onnx_sbs

August 14, 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("""
1.0000000000000000e+02,1.0612779713077667e+02,1.472195004809226493e+00,2.
↪3071250694976265 52e-02,4.539948095743629591e-02,2.855191098141335870e-01
1.0000000000000000e+02,9.417031896832908444e+01,1.249743892709246573e+00,2.
↪3704161743396207 07e-02,2.613847280316268853e-02,5.097165413593484073e-01
1.0000000000000000e+02,9.305231488674536422e+01,1.795726729335217264e+00,2.
↪4732747338022706 42e-02,1.349765645107412620e-02,9.410288840541443378e-02
1.0000000000000000e+02,7.411264142156210255e+01,1.747723020195752319e+00,1.
↪5596956634176459 97e-02,4.230394035515055301e-02,2.225492746314280956e-01
1.0000000000000000e+02,9.326006195761877393e+01,1.738860294343326229e+00,2.
↪2801601357676525 02e-02,4.883335335161764074e-02,2.806808409247734115e-01
1.0000000000000000e+02,8.341529291866362428e+01,5.119682123742423929e-01,2.
↪4887957686358160 03e-02,4.887573336092913834e-02,1.673462179673477768e-01
1.0000000000000000e+02,1.182436477919874562e+02,1.733516391831658954e+00,1.
↪5335209303494768 20e-02,3.131213519485807895e-02,1.955345358785769427e-01
```

```
1.0000000000000000e+02,1.2289825832992571e+02,1.1155999964058316e+00,1.
↪9293541550799389 59e-02,3.0569963085440967 15e-03,1.1970527639982710 13e-01
1.0000000000000000e+02,1.1603032693861088 38e+02,1.0186270210149273 03e+00,2.
↪2487849816164598 44e-02,2.6881115471143076 51e-02,3.3261051317787243 55e-01
1.0000000000000000e+02,1.1634143746403960 05e+02,6.6442995458040776 67e-01,1.
↪5080884177136029 06e-02,4.4518366576137891 06e-02,3.2456430442048084 25e-01
""".strip("\n\r ")), header=None).values
```

Then the kernel.

[5]:
```
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]:

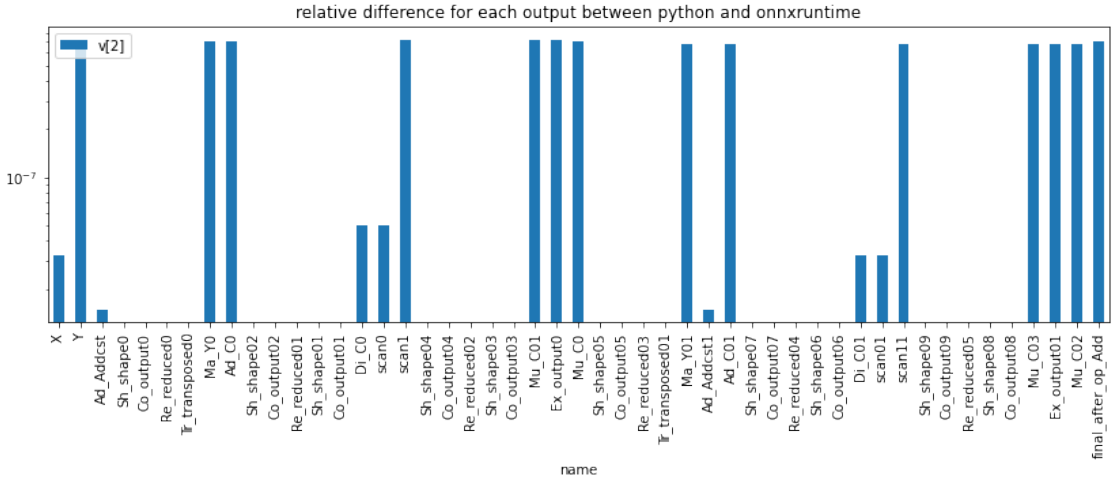
	metric	step	v[0]	v[1]	v[2]	cmp	\
0	nb_results	-1	49	4.900000e+01	4.900000e+01	OK	
1	abs-diff	0	0	0.000000e+00	3.250289e-08	OK	
2	abs-diff	1	0	9.059079e-08	7.106327e-07	OK	
3	abs-diff	2	0	0.000000e+00	1.490116e-08	OK	
4	abs-diff	3	0	0.000000e+00	0.000000e+00	OK	
5	abs-diff	4	0	0.000000e+00	0.000000e+00	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)

[17]:
```
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");
```

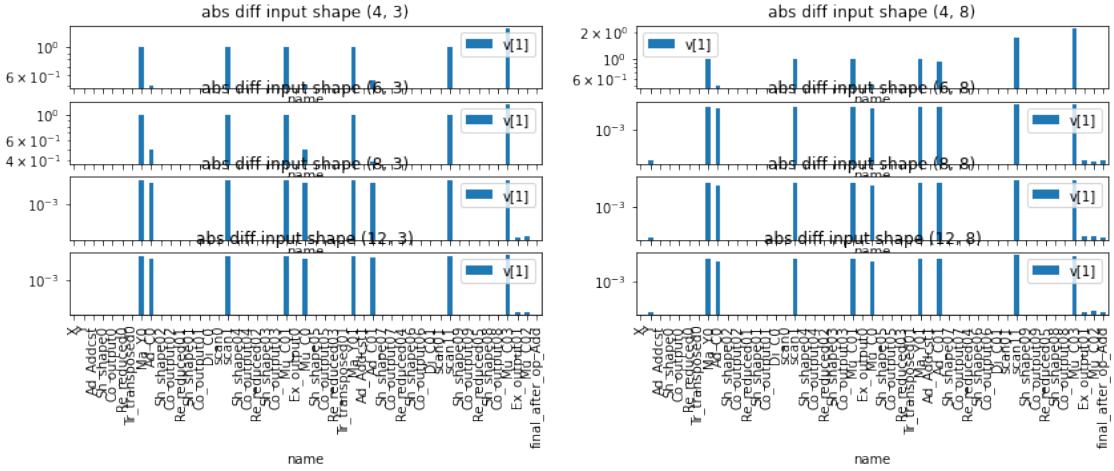


Let's try for other inputs.

[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]:
```

```