

Multi-Agent Workflows

Build AI Agent Systems That Automate Your Job

Ayushi Parmar

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Key tools you’ll master

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What to do next

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The “one-agent” sweet spot

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Example: Single-agent blog summary

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When a single agent falls short

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Tasks are multi-step and complex

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Different steps need different skills

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Coordination and iteration matter

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You want to reuse roles across projects

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The multi-agent mindset

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Orchestrator / Planner Agent

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Worker Agents

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Reviewer / Supervisor Agent

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When to split into multiple agents

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✔ Split into multiple agents when:

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✘ Stay with a single agent when:

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Example: From single agent to multi-agent blog pipeline

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Level 1 – Single-agent blog writer

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Level 2 – Two-agent: Research + Write

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Level 3 – Three-agent: Research + Write + Edit

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Level 4 – Full multi-agent blog crew

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When to use LangChain vs CrewAI vs AutoGPT-style

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Use LangChain alone when:

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2.1 Prepare the tool

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2.2 Define the Researcher Agent

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3.1 Define the Writer Agent's role

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Step 4 – Build the Editor Agent

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4.1 Define the Editor Agent's role

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Step 5 – Orchestrate the multi-agent workflow

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2.2 Analyzer Agent

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2.3 Fixer Agent

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2.4 Reviewer Agent

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Step 3 – Build the workflow with CrewAI

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Step 4 – How this fits into real-world DevOps

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CI-style agent pipeline

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Developer-assistant plugins

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Auto-testing workflows

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Unsafe code changes

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Over-reliance on hallucination

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Noise in the review

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Generic or fluffy copy

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Ignoring brand voice

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The cost problem in multi-agent systems

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Strategy 1 – Model-level cost optimization

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9.1 Use smaller models for “simple” agents

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9.2 Example: Model-sensitive agent roles

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Strategy 2 – Prompt and tool optimizations

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9.3 Trim system prompts and tool definitions

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9.4 Limit tokens per call

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9.5 Use tools instead of LLM calls

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Strategy 3 – Batching and async patterns

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9.6 Batch multiple requests together

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9.7 Use async calls where possible

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Strategy 4 – Caching and memoization

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9.8 Cache agent outputs

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Strategy 5 – Observability and monitoring

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9.9 Monitor your token usage

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9.10 Set alerts and quotas

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Real-world cost example

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Chapter 9 cheat sheet

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Cost optimization patterns

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Latency optimization patterns

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Scaling patterns

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What you'll learn in this chapter

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

The core failure patterns in multi-agent systems

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 1 – Hallucinations that cascade across agents

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What happens

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 2 – Coordination failures and stuck agents

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What happens

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How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 3 – Task duplication and “everyone does everything”

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What happens

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How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 4 – Loops and retries that never end

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What happens

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How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 5 – Tool misuse and “wrong tool, wrong place”

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What happens

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How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Failure 6 – Silent failures and “it looks fine but it’s wrong”

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What happens

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How to fix it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Chapter 10 cheat sheet (troubleshooting playbook)

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Failure patterns (with fixes)

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How to present this

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What you'll learn in this chapter

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

The security risks in multi-agent systems

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Core security principles for your agents

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 1 – Role-based access control (RBAC) for agents

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What it is

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How to implement it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 2 – Data privacy and PII handling

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What to avoid

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How to do it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 3 – Secure communication and tool usage

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What to secure

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How to secure it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 4 – Human-in-the-loop and governance agents

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Why humans matter

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How to implement it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 5 – Logging, observability, and audits

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Why logs matter

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How to implement it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Pattern 6 – Testing and simulating attacks

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Why simulate attacks

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How to do it

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Chapter 11 cheat sheet (security and governance playbook)

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Core security patterns

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Framing tips

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

What you'll learn in this chapter

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

The shift from “assistants” to “autonomous workflows”

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

The agentic organization of the future

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Where LangChain, CrewAI, and AutoGPT-style fit

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LangChain

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CrewAI

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

AutoGPT-style / plan-and-execute models

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Real-world use cases on the horizon

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How this changes your career and income

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

1. Consulting and advisory

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

2. Productized automation tools

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

3. Courses and training

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

4. Sequel books

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

How to stay ahead of the curve

This content is not available in the sample book. The book can be purchased on Leanpub at <https://leanpub.com/multi-agentworkflows>.

Closing thought

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Writing in Markua

Writing in Markua is easy! You can learn most of what you need to know with just a few examples.

To make *italic text* you surround it with single asterisks. To make **bold text** you surround it with double asterisks.

Section One

You can start new sections by starting a line with two # signs and a space, and then typing your section title.

Sub-Section One

You can start new sub-sections by starting a line with three # signs and a space, and then typing your sub-section title.

Including a Chapter in the Sample Book

At the top of this file, you will also see a line at the top:

```
1 {sample: true}
```

Leanpub has the ability to make a sample book, which interested readers can download or read online. If you add this line above a chapter heading, then when you publish your book, this chapter will be included in a separate sample book for these interested readers.

Links

You can add web links easily.

Here's a link to the [Leanpub homepage](#).

Images

You can add an image to your book in a similar way.

First, add the image to the “Resources” folder for your book. You will find the “Resources” folder under the “Manuscript” menu to the left.

If you look in your book’s “Resources” folder right now, you will see that there is an example image there with the file name “palm-trees.jpg”. Here’s how you can add this image to your book:



If you want to add a figure title, you put it in quotes:



Figure 1. Palm Trees

If you want to add descriptive alt text, which is good for accessibility, you put it between the square brackets:



Figure 2. Palm Trees

You can also set the alt text and/or the figure title in an attribute list:



Figure 3. Palm Trees

Finally, if no title is provided, and the `alt-title` document setting is the default of `all`, the alt text will be used as the figure title instead of as alt text.



Figure 4. Palm Trees

You can set the important document settings at Settings > Generation Settings.

Lists

Numbered Lists

You make a numbered list like this:

1. kale
2. carrot
3. ginger

Bulleted Lists

You make a bulleted list like this:

- kale

- carrot
- ginger

Definition Lists

You can even have definition lists!

term 1

definition 1a

definition 1b

term 2

definition 2

Page Breaks

We don't recommend that you manually break pages, since that is brittle and can lead to unexpected formatting if you edit text earlier in your chapter and forget about the manual page breaks. But if you really want to add a page break, you use the `{pagebreak}` directive on a line by itself, with blank lines above it and below it.

Code Samples

You can add code samples really easily. Code can be in separate files (a “local” resource) or in the manuscript itself (an “inline” resource).

Local Code Samples

Here’s a local code resource:

Figure 5. Hello World in Ruby

```
1 require 'time'
2
3 # This is just some pointless code so you can see the syntax highlighting...
4 def display_info
5   pi = Math::PI.round(10)
6   time_last_year = (Time.now - 365 * 24 * 60 * 60).getlocal("-08:00")
7   formatted_time = time_last_year.strftime("%Y-%m-%d %H:%M:%S")
8   puts "Pi to 10 decimal places: #{pi}"
9   puts "The time 1 year ago in Pacific Time: #{formatted_time}"
10 end
```

Inline Code Samples

Inline code samples can either be spans or figures.

A span looks like `puts "hello world"` this.

A figure looks like this:

```
1 require 'time'
2
3 # This is just some pointless code so you can see the syntax highlighting...
4 def display_info
5   pi = Math::PI.round(10)
6   time_last_year = (Time.now - 365 * 24 * 60 * 60).getlocal("-08:00")
7   formatted_time = time_last_year.strftime("%Y-%m-%d %H:%M:%S")
8   puts "Pi to 10 decimal places: #{pi}"
9   puts "The time 1 year ago in Pacific Time: #{formatted_time}"
10 end
```

You can also add a figure title using the title attribute:

Figure 6. Hello World in Ruby

```

1 require 'time'
2
3 # This is just some pointless code so you can see the syntax highlighting...
4 def display_info
5   pi = Math::PI.round(10)
6   time_last_year = (Time.now - 365 * 24 * 60 * 60).getlocal("-08:00")
7   formatted_time = time_last_year.strftime("%Y-%m-%d %H:%M:%S")
8   puts "Pi to 10 decimal places: #{pi}"
9   puts "The time 1 year ago in Pacific Time: #{formatted_time}"
10 end

```

Tables

You can insert tables easily inline, using the GitHub Flavored Markdown (GFM) table syntax:

Header 1	Header 2
Content 1	Content 2
Content 3	Content 4 Can be Different Length

Tables work best for numeric tabular data involving a small number of columns containing small numbers:

Central Bank	Rate
JPY	-0.10%
EUR	0.00%
USD	0.00%
CAD	0.25%

Definition lists are preferred to tables for most use cases, since reading a large table with many columns is terrible on phones and since typing text in a table quickly gets annoying.

Math

You can easily insert math equations inline using either spans or figures.

Here's one of the kinematic equations $d = v_i t + \frac{1}{2} a t^2$ inserted as a span inside a sentence.

Here's some math inserted as a figure.

$$\left| \sum_{i=1}^n a_i b_i \right| \leq \left(\sum_{i=1}^n a_i^2 \right)^{1/2} \left(\sum_{i=1}^n b_i^2 \right)^{1/2}$$

Figure 7. Something Involving Sums

Headings

Markua supports both of Markdown's heading styles.

The preferred style, called atx headers, has the following meaning in Markua:

```

1 {class: part}
2 # Part
3
4 This is a paragraph.
5
6 # Chapter
7
8 This is a paragraph.
9
10 ## Section
11
12 This is a paragraph.
13
14 ### Sub-section
15
16 This is a paragraph.
17
18 #### Sub-sub-section
19
20 This is a paragraph.
21
22 ##### Sub-sub-sub-section
23
```

```

24 This is a paragraph.
25
26 ##### Sub-sub-sub-sub-section
27
28 This is a paragraph.

```

Note the use of three backticks in the above example, to treat the Markua like inline code (instead of actually like headers).

The other style of headers, called Setext headers, has the following headings:

```

1 {class: part}
2 Part
3 ====
4
5 This is a paragraph.
6
7 Chapter
8 =====
9
10 This is a paragraph.
11
12 Section
13 -----
14
15 This is a paragraph.

```

Setext headers look nice, but only if you're only using chapters and sections. If you want to add sub-sections (or lower), you'll be using atx headers for at least some of your headers. My advice is to just use atx headers all the time. (The `{class: part}` attribute list on a chapter header to make a part header does actually work with Setext headers, but it's really ugly.)

Note that while it is confusing and ugly to mix and match using atx and Setext headers for chapters and sections in the same document, you can do it. However, please don't.

Block quotes, Asides and Blurbs

Block quotes are really easy too.

—Peter Armstrong, *Markua Spec*

Asides are useful for longer text.
But typing them like this isn't fun.

Asides can be written this way, since adding a bunch of A> stuff at the beginning of each line can get annoying with longer asides.

Blurbs are useful

Blurbs are useful

There are many types of blurbs, which will be familiar to you if you've ever read a computer programming book.



This is a discussion.

You can also specify them this way:



This is a discussion



This is an error.



This is information.



This is a question. (Not a question in a Markua course; those are done differently!)



This is a tip.



This is a warning.



This is an exercise. (Not an exercise in a Markua course; those are done differently!)

Good luck, have fun!

If you've read this far, you're definitely the right type of person to be here!

Our last piece of advice is simple: once you have a couple chapters completed, publish your book in-progress!

This approach is called Lean Publishing. It's why Leanpub is called Leanpub.

If you want to learn more about Lean Publishing, read [this](#) or watch [this](#).