**gdp\_col/column.py**

In this code and are equivalent to what we called and in the reactor model, and those variables are used to define the existence/nonexistence of a tray for . Due to the constraint they are using in line 220, and the fact that the feed location is fixed, they can find the optimal number of stages and the optimal location of the feeds by using alone. Thus, this problem (as formulated in the code) cannot be directly reformulated with external variables, i.e. there are no Boolean variables with an inherent ordering where exactly 1 (or exactly ) must be selected.

In this case, an additional step is required to apply the external variables reformulation. The steps are below:

* Define new Boolean variables and over
* Define a new subset
* Define a new subset with
* Define a new subset .
* These Boolean variables must satisfy (one reflux and one boil up only+reflux occurs in the upper section and boil up in the lower section):

\*Note that in this case the reboiler stage is and the condenser stage is

* If there is **at least one** reflux between and **and [** none of the trays between and has the boil-up flow **or** tray has the boil-up fow],  **then**  exists.
* It is not necessary to delete equations in the existing code, but constraint in line 220 can be deleted if you want.
* Note that and fulfill the requirements: **exactly k=1 + order**. Thus, the problem can now be reformulated with external variables.