CSE4112: Parallel Processing and Distributed System Lab

Source: https://github.com/ahnafshahrear/Parallel-Processing-And-Distributed-System-Lab?tab=readme-ov-file

Lab Tasks

- **Write a simple C++ program in MPI to multiply two matrices of size MxN and NxP**
- **Write a program in MPI to simulate a simple calculator. Perform each operation using a different process in parallel**
- **Write a program in C++ to count the words in a file and sort it in descending order of frequency of words that is, the highest occurring word must come first and least occurring word must come last**
- **Write a MPI program using synchronous send. The sender process sends a word to the receiver. The second process receives the word, toggles each letter of the word and sends it back to the first process. Both processes use synchronous send operations**
- **Write a MPI program to add an array of size N using two processes. Print the result in the root process. Investigate the amount of time taken by each process**
- **Write a Cuda program for matrix multiplication**
- **Write a Cuda program to find out maximum common subsequence**
- **Given a paragraph and a pattern like %x%. Now write a cuda program to find out the line number where %x% this pattern exists in the given paragraph**

CSE4122: Object Oriented Design and Design Patterns Lab

Source: https://github.com/ahnafshahrear/Object-Oriented-Design-And-Design-Patterns-Lab

and Thanks to Prema

Implementation Steps of Facade Pattern (with Example)

Lab Assignment 3: Write a Java program that demonstrate the implementation of a facade design pattern for a Banking Service with Cheaquing, Saving, and Investment modules.

- **Expressing this in Java can be broken down into steps.**
  1. Design the interface.
  2. Implement the interface with one or more classes.
  3. Create the façade class and wrap the classes that implement the interface.
  4. Use the façade class to access the subsystem.

Follow Notes for idea and implementation. Submit the assignment is due date.

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Implementation Steps of Composite Pattern (with Example)

Lab Assignment 4: Write a Java program that demonstrate the implementation of a composite design pattern by using an example with a building composed of generic housing structures.

- **Expressing this in Java can be broken down into steps.**
  1. Design the interface that defines the overall type.
  2. Implement the composite class.
  3. Implement the leaf class

Follow Notes for idea and implementation. Submit the assignment is due date.

Implementation Steps of Proxy Pattern (with Example)

Lab Assignment 5: Write a Java program that demonstrate the implementation of a proxy pattern for an online retail store with global distribution and warehousing.

- **Expressing this in Java can be broken down into steps.**
  1. Design the subject interface.
  2. Implement the real subject class.
  3. Implement the proxy class.

Follow Notes for idea and implementation. Submit the assignment is due date.

Lab Assignment 6: Write a Java program that demonstrate the implementation of a decorator pattern for a web page, which might display complex behavior, such as only allowing access to authorized users, or splitting search results across multiple pages.

- **Expressing this in Java can be broken down into steps.**
  1. Design the component interface.
  2. Implement the interface with your base concrete component class.
  3. Implement the interface with your abstract decorator class.
  4. Inherit from the abstract decorator and implement the component interface with concrete decorator classes.

Follow Notes for idea and implementation. Submit the assignment is due date.

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Lab Assignment 7: Write a Java program that demonstrate the implementation of a state design pattern for a vending machine functionality on purchasing items.

- **Express the problem in Java with respective steps.**

Follow Notes for idea and implementation. Submit the assignment is due date.

CSE4132: Computer Simulation and Modeling Lab

Source: Lecturers collected from RU

A fighter aircraft sights an enemy bomber aircraft and flies directly toward it, in order to catch up with the bomber and destroy it. The bomber (the target) continues flying (along a specified curve) so the fighter (the pursuer) has to change its direction to keep pointed toward the target. **We are interested in determining the attack course of the fighter and in knowing how long it would take for it to catch up with the bomber.** Solve this problem under the following conditions. You need to plot the whole path of fighter as well as bomber:

Logic behind the pure pursuit problem of simulation:

- Bomber Aircraft and a Fighter Aircraft are flying in the same horizontal plane.
- Fighter aircraft and bomber aircraft both are moving inside the rectangular range.
- The fighters and bombers have a velocity given, suppose **s = 20 (input from screen)**.
- The bomber and the fighter path co-ordinate (i.e., its position as a function of time) are randomizing from 1 to 1000.

- When the distance of the bomber and the fighter is less than 900km and greater than 100km, it is assumed that the bomber is shot down or destroyed. Otherwise, the bomber escaped from sight.

Sample Output:

```
BOMBER  ESCAPES FROM  THE SIGHT OF FIGHTER
time=0   xf=642.00  yf=902.00  xb=788.00  yb=709.00  distance=242.00
time=1   xf=654.07  yf=886.05  xb=585.00  yb=997.00  distance=130.69
time=2   xf=643.50  yf=903.03  xb=587.00  yb= 6.00  distance=898.81
time=3   xf=642.24  yf=883.07  xb=11.00  yb=162.00  distance=958.33
The bomber plane escaped from sight at 3 second
```

Question 2: Simulation of critical path method

A furniture making company builds tables that consist of a drawer, four legs, and the top of the table. Building legs takes 11 hours, building the top takes 3 hours, and building the drawer takes 10 hours. After each part is built, each part is painted. The legs take 2 hours, top 1 hour, and the drawer 3 hours. The drawer is then attached to the tabletop (1 hour). After the top and drawer are attached, the four legs can be attached (1 hour). Draw the network diagram from Table 1. Also write program to find the critical Path.

Activity	Start Node	End Node	Activity Time
A-Build Legs	1	2	11
B-Build Top	1	3	3
C-Build Drawer	1	4	10
D-Paint Drawer	4	5	3
E-Paint Top	3	5	1
F-Paint Legs	2	6	2
G-Attach Drawer to Top	5	6	1
H-Attach Legs	6	7	1

Table: The data is in topological order

Input: From file
Output: On screen & file

Question 3: Simulation of linear congruential generator method

Problem Statement: Write a program for linear congruential generator method to generate a sequence of random integers between zero and *M-1*. For example, the following table shows the sequences that result for various choices of a (multiplicative constant), b (additive constant), c (seed), and M (modulus).

a	b	c	M	x_0	x_1	x_2	x_3	x_4	x_5	x_6	x_7	x_8	x_9	x_{10}	x_{11}	x_{12}
1	3	0	10	0	3	6	9	2	5	8	1	4	7	0	3	6
2	1	0	10	0	1	3	7	5	1	3	7	5	1	3	7	5
22	1	0	72	0	1	23	3	67	35	51	43	11	27	19	59	3
11	37	1	100	1	48	65	52	9	36	33	0	37	44	21	68	85
8	20	10	100	10	0	20	80	60	0	20	80	60	0	20	80	60

Question 4: Simulation of a Chemical Reactor

Problem Statement: There are two substances A and B. They produce third substance C. The rate of formation of C is proportional to presence of A and B. Write a program to simulate how much of C has been produced as a function of time, $\Delta t = 0.1$. Assume that a = 100g, b = 50g and c = 0g are quantities of A, B and C at time t = 0. Rate constants are also given as follows $k_1 = 0.008$ and $k_2 = 0.002$.

Question 5: Simulation of a cubic Bezier curve

Problem Statement: There are four control points P_0, P_1, P_2, and P_3 position in 2D space. You have to write a program to construct the spline using Cubic Bezier curve construction approach. Also need to display the output for each new point.

Question 6: Forecasting by ARIMA model

a) **Identify ARIMA Order (p, d, q):** Plot the Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) to
b) **Model Estimation:** Fit the ARIMA model to the training data using the identified order (p, d, q).
c) **Model Evaluation:** Evaluate the model's performance on the testing set. Use MSE, RMSE.
d) **Forecasting:** Generate forecasts for future time points using the trained ARIMA model. Visualize the forecasts along with confidence intervals.

CSE4182: Digital Image Processing Lab

Source: https://github.com/ahnafshahrear/Digital-Image-Processing-Lab/blob/main/Lab%20Tasks.docx

Digital Image Processing Laboratory

1. Take grayscale image of size 512x512 and perform the following operations -

   (a) Decrease its spatial resolution by half every time and observe its change when displaying in the same window size

   (b) Decrease it intensity level resolution by one bit up to reach its binary format observe its change when displaying in the same window size

   (c) Illustrate the histogram of the image and make single threshold segmentation observed from the histogram

2. Take grayscale image of size 512x512 and perform the following operations –

   (a) Perform the brightness enhancement of a specific range of gray levels and observe its result

   (b) Differentiate the results of power law transform and inverse logarithmic transform

   (c) Find the difference image between original and the image obtained by last three bits (MSB)

3. Take grayscale image of size 512x512, add some salt & pepper noise and perform the following operations –

   (a) Apply average and median spatial filters with 5x5 mask and observe their performance for noise suppression in term of PSNR

   (b) Use different size of mask (3x3, 5x5, 7x7) with average filter for noise suppression and observe their performance in term of PSNR

   (c) Apply harmonic and geometric mean filter on the noisy image and compare their performance with PSNR

4. Take grayscale image of size 512x512, add some Gaussian noise and perform the following operations in frequency domain –

   (a) Apply 4^{th} order Butterworth and Gaussian low pass filter to analyze their performance quantitatively

   (b) Observe the ringing effect of ideal low pass filter on the image. Use different radius (D0) of ideal low pass filter and display their results

   (c) Perform edge detection of given the noise and clean image using ideal and Gaussian high pass filters.

5. Take a binary image and a structuring element to perform the following morphological operations –

   (a) Erosion and Dilation operations

   (b) Opening and Closing operations

   (c) Boundary extraction using morphological operation