

Pseudo-code for LU decomposition with partial pivoting: LU decomposition with partial pivoting

```
Input: A \in \mathbb{R}^{n \times n}
U \leftarrow A, L \leftarrow I, P \leftarrow I
                                                (initialise matrices)
for k = 1 : n - 1
                                                (loop through pivot columns)
    Select i \ge k to maximise |U_{i,k}|
                                                (choose pivot element)
    U_{k,k:n} \leftrightarrow U_{i,k:n}
                                                (swap rows of U)
    L_{k,1:k-1} \leftrightarrow L_{i,1:k-1}
                                                (swap rows of L up to pivot)
    P_{k,:} \leftrightarrow P_{i,:}
                                                (swap rows of P)
                                                (loop through rows under pivot)
    for j = k + 1 : n
                                                (store multiplier in L matrix)
         L_{i,k} \leftarrow U_{i,k}/U_{k,k}
         U_{j,k:n} \leftarrow U_{j,k:n} - L_{j,k}U_{k,k:n} (update row j of U matrix)
    end for
end for
Output: Matrices L, U and P
```

2072U, Winter 2021 7/1

Iterate over columns to find pivot elements

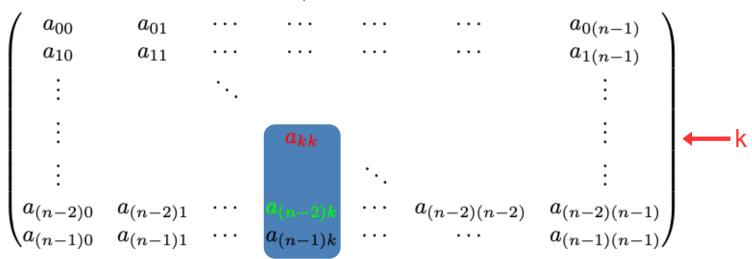
1	(a_{00})	a_{01}					$a_{0(n-1)}$
1	a_{10}	(a_{11})	• • •	• • •	• • •	• • •	$a_{1(n-1)}$
	÷						:
	÷			(a_{kk})			÷
	:						i l
10	$a_{(n-2)0}$	$a_{(n-2)1}$	• • •	$a_{(n-2)k}$	• • •	$a_{(n-2)(n-2)}$	$a_{(n-2)(n-1)}$
1	$a_{(n-1)0}$	$a_{(n-1)1}$	• • •	$a_{(n-1)k}$	• • •	• • •	$a_{(n-1)(n-1)}$

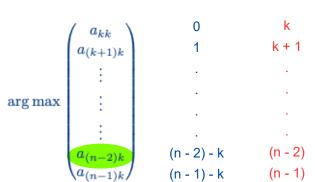


$$\begin{pmatrix} a_{00} & a_{01} & \cdots & \cdots & \cdots & a_{0(n-1)} \\ a_{10} & a_{11} & \cdots & \cdots & \cdots & a_{1(n-1)} \\ \vdots & & \ddots & & & \vdots \\ \vdots & & a_{kk} & & & \vdots \\ \vdots & & \ddots & & & \vdots \\ a_{(n-2)0} & a_{(n-2)1} & \cdots & a_{(n-2)k} & \cdots & a_{(n-2)(n-2)} & a_{(n-2)(n-1)} \\ a_{(n-1)0} & a_{(n-1)1} & \cdots & a_{(n-1)k} & \cdots & \cdots & a_{(n-1)(n-1)} \end{pmatrix}$$

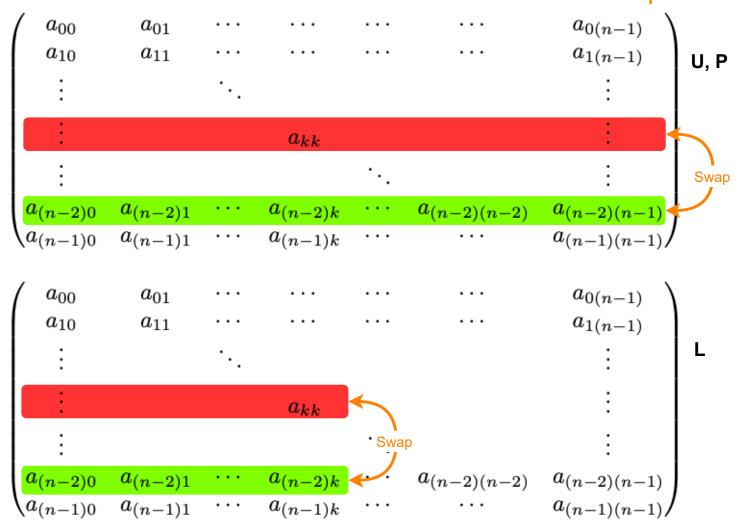


Find pivot element





Swap Rows



 $a_{(n-1)k}$