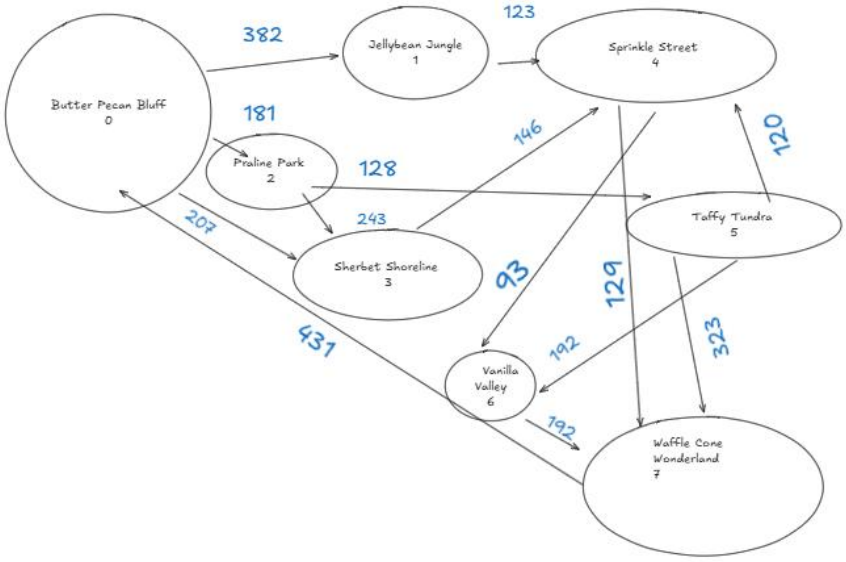
Module 07 – Maximal Flow

Exploratory Data Analysis

In this section, you should perform some data analysis on the data provided to you. Please format your findings in a visually pleasing way and please be sure to include these cuts:

- *Make a visual graph of your data like what we saw for the sample problem*
    - https://excalidraw.com
    - https://mermaid.live
    - https://dreampuf.github.io/GraphvizOnline
    - Powerpoint/Word



Model Formulation

Write the formulation of the model into here prior to implementing it in your Excel model. Be explicit with the definition of the decision variables, objective function, and constraints.

Objective Function:
MAX: X_70

Decision Variables:
0<=X01<=382
0<=X02<=181
O<=X03<=207
0<=X14<=123
0<=X23<=243
0<=X25<=128
0<=X34<=146
0<=X47<=129
0<=X46<=93
0<=X57<=323
0<=X54<=120
0<=X56<=192
0<=X67<=425
0<=X70<=Inf

Constraints:
+X_70- X_01-X_02=0
+X_01- X_14=0
+X_02-X_23-X_25=0
+X_03+X_23- X_34=0
+X_34-X_47- X_46=0
+X_14+X_34+X_54- X_47-X_46=0
+X_25-X_57-X_54-X_56=0
+X_46+X_56-X_67=0
+X_47+X_67-X_70

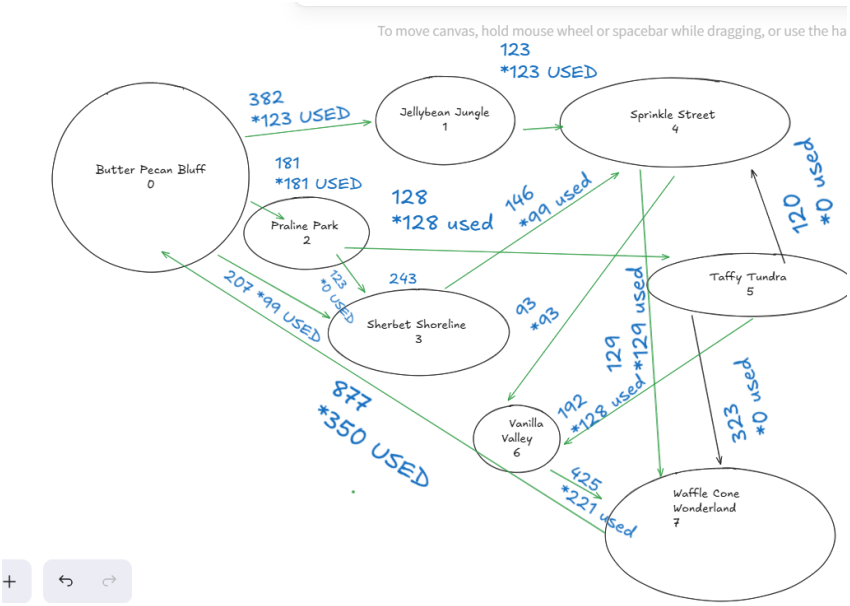
Model Optimized for Maximal Flow

Implement your formulation into Excel and be sure to make it neat. This section should include:

- *A screenshot of your optimized final model (formatted nicely, of course)*
- *A text explanation of what your model is recommending, especially any identified bottlenecks*
- *Update your graph from the EDA section to bold/color the links being used (and show how much is going through that link)*

				Maximal Flow	388
Units Flow		**From**		**To**	**Upper Bound**
207	0	Butter Pecan Bluff	1	Jellybean Jungle	382
181	0	Butter Pecan Bluff	2	Praline Park	181
207	1	Jellybean Jungle	4	Sprinkle Street	207
0	2	Praline Park	3	Sherbet Shoreline	123
181	2	Praline Park	5	Taffy Tundra	243
0	3	Sherbet Shoreline	4	Sprinkle Street	128
146	4	Sprinkle Street	7	Waffle Cone Wonderland	146
61	4	Sprinkle Street	6	Vanilla Valley	129
61	5	Taffy Tundra	7	Waffle Cone Wonderland	93
0	5	Taffy Tundra	4	Sprinkle Street	323
120	5	Taffy Tundra	6	Vanilla Valley	120
181	6	Vanilla Valley	7	Waffle Cone Wonderland	192
388	7	Waffle Cone Wonderland	0	Butter Pecan Bluff	431

Nodes		Inflow	Outflow	Net Flow	Supply / Demand
0	Butter Pecan Bluff	388	388	0	0
1	Jellybean Jungle	207	207	0	0
2	Praline Park	181	181	0	0
3	Sherbet Shoreline	0	0	0	0
4	Sprinkle Street	207	207	0	0
5	Taffy Tundra	181	181	0	0
6	Vanilla Valley	181	181	0	0
7	Waffle Cone Wonderlar	388	388	0	0



Recommending a Maximal flow to be done, these are the decision variables needed.

Model with Stipulation

Please copy the tab of your original model before continuing with the next part to avoid messing up your original solution.

Let's demonstrate the "Flow Aggregation" special consideration that was discussed in the textbook and the Follow Along – Model Formulation video. Please follow these steps:

- *Identify an edge that is not used with your current solution*
  - *If by chance all your edges are in use, then apply the next step to an under-utilized edge*
- *Add a lower bound (LB) constraint to that edge (i.e. there must be a non-zero flow to the edge)*
  - *The LB should be 10% of the capacity of that edge (i.e. if the unused edge supports 500 unit flow, then we should had a LB of 50 units through that edge)*
- *Discuss the changes to the optimal solution with this change and how it impacts the model formulation*

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Units Flow		**From**		**To**	**Upper Bound**
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181	**0**	Butter Pecan Bluff	**2**	Praline Park	181
207	**1**	Jellybean Jungle	**4**	Sprinkle Street	207
0	**2**	Praline Park	**3**	Sherbet Shoreline	123
181	**2**	Praline Park	**5**	Taffy Tundra	243
0	**3**	Sherbet Shoreline	**4**	Sprinkle Street	128
146	**4**	Sprinkle Street	**7**	Waffle Cone Wonderland	146
61	**4**	Sprinkle Street	**6**	Vanilla Valley	129
61	**5**	Taffy Tundra	**7**	Waffle Cone Wonderland	93
0	**5**	Taffy Tundra	**4**	Sprinkle Street	323
120	**5**	Taffy Tundra	**6**	Vanilla Valley	120
181	**6**	Vanilla Valley	**7**	Waffle Cone Wonderland	192
388	**7**	Waffle Cone Wonderland	**0**	Butter Pecan Bluff	431

	Nodes	Inflow	Outflow	Net Flow	Supply / Demand
0	Butter Pecan Bluff	388	388	0	0
1	Jellybean Jungle	207	207	0	0
2	Praline Park	181	181	0	0
3	Sherbet Shoreline	0	0	0	0
4	Sprinkle Street	207	207	0	0
5	Taffy Tundra	181	181	0	0
6	Vanilla Valley	181	181	0	0
7	Waffle Cone Wonderlar	388	388	0	0