AML T1 Report

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Issues:

1. Some of the data in the dataset was in float64, they were down casted to float32
2. Even after explicitly specifying a model_dir for each version of the classifier it tries to checkpoint and load it from the same model_dir folder of the first classifier.

Configuration:

1. Adam Optimization
2. Relu activation function
3. 100 Epochs
4. Batch size 64
5. Normalized values by dividing by the range of values (i.e data/(data.max()-data.min())

Approach:

Our method involved creating a subclass of tf.estimator.Estimator called "MyDNNRegressor" as suggested in the problem.

After that we wrote different versions of the "model_fn" by building a simple neural network with one hidden layer and one output layer whose respective units are specified by the "params" parameter in that function. Since "MyDNNRegressor" is a subclass of the Estimator class specifying model_fn = our_model_fn on instantiating the object made sure that only the neural network created in our_model_fn is executed.

(Note: our_model_fn also calculates certain metrics such as accuracy and rmse)

Finally we also wrote two methods in the "MyDNNRegressor" namely:

1. **get_layer_params(id):**
   This function takes in as input, a string ID for a specific layer in our model and searches the compute_graph by name and returns its internal value using the function "*get_variable_value(id)*" .This way both the weights and bias of a particular layer can be accessed.

2. **get_layer_activations(id):**
   This function takes in as input, a string ID for a specific layer in our model and uses the get_layer_params to access both the weights 'W' and bias 'b' of the hidden layer.
   We then compute Relu(W.x+b) for a specific input x and return this value.

(Note: Relu is the activation unit of our hidden layer, hence we use Relu else we would have used whatever other activation function that particular layer has!)

Deliverables:(Just the numbers & values!!)

Metrics/Values	3rd column label & hidden_units=2	4th column label & hidden_units=2	3rd+4th column label & hidden_units=2	3rd column label & hidden_units=3	4th column label & hidden_units=3	3rd+4th column label & hidden_units=3
Final Loss	2.9874594	0.10935463	2.520883	3.379712	2.887131	5.7023387
Final rmse	0.15313901	0.029299041	0.14067315	0.1628826	0.1505456	0.21157354
Hidden Layer weights	[[-0.7553347 -1.0097673] [0.27366415 -0.6654497]]	[[0.34242925 -0.48995388] [-0.8998742 -0.13784826]]	[[0.07440785 0.63537407] [0.15061176 0.60248744]]]	[[0.754212 -0.71897864 0.09878396] [-0.83547074 -0.15289444 0.1583525]]	[[0.46781093 -0.8223893 0.8388115] [-0.72959733 0.11084794 -1.116663]]	[[-0.40600175 -0.8305598 0.7578669] [-0.6333935 0.4068953 -0.5944415]]
Hidden Layer Bias	[0.22309995 0.]	[-0.113399 -0.01159593]	[-0.05119552 -0.03977783]	[-0.05670537 0. -0.07438954]	[-0.0790143 -0.06482318 -0.07755946]	[0. -0.08481121 -0.08135027]
Output Layer weights	[[-1.1394113] [0.3539226]]	[[-0.728452] [-1.1793032]]	[[-1.1639882 -0.34212086] [0.04304117 -0.05259465]]	[[0.98834646] [0.23031044] [1.00656]]	[[-0.8879254] [1.1438901] [-0.5722948]]	[[0.24737692 0.10847652] [0.66898364 -0.26196858] [-0.37944865 -0.63974375]]
Output Layer bias	[0.0779909]	[0.00910946]	[0.04935431 0.05295561]	[-0.07515906]	[0.06554074]	[0.03890631 0.06793098]

Equations:

After looking at the inputs and outputs and activations for both problems(along with the training data:)) we have found that:

1.The equation with the third column as output has an equation of :

` $$f(x,y) = x^2-y^2$$

2. The equation with the fourth column as output has an equation of:

f(x,y) = x/y

Screenshots:(Includes the loss and metrics for each test):

Test#1:(Hidden units =2)

```
[14] INFO:tensorflow:Using config: {'_model_dir': './03', '_tf_random_seed': None, '_save_summary_steps': 100, '_save_checkpoint
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Create CheckpointSaverHook.
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Restoring parameters from ./03/model.ckpt-100
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Saving checkpoints for 100 into ./03/model.ckpt.
INFO:tensorflow:loss = 4.993519, step = 101
INFO:tensorflow:Saving checkpoints for 200 into ./03/model.ckpt.
INFO:tensorflow:Loss for final step: 2.6839747.
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Starting evaluation at 2018-09-18-16:39:53
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Restoring parameters from ./03/model.ckpt-200
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Finished evaluation at 2018-09-18-16:40:04
INFO:tensorflow:Saving dict for global step 200: accuracy = 0.0, global_step = 200, loss = 2.9874594, rmse = 0.15313901
INFO:tensorflow:Saving 'checkpoint_path' summary for global step 200: ./03/model.ckpt-200
metrics-col3-output: {'accuracy': 0.0, 'loss': 2.9874594, 'rmse': 0.15313901, 'global_step': 200}
Hidden_weights [[-0.7553347  -1.0097673 ]
 [ 0.27366415 -0.6654497 ]]
Hidden_bias [0.22309995 0.        ]
```

```
output_weights,output_bias=classifier.get_layer_params('output_layer')
print("Output_weights",output_weights)
print("Output_bias",output_bias)
```

```
Output_weights [[-1.1394113]
 [ 0.3539226]]
Output_bias [0.0779909]
```

```
[45] INFO:tensorflow:Done running local_init_op.
     INFO:tensorflow:Saving checkpoints for 0 into ./34/model.ckpt.
     INFO:tensorflow:loss = 7.085196, step = 1
     INFO:tensorflow:Saving checkpoints for 100 into ./34/model.ckpt.
     INFO:tensorflow:Loss for final step: 2.4427347.
     INFO:tensorflow:Calling model_fn.
     INFO:tensorflow:Done calling model_fn.
     INFO:tensorflow:Starting evaluation at 2018-09-18-15:54:22
     INFO:tensorflow:Graph was finalized.
     INFO:tensorflow:Restoring parameters from ./34/model.ckpt-100
     INFO:tensorflow:Running local_init_op.
     INFO:tensorflow:Done running local_init_op.
     INFO:tensorflow:Finished evaluation at 2018-09-18-15:54:33
     INFO:tensorflow:Saving dict for global step 100: accuracy = 0.0, global_step = 100, loss = 2.520883, rmse = 0.14067315
     INFO:tensorflow:Saving 'checkpoint_path' summary for global step 100: ./34/model.ckpt-100
     metrics-col3_4-output: {'accuracy': 0.0, 'loss': 2.520883, 'rmse': 0.14067315, 'global_step': 100}
```

```
[46] hidden_weights,hidden_bias=classifier.get_layer_params('mylayer')
     print("Hidden_weights",hidden_weights)
     print("Hidden_bias",hidden_bias)

     Hidden_weights [[0.07440785 0.63537407]
      [0.15061176 0.60248744]]
     Hidden_bias [-0.05119552 -0.03977783]
```

CODE TEXT

```
     output_weights,output_bias=classifier.get_layer_params('output_layer')
     print("Output_weights",output_weights)
     print("Output_bias",output_bias)

     Output_weights [[-1.1639882  -0.34212086]
      [ 0.04304117 -0.05259465]]
     Output_bias [0.04935431 0.05295561]
```

```
     INFO:tensorflow:Using config: {'_model_dir': './4', '_tf_random_seed': None, '_save_summary_steps': 100, '_save_checkpoints_
     INFO:tensorflow:Calling model_fn.
     INFO:tensorflow:Done calling model_fn.
     INFO:tensorflow:Create CheckpointSaverHook.
     INFO:tensorflow:Graph was finalized.
     INFO:tensorflow:Running local_init_op.
     INFO:tensorflow:Done running local_init_op.
     INFO:tensorflow:Saving checkpoints for 0 into ./4/model.ckpt.
     INFO:tensorflow:loss = 0.59803504, step = 1
     INFO:tensorflow:Saving checkpoints for 100 into ./4/model.ckpt.
     INFO:tensorflow:Loss for final step: 0.07525956.
     INFO:tensorflow:Calling model_fn.
     INFO:tensorflow:Done calling model_fn.
     INFO:tensorflow:Starting evaluation at 2018-09-18-16:14:56
     INFO:tensorflow:Graph was finalized.
     INFO:tensorflow:Restoring parameters from ./4/model.ckpt-100
     INFO:tensorflow:Running local_init_op.
     INFO:tensorflow:Done running local_init_op.
     INFO:tensorflow:Finished evaluation at 2018-09-18-16:15:06
     INFO:tensorflow:Saving dict for global step 100: accuracy = 0.0, global_step = 100, loss = 0.10935463, rmse = 0.029299041
     INFO:tensorflow:Saving 'checkpoint_path' summary for global step 100: ./4/model.ckpt-100
     metrics-col4-output: {'accuracy': 0.0, 'loss': 0.10935463, 'rmse': 0.029299041, 'global_step': 100}
     Hidden_weights [[ 0.34242925 -0.48995388]
      [-0.8998742  -0.13784826]]
     Hidden_bias [-0.07235523  0.        ]
```

```
[8]  output_weights,output_bias=classifier.get_layer_params('output_layer')
     print("Output_weights",output_weights)
     print("Output_bias",output_bias)

     Output_weights [[-0.728452 ]
      [-1.1793032]]
     Output_bias [0.00910946]
```

```
[ ]  hidden_activation=classifier2.get_layer_activations('mylayer')
     print(hidden_activation)
```

Test#1:(Hidden units =3)

```
INFO:tensorflow:Using config: {'_model_dir': './33', '_tf_random_seed': None, '_save_summary_steps': 100, '_save_checkp
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Create CheckpointSaverHook.
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Saving checkpoints for 0 into ./33/model.ckpt.
INFO:tensorflow:loss = 18.232418, step = 1
INFO:tensorflow:Saving checkpoints for 100 into ./33/model.ckpt.
INFO:tensorflow:Loss for final step: 3.1346848.
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Starting evaluation at 2018-09-18-16:23:40
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Restoring parameters from ./33/model.ckpt-100
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Finished evaluation at 2018-09-18-16:23:51
INFO:tensorflow:Saving dict for global step 100: accuracy = 0.0, global_step = 100, loss = 3.379712, rmse = 0.1628826
INFO:tensorflow:Saving 'checkpoint_path' summary for global step 100: ./33/model.ckpt-100
metrics-col3-output: {'accuracy': 0.0, 'loss': 3.379712, 'rmse': 0.1628826, 'global_step': 100}
```

```
[20] hidden_weights,hidden_bias=classifier.get_layer_params('mylayer')
     print("Hidden_weights",hidden_weights)
     print("Hidden_bias",hidden_bias)
```

```
Hidden_weights [[ 0.754212   -0.71897864  0.09878396]
 [-0.83547074 -0.15289444  0.1583525 ]]
Hidden_bias [-0.05670537  0.         -0.07438954]
```

```
[21] output_weights,output_bias=classifier.get_layer_params('output_layer')
     print("Output_weights",output_weights)
     print("Output_bias",output_bias)
```

```
Output_weights [[0.98834646]
 [0.23031044]
 [1.00656   ]]
Output_bias [-0.07515906]
```

```
[22] INFO:tensorflow:Using config: {'_model_dir': './44', '_tf_random_seed': None, '_save_summary_steps': 100, '_save_checkpoints_steps': None, '_save_checkpoi
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Create CheckpointSaverHook.
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Saving checkpoints for 0 into ./44/model.ckpt.
INFO:tensorflow:loss = 11.980504, step = 1
INFO:tensorflow:Saving checkpoints for 100 into ./44/model.ckpt.
INFO:tensorflow:Loss for final step: 2.6864958.
INFO:tensorflow:Calling model_fn.
INFO:tensorflow:Done calling model_fn.
INFO:tensorflow:Starting evaluation at 2018-09-18-16:27:01
INFO:tensorflow:Graph was finalized.
INFO:tensorflow:Restoring parameters from ./44/model.ckpt-100
INFO:tensorflow:Running local_init_op.
INFO:tensorflow:Done running local_init_op.
INFO:tensorflow:Finished evaluation at 2018-09-18-16:27:12
INFO:tensorflow:Saving dict for global step 100: accuracy = 0.0, global_step = 100, loss = 2.887131, rmse = 0.1505456
INFO:tensorflow:Saving 'checkpoint_path' summary for global step 100: ./44/model.ckpt-100
metrics-col3-output: {'accuracy': 0.0, 'loss': 2.887131, 'rmse': 0.1505456, 'global_step': 100}
```

```
[23] hidden_weights,hidden_bias=classifier.get_layer_params('mylayer')
     print("Hidden_weights",hidden_weights)
     print("Hidden_bias",hidden_bias)
```

```
Hidden_weights [[ 0.46781093 -0.8223893   0.8388115 ]
 [-0.72959733  0.11084794 -1.116663  ]]
Hidden_bias [-0.0790143  -0.06482318 -0.07755946]
```

```
output_weights,output_bias=classifier.get_layer_params('output_layer')
print("Output_weights",output_weights)
print("Output_bias",output_bias)
```

```
Output_weights [[-0.8879254]
 [ 1.1438901]
 [-0.5722948]]
Output_bias [0.06554074]
```

```
[7] INFO:tensorflow:Running local_init_op.
    INFO:tensorflow:Done running local_init_op.
    INFO:tensorflow:Saving checkpoints for 0 into ./343/model.ckpt.
    INFO:tensorflow:loss = 11.212599, step = 1
    INFO:tensorflow:Saving checkpoints for 100 into ./343/model.ckpt.
    INFO:tensorflow:Loss for final step: 5.7584815.
    INFO:tensorflow:Calling model_fn.
    INFO:tensorflow:Done calling model_fn.
    INFO:tensorflow:Starting evaluation at 2018-09-18-16:33:20
    INFO:tensorflow:Graph was finalized.
    INFO:tensorflow:Restoring parameters from ./343/model.ckpt-100
    INFO:tensorflow:Running local_init_op.
    INFO:tensorflow:Done running local_init_op.
    INFO:tensorflow:Finished evaluation at 2018-09-18-16:33:31
    INFO:tensorflow:Saving dict for global step 100: accuracy = 0.0, global_step = 100, loss = 5.7023387, rmse = 0.21157354
    INFO:tensorflow:Saving 'checkpoint_path' summary for global step 100: ./343/model.ckpt-100
    metrics-col343-output: {'accuracy': 0.0, 'loss': 5.7023387, 'rmse': 0.21157354, 'global_step': 100}
```

```
[9] hidden_weights,hidden_bias=classifier.get_layer_params('mylayer')
    print("Hidden_weights",hidden_weights)
    print("Hidden_bias",hidden_bias)

    Hidden_weights [[-0.40600175 -0.8305598   0.7578669 ]
     [-0.6333935   0.4068953  -0.5944415 ]]
    Hidden_bias [ 0.         -0.08481121 -0.08135027]
```

```
    output_weights,output_bias=classifier.get_layer_params('output_layer')
    print("Output_weights",output_weights)
    print("Output_bias",output_bias)

    Output_weights [[ 0.24737692  0.10847652]
     [ 0.66898364 -0.26196858]
     [-0.37944865 -0.63974375]]
    Output_bias [0.03890631 0.06793098]
```

Code:
https://colab.research.google.com/drive/1XgXIezSCyH7FlJoP0EUIBshli_Wgq-97