**FL96 Automation Engineering RA** – **Coding Exercise**

**Overview**

In this exercise, we would like you to develop a hypothetical workflow for automation of liquid handling for synthesis of inorganic materials. You are designing a software tool that will take any list of requested compositions and generate a script that the liquid handler can use to prepare those materials.

The precursor solutions used by the liquid handler contain various metals with different concentrations. These solutions need to be mixed in the correct quantities to produce the desired volume and ratio of metals in the final solution.

For example, say that you are provided with the following precursors and target:

*Precursor 1: Fe, 1 mol/L*

*Precursor 2: Zn, 2 mol/L*

*Target: 3mL of Fe0.5Zn0.5 solution*

This request could be completed by mixing 2mL of precursor 1 and 1mL of precursor 2, to produce 3mL of solution with the correct Fe:Zn ratio.

**Input files**

The inputs to the workflow are two spreadsheets:

* precursors.csv containing information on the precursor inventory of the liquid handler
* targets.csv containing a list of desired target mixtures to be prepared

**Hardware**

The workflow is intended to be run on a robotic liquid handling platform that can transfer liquids between containers stored on its deck. The scripts that are used as inputs by the liquid handler are text files containing a list of commands with the format:

*transfer(source, destination, volume)*

to transfer a volume in mL from the source to destination locations on the deck. The source and destination locations should match the ones in the precursors.csv and targets.csv spreadsheets.

**Output file**

The output of the code should be the script file that will be executed by the liquid handler to prepare the desired mixtures. An example snippet of some lines in the script would look something like this:

*…*

*transfer(“A1”, “B1”, 0.1)*

*transfer(“A1”, “B2”, 0.25)*

*transfer(“A2”, “B1”, 0.15)*

*…*

**Deliverables:**

1. Workflow outline: Provide a brief descriptive outline of the code that would be used to implement the liquid handling workflow, detailing the steps needed to calculate the required quantities of each precursor and generate a series of robot commands to prepare the mixtures.
2. Pseudocode: Write python-based pseudocode that would implement your outlined workflow. The pseudocode should contain features such as comments, functions, and classes which can be used to separate out sections performing different tasks.

**Note:** While you are not required to provide functioning code, you are welcome to do so if you would like. If you choose to provide code, please change the file extension to .txt before returning via email, as our security filter automatically rejects .py and .ipynb attachments.