

PART 2: DATA STRUCTURES & TECHNICAL IMPLEMENTATION

COMPLETE DATA STRUCTURE

Definitions (continued)

javascript

```
const definitions = [  
  // ... (previous definitions)  
  {  
    term: "Vector Database",  
    definition: "A database optimized for storing and retrieving vector embeddings for semantic search (e.g., Pinecone, Weaviate)",  
    category: "tech-stack"  
  },  
  {  
    term: "Embedding Model",  
    definition: "Converts text/images into numerical vectors (embeddings) for semantic similarity (e.g., OpenAI, Voyage AI, Cohere)",  
    category: "tech-stack"  
  },  
  {  
    term: "Tool Use / Function Calling",  
    definition: "Agent's ability to call external APIs, databases, calculators, or custom functions to perform actions.",  
    category: "fundamentals"  
  },  
  {  
    term: "MCP (Model Context Protocol)",  
    definition: "Standardized protocol for connecting AI models to external tools and data sources with minimal code.",  
    category: "tech-stack"  
  },  
  {  
    term: "ReAct Pattern",  
    definition: "Reasoning and Acting pattern where agents alternate between thinking (reason) and doing (action).",  
    category: "patterns"  
  },  
  {  
    term: "Chain-of-Thought Prompting",  
    definition: "Technique that encourages LLMs to break down complex problems into step-by-step reasoning.",  
    category: "patterns"  
  },  
  {  
    term: "Self-Reflection",  
    definition: "Pattern where agents evaluate their own outputs, identify errors, and iteratively improve.",  
    category: "patterns"  
  },  
  {  
    term: "Multi-Agent System",  
    definition: "Multiple specialized agents working together, each with defined roles, to solve complex problems.",  
    category: "patterns"  
  },  
  {  
    term: "Agentic Workflow",  
    definition: "A sequence of tasks and decisions that an AI agent can perform autonomously to achieve a goal.",  
    category: "patterns"  
  },  
  {  
    term: "Guardrails",  
    definition: "Mechanisms to control and limit the behavior of an AI agent, ensuring it stays within defined boundaries and follows safety protocols.",  
    category: "fundamentals"  
  },  
  {  
    term: "Prompt Engineering",  
    definition: "The practice of designing and refining prompts to elicit specific, high-quality responses from an LLM.",  
    category: "fundamentals"  
  },  
  {  
    term: "System Prompt",  
    definition: "A high-level instruction or set of guidelines that defines the role, capabilities, and behavior of an AI agent.",  
    category: "fundamentals"  
  },  
  {  
    term: "User Prompt",  
    definition: "A specific request or question provided by a user to an AI agent.",  
    category: "fundamentals"  
  },  
  {  
    term: "Context Window",  
    definition: "The maximum amount of information (tokens) that an LLM can process and remember during a single interaction.",  
    category: "tech-stack"  
  },  
  {  
    term: "Tokenization",  
    definition: "The process of breaking down text into smaller units (tokens) that an LLM can process.",  
    category: "tech-stack"  
  },  
  {  
    term: "Temperature",  
    definition: "A parameter that controls the randomness of the LLM's output. Lower values result in more deterministic responses, while higher values result in more creative and varied responses.",  
    category: "tech-stack"  
  },  
  {  
    term: "Top-P Sampling",  
    definition: "A method of selecting the next token in an LLM's output based on the cumulative probability of the top-p most likely tokens.",  
    category: "tech-stack"  
  },  
  {  
    term: "Beam Search",  
    definition: "A search algorithm used in LLMs to find the most likely sequence of tokens by maintaining a limited number of the most promising partial sequences.",  
    category: "tech-stack"  
  },  
  {  
    term: "Inference",  
    definition: "The process of using a trained LLM to generate output based on a given input.",  
    category: "tech-stack"  
  },  
  {  
    term: "Training",  
    definition: "The process of feeding an LLM large amounts of data to learn the underlying patterns and relationships in the data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Fine-tuning",  
    definition: "The process of taking a pre-trained LLM and adapting it to a specific task or domain by providing additional training data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Zero-shot",  
    definition: "The ability of an LLM to perform a task without having been explicitly trained on that task.",  
    category: "fundamentals"  
  },  
  {  
    term: "One-shot",  
    definition: "The ability of an LLM to perform a task by learning from a single example provided in the prompt.",  
    category: "fundamentals"  
  },  
  {  
    term: "Few-shot",  
    definition: "The ability of an LLM to perform a task by learning from a small number of examples provided in the prompt.",  
    category: "fundamentals"  
  },  
  {  
    term: "Chain-of-Thought",  
    definition: "A reasoning process where an LLM generates a series of intermediate steps to solve a problem.",  
    category: "patterns"  
  },  
  {  
    term: "Self-Consistency",  
    definition: "A method of improving LLM output by generating multiple responses and selecting the most consistent one.",  
    category: "patterns"  
  },  
  {  
    term: "Tree of Thoughts",  
    definition: "A reasoning process where an LLM generates multiple potential paths of thought and evaluates them to find the most promising one.",  
    category: "patterns"  
  },  
  {  
    term: "Program of Thoughts",  
    definition: "A method of solving a problem by breaking it down into a sequence of sub-problems, each solved by a different LLM.",  
    category: "patterns"  
  },  
  {  
    term: "ReAct",  
    definition: "A reasoning and acting framework where an LLM generates a plan, executes it, and reflects on the results.",  
    category: "patterns"  
  },  
  {  
    term: "Plan-and-Solve",  
    definition: "A reasoning process where an LLM generates a plan to solve a problem and then executes the plan.",  
    category: "patterns"  
  },  
  {  
    term: "Act-and-Reflect",  
    definition: "A reasoning process where an LLM generates an action, executes it, and reflects on the results.",  
    category: "patterns"  
  },  
  {  
    term: "Tool-Augmented LLM",  
    definition: "An LLM that is augmented with external tools or APIs to perform tasks that require specialized knowledge or capabilities.",  
    category: "tech-stack"  
  },  
  {  
    term: "Function Calling",  
    definition: "The ability of an LLM to call external functions or APIs to perform actions.",  
    category: "tech-stack"  
  },  
  {  
    term: "API Integration",  
    definition: "The process of connecting an LLM to external APIs to enable it to interact with other systems.",  
    category: "tech-stack"  
  },  
  {  
    term: "Database Integration",  
    definition: "The process of connecting an LLM to a database to enable it to retrieve and store information.",  
    category: "tech-stack"  
  },  
  {  
    term: "Web Browsing",  
    definition: "The ability of an LLM to access and retrieve information from the internet.",  
    category: "tech-stack"  
  },  
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    term: "Code Execution",  
    definition: "The ability of an LLM to execute code snippets and analyze the results.",  
    category: "tech-stack"  
  },  
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    term: "Image Generation",  
    definition: "The ability of an LLM to generate images based on a text prompt.",  
    category: "tech-stack"  
  },  
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    term: "Text-to-Speech",  
    definition: "The ability of an LLM to generate audio output from a text prompt.",  
    category: "tech-stack"  
  },  
  {  
    term: "Speech-to-Text",  
    definition: "The ability of an LLM to transcribe audio input into text.",  
    category: "tech-stack"  
  },  
  {  
    term: "Multimodal LLM",  
    definition: "An LLM that can process and generate both text and other types of data, such as images or audio.",  
    category: "tech-stack"  
  },  
  {  
    term: "Generative AI",  
    definition: "AI systems that can generate new content, such as text, images, or audio, based on a prompt.",  
    category: "tech-stack"  
  },  
  {  
    term: "Large Language Model",  
    definition: "A type of AI model that is trained on a large amount of text data and can generate human-like text.",  
    category: "tech-stack"  
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  {  
    term: "Natural Language Processing",  
    definition: "The field of AI that focuses on enabling computers to understand and process human language.",  
    category: "tech-stack"  
  },  
  {  
    term: "Artificial Intelligence",  
    definition: "The field of computer science that focuses on creating machines that can perform tasks that typically require human intelligence.",  
    category: "fundamentals"  
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  {  
    term: "Machine Learning",  
    definition: "A subset of AI that focuses on creating models that can learn from data and make predictions or decisions.",  
    category: "tech-stack"  
  },  
  {  
    term: "Deep Learning",  
    definition: "A subset of machine learning that focuses on creating models that are inspired by the structure and function of the human brain.",  
    category: "tech-stack"  
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  {  
    term: "Neural Networks",  
    definition: "A type of machine learning model that is composed of layers of interconnected nodes, resembling the structure of a neural network in the human brain.",  
    category: "tech-stack"  
  },  
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    term: "Transformer Architecture",  
    definition: "A type of neural network architecture that is used in many LLMs, characterized by its ability to process sequential data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Attention Mechanism",  
    definition: "A mechanism used in transformer architectures that allows the model to focus on specific parts of the input sequence when generating output.",  
    category: "tech-stack"  
  },  
  {  
    term: "Scalability",  
    definition: "The ability of a system to handle increasing amounts of data or users without a significant decrease in performance.",  
    category: "tech-stack"  
  },  
  {  
    term: "Performance",  
    definition: "The speed and efficiency with which a system can process data or perform tasks.",  
    category: "tech-stack"  
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    term: "Latency",  
    definition: "The time delay between a request being made and the response being received.",  
    category: "tech-stack"  
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    term: "Throughput",  
    definition: "The number of requests or tasks that a system can process in a given unit of time.",  
    category: "tech-stack"  
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    term: "Reliability",  
    definition: "The ability of a system to consistently perform its intended function over time.",  
    category: "tech-stack"  
  },  
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    term: "Availability",  
    definition: "The ability of a system to be accessed and used by users at any time.",  
    category: "tech-stack"  
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    term: "Security",  
    definition: "The measures taken to protect a system and its data from unauthorized access, use, or disclosure.",  
    category: "tech-stack"  
  },  
  {  
    term: "Compliance",  
    definition: "The process of ensuring that a system and its data adhere to relevant laws, regulations, and standards.",  
    category: "tech-stack"  
  },  
  {  
    term: "Interoperability",  
    definition: "The ability of different systems or components to work together and exchange data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Integration",  
    definition: "The process of combining different systems or components into a single, unified system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Automation",  
    definition: "The process of using technology to perform tasks that would otherwise require human intervention.",  
    category: "tech-stack"  
  },  
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    term: "Workflow",  
    definition: "A sequence of tasks or steps that are performed in a specific order to achieve a goal.",  
    category: "tech-stack"  
  },  
  {  
    term: "Pipeline",  
    definition: "A sequence of processing steps that transform input data into output data.",  
    category: "tech-stack"  
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  {  
    term: "Data Ingestion",  
    definition: "The process of collecting and loading data from various sources into a data store.",  
    category: "tech-stack"  
  },  
  {  
    term: "Data Storage",  
    definition: "The process of saving and organizing data in a way that allows it to be retrieved and used later.",  
    category: "tech-stack"  
  },  
  {  
    term: "Data Processing",  
    definition: "The process of transforming raw data into a format that is useful for analysis or decision-making.",  
    category: "tech-stack"  
  },  
  {  
    term: "Data Analysis",  
    definition: "The process of examining data to identify patterns, trends, and insights.",  
    category: "tech-stack"  
  },  
  {  
    term: "Data Visualization",  
    definition: "The process of representing data in a visual format, such as a chart or graph, to make it easier to understand.",  
    category: "tech-stack"  
  },  
  {  
    term: "Reporting",  
    definition: "The process of generating and distributing reports that summarize data and provide insights.",  
    category: "tech-stack"  
  },  
  {  
    term: "Dashboard",  
    definition: "A collection of visualizations and reports that provide a high-level overview of data and key performance indicators.",  
    category: "tech-stack"  
  },  
  {  
    term: "Monitoring",  
    definition: "The process of tracking and observing the performance and health of a system over time.",  
    category: "tech-stack"  
  },  
  {  
    term: "Alerting",  
    definition: "The process of sending notifications or alerts when a system or component is experiencing a problem or anomaly.",  
    category: "tech-stack"  
  },  
  {  
    term: "Logging",  
    definition: "The process of recording events and activities that occur within a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Debugging",  
    definition: "The process of identifying and fixing errors or bugs in a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Testing",  
    definition: "The process of verifying that a system or component meets the requirements and behaves as expected.",  
    category: "tech-stack"  
  },  
  {  
    term: "Deployment",  
    definition: "The process of putting a system or component into production and making it available to users.",  
    category: "tech-stack"  
  },  
  {  
    term: "Maintenance",  
    definition: "The process of keeping a system or component up-to-date and in good working order.",  
    category: "tech-stack"  
  },  
  {  
    term: "Updates",  
    definition: "Changes or improvements made to a system or component to enhance its performance or add new features.",  
    category: "tech-stack"  
  },  
  {  
    term: "Patches",  
    definition: "Small pieces of code that are used to fix specific bugs or vulnerabilities in a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Security Updates",  
    definition: "Updates or patches that are used to address security vulnerabilities in a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Performance Updates",  
    definition: "Updates or patches that are used to improve the performance or efficiency of a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Feature Updates",  
    definition: "Updates or patches that are used to add new features or functionality to a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Bug Fixes",  
    definition: "Updates or patches that are used to address specific bugs or errors in a system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Hotfixes",  
    definition: "A type of update or patch that is used to quickly address a production issue.",  
    category: "tech-stack"  
  },  
  {  
    term: "Rollbacks",  
    definition: "The process of reverting a system or component to a previous version in the event of a problem.",  
    category: "tech-stack"  
  },  
  {  
    term: "Disaster Recovery",  
    definition: "The process of restoring a system or component to its original state in the event of a disaster or data loss.",  
    category: "tech-stack"  
  },  
  {  
    term: "Business Continuity",  
    definition: "The process of ensuring that a business can continue to operate in the event of a disaster or other major disruption.",  
    category: "tech-stack"  
  },  
  {  
    term: "Risk Management",  
    definition: "The process of identifying, assessing, and mitigating risks to a business or system.",  
    category: "tech-stack"  
  },  
  {  
    term: "Compliance",  
    definition: "The process of ensuring that a business or system adheres to relevant laws, regulations, and standards.",  
    category: "tech-stack"  
  },  
  {  
    term: "Documentation",  
    definition: "The process of creating and maintaining records of a system or component, including its design, configuration, and usage.",  
    category: "tech-stack"  
  },  
  {  
    term: "Training",  
    definition: "The process of teaching a system or component how to perform a specific task or function.",  
    category: "tech-stack"  
  },  
  {  
    term: "Onboarding",  
    definition: "The process of getting a new user or customer familiar with a system or product.",  
    category: "tech-stack"  
  },  
  {  
    term: "Support",  
    definition: "The process of helping users or customers with problems or questions related to a system or product.",  
    category: "tech-stack"  
  },  
  {  
    term: "Feedback",  
    definition: "The process of collecting and analyzing input from users or customers to improve a system or product.",  
    category: "tech-stack"  
  },  
  {  
    term: "Iterative Development",  
    definition: "A process of developing a system or product through a series of small, incremental changes and improvements.",  
    category: "tech-stack"  
  },  
  {  
    term: "Agile Development",  
    definition: "A methodology for software development that emphasizes flexibility, collaboration, and frequent releases.",  
    category: "tech-stack"  
  },  
  {  
    term: "Scrum",  
    definition: "A framework for agile development that uses sprints to manage work and deliver value.",  
    category: "tech-stack"  
  },  
  {  
    term: "Kanban",  
    definition: "A methodology for agile development that uses a visual board to manage work and deliver value.",  
    category: "tech-stack"  
  },  
  {  
    term: "DevOps",  
    definition: "A culture and practice that emphasizes collaboration and communication between development and operations teams.",  
    category: "tech-stack"  
  },  
  {  
    term: "CI/CD",  
    definition: "A practice of automating the integration and deployment of code changes.",  
    category: "tech-stack"  
  },  
  {  
    term: "Infrastructure as Code",  
    definition: "A practice of managing infrastructure using code and automation.",  
    category: "tech-stack"  
  },  
  {  
    term: "Cloud Computing",  
    definition: "The practice of using remote servers to store, manage, and process data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Serverless",  
    definition: "A cloud computing model where the provider manages the infrastructure and the user only needs to provide the code.",  
    category: "tech-stack"  
  },  
  {  
    term: "Microservices",  
    definition: "An architectural style where an application is built as a collection of small, independent services that communicate with each other.",  
    category: "tech-stack"  
  },  
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    term: "Containerization",  
    definition: "A technology that allows applications to run in isolated containers on a single host.",  
    category: "tech-stack"  
  },  
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    term: "Kubernetes",  
    definition: "An open-source container orchestration system that automates the deployment and management of containers.",  
    category: "tech-stack"  
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  {  
    term: "Docker",  
    definition: "A platform for developing, shipping, and running applications in containers.",  
    category: "tech-stack"  
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  {  
    term: "Jenkins",  
    definition: "An open-source automation server that can be used to automate the build, test, and deployment of code.",  
    category: "tech-stack"  
  },  
  {  
    term: "Git",  
    definition: "A distributed version control system that tracks changes in the code and allows multiple developers to work on the same project.",  
    category: "tech-stack"  
  },  
  {  
    term: "GitHub",  
    definition: "A web-based platform for hosting and managing code repositories.",  
    category: "tech-stack"  
  },  
  {  
    term: "GitLab",  
    definition: "A self-hosted platform for hosting and managing code repositories.",  
    category: "tech-stack"  
  },  
  {  
    term: "Bitbucket",  
    definition: "A cloud-based platform for hosting and managing code repositories.",  
    category: "tech-stack"  
  },  
  {  
    term: "Jira",  
    definition: "A software development tool that is used for tracking and managing work items.",  
    category: "tech-stack"  
  },  
  {  
    term: "Confluence",  
    definition: "A collaborative workspace for creating and organizing content.",  
    category: "tech-stack"  
  },  
  {  
    term: "Slack",  
    definition: "A cloud-based messaging and collaboration platform.",  
    category: "tech-stack"  
  },  
  {  
    term: "Zoom",  
    definition: "A cloud-based video conferencing platform.",  
    category: "tech-stack"  
  },  
  {  
    term: "Microsoft Teams",  
    definition: "A cloud-based collaboration platform that integrates messaging, video conferencing, and document sharing.",  
    category: "tech-stack"  
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    term: "Salesforce",  
    definition: "A cloud-based customer relationship management (CRM) platform.",  
    category: "tech-stack"  
  },  
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    term: "HubSpot",  
    definition: "A cloud-based marketing and sales platform.",  
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    term: "Braze",  
    definition: "A cloud-based customer engagement platform.",  
    category: "tech-stack"  
  },  
  {  
    term: "Segment",  
    definition: "A cloud-based customer data platform (CDP) that helps businesses collect, unify, and activate customer data.",  
    category: "tech-stack"  
  },  
  {  
    term: "Snowflake",  
    definition: "A cloud-based data warehouse platform.",  
    category: "tech-stack"  
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  {  
    term: "Databricks",  
    definition: "A cloud-based data lake and analytics platform.",  
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    term: "Amazon Redshift",  
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    term: "Google BigQuery",  
    definition: "A cloud-based data warehouse service from Google.",  
    category: "tech-stack"  
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    definition: "A cloud computing platform and ecosystem from Microsoft.",  
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    category: "tech-stack"  
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    definition: "A cloud-based customer engagement platform.",  
    category: "tech-stack"  
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    term: "Segment",  
    definition: "A cloud-based customer data platform (CDP) that helps businesses collect, unify, and activate customer data.",  
    category: "tech-stack"  
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    definition: "A cloud-based data warehouse platform.",  
    category: "tech-stack"  
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    definition: "A cloud-based data lake and analytics platform.",  
    category: "tech-stack"  
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    definition: "A cloud-based data warehouse service from Amazon.",  
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    definition: "A cloud computing platform and ecosystem from Microsoft.",  
    category: "tech-stack"  
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```
term: "Agent Orchestration",
definition: "The system that connects models, memory, tools, and steps in order (e.g., LangChain, CrewAI, AutoGen).",
category: "frameworks"
},
{
term: "Memory (Short-term)",
definition: "Current session or task history stored temporarily (e.g., episodic memory, working memory).",
category: "fundamentals"
},
{
term: "Memory (Long-term)",
definition: "Persistent user preferences, past decisions, and knowledge stored across sessions (e.g., Vector DB, SQL, file storage).",
category: "fundamentals"
},
{
term: "Guardrails",
definition: "Safety mechanisms that ensure agents behave responsibly, avoiding harmful or biased outputs.",
category: "best-practices"
},
{
term: "Multimodal AI",
definition: "AI systems that can process multiple types of data: text, images, audio, video (e.g., GPT-4V, Gemini).",
category: "advanced"
},
{
term: "HyDE (Hypothetical Document Embeddings)",
definition: "RAG technique where LLM generates hypothetical documents for better semantic search.",
category: "rag"
},
{
term: "Agentic Design Pattern",
definition: "Architectural approaches for building agents: ReAct, Planning, Multi-Agent, Self-Reflection, etc.",
category: "patterns"
},
{
term: "System Prompt",
definition: "Instructions that define agent's role, behavior, personality, and operational procedures.",
category: "fundamentals"
},
{
term: "Context Window",
definition: "Maximum amount of text (in tokens) an LLM can process at once (e.g., 128k tokens for GPT-4).",
category: "fundamentals"
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```

```
{
  term: "Token",
  definition: "Basic unit of text processing in LLMs, roughly equivalent to 4 characters or 0.75 words.",
  category: "fundamentals"
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{
  term: "Fine-tuning",
  definition: "Training a pre-trained model on domain-specific data to improve performance for specialized tasks.",
  category: "advanced"
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{
  term: "Prompt Engineering",
  definition: "Craft of designing effective prompts to guide AI behavior and improve output quality.",
  category: "best-practices"
}
];
```

Design Patterns (6 main patterns)

javascript

```

const designPatterns = [
  {
    id: "react",
    name: "ReAct Agent",
    category: "Single-Agent",
    description: "A reasoning and acting framework where an agent alternates between reasoning (using LLMs) and acting (usi
    usedBy: "Most AI Agent Products",
    whenToUse: "General purpose tasks requiring flexible decision-making and tool use",
    diagram: "react-diagram.png",
    workflow: ["Query", "LLM (Reason)", "Tools (Action)", "Output"],
    pros: ["Simple to implement", "Flexible", "Works with most LLMs"],
    cons: ["Can be slow", "May loop unnecessarily"],
    codeExamples: {
      python: `from langchain.agents import create_react_agent
from langchain_openai import ChatOpenAI
from langchain.tools import WikipediaQueryRun

llm = ChatOpenAI(model="gpt-4o")
tools = [WikipediaQueryRun()]

agent = create_react_agent(
    llm=llm,
    tools=tools,
    prompt="You are a helpful research assistant"
)

result = agent.invoke({"input": "What is quantum computing?"})`,
      javascript: `import { ReActAgent } from "@langchain/agents";
import { ChatOpenAI } from "@langchain/openai";

const model = new ChatOpenAI({ model: "gpt-4o" });
const agent = new ReActAgent({ model, tools: [] });

const result = await agent.invoke({
  input: "What is quantum computing?"
});`,
      go: `// Go example using Go-LangChain
package main

import (
    "github.com/tmc/langchaingo/agents"
    "github.com/tmc/langchaingo/llms/openai"
)

```

```

func main() {
    llm := openai.New()
    agent := agents.NewReActAgent(llm, tools)
    result := agent.Run("What is quantum computing?")
} `,

    java: `// Java example using LangChain4j
import dev.langchain4j.agent.Agent;
import dev.langchain4j.model.openai.OpenAiChatModel;

OpenAiChatModel model = OpenAiChatModel.builder()
    .apiKey(System.getenv("OPENAI_API_KEY"))
    .modelName("gpt-4o")
    .build();

Agent agent = Agent.builder()
    .chatLanguageModel(model)
    .tools(tools)
    .build();

String result = agent.chat("What is quantum computing?");`
},
links: [
    { title: "ReAct Paper", url: "https://arxiv.org/abs/2210.03629" },
    { title: "LangChain ReAct Docs", url: "https://python.langchain.com/docs/modules/agents/agent_types/react" },
    { title: "Tutorial Video", url: "https://youtube.com/watch?v=..." }
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{
    id: "codeact",
    name: "CodeAct Agent",
    category: "Single-Agent",
    description: "The CodeAct architecture by Manus AI allows agents to autonomously execute Python code instead of using .",
    usedBy: "Manus AI",
    whenToUse: "Complex data processing, mathematical computations, file operations",
    diagram: "codeact-diagram.png",
    workflow: ["User", "Agent (Think)", "CodeAct", "Environment", "Observation", "Result"],
    pros: ["Can handle complex logic", "More precise than text", "Native code execution"],
    cons: ["Security risks", "Requires sandboxing", "Limited LLM code quality"],
    codeExamples: {
        python: `# CodeAct pattern with code execution
from langchain_experimental.utilities import PythonREPL

python_repl = PythonREPL()

```

```

def code_agent(query):
    # Agent decides to write code
    code = llm.generate_code(query)

    # Execute code in sandbox
    result = python_repl.run(code)

    return result

# Example: "Calculate factorial of 10"
result = code_agent("Calculate factorial of 10")`
    javascript: `// JavaScript with VM2 sandbox
const { VM } = require('vm2');

function codeAgent(query) {
    const code = llm.generateCode(query);

    const vm = new VM({ timeout: 1000 });
    const result = vm.run(code);

    return result;
}

},
links: [
    { title: "CodeAct Paper", url: "https://arxiv.org/abs/2402.01030" },
    { title: "Manus AI", url: "https://manus.im" }
],
{
    id: "self-reflection",
    name: "Self-Reflection",
    category: "Self-Improving",
    description: "Self-Reflection or Reflexion involves self-evaluating outputs, using feedback loops to identify errors, and iter
    usedBy: "Open Serve AI",
    whenToUse: "High-quality outputs needed, writing tasks, complex problem solving",
    workflow: ["Query", "LLM", "Memory/Tools", "First draft", "Critique", "Generator", "Result"],
    codeExamples: {
        python: `from langchain.prompts import PromptTemplate

def self_reflection_agent(query):
    # Generate initial response
    draft = llm.invoke(query)

```

```

# Self-critique
critique_prompt = f"Critique this response: {draft}"
critique = llm.invoke(critique_prompt)

# Improve based on critique
improve_prompt = f"Improve this based on critique:\n{draft}\n\nCritique: {critique}"
final = llm.invoke(improve_prompt)

return final`
},
{
    id: "multi-agent",
    name: "Multi-Agent Workflow",
    category: "Collaborative",
    description: "A Multi-Agent Workflow is a collaborative system where multiple specialized agents work together to build a",
    usedBy: "Gemini Deep Research",
    whenToUse: "Complex tasks requiring specialized expertise, parallel processing",
    workflow: ["Query", "Agent 1 (Manager)", "Agent 2/3/n (Specialists)", "Aggregator LLM", "Output"],
    codeExamples: {
        python: `from crewai import Agent, Task, Crew

# Define specialized agents
researcher = Agent(
    role='Researcher',
    goal='Gather comprehensive information',
    tools=[search_tool]
)

analyst = Agent(
    role='Data Analyst',
    goal='Analyze and synthesize findings',
    tools=[analysis_tool]
)

writer = Agent(
    role='Writer',
    goal='Create final report',
    tools=[]
)

# Coordinate agents
crew = Crew(
    agents=[researcher, analyst, writer],

```



```

tasks=[research_task, analysis_task, writing_task]
)

result = crew.kickoff(`
    }
},
{
    id: "agentic-rag",
    name: "Agentic RAG",
    category: "Advanced RAG",
    description: "Agentic RAG involves AI agents retrieving and evaluating relevant data to generate context-aware and well re
    usedBy: "Perplexity",
    whenToUse: "Question answering with citations, research tasks, fact-checking",
    workflow: ["Query", "Planning Agent", "Retrieval Agent", "Generator Agent", "Response Judge"],
    codeExamples: {
        python: `from langchain.agents import create_agent
from langchain.tools.retriever import create_retriever_tool

# Create retrieval tool
retriever_tool = create_retriever_tool(
    retriever=vector_store.as_retriever(),
    name="knowledge_base",
    description="Search the knowledge base"
)

# Planning agent decides queries
planner = create_agent(llm, [retriever_tool])

# Execute agentic RAG
result = planner.invoke({
    "input": "Compare quantum computing approaches"
})`
    }
},
{
    id: "planning",
    name: "Planning Pattern",
    category: "Goal-Oriented",
    description: "The AI breaks a high-level goal into smaller steps, executes them with the help of agents, and revises the plan
    whenToUse: "Multi-step projects, task decomposition, complex workflows",
    workflow: ["High-Level Goal", "Planning", "Generate Task", "Single Task Agent", "Adjusted Task", "Replan"],
    codeExamples: {
        python: `def planning_agent(goal):
# Break down goal

```

```
plan = llm.invoke(f"Break this into steps: {goal}")

tasks = parse_plan(plan)
results = []

for task in tasks:
    result = execute_task(task)

    if not result.success:
        # Replan
        tasks = replan(task, result.error)
    else:
        results.append(result)

return aggregate_results(results)`
}
}
];
```

Frameworks Data (Top 10)

javascript

```
const frameworks = [
  {
    id: "langchain",
    name: "LangChain",
    logo: "langchain-logo.png",
    category: "Modular",
    tagline: "Build custom LLM agents using reusable components",
    description: "Modular framework to build complex, multi-turn conversational agents using LLMs and custom tools. Industry leading for building complex, multi-turn conversational agents using LLMs and custom tools.",
    features: ["Agent executors", "Memory modules", "Tool integration", "Built-in templates"],
    bestFor: "Building complex, multi-turn conversational agents using LLMs and custom tools",
    pricing: "Free (Open Source)",
    languages: ["Python", "JavaScript"],
    stars: "90k+",
    difficulty: "Intermediate",
    officialLinks: {
      docs: "https://python.langchain.com",
      github: "https://github.com/langchain-ai/langchain",
      tutorials: "https://youtube.com/c/langchain"
    },
    codeExample: "// See design patterns section",
    pros: ["Extensive ecosystem", "Great documentation", "Large community"],
    cons: ["Can be complex", "Steep learning curve for beginners"],
    useCases: ["Chatbots", "RAG systems", "Document QA", "Agent workflows"]
  },
  // ... (add other 9 frameworks similarly)
];
```

Tech Stack Data (by layer)

javascript

```
const techStack = {
  deployment: [
    { name: "Groq", category: "Infrastructure", description: "Ultra-fast LLM inference", url: "https://groq.com", pricing: "Pay-as-you-go" },
    { name: "AWS", category: "Cloud", description: "Amazon cloud services", url: "https://aws.amazon.com", pricing: "Pay-as-you-go" },
    { name: "Together.ai", category: "Inference", description: "Hosted model inference", url: "https://together.ai", pricing: "Pay-as-you-go" },
    // ... more tools
  ],
  evaluation: [
    { name: "LangSmith", category: "Monitoring", description: "LangChain observability", url: "https://smith.langchain.com", pricing: "Free" },
    { name: "Weights & Biases", category: "MLOps", description: "Experiment tracking", url: "https://wandb.ai", pricing: "Free" },
    // ... more tools
  ],
  // ... other layers
};
```

TECHNICAL IMPLEMENTATION REQUIREMENTS

HTML Structure

```
html
```

```
<!DOCTYPE html>
<html lang="en">
<head>
  <meta charset="UTF-8">
  <meta name="viewport" content="width=device-width, initial-scale=1.0">
  <title>Building Agentic Systems Guide</title>
  <style>
    /* Color Variables */
    :root {
      --primary-purple: #7C3AED;
      --accent-blue: #3B82F6;
      --teal: #06B6D4;
      --orange: #F97316;
      --dark-bg: #1E293B;
      --card-bg: #334155;
      --text-primary: #F1F5F9;
      --text-secondary: #94A3B8;
      --success: #10B981;
      --warning: #FBBF24;
    }

    * {
      margin: 0;
      padding: 0;
      box-sizing: border-box;
    }

    body {
      font-family: 'Inter', -apple-system, BlinkMacSystemFont, sans-serif;
      background: var(--dark-bg);
      color: var(--text-primary);
      line-height: 1.6;
    }

    /* Tab Navigation */
    .tabs {
      display: flex;
      gap: 1rem;
      padding: 1rem 2rem;
      background: linear-gradient(135deg, var(--primary-purple), var(--accent-blue));
      overflow-x: auto;
      position: sticky;
      top: 0;
    }
  </style>
</head>
<body>
```

```
    z-index: 100;
}

.tab {
    padding: 0.75rem 1.5rem;
    border: none;
    background: rgba(255, 255, 255, 0.1);
    color: white;
    cursor: pointer;
    border-radius: 8px;
    transition: all 0.3s;
    white-space: nowrap;
}

.tab:hover {
    background: rgba(255, 255, 255, 0.2);
    transform: translateY(-2px);
}

.tab.active {
    background: white;
    color: var(--primary-purple);
}

/* Main Content Area */
.content {
    max-width: 1400px;
    margin: 0 auto;
    padding: 2rem;
}

.tab-content {
    display: none;
}

.tab-content.active {
    display: block;
    animation: fadeIn 0.3s;
}

@keyframes fadeIn {
    from { opacity: 0; transform: translateY(10px); }
    to { opacity: 1; transform: translateY(0); }
}
```

```
/* Card Styles */
```

```
.card {  
  background: var(--card-bg);  
  border-radius: 12px;  
  padding: 2rem;  
  margin-bottom: 2rem;  
  border: 1px solid rgba(255, 255, 255, 0.1);  
  transition: all 0.3s;  
}  
  
.card:hover {  
  transform: translateY(-5px);  
  box-shadow: 0 10px 30px rgba(124, 58, 237, 0.3);  
}
```

```
/* Code Block Styles */
```

```
.code-block {  
  background: #0f172a;  
  border-radius: 8px;  
  padding: 1rem;  
  margin: 1rem 0;  
  position: relative;  
}  
  
.language-tabs {  
  display: flex;  
  gap: 0.5rem;  
  margin-bottom: 1rem;  
}  
  
.language-tab {  
  padding: 0.5rem 1rem;  
  background: rgba(255, 255, 255, 0.05);  
  border: none;  
  color: var(--text-secondary);  
  cursor: pointer;  
  border-radius: 4px;  
}  
  
.language-tab.active {  
  background: var(--primary-purple);  
  color: white;  
}
```

```
.copy-button {  
  position: absolute;  
  top: 1rem;  
  right: 1rem;  
  padding: 0.5rem 1rem;  
  background: var(--accent-blue);  
  border: none;  
  color: white;  
  border-radius: 4px;  
  cursor: pointer;  
}
```

```
/* Wizard Styles */
```

```
.wizard {  
  max-width: 900px;  
  margin: 0 auto;  
}
```

```
.wizard-step {  
  display: none;  
}
```

```
.wizard-step.active {  
  display: block;  
}
```

```
.progress-bar {  
  height: 4px;  
  background: rgba(255, 255, 255, 0.1);  
  border-radius: 2px;  
  margin-bottom: 2rem;  
}
```

```
.progress-fill {  
  height: 100%;  
  background: linear-gradient(90deg, var(--primary-purple), var(--teal));  
  border-radius: 2px;  
  transition: width 0.3s;  
}
```

```
/* Search */
```

```
.search-box {  
  width: 100%;
```



```
padding: 1rem;
background: var(--card-bg);
border: 1px solid rgba(255, 255, 255, 0.1);
border-radius: 8px;
color: white;
font-size: 1rem;
margin-bottom: 2rem;
}
```

```
/* Modal for Graphics */
```

```
.modal {
  display: none;
  position: fixed;
  top: 0;
  left: 0;
  width: 100%;
  height: 100%;
  background: rgba(0, 0, 0, 0.9);
  z-index: 1000;
  justify-content: center;
  align-items: center;
}
```

```
.modal.active {
  display: flex;
}
```

```
.modal-content {
  max-width: 90%;
  max-height: 90%;
}
```

```
/* Comparison Matrix */
```

```
.comparison-table {
  width: 100%;
  border-collapse: collapse;
  margin: 2rem 0;
}
```

```
.comparison-table th,
.comparison-table td {
  padding: 1rem;
  border: 1px solid rgba(255, 255, 255, 0.1);
  text-align: left;
```

```

}

.comparison-table th {
  background: var(--primary-purple);
  position: sticky;
  top: 0;
}

/* Responsive */
@media (max-width: 768px) {
  .tabs {
    padding: 1rem;
  }

  .content {
    padding: 1rem;
  }

  .card {
    padding: 1rem;
  }
}
</style>
</head>
<body>
  <!-- Navigation Tabs -->
  <div class="tabs">
    <button class="tab active" data-tab="home">Home</button>
    <button class="tab" data-tab="builder">★ Agent Builder</button>
    <button class="tab" data-tab="fundamentals">Fundamentals</button>
    <button class="tab" data-tab="patterns">Design Patterns</button>
    <button class="tab" data-tab="frameworks">Frameworks</button>
    <button class="tab" data-tab="advanced">Advanced Patterns</button>
    <button class="tab" data-tab="techstack">Tech Stack</button>
    <button class="tab" data-tab="best-practices">Best Practices</button>
    <button class="tab" data-tab="tools">Free Tools</button>
    <button class="tab" data-tab="graphics">Reference Graphics</button>
  </div>

  <!-- Main Content -->
  <div class="content">
    <!-- HOME TAB -->
    <div id="home" class="tab-content active">
      <!-- Home content here -->
    </div>
  </div>

```

```
</div>
```

```
<!-- AGENT BUILDER TAB -->
```

```
<div id="builder" class="tab-content">
```

```
  <div class="wizard">
```

```
    <div class="progress-bar">
```

```
      <div class="progress-fill" style="width: 0%"></div>
```

```
    </div>
```

```
  <div class="wizard-step active" data-step="1">
```

```
    <!-- Step 1 content -->
```

```
  </div>
```

```
  <!-- More steps... -->
```

```
</div>
```

```
</div>
```

```
<!-- Other tabs... -->
```

```
</div>
```

```
<!-- Graphics Modal -->
```

```
<div class="modal" id="graphicModal">
```

```
  <button class="close-btn">×</button>
```

```
  <button class="nav-btn prev"></button>
```

```
  <img class="modal-content" id="modalImage" src="" alt="">
```

```
  <button class="nav-btn next"></button>
```

```
</div>
```

```
<script>
```

```
  // Tab switching
```

```
  const tabs = document.querySelectorAll('.tab');
```

```
  const tabContents = document.querySelectorAll('.tab-content');
```

```
  tabs.forEach(tab => {
```

```
    tab.addEventListener('click', () => {
```

```
      const targetId = tab.dataset.tab;
```

```
      tabs.forEach(t => t.classList.remove('active'));
```

```
      tab.classList.add('active');
```

```
      tabContents.forEach(content => {
```

```
        content.classList.remove('active');
```

```
        if (content.id === targetId) {
```

```
          content.classList.add('active');
```

```

    }
  });

  // Save progress
  localStorage.setItem('lastTab', targetId);
});

});

// Load graphics from CSV
async function loadGraphics() {
  // Read graphics.csv
  // Display as thumbnail grid
  // Add click handlers for modal
}

// Copy code functionality
function setupCopyButtons() {
  document.querySelectorAll('.copy-button').forEach(btn => {
    btn.addEventListener('click', async (e) => {
      const codeBlock = e.target.closest('.code-block');
      const code = codeBlock.querySelector('code').textContent;
      await navigator.clipboard.writeText(code);
      btn.textContent = 'Copied!';
      setTimeout(() => btn.textContent = 'Copy', 2000);
    });
  });
}

// Initialize app
document.addEventListener('DOMContentLoaded', () => {
  loadGraphics();
  setupCopyButtons();

  // Load last viewed tab
  const lastTab = localStorage.getItem('lastTab');
  if (lastTab) {
    document.querySelector(`[data-tab="${lastTab}"]`).click();
  }
});
</script>
</body>
</html>

```

READING GRAPHICS FROM CSV

The app must read `graphics.csv` which has this structure:

- FileName
- FilePath (relative path)
- Title

Use Papaparse to read the CSV:

```
javascript
```

```

async function loadGraphicsFromCSV() {
  const response = await fetch('graphics.csv');
  const csvText = await response.text();

  Papa.parse(csvText, {
    header: true,
    skipEmptyLines: true,
    complete: (results) => {
      const graphics = results.data;
      renderGraphicsGallery(graphics);
    }
  });
}

function renderGraphicsGallery(graphics) {
  const gallery = document.getElementById('graphics-gallery');

  graphics.forEach((graphic, index) => {
    const thumbnail = document.createElement('div');
    thumbnail.className = 'graphic-thumbnail';
    thumbnail.innerHTML = `
      
      <h4>${graphic.Title}</h4>
    `;

    thumbnail.addEventListener('click', () => {
      openGraphicModal(graphic, index, graphics);
    });

    gallery.appendChild(thumbnail);
  });
}

function openGraphicModal(graphic, index, allGraphics) {
  const modal = document.getElementById('graphicModal');
  const img = document.getElementById('modalImage');

  img.src = graphic.FilePath;
  img.alt = graphic.Title;
  modal.classList.add('active');

  // Navigation
  document.querySelector('.prev').onclick = () => {

```

```
const newIndex = (index - 1 + allGraphics.length) % allGraphics.length;
openGraphicModal(allGraphics[newIndex], newIndex, allGraphics);
};

document.querySelector('.next').onclick = () => {
  const newIndex = (index + 1) % allGraphics.length;
  openGraphicModal(allGraphics[newIndex], newIndex, allGraphics);
};
}
```

PERSISTENCE WITH `localStorage`

Track user progress:

```
javascript
```

```
const AppState = {
  progress: {
    completedSections: [],
    bookmarks: [],
    journalEntries: [],
    lastTab: 'home'
  },

  save() {
    localStorage.setItem('agenticSystemsProgress', JSON.stringify(this.progress));
  },

  load() {
    const saved = localStorage.getItem('agenticSystemsProgress');
    if (saved) {
      this.progress = JSON.parse(saved);
    }
  },

  markComplete(sectionId) {
    if (!this.progress.completedSections.includes(sectionId)) {
      this.progress.completedSections.push(sectionId);
      this.save();
    }
  },

  addBookmark(item) {
    this.progress.bookmarks.push(item);
    this.save();
  },

  addJournalEntry(entry) {
    this.progress.journalEntries.push({
      date: new Date().toISOString(),
      ...entry
    });
    this.save();
  }
};
```


FINAL CHECKLIST

- ✓ All 10 tabs implemented
 - ✓ Interactive Agent Builder Wizard with 14 steps
 - ✓ Code examples in Python, JavaScript, TypeScript, Go, Java
 - ✓ Language toggle for all code blocks
 - ✓ Framework comparison matrix
 - ✓ All 44 graphics displayed as clickable thumbnails
 - ✓ Modal with prev/next navigation
 - ✓ Read graphics from CSV file
 - ✓ Progress tracking with localStorage
 - ✓ Learning journal
 - ✓ Search functionality
 - ✓ Bookmarks/favorites
 - ✓ Copy code buttons
 - ✓ Resource links for all frameworks/tools
 - ✓ Responsive design
 - ✓ Dark mode with infographic color scheme
-

END OF PROMPT PART 2