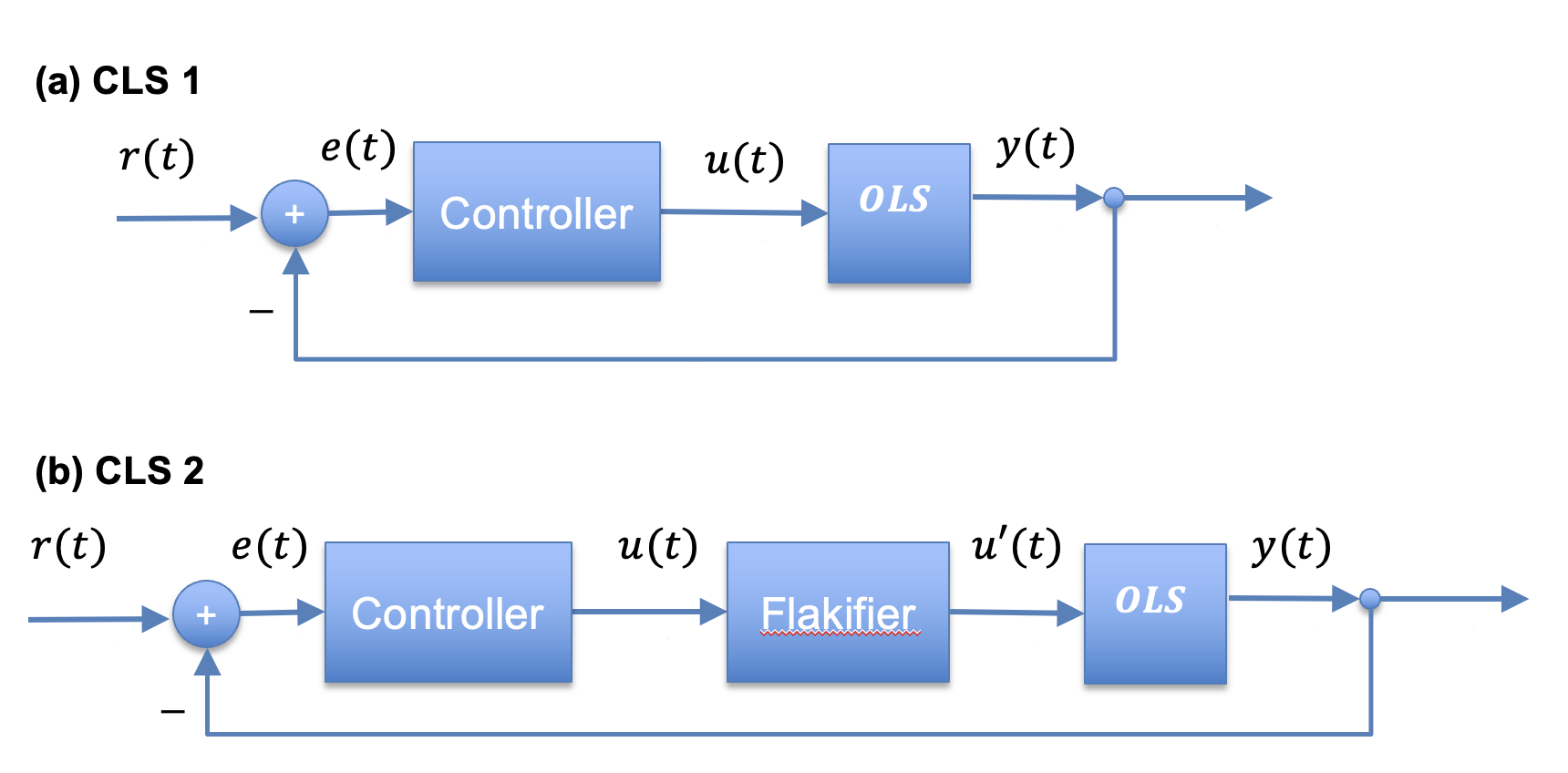
Homework 1: Closed Loop Design and Testbed Construction

In this homework, you will implement testbeds for two closed loop systems, CLS 1, CLS 2.



1. (10 pt) Choose an ODE model [curated BioModels.](https://www.ebi.ac.uk/biomodels/search?query=*%3A*%20AND%20curationstatus%3A%22Manually%20curated%22%20AND%20modellingapproach%3A%22ordinary%20differential%20equation%20model%22&domain=biomodels&offset=0&numResults=10)
   1. Create a notebook that runs the model using Tellurium.
   2. Find a measurement output (y(t)) that you want to control and a control input (u(t)) that can manipulate it.
   3. Specify control objectives that include one or more of the following: (i) setpoint, (ii) settling time, (iii) absence (or presence) of oscillations.
2. (30 pt) Construct a closed loop system for youe OLS using the CLS 1 architecture. Tune the controller to achieve your control objectives. Plot the time response of the system, showing y(t) and r(t).
3. (50) Now consider the CLS 2 architecture that has an additional element, the Flakifier. The Falkifier causes u(t) signals to be randomly lost but with filtering.. The state equation is with probability *p* and dy = 0 with probability *1-p*. So, when *p=1*, this is a filter. When *p=0*, this is a system with a constant 0 output.
   1. Implement a function that returns a NonlinearIOSystem that is a Flakifier with parameter *p.*
   2. Implement a testbed for architecture CLS 2 using your OLS.
   3. What is the smallest value of *p* for which the model is solvable? Tune your controller for CLS 2 with this value of *p*.
4. (10 pt) Summarize the challenges your encountered with tuning CLS 1, CLS 2 with p=0.8, and CLS 2 with p= 0.2.

This homework will be submitted as a Jupyter Notebook that you upload into your student folder in this [directory](https://drive.google.com/drive/folders/1v_5E8ilRBS1O4t_Y5HjKNWsaRnVqxcGg).