RAMA UNIVERSITY

www.ramauniversity.ac.in

FACULTY OF EGINEERING AND TECHNOLOGY

Distributed Systems (BCS-701)

LECTURE -16

Dr. Hariom Sharan
Professor & Dean
Computer Science & Engineering

OUTLINE

- Deadlock
- Fundamental Causes of Deadlock
- Deadlock Handling Strategies
-
- MCQ
- Reference

Deadlock

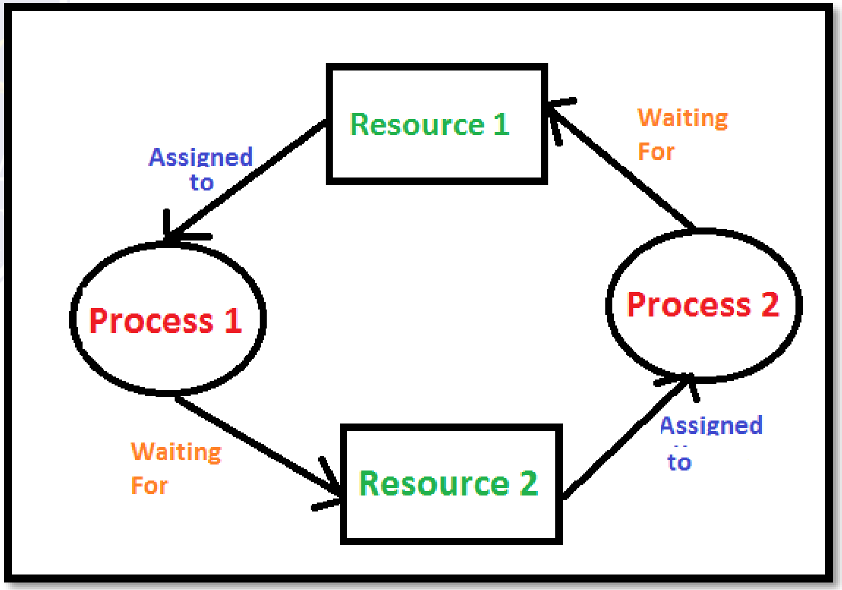
Deadlock is a situation where a set of processes are blocked because each process is holding a resource and waiting for another resource acquired by some other process.

Resource deadlock:

each process requests resources held by another process in the set and it must receive all the requested resources before it can become unblocked.

Communication deadlock:

each process is waiting for communication from another process, and will not communicate until it receives the communication for which it is waiting.



DISTRIBUTED DEADLOCK DETECTION

Fundamental Causes of Deadlock

- exclusive access
- wait while holding
- no preemption
- circular wait

All these conditions are necessary for deadlock to occur Hence, by preventing any one of these we prevent deadlock.

Deadlock Handling Strategies

- prevention
- avoidance
- detection

DISTRIBUTED DEADLOCK DETECTION

System Model

- The systems have only reusable resources.
- Processes are allowed only exclusive access to resources.
- There is only one copy of each resource.

Distributed Deadlock Models

Based on WFG (not GRG)

- Nodes are processes
- Resources are located at a site, but may be held by processes at other sites
- Edge (P,Q) indicates P is blocked and waiting for Q to release some resource
- Deadlock exists if there is a directed cycle or knot.

DISTRIBUTED DEADLOCK DETECTION

Distributed Deadlock Handling Strategies

Deadlock prevention

- All resource at once.
- Preventing a process from holding while waiting
- inefficient, can become deadlocked at resource acquiring phase, resource requirements are unpredictable -- not an efficient, universal solution.

Deadlock avoidance

- A resource is granted to a process if the resulting state is safe
- Every site has to maintain the global state
- The checking for a safe state must be done with mutual exclusion
- The number of processes and resources in a distributed system is large
- Not a practical solution

Deadlock detection

- Once deadlock, always deadlock -- detection won't be outdated
- deadlock detection can be preceed concurrently with normal activities
- This is the usual approach

DISTRIBUTED DEADLOCK DETECTION

Distributed Deadlock Detection Issues

issues

- maintenance of WFG
- detection of cycles (or knots) in the WFG

requirements

- progress = no undetected deadlocks
- safety = no false deadlocks

Categorization of Methods

- centralized control
- distributed control
- hierarchical control

DISTRIBUTED DEADLOCK DETECTION

Classification of Distributed Detection Algorithms

path-pushing

- path information transmitted, accumulated

edge-chasing

- ``I'm waiting for you'' probes are sent along edges
- single returned probe indicates a cycle

diffusion

- ``Are you blocked?'' probes are sent along all edges
- all queries returned indicates a cycle

global state detection

- take and use snapshot of system state

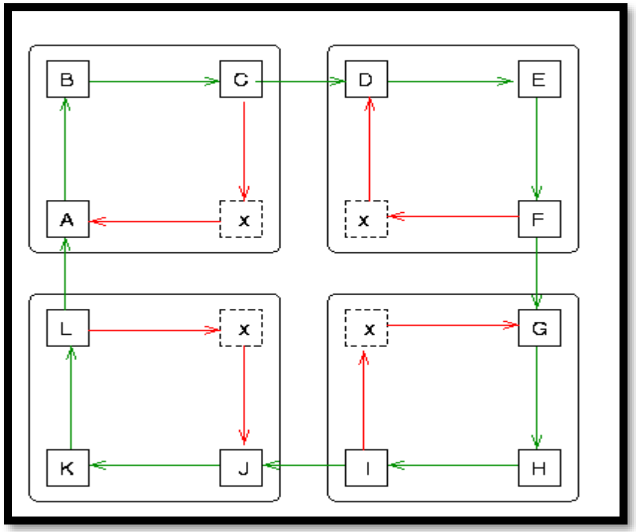
Obermarck's Path-Pushing Algorithm

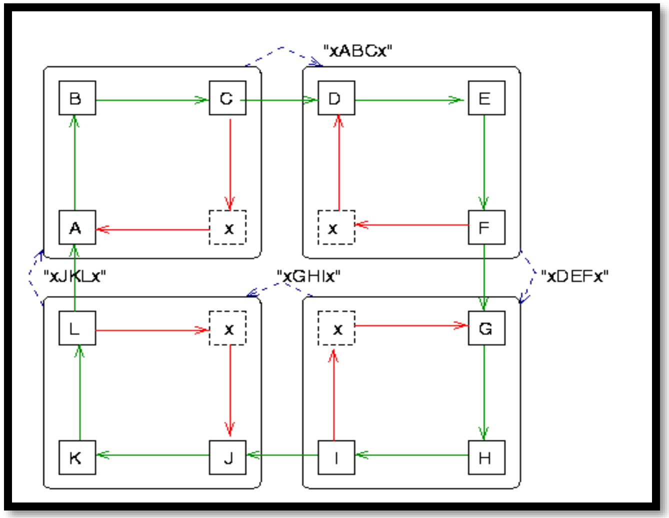
- designed for distributed database systems
- processes are called ``transactions'' T1, T2, …………Tn
- there is special virtual node *Ex*
- transactions are totally ordered

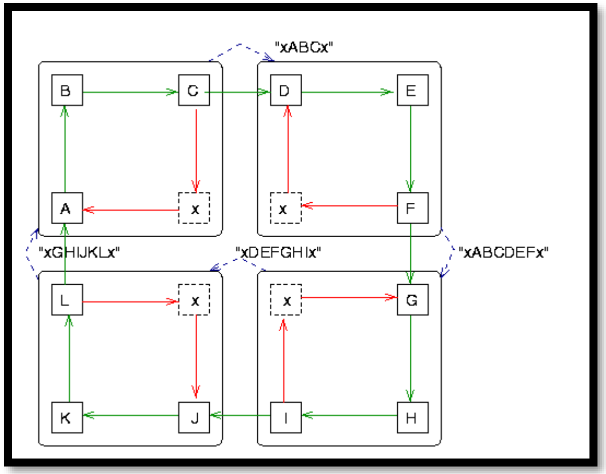
Obermarck's Path-Pushing Algorithm

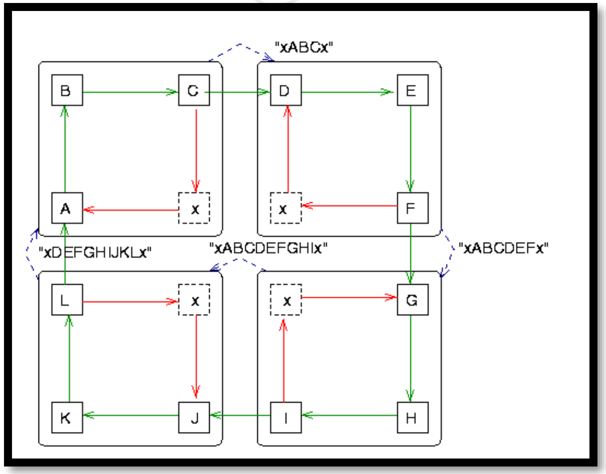
1. wait for info from previous iteration of Step 3
2. combine received info with local TWFG
    - detect all cycles
    - break local cycles
3. send each cycle including the node *Ex* to the external nodes it is waiting for
4. time-saver: only send path to other sites if last transaction is higher in lexical order than the first

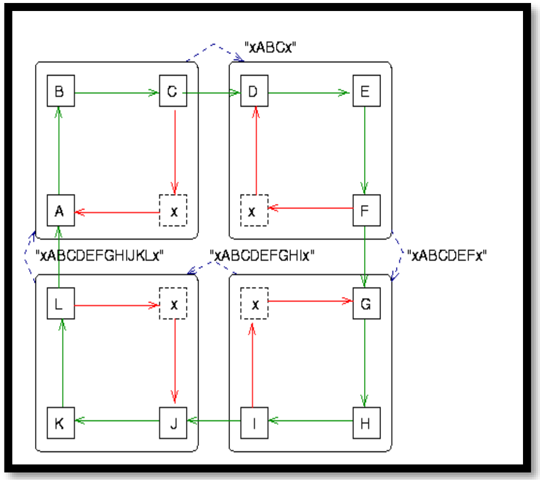
Obermarck's Path-Pushing Algorithm











Problems with Obermarck's Path-Pushing Algorithm

- Detects false deadlocks, due to asynchronous snapshots at different sites.
- Message complexity? Message size? Detection delay?
- Exactly how are paths combined and checked?

Obermarck's Path-Pushing Algorithm: Performance

- O(n(n-1)/2) messages
- O(n) message size
- O(n) delay to detect deadlock

DISTRIBUTED DEADLOCK DETECTION

Chandy-Misra-Haas Edge-Chasing Algorithm

- for AND request model
- probe= (i,j,k) is sent for detection initiated by Pi, by site of Pj to site of Pk
- deadlock is detected when a probe returns to its initiator

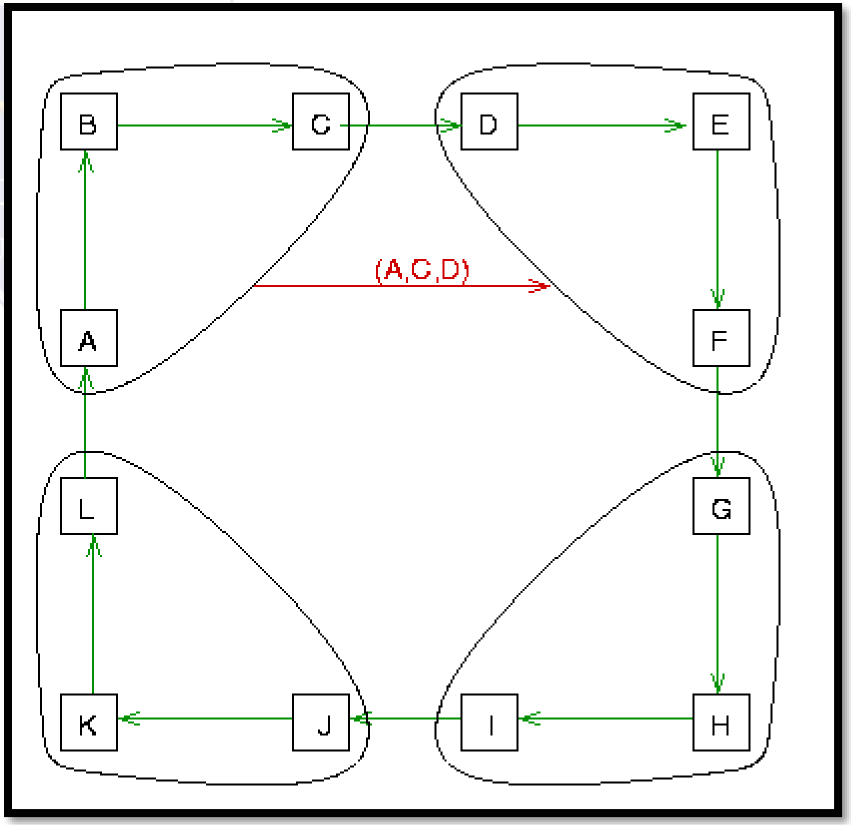
Terminology

- Pj is dependent on Pk if there is a sequence Pj,Pi1,Pi2,…….Pim, Pk such that each process except Pk is blocked and each process except the first holds a resource for which the previous process is waiting
- Pj is locally dependent on Pk if it is dependent and both processes are at the same site
- array dependent i(j) = true Û Pi knows that Pj is dependent on it

Algorithm Initiation by Pi

if Pi is locally dependent on itself then declare a deadlock else send probe (i, j, k) to home site of Pk for each j, k such that all of the following hold

- Pi is locally dependent on Pj
- Pj is waiting on Pk
- Pj and Pk are on different sites



DISTRIBUTED DEADLOCK DETECTION

Algorithm on receipt of probe (i,j,k)

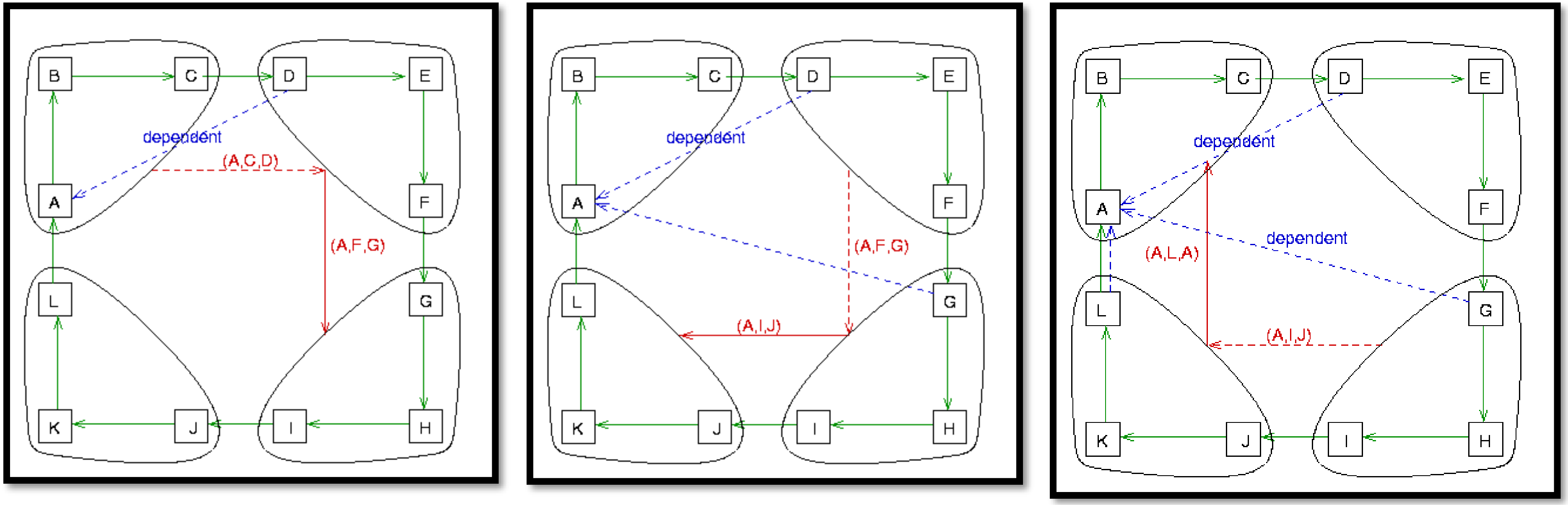
check the following conditions

- Pk is blocked
- Dependent k(i) = false
- Pk has not replied to all requests of Pj

if these are all true, do the following

- set dependentk(i) = true
- if k=i declare that Pi is deadlocked
- else send probe (i,m,n) to the home site of Pn for every m and n such that the following all hold
  - Pk is locally dependent on Pm
  - Pm is waiting on Pn
  - Pm and Pn are on different sites

Algorithm on receipt of probe (i,j,k)



DISTRIBUTED DEADLOCK DETECTION

Algorithm on receipt of probe (i,j,k)

Chandy Misra Haas Complexity

- m(n-1)/2 messages for m processes at n sites in the book, is this right?
- 3-word message length
- O(n) delay to detect deadlock

MCQ

1. What is the access point (AP) in a wireless LAN?

a) device that allows wireless devices to connect to a wired network

b) wireless devices itself

c) both device that allows wireless devices to connect to a wired network and wireless devices itself

d) all the nodes in the network

2. In wireless ad-hoc network _________

a) access point is not required

b) access point is must

c) nodes are not required

d) all nodes are access points

3. Which multiple access technique is used by IEEE 802.11 standard for wireless LAN?

a) CDMA

b) CSMA/CA

c) ALOHA

d) CSMA/CD

4. In wireless distribution system __________

a) multiple access point are inter-connected with each other

b) there is no access point

c) only one access point exists

d) access points are not required

5. A wireless network interface controller can work in _______

a) infrastructure mode

b) ad-hoc mode

c) both infrastructure mode and ad-hoc mode

d) WDS mode

REFERENCES

- http://cs-www.cs.yale.edu/homes/aspnes/classes/465/notes.pdf
- https://www.geeksforgeeks.org/mutual-exclusion-in-distributed-system/
- https://www.vidyarthiplus.com/vp/attachment.php?aid=43022
- http://www.cs.fsu.edu/~xyuan/cop5611/lecture9.html
- http://www.cs.fsu.edu/~xyuan/cop5611/lecture10.html