Using Python with Eclipse and OPM

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Installation

```
bash% git clone git@github.com:Statoi/libecl
bash% cd libecl
bash% mkdir build ; cd build
bash% cmake .. -DBUILD_PYTHON=ON -DCMAKE_INSTALL_PREFIX=$prefix
bash% make ; make install

bash% export PYTHONPATH=$prefix/lib/python2.7/{site|dist}-
packages
bash% pydoc ecl.ecl.EclGrid
```

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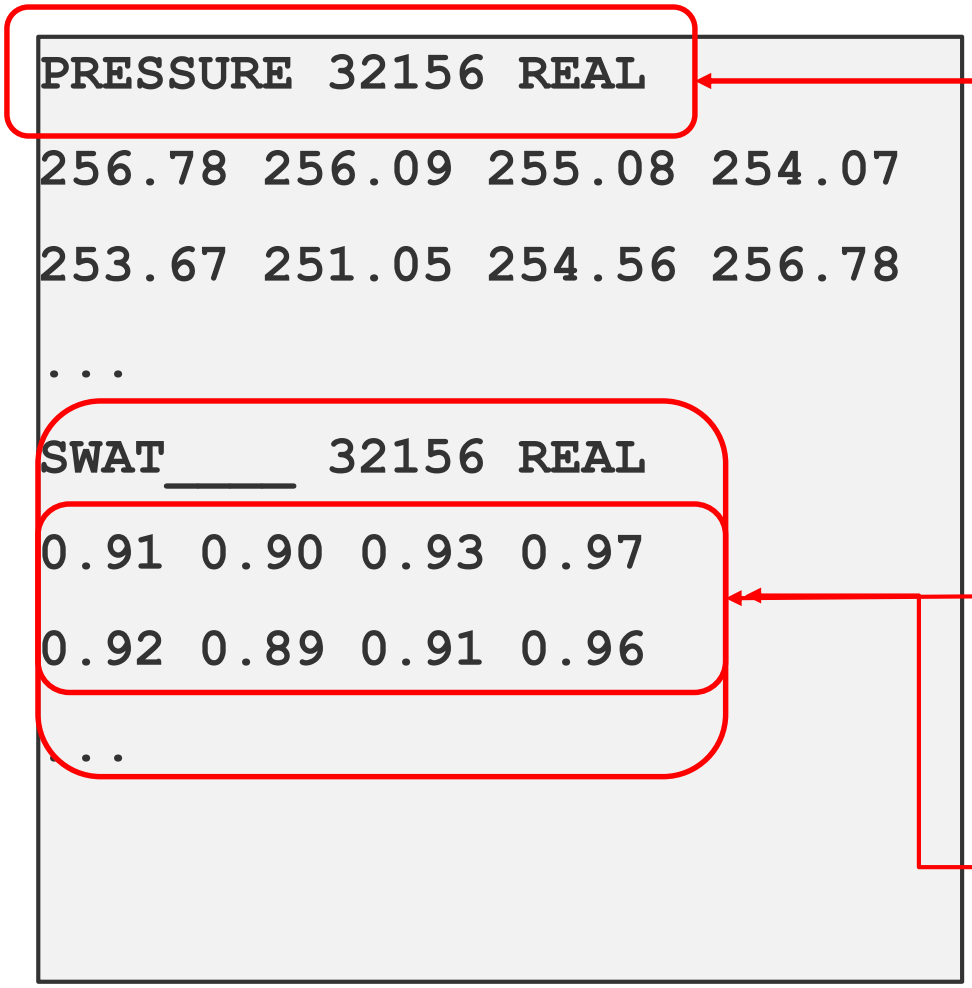
The ECLIPSE binary format



1. Name: 8 character string
2. Data size: integer
3. Data type: 4 character string

1. Fortran IO with embedded block sizes.
2. Endian swapping

Data in *blocks.*

EclKW

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Small libecl binary utilities

convert.x:

Will convert an ECLIPSE output file back and forth between binary and ASCII represenetation. Will consider file name extension to determine the desired conversion

```
bash% convert.x CASE.UNRST => CASE.FUNRST
```

ecl_pack.x / ecl_unpack.x

Will convert ECLIPSE summary and restart files between the unifed and multiple file formats

```
bash% ecl_pack.x CASE.X* => CASE.UNRST
```

kw_list.x

Will list all the keyword headers from an ECLIPSE output file:

```
bash% ecl_pack.x CASE.X* => CASE.UNRST
```

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EclKW – «interactive» demo:

```
>>> from ecl.ecl import EclKW, EclDataType, openFortIO, FortIO, EclFile
>>> kw = EclKW("MY-KW", 1000, EclDataType.ECL_FLOAT)
>>> print len(kw)
1000
>>> kw[0:500] = 1
>>> kw[500:1000] = 2
>>> print kw.sum(), kw.get_min_max()
1500.0, 1, 2
>>> with openFortIO( "MY_FILE", FortIO.WRITE_MODE) as f:
...     kw.fwrite( f )
...
>>> f = EclFile("MY_FILE")
>>> kw2 = f["MY-KW"][0]
>>> print kw == kw2
True
>>> kw3 = 0.5*kw + kw2
```

Import the required symbols

Create a new EclKW

Access some properties

File IO

Basic arithmetic

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Reading restart file

SEQNUM	1:INTE
INTEHEAD	296:INTE
STARTSOL	0:MESS
PRESSURE	34770:REAL
SWAT	34770:REAL
SGAS	34770:REAL
RS	34770:REAL
RV	34770:REAL
ENDSOL	0:MESS

Report ste

```
>>> from ecl.ecl import EclFile
>>> rst_file = EclFile("ECLIPSE.UNRST")
>>> p_list = rst_file["PRESSURE"]
>>> p_list = [ p1, p2, p3 ]
```

SEQNUM	1:INTE
INTEHEAD	296:INTE
STARTSOL	0:MESS
PRESSURE	34770:REAL
SWAT	34770:REAL
SGAS	34770:REAL
RS	34770:REAL
RV	34770:REAL
ENDSOL	0:MESS

R

```
>>> from ecl.ecl import EclRestartFile
>>> rst_file = EclRestartFile("ECLIPSE.UNRST")
>>> view = rst_file.restart_view( report_step = 2 )
```

#st of keyword instances.

SEQNUM	1:INTE
INTEHEAD	296:INTE
STARTSOL	0:MESS
PRESSURE	34770:REAL
SWAT	34770:REAL
SGAS	34770:REAL
RS	34770:REAL
RV	34770:REAL
ENDSOL	0:MESS

Report step 3

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EclSummary

```
#!/usr/bin/env python
import sys
from ecl.ecl import EclSum


case = EclSum( sys.argv[1] )
 for key in case.keys('WWCT:*'):
      bt = case.solve_days( key , 0.25)
      print 'Water breakthrough in %s after %g days' % (key,
days)
```

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EclRegion : select grid cells

```
#!/usr/bin/env python
from ecl.ecl import EclGrid, EclRegion, EclFile


grid = EclGrid('CASE.EGRID')
region = EclRegion(grid, False)
init_file = EclFile('CASE.INIT')


satnum = ini
poro = init_
permx = init_file['PERMX'][0]
...
permx.assign(0, mask = region)
with open('permx.grdecl','w') as f:
    permx.write_grdecl( f )
```

Intersect with thin cells:

```
region.select_thin( 0.1, intersect = True)
```

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Example 1

Find smallest and largest cell in grid and all thin cells.

```
bash% ./grid_info.py CASE
Smallest cell       : 37945.4
Largest cell        : 103195
Thin active cells : 2
(10,7,4)
(10,8,4)
```

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Example 2

Find connected cells and transmissibility for all NNC; sort by index.

```
bash%./cmp_nnc.py CASE
(35,02,01) -> (36,02,01)   T:2.18474
(35,02,02) -> (36,02,02)   T:2.00374
(35,02,03) -> (36,02,03)   T:1.09813
(35,02,04) -> (36,02,04)   T:2.05271
(35,02,05) -> (36,02,05)   T:2.30133
...
```

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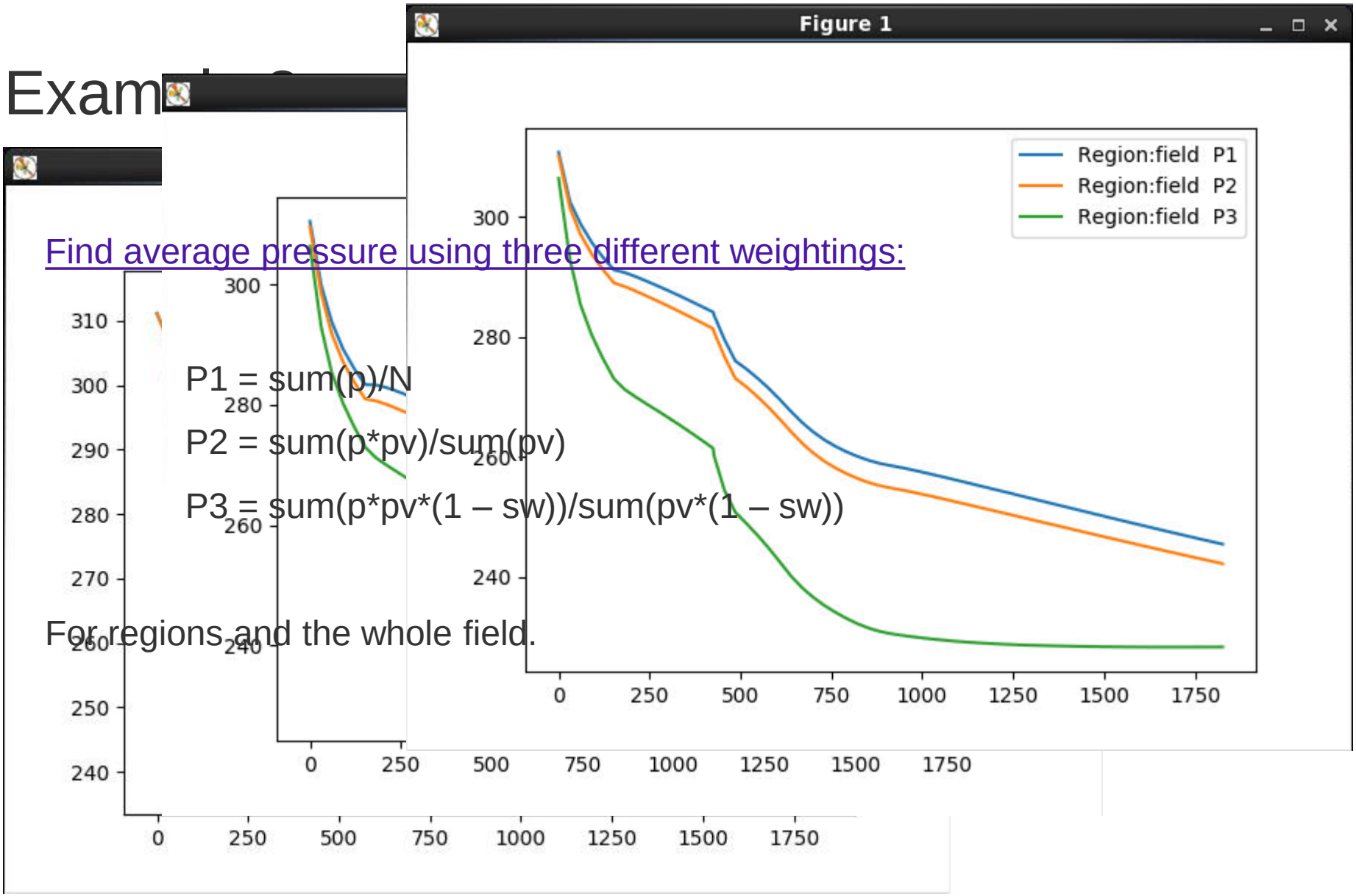
Exam



Find average pressure using three different weightings:

P1 = sum(p)/N

P2 = sum(p*pv)/sum(pv)

P3 = sum(p*pv*(1 – sw))/sum(pv*(1 – sw))

For regions and the whole field.

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Sunbeam

Python wrappers for Opm-parser

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Installation

```
bash% git clone --recursive git@github.com:Statoi/sunbeam
bash% cd sunbeam
bash% mkdir build ; cd build
bash% c
bash% m
bash% c                                                    -
package
bash% pydoc sunbeam
```

NB: Currently sunbeam does not work with opm-parser master; need to use the tag: sunbeam-2017.10 from opm-parser.

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Sunbeam

- Based on Boost Python
- Very much work in progress
- Trying to strike a good balance between Pythonic look and feel and the existing C++ codebase.

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Deck splitter 1

```
if __name__ == "__main__":
    input_deck = sys.argv[1]
    output_path = sys.argv[2]

    deck = sunbeam.parse_deck( input_deck )
    if not os.path.isdir( output_path ):
        os.makedirs( output_path )

    output_deck( deck , output_path, os.path.basename( input_deck ))
```

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Deck splitter 2

```
#!/usr/bin/env python
import sunbeam
import sys
import os

def output_deck(deck, output_path, input_name):
    sections = set(["RUNSPEC","GRID", "PROPS", "REGIONS", "SCHEDULE", "SUMMARY"])
    baseH = open( os.path.join( output_path , input_name), "w")
    fileH = baseH
    for kw in deck:
        if kw.name in sections:
            baseH.write("INCLUDE\n   \'%s\' /\n\n" % kw.name)
            fileH = open( os.path.join( output_path, kw.name ), "w")
        fileH.write( str(kw) )
```

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Well target rate:

```
#!/usr/bin/env python
import sunbeam
import sys

ecl_state = sunbeam.parse( sys.argv[1] )
sched = ecl_state.sched
for i in len(sched.timesteps):
    print sched.timesteps[i],
    for well in ecl_state.sched.wells:
        print well.guide_rate,
    print
```

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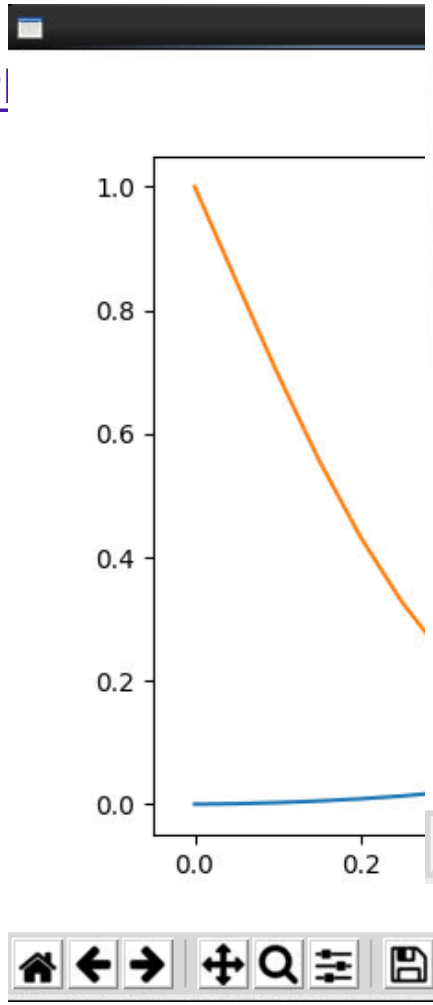

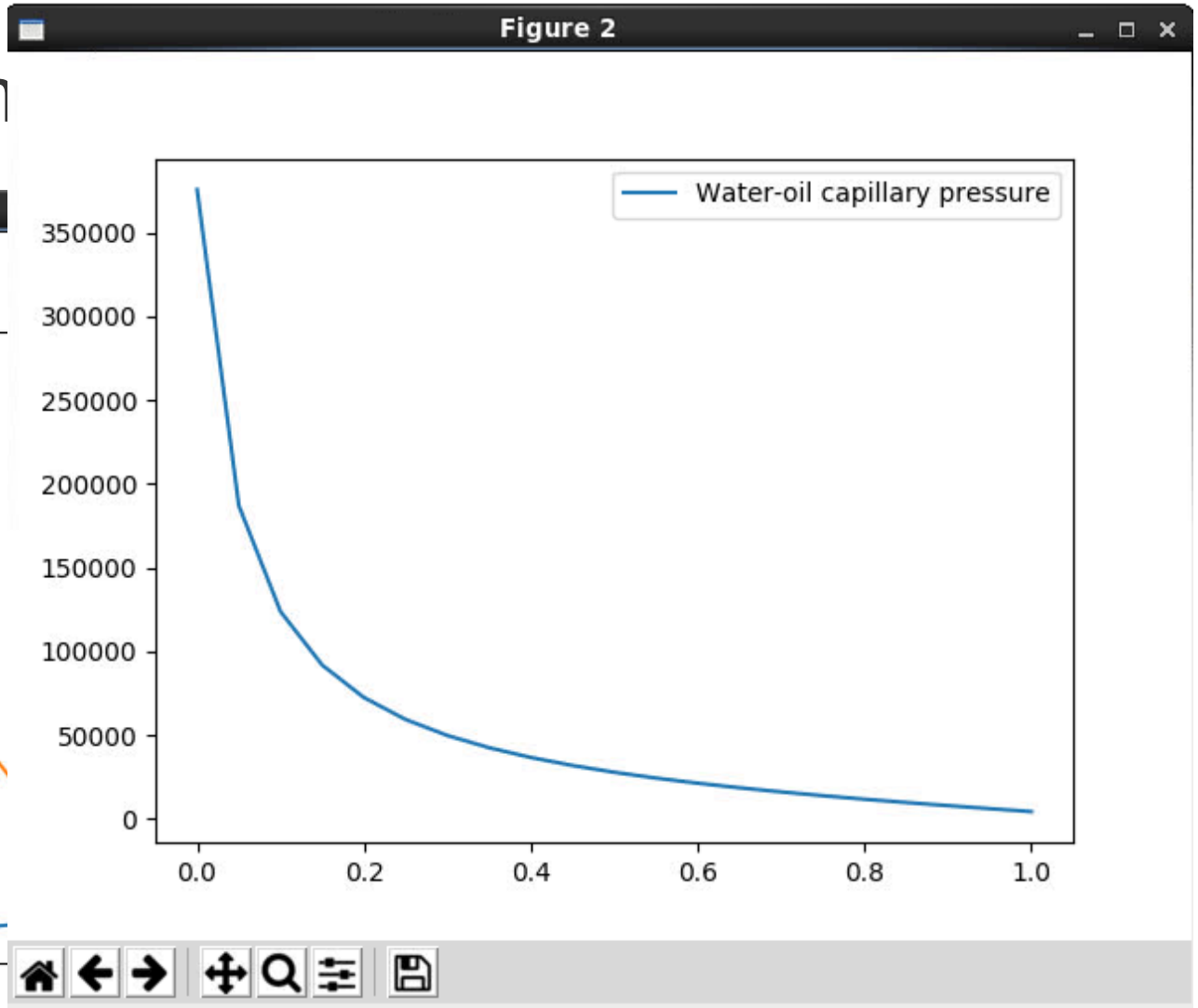

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