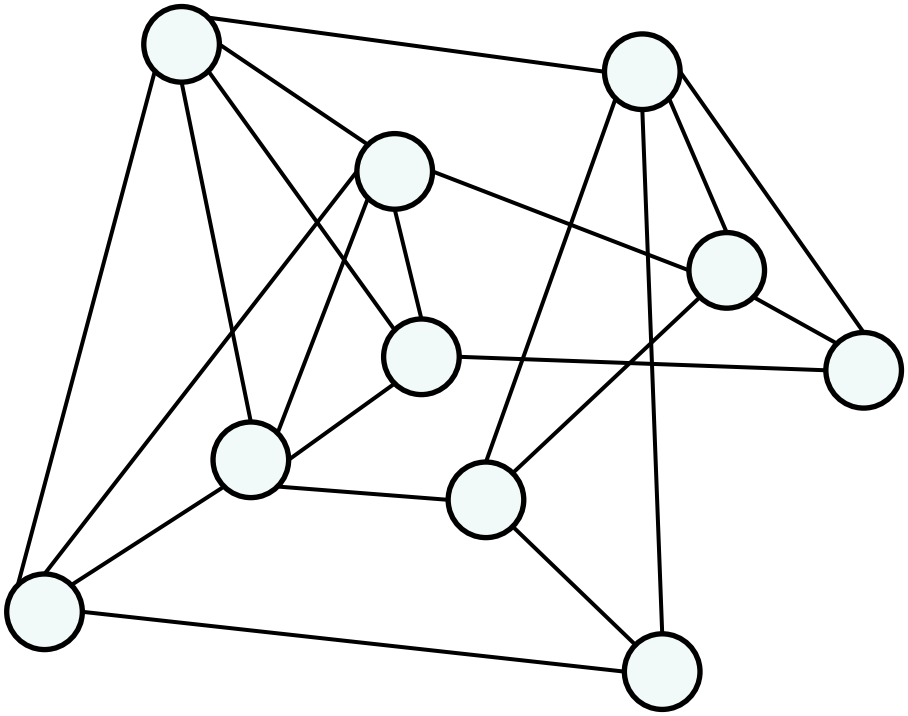
Distributed Algorithms: A Simple Example

How Many Nodes in Network?



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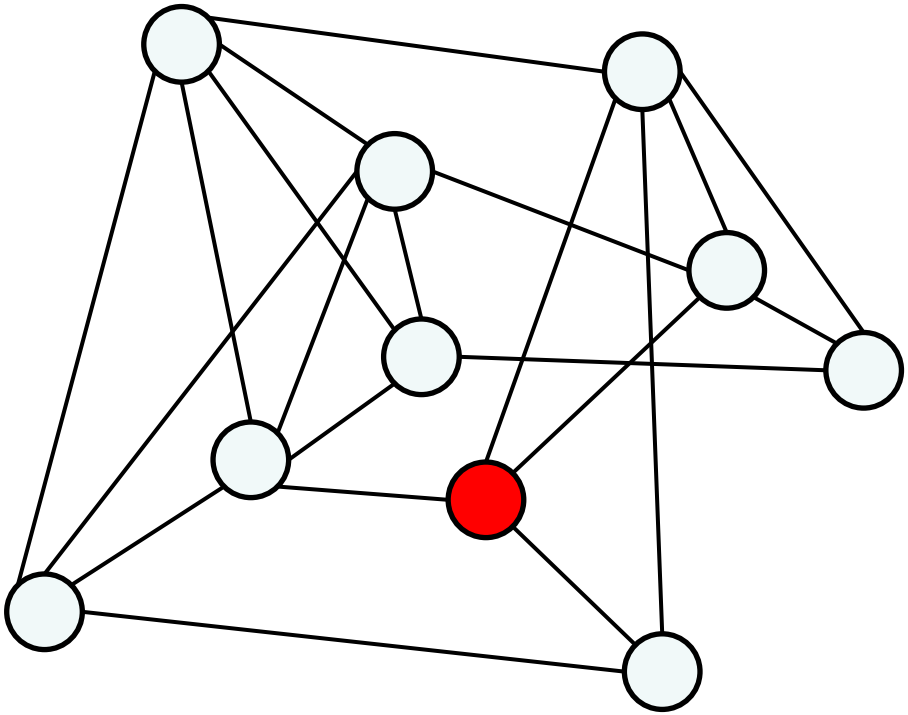

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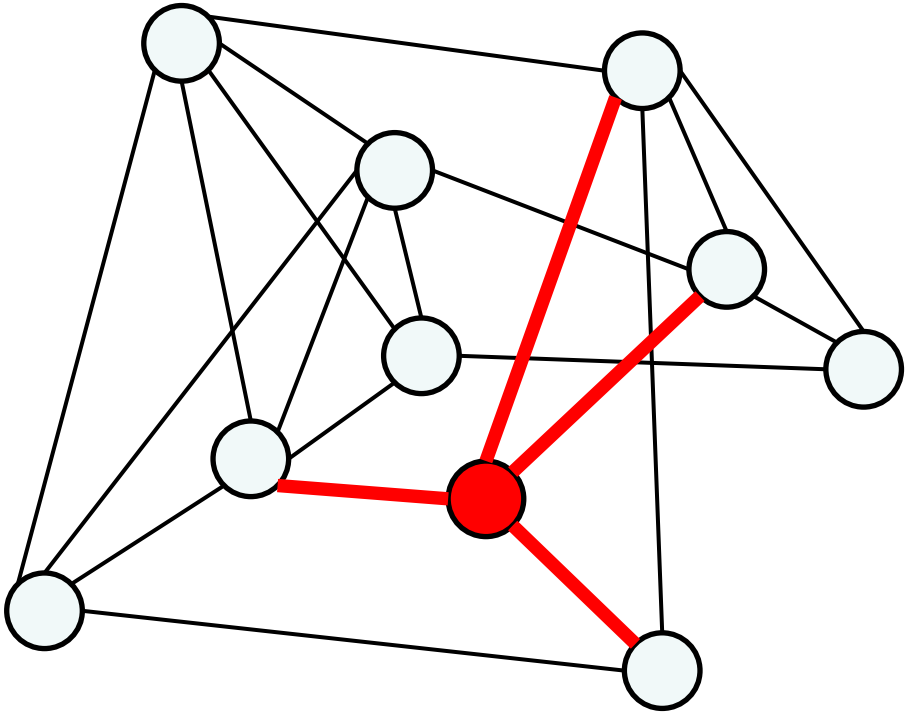

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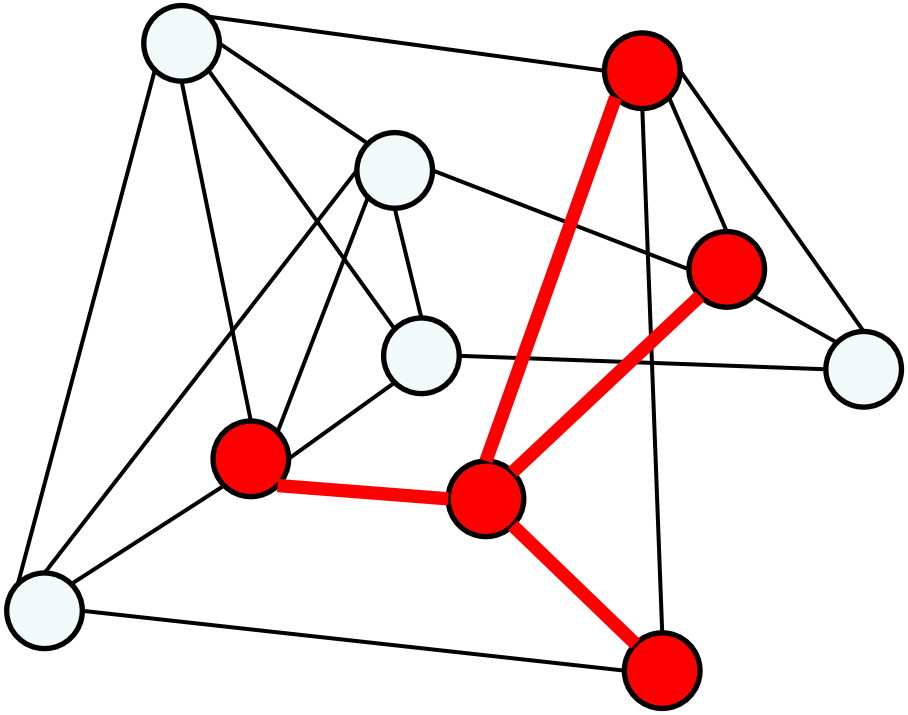

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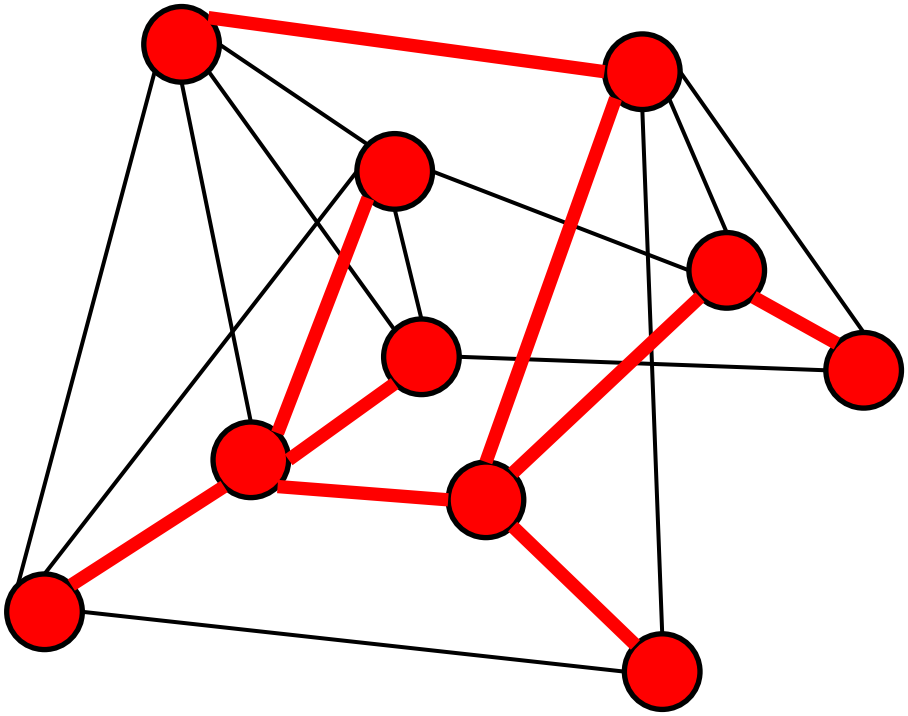

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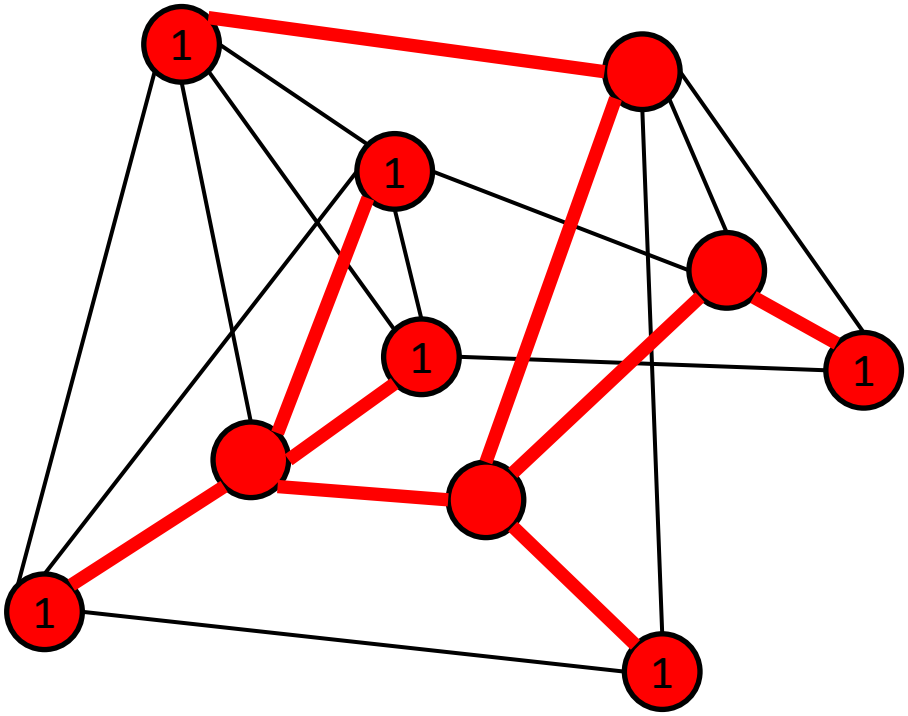

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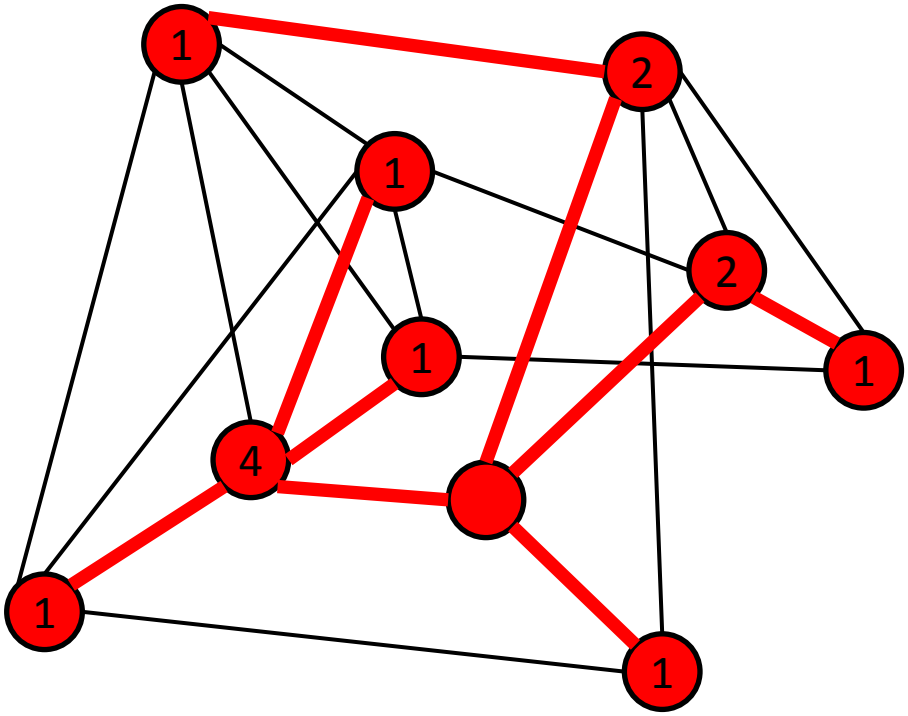

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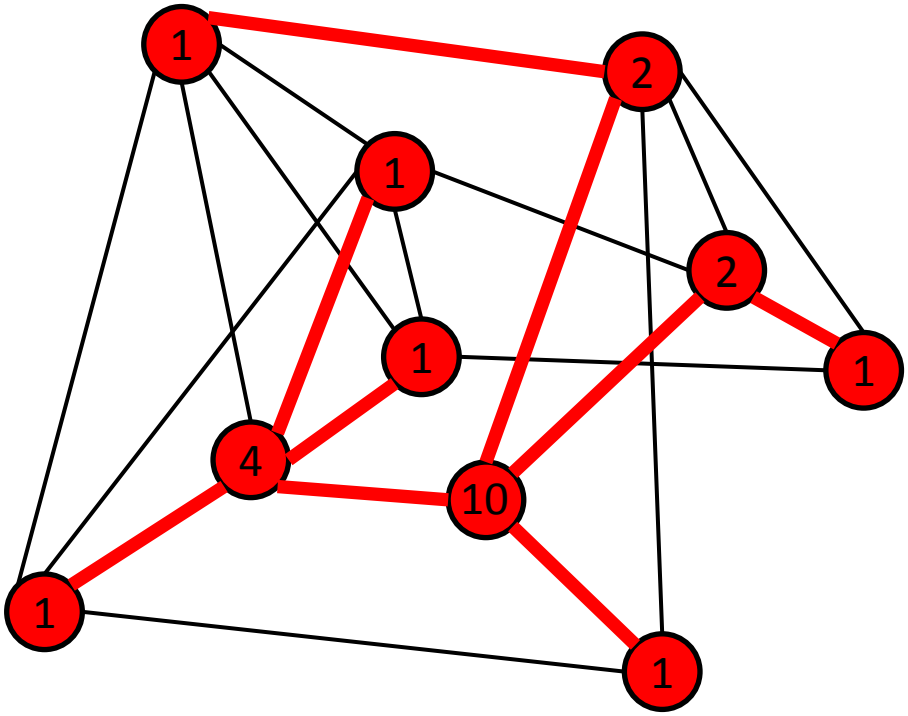
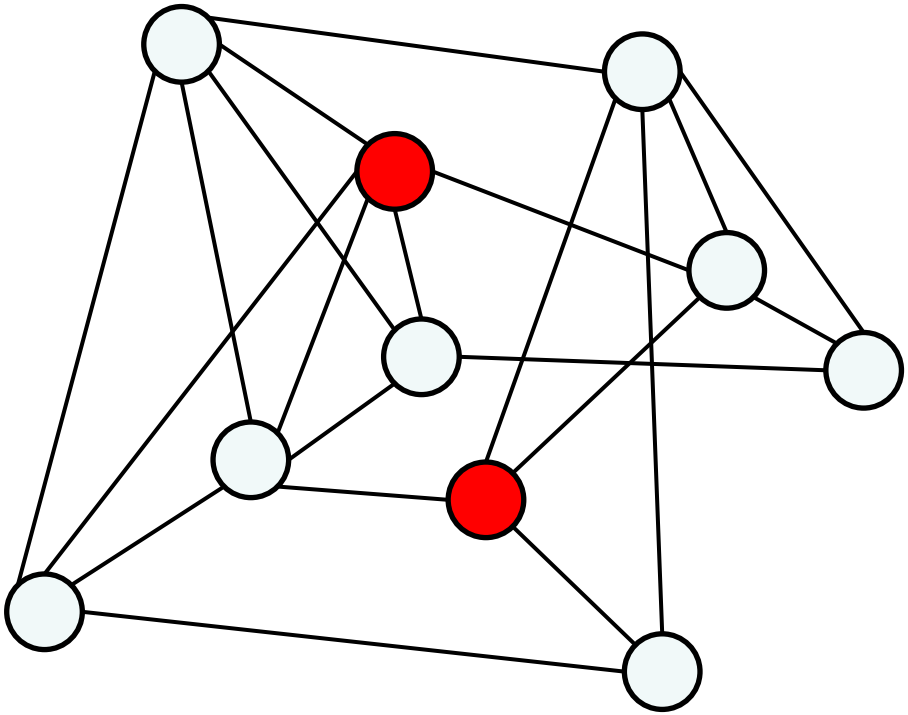


With a simple flooding/echo process, a network can find the number of nodes in time $O(D)$, where D is the diameter (size) of the network.

Diameter (Size) of Network?



- Distance between two nodes = Number of hops of shortest path

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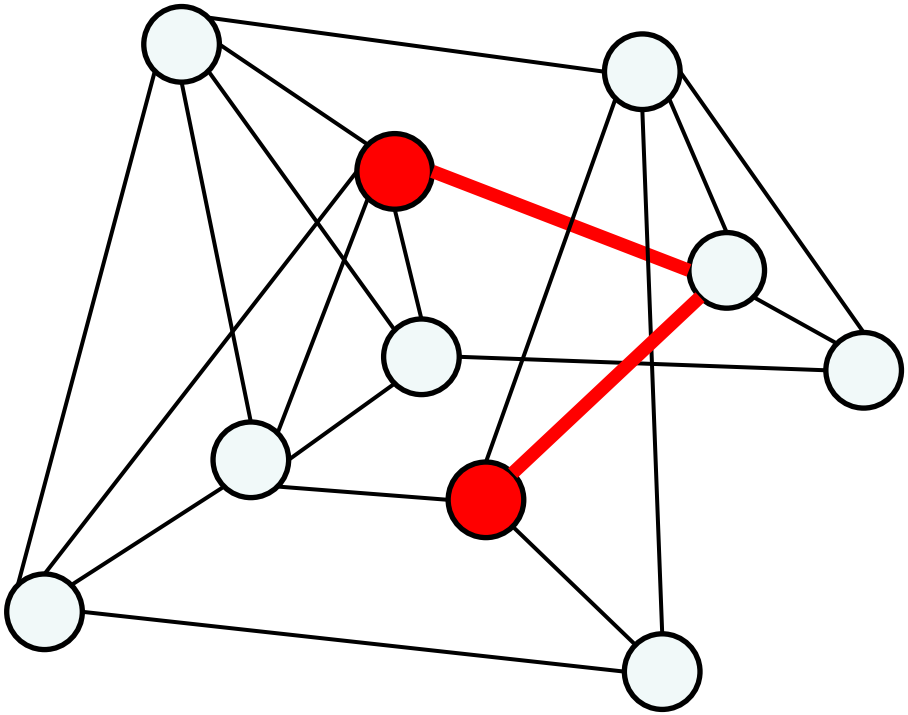

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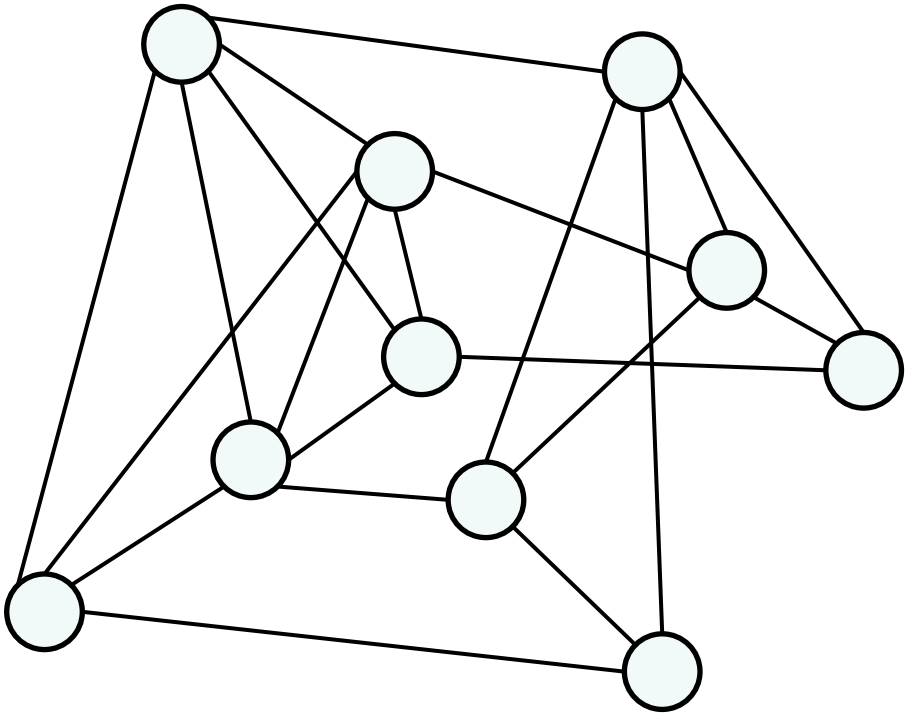
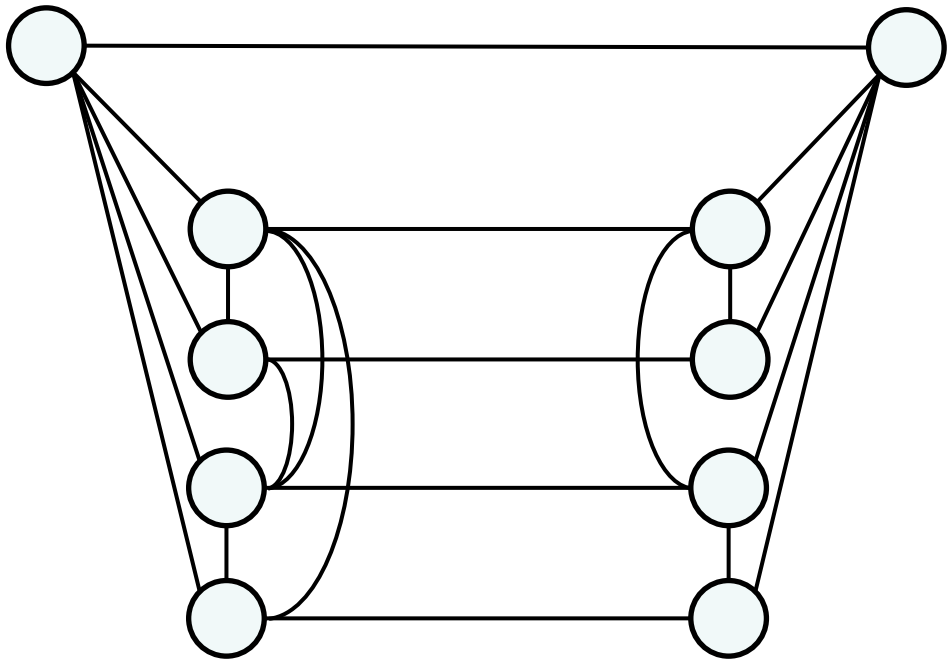


- Distance between two nodes = Number of hops of shortest path
- Diameter of network = Maximum distance, between any two nodes

Networks Cannot Compute Their Diameter in Sublinear Time!

(even if diameter is just a small constant)



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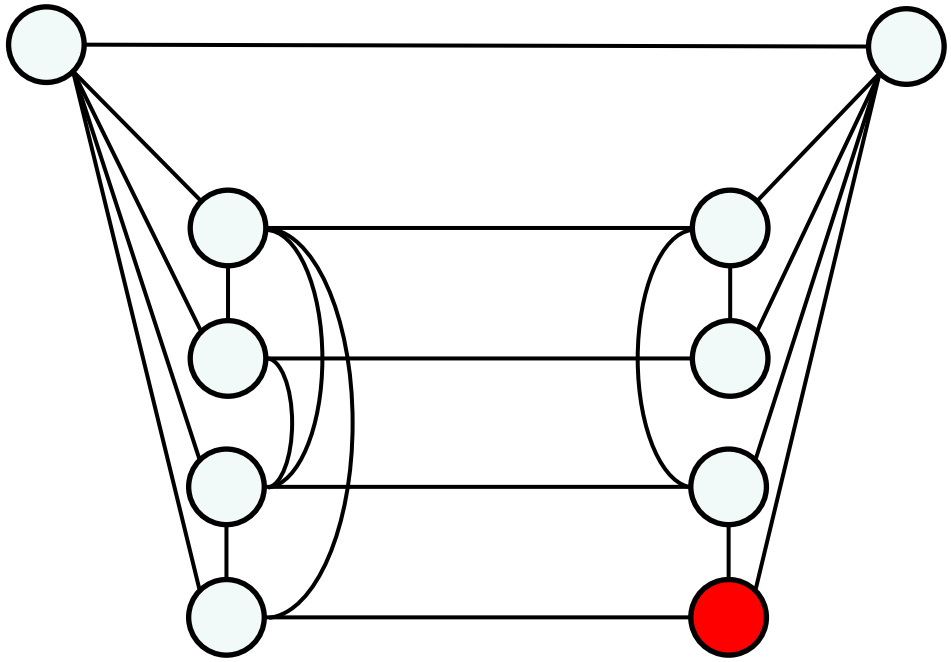

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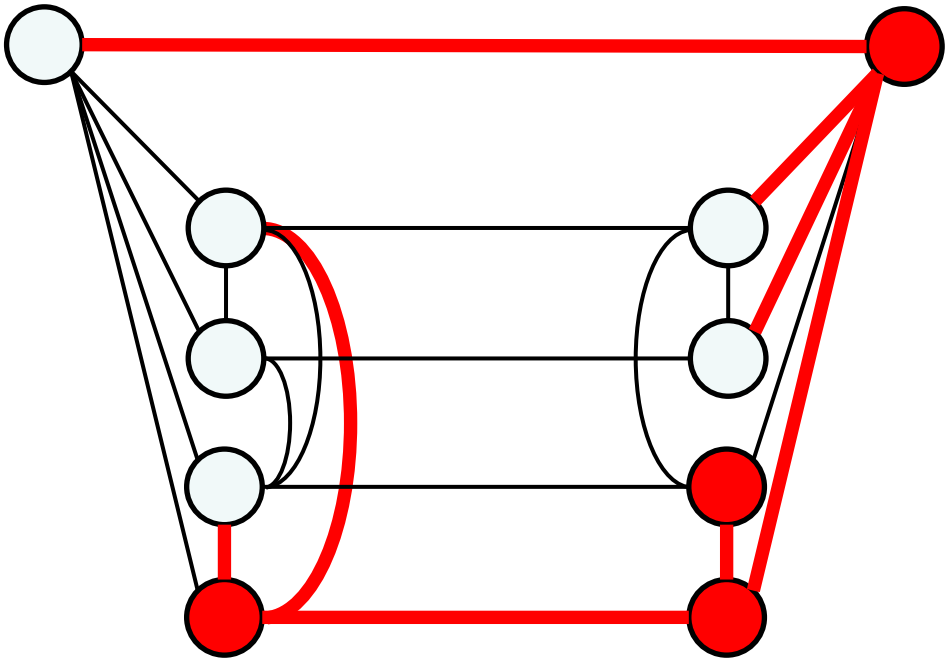

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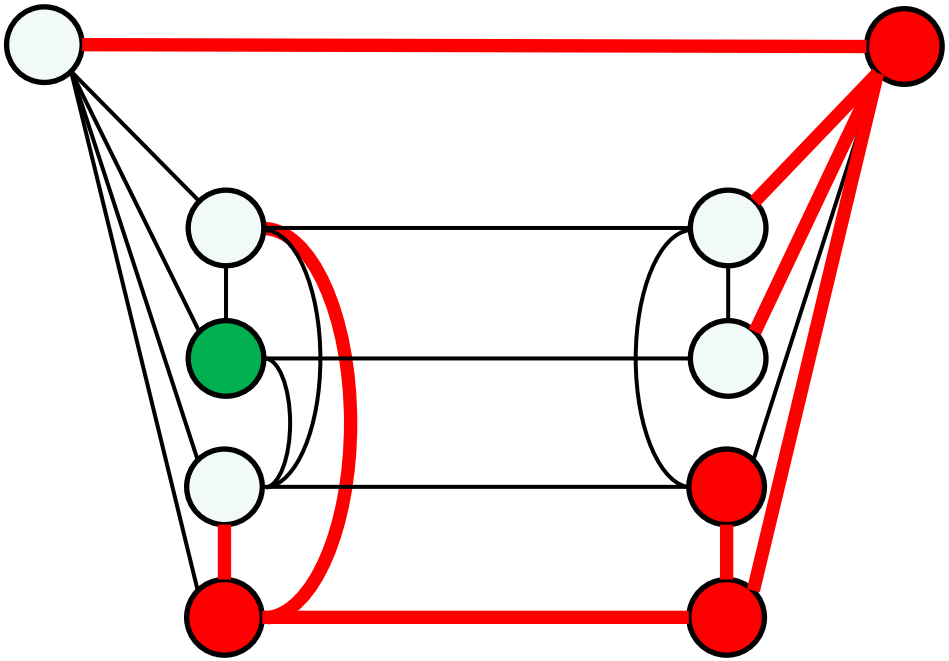

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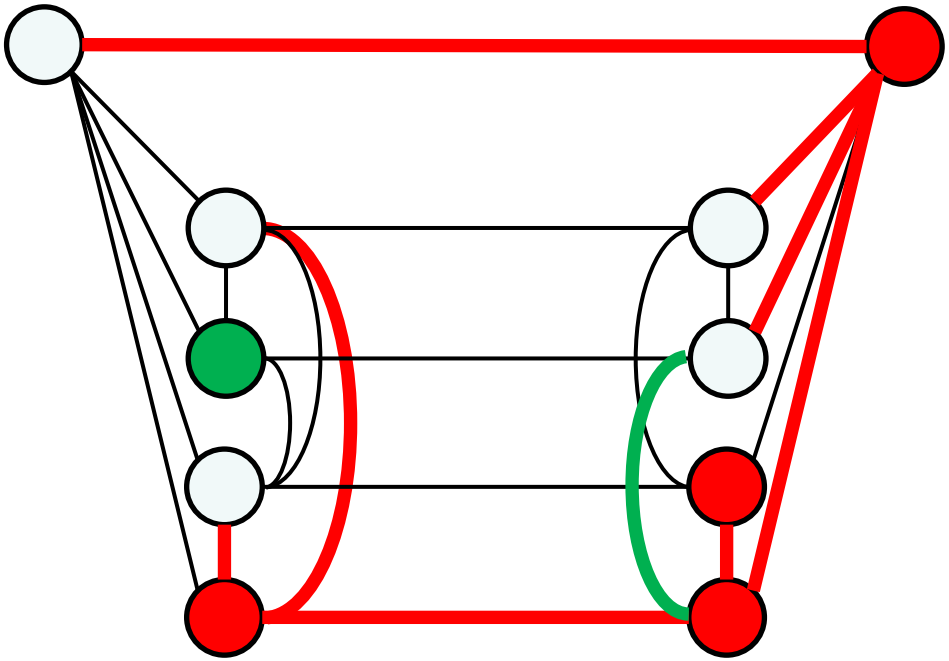

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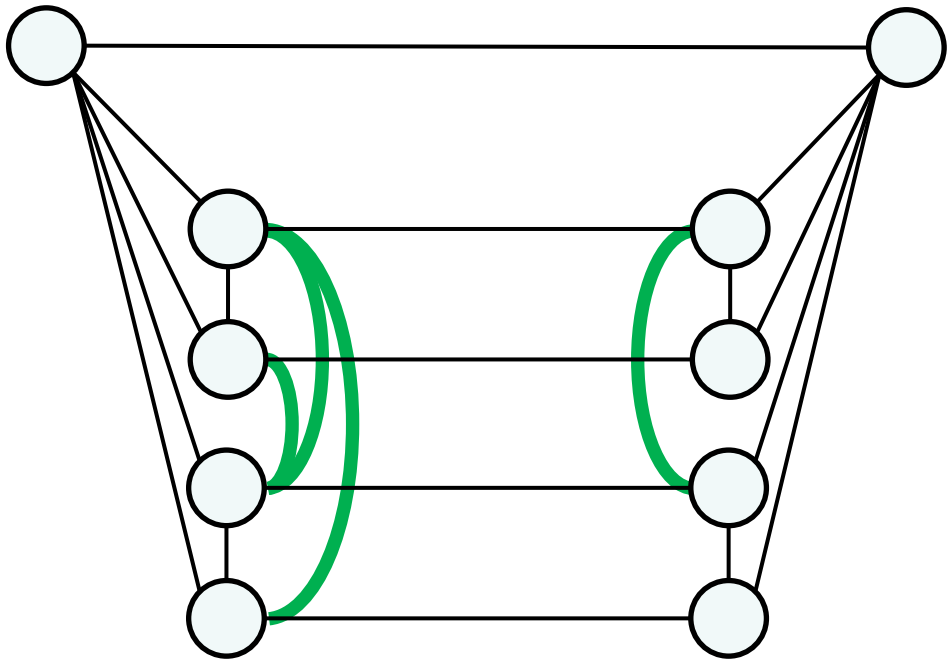

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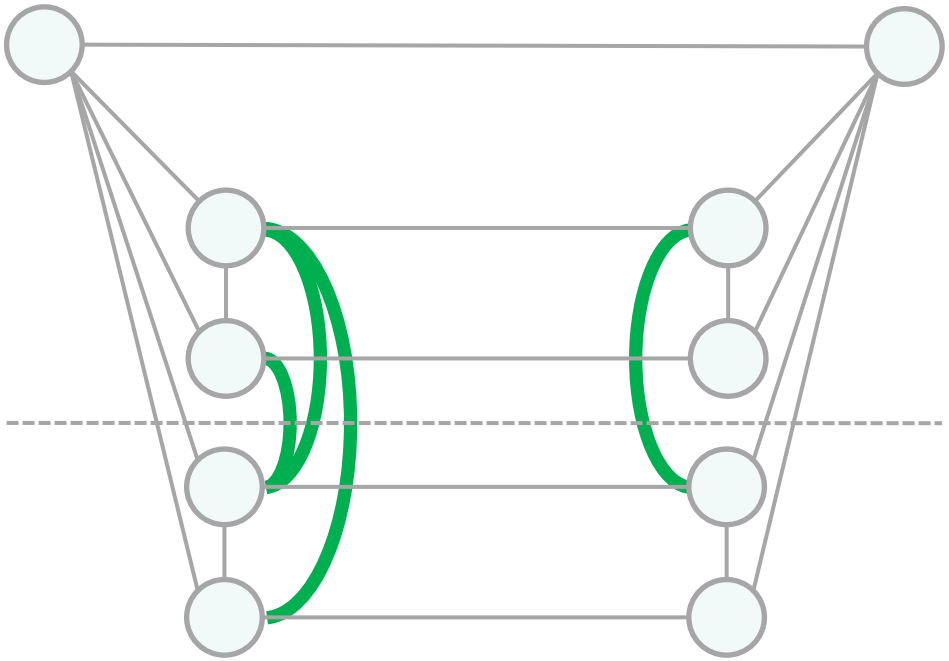

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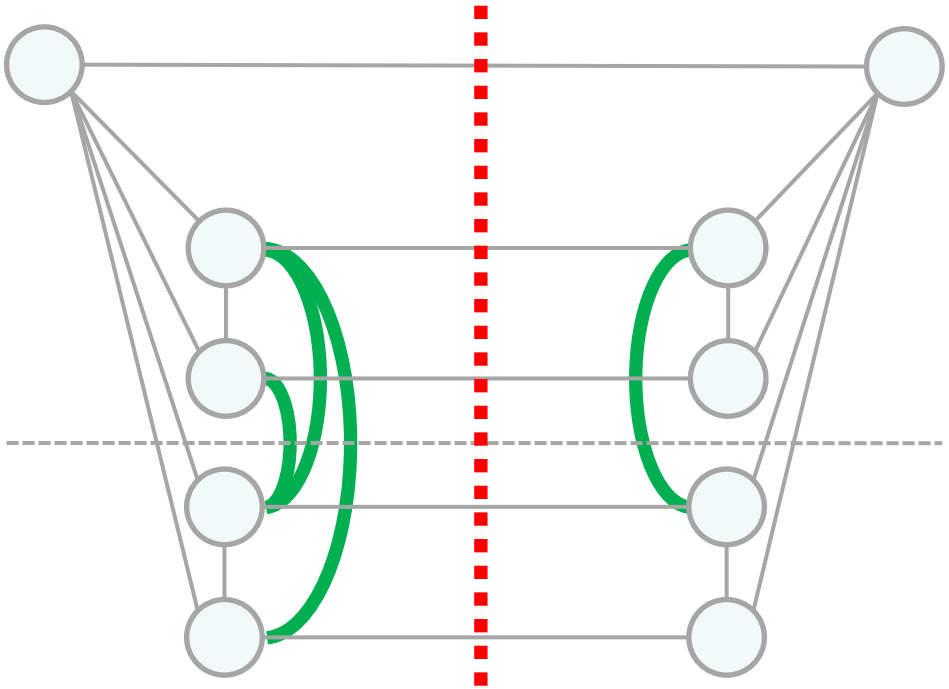

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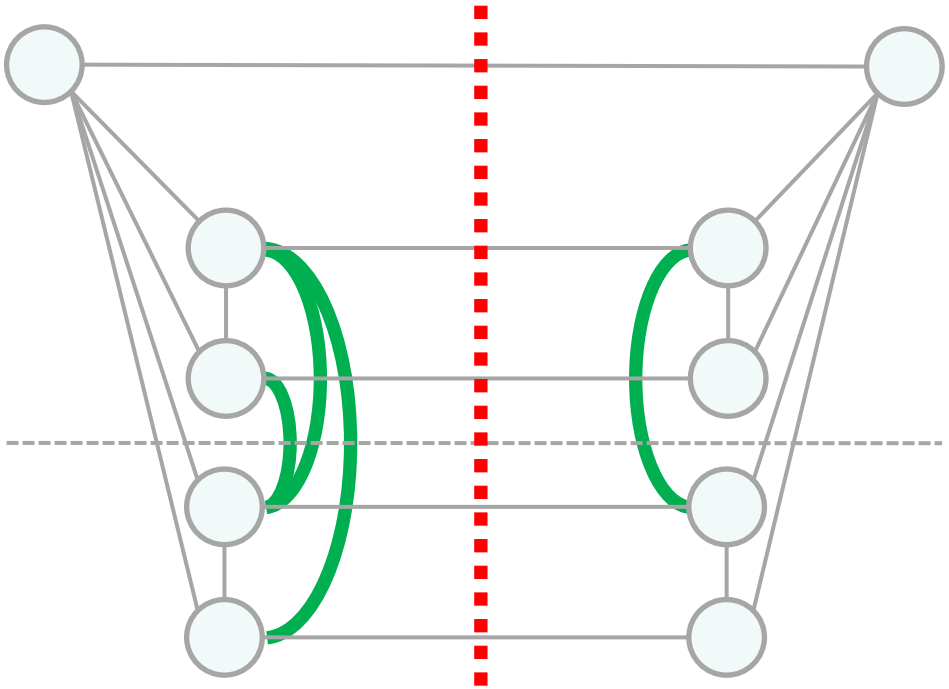

Pair of nodes not connected on both sides? We have $\Theta(n^2)$ information that has to be transmitted over $O(n)$ edges, which takes $\Omega(n)$ time!

[Frischknecht, Holzer, W, 2012]