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UNIVERSITY OF TOMORROW

RANKING 2023

#**RANKED 52**
IN INDIA

#University Category

QS WORLD UNIVERSITY RANKINGS

NO.1 PVT. UNIVERSITY IN
ACADEMIC REPUTATION IN INDIA

ACCREDITED WITH GRADE
A NAAC

ACCREDITED **GRADE 'A'**
BY NAAC

E-LEAD

PERFECT SCORE OF **150/150** AS A TESTAMENT
TO EXECEPTIONAL E-LEARNING METHODS

Unit 1 : Introduction to AI

What is Intelligence

- Intelligence refers to the ability to learn, reason, and solve problems.

Or

- The ability to solve complex problems or make decisions with outcomes benefiting for others.

- For human/animals, problem-solving and decision-making are functions of their nervous systems, including the brain, so intelligence is closely related to the nervous (neural) system.

What is Artificial Intelligence (AI)

- AI is a branch of computer science that focuses on creating systems or machines capable of performing tasks that typically require human intelligence.
- These tasks include:
  - Problem-solving
  - decision-making
  - Learning
  - Perception
  - Language understanding
- AI aims to mimic human cognitive functions through the development of algorithms and computational models.

Examples of AI

Here are some common examples of AI in everyday life:

1.**Virtual Assistants:** Siri, Alexa, and Google Assistant use AI to understand and respond to voice commands, manage tasks, and provide information.

2.**Recommendation Systems:** Platforms like Netflix and Amazon use AI to recommend movies, shows, and products based on your browsing and purchasing history.

3.**Autonomous Vehicles:** Self-driving cars use AI to navigate roads, recognize obstacles, and make driving decisions.

4.**Chatbots:** Many websites use AI-driven chatbots to provide customer support and answer frequently asked questions.

5.**Image and Speech Recognition:** AI powers tools that can identify objects in images or transcribe spoken language into text.

Examples of AI

6. Fraud Detection: Banks and financial institutions use AI to monitor transactions and detect fraudulent activity by recognizing unusual patterns.

7. Language Translation: Services like Google Translate use AI to translate text and speech between different languages.

8. Personalized Learning: Educational platforms use AI to adapt learning materials and exercises based on a student's progress and needs.

9. Healthcare Diagnostics: AI assists in diagnosing medical conditions by analyzing medical images, patient data, and historical health records.

10. Smart Home Devices: AI in smart home devices like thermostats and security systems learns from user behavior to optimize energy use and enhance security.

Key Components of AI

The key components of AI include:

1. **Data:** AI systems rely on large volumes of data to learn and make decisions. This data can come from various sources, including sensors, databases, and user interactions.

2. **Algorithms:** These are the mathematical and computational procedures used to process data and make predictions or decisions. Common algorithms include machine learning algorithms, optimization techniques, and neural networks.

3. **Models:** AI models are created using algorithms and trained on data. They represent patterns and relationships in the data, enabling the system to make predictions or perform tasks based on new inputs.

4. **Training:** This involves feeding data into an AI model and adjusting the model's parameters to improve its performance. Training helps the model learn from the data and refine its predictions or decisions.

5. **Inference:** After training, AI models are used to make predictions or decisions based on new, unseen data. This process is known as inference and involves applying the learned patterns to real-world scenarios.

Key Components of AI

6. Hardware: AI systems often require specialized hardware, such as GPUs (Graphics Processing Units) or TPUs (Tensor Processing Units), to handle the large computational demands of training and inference.

7. Software: AI software includes frameworks and libraries that facilitate the development, training, and deployment of AI models. Popular examples are TensorFlow, PyTorch, and Scikit-learn.

8. Evaluation: AI systems need to be evaluated to ensure they are performing accurately and reliably. Evaluation metrics help assess the model's performance and identify areas for improvement.

9. Deployment: Once trained and evaluated, AI models are deployed into production environments where they can interact with users and perform their intended tasks.

10. Feedback Mechanisms: These are used to continually improve the AI system by collecting user feedback and updating the model based on new data and insights.

3 stages of AI

Narrow AI
Dedicated to assist with or take over specific tasks

General AI
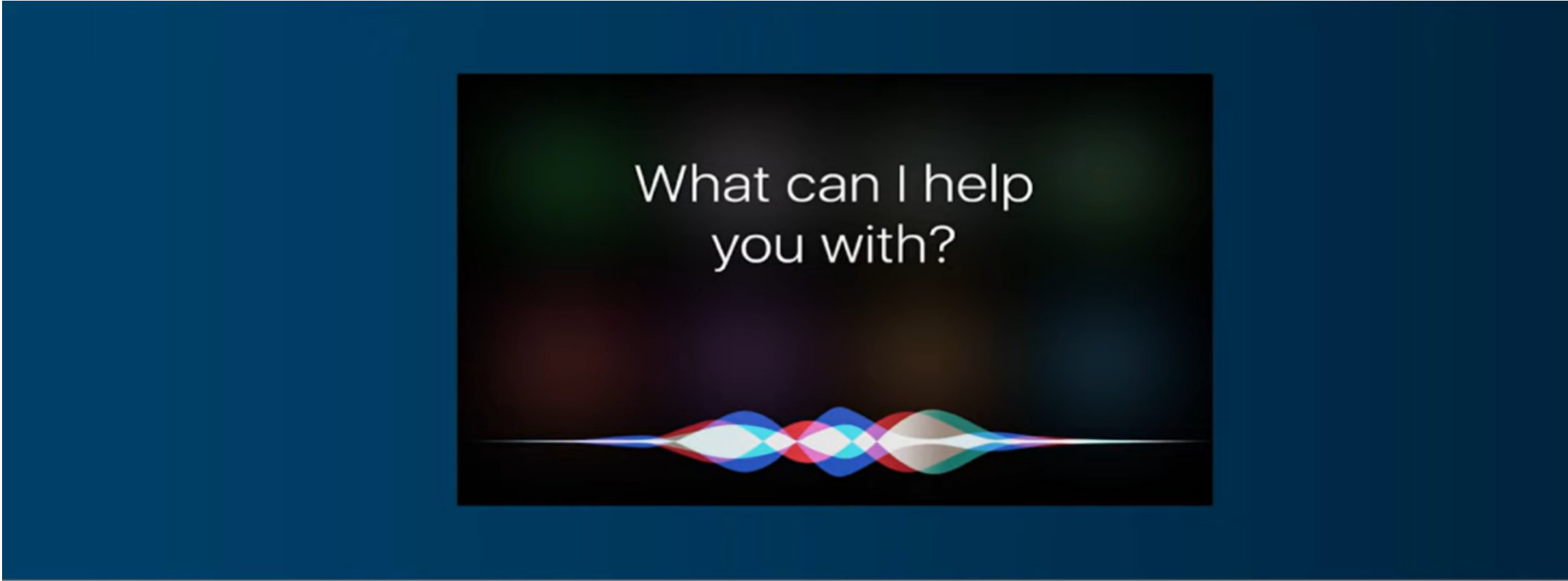Takes knowledge from one domain, transfers to other domain

Super AI
Machines that are an order of magnitude smarter than humans

Types/Stages of AI

- **Narrow AI (Weak AI)**:
  - **Definition**: AI that is designed and trained for a specific task or a narrow range of tasks.
  - **Example**: Virtual assistants like Siri and Alexa that can perform tasks like setting reminders or playing music.

- **General AI (Strong AI)**:
  - **Definition**: AI with the ability to understand, learn, and apply knowledge across a broad range of tasks, much like a human.
  - **Example**: This level of AI remains theoretical and has not yet been achieved.

- **Superintelligent AI**:
  - **Definition**: AI that surpasses human intelligence and capabilities in all aspects.
  - **Example**: A hypothetical concept that raises ethical and safety concerns.

What can I help
you with?

Artificial Narrow Intelligence (ANI)

Also known as Weak AI, ANI is the stage of Artificial Intelligence involving machines that can perform only a narrowly defined set of specific tasks.

- **AI that is designed and trained for a specific task or a narrow range of tasks.**

- **Example: Virtual assistants that can perform tasks like setting reminders or playing music.**

Artificial General Intelligence (AGI)

Also known as Strong AI, AGI is the stage in the evolution of Artificial Intelligence wherein machines will possess the ability to think and make decisions just like us humans.

- **AI with the ability to understand, learn, and apply knowledge across a broad range of tasks, much like a human.**

- **Example: Smart cars, games, chatbots, etc.**
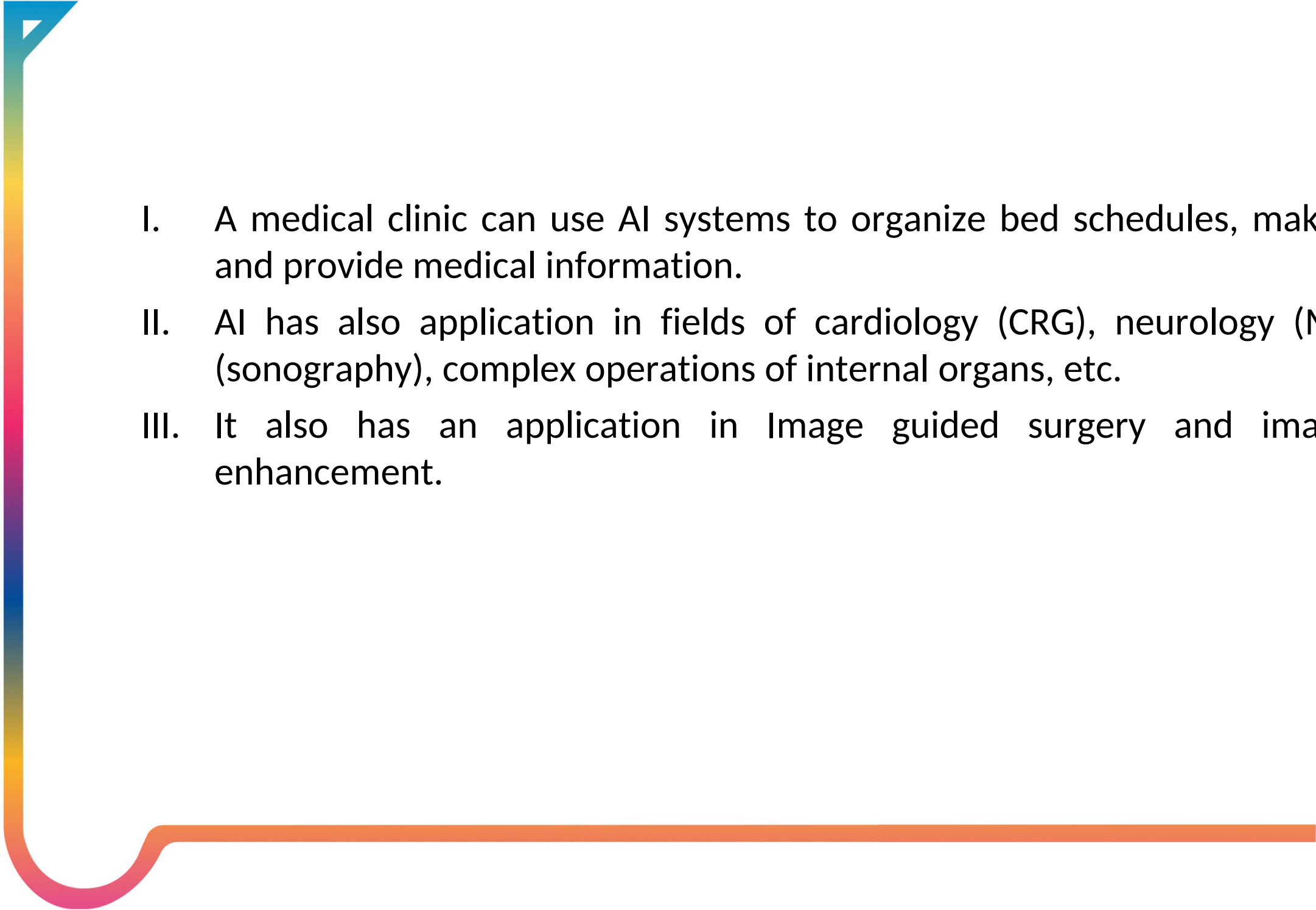
Artificial Super Intelligence (ASI)

Artificial Super Intelligence is the stage of Artificial Intelligence when the capability of computers will surpass human beings.

- **AI that surpasses human intelligence and capabilities in all aspects.**

- **Example: A hypothetical concept that raises ethical and safety concerns.**
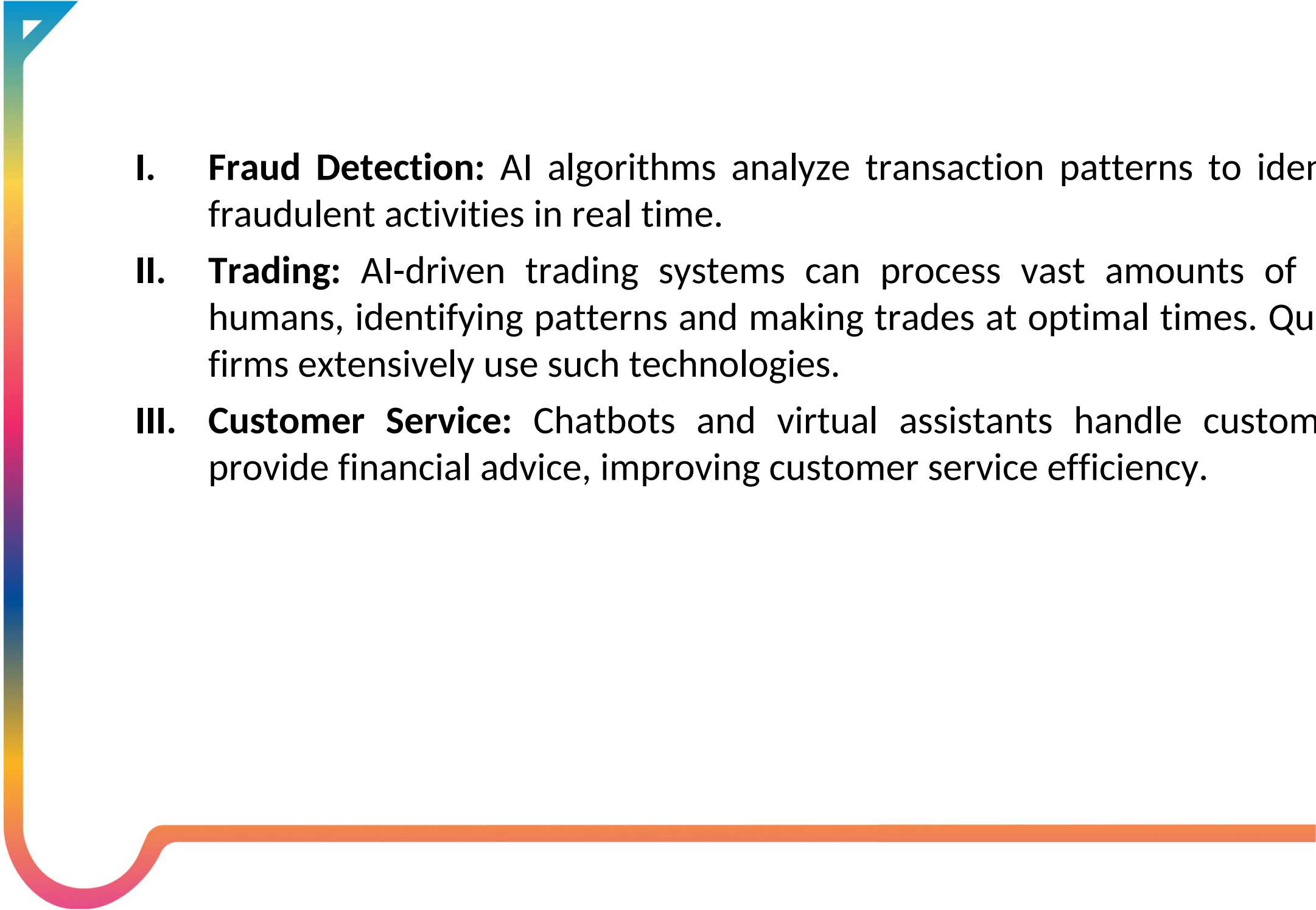
Applications of AI

1. In medical field
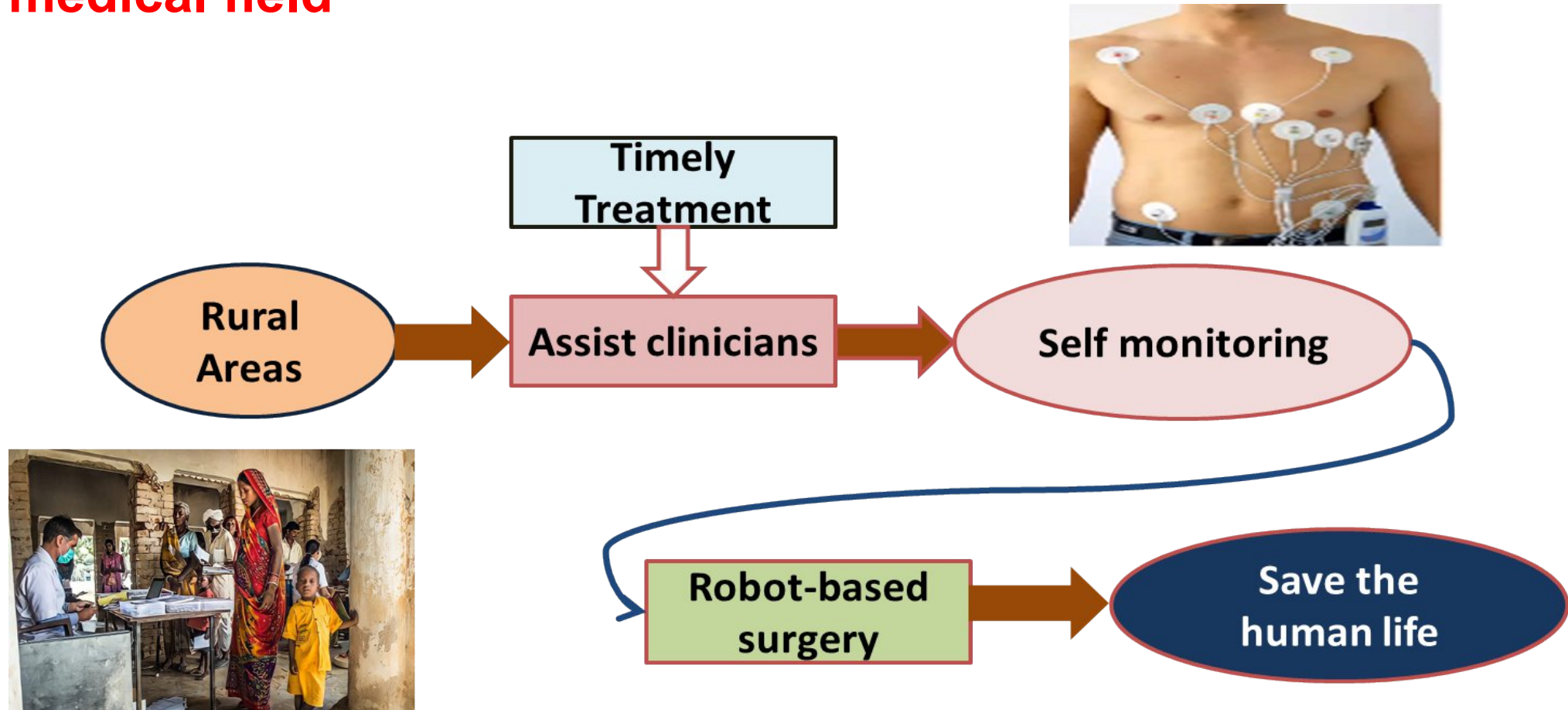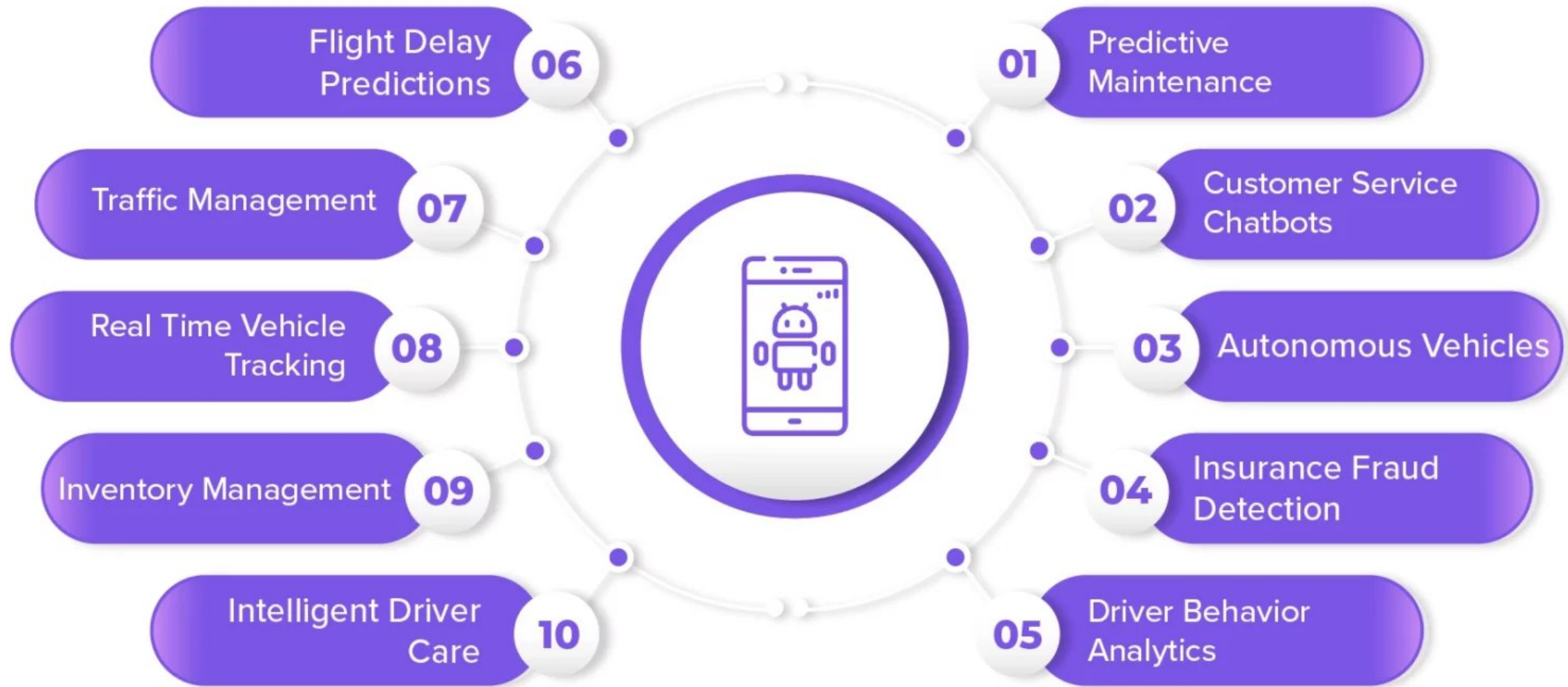
I. A medical clinic can use AI systems to organize bed schedules, make a staff rotation and provide medical information.

II. AI has also application in fields of cardiology (CRG), neurology (MRI), embryology (sonography), complex operations of internal organs, etc.

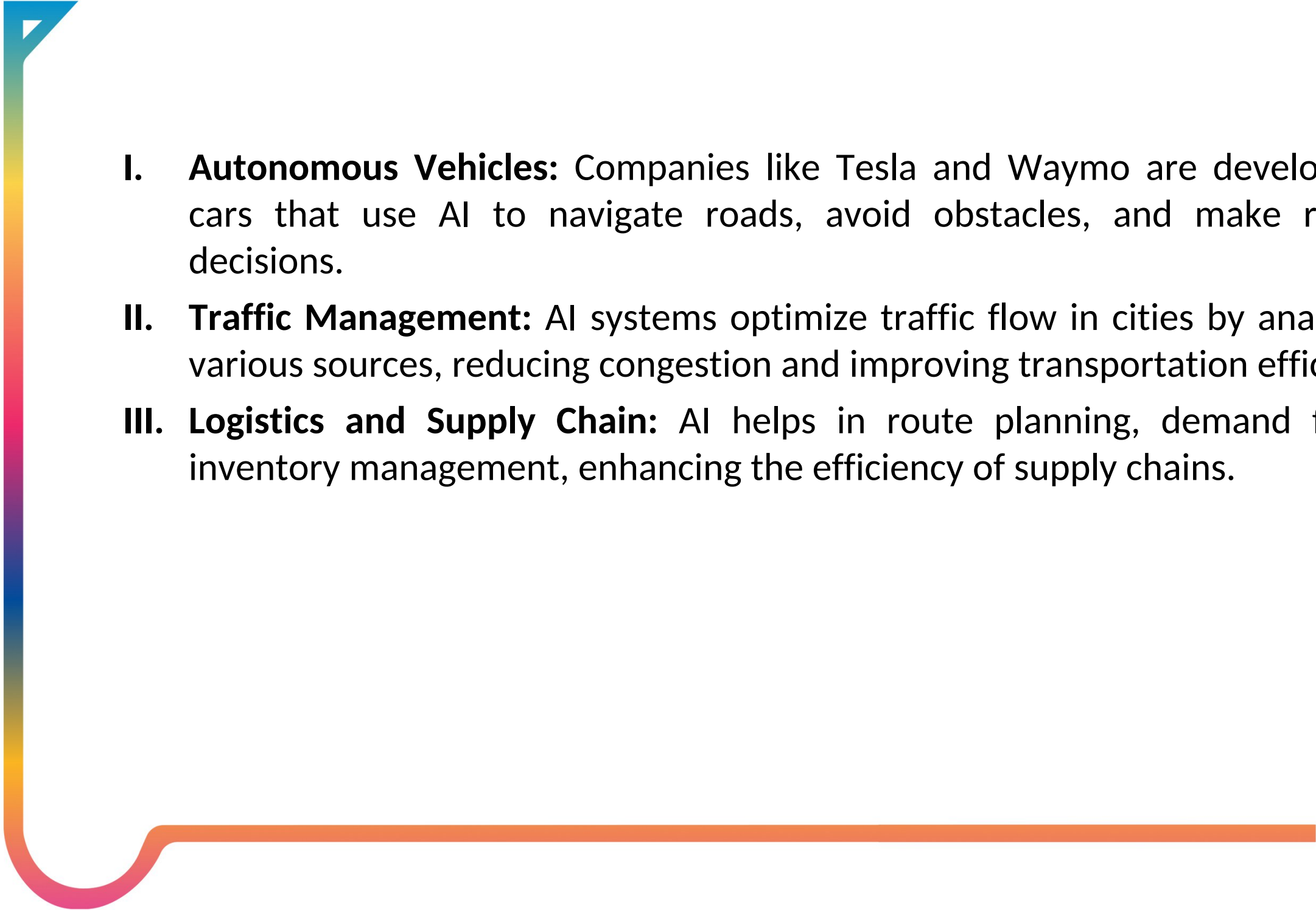III. It also has an application in Image guided surgery and image analysis and enhancement.

2. Finance

Application of AI in Financial Services

1. Automated Investment Adviced
2. Fraud Detection
3. Risk Management
4. Credit Scoring
5. Personal Financial Management
6. Trading and Execution

I.   **Fraud Detection:** AI algorithms analyze transaction patterns to identify and prevent fraudulent activities in real time.

II.   **Trading:** AI-driven trading systems can process vast amounts of data faster than humans, identifying patterns and making trades at optimal times. Quantitative trading firms extensively use such technologies.

III.   **Customer Service:** Chatbots and virtual assistants handle customer inquiries and provide financial advice, improving customer service efficiency.

3. Transportation

- 06 Flight Delay Predictions
- 07 Traffic Management
- 08 Real Time Vehicle Tracking
- 09 Inventory Management
- 10 Intelligent Driver Care
- 01 Predictive Maintenance
- 02 Customer Service Chatbots
- 03 Autonomous Vehicles
- 04 Insurance Fraud Detection
- 05 Driver Behavior Analytics

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I. **Autonomous Vehicles:** Companies like Tesla and Waymo are developing self-driving cars that use AI to navigate roads, avoid obstacles, and make real-time driving decisions.

II. **Traffic Management:** AI systems optimize traffic flow in cities by analyzing data from various sources, reducing congestion and improving transportation efficiency.

III. **Logistics and Supply Chain:** AI helps in route planning, demand forecasting, and inventory management, enhancing the efficiency of supply chains.

4. Retail

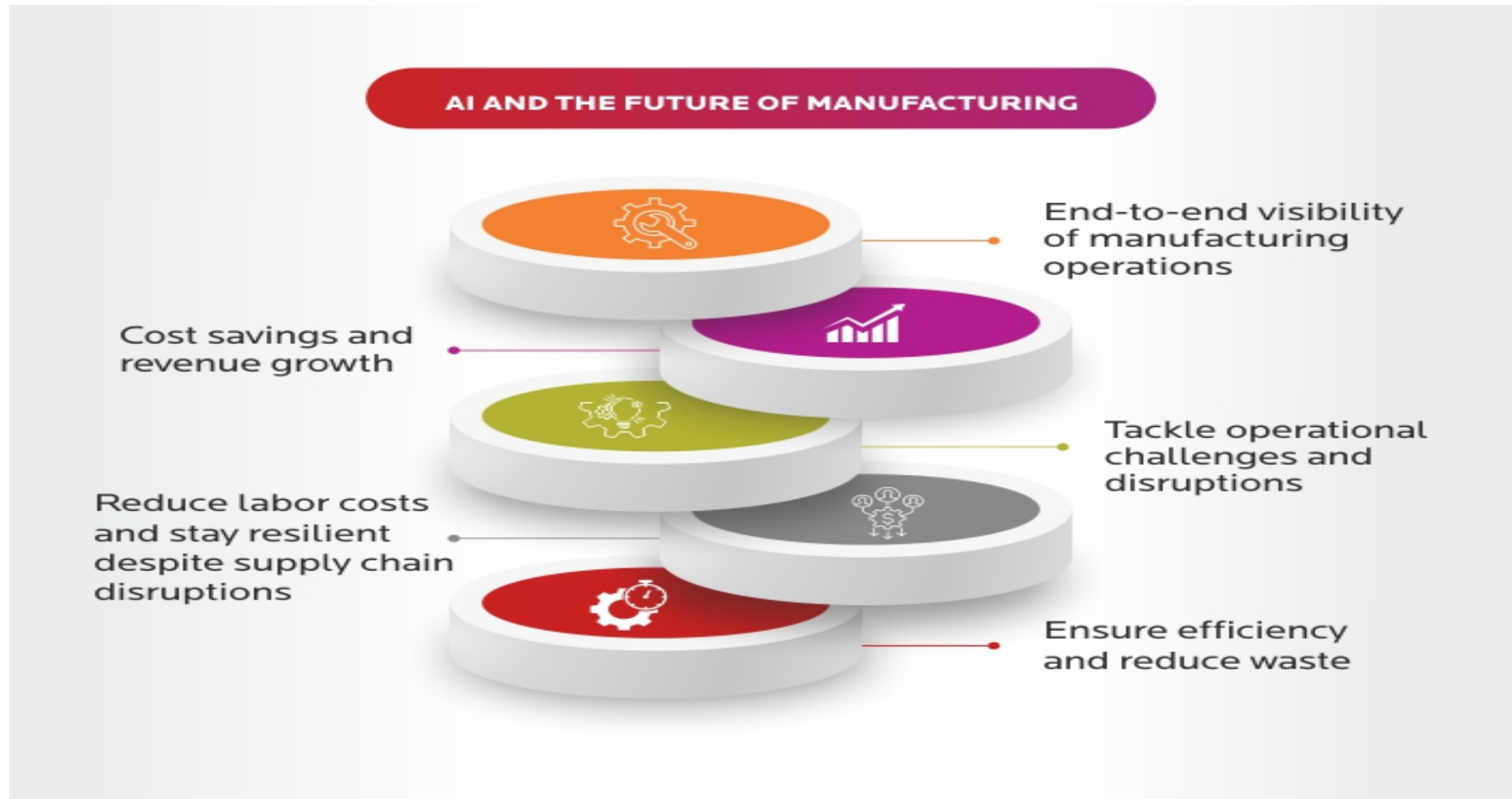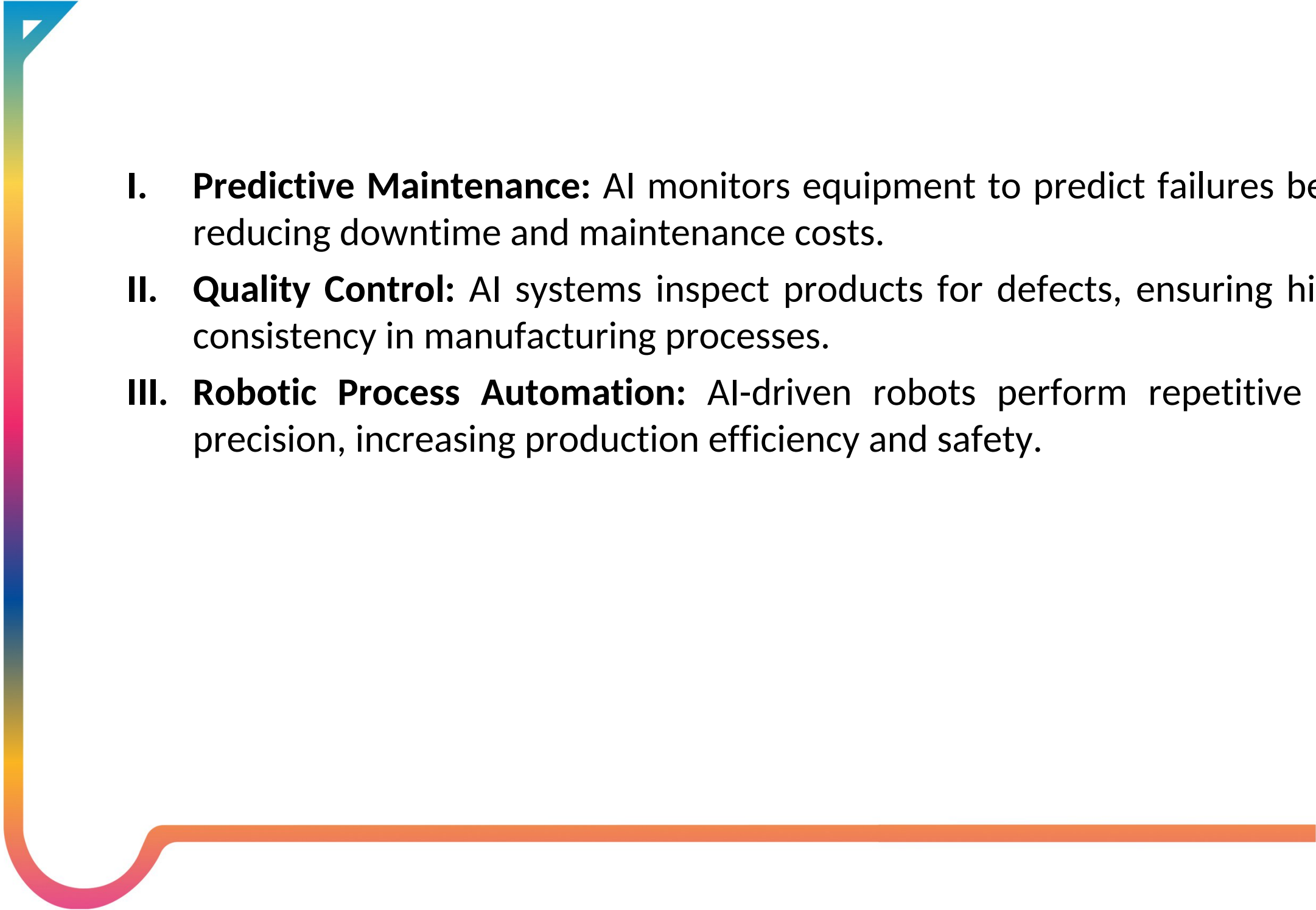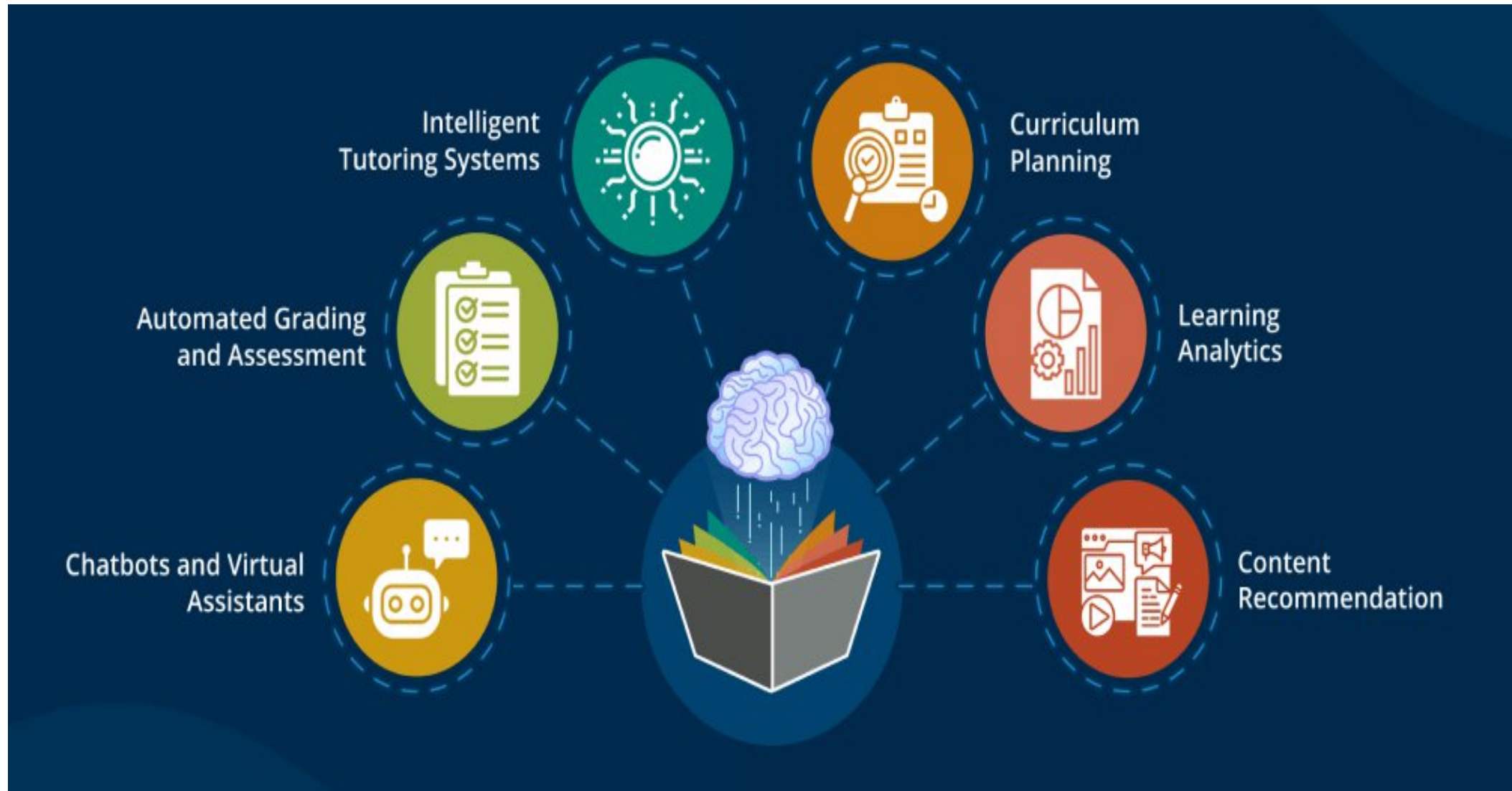I. **Personalized Shopping Experiences:** AI algorithms analyze customer data to provide personalized product recommendations, improving the shopping experience.

II. **Inventory Management:** AI systems predict demand trends and manage inventory levels to ensure that products are available when needed without overstocking.

III. **Customer Service:** AI-powered chatbots and virtual assistants handle customer inquiries, process orders, and provide support, improving customer satisfaction.

5. Manufacturing

AI AND THE FUTURE OF MANUFACTURING

- End-to-end visibility of manufacturing operations
- Cost savings and revenue growth
- Tackle operational challenges and disruptions
- Reduce labor costs and stay resilient despite supply chain disruptions
- Ensure efficiency and reduce waste
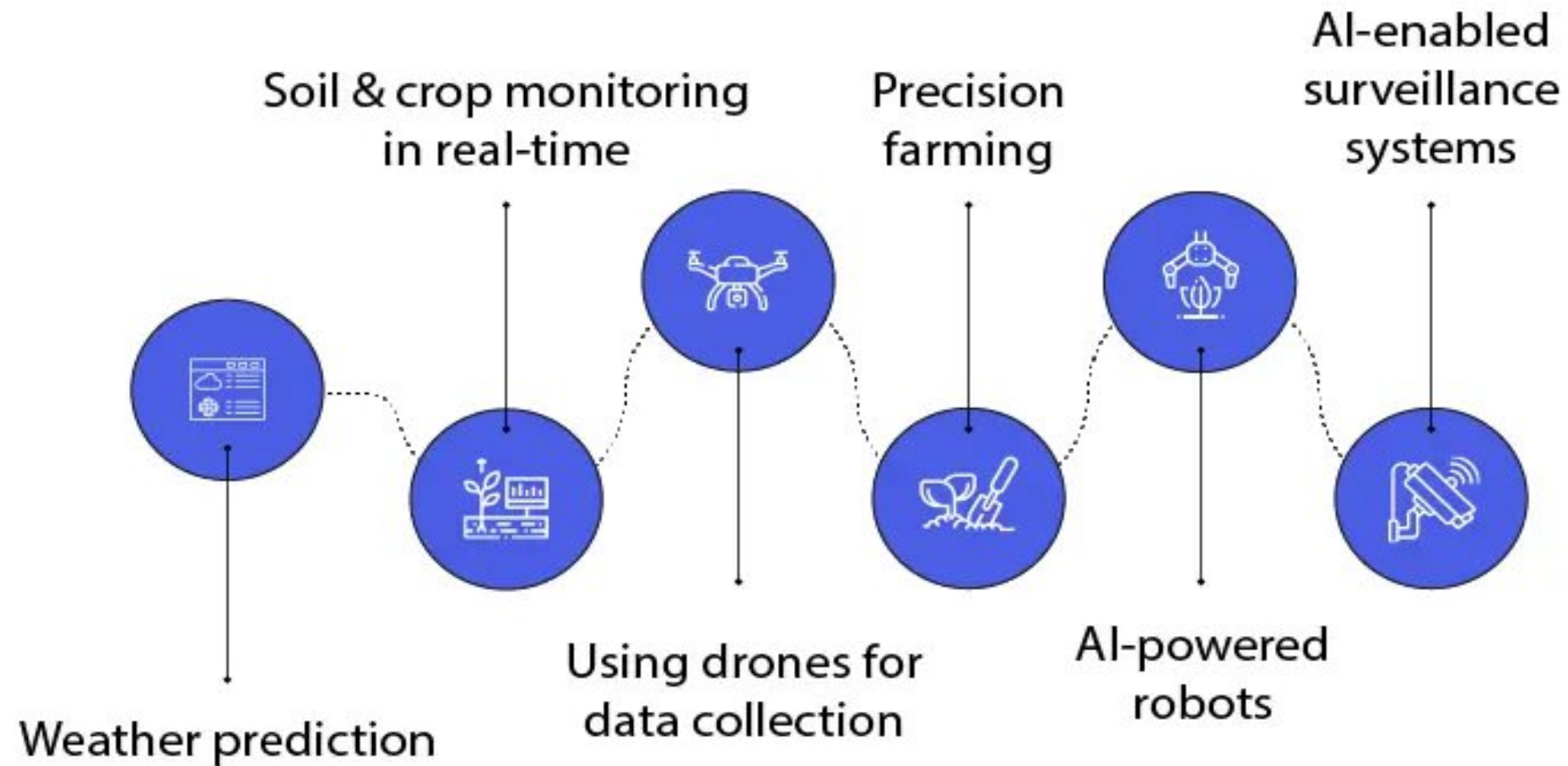
I. **Predictive Maintenance:** AI monitors equipment to predict failures before they occur, reducing downtime and maintenance costs.

II. **Quality Control:** AI systems inspect products for defects, ensuring higher quality and consistency in manufacturing processes.

III. **Robotic Process Automation:** AI-driven robots perform repetitive tasks with high precision, increasing production efficiency and safety.

6. Education

I.   **Personalized Learning:** AI provides customized learning experiences based on individual student needs, preferences, and progress.

II. **Administrative Tasks:** AI automates administrative tasks such as grading and scheduling, allowing educators to focus more on teaching.

III. **Virtual Tutors:** AI-powered virtual tutors offer additional support to students, helping them understand complex subjects and providing instant feedback.

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7. Agriculture

Soil & crop monitoring in real-time

Precision farming

AI-enabled surveillance systems

Weather prediction

Using drones for data collection

AI-powered robots
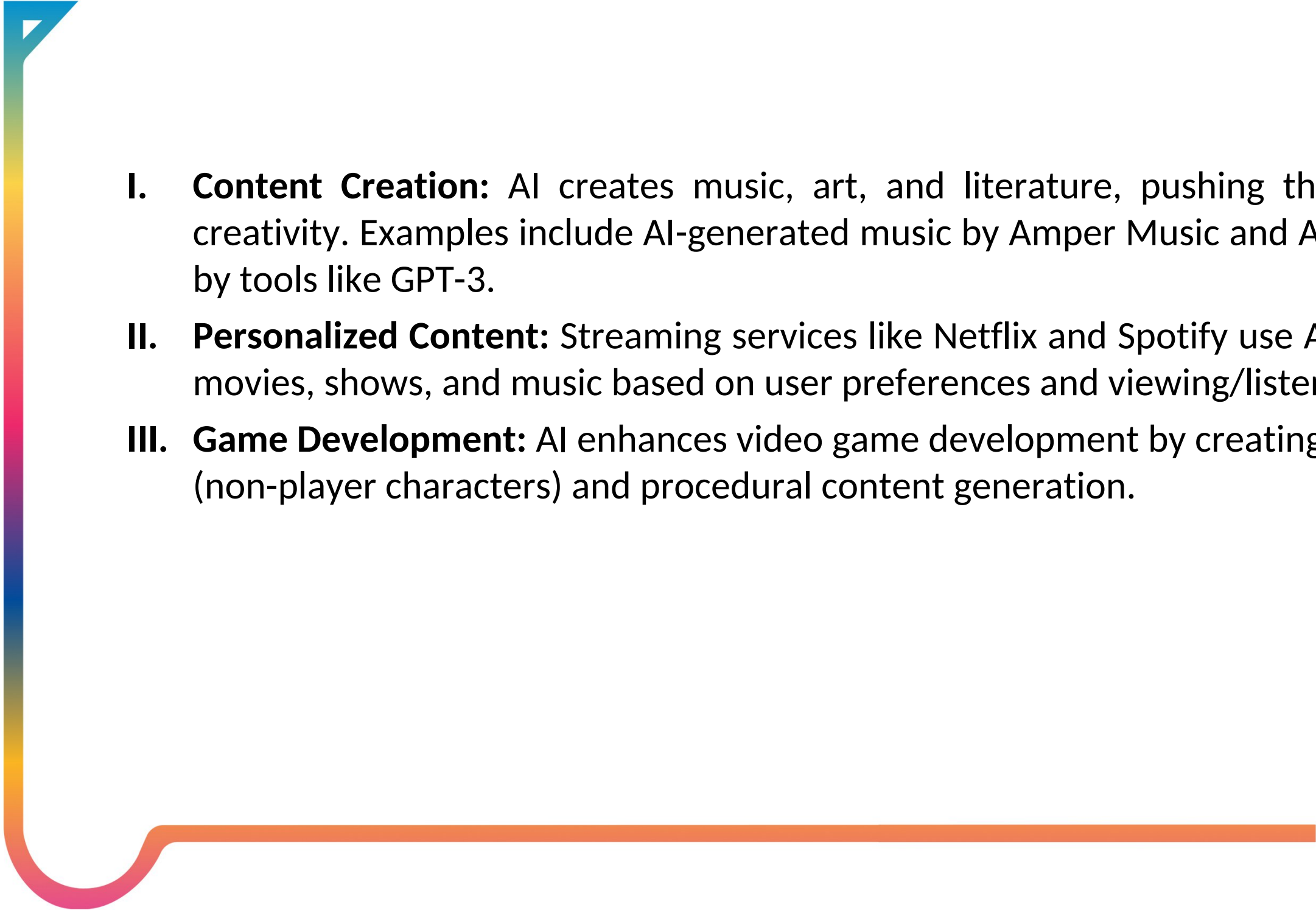
I. **Precision Farming:** AI analyzes data from sensors and drones to optimize planting, watering, and harvesting, increasing crop yields and resource efficiency.

II. **Crop Monitoring:** AI systems detect diseases, pests, and nutrient deficiencies in crops, enabling timely intervention and reducing losses.

III. **Supply Chain Optimization:** AI improves the efficiency of the agricultural supply chain by predicting demand and optimizing logistics.

8. Entertainment

Personalisation of content

Subtitle new generation

Search engine

Movie production

Metadata

Use of VR and AR

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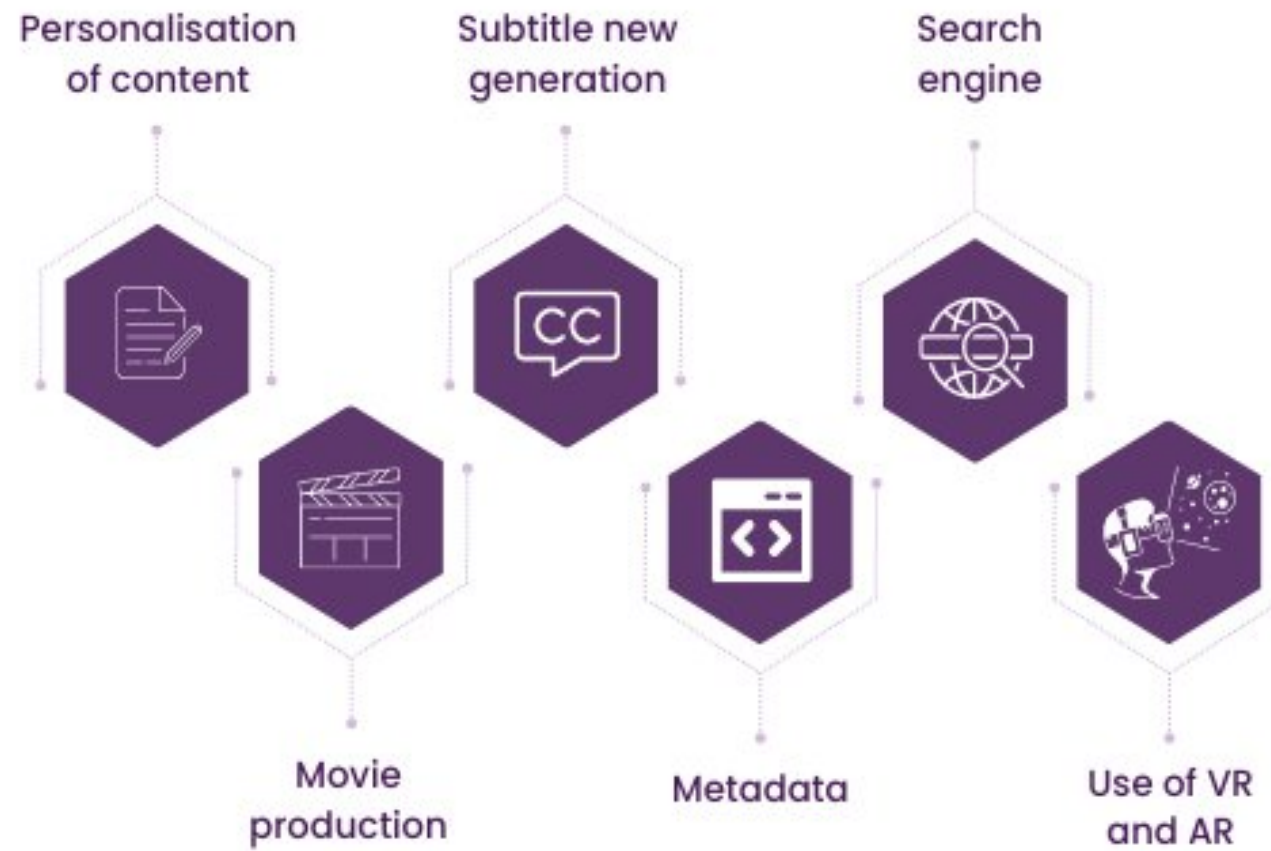
I. **Content Creation:** AI creates music, art, and literature, pushing the boundaries of creativity. Examples include AI-generated music by Amper Music and AI-written articles by tools like GPT-3.

II. **Personalized Content:** Streaming services like Netflix and Spotify use AI to recommend movies, shows, and music based on user preferences and viewing/listening history.

III. **Game Development:** AI enhances video game development by creating intelligent NPCs (non-player characters) and procedural content generation.

9. Security

Faster Detection · Network Security · Phishing Detection · Secure Authentication · Behavioural Analytics · Preventing Online Frauds
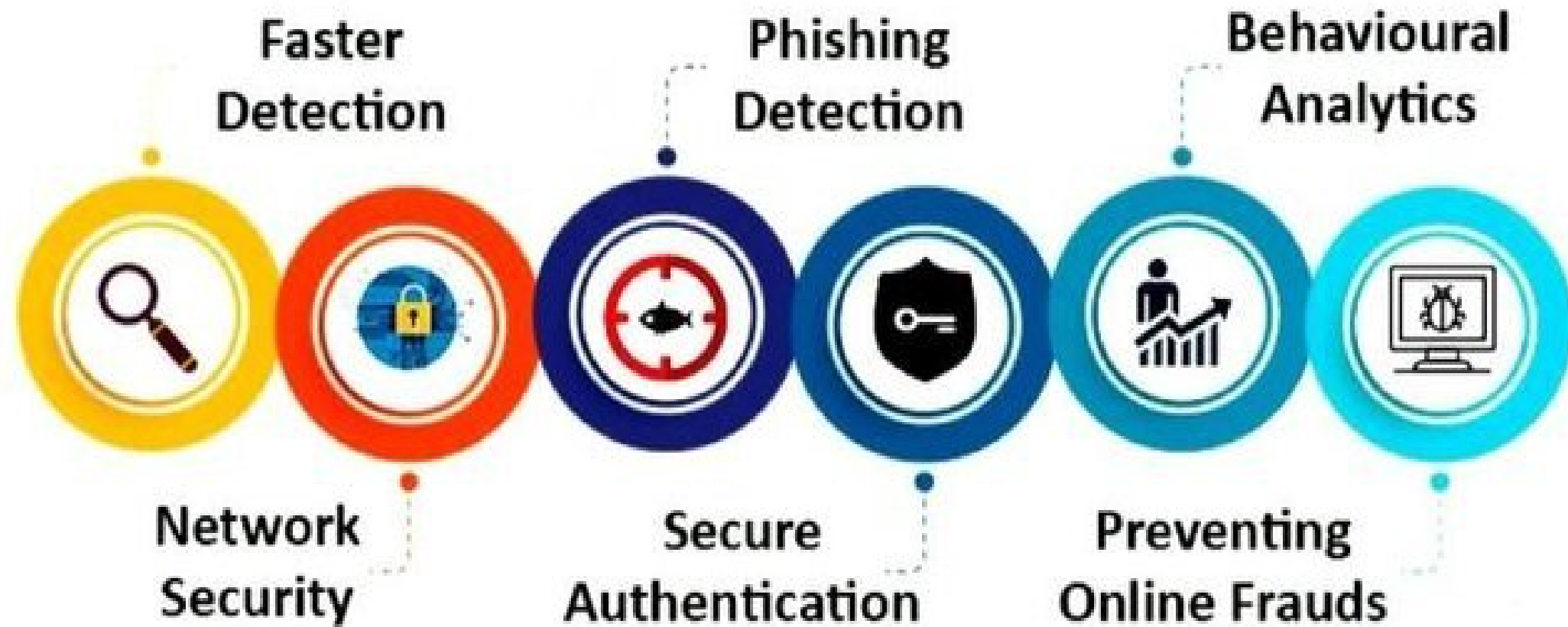
I. **Surveillance:** AI systems analyze video feeds to detect unusual activities and potential security threats in real time.

II. **Cybersecurity:** AI detects and responds to cyber threats by analyzing patterns in network traffic and identifying anomalies.

III. **Identity Verification:** AI enhances security in access control systems through facial recognition and biometric analysis.

I. **Climate Modeling:** AI analyzes climate data to improve weather forecasts and model climate change scenarios.

II. **Wildlife Conservation:** AI tracks animal movements and monitors habitats to aid in wildlife conservation efforts.

III. **Energy Management:** AI optimizes energy use in buildings and industries, contributing to more sustainable energy consumption.

The applications of AI are vast and continually expanding, transforming industries and improving efficiency, accuracy, and outcomes across various fields.

As AI technology evolves, it is expected to play an even more integral role in solving complex global challenges and driving innovation.

AI Techniques

- AI techniques refer to a set of methods and algorithms used to develop intelligent systems that can perform tasks requiring human-like intelligence.
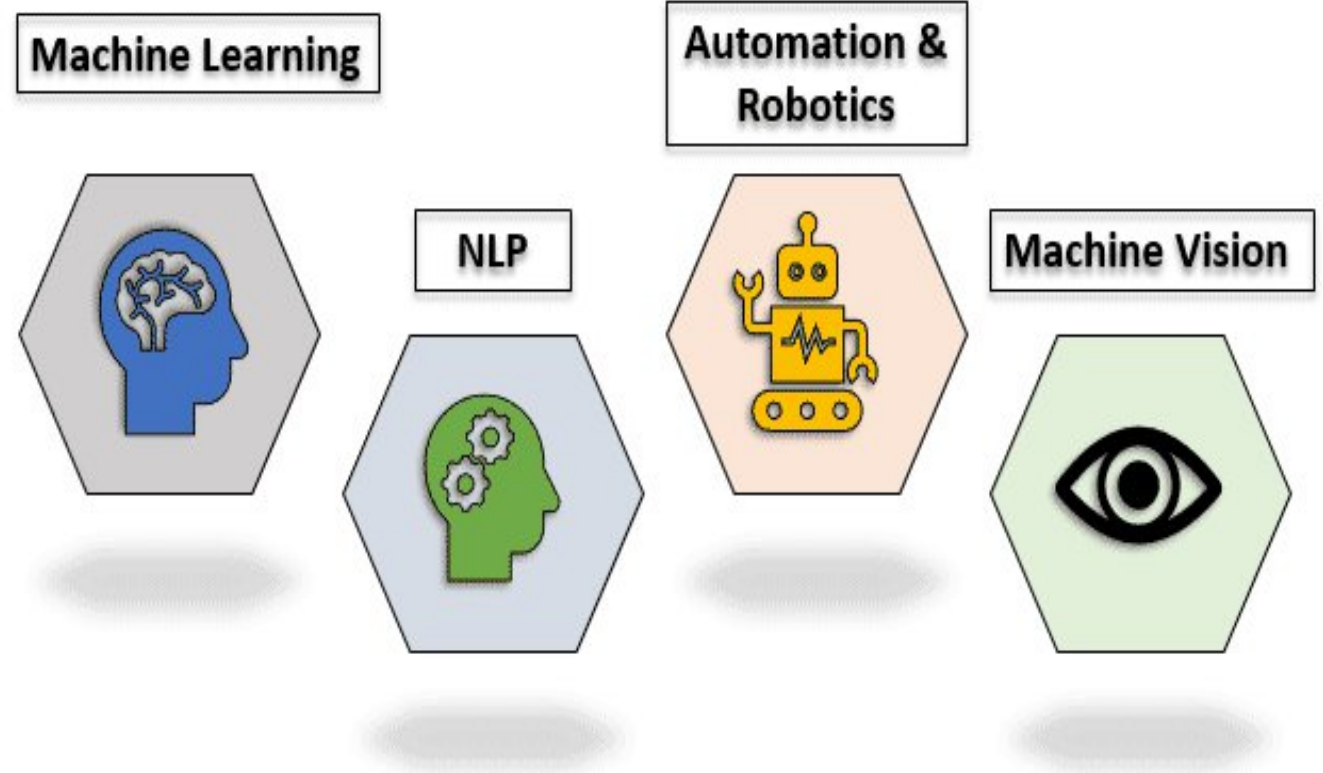
Key Techniques:

Machine Learning

Deep Learning

Natural Language Processing (NLP)

Computer Vision

Top 4 Techniques of Artificial Intelligence

Machine Learning

NLP

Automation & Robotics

Machine Vision

Machine Learning

➢ Machine learning is a subset of AI techniques that involves training algorithms to learn from data.

Types of ML:
1. Supervised Learning
2. Unsupervised Learning
3. Semi supervised Learning
4. Reinforcement Learning

Deep Learning

➢ Deep learning is a specialized form of machine learning that uses neural networks with multiple hidden layers.

Key Concepts:
1. Neural Networks
2. Convolutional Neural Networks (CNNs)
3. Recurrent Neural Networks (RNNs)

Machine Learning

Input — Feature extraction — Classification — Output (Car / Not Car)

Deep Learning

Input — Feature extraction + Classification — Output (Car / Not Car)
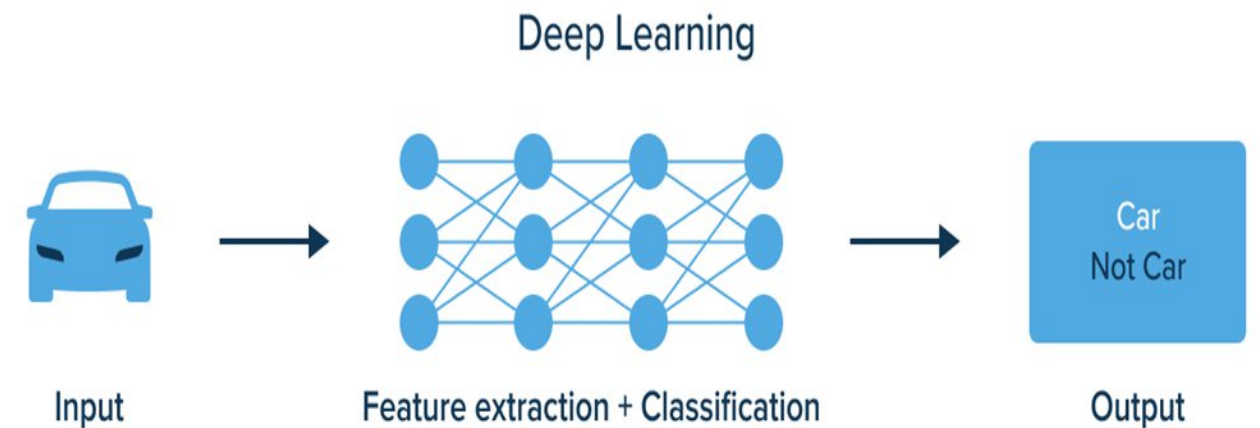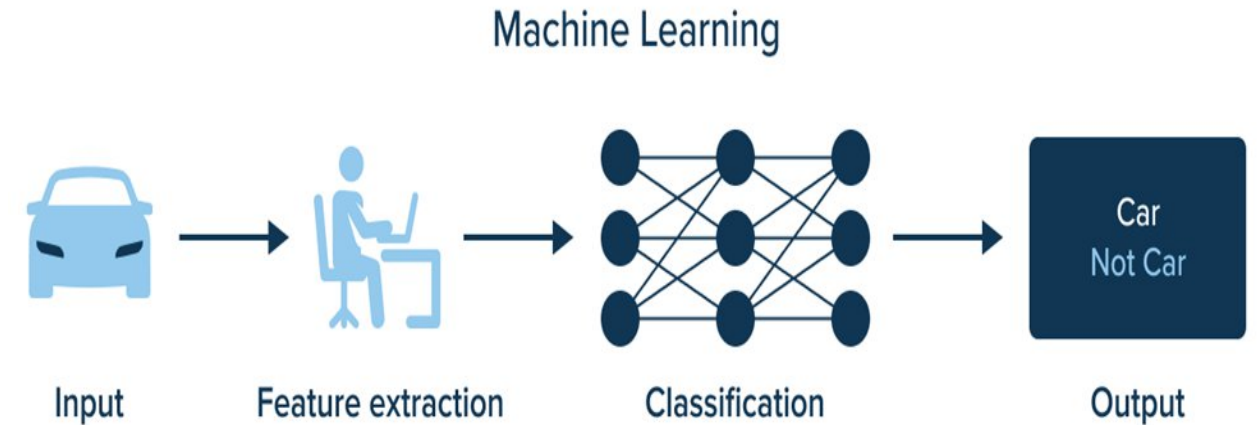
Natural Language Processing (NLP)

➢ Natural Language Processing involves programming computers to process human languages to facilitate interactions between humans and computers.

Key Techniques:

- Tokenization,

- Sentiment Analysis

- Machine Translation

Applications:

- Chatbots,

- Language Translation

- Text Analytics

Computer Vision

➢ Computer vision involves teaching machines to interpret and analyze visual information from the real world.

Key Applications:
- Image Classification
- Object Détection
- Image Segmentation.

Summary

➢ AI techniques enable machines to simulate human intelligence.

➢ Machine learning trains algorithms to learn from data.

➢ Deep learning uses neural networks with multiple layers.

➢ NLP enables machines to understand and generate human language.

➢ Reinforcement learning involves an agent learning by interacting with its environment.

➢ Genetic algorithms are inspired by natural selection.

➢ Expert systems emulate human decision-making abilities.

➢ Fuzzy logic handles uncertainty and imprecision.

Agents/Intelligent Agents

➢ Agents are autonomous entities that perceive their environment and make decisions to achieve specific goals.

➢ In AI, an agent is a computer program or system that is designed to perceive its environment, make decisions and take actions to achieve a specific goal or set of goals.
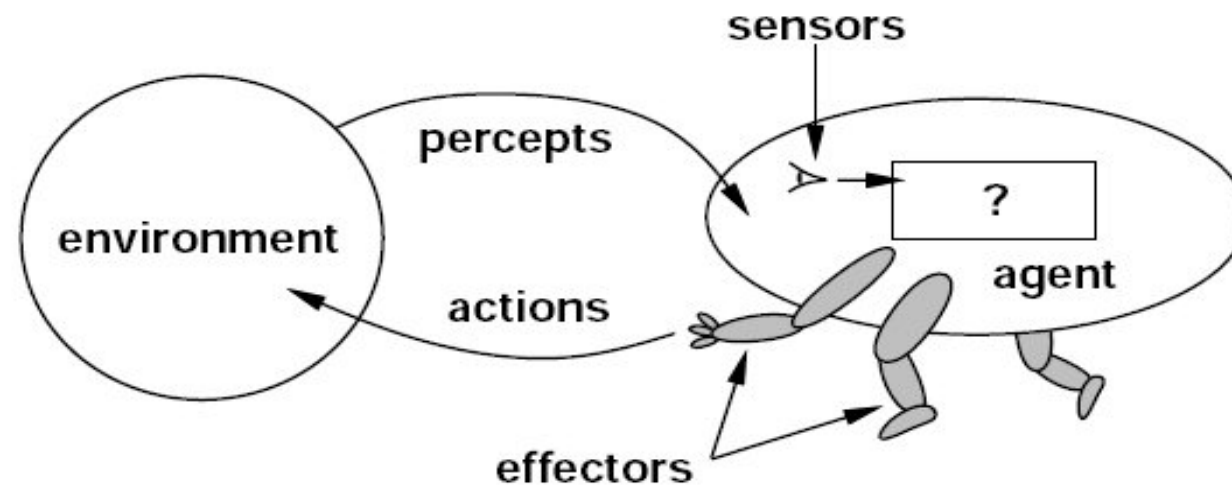
➢ Example: A human a   isors and hands, legs, vocal tract, and so on for actuators.

➢ A robotic agent might have cameras and infrared range finders for sensors and various motors for actuators.

➢ A software agent receives keystrokes, file contents, and network packets as sensory inputs and acts on the environment by displaying on the screen, writing files, and sending network packets.

➢ The agent operates autonomously, meaning it is not directly controlled by a human operator.

➢ Agents can be classified into different types **based on their characteristics**, such as

❑ reactive or proactive

❑ fixed or dynamic environment

❑ single or multi-agent systems.

➢ Reactive agents are those that respond to immediate stimuli from their environment and take actions based on those stimuli.

➢ Proactive agents are those that take initiative and plan ahead to achieve their goals.

➢ The environment in which an agent operates can also be fixed or dynamic.

➢ Fixed environments have a static set of rules that do not change, while dynamic environments are constantly changing and require agents to adapt to new situations.

➢ Multi-agent systems involve multiple agents working together to achieve a common goal.

➢ These agents may have to coordinate their actions and communicate with each other to achieve their objectives.

Rules all AI agents must adhere to:

➢ Rule 1: An AI agent must be able to perceive the environment.

➢ Rule 2: The environmental observations must be used to make decisions.

➢ Rule 3: The decisions should result in action.

➢ Rule 4: The action taken by the AI agent must be a rational. Rational actions are actions that maximize performance and yield the best positive outcome.

Functions of an AI Agent:

➢ Perceiving dynamic conditions in the environment

➢ Acting to affect conditions in the environment

➢ Using reasoning to interpret perceptions

➢ Problem-solving

➢ Drawing inferences

➢ Determining actions and their outcomes.

Types of Agents in AI
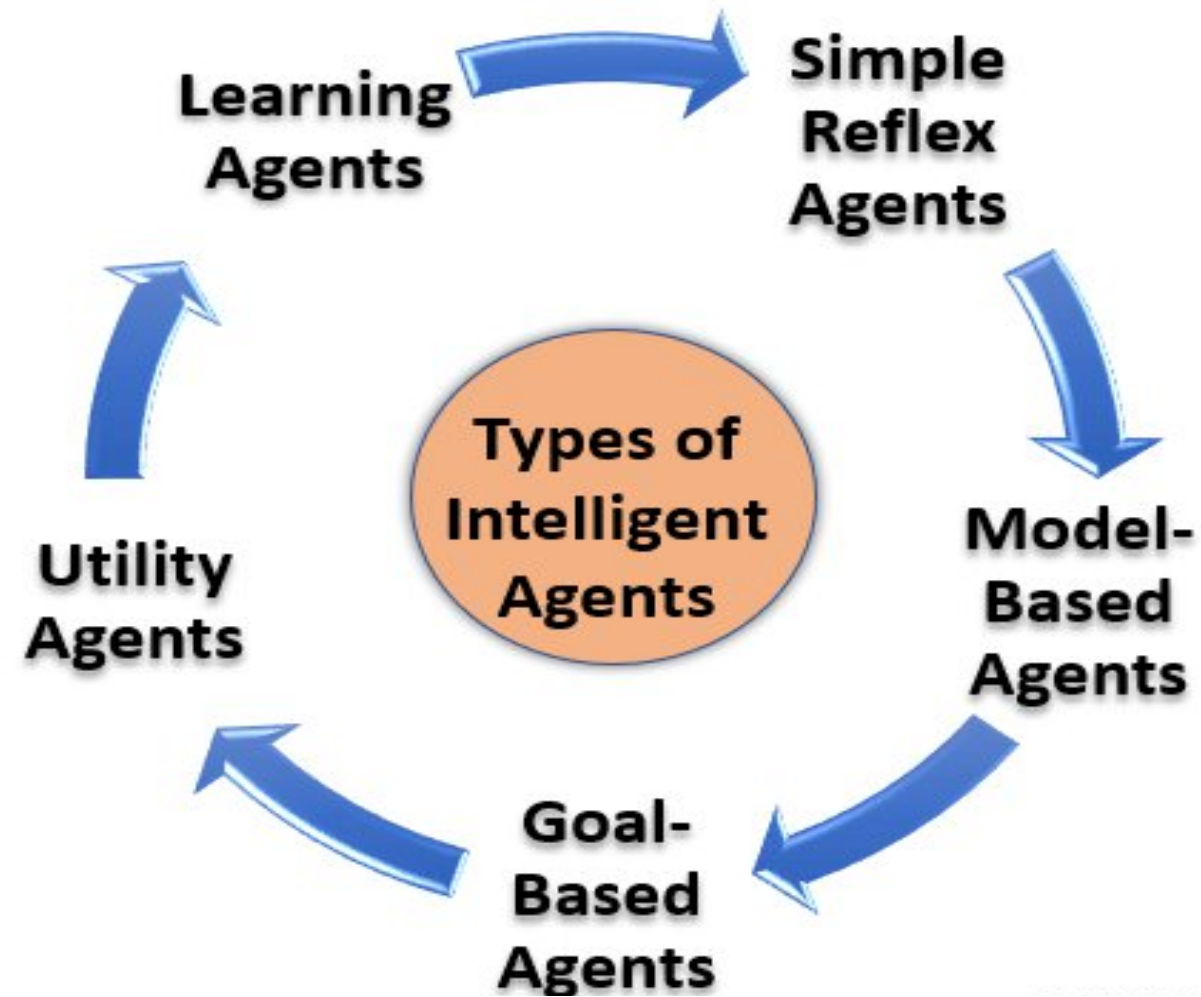
➢ **Simple reflex agents:** This is one of the most important types of agents in ai. These agents act purely in the present, without taking into account the past or the future. They work well in settings with quick and predictable results.

➢ **Model-based Agents:** These agents choose their actions like reflex agents do, but they have a better comprehensive view of the environment. An environmental model is programmed into the internal system, incorporating into the Agent's history.

➢ **Goal-based agents:** These agents build on the information that a model-based agent stores by augmenting it with goal information or data regarding desirable outcomes and situations.

➢ **Utility-based agents:** These are comparable to the goal-based agents, except they offer an extra utility measurement. This measurement rates each possible scenario based on the desired result and selects the action that maximizes the outcome. Rating criteria examples include variables such as success probability or the number of resources required.

➢ **Learning agents:** These agents employ an additional learning element to gradually improve and become more knowledgeable over time about an environment. The learning element uses feedback to decide how the performance elements should be gradually changed to show improvement.

Advantages of AI

1. Efficiency and Productivity

- **Automation of Routine Tasks:** AI can automate repetitive tasks, freeing up human workers to focus on more complex and creative activities.
- **24/7 Availability:** AI systems can operate continuously without fatigue, providing services and monitoring systems around the clock.

2. Accuracy and Precision

- **Reduced Errors:** AI systems can process large amounts of data with high accuracy, reducing the likelihood of human errors.
- **Precision in Tasks:** In fields like medicine and manufacturing, AI can perform tasks with a level of precision unattainable by humans.

3. Data Processing and Analysis

- **Big Data Insights:** AI can analyze vast datasets quickly, identifying patterns and trends that would be impossible for humans to discern.
- **Predictive Analytics:** AI systems can forecast future trends and outcomes, aiding in decision-making and strategic planning.

4. Innovation and Discovery

New Solutions: AI can help discover new solutions to complex problems, such as drug discovery in pharmaceuticals and climate modeling.

Enhanced Creativity: AI tools assist in creative fields by generating music, art, and content, pushing the boundaries of human creativity.

5. Cost Savings

Operational Efficiency: By automating processes and optimizing operations, AI can significantly reduce costs for businesses.

Reduced Labor Costs: AI can perform tasks that would otherwise require a large workforce, leading to labor cost savings.

6. Improved Customer Experience

Personalization: AI enables personalized experiences in retail, entertainment, and online services, increasing customer satisfaction.

Enhanced Support: AI-driven chatbots and virtual assistants provide quick and efficient customer service.

Disadvantages of AI

1. Job Displacement

- **Unemployment:** The automation of tasks traditionally performed by humans can lead to job losses and increased unemployment in certain sectors.

- **Skill Gaps:** There is a growing need for workers to acquire new skills to stay relevant in an AI-driven job market.

2. High Implementation Costs

- **Initial Investment:** Developing and implementing AI systems can be expensive, requiring significant upfront investment.

- **Maintenance Costs:** AI systems require ongoing maintenance, updates, and fine-tuning, adding to operational costs.

3. Ethical and Privacy Concerns

- **Bias and Discrimination:** AI systems can perpetuate and even exacerbate biases present in the training data, leading to unfair outcomes.

- **Privacy Issues:** The use of AI in surveillance and data analysis raises concerns about privacy and the potential misuse of personal data.

4. Complexity and Understanding

   Lack of Transparency: Many AI systems, especially those using deep learning, operate as "black boxes," making it difficult to understand how they make decisions.

   Dependence on Quality Data: AI's effectiveness is heavily dependent on the quality and quantity of data available, and poor data can lead to poor outcomes.

5. Security Risks

   Cyber Attacks: AI systems can be vulnerable to hacking and other cyber threats, potentially leading to significant security breaches.

   Autonomous Weapons: The development of AI-powered weapons poses significant ethical and security risks.

6. Loss of Human Touch

   Impersonal Interactions: Over-reliance on AI for customer service and other interactions can lead to a lack of human touch and personal connection.

   Dehumanization: In some applications, the use of AI can lead to the dehumanization of certain processes and interactions.

Limitations of AI

Artificial Intelligence (AI) has transformative potential, but it also comes with several limitations that impact its effectiveness and broader adoption. Here are some of the primary limitations of AI:

1. Data Dependency

- **Quality of Data:** AI systems require high-quality data for training. Poor-quality data, including biased, incomplete, or noisy data, can lead to inaccurate models and flawed outcomes.

- **Quantity of Data:** Many AI models, especially those using deep learning, need large amounts of data to perform well. In domains where data is scarce, this can be a significant barrier.

2. Lack of Generalization

- **Specific Task Performance:** Most AI systems are designed for specific tasks and cannot generalize their knowledge to different contexts or tasks. They excel in narrow applications but struggle with tasks outside their training scope.

- **Transfer Learning Limitations:** While techniques like transfer learning aim to apply knowledge from one domain to another, they are not always effective and require careful adaptation.

3. Explainability and Transparency

- **Black Box Models:** Many AI models, particularly deep learning networks, operate as "black boxes" with decision-making processes that are difficult to understand or explain.

- **Trust Issues:** The lack of transparency can lead to trust issues among users and stakeholders, especially in critical applications like healthcare and finance where understanding the rationale behind decisions is crucial.

4. Ethical and Bias Concerns

- **Bias in AI:** AI systems can inherit biases present in their training data, leading to discriminatory outcomes in areas like hiring, lending, and law enforcement.

- **Ethical Dilemmas:** AI poses ethical challenges related to privacy, surveillance, and the potential for misuse, such as autonomous weapons or deepfakes.

5. Computational and Resource Intensity

- **High Computational Costs:** Training advanced AI models, particularly deep neural networks, requires significant computational resources, which can be expensive and environmentally taxing.

- **Energy Consumption:** The energy required for training and running AI models can be substantial, contributing to a larger carbon footprint.

6. Security and Privacy Issues

- **Vulnerability to Attacks:** AI systems can be vulnerable to adversarial attacks where small, carefully crafted changes to input data can cause the AI to make incorrect decisions.

- **Privacy Concerns:** The use of AI in data analysis raises concerns about the privacy of individuals, as AI systems can infer sensitive information from seemingly innocuous data.

7. Human-AI Interaction

User Dependence: Over-reliance on AI systems can lead to skill degradation in humans and an overdependence on automated systems.

Lack of Common Sense: AI lacks the common sense reasoning that humans possess, making it difficult for AI to handle unexpected situations or understand context as humans do.

8. Regulatory and Legal Challenges

Regulatory Uncertainty: The fast-paced development of AI technologies often outstrips the creation of relevant regulations and laws, leading to uncertainty and potential misuse.

Legal Accountability: Determining accountability and liability in cases where AI systems make erroneous or harmful decisions is complex and unresolved in many jurisdictions.

9. Economic and Social Impact

Job Displacement: AI and automation can lead to job losses in certain sectors, contributing to economic disruption and social inequality.

Access and Equity: The benefits of AI are not evenly distributed, with advanced AI technologies often being accessible only to large organizations or affluent regions, exacerbating existing disparities.

Thank You