HelpFromRabbeim

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1   Network Flow Problem

This problem has a group of Rabbeim with specific capacities, and a group of talmidim with specific needs for subjects. Our goal is to make sure every single talmid will receive the help they need. We can look at the connection between the rabbeim and subjects as flow edges, with certain rebbeim having edges towards the subjects they can help. Now, since some talmidim may require help with the same subjects, some vertexes (subjects) may have capacities that are higher than 1, but each Rebbe will only have a flow of 1 to work with (Rebbeim can't teach two students at once). It's clear that max flow can solve this problem, we want the sink to have as much flow as the subject vertexes pointing to it can hold. If this happens, it means that every subject has found the necessary amount of rebbeim they need, and the problem will be solved.

2   How does Network Flow Solve This

First, we need to create a proper network flow graph. The source vertex will point to all the rebbeim we have, sending a flow of 1 to each, so each can send a flow of 1 to only one subject. Then we create the subject vertexes, there will be one vertex for each subject requested, and each subject vertex will have a capacity equal to the number of requests for help with that subject. Now, each rebbe vertex will point to all the subject vertexes that he has the ability to teach. Finally, all the subject vertexes point to the sink, which has a capacity equal to the number of subjects requested.

Now, we can run Ford Fulkerson on this graph, which will attempt to get a max flow so that the sink's capacity will be maxed. If this is the case, we have solved the problem, and we can look at all the edges from rebbe to subject to see which rebbe helped with which subject (which rebbe sent flow to which subject). We know this means the problem is solved because it means all the subject vertexes capacities were filled as well, meaning we found enough Rabbeim to help with every subject needed. If it's not the case, this problem has no solution, and not all subjects were able to be helped with.

3   Graph

Rebbeim			
YP	BMP	IBC	JSS
Brochos	Brochos	Brochos	Mussar
BavaKamma	Mussar	Nach	Nach
Sanhedrin	BavaKamma		

Request: 2 Mussar, 1 Brochos, 1 Nach