Ain Shams University
Faculty of Engineering

Course Assessment Specification (CAS)

Programme Title : **Computer Engineering and Software Systems**
Coursework Title : **Programming Project**
Module Name (UEL) : **Computer Networks and Distributed Systems**
Course Name (ASU) : **Distributed Computing**
Module/Course Code : **EG7533/ CSE354**
Level UEL/ASU : **5 / 3**
UEL Credit Rating : **15 Credits** **ASU Credit Rating** : **3 Credits**
Weighting : **35%**

Maximum mark available:

- 35 on software projects (1 project)

Lecturer : Prof. Ayman M. Bahaa-Eldin

Contact : If you have any issues with this coursework you may contact your lecturer.

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Hand-out Date : As shown in submission matrix
Hand-in Date : As shown in submission matrix
Hand-in Method : Submission through LMS
Feedback Date : Your work will be marked and returned within two weeks.

Introduction

This coursework is itemized into several parts to get the 35 marks associated to it.
You must use the templates provided by the instructor to prepare your work.
All assignments and projects will be handed-in electronically, while quizzes and exams are written
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Learning Outcome to be assessed

7. Design a distributed computing model to solve a complex problem
9. Design and Implement a distributed computing model
9. Configure a working environment for distributed computing
10. Work and communicate effectively in a team

Detail of the task

Attached separate file for each task.

89% and above:

Your work must be of outstanding quality and fully meet the requirements of the coursework specification and learning outcomes stated. You must show independent thinking and apply this to your work showing originality and consideration of key issues. There must be evidence of wider reading on the subject. In addition, your proposed solution should:

- illustrate a professional ability of drafting construction details,
- express a deep understanding of the in-hand problem definition,
- and applying, masterly, the learned knowledge in the proposed solution.

76% - 89%:

Your work must be of good quality and meet the requirements of the coursework specification and learning outcomes stated. You must demonstrate some originality in your work and show this by applying new learning to the key issues of the coursework. There must be evidence of wider reading on the subject. In addition, your proposed solution should:

- illustrate a Good ability of drafting construction details,
- express a very Good understanding of the in-hand problem definition,
- and applying most of the learned knowledge, correctly, in the proposed solution.

67% - 76%:

Your work must be comprehensive and meet all of the requirements stated by the coursework specification and learning outcomes. You must show a good understanding of the key concepts and be able to apply them to solve the problem set by the coursework. There must be enough depth to your work to provide evidence of wider reading. In addition, your proposed solution should:

- illustrate a moderate ability of drafting construction details,
- express a good understanding of the in-hand problem definition,
- and applying most of the learned knowledge, correctly, in the proposed solution.

60% - 67%:

Your work must be of a standard that meets the requirements stated by the coursework specification and learning outcomes. You must show a reasonable level of understanding of the key concepts and principles and you must have applied this knowledge to the coursework problem. There should be some evidence of wider reading. In addition, your proposed solution should:

- illustrate a fair ability of drafting construction details,
- express a fair understanding of the in-hand problem definition,
- and applying some of the learned knowledge, correctly, in the proposed solution.

Below 60%:

Your work is of poor quality and does not meet the requirements stated by the coursework specification and learning outcomes. There is a lack of understanding of key concepts and knowledge and no evidence of wider reading. In addition, your proposed solution would be:

- Illustrate an inability of drafting construction details,
- Failed to define the parameters, limitations, and offerings of the in-hand problem,
- Failed to apply correctly the learned knowledge for proposing a valid solution.

Academic Misconduct

The University defines Academic Misconduct as 'any case of deliberate, premeditated cheating, collusion, plagiarism or falsification of information, in an attempt to deceive and gain an unfair advantage in assessment'. This includes attempting to gain marks as part of a team without making a contribution. The department takes Academic Misconduct very seriously and any suspected cases will be investigated through the University's standard policy. If you are found guilty, you may be expelled from the University with no award.

It is your responsibility to ensure that you understand what constitutes Academic Misconduct and to ensure that you do not break the rules. If you are unclear about what is required, please ask.

Distributed Image Processing System using Cloud Computing

This project should be done in teams of 3 to 4 students.
For this project, you will design, implement, and thoroughly test a distributed system,

Title: Distributed Image Processing System using Cloud Computing

Description: This project aims to develop a distributed image processing system using cloud computing technologies. The system will be implemented in Python, leveraging cloud-based virtual machines for distributed computing. The application will use OpenCL or MPI for parallel processing of image data.

Features and Specifications:

- **Distributed Processing:** The system should be able to distribute image processing tasks across multiple virtual machines in the cloud.
- **Image Processing Algorithms:** Implement various image processing algorithms such as filtering, edge detection, and color manipulation.
- **Scalability:** The system should be scalable, allowing for the addition of more virtual machines as the workload increases.
- **Fault Tolerance:** The system should be resilient to failures, with the ability to reassign tasks from failed nodes to operational ones.

User Stories:

- As a user, I want to upload an image to the system for processing.
- As a user, I want to select the type of image processing operation to be performed.
- As a user, I want to download the processed image once the operation is complete.
- As a user, I want to monitor the progress of the image processing task.

Python Code Skeleton

simplified Python code snippet for a worker thread that could be part of your distributed image processing system. This worker is responsible for receiving an image processing task, performing the task, and sending the result back.

```
import threading
import queue
import cv2  # OpenCV for image processing
from mpi4py import MPI  # MPI for distributed computing

class WorkerThread(threading.Thread):
    def __init__(self, task_queue):
        threading.Thread.__init__(self)
        self.task_queue = task_queue
        self.comm = MPI.COMM_WORLD
        self.rank = self.comm.Get_rank()

    def run(self):
        while True:
            task = self.task_queue.get()
            if task is None:
                break
            image, operation = task
```

```
            result = self.process_image(image, operation)
            self.send_result(result)

    def process_image(self, image, operation):
        # Load the image
        img = cv2.imread(image, cv2.IMREAD_COLOR)

        # Perform the specified operation
        if operation == 'edge_detection':
            result = cv2.Canny(img, 100, 200)
        elif operation == 'color_inversion':
            result = cv2.bitwise_not(img)
        # Add more operations as needed...

        return result

    def send_result(self, result):
        # Send the result to the master node
        self.comm.send(result, dest=0)

# Create a queue for tasks
task_queue = queue.Queue()

# Create worker threads
for i in range(MPI.COMM_WORLD.Get_size() - 1):
    WorkerThread(task_queue).start()
```

Project Phases

Sure, here's a suggested breakdown of the project into four phases:

1. **Phase 1: Project Planning and Design (2-3 weeks)**
    - Define the project scope, objectives, and requirements.
    - Design the system architecture and select the appropriate technologies.
    - Create a detailed project plan with tasks, responsibilities, and timelines.
    - User Stories: As a team, we want to have a clear understanding of the project requirements and a detailed plan for execution.
2. **Phase 2: Development of Basic Functionality (2-3 weeks)**
    - Implement basic image processing operations.
    - Set up the cloud environment and virtual machines.
    - Develop the worker thread for processing tasks.
    - User Stories: As a user, I want to be able to upload an image and apply basic image processing operations.
3. **Phase 3: Development of Advanced Functionality (2-3 weeks)**
    - Implement advanced image processing operations.
    - Develop the distributed processing functionality using MPI or OpenCL.
    - Implement scalability and fault tolerance features.
    - User Stories: As a user, I want the system to efficiently process images using distributed computing and handle failures gracefully.
4. **Phase 4: Testing, Documentation, and Deployment (2-3 weeks)**
    - Conduct thorough testing to ensure the system works as expected.
    - Document the system design, code, and user instructions.
    - Deploy the system to the cloud and ensure it is operational.
    - User Stories: As a user, I want a well-documented, fully functional, and reliable system for distributed image processing.

Deliverables

Phase	Questions to be Answered in your Report
1	1. What is the main objective of our project? 2. Which technologies have we decided to use and why? 3. What are the key components of our system architecture?
2	1. How does our worker thread process tasks? 2. What basic image processing operations have we implemented? 3. How have we set up our cloud environment?
3	1. What advanced image processing operations have we implemented? 2. How does our system handle distributed processing? 3. How have we implemented scalability and fault tolerance?
4	1. What were the results of our system testing? 2. What information is included in our system documentation? 3. How did we deploy our system to the cloud?