The Multi-Agent Programming Contest

A challenge for everyone

Tobias Ahlbrecht Jürgen Dix
Niklas Fiekas Tabajara Krausburg
Department of Informatics, Clausthal University of Technology

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Outline

1. What is the MAPC?

Origins

Toni/Torroni (2004): Need for a competition event for

1. **modelling** (problems using logic-based agents)
2. **specifying** (logic-based multi-agent systems, given a problem)
3. **programming/implementing** (logic-based multi-agent solutions)

Dastani/Dix/Novak were lured into it. Jomi Hübner joined later. Current SC: Dix, Hübner, Novak. 15 Agent Contests by now.

Simulation Server: Suitable for problems like simulated mobile/cognitive robotics. **Provide a dynamic environment for those simulated players.**

Aim

- Stimulate research in the area of **agent-oriented programming**
- Identify **key problems** for MAS
- Collect **suitable benchmarks** that can serve as milestones for evaluating new tools, models, and techniques
- Gathering test cases which require and enforce **coordinated actions**

First Contest in 2005

- No **server platform** available.
- Participants were provided with a precisely defined scenario.
- They had to implement the scenario and solve the problem.
- Complete system sent to us for inspection.

Running these systems . . . was a nightmare.

2. The MASSim platform

The MASSim Platform

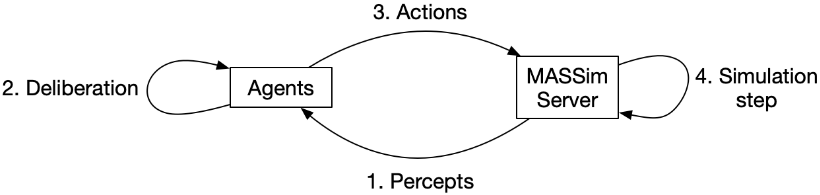
Server: Unified scenario implementation

Agents: Connect remotely (sockets)

- Receive percepts (state of the visible environment)
- Deliberate and send actions back

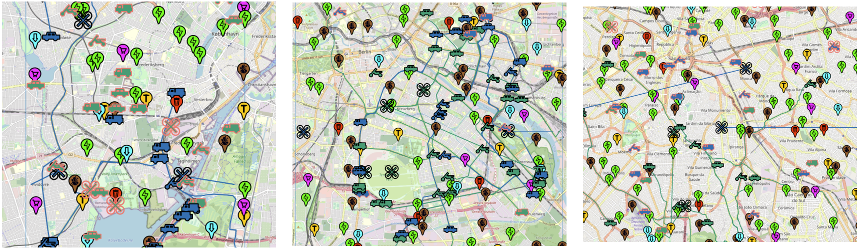
Simulation: Discrete steps

- actions of all agents processed after each step



Tournament

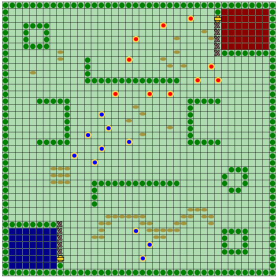
- Games between **2 teams** of agents
- Each team plays against each other
- Deliberation: **4 seconds** per step for network roundtrip and action computation
- **3 simulations** (different parameters per match)
  - environment characteristics
  - agent characteristics (features, number, . . .)

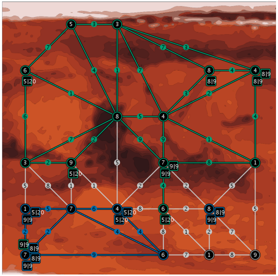


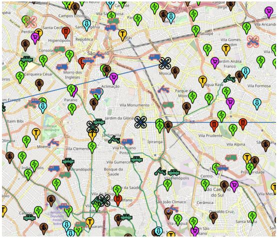
3. Games of the MAPC

Scenarios

- Six **distinct** scenarios so far
- Scenarios **evolve** over multiple years
- Specific **design goals**
  - **Advantages** for agent-based solutions
  - Enforce **cooperation**
  - No single best **winning strategy**
  - **Simple** to start, but **hard** to master

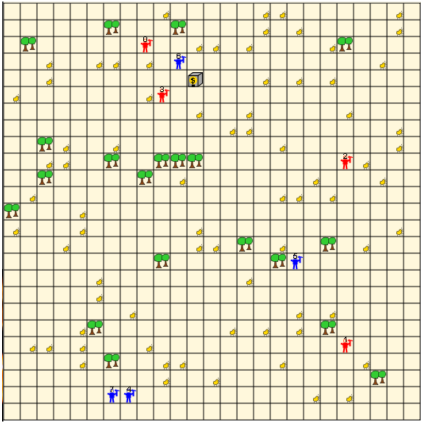


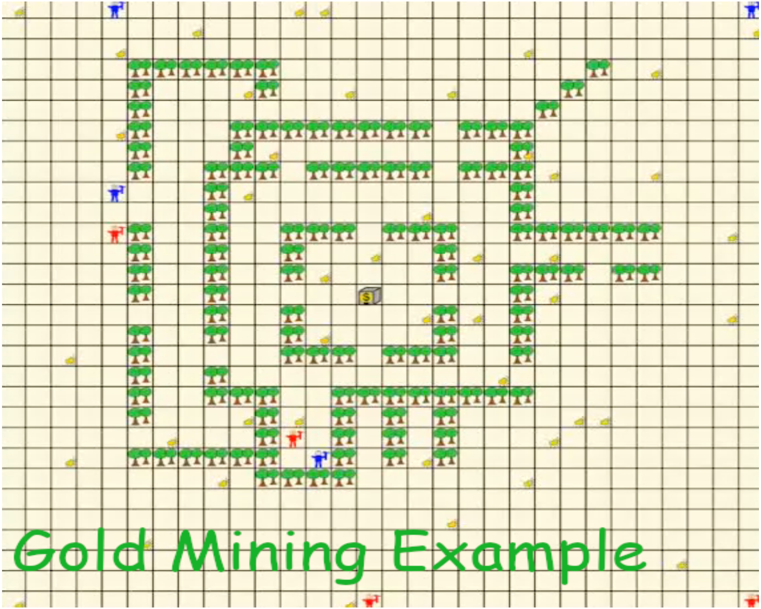




The early days: Food gathering & Gold mining (2005-2007)

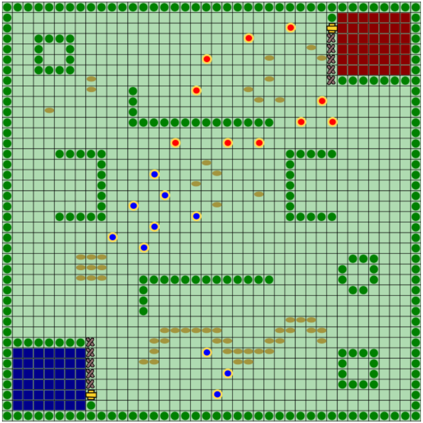
- Simple **grid** environment
- Food/gold appears **dynamically**
- Teams of four agents collect and deliver
- Agents perceive food/gold at their current position only
- Solutions based on **computational logic**

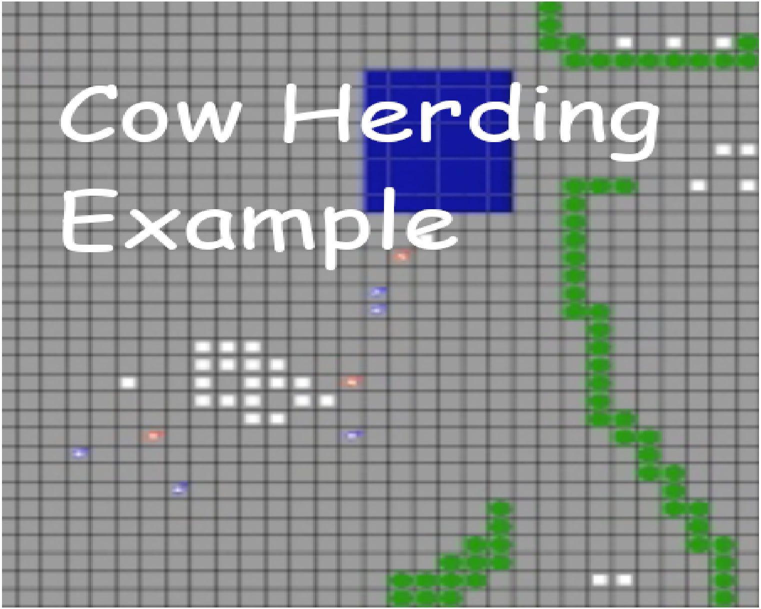



Gold Mining Example

More cooperation: Cow Herding (2008-2010)

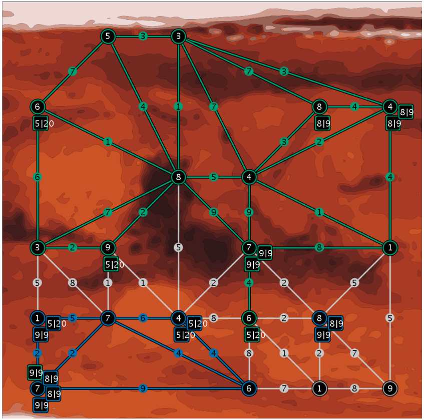
- **Grid** environment again
- Navigation: Obstacles
- Dynamic entities: **Cows**
  - Flocking behaviour
- Cooperation: **Fences**
- Goal: Corrals





Cow Herding Example

Leaving earth behind: Agents on Mars (2011-2014)



- **Graph** environment
- Goal: Occupy zones
- Agents have **roles**
  - e.g. explorer, saboteur, . . .
- Interaction (**attack** and **repair** actions)
- Achievements and upgrades

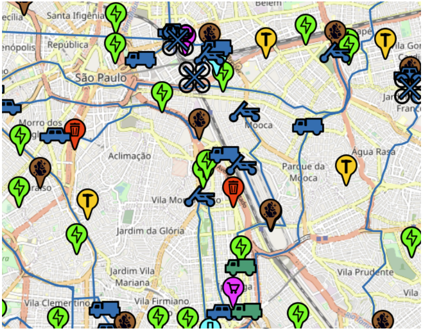
Looking back (but not in anger)

Are MAS really better than traditional programming languages? **Are there killer applications?**

- How to design a scenario?
  - Not: A scenario that can be solved with a smart idea.
  - A scenario that evaluates various aspects of a MAS.
  - **Collaboration** should pay of.
  - Teams should evolve dynamically, not planned ahead.
  - Are some scenarios better suited for MAS?
  - Destructive strategies . . .
- Determinism vs indeterminism: learning agents.
- A game of **two (or more?)** MAS?

Agents in the city (2016-2018)

- **OpenStreetMap**-based environment
- Agents: Different vehicles
- Goal: complete jobs
  - Buy or gather **resources**
  - Assemble items (cooperation)
  - Deliver items
  - Don’t forget to recharge



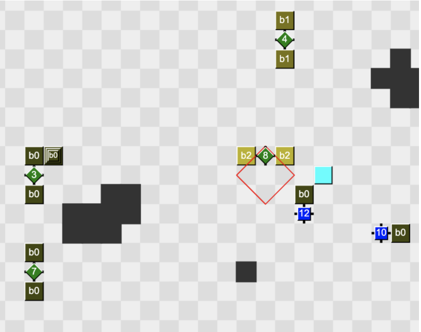
Today and beyond: Agents assemble (2019-?)

Idea: Combine some of the “best” features from previous scenarios.

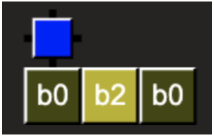
- **Environment structure** (Cow Scenario)
  - Good visibility (what’s going on?)
  - Agents interact and interfere “physically”
- **Goals** (City Scenario)
  - High degree of planning and cooperation required
- Explicit action to **interfere** with opposing agents (Mars Scenario) (`clear`)

Agents assemble

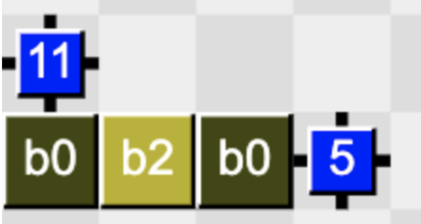
- **Grid** environment
- Agents can carry **blocks**
- **Obstacles** complicate navigation
  - … but can be destroyed!
- Goal: Complete **tasks** to earn points
- **Actions**: move, attach/detach blocks, connect blocks, clear
- Dynamic **events**



Completing tasks

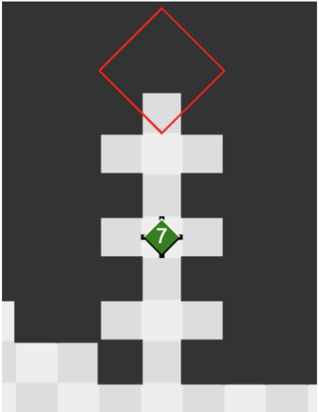


Task description

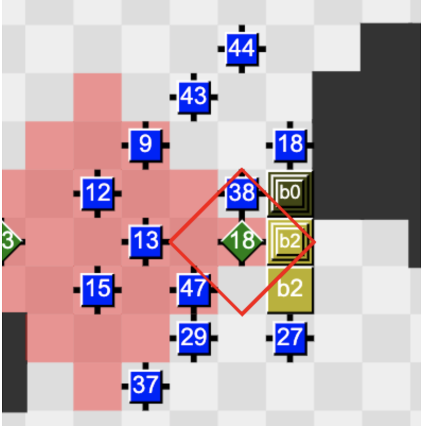


Agents assemble together

Clear action

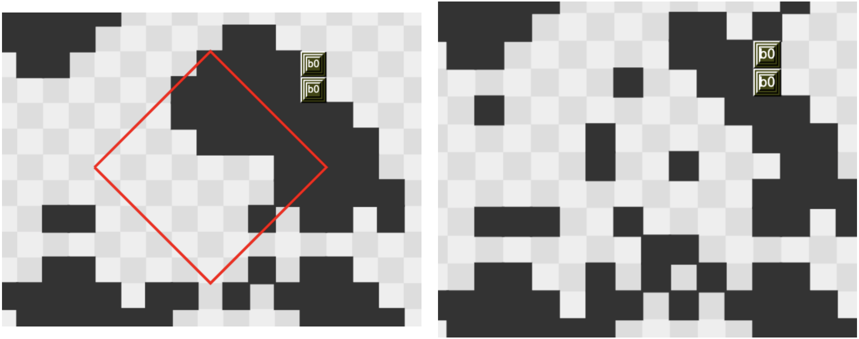


Clears a path



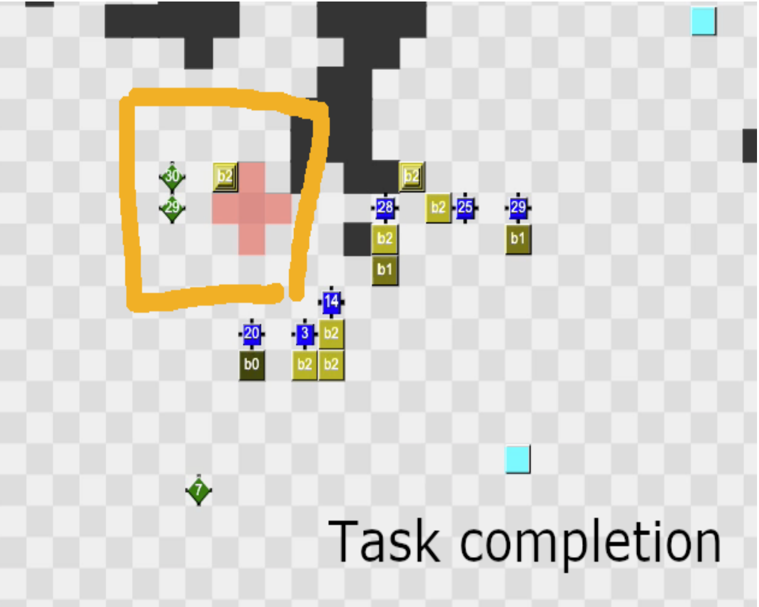
Disables (or scares) agents

Clear events



Remove and scatter new obstacles

- Make navigation more difficult
- May force static agents to leave their place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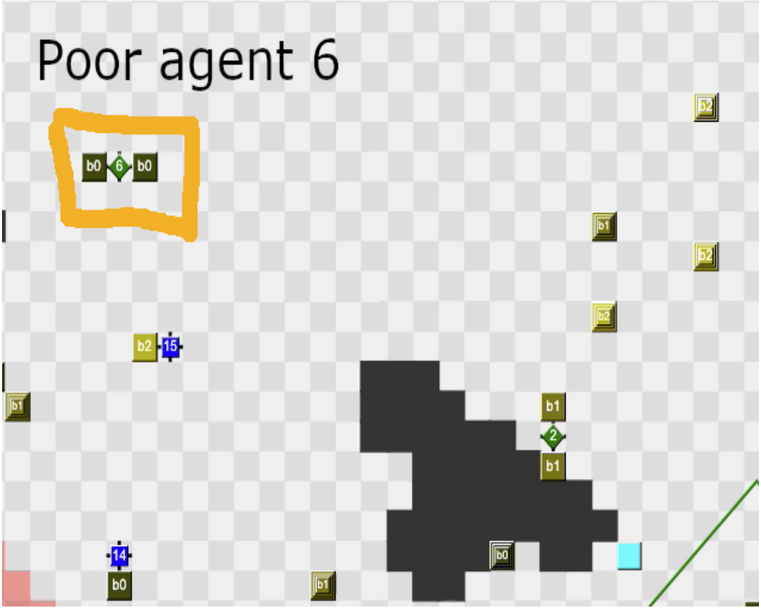
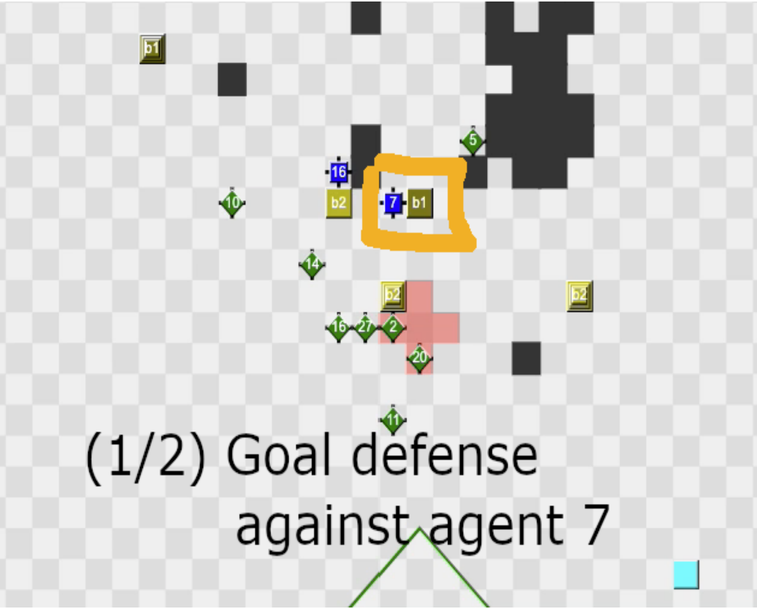
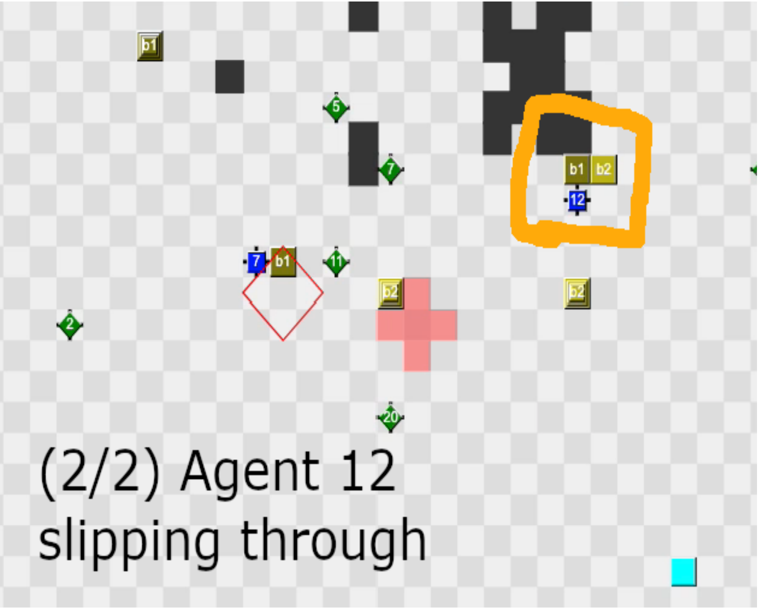
Task completion



Poor agent 6



(1/2) Goal defense against agent 7



(2/2) Agent 12
slipping through

4. Lessons learned

Lessons learned (so far)

- Cooperation needs to be **enforced by all means**
- Agents (and people) tend to take the **path of least resistance**
- **Debugging** MAS is very challenging
- Difficult to discourage **centralized** coordinators
  - Still: mostly agent platforms winning
- **Statistics and visualisations** important for analysis

Why do people participate?

Results from questionnaire:

- Learn about agent programming
- Practice using an agent programming language
- Evaluate (their own) agent platforms, techniques, …

5. Participating

How to participate in the MAPC?

- Contest announcement: September/October
- Contest: Spring 2022
- Join the mailing list
- Join the short course **tomorrow**!

Links

- `https://multiagentcontest.org`
- `https://twitter.com/AgentContest`
- `https://groups.google.com/forum/#!forum/agentcontest`

6. Future of the MAPC

Future of the MAPC

- Try to run agents on the contest server again
  - New technologies like containers etc.
- Test agent **autonomy and robustness** with more games, longer games, . . .
- Improve (semi-)automatic **analysis**
- Experiment with **continuous** (time and space) environments?

Thank you