Steels Mars Explorer:

In the previous assignment, all the agents on the mars communicated indirectly through radioactive crumbs trails. An agent can detect the rock cluster if it finds a trail.

The scenario I considered above was basically, the rock clusters were distributed randomly each with different energy levels (No. of rocks per cluster). Now each agent wanders until it finds a cluster and if it did, then leaves a trail for other agents. If any other agent finds this trail in the way leads to the rock cluster. This is certainly not an optimal way to collect the rock sample as if we consider a large enough space, the chance of agents running into one another paths decreases. Also, one point to note here is, if we increase the number of agents, then the chance of each agent running into each other increases and hence performance of the agent system increases. In terms of scalability, this method may lead to an optimal solution.

Agents with Cooperation:

When we consider communication between agents, all the agents tend to collect rock samples from one rock cluster at a time. Although the collection of rocks from the cluster can be efficient, if the given rock density is sufficiently low, chance of finding other rock clusters can be minimized. This may not lead to an optimal solution. As per the evaluation of the system under the following configuration, the performance is as follows:

No. of Agents = 5

Rock – Density: 1 on scale of 10

No. of ticks = 626

No. of Agents = 10 and rock-density = 1 on scale of 10

No. of ticks it took to collect rock samples = 260

For No. of Agents = 15 with same rock-density, it takes 288 ticks to complete.

No. of Agents = 20

Rock-density = 1 on scale of 10

No. of ticks = 326

As we see from above measurements, there is no pattern in terms of scalability. One thing to remember here is that the rock clusters energy changes in every run. This might be the reason for the randomness in the performance of the system. Also one more factor that contributes to this is that the number of rock clusters changes in each run. We can attribute the randomness in the performance to both of these factors.

For example, in the previous part without any direct communication, for the following configuration, we had the following performance:

With rock-density = 1 on scale of 10; obstacle-density = 1 on scale of 10; diffusion-rate = 10%; decay-rate = 10%; No. of agents = 5, it took around 3400 ticks to collect 200 rocks form different clusters.

Pros for Cooperation:

* With cooperation, each agent can be rewarded fairly.

Cons for competition:

* We cannot reach optimality with cooperation since agents will fairly share the task.
* The agents might take more time to finish

Agents competing:

In this mode, agents no longer communicate with each other (neither directly nor indirectly). Each agent collects rocks to gain the maximum rewards. One way to gain maximum rewards is that to choose the rock clusters that are at a minimum distance from the agent and also the spaceship as well. For the same configuration as explained in the indirect communication part, it took around 300 ticks to complete the rock collection even with obstacles. In terms of scalability, this performs better since all the agents try to increase their own rewards. We increase the rewards each time an agent collects a rock. We can set the decay function to 1000/t here. This solution is not pareto optimal since it is not taking other agents outcomes into account. In terms of scalability, it performs better. So, yes. This method is scalable.

When agents are competing against each other, there might be some cases when agents act selfishly as well as unselfishly. Basing on the case, we might reach the pareto optimality.