

# The Art of Iterating: Update-Strategies in ABS

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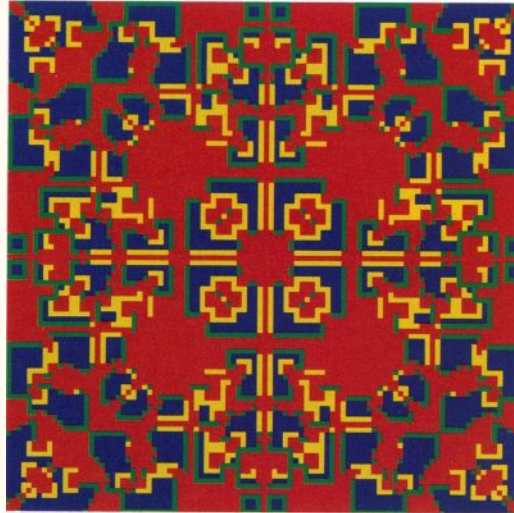
Jonathan Thaler

# Motivation

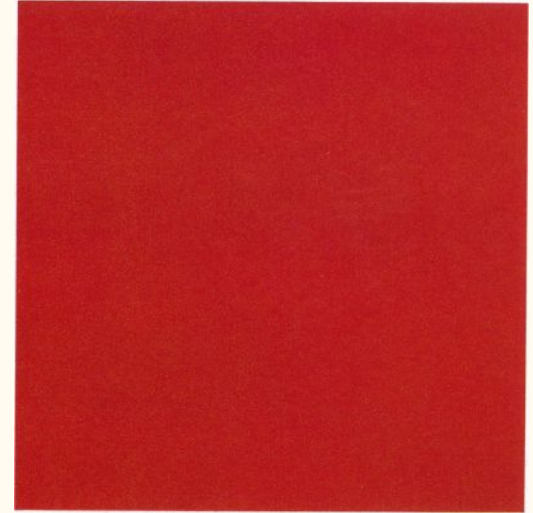


# Prisoner-Dilemma on 2D-Grid<sup>1</sup>

- Cooperate or Defect
- 1 Defector @ center
- Neighbourhood plays
- Highest payoff wins



synchronous<sup>2</sup>



asynchronous<sup>2</sup>

[1] Nowak, M. A., and May, R. M. Evolutionary games and spatial chaos. Nature 359, 6398 (Oct. 1992), 826–829.

[2] Huberman, B. A., and Glance, N. S. Evolutionary games and computer simulations. Proceedings of the National Academy of Sciences 90, 16 (Aug. 1993), 7716–7718.

# Message & Aim

**Select the update-strategy which  
reflects the semantics of the model.**

- Present new terminology
- Compare three very different languages

# New Terminology

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# Properties of ABS

## 1. Iteration-Order

**Sequential** or **Parallel**?

## 2. Global Synchronization

**Yes** or **No**?

## 3. Thread of Execution

**Separate** or **Shared**?

## 4. Message-Handling

**Immediately** or **Queued**?

## 5. Visibility of Changes

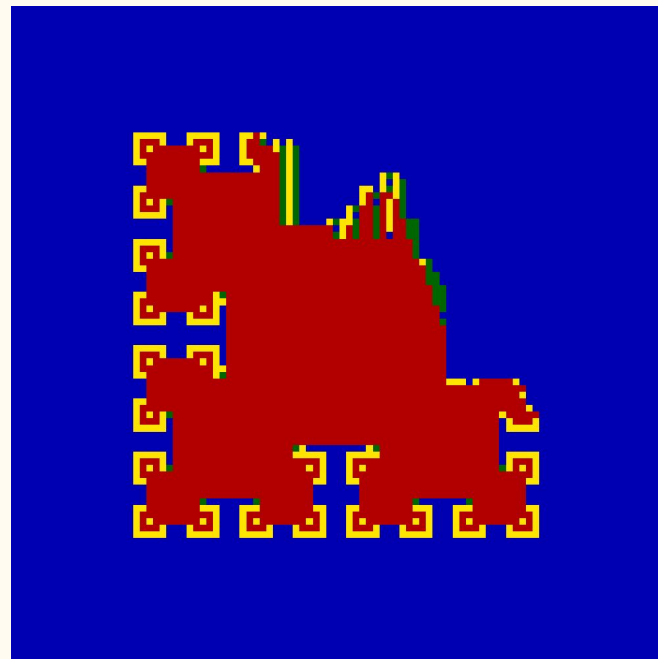
**In-Iteration** or **Post-Iteration**?

## 6. Repeatability

**Deterministic** or **Non-Deterministic**?

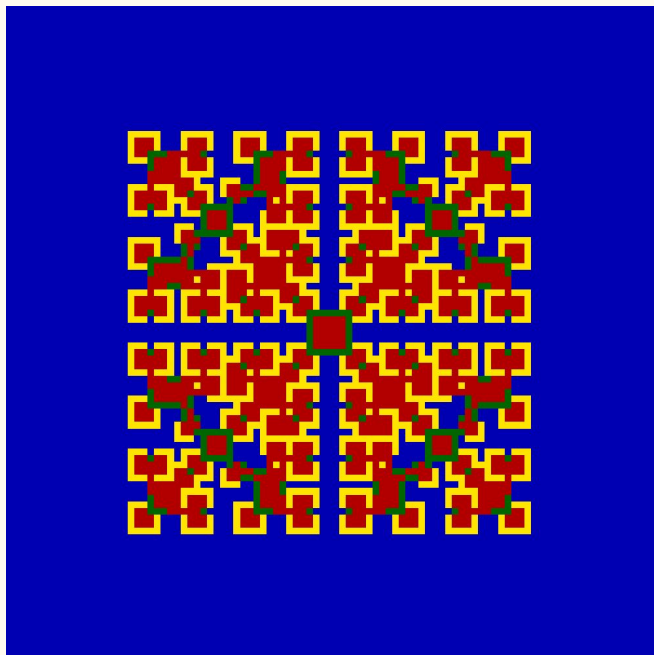
# I Sequential Strategy

- Global synchronization
- Update Agents sequentially
- Changes visible immediately
- Shared global thread



## II Parallel Strategy

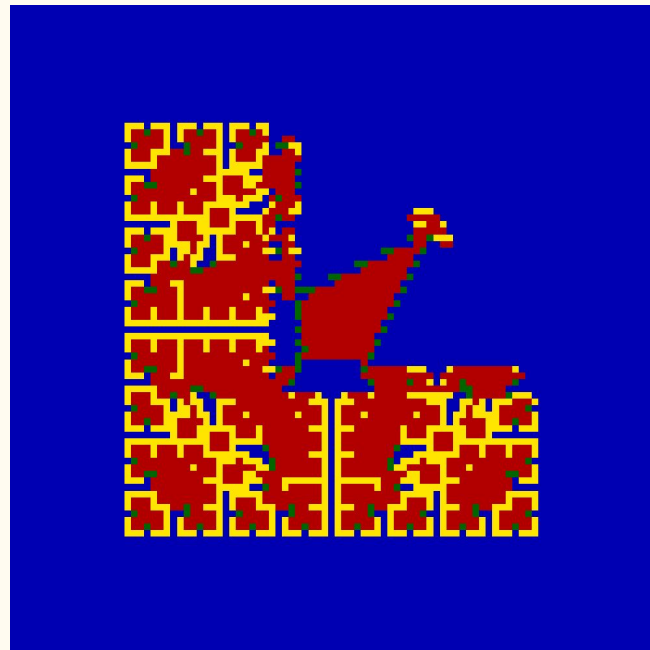
- Global synchronization
- Update Agents parallel
- Changes visible NEXT iteration
- Shared global / separate thread





# III Concurrent Strategy

- Global synchronization
- Update Agents parallel
- Changes visible immediately
- Separate thread



## IV Actors Strategy

- No global synchronization
- Update Agents parallel
- Changes visible immediately
- Separate thread



# Language Comparison

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# Java

- **Ease-Of-Use:** all Strategies faithfully
- **Benefits:** widespread, high-performance
- **Deficits:** parallelism and concurrency guidance
- **Natural:** Sequential Strategy



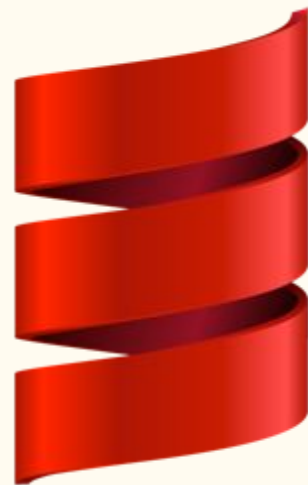
# Haskell



- **Ease-Of-Use:** all Strategies faithfully
- **Benefits:** static type-system, parallelism and concurrency
- **Deficits:** immediate message-handling, performance
- **Natural:** Parallel & Concurrency Strategy

# Scala with Actors

- **Ease-Of-Use:** only implemented Actor Strategy
- **Benefits:** elegant solutions, concurrency
- **Deficits:** Nondeterministic
- **Natural:** Actor Strategy



# Conclusion

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# Conclusion

- Properties of ABS & Update-Strategies
- Haskell surprised!
- Actor-Model promising in ABS
- **Update-Strategy must match Model**



Q & A