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M.S. Ramaiah Institute of Technology
(Autonomous Institute, Affiliated to VTU)
Department of Computer Science and Engineering

Course Name: Distributed Systems

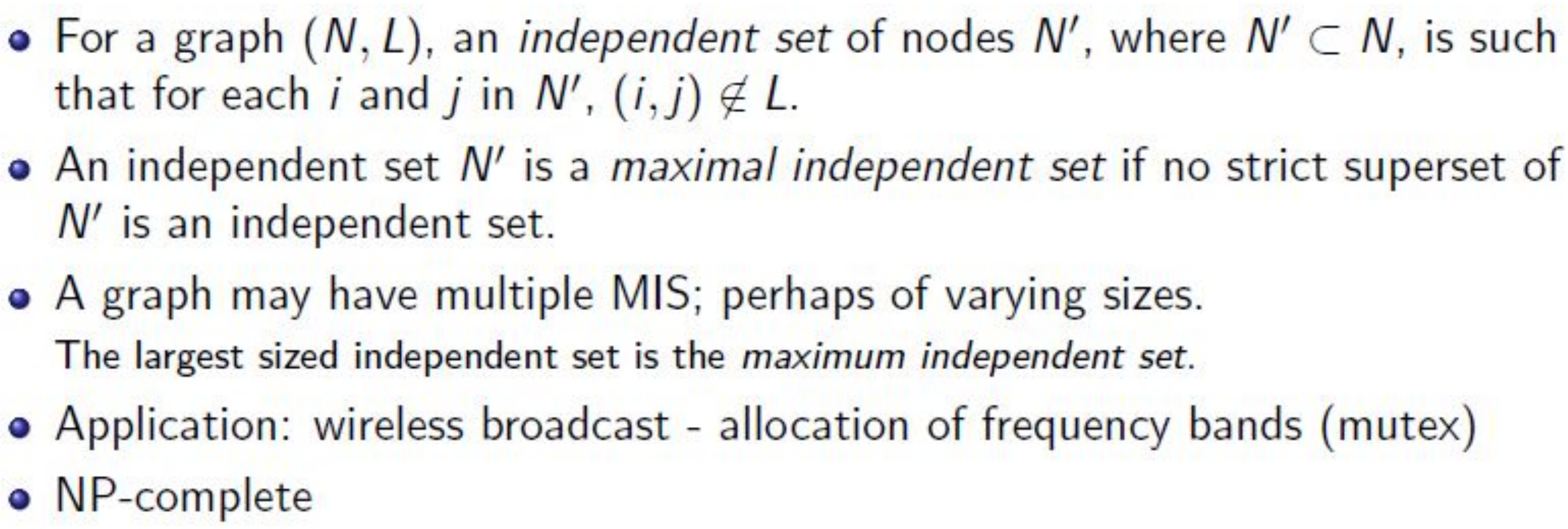
Course Code: CSE751/CSE20(O)

Credits: 3:0:0 / 3:0:0:1

Term: Oct 2021-Feb 2022

Faculty:
Sini Anna Alex

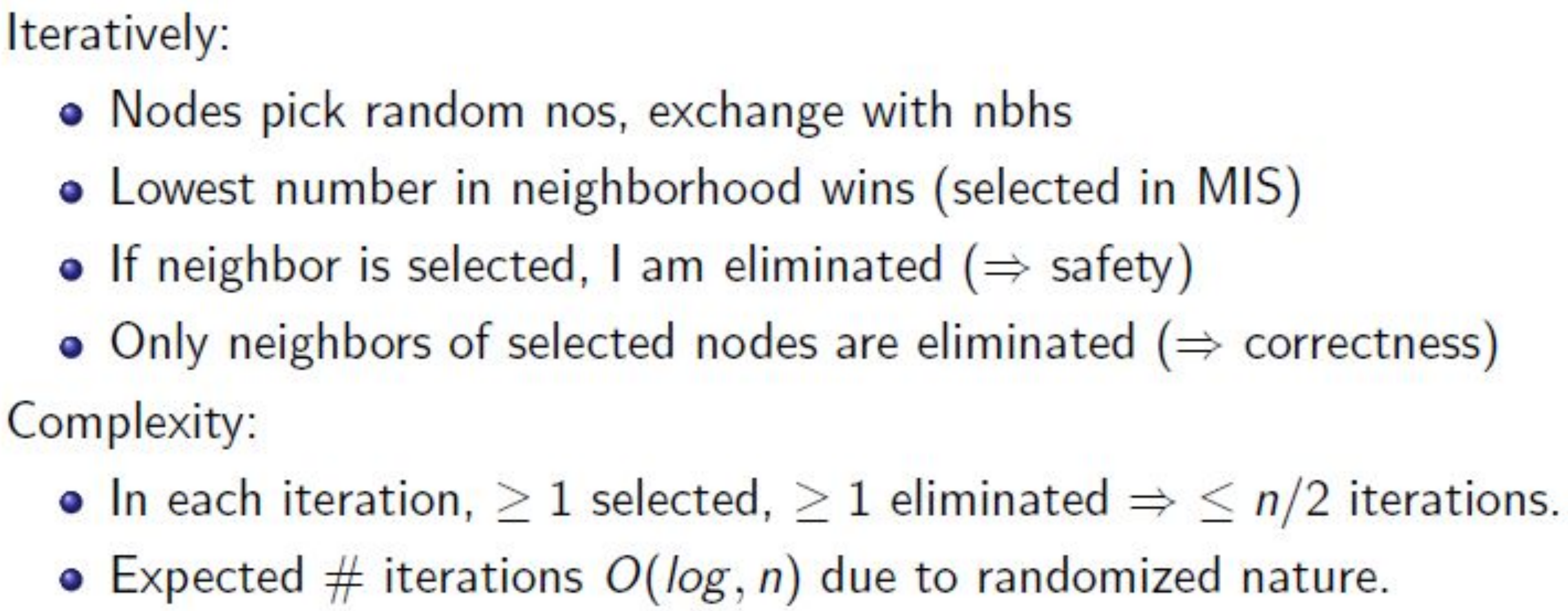
Maximal Independent Set: Definition



- For a graph (N, L), an *independent set* of nodes N', where $N' \subset N$, is such that for each i and j in N', $(i, j) \notin L$.
- An independent set N' is a *maximal independent set* if no strict superset of N' is an independent set.
- A graph may have multiple MIS; perhaps of varying sizes.

  The largest sized independent set is the *maximum independent set*.
- Application: wireless broadcast - allocation of frequency bands (mutex)
- NP-complete

Luby’s Randomized Maximal Independent set algorithm



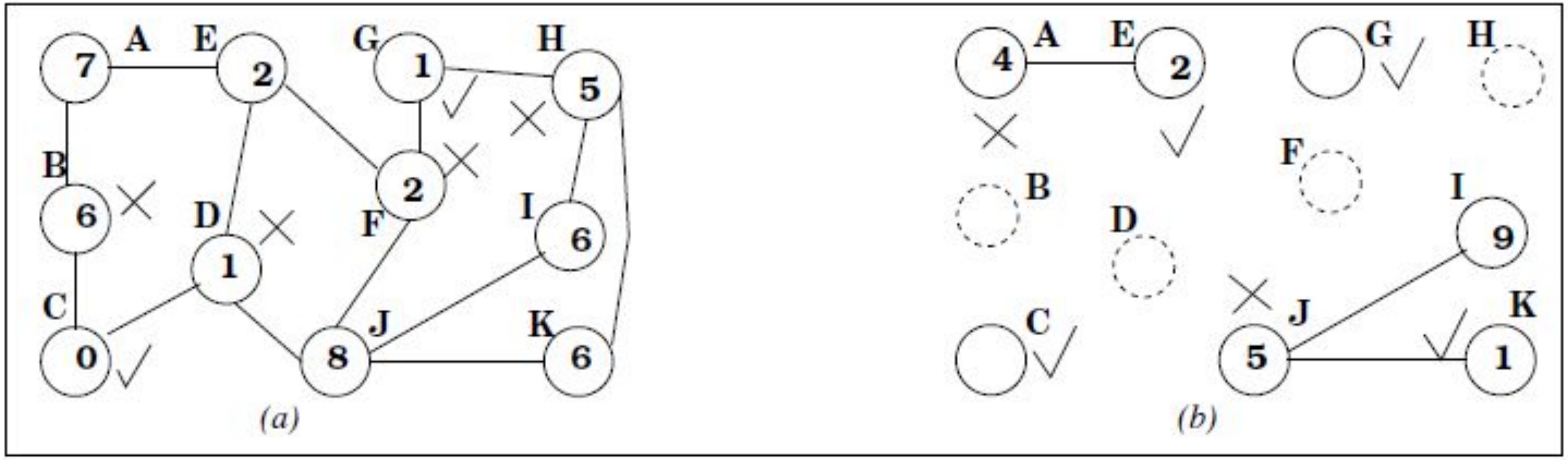
Iteratively:

- Nodes pick random nos, exchange with nbhs
- Lowest number in neighborhood wins (selected in MIS)
- If neighbor is selected, I am eliminated ($\Rightarrow$ safety)
- Only neighbors of selected nodes are eliminated ($\Rightarrow$ correctness)

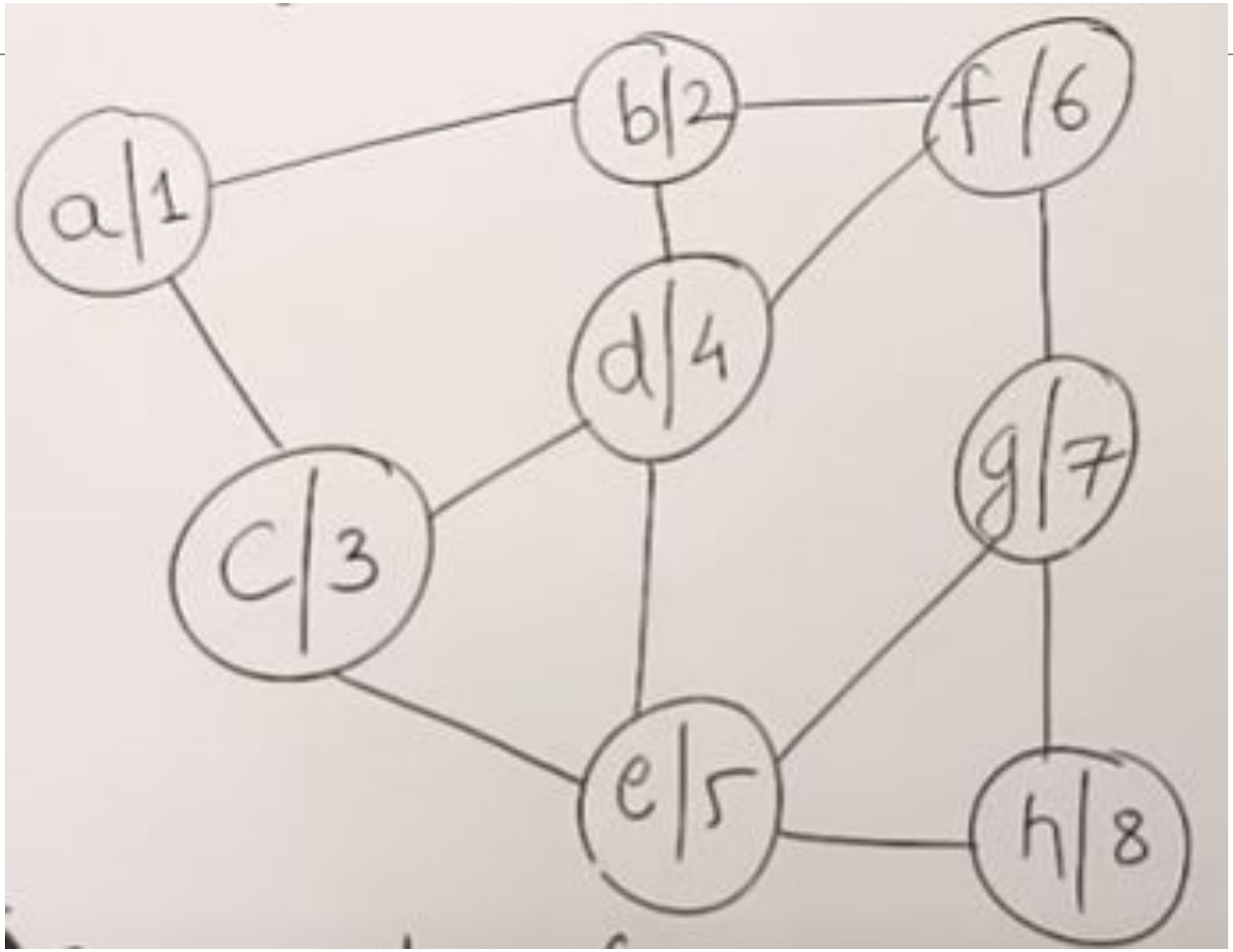
Complexity:

- In each iteration, ≥ 1 selected, ≥ 1 eliminated $\Rightarrow \leq n/2$ iterations.
- Expected # iterations $O(log, n)$ due to randomized nature.

Luby's Randomized Maximal Independent set algorithm

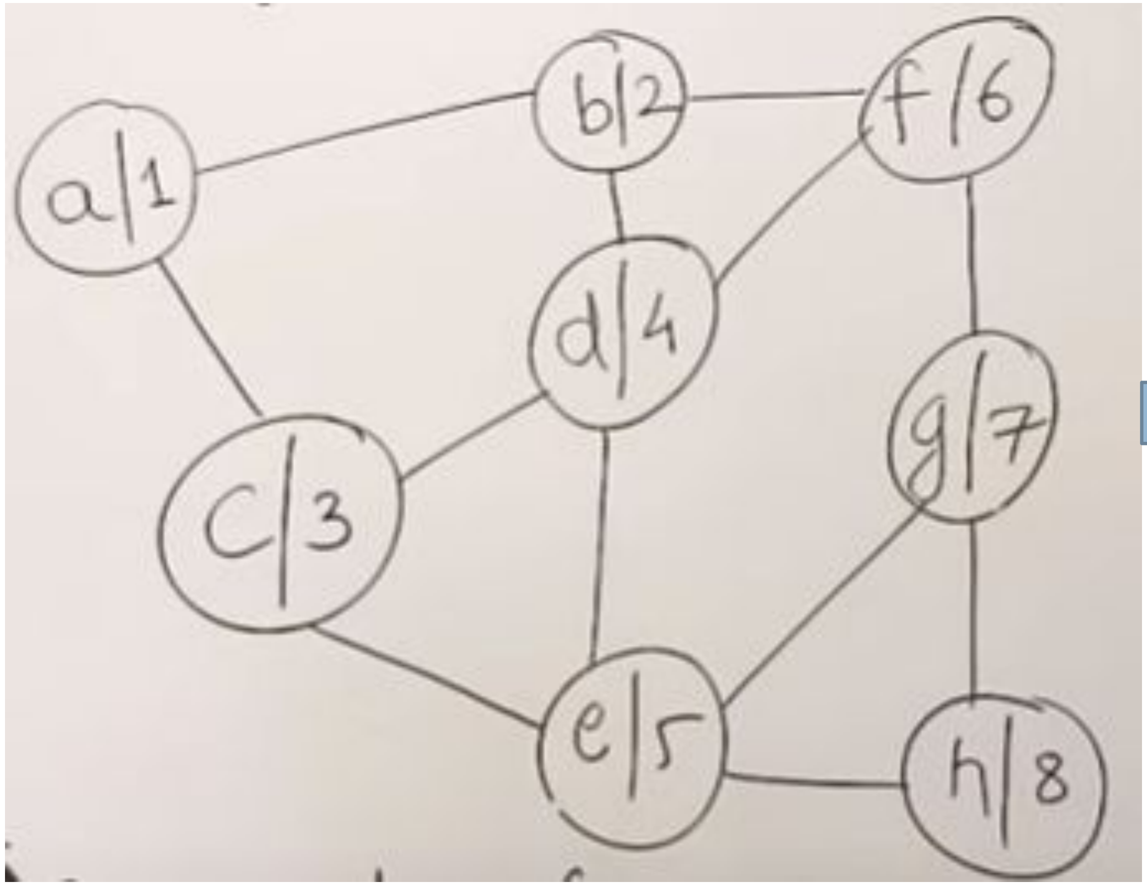


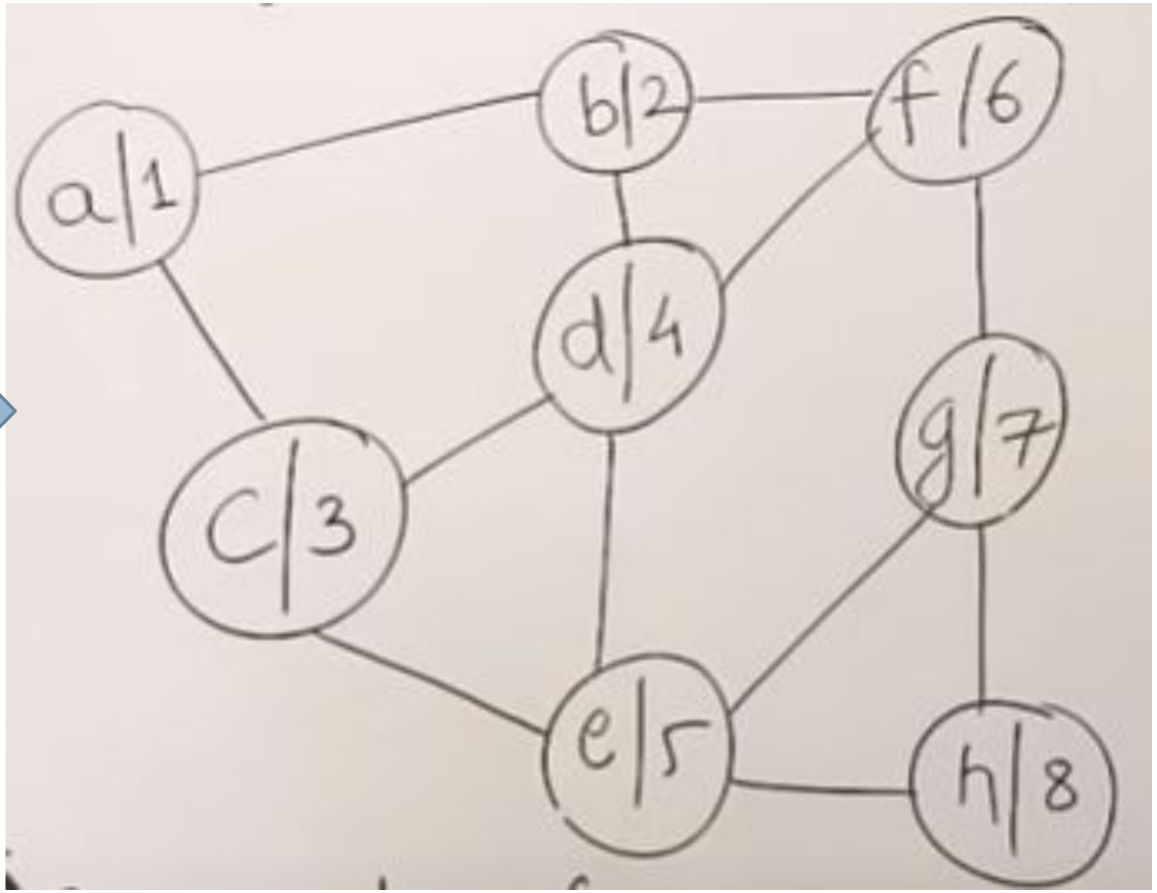
Luby’s Randomized Maximal Independent set- Example



Luby’s Randomized Maximal Independent set algorithm

C={a,b,c,d,e,f,g,h}
I={}





Leader Election

LeLang Chang Roberts (LCR) algorithm

- Asynchronous unidirectional ring
- All processes have unique IDs
- Processes circulate their IDs; highest ID wins

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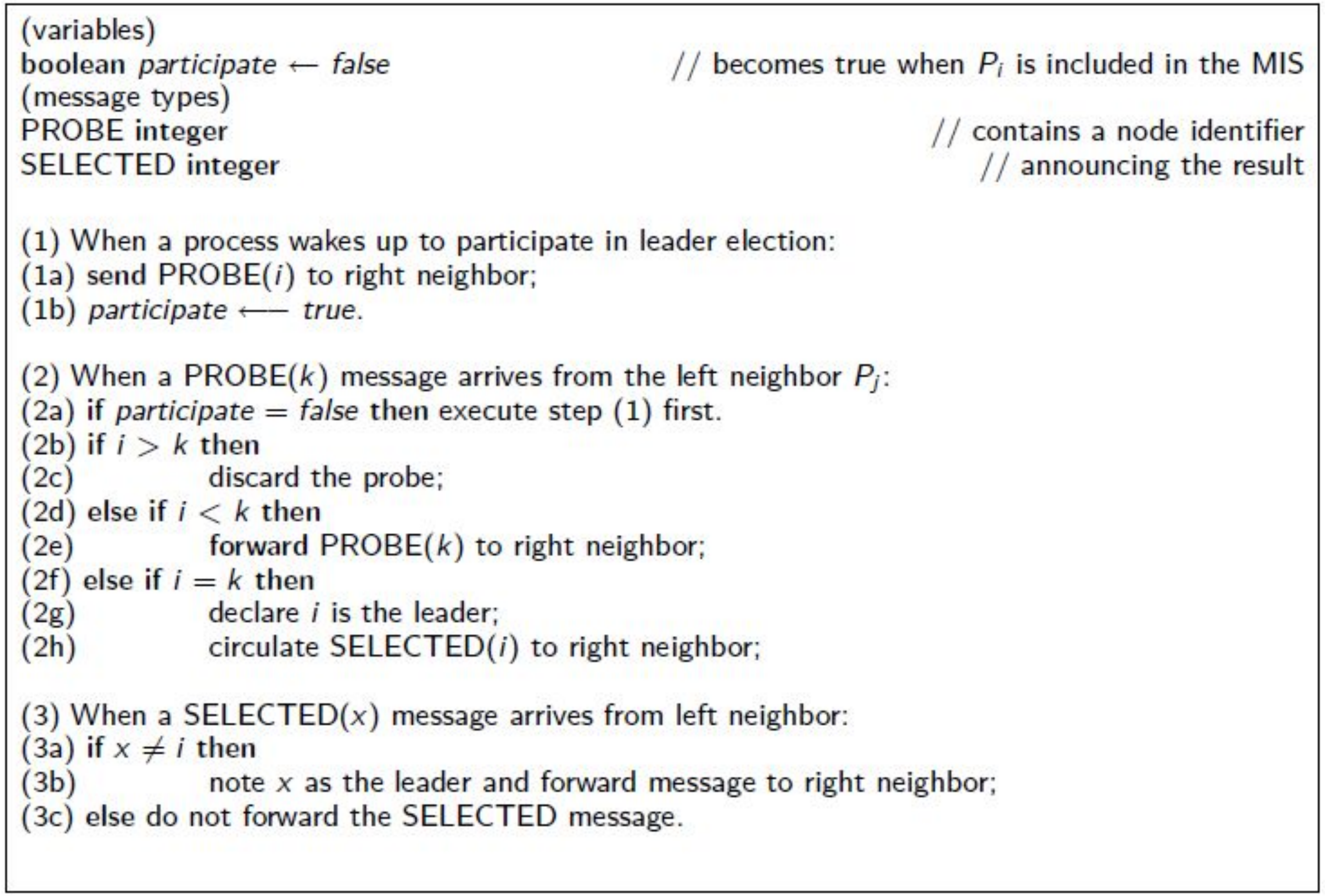
Leader Election - LCR algorithm: Code (Lehann-Chang Robots)



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(variables)
boolean participate ← false          // becomes true when $P_i$ is included in the MIS
(message types)
PROBE integer                                            // contains a node identifier
SELECTED integer                                           // announcing the result

(1) When a process wakes up to participate in leader election:
(1a) send PROBE($i$) to right neighbor;
(1b) participate ⟵ true.

(2) When a PROBE($k$) message arrives from the left neighbor $P_j$:
(2a) if participate = false then execute step (1) first.
(2b) if $i > k$ then
(2c)         discard the probe;
(2d) else if $i < k$ then
(2e)         forward PROBE($k$) to right neighbor;
(2f) else if $i = k$ then
(2g)         declare $i$ is the leader;
(2h)         circulate SELECTED($i$) to right neighbor;

(3) When a SELECTED($x$) message arrives from left neighbor:
(3a) if $x \neq i$ then
(3b)         note $x$ as the leader and forward message to right neighbor;
(3c) else do not forward the SELECTED message.
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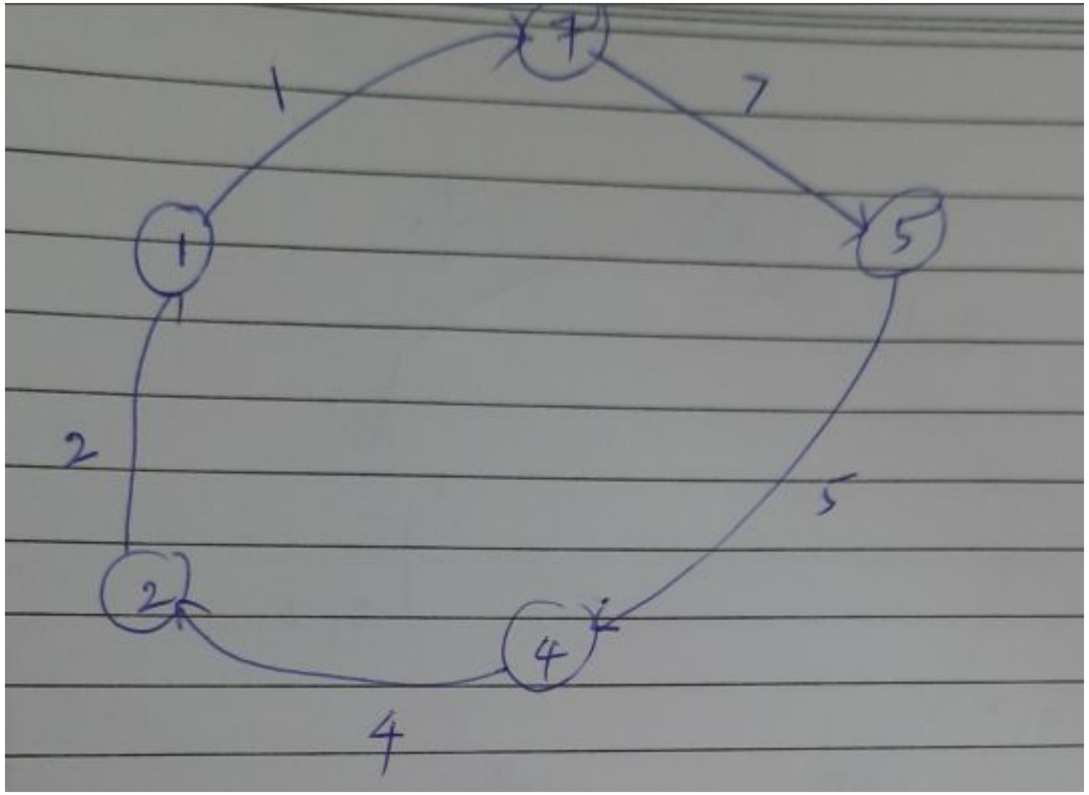

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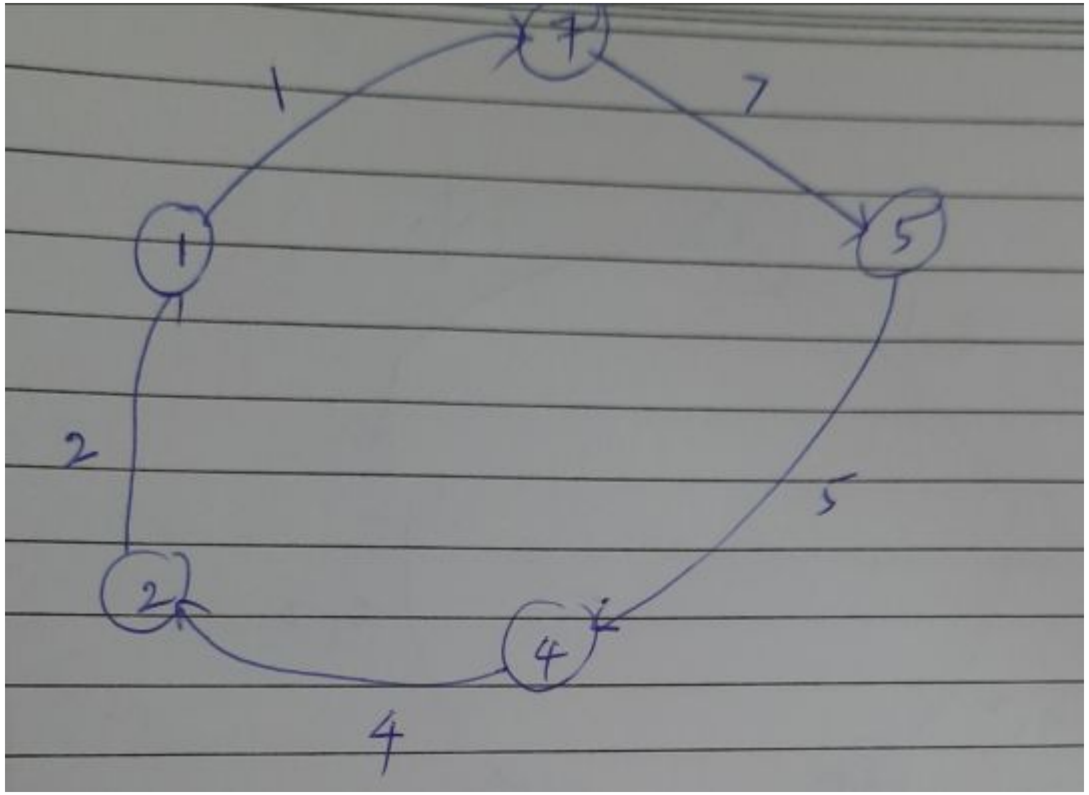
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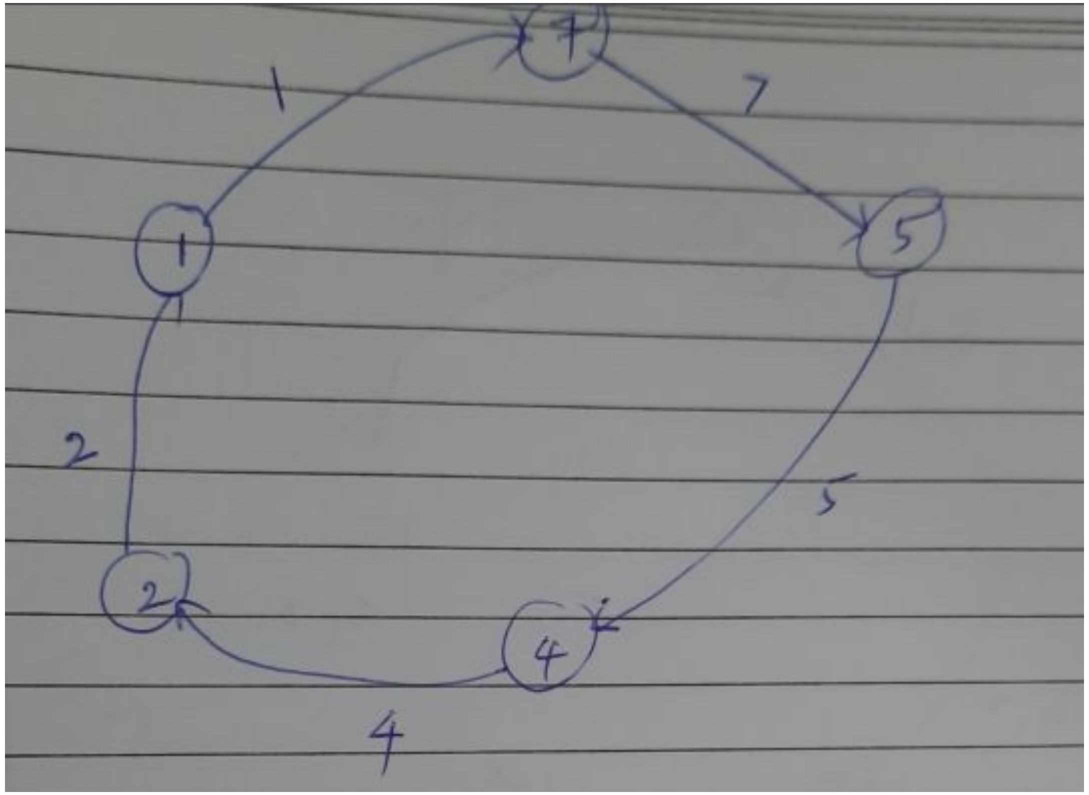
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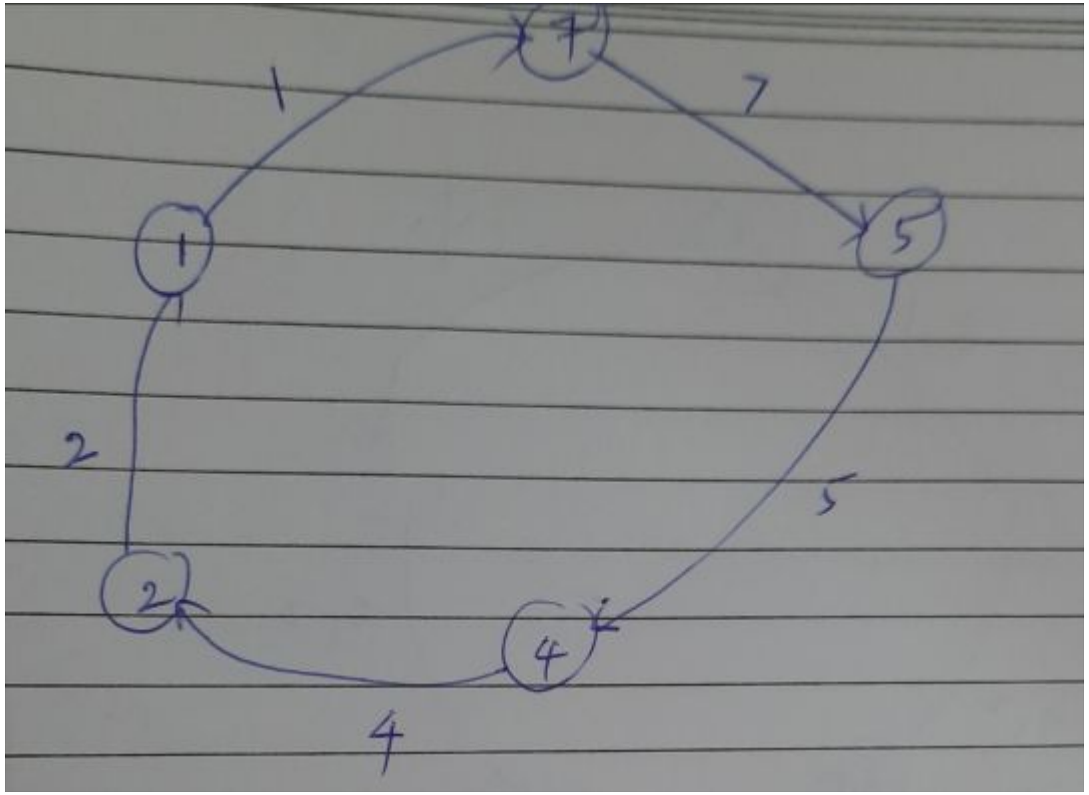
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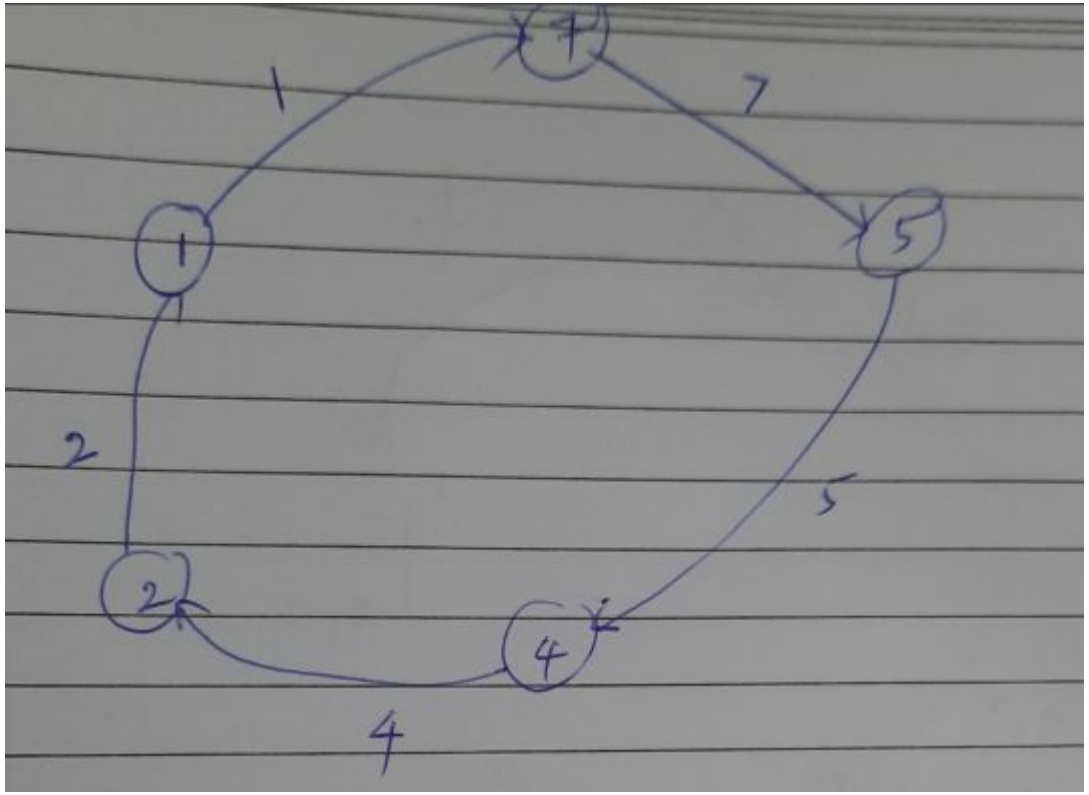
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Thank you