

Fundamentals of AI

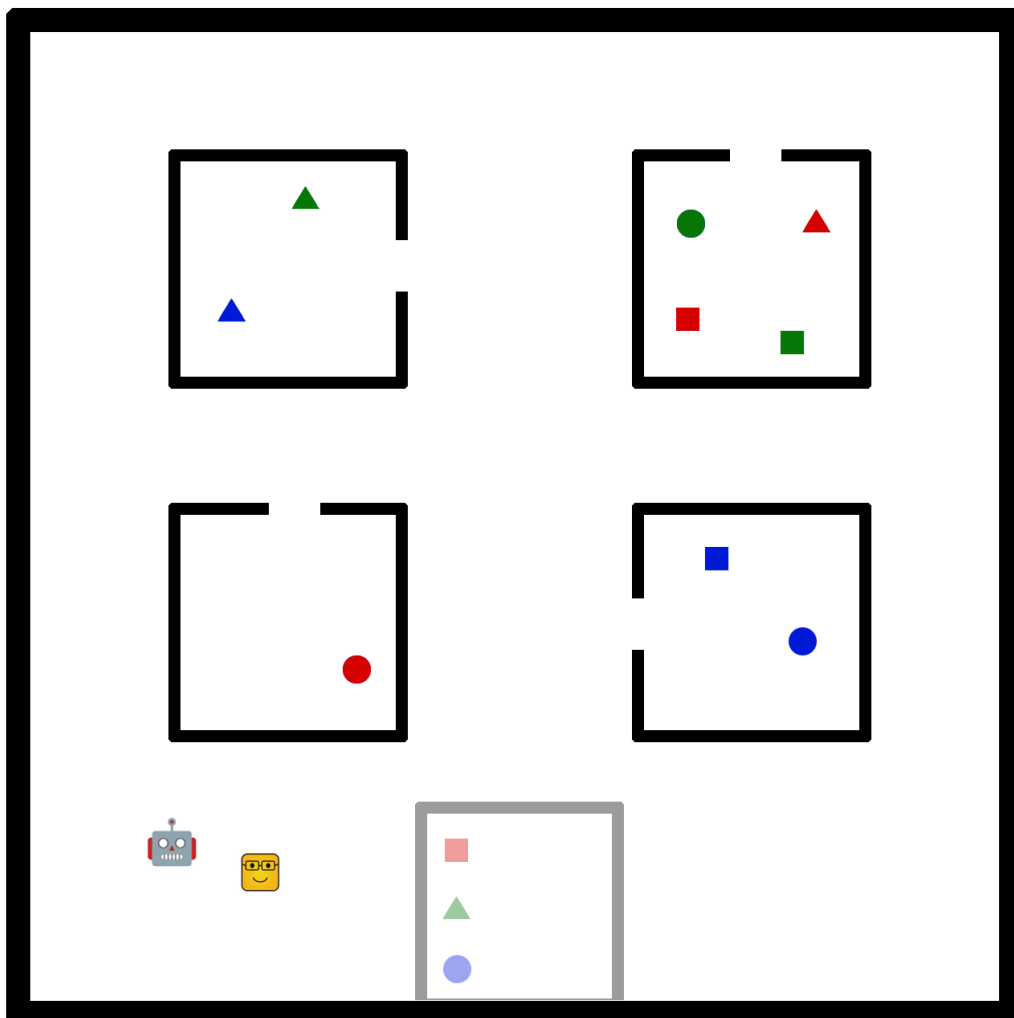
Multi-Agent systems assignment

Part 1. Interdependence analysis

In this assignment, you will do an interdependence analysis. To give you a starting point, the tasks and required capabilities of the task have already been established.

























The setting is a single agent collaborating with a single human in a digital grid environment. In this environment, there are rooms which the agent and human can navigate in and out of. The main goal is to find a set of objects and drop them off on another location in the correct order.

The figure below shows what this would look like. The task here is to collect a blue circle, green triangle and red square, in that order, to the grey outlined area. The agent (grey robot face) and human (yellow emoticon face) can move around this space, but not pass through the black walls. When performing the task, the human and agent can only 'see' a small distance away. The coloured items will only show up if the agent is right next to it, so to find the items, it's necessary to look through all the rooms by moving around.



Step 1: Fill out the table below with the right colours.

In this task, you can assume the following capabilities: Finding all objects in the room is possible for both human and agent, but it's easy to accidentally miss an object for both. The robot has shape detection, but this is imperfect, and it cannot see colour. Meanwhile, the human cannot pick up an object without help, and an object can only be carried by the human and robot together.

Tasks	Hierarchical Sub-tasks	Required capacities	Team member role alternatives			
			Alternative 1		Alternative 2	
			Performer	Supporting team members	Performer	Supporting team members
			Robot	Human	Human	Robot
Search room	Search the room	Move around the room	A 		A 	
		Find object	B 	SC 	B 	SC 
	Identify object	Identify shape	B 	SC 	A 	
		Identify colour		U 	A 	
	Pick up object	Pick up object	A 	S 	HC 	HC 
	Move object to drop off	Carry object	HC 	HC 	HC 	HC 

Step 2: Based on the filled-in table above, list the constraints that exist.

Use Figure 8. From the Johnson et al. paper, and write down what feasible interdependence combinations exist according to your colour scheme.

Step 3: Finish the interdependence analysis by identifying the OPD Requirements

Based on the previous two steps, finish the analysis by interpreting the interdependencies, and list the Observability, Predictability & Dependability requirements for each activity. You can use the table below, or just make a list

Required capacities	Roles				Interpretation & OPD Requirements
	1		2		
	R	H	R	H	
Move around the room					Independent operation by performer
Find object see colours above					Performer < 100 reliable, but assistance could improve reliability
Identify shape					Independent operation by performer is viable but assistance improve reliability
Identify colour					Independent operation by human performer is necessary
Pick up object					Robot requires assistance, human can provide it and also do independent
Carry object					Performer requires assistance. team member can provide it

Part 2. Trust & Reputation

In this exercise you will build a trust function which an agent can use to determine who in its network to trust (i.e., to determine an agent's trust beliefs) for a certain situation. The goal of the function is to form a trust evaluation. This exercise is highly advised to be solved in Jupyter. You can then submit the resulting pdf.

Your agent is in charge of scheduling and delegating tasks and exists in a warehouse workplace where people and AI work together. In the warehouse there are both robots and human employees who can collect packages from different areas and of different sizes. There are packing robots and employees, as well as humans and agents who assist with the admin side of things. In determining who to trust with what, your agent doesn't take into account whether another agent is human or artificial, so we will just talk about agents from now on.

You will build a trust function for the agent to use in these two different contexts. The function should provide different results for the different contexts. The contexts are:

1. The first context is social. In this case, your agent's closest co-worker has something to celebrate, and you wish to organize a small social event with colleagues for them. You need to delegate the present-buying task, and you wish to know who to entrust it to.
2. The second context is work related. You have a particular odd-shaped package which needs to be loaded nicely, but very quickly. It is for an important client, so displeasing them would hurt the company. You need to determine what colleague to entrust this task to.

These are the agents that exist in the network and their characteristics. The characteristics regarding the agent's personality traits are in a scale of 0 to 10. Employment years are not scaled.

Agent	Social info	Experiences	Reputation score (?)
Yours	{function: logistics, employment_time: 7, friendliness: 6, openness: 3, neuroticism: 4, conscientiousness: 8, agreeableness: 6, extraversion: 5, social group: small, hobby: chess}	-	-
1	{function: manager, employment_time: 10, friendliness: 8, openness: 8, neuroticism: 7, conscientiousness: 6, agreeableness: 9, extraversion: 9, social group: medium, hobby: marathons}	{direct: {efficiency: 6, accuracy: 8, flexibility: 2, creativity: 5, helpful: 8}, communicated: {efficiency: 4, flexibility: 9, accuracy: 1, creativity: 3, helpful: 8}}	5
2	{function: loader, employment_time: 1, friendliness: 4, openness: 4, neuroticism: 2, conscientiousness: 6,	{direct: {efficiency: 5, accuracy: 8, flexibility: 3, creativity: 5, helpful: 4},	7

	agreeableness: 9, extraversion: 9, social group: small, hobby: dance}	communicated: {efficiency: 6, flexibility: 1, accuracy: 9, creativity: 3, helpful: 6}}	
3	{function: associate, employment_time: 4, friendliness: 8, openness: 4, neuroticism: 7, conscientiousness: 9, agreeableness: 6, extraversion: 8, social group: large, hobby: novelist}	{direct: {efficiency: 8, accuracy: 8, flexibility: 8, creativity: 9, helpful: 8}, communicated: {efficiency: 9, flexibility: 8, accuracy: 6, creativity: 8, helpful: 9}}	8
4	{function: forklift driver, employment_time: 15, friendliness: 6, openness: 4, neuroticism: 3, conscientiousness: 9, agreeableness: 3, extraversion: 8, social group: medium, hobby: photographer}	{direct: {efficiency: 8, accuracy: 5, flexibility: 6, creativity: 6, helpful: 5}, communicated: {efficiency: 6, flexibility: 7, accuracy: 6, creativity: 4, helpful: 6}}	7
5	{function: machine operator, employment_time: 4, friendliness: 8, openness: 4, neuroticism: 7, conscientiousness: 9, agreeableness: 6, extraversion: 8, social group: large, hobby: gym}	{direct: {efficiency: 5, accuracy: 8, flexibility: 5, creativity: 5, helpful: 3}, communicated: {efficiency: 6, flexibility: 6, accuracy: 9, creativity: 6, helpful: 5}}	9
6	{function: loader, employment_time: 4, friendliness: 2, openness: 6, neuroticism: 5, conscientiousness: 5, agreeableness: 6, extraversion: 3, social group: small, hobby: fishing}	{direct: {efficiency: 5, accuracy: 5, flexibility: 3, creativity: 4, helpful: 6}, communicated: {efficiency: 3, flexibility: 1, accuracy: 3, creativity: 1, helpful: 3}}	2
7	{function: loader, employment_time: 10, friendliness: 7, openness: 7, neuroticism: 7, conscientiousness: 3, agreeableness: 3, extraversion: 8, social group: large, hobby: writing}	{direct: {efficiency: 7, accuracy: 6, flexibility: 3, creativity: 7, helpful: 8}, communicated: {efficiency: 6, flexibility: 6, accuracy: 9, creativity: 8, helpful: 7}}	6

Step 1: Determine what information to use

There are different types of information which you can use to form a trust evaluation. For each context, determine which information to use. Do you use all information available, or is some irrelevant to your context? Motivate your choices.

Social context:

Social info: friendliness, openness, neuroticism, conscientiousness, agreeableness, social group.
We don't think that your function & employment time has much to do whether you can buy good presents

Experiences: both experiences are included

Work context:

Social info: function, employment time, neuroticism, conscientiousness

Experiences: direct is more important than communicated one. And from that, all of it: efficiency, accuracy, flexibility, creativity (because it has to be packed nicely), helpful.

Step 2: Determine the relative importance of the information

Determine the relative importance of each source of information. Make this precise, you can for instance express it in percentages. Motivate why you picked this relative importance for both contexts and relate it to the story. see below

Step 3: Reliability

Determine if you will use reliability to interpret the information you get from other agents. If so, in what way will you determine the reliability for each of the different contexts? Motivate your choice with the context. see below

Step 4: Build the function

Determine the complete function to determine your agent's trust beliefs for a certain situation. Write the function code in a programming language of your liking (suggested python). Explain your code. Run it to calculate what agent you would entrust each of your tasks to.

Reflect on the outcome. Was this expected? Was there information you would've liked to use missing? Would the outcome change your initial function? see notebook

Step 5: Iterate

Imagine that you have made the decisions, you are now in the future where you need to make the exact same decisions again. Determine what would happen if: The agent you trusted the first time failed at the task spectacularly. How would you represent this information so that your decision would change? Write a function to update your trust beliefs.

see notebook

Step 2:

1. Social context
Friendliness: 10%
Openness: 10%
Neuroticism: 5%
Conscientiousness: 10%
Agreeableness: 5%
Social group: 10%
Direct experiences:
efficiency: 2.5%
accuracy: 2.5%
flexibility: 5%
creativity: 7.5%
helpful: 7.5%
Communicated experiences
efficiency 2.5%
accuracy 2.5%
flexibility 5%
creativity 7.5%
helpful 7.5%

Step 2:

1. Work context
Function: 10%
Employment time 15%
Neuroticism: 15%
Conscientiousness: 10%
Direct experiences:
efficiency: 10%
accuracy: 7%
flexibility: 3%
creativity: 3%
helpful: 8%
Communicated experiences
efficiency 5%
accuracy 3%
flexibility 2%
creativity 1%
helpful 6%