What is AI?

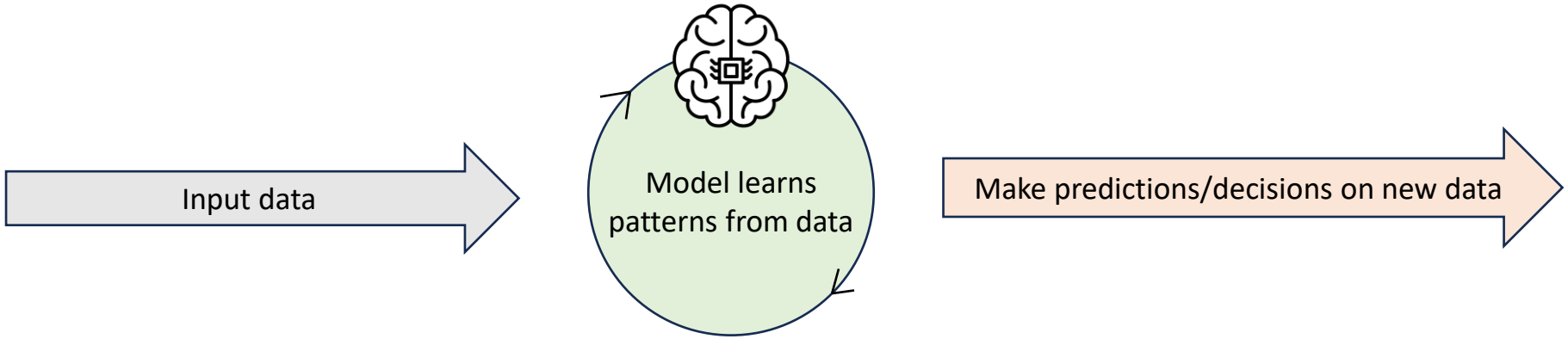
- **Artificial intelligence (AI)** uses computers to simulate intelligence, allowing them to exhibit behaviors typically associated with humans, such as recognizing patterns, learning, making decisions, and solving problems.
  - Although ChatGPT is on everyone's mind these days, the field of AI is much wider.

- Some examples:
  - **Virtual assistants**: Siri, Alexa, Google Assistant
  - **Recommendation systems**: Netflix, YouTube, Amazon product recommendations
  - **Self-driving cars and robotics**: Tesla FSD, Waymo
  - **Chatbots**: ChatGPT, virtual concierges
  - **Game play and analysis**: Stockfish (Chess), AlphaGo (Go)
  - …and many more!

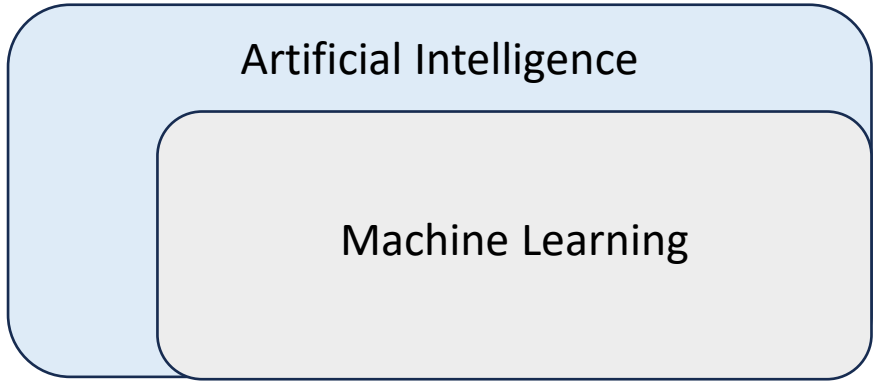
- AI is growing in importance, driven by increased computing power, availability of big data, and breakthroughs in AI research (i.e. the AI boom since ChatGPT's release).

What is ML?

- **Machine learning (ML)** is a subset of AI that focuses on enabling computers to learn from data and improve without the need for explicit programming.
  - Instead of hard-coded instructions (programmed by a human), ML algorithms identify patterns in data and make predictions or decisions based on those patterns.



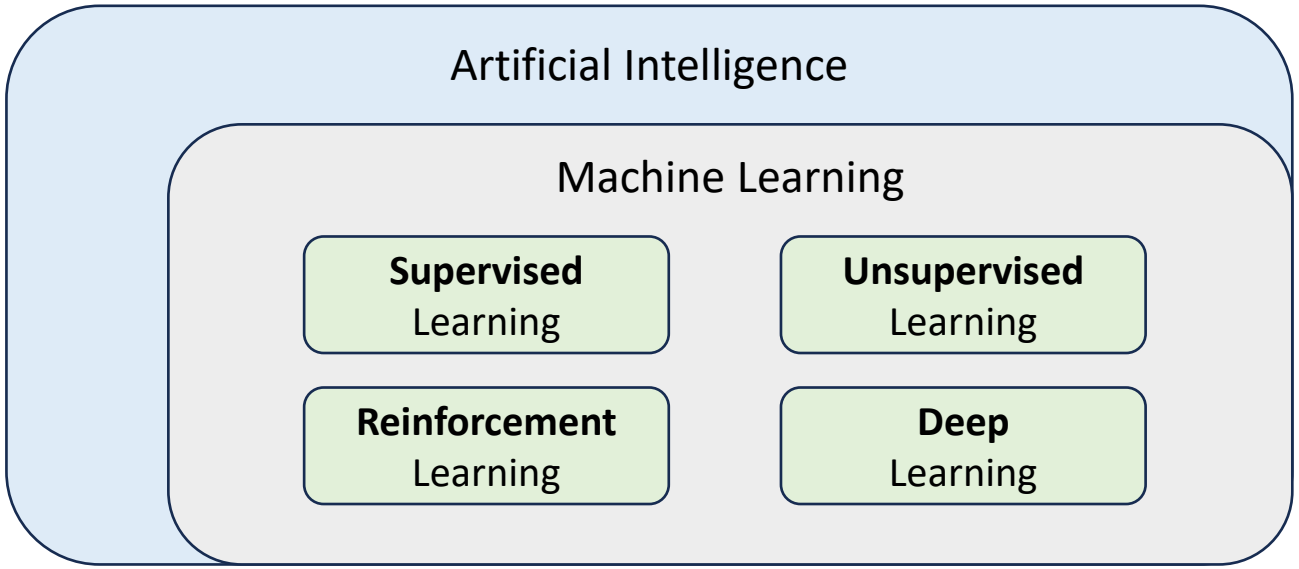
- Some examples:
  - Email spam filtering
  - Personalized product recommendations
  - Fraud detection (banking)
  - Natural language processing (NLP)
  - …and more!



- ML is the driving force behind many modern AI applications.

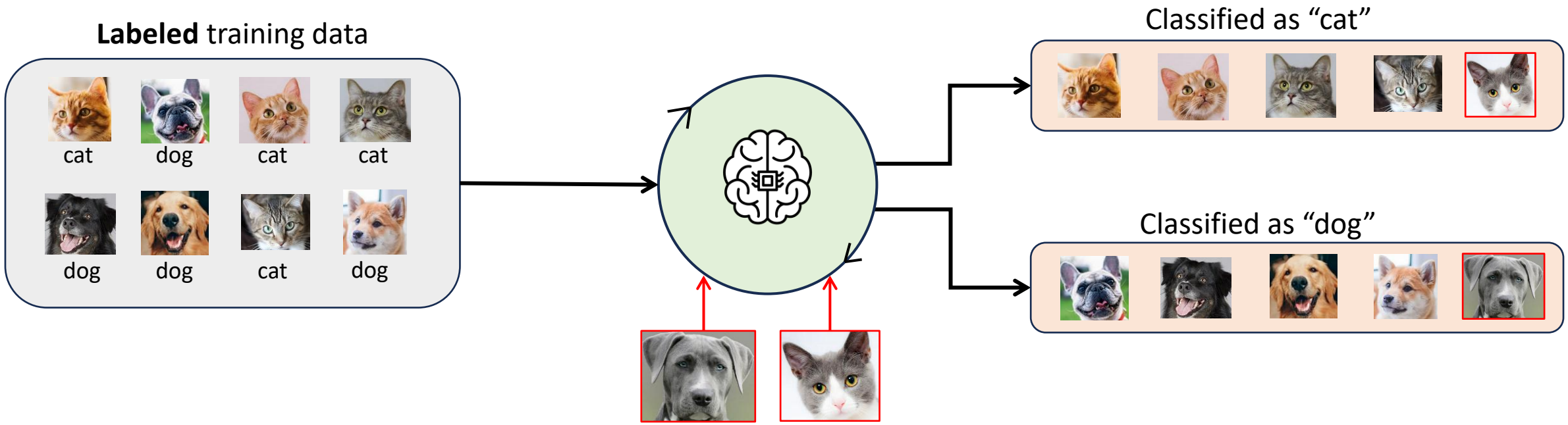
Types of ML

- **Supervised learning**
  - The model is trained on labeled data, where the correct answers are provided, to make predictions or classifications on new data.
- **Unsupervised learning**
  - The model is given unlabeled data and tasked with finding patterns, relationships, or groupings within the data.
- **Reinforcement learning**
  - The model learns by interacting with an environment, receiving rewards or penalties based on its actions to maximize its performance over time.
- **Deep learning**
  - A specialized subset of ML that uses multi-layered neural networks to handle large datasets and perform complex tasks like image recognition and natural language processing.



Supervised learning

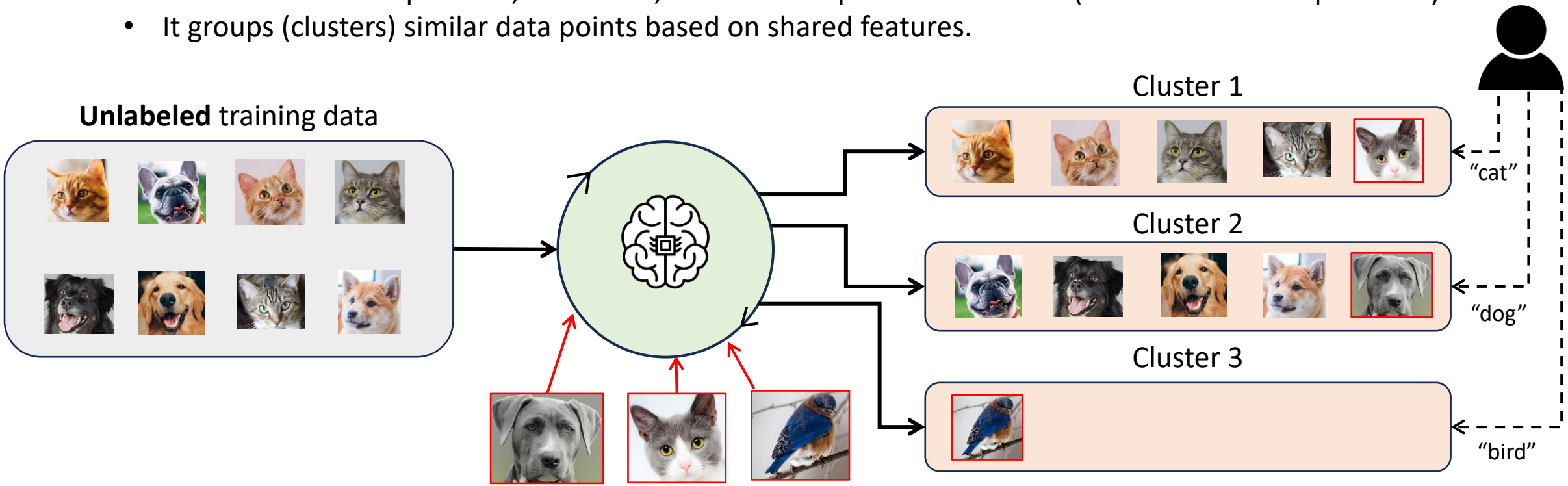
- **Supervised learning** trains the model on a labeled dataset.
  - Each input provided to the model for training has a corresponding label.
  - By examining these labeled examples, the model learns the relationship between the data and the given label.



- By training on labeled examples, the model learns to classify new, unseen data with high accuracy.
  - **Advantages**:
    - Highly accurate when labeled data is available.
    - Straightforward to understand and implement.
  - **Disadvantages**:
    - Requires large, labeled datasets, which can be expensive and time-consuming to create.
    - Output is limited to the labels in the training data.

Unsupervised learning

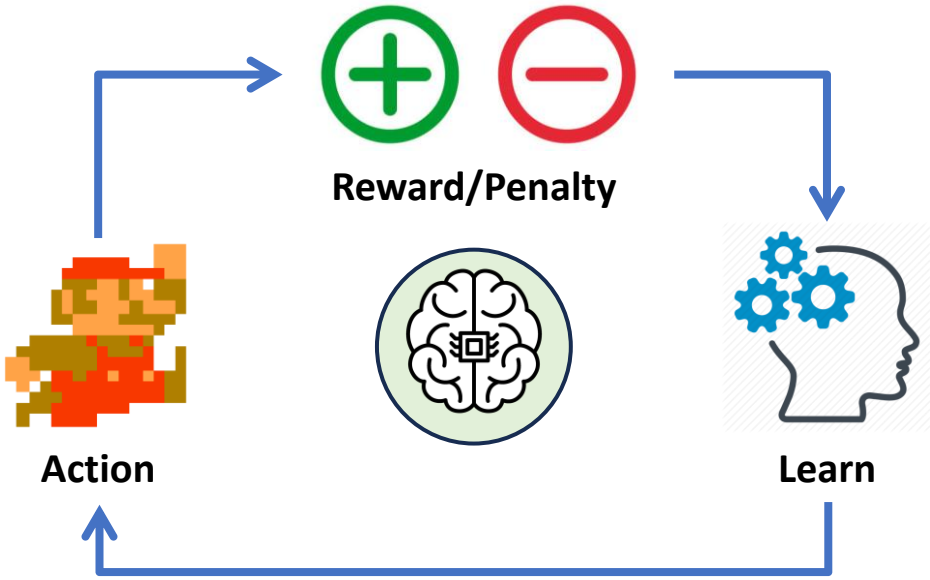
- **Unsupervised learning** trains the model on an unlabeled dataset.
  - No predefined labels are provided.
  - The model can discover patterns, structures, or relationships within the data (without human supervision).
    - It groups (clusters) similar data points based on shared features.



- **Advantages**:
  - No need for labeled data.
  - Reveals hidden patterns.
- **Disadvantages**:
  - Interpretation and labeling of the results is required.
  - Less accurate.

Reinforcement learning

- **Reinforcement learning** trains a model by rewarding or penalizing its actions in a given environment to maximize its performance over time.
  - The model learns to take actions that achieve the highest reward or best outcome.



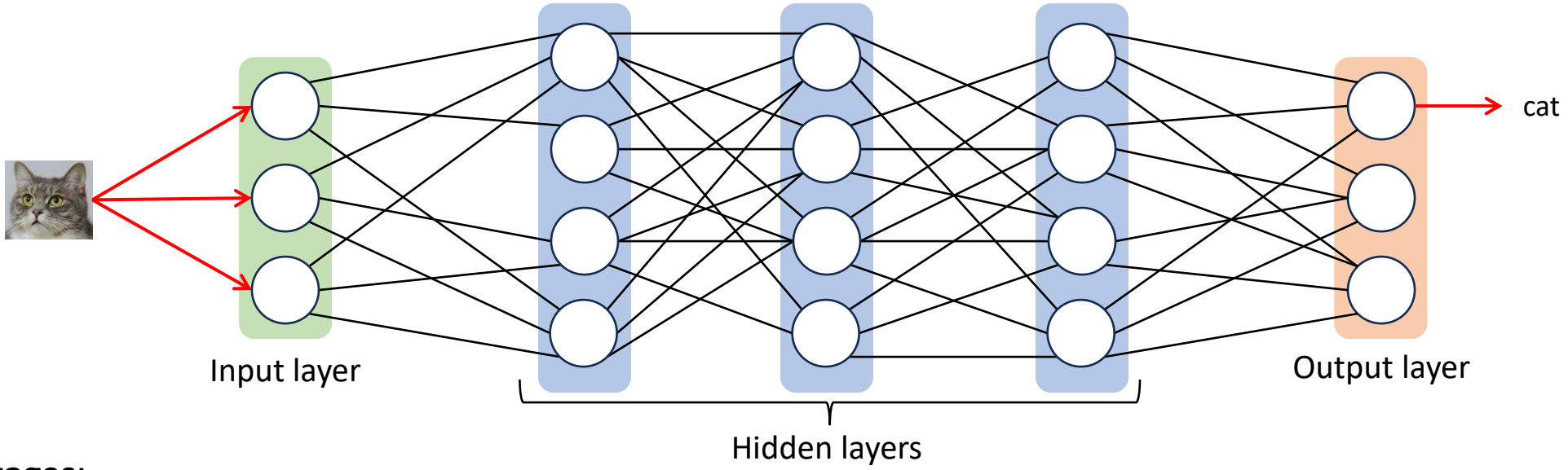
- **How it works**:
  - The model (called an agent) interacts with an environment.
  - It takes an action and receives feedback (reward or penalty).
  - Over time, it learns which actions lead to the best results.

- Applications include…
  - **Self-driving cars**: Learning how to navigate safely by trial and error.
  - **Game AI**: Mastering strategies in games like Chess, Go, or video games.
  - **Robotics**: Teaching robots how to walk, pick up objects, or perform tasks.

- **Advantages**:
  - Capable of learning complex behaviors.
  - Adapts to dynamic environments.
- **Disadvantages**:
  - Resource intensive.
  - Risk of suboptimal learning if the reward system isn't properly designed.

Deep Learning

- **Deep learning** uses artificial neural networks to process and learn from large and complex datasets.
  - An *artificial neural network* is a computational model inspired by how biological neural networks like the human brain process information.
  - Data is passed through multiple layers of nodes (neurons), with each layer extracting increasingly abstract features.
  - The neural network can be trained using supervised, unsupervised, and/or reinforcement methods.



- **Advantages**:
  - Deep learning excels at handling large, unstructured datasets like images, audio, and text.
  - Achieves state-of-the-art performance in tasks like image recognition, natural language processing (NLP), and autonomous driving.
- **Disadvantages**:
  - Resource intensive.
  - The model can be a “black box”, making it difficult to interpret how it arrives at its decisions.

Types of ML

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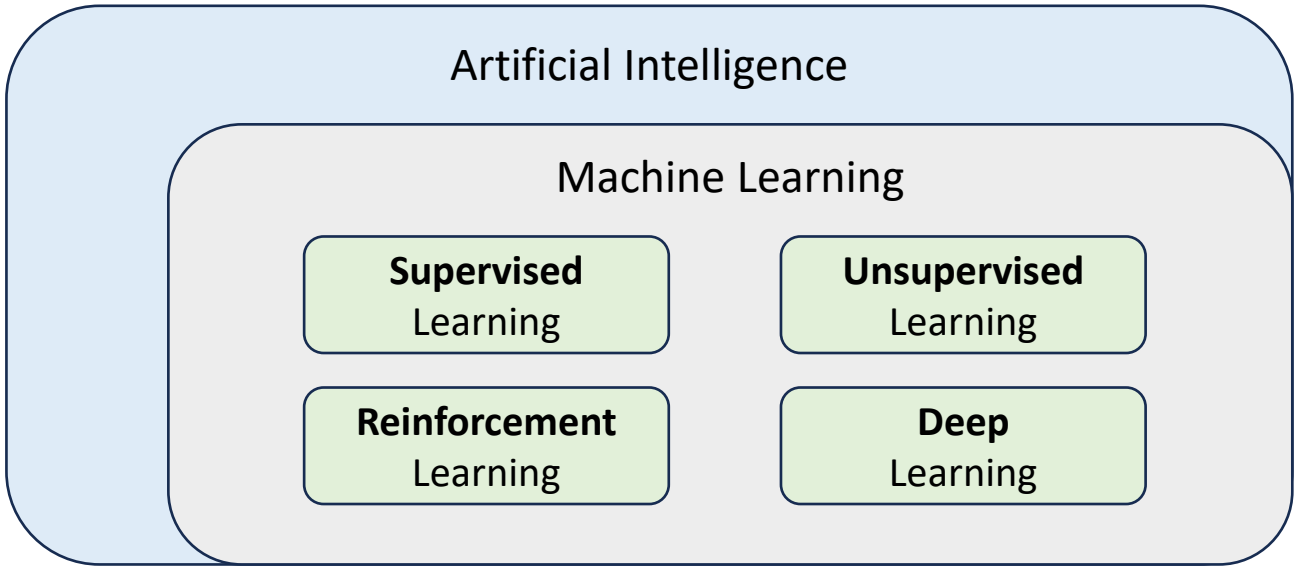
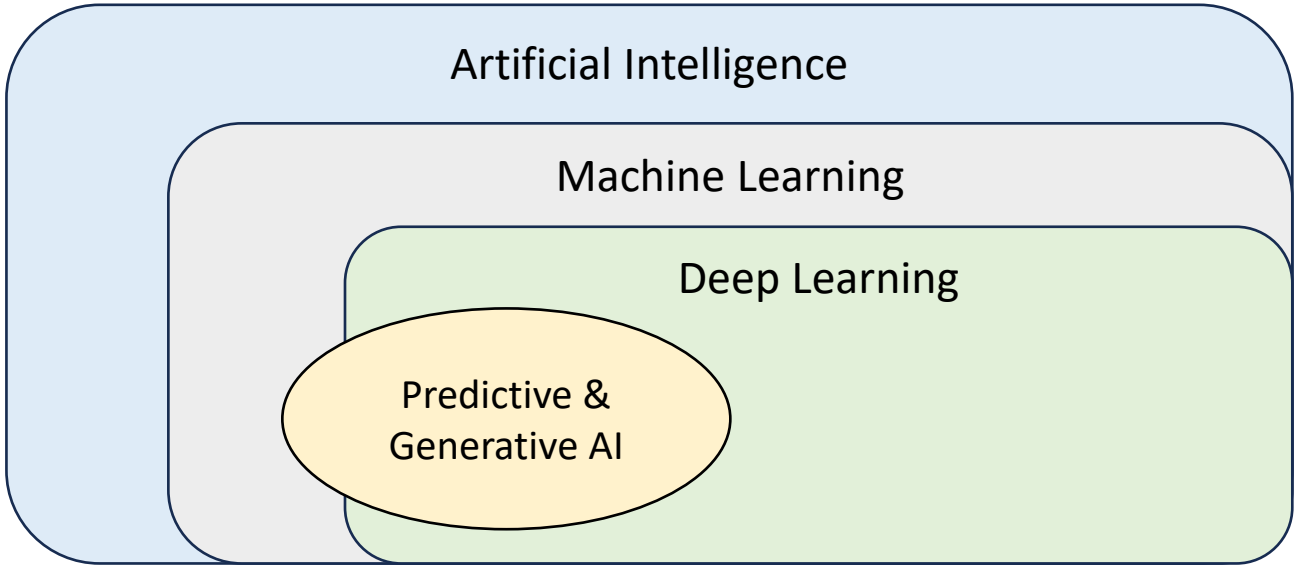


Predictive and Generative AI

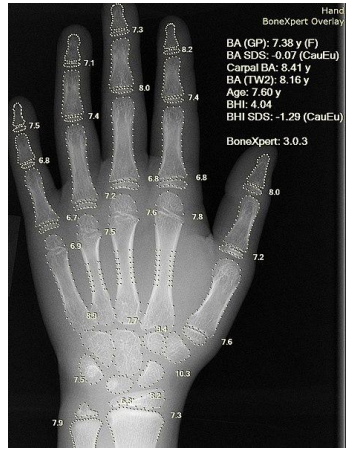
- **Predictive AI**
  - Uses machine learning to analyze historical data and predict future outcomes or trends.
    - Security anomaly detection, weather forecasting.

- **Generative AI**
  - Uses machine learning to learn patterns from existing data and create new content, such as text, images, or audio.
    - ChatGPT, Gemini, Midjourney, DALL-E, etc.

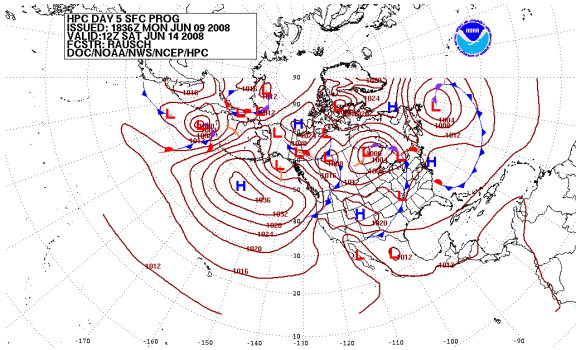


Predictive AI

- **Predictive AI** analyzes historical data to forecast future outcomes, trends, or events.
  - The model identifies patterns and correlations in past data.
  - The learned patterns are applied to make predictions.



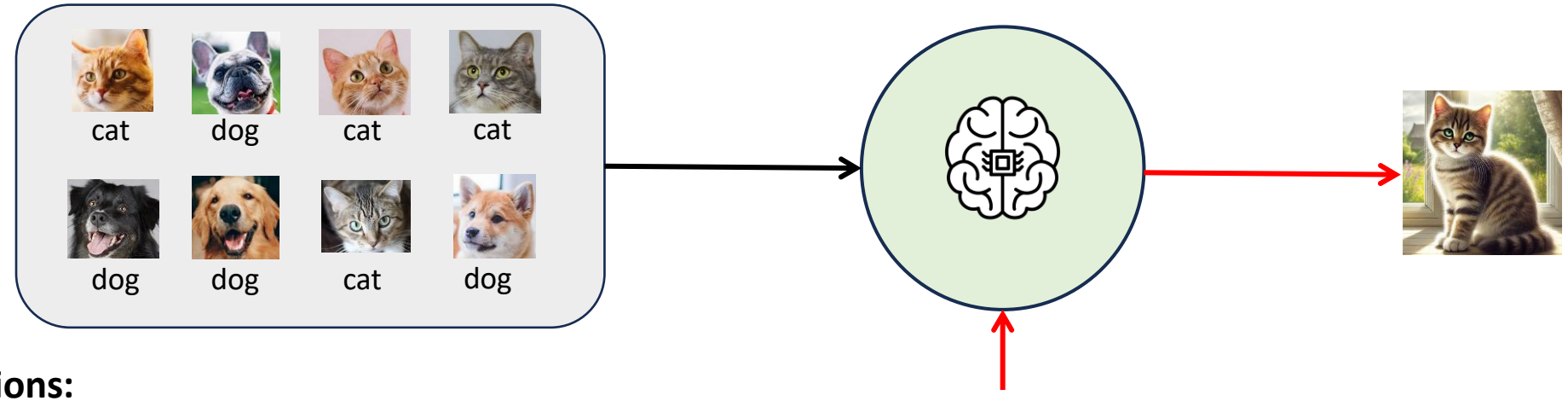
- **Applications**:
  - **Healthcare**: Predicting patient outcomes or disease progression.
  - **Network security**: Detecting anomalies that might indicate a potential threat or failure.
  - **Traffic management**: Predicting congestion based on historical and real-time traffic data.
  - **Business forecasting**: Predicting sales trends or customer behavior.
  - **Weather Forecasting**: Analyzing meteorological data to predict weather conditions.



- **Advantages**:
  - Improves decision-making by providing actionable insights.
  - Detects potential problems before they occur (e.g., network issues or severe weather)
- **Disadvantages**:
  - Requires high-quality, relevant historical data.
  - Accuracy depends on how well the patterns in past data generalize to new scenarios.

Generative AI

- **Generative AI** learns patterns from existing data and creates new content such as text, images, and audio.
  - It focuses on producing outputs that resemble the input that it was trained on.



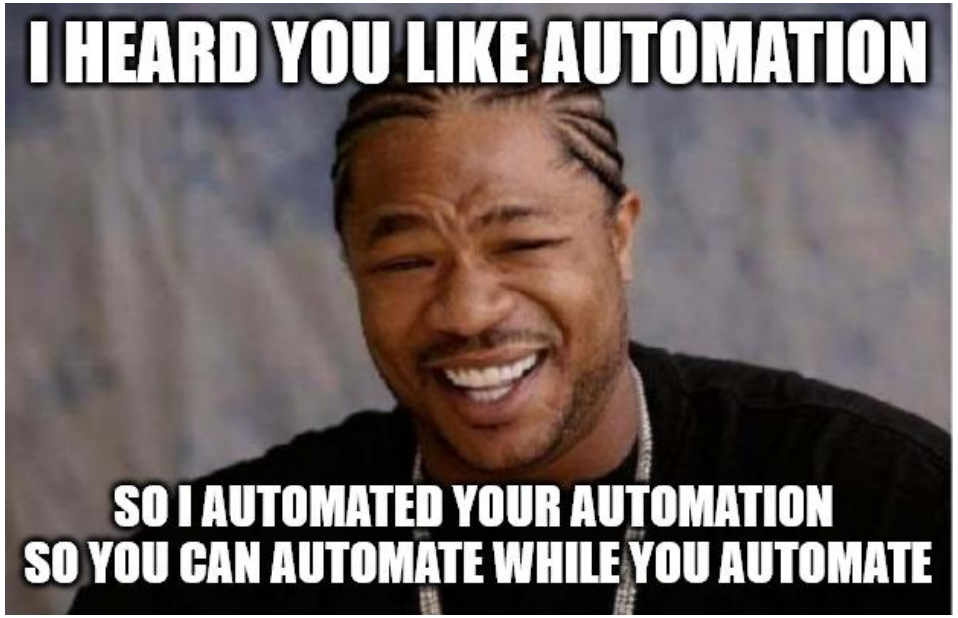
- **Applications:**
  - **Text generation**: ChatGPT, Gemini, Copilot
  - **Image generation**: Midjourney, DALL-E
  - **Video generation**: Sora (OpenAI), Veo 2 (Google)

- **Advantages**:
  - Great for creative tasks where human input is limited or time-consuming.
  - Enables automation of content creation across various fields.
- **Disadvantages**:
  - Risk of misuse (e.g., deepfakes, plagiarism).
  - Generated content is only as good as the quality of the training material.
  - Hallucinations

Predictive & Generative AI in networks

- **Predictive AI:**
  - **Traffic forecasting**: Predict network traffic patterns to optimize bandwidth allocation and prevent congestion.
  - **Security threat detection**: Identify anomalies or suspicious patterns in real-time to mitigate potential security threats.
  - **Predictive maintenance**: Anticipate hardware failures by analyzing historical and current performance data, reducing downtime.

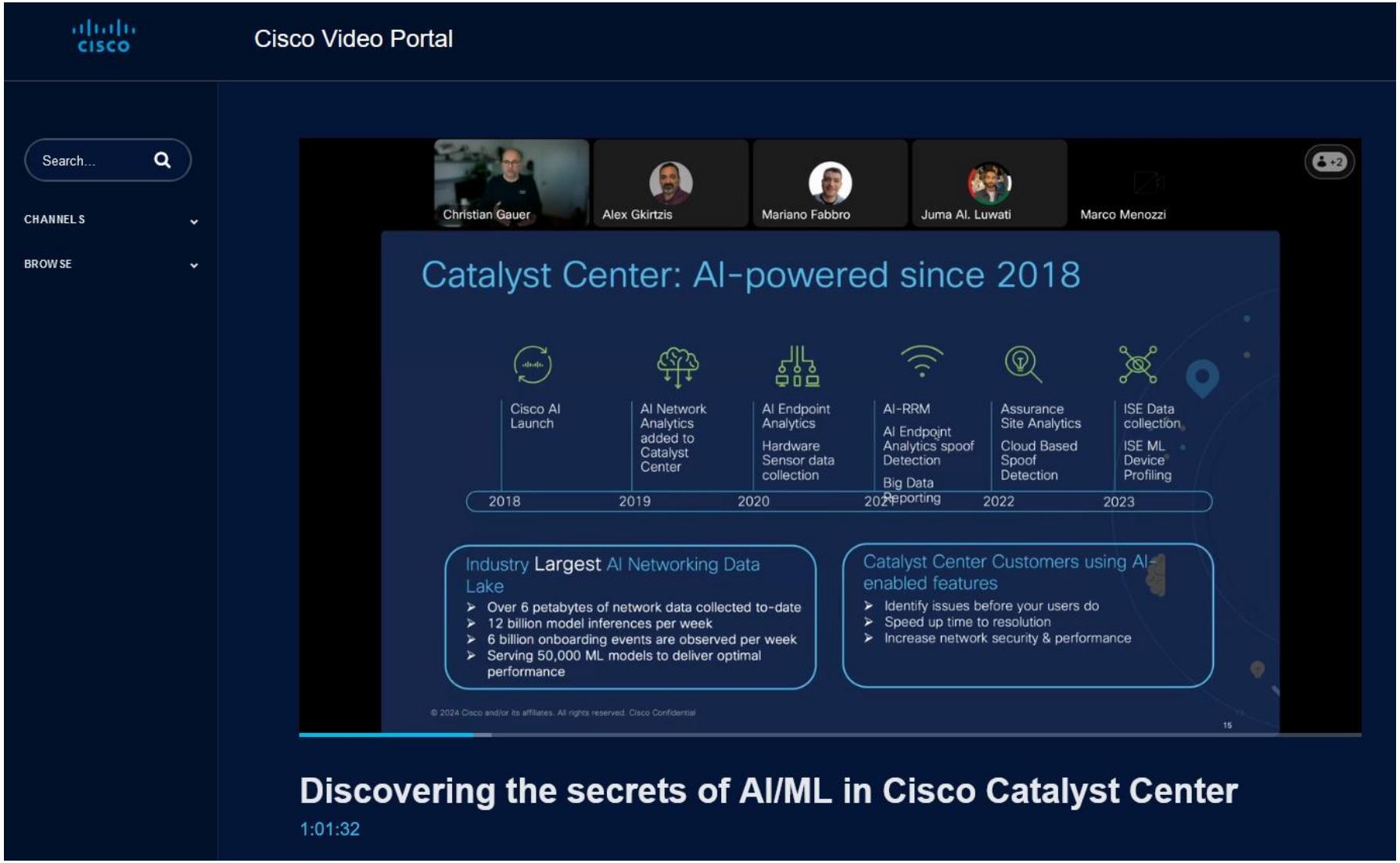
- **Generative AI:**
  - **Network documentation**: Generate documentation about network configurations, policies, etc.
  - **Configuration generation**: Automatically generate configurations for network devices based on desired policies and requirements.
  - **Network design**: Suggest optimized network layouts or modifications tailored to specific business needs and workloads.
  - **Troubleshooting**: Produce solutions or diagnostics based on log files or error messages to resolve issues efficiently.
  - **Script generation**: Automatically generate network automation scripts (e.g., Python scripts to configure network devices).



AI in Cisco Catalyst Center

- Cisco **Catalyst Center** (formerly DNA Center) features a variety of AI-enabled features to identify issues before they impact users, reduce the time required to resolve issues, and increase the performance and security of the network.

jitl.jp/cat-ai



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- Features include…
  - **AI Network Analytics**
    - Uses AI to establish the baseline behavior of the network.
    - Provides insights and recommendations for optimizing network performance.
    - Continuously monitors the network to predict and detect anomalies.

AI Network Analytics

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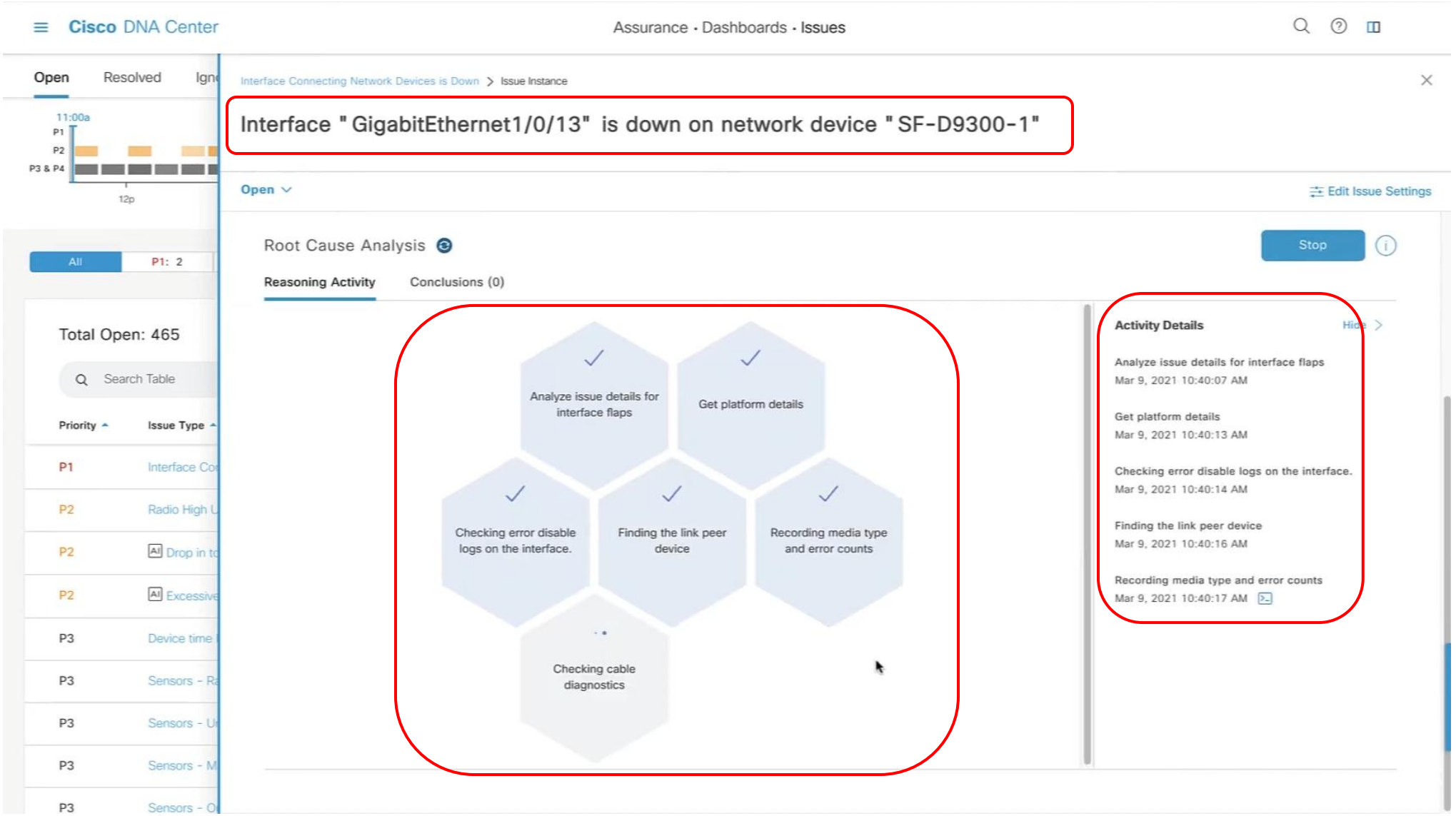
  - **Machine Reasoning Engine (MRE)**
    - Uses AI to perform root-cause analysis when network issues arise.
    - Suggests resolutions or takes automated corrective actions without requiring manual intervention.
    - Reduces downtime by identifying and resolving issues faster than traditional methods.

Machine Reasoning Engine



https://www.youtube.com/watch?v=qDb8NgEV6Mw

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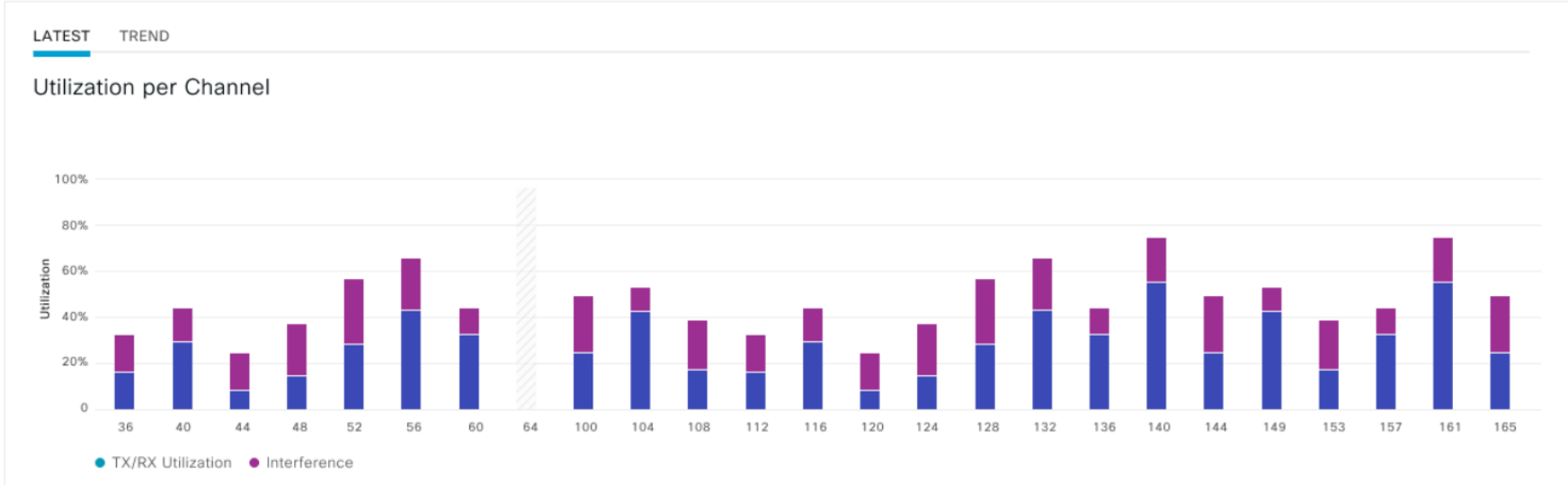
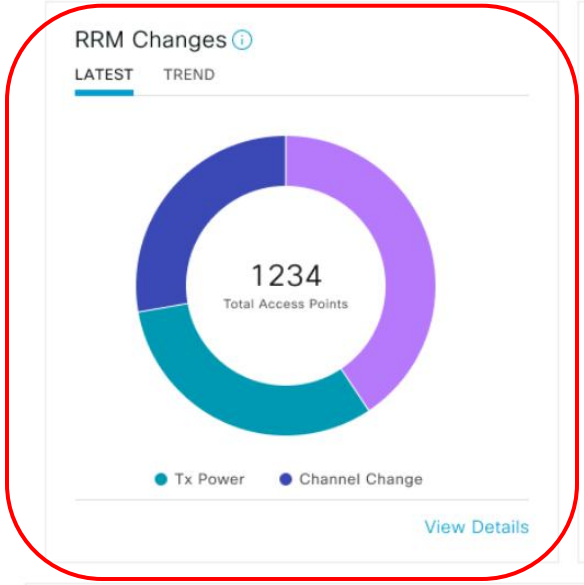
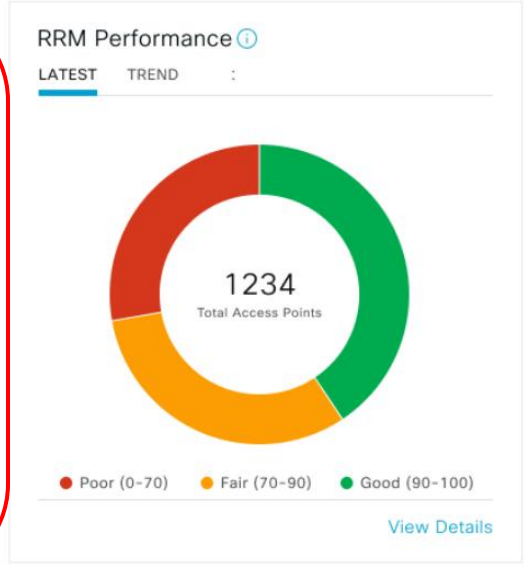
  - **AI Endpoint Analytics**
    - Identifies and classifies devices on the network, providing detailed visibility.
    - Detects unauthorized devices or unusual behavior.
    - Simplifies device onboarding by automating profiling and segmentation.

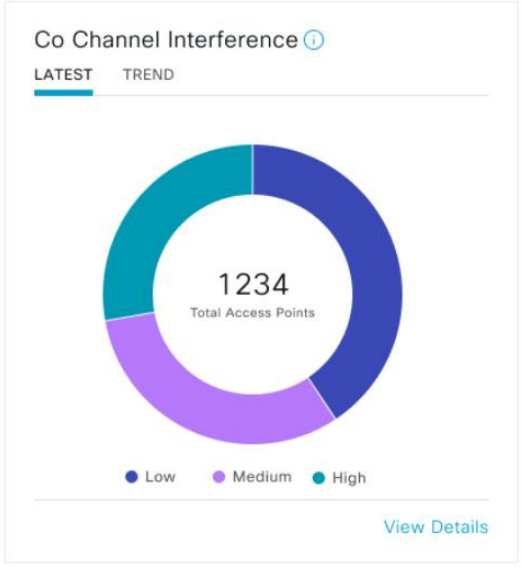
  - **AI-enhanced Radio Resource Management (RRM)**
    - Optimizes wireless network performance by dynamically adjusting radio settings.
    - Uses AI to balance load, reduce interference, and improve coverage across wireless access points.

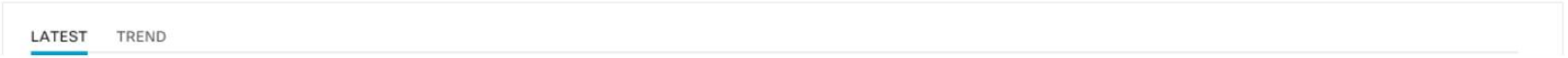
AI-Enhanced RRM











Summary

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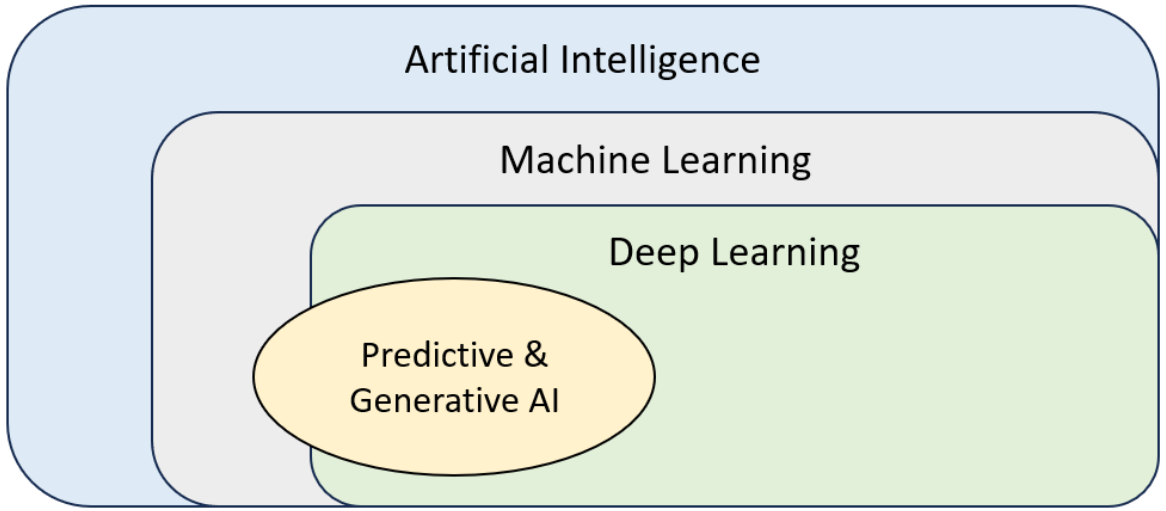
  - Network traffic forecasting, threat detection, predictive maintenance

- **Generative AI** uses machine learning to learn patterns from existing data and create new content, such as text and images.
  - Configuration generation, troubleshooting, script generation

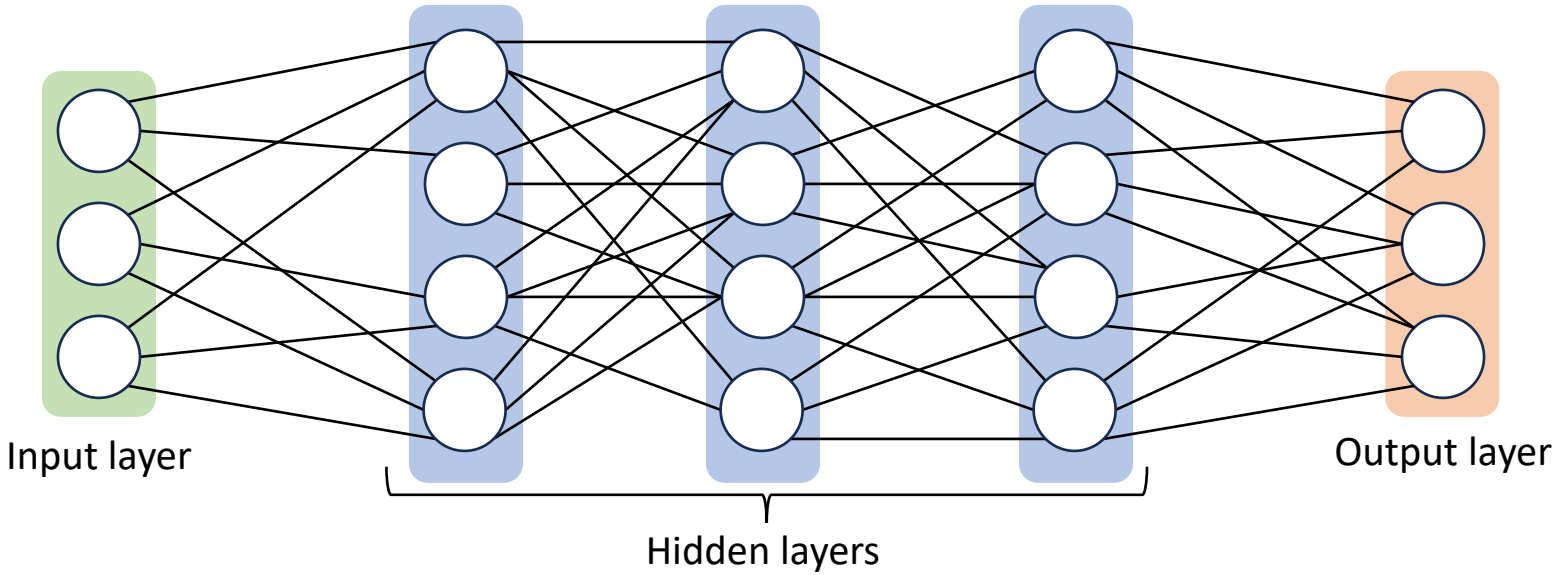
- Cisco **Catalyst Center** includes several AI-enabled features:
  - AI Network Analytics
  - Machine Reasoning Engine (MRE)
  - AI Endpoint Analytics
  - AI-enhanced Radio Resource Management (RRM)



Quiz 1

Which of the following types of ML imitates the human brain?

- A) Supervised learning
- B) Reinforcement learning
- C) Deep learning
- D) Unsupervised learning



Quiz 2

Which of the following Catalyst Center features leverages AI to perform a root-cause analysis of network issues and propose resolutions?

- A) AI Endpoint Analytics
- B) AI Remediation
- C) MRE
- D) AI-enhanced RRM

Quiz 3

Which of the following statements are true? (select three)

- A) Reinforcement learning uses a penalty/reward system.
- B) Supervised learning is effective at revealing hidden patterns in data.
- C) Predictive and generative AI require deep learning.
- D) Reinforcement learning works well for game AIs.
- E) Supervised and unsupervised learning cannot be used together.
- F) Unsupervised learning uses unlabeled datasets.