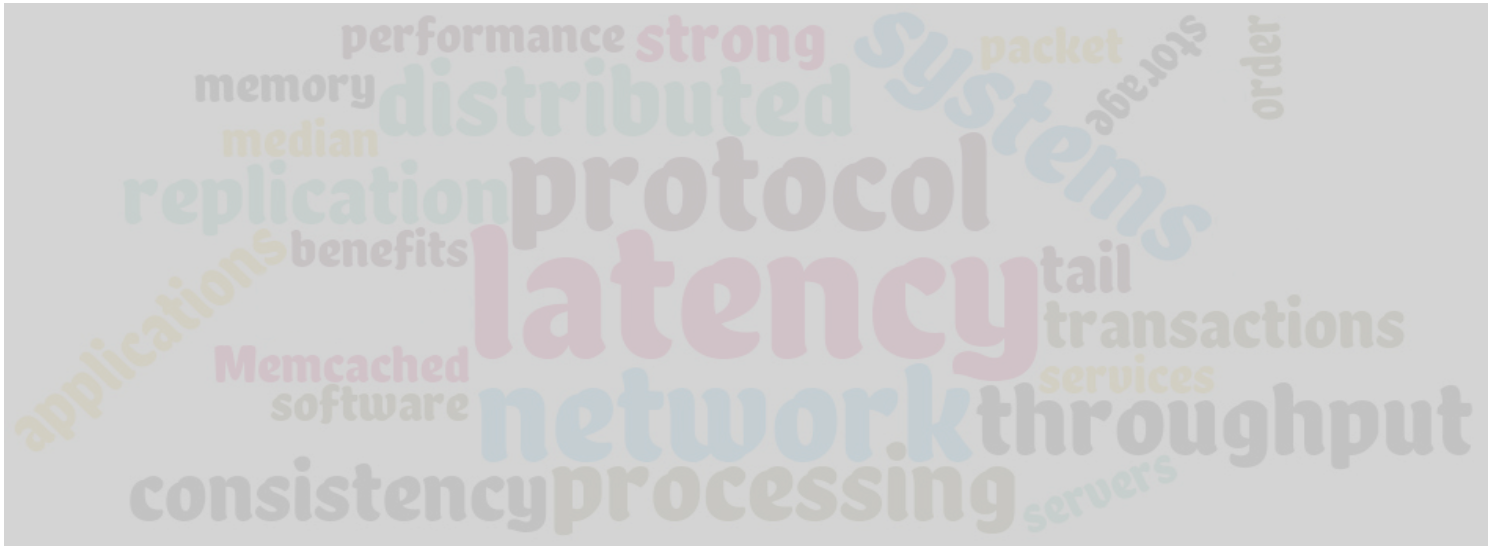




# Introduction

## Course: Distributed Computing

## Faculty: Dr. Rajendra Prasath

**Spring 2019**

# About this Course

This course covers essential aspects that every serious programmer needs to know about **distributed algorithms**, **design principles and their analysis**, with emphasis on **real-time implementations** and **scalable applications development**

# What do we learn?

Distributed Computing (DC)

- ➔ Core Theoretical Concepts
- ➔ Design Principles of DC
- ➔ Discrete Events Simulations
- ➔ Experimental Evaluations
- ➔ Designing Efficient Solution(s) ??
  - ➔ To Solve Some Interesting Problems !!

➔ An Overview of Distributed Computing

➔ ➔ Simple to advanced?

# An Overview

Consider Simple Problem-Solving:

- What are the constraints in solving a specific problem?
- How to do problem-solving in a sequential machine?
- How do we parallelize the solution?
- How to make the systems to co-ordinate to solve the specific problems given the specific constraints?

# Distributed Computing

➔ Study of Distributed Systems

A Distributed System?

➔ A model in which components communicate among themselves by passing messages and coordinate (regulated by interaction or interdependence) to accomplish a specific task / problem given to them

➔ Is it different from parallel processing?

# Parallel vs Distributed

- Parallel System?
  - Having n processors with a common shared memory
- Distributed System?
  - Having n processors but NO common shared memory

# More Formally …

## Distributed System:

- A collection of independent computers that appears to its users as a single coherent system
- A system in which hardware and software components of networked computers communicate and coordinate their activity only by passing messages
- A computing platform built with many computers that:
  - Operate concurrently
  - Are physically distributed (have their own failure modes)
  - Are linked by a network
  - Have independent clocks

# Characteristics

- Concurrent execution of processes:
  - Non-determinism, race conditions, synchronisation, deadlocks, and so on
- No global clock
  - Coordination is done by message exchange
  - No single global notion of the correct time
- No global state
  - No process has a knowledge of the current global state of the system
- Units may fail independently
  - Network faults may isolate computers that are still running
  - System failures may not be immediately known

# Need of Distributed Syst.

## Why do we need distributed systems?

- ➔ People are distributed but need to work together
- ➔ Hardware needs to be physically close to people (who are distributed)
- ➔ Information is distributed but needs to be shared (trustworthily)
- ➔ Hardware can be shared (increases computing power by doing work in parallel; more efficient resource utilization)

# Examples of DS

- Intranets, Internet, World Wide Web
- Distributed supercomputers
- Grid / Cloud computing – AWS-EC2
- Electronic banking
- Airline reservation systems
- Railway Reservation Systems
- Peer-to-peer networks
- Sensor networks – IBM systems
- Web Searching / Web Crawling

. . . and so on

# Course Content

- Course is divided into several modules:
- Covers Basics to Advanced Components (at least one example problem with detailed analysis)
- Course is supposed to be an interactive course and class performance bonus would be given to students who solve the given set of problems efficiently

➔ Course Content follows …

# Course Content - Topics

- Introduction
- A model of distributed computations
- Logical time
- Global state and snapshot recording algorithms
- Topology abstraction and overlays
- Message ordering and group communication
- Termination detection
- Distributed mutual exclusion algorithms

# Course Content – Topics (contd…)

- Deadlock detection in distributed systems
- Distributed shared memory
- Check Pointing and Rollback Recovery
- Consensus and agreement algorithms
- Self-stabilization
- Authentication in distributed systems
- Peer-to-peer computing and overlay graphs

➔ and Practice Problems

# Case Studies

- Discrete Event Simulations
  - Distributed Sorting on a line network
  - Distributed Sorting on different interconnection networks
- Map Reduce and Big Data
  - How to process a huge volume of data
  - Specific focus would be on scalable data processing especially in text format
- Authentication & Security in DS
  - We will focus more on Decentralized Application development

# Take Home Assignments

- Solve a set of problems every week
- Must be solved by individuals & must be finished before the deadline specified

- All Assignments are COMPULSARY
- Total Weightage: 20%;

- Solutions would be cross checked !!
- Solutions submitted after the deadline will not be considered for evaluation
- Submission Procedure would be given.

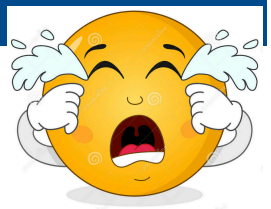
# Examinations

- Mid Semester – 1: 10 Marks
- Mid Semester – 2: 15 Marks
- End Semester : 25 Marks

- Total Weightage (100) = Take Home Assignments (20) + Exams (50) + Best Solutions (10) + Class Performance (20)

- Academic Code of Conduct
  - Explore PENALTIES

# Penalties



- Every Student is expected to strictly follow a fair Academic Code of Conduct to avoid severe penalties
- Penalties would be heavy for those who involve in:
  - **Copy and Pasting** the code
  - **Plagiarism** (copied from your neighbor or friend – in this case, both will get "0" marks for that specific take home assignments)
  - If the candidate is **unable to explain his own solution**, it would be taken as a "copied case" !!
  - **Any other unfair means** of completing the assignments

# Help among Yourselves?

- **Perspective Students** (having CGPA above 8.5 and above)
- **Promising Students** (having CGPA above 6.5 and less than 8.5)

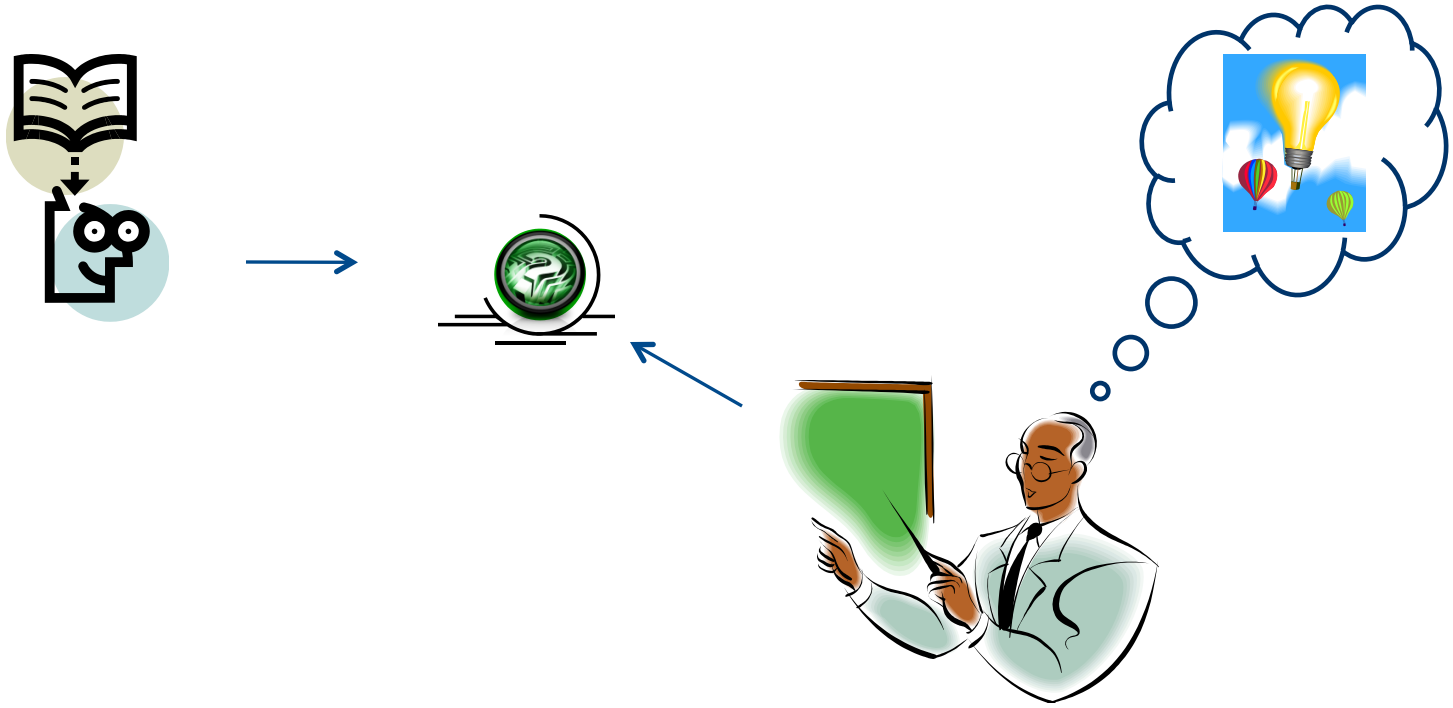
- **Needy Students** (having CGPA less than 6.5)
  - Can the above group help these students? (Your work will also be rewarded)

- You may grow a culture of **collaborative learning** by helping the needy students

# Assistance

- You may post your questions to me at any time
- You may meet me in person on available time or with an appointment
- TA s would assist you to clear your doubts.
- You may leave me an email any time (email is the best way to reach me faster)

# Thanks …



… Questions ???