PyFMI ver 2.7.4 installation and then BPL_TEST2_Batch script

The key library PyFMI v2.7.4 is installed and downgrading is done Numpy v1.19.1. To simplify this we first install conda.

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 18.04.6 LTS
Release:        18.04
Codename:       bionic
```

```
%env PYTHONPATH=
```

```
env: PYTHONPATH=
```

```
!wget https://repo.anaconda.com/miniconda/Miniconda3-py37_4.12.0-Linux-x86_64.sh
!chmod +x Miniconda3-py37_4.12.0-Linux-x86_64.sh
!bash ./Miniconda3-py37_4.12.0-Linux-x86_64.sh -b -f -p /usr/local
import sys
sys.path.append('/usr/local/lib/python3.7/site-packages/')
```

```
Package lxml conflicts for:
pyfmi -> lxml
lxml

Package pycosat conflicts for:
conda==4.12.0=py37h06a4308_0 -> pycosat[version='>=0.6.3']
pycosat==0.6.3=py37h27cfd23_0

Package wheel conflicts for:
pip==21.2.2=py37h06a4308_0 -> wheel
wheel==0.37.1=pyhd3eb1b0_0

Package libxslt conflicts for:
pyfmi -> lxml -> libxslt[version='>=1.1.33,<2.0a0']
lxml -> libxslt[version='>=1.1.33,<2.0a0']
libxslt

Package pysocks conflicts for:
pysocks==1.7.1=py37_1
urllib3==1.26.8=pyhd3eb1b0_0 -> pysocks[version='>=1.5.6,<2.0,!=1.5.7']
requests==2.27.1=pyhd3eb1b0_0 -> urllib3[version='>=1.21.1,<1.27'] -> pysocks[

Package six conflicts for:
six==1.16.0=pyhd3eb1b0_1
```

```
      six==1.16.0=pyhd3eb1b0_1
      conda-content-trust==0.1.1=pyhd3eb1b0_0 -> six

      Package sundials conflicts for:
      pyfmi -> assimulo[version='>=3.0'] -> sundials[version='>=5.8.0,<5.9.0a0']
      sundials
      assimulo -> sundials[version='>=5.8.0,<5.9.0a0']The following specifications w

        - feature:/linux-64::__glibc==2.27=0
        - feature:|@/linux-64::__glibc==2.27=0
        - brotlipy==0.7.0=py37h27cfd23_1003 -> libgcc-ng[version='>=7.3.0'] -> __gli
        - cffi==1.15.0=py37hd667e15_1 -> libgcc-ng[version='>=7.5.0'] -> __glibc[ver
        - conda-package-handling==1.8.1=py37h7f8727e_0 -> libgcc-ng[version='>=7.5.0
        - cryptography==36.0.0=py37h9ce1e76_0 -> libgcc-ng -> __glibc[version='>=2.1
        - fmilib -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='>=2.17']
        - gmp -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='>=2.17']
        - libffi==3.3=he6710b0_2 -> libgcc-ng[version='>=7.3.0'] -> __glibc[version=
        - libgcc-ng==9.3.0=h5101ec6_17 -> __glibc[version='>=2.17']
        - libstdcxx-ng==9.3.0=hd4cf53a_17 -> __glibc[version='>=2.17']
        - libxml2 -> libgcc-ng[version='>=9.3.0'] -> __glibc[version='>=2.17']
        - libxslt -> libgcc-ng[version='>=9.3.0'] -> __glibc[version='>=2.17']
        - metis -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='>=2.17']
        - mpfr -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='>=2.17']
        - ncurses==6.3=h7f8727e_2 -> libgcc-ng[version='>=7.5.0'] -> __glibc[version
        - numpy -> libgcc-ng[version='>=7.3.0'] -> __glibc[version='>=2.17']
        - numpy-base -> libgcc-ng[version='>=7.3.0'] -> __glibc[version='>=2.17']
        - openssl==1.1.1n=h7f8727e_0 -> libgcc-ng[version='>=7.5.0'] -> __glibc[vers
        - pycosat==0.6.3=py37h27cfd23_0 -> libgcc-ng[version='>=7.3.0'] -> __glibc[v
        - pyfmi -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='>=2.17']
        - python==3.7.13=h12debd9_0 -> libgcc-ng[version='>=7.5.0'] -> __glibc[versi
        - readline==8.1.2=h7f8727e_1 -> libgcc-ng[version='>=7.5.0'] -> __glibc[vers
        - ruamel_yaml==0.15.100=py37h27cfd23_0 -> libgcc-ng[version='>=7.3.0'] -> __
        - tk==8.6.11=h1ccaba5_0 -> libgcc-ng[version='>=7.5.0'] -> __glibc[version='
        - xz==5.2.5=h7b6447c_0 -> libgcc-ng[version='>=7.3.0'] -> __glibc[version='>
        - yaml==0.2.5=h7b6447c_0 -> libgcc-ng[version='>=7.3.0'] -> __glibc[version=
```

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

```
      Collecting package metadata (current_repodata.json): done
      Solving environment: done

      # All requested packages already installed.

      Retrieving notices: ...working... done
```

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

```
      conda 22.9.0
      Python 3.7.13
```

```
!conda install -c conda-forge pyfmi==2.7.4 --yes # Install the key package
```

```
          libgcc-ng-12.2.0            |       h65d4601_18         936 KB  conda-forge
          libgomp-12.2.0              |       h65d4601_18         455 KB  conda-forge
          liblapack-3.9.0             |16_linux64_openblas          13 KB  conda-forg
          liblapacke-3.9.0            |16_linux64_openblas          13 KB  conda-forg
          libopenblas-0.3.21          |pthreads_h78a6416_3        10.1 MB  conda-forg
```

```
  llvm-openmp-14.0.6          |       h9e868ea_0         4.4 MB
  openblas-0.3.21             |pthreads_h320a7e8_3        10.8 MB  conda-forg
  openssl-1.1.1q              |       h166bdaf_0         2.1 MB  conda-forge
  ------------------------------------------------------------
                                         Total:        28.9 MB

The following NEW packages will be INSTALLED:

  blas-devel         conda-forge/linux-64::blas-devel-3.9.0-16_linux64_openbla
  liblapacke         conda-forge/linux-64::liblapacke-3.9.0-16_linux64_openbla
  llvm-openmp        pkgs/main/linux-64::llvm-openmp-14.0.6-h9e868ea_0 None
  openblas           conda-forge/linux-64::openblas-0.3.21-pthreads_h320a7e8_3

The following packages will be UPDATED:

  blas                       pkgs/main::blas-1.0-openblas --> conda-forge::b
  ca-certificates    pkgs/main::ca-certificates-2022.07.19~ --> conda-forge::c
  conda              pkgs/main::conda-22.9.0-py37h06a4308_0 --> conda-forge::c
  libblas                       3.9.0-15_linux64_openblas --> 3.9.0-16_linux
  libcblas                      3.9.0-15_linux64_openblas --> 3.9.0-16_linux
  libgcc-ng          pkgs/main::libgcc-ng-11.2.0-h1234567_1 --> conda-forge::l
  libgomp              pkgs/main::libgomp-11.2.0-h1234567_1 --> conda-forge::l
  liblapack                     3.9.0-15_linux64_openblas --> 3.9.0-16_linux
  libopenblas                  0.3.20-pthreads_h78a6416_0 --> 0.3.21-pthread

The following packages will be SUPERSEDED by a higher-priority channel:

  _libgcc_mutex           pkgs/main::_libgcc_mutex-0.1-main --> conda-forge::_
  _openmp_mutex          pkgs/main::_openmp_mutex-5.1-1_gnu --> conda-forge::_
  certifi            pkgs/main/linux-64::certifi-2022.9.24~ --> conda-forge/no
  openssl              pkgs/main::openssl-1.1.1q-h7f8727e_0 --> conda-forge::o



Downloading and Extracting Packages
libgomp-12.2.0       | 455 KB    | : 100% 1.0/1 [00:00<00:00,  6.75it/s]
liblapacke-3.9.0     | 13 KB     | : 100% 1.0/1 [00:00<00:00, 31.40it/s]
_libgcc_mutex-0.1    | 3 KB      | : 100% 1.0/1 [00:00<00:00, 32.92it/s]
blas-2.116           | 13 KB     | : 100% 1.0/1 [00:00<00:00, 31.67it/s]
libblas-3.9.0        | 13 KB     | : 100% 1.0/1 [00:00<00:00, 24.70it/s]
libgcc-ng-12.2.0     | 936 KB    | : 100% 1.0/1 [00:00<00:00,  5.82it/s]
llvm-openmp-14.0.6   | 4.4 MB    | : 100% 1.0/1 [00:00<00:00,  3.19it/s]
libcblas-3.9.0       | 13 KB     | : 100% 1.0/1 [00:00<00:00, 27.18it/s]
liblapack-3.9.0      | 13 KB     | : 100% 1.0/1 [00:00<00:00, 26.21it/s]
blas-devel-3.9.0     | 12 KB     | : 100% 1.0/1 [00:00<00:00, 28.17it/s]
libopenblas-0.3.21   | 10.1 MB   | : 100% 1.0/1 [00:01<00:00,  1.94s/it]
openssl-1.1.1q       | 2.1 MB    | : 100% 1.0/1 [00:00<00:00,  2.54it/s]
openblas-0.3.21      | 10.8 MB   | : 100% 1.0/1 [00:02<00:00,  2.56s/it]
_openmp_mutex-4.5    | 6 KB      | : 100% 1.0/1 [00:00<00:00, 33.75it/s]
Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Retrieving notices: ...working... done
```

```
!conda install numpy=1.19.1 --yes # Need to downgrade numpy
```

```
Collecting package metadata (current_repodata.json): done
Solving environment: done
```

```
## Package Plan ##

  environment location: /usr/local

  added / updated specs:
    - numpy=1.19.1


The following packages will be SUPERSEDED by a higher-priority channel:

  ca-certificates    conda-forge::ca-certificates-2022.9.2~ --> pkgs/main::ca-
  certifi            conda-forge/noarch::certifi-2022.9.24~ --> pkgs/main/linu
  conda              conda-forge::conda-22.9.0-py37h89c186~ --> pkgs/main::con
  openssl            conda-forge::openssl-1.1.1q-h166bdaf_0 --> pkgs/main::ope


Preparing transaction: done
Verifying transaction: done
Executing transaction: done
Retrieving notices: ...working... done
```

Now specific installation run a simulation and notebook for that

Start with connecting to Github. Then upload the two files:

- FMU - BPL_TEST2_Batch_linux_jm_cs.fmu
- Setup-file - BPL_TEST2_Batch_explore.py

```
# Filter out DepracationWarnings for 'np.float as alias' is needed - wish I could m
import warnings
warnings.filterwarnings("ignore")
```

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

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

```
%cd BPL_TEST2_Batch
```

```
/content/BPL_TEST2_Batch/BPL_TEST2_Batch/BPL_TEST2_Batch
```

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

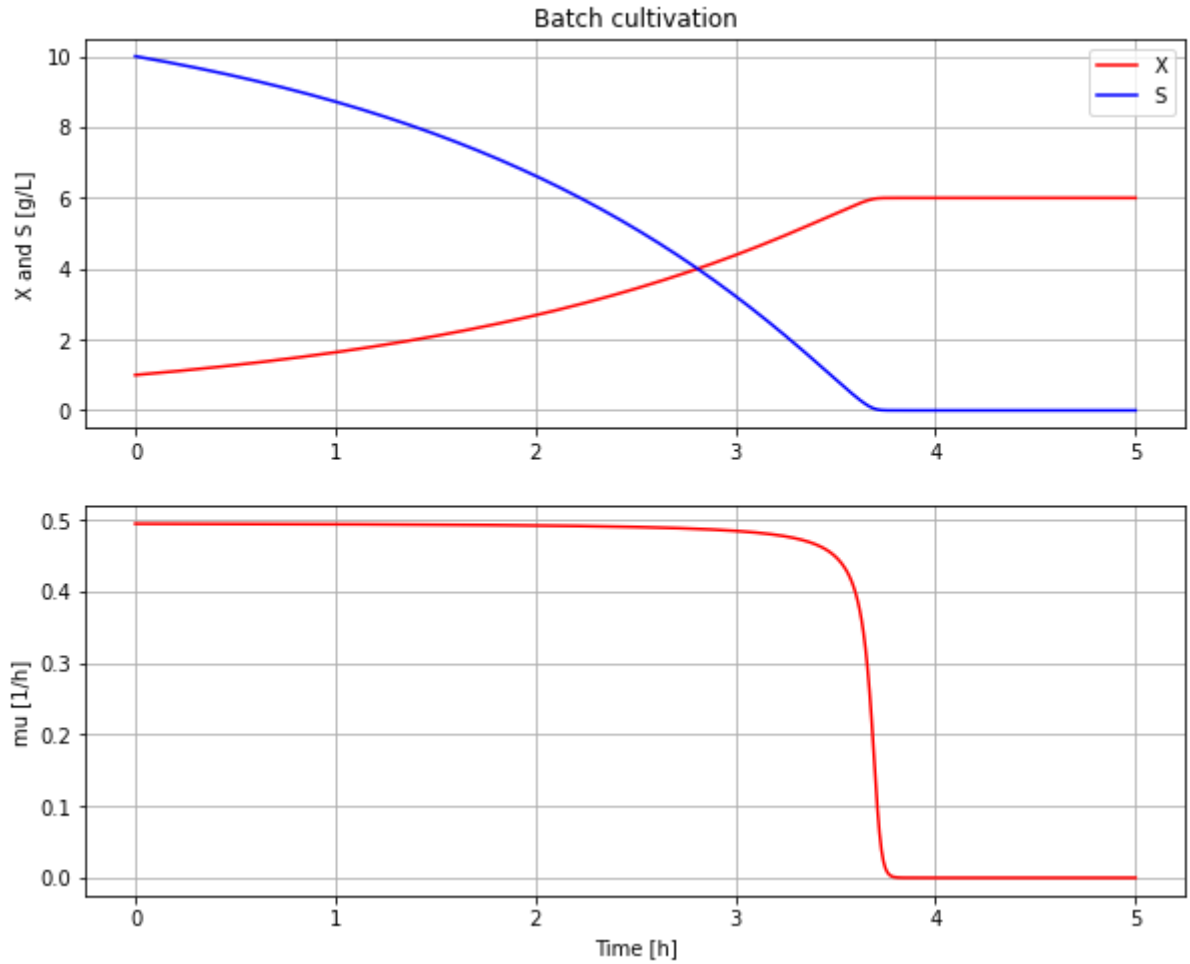
```
Linux - run FMU pre-comiled JModelica 2.4

Model for bioreactor has been setup. Key commands:
 - par()       - change of parameters and initial values
 - init()      - change initial values only
 - simu()      - simulate and plot
```

```
%matplotlib inline
plt.rcParams['figure.figsize'] = [25/2.54, 20/2.54]
```

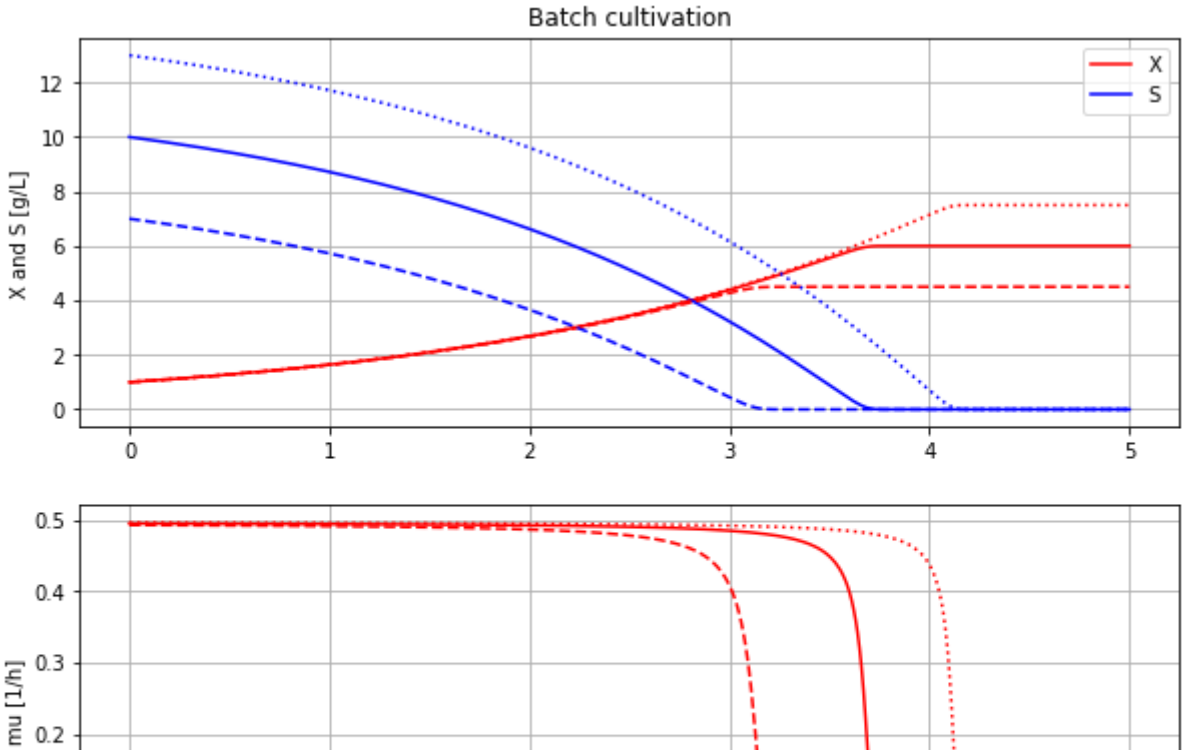
```
 - describe()  - describe culture, broth, parameters, variables with values
```

```
# Simulation with default values of the process
newplot(plotType='TimeSeries')
simu()
```




```
# 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)
```




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

```
    Y : 0.5
    qSmax : 1.0
    Ks : 0.1
```

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

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

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

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

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

```
    MSL: 3.2.2 build 3 - used components: none
```

```
system_info()
```

```
    System information
     -OS: Linux
     -Python: 3.7.14
     -Scipy: not installed in the notebook
     -PyFMI: 2.7.4
     -FMU by: JModelica.org
     -FMI: 2.0
     -Type: FMUModelCS2
     -Name: BPL_TEST2.Batch
     -Generated: 2022-10-17T08:53:15
     -MSL: 3.2.2 build 3
```

```
-Description: Bioprocess Library version 2.1.0
-Interaction: FMU-explore ver 0.9.5
```


✓ 0s completed at 10:56