# Kruskal’s Algorithm Process

1. Create a new list of edges that is a copy of the current list of edges.
2. Sort the new list:
   1. Look for and remove any loops (A-A)
   2. Remove duplicate edges:
      1. For edge A-B, there is also edge B-A. Remove B-A.
   3. Order remaining edges by distance from least to greatest.
3. Create a new list for the minimum spanning tree (MST).
4. Add the smallest edge in the sorted list to the MST and then remove it from the sorted list.
5. Repeat step 4.
6. While the number of edges in the MST does not equal the number of nodes – 1:
   1. Look at the smallest edge in the sorted list.
   2. Check if adding it causes a loop. (See Loop Check Process)
   3. If it does not cause a loop, add it to the MST.
   4. Remove the edge form the sorted list.
7. Add duplicate edges back into the MST. (Reversing step 2:b)

This allows for proper printing.

# Loop Check Process

**(In regards to an edge)**

1. Look for the start node of the edge in the MST. If it is not found, no loop will be created. If it is found, continue.
2. Look for the end node of the edge in the MST. If it is not found, no loop will be created. If it is found, continue.
3. Find all nodes connected to the start and end nodes of the edge, creating lists for each tree. (Recursive Function) **ONLY ADD NODES TO THE TREE IF THEY AREN’T ALREADY IN THE TREE**
4. Look for any node matches between the start and end node trees. If a match is found, a loop will be created, so don’t add the edge to the MST. If no match is found, no loop will be created, so add the edge to the MST.

# Kruskal Test Map



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Unsorted List | Sort | Sorted List | Kruskals | MST |
| 1 | A-B : 4 |  | H-G : 1 |  | H-G : 1 |
| 2 | B-C : 8 | C-I : 2 | C-I : 2 |
| 3 | A-H : 8 | F-G : 2 | F-G : 2 |
| 4 | B-H : 11 | A-B : 4 | A-B : 4 |
| 5 | H-I : 7 | C-F : 4 | C-F : 4 |
| 6 | H-G : 1 | G-I : 6 | C-D : 7 |
| 7 | G-I : 6 | H-I : 7 | B-C : 8 |
| 8 | C-I : 2 | C-D : 7 | D-E : 9 |
| 9 | C-D : 7 | B-C : 8 |  |
| 10 | C-F : 4 | A-H : 8 |  |
| 11 | F-G : 2 | D-E : 9 |  |
| 12 | D-F : 14 | F-E : 10 |  |
| 13 | D-E : 9 | B-H : 11 |  |
| 14 | F-E : 10 | D-F : 14 |  |

As you add edges to the MST add their nodes to a list:

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|  |  |  |  |  |  | G | H |  |
|  |  | C |  |  |  | G | H | I |
|  |  | C |  |  | F | G | H | I |
| A | B | C |  |  | F | G | H | I |
| A | B | C |  |  | F | G | H | I |
| A | B | C | D |  | F | G | H | I |
| A | B | C | D |  | F | G | H | I |
| A | B | C | D | E | F | G | H | I |

# Minimum Spanning Tree (Using Kruskal’s)

