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Day 18 of Mastering AI Agents

Advanced LangGraph Techniques

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Dynamic Edge Routing

Concept: Instead of static transitions, you can define edges that conditionally route to different nodes based on the current state or output of a node.

Use Case: Imagine a customer support bot deciding whether to escalate to a human or offer a solution based on sentiment.

Example:

```
def route_based_on_sentiment(state):
    if state["sentiment"] == "negative":
        return "human_escalation_node"
    else:
        return "auto_reply_node"

graph.add_conditional_edges("analyze_sentiment_node", route_based_on_sentiment)
```

Pro Tip: Use this to implement context-sensitive logic, branching based on real-time analysis rather than hardcoded sequences.

Custom Memory Integrations

LangGraph supports pluggable memory systems. You're not limited to the inbuilt memory — you can plug in vector stores, Redis, Postgres, or even custom APIs.

Use Case: Track long-term user intent across sessions using an external vector database (like FAISS or Weaviate).

Example:

```
class CustomVectorMemory:
    def load_memory(self, state):
        # fetch memory from vector DB
        return memory_data

    def save_memory(self, state, memory):
        # update external memory store
        pass
```

Suggestion: Integrate memory with LangChain agents to enable agentic reasoning with persistent context.

Looping and Iterative Flows

LangGraph allows for feedback loops. You can route a node back to itself (or a previous node) to enable reflection, revision, or multi-turn decision making.

Example Use Case: Let an LLM rewrite a piece of text until it passes a quality check node.

Pattern:

```
def review_and_loop(state):
    if state["quality_score"] < 0.9:
        return "rewrite_node"
    else:
        return "finalize_node"

graph.add_conditional_edges("quality_check_node",
review_and_loop)
```

Why It Matters: Perfect for use cases where human-like iteration is needed: code generation, essay refinement, negotiation bots, etc.

Multi-Agent Collaboration Patterns

You can design graphs where different LLMs or agents (each with distinct prompts, tools, or personas) work together. Patterns:

- **Debate Graphs**: Multiple agents argue and a judge node decides.
- **Specialist Graphs**: Each node is a domain expert (e.g., legal, medical, financial).
- **Planner-Executor**: One agent plans, the other executes step-by-step.

Example Setup:

```
graph.add_node("planner_agent", planner_fn)
graph.add_node("executor_agent", executor_fn)
graph.add_edge("planner_agent", "executor_agent")
```

Tip: Define distinct system prompts and tools per agent to simulate realistic collaboration.

External Tool Calling

Leverage LangGraph + LangChain tools for enhanced workflows:

- Search APIs
- SQL databases
- Code interpreters
- Custom tools (e.g., Jira integration, CRM calls)

```
tool_node = ToolInvocationNode(tools=[search_tool, math_tool])
graph.add_node("tool_node", tool_node)
```

Use Case: Autonomous research assistants or agents that fetch, process, and summarize external data dynamically.

Retry, Timeout, and Fallback Mechanisms

In production, resilience is key. LangGraph supports retry policies, timeouts, and fallback paths for robustness.

Pattern:

```
graph.set_retry_policy(node="risky_node", retries=3, delay=1.0)
graph.set_timeout(node="slow_node", seconds=10)
graph.add_fallback("critical_node",
fallback_node="safe_mode_node")
```

Real World Tip: Use this for agents calling external APIs or performing uncertain tasks — it's your safety net.

Debugging and Observability

Use graph tracing tools and logs to monitor flows, inspect state transitions, and debug.

- Use LangGraphVisualizer to display state and transitions.
- Plug into logging frameworks for auditability.
- Consider exporting the graph to DOT/JSON for visualization or static analysis.

Modular Graph Composition

Split complex workflows into modular subgraphs.

- Build reusable subgraphs (e.g., summarization, Q&A, verification)
- Compose them like functions
- Isolate complexity into testable units

Pattern:

```
summary_subgraph = build_summary_graph()
qa_subgraph = build_qa_graph()

main_graph.add_subgraph("summary_step", summary_subgraph)
main_graph.add_subgraph("qa_step", qa_subgraph)
```

Reasoning: Encourages clean architecture, maintainability, and testability.

Bonus: Prompt Injection Guards

LangGraph doesn’t inherently protect against prompt injection. But you can build in intermediate filters, sanitizers, or classifier nodes to prevent malicious inputs.

Idea: Add a node that checks for jailbreak attempts using a classifier model before passing state forward.