Classification of Algorithms

Distinctive Characteristics

1

Important Definitions

- Correctness: The correctness for an algorithm in a distributed system is defined on two different metrics.
  - Liveness: The right must eventually occur
  - Safety: The wrong must not occur
- An algorithm is correct if and only it ensures both liveness and safety.

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Fairness

- Fairness property generally means that the processes are executed in the order of their arrival in the system
- Each process gets a fair chance to execute the CS.
- Does fairness cause priority inversion?

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Common Performance Metrics

- Message complexity: The number of control messages required to be exchanged per execution of an algorithm
- Synchronization delay: The time required between two successive executions
  - e.g., it is the time required between a process leaves its CS and the next one enters its CS.

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Common Performance Metrics

- Response time: The time interval that a request waits before the result is computed
- Throughput: The rate at which the algorithms are executed.
  - Throughput = 1/(SD+E)

    where SD is the synchronization delay and E is the average execution time.

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Four Major Classes

- Symmetric algorithms
- Diffusion Computation based algorithms
- Token based algorithms
- Edge Chasing algorithms

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Four Major Classes

- Symmetric algorithms
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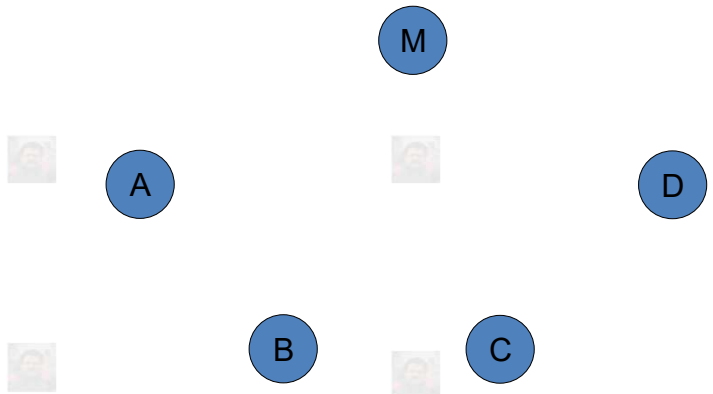
Symmetric Algorithms



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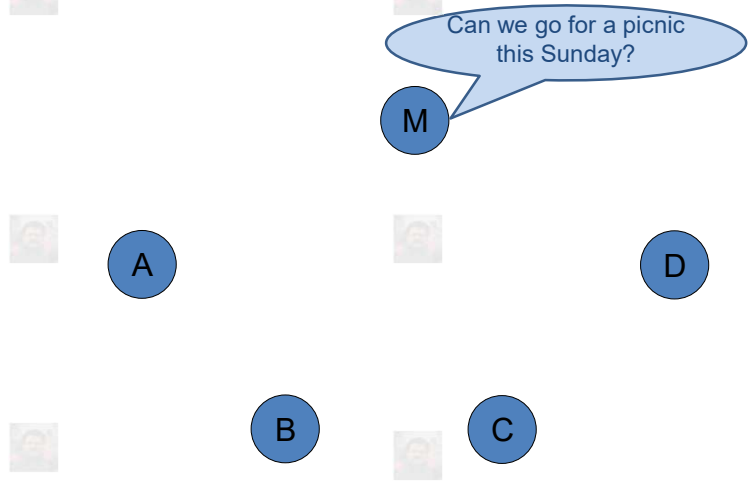
Symmetric Algorithms



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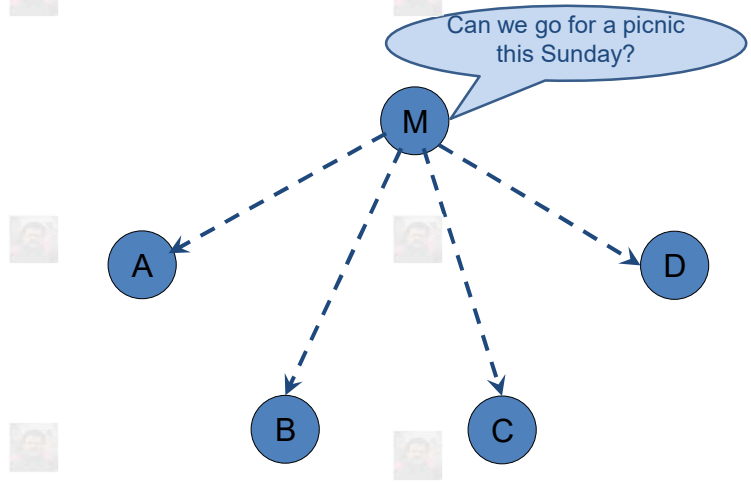
Symmetric Algorithms



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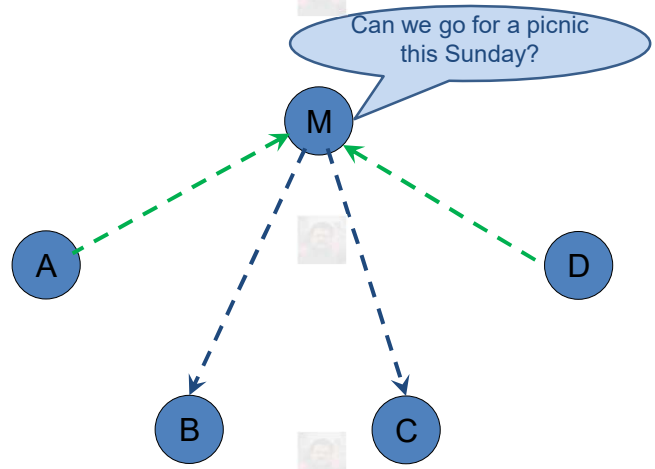
Symmetric Algorithms



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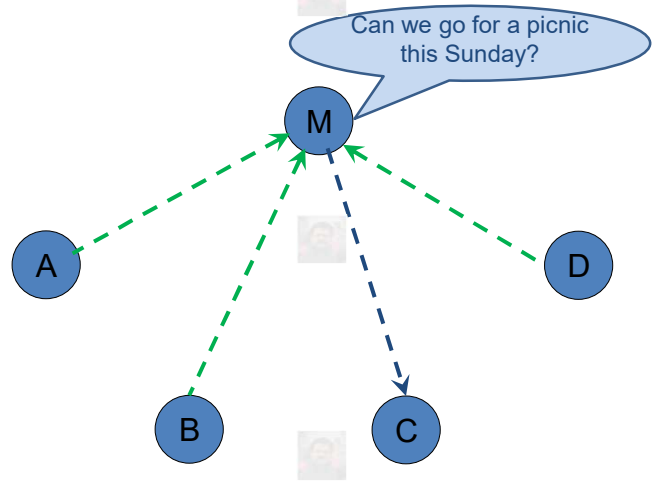
Symmetric Algorithms



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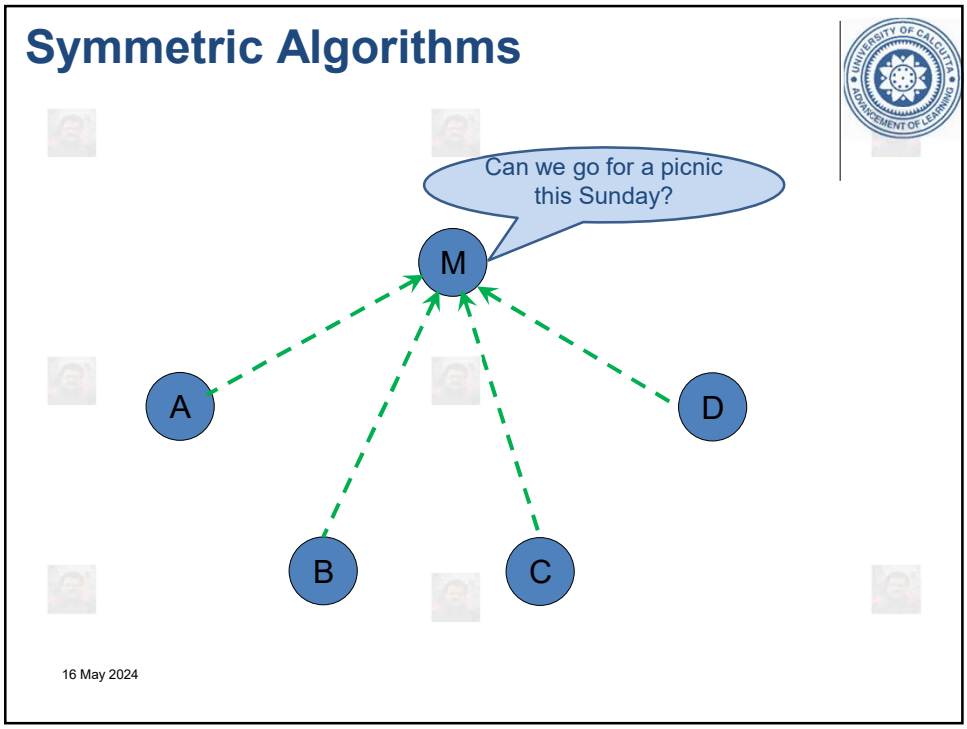
Symmetric Algorithms
Can we go for a picnic this Sunday?
M
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B
C
D
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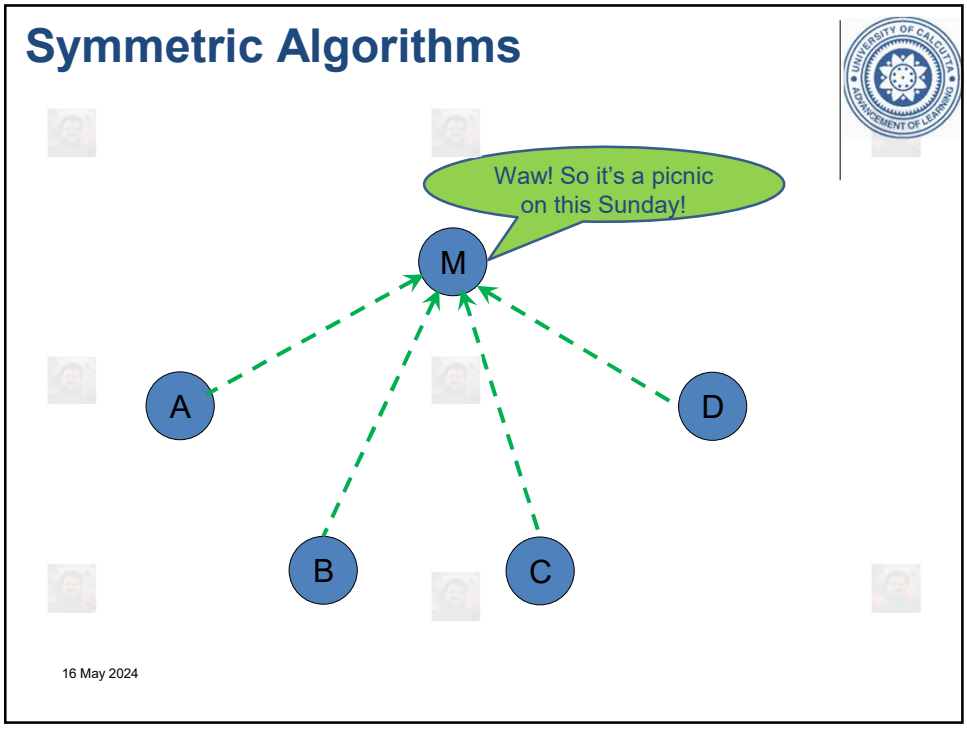
Symmetric Algorithms
Waw! So it's a picnic on this Sunday!
M
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B
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D
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Symmetric Algorithms

- Decisions are taken collectively and based on mutual consent
- Simple to understand, design and implement
- Large number of messages are exchanged between the participating processes

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Four Major Classes

- Symmetric algorithms
- Diffusion Computation based algorithms
- Token based algorithms
- Edge Chasing algorithms

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Diffusion Computation Algorithms

Image courtesy: Fine Art America

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Diffusion Computation Algorithms

- Just like salt diffuses in water, the computing problem starts spreading from an INITIATOR node
- Growth Phase
- Shrinking Phase

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Diffusion Computation Algorithms

- Engaging queries
  - Engaging replies
- Non-engaging queries
  - Non-engaging replies

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Diffusion Computation Algorithms

- Partial results are queued in a node, till all the sub-tasks are done
- Lower message complexity as compared to symmetric algorithms
- Fault tolerant

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A scenario…

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Image courtesy: The New York Times

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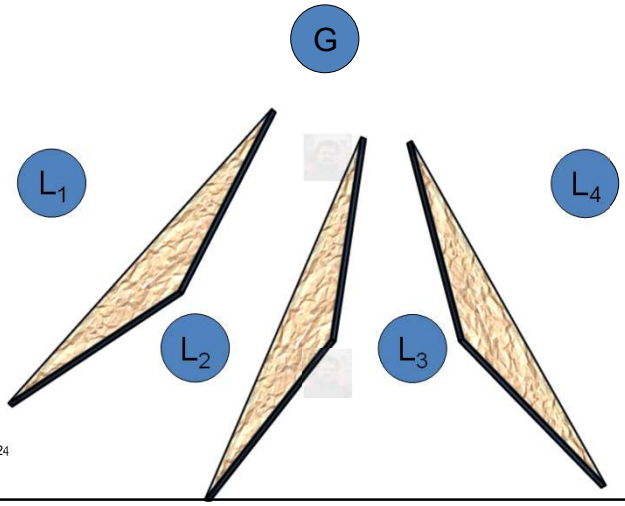
Diffusion Computation Algorithms



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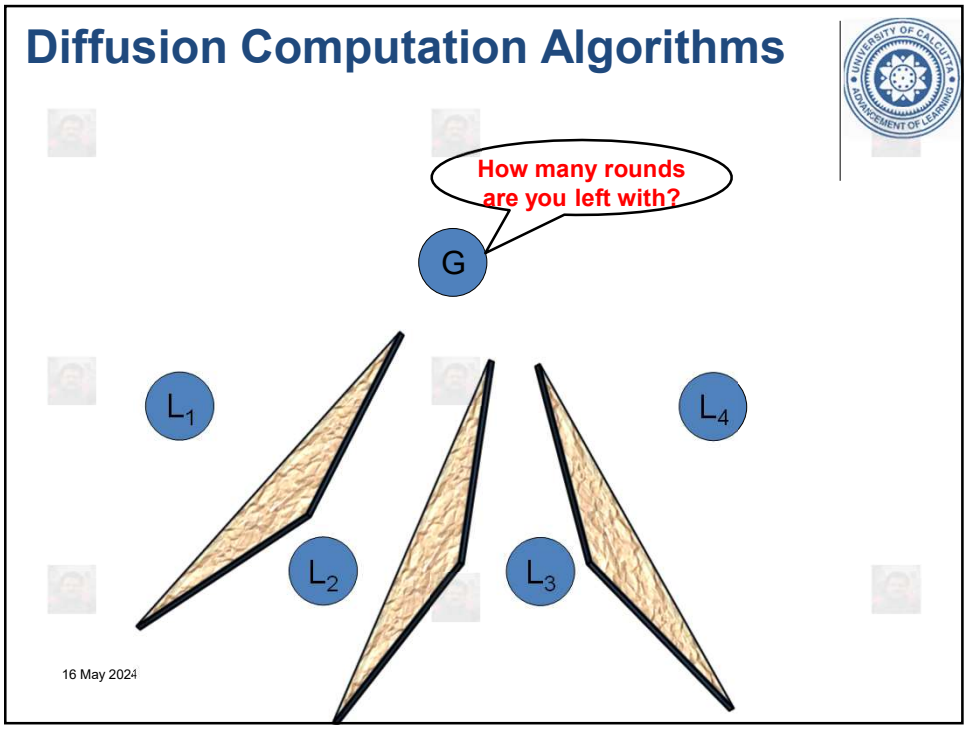
Diffusion Computation Algorithms



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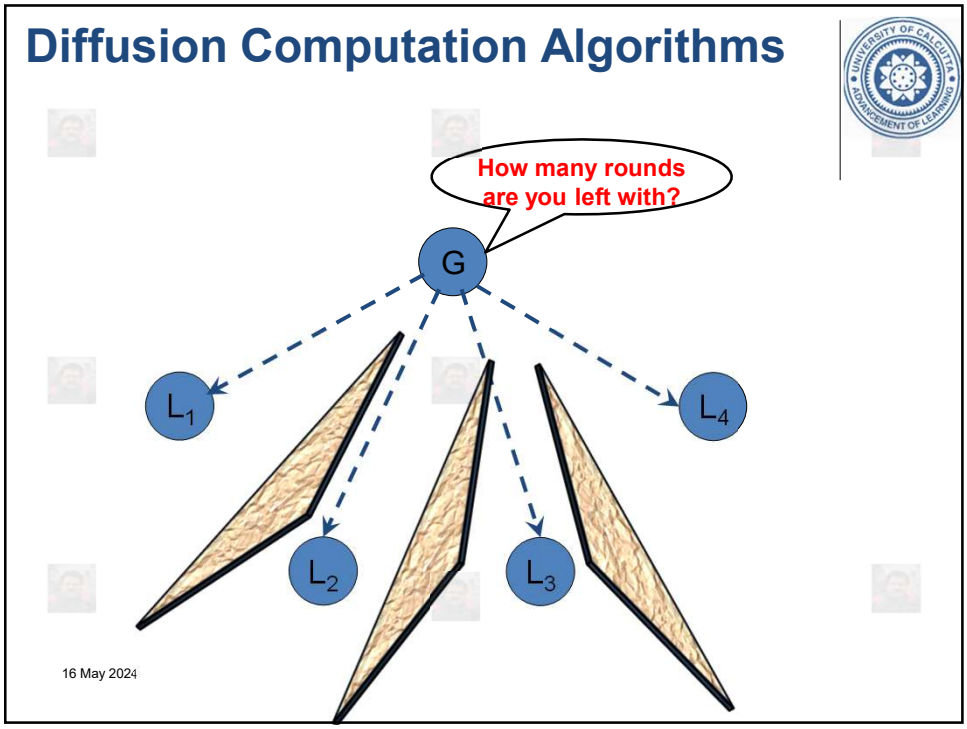
Diffusion Computation Algorithms



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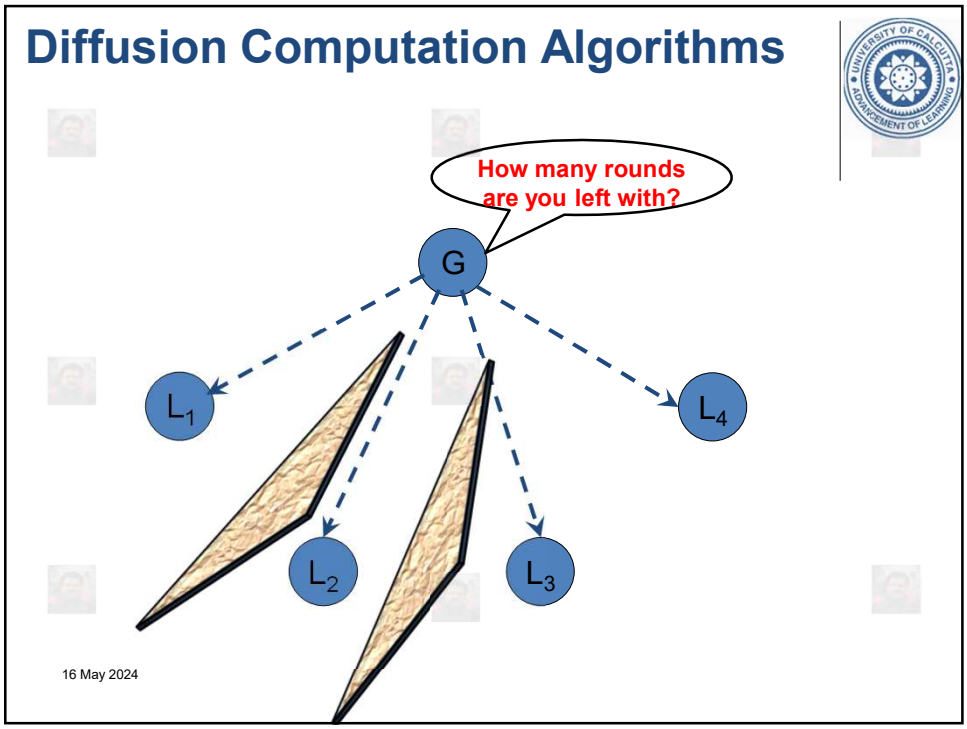
Diffusion Computation Algorithms
How many rounds are you left with?
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L1
L2
L3
L4
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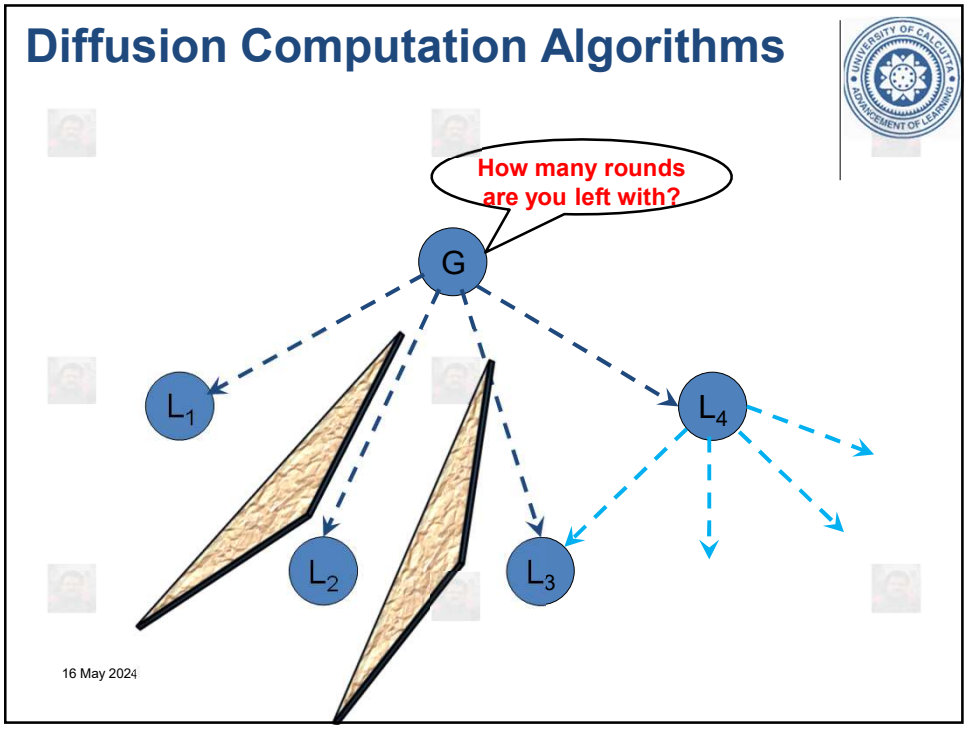
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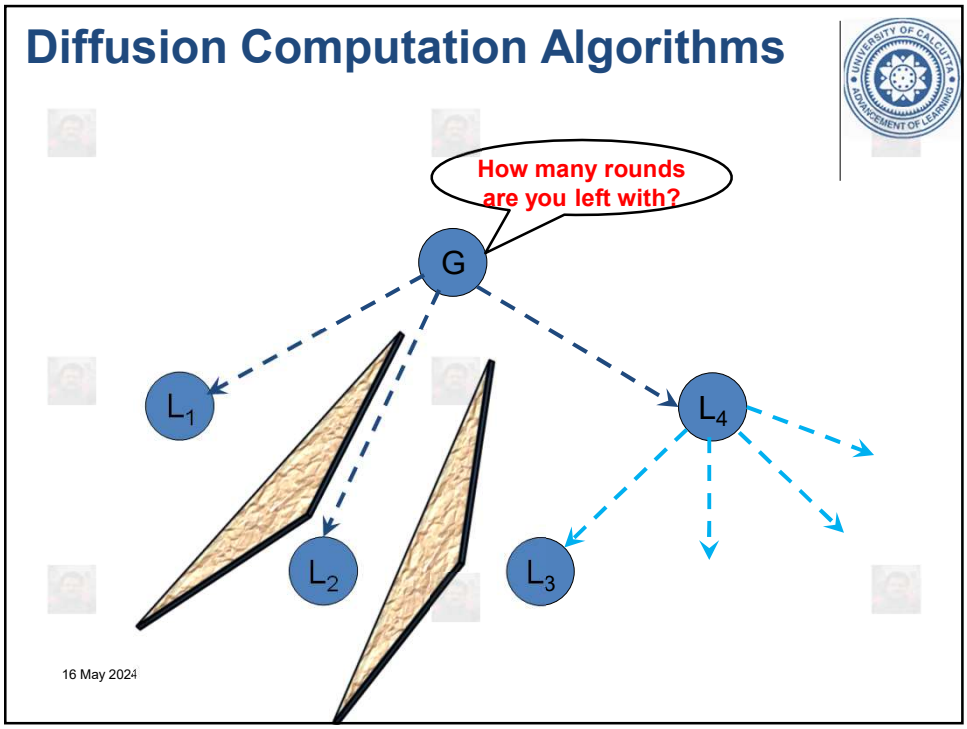
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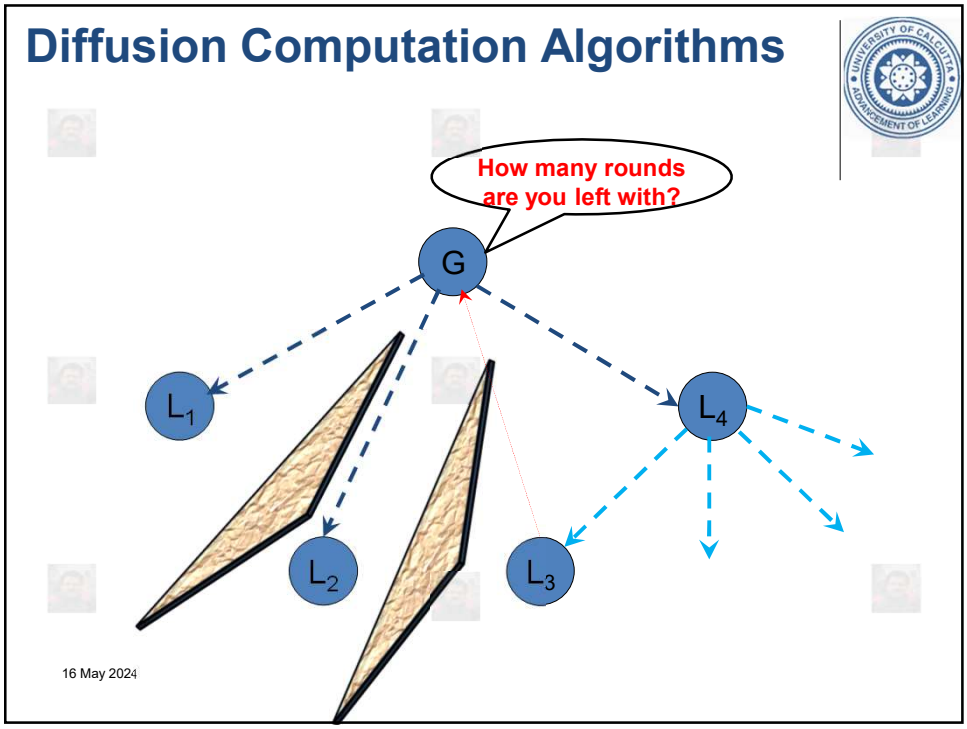
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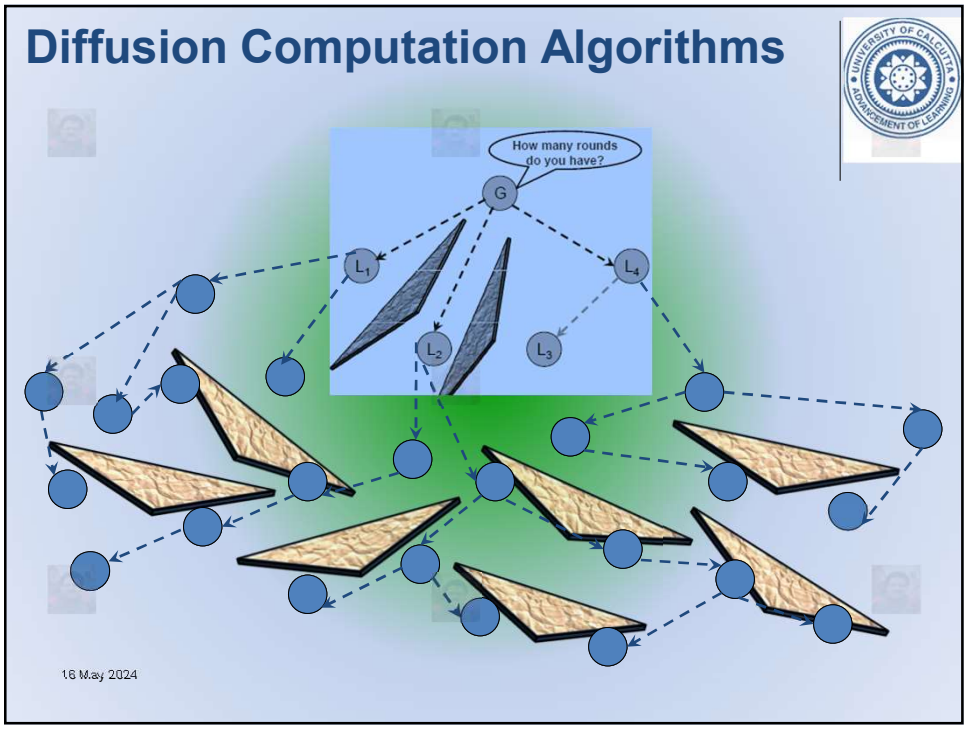
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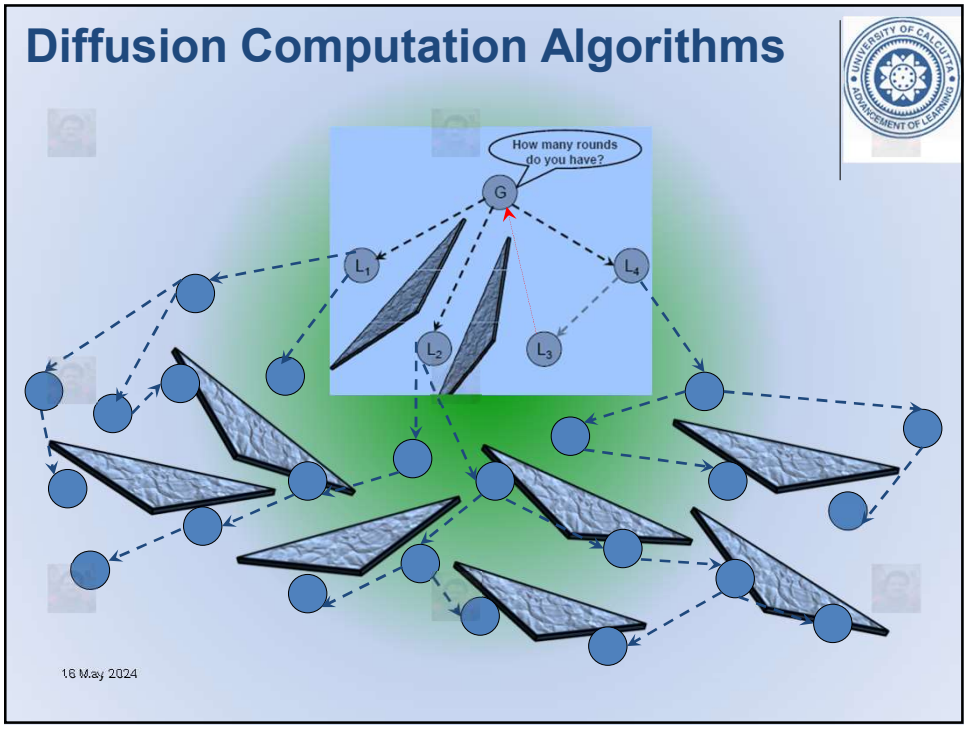
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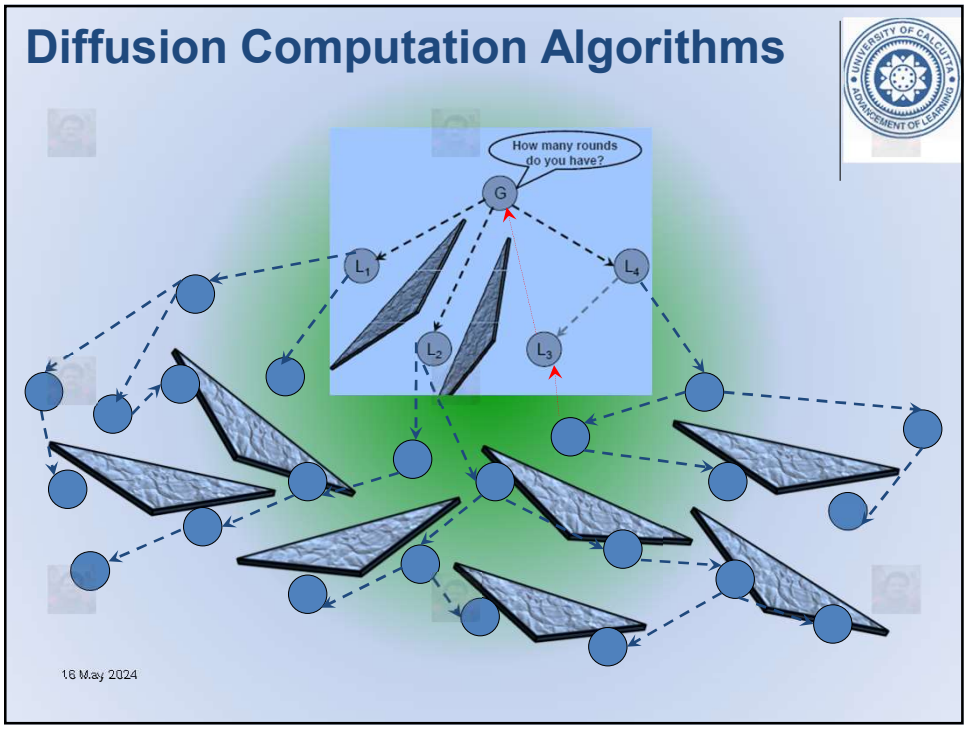
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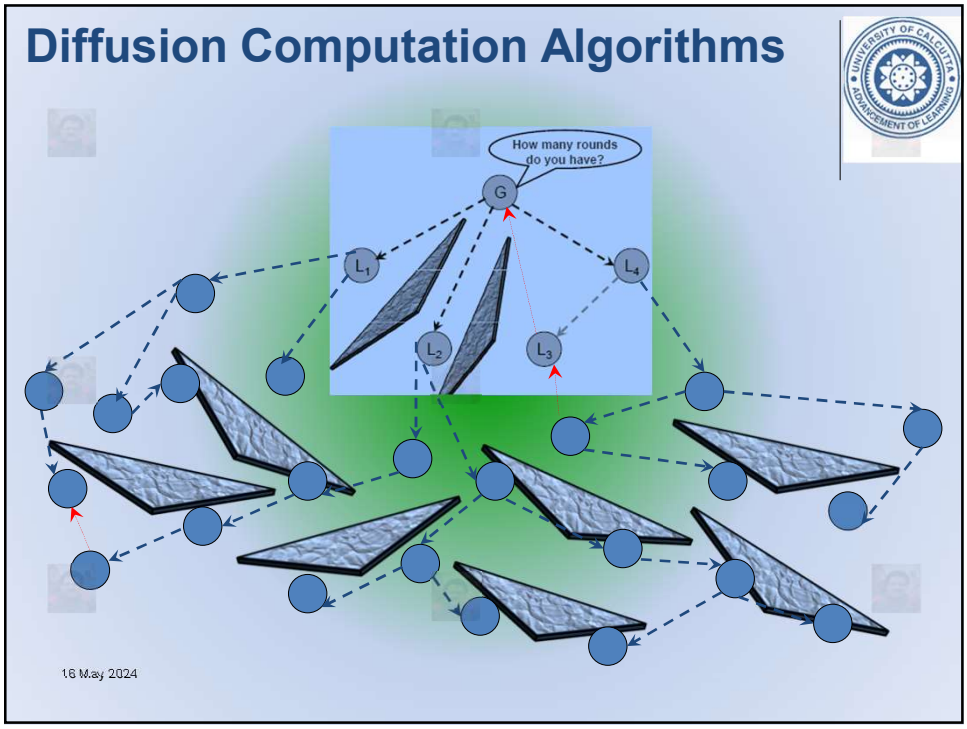
Diffusion Computation Algorithms
How many rounds do you have?
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Diffusion Computation Algorithms

- Process that diffuse a query never knows whether the communication will be an engaging or non-engaging query for the recipient
- Recipient decides whether the diffusion is to continue
- A hierarchy evolves dynamically for a particular execution

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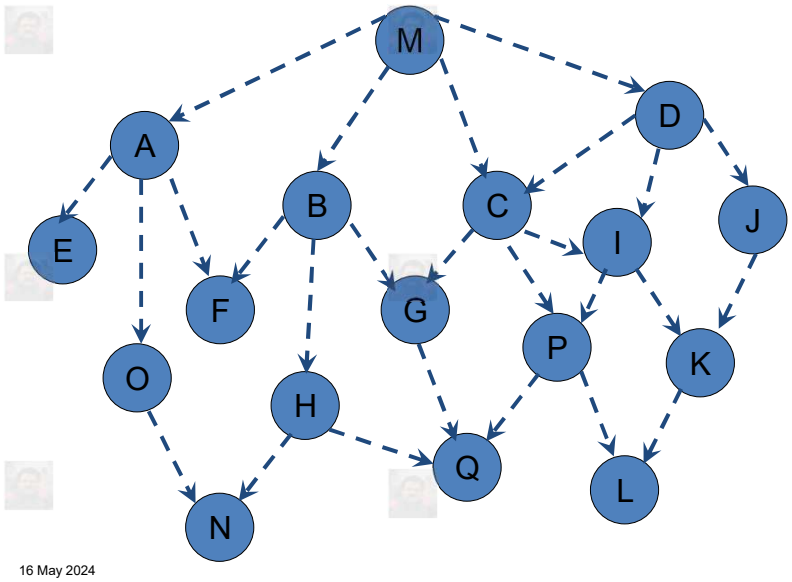
Diffusion Computation Algorithms



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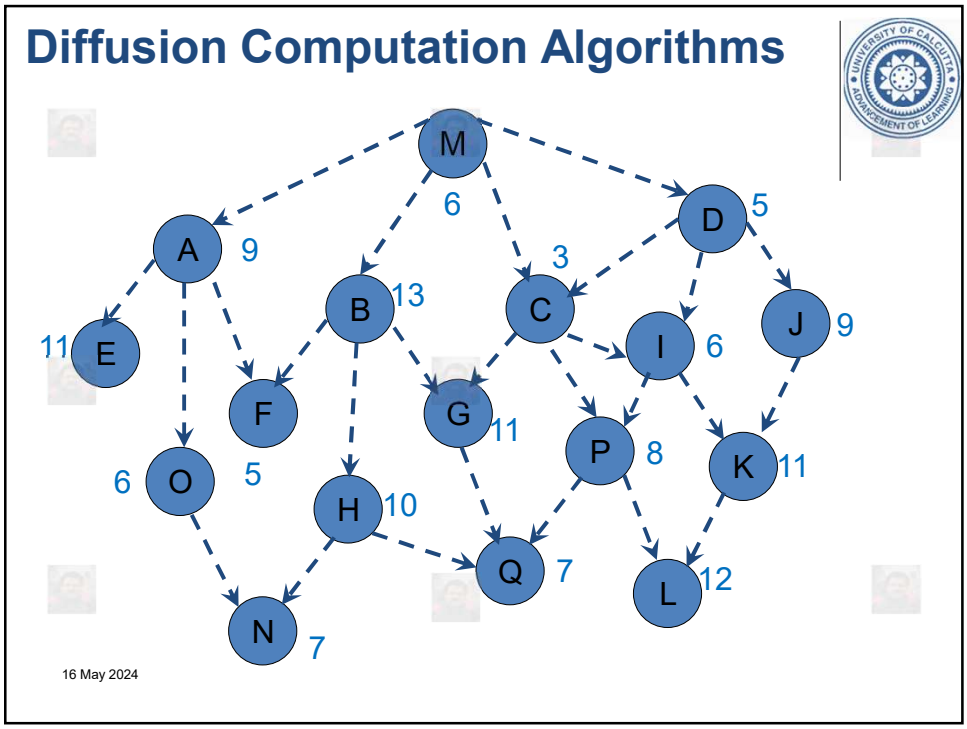
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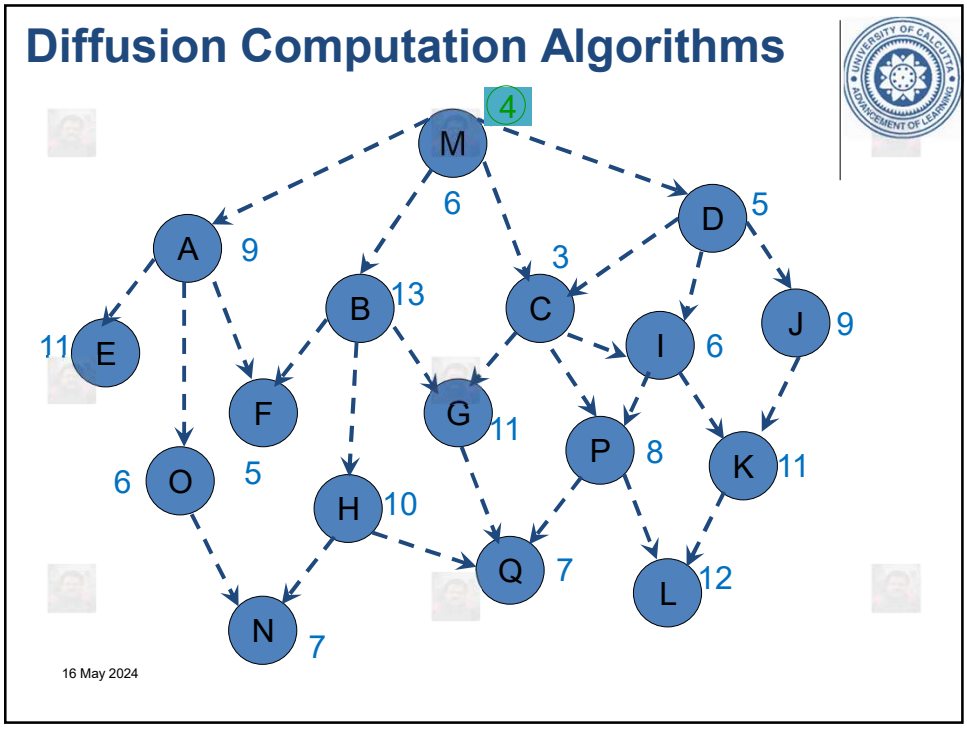
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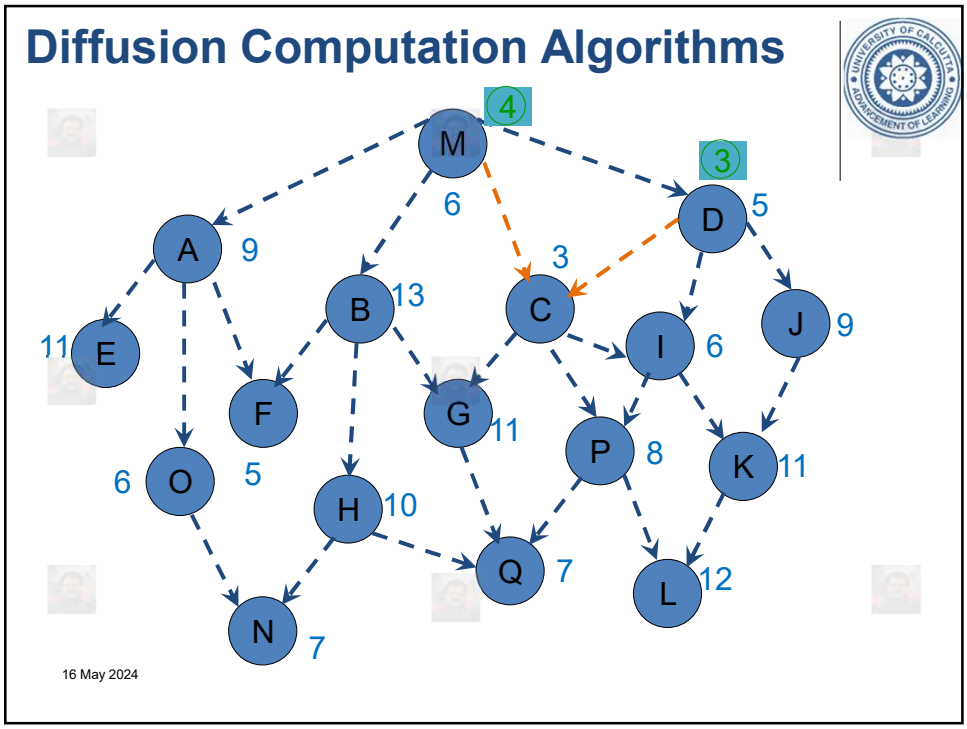
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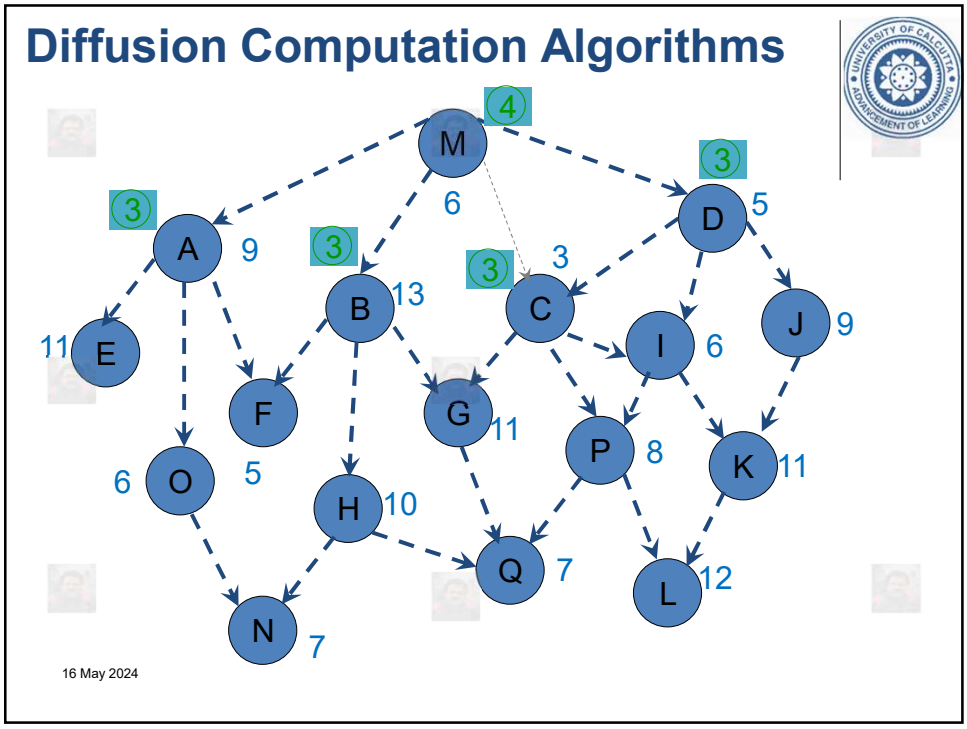
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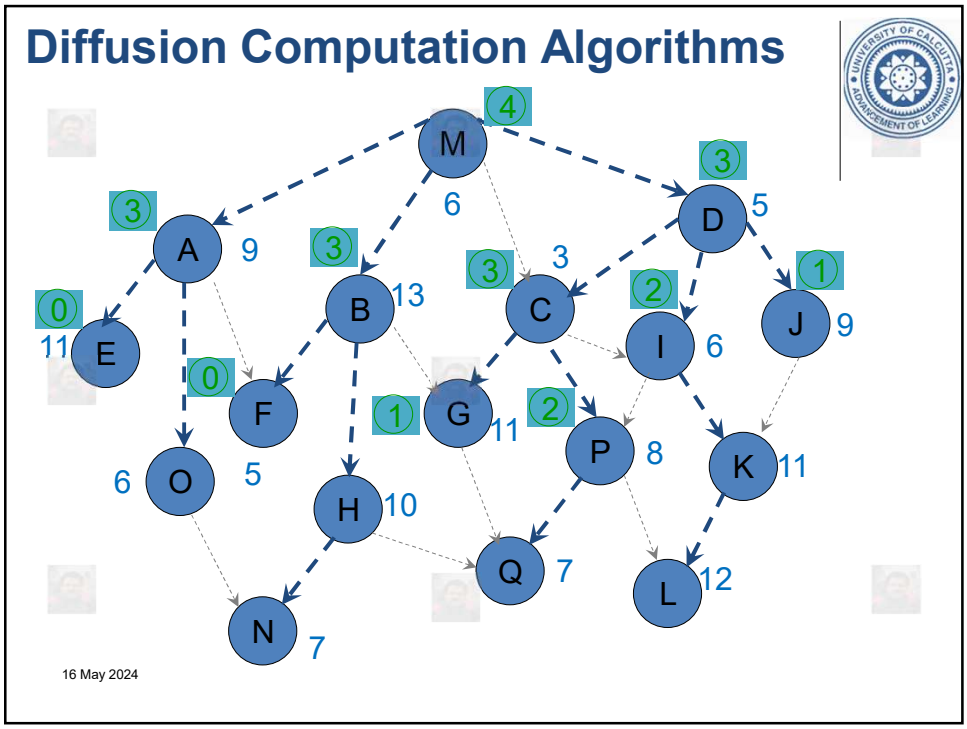
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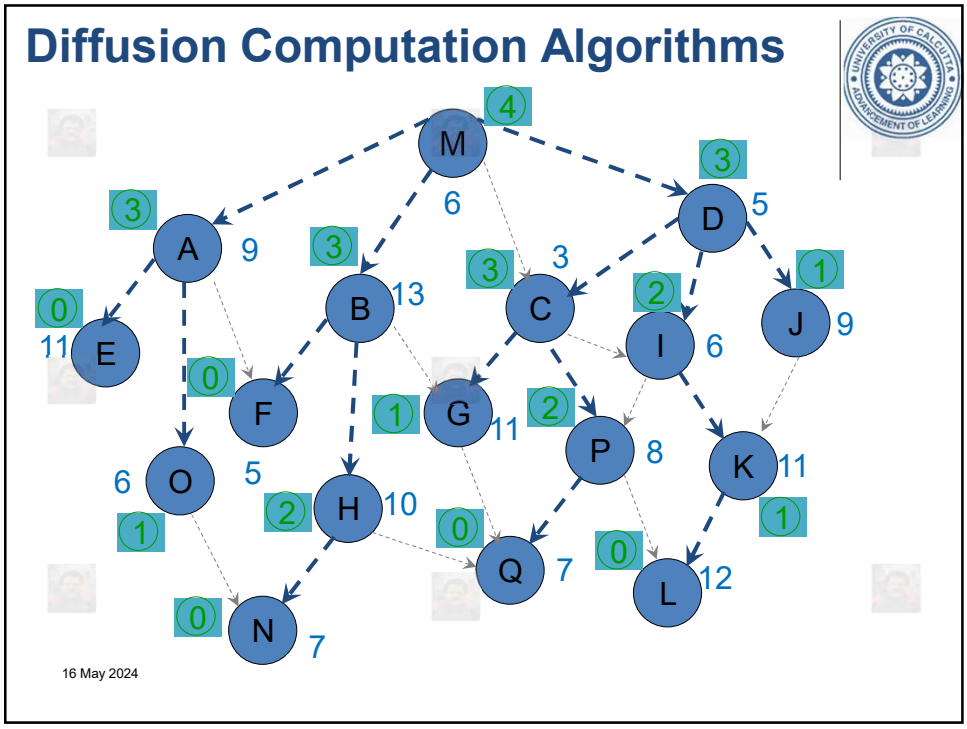
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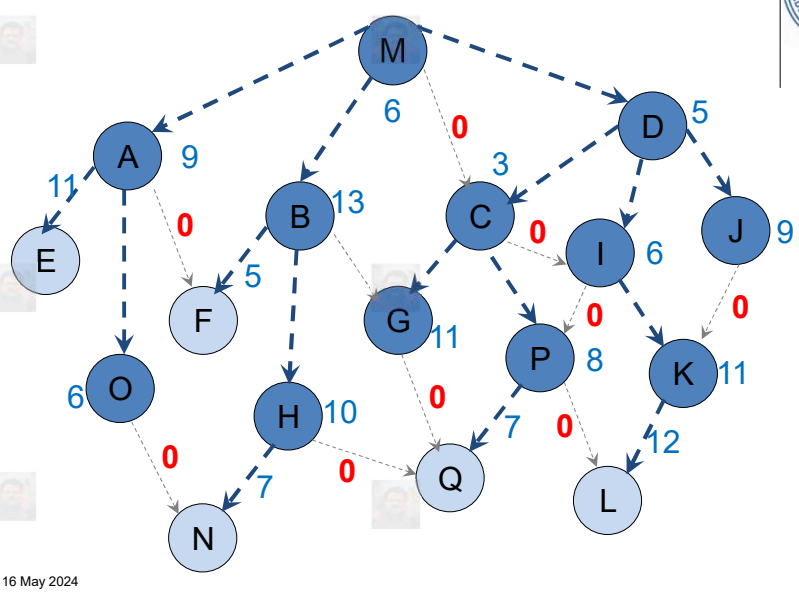
Diffusion Computation Algorithms



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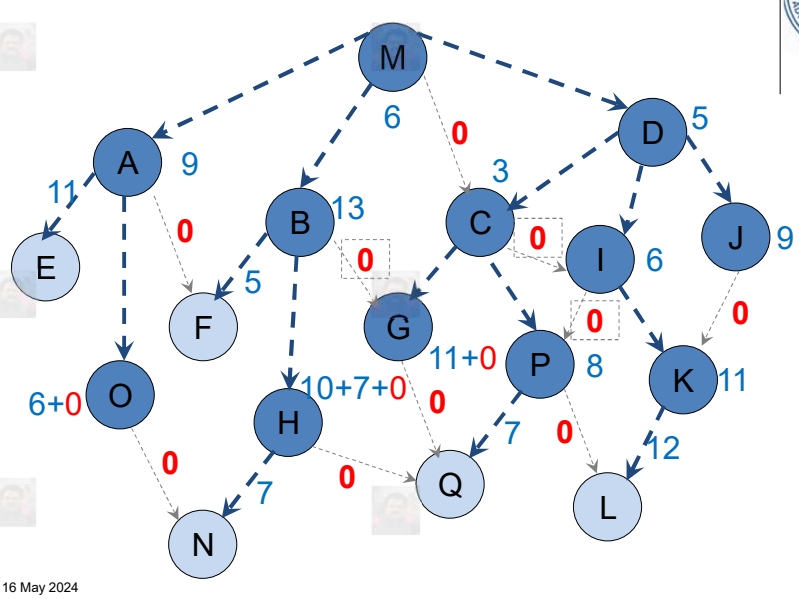
Diffusion Computation Algorithms



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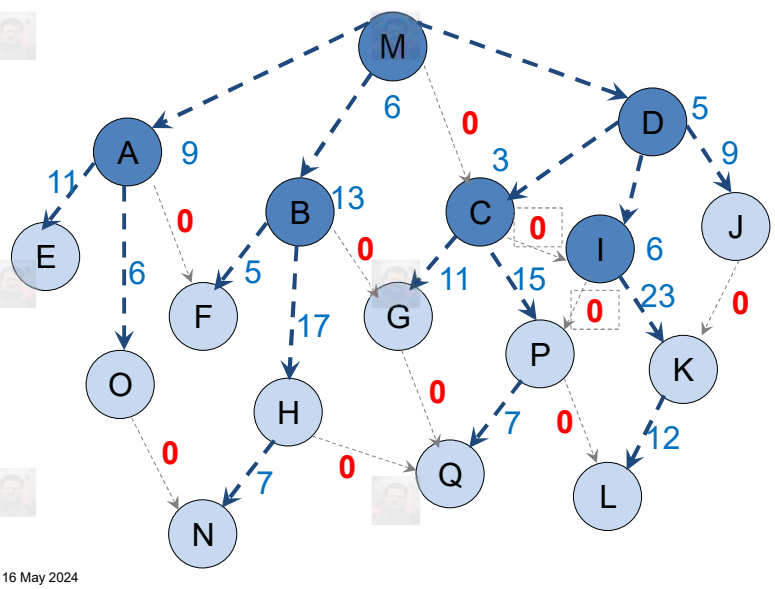
Diffusion Computation Algorithms



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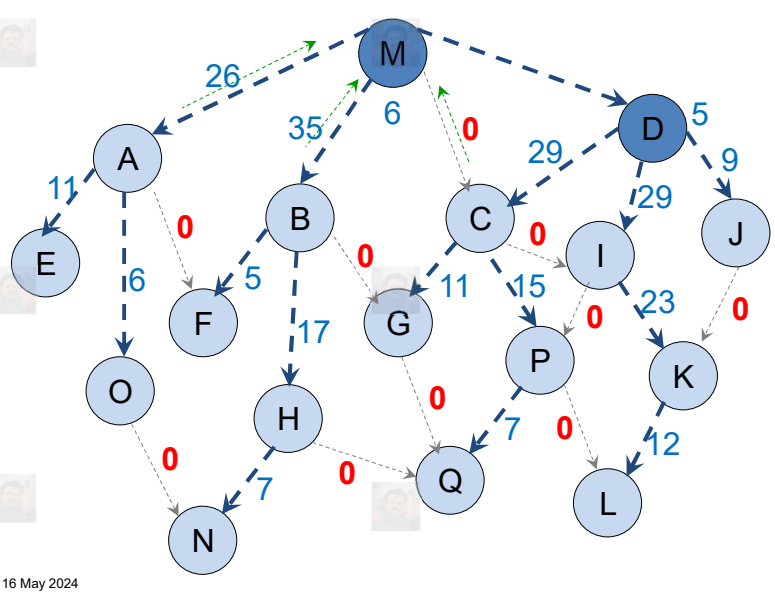
Diffusion Computation Algorithms



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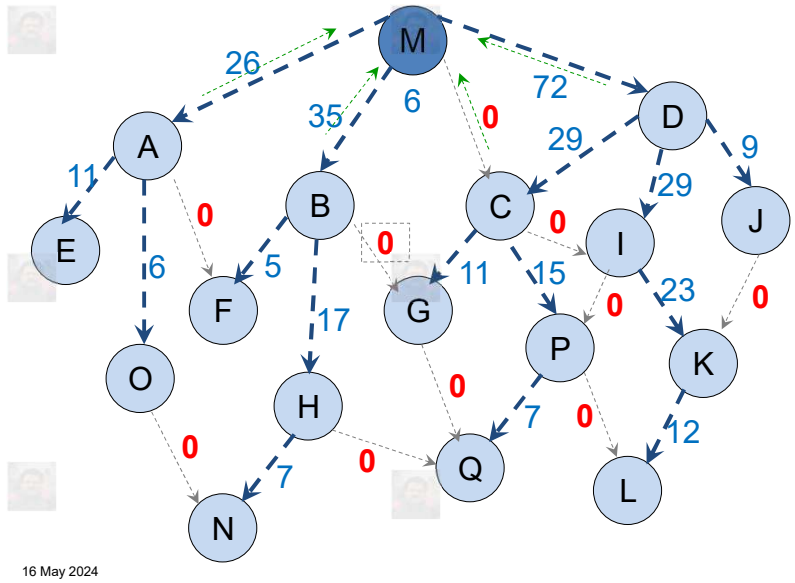
Diffusion Computation Algorithms



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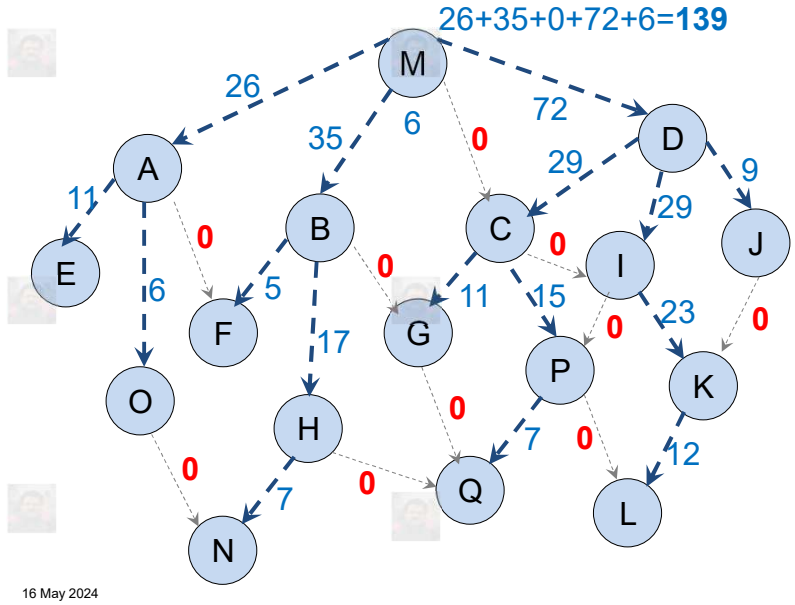
Diffusion Computation Algorithms



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Four Major Classes

- Symmetric algorithms
- Diffusion Computation based algorithms
- Token based algorithms
- Edge Chasing algorithms

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Token-based Algorithms

- There will be a token for each instance of resource
- Algorithm is to be designed to get hold of the token in order to access the resource
- Predominantly used for scheduling, mutual exclusion

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Token-based Algorithms - Correctness

- A token-based algorithm is inherently safe as long as a single token exists for each instance of a resource under contention
- Thus, a token-based algorithm is correct if its liveness is ensured.

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Four Major Classes

- Symmetric algorithms
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Edge Chasing Algorithms

- Edge-chasing is a technique, often used for deadlock detection in distributed systems.
- When a process, say P, is blocked for some resource held by another process, say Q, a probe message is sent to all processes in the wait for graph with P as the start node

Edge Chasing Algorithms

- Non-blocked processes will discard the probe.
- If the probe returns to process P, a circular wait is detected along with the processes in the cycle.
- Intuitive and limited scope of applications

Thanks for your kind attention

Questions??

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