## Question 4

### (a) Give an example of a matrix M that is not rearrangeable even through every column and every row contains at least one entry that equals 1.

$$\begin{bmatrix}1 & 0 & 01 & 0 & 00 & 0 & 1\end{bmatrix}$$

### (b) Describe an efficient algorithm that determines if M is rearrangeable.

We can use bipartite matching to determine if $M$ is rearrangeable. One way to do this is to create a graph with one vertex for every column and one vertex for every row. You then add edges for every element in $M$ that equals $1$ connecting the $i$th row vertex with the $j$th column vertex. If the number of bipartite matches equals $n$, $M$ is rearrangeable.

Since the number of vertexes is $2n$, and the worst case number of edges is $O(n^2)$ since every element in the matrix could be $1$. Finding a bipartite matching requires solving a max flow problem which is $O(|V| * |E|)$. Thus, this algorithm has a worst case of $O(n^3)$ which is in polynomial time.