6. Emerging Trends



Fig 6.0: How the four trends connect

6.1 Edge Computing

> **Definition:** Edge computing processes data close to where it is generated (devices, gateways, local servers) instead of sending everything to a distant cloud.

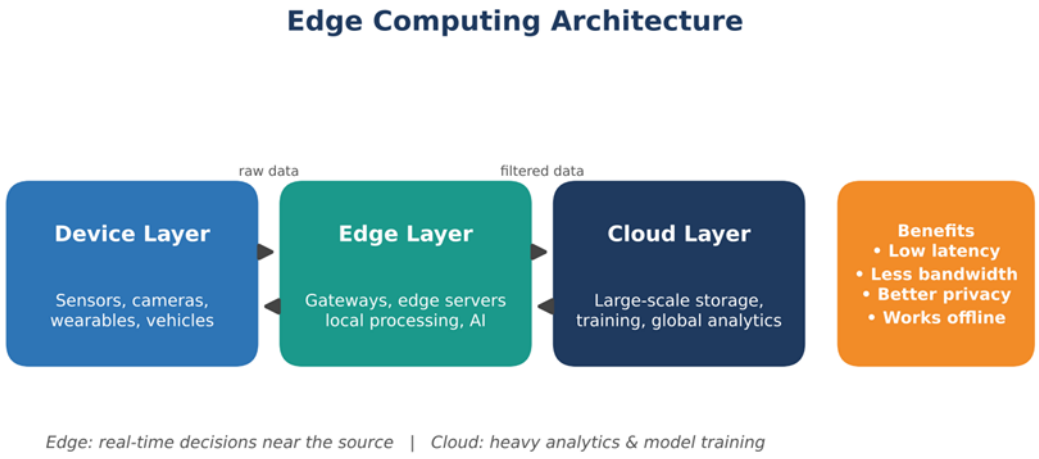


Fig 6.1: Edge computing architecture (Device, Edge, Cloud)

- **Key features:** low latency, reduced bandwidth, better privacy (data stays local), offline operation.
- **Applications:** autonomous vehicles, smart factories, healthcare wearables, video surveillance, smart retail.

- **Advantages:** speed, cost saving, resilience, data sovereignty.
- **Challenges:** limited compute and storage, device management at scale, security of distributed nodes.
- **Technologies:** AWS IoT Greengrass, Azure IoT Edge, NVIDIA Jetson, TinyML.

6.2 Cloud Analytics

> **Definition:** Performing data storage, processing, analysis and visualization on cloud platforms, delivered as an on-demand service.

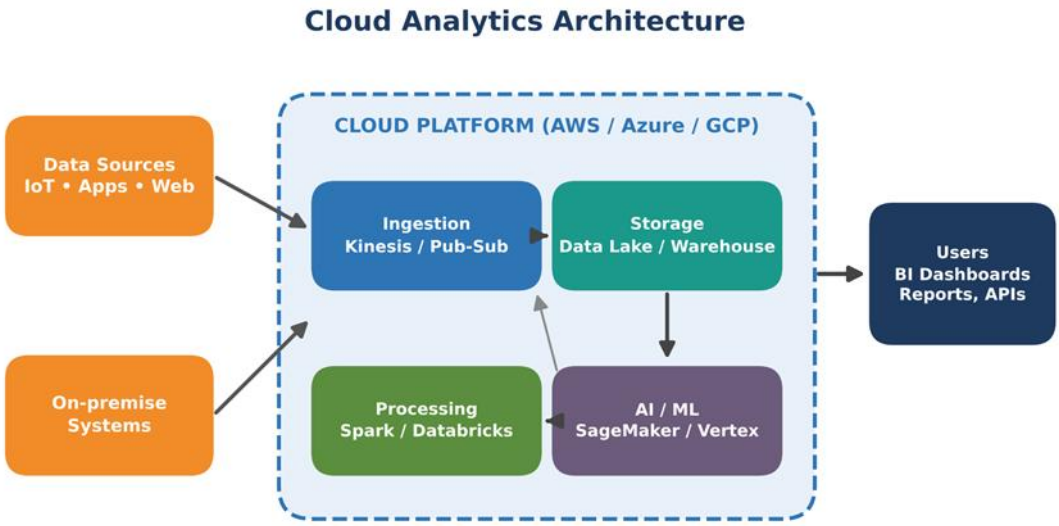


Fig 6.2: Cloud analytics architecture

- **Service models:** IaaS, PaaS, SaaS (Analytics-as-a-Service).
- **Deployment models:** public, private, hybrid, multi-cloud.
- **Platforms:** AWS (Redshift, SageMaker), Google Cloud (BigQuery, Vertex AI), Azure (Synapse, Azure ML), Snowflake, Databricks.
- **Benefits:** scalability and elasticity, pay-as-you-go cost, no infrastructure maintenance, global access, integrated AI/ML, backup and disaster recovery.

- **Challenges:** security and compliance, vendor lock-in, latency, data transfer costs.
- **Use cases:** BI dashboards, real-time analytics, large-scale ML training.

6.3 Generative AI for Data Interpretation

> **Definition:** Using generative models, mainly Large Language Models (LLMs), to explain, summarize and create insights from data.

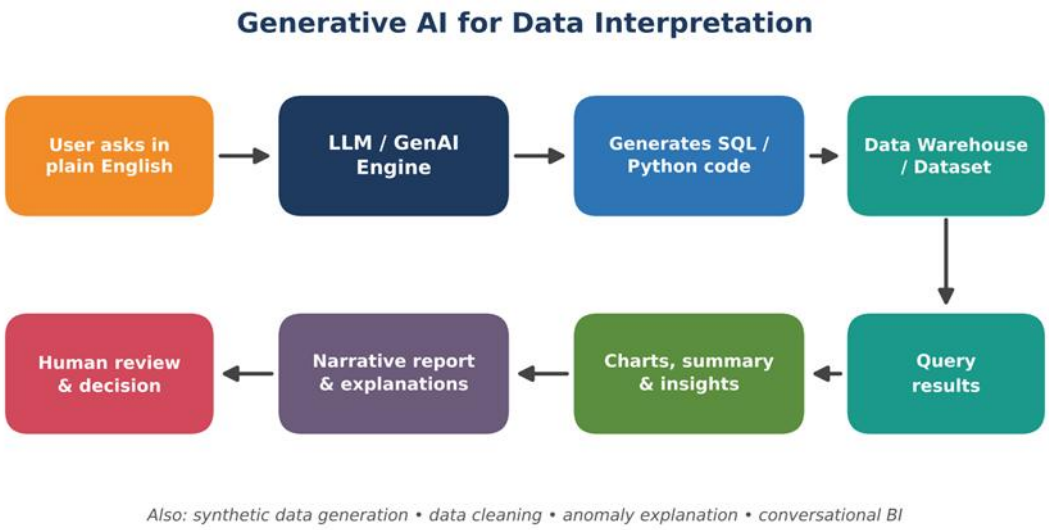


Fig 6.3: Generative AI workflow for data interpretation

- **Natural language querying:** ask in plain English and the system generates SQL or code (text-to-SQL).
- **Automated insight generation:** summarizes trends, anomalies and key drivers.
- **Report and narrative generation:** converts charts and tables into written explanations.
- **Synthetic data generation:** creates artificial data for training while protecting privacy (GANs, VAEs).
- **Code assistance:** generates Python/R analysis code and visualizations.
- **Conversational BI:** copilots in Power BI, Tableau and BigQuery.

- **Benefits:** democratizes analytics for non-technical users and speeds up decisions.
- **Risks:** hallucinations, bias, privacy leakage, low explainability; outputs need human validation.