

CMPE 593 - FALL 2017

Report - Assignment I

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# Conference Helper BDI Agent

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## 1 INTRODUCTION

We propose Conference Helper BDI Agent, an agent which prepares a schedule and makes the necessary arrangements for a user who is going to a conference in Amsterdam between July 16-21. Conference Helper BDI Agent adapts to on-the-fly changes in desires. We implement Conference Helper BDI Agent in pure Java. We did not use any other third-party libraries. We present a very rich scenario in terms of cancels, date changes, and other unexpected situations. We obtain new scenarios from this main scenario by making subtle but important changes to our main scenario and show that Conference Helper BDI Agent is capable to handle these changes.

Normally, only beliefs and intentions change in BDI design. However, while developing our main scenario, we found out that desires of a person can change as well. Hence, we implemented Conference Helper BDI Agent such that it also adapts to the changes in desires. We show how a change in desire can happen and how our agent adapts to it in our main scenario.

In Section 2, we discuss the output format of Conference Helper BDI Agent. Then, we present our main scenario and execute it using Conference Helper BDI Agent in Section 3. In Section 4, we describe the implementation details of Conference Helper BDI Agent. We conclude this report by describing future work in Section 5 and with a short summary of our work in Section 6.

## 2 OUTPUT FORMAT

Conference Helper BDI Agent outputs six lists and the current date. We call this output a summary. The summary includes the following lists:

1. List of BELIEFS: We define a belief as an event broadcasted by a service or proposal from an acquaintance. Each belief has a description and a date associated with it. We sort our list of beliefs w.r.t. their dates.
2. List of FUTURE INTENTIONS: We define an intention as an action which is triggered by a belief and related to a desire. Conference Helper BDI Agent generates a list of intentions that are expected to be completed in the future, which we call FUTURE INTENTIONS or in short, a plan. Conference Helper BDI Agent aims to maximize the utility of its user while generating this plan.
3. List of COMPLETED INTENTIONS: If a FUTURE INTENTION is not dropped, and the current date passes the date of the intention, we assume that the user completed this intention.
4. List of SATISFIED DESIRES: A desire is a construct formed by a rank (an integer) and a description. We use ranks to sort all desires. Lower rank means higher utility for the user if the desire is satisfied. We use descriptions to find which intentions satisfy which desires.
5. List of FUTURE DESIRES: Conference Helper BDI Agent keeps a list of desires that are expected to be satisfied in the future. Conference Helper BDI Agent derives this list by looking at the FUTURE INTENTIONS list.
6. List of FUTURE DESIRES TO FORGET ABOUT: There may be desires that are not going to be satisfied by the plan Conference Helper BDI Agent comes up with. We put these desires into the list of FUTURE DESIRES TO FORGET ABOUT.

For the sake of simplicity, we discretize the time as follows. Each day has a morning (09:00) and an evening (18:00) slot. Although this may not seem realistic, it's trivial to create a higher number of slots for each day.

At each date  $d$ , Conference Helper BDI Agent outputs its summary. We call the time between each consecutive  $d$  an epoch. Cancels, date changes, and all other unexpected situations arrive between each epoch.

In this section, we first describe desires of the Conference Helper BDI Agent's user. Then, we present the surrounding environment, in terms of services and friends, who are agents that the Conference Helper BDI Agent constructs its beliefs from. Third, we show the output of Conference Helper BDI Agent at each epoch and explain its decisions.

The user enters his desires and their rankings as follows.

0. Desire: Present the paper
1. Desire: Attend Conference Dinner
2. Desire: Go to concert theatre festival
3. Desire: Go to art museum stuff
4. Desire: Go to basketball bicycle activities
5. Desire: NOT have free time
6. Desire: Do shopping

Note that the user may change his desires at any given epoch.

In our main scenario, we present the following service and friend agents of the user. MASConference: Represents the conference organization. Announces paper presentation and conference dinner dates. Eventful: Represents Amsterdam.eventful webpage which announces nearby arts and sports events. FriendA: Represents a friend whom the user wants to go shopping with. Girlfriend: In our scenario, the user meets his new girlfriend during the conference. This agent represents that girlfriend. The user is going to desire to go to cinema or sports activities with her. Note that the user did not have this desire before.

### 3 MAIN SCENARIO

Now, we describe the details of our main scenario. First, our agent fills a scheduling table with its beliefs as shown in Table 3.1. Note that each cell represents an epoch, hence our agent can follow only one belief for each cell. Our agent chooses beliefs such that it satisfies the lowest ranking desires. We call this selection of beliefs the *best plan*. Figure 3.1 shows the intentions we construct from the selected beliefs and expected desires to satisfy.

In our scenario, the paper date changes right before the presentation. This change affects our plan as shown in Figure 3.2. Then the user meets with his girlfriend in the evening. After meeting his girlfriend, the user adds a new desire, namely "Go to cinema trekking with girlfriend" to his initial desires. This makes our agent reconsider its best plan at the next epoch as shown in Figure 3.3. Our agent decides to replace its basketball and museum intentions with cinema and trekking intentions since the user gives a lower rank to do stuff with his girlfriend. Also, note that the desire to go to art museum stuff is satisfied. Our agent automatically ranks this desire with the highest number. This is because our agent does not need to satisfy this desire any further by scheduling more related intentions.

### 4 IMPLEMENTATION

We used pure Java to implement the Conference Helper BDI Agent. We did not use any third party libraries. Implementing such an agent presented several challenges to us as we describe below.

Table 3.1: The Best Plan at Epoch July 16, 09:00

	09:00	18:00
July 16	Paper Date Art Gallery	Concert Festival
July 17	Basketball Match Campus Tour Cinema	
July 18	Museum Tour	
July 19		Theatre Bicycle Tour in Vondelpark
July 20	Bicycle Tour in Vondelpark	Conference Dinner
July 21	Shopping	

FUTURE INTENTIONS =  
 Intention : Paper Date @Mon Jul 16 09:00:00 MSK 2018 [RELATED TO : Present the paper]  
 Intention : Concert @Mon Jul 16 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]  
 Intention : Basketball Match @Tue Jul 17 09:00:00 MSK 2018 [RELATED TO : Go to basketball bicycle activities]  
 Intention : Museum Tour @Wed Jul 18 09:00:00 MSK 2018 [RELATED TO : Go to art museum stuff]  
 Intention : Theatre @Thu Jul 19 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]  
 Intention : Bicycle Tour in Vondelpark @Fri Jul 20 09:00:00 MSK 2018 [RELATED TO : Go to basketball bicycle activities]  
 Intention : Conference Dinner @Fri Jul 20 18:00:00 MSK 2018 [RELATED TO : Attend Conference Dinner]  
 Intention : Shopping @Sat Jul 21 09:00:00 MSK 2018 [RELATED TO : Do shopping]

COMPLETED INTENTIONS =

SATISFIED DESIRES =

FUTURE DESIRES =  
 0.Desire : Present the paper  
 1.Desire : Attend Conference Dinner  
 2.Desire : Go to concert theatre festival  
 3.Desire : Go to art museum stuff  
 4.Desire : Go to basketball bicycle activities  
 6.Desire : Do shopping

FUTURE DESIRES TO FORGET ABOUT =  
 5.Desire : NOT have free time

NOW = Mon Jul 16 09:00:00 MSK 2018

Figure 3.1: Summary of Epoch July 16, 09:00

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FUTURE INTENTIONS =
Intention : Art Gallery @Mon Jul 16 09:00:00 MSK 2018 [RELATED TO : Go to art museum stuff]
Intention : Concert @Mon Jul 16 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]
Intention : Basketball Match @Tue Jul 17 09:00:00 MSK 2018 [RELATED TO : Go to basketball bicycle activities]
Intention : Museum Tour @Wed Jul 18 09:00:00 MSK 2018 [RELATED TO : Go to art museum stuff]
Intention : Paper Date @Thu Jul 19 09:00:00 MSK 2018 [RELATED TO : Present the paper]
Intention : Theatre @Thu Jul 19 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]
Intention : Bicycle Tour in Vondelpark @Fri Jul 20 09:00:00 MSK 2018 [RELATED TO : Go to basketball bicycle activities]
Intention : Conference Dinner @Fri Jul 20 18:00:00 MSK 2018 [RELATED TO : Attend Conference Dinner]
Intention : Shopping @Sat Jul 21 09:00:00 MSK 2018 [RELATED TO : Do shopping]

COMPLETED INTENTIONS =

SATISFIED DESIRES =

FUTURE DESIRES =
0.Desire : Present the paper
1.Desire : Attend Conference Dinner
2.Desire : Go to concert theatre festival
3.Desire : Go to art museum stuff
4.Desire : Go to basketball bicycle activities
6.Desire : Do shopping

FUTURE DESIRES TO FORGET ABOUT =
5.Desire : NOT have free time

NOW = Mon Jul 16 09:00:00 MSK 2018

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Figure 3.2: Summary of Epoch July 16, 09:00 after paper date change

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FUTURE INTENTIONS =
Intention : Concert @Mon Jul 16 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]
Intention : Cinema @Tue Jul 17 09:00:00 MSK 2018 [RELATED TO : Go to cinema trekking with girlfriend]
Intention : Trekking @Wed Jul 18 09:00:00 MSK 2018 [RELATED TO : Go to cinema trekking with girlfriend]
Intention : Paper Date @Thu Jul 19 09:00:00 MSK 2018 [RELATED TO : Present the paper]
Intention : Theatre @Thu Jul 19 18:00:00 MSK 2018 [RELATED TO : Go to concert theatre festival]
Intention : Bicycle Tour in Vondelpark @Fri Jul 20 09:00:00 MSK 2018 [RELATED TO : Go to basketball bicycle activities]
Intention : Conference Dinner @Fri Jul 20 18:00:00 MSK 2018 [RELATED TO : Attend Conference Dinner]
Intention : Shopping @Sat Jul 21 09:00:00 MSK 2018 [RELATED TO : Do shopping]

COMPLETED INTENTIONS =
Intention : Art Gallery @Mon Jul 16 09:00:00 MSK 2018 [RELATED TO : Go to art museum stuff]

SATISFIED DESIRES =
7.Desire : Go to art museum stuff

FUTURE DESIRES =
0.Desire : Present the paper
1.Desire : Attend Conference Dinner
2.Desire : Go to concert theatre festival
3.Desire : Go to cinema trekking with girlfriend
4.Desire : Go to basketball bicycle activities
6.Desire : Do shopping

FUTURE DESIRES TO FORGET ABOUT =
5.Desire : NOT have free time

NOW = Mon Jul 16 18:00:00 MSK 2018

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Figure 3.3: Summary of Epoch July 16, 18:00

First, our agent needs to identify which intentions can it form from the beliefs that it has. Also, these intentions must be related to the desires entered by the user. We accomplish this task by a simple tokenization of given descriptions for the beliefs, intentions, and desires. We split these descriptions into words, and relate the descriptions with a similarity score as shown in Equation 4.1. We picked this equation for the sake of simplicity.

$$\text{similarity}(d_1, d_2) = \# \text{ common words btw } d_1 \text{ and } d_2 \quad (4.1)$$

Second, our agent needs to reconsider its plan at each alteration. These alterations can be the user altering his desires or the services/friends notifying the user that some dates changed, events canceled, and so on. Conference Helper BDI Agent reconstructs all of its beliefs, intentions, and future desires in case of an alteration.

Third, for the sake of simplicity, we define friends of the user as service agents, since they are equivalent in implementation level.

Fourth, our selection of the best plan is *greedy*, i.e. we choose the belief with the lowest ranking related desire for each epoch. However, this selection may make it impossible to satisfy a lower ranking desire in the future. We argue that beliefs are likely to change at each epoch, therefore our agent is justified to satisfy its lowest ranking desires as soon as possible.

Finally, we implement our scenarios as the main Java class. In this class, we first declare initial desires, service agents, and events. Then, we declare our BDI Agent. Last, we simulate each epoch in a for loop, making alterations and printing summaries at each iteration. We pause at each iteration and wait for a keyboard input.

## 5 FUTURE WORK

In future, we will consider scenarios that include multiple desires with the same ranking. Currently, our agent chooses one of the desires at the same rank randomly in case of a conflict.

Currently, each desire must be satisfied exactly once. In future, we plan to quantify desires to cover more scenarios.

Currently, we take scenarios as main Java classes. In future, we plan to read scenarios from text files.

Currently, each event takes one epoch to complete. In future, we will assign two date attributes to each event.

Currently, we output in a complex text format. To produce more readable output, we will change our output format to calendar representation.

## 6 CONCLUSION

We implemented Conference Helper BDI Agent, a Java agent which obtains a sub-optimal plan that satisfies the lowest ranking unit desires. We stated that our design currently handles unit desires only, i.e. desires that can be satisfied exactly once and satisfied only fully. We showed that Conference Helper BDI Agent handles changes in not just beliefs and intentions, but also desires. We presented a scenario in which the user goes to a conference in Amsterdam, and has to change his schedule due to cancels and date alterations. Also, the user meets with new people who influence the user to change his desires. We argue that our scenario is realistic and therefore agents should be adaptive to changes in desires as we show in our scenario. We encourage the reader to come up with new scenarios to play around with the Conference Helper BDI Agent.