# Foster’s Algorithm

## Partitioning & Communication

There are three main tasks for this problem of LU decomposition, calculating the U matrix, the L matrix, and the P matrix. Calculating the U matrix is divided into each row and determining how to eliminate the rows in the column below the row’s starting value. Calculating the L matrix, is just a matter of finding the scalar that was used in eliminating the rows in calculating the U matrix. The P matrix can be calculated as we find zeros on the diagonal and swap rows as necessary, looking to put the max absolute value in the diagonal. So the main task we can put into parallel is calculating the scalars to calculate the U. The L matrix is created as we are calculating the U matrix. To calculate P we just need to swap the corresponding rows that we swapped in A as we were calculating U, however we only need to swap rows after we have started eliminating rows. With each row swap in U and P… we’ll have to swap rows below the diagonal in L.

What we have to communicate U, as that is both an input and what we are calculating. We must also communicate the L matrix, as well as the P matrix. Each process will only need 1 row however.

## Agglomeration

Each, row in U needs to eliminate the values in the column below its starting value. Since L is dependent on these scalar values, we need to calculate matrix U first. However, since we have the scalars at the time of calculating U, we can actually combine the two tasks. As we step down through the rows in the U matrix, we can insert the resulting scalars into matrix L. This means we will have to only communicate each row of U at each phase of the program. This also is true of creating the P matrix. So we can create the L and P matrices at the time of

## Mapping

We can map each row in U to a process. This would result in solving the U matrix, L matrix, and P matrix in Phases, one for each row. Where the process whose phase it is, broadcasts its row to the other processes and they calculate the scalar necessary to negate the appropriate values in their row, and place this value into their row in the L matrix. As they are going through… and its discovered that swaps are necessary… we need to swap the rows.