

FAST National University of  
Computer and Emerging Sciences

# Parallel Distributed Computing:

# Project Report

Group Members:

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# **Challenges:**

We faced a lot of problems in the pre-processing phase, which included understanding the given datasets and how to process them into graphs.

# **Pre-processing:**

* **Data Formatting:**
  + Converting the provided datasets into a graph the program understands.
  + A lot of our problems were simplified, thanks to the geeksforgeeks provided code.
  + Transformation of edge lists into adjacency lists was also a great challenge.
* **Data Distribution:**
  + Determining the best way to partition the graph for distribution across MPI processes was a complex task.

# **Implementation:**

* **Memory Management:**
  + Efficiently managing memory in a parallel environment, ensuring that each MPI process has access to data without redundancy.
* **Load balancing:**
  + Ensuring that all processes and threads have an equal amount of work to prevent race conditions or overloading of work to some processes whereas some sit idle.

# **Testing:**

* **Scalability Issues:**
  + Due to limited computing power, we are not able to process graphs with more than 2000 nodes.
  + The program may not run as expected when increasing the number of nodes and edges, which will result in insufficient memory errors.

# **Optimizations:**

* **Parallel Design:**
  + Ensuring that the algorithm minimizes inter-process communication;
* **Communication Balancing:**
  + Minimizing the data transfer between processes.

# **Results:**

1. **Email-Enroll.txt:**

* Sequential Performance:
  + With printing all read edges and their weights:
    - More than 60 seconds.
  + Without printing all read edges and their weights:
    - 50-60 seconds.
* Parallel Performance:
  + With printing all read edges and their weights:
    - 50-60 seconds.
  + Without printing all read edges and their weights:
    - 30-40 seconds.
* Speed-Up:
  + 20 seconds.

1. **Email-EuAll.txt:**

* Sequential Performance:
  + With printing all read edges and their weights:
    - More than 1 minute 20 seconds.
  + Without printing all read edges and their weights:
    - More than 60 seconds.
* Parallel Performance:
  + With printing all read edges and their weights:
    - More than 60 seconds.
  + Without printing all read edges and their weights:
    - 50-60 seconds.
* Speed-Up:
  + 15 seconds.

**DoctorWho:**

* Sequential Performance:
  + With printing all read edges and their weights:
    - More than 1 minute 40 seconds.
  + Without printing all read edges and their weights:
    - More than 1 minute 10 seconds.
* Parallel Performance:
  + With printing all read edges and their weights:
    - More than 1 minute 10 seconds.
  + Without printing all read edges and their weights:
    - Around 60 seconds, varies each time.
* Speed-Up:
  + 20 seconds.