▾ BPL_TEST2_Batch script with PyFMI

The key library PyFMI is installed.

After the installation a small application BPL_TEST2_Batch is loaded and run. You can continue with this example if you like.

```
!lsb_release -a # Actual VM Ubuntu version used by Google
```

```
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 20.04.5 LTS
Release:        20.04
Codename:       focal
```

```
%env PYTHONPATH=
```

```
env: PYTHONPATH=
```

```
!wget https://repo.anaconda.com/miniconda/Miniconda3-py310_23.1.0-1-Linux-x86_64.sh
!chmod +x Miniconda3-py310_23.1.0-1-Linux-x86_64.sh
!bash ./Miniconda3-py310_23.1.0-1-Linux-x86_64.sh -b -f -p /usr/local
import sys
sys.path.append('/usr/local/lib/python3.10/site-packages/')
```

```
--2023-06-01 06:15:21--  https://repo.anaconda.com/miniconda/Miniconda3-py310_23.1.0-1-Linux-:
Resolving repo.anaconda.com (repo.anaconda.com)... 104.16.130.3, 104.16.131.3, 2606:4700::681(
Connecting to repo.anaconda.com (repo.anaconda.com)|104.16.130.3|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 74403966 (71M) [application/x-sh]
Saving to: 'Miniconda3-py310_23.1.0-1-Linux-x86_64.sh'

Miniconda3-py310_23 100%[===================>]  70.96M   309MB/s    in 0.2s

2023-06-01 06:15:22 (309 MB/s) - 'Miniconda3-py310_23.1.0-1-Linux-x86_64.sh' saved [74403966/`

PREFIX=/usr/local
Unpacking payload ...

Installing base environment...


Downloading and Extracting Packages


Downloading and Extracting Packages

Preparing transaction: done
Executing transaction: done
installation finished.
```

```
!conda update -n base -c defaults conda --yes
```

```
      Preparing transaction: done
      Verifying transaction: done
      Executing transaction: done
```

```
!conda --version
!python --version
```

```
      conda 23.5.0
      Python 3.10.9
```

```
!conda install -c conda-forge pyfmi --yes # Install the key package
```

```
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
```

▾ BPL_TEST2_Batch setup

Now specific installation and the run simulations. Start with connecting to Github. Then upload the two files:

- FMU - BPL_TEST2_Batch_linux_om_me.fmu
- Setup-file - BPL_TEST2_Batch_explore.me.py

```
%%bash
git clone https://github.com/janpeter19/BPL_TEST2_Batch
```

```
Cloning into 'BPL_TEST2_Batch'...
```

```
%cd BPL_TEST2_Batch
```

```
/content/BPL_TEST2_Batch
```

```
run -i BPL_TEST2_Batch_explore.py
```

```
        Linux - run FMU pre-comiled OpenModelica 1.21.0

        Model for bioreactor has been setup. Key commands:
         - par()        - change of parameters and initial values
         - init()       - change initial values only
         - simu()       - simulate and plot
         - newplot()    - make a new plot
         - show()       - show plot from previous simulation
         - disp()       - display parameters and initial values from the last simulation
         - describe()   - describe culture, broth, parameters, variables with values/units

        Note that both disp() and describe() takes values from the last simulation

        Brief information about a command by help(), eg help(simu)
        Key system information is listed with the command system_info()
```

```
%matplotlib inline
plt.rcParams['figure.figsize'] = [25/2.54, 20/2.54]
```
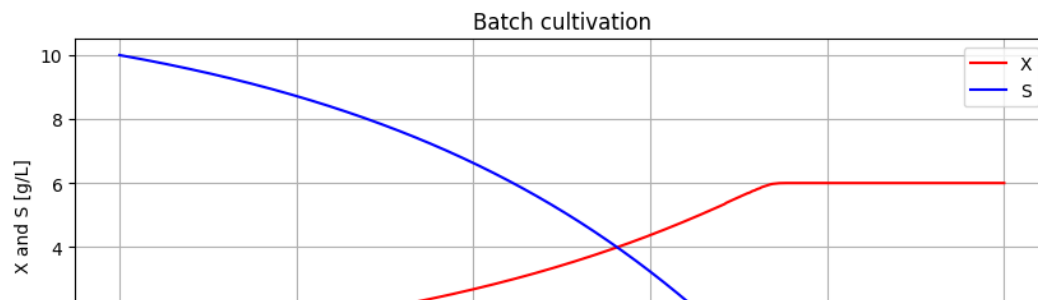
```
import warnings
warnings.filterwarnings("ignore")
```

▾ BPL_TEST2_Batch - demo

```
describe('culture'); print(); #describe('liquidphase')                                    # Pump sche
```
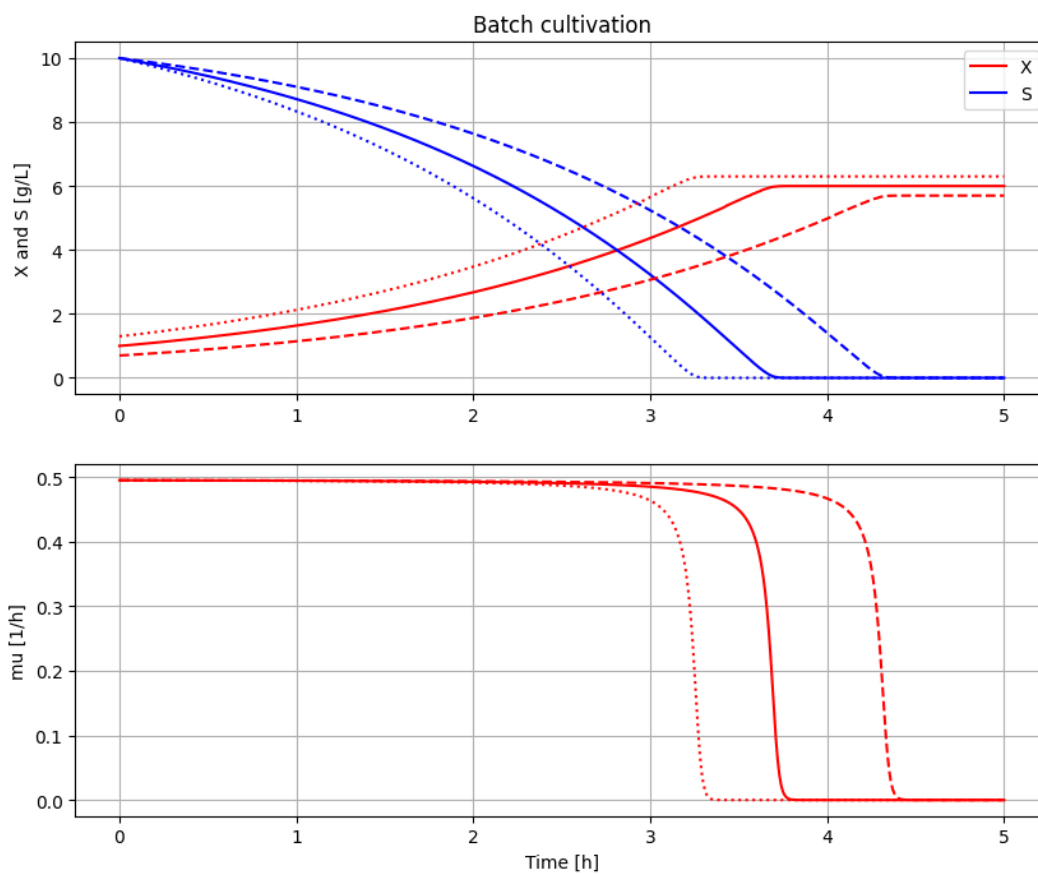
```
        Simplified text book model - only substrate S and cell concentration X
```

```
# Simulation with default values of the process
newplot(plotType='TimeSeries')
simu()
```
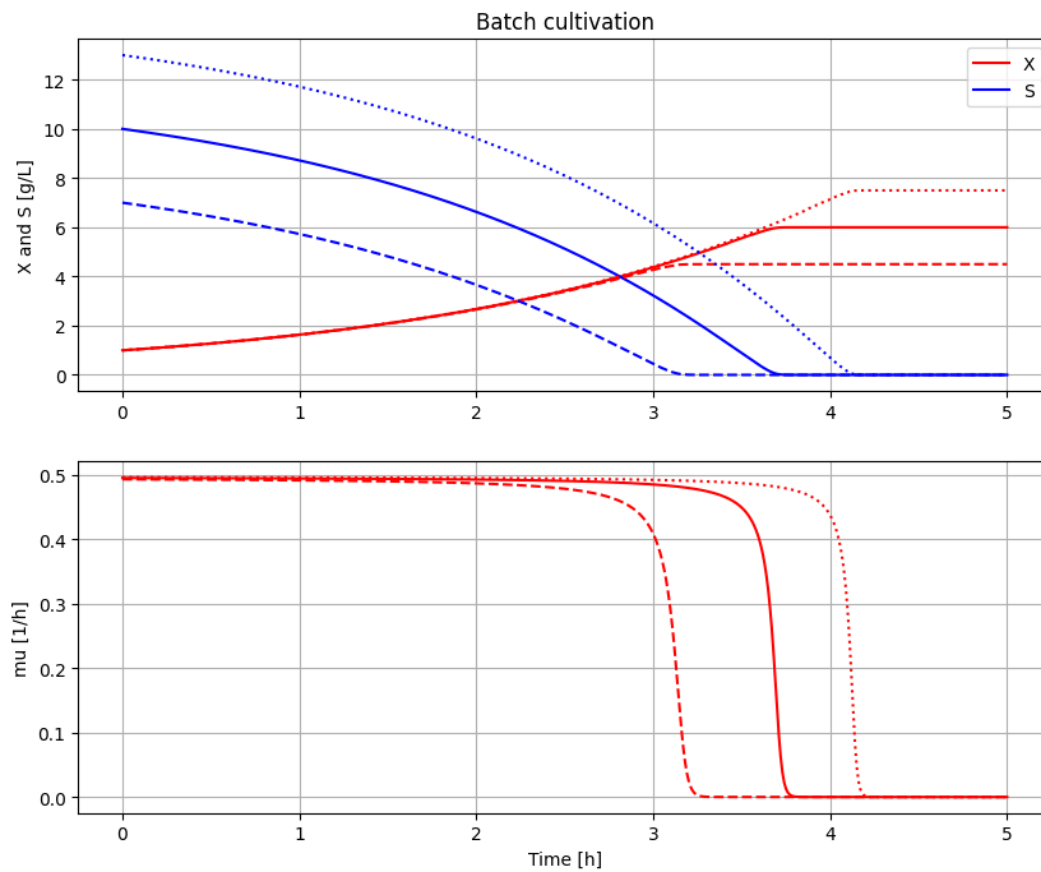
```
# Simulation were initial value of biomass VX_0 is varied
newplot(plotType='TimeSeries')
for value in [1.0, 0.7, 1.3]: init(VX_0=value); simu(5)

# Restore default value of VX_0
init(VX_0=1.0)
```



```
# Simulation were initial value of substrate VS_0 is varied
newplot(plotType='TimeSeries')
for value in [10, 7, 13]: init(VS_0=value); simu(5)

# Restore default value of VS_0
init(VS_0=10)
```
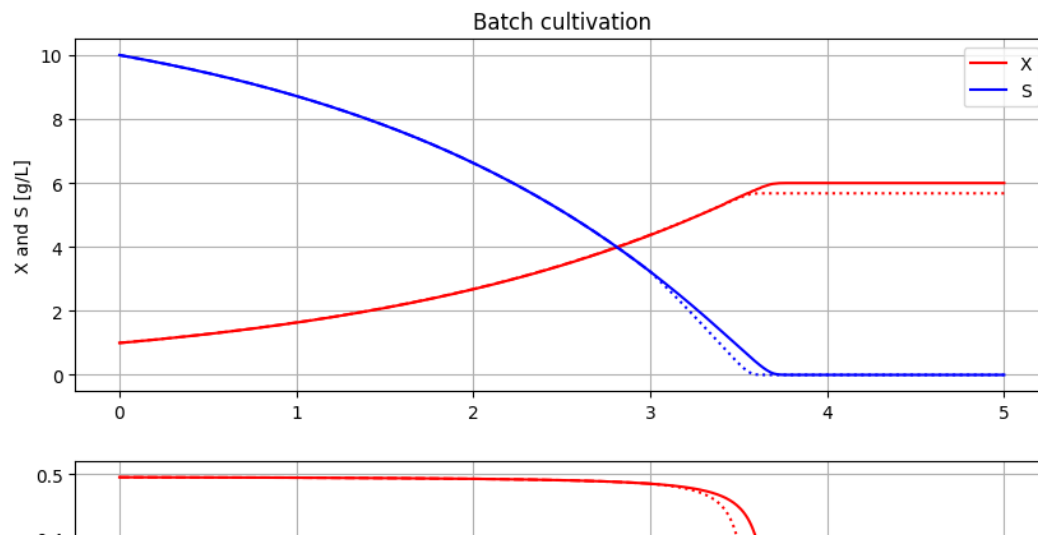
```
# Simulation where metabolism is changed after 3 hours
newplot(plotType='TimeSeries')
simu(5)

simu(3)
par(Y=0.4, qSmax=1.0/(0.4/0.5)); simu(2, 'cont')

# Restore default value of Y and qSmax
par(Y=0.5, qSmax=1.0)
```

Batch cultivation


```
disp('culture')
```

```
    Y : 0.4
    qSmax : 1.25
    Ks : 0.1
```



```
describe('mu')
```

```
    Cell specific growth rate variable : 0.0 [ 1/h ]
```

```
describe('parts')
```

```
    ['bioreactor', 'bioreactor.culture']
```

```
describe('MSL')
```

```
    MSL: 3.2.3 - used components: none
```

```
system_info()
```

```
    System information
     -OS: Linux
     -Python: 3.10.11
     -Scipy: not installed in the notebook
     -PyFMI: 2.10.3
     -FMU by: OpenModelica Compiler OpenModelica 1.21.0
     -FMI: 2.0
     -Type: FMUModelME2
     -Name: BPL_TEST2.Batch
     -Generated: 2023-04-19T18:37:26Z
     -MSL: 3.2.3
     -Description: Bioprocess Library version 2.1.1
     -Interaction: FMU-explore version 0.9.7
```

✓ 0s   completed at 08:16   ● ✕