Programming Assignment 2

CS 218 : Design and Analysis of Algorithms

Nikil S (22B0963)

April 19, 2024

Functions

My Algorithm to solve the given problem is to call a function myfunc(), which in turn calls a recursive function recfunc(), whose functionalities are given below:

myfunc()

Takes in a vector of elements and memory matrix as input. It defines more variables namely dp,subs and perm. Now this calls recfunc(), which does the computation recursively.

recfunc()

This is the crux of the program that recursively computes the needed result. The arguments include:

- const vector<int> &elements: This is a vector of IDs of all processes.
- int subs: An integer whose binary representation would reveal the elements considered in the current subset (like a characteristic vector). Initially all processes would be included so this has value of 111..1 (n 1s).
- vector<int> &perm: The vector of elements already considered by the parent call. Initially empty.
- map<int,int> &dp This map stores the values of output of different recursive calls made during the entire run. This helps in saving a lot of computation as multiple calls are made to the same subset. Maps subset(binary int) to output(memory terms of the subset for given order.)
- const vector<vector<int>> &mem: Contains the data regarding each process, and we will refer to it as the memory matrix.

memreq()

Evaluates the memory required while running the current process ID, for a given order of process IDs.

Algorithm

It is a dynamic programming algorithm which stores the maximum peak memory required for the given subset of elements that occur at the last of a given order. This saves a lot of computation as the same subset of elements at the last are seen in multiple calls to the recursive function. The time complexity of the given algorithm is $O(2^n * n^3)$. This is so because there exists 2^n unique calls to the function recfunc() and in each call, the memreq() function is called which runs in $O(n^3)$.
Also, magically, my program runs in less than 0.1 seconds for input10!

References

- https://www.geeksforgeeks.org/write-a-c-program-to-print-all-permutations-of-a-given-string/
- https://chat.openai.com/