Goal:

The goal of this lab is to implement a simple but non-trivial parallel algorithm.

Requirement:

Solve the problem below:

Given a directed graph, find a Hamiltonean cycle, if one exists. Use multiple threads to parallelize the search.

The documentation will describe:

- the algorithms,
- the synchronization used in the parallelized variants,
- the performance measurements

The way the algorithm works is not that complicated. We start from the first vertex and check all of its neighbors that are not already in the result path, then for each neighbor we do the same, calling the function recursively on a new thread. We do this until the result path has the same length as the number of vertices.

```java
//we start checking all possible vertices
for(int i=0;i<graph.size();i++){

    //if there is an edge we add it to the path
    //and mark it as visited(temporarly remove the edge)
    if(graph.get(currentVertex).get(i)==1){

        path.set(pathCount++,i);
        graph.get(currentVertex).set(i,0);
        graph.get(i).set(currentVertex,0);

        //if we didn't check the path of this vertex we
        //call this function recursively on a new thread
        if(!checkVisited(i,path,pathCount)){

            ExecutorService ex = Executors.newSingleThreadExecutor();
            final int vertex = i;
            final int count = pathCount;
            final Runnable task = () -> {
                try{
                    System.out.println("ok");
                    search(vertex,path,count);
                } catch (Exception e) {
                    throw new RuntimeException(e.getMessage());
                }
            };
            //this will be a future and we need to get the result
            ex.submit(task).get();
```

Testing:

Small graph with 5 vertexes that has a hamiltonean cycle: 0.014 seconds

Small graph with 5 vertexes that does not have a hamiltonean cycle: 0.025 seconds

Big graph with 15 vertexes that does have a hamiltonean cycle: 9.086 seconds

Big graph with 15 vertexes that does not have a hamiltonean cycle: 11.786 seconds