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Assignment: **Stable Marriage - Backtracking with 2 while loops:** You have n men and n woman, and their preference rankings of each other, and you need to match them up so that the total matching is “stable.”

Short Report/Summary:

In the main function, first initialized c and q[] where c represents the men and q[] represents the women, q[c] represents the woman assigned to man c. Total number of elements of the array is 3 because we have 3 men and 3 women as input for this problem.

**The program first assigns the woman #0 with man #0. Then it goes to the very next man (man #1) and starts checking from the first woman until it finds a perfect match. It calls the ok function which basically tests if the woman is a perfect pair with the current man by checking 3 conditions: first, it checks if the woman is already married to another man, if it is, then that woman isn’t suitable for the current man. If the woman passes this first condition, then it checks second and third condition. 2nd and 3rd condition deals with the stability. An instability is the situation where there is a mutual greater preference for the other person’s partner than for one’s own. None of the current man or woman should have mutual greater preference than their own partners. Inside the ok function, the 2nd condition checks if the current man has mutual greater preference with any woman of any previous pair, and the 3rd condition in the same if statement checks if the current woman has mutual greater preference with any man from any previous pair. If it passes all these conditions, then that woman gets assigned to current man and it goes to the next man to find a suitable woman for him. Otherwise, it checks next woman for the same current man. Thus, it goes on until it finds all stable pairs. But if it checks all women, still can’t find a match for a man, then it backtracks and changes the pair, find next stable woman for that previous man. Thus, the program goes on until it finds all the stable matches. When it finds, it calls the print function which prints that one found solution. Then it backtracks again to find another combination of solutions which follows those conditions. Thus, when the program finds and prints all the possible combinations of stable matches, the outer while loop gets terminated and the program comes to an end. This is the algorithm for the program I coded.**

Nested while loop was used, where the outer loop terminates according to its condition only when the value of c becomes less than 0, which means, when it finds all the possible solutions, and backtrack to c=-1. Inside the outer while loop, first it goes to the next man, then checks if c=3 (which means if it has found one complete solution). If it is, then it calls the print function. I created the custom void function named ‘print’ to print the found result as pairs of man and woman.

Inside the inner while loop, it checks if the current woman (q[c]) is a stable match with current man (c) by calling ok function. I created the custom bool function named ‘ok’ which first checks if the woman is already married to a different man. Then checks if the current man or woman (any of them) has mutual greater preference with another woman or man from previous pair, which means, it checks if there is any instability. If it can’t find any instability, then this bool function returns true. Otherwise, returns false. Returning false triggers this inner while loop to check the next woman if she’s a perfect stable match with the same current man. After finding a suitable woman for the current man, this inner while loop breaks, as a result it goes back to the beginning of the outer while loop.

Inside the ok function, I initialized mp[][] and wp[][] which are two arrays that represent men’s and women’s preference table (preference ranking). In these arrays, rows represent the number of men or women. And the columns represent the rankings (preference). Lowest number of column (0) represents the most preferred man/woman, where highest column (column #2) represents the least preferred man/woman.

Comment: This is my algorithm & summary to solve the stable marriage problem. The main function is almost the same as few previous assignments’ (except the arrays and few values). The biggest difference is inside the ok function. I had to change the tests and set them according to the conditions of the current assignment and put the preference tables as input in the ok function. I compiled and ran the code; it ran successfully and printed all (2) correct solutions.

Screenshot of Output:  
  
