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Artificial Intelligence Course Syllabi

If students Complete Artificial Intelligence Systems and Automation (72 hours) and Agentic Artificial Intelligence (72 hours) certificates they will be awarded a Fundamentals of Artificial Intelligence certificate (144 hours)

Certificate Name: Artificial Intelligence Systems and Automation

AI-1: *Foundations of Artificial Intelligence & Prompt Engineering* (24 Hours, 4 weeks)

Course Description

This course provides the foundation for working effectively with modern AI systems, specifically Large Language Models (LLMs). Students will learn how LLMs process inputs (embeddings, tokens, and context windows), how to structure clear and reliable prompts, and common failure modes (hallucinations, grounding, safety). By completing this course, students will be able to identify good AI use cases, apply appropriate patterns, and produce consistent and safe outputs from within a chat interface. AI-1 prepares learners for AI-1, where they will begin leveraging these concepts within pipelines.

Prerequisites

None

Student Learning Outcomes

Students will:

- Explain how AI/LLMs process information (tokens, context, embeddings)
- Construct structured, reliable prompts
- Produce consistent and structured output (no code)
- Evaluate whether a problem is a good target for AI/LLMs
- Apply basic safety and ethical AI practices

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Class Schedule (4 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 – Introduction to AI & LLMs

- LLM Overview - tokens, context windows
- Prompt components

Session 1.2 – Structured Output and Reliability

- Pattern-based prompting, Few-shot prompting
- Frameworks and output control

Week 2

Session 2.1 – Personas and Guardrails

- Personas and bias
- Guardrails and constraints (sources, refusals)

Session 2.2 – Iteration and Evaluation

- Iterative refinement and test sets
- Failure modes

Week 3

Session 3.1 – Grounding and Context Injection

- Grounding with sources and citation
- Manual Retrieval

Session 3.2 – Safety, Risk, and Target Evaluation

- Problem Evaluation - use case screening rubric
- PII and LLMs

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Week 4

Session 4.1 – Applied Prompt Workshop

- Turning a real world task into an assisted workflow
- Packaging templates

Session 4.2 – Module Test

- Practical prompt exam
- Problem evaluation exam

Grading

Lab 1	15%
Lab 2 - RAG Pipeline Evaluation - Naive vs Aware	15%
Final Project	15%
Written Exam	45%
Participation	10%
Pass	70 or above

AI-2 SYLLABUS - AI Backend Engineering (24 Hours, 4 Weeks)

Course Description

AI-2 focuses on building AI assisted pipelines in Python. We will extract structure from unstructured inputs, explore embeddings, ingest and leverage vector databases, and use retrieval augmented generation (RAG) patterns to improve model output. Students will build a CLI tool that answers questions with sources and provides basic observability and retrieval metrics.

Prerequisites

Completion of Data Engineering and Python Courses (or test-out)

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Learning Objectives

Students will:

- Build extraction pipelines with schema validation
- Understand and explain embedding tradeoffs
- Implement chunking, ingestion, and structured metadata for vector retrieval pipelines
- Build and evaluate RAG pipelines (naive vs metadata)
- Add basic pipeline observability

Class Schedule (4 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 - LLMs API Integration

- Authorization, secrets, course setup
- Connect and interact with LLMs via API

Session 1.2 - Batch Processing and Extraction

- Batch processing patterns
- Structured output and validation

Week 2

Session 2.1 - Embeddings, Choosing the correct model

- Embedding dimensions and considerations
- Measuring embeddings performance on retrieval

Session 2.2 - Chunking and Vector Ingestion

- Chunking Strategy (seams, overlap, semantic vs fixed)
- Vector Store Ingestion

Week 3

Session 3.1 - Naive RAG

- Retrieval Augmentation Generation mechanics
- Semantic similarity - pitfalls and considerations

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Session 3.2 - Metadata-Aware RAG

- Filtered retrieval patterns
- Naive vs Aware Evaluation

Week 4

Session 4.1 - Observability and Debugging

- Logging: Sources, scores, timing
- Diagnosing retrieval and relevancy scoring

Session 4.2 - Module Test

- CLI Demo
- Written Evaluation

Grading

Lab 1	15%
Lab 2 - RAG Pipeline Evaluation - Naive vs Aware	15%
Final Project	15%
Written Exam	45%
Participation	10%
Pass	70 or above

AI-3: Full Stack AI Engineering (24 Hours / 4 Weeks)

Course Description

AI-3 is a continuation of the material learned in AI-2. This course will turn the AI-2 pipeline into a user-facing application. Students will build a Streamlit (or similar) application with stateful chat, source visibility, response feedback capture, apply basic defenses for safety and security, and deploy this application for others to use.

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Prerequisites

AI-2

Learning Objectives

Students will:

- Build a stateful chat UI with dynamic context management
- Integrate a backend retrieval pipeline
- Implement feedback collection (Human in the Loop)
- Defend against common prompt injection patterns
- Build an evaluation framework for reliability and regression testing

Class Schedule (12 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 - Streamlit App Foundation

- Introduction to Streamlit and Frontend frameworks
- State management

Session 1.2 – Backend Integration

- Integrate a RAG pipeline into the UI
- Handling latency (streaming vs loading)

Week 2

Session 2.1 – Context Windows and Chat History

- Managing token and dynamic context windows
- Message history, output consistency

Session 2.2 - Feedback Loops and Logging

- Capturing user feedback within the UI
- Logging and observability fundamentals

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Week 3

Session 3.1 - Prompt Injection and Defensive Design

- Explore prompt injection and failure modes
- Defensive strategies and grounding with source material

Session 3.2 - Eval-Driven Development

- Developing a “golden” data set
- Using evaluation to guide application improvements

Week 4

Session 4.1 - Deployment Readiness

- Explore deployment avenues (Docker, CloudRun)
- Configuration and Reliability checklist

Session 4.2 - Final

- Product Demonstrations
- Written Exam

Grading

Lab 1 - Streamlit Chat Application	15%
Lab 2 - Evaluation Demonstration (Golden Set)	15%
Final Project - End-to-end demonstration	15%
Final Exam	45%
Participation	10%
Pass	70 or above

Student Records (Rule 41)

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Certificate Name: Agentic Artificial Intelligence Engineer

Agentic Artificial Intelligence AG-1: *Tool-Augmented AI* (24 Hours / 4 Weeks)

Course Description

This course teaches students to extend LLMs with tools, process documents, and produce reliable structured outputs while building testable, and safe pipelines. Students will build a system for processing documents that extracts structured data from messy inputs, applies business rules, and produces consistent artifacts. AG-1 establishes the foundation for AI Systems Engineering.

Prerequisites

Completion of Certificate 1 (AI Foundations & Prompt Engineering)

Python Competency Assessment

Student Learning Outcomes

Students will:

- Implement tool calling using an LLM API
- Build structured outputs using Pydantic schemas
- Process documents using multimodal inputs (e.g., vision)
- Create contract tests (golden input → expected output)
- Defend against tool-based prompt injection attacks

Class Schedule (4 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 – Environment Setup & Tool Calling Foundations

- Development environment setup
- Tool calling via API
- First tool implementations

Session 1.2 – Structured Outputs & Contract Testing

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- Why structured outputs matter
- Pydantic schema definition
- Contract tests: golden input : expected output pairs

Week 2

Session 2.1 – Document Processing & Extraction

- Document types and processing strategies
- Multimodal processing (e.g., vision)
- Extraction design patterns

Session 2.2 – Basic Processing Pipeline

- Complete extraction pipeline
- Schema implementation
- Contract test creation

Week 3

Session 3.1 – Batch Processing, Classification & Tool Safety

- Batch processing patterns
- Classification/categorization approaches
- Tool safety: argument allowlists, injection defense, output sanitization

Session 3.2 – Business Rules, Error Handling & Reliability

- Business rule implementation
- Error handling with safe retries
- State persistence and reliability

Week 4

Session 4.1 – Complete Processing System

- Full pipeline integration
- Adversarial input handling
- Report or summary generation

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Session 4.2 – Final Exam

- Practical assessment: pipeline + tests + safety controls
- Written evaluation: concepts, scenarios, tool safety

Grading

Lab 1	15%
Lab 2	15%
Final Project	15%
Written Evaluation	45%
Participation	10%
Pass	70 or above

AG-2: Routing, Evaluation, and System Budgets (24 Hours / 4 Weeks)

Course Description

AG-2 teaches students to engineer cost-effective AI systems through model selection, evaluation, and intelligent routing. Students will build a routing pipeline that classifies inputs, routes to appropriate handlers, tracks cost/latency, and makes budget-aware decisions.

Prerequisites

AG-1

Student Learning Outcomes

Students will:

- Compare model types and choose appropriate tools for a task (LLMs vs specialized models)
- Use external inference APIs for classification-style workloads
- Build evaluation frameworks (quality, latency, and cost metrics)
- Implement routing based on type, confidence, and system budgets
- Design and enforce cost/latency budgets with decision logs

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- Make explicit tradeoffs across the cost/quality/latency triangle

Class Schedule (4 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 – The Model Landscape & Selection

- Model types: encoder vs decoder, vision, audio, multimodal
 - BERT, LayoutLM, Whisper, etc
- When LLMs are not the right tool

Session 1.2 – Using Pre-trained Models via API

- Inference API patterns (classification and extraction-adjacent tasks)
- API-based models vs LLM comparison
- Latency/cost tradeoffs

Week 2

Session 2.1 – Model Evaluation & Comparison

- Quality metrics: accuracy, precision, recall, F1 (as applicable)
- Operational metrics: latency (p50, p95), cost per call
- Evaluation harness design and replay fixtures

Session 2.2 – Multi-Model Comparison

- Evaluation harness implementation
- Comparative results: LLM vs specialized model vs hybrid
- Recommendation report with data justification

Week 3

Session 3.1 – Intelligent Routing Patterns

- Triage pattern: classify then route
- Confidence-based routing
- Fallback chains and escalation paths

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Session 3.2 – Budgets & Decision Logging

- The optimization triangle (cost/quality/latency)
- Cost tracking implementation
- Budget enforcement strategies and audit logs

Week 4

Session 4.1 – Intelligent Routing Pipeline

- Router implementation (type + confidence)
- Budget enforcement logic
- Analytics and decision logging

Session 4.2 – Final Exam

- Practical assessment: routing + budgets + logs
- Written evaluation: model selection, routing design, evaluation concepts

Grading

Lab 1 - Model Comparison	15%
Lab 2 - Intelligent Routing	15%
Final Project	15%
Written Evaluation	45%
Participation	10%
Pass	70 or above

AG-3: Orchestration & Agentic Systems (24 Hours / 4 Weeks)

Course Description

AG-3 teaches agentic patterns with context management as the core skill. Students learn that agents are not personas—they are context boundaries that make decisions. This course context

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boundaries and agent orchestration. Students will leverage modules build in AG-1 and AG-2 to complete a design of a multi-agent system (Orchestrator → Researcher → Validator).

Prerequisites

AG-2

Student Learning Outcomes

Students will:

- Distinguish agents (context managers) from tools (business logic pipelines)
- Build an Orchestrator that holds state and enforces budgets
- Integrate a Researcher agent that distills messy data into structured briefs
- Implement a Validator agent for blind verification
- Prove context isolation through logs and token/call ledgers
- Identify problems suitable for agentic solutions using a screening rubric

Class Schedule (4 Weeks, 2 Sessions/Week)

Week 1

Session 1.1 – The Agentic Mindset

- What makes a system “agentic” (context managers, not personas)
- Agents vs tools/pipelines distinction
- Orchestrator pattern introduction

Session 1.2 – The Researcher Agent (Context Distillation)

- ResearchBrief contract (nugget, confidence, evidence_pack, token_ledger)
- RAG vs Research: single query vs iterative investigation
- Orchestrator -> Researcher integration

Week 2

Session 2.1 – The Validator Agent & Error Recovery

- Blind verification: what the Validator sees vs does not see

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- Rejection loops and retry budgets
- Human escalation as the final layer

Session 2.2 – Multi-Agent Integration

- Wire Orchestrator -> Researcher -> Processor -> Validator
- Context injection pattern implementation
- Budget compliance demonstration via logs

Week 3

Session 3.1 – Full System Integration

- All components integrated (agents and processor pipeline)
- Router and budget tracker integration

Session 3.2 – Problem Identification Workshop

- What makes a problem “agentic-appropriate”
- “The Context Trap” screening rubric
- ResearchBrief schema design for new domains

Week 4

Session 4.1 – Capstone Design Development

- Problem selection and architecture design
- Context & budget plan documentation
- Risk pack and evaluation plan

Session 4.2 – Final Exam

- Written evaluation: agentic concepts, architecture design, context budgets
- Design Review

Grading

Lab 1 - Multi Agent Integration	15%
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Lab 2 - Problem Identification	15%
Final Project	15%
Written Evaluation	45%
Participation	10%
Pass	70 or above

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