

PARABELLUM

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1 | What is Parabellum?

Parabellum is a JAX-based combat simulation environment designed for:

- ▶ Multi-agent reinforcement learning
- ▶ Tactical simulations
- ▶ Combat system modeling
- ▶ Testing AI-driven decision making

1 | What is Parabellum?

- ▶ **Geography and Terrain:** Realistic environmental modeling
- ▶ **Unit Types:** Different capabilities and parameters
- ▶ **Combat Mechanics:** Damage, range, line of sight
- ▶ **Multi-agent Framework:** Teams of allied and enemy units
- ▶ **JAX Optimization:** Fast, differentiable simulation components

2 | Technical Implementation

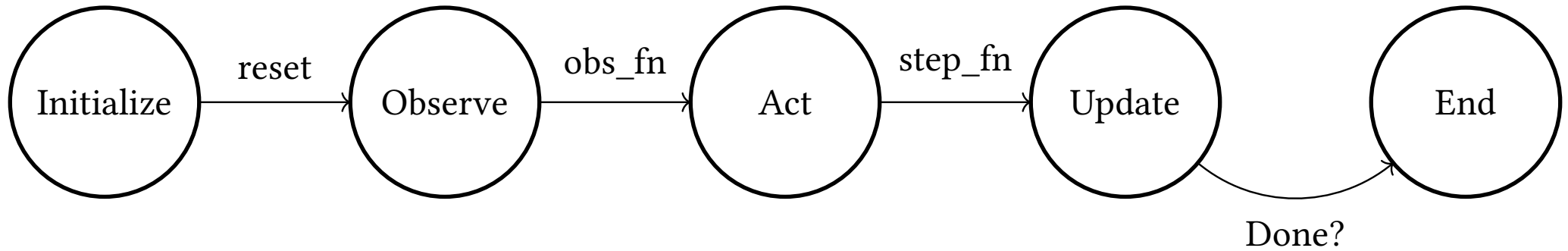
Core Technologies:

- ▶ JAX for differentiable programming and XLA
- ▶ Equinox for filtering JIT compilation
- ▶ OpenStreetMap for terrain data

Key Features:

- ▶ Vectorized operations
- ▶ Efficient state representation
- ▶ Obstacle and visibility handling
- ▶ Modular component design

3 | Simulation Flow



4 | Reinforcement Learning Applications

- ▶ **Policy Learning:** Training agents to make tactical decisions
- ▶ **Multi-agent Coordination:** Team-based strategy development
- ▶ **Adversarial Learning:** Red vs. blue team competitions
- ▶ **Scenario Generation:** Creating varied testing environments

5 | Example Use Cases

- ▶ Military tactical simulations
- ▶ Game AI development
- ▶ Strategic planning systems
- ▶ Multi-agent coordination research
- ▶ Emergent behavior studies

6 | Future Directions

- ▶ Enhanced terrain generation
- ▶ More sophisticated unit types and abilities
- ▶ Integration with larger simulation frameworks
- ▶ Performance optimizations
- ▶ Extended visualization capabilities

7 | Conclusion

Thank you!

- ▶ Repository: github.com/noahsyrkis/parabellum
- ▶ Documentation: parabellum.readthedocs.io

Questions?