

CS3283: DISTRIBUTED SYSTEMS

Effective Term

Semester A 2022/23

Part I Course Overview

Course Title

Distributed Systems

Subject Code

CS - Computer Science

Course Number

3283

Academic Unit

Computer Science (CS)

College/School

College of Engineering (EG)

Course Duration

One Semester

Credit Units

3

Level

B1, B2, B3, B4 - Bachelor's Degree

Medium of Instruction

English

Medium of Assessment

English

Prerequisites

Nil

Precursors

CS3103 Operating Systems or equivalent and CS3201 Computer Networks or equivalent

Equivalent Courses

Nil

Exclusive Courses

Nil

Part II Course Details

Abstract

This course aims to explain the rationales of distributed computing, the architectures of different modern distributed computing systems, and to provide fundamental knowledge on the key issues in distributed system designs including

inter-process communication, multi-threading, data coordination, consistency management and distributed concurrency control, distributed replications and deadlock resolution

Course Intended Learning Outcomes (CILOs)

| CILOs | Weighting (if app.) | DEC-A1 | DEC-A2 | DEC-A3 |
|-------|--|--------|--------|--------|
| 1 | Identify the basic architectures of distributed systems, the problems in providing distributed transparency, and the rationales and trade-offs of different types of transparencies. | x | x | |
| 2 | Create program and evaluate the problems in inter-process communications. | | x | |
| 3 | Analyse and evaluate the basic algorithms for distributed systems such as time synchronization, name management, process and data coordination. | x | | |
| 4 | Analyse and evaluate the performance characteristics of different algorithms for transaction management and distributed deadlock resolution. | | x | |
| 5 | Develop the ability to investigate the trends and problems of current distributed systems using examples and case studies. | | | |

A1: Attitude

Develop an attitude of discovery/innovation/creativity, as demonstrated by students possessing a strong sense of curiosity, asking questions actively, challenging assumptions or engaging in inquiry together with teachers.

A2: Ability

Develop the ability/skill needed to discover/innovate/create, as demonstrated by students possessing critical thinking skills to assess ideas, acquiring research skills, synthesizing knowledge across disciplines or applying academic knowledge to real-life problems.

A3: Accomplishments

Demonstrate accomplishment of discovery/innovation/creativity through producing /constructing creative works/new artefacts, effective solutions to real-life problems or new processes.

Teaching and Learning Activities (TLAs)

| TLAs | Brief Description | CILO No. | Hours/week (if applicable) | |
|------|------------------------|---|----------------------------|--------------------------|
| 1 | Lecture | Explain the keys concepts in the design of distributed systems. | 1, 3, 4 | Lecture: 3 hours/week |
| 2 | Programming assignment | To reinforce what is learned from the lecture, students are given a programming assignment to create a program and evaluate the problems in inter-process communications. | 2 | |

| | | | | |
|---|------------------------------------|--|---------|-------------------------------|
| 3 | Presentation and class discussion | Class participation and knowledge sharing is an important part of the learning process. Students will be grouped to present their studies on a selected topic on modern distributed systems. This activity helps develop their ability to investigate the trends and problems of modern distributed systems. | 1, 3, 4 | Tutorial: 8 hours/semester |
| 4 | Mid-term quiz and class discussion | Students will be encouraged to discuss the key concepts in the design of distributed systems. | 1, 3 | |

Assessment Tasks / Activities (ATs)

| ATs | CILO No. | Weighting (%) | Remarks (e.g. Parameter for GenAI use) |
|-----|---------------------------------------|---------------|--|
| 1 | Presentation and report | 1, 4, 5 | 10 |
| 2 | Programming assignment | 2 | 8 |
| 3 | Mid-term quiz and class participation | 1, 3, 4 | 12 |

Continuous Assessment (%)

30

Examination (%)

70

Examination Duration (Hours)

2

Additional Information for ATs

For a student to pass the course, at least 30% of the maximum mark for the examination must be obtained.

Assessment Rubrics (AR)**Assessment Task**

Presentation and report

Criterion

ABILITY to EXPLAIN the trend of modern distributed systems

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Programming assignment

Criterion

ABILITY to APPLY the techniques to create and evaluate the problems in inter-process communication

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Assessment Task

Mid-term quiz and class participation

Criterion

ABILITY to EXPLAIN the key concepts in distributed systems

Excellent (A+, A, A-)

High

Good (B+, B, B-)

Significant

Fair (C+, C, C-)

Moderate

Marginal (D)

Basic

Failure (F)

Not even reaching marginal levels

Part III Other Information

Keyword Syllabus

Distributed systems architectures; Transparency requirements and issues; Inter-process Communications (IPC); Distributed Services and Naming Services; Consistency maintaining; Distributed synchronization; Distributed coordination; Concurrency Control, Network Security, Distributed Deadlock, Replications and Distributed Transaction Atomicity, Mobile and Pervasive Computing, Peer-to-peer Computing.

Syllabus

Architectures and paradigms of distributed systems will be presented during the lectures, with discussions on the following issues and the related techniques/algorithms:

- Basic issues of concepts of distributed system: characteristics, transparency, system modeling.
- Inter-networking and communications: characteristics of various networks, RPC and interprocess communications using Java.
- Distributed services and naming services: distributed file and name services and architecture, directory services and domain name services.
- Time and global states: clock synchronization, logical clock, vector clock, ordering, time synchronization, Cristian algorithm, network time protocol, Lamport algorithms, global states and consistency cut.
- Distributed transaction management: transaction properties, distributed deadlock detection, distributed concurrency control, replication, durability and atomicity.

Reading List

Compulsory Readings

| Title | |
|-------|--|
| 1 | Coulouris G., Dollimore J. and Kindberg T. (2011). Distributed System, Concepts and Design. . Addison Wesley, 5th edition. |

Additional Readings

| Title | |
|-------|---|
| 1 | Tanenbaum, Andrew S. and Van Steen, Maarten (2002). Distributed System, Principles and Paradigms. |