT security specialists, AI ethicists, data scientists, and robotics engineers.
- **Transformation of Existing Jobs:** AI and IoT act as "co-pilots" in many professions. Doctors use AI for diagnosis, and farmers use IoT for precision agriculture. Workers must upskill to collaborate effectively with these technologies.
- **Work Environment Changes:** Remote work is enabled by IoT and cloud technologies, while AI tools increase productivity but also raise concerns about worker surveillance and the "gig economy."

7

Explain the role of policy and regulatory frameworks in addressing the challenges of AI and IoT. Provide examples of existing frameworks and discuss their effectiveness.

Policy and regulatory frameworks are essential to govern the development and deployment of AI and IoT, ensuring they are safe, ethical, and equitable.

- **Role:** They establish legal standards for data privacy, security, accountability, and non-discrimination. They protect citizens from harm and ensure fair competition.
- **Examples:** The **General Data Protection Regulation (GDPR)** in the EU sets strict rules on data privacy, giving users control over their personal data. The **California Consumer Privacy Act (CCPA)** provides similar protections in the US. The EU's proposed **AI Act** categorizes AI applications by risk level and imposes strict requirements on high-risk systems.
- **Effectiveness:** While these frameworks are a good start, their effectiveness is often limited by rapid technological advancements. Regulations can become outdated quickly, and enforcing them across global borders is challenging. There is a constant need for adaptive, agile policymaking that balances innovation with protection.

8

Describe the concept of algorithmic bias and its implications in AI-powered decision-making processes. Suggest strategies to mitigate the risks of algorithmic bias.

Algorithmic bias occurs when an AI system produces systematically unfair outcomes due to biased assumptions in the algorithm or biased data used to train it.

- **Implications:** In hiring, biased AI might reject qualified female or minority candidates. In criminal justice, it might predict higher recidivism rates for certain demographics, leading to harsher sentencing. In healthcare, it might misdiagnose conditions for underrepresented groups. This perpetuates systemic inequality.

Mitigation Strategies:

1. **Diverse Data:** Ensure training datasets are representative of the entire population.
2. **Bias Auditing:** Regularly test AI models for biased outcomes using fairness metrics.
3. **Transparency:** Use explainable AI (XAI) to understand how decisions are made.
4. **Diverse Teams:** Involve people from diverse backgrounds in the design and development phases.
5. **Human-in-the-Loop:** Keep humans involved in critical decision-making processes to override biased AI outputs.

9

Develop a set of ethical principles and guidelines for the responsible development and deployment of AI and IoT technologies.

Responsible development of AI and IoT should be guided by the following ethical principles:

- 1. Beneficence and Non-maleficence:** Technologies must be designed to benefit humanity and avoid causing harm.
- 2. Transparency and Explainability:** Systems should be transparent, and their decisions should be explainable to users and stakeholders.
- 3. Privacy and Data Protection:** User data must be securely stored, and individuals must have control over their personal information.
- 4. Fairness and Non-discrimination:** AI systems must be designed to avoid bias and promote equitable outcomes for all demographics.
- 5. Accountability:** There must be clear lines of responsibility for the actions and failures of AI and IoT systems.
- 6. Human Autonomy:** Humans should retain ultimate control over critical decisions; AI should assist, not replace, human judgment.
- 7. Sustainability:** Development should consider the environmental impact of manufacturing and deploying these technologies.

These guidelines should be enforced through a combination of industry self-regulation, government oversight, and continuous ethical review.



Well Done!

You have completed Chapter 10

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