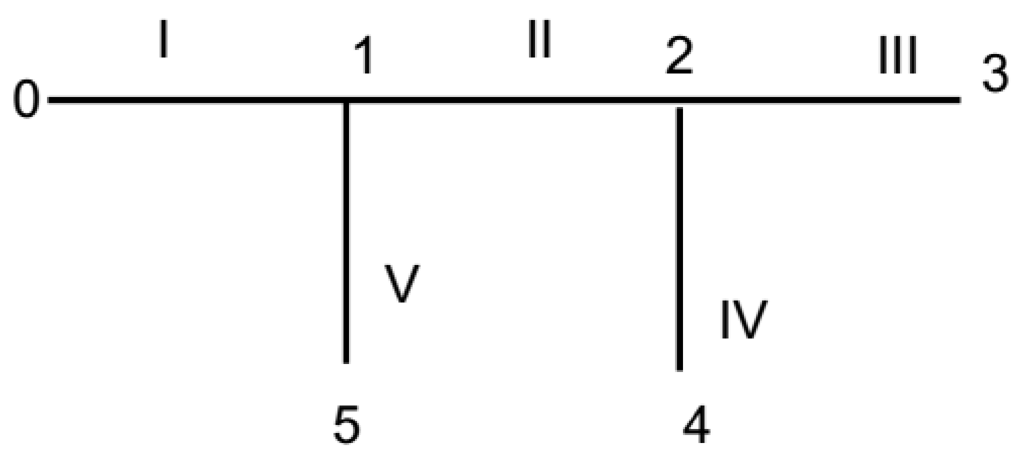
Optimal pipe selection for a branched network (From a set of discrete diameters)

Consider the following network. Node 0 is the source node and the rest are demand nodes. The flow in links are as follows:

Link I : 8.5 m^3/min
II : 5.8
III : 1.2
IV : 1.6
V : 1.3



The lengths of the pipes are as follows:
Pipe I :1000m
II :600
III :400
IV :300
V :300

The head available at node 0 is 115 m and the minimum required head at the other nodes are as follows:

Node 1: 90m
2: 85
3: 80
4: 80
5: 80

The optimal pipe diameters for the network if any diameter (any positive real value) was commercially available is as follows:

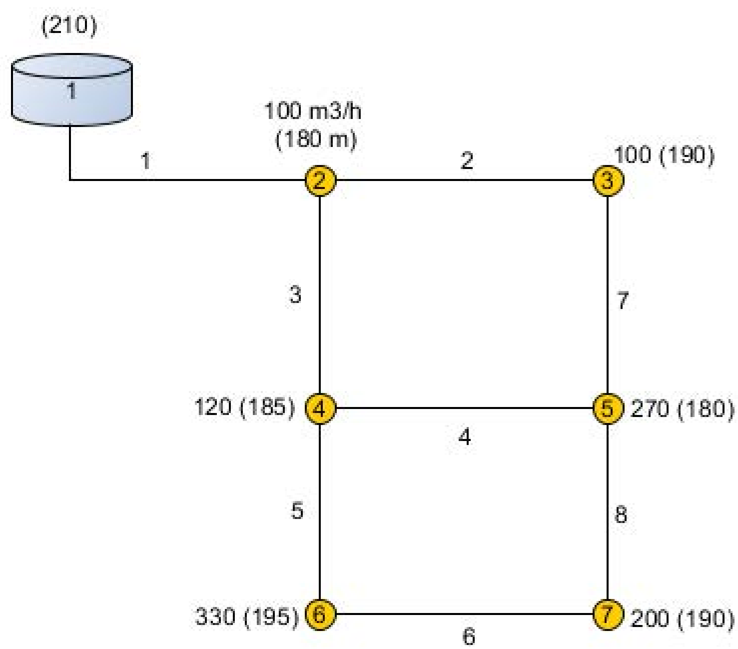
Pipe I :304.9mm
II :267.5
III :152.0
IV :159.8
V :119.8

Now, the commercially available pipe diameters and their corresponding unit cost is tabulated below. Find out the optimal pipe diameters from the commercially available pipes. Consider that, in the optimal solution for this discrete diameter problem, the diameter of any pipe would be one of the three commercially available diameters which are closest to the optimal diameter of the continuous diameter problem. That is, now you have three discrete choices for diameter of each pipe and you have to pick one of it as per the solution of your optimization problem. Refer to the paper by Richard S Mah, (AIChE, 1976) for the method to be followed.

#	Pipe Dia (mm)	Unit cost (Rs/m)
1	80	424
2	100	570
3	125	767
4	150	977
5	200	1431
6	250	1924
7	300	2451
8	350	3008
9	400	3591
10	450	4198
11	500	4828
12	600	6149
13	700	7545
14	750	8269

Assignment- Optimization of Water Network (part 2)

The optimal pipe diameters for the following water network has to be determined. It is a gravity driven network and all the eight pipes are of length 1000m. The demand to be satisfied for each node is written beside the node and the required head is added in parenthesis.



The available pipe diameters in inches are given below with their cost per unit length in parenthesis (Its some arbitrary unit):
1 inch (2 units), 2 (5), 3 (8), 4(11), 6(16), 8(23), 10(32), 12(50), 14(60), 16(90), 18(130), 20(170), 22(300) and 24 (550).
The Hazen Williams formula for head loss calculations to be applied here is:

$$h_f = \frac{162.9\ L\ Q^{1.85}}{130^{1.85} D^{4.87}}$$

Where, the head loss and length are in meters, discharge in m^3/hr and the diameter is in inches.

This assignment is based on the 'replacement-elimination' method.

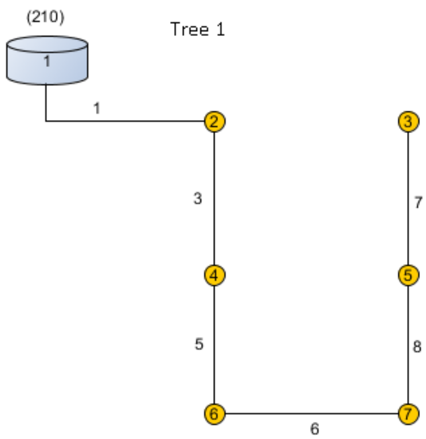
The procedure to be followed is described below:

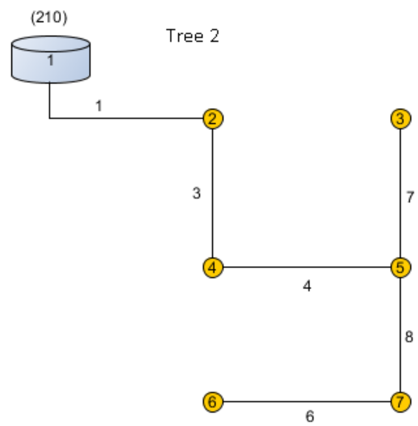
1) Start with the spanning tree **assigned to you** (Given at the end of the document) and find the optimal set of diameters for the tree
2) Pick a loop, move clockwise and see if the next tree gives a better solution. If it does not, move anticlockwise and check for any improvement in cost. If both the directions does not give any

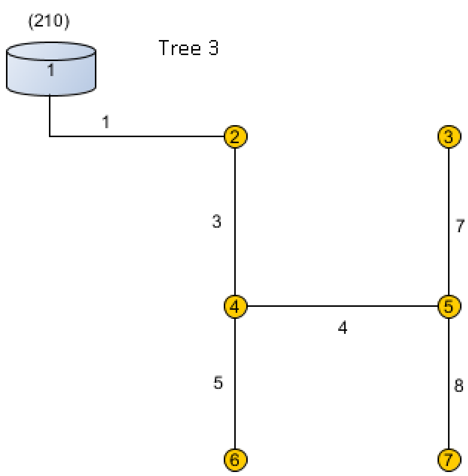
improvement, pick the other loop and repeat the procedure. (You have to find only one tree that is better than the one assigned to you, go no further)

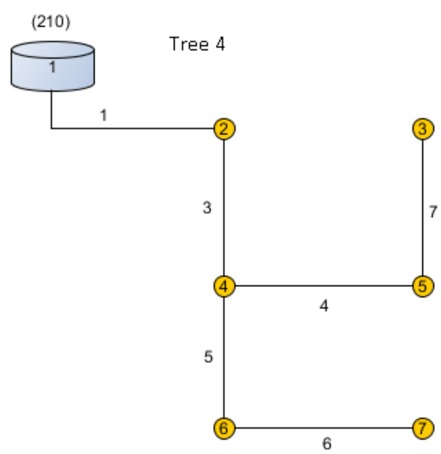
3) Report the tree that has a better solution than yours in the wiki on moodle and make a report on the procedure you followed.
4) Once sufficient responses are up there on wiki, identify the trees you would have traversed through, had you continued step 2 until you reach optima (this need not be a unique answer, identify multiple answers if you have). Add this to your report and upload it.

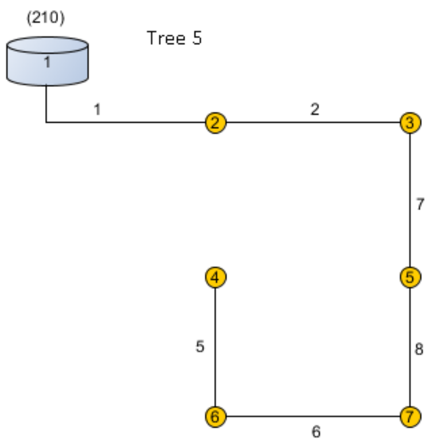
The available trees with their number is given below. Please follow the same numbering in the wiki as well as the report you make.










(210)
Tree 5
1
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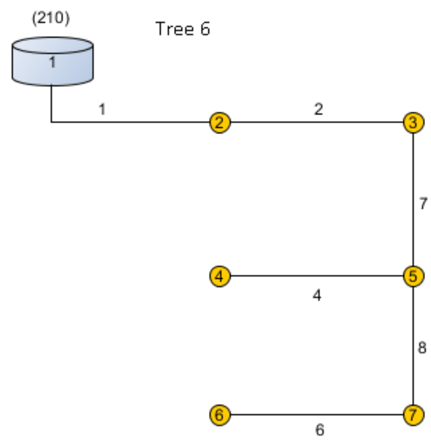
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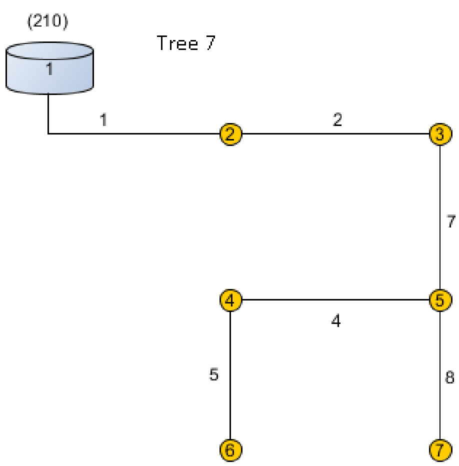
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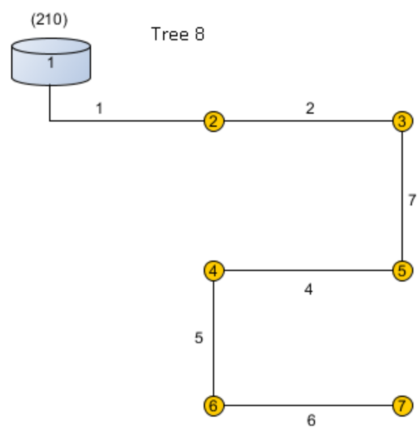
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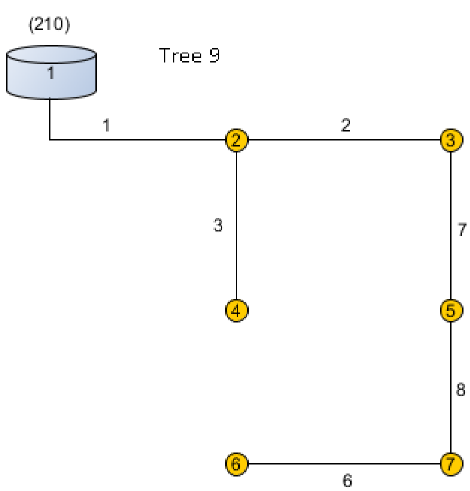
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Tree 9
1
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8
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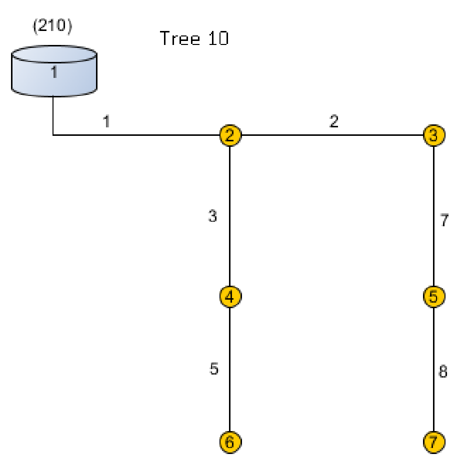
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Tree 10
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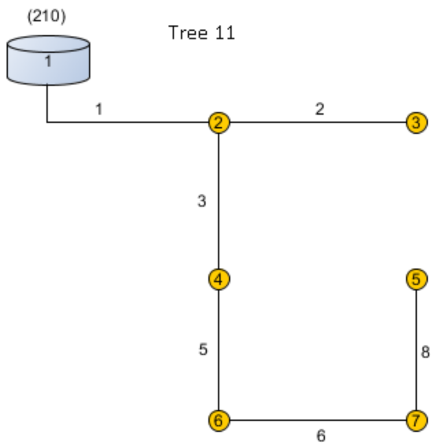

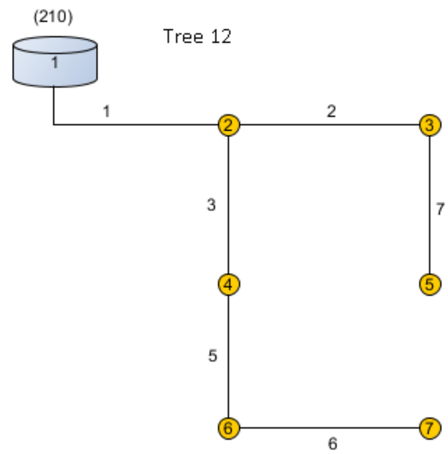

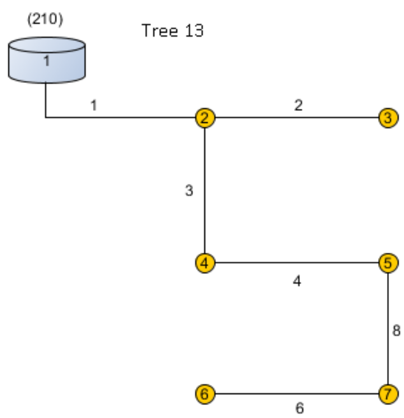

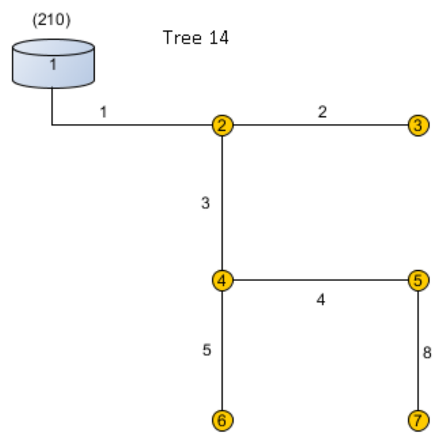

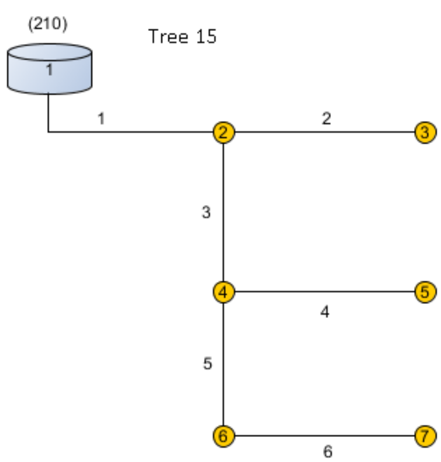

The allotment of spanning tree to start with is as follows:

Student	Tree allotted
AE15D405 AMARDEEP	11
AE15D412 GOBIHA D	2