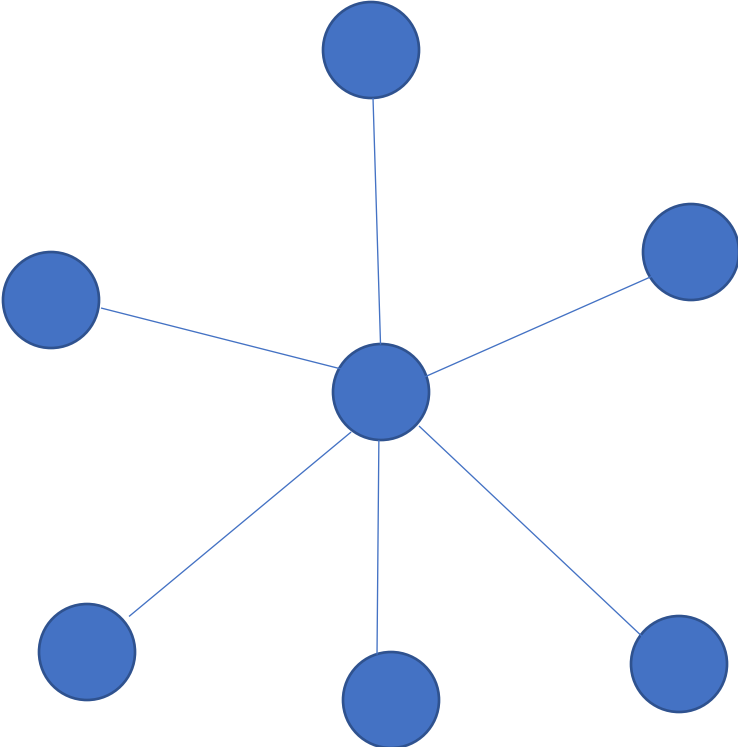


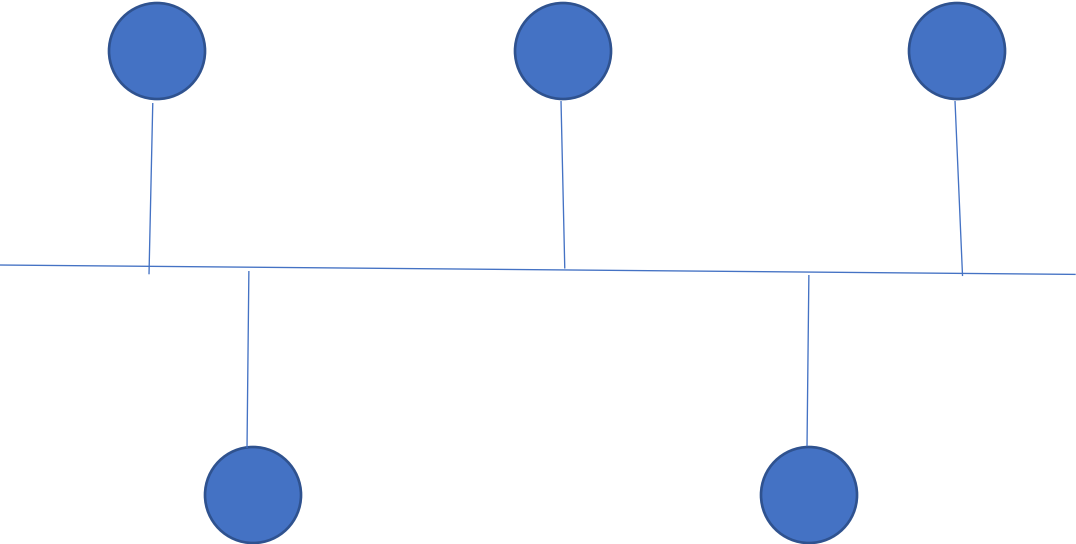
# DISTRIBUTED COMPUTING ON PERIPHERY NETWORKS

AXIOM BASED DESIGN

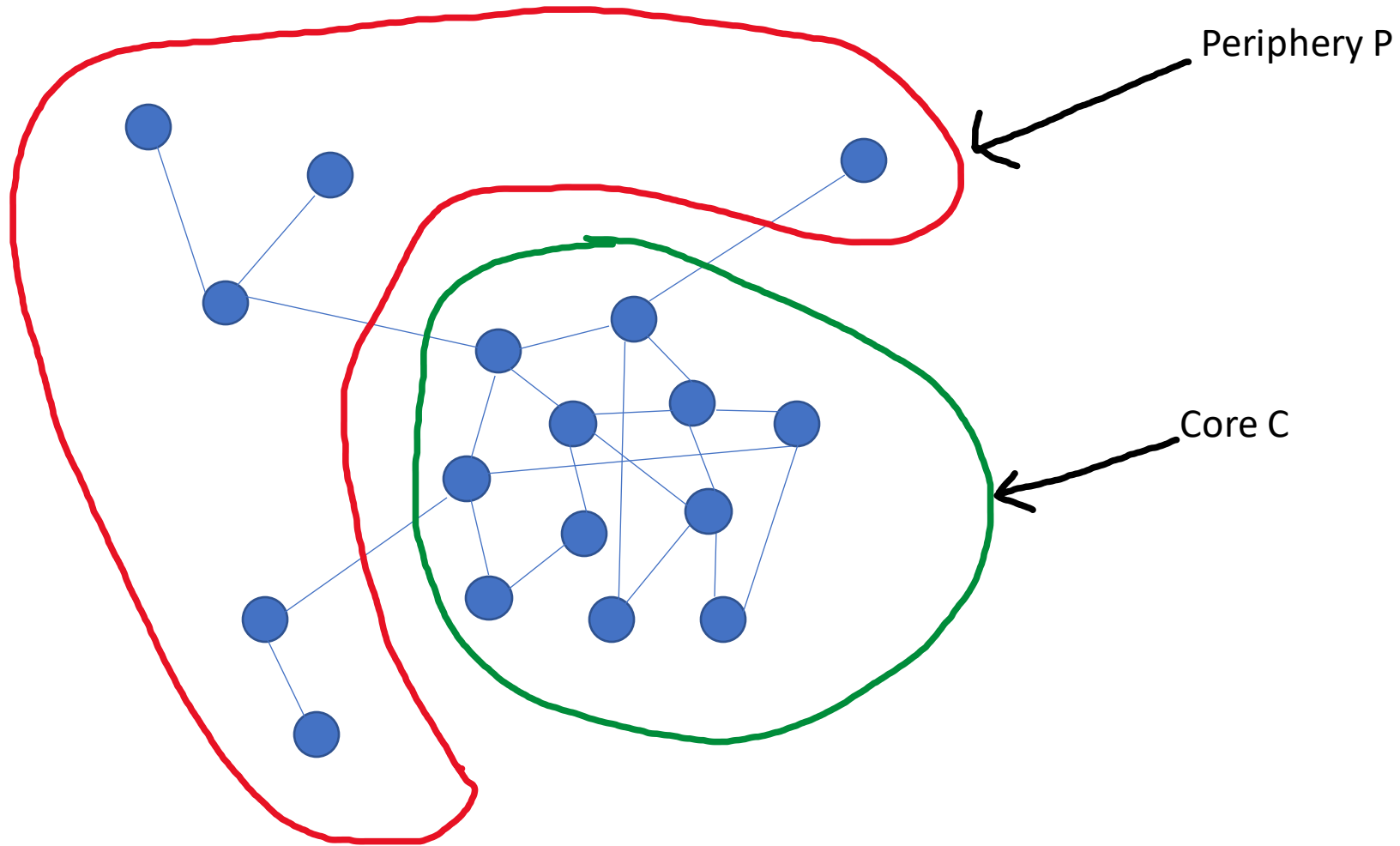
# Star



# Bus



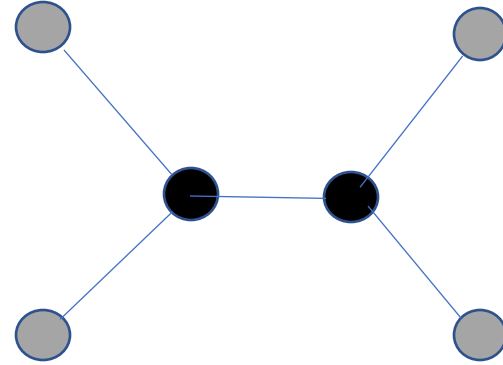
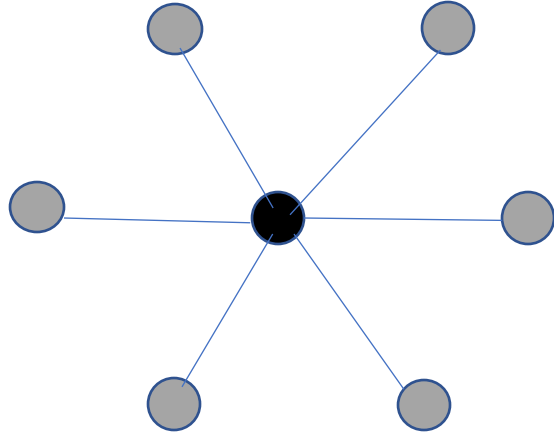
# Partitioned Network $G(V,E,C,P)$



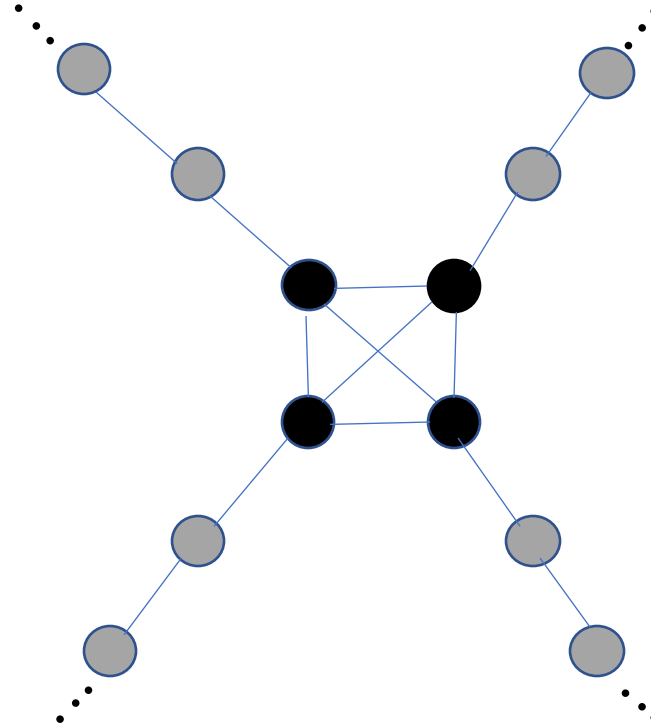
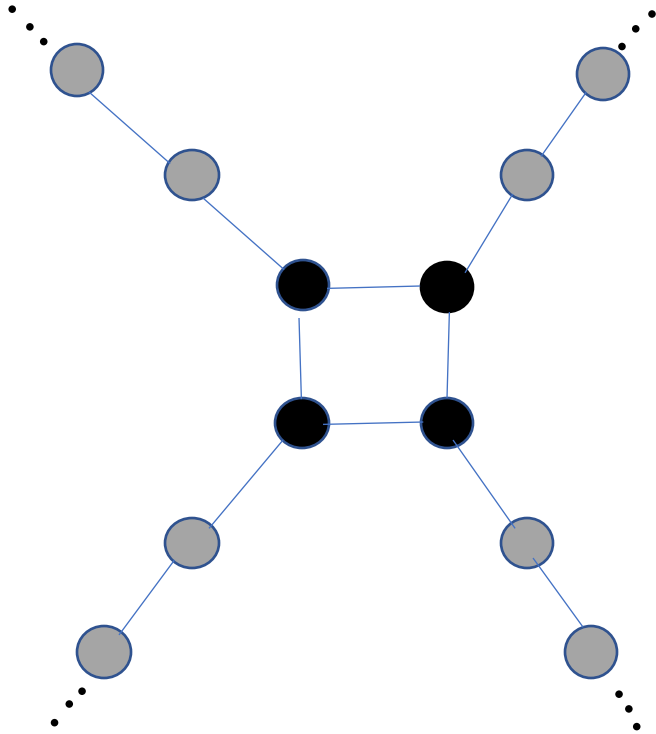
# 3 Axioms

- Balanced Periphery-Core Boundary  $A_B$
- Clique Emulation  $A_E$
- Periphery-Core Convergecast  $A_C$

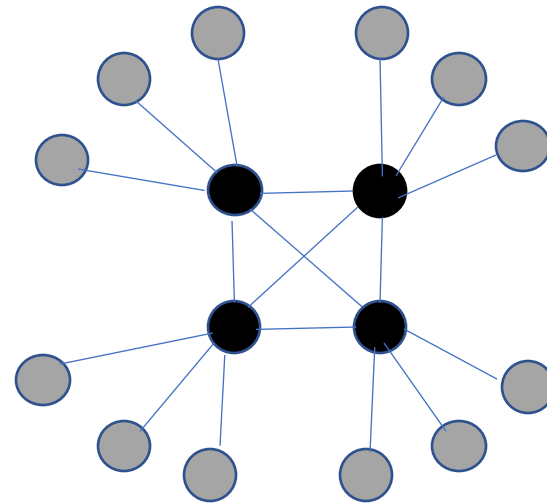
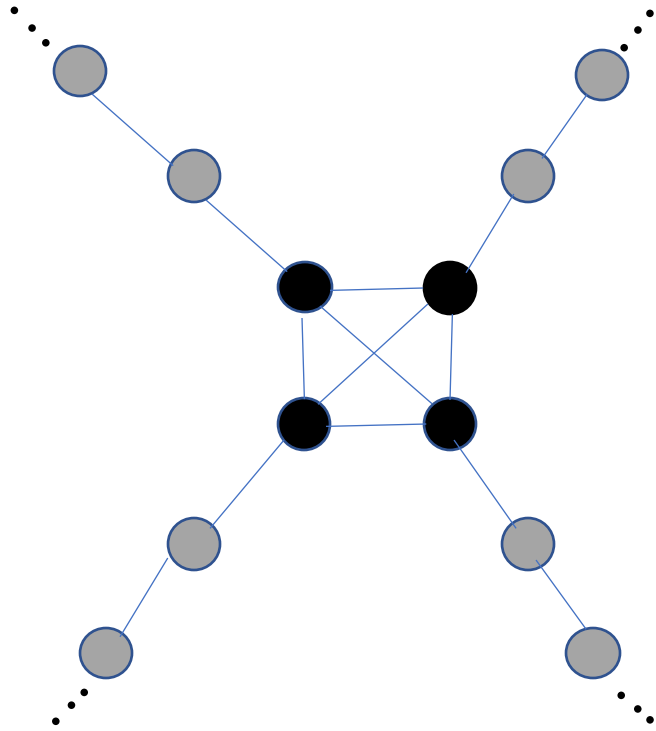
# Balanced Periphery-Core Boundary $A_B$



# Clique Emulation $A_E$

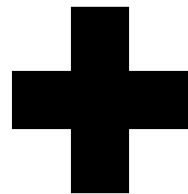
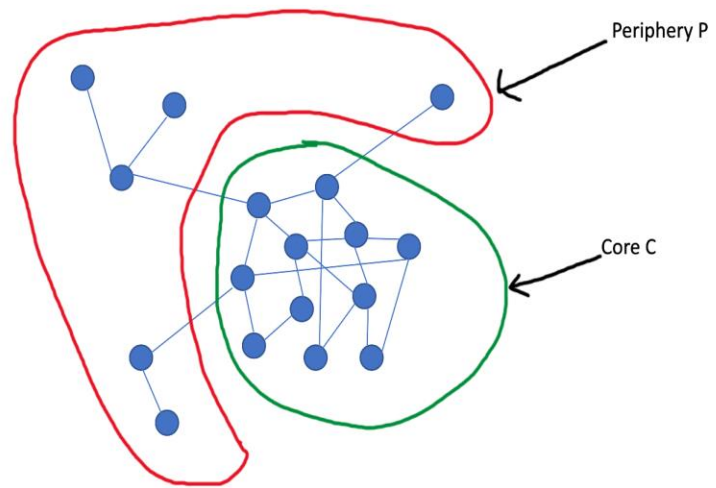


# Fast Periphery-Core Convergecast $A_c$





# Partitioned Network



# Axioms

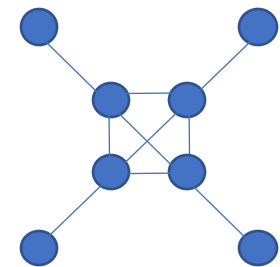
$A_B$

$A_E$

$A_C$



# CP-Network



Task	Runtime on CP-Networks	All Axioms	Any 2 Axioms
MST	$O(\log^2 n)$	$\Omega(1)$	$\Omega(\sqrt[4]{n})$
Matrix transposition	$O(k)$	$\Omega(k)$	$\Omega(n)$
Find my rank	$O(1)$	$\Omega(1)$	$\Omega(n)$
Find mode	$O(1)$	$\Omega(1)$	$\Omega(n/\log n)$

k= maximum number of nonzero entries or a row or column

# Theorem

Clique  $\rightarrow \Theta(1)$  rounds for :

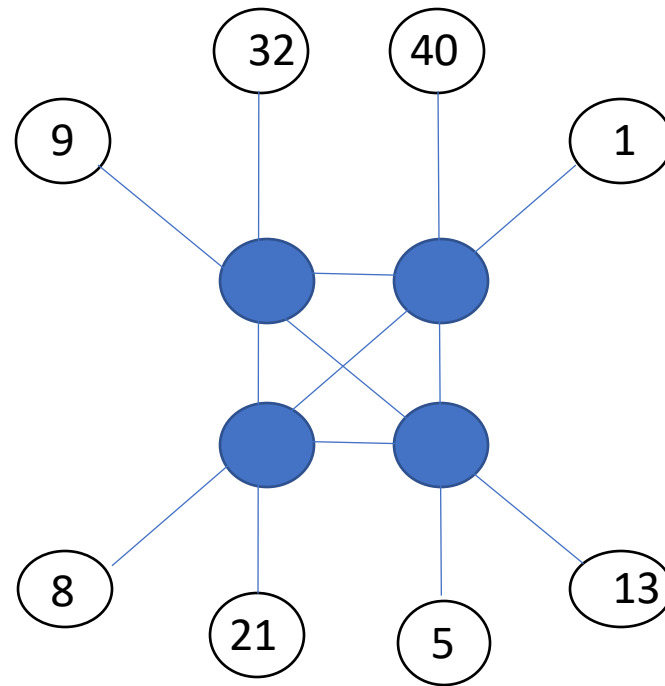
1. Node  $i$  needs to learn the values of the other nodes according the total order of all values.
2. Node  $i$  needs to determine the indices of its input (initial) values in the total order of all values

# Find my rank

Each node needs to know the position of its value in the ordered list of all the values, i.e., the rank of its value.

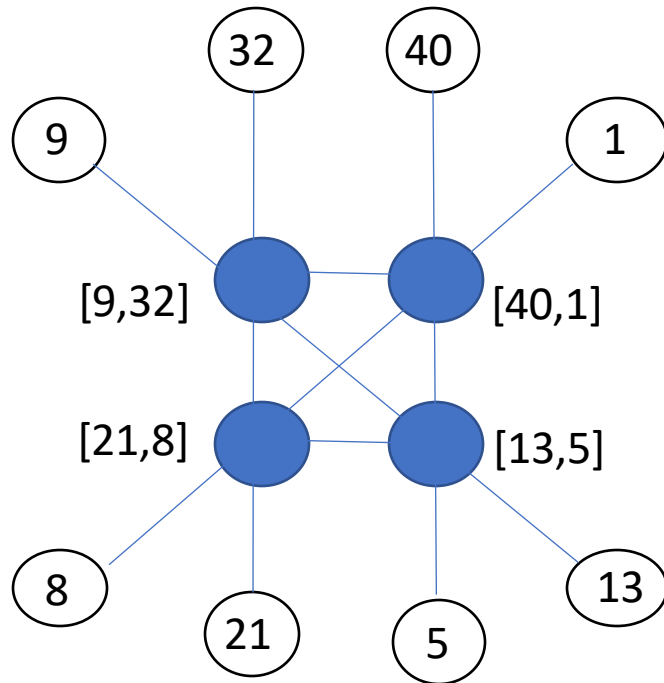
Any network  $\rightarrow \Omega(D)$

$D$  = diameter of the graph



# Find my rank on CP-network

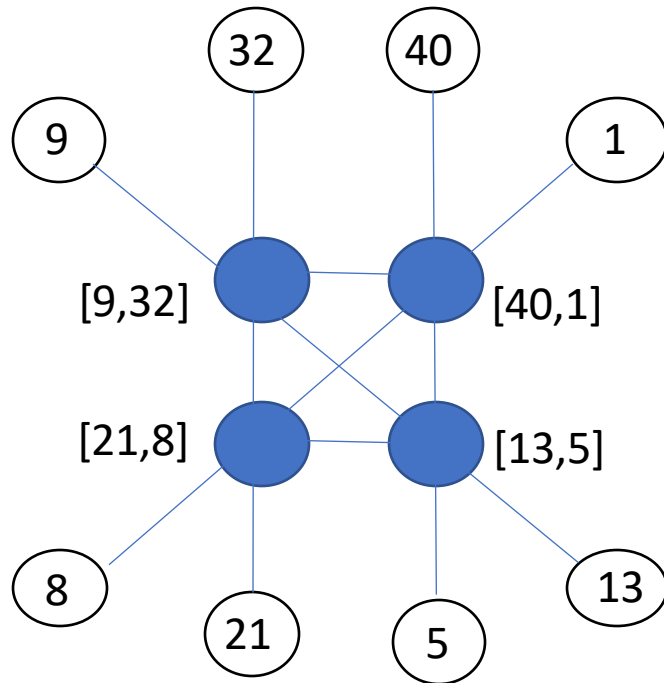
Step 1: send value to representative



$A_c \rightarrow O(1)$

# Find my rank on CP-network

## Step 2: Core sorts



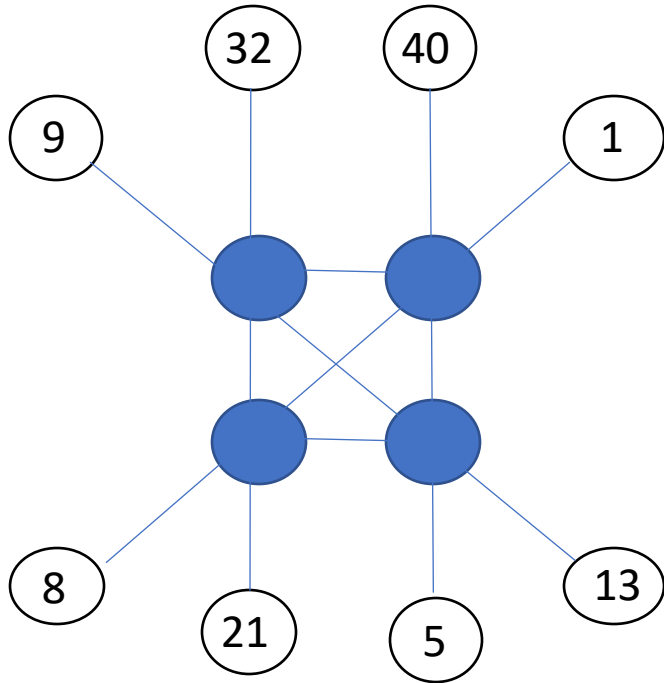
Sort ->

Val	1	5	8	9	13	21	32	40
ID	4	6	8	1	5	7	2	3
Rank	1	2	3	4	5	6	7	8

$A_E \rightarrow O(1)$  rounds

# Find my rank on CP-network

Step 3: Core delivers rank



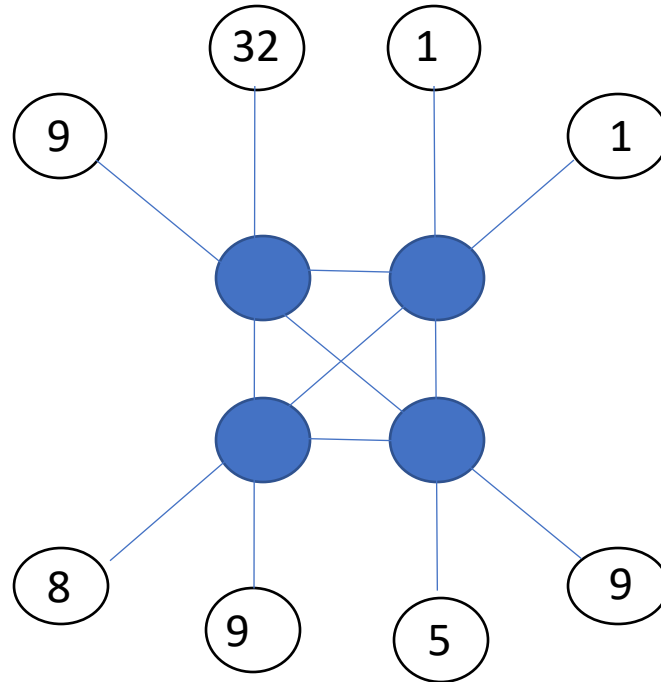
Val	1	5	8	9	13	21	32	40
ID	4	6	8	1	5	7	2	3
Rank	1	2	3	4	5	6	7	8

$A_c \rightarrow O(1)$  rounds

# Find mode

Each node needs to know the value (values) that appears most frequently

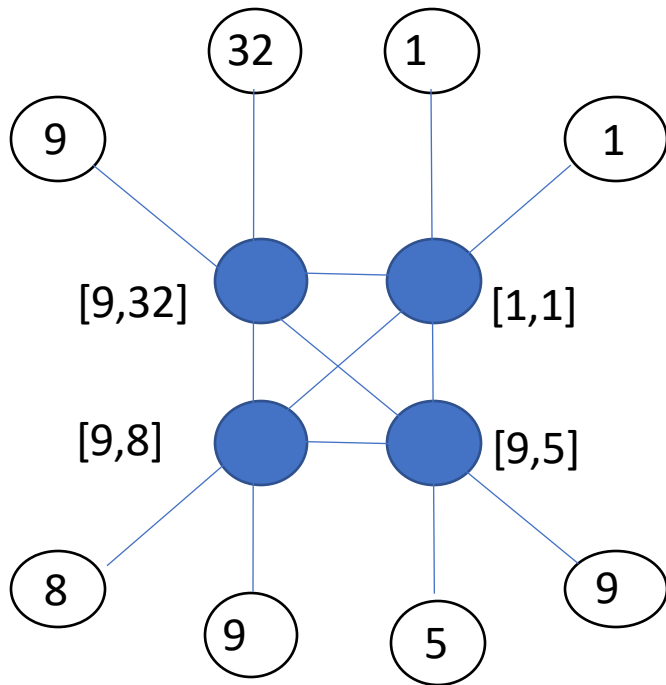
Any network  $\rightarrow \Omega(D)$





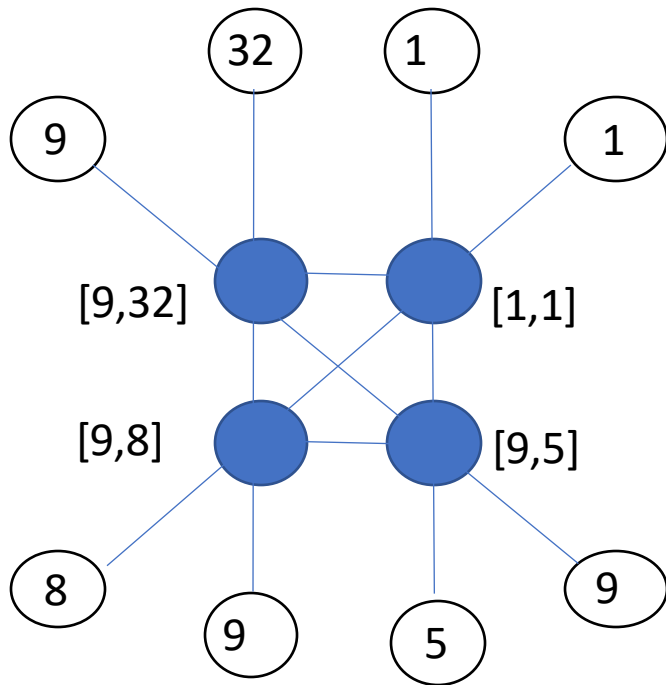
# Find mode on CP-network

Step 1: send value to representative  $A_c \rightarrow O(1)$



# Problem: Find mode on CP-network

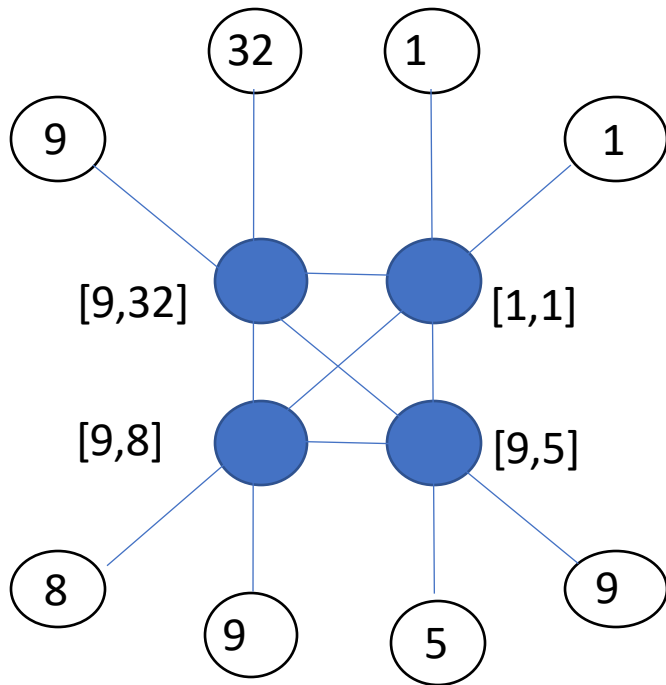
- Step 2: Core sorts and gets rank  $\rightarrow O(1)$  as seen in find rank



Val	1	1	5	8	9	9	9	32
ID	3	4	6	8	1	5	7	2
Rank	1	2	3	4	5	6	7	8

# Problem: Find mode on CP-network

Step 3: Core nodes exchange their most frequent values

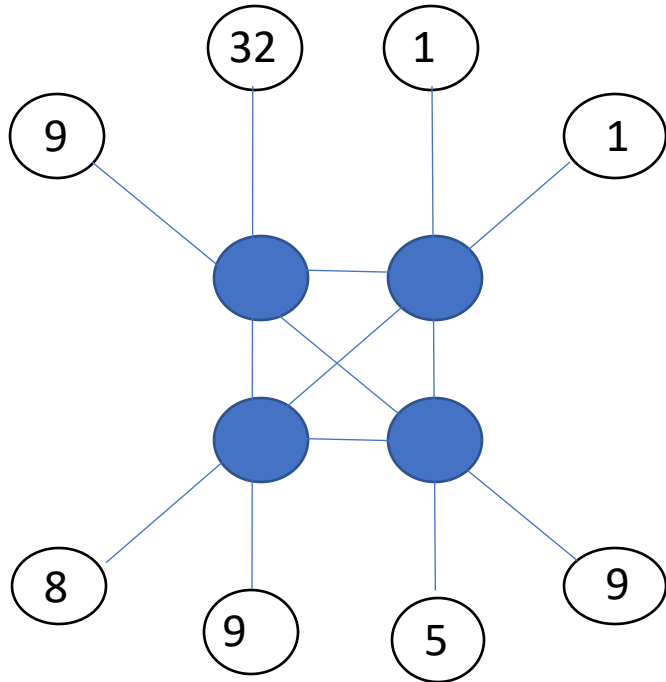


$A_E \rightarrow O(1)$

Most Frequent	9	1	32	8	5
Frequency	3	2	1	1	1

# Problem: Find mode on CP-network

Step 4: send most frequent value to nodes in Periphery



$A_c \rightarrow O(1)$  rounds

# QUESTIONS