onnx_sbs

April 5, 2022

1 ONNX side by side

The notebook compares two runtimes for the same ONNX and looks into differences at each step of the graph.

```
[1]: from jyquickhelper import add_notebook_menu
     add_notebook_menu()
```

```
[1]: <IPython.core.display.HTML object>
```

```
[2]: %load_ext mlprodict
```

```
The mlprodict extension is already loaded. To reload it, use:
  %reload_ext mlprodict
```

```
[3]: %matplotlib inline
```

1.1 The ONNX model

We convert kernel function used in GaussianProcessRegressor. First some values to use for testing.

```
[4]: import numpy
     import pandas
     from io import StringIO

     Xtest = pandas.read_csv(StringIO("""
     1.000000000000000000e+02,1.061277971307766705e+02,1.472195004809226493e+00,2.
     ↪307125069497626552e-02,4.539948095743629591e-02,2.855191098141335870e-01
     1.000000000000000000e+02,9.417031896832908444e+01,1.249743892709246573e+00,2.
     ↪370416174339620707e-02,2.613847280316268853e-02,5.097165413593484073e-01
     1.000000000000000000e+02,9.305231488674536422e+01,1.795726729335217264e+00,2.
     ↪473274733802270642e-02,1.349765645107412620e-02,9.410288840541443378e-02
     1.000000000000000000e+02,7.411264142156210255e+01,1.747723020195752319e+00,1.
     ↪559695663417645997e-02,4.230394035515055301e-02,2.225492746314280956e-01
     1.000000000000000000e+02,9.326006195761877393e+01,1.738860294343326229e+00,2.
     ↪280160135767652502e-02,4.883335335161764074e-02,2.806808409247734115e-01
     1.000000000000000000e+02,8.341529291866362428e+01,5.119682123742423929e-01,2.
     ↪488795768635816003e-02,4.887573336092913834e-02,1.673462179673477768e-01
     1.000000000000000000e+02,1.182436477919874562e+02,1.733516391831658954e+00,1.
     ↪533520930349476820e-02,3.131213519485807895e-02,1.955345358785769427e-01
```

```
  1.000000000000000000e+02,1.228982583299257101e+02,1.115599996405831629e+00,1.
  ↪929354155079938959e-02,3.056996308544096715e-03,1.197052763998271013e-01
  1.000000000000000000e+02,1.160303269386108838e+02,1.018627021014927303e+00,2.
  ↪248784981616459844e-02,2.688111547114307651e-02,3.326105131778724355e-01
  1.000000000000000000e+02,1.163414374640396005e+02,6.644299545804077667e-01,1.
  ↪508088417713602906e-02,4.451836657613789106e-02,3.245643044204808425e-01
  """.strip("\n\r ")), header=None).values
```

Then the kernel.

```python
from sklearn.gaussian_process.kernels import RBF, ConstantKernel as CK, Sum

ker = Sum(
    CK(0.1, (1e-3, 1e3)) * RBF(length_scale=10,
                               length_scale_bounds=(1e-3, 1e3)),
    CK(0.1, (1e-3, 1e3)) * RBF(length_scale=1,
                               length_scale_bounds=(1e-3, 1e3))
)

ker
```

[5]: 0.316**2 * RBF(length_scale=10) + 0.316**2 * RBF(length_scale=1)

[6]: `ker(Xtest)`

```
[6]: array([[2.00000000e-01, 4.88993040e-02, 4.25048140e-02, 5.94472678e-04,
          4.36813578e-02, 7.54738292e-03, 4.79816083e-02, 2.44870899e-02,
          6.11804858e-02, 5.91636643e-02],
         [4.88993040e-02, 2.00000000e-01, 1.41439850e-01, 1.33559792e-02,
          1.56539930e-01, 5.58967934e-02, 5.50622994e-03, 1.61259456e-03,
          9.16550083e-03, 8.54623880e-03],
         [4.25048140e-02, 1.41439850e-01, 2.00000000e-01, 1.66351088e-02,
          1.95919797e-01, 6.23358040e-02, 4.18740453e-03, 1.16061688e-03,
          7.11297248e-03, 6.59679571e-03],
         [5.94472678e-04, 1.33559792e-02, 1.66351088e-02, 2.00000000e-01,
          1.59911246e-02, 6.43812362e-02, 5.90141166e-06, 6.77520700e-07,
          1.52525053e-05, 1.33384349e-05],
         [4.36813578e-02, 1.56539930e-01, 1.95919797e-01, 1.59911246e-02,
          2.00000000e-01, 6.11287461e-02, 4.41158561e-03, 1.23488073e-03,
          7.46433076e-03, 6.92846776e-03],
         [7.54738292e-03, 5.58967934e-02, 6.23358040e-02, 6.43812362e-02,
          6.11287461e-02, 2.00000000e-01, 2.30531400e-04, 4.11226399e-05,
          4.89214341e-04, 4.42318453e-04],
         [4.79816083e-02, 5.50622994e-03, 4.18740453e-03, 5.90141166e-06,
          4.41158561e-03, 2.30531400e-04, 2.00000000e-01, 8.95609518e-02,
          1.03946894e-01, 1.06810568e-01],
         [2.44870899e-02, 1.61259456e-03, 1.16061688e-03, 6.77520700e-07,
          1.23488073e-03, 4.11226399e-05, 8.95609518e-02, 2.00000000e-01,
          7.89686728e-02, 8.05577562e-02],
         [6.11804858e-02, 9.16550083e-03, 7.11297248e-03, 1.52525053e-05,
          7.46433076e-03, 4.89214341e-04, 1.03946894e-01, 7.89686728e-02,
          2.00000000e-01, 1.89352355e-01],
         [5.91636643e-02, 8.54623880e-03, 6.59679571e-03, 1.33384349e-05,
          6.92846776e-03, 4.42318453e-04, 1.06810568e-01, 8.05577562e-02,
```

```
               1.89352355e-01, 2.00000000e-01]])
```

1.2 Conversion to ONNX

The function is not an operator, the function to use is specific to this usage.

```
[7]:  from skl2onnx.operator_converters.gaussian_process import convert_kernel
      from skl2onnx.common.data_types import FloatTensorType, DoubleTensorType
      from skl2onnx.algebra.onnx_ops import OnnxIdentity
      onnx_op = convert_kernel(ker, 'X', output_names=['final_after_op_Add'],
                               dtype=numpy.float32, op_version=12)
      onnx_op = OnnxIdentity(onnx_op, output_names=['Y'], op_version=12)
      model_onnx = model_onnx = onnx_op.to_onnx(
                     inputs=[('X', FloatTensorType([None, None]))],
                     target_opset=12)

      with open("model_onnx.onnx", "wb") as f:
          f.write(model_onnx.SerializeToString())
```

`[('X', FloatTensorType([None, None]))]` means the function applies on every tensor whatever its dimension is.

```
[8]:  %onnxview model_onnx
```

```
[8]:  <jyquickhelper.jspy.render_nb_js_dot.RenderJsDot at 0x22d21cfd8d0>
```

```
[9]:  from mlprodict.onnxrt import OnnxInference
      from mlprodict.tools.asv_options_helper import get_ir_version_from_onnx
      # line needed when onnx is more recent than onnxruntime
      model_onnx.ir_version = get_ir_version_from_onnx()
      pyrun = OnnxInference(model_onnx, inplace=False)
      rtrun = OnnxInference(model_onnx, runtime="onnxruntime1")
```

```
[10]:  pyres = pyrun.run({'X': Xtest.astype(numpy.float32)})
       pyres
```

```
[10]:  {'Y': array([[2.00000003e-01, 4.88993339e-02, 4.25047986e-02, 5.94472338e-04,
                4.36813496e-02, 7.54737947e-03, 4.79816124e-02, 2.44870633e-02,
                6.11804537e-02, 5.91636561e-02],
               [4.88993339e-02, 2.00000003e-01, 1.41439855e-01, 1.33559676e-02,
                1.56540006e-01, 5.58967553e-02, 5.50623611e-03, 1.61259342e-03,
                9.16550029e-03, 8.54624342e-03],
               [4.25047986e-02, 1.41439855e-01, 2.00000003e-01, 1.66351143e-02,
                1.95919767e-01, 6.23358004e-02, 4.18740092e-03, 1.16061396e-03,
                7.11296080e-03, 6.59678876e-03],
               [5.94472338e-04, 1.33559676e-02, 1.66351143e-02, 2.00000003e-01,
                1.59911271e-02, 6.43812567e-02, 5.90140644e-06, 6.77518699e-07,
                1.52524681e-05, 1.33384119e-05],
               [4.36813496e-02, 1.56540006e-01, 1.95919767e-01, 1.59911271e-02,
                2.00000003e-01, 6.11287355e-02, 4.41158377e-03, 1.23487751e-03,
                7.46431900e-03, 6.92846393e-03],
               [7.54737947e-03, 5.58967553e-02, 6.23358004e-02, 6.43812567e-02,
                6.11287355e-02, 2.00000003e-01, 2.30531194e-04, 4.11224828e-05,
                4.89213213e-04, 4.42317745e-04],
               [4.79816124e-02, 5.50623611e-03, 4.18740092e-03, 5.90140644e-06,
```

```
             4.41158377e-03, 2.30531194e-04, 2.00000003e-01, 8.95609260e-02,
             1.03946947e-01, 1.06810644e-01],
            [2.44870633e-02, 1.61259342e-03, 1.16061396e-03, 6.77518699e-07,
             1.23487751e-03, 4.11224828e-05, 8.95609260e-02, 2.00000003e-01,
             7.89686665e-02, 8.05577263e-02],
            [6.11804537e-02, 9.16550029e-03, 7.11296080e-03, 1.52524681e-05,
             7.46431900e-03, 4.89213213e-04, 1.03946947e-01, 7.89686665e-02,
             2.00000003e-01, 1.89352334e-01],
            [5.91636561e-02, 8.54624342e-03, 6.59678876e-03, 1.33384119e-05,
             6.92846393e-03, 4.42317745e-04, 1.06810644e-01, 8.05577263e-02,
             1.89352334e-01, 2.00000003e-01]], dtype=float32)}
```

[11]:
```
rtres = rtrun.run({'X': Xtest.astype(numpy.float32)})
rtres
```

[11]:
```
{'Y': array([[2.00000003e-01, 4.88993339e-02, 4.25047986e-02, 5.94472338e-04,
             4.36813496e-02, 7.54737947e-03, 4.79816124e-02, 2.44870633e-02,
             6.11804537e-02, 5.91636561e-02],
            [4.88993339e-02, 2.00000003e-01, 1.41439855e-01, 1.33559657e-02,
             1.56540006e-01, 5.58967553e-02, 5.50623611e-03, 1.61259342e-03,
             9.16550029e-03, 8.54624342e-03],
            [4.25047986e-02, 1.41439855e-01, 2.00000003e-01, 1.66351143e-02,
             1.95919767e-01, 6.23358078e-02, 4.18740092e-03, 1.16061396e-03,
             7.11296080e-03, 6.59678876e-03],
            [5.94472338e-04, 1.33559657e-02, 1.66351143e-02, 2.00000003e-01,
             1.59911271e-02, 6.43812567e-02, 5.90140644e-06, 6.77518699e-07,
             1.52524681e-05, 1.33384119e-05],
            [4.36813496e-02, 1.56540006e-01, 1.95919767e-01, 1.59911271e-02,
             2.00000003e-01, 6.11287355e-02, 4.41158377e-03, 1.23487751e-03,
             7.46431900e-03, 6.92846393e-03],
            [7.54737947e-03, 5.58967553e-02, 6.23358078e-02, 6.43812567e-02,
             6.11287355e-02, 2.00000003e-01, 2.30531194e-04, 4.11224828e-05,
             4.89213213e-04, 4.42317745e-04],
            [4.79816124e-02, 5.50623611e-03, 4.18740092e-03, 5.90140644e-06,
             4.41158377e-03, 2.30531194e-04, 2.00000003e-01, 8.95609260e-02,
             1.03946947e-01, 1.06810644e-01],
            [2.44870633e-02, 1.61259342e-03, 1.16061396e-03, 6.77518699e-07,
             1.23487751e-03, 4.11224828e-05, 8.95609260e-02, 2.00000003e-01,
             7.89686665e-02, 8.05577263e-02],
            [6.11804537e-02, 9.16550029e-03, 7.11296080e-03, 1.52524681e-05,
             7.46431900e-03, 4.89213213e-04, 1.03946947e-01, 7.89686665e-02,
             2.00000003e-01, 1.89352334e-01],
            [5.91636561e-02, 8.54624342e-03, 6.59678876e-03, 1.33384119e-05,
             6.92846393e-03, 4.42317745e-04, 1.06810644e-01, 8.05577263e-02,
             1.89352334e-01, 2.00000003e-01]], dtype=float32)}
```

[12]:
```
from mlprodict.onnxrt.validate.validate_difference import measure_relative_difference
measure_relative_difference(pyres['Y'], rtres['Y'])
```

[12]: 9.059079e-08

The last runtime uses the same runtime but with double instead of floats.

```
[13]: onnx_op_64 = convert_kernel(ker, 'X', output_names=['final_after_op_Add'],
                                 dtype=numpy.float64, op_version=12)
      onnx_op_64 = OnnxIdentity(onnx_op_64, output_names=['Y'], op_version=12)
      model_onnx_64 = onnx_op_64.to_onnx(
                            inputs=[('X', DoubleTensorType([None, None]))],
                            target_opset=12)
```

```
[14]: pyrun64 = OnnxInference(model_onnx_64, runtime="python", inplace=False)
      pyres64 = pyrun64.run({'X': Xtest.astype(numpy.float64)})
      measure_relative_difference(pyres['Y'], pyres64['Y'])
```

[14]: 7.106326595962827e-07

1.3 Side by side

We run every node independently and we compare the output at each step.

```
[15]: %matplotlib inline
```

```
[16]: from mlprodict.onnxrt.validate.side_by_side import side_by_side_by_values
      from pandas import DataFrame

      def run_sbs(r1, r2, r3, x):
          sbs = side_by_side_by_values([r1, r2, r3],
                                       inputs=[
                                           {'X': x.astype(numpy.float32)},
                                           {'X': x.astype(numpy.float32)},
                                           {'X': x.astype(numpy.float64)},
                                       ])
          df = DataFrame(sbs)
          dfd = df.drop(['value[0]', 'value[1]', 'value[2]'], axis=1).copy()
          dfd.loc[dfd.cmp == 'ERROR->=inf', 'v[1]'] = 10
          return dfd, sbs

      dfd, _ = run_sbs(pyrun, rtrun, pyrun64, Xtest)
      dfd
```

[16]:

	metric	step	v[0]	v[1]	v[2]	cmp
0	nb_results	-1	49	4.900000e+01	4.900000e+01	OK
1	abs-diff	0	0	0.000000e+00	3.250289e-08	OK
2	abs-diff	1	0	9.059079e-08	7.106327e-07	OK
3	abs-diff	2	0	0.000000e+00	1.490116e-08	OK
4	abs-diff	3	0	0.000000e+00	0.000000e+00	OK
5	abs-diff	4	0	0.000000e+00	0.000000e+00	OK
6	abs-diff	5	0	0.000000e+00	0.000000e+00	OK
7	abs-diff	6	0	0.000000e+00	0.000000e+00	OK
8	abs-diff	7	0	1.000000e+00	7.106327e-07	ERROR->=1.0
9	abs-diff	8	0	4.863269e+00	7.106327e-07	ERROR->=4.9
10	abs-diff	9	0	0.000000e+00	0.000000e+00	OK
11	abs-diff	10	0	0.000000e+00	0.000000e+00	OK
12	abs-diff	11	0	0.000000e+00	0.000000e+00	OK
13	abs-diff	12	0	0.000000e+00	0.000000e+00	OK
14	abs-diff	13	0	0.000000e+00	0.000000e+00	OK
15	abs-diff	14	0	0.000000e+00	4.969472e-08	OK

```
16   abs-diff   15   0   0.000000e+00   4.969472e-08          OK
17   abs-diff   16   0   9.471974e+01   7.215496e-07   ERROR->=94.7
18   abs-diff   17   0   0.000000e+00   0.000000e+00          OK
19   abs-diff   18   0   0.000000e+00   0.000000e+00          OK
20   abs-diff   19   0   0.000000e+00   0.000000e+00          OK
21   abs-diff   20   0   0.000000e+00   0.000000e+00          OK
22   abs-diff   21   0   0.000000e+00   0.000000e+00          OK
23   abs-diff   22   0   4.736030e+01   7.215496e-07   ERROR->=47.4
24   abs-diff   23   0   7.247263e-08   7.215496e-07          OK
25   abs-diff   24   0   5.000000e-01   7.106327e-07   ERROR->=0.5
26   abs-diff   25   0   0.000000e+00   0.000000e+00          OK
27   abs-diff   26   0   0.000000e+00   0.000000e+00          OK
28   abs-diff   27   0   0.000000e+00   0.000000e+00          OK
29   abs-diff   28   0   0.000000e+00   0.000000e+00          OK
30   abs-diff   29   0   1.000000e+00   6.830406e-07   ERROR->=1.0
31   abs-diff   30   0   0.000000e+00   1.490116e-08          OK
32   abs-diff   31   0   1.000000e+00   6.830406e-07   ERROR->=1.0
33   abs-diff   32   0   0.000000e+00   0.000000e+00          OK
34   abs-diff   33   0   0.000000e+00   0.000000e+00          OK
35   abs-diff   34   0   0.000000e+00   0.000000e+00          OK
36   abs-diff   35   0   0.000000e+00   0.000000e+00          OK
37   abs-diff   36   0   0.000000e+00   0.000000e+00          OK
38   abs-diff   37   0   0.000000e+00   3.250289e-08          OK
39   abs-diff   38   0   0.000000e+00   3.250289e-08          OK
40   abs-diff   39   0   1.947547e+03   6.849032e-07   ERROR->=1947.5
41   abs-diff   40   0   0.000000e+00   0.000000e+00          OK
42   abs-diff   41   0   0.000000e+00   0.000000e+00          OK
43   abs-diff   42   0   0.000000e+00   0.000000e+00          OK
44   abs-diff   43   0   0.000000e+00   0.000000e+00          OK
45   abs-diff   44   0   0.000000e+00   0.000000e+00          OK
46   abs-diff   45   0   9.737733e+02   6.849032e-07   ERROR->=973.8
47   abs-diff   46   0   0.000000e+00   6.849032e-07          OK
48   abs-diff   47   0   0.000000e+00   6.830406e-07          OK
49   abs-diff   48   0   9.059079e-08   7.106327e-07          OK
```

	name	shape[0]	shape[1]	shape[2]
0	NaN	NaN	NaN	NaN
1	X	(10, 6)	(10, 6)	(10, 6)
2	Y	(10, 10)	(10, 10)	(10, 10)
3	Ad_Addcst	(1,)	(1,)	(1,)
4	Sh_shape0	(2,)	(2,)	(2,)
5	Co_output0	(10, 6)	(10, 6)	(10, 6)
6	Re_reduced0	(10, 1)	(10, 1)	(10, 1)
7	Tr_transposed0	(1, 10)	(1, 10)	(1, 10)
8	Ma_Y0	(10, 10)	(10, 10)	(10, 10)
9	Ad_C0	(10, 10)	(10, 10)	(10, 10)
10	Sh_shape02	(2,)	(2,)	(2,)
11	Co_output02	(10, 6)	(10, 6)	(10, 6)
12	Re_reduced01	(6,)	(6,)	(6,)
13	Sh_shape01	(1,)	(1,)	(1,)
14	Co_output01	(6,)	(6,)	(6,)
15	Di_C0	(10, 6)	(10, 6)	(10, 6)
16	scan0	(10, 6)	(10, 6)	(10, 6)

```
17              scan1  (10, 10)  (10, 10)  (10, 10)
18        Sh_shape04     (2,)      (2,)      (2,)
19        Co_output04   (10, 6)   (10, 6)   (10, 6)
20       Re_reduced02   (10, 1)   (10, 1)   (10, 1)
21        Sh_shape03     (2,)      (2,)      (2,)
22        Co_output03   (10, 1)   (10, 1)   (10, 1)
23             Mu_C01  (10, 10)  (10, 10)  (10, 10)
24         Ex_output0  (10, 10)  (10, 10)  (10, 10)
25              Mu_C0  (10, 10)  (10, 10)  (10, 10)
26        Sh_shape05     (2,)      (2,)      (2,)
27        Co_output05   (10, 6)   (10, 6)   (10, 6)
28       Re_reduced03   (10, 1)   (10, 1)   (10, 1)
29     Tr_transposed01   (1, 10)   (1, 10)   (1, 10)
30             Ma_Y01  (10, 10)  (10, 10)  (10, 10)
31          Ad_Addcst1    (1,)      (1,)      (1,)
32             Ad_C01  (10, 10)  (10, 10)  (10, 10)
33        Sh_shape07     (2,)      (2,)      (2,)
34        Co_output07   (10, 6)   (10, 6)   (10, 6)
35       Re_reduced04     (6,)      (6,)      (6,)
36        Sh_shape06     (1,)      (1,)      (1,)
37        Co_output06     (6,)      (6,)      (6,)
38             Di_C01   (10, 6)   (10, 6)   (10, 6)
39             scan01   (10, 6)   (10, 6)   (10, 6)
40             scan11  (10, 10)  (10, 10)  (10, 10)
41        Sh_shape09     (2,)      (2,)      (2,)
42        Co_output09   (10, 6)   (10, 6)   (10, 6)
43       Re_reduced05   (10, 1)   (10, 1)   (10, 1)
44        Sh_shape08     (2,)      (2,)      (2,)
45        Co_output08   (10, 1)   (10, 1)   (10, 1)
46             Mu_C03  (10, 10)  (10, 10)  (10, 10)
47         Ex_output01  (10, 10)  (10, 10)  (10, 10)
48             Mu_C02  (10, 10)  (10, 10)  (10, 10)
49  final_after_op_Add  (10, 10)  (10, 10)  (10, 10)
```
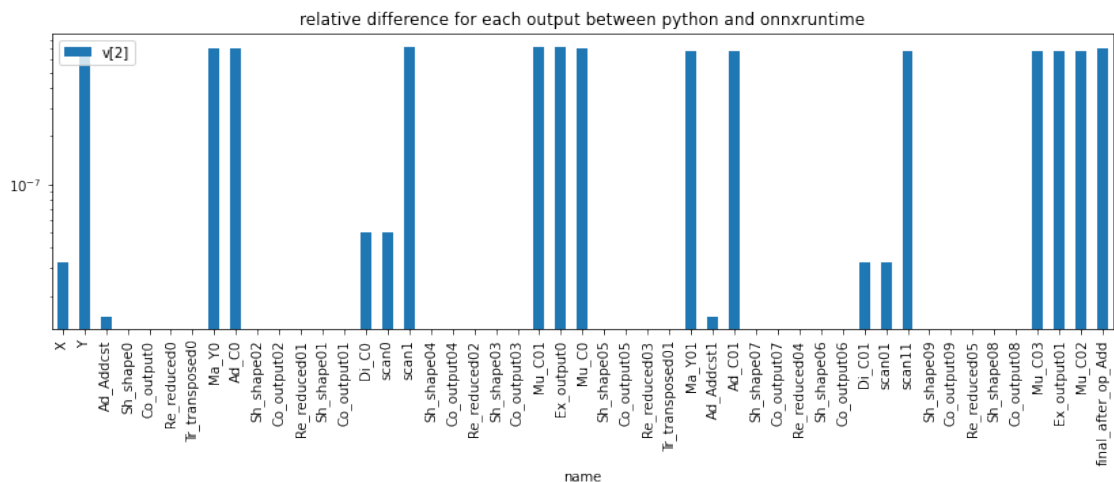
```python
ax = dfd[['name', 'v[2]']].iloc[1:].set_index('name').plot(kind='bar', figsize=(14,4),
      logy=True)
ax.set_title("relative difference for each output between python and onnxruntime");
```


relative difference for each output between python and onnxruntime

Let's try for other inputs.

```
[18]: import warnings
      from matplotlib.cbook.deprecation import MatplotlibDeprecationWarning
      import matplotlib.pyplot as plt

      with warnings.catch_warnings():
          warnings.simplefilter("ignore", MatplotlibDeprecationWarning)
          values = [4, 6, 8, 12]
          fig, ax = plt.subplots(len(values), 2, figsize=(14, len(values) * 4))

          for i, d in enumerate(values):
              for j, dim in enumerate([3, 8]):
                  mat = numpy.random.rand(d, dim)
                  dfd, _ = run_sbs(pyrun, rtrun, pyrun64, mat)
                  dfd[['name', 'v[1]']].iloc[1:].set_index('name').plot(
                      kind='bar', figsize=(14,4), logy=True, ax=ax[i, j])
                  ax[i, j].set_title("abs diff input shape {}".format(mat.shape))
                  if i < len(values) - 1:
                      for xlabel_i in ax[i, j].get_xticklabels():
                          xlabel_i.set_visible(False)
```
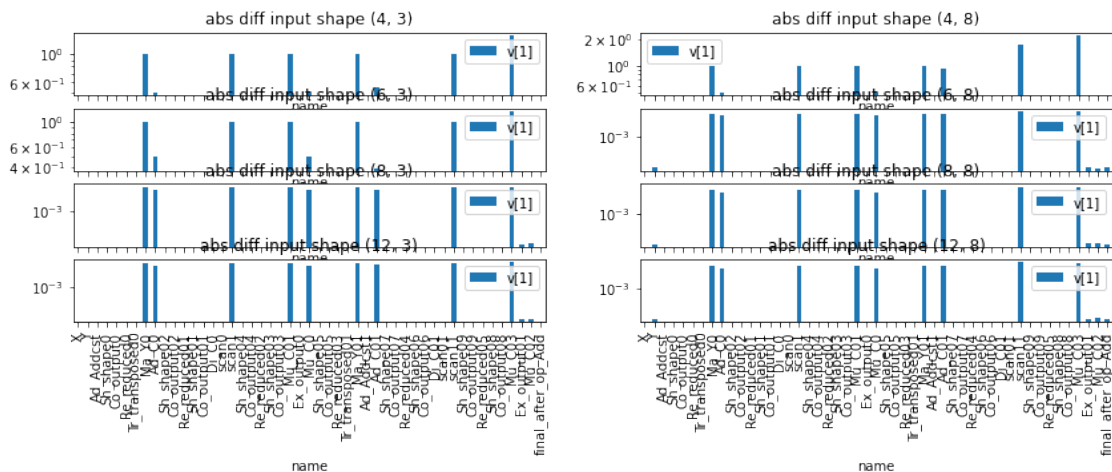

1.4 Further analysis

If there is one issue, we can create a simple graph to test. We consider `Y = A + B` where A and B have the following name in the *ONNX* graph:

```
[19]: node = pyrun.sequence_[-2].onnx_node
      final_inputs = list(node.input)
      final_inputs
```

```
[19]: ['Mu_C0', 'Mu_C02']
```

```
[20]: _, sbs = run_sbs(pyrun, rtrun, pyrun64, Xtest)

      names = final_inputs + ['Y']
      values = {}
      for row in sbs:
          if row.get('name', '#') not in names:
              continue
          name = row['name']
          values[name] = [row["value[%d]" % i] for i in range(3)]

      list(values.keys())
```

[20]: `['Y', 'Mu_C0', 'Mu_C02']`

Let's check.

```
[21]: for name in names:
          if name not in values:
              raise Exception("Unable to find '{}' in\n{}".format(
                  name, [_.get('name', "?") for _ in sbs]))

      a, b, c = names
      for i in [0, 1, 2]:
          A = values[a][i]
          B = values[b][i]
          Y = values[c][i]
          diff = Y - (A + B)
          dabs = numpy.max(numpy.abs(diff))
          print(i, diff.dtype, dabs)
```

```
0 float32 0.10000001
1 float32 0.0
2 float64 0.10000000000000003
```

If the second runtime has issue, we can create a single node to check something.

```
[22]: from skl2onnx.algebra.onnx_ops import OnnxAdd
      onnx_add = OnnxAdd('X1', 'X2', output_names=['Y'], op_version=12)
      add_onnx = onnx_add.to_onnx({'X1': A, 'X2': B}, target_opset=12)
```

```
[23]: add_onnx.ir_version = get_ir_version_from_onnx()
      pyrun_add = OnnxInference(add_onnx, inplace=False)
      rtrun_add = OnnxInference(add_onnx, runtime="onnxruntime1")
```

```
[24]: res1 = pyrun_add.run({'X1': A, 'X2': B})
      res2 = rtrun_add.run({'X1': A, 'X2': B})
```

```
[25]: measure_relative_difference(res1['Y'], res2['Y'])
```

[25]: `0.0`

No mistake here.

1.5 onnxruntime

```
[26]: from onnxruntime import InferenceSession, RunOptions, SessionOptions
      opt = SessionOptions()
      opt.enable_mem_pattern = True
      opt.enable_cpu_mem_arena = True
      sess = InferenceSession(model_onnx.SerializeToString(), opt)
      sess
```

```
[26]: <onnxruntime.capi.session.InferenceSession at 0x22d1e846278>
```

```
[27]: res = sess.run(None, {'X': Xtest.astype(numpy.float32)})[0]
      measure_relative_difference(pyres['Y'], res)
```

```
[27]: 9.059079e-08
```

```
[28]: res = sess.run(None, {'X': Xtest.astype(numpy.float32)})[0]
      measure_relative_difference(pyres['Y'], res)
```

```
[28]: 9.059079e-08
```

1.6 Side by side for MLPRegressor

```
[29]: from sklearn.datasets import load_iris
      from sklearn.model_selection import train_test_split
      from sklearn.neural_network import MLPRegressor
      iris = load_iris()
      X, y = iris.data, iris.target
      X_train, X_test, y_train, y_test = train_test_split(X, y)
      clr = MLPRegressor()
      clr.fit(X_train, y_train)
```

```
[29]: MLPRegressor()
```

```
[30]: from mlprodict.onnx_conv import to_onnx
      onx = to_onnx(clr, X_train.astype(numpy.float32), target_opset=12)
```

```
[31]: onx.ir_version = get_ir_version_from_onnx()
      pyrun = OnnxInference(onx, runtime="python", inplace=False)
      rtrun = OnnxInference(onx, runtime="onnxruntime1")
      rt_partial_run = OnnxInference(onx, runtime="onnxruntime2")
      dfd, _ = run_sbs(rtrun, rt_partial_run, pyrun, X_test)
      dfd
```

```
[31]:       metric  step  v[0]  v[1]          v[2]  cmp           name  \
      0  nb_results    -1    13  13.0  1.300000e+01   OK            NaN
      1    abs-diff     0     0   0.0  3.973643e-08   OK              X
      2    abs-diff     1     0   0.0  0.000000e+00   OK    coefficient
      3    abs-diff     2     0   0.0  0.000000e+00   OK     intercepts
      4    abs-diff     3     0   0.0  0.000000e+00   OK   coefficient1
      5    abs-diff     4     0   0.0  0.000000e+00   OK     intercepts1
      6    abs-diff     5     0   0.0  0.000000e+00   OK   shape_tensor
      7    abs-diff     6     0   0.0  0.000000e+00   OK     cast_input
```

```
8    abs-diff    7    0    0.0  1.000000e+00  ERROR->=1.0       mul_result
9    abs-diff    8    0    0.0  1.000000e+00  ERROR->=1.0       add_result
10   abs-diff    9    0    0.0  0.000000e+00          OK  next_activations
11   abs-diff   10    0    0.0  2.311237e-02       e<0.1       mul_result1
12   abs-diff   11    0    0.0  0.000000e+00          OK       add_result1
13   abs-diff   12    0    0.0  0.000000e+00          OK          variable

     shape[0]     shape[1]     shape[2]
0        NaN          NaN          NaN
1     (38, 4)      (38, 4)      (38, 4)
2    (4, 100)     (4, 100)     (4, 100)
3    (1, 100)     (1, 100)     (1, 100)
4    (100, 1)     (100, 1)     (100, 1)
5      (1, 1)       (1, 1)       (1, 1)
6       (2,)         (2,)         (2,)
7     (38, 4)      (38, 4)      (38, 4)
8   (38, 100)    (38, 100)    (38, 100)
9   (38, 100)    (38, 100)    (38, 100)
10  (38, 100)    (38, 100)    (38, 100)
11    (38, 1)      (38, 1)      (38, 1)
12    (38, 1)      (38, 1)      (38, 1)
13    (38, 1)      (38, 1)      (38, 1)
```

[32]: `%onnxview onx`

[32]: `<jyquickhelper.jspy.render_nb_js_dot.RenderJsDot at 0x22d1e846f28>`

[33]: