



# TREASURE HUNT PROBLEM

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INTRODUCTION TO MULTI-AGENT SYSTEMS

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MASTER IN ARTIFICIAL INTELLIGENCE

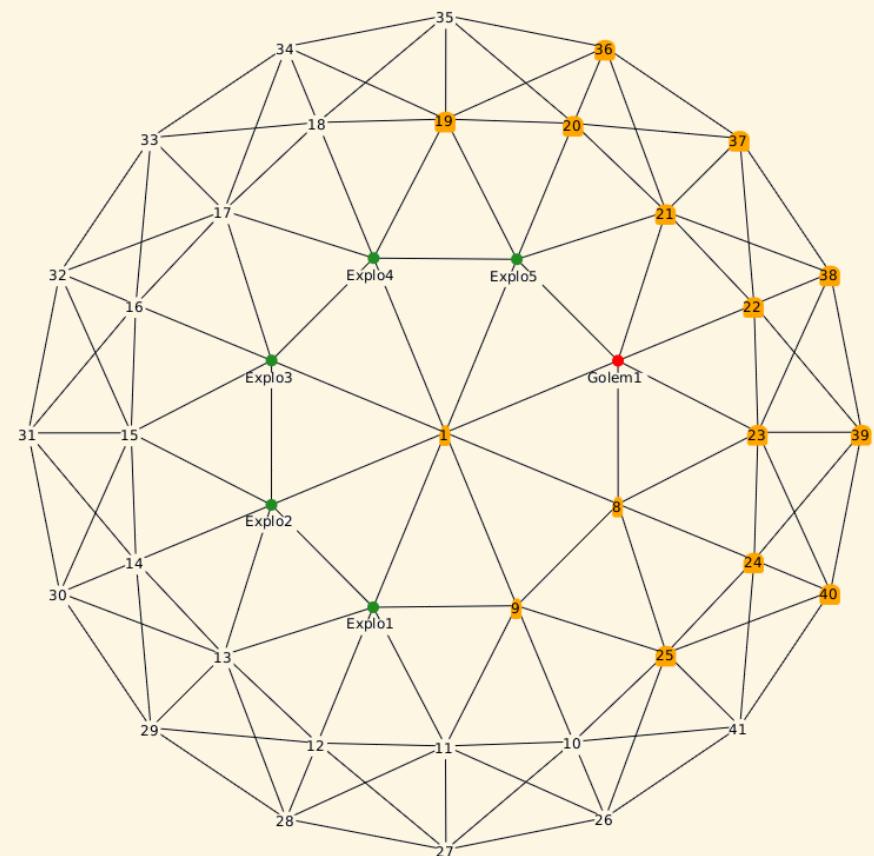
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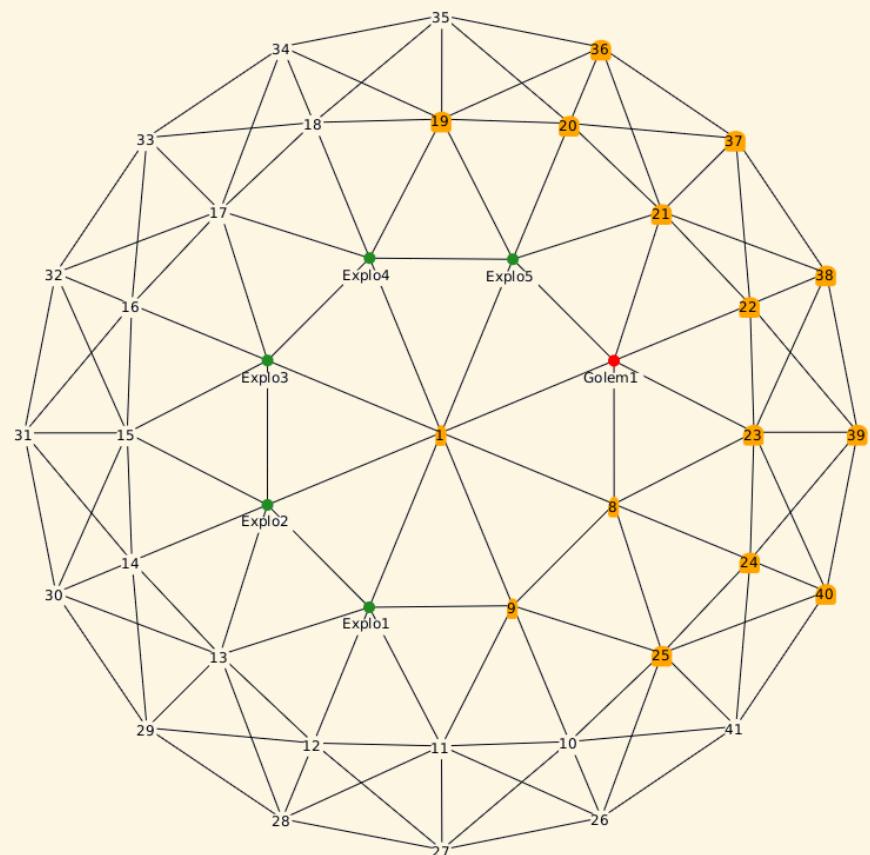
Martín Suárez | Isabel Piedrahita | Mario Rosas | Laura Roldan | Alam López

# PROBLEM DESCRIPTION



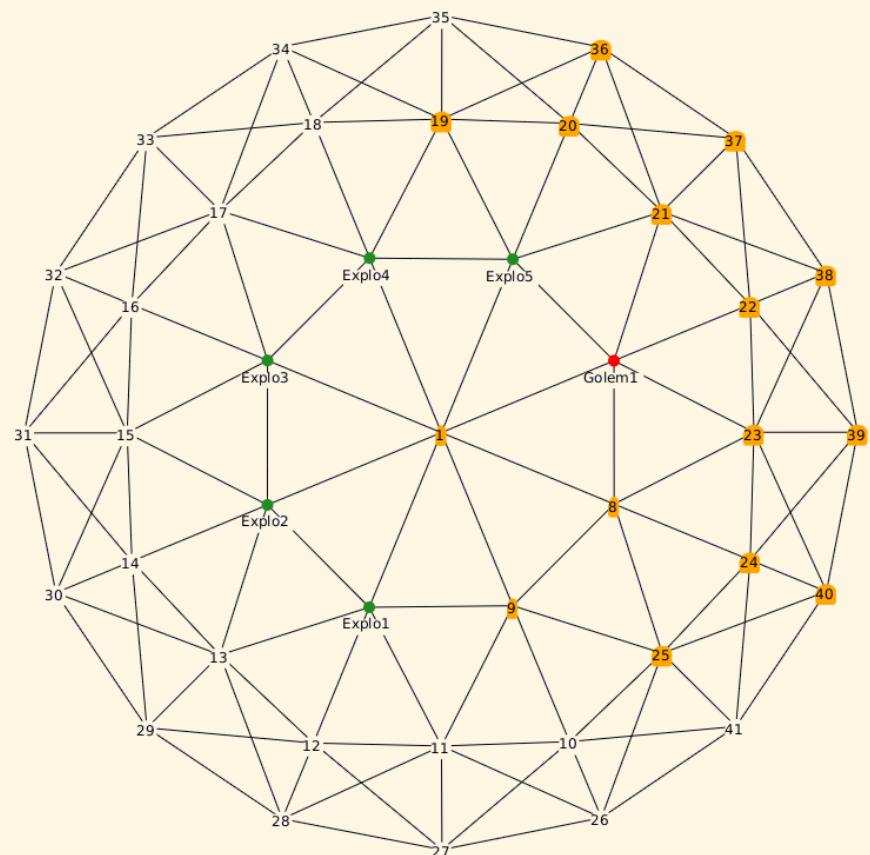
# PROBLEM DESCRIPTION

- Implementation of a treasure hunt simulation with the goal of optimizing treasure exploration and collection.



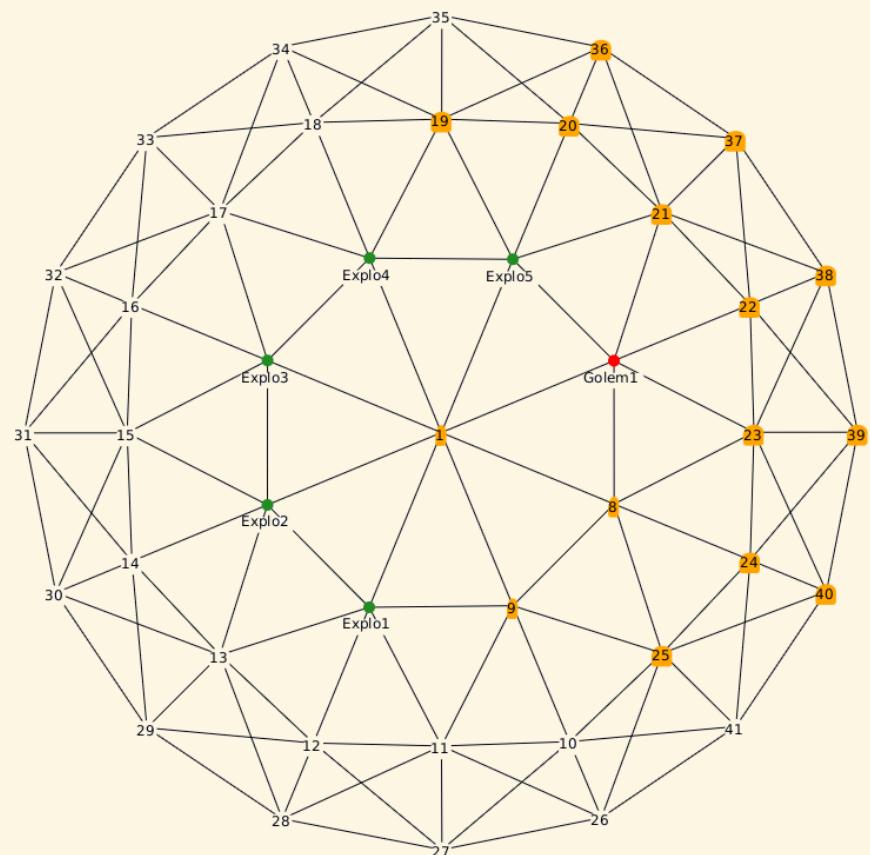
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- Implementation of a treasure hunt simulation with the goal of optimizing treasure exploration and collection.
- Inclusion of various agent types, coordination mechanisms, communication protocols, and cooperation strategies.



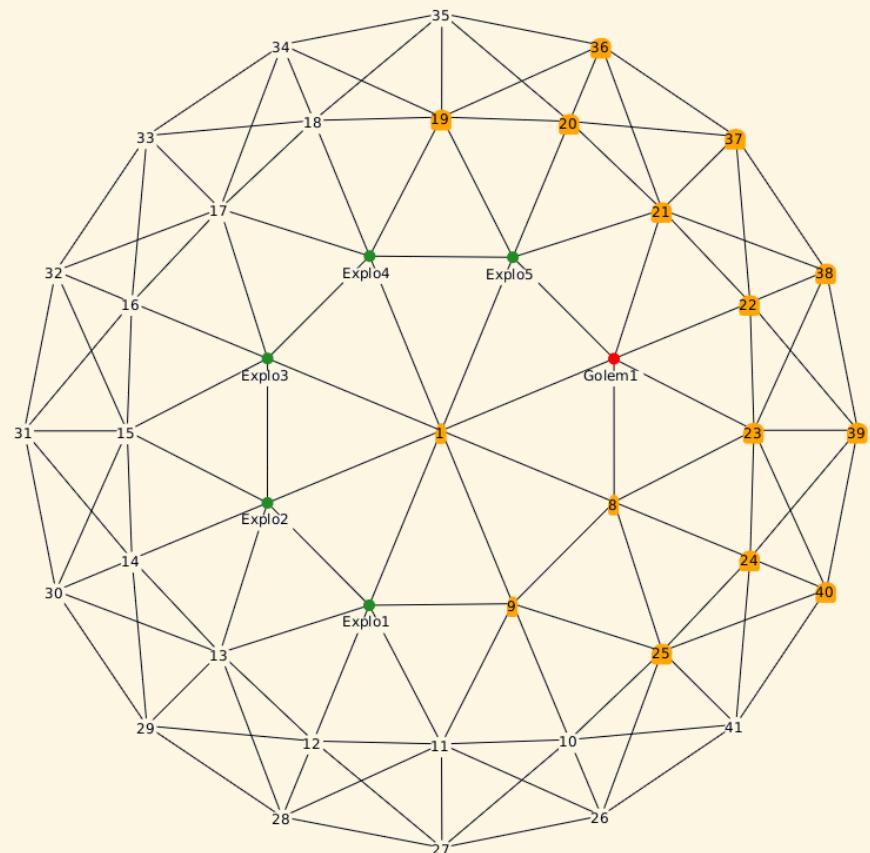
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- Inclusion of various agent types, coordination mechanisms, communication protocols, and cooperation strategies.
- Utilization of an undirected graph as the world map.
- Evaluation of time and step requirements for task completion.



# GENERAL ANALYSIS

- Environment Characteristics
- Metrics
- The map



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- Environment Characteristics
  - Fully vs Partially observable
  - Deterministic
  - Dynamic
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  - Total collected goal
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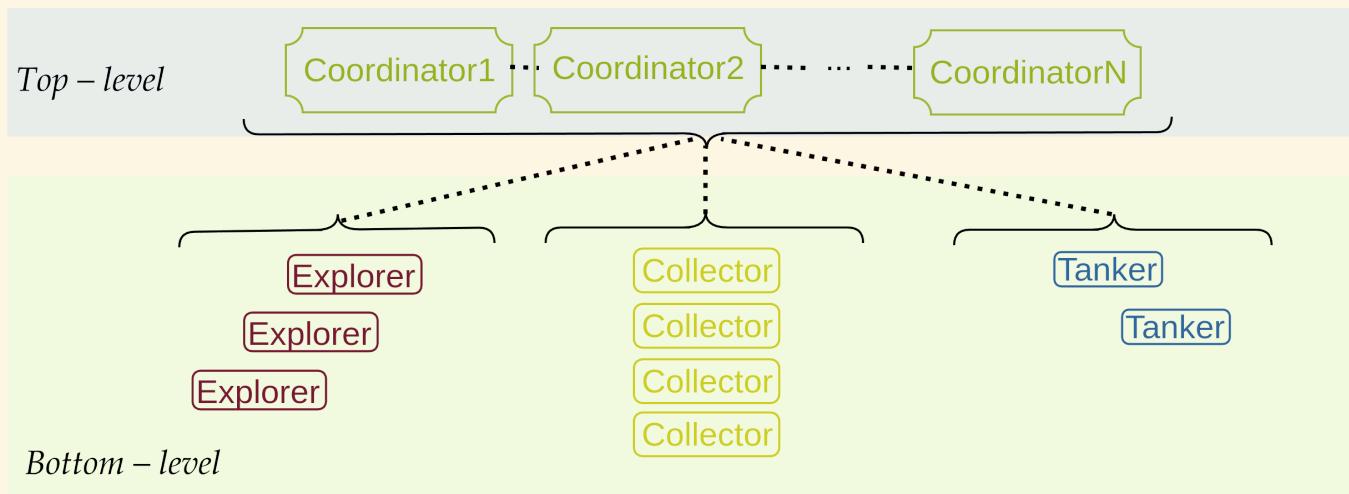
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- **Metrics**
  - Total collected goal
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- **The map**
  - 579 Nodes
  - Based on León
  - Undirected, biconnected graph
  - Treasure placement definition

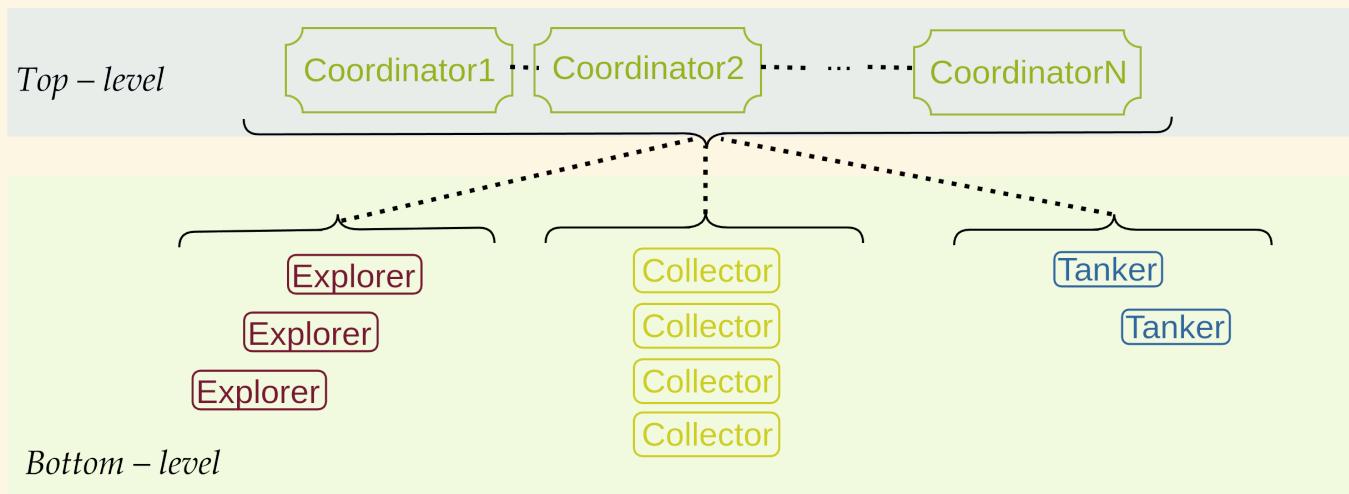
# GENERAL SYSTEM ARCHITECTURE

- Architecture Characteristics



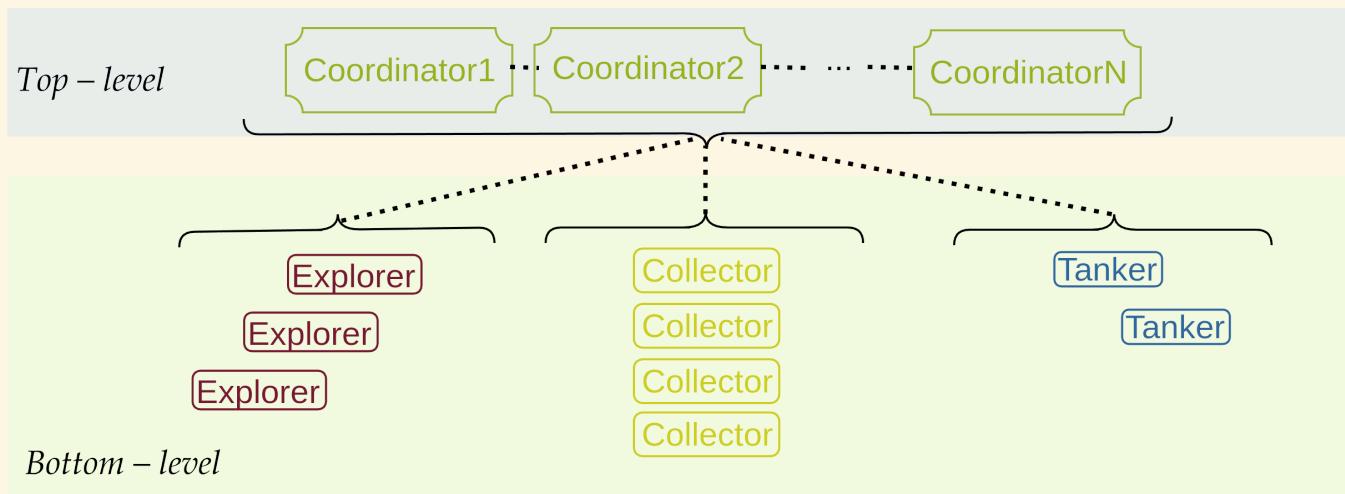
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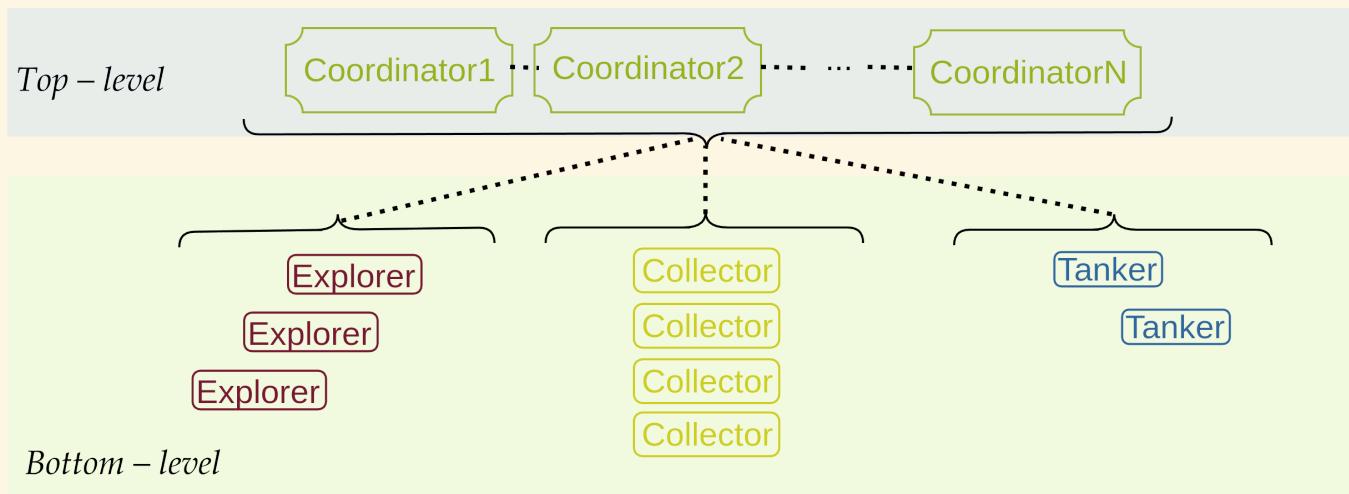
# GENERAL SYSTEM ARCHITECTURE

- **Architecture Characteristics**
  - Hierarchical



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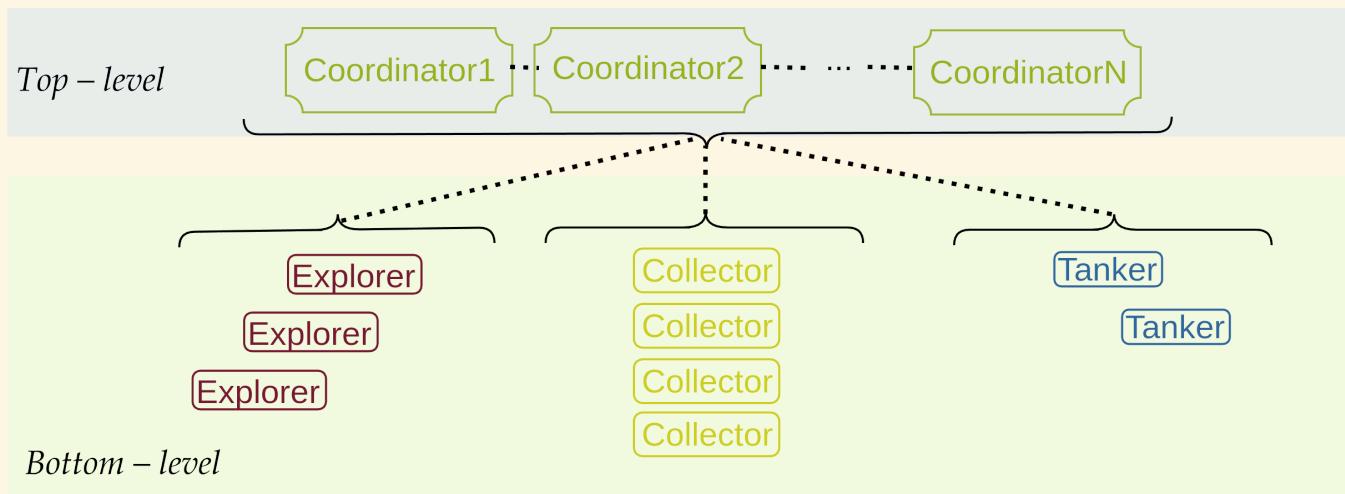
- **Architecture Characteristics**
  - Hierarchical
  - Efficient task distribution and coordination



# GENERAL SYSTEM ARCHITECTURE

- **Architecture Characteristics**

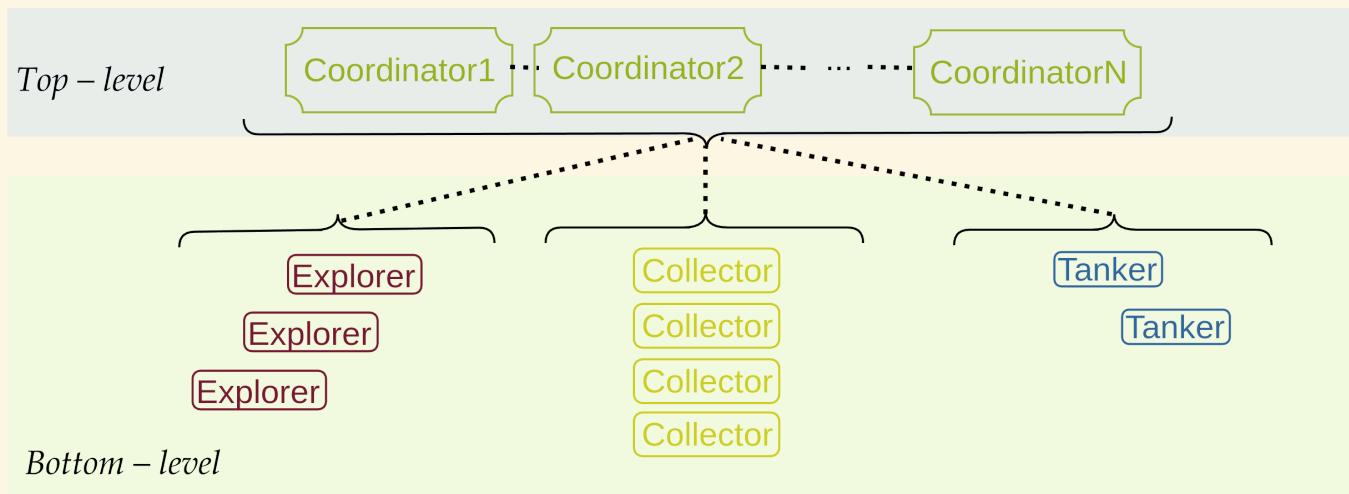
- Hierarchical
- Efficient task distribution and coordination
- Multi-level control



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- **Architecture Characteristics**

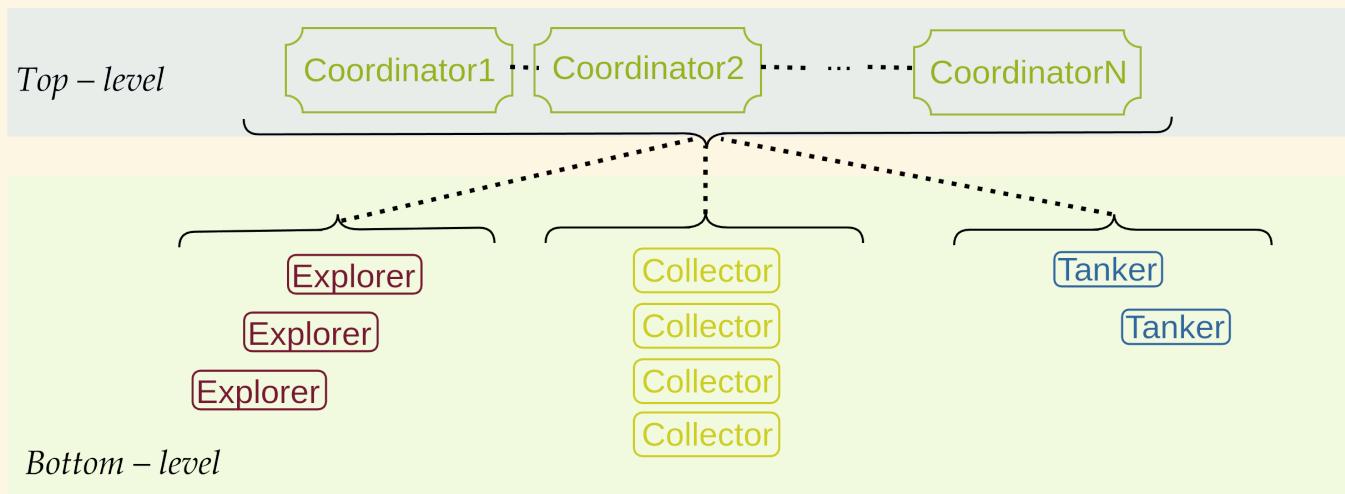
- Hierarchical
- Efficient task distribution and coordination
- Multi-level control
- Overall statistical measures



# GENERAL SYSTEM ARCHITECTURE

- **Architecture Characteristics**

- Hierarchical
- Efficient task distribution and coordination
- Multi-level control
- Overall statistical measures
- Focus and Adaptability

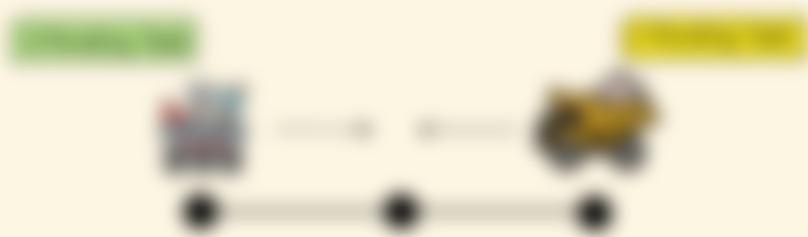


# PROBLEM DECOMPOSITION

- Map Exploration



- Deadlock Management



- Treasure collection

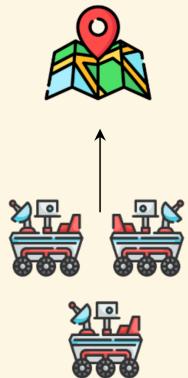


- Communication and Information Sharing
- Basic Behaviours and Dynamic Task Allocation



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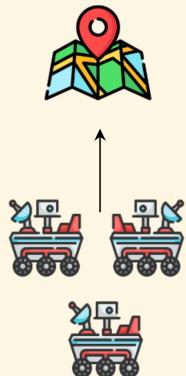


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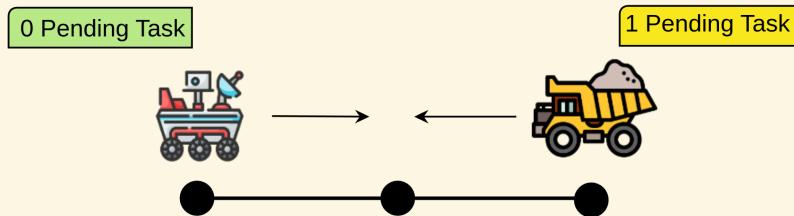


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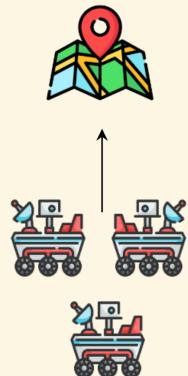


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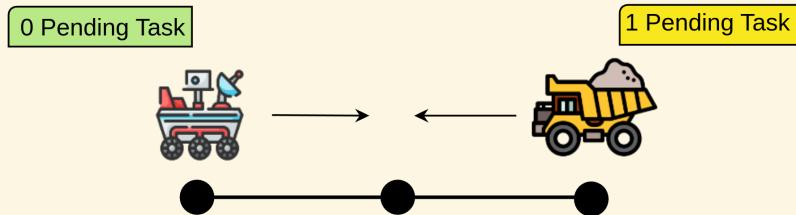


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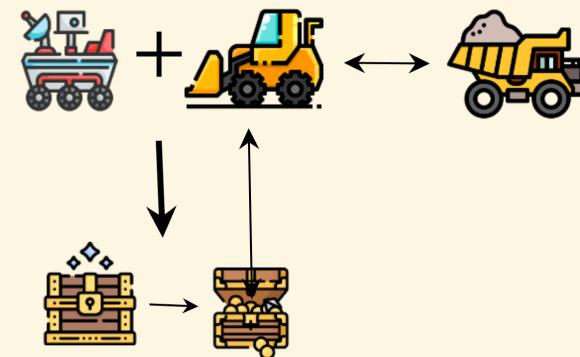
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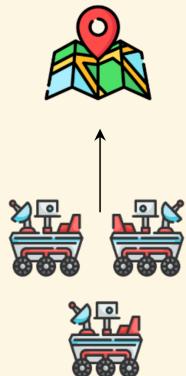


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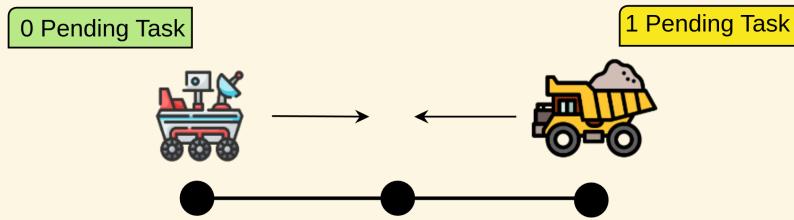


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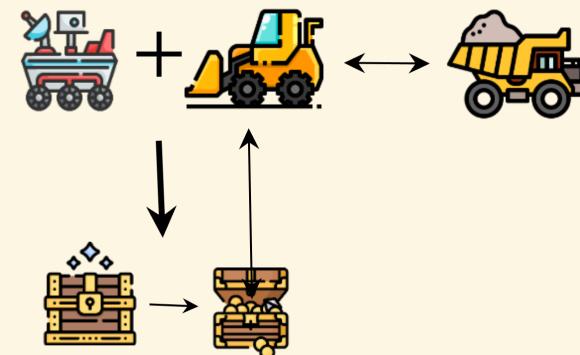
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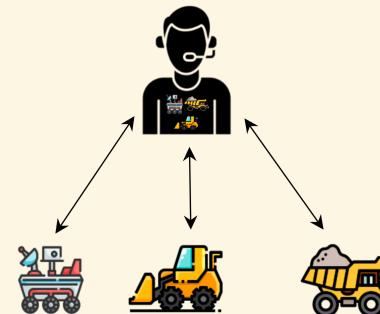
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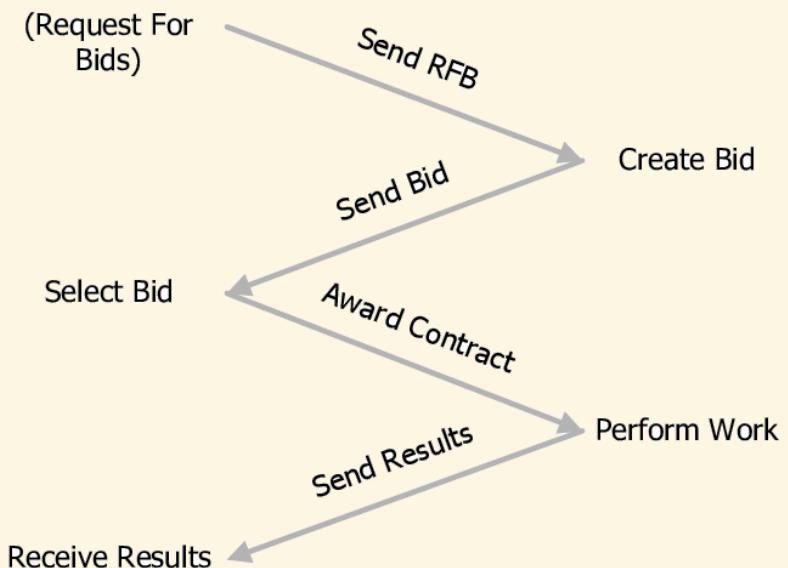


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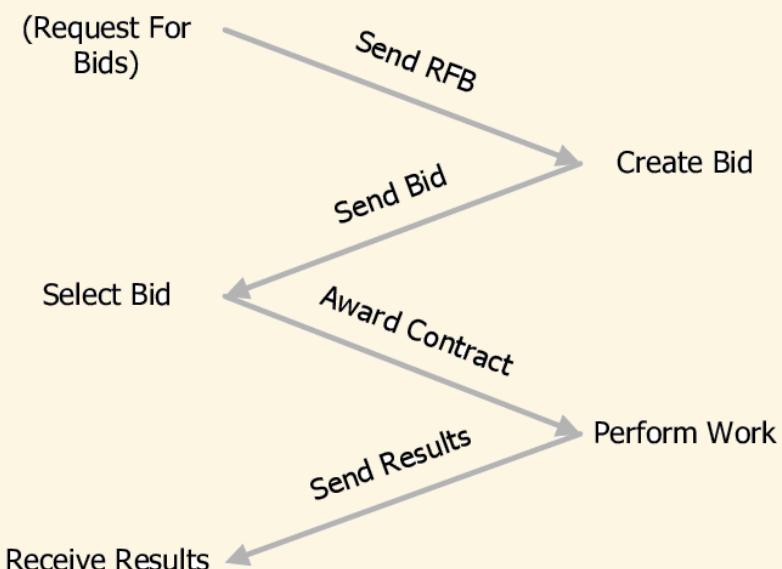


# TASK SHARING

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## CONTRACT NET

Managers - Coordinators

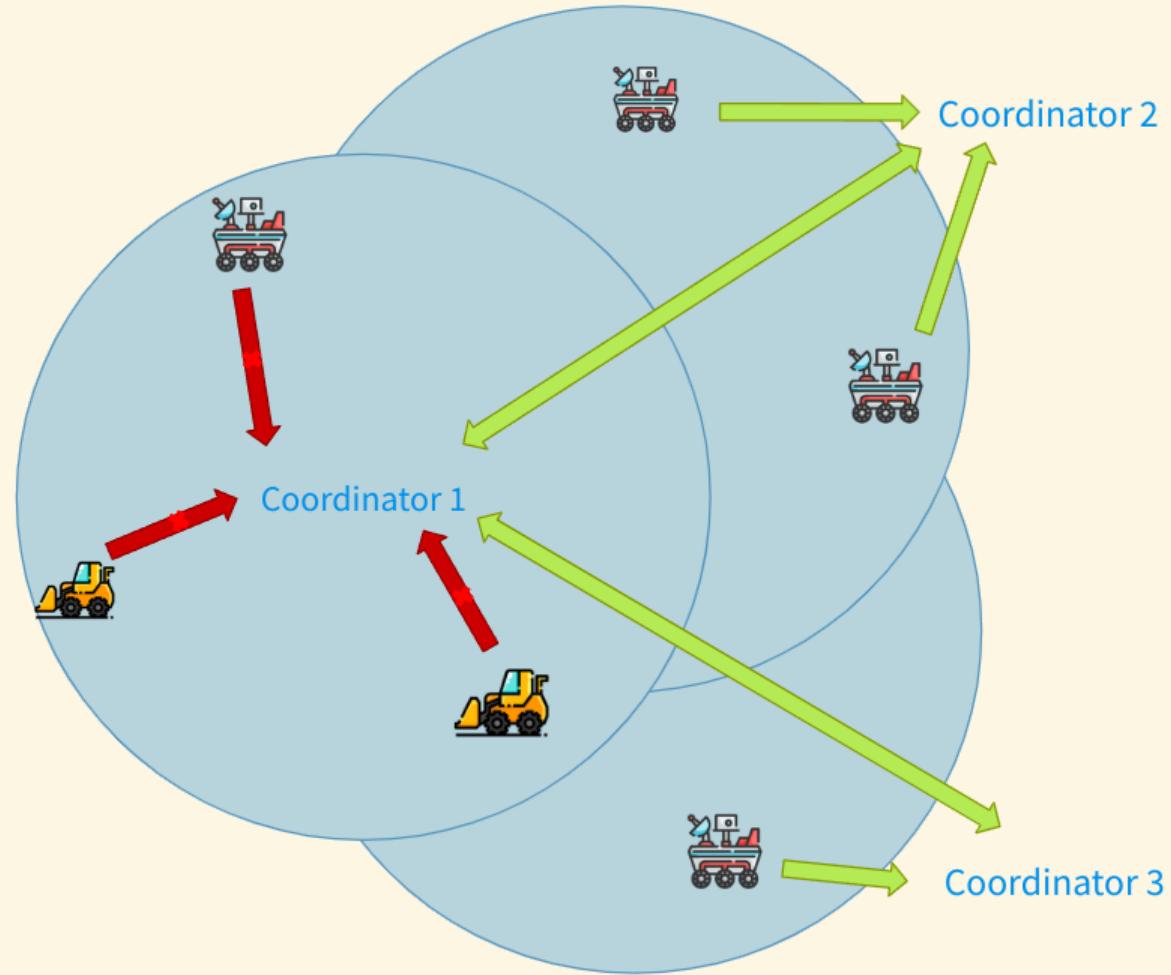
Contractors - Low-level agents

Contract	Contractors	Cost function
Safe opening	A small icon showing a red excavator and a yellow truck.	$C = d + \alpha (lp_a)$
Treasure collection	A small icon showing a yellow excavator and a yellow dump truck.	$C = d$

# TASK SHARING BROADCASTING CONTRACTS

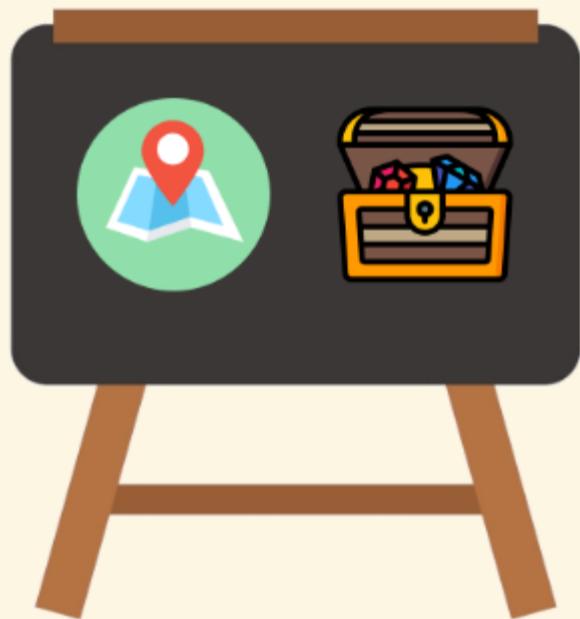
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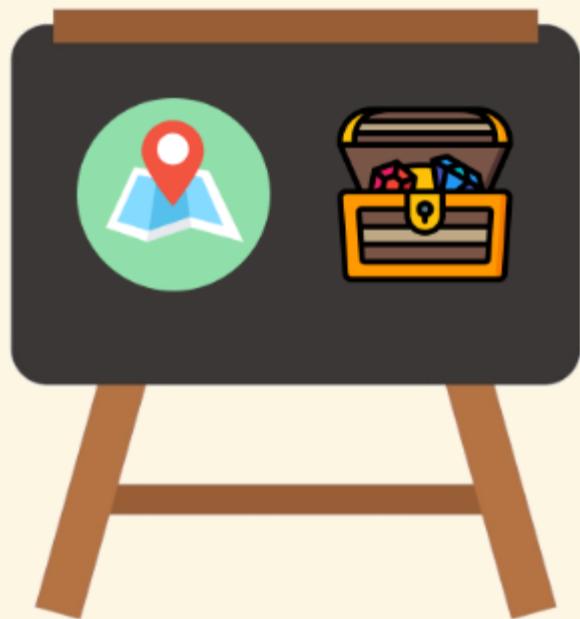
# RESULTS SHARING

BLACKBOARD



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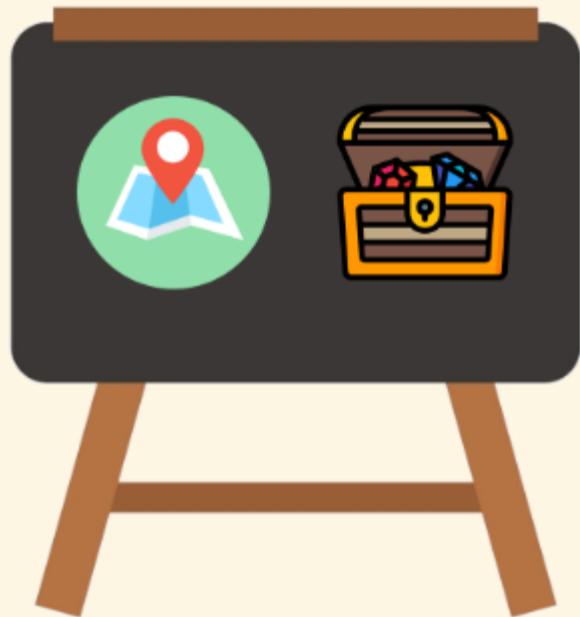
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- Current state of progress og the map and treasures

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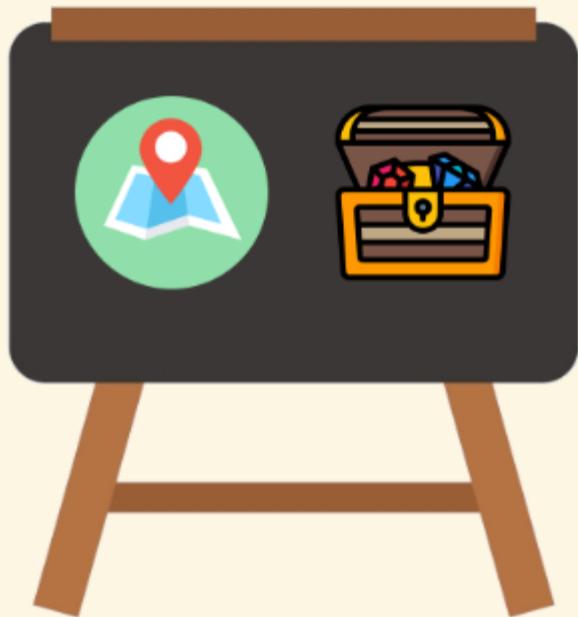
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- Current state of progress og the map and treasures
- Global list with different access levels accordinf to the type of agent

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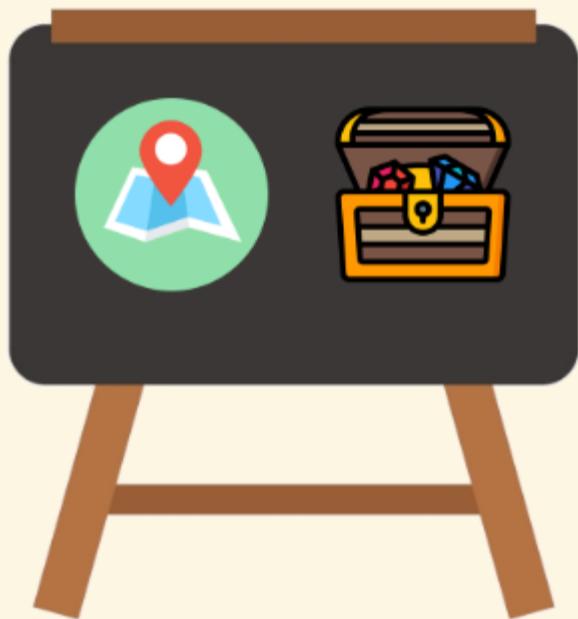
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- Current state of progress og the map and treasures
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- Treasure states:

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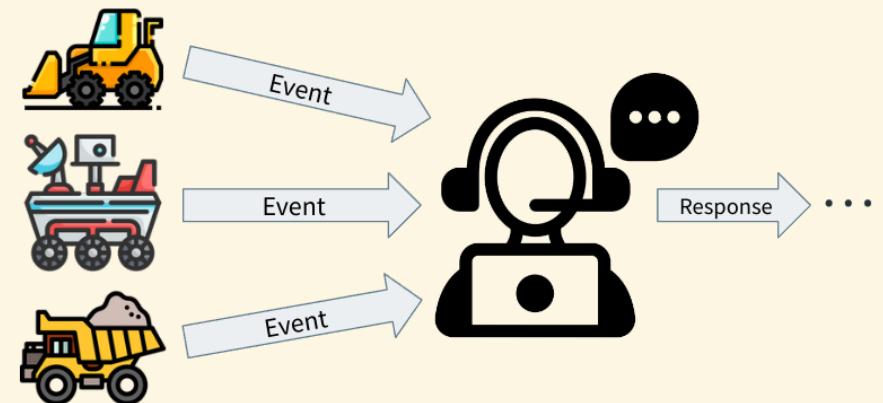


- Current state of progress og the map and treasures
- Global list with different access levels accordinf to the type of agent
- Treasure states:
  - Not Found
  - Discovered
  - Searching
  - Collected
  - Stores

# RESULTS SHARING

## PUBLISH/SUBSCRIBE

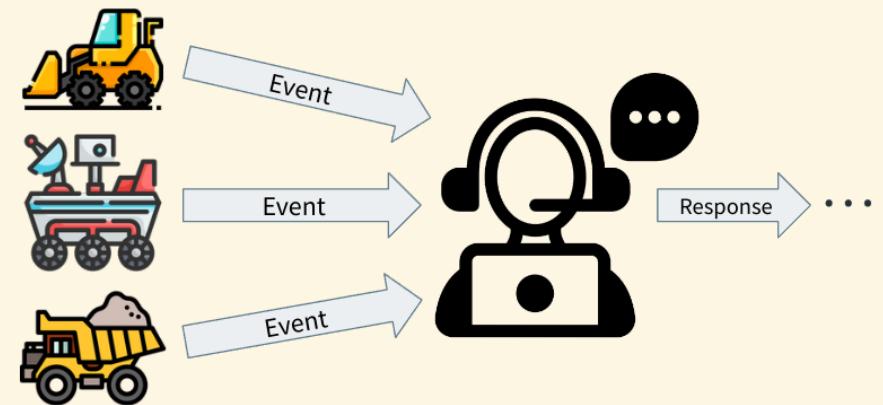
- Events:



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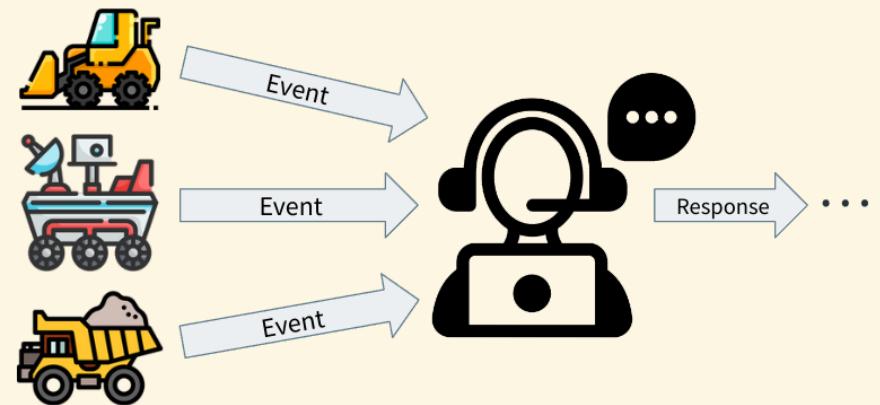
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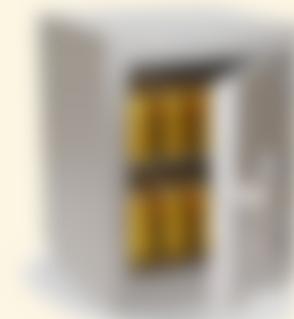
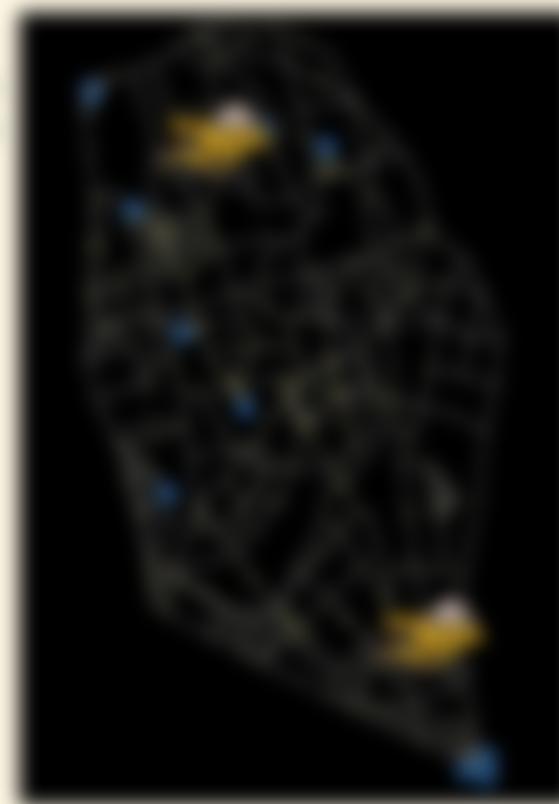
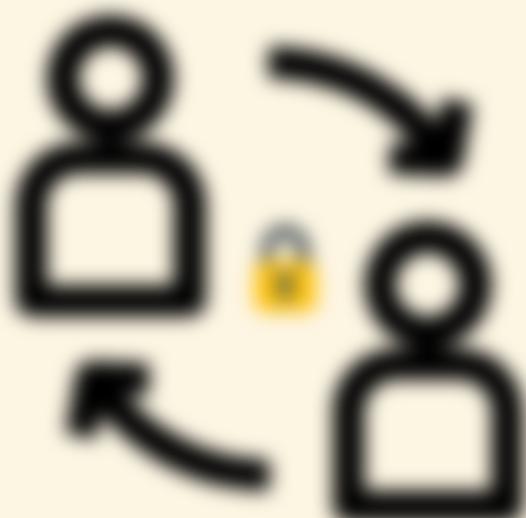
# RESULTS SHARING

## PUBLISH/SUBSCRIBE

- Events:
  - Explorer
    - Explorer finds a treasure
    - Explorer opens a treasure
  - Collector
    - Collector finds a treasure
    - Collector opens a treasure
    - Collector collects a treasure
  - Tanker
    - Tanker stores a treasure

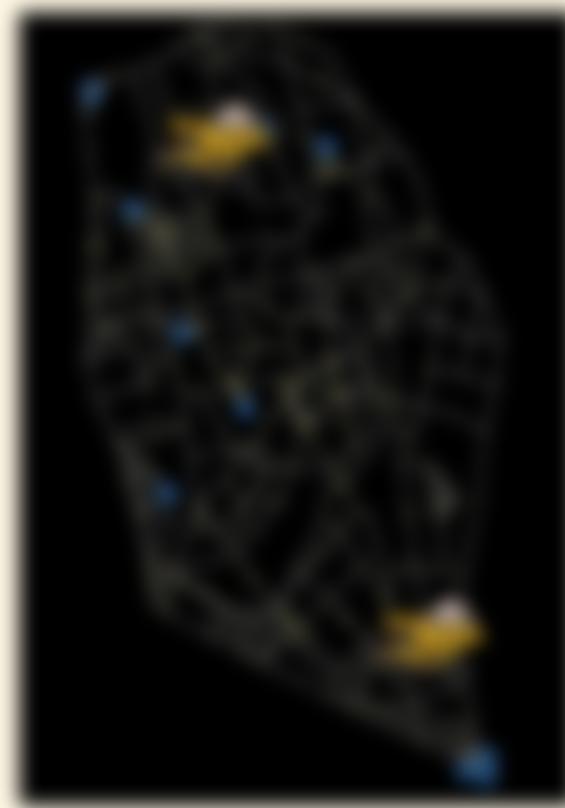
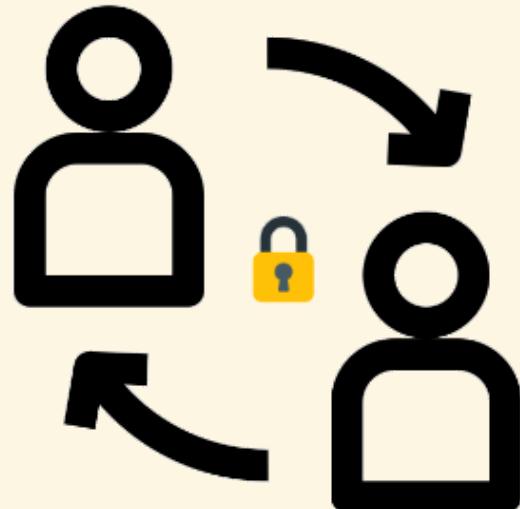


# SOCIAL NORMS



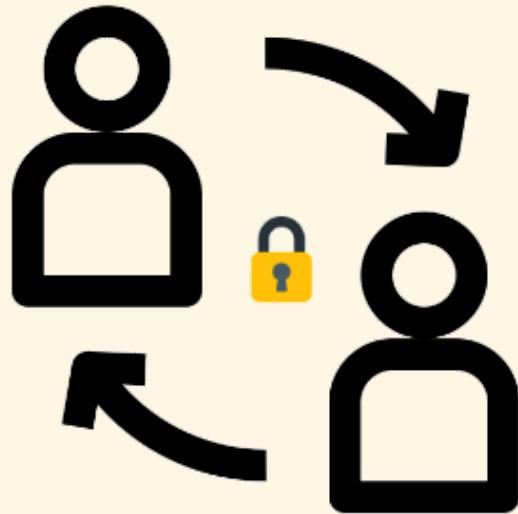
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$$f(H) = \begin{cases} id_x & \text{if } busy_x > busy_y \\ id_y & \text{if } busy_x < busy_y \\ id_x & \text{if } type_x > type_y \text{ and } busy_x = busy_y \\ id_y & \text{if } type_x < type_y \text{ and } busy_x = busy_y \\ id_x & \text{otherwise} \end{cases}$$



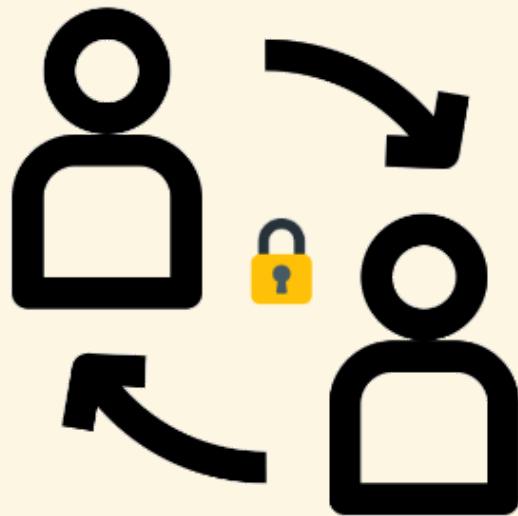
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