Tema 1 IA - Scheduling Program

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1 Introduction

This document presents a comparison between the A* algorithm and the Hill Climbing algorithm as applied to a scheduling problem. Both algorithms have their strengths and weaknesses in different scenarios, which we will explore.

2 Algorithms Descriptions and Comparison

2.1 Hill Climbing Algorithm

The first algorithm that I implemented was Hill Climbing. The starting point for this algorithm was finding from the beginning a state that satisfies as many constraints (hard and soft) as possible. By doing this, the algorithm must then search through violated soft constraints (hard constraints are respected already) and create new states based on those.

In order to create successors of the current state, the algorithm checks if it can resolve those:

- gets a random violated slot (day, interval) from violated constraints
- generates some available slots
- searches through each available slot and tries several things: moves the whole course and all students to another slot if classrooms are the same / moves as many students as it can to another slot if the classrooms are different and then assign the rest of them to another slot / changes the actual professor with another available one

When it comes to effectiveness and speed, the algorithm works very well on relaxed and small schedules, because the initial state is very well created. Here are several outputs for each test case.

- dummy (Figure 1, Figure 2)
- orar mic exact (Figure 3, Figure 4)
- orar mediu relaxat (Figure 5, Figure 6)

- orar mare relaxat (Figure 7, Figure 8)
- orar constrans incalcat (Figure 9, Figure 10, Figure 11)

As it can be seen in 3 of "Orar Constrans" tests, the costs are between 0 and 3. The number of restarts used in the tests are either 500 or 5000 and in both cases the program reaches a cost lower than 3 in a very short time. There are also cases when the program finds a cost 0 solution, but unfortunately these are not so frequent solutions. A way to find those solutions would be modifying the successors function to keep track of much more constraints when one is resolved.

Comparing to the solution in the laboratory, this new algorithm checks if the new state cost is ¡= than old state cost to let the program change state easier (not only when new cost ¡ old cost).

2.2 A* Algorithm

This algorithm uses the same initial state creation used in HC algorithm. When testing small schedules and less contraints it still finds a good solution because of the effectiveness of the method used.

The heuristic used for this algorithm estimates the cost from any given state to the goal state, focusing on minimizing the violation of preferences such as professor course preferences and classroom assignments. This function is pivotal as it guides the search, prioritizing states that potentially lead to an optimal solution.

Transition costs between states are calculated based on the changes made to professor assignments and classroom allocations. Each change incurs a penalty, especially if it disrupts a professor's preferences, thus discouraging unnecessary alterations and stabilizing the schedule.

The algorithm begins with an initial state where the heuristic is calculated, and this state is then placed into a priority queue. The priority queue orders states by their total cost, which combines the path cost from the start state with the heuristic value.

During the algorithm's execution, states are continuously dequeued based on their priority, and for each state, the total cost is updated and compared against the best-known solution. If a state proves valid and offers a lower cost, it is considered as a potential solution.

Successors are generated by exploring different reassignments of courses to available time slots and classrooms that resolve existing violations without creating new ones. This generation process is crucial as it expands the search space dynamically based on the current state's configuration.

There are times when the algorithm gets stuck in a loop for "Orar Constrans" because there are a lot of new states found, but the costs are not better.

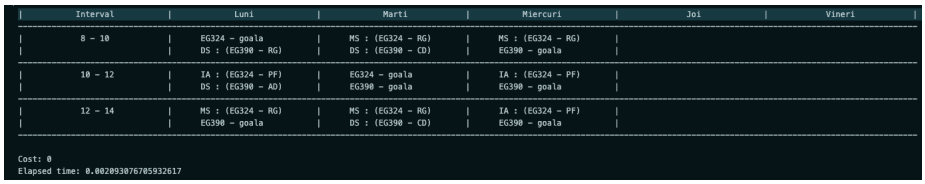
The tests used are same as in HC algorithm:

- dummy (Figure 12, Figure 13)
- orar mic exact (Figure 14, Figure 15)

- orar mediu relaxat (Figure 16, Figure 17)
- orar mare relaxat (Figure 18, Figure 19)
- orar constrans incalcat (Figure 20, Figure 21)

2.3 Comparison

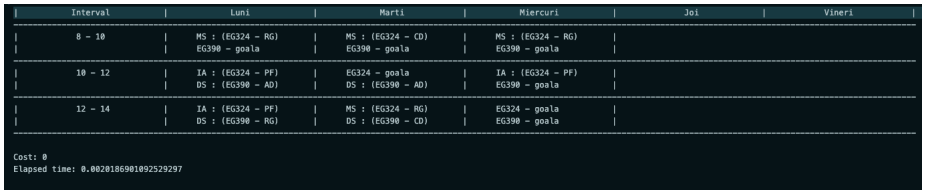
Comparing to HC algorithm, because A* uses the same initial state, it does not find the cost 0 or a better cost because the initial state is very well constructed. If I would start implementing the A* algorithm again, I would create a more relaxed initial state, as it lets the program get a better state. In terms of speed, the A* algorithm is faster because it stores the states that were already discovered and it stops when no new state is found (the Hill Climbing algorithm needs an iteration limit.



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	EG324 – goala DS : (EG390 – RG)	MS : (EG324 – RG) DS : (EG390 – CD)	MS : (EG324 – RG) EG390 – goala		
10 – 12	IA : (EG324 – PF) DS : (EG390 – AD)	EG324 – goala EG390 – goala	IA : (EG324 – PF) EG390 – goala		
12 – 14	MS : (EG324 – RG) EG390 – goala	MS : (EG324 – RG) DS : (EG390 – CD)	IA : (EG324 – PF) EG390 – goala		

Cost: 0
Elapsed time: 0.002093076705932617

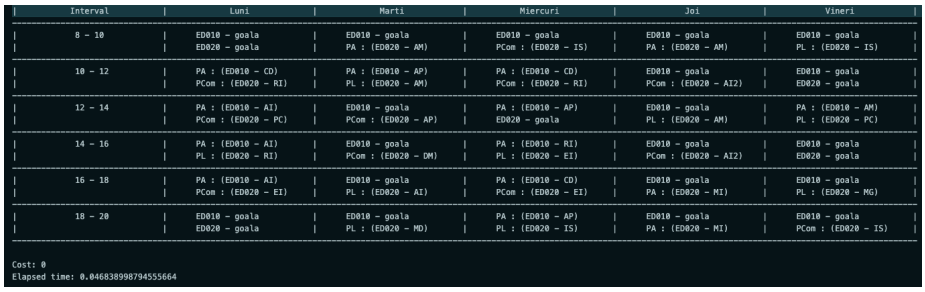
Figure 1: Dummy 1 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	MS : (EG324 – RG) EG390 – goala	MS : (EG324 – CD) EG390 – goala	MS : (EG324 – RG) EG390 – goala		
10 – 12	IA : (EG324 – PF) DS : (EG390 – AD)	EG324 – goala DS : (EG390 – AD)	IA : (EG324 – PF) EG390 – goala		
12 – 14	IA : (EG324 – PF) DS : (EG390 – RG)	MS : (EG324 – RG) DS : (EG390 – CD)	EG324 – goala EG390 – goala		

Cost: 0
Elapsed time: 0.0020186901092529297

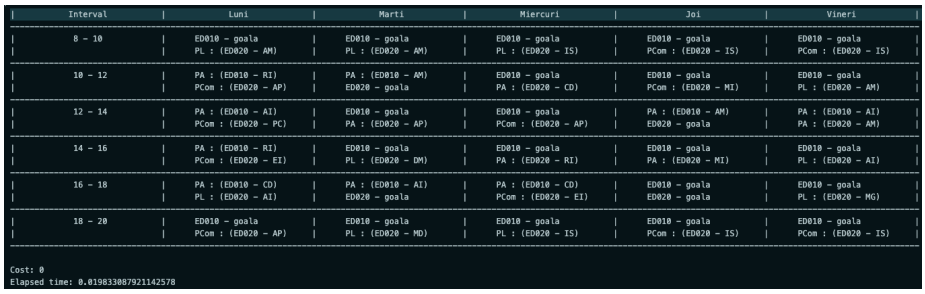
Figure 2: Dummy 2 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED010 – goala ED020 – goala	ED010 – goala PA : (ED020 – AM)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PA : (ED020 – AM)	ED010 – goala PL : (ED020 – IS)
10 – 12	PA : (ED010 – CD) PCom : (ED020 – RI)	PA : (ED010 – AP) PL : (ED020 – AM)	PA : (ED010 – CD) PCom : (ED020 – RI)	ED010 – goala PCom : (ED020 – AI2)	ED010 – goala ED020 – goala
12 – 14	PA : (ED010 – AI) PCom : (ED020 – PC)	ED010 – goala PCom : (ED020 – AP)	PA : (ED010 – AP) ED020 – goala	ED010 – goala PL : (ED020 – AM)	PA : (ED010 – AM) PL : (ED020 – PC)
14 – 16	PA : (ED010 – AI) PL : (ED020 – RI)	ED010 – goala PCom : (ED020 – DM)	PA : (ED010 – RI) PL : (ED020 – EI)	ED010 – goala PCom : (ED020 – AI2)	ED010 – goala ED020 – goala
16 – 18	PA : (ED010 – AI) PCom : (ED020 – EI)	ED010 – goala PL : (ED020 – AI)	PA : (ED010 – CD) PCom : (ED020 – EI)	ED010 – goala PA : (ED020 – MI)	ED010 – goala PL : (ED020 – MG)
18 – 20	ED010 – goala ED020 – goala	ED010 – goala PL : (ED020 – MD)	PA : (ED010 – AP) PL : (ED020 – IS)	ED010 – goala PA : (ED020 – MI)	ED010 – goala PCom : (ED020 – IS)

Cost: 0
Elapsed time: 0.046838998794555664

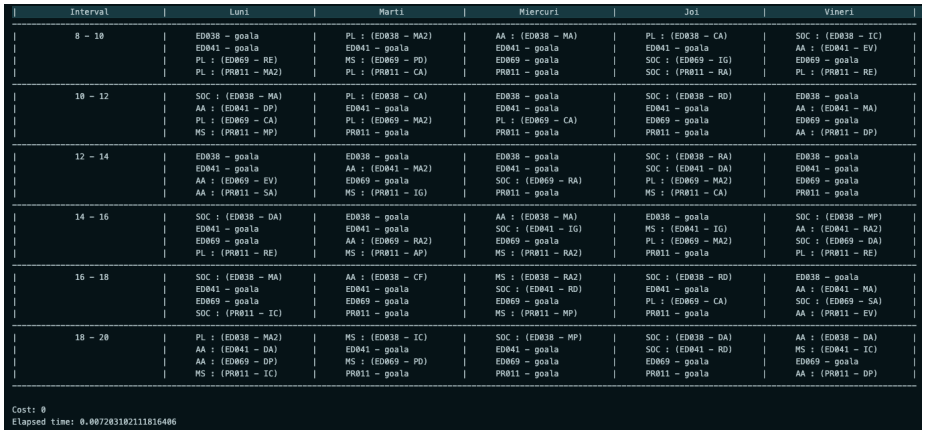
Figure 3: Orar Mic 1 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED010 – goala PL : (ED020 – AM)	ED010 – goala PL : (ED020 – AM)	ED010 – goala PL : (ED020 – IS)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PCom : (ED020 – IS)
10 – 12	PA : (ED010 – RI) PCom : (ED020 – AP)	PA : (ED010 – AM) ED020 – goala	ED010 – goala PA : (ED020 – CD)	ED010 – goala PCom : (ED020 – MI)	ED010 – goala PL : (ED020 – AM)
12 – 14	PA : (ED010 – AI) PCom : (ED020 – PC)	ED010 – goala PA : (ED020 – AP)	ED010 – goala PCom : (ED020 – AP)	PA : (ED010 – AM) ED020 – goala	PA : (ED010 – AI) PA : (ED020 – AM)
14 – 16	PA : (ED010 – RI) PCom : (ED020 – EI)	ED010 – goala PL : (ED020 – DM)	ED010 – goala PA : (ED020 – RI)	ED010 – goala PA : (ED020 – MI)	ED010 – goala PL : (ED020 – AI)
16 – 18	PA : (ED010 – CD) PL : (ED020 – AI)	PA : (ED010 – AI) ED020 – goala	PA : (ED010 – CD) PCom : (ED020 – EI)	ED010 – goala ED020 – goala	ED010 – goala PL : (ED020 – MG)
18 – 20	ED010 – goala PCom : (ED020 – AP)	ED010 – goala PL : (ED020 – MD)	ED010 – goala PL : (ED020 – IS)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PCom : (ED020 – IS)

Cost: 0
Elapsed time: 0.019833087921142578

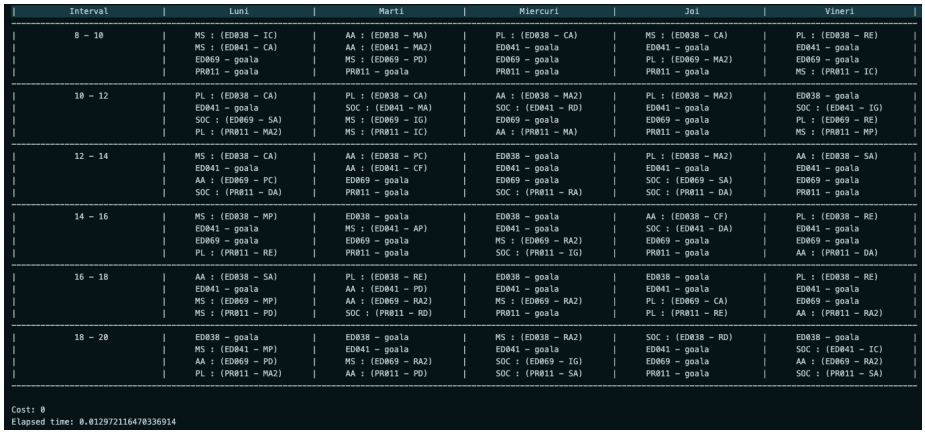
Figure 4: Orar Mic 2 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED038 – goala ED041 – goala PL : (ED069 – RE) PL : (PR011 – MA2)	PL : (ED038 – MA2) ED041 – goala MS : (ED069 – PD) PL : (PR011 – CA)	AA : (ED038 – MA) ED041 – goala ED069 – goala PR011 – goala	PL : (ED038 – CA) ED041 – goala SOC : (ED069 – IG) SOC : (PR011 – RA)	SOC : (ED038 – IC) AA : (ED041 – EV) ED069 – goala PL : (PR011 – RE)
10 – 12	SOC : (ED038 – MA) AA : (ED041 – DP) PL : (ED069 – CA) MS : (PR011 – MP)	PL : (ED038 – CA) ED041 – goala PL : (ED069 – MA2) PR011 – goala	ED038 – goala ED041 – goala PL : (ED069 – CA) PR011 – goala	SOC : (ED038 – RD) ED041 – goala ED069 – goala PR011 – goala	ED038 – goala AA : (ED041 – MA) ED069 – goala AA : (PR011 – DP)
12 – 14	ED038 – goala ED041 – goala AA : (ED069 – EV) AA : (PR011 – SA)	ED038 – goala AA : (ED041 – MA2) ED069 – goala MS : (PR011 – IG)	ED038 – goala ED041 – goala SOC : (ED069 – RA) PR011 – goala	SOC : (ED038 – RA) SOC : (ED041 – DA) PL : (ED069 – MA2) MS : (PR011 – CA)	ED038 – goala ED041 – goala ED069 – goala PR011 – goala
14 – 16	SOC : (ED038 – DA) ED041 – goala ED069 – goala PL : (PR011 – RE)	ED038 – goala ED041 – goala AA : (ED069 – RA2) MS : (PR011 – AP)	AA : (ED038 – MA) SOC : (ED041 – IG) ED069 – goala MS : (PR011 – RA2)	ED038 – goala MS : (ED041 – IG) PL : (ED069 – MA2) PR011 – goala	SOC : (ED038 – MP) AA : (ED041 – RA2) SOC : (ED069 – DA) PL : (PR011 – RE)
16 – 18	SOC : (ED038 – MA) ED041 – goala ED069 – goala SOC : (PR011 – IC)	AA : (ED038 – CF) ED041 – goala ED069 – goala PR011 – goala	MS : (ED038 – RA2) SOC : (ED041 – RD) ED069 – goala MS : (PR011 – MP)	SOC : (ED038 – RD) ED041 – goala PL : (ED069 – CA) PR011 – goala	ED038 – goala AA : (ED041 – MA) SOC : (ED069 – SA) AA : (PR011 – EV)
18 – 20	PL : (ED038 – MA2) AA : (ED041 – DA) AA : (ED069 – DP) MS : (PR011 – IC)	MS : (ED038 – IC) ED041 – goala MS : (ED069 – PD) PR011 – goala	SOC : (ED038 – MP) ED041 – goala ED069 – goala PR011 – goala	SOC : (ED038 – DA) SOC : (ED041 – RD) ED069 – goala PR011 – goala	AA : (ED038 – DA) MS : (ED041 – IC) ED069 – goala AA : (PR011 – DP)

Cost: 0
Elapsed time: 0.007203102111816406

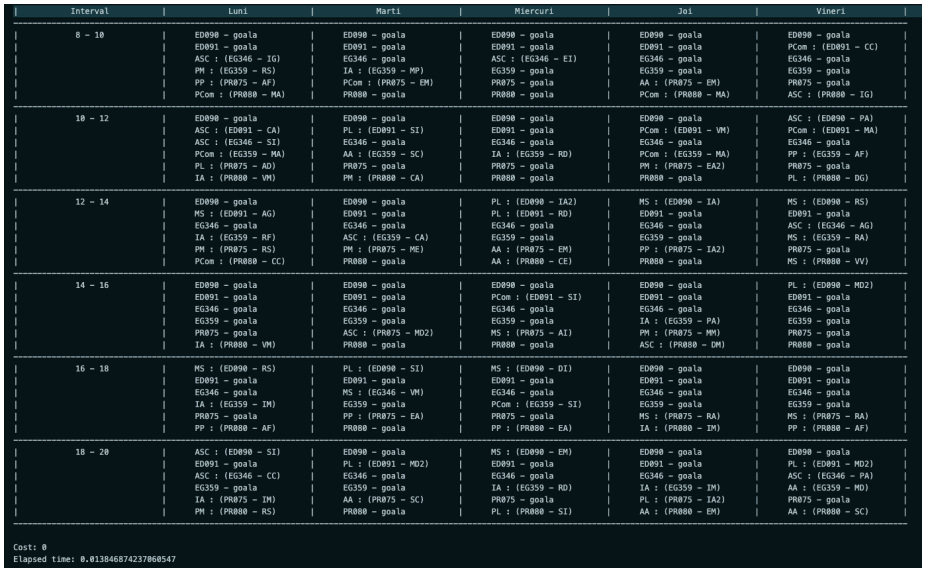
Figure 5: Orar Mediu Relaxat 1 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	MS : (ED038 – IC) MS : (ED041 – CA) ED069 – goala PR011 – goala	AA : (ED038 – MA) AA : (ED041 – MA2) MS : (ED069 – PD) PR011 – goala	PL : (ED038 – CA) ED041 – goala ED069 – goala PR011 – goala	MS : (ED038 – CA) ED041 – goala PL : (ED069 – MA2) PR011 – goala	PL : (ED038 – RE) ED041 – goala ED069 – goala MS : (PR011 – IC)
10 – 12	PL : (ED038 – CA) ED041 – goala SOC : (ED069 – SA) PL : (PR011 – MA2)	PL : (ED038 – CA) SOC : (ED041 – MA) MS : (ED069 – IG) MS : (PR011 – IC)	AA : (ED038 – MA2) SOC : (ED041 – RD) ED069 – goala AA : (PR011 – MA)	PL : (ED038 – MA2) ED041 – goala ED069 – goala PR011 – goala	ED038 – goala SOC : (ED041 – IG) PL : (ED069 – RE) MS : (PR011 – MP)
12 – 14	MS : (ED038 – CA) ED041 – goala AA : (ED069 – PC) SOC : (PR011 – DA)	AA : (ED038 – PC) AA : (ED041 – CF) ED069 – goala PR011 – goala	ED038 – goala ED041 – goala ED069 – goala SOC : (PR011 – RA)	PL : (ED038 – MA2) ED041 – goala SOC : (ED069 – SA) SOC : (PR011 – DA)	AA : (ED038 – SA) ED041 – goala ED069 – goala PR011 – goala
14 – 16	MS : (ED038 – MP) ED041 – goala ED069 – goala PL : (PR011 – RE)	ED038 – goala MS : (ED041 – AP) ED069 – goala PR011 – goala	ED038 – goala ED041 – goala MS : (ED069 – RA2) SOC : (PR011 – IG)	AA : (ED038 – CF) SOC : (ED041 – DA) ED069 – goala PR011 – goala	PL : (ED038 – RE) ED041 – goala ED069 – goala AA : (PR011 – DA)
16 – 18	AA : (ED038 – SA) ED041 – goala MS : (ED069 – MP) MS : (PR011 – PD)	PL : (ED038 – RE) AA : (ED041 – PD) AA : (ED069 – RA2) SOC : (PR011 – RD)	ED038 – goala ED041 – goala MS : (ED069 – RA2) PR011 – goala	ED038 – goala ED041 – goala PL : (ED069 – CA) PL : (PR011 – RE)	PL : (ED038 – RE) ED041 – goala ED069 – goala AA : (PR011 – RA2)
18 – 20	ED038 – goala MS : (ED041 – MP) AA : (ED069 – PD) PL : (PR011 – MA2)	ED038 – goala ED041 – goala MS : (ED069 – RA2) AA : (PR011 – PD)	MS : (ED038 – RA2) ED041 – goala SOC : (ED069 – IG) SOC : (PR011 – SA)	SOC : (ED038 – RD) ED041 – goala ED069 – goala PR011 – goala	ED038 – goala SOC : (ED041 – IC) AA : (ED069 – RA2) SOC : (PR011 – SA)

Cost: 0
Elapsed time: 0.012972116470336914

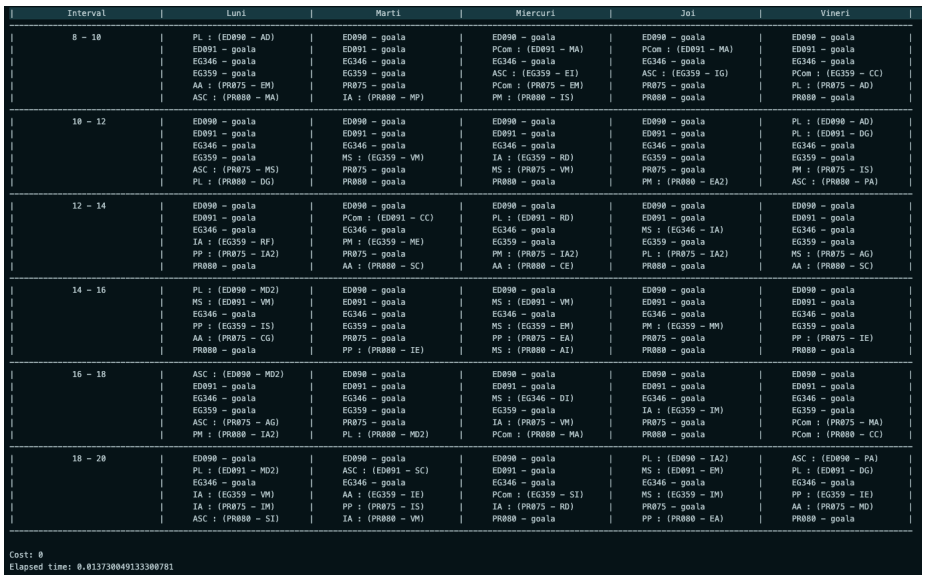
Figure 6: Orar Mediu Relaxat 2 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	PCom : (ED091 – CC)
	ASC : (EG346 – IG)	EG346 – goala	ASC : (EG346 – EI)	EG346 – goala	EG346 – goala
	PM : (EG359 – RS)	IA : (EG359 – MP)	EG359 – goala	EG359 – goala	EG359 – goala
	PP : (PR075 – AF)	PCom : (PR075 – EM)	PR075 – goala	AA : (PR075 – EM)	PR075 – goala
	PCom : (PR080 – MA)	PR080 – goala	PR080 – goala	PCom : (PR080 – MA)	ASC : (PR080 – IG)
10 – 12	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ASC : (ED090 – PA)
	ASC : (ED091 – CA)	PL : (ED091 – SI)	ED091 – goala	PCom : (ED091 – VM)	PCom : (ED091 – MA)
	ASC : (EG346 – SI)	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	PCom : (EG359 – MA)	AA : (EG359 – SC)	IA : (EG359 – RD)	PCom : (EG359 – MA)	PP : (EG359 – AF)
	PL : (PR075 – AD)	PR075 – goala	PR075 – goala	PM : (PR075 – EA2)	PR075 – goala
	IA : (PR080 – VM)	PM : (PR080 – CA)	PR080 – goala	PR080 – goala	PL : (PR080 – DG)
12 – 14	ED090 – goala	ED090 – goala	PL : (ED090 – IA2)	MS : (ED090 – IA)	MS : (ED090 – RS)
	MS : (ED091 – AG)	ED091 – goala	PL : (ED091 – RD)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	ASC : (EG346 – AG)
	IA : (EG359 – RF)	ASC : (EG359 – CA)	EG359 – goala	EG359 – goala	MS : (EG359 – RA)
	PM : (PR075 – RS)	PM : (PR075 – ME)	AA : (PR075 – EM)	PP : (PR075 – IA2)	PR075 – goala
	PCom : (PR080 – CC)	PR080 – goala	AA : (PR080 – CE)	PR080 – goala	MS : (PR080 – VV)
14 – 16	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	PL : (ED090 – MD2)
	ED091 – goala	ED091 – goala	PCom : (ED091 – SI)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	EG359 – goala	EG359 – goala	IA : (EG359 – PA)	EG359 – goala
	PR075 – goala	ASC : (PR075 – MD2)	MS : (PR075 – AI)	PM : (PR075 – MM)	PR075 – goala
	IA : (PR080 – VM)	PR080 – goala	PR080 – goala	ASC : (PR080 – DM)	PR080 – goala
16 – 18	MS : (ED090 – RS)	PL : (ED090 – SI)	MS : (ED090 – DI)	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	MS : (EG346 – VM)	EG346 – goala	EG346 – goala	EG346 – goala
	IA : (EG359 – IM)	EG359 – goala	PCom : (EG359 – SI)	EG359 – goala	EG359 – goala
	PR075 – goala	PP : (PR075 – EA)	PR075 – goala	MS : (PR075 – RA)	MS : (PR075 – RA)
	PP : (PR080 – AF)	PR080 – goala	PP : (PR080 – EA)	IA : (PR080 – IM)	PP : (PR080 – AF)
18 – 20	ASC : (ED090 – SI)	ED090 – goala	MS : (ED090 – EM)	ED090 – goala	ED090 – goala
	ED091 – goala	PL : (ED091 – MD2)	ED091 – goala	ED091 – goala	PL : (ED091 – MD2)
	ASC : (EG346 – CC)	EG346 – goala	EG346 – goala	EG346 – goala	ASC : (EG346 – PA)
	EG359 – goala	EG359 – goala	IA : (EG359 – RD)	IA : (EG359 – IM)	AA : (EG359 – MD)
	IA : (PR075 – IM)	AA : (PR075 – SC)	PR075 – goala	PL : (PR075 – IA2)	PR075 – goala
	PM : (PR080 – RS)	PR080 – goala	PL : (PR080 – SI)	AA : (PR080 – EM)	AA : (PR080 – SC)

Cost: 0
Elapsed time: 0.013846874237060547

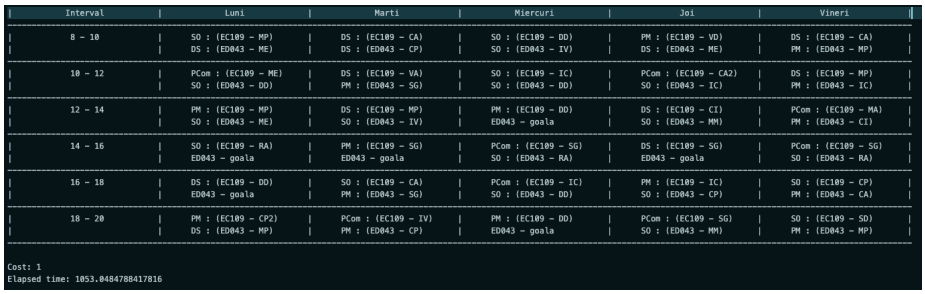
Figure 7: Orar Mare 1 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	PL : (ED090 – AD)	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	PCom : (ED091 – MA)	PCom : (ED091 – MA)	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	EG359 – goala	ASC : (EG359 – EI)	ASC : (EG359 – IG)	PCom : (EG359 – CC)
	AA : (PR075 – EM)	PR075 – goala	PCom : (PR075 – EM)	PR075 – goala	PL : (PR075 – AD)
	ASC : (PR080 – MA)	IA : (PR080 – MP)	PM : (PR080 – IS)	PR080 – goala	PR080 – goala
10 – 12	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	PL : (ED090 – AD)
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	PL : (ED091 – DG)
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	MS : (EG359 – VM)	IA : (EG359 – RD)	EG359 – goala	EG359 – goala
	ASC : (PR075 – MS)	PR075 – goala	MS : (PR075 – VM)	PR075 – goala	PM : (PR075 – IS)
	PL : (PR080 – DG)	PR080 – goala	PR080 – goala	PM : (PR080 – EA2)	ASC : (PR080 – PA)
12 – 14	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ED091 – goala	PCom : (ED091 – CC)	PL : (ED091 – RD)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	MS : (EG346 – IA)	EG346 – goala
	IA : (EG359 – RF)	PM : (EG359 – ME)	EG359 – goala	EG359 – goala	EG359 – goala
	PP : (PR075 – IA2)	PR075 – goala	PM : (PR075 – IA2)	PL : (PR075 – IA2)	MS : (PR075 – AG)
	PR080 – goala	AA : (PR080 – SC)	AA : (PR080 – CE)	PR080 – goala	AA : (PR080 – SC)
14 – 16	PL : (ED090 – MD2)	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	MS : (ED091 – VM)	ED091 – goala	MS : (ED091 – VM)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	PP : (EG359 – IS)	EG359 – goala	MS : (EG359 – EM)	PM : (EG359 – MM)	EG359 – goala
	AA : (PR075 – CG)	PR075 – goala	PP : (PR075 – EA)	PR075 – goala	PP : (PR075 – IE)
	PR080 – goala	PP : (PR080 – IE)	MS : (PR080 – AI)	PR080 – goala	PR080 – goala
16 – 18	ASC : (ED090 – MD2)	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	MS : (EG346 – DI)	EG346 – goala	EG346 – goala
	EG359 – goala	EG359 – goala	EG359 – goala	IA : (EG359 – IM)	EG359 – goala
	ASC : (PR075 – AG)	PR075 – goala	IA : (PR075 – VM)	PR075 – goala	PCom : (PR075 – MA)
	PM : (PR080 – IA2)	PL : (PR080 – MD2)	PCom : (PR080 – MA)	PR080 – goala	PCom : (PR080 – CC)
18 – 20	ED090 – goala	ED090 – goala	ED090 – goala	PL : (ED090 – IA2)	ASC : (ED090 – PA)
	PL : (ED091 – MD2)	ASC : (ED091 – SC)	ED091 – goala	MS : (ED091 – EM)	PL : (ED091 – DG)
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	IA : (EG359 – VM)	AA : (EG359 – IE)	PCom : (EG359 – SI)	MS : (EG359 – IM)	PP : (EG359 – IE)
	IA : (PR075 – IM)	PP : (PR075 – IS)	IA : (PR075 – RD)	PR075 – goala	AA : (PR075 – MD)
	ASC : (PR080 – SI)	IA : (PR080 – VM)	PR080 – goala	PP : (PR080 – EA)	PR080 – goala

Cost: 0
Elapsed time: 0.013730049133300781

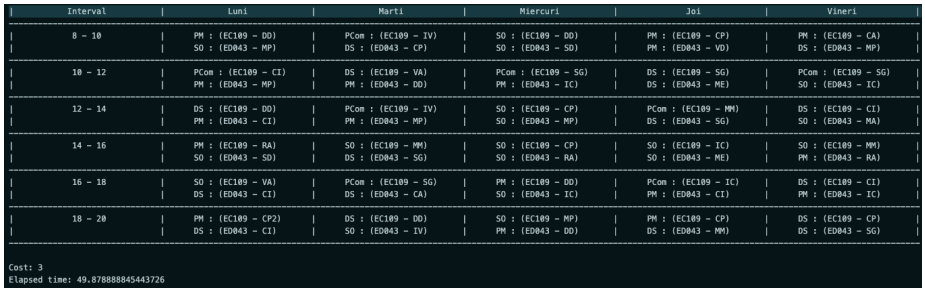
Figure 8: Orar Mare 2 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	SO : (EC109 – MP) DS : (ED043 – ME)	DS : (EC109 – CA) DS : (ED043 – CP)	SO : (EC109 – DD) SO : (ED043 – IV)	PM : (EC109 – VD) DS : (ED043 – ME)	DS : (EC109 – CA) PM : (ED043 – MP)
10 – 12	PCom : (EC109 – ME) SO : (ED043 – DD)	DS : (EC109 – VA) PM : (ED043 – SG)	SO : (EC109 – IC) SO : (ED043 – DD)	PCom : (EC109 – CA2) SO : (ED043 – IC)	DS : (EC109 – MP) PM : (ED043 – IC)
12 – 14	PM : (EC109 – MP) SO : (ED043 – ME)	DS : (EC109 – MP) SO : (ED043 – IV)	PM : (EC109 – DD) ED043 – goala	DS : (EC109 – CI) SO : (ED043 – MM)	PCom : (EC109 – MA) PM : (ED043 – CI)
14 – 16	SO : (EC109 – RA) ED043 – goala	PM : (EC109 – SG) ED043 – goala	PCom : (EC109 – SG) SO : (ED043 – RA)	DS : (EC109 – SG) ED043 – goala	PCom : (EC109 – SG) SO : (ED043 – RA)
16 – 18	DS : (EC109 – DD) ED043 – goala	SO : (EC109 – CA) PM : (ED043 – SG)	PCom : (EC109 – IC) SO : (ED043 – DD)	PM : (EC109 – IC) SO : (ED043 – CP)	SO : (EC109 – CP) PM : (ED043 – CA)
18 – 20	PM : (EC109 – CP2) DS : (ED043 – MP)	PCom : (EC109 – IV) PM : (ED043 – CP)	PM : (EC109 – DD) ED043 – goala	PCom : (EC109 – SG) SO : (ED043 – MM)	SO : (EC109 – SD) PM : (ED043 – MP)

Cost: 1
Elapsed time: 1053.0484788417816

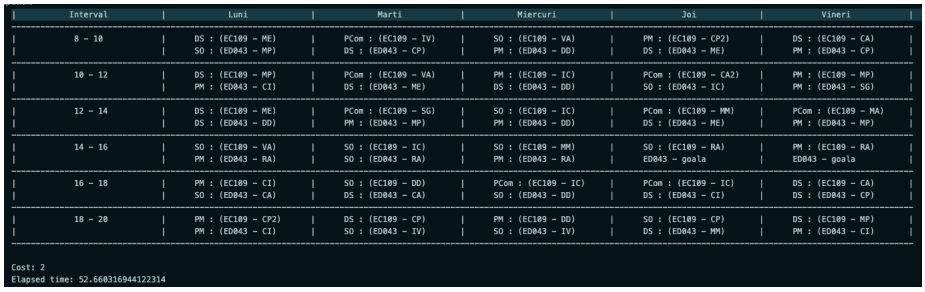
Figure 9: Orar Constrans 1 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	PM : (EC109 – DD) SO : (ED043 – MP)	PCom : (EC109 – IV) DS : (ED043 – CP)	SO : (EC109 – DD) SO : (ED043 – SD)	PM : (EC109 – CP) PM : (ED043 – VD)	PM : (EC109 – CA) DS : (ED043 – MP)
10 – 12	PCom : (EC109 – CI) PM : (ED043 – MP)	DS : (EC109 – VA) PM : (ED043 – DD)	PCom : (EC109 – SG) PM : (ED043 – IC)	DS : (EC109 – SG) DS : (ED043 – ME)	PCom : (EC109 – SG) SO : (ED043 – IC)
12 – 14	DS : (EC109 – DD) PM : (ED043 – CI)	PCom : (EC109 – IV) PM : (ED043 – MP)	SO : (EC109 – CP) SO : (ED043 – MP)	PCom : (EC109 – MM) DS : (ED043 – SG)	DS : (EC109 – CI) SO : (ED043 – MA)
14 – 16	PM : (EC109 – RA) SO : (ED043 – SD)	SO : (EC109 – MM) DS : (ED043 – SG)	SO : (EC109 – CP) SO : (ED043 – RA)	SO : (EC109 – IC) SO : (ED043 – ME)	SO : (EC109 – MM) PM : (ED043 – RA)
16 – 18	SO : (EC109 – VA) DS : (ED043 – CI)	PCom : (EC109 – SG) DS : (ED043 – CA)	PM : (EC109 – DD) SO : (ED043 – IC)	PCom : (EC109 – IC) PM : (ED043 – CI)	DS : (EC109 – CI) PM : (ED043 – IC)
18 – 20	PM : (EC109 – CP2) DS : (ED043 – CI)	DS : (EC109 – DD) SO : (ED043 – IV)	SO : (EC109 – MP) PM : (ED043 – DD)	PM : (EC109 – CP) DS : (ED043 – MM)	DS : (EC109 – CP) DS : (ED043 – SG)

Cost: 3
Elapsed time: 49.878888845443726

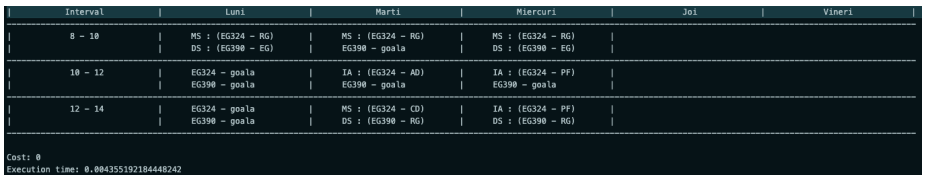
Figure 10: Orar Constrans 2 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	DS : (EC109 – ME) SO : (ED043 – MP)	PCom : (EC109 – IV) DS : (ED043 – CP)	SO : (EC109 – VA) PM : (ED043 – DD)	PM : (EC109 – CP2) DS : (ED043 – ME)	DS : (EC109 – CA) PM : (ED043 – CP)
10 – 12	DS : (EC109 – MP) PM : (ED043 – CI)	PCom : (EC109 – VA) DS : (ED043 – ME)	PM : (EC109 – IC) DS : (ED043 – DD)	PCom : (EC109 – CA2) SO : (ED043 – IC)	PM : (EC109 – MP) PM : (ED043 – SG)
12 – 14	DS : (EC109 – ME) DS : (ED043 – DD)	PCom : (EC109 – SG) PM : (ED043 – MP)	SO : (EC109 – IC) PM : (ED043 – DD)	PCom : (EC109 – MM) DS : (ED043 – ME)	PCom : (EC109 – MA) PM : (ED043 – MP)
14 – 16	SO : (EC109 – VA) PM : (ED043 – RA)	SO : (EC109 – IC) SO : (ED043 – RA)	SO : (EC109 – MM) PM : (ED043 – RA)	SO : (EC109 – RA) ED043 – goala	PM : (EC109 – RA) ED043 – goala
16 – 18	PM : (EC109 – CI) SO : (ED043 – CA)	SO : (EC109 – DD) DS : (ED043 – CA)	PCom : (EC109 – IC) SO : (ED043 – DD)	PCom : (EC109 – IC) DS : (ED043 – CI)	DS : (EC109 – CA) DS : (ED043 – CP)
18 – 20	PM : (EC109 – CP2) PM : (ED043 – CI)	DS : (EC109 – CP) SO : (ED043 – IV)	PM : (EC109 – DD) SO : (ED043 – IV)	SO : (EC109 – CP) DS : (ED043 – MM)	DS : (EC109 – MP) PM : (ED043 – CI)

Cost: 2
Elapsed time: 52.660316944122314

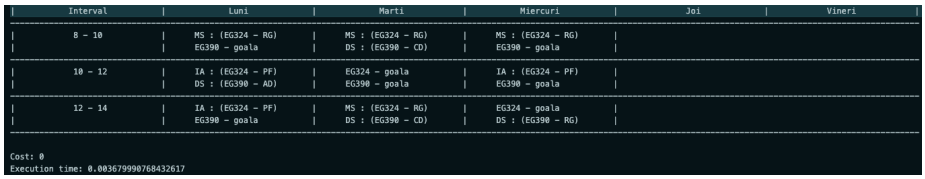
Figure 11: Orar Constrans 3 (HC)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	MS : (EG324 – RG) DS : (EG390 – EG)	MS : (EG324 – RG) EG390 – goala	MS : (EG324 – RG) DS : (EG390 – EG)		
10 – 12	EG324 – goala EG390 – goala	IA : (EG324 – AD) EG390 – goala	IA : (EG324 – PF) EG390 – goala		
12 – 14	EG324 – goala EG390 – goala	MS : (EG324 – CD) DS : (EG390 – RG)	IA : (EG324 – PF) DS : (EG390 – RG)		

Cost: 0
Execution time: 0.004355192184448242

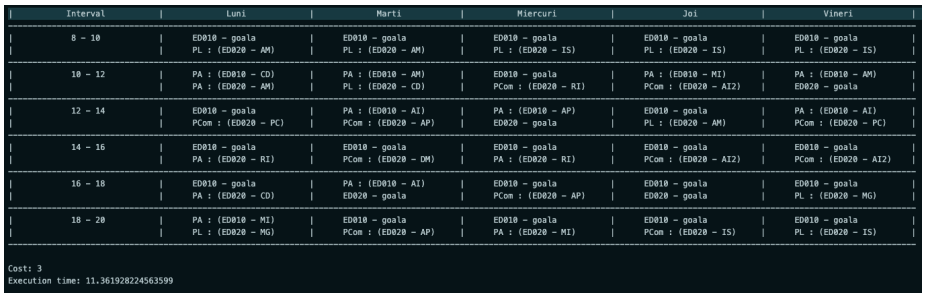
Figure 12: Dummy (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	MS : (EG324 – RG) EG390 – goala	MS : (EG324 – RG) DS : (EG390 – CD)	MS : (EG324 – RG) EG390 – goala		
10 – 12	IA : (EG324 – PF) DS : (EG390 – AD)	EG324 – goala EG390 – goala	IA : (EG324 – PF) EG390 – goala		
12 – 14	IA : (EG324 – PF) EG390 – goala	MS : (EG324 – RG) DS : (EG390 – CD)	EG324 – goala DS : (EG390 – RG)		

Cost: 0
Execution time: 0.0036799907684326 17

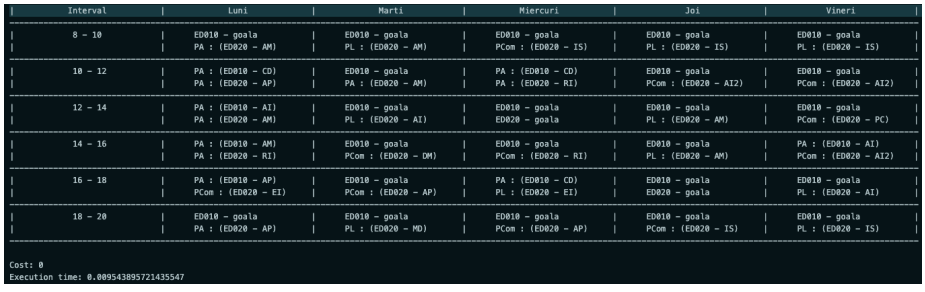
Figure 13: Dummy (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED010 – goala PL : (ED020 – AM)	ED010 – goala PL : (ED020 – AM)	ED010 – goala PL : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)
10 – 12	PA : (ED010 – CD) PA : (ED020 – AM)	PA : (ED010 – AM) PL : (ED020 – CD)	ED010 – goala PCom : (ED020 – RI)	PA : (ED010 – MI) PCom : (ED020 – AI2)	PA : (ED010 – AM) ED020 – goala
12 – 14	ED010 – goala PCom : (ED020 – PC)	PA : (ED010 – AI) PCom : (ED020 – AP)	PA : (ED010 – AP) ED020 – goala	ED010 – goala PL : (ED020 – AM)	PA : (ED010 – AI) PCom : (ED020 – PC)
14 – 16	ED010 – goala PA : (ED020 – RI)	ED010 – goala PCom : (ED020 – DM)	ED010 – goala PA : (ED020 – RI)	ED010 – goala PCom : (ED020 – AI2)	ED010 – goala PCom : (ED020 – AI2)
16 – 18	ED010 – goala PA : (ED020 – CD)	PA : (ED010 – AI) ED020 – goala	ED010 – goala PCom : (ED020 – AP)	ED010 – goala ED020 – goala	ED010 – goala PL : (ED020 – MG)
18 – 20	PA : (ED010 – MI) PL : (ED020 – MG)	ED010 – goala PCom : (ED020 – AP)	ED010 – goala PA : (ED020 – MI)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)

Cost: 3
Execution time: 11.361928224563599

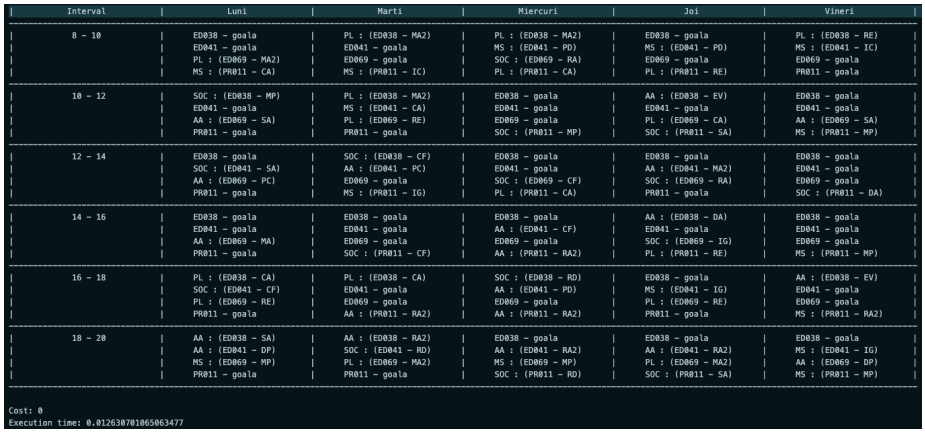
Figure 14: Orar Mic (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED010 – goala PA : (ED020 – AM)	ED010 – goala PL : (ED020 – AM)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)
10 – 12	PA : (ED010 – CD) PA : (ED020 – AP)	ED010 – goala PA : (ED020 – AM)	PA : (ED010 – CD) PA : (ED020 – RI)	ED010 – goala PCom : (ED020 – AI2)	ED010 – goala PCom : (ED020 – AI2)
12 – 14	PA : (ED010 – AI) PA : (ED020 – AM)	ED010 – goala PL : (ED020 – AI)	ED010 – goala ED020 – goala	ED010 – goala PL : (ED020 – AM)	ED010 – goala PCom : (ED020 – PC)
14 – 16	PA : (ED010 – AM) PA : (ED020 – RI)	ED010 – goala PCom : (ED020 – DM)	ED010 – goala PCom : (ED020 – RI)	ED010 – goala PL : (ED020 – AM)	PA : (ED010 – AI) PCom : (ED020 – AI2)
16 – 18	PA : (ED010 – AP) PCom : (ED020 – EI)	ED010 – goala PCom : (ED020 – AP)	PA : (ED010 – CD) PL : (ED020 – EI)	ED010 – goala ED020 – goala	ED010 – goala PL : (ED020 – AI)
18 – 20	ED010 – goala PA : (ED020 – AP)	ED010 – goala PL : (ED020 – MD)	ED010 – goala PCom : (ED020 – AP)	ED010 – goala PCom : (ED020 – IS)	ED010 – goala PL : (ED020 – IS)

Cost: 0
Execution time: 0.009543895721435547

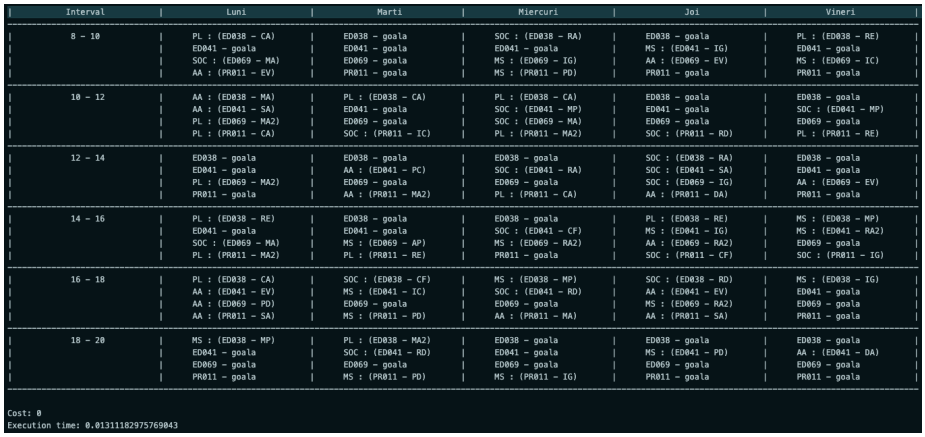
Figure 15: Orar Mic (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED038 – goala	PL : (ED038 – MA2)	PL : (ED038 – MA2)	ED038 – goala	PL : (ED038 – RE)
	ED041 – goala	ED041 – goala	MS : (ED041 – PD)	MS : (ED041 – PD)	MS : (ED041 – IC)
	PL : (ED069 – MA2)	ED069 – goala	SOC : (ED069 – RA)	ED069 – goala	ED069 – goala
	MS : (PR011 – CA)	MS : (PR011 – IC)	PL : (PR011 – CA)	PL : (PR011 – RE)	PR011 – goala
10 – 12	SOC : (ED038 – MP)	PL : (ED038 – MA2)	ED038 – goala	AA : (ED038 – EV)	ED038 – goala
	ED041 – goala	MS : (ED041 – CA)	ED041 – goala	ED041 – goala	ED041 – goala
	AA : (ED069 – SA)	PL : (ED069 – RE)	ED069 – goala	PL : (ED069 – CA)	AA : (ED069 – SA)
	PR011 – goala	PR011 – goala	SOC : (PR011 – MP)	SOC : (PR011 – SA)	MS : (PR011 – MP)
12 – 14	ED038 – goala	SOC : (ED038 – CF)	ED038 – goala	ED038 – goala	ED038 – goala
	SOC : (ED041 – SA)	AA : (ED041 – PC)	ED041 – goala	AA : (ED041 – MA2)	ED041 – goala
	AA : (ED069 – PC)	ED069 – goala	SOC : (ED069 – CF)	SOC : (ED069 – RA)	ED069 – goala
	PR011 – goala	MS : (PR011 – IG)	PL : (PR011 – CA)	PR011 – goala	SOC : (PR011 – DA)
14 – 16	ED038 – goala	ED038 – goala	ED038 – goala	AA : (ED038 – DA)	ED038 – goala
	ED041 – goala	ED041 – goala	AA : (ED041 – CF)	ED041 – goala	ED041 – goala
	AA : (ED069 – MA)	ED069 – goala	ED069 – goala	SOC : (ED069 – IG)	ED069 – goala
	PR011 – goala	SOC : (PR011 – CF)	AA : (PR011 – RA2)	PL : (PR011 – RE)	MS : (PR011 – MP)
16 – 18	PL : (ED038 – CA)	PL : (ED038 – CA)	SOC : (ED038 – RD)	ED038 – goala	AA : (ED038 – EV)
	SOC : (ED041 – CF)	ED041 – goala	AA : (ED041 – PD)	MS : (ED041 – IG)	ED041 – goala
	PL : (ED069 – RE)	ED069 – goala	ED069 – goala	PL : (ED069 – RE)	ED069 – goala
	PR011 – goala	AA : (PR011 – RA2)	AA : (PR011 – RA2)	PR011 – goala	MS : (PR011 – RA2)
18 – 20	AA : (ED038 – SA)	AA : (ED038 – RA2)	ED038 – goala	ED038 – goala	ED038 – goala
	AA : (ED041 – DP)	SOC : (ED041 – RD)	AA : (ED041 – RA2)	AA : (ED041 – RA2)	MS : (ED041 – IG)
	MS : (ED069 – MP)	PL : (ED069 – MA2)	MS : (ED069 – MP)	PL : (ED069 – MA2)	AA : (ED069 – DP)
	PR011 – goala	PR011 – goala	SOC : (PR011 – RD)	SOC : (PR011 – SA)	MS : (PR011 – MP)

Cost: 0
Execution time: 0.012630701065063477

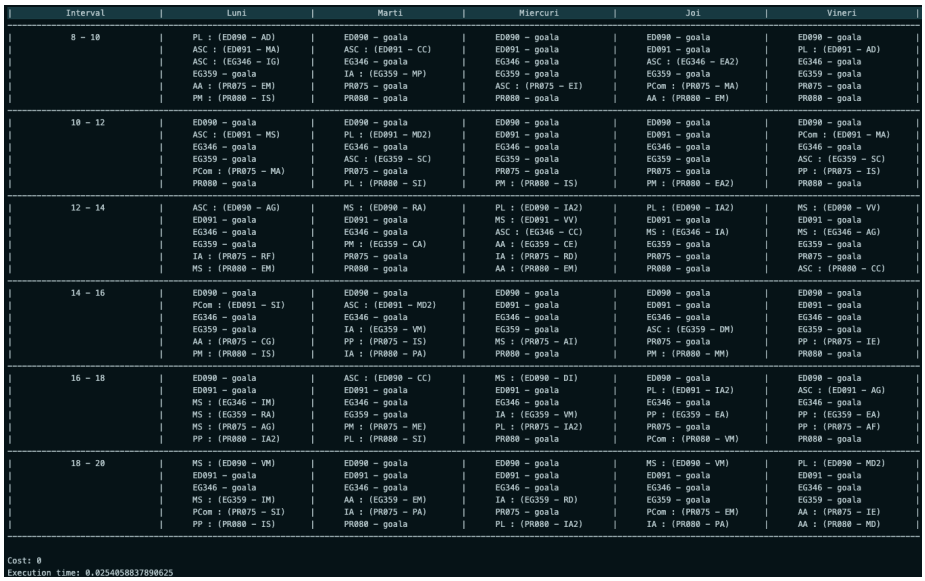
Figure 16: Orar Mediu Relaxat 1 (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	PL : (ED038 – CA)	ED038 – goala	SOC : (ED038 – RA)	ED038 – goala	PL : (ED038 – RE)
	ED041 – goala	ED041 – goala	ED041 – goala	MS : (ED041 – IG)	ED041 – goala
	SOC : (ED069 – MA)	ED069 – goala	MS : (ED069 – IG)	AA : (ED069 – EV)	MS : (ED069 – IC)
	AA : (PR011 – EV)	PR011 – goala	MS : (PR011 – PD)	PR011 – goala	PR011 – goala
10 – 12	AA : (ED038 – MA)	PL : (ED038 – CA)	PL : (ED038 – CA)	ED038 – goala	ED038 – goala
	AA : (ED041 – SA)	ED041 – goala	SOC : (ED041 – MP)	ED041 – goala	SOC : (ED041 – MP)
	PL : (ED069 – MA2)	ED069 – goala	SOC : (ED069 – MA)	ED069 – goala	ED069 – goala
	PL : (PR011 – CA)	SOC : (PR011 – IC)	PL : (PR011 – MA2)	SOC : (PR011 – RD)	PL : (PR011 – RE)
12 – 14	ED038 – goala	ED038 – goala	ED038 – goala	SOC : (ED038 – RA)	ED038 – goala
	ED041 – goala	AA : (ED041 – PC)	SOC : (ED041 – RA)	SOC : (ED041 – SA)	ED041 – goala
	PL : (ED069 – MA2)	ED069 – goala	ED069 – goala	SOC : (ED069 – IG)	AA : (ED069 – EV)
	PR011 – goala	AA : (PR011 – MA2)	PL : (PR011 – CA)	AA : (PR011 – DA)	PR011 – goala
14 – 16	PL : (ED038 – RE)	ED038 – goala	ED038 – goala	PL : (ED038 – RE)	MS : (ED038 – MP)
	ED041 – goala	ED041 – goala	SOC : (ED041 – CF)	MS : (ED041 – IG)	MS : (ED041 – RA2)
	SOC : (ED069 – MA)	MS : (ED069 – AP)	MS : (ED069 – RA2)	AA : (ED069 – RA2)	ED069 – goala
	PL : (PR011 – MA2)	PL : (PR011 – RE)	PR011 – goala	SOC : (PR011 – CF)	SOC : (PR011 – IG)
16 – 18	PL : (ED038 – CA)	SOC : (ED038 – CF)	MS : (ED038 – MP)	SOC : (ED038 – RD)	MS : (ED038 – IG)
	AA : (ED041 – EV)	MS : (ED041 – IC)	SOC : (ED041 – RD)	AA : (ED041 – EV)	ED041 – goala
	AA : (ED069 – PD)	ED069 – goala	ED069 – goala	MS : (ED069 – RA2)	ED069 – goala
	AA : (PR011 – SA)	MS : (PR011 – PD)	AA : (PR011 – MA)	AA : (PR011 – SA)	PR011 – goala
18 – 20	MS : (ED038 – MP)	PL : (ED038 – MA2)	ED038 – goala	ED038 – goala	ED038 – goala
	ED041 – goala	SOC : (ED041 – RD)	ED041 – goala	MS : (ED041 – PD)	AA : (ED041 – DA)
	ED069 – goala	ED069 – goala	ED069 – goala	ED069 – goala	ED069 – goala
	PR011 – goala	MS : (PR011 – PD)	MS : (PR011 – IG)	PR011 – goala	PR011 – goala

Cost: 0
Execution time: 0.013111829757690043

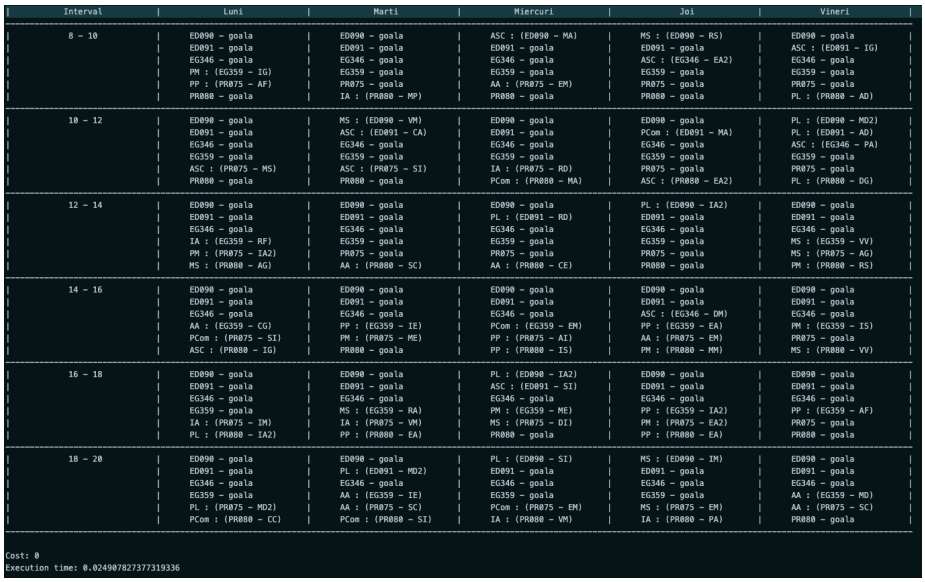
Figure 17: Orar Mediu Relaxat 2 (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	PL : (ED090 – AD)	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ASC : (ED091 – MA)	ASC : (ED091 – CC)	ED091 – goala	ED091 – goala	PL : (ED091 – AD)
	ASC : (EG346 – IG)	EG346 – goala	EG346 – goala	ASC : (EG346 – EA2)	EG346 – goala
	EG359 – goala	IA : (EG359 – MP)	EG359 – goala	EG359 – goala	EG359 – goala
	AA : (PR075 – EM)	PR075 – goala	ASC : (PR075 – EI)	PCom : (PR075 – MA)	PR075 – goala
	PM : (PR080 – IS)	PR080 – goala	PR080 – goala	AA : (PR080 – EM)	PR080 – goala
10 – 12	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ASC : (ED091 – MS)	PL : (ED091 – MD2)	ED091 – goala	ED091 – goala	PCom : (ED091 – MA)
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	ASC : (EG359 – SC)	EG359 – goala	EG359 – goala	ASC : (EG359 – SC)
	PCom : (PR075 – MA)	PR075 – goala	PR075 – goala	PR075 – goala	PP : (PR075 – IS)
	PR080 – goala	PL : (PR080 – SI)	PM : (PR080 – IS)	PM : (PR080 – EA2)	PR080 – goala
12 – 14	ASC : (ED090 – AG)	MS : (ED090 – RA)	PL : (ED090 – IA2)	PL : (ED090 – IA2)	MS : (ED090 – VV)
	ED091 – goala	ED091 – goala	MS : (ED091 – VV)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	ASC : (EG346 – CC)	MS : (EG346 – IA)	MS : (EG346 – AG)
	EG359 – goala	PM : (EG359 – CA)	AA : (EG359 – CE)	EG359 – goala	EG359 – goala
	IA : (PR075 – RF)	PR075 – goala	IA : (PR075 – RD)	PR075 – goala	PR075 – goala
	MS : (PR080 – EM)	PR080 – goala	AA : (PR080 – EM)	PR080 – goala	ASC : (PR080 – CC)
14 – 16	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	PCom : (ED091 – SI)	ASC : (ED091 – MD2)	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	IA : (EG359 – VM)	EG359 – goala	ASC : (EG359 – DM)	EG359 – goala
	AA : (PR075 – CG)	PP : (PR075 – IS)	MS : (PR075 – AI)	PR075 – goala	PP : (PR075 – IE)
	PM : (PR080 – IS)	IA : (PR080 – PA)	PR080 – goala	PM : (PR080 – MM)	PR080 – goala
16 – 18	ED090 – goala	ASC : (ED090 – CC)	MS : (ED090 – DI)	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	PL : (ED091 – IA2)	ASC : (ED091 – AG)
	MS : (EG346 – IM)	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	MS : (EG359 – AA)	EG359 – goala	IA : (EG359 – VM)	PP : (EG359 – EA)	PP : (EG359 – EA)
	MS : (PR075 – AG)	PM : (PR075 – ME)	PL : (PR075 – IA2)	PR075 – goala	PP : (PR075 – AF)
	PP : (PR080 – IA2)	PL : (PR080 – SI)	PR080 – goala	PCom : (PR080 – VM)	PR080 – goala
18 – 20	MS : (ED090 – VM)	ED090 – goala	ED090 – goala	MS : (ED090 – VM)	PL : (ED090 – MD2)
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	MS : (EG359 – IM)	AA : (EG359 – EM)	IA : (EG359 – RD)	EG359 – goala	EG359 – goala
	PCom : (PR075 – SI)	IA : (PR075 – PA)	PR075 – goala	PCom : (PR075 – EM)	AA : (PR075 – IE)
	PP : (PR080 – IS)	PR080 – goala	PL : (PR080 – IA2)	IA : (PR080 – PA)	AA : (PR080 – MD)

Cost: 0
Execution time: 0.02540588378906255

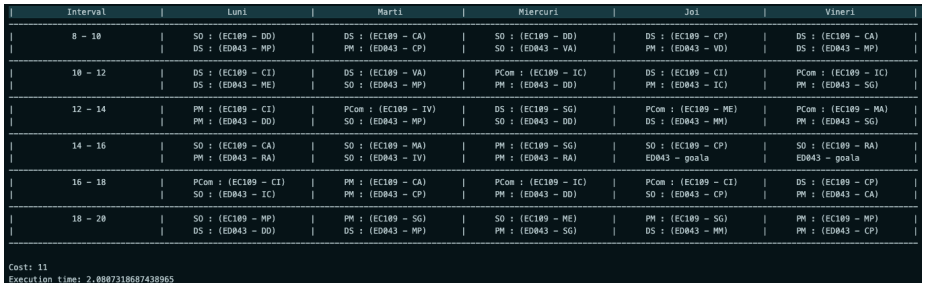
Figure 18: Orar Mare 1 (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	ED090 – goala	ED090 – goala	ASC : (ED090 – MA)	MS : (ED090 – RS)	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	ASC : (ED091 – IG)
	EG346 – goala	EG346 – goala	EG346 – goala	ASC : (EG346 – EA2)	EG346 – goala
	PM : (EG359 – IG)	EG359 – goala	EG359 – goala	EG359 – goala	EG359 – goala
	PP : (PR075 – AF)	PR075 – goala	AA : (PR075 – EM)	PR075 – goala	PR075 – goala
	PR080 – goala	IA : (PR080 – MP)	PR080 – goala	PR080 – goala	PL : (PR080 – AD)
10 – 12	ED090 – goala	MS : (ED090 – VM)	ED090 – goala	ED090 – goala	PL : (ED090 – MD2)
	ED091 – goala	ASC : (ED091 – CA)	ED091 – goala	PCom : (ED091 – MA)	PL : (ED091 – AD)
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	ASC : (EG346 – PA)
	EG359 – goala	EG359 – goala	EG359 – goala	EG359 – goala	EG359 – goala
	ASC : (PR075 – MS)	ASC : (PR075 – SI)	IA : (PR075 – RD)	PR075 – goala	PR075 – goala
	PR080 – goala	PR080 – goala	PCom : (PR080 – MA)	ASC : (PR080 – EA2)	PL : (PR080 – DG)
12 – 14	ED090 – goala	ED090 – goala	ED090 – goala	PL : (ED090 – IA2)	ED090 – goala
	ED091 – goala	ED091 – goala	PL : (ED091 – RD)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	IA : (EG359 – RF)	EG359 – goala	EG359 – goala	EG359 – goala	MS : (EG359 – VV)
	PM : (PR075 – IA2)	PR075 – goala	PR075 – goala	PR075 – goala	MS : (PR075 – AG)
	MS : (PR080 – AG)	AA : (PR080 – SC)	AA : (PR080 – CE)	PR080 – goala	PM : (PR080 – RS)
14 – 16	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	ASC : (EG346 – DM)	EG346 – goala
	AA : (EG359 – CG)	PP : (EG359 – IE)	PCom : (EG359 – EM)	PP : (EG359 – EA)	PM : (EG359 – IS)
	PCom : (PR075 – SI)	PM : (PR075 – ME)	PP : (PR075 – AI)	AA : (PR075 – EM)	PR075 – goala
	ASC : (PR080 – IG)	PR080 – goala	PP : (PR080 – IS)	PM : (PR080 – MM)	MS : (PR080 – VV)
16 – 18	ED090 – goala	ED090 – goala	PL : (ED090 – IA2)	ED090 – goala	ED090 – goala
	ED091 – goala	ED091 – goala	ASC : (ED091 – SI)	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	MS : (EG359 – RA)	PM : (EG359 – ME)	PP : (EG359 – IA2)	PP : (EG359 – AF)
	IA : (PR075 – IM)	IA : (PR075 – VM)	MS : (PR075 – DI)	PM : (PR075 – EA2)	PR075 – goala
	PL : (PR080 – IA2)	PP : (PR080 – EA)	PR080 – goala	PP : (PR080 – EA)	PR080 – goala
18 – 20	ED090 – goala	ED090 – goala	PL : (ED090 – SI)	MS : (ED090 – IM)	ED090 – goala
	ED091 – goala	PL : (ED091 – MD2)	ED091 – goala	ED091 – goala	ED091 – goala
	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala	EG346 – goala
	EG359 – goala	AA : (EG359 – IE)	EG359 – goala	EG359 – goala	AA : (EG359 – MD)
	PL : (PR075 – MD2)	AA : (PR075 – SC)	PCom : (PR075 – EM)	MS : (PR075 – EM)	AA : (PR075 – SC)
	PCom : (PR080 – CC)	PCom : (PR080 – SI)	IA : (PR080 – VM)	IA : (PR080 – PA)	PR080 – goala

Cost: 0
Execution time: 0.024907827377319336

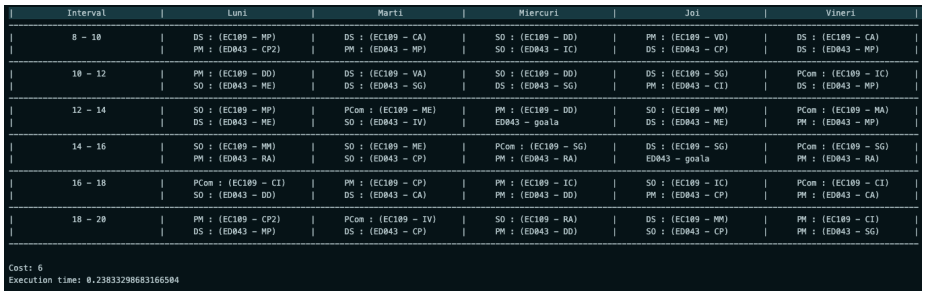
Figure 19: Orar Mare 2 (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	SO : (EC109 – DD) DS : (ED043 – MP)	DS : (EC109 – CA) PM : (ED043 – CP)	SO : (EC109 – DD) SO : (ED043 – VA)	DS : (EC109 – CP) PM : (ED043 – VD)	DS : (EC109 – CA) DS : (ED043 – MP)
10 – 12	DS : (EC109 – CI) DS : (ED043 – ME)	DS : (EC109 – VA) SO : (ED043 – MP)	PCom : (EC109 – IC) PM : (ED043 – DD)	DS : (EC109 – CI) PM : (ED043 – IC)	PCom : (EC109 – IC) PM : (ED043 – SG)
12 – 14	PM : (EC109 – CI) PM : (ED043 – DD)	PCom : (EC109 – IV) SO : (ED043 – MP)	DS : (EC109 – SG) SO : (ED043 – DD)	PCom : (EC109 – ME) DS : (ED043 – MM)	PCom : (EC109 – MA) PM : (ED043 – SG)
14 – 16	SO : (EC109 – CA) PM : (ED043 – RA)	SO : (EC109 – MA) SO : (ED043 – IV)	PM : (EC109 – SG) PM : (ED043 – RA)	SO : (EC109 – CP) ED043 – goala	SO : (EC109 – RA) ED043 – goala
16 – 18	PCom : (EC109 – CI) SO : (ED043 – IC)	PM : (EC109 – CA) PM : (ED043 – CP)	PCom : (EC109 – IC) PM : (ED043 – DD)	PCom : (EC109 – CI) SO : (ED043 – CP)	DS : (EC109 – CP) PM : (ED043 – CA)
18 – 20	SO : (EC109 – MP) DS : (ED043 – DD)	PM : (EC109 – SG) DS : (ED043 – MP)	SO : (EC109 – ME) PM : (ED043 – SG)	PM : (EC109 – SG) DS : (ED043 – MM)	PM : (EC109 – MP) PM : (ED043 – CP)

Cost: 11
Execution time: 2.0807318687438965

Figure 20: Orar Constrans 1 (A*)



Interval	Luni	Marti	Miercuri	Joi	Vineri
8 – 10	DS : (EC109 – MP) PM : (ED043 – CP2)	DS : (EC109 – CA) PM : (ED043 – MP)	SO : (EC109 – DD) SO : (ED043 – IC)	PM : (EC109 – VD) DS : (ED043 – CP)	DS : (EC109 – CA) DS : (ED043 – MP)
10 – 12	PM : (EC109 – DD) SO : (ED043 – ME)	DS : (EC109 – VA) DS : (ED043 – SG)	SO : (EC109 – DD) DS : (ED043 – SG)	DS : (EC109 – SG) PM : (ED043 – CI)	PCom : (EC109 – IC) DS : (ED043 – MP)
12 – 14	SO : (EC109 – MP) DS : (ED043 – ME)	PCom : (EC109 – ME) SO : (ED043 – IV)	PM : (EC109 – DD) ED043 – goala	SO : (EC109 – MM) DS : (ED043 – ME)	PCom : (EC109 – MA) PM : (ED043 – MP)
14 – 16	SO : (EC109 – MM) PM : (ED043 – RA)	SO : (EC109 – ME) SO : (ED043 – CP)	PCom : (EC109 – SG) PM : (ED043 – RA)	DS : (EC109 – SG) ED043 – goala	PCom : (EC109 – SG) PM : (ED043 – RA)
16 – 18	PCom : (EC109 – CI) SO : (ED043 – DD)	PM : (EC109 – CP) DS : (ED043 – CA)	PM : (EC109 – IC) PM : (ED043 – DD)	SO : (EC109 – IC) PM : (ED043 – CP)	PCom : (EC109 – CI) PM : (ED043 – CA)
18 – 20	PM : (EC109 – CP2) DS : (ED043 – MP)	PCom : (EC109 – IV) DS : (ED043 – CP)	SO : (EC109 – RA) PM : (ED043 – DD)	DS : (EC109 – MM) SO : (ED043 – CP)	PM : (EC109 – CI) PM : (ED043 – SG)

Cost: 6
Execution time: 0.23833298683166504

Figure 21: Orar Constrans 2 (A*)