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

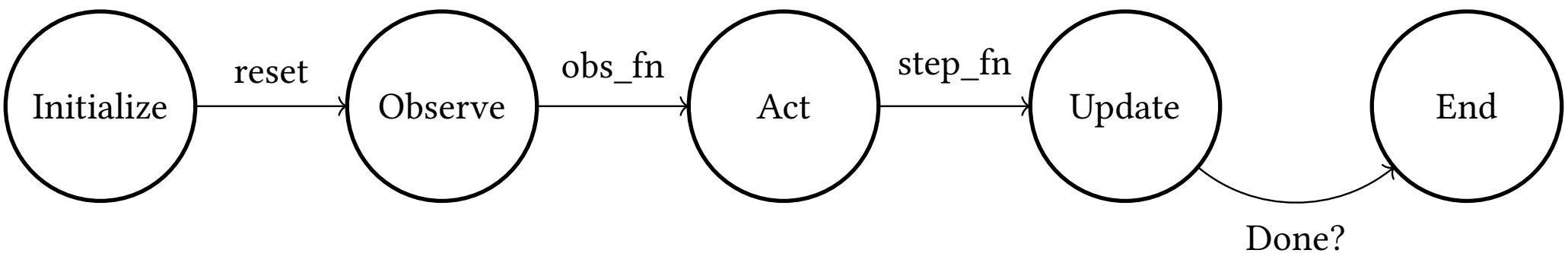
Core Technologies:

- 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?