Handbook of
Gurobi All-In-One Jupyter GUI

1. Prerequisite

Before diving into the Python file “Gurobi_All_in_One_Jupyter_GUI.ipynb” , ensure you have set up the necessary environment:

Gurobi Installation and Licensing

- Register a Gurobi account from Gurobi's official website.
- After registration, obtain a license. For academic users, a free license is available. Follow the instructions on the Gurobi License page.
- Activate your Gurobi license according to the guidance.

Jupyter Setup

- Download and install Python from Python's official website. While installing, make sure to check the box that says "Add Python to PATH" to ensure the Python and pip are available from your system's command prompt or terminal.
- Once Python is installed, open your system's command prompt (Windows) or terminal (macOS).
- Use pip (Python package manager) to install Jupyter:

```
pip install jupyter
```

Library Installations

- Install necessary Python libraries:

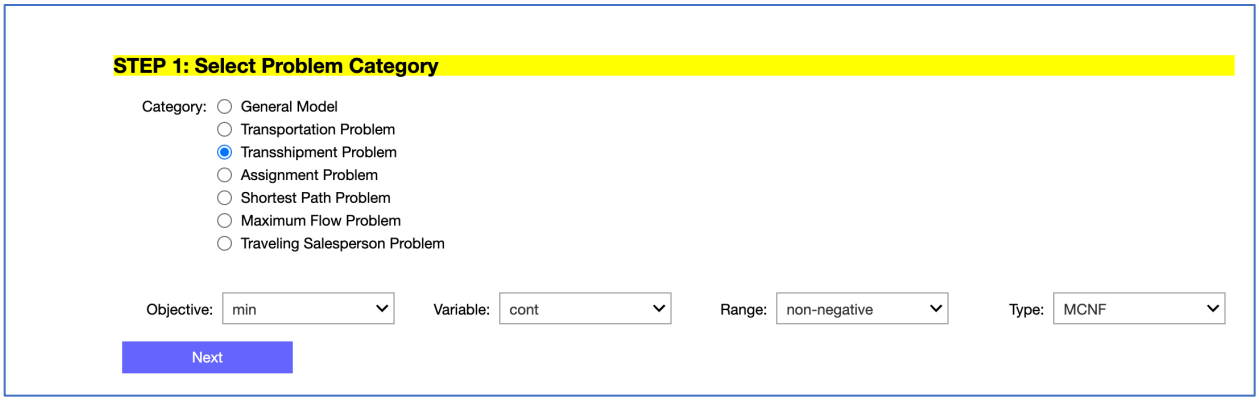
```
pip install gurobipy
pip install qgrid
pip install ipywidgets
```

- Enable “qgrid” and “ipywidgets” in Jupyter:

```
jupyter nbextension enable --py --sys-prefix qgrid
jupyter nbextension enable --py widgetsnbextension
```

2. Areas Model Applied

Thanks to the Graphical User Interface (GUI), the "Gurobi_JUP_GUI.ipynb" file offers a user-friendly approach to solving 6 network-related optimization problems. The model is designed to generate constraints based on the data you provide automatically.



These problems belong to 3 type: Minimum Cost Network Flow (MCNF), Maximum Flow Problem (MFP), and Traveling Salesperson Problem (TSP). The detailed introduction[1]:

Transportation Problem

The Transportation Problem concerns the optimal way to transport a commodity from several supply sources to several demand destinations while minimizing the transportation cost. Each route from a supply source to a demand destination has its associated cost, and the objective is to determine the amount of commodity to be transported on each route to meet the demand at the least possible cost. It belongs to the MCNF problem.

Transshipment Problem

The Transshipment Problem is an extension of the transportation problem. Here, commodities can be transshipped through intermediate nodes (or warehouses) before reaching their final destination. The goal remains to determine the optimal shipping routes to minimize the total transportation and handling costs. It belongs to the MCNF problem.

Assignment Problem

The Assignment Problem deals with assigning tasks to agents most efficiently. Imagine a set of tasks that need to be completed and a set of agents that can perform these tasks, with each agent-task combination having a different cost. The problem is determining the optimal assignment of agents to tasks such that all tasks are completed, and the total cost is minimized. It belongs to the MCNF problem.

[1] The definitions of problems are generated by ChatGPT 4.0

Shortest Path Problem

This problem revolves around finding the shortest path from a starting point to a destination in a network. Such networks might represent roads, pipes, wires, etc. The "shortness" of a path can be defined in terms of distance, cost, time, or any other measurable criteria. It belongs to the MCNF problem.

Maximum Flow Problem(MFP)

In the Maximum Flow Problem, we are given a network with capacities assigned to its edges. The objective is to determine the maximum amount of flow that can be sent from a source node to a sink (or target) node without violating the capacities. It belongs to the MFP problem.

Traveling Salesperson Problem (TSP)

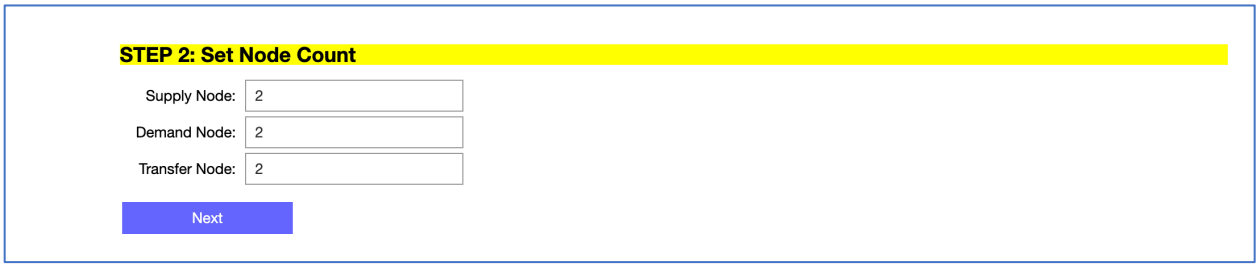
The TSP is a classic optimization problem. It involves a salesperson who needs to visit several cities and return to the starting city. The challenge is finding the shortest route that visits each city exactly once. This problem has applications in route optimization, logistics and is also used as a benchmark in optimization research. It belongs to the TSP problem.

General Model

Additionally, for problems outside the realm of network optimization, the "General Model" option allows you to input constraints and solve general optimization problems manually.

3. Running the Model

Depending on the problem type chosen, you'll be prompted to enter relevant parameters, such as the number of supply nodes, demand nodes, etc. Fill in the necessary input fields or grids.



STEP 3: Set Node Names & Capacities

Supply Node:

	Name of Node	Capacity of Node
1	Denver	200
2	LA	150

Demand Node:

	Name of Node	Demand of Node
1	NY	130
2	Boston	130

Transfer Node:

	Name of Node
1	Chicago
2	Memphis

Next

STEP 4: Set Flow Amounts Between Nodes

	Chicago	Memphis	NY	Boston
Denver	6	8	0	0
LA	12	10	0	0
Chicago	0	0	4	5
Memphis	0	0	5	7

Next

STEP 5: All Constraints

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	constraint type	RHS values
0	1	0	0	0	1	0	0	0	1	-1	-1	-1	1	0	0	0	=	0
1	0	1	0	0	0	1	0	0	0	1	0	0	-1	1	-1	-1	=	0
2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	<=	200
3	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	<=	150
4	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	0	>=	130
5	0	0	0	1	0	0	0	1	0	0	0	1	0	0	0	1	>=	130
6	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	>=	0
7	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	>=	0
8	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	>=	0
9	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	>=	0
10	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	>=	0
11	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	>=	0
12	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	>=	0
13	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	>=	0
14	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	>=	0
15	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	>=	0
16	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	>=	0
17	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	>=	0
18	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	>=	0
19	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	>=	0
20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	>=	0
21	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	>=	0

Run Gurobi

Final Results

Upon successful execution, you'll receive the optimized results in a tabulated format. This will include optimized values, objective function values, and other relevant metrics.

FINAL RESULT

```
3030.0

    Variable            X
-------------------------
Denver_TO_Chicago          200
LA_TO_Memphis           60
Chicago_TO_NY           70
Chicago_TO_Boston          130
Memphis_TO_NY           60
```

Attention

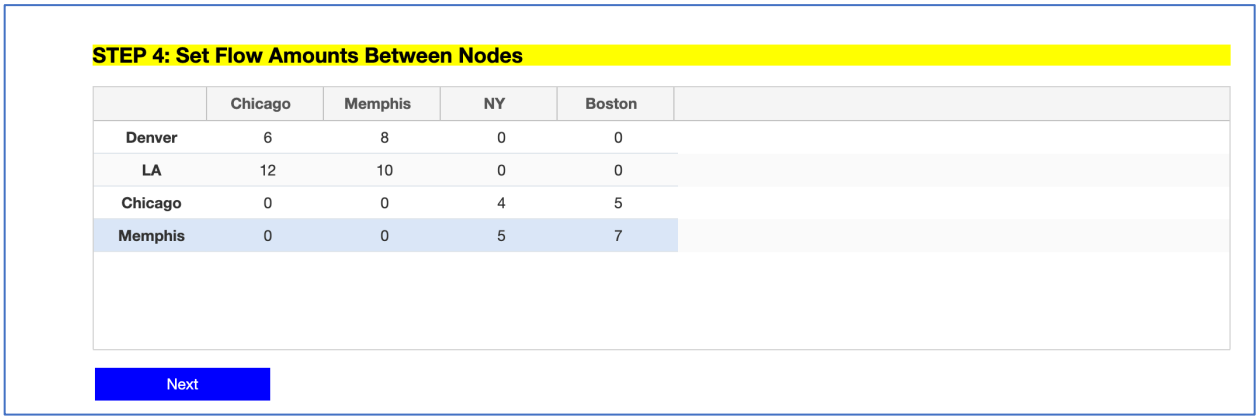
Ensure the number is entered successfully before you click the “Next” button. In “Screenshot 1”, do not click the button since the number “7” in the last cell is not entered. In “Screenshot 2”, the number “7” in the last cell is entered.

STEP 4: Set Flow Amounts Between Nodes

	Chicago	Memphis	NY	Boston
Denver	6	8	0	0
LA	12	10	0	0
Chicago	0	0	4	5
Memphis	0	0	5	7

Next

Screenshot 1: Number“7” is not entered



Screenshot 2: Number“7” is entered