

Distributed Systems

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Leader Election

FloodMax algorithm (informal):

Every process maintains a record of the maximum UID it has seen so far (initially its own). At each round, each process propagates this maximum on all of its outgoing edges. After *diam* rounds, if the maximum value seen is the process's own UID, the process elects itself the leader; otherwise, it is a non-leader.

***FloodMax* algorithm (formal):**

states_i consists of components:

u, a UID, initially *i*'s UID

max-uid, a UID, initially *i*'s UID

status $\in \{\text{unknown}, \text{leader}, \text{non-leader}\}$, initially *unknown*

rounds, an integer, initially 0

msgs_i:

if *rounds* < *diam* then

 send *max-uid* to all $j \in \text{out-nbrs}$

trans_i:

rounds := *rounds* + 1

let *U* be the set of UIDs that arrive from processes in *in-nbrs*

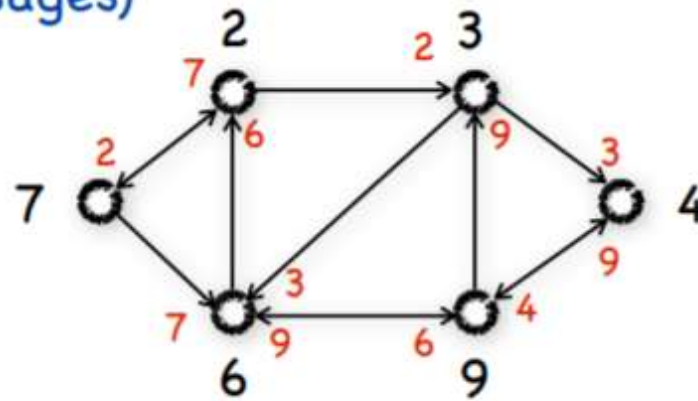
max-uid := max($\{\text{max-uid}\} \cup U$)

if *rounds* = *diam* then

 if *max-uid* = *u* then *status* := *leader*

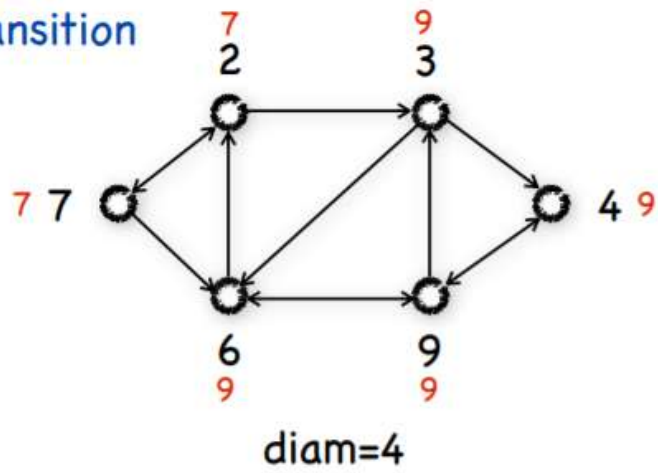
 else *status* := *non-leader*

round 1
(send messages)

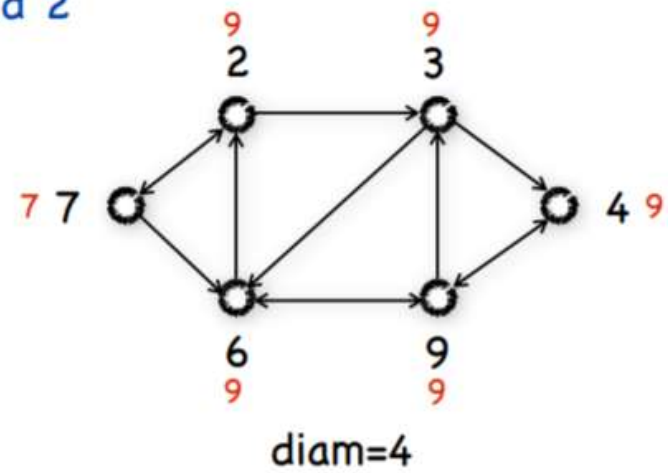


diam=4

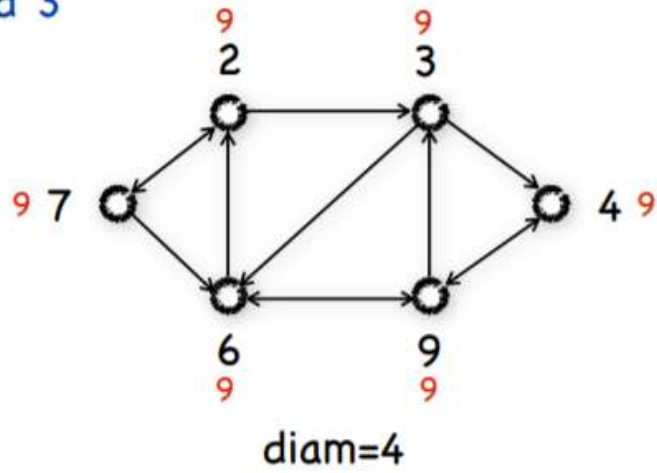
round 1
state transition



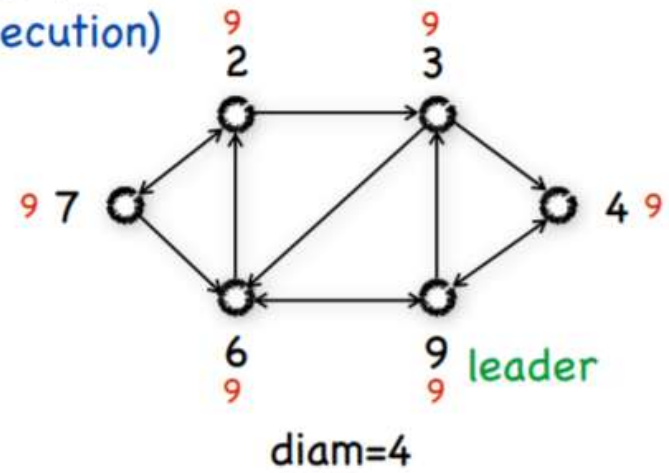
round 2



round 3



round 4
(after execution)



Complexity

Time: Diam rounds

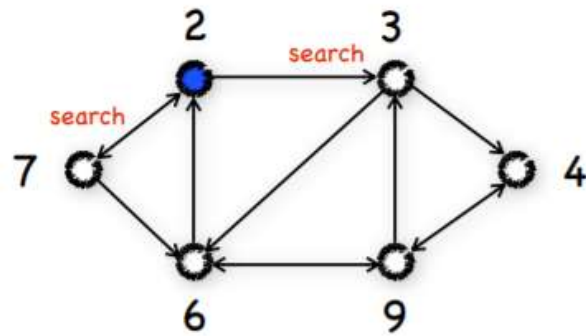
Message: diam. |E|

Breadth-First Search (BFS)

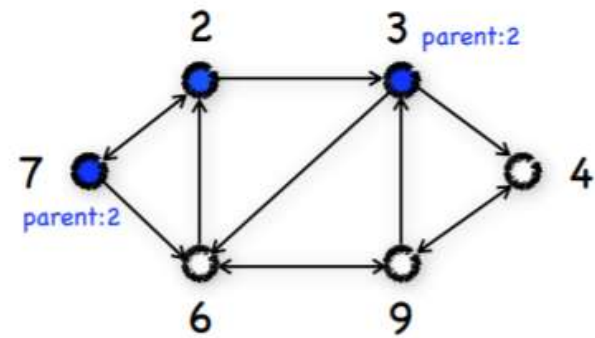
SynchBFS algorithm:

At any point during execution, there is some set of processes that is “marked,” initially just i_0 . Process i_0 sends out a *search* message at round 1, to all of its outgoing neighbors. At any round, if an unmarked process receives a *search* message, it marks itself and chooses one of the processes from which the *search* has arrived as its parent. At the first round after a process gets marked, it sends a *search* message to all of its outgoing neighbors.

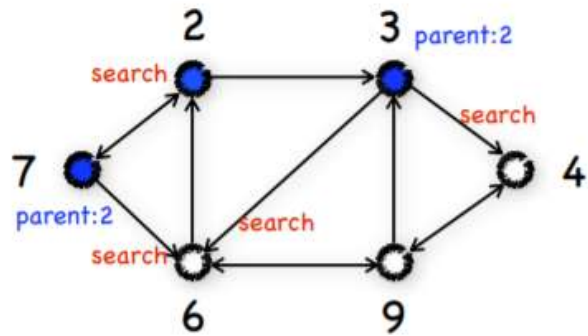
round 1



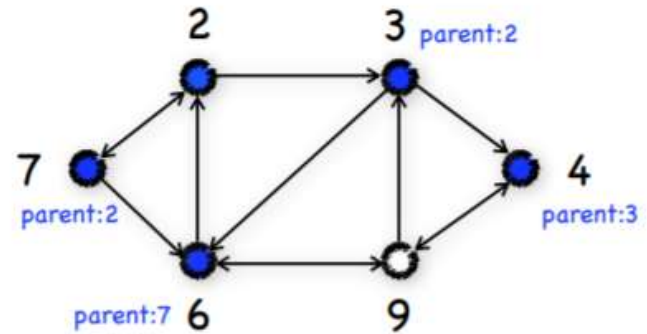
round 1



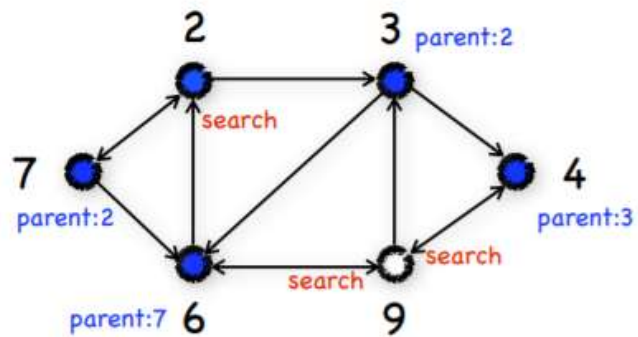
round 2



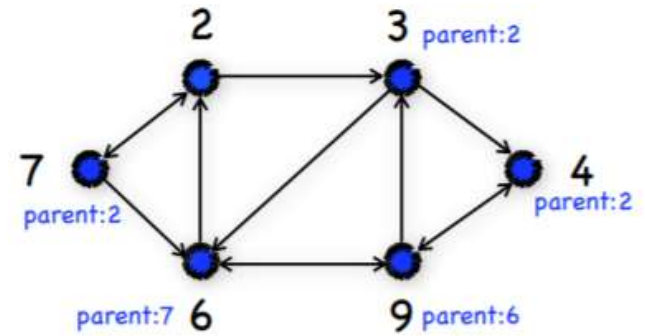
round 2



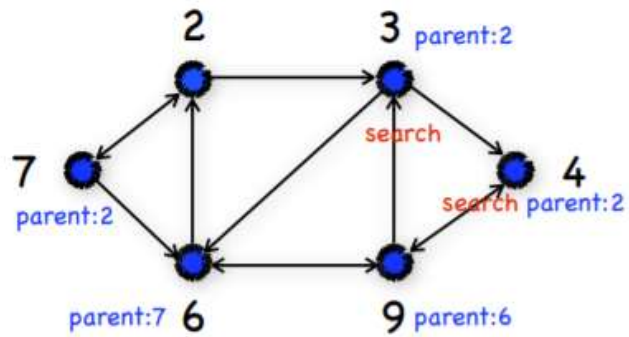
round 3



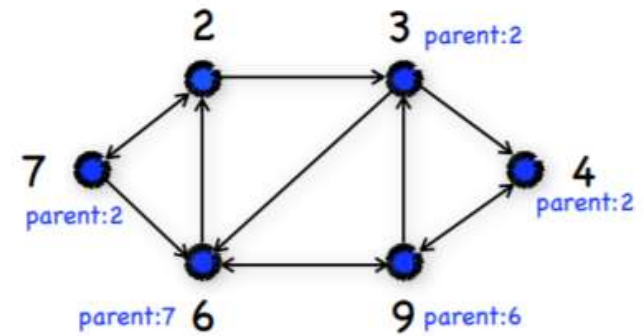
round 3



round 4



round 4



Complexity

Time: Diam rounds

Message: $|E|$