MAI IMAS

Coordination Tasks and Agent Cooperation

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Self-Interested Agents

Work independently to further their own interests

Sometimes at the expense of others

Self-Interested Agents

Discrete MAS	**MAS with emergent behaviour**
Agents work independently	Agents work independently
No relation or cooperation	Can end up unintentionally cooperating

Application to garbage scouting

ScoutAgents' only goal is to find garbage

Reactively search, no organised cooperation

Possible, but suboptimal

Assumptions

Agents are benevolent

Explicitly cooperate
(with communication)

Coordination Tasks

A Scouting Coordination

B Harvesting Coordination

C Vehicle Coordination

Cooperation Mechanisms

Deliberative	**Negotiators**
1 PGP / GPGP	3 Contract Net
2 Coalitions	4 Auctions
	5 Voting

PGP

Each agent creates a local plan

Agents exchange local plans and generate PGP by combining local partial plans

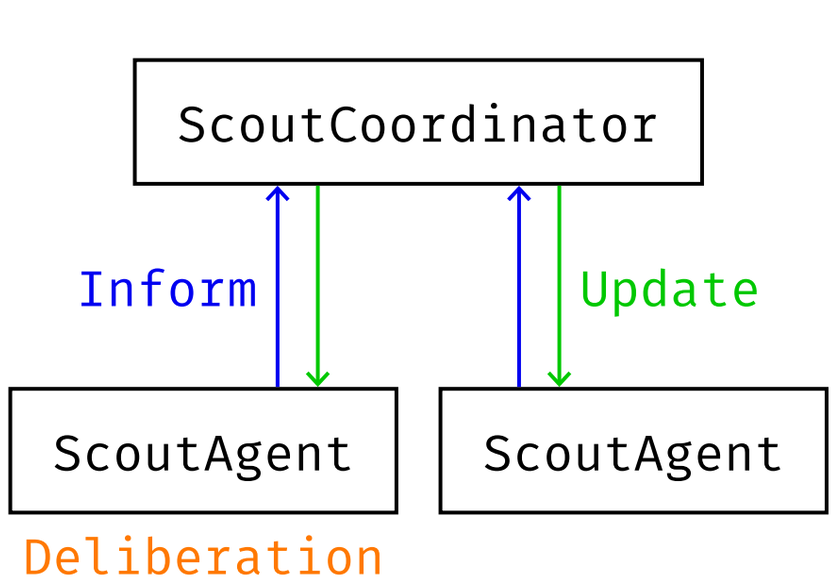
Optimise PGP: analyse received information

GPGP

Domain-independent extension

Scouting Coordination

1. ScoutAgents decide their own paths (local plans)
2. ScoutCoordinator collects local plans and builds PGP
3. ScoutCoordinator checks for conflicts, returns modified PGP



PGP / GPGP — Advantages and Disadvantages

+ Flexibility in a dynamic environment

+ Efficiency: elimination of conflicts and redundancy

– Complexity

Coalitions

Several agents work together in a coalition

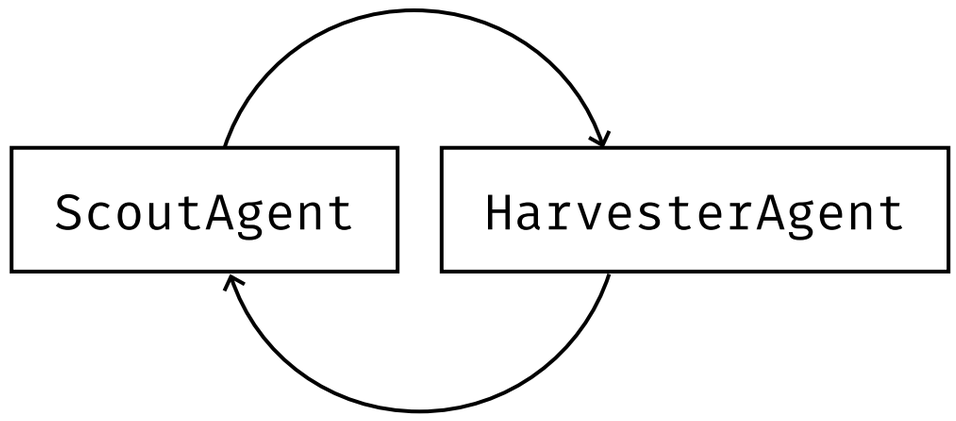
Achieve tasks that could not be achieved individually

Complete tasks more efficiently

Vehicle Coordination

Vehicles, that come close to each other, enter in a coalition

Objective is to move on fast and efficiently without colliding



Coalitions — Pros and Cons

+ Coalitions can prevent collisions
– A lot of communication
– When to form a coalition?
– Which mechanism to use?

Contract Net

Based on the way in which companies put contracts out to tender

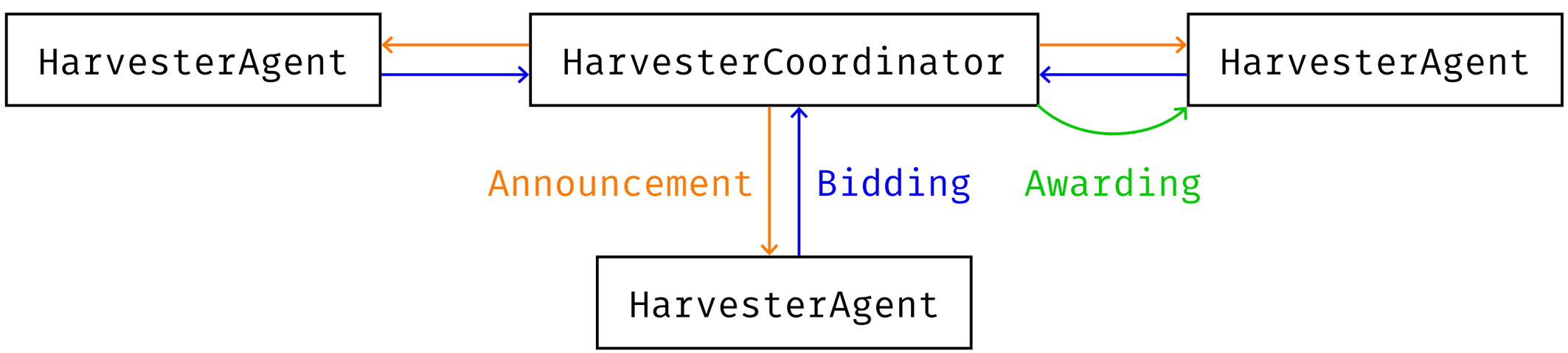
Five phases:

1. Recognition
2. Announcement
3. Bidding
4. Awarding
5. Expediting

Contract Net — Applicability

Harvesting Coordination

1. HarvesterCoordinator announces garbage
2. HarvesterAgents submit tenders
3. HarvesterCoordinator assigns task to one or more



Contract Net — Pros and Cons

+ Garbage collection is dividable into subgoals

+ Garbage collection subgoals are complex, it makes sense to distribute them efficiently

– Computational effort (deliberation)

– Time delay (exchange of messages)

Auctions

Allocate goods/resources among competing self-interested parties

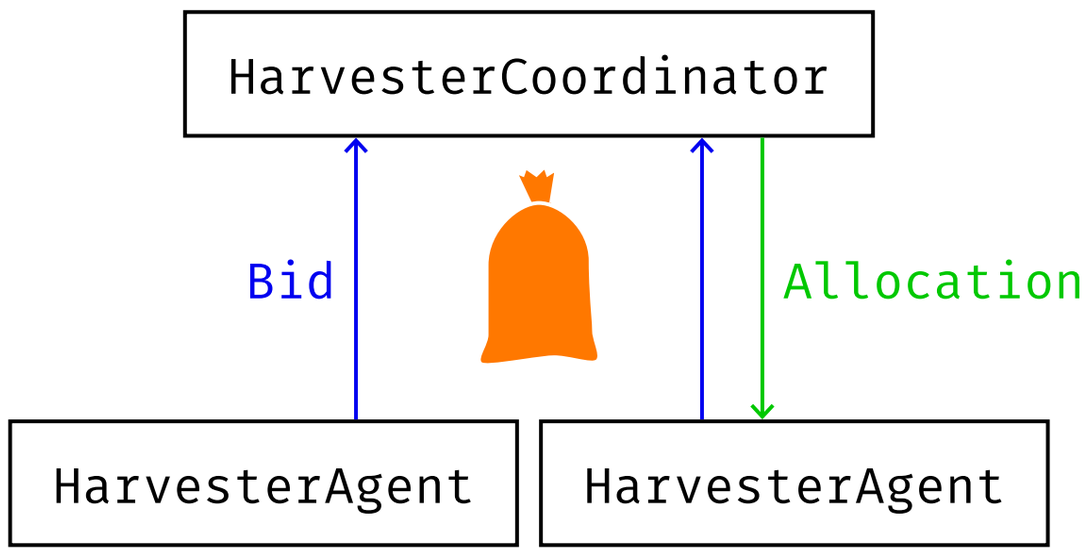
English
Dutch
First price sealed bid (FPSB)
Vickrey

Multi-unit
Multi-attribute
Combinatorial

Auctions — Applicability

Harvesting Coordination: FPSB

1. Auctions of each group of garbage
2. HavesterAgents bid (based on their current state, load, distance from garbage)
3. HarvesterAgent allocates tasks to one or more



Auctions — Pros and Cons

+ Multi-attribute auctions would allow for allocation based on additional attributes/ information

– Agents are not self-interested and competitive, but want to reach a common goal together

Voting

Distributed deliberation process,
decisions are taken collectively

Simple voting
Plurality, Anti-plurality, Best-worst, Approval

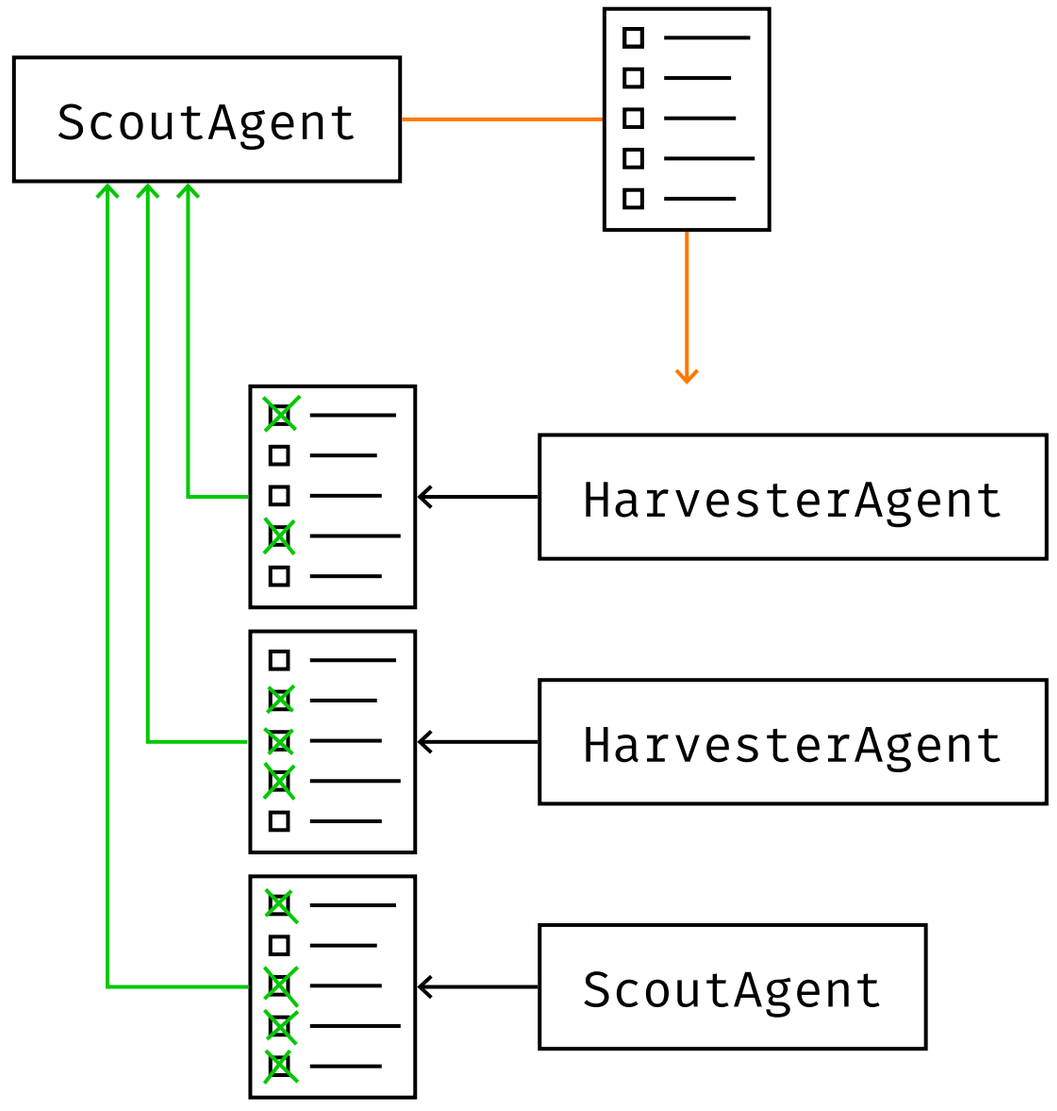
Total order voting
Binary, Borda, Condorcet

Voting — Applicability

Vehicle Coordination: Approval Voting

1 Each vehicle puts a list of possible routes to a public vote

2 Other vehicles approve those paths that do not interfere with their own route



Voting — Pros and Cons

+ Agents have different destinations (objectives), and their decisions affect others

+ Equality principle: each vote has same weight

– Many vehicles have to determine their route at the same time: we need an order

– Unnecessary high computational cost to calculate alternative routes

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