

Vahana.jl Workshop

Part II - Handling Simulation Data

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Session Goals

1. Writing/Restoring Simulations

- ▶ Snapshots & metadata
- ▶ Postprocessing example: Plot showing the development of opinions over time

2. Global Values

- ▶ Mean opinion tracking
- ▶ Visualization

3. Simulation Visualization

- ▶ Graph plotting
- ▶ Edge/node styling

Vahana.jl uses HDF5 for simulation storage

HDF5 is a hierarchical file format optimized for storing large scientific datasets.

Benefits:

- ▶ Self-describing through metadata
- ▶ Platform independent
- ▶ Efficient storage and access of large datasets
- ▶ Single file for the whole simulation dataset
- ▶ Partial data access (without loading entire file)
- ▶ Supports parallel read/write operations

Trade-offs:

- ▶ **HDF5.jl does not support all DataTypes**
- ▶ Complex file structure requires specific tools
- ▶ File corruption can affect entire dataset

A peek into an HDF5 file

Hegselmann-Krause-A...

> _meta

▼ agents

▼ Location

> _meta

> t_1

▼ Person

> _meta

> t_1

> t_10

▼ t_100

☰ died

☰ **state**

> t_103

> t_106

agents > Person > t_100 > state

DisplayInspect

Compound

Cell width120

NotationAutoScientificFixed-point

		opinion
n	30	
x	D0	
	0	3.601e-1
	1	7.187e-1
	2	8.109e-1
	3	7.251e-1
	4	1.798e-1
	5	3.601e-1
	6	3.031e-1
	7	5.213e-1
	8	7.251e-1
	9	5.213e-1
	10	4.051e-1
	11	7.251e-1
	12	7.251e-1

Using HDF5 in Vahana.jl

Writing Simulations

```
# Save complete simulation state  
write_snapshot(sim, "snapshot_1")  
  
# Add custom metadata  
write_sim_metadata(sim, "steps", 100)
```

Reading Simulations

```
# Load specific snapshot  
read_snapshot!(sim; comment = "snapshot_1")  
  
# Access metadata  
steps = read_sim_metadata(sim, "steps")
```

Using HDF5 in Vahana.jl

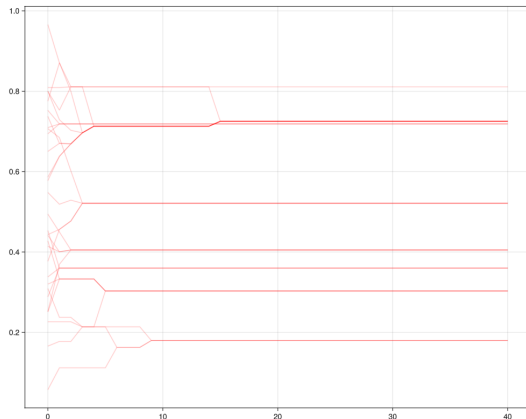
`read_snapshot!` requires an existing and matching simulation instance. If you don't need to restore the complete simulation, alternatives exist:

```
read_agents("Hegselmann-Krause-Analysis", Person)
```

Per default, files are stored in and read from a `h5` subfolder of the current working directory. You can customize this location using `set_hdf5_path(path::String)`

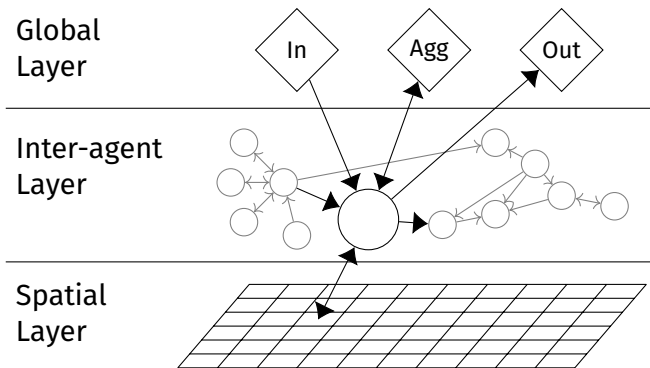
Task 1

The first task involves writing snapshots for each step, then reading and combining all opinions over time to generate this visualization:



The Global Layer

The global layer conceptually contains **vertices linked to all others**, allowing distribution of parameters and aggregation of agent data, and has also a set of **helper functions**.



Working with Global Values in Vahana.jl

Globals can either be defined as a struct and passed to `create_simulation`, or registered individually using `register_global!` on the model, where the last argument is the initial value.

```
register_global!(model, :mean_opinion, Float64[])
```

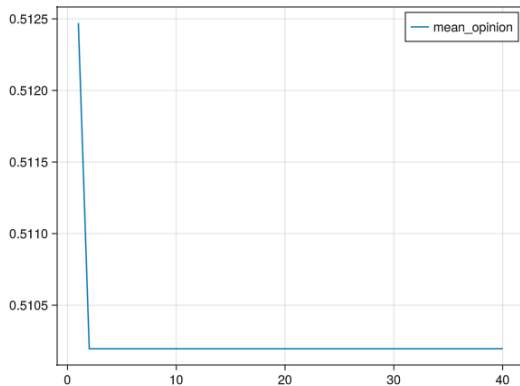
You can set a global value using `set_global!`, or in the case of a vector-type global value, append additional values using `push_global!`.

To access a global value, use `get_global`

Visualization of Time Series Data from Globals:

Global value vectors can be visualized using the provided `plot_globals` function:

```
plot_globals(sim, :mean_opinion) |> first
```



Aggregate values / mapreduce

To aggregate values in distributed simulations, we need to consider that agents are scattered across different processes. Vahana.jl handles this with `mapreduce`, which automatically collects and combines values from all processes, e.g. ...,

```
mapreduce(sim, a -> a.opinion, +, Person)
```

... to sum opinions across the entire simulation.

Task 2 is to add a global value tracking the mean opinion across all agents (although this metric is not be particularly meaningful in this context).

Interactive Graph Plots

Task 3 is to create an interactive visualization of the simulation using GraphMakie.jl, showing agents, locations, and their connections.

