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MAS Assignment #01 : Miners

This report aims to summarize at a very high level the analysis, procedures and problems encountered while solving this assignment. It is presented, in general, the reasoning behind the decisions taken for design considerations, as well as a recopilation of the problems faced at the time of implementation, their workarounds and solutions.

Problem

I. PEAS

P [Performance Measure]	How many steps are taken by each agent to finish exploring the mine? How many steps in total were taken to finish exploring the mine?
E [Environment]	Environment dimensions are fixed. Structure of the environment is fixed. Gold and depots could be anywhere in the environment. Agents move around the environment.
A [Actuators]	Movement actuators. Pick and drop gold. Sense percepts: what is around me and where?
S [Sensual perceptors]	Agent knows its position. Agent knows the dimensions of the map. Agent can detect if there is an obstacle, an agent, a depot, or gold around him.

II. BDI [Belief-Desire-Intention] reasoning

Environment:

● Dimensions ● Segments ● Quadrants ● Gold locations	● Depot locations ● Agent locations ● Obstacle locations ● Anything that is not an obstacle can be potentially travelled

Beliefs:

Should I / Can I explore / navigate? - Should I explore a quadrant? - Should I move freely while aiming for unvisited locations? Do I know some gold locations? Am I carrying any gold?	Should I / Can I help another miner? Do I know where the depot is? Should I go to the depot? Am I stuck? What is the setting of the map? Is it narrow, or wide?

Deliberation [Strategic Reasoning]:

Taking into account my current beliefs and status, should I:
- Explore
- Go to gold
- Go to help
- Pick up gold
- Go to depot
- Wander around aimlessly

Means-End Reasoning [Tactical Reasoning]:

What do I need to do to explore? - Wander around unexplored areas that surround me - Go to less explored areas, according to knowledge built on shared information What can I do to get to the gold? - Find gold, first of all - Make sure there is a friend nearby to ask for help, in order to maximize utility - Build path to get to the gold How can I get to help quickly? - Shake hand to acknowledge request	- Build path to get to friend - Handle obstacles on the way How do I handle help on the way? - Receive nearest friend answer - Cancel any other request that arrives, if already received a message that a friend is on the way - Handle obstacles on the way How do I get to the depot? - If don't know where the depot is, find it - Build path to get to the depot - Handle obstacles on the way

Plans and Action:

Build knowledge of environment: keep exploring **Open minded [threshold - when find depot]** Coordinate with mate to pick up gold: build route **Single minded**	Share information with mates **Single minded** Get unstuck: ask for permission **Single minded** Get unstuck: move around (avoid obstacle) **Single minded**

General Outline	
Desire #0: Explore	
There is a position, in immediate proximity, that I can explore	Action: Move to unvisited position
The map is of open characteristics (not a lot of narrow paths), and either less than 50% (~ some threshold percentage) of the map has been explored	Action: Make a move that will get you closer to that position
Don't know where there is some gold, or still need to find the depot	Action: Move to unvisited position
Desire #1: Pick up gold	
Know some gold locations	Action: Move to gold, request help and wait for it
Desire #2: Go to help	
Desire #3: Drop off gold in the depot	
Exploring the map is not important at all We know where the gold is	Action: Carry gold around until can go to depot
Exploring the map is not important anymore We have a good understanding of where the gold is We know where the depot is	Action: Take it to the depot with your friend

III. On strategies and problems encountered during implementation

a. To find key positions such as gold and depots, a strategy of exploration through navigation was taken, giving priority when entering the mine to reach to unexplored areas in order to share knowledge between peers, and build a comprehensive understanding of the environment we're immersed in.
b. A sort-of handshaking contract technique was used to answer some message requests, so that both individual and cooperative utility can be maximized. With this approach, after a request is acknowledged by a peer, the same request made to others is cancelled.
c. One problem that was also encountered was that, when setting too definite desires and strategies, agents tend to answer immediately, creating instability and loss in the system. An example would be, going to a gold mine as soon as we have a location. How can we make sure that only one miner will go there? With the addition of more messages. But this is not really necessary if we establish bounds that isolate as much as possible the correlations that can arise between agents and the actions they chose at any given time. We can take into consideration states specific to each agent, to condition their actions so that they are more independent; ie, location, friends nearby, distances, current status flags, etc.
d. Also, there arose an issue when a request was not answered, or some error happened between sender and receiver, so that synchronization was lost. This was solved by sending recurring requests, separated by a certain amount of time, and limited by a limit of trials (open minded commitment).
e. How to use the knowledge of the environment to build routes to get to objectives? Implementing an adapted version of *breadth-first search* algorithm.
f. How to deal with conflicting commitments? An example, when an agent wants to go to a certain position, but some other agent is blocking the way by waiting for someone. How this was solved? In the first levels, by randomization and performing several trials. However, a more advanced technique was envisioned in the latest levels: asking for permission.
g. When waiting for some action or response, need to set a limit so that the dynamics don't stop. Stalling is the worst that can be done in these kinds of environment. There must always be a way to keep moving, changing the conditions, so that new interactions may arise.