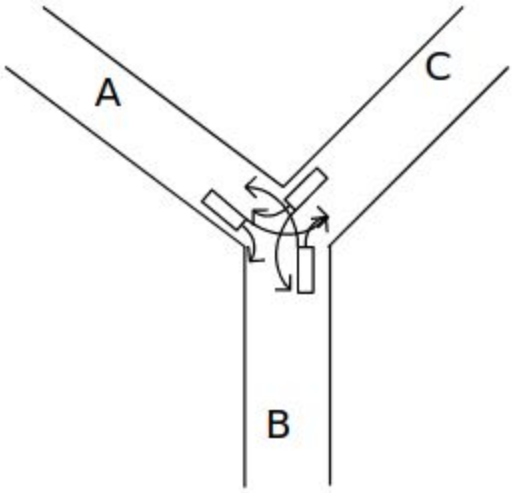
In this assignment you are supposed to hand in hand written solution with pseudocode, that solves the following problems. You may additionally write code for them as a practise for your lab exam.

Submission guidelines:

- **Blank A4 sized pages only**
- **No over writing**
- **No cover page/ binding/folder**
- **Neatly staple more than one pages together**

Problem 1

Consider the intersection shown in the figure below.



Cars arrive at the intersection along the roads marked A, B, and C, and proceed to take a left or a right turn. Thus Car A taking a right turn goes to road B and taking a left turn goes to road C, etc. The intersection has no traffic light or any other traffic control signs. Each car knows the road it is on and the turn it wants to take. Cars along each road come in one at a time and execute a procedure LEFT or RIGHT to go left or right respectively, passing the identity of the road it is coming from as an argument. (Thus car coming on road B and wanting to take a left will execute LEFT(B)).

A. Design the procedures LEFT and RIGHT using semaphores. The correct solution should support maximal parallelism, assure that no deadlocks occur, and there is no starvation. Of course there should be no collisions of the cars.
B. How many semaphore variables does your solution require and why?

C. What is the maximum number of cars that can be in the intersection in your solution?

Problem 2

You have to solve a variation of the readers-writers problem, in which multiple writers can write at the same time. Specifically, there are readers and writers. Up to 5 reads at the same time are allowed, but only one write at the same time are allowed. A read and write at the same time is not allowed.

Provide a solution using semaphores with the following properties:

- no busy waiting
- starvation-free (i.e. a continuous stream of readers does not starve writers, and vice versa) is desirable but not compulsory (but you will lose some points)
- you cannot use process ids and you cannot have a separate semaphore for every process.

Problem 3

Some monkeys are trying to cross a ravine. A single rope traverses the ravine, and monkeys can cross hand-over-hand. Up to five monkeys can hang on the rope at any one time. If there are more than five, then the rope will break and they will all fall to their end. Also, if eastward-moving monkeys encounter westward-moving monkeys, all will fall to their end. Write pseudocode for the problem that solves this synchronization problem.