Minimum Spanning Tree

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DPHPC

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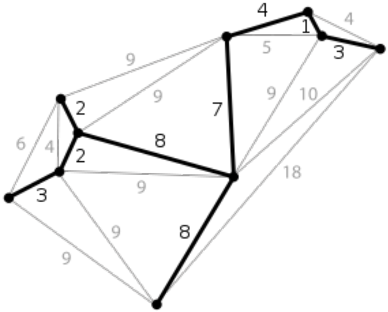
Problem definition - reminder

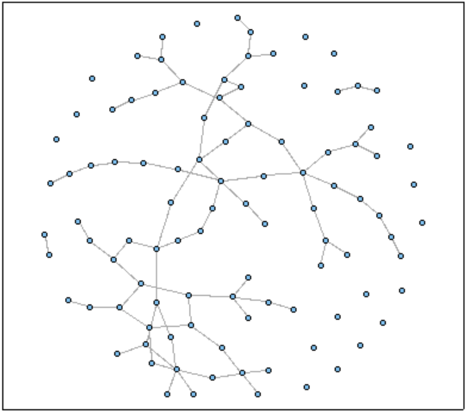
The MST problem

A minimum spanning tree (MST) or minimum weight spanning tree is a subset of the edges of a connected, edge-weighted (un)directed graph that connects all the vertices together, without any cycles and with the minimum possible total edge weight.



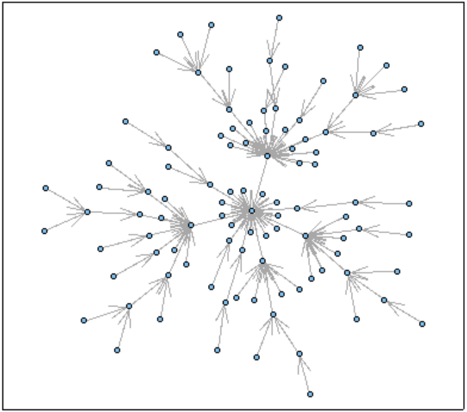
Input sets: $G(n, p)$

$G(100, 0.02)$



Input sets: $PA(n)$

$PA(100)$



Input sets: 9^{th} DIMACS challenge dataset

USA Roads

Name	Description	# nodes	# arcs	L
USA	Full USA	23,947,347	58,333,344	-
CTR	Central USA	14,081,816	34,292,496	[
W	Western USA	6,262,104	15,248,146	[
E	Eastern USA	3,598,623	8,778,114	[
LKS	Great Lakes	2,758,119	6,885,658	[
CAL	California and Nevada	1,890,815	4,657,742	[
NE	Northeast USA	1,524,453	3,897,636	[
NW	Northwest USA	1,207,945	2,840,208	[
FLA	Florida	1,070,376	2,712,798	[
COL	Colorado	435,666	1,057,066	[
BAY	San Francisco Bay Area	321,270	800,172	[
NY	New York City	264,346	733,846	[

Algorithms and parallel implementations

Sollin

1: F = set(one-vertex trees)
2: **while** $|F| > 1$ **do**
3: TODO
4: **end while**

Kruskal

$A = \emptyset$

for all $v \in G.V$ **do**

    MAKE-SET(v)

end for

Sort (asc.) $(weight(u, v))_{(u,v) \in G.E}$

for all (u, v) in $G.E$ ordered by weight **do**

    if FIND-SET(u) $\neq$ FIND-SET(v) **then**

        $A = A \cup (u, v)$

        UNION(u, v)

    end if

end for

return A

Boost implementations

- Boost-Kruskal used as a reference

Parallel sorting on Kruskal

Filter Kruskal

Filter Sollin

Results overview

EULER Cluster

Scalability

Speedups