

AI-Assisted Operations

Strategy and Tactics for AI usage in the jbox Project

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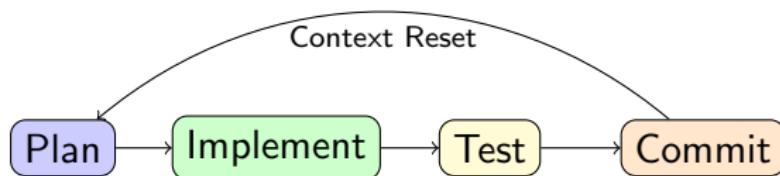
December 17, 2025

Outline

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- Best Practices
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Development Cycle

The development process follows a **plan-implement-verify-commit** cycle that maximizes AI effectiveness while maintaining code quality.



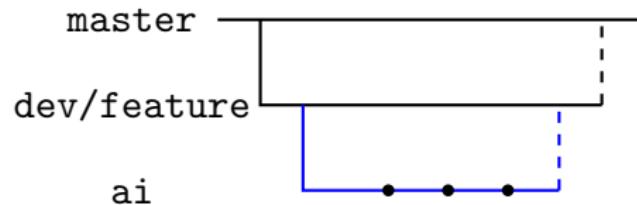
Key principle: **Incremental progress with context resets** maintains coherence across sessions.

Branching Strategy

Workflow

AI-assisted development uses a dedicated branch to isolate AI work:

- ① **Create AI branch** — Branch off from current dev/feature branch
- ② **AI performs work** — All implementation on the ai branch
- ③ **Merge to dev/feature** — Once complete, merge back
- ④ **Merge to master** — Final integration



Branching Strategy

Benefits

- **Isolation** — AI work is separated from ongoing development
- **Review opportunity** — Changes can be reviewed before merging
- **Easy rollback** — Branch can be discarded if issues arise
- **Clean history** — Squash merges consolidate AI commits

Project Setup

Establish Conventions Early

Before implementation, establish clear conventions the AI will follow:

`CONVENTIONS.md` Code style, naming, standards (C23, etc.)

`APPANATOMY.md` Standard command structure and modules

`CLITools.md` CLI specification for agent-facing commands

`CLAUDE.md` Project-level instructions for the AI

Key insight: Specification files define *target architecture* before features are implemented, ensuring coherence across the codebase.

Project Setup

Standardize Testing

Choose a single testing framework and format:

- **Python unittest** for all tests in this project
- Consistent naming: `test_<component>.py`
- Consistent structure: `tests/<category>/<component>/`
- Tests generated *alongside* implementation

Benefit

Uniform testing structure allows AI to generate tests consistently without needing repeated instructions.

Feature Implementation

Phase 1: Planning

Write a Detailed Specification:

- Feature requirements and behavior
- Input/output specifications
- Edge cases and error handling
- Integration points with existing code

Generate Implementation Plan:

- Ask AI to output AI_TODO_<N>.md
- Include phase breakdown with milestones
- Task checklists with [] checkboxes
- File locations and dependencies

Feature Implementation

Phase 2: Implementation

Instruct the AI to execute with clear constraints:

```
Proceed with the implementation plan in AI_TODO_<N>.md.
```

Constraints:

- Check off todos as they are completed
- Generate tests in the appropriate directory
- Update Makefile targets when necessary
- Follow conventions in CONVENTIONS.md
- Generate Doxygen-style docstrings
- Commit changes after each implementation phase

Incremental Progress: Implement → Test → Update build → Mark complete → Commit

Feature Implementation

Phase 3: Context Management

After each major phase or commit:

- ① **Reset the conversation context** (start fresh session)
- ② Instruct AI to continue from where it left off
- ③ Reference the AI_TODO_<N>.md file as persistent state

Why Reset Context?

- Prevents context overflow in long implementations
- Maintains fresh, focused sessions
- AI_TODO file serves as the “memory”

Quick Changes Workflow

For small changes that don't require extensive planning:

Change → **Test** → **Commit**

Characteristics:

- Single session, no plan required
- Changes made directly
- Tests run to verify
- Committed immediately

Examples: Bug fixes, documentation updates, small refactors, configuration changes

Debugging Workflow

When tests fail or bugs are detected:

- ① **Reset context** if necessary (avoid confusion)
- ② **Provide clear bug report:**

```
A bug has been detected in <component>.
```

Symptoms:

- <what is happening>

Expected behavior:

- <what should happen>

Relevant files:

- <file paths>

Test output:

```
<paste failing test output>
```

AI then: Analyze → Identify root cause → Fix → Verify → Commit

Documentation Standards

Doxygen-Style Docstrings

All functions include documentation:

```
/**  
 * @brief Short description of the function  
 *  
 * Longer description if needed, explaining  
 * behavior, edge cases, and important details.  
 *  
 * @param param1 Description of first parameter  
 * @param param2 Description of second parameter  
 * @return Description of return value  
 */  
int function_name(int param1, char *param2);
```

Documentation Standards

AI_TODO File Format

Implementation plans follow a consistent structure:

```
# Feature Implementation Plan

## Overview
Brief description of what's being implemented.

## Phase 1: Component Name
### 1.1 Task Group
- [ ] Specific task
- [ ] Another task

## Phase 2: Next Component
...

## Notes
Additional context, dependencies, considerations.
```

Best Practices

Do

- **Be specific** in requirements and constraints
- **Break large features** into multiple phases
- **Reset context** between major phases
- **Verify plans** before implementation
- **Test incrementally** as features are built
- **Commit frequently** with descriptive messages

Best Practices

Don't

- Don't let context grow too large
- Don't skip the planning phase for complex features
- Don't implement without tests
- Don't ignore failing tests
- Don't forget to update build system

Session Templates

New Feature Session

```
Implement <feature> for the jbox project.
```

```
<detailed requirements>
```

```
Output an implementation plan as AI_TODO_<N>.md  
following the format in existing AI_TODO files.
```

Session Templates

Continue Implementation Session

Continue with the implementation plan in
ai/plans/AI_TODO_<N>.md.

Resume from Phase <X>.

Constraints:

- Check off todos as completed
- Generate tests in tests/<category>/
- Update Makefile when needed
- Use Doxygen-style docstrings
- Follow CONVENTIONS.md
- Commit after each phase

Session Templates

Bug Fix & Quick Change

Bug Fix:

```
Debug the following issue in <component>:
```

```
<bug description and test output>
```

```
Fix the bug and verify with tests.
```

Quick Change:

```
<describe the change needed>
```

```
Make the change, test it, and commit.
```

Workflow Summary

Scenario	Approach
New major feature	Plan → Implement → Test → Commit → Reset
Small change	Change → Test → Commit
Bug fix	Reset → Debug → Fix → Test → Commit
Documentation	Write → Review → Commit

This strategy enables efficient AI-assisted development while maintaining **code quality, consistency, and project coherence.**

Key Takeaways

Lessons Learned

① AI works best on well-defined incremental changes

- Small, focused tasks yield better results than large ambiguous ones

② Project structure matters

- Modular design allows changes to slot in cleanly
- Tests can be added systematically
- Build system can be easily expanded

③ Simple, statically-typed languages help

- C with well-established best practices
- AI translates specifications to code more consistently
- Clear contracts reduce ambiguity

Key Takeaways

Lessons Learned (cont.)

④ AI struggles with contract changes

- Updating callers when interfaces change is error-prone
- Since “generating” code is cheap, define first:
 - ① Architecture and contracts
 - ② Dependencies
 - ③ Tests
- Then generate tests, then proceed with implementation

⑤ Design before generation

- Front-load architectural decisions
- Use specification documents as the source of truth
- Let AI implement against a predetermined design

Key Takeaways

The Formula

Well-Defined Structure

+

Clear Specifications

+

Incremental Changes

=

Effective AI-Assisted Development

Questions?