IE 492 PROJECT FINAL PRESENTATION

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Presentation Outline

I. Introduction & Problem Definition
II. Project's Scope and Objective
III. Project
    a. Context Diagram
    b. Schedule Generation
    c. Frequently Asked Questions
    d. Explanation Generation
    e. ChatGPT's Role
    f. Limitations
    g. Ethical Considerations
IV. Conclusion

Introduction & Problem Definition

CHALLENGE
Employee Scheduling in Service Industry

Why mostly in Service Industry?
- Continuous & Fluctuating Demand
- Flexible Shifts
  - Ex #1: Hospital Staff Scheduling
  - Ex #2: Airport Staff Scheduling → Our Case

PROBLEM
Explaining the Schedule to Stakeholders

Focus of the Project: Explaining the Schedule
- Answering Schedule-related FAQ
  - Complaints, Requests, Objections, Clarifications
  - Explaining the reasoning behind Schedule decisions

Project Scope

Step By Step

Step1: Generating a schedule for an airport staff

- Assigning to shifts and tasks such that # of uncovered tasks are minimized
- Subject to a list of given constraints

Step 2: Implementing the functions for answering FAQ

Query:

➢Information Retrieval

Request/Objection/Reasoning:

➢Rejection

- Infeasible → Constraint Viol.
- Feasible → Drastic Change in Objective or Schedule

➢Acceptance

- Feasible → Few changes in Schedule and Objective

Step 3: ChatGPT Integration & Streamlit User Interface

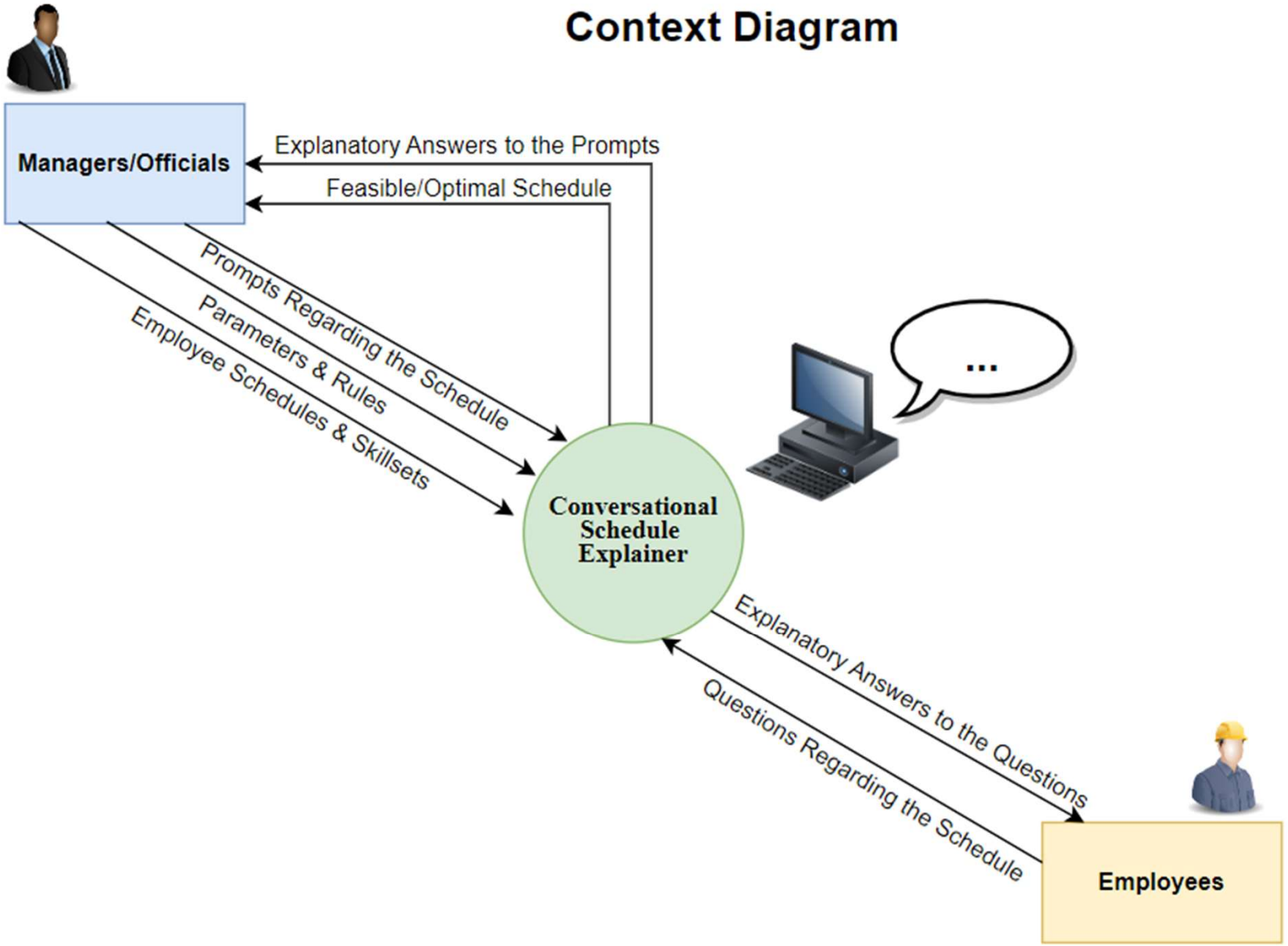
- Needed for the actualization of the Project
- Employees are not proficient with Python
- Natural Language processing
- To provide an **ergonomic** user experience

Project Objective

By implementing this Project, we aim to make stakeholders

- Understand the reasoning behind the scheduling decisions.
- Check the feasibility of schedule related requests
- Retrieve info about schedule

Context Diagram



Benefits to Stakeholders

I love this job!

Here comes the moneeey!

Engaged and Motivated Employees

Employee's Benefit

Improved Workforce Productivity

Increased Profits

Manager's Benefit

An Instance From the Schedule We Generated

Task ID	Required Skill	Task Start Time	Task End Time	Assigned Employee	Employee Skillset	Shift Index	Shift Start Time	Shift End Time
1	**7**	2023-07-10 15:15:00	2023-07-10 23:45:00	C0161	**[3, 4, 5, 7]**	11	2023-07-10 15:00:00	2023-07-11 02:00:00
10	**6**	2023-07-10 15:30:00	2023-07-10 19:00:00	C0129	**[3, 4, 5, 6]**	11	2023-07-10 15:00:00	2023-07-11 02:00:00
13	**6**	2023-07-11 02:00:00	2023-07-11 03:20:00	C0307	**[3, 4, 5, 6]**	22	2023-07-11 02:00:00	2023-07-11 13:00:00
14	**6**	2023-07-11 04:00:00	2023-07-11 05:00:00	C0307	**[3, 4, 5, 6]**	22	2023-07-11 02:00:00	2023-07-11 13:00:00
15	**6**	2023-07-11 04:15:00	2023-07-11 05:00:00	C0359	**[3, 6, 7]**	24	2023-07-11 04:00:00	2023-07-11 13:00:00

Objective:

- Minimizing the # of uncovered tasks

One can adjust these constraints as needed
These constraints are assumptions of our model

Constraints:

- Skill match
- No overlapping tasks to same employee
- Task's timeframe within shift's boundary
- Resting time between shifts
- 2 off days per week

FAQ

QUESTION

QUERY QUESTIONS

- *"Who is on the same shift as me on [date]?"*
- *"Who else has the same skill set as me and is working on [shift time]?"*

REQUEST & OBJECTION QUESTIONS

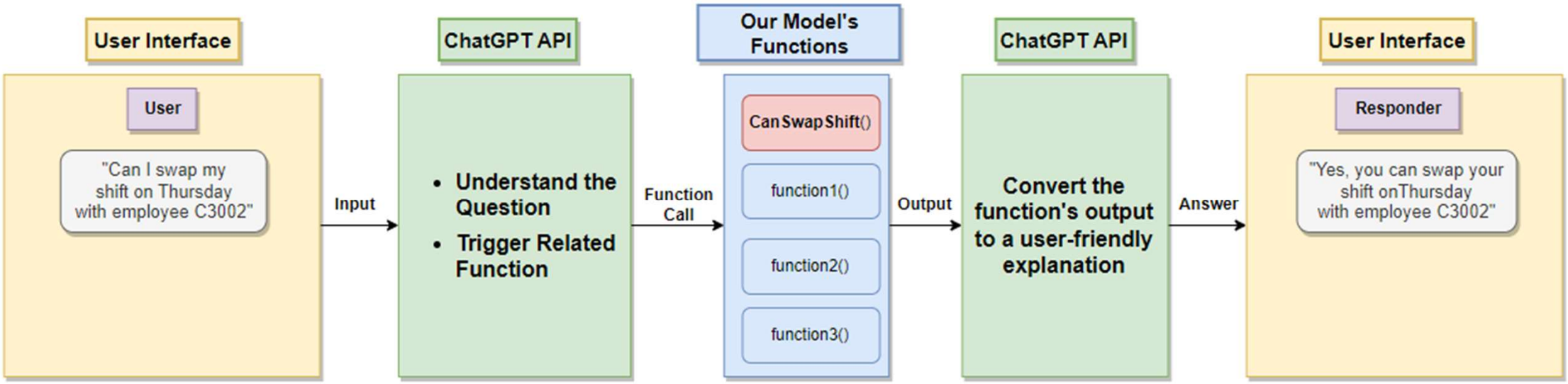
- *"I can't make it to my shift tomorrow. Can it be rescheduled?"*
- *"Can I avoid being scheduled on [Date] for religious reasons?"*
- *"Can I be scheduled for the opening shift during weekends? I prefer starting early."*
- *"Can I be assigned to tasks that require my [skill] more frequently?"*
- *"Can I avoid being scheduled with [Employee's Name] for a while due to personal reasons?"*
- *"Can I be scheduled for more shifts with [Employee's Name] since we coordinate well together?"*

REASONING QUESTIONS

- *"Why am I not assigned to shift [ID]?*
- *"Why am I not assigned to Task [ID]?*

ÖM1

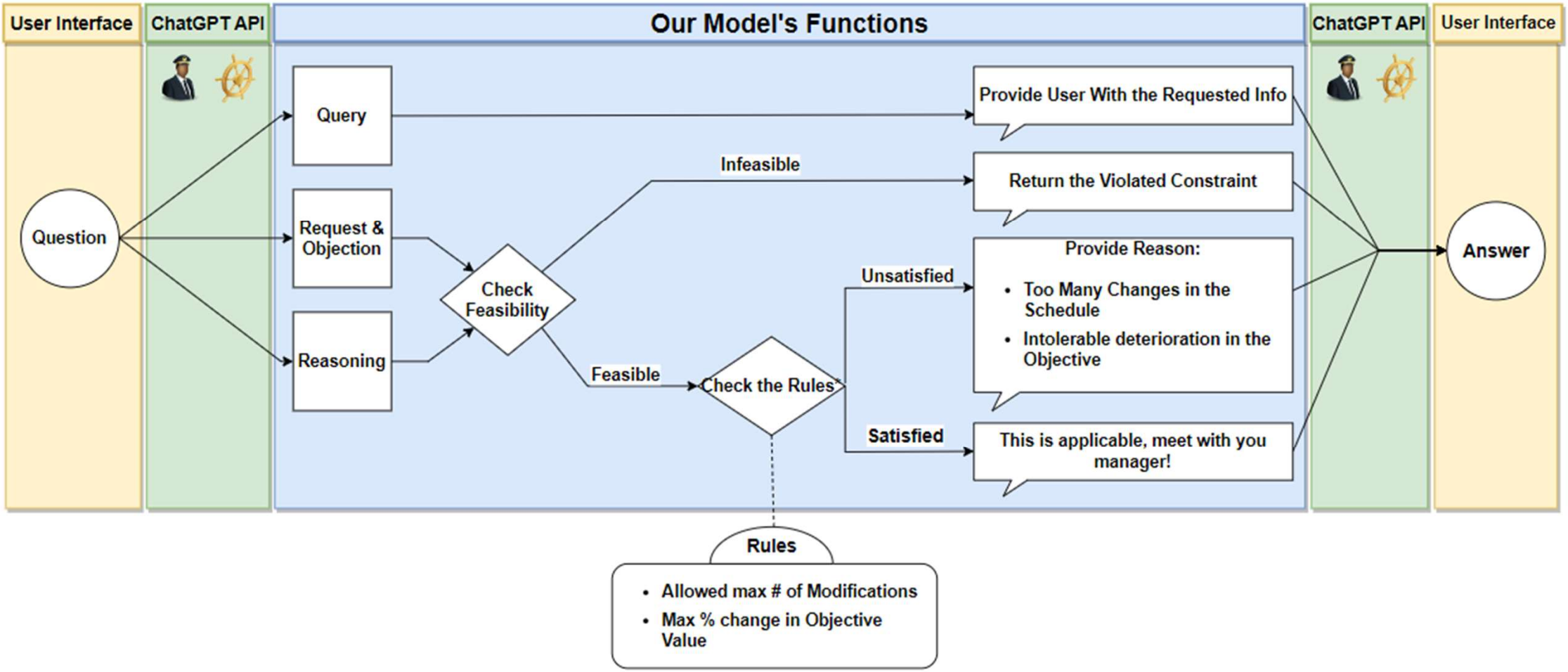
EXPLANATION GENERATION PROCESS



Slide 10

ÖM1 Ömercan Mısırlıoğlu, 12/27/2023

General Logic of the Model



Query-Type Questions: Function Logic & ChatGPT Example

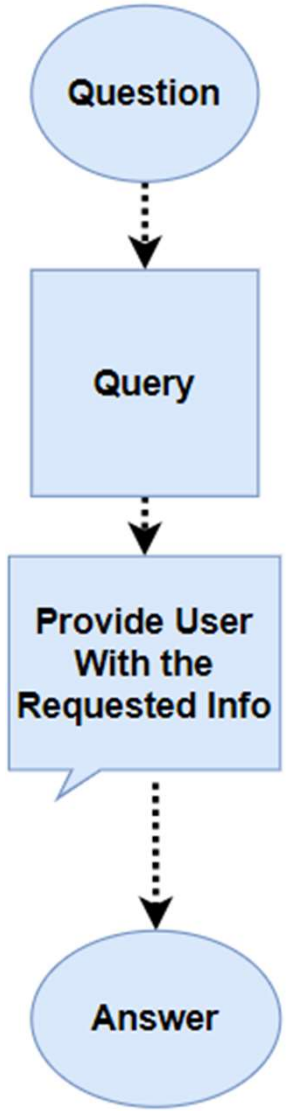
Conversational Schedule Explainer

Clear Conversation

Enter your input:

Who I can change my shift on 2023-07-10, I am C0001

Process



Request-Type Questions: Function Logic & ChatGPT Example

Conversational Schedule Explainer

Clear Conversation

Enter your input:

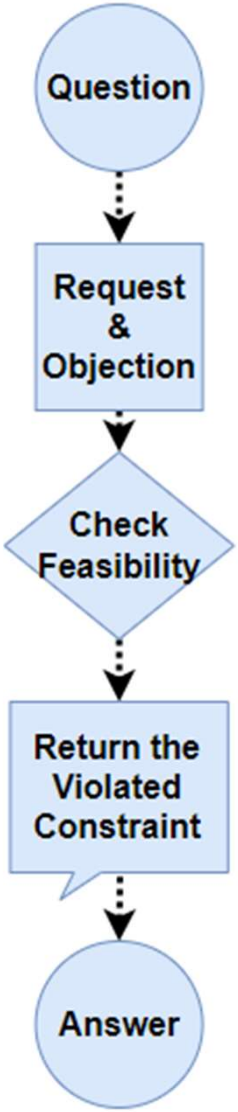
Can I change my shift with employee C0003 on 2023-07-10

Press Enter to apply

Process

Who I can change my shift on 2023-07-10, I am C0001

You can potentially swap shifts with the following employees on 2023-07-10: C0003, C0006, C0008, C0012, C0013, C0026, C0027, C0036, C0040, C0043, C0046, C0048, C0050.



Reasoning-Type Questions: Function Logic & ChatGPT Example

Enter your input:

I am C0002, why I am not assigned to task '18'

Process

Who I can change my shift on 2023-07-10, I am C0001

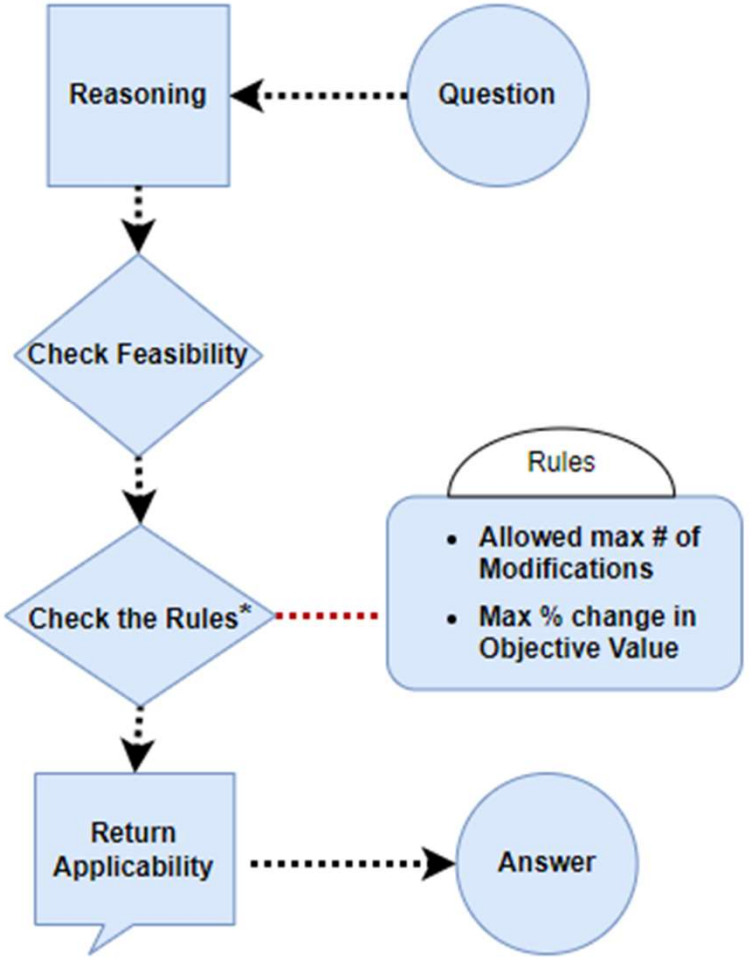
You can potentially swap shifts with the following employees on 2023-07-10: C0003, C0006, C0008, C0012, C0013, C0026, C0027, C0036, C0040, C0043, C0046, C0048, C0050.

Can I change my shift with employee C0003 on 2023-07-10

Yes, you can change your shift with employee C0003 on 2023-07-10. The swap request is feasible.

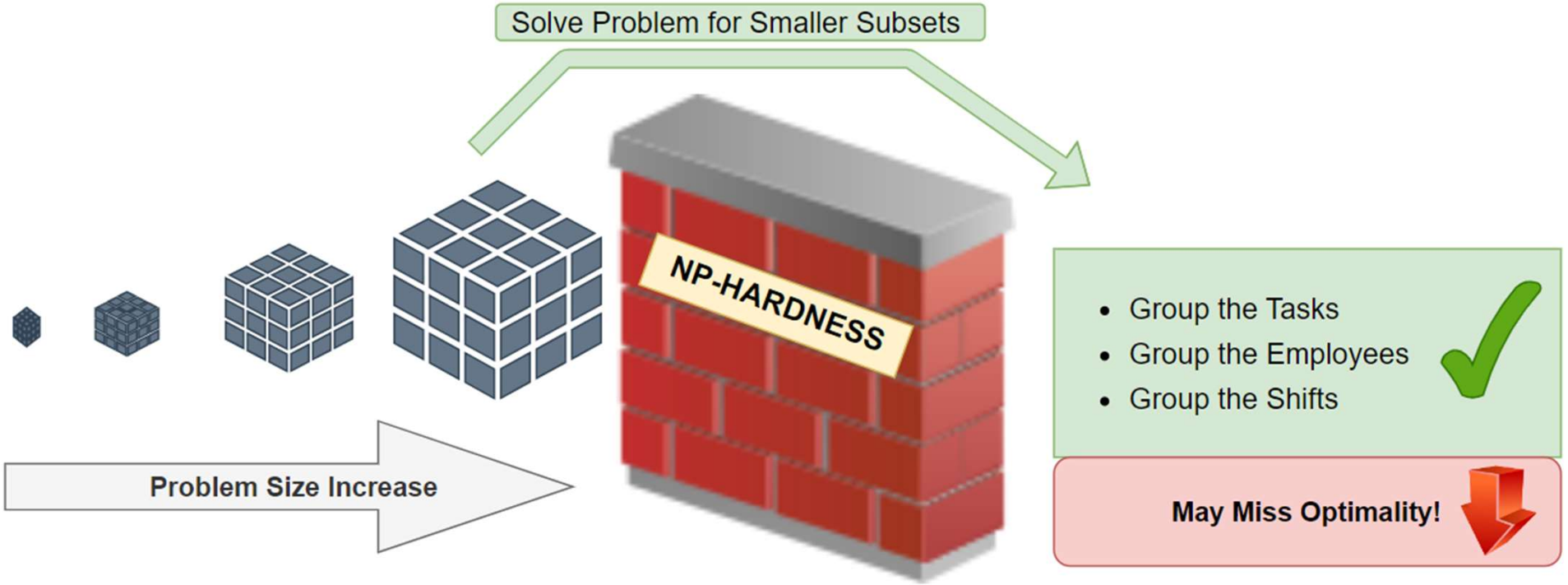
Can I change my task '1' with employee C0002's task '426'

No, you cannot change your task '1' with Employee C0002's task '426' because Employee 2 already has another task assigned during the same time period.



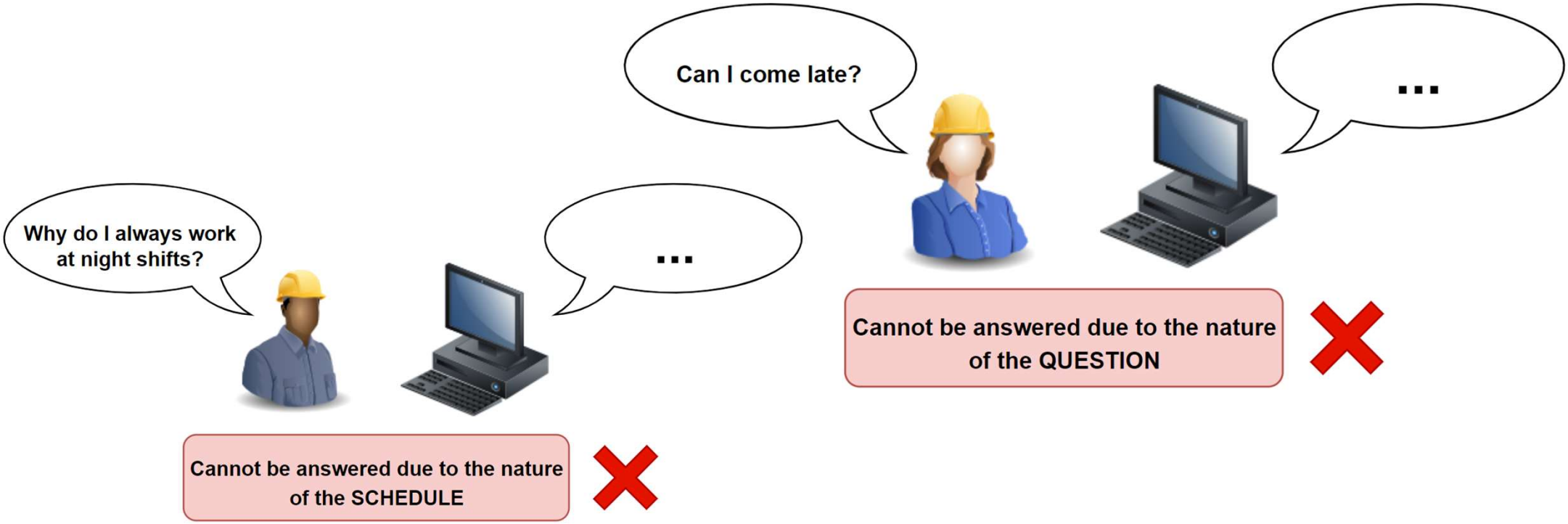
LIMITATIONS #1

NP-HARDNESS



LIMITATIONS #2

LACK OF CLARITY IN PROMPTS



Ethical Considerations

- Teach the model which data is **available to share**
  - **Consent of the employee** to share his/her schedule info is required
  - Some employees may have **private constraints** (e.g. Health related)
  - **Mis-use** of query functions must be prevented
  - System must be protected against **hacking threats**.

- Comply with **laws** and **regulations**
  - Model should be modified for the **particular region/country** it is used
  - Use a multidisciplinary team which consist of **ethicists**, **legal experts** and **representatives from the workforce** to guide developments of this tool according to **ethical principles** and **legal requirements**.

CONCLUSION & FINAL REMARKS

Our project stands at the intersection of advanced scheduling needs and the transformative potential of explainable AI.

ChatGPT Integration promises an even more interactive and user-friendly interface, introducing a new era where explainable AI becomes a standard in the industry.

Literature Review & References

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THANK YOU FOR YOUR ATTENTION

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MATHEMATICAL MODEL

- *Python and Gurobi Optimizer are used for modeling and solving the problem.*

Sets:

- T: Tasks
- E: Employees
- S: Shift start times

Parameters:

- t^t_{start}: Start of task t
- t^t_{end}: End of task t
- $skill^t$: Required skill for task t
- $skillset_e$: Skills of employee e
- $shiftEnd_s$: End of shift at time s

Decision Vars:

- $x_{e,s}$: 1 if employee e starts at s, else 0
- $y_{e,t}$: 1 if employee e covers task t, else 0
- z_t: 1 if task t is uncovered, else 0

Objective:

Minimize $\sum_{t \in T} z_t$

Constraints:

1. $\sum_{e \in E} y_{e,t} + z_t = 1, \quad \forall t \in T$
2. $y_{e,t} \leq \sum_{s=t_{\text{start}}}^{shiftEnd_{t_{\text{end}}}} x_{e,s}, \quad \forall e \in E, t \in T$
3. $\sum_{s \in S} x_{e,s} \leq 5, \quad \forall e \in E$
4. $x_{e,s'} + x_{e,s''} \leq 1$ where $s' > s$ and $s' - s \leq 24, \quad \forall e \in E$
5. $y_{e,t} \leq 1$ if $skill^t \in skillset_e$, else 0, $\forall e \in E, t \in T$
6. $y_{e,t_1} + y_{e,t_2} \leq 1$ for overlapping $t_1, t_2, \forall e \in E$