

Artificial Intelligence Technical Standards

Standard 1.0 Introduction to Artificial Intelligence Fundamentals

- 1.1 Explain key terms and fundamental concepts related to AI and ML, including algorithms, data, training, and models.
- 1.2 Distinguish between Artificial Intelligence, Machine Learning, and Deep Learning through examples and simple analogies.
- 1.3 Trace key milestones in AI and ML development from Alan Turing's early theories and symbolic AI, through the rise of neural networks and the AI winters, to modern breakthroughs such as deep learning and generative AI.
- 1.4 Identify and classify different types of AI problems (tasks) such as regression, classification, clustering, and reinforcement learning using real-world case studies.
- 1.5 Identify real-world problems or challenges that can be addressed using AI and evaluate when AI is or isn't an appropriate solution.
- 1.6 Explore and evaluate new technologies in AI, such as generative AI, edge AI, and multimodal AI, emphasizing their current uses and future potential.
- 1.7 Describe the three primary domains of AI data and machine learning, computer vision, and natural language processing and their applications in daily life.

Standard 2.0 Responsible and Ethical AI

- 2.1 Define and explain the core principles of Responsible AI, including fairness, accountability, transparency, privacy, safety, and human-centeredness.
- 2.2 Identify and categorize AI risks such as bias, privacy violations, discrimination, misuse, adversarial attacks, and unintended consequences.
- 2.3 Apply best practices to ensure responsible AI development, including fairness testing, model cards, human-in-the-loop systems, and explainability methods.
- 2.4 Analyze case studies of ethical AI successes and failures to understand the social, economic, and cultural impact of AI decisions.
- 2.5 Evaluate and compare global frameworks for Responsible AI governance, including NIST AI Risk Management Framework, and IEEE Ethically Aligned Design, OECD AI Principles, and the EU AI Act.
- 2.6 Monitor deployed AI systems for ethical compliance, model drift, and real-world impact, and propose corrective actions to maintain fairness, safety, and accountability.

Standard 3.0 Hardware for Artificial Intelligence Systems

- 3.1 Explain how computing power affects the speed and capacity of AI models.
- 3.2 Describe the role of GPUs, NPUs, and accelerators using simple comparisons.
- 3.3 Compare running AI on a local computer and in the cloud and describe benefits and limitations.
- 3.4 Explain how sensors, cameras, microphones, and IoT devices collect data for AI systems.
- 3.5 Identify how hardware limits such as memory and storage affect classroom AI projects.
- 3.6 Explore examples of hardware used in robotics, autonomous vehicles, gaming, and mobile devices.

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Standard 4.0 Introduction to Data Science and Analysis Using Excel

- 4.1 Enter, format, and organize datasets in Excel or Google Sheets using tables, filters, and data validation to ensure accuracy and consistency.
- 4.2 Identify and correct common data issues such as missing values, duplicates, and inconsistent formats using spreadsheet tools such as Remove Duplicates, Find and Replace, IF, and ISBLANK.
- 4.3 Use formulas such as TEXT, VALUE, CONCAT, LEFT, and RIGHT, along with sorting and filtering tools, to manipulate or reshape data for analysis.
- 4.4 Explain responsible data practices including privacy, security, and ethical considerations when collecting, storing, or analyzing AI datasets.

Standard 5.0 Apply Mathematics and Statistics Fundamentals for AI/ML using Excel

- 5.1 Use spreadsheet formulas to represent features and samples related to how ML models view data.
- 5.2 Calculate descriptive statistics such as median, mode, range, variance, and standard deviation and explain what they show about a dataset.
- 5.3 Use covariance and correlation to discuss relationships between features.
- 5.4 Create visualizations of data distributions and explain what the patterns might indicate.
- 5.5 Apply probability concepts to real scenarios and evaluate likelihoods.
- 5.6 Identify data types and apply basic encoding and scaling in Excel.
- 5.7 Build and interpret visualizations to identify trends or outliers.

Standard 6.0 Programming Fundamentals for AI/ML with Python

- 6.1 Write Python programs using variables, operators, conditional statements, loops, functions, and data structures (lists, dictionaries, sets, tuples) to solve computational problems relevant to AI and data processing.
- 6.2 Use essential Python libraries, including NumPy for numerical operations, Pandas for data manipulation, and Matplotlib for data visualization, to compute statistics, analyze datasets, and create informative charts that support AI/ML workflows.
- 6.3 Prepare datasets for AI/ML by cleaning, transforming, and exploring data using Python, handling missing values, filtering and sorting records, creating summary statistics, and identifying patterns or anomalies through visual and numerical analysis.
- 6.4 Retrieve and integrate data into Python programs by importing CSV files and interacting with simple APIs, enabling them to work with real-world datasets commonly used in AI and data science applications.
- 6.5 Create, organize, and document AI/ML projects using Jupyter Notebook or Google Colab, applying Markdown cells, code cells, and environment tools to support analysis, experimentation, and reproducibility.
- 6.6 Describe the purpose, capabilities, and real-world applications of major AI/ML libraries, including TensorFlow, PyTorch, scikit-learn, OpenCV, MediaPipe, and Transformers and explain when each library is used in industry (vision, NLP, deep learning, model training, inference).

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6.7 Explain and apply foundational OOP concepts such as classes, objects, attributes, and methods to understand how AI/ML models, datasets, and pipeline components are structured in Python libraries (e.g., scikit-learn's model objects).

6.8 Identify and fix common programming errors using debugging strategies including print-based tracing, reading error messages, using try/except blocks, and refactoring code for clarity and reliability.

6.9 Apply version control commands (commit, push, pull) to track code changes, maintain project history, and publish AI/ML projects to GitHub for documentation, collaboration, and portfolio development.

6.10 Document Python programs using comments, docstrings, and Markdown explanations to clearly communicate code functionality, data transformations, visualizations, and AI/ML workflows for reproducibility and explainability.

Standard 7.0 Introduction to Machine Learning Models

7.1 Identify supervised, unsupervised, and reinforcement learning paradigms and match ML workloads to real-world scenarios.

7.2 Prepare datasets for modeling by identifying features and labels, handling missing data, splitting datasets, and applying basic transformations.

7.3 Build introductory regression, classification, and clustering models using Python libraries to generate predictions.

7.4 Evaluate model performance using accuracy, precision, recall, F1-score, confusion matrices, and basic regression error metrics.

7.5 Analyze limitations and responsible AI considerations in machine learning, including fairness, bias, transparency, and conceptual understanding of overfitting and underfitting.

STANDARD 8.0 Deep Learning Fundamentals Using Pretrained Models

8.1 Describe neural networks, layers, activations, and how data flows through a network.

8.2 Explain how GPUs accelerate deep learning and why optimization matters (conceptual)

8.3 Explore tensors using NumPy/PyTorch/TensorFlow without complex math.

8.4 Apply pre-trained deep learning models for image, text, or audio tasks.

8.5 Use beginner-friendly CNN demos (no training from scratch required).

8.6 Identify when deep learning is appropriate for solving real-world problems.

8.7 Plan, build, document, and present a deep learning project using pre-trained models.

STANDARD 9.0 Computer Vision Fundamentals

9.1 Explain how images and videos are converted into numerical data (pixels, channels, resolution, frames).

9.2 Identify and compare computer vision tasks (classification, detection, segmentation, tracking, OCR).

9.3 Apply practical image processing techniques using Python/OpenCV (resizing, filtering, color conversion, thresholding, edge detection).

9.4 Use pre-trained CV models (Azure Vision, OpenCV, MediaPipe) to detect, classify, and analyze objects or text.

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- 9.5 Design real-world CV projects (accessibility, safety, automation).
- 9.6 Interpret CV model outputs (labels, bounding boxes, confidence scores).
- 9.7 Analyze ethical and social implications (bias, surveillance, privacy)
- 9.8 Compare cloud CV (Azure Vision) with local CV (OpenCV) in terms of cost, speed, privacy, and scalability.

STANDARD 10.0 Natural Language Processing (NLP)

- 10.1 Describe how machines process and represent human language.
- 10.2 Perform text preprocessing (tokenization, stopwords, stemming, lemmatization).
- 10.3 Represent text using Bag-of-Words and TF-IDF (concept + library functions).
- 10.4 Apply NLP libraries (spaCy, NLTK, HuggingFace) to perform sentiment analysis, NER, summarization, and translation.
- 10.5 Build simple NLP applications (chatbots, document classifiers).
- 10.6 Evaluate NLP models using accuracy, precision, recall, confusion matrices.
- 10.7 Explain ethical considerations in NLP (bias, toxicity, fairness, privacy).
- 10.8 Explore generative NLP (GPT, Claude, Gemini) and Retrieval-Augmented Generation (RAG).

STANDARD 11.0 Generative & Agentic AI Systems

- 11.1 Explain prompts, tokens, latent space (conceptual), and how generative models create text, images, and audio.
- 11.2 Compare discriminative and generative models and identify major generative model types (transformers, diffusion models, GANs).
- 11.3 Apply structured prompting techniques (examples, constraints, roles, tone, temperature).
- 11.4 Use Azure AI Studio, ChatGPT Playground, RunwayML, and HuggingFace Spaces to generate and modify text, images, audio, or video.
- 11.5 Evaluate generated content for bias, accuracy, originality, and quality.
- 11.6 Describe what agentic AI is and how agents use planning, memory, and tool-use to complete multi-step tasks.
- 11.7 Build simple agentic workflows using Azure AI Agents, ChatGPT Agents, or LangGraph Lite.
- 11.8 Configure tools for agents (search, file reader, calculator, OCR, image analyzer).
- 11.9 Build retrieval-augmented agents using PDFs, classroom notes, or structured datasets.
- 11.10 Analyze safety concerns in agentic AI (runaway loops, misinformation, unsafe actions) and apply human-in-loop guardrails.

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Standard 12.0 Building and Deploying AI Applications

- 12.1 Develop interactive AI-enabled applications (chatbots, recommenders, vision tools).
- 12.2 Integrate pre-trained models into simple web or mobile interfaces.
- 12.3 Explain deployment, testing, and basic monitoring **conceptually** (no MLOps math).
- 12.4 Apply usability and accessibility principles during application design.
- 12.5 Use CV and NLP preprocessing techniques in final projects.
- 12.6 Translate client requests into clear AI project requirements and deliverables.

STANDARD 13.0 Professionalism, Career Readiness, & CTSO 13.1 Communicate AI/ML project results clearly to technical and non-technical audiences.

- 13.2 Demonstrate professionalism through responsibility, punctuality, teamwork, and adaptability.
- 13.3 Explore and compare AI career pathways (Data Analyst, ML Engineer, AI Product Manager, Prompt Engineer, AI Tester, Ethics roles).
- 13.4 Prepare for CTSO competitions aligned with AI/ML skills (FBLA Data Analysis, FBLA Coding, etc).
- 13.5 Create resumes, portfolios, GitHub repositories, and LinkedIn profiles showcasing AI projects.
- 13.6 Participate in mock interviews, industry speaker events, and project showcases.
- 13.7 Apply workplace ethics and Responsible AI principles throughout all projects.

Standard 14.0 Testing, Debugging, and the AI Project Lifecycle

- 14.1 Identify, explain, and correct common coding and data errors in Python, Excel, and beginner ML tools (Teachable Machine, Azure ML Studio).
- 14.2 Evaluate simple models using accuracy, confusion matrices (beginner), and fairness testing using clean vs biased datasets.
- 14.3 Describe the AI project cycle: define the problem, collect simple data, clean data, train a beginner ML model, test accuracy, and present results
- 14.4 Documentation for AI Projects: problem statement, dataset description, model summary, and results and reflections
- 14.5 Apply testing concepts such as unit testing, integration testing, and troubleshooting ML pipelines in Python notebooks.
- 14.6 Test models using multiple datasets, validating accuracy, precision, recall, and fairness.
- 14.7 Explain the idea of automating model retraining, testing, and deployment pipelines used by companies (no implementation required).

Standard 15.0 Business and Industry Applications for AI

- 15.1 Analyze case studies showing how AI solves real problems in banking, healthcare, retail, cybersecurity, and transportation.
- 15.2 Evaluate how laws, ethics, safety, and fairness affect AI use in business.

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15.3 Explore monetization strategies such as APIs, SaaS platforms, and model-as-a-service offerings

15.4 Define, collect, and track business impact metrics such as efficiency gains, customer satisfaction, or revenue growth.

15.5 Present project findings and recommendations clearly to business stakeholders through reports and presentations.

15.6 Evaluate ethical, legal, and regulatory considerations that affect how AI is deployed across industries.