In [0]:

```
# Importing Libraries
```

In [3]:

```
import pandas as pd
import numpy as np
!pip install talos
import warnings
warnings.filterwarnings('ignore')
```

```
Collecting talos
  Downloading
https://files.pythonhosted.org/packages/1d/df/c352679af3259829dafa7d55f2d3e9fca201c848351cb3c841a06
01c/talos-0.6.3.tar.gz
Collecting wrangle
  Downloading
https://files.pythonhosted.org/packages/85/35/bc729e377417613f2d062a890faea5d649ef1a554df21499e9c3a
01a/wrangle-0.6.7.tar.gz
Requirement already satisfied: numpy in /usr/local/lib/python3.6/dist-packages (from talos)
(1.17.3)
Requirement already satisfied: pandas in /usr/local/lib/python3.6/dist-packages (from talos)
(0.25.2)
Requirement already satisfied: keras in /usr/local/lib/python3.6/dist-packages (from talos)
(2.2.5)
Collecting astetik
  Downloading
https://files.pythonhosted.org/packages/3c/ba/f8622951da73d9b47b45bb847112c388651f9c6e413e712954f26
d9f/astetik-1.9.9.tar.gz
Requirement already satisfied: sklearn in /usr/local/lib/python3.6/dist-packages (from talos)
(0.0)
Requirement already satisfied: tqdm in /usr/local/lib/python3.6/dist-packages (from talos)
(4.28.1)
Collecting chances
  Downloading
https://files.pythonhosted.org/packages/fa/d8/d61112d7476dc3074b855f1edd8556cde9b49b7106853f0b0601c
c82/chances-0.1.9.tar.gz
Collecting kerasplotlib
  Downloading
https://files.pythonhosted.org/packages/e8/2e/b8628bfef6a817da9be863f650cf67187676b10d27d94b23f248c
2b4/kerasplotlib-0.1.4.tar.gz
Requirement already satisfied: requests in /usr/local/lib/python3.6/dist-packages (from talos)
(2.21.0)
Collecting scipy==1.2
  Downloading
https://files.pythonhosted.org/packages/67/e6/6d4edaceee6a110ecf6f318482f5229792f143e468b34a631f5a0
56d/scipy-1.2.0-cp36-cp36m-manylinux1_x86_64.whl (26.6MB)
     |████████████████████████████████| 26.6MB 92kB/s
Requirement already satisfied: statsmodels in /usr/local/lib/python3.6/dist-packages (from
wrangle->talos) (0.10.1)
Requirement already satisfied: python-dateutil>=2.6.1 in /usr/local/lib/python3.6/dist-packages
(from pandas->talos) (2.6.1)
Requirement already satisfied: pytz>=2017.2 in /usr/local/lib/python3.6/dist-packages (from
pandas->talos) (2018.9)
Requirement already satisfied: h5py in /usr/local/lib/python3.6/dist-packages (from keras->talos)
(2.8.0)
Requirement already satisfied: pyyaml in /usr/local/lib/python3.6/dist-packages (from keras-
>talos) (3.13)
Requirement already satisfied: six>=1.9.0 in /usr/local/lib/python3.6/dist-packages (from keras-
>talos) (1.12.0)
Requirement already satisfied: keras-applications>=1.0.8 in /usr/local/lib/python3.6/dist-packages
(from keras->talos) (1.0.8)
Requirement already satisfied: keras-preprocessing>=1.1.0 in /usr/local/lib/python3.6/dist-
packages (from keras->talos) (1.1.0)
Collecting geonamescache
  Downloading
https://files.pythonhosted.org/packages/32/c1/efb823270c8526b2f4f3eb8c804c5a0a55277267ad2312f5eb47b
370/geonamescache-1.1.0-py3-none-any.whl (830kB)
     |████████████████████████████████| 839kB 30.6MB/s
Requirement already satisfied: scikit-learn in /usr/local/lib/python3.6/dist-packages (from
sklearn->talos) (0.21.3)
Requirement already satisfied: urllib3<1.25,>=1.21.1 in /usr/local/lib/python3.6/dist-packages
```

```
Requirement already satisfied: urllib3<1.25,>=1.21.1 in /usr/local/lib/python3.6/dist-packages
(from requests->talos) (1.24.3)
Requirement already satisfied: chardet<3.1.0,>=3.0.2 in /usr/local/lib/python3.6/dist-packages
(from requests->talos) (3.0.4)
Requirement already satisfied: idna<2.9,>=2.5 in /usr/local/lib/python3.6/dist-packages (from
requests->talos) (2.8)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.6/dist-packages (from
requests->talos) (2019.9.11)
Requirement already satisfied: patsy>=0.4.0 in /usr/local/lib/python3.6/dist-packages (from
statsmodels->wrangle->talos) (0.5.1)
Requirement already satisfied: joblib>=0.11 in /usr/local/lib/python3.6/dist-packages (from
scikit-learn->sklearn->talos) (0.14.0)
Building wheels for collected packages: talos, wrangle, astetik, chances, kerasplotlib
  Building wheel for talos (setup.py) ... done
  Created wheel for talos: filename=talos-0.6.3-cp36-none-any.whl size=49626
sha256=429598a01732cca12f51e13d76cde2446b0aed7025531b388dcc8f77c5392f1c
  Stored in directory:
/root/.cache/pip/wheels/bb/d7/6b/86fd8b1fc7cfbd2c54796412f86efb5fb6a3a5c734014f6a66
  Building wheel for wrangle (setup.py) ... done
  Created wheel for wrangle: filename=wrangle-0.6.7-cp36-none-any.whl size=49894
sha256=2a46c68bd3232a9aa752593b5608b37e784e44b06c13780278fc7887df35ede0
  Stored in directory:
/root/.cache/pip/wheels/bf/1b/50/d0403ce6ef269e364894da7b50db68db14c4ac62c577561e2d
  Building wheel for astetik (setup.py) ... done
  Created wheel for astetik: filename=astetik-1.9.9-cp36-none-any.whl size=56960
sha256=7fcad50c2d64c39f095fb33343db2733521792fb3e85b87ac4c283f14f199641
  Stored in directory:
/root/.cache/pip/wheels/ae/70/21/c475cd079ec401dd6e1b9b1d42b4c38554ce12679bfb214aad
  Building wheel for chances (setup.py) ... done
  Created wheel for chances: filename=chances-0.1.9-cp36-none-any.whl size=41609
sha256=fc316e17f5b7ddb03ef40a307c009241711cd8b6c8a47d306f978c5788fc8d08
  Stored in directory:
/root/.cache/pip/wheels/75/33/46/c871b94249bd57d17797d049b3dff8e3a09c315afb67eb14c6
  Building wheel for kerasplotlib (setup.py) ... done
  Created wheel for kerasplotlib: filename=kerasplotlib-0.1.4-cp36-none-any.whl size=3579
sha256=59d3ee0aa71c8391c2c52594a26197ef9ab430626bffaada226b7127c8c0365f
  Stored in directory:
/root/.cache/pip/wheels/36/6b/4c/e1fc6d7d8811940fbea1147b1519c7baa6933e4baeff904433
Successfully built talos wrangle astetik chances kerasplotlib
ERROR: albumentations 0.1.12 has requirement imgaug<0.2.7,>=0.2.5, but you'll have imgaug 0.2.9 wh
ich is incompatible.
Installing collected packages: scipy, wrangle, geonamescache, astetik, chances, kerasplotlib, talo
s
  Found existing installation: scipy 1.3.1
    Uninstalling scipy-1.3.1:
      Successfully uninstalled scipy-1.3.1
Successfully installed astetik-1.9.9 chances-0.1.9 geonamescache-1.1.0 kerasplotlib-0.1.4 scipy-1.
2.0 talos-0.6.3 wrangle-0.6.7
```

In [0]:

```
# Activities are the class labels
# It is a 6 class classification
ACTIVITIES = {
    0: 'WALKING',
    1: 'WALKING_UPSTAIRS',
    2: 'WALKING_DOWNSTAIRS',
    3: 'SITTING',
    4: 'STANDING',
    5: 'LAYING',
}

# Utility function to print the confusion matrix
def confusion_matrix(Y_true, Y_pred):
    Y_true = pd.Series([ACTIVITIES[y] for y in np.argmax(Y_true, axis=1)])
    Y_pred = pd.Series([ACTIVITIES[y] for y in np.argmax(Y_pred, axis=1)])

    return pd.crosstab(Y_true, Y_pred, rownames=['True'], colnames=['Pred'])
```

Data

In [5]:

```
# Data directory
```

```
from google.colab import drive
drive.mount("/content/drive")
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client_id=947318989803-6bn6
qk8qdgf4n4g3pfee6491hc0brc4i.apps.googleusercontent.com&redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%
b&scope=email%20https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fdocs.test%20https%3A%2F%2Fwww.googleapis.
2Fauth%2Fdrive%20https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fdrive.photos.readonly%20https%3A%2F%2Fww
ogleapis.com%2Fauth%2Fpeopleapi.readonly&response_type=code

Enter your authorization code:
··········
Mounted at /content/drive
```

In [0]:

```
# Raw data signals
# Signals are from Accelerometer and Gyroscope
# The signals are in x,y,z directions
# Sensor signals are filtered to have only body acceleration
# excluding the acceleration due to gravity
# Triaxial acceleration from the accelerometer is total acceleration
SIGNALS = [
    "body_acc_x",
    "body_acc_y",
    "body_acc_z",
    "body_gyro_x",
    "body_gyro_y",
    "body_gyro_z",
    "total_acc_x",
    "total_acc_y",
    "total_acc_z"
]
```

In [0]:

```
# Utility function to read the data from csv file
def _read_csv(filename):
    return pd.read_csv(filename, delim_whitespace=True, header=None)

# Utility function to load the load
def load_signals(subset):
    signals_data = []

    for signal in SIGNALS:
        filename = f'/content/drive/My Drive/{signal}_{subset}.txt'
        signals_data.append(
            _read_csv(filename).as_matrix()
        )

    # Transpose is used to change the dimensionality of the output,
    # aggregating the signals by combination of sample/timestep.
    # Resultant shape is (7352 train/2947 test samples, 128 timesteps, 9 signals)
    return np.transpose(signals_data, (1, 2, 0))
```

In [0]:

```
def load_y(subset):
    """
    The objective that we are trying to predict is a integer, from 1 to 6,
    that represents a human activity. We return a binary representation of
    every sample objective as a 6 bits vector using One Hot Encoding
    (https://pandas.pydata.org/pandas-docs/stable/generated/pandas.get_dummies.html)
    """
    filename = f'/content/drive/My Drive/y_{subset}.txt'
    y = _read_csv(filename)[0]

    return pd.get_dummies(y).as_matrix()
```

In [0]:

```
def load_data():
    """
    Obtain the dataset from multiple files
```

```
    Obtain the dataset from multiple files.
    Returns: X_train, X_test, y_train, y_test
    """
    X_train, X_test = load_signals('train'), load_signals('test')
    y_train, y_test = load_y('train'), load_y('test')

    return X_train, X_test, y_train, y_test
```

In [10]:

```
# Importing tensorflow
np.random.seed(42)
import tensorflow as tf
tf.set_random_seed(42)
```

The default version of TensorFlow in Colab will soon switch to TensorFlow 2.x.
We recommend you upgrade now or ensure your notebook will continue to use TensorFlow 1.x via the `%tensorflow_version 1.x` magic: more info.

In [0]:

```
# Configuring a session
session_conf = tf.ConfigProto(
    intra_op_parallelism_threads=1,
    inter_op_parallelism_threads=1
)
```

In [12]:

```
# Import Keras
from keras import backend as K
sess = tf.Session(graph=tf.get_default_graph(), config=session_conf)
K.set_session(sess)
```

```
Using TensorFlow backend.
```

In [0]:

```
# Importing libraries
from keras.models import Sequential
from keras.layers import LSTM
from keras.layers.core import Dense, Dropout
```

In [0]:

```
# Utility function to count the number of classes
def _count_classes(y):
    return len(set([tuple(category) for category in y]))
```

In [0]:

```
# Loading the train and test data
X_train, X_test, Y_train, Y_test = load_data()
```

In [16]:

```
timesteps = len(X_train[0])
input_dim = len(X_train[0][0])
n_classes = _count_classes(Y_train)

print(timesteps)
print(input_dim)
print(len(X_train))
```

```
128
9
7352
```

- Defining the Architecture of LSTM

In [0]:

```
# Initializing parameters
#epochs = 30
#n_hidden = 10

#param_grid = dict(epochs=[30,40],n_hidden=[10,15,20,25,30,35,40,45,50,55,60])
#grid = GridSearchCV(estimator=model, param_grid=param_grid, n_jobs=-1, cv=3)
#grid_result = grid.fit(X, Y)
```

In [0]:

```
def HAR_LSTM(X_train, Y_train, X_test, Y_test, params):

    model = Sequential()
    model.add(LSTM(params['n_hidden'], input_shape=(timesteps, input_dim)))
    model.add(Dropout(params['dropout']))
    model.add(Dense(n_classes, activation='sigmoid'))
    model.summary()
    model.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
    history = model.fit(X_train, Y_train,validation_data = (X_test, Y_test),batch_size=40,epochs=30
,verbose=0)
    return history, model
```

Now lets test various combinations of n_hidden ad dropout. We will check for n_hidden from range 0 to 65 (not all , but at interval of 5) and dropout from range .2 to .8, with internal of .1, (i.e dropout from 20% to 80%)

Now since this will take lot of time and sometimes google colab kicks me out after long period of inactivity within a cell. I am breaking it into chunks

In [0]:

```
p1 = {'n_hidden':[15,25,35,45,55,65],
     'dropout': [0.2,0.3]}

p2 = {'n_hidden':[10,15,25,35,45,55,65],
     'dropout': [0.4,0.5]}

p3 = {'n_hidden':[10,15,25,35,45,55,65],
     'dropout': [0.6,0.7]}

p4 = {'n_hidden':[10,15,25,35,45,55,65],
     'dropout': [0.8]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t1 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p1,experiment_name='1',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/12 [00:00<?, ?it/s]
```

```
{'dropout': 0.2, 'n_hidden': 15}
Model: "sequential_2"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_2 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_2 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_2 (Dense)              (None, 6)                 96
=================================================================
```

```
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:107: The name tf.reset_default_graph is deprecated. P
lease use tf.compat.v1.reset_default_graph instead.


  8%|▊         | 1/12 [04:07<45:20, 247.29s/it]

{'dropout': 0.2, 'n_hidden': 25}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________

 17%|█▋        | 2/12 [08:39<42:26, 254.67s/it]

{'dropout': 0.2, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________

 25%|██▌       | 3/12 [13:37<40:09, 267.75s/it]

{'dropout': 0.2, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________

 33%|███▎      | 4/12 [18:59<37:52, 284.06s/it]

{'dropout': 0.2, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
```

```
_
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 42%|████      | 5/12 [24:54<35:37, 305.39s/it]
```

```
{'dropout': 0.2, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|█████     | 6/12 [30:58<32:17, 322.88s/it]
```

```
{'dropout': 0.3, 'n_hidden': 15}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
```

```
 58%|██████    | 7/12 [34:32<24:11, 290.27s/it]
```

```
{'dropout': 0.3, 'n_hidden': 25}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|███████   | 8/12 [38:29<18:16, 274.18s/it]
```

```
{'dropout': 0.3, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
```

```
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 75%|███████▌  | 9/12 [42:55<13:35, 271.85s/it]
```

```
{'dropout': 0.3, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎ | 10/12 [47:44<09:13, 276.87s/it]
```

```
{'dropout': 0.3, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 92%|█████████▏| 11/12 [53:04<04:49, 289.92s/it]
```

```
{'dropout': 0.3, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 12/12 [59:02<00:00, 310.32s/it]
```

In [0]:

```
print (t1.data)
```

```
    round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0             30  0.535842  0.778332  0.539308  0.780023      0.2        15
1             30  0.443391  0.796464  0.482837  0.785464      0.2        25
2             30  0.456516  0.821850  0.414255  0.853673      0.2        35
```

3	30	0.320570	0.860834	0.327982	0.870190	0.2	45
4	30	0.327954	0.868540	0.348676	0.878352	0.2	55
5	30	0.153704	0.934723	0.187573	0.932569	0.2	65
6	30	0.748829	0.621940	0.793479	0.557909	0.3	15
7	30	0.628224	0.694016	0.727207	0.665954	0.3	25
8	30	0.568490	0.785131	0.625008	0.763894	0.3	35
9	30	0.219541	0.922484	0.257486	0.913331	0.3	45
10	30	0.736938	0.590209	0.787109	0.576953	0.3	55
11	30	0.261446	0.912511	0.277876	0.907112	0.3	65

In [0]:

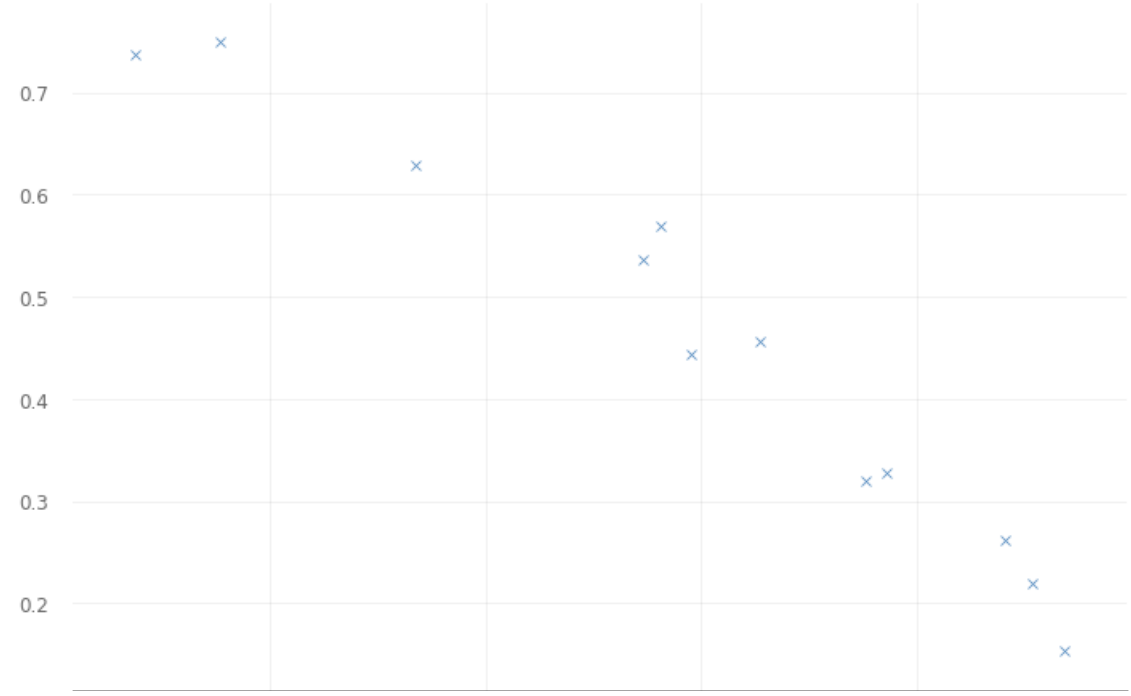
```
analyze_object = ta.Analyze(t1)
print (analyze_object.data)
print ("#############")
print (analyze_object.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

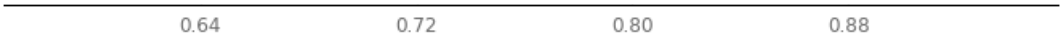
```
    round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0             30  0.535842  0.778332  0.539308  0.780023      0.2        15
1             30  0.443391  0.796464  0.482837  0.785464      0.2        25
2             30  0.456516  0.821850  0.414255  0.853673      0.2        35
3             30  0.320570  0.860834  0.327982  0.870190      0.2        45
4             30  0.327954  0.868540  0.348676  0.878352      0.2        55
5             30  0.153704  0.934723  0.187573  0.932569      0.2        65
6             30  0.748829  0.621940  0.793479  0.557909      0.3        15
7             30  0.628224  0.694016  0.727207  0.665954      0.3        25
8             30  0.568490  0.785131  0.625008  0.763894      0.3        35
9             30  0.219541  0.922484  0.257486  0.913331      0.3        45
10            30  0.736938  0.590209  0.787109  0.576953      0.3        55
11            30  0.261446  0.912511  0.277876  0.907112      0.3        65
#############
[[65.   0.2 30.   0. ]
 [45.   0.3 30.   1. ]
 [65.   0.3 30.   2. ]
 [55.   0.2 30.   3. ]
 [45.   0.2 30.   4. ]
 [35.   0.2 30.   5. ]
 [25.   0.2 30.   6. ]
 [35.   0.3 30.   7. ]
 [15.   0.2 30.   8. ]
 [25.   0.3 30.   9. ]]
```

In [0]:

```
analyze_object.plot_regs('val_acc', 'val_loss')
```

```
findfont: Font family ['Verdana'] not found. Falling back to DejaVu Sans.
```





In [0]:

```
analyze_object.best_params('val_acc', ['acc', 'loss', 'val_loss'])
```

Out[0]:

```
array([[65. ,  0.2, 30. ,  0. ],
       [45. ,  0.3, 30. ,  1. ],
       [65. ,  0.3, 30. ,  2. ],
       [55. ,  0.2, 30. ,  3. ],
       [45. ,  0.2, 30. ,  4. ],
       [35. ,  0.2, 30. ,  5. ],
       [25. ,  0.2, 30. ,  6. ],
       [35. ,  0.3, 30. ,  7. ],
       [15. ,  0.2, 30. ,  8. ],
       [25. ,  0.3, 30. ,  9. ]])
```

In [0]:

```
import talos as ta
import warnings
warnings.filterwarnings('ignore')

t2 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p2,experiment_name='2',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/14 [00:00<?, ?it/s]
{'dropout': 0.4, 'n_hidden': 10}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 10)                800
_________________________________________________________________
dropout_1 (Dropout)          (None, 10)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 66
=================================================================
Total params: 866
Trainable params: 866
Non-trainable params: 0
_________________________________________________________________
  7%|▋         | 1/14 [03:32<46:01, 212.44s/it]
{'dropout': 0.4, 'n_hidden': 15}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
 14%|█▍        | 2/14 [07:13<43:01, 215.13s/it]
{'dropout': 0.4, 'n_hidden': 25}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
```

```
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________
```

```
 21%|██        | 3/14 [11:18<41:03, 223.94s/it]
```

```
{'dropout': 0.4, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 29%|██        | 4/14 [15:48<39:39, 237.93s/it]
```

```
{'dropout': 0.4, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 36%|███       | 5/14 [20:42<38:10, 254.55s/it]
```

```
{'dropout': 0.4, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 43%|████      | 6/14 [26:06<36:43, 275.41s/it]
```

```
{'dropout': 0.4, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
```

```
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|█████     | 7/14 [32:07<35:07, 301.05s/it]
```

```
{'dropout': 0.5, 'n_hidden': 10}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 10)                800
_________________________________________________________________
dropout_1 (Dropout)          (None, 10)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 66
=================================================================
Total params: 866
Trainable params: 866
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|██████    | 8/14 [35:39<27:27, 274.54s/it]
```

```
{'dropout': 0.5, 'n_hidden': 15}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
```

```
 64%|██████▍   | 9/14 [39:22<21:34, 258.91s/it]
```

```
{'dropout': 0.5, 'n_hidden': 25}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________
```

```
 71%|███████   | 10/14 [43:26<16:58, 254.63s/it]
```

```
{'dropout': 0.5, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
```

```
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 79%|███████▉  | 11/14 [47:58<12:59, 259.70s/it]
```

```
{'dropout': 0.5, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|████████▌ | 12/14 [52:53<09:00, 270.42s/it]
```

```
{'dropout': 0.5, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 93%|█████████▎ | 13/14 [58:19<04:47, 287.10s/it]
```

```
{'dropout': 0.5, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 14/14 [1:04:21<00:00, 309.34s/it]
```

In [0]:

```
print (t2.data)
```

In [0]:

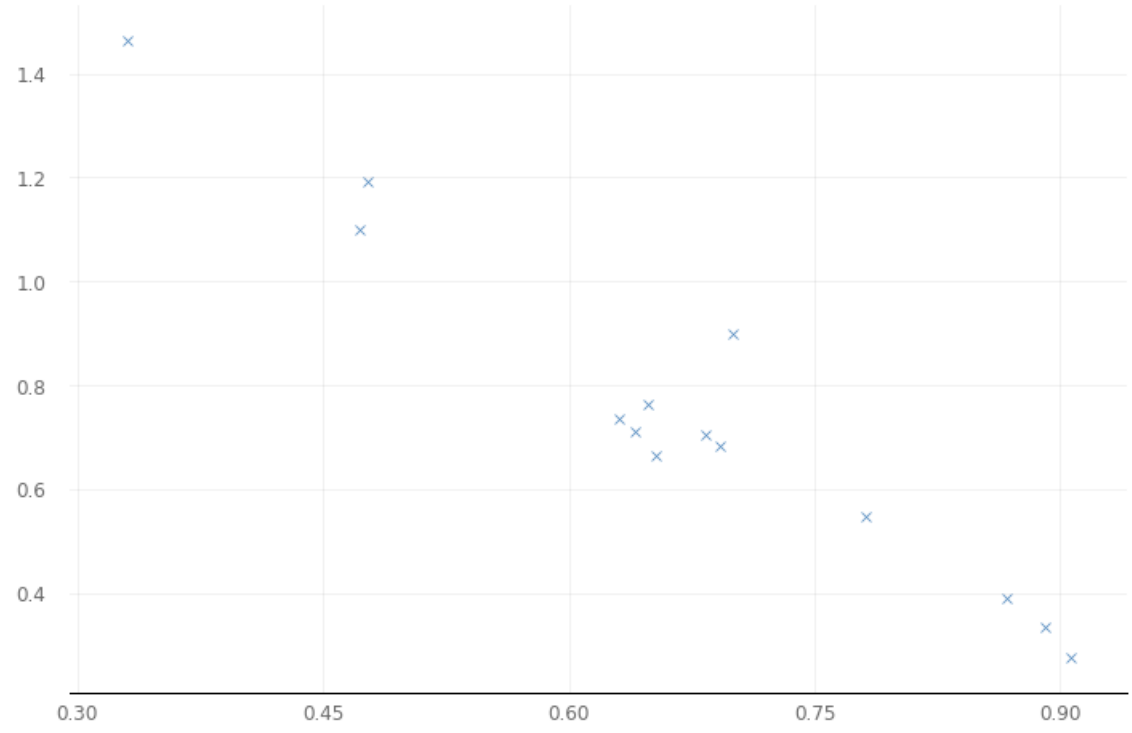
```
analyze_object2 = ta.Analyze(t2)
```

```
print (analyze_object2.data)
print ("#############")
print (analyze_object2.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
    round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0             30  0.705121  0.683590  0.809682  0.641663      0.4        10
1             30  0.682834  0.692656  0.726294  0.669452      0.4        15
2             30  0.898698  0.699909  1.034566  0.579868      0.4        25
3             30  0.390169  0.867180  0.509215  0.834629      0.4        35
4             30  0.276417  0.906165  0.348644  0.871356      0.4        45
5             30  1.192201  0.476881  1.213438  0.486592      0.4        55
6             30  0.545816  0.781052  0.673832  0.722309      0.4        65
7             30  1.100086  0.472348  1.117126  0.498834      0.5        10
8             30  0.710729  0.640526  0.796891  0.628449      0.5        15
9             30  0.736238  0.630553  0.702828  0.664983      0.5        25
10            30  0.761507  0.648232  0.819030  0.610377      0.5        35
11            30  0.334457  0.890752  0.344861  0.897007      0.5        45
12            30  0.662877  0.653218  0.738219  0.627089      0.5        55
13            30  1.464748  0.330462  1.400331  0.434124      0.5        65
#############
[[45.   0.4 30.   0. ]
 [45.   0.5 30.   1. ]
 [35.   0.4 30.   2. ]
 [65.   0.4 30.   3. ]
 [25.   0.4 30.   4. ]
 [15.   0.4 30.   5. ]
 [10.   0.4 30.   6. ]
 [55.   0.5 30.   7. ]
 [35.   0.5 30.   8. ]
 [15.   0.5 30.   9. ]]
```

In [0]:

```
analyze_object2.plot_regs('val_acc', 'val_loss')
```



In [0]:

```
analyze_object2.best_params('val_acc', ['acc', 'loss', 'val_loss'])
```

Out[0]:

```
array([[45. ,  0.4, 30. ,  0. ],
       [45. ,  0.5, 30. ,  1. ],
       [35. ,  0.4, 30. ,  2. ],
       [65. ,  0.4, 30. ,  3. ],
       [25. ,  0.4, 30. ,  4. ],
```

```
       [15. ,  0.4, 30. ,  5. ],
       [10. ,  0.4, 30. ,  6. ],
       [55. ,  0.5, 30. ,  7. ],
       [35. ,  0.5, 30. ,  8. ],
       [15. ,  0.5, 30. ,  9. ]])
```

In [0]:

```
import talos as ta
import warnings
warnings.filterwarnings('ignore')

t3 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p1,experiment_name='3',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/12 [00:00<?, ?it/s]
```

```
{'dropout': 0.2, 'n_hidden': 15}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
```

```
  8%|▊         | 1/12 [03:42<40:52, 222.99s/it]
```

```
{'dropout': 0.2, 'n_hidden': 25}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________
```

```
 17%|█▋        | 2/12 [07:49<38:21, 230.15s/it]
```

```
{'dropout': 0.2, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 25%|██▌       | 3/12 [12:23<36:27, 243.08s/it]
```

```
{'dropout': 0.2, 'n_hidden': 45}
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 4/12 [17:17<34:27, 258.41s/it]
```

```
{'dropout': 0.2, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 42%|████      | 5/12 [22:43<32:31, 278.79s/it]
```

```
{'dropout': 0.2, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|█████     | 6/12 [28:44<30:20, 303.46s/it]
```

```
{'dropout': 0.3, 'n_hidden': 15}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
_________________________________________________________________
```

```
 58%|██████    | 7/12 [32:26<23:15, 279.10s/it]
```

```
{'dropout': 0.3, 'n_hidden': 25}
Model: "sequential_1"
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 8/12 [36:31<17:55, 268.77s/it]
```

```
{'dropout': 0.3, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 75%|███████▌  | 9/12 [41:04<13:29, 270.00s/it]
```

```
{'dropout': 0.3, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎ | 10/12 [45:52<09:10, 275.36s/it]
```

```
{'dropout': 0.3, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 92%|█████████▏| 11/12 [51:01<04:45, 285.37s/it]
```

```
{'dropout': 0.3, 'n_hidden': 65}
Model: "sequential_1"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 12/12 [56:43<00:00, 302.59s/it]
```

In [0]:

```
print (t3.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.682995	0.658658	0.722424	0.671784	0.2	15
1	30	1.054739	0.623300	1.085866	0.546444	0.2	25
2	30	0.529008	0.767452	0.535910	0.763311	0.2	35
3	30	0.366875	0.878060	0.409616	0.865138	0.2	45
4	30	0.235800	0.914325	0.272757	0.909444	0.2	55
5	30	0.276946	0.907072	0.276064	0.897007	0.2	65
6	30	0.787219	0.641886	0.996860	0.600661	0.3	15
7	30	0.828878	0.592928	0.877912	0.603964	0.3	25
8	30	0.271579	0.907525	0.237677	0.921492	0.3	35
9	30	0.616223	0.753400	0.724502	0.692771	0.3	45
10	30	0.397681	0.874887	0.445539	0.840070	0.3	55
11	30	0.499969	0.825929	0.602736	0.772445	0.3	65

In [0]:

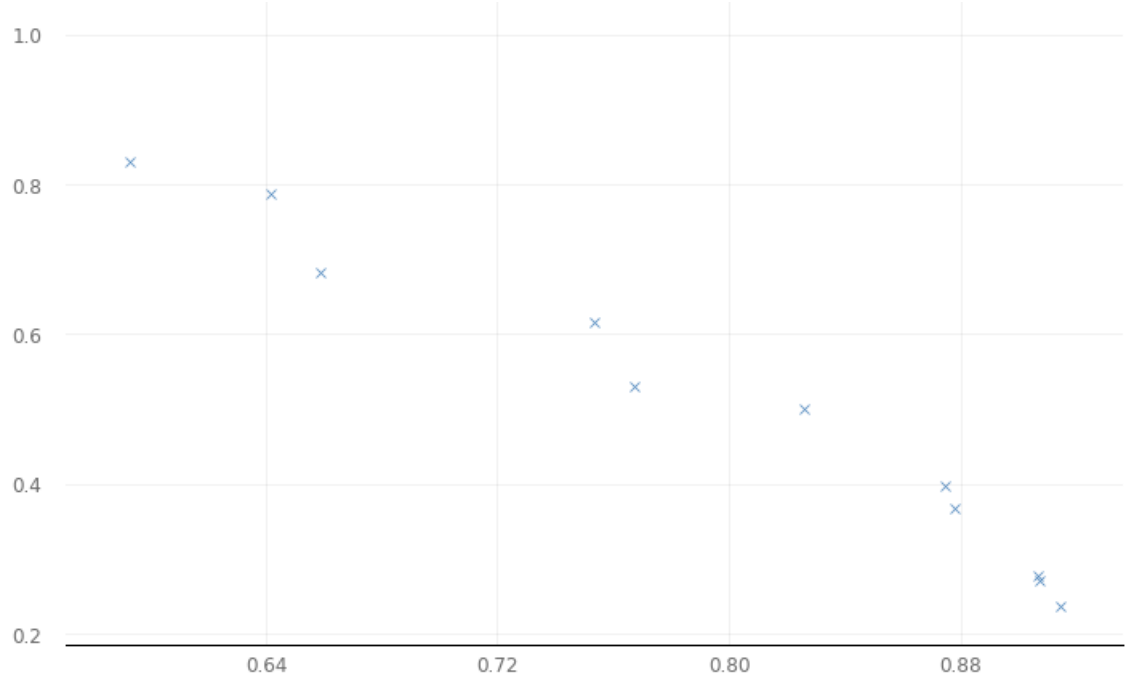
```
analyze_object3 = ta.Analyze(t3)
print (analyze_object3.data)
print ("#############")
print (analyze_object3.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.682995	0.658658	0.722424	0.671784	0.2	15
1	30	1.054739	0.623300	1.085866	0.546444	0.2	25
2	30	0.529008	0.767452	0.535910	0.763311	0.2	35
3	30	0.366875	0.878060	0.409616	0.865138	0.2	45
4	30	0.235800	0.914325	0.272757	0.909444	0.2	55
5	30	0.276946	0.907072	0.276064	0.897007	0.2	65
6	30	0.787219	0.641886	0.996860	0.600661	0.3	15
7	30	0.828878	0.592928	0.877912	0.603964	0.3	25
8	30	0.271579	0.907525	0.237677	0.921492	0.3	35
9	30	0.616223	0.753400	0.724502	0.692771	0.3	45
10	30	0.397681	0.874887	0.445539	0.840070	0.3	55
11	30	0.499969	0.825929	0.602736	0.772445	0.3	65

```
#############
[[55.   0.2 30.   0. ]
 [35.   0.3 30.   1. ]
 [65.   0.2 30.   2. ]
 [45.   0.2 30.   3. ]
 [55.   0.3 30.   4. ]
 [65.   0.3 30.   5. ]
 [35.   0.2 30.   6. ]
 [45.   0.3 30.   7. ]
 [15.   0.2 30.   8. ]
 [15.   0.3 30.   9. ]]
```

In [0]:

```
analyze_object3.plot_regs('val_acc', 'val_loss')
```



In [0]:

```
analyze_object3.best_params('val_acc', ['acc', 'loss', 'val_loss'])
```

Out[0]:

```
array([[55. ,  0.2, 30. ,  0. ],
       [35. ,  0.3, 30. ,  1. ],
       [65. ,  0.2, 30. ,  2. ],
       [45. ,  0.2, 30. ,  3. ],
       [55. ,  0.3, 30. ,  4. ],
       [65. ,  0.3, 30. ,  5. ],
       [35. ,  0.2, 30. ,  6. ],
       [45. ,  0.3, 30. ,  7. ],
       [15. ,  0.2, 30. ,  8. ],
       [15. ,  0.3, 30. ,  9. ]])
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t4 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p4,experiment_name='4',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/7 [00:00<?, ?it/s]
```

```
{'dropout': 0.8, 'n_hidden': 10}
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:541: The name tf.placeholder is deprecated. Please us
e tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:4432: The name tf.random_uniform is deprecated. Pleas
e use tf.random.uniform instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:148: The name tf.placeholder_with_default is
deprecated. Please use tf.compat.v1.placeholder_with_default instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3733: calling dropout (from
tensorflow.python.ops.nn_ops) with keep_prob is deprecated and will be removed in a future
version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`
```

```
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`.
WARNING:tensorflow:Large dropout rate: 0.8 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 10)                800
_________________________________________________________________
dropout_1 (Dropout)          (None, 10)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 66
=================================================================
Total params: 866
Trainable params: 866
Non-trainable params: 0
_________________________________________________________________
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/optimizers.py:793: The name t
f.train.Optimizer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3576: The name tf.log is deprecated. Please use tf.ma
th.log instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1033: The name tf.assign_add is deprecated. Please us
e tf.compat.v1.assign_add instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1020: The name tf.assign is deprecated. Please use tf
.compat.v1.assign instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:190: The name tf.get_default_session is deprecated. P
lease use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:207: The name tf.global_variables is deprecated. Plea
se use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:216: The name tf.is_variable_initialized is
deprecated. Please use tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:223: The name tf.variables_initializer is deprecated.
Please use tf.compat.v1.variables_initializer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:107: The name tf.reset_default_graph is deprecated. P
lease use tf.compat.v1.reset_default_graph instead.


 14%|▉         | 1/7 [03:41<22:06, 221.17s/it]

{'dropout': 0.8, 'n_hidden': 15}
WARNING:tensorflow:Large dropout rate: 0.8 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15)                1500
_________________________________________________________________
dropout_1 (Dropout)          (None, 15)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 96
=================================================================
Total params: 1,596
Trainable params: 1,596
Non-trainable params: 0
```

```
_________________________________________________________________

 29%|██▉       | 2/7 [07:35<18:44, 224.97s/it]

{'dropout': 0.8, 'n_hidden': 25}
WARNING:tensorflow:Large dropout rate: 0.8 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 25)                3500
_________________________________________________________________
dropout_1 (Dropout)          (None, 25)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 156
=================================================================
Total params: 3,656
Trainable params: 3,656
Non-trainable params: 0
_________________________________________________________________

 43%|████▎     | 3/7 [11:52<15:39, 234.80s/it]

{'dropout': 0.8, 'n_hidden': 35}
WARNING:tensorflow:Large dropout rate: 0.8 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________

 57%|█████▋    | 4/7 [16:48<12:39, 253.05s/it]

{'dropout': 0.8, 'n_hidden': 45}
WARNING:tensorflow:Large dropout rate: 0.8 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________

 71%|███████   | 5/7 [22:14<09:09, 274.99s/it]

{'dropout': 0.8, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
```

```
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|████████▋ | 6/7 [28:06<04:58, 298.00s/it]
```

```
{'dropout': 0.8, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 7/7 [34:33<00:00, 324.88s/it]
```

In [0]:

```
print (t4.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.847336  0.603808  1.161567  0.450641      0.8        10
1            30  0.801301  0.633726  1.091286  0.452002      0.8        15
2            30  0.707703  0.662738  0.857464  0.593471      0.8        25
3            30  1.300074  0.365820  1.351471  0.350369      0.8        35
4            30  0.638376  0.661831  0.724587  0.639526      0.8        45
5            30  0.909026  0.611514  1.036294  0.565293      0.8        55
6            30  1.450603  0.503173  0.837978  0.586864      0.8        65
```

In [0]:

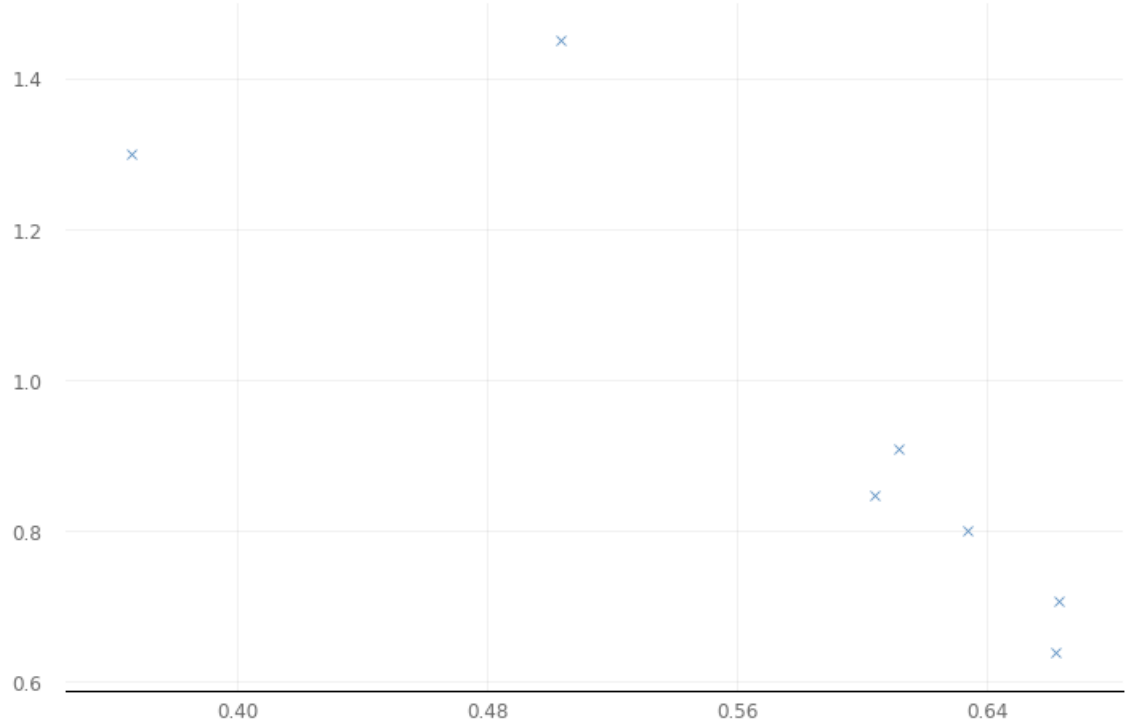
```
analyze_object4 = ta.Analyze(t4)
print (analyze_object4.data)
print ("#############")
print (analyze_object4.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.847336  0.603808  1.161567  0.450641      0.8        10
1            30  0.801301  0.633726  1.091286  0.452002      0.8        15
2            30  0.707703  0.662738  0.857464  0.593471      0.8        25
3            30  1.300074  0.365820  1.351471  0.350369      0.8        35
4            30  0.638376  0.661831  0.724587  0.639526      0.8        45
5            30  0.909026  0.611514  1.036294  0.565293      0.8        55
6            30  1.450603  0.503173  0.837978  0.586864      0.8        65
#############
[[25.   0.8 30.   0. ]
 [45.   0.8 30.   1. ]
 [15.   0.8 30.   2. ]
 [55.   0.8 30.   3. ]
 [10.   0.8 30.   4. ]
 [65.   0.8 30.   5. ]
 [35.   0.8 30.   6. ]]
```

In [0]:

```
analyze_object4.plot_regs('val_acc', 'val_loss')
```

```
findfont: Font family ['Verdana'] not found. Falling back to DejaVu Sans.
```



In [0]:

```
analyze_object4.best_params('val_acc', ['acc', 'loss', 'val_loss'])
```

Out[0]:

```
array([[25. ,  0.8, 30. ,  0. ],
       [45. ,  0.8, 30. ,  1. ],
       [15. ,  0.8, 30. ,  2. ],
       [55. ,  0.8, 30. ,  3. ],
       [10. ,  0.8, 30. ,  4. ],
       [65. ,  0.8, 30. ,  5. ],
       [35. ,  0.8, 30. ,  6. ]])
```

So i have manually copied all the combinations which produces best result. Below is the table: ``` round_epochs val_loss val_acc loss acc dropout n_hidden 30 0.153704 0.934723 0.187573 0.932569 0.2 65 30 0.219541 0.922484 0.257486 0.913331 0.3 45 30 0.261446 0.912511 0.277876 0.907112 0.3 65 30 0.271579 0.907525 0.237677 0.921492 0.3 35 30 0.276417 0.906165 0.348644 0.871356 0.4 45 30 0.334457 0.890752 0.344861 0.897007 0.5 45

So we see the best performance is when dropout is less probably reason could be we dont have much points so dropout has to be less. Also when number of neurons is on "bit higher" side then also we have better performance.

So now lets try to further fine tune as per our learnings

In [0]:

```
p5 = {'n_hidden':[35,40,45,50,55,60,65,70,75],
     'dropout': [0.1]}

p6 = {'n_hidden':[35,40,45,50,55,60,65,70,75],
     'dropout': [0.15]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t5 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p5,experiment_name='5',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/9 [00:00<?, ?it/s]
```

```
{'dropout': 0.1, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 11%|▉         | 1/9 [04:52<38:58, 292.26s/it]
```

```
{'dropout': 0.1, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 40)                8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 8,246
Trainable params: 8,246
Non-trainable params: 0
_________________________________________________________________
```

```
 22%|██        | 2/9 [09:50<34:17, 293.91s/it]
```

```
{'dropout': 0.1, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 3/9 [15:15<30:19, 303.27s/it]
```

```
{'dropout': 0.1, 'n_hidden': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_1 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 44%|████      | 4/9 [20:55<26:12, 314.54s/it]
```

```
{'dropout': 0.1, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 56%|█████     | 5/9 [26:49<21:44, 326.14s/it]
```

```
{'dropout': 0.1, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████    | 6/9 [32:59<16:58, 339.54s/it]
```

```
{'dropout': 0.1, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 78%|███████   | 7/9 [40:00<12:07, 363.69s/it]
```

```
{'dropout': 0.1, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 89%|████████  | 8/9 [47:10<06:23, 383.59s/it]
```

```
{'dropout': 0.1, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 456
=================================================================
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 9/9 [54:45<00:00, 405.29s/it]
```

In [0]:

```
print (t5.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.330125	0.889846	0.343399	0.889623	0.1	35
1	30	0.717082	0.823663	1.053372	0.634473	0.1	40
2	30	0.194613	0.938350	0.199511	0.934512	0.1	45
3	30	0.555475	0.776972	0.603254	0.764672	0.1	50
4	30	0.452976	0.851768	0.537753	0.791683	0.1	55
5	30	0.496540	0.845875	0.646201	0.784493	0.1	60
6	30	0.197542	0.932457	0.212292	0.932569	0.1	65
7	30	0.174414	0.928830	0.170497	0.939565	0.1	70
8	30	0.150804	0.933817	0.146176	0.943257	0.1	75

In [0]:

```
analyze_object5 = ta.Analyze(t5)
print ("#############")
print (analyze_object5.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[45.   0.1 30.   0. ]
 [75.   0.1 30.   1. ]
 [65.   0.1 30.   2. ]
 [70.   0.1 30.   3. ]
 [35.   0.1 30.   4. ]
 [55.   0.1 30.   5. ]
 [60.   0.1 30.   6. ]
 [40.   0.1 30.   7. ]
 [50.   0.1 30.   8. ]]
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t6 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p6,experiment_name='6',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/9 [00:00<?, ?it/s]
```

```
{'dropout': 0.15, 'n_hidden': 35}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 35)                6300
_________________________________________________________________
dropout_1 (Dropout)          (None, 35)                0
```

```
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 216
=================================================================
Total params: 6,516
Trainable params: 6,516
Non-trainable params: 0
_________________________________________________________________
```

```
 11%|█         | 1/9 [05:01<40:15, 301.95s/it]
```

```
{'dropout': 0.15, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 40)                8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 8,246
Trainable params: 8,246
Non-trainable params: 0
_________________________________________________________________
```

```
 22%|██        | 2/9 [10:05<35:16, 302.29s/it]
```

```
{'dropout': 0.15, 'n_hidden': 45}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 45)                9900
_________________________________________________________________
dropout_1 (Dropout)          (None, 45)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 276
=================================================================
Total params: 10,176
Trainable params: 10,176
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 3/9 [15:34<31:02, 310.49s/it]
```

```
{'dropout': 0.15, 'n_hidden': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_1 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 44%|████      | 4/9 [21:22<26:49, 321.84s/it]
```

```
{'dropout': 0.15, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
```

```
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 56%|█████▌    | 5/9 [27:32<22:24, 336.14s/it]
```

```
{'dropout': 0.15, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 6/9 [33:47<17:23, 347.70s/it]
```

```
{'dropout': 0.15, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 78%|███████▊  | 7/9 [40:18<12:01, 360.86s/it]
```

```
{'dropout': 0.15, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 89%|████████▉ | 8/9 [47:13<06:17, 377.02s/it]
```

```
{'dropout': 0.15, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 456
```

```
_________________________________________________________________
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 9/9 [54:31<00:00, 395.26s/it]
```

In [0]:

```
print (t6.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.512010  0.743427  0.523001  0.758842     0.15        35
1            30  0.655865  0.666364  0.525803  0.764866     0.15        40
2            30  0.242144  0.929737  0.417031  0.881073     0.15        45
3            30  0.371006  0.850861  0.461848  0.818500     0.15        50
4            30  0.173087  0.938803  0.191239  0.938787     0.15        55
5            30  0.189247  0.935630  0.174809  0.934512     0.15        60
6            30  0.935341  0.589755  1.214595  0.543529     0.15        65
7            30  0.269311  0.907525  0.320584  0.888263     0.15        70
8            30  0.168008  0.926111  0.168829  0.926739     0.15        75
```

In [0]:

```
analyze_object6 = ta.Analyze(t6)
print ("#############")
print (analyze_object6.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[55.    0.15 30.    0.  ]
 [60.    0.15 30.    1.  ]
 [45.    0.15 30.    2.  ]
 [75.    0.15 30.    3.  ]
 [70.    0.15 30.    4.  ]
 [50.    0.15 30.    5.  ]
 [35.    0.15 30.    6.  ]
 [40.    0.15 30.    7.  ]
 [65.    0.15 30.    8.  ]]
```

In [0]:

```
p7 = {'n_hidden':[50,55,60,65,70,75,80],
     'dropout': [0.2]}

p8 = {'n_hidden':[50,55,60,65,70,75,80],
     'dropout': [0.25]}

p9 = {'n_hidden':[50,55,60,65,70,75,80],
     'dropout': [0.3]}

p10 = {'n_hidden':[50,55,60,65,70,75,80],
     'dropout': [0.35]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t7 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p7,experiment_name='7',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/7 [00:00<?, ?it/s]
```

```
{'dropout': 0.2, 'n_hidden': 50}
Model: "sequential_3"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_3 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_3 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_3 (Dense)              (None, 6)                 306
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 14%|█         | 1/7 [05:34<33:29, 334.84s/it]
```

```
{'dropout': 0.2, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 29%|██        | 2/7 [11:31<28:26, 341.29s/it]
```

```
{'dropout': 0.2, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
_________________________________________________________________
```

```
 43%|████      | 3/7 [17:54<23:35, 353.90s/it]
```

```
{'dropout': 0.2, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|█████     | 4/7 [24:51<18:38, 372.95s/it]
```

```
{'dropout': 0.2, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 71%|███████   | 5/7 [31:40<12:47, 383.79s/it]
```

```
{'dropout': 0.2, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 456
=================================================================
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|████████  | 6/7 [38:56<06:39, 399.18s/it]
```

```
{'dropout': 0.2, 'n_hidden': 80}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 80)                28800
_________________________________________________________________
dropout_1 (Dropout)          (None, 80)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 486
=================================================================
Total params: 29,286
Trainable params: 29,286
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 7/7 [46:05<00:00, 408.28s/it]
```

In [0]:

```
print (t7.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.460079  0.818676  0.461717  0.814419      0.2        50
1            30  0.429562  0.818676  0.324850  0.883599      0.2        55
2            30  0.169819  0.925657  0.188048  0.934124      0.2        60
3            30  0.547212  0.724388  0.541891  0.719394      0.2        65
4            30  0.217526  0.916138  0.225114  0.928294      0.2        70
5            30  0.221293  0.915231  0.179503  0.936650      0.2        75
6            30  0.276090  0.902992  0.402867  0.879907      0.2        80
```

In [0]:

```
analyze_object7 = ta.Analyze(t7)
print ("#############")
print (analyze_object7.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[60.   0.2 30.   0. ]
 [70.   0.2 30.   1. ]
 [75.   0.2 30.   2. ]
 [80.   0.2 30.   3. ]
 [50.   0.2 30.   4. ]
 [55.   0.2 30.   5. ]
 [65.   0.2 30.   6. ]]
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t8 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p8,experiment_name='8',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/7 [00:00<?, ?it/s]
```

```
{'dropout': 0.25, 'n_hidden': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_1 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 14%|▉         | 1/7 [05:43<34:18, 343.14s/it]
```

```
{'dropout': 0.25, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________
```

```
 29%|██        | 2/7 [11:46<29:06, 349.23s/it]
```

```
{'dropout': 0.25, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
```

```
lstm_1 (LSTM)                 (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)           (None, 60)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
_________________________________________________________________
```

```
 43%|████      | 3/7 [18:01<23:47, 356.97s/it]
```

```
{'dropout': 0.25, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)           (None, 65)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|█████     | 4/7 [24:38<18:27, 369.08s/it]
```

```
{'dropout': 0.25, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)           (None, 70)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 71%|██████    | 5/7 [31:25<12:40, 380.40s/it]
```

```
{'dropout': 0.25, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)           (None, 75)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 456
=================================================================
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|███████   | 6/7 [38:55<06:41, 401.16s/it]
```

```
{'dropout': 0.25, 'n_hidden': 80}
Model: "sequential_1"
```

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 80)                28800
_________________________________________________________________
dropout_1 (Dropout)          (None, 80)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 486
=================================================================
Total params: 29,286
Trainable params: 29,286
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 7/7 [46:04<00:00, 409.56s/it]
```

In [0]:

```
print (t8.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.385329	0.866274	0.420450	0.838321	0.25	50
1	30	0.238181	0.913418	0.315607	0.903031	0.25	55
2	30	0.232557	0.915684	0.234352	0.914497	0.25	60
3	30	0.506204	0.771532	0.549081	0.749320	0.25	65
4	30	0.427905	0.775612	0.411445	0.817140	0.25	70
5	30	0.171499	0.927924	0.194620	0.929265	0.25	75
6	30	0.290419	0.898005	0.331445	0.889234	0.25	80

In [0]:

```
analyze_object8 = ta.Analyze(t8)
print ("#############")
print (analyze_object8.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[75.    0.25 30.    0.  ]
 [60.    0.25 30.    1.  ]
 [55.    0.25 30.    2.  ]
 [80.    0.25 30.    3.  ]
 [50.    0.25 30.    4.  ]
 [70.    0.25 30.    5.  ]
 [65.    0.25 30.    6.  ]]
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t9 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p9,experiment_name='9',disable_progress_bar=
False,print_params=True)
```

```
  0%|          | 0/7 [00:00<?, ?it/s]
```

```
{'dropout': 0.3, 'n_hidden': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_1 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
```

```
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________

 14%|█         | 1/7 [05:42<34:15, 342.55s/it]

{'dropout': 0.3, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________

 29%|██        | 2/7 [11:41<28:56, 347.40s/it]

{'dropout': 0.3, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
_________________________________________________________________

 43%|████      | 3/7 [17:57<23:44, 356.03s/it]

{'dropout': 0.3, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________

 57%|█████     | 4/7 [24:35<18:25, 368.62s/it]

{'dropout': 0.3, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)          (None, 70)                0
```

```
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 71%|███████   | 5/7 [31:23<12:40, 380.32s/it]
```

```
{'dropout': 0.3, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 456
=================================================================
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|████████  | 6/7 [38:34<06:35, 395.69s/it]
```

```
{'dropout': 0.3, 'n_hidden': 80}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 80)                28800
_________________________________________________________________
dropout_1 (Dropout)          (None, 80)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 486
=================================================================
Total params: 29,286
Trainable params: 29,286
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 7/7 [45:37<00:00, 403.73s/it]
```

In [0]:

```
print (t9.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.537964	0.682230	0.562778	0.699767	0.3	50
1	30	0.300200	0.887126	0.342550	0.890789	0.3	55
2	30	0.614890	0.778785	0.283760	0.905752	0.3	60
3	30	0.162949	0.940617	0.188429	0.938787	0.3	65
4	30	0.599148	0.720762	0.689545	0.690245	0.3	70
5	30	0.805204	0.719855	1.004682	0.664983	0.3	75
6	30	0.601065	0.797824	0.317339	0.890983	0.3	80

In [0]:

```
analyze_object9 = ta.Analyze(t9)
print (analyze_object9.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
[[65.   0.3 30.   0. ]
 [55.   0.3 30.   1. ]
 [80.   0.3 30.   2. ]
```

```
 [60.   0.3 30.   3. ]
 [70.   0.3 30.   4. ]
 [75.   0.3 30.   5. ]
 [50.   0.3 30.   6. ]]
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t10 =
ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p10,experiment_name='10',disable_progress_bar=Fal
se,print_params=True)
```

```
  0%|          | 0/7 [00:00<?, ?it/s]
{'dropout': 0.35, 'n_hidden': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 50)                12000
_________________________________________________________________
dropout_1 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________

 14%|█▍        | 1/7 [05:38<33:49, 338.30s/it]
{'dropout': 0.35, 'n_hidden': 55}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 55)                14300
_________________________________________________________________
dropout_1 (Dropout)          (None, 55)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 336
=================================================================
Total params: 14,636
Trainable params: 14,636
Non-trainable params: 0
_________________________________________________________________

 29%|██▊       | 2/7 [11:32<28:35, 343.08s/it]
{'dropout': 0.35, 'n_hidden': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 60)                16800
_________________________________________________________________
dropout_1 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 17,166
Trainable params: 17,166
Non-trainable params: 0
```

```
_________________________________________________________________
```

```
 43%|████      | 3/7 [17:40<23:22, 350.58s/it]
```

```
{'dropout': 0.35, 'n_hidden': 65}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 65)                19500
_________________________________________________________________
dropout_1 (Dropout)          (None, 65)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 396
=================================================================
Total params: 19,896
Trainable params: 19,896
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|█████     | 4/7 [24:10<18:07, 362.40s/it]
```

```
{'dropout': 0.35, 'n_hidden': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 70)                22400
_________________________________________________________________
dropout_1 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 22,826
Trainable params: 22,826
Non-trainable params: 0
_________________________________________________________________
```

```
 71%|██████    | 5/7 [31:03<12:35, 377.52s/it]
```

```
{'dropout': 0.35, 'n_hidden': 75}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 75)                25500
_________________________________________________________________
dropout_1 (Dropout)          (None, 75)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 456
=================================================================
Total params: 25,956
Trainable params: 25,956
Non-trainable params: 0
_________________________________________________________________
```

```
 86%|███████   | 6/7 [38:19<06:35, 395.21s/it]
```

```
{'dropout': 0.35, 'n_hidden': 80}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 80)                28800
_________________________________________________________________
dropout_1 (Dropout)          (None, 80)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 486
=================================================================
```

```
Total params: 29,286
Trainable params: 29,286
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 7/7 [45:24<00:00, 404.16s/it]
```

In [0]:

```
print (t10.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.737335  0.635993  0.789538  0.629615     0.35        50
1            30  0.477936  0.809610  0.545819  0.769724     0.35        55
2            30  0.193315  0.941976  0.245772  0.921104     0.35        60
3            30  0.407638  0.803264  0.484697  0.785076     0.35        65
4            30  0.231399  0.917498  0.277376  0.894287     0.35        70
5            30  0.604080  0.715775  0.645414  0.694520     0.35        75
6            30  0.354007  0.844968  0.430728  0.834629     0.35        80
```

In [0]:

```
analyze_object10 = ta.Analyze(t10)
print ("#############")
print (analyze_object10.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[60.    0.35 30.    0.  ]
 [70.    0.35 30.    1.  ]
 [80.    0.35 30.    2.  ]
 [55.    0.35 30.    3.  ]
 [65.    0.35 30.    4.  ]
 [75.    0.35 30.    5.  ]
 [50.    0.35 30.    6.  ]]
```

In [0]:

```
p11 = {'n_hidden':[85,95,100,110],
     'dropout': [0.1,.05]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t11 =
ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p11,experiment_name='11',disable_progress_bar=Fal
se,print_params=True)
```

```
  0%|          | 0/8 [00:00<?, ?it/s]
```

```
{'dropout': 0.1, 'n_hidden': 85}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 85)                32300
_________________________________________________________________
dropout_1 (Dropout)          (None, 85)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 516
=================================================================
Total params: 32,816
Trainable params: 32,816
Non-trainable params: 0
```

```
Non-trainable params: 0
_________________________________________________________________

 12%|▉         | 1/8 [09:13<1:04:36, 553.82s/it]

{'dropout': 0.1, 'n_hidden': 95}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 95)                39900
_________________________________________________________________
dropout_1 (Dropout)          (None, 95)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 576
=================================================================
Total params: 40,476
Trainable params: 40,476
Non-trainable params: 0
_________________________________________________________________

 25%|██        | 2/8 [18:21<55:12, 552.03s/it]

{'dropout': 0.1, 'n_hidden': 100}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 100)               44000
_________________________________________________________________
dropout_1 (Dropout)          (None, 100)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 606
=================================================================
Total params: 44,606
Trainable params: 44,606
Non-trainable params: 0
_________________________________________________________________

 38%|███▊      | 3/8 [27:39<46:09, 553.84s/it]

{'dropout': 0.1, 'n_hidden': 110}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 110)               52800
_________________________________________________________________
dropout_1 (Dropout)          (None, 110)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 666
=================================================================
Total params: 53,466
Trainable params: 53,466
Non-trainable params: 0
_________________________________________________________________

 50%|████▌     | 4/8 [37:54<38:08, 572.03s/it]

{'dropout': 0.05, 'n_hidden': 85}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 85)                32300
_________________________________________________________________
dropout_1 (Dropout)          (None, 85)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 516
```

```
=================================================================
Total params: 32,816
Trainable params: 32,816
Non-trainable params: 0
_________________________________________________________________
```

```
 62%|██████    | 5/8 [46:09<27:26, 548.86s/it]
```

```
{'dropout': 0.05, 'n_hidden': 95}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 95)                39900
_________________________________________________________________
dropout_1 (Dropout)          (None, 95)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 576
=================================================================
Total params: 40,476
Trainable params: 40,476
Non-trainable params: 0
_________________________________________________________________
```

```
 75%|███████   | 6/8 [54:56<18:04, 542.49s/it]
```

```
{'dropout': 0.05, 'n_hidden': 100}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 100)               44000
_________________________________________________________________
dropout_1 (Dropout)          (None, 100)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 606
=================================================================
Total params: 44,606
Trainable params: 44,606
Non-trainable params: 0
_________________________________________________________________
```

```
 88%|████████▊ | 7/8 [1:04:10<09:05, 545.92s/it]
```

```
{'dropout': 0.05, 'n_hidden': 110}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 110)               52800
_________________________________________________________________
dropout_1 (Dropout)          (None, 110)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 666
=================================================================
Total params: 53,466
Trainable params: 53,466
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 8/8 [1:14:20<00:00, 565.13s/it]
```

In [0]:

```
print (t11.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
```

```
0            30  0.169475  0.940617  0.183592  0.932569      0.10         85
1            30  0.189383  0.927471  0.220780  0.919938      0.10         95
2            30  0.436723  0.817316  0.426182  0.819471      0.10        100
3            30  0.138878  0.934723  0.146630  0.941897      0.10        110
4            30  0.147089  0.936990  0.177823  0.935290      0.05         85
5            30  0.322639  0.864007  0.235360  0.912165      0.05         95
6            30  0.133119  0.946963  0.141348  0.946949      0.05        100
7            30  0.156973  0.936537  0.159637  0.938010      0.05        110
```

In [0]:

```
analyze_object11 = ta.Analyze(t11)
print ("#############")
print (analyze_object11.best_params('val_acc', ['acc', 'loss', 'val_loss']))
```

```
#############
[[1.0e+02 5.0e-02 3.0e+01 0.0e+00]
 [8.5e+01 1.0e-01 3.0e+01 1.0e+00]
 [8.5e+01 5.0e-02 3.0e+01 2.0e+00]
 [1.1e+02 5.0e-02 3.0e+01 3.0e+00]
 [1.1e+02 1.0e-01 3.0e+01 4.0e+00]
 [9.5e+01 1.0e-01 3.0e+01 5.0e+00]
 [9.5e+01 5.0e-02 3.0e+01 6.0e+00]
 [1.0e+02 1.0e-01 3.0e+01 7.0e+00]]
```

So we see as number of hidden layers is increasing the model is performing better, may be all those layers are learning many other different aspects. Let us keep increasing hidden layers a bit more if it still gives better performance becuase it is likely at one point with too many hidden layer model would tend towards overfitting

In [0]:

```
p12 = {'n_hidden':[115,120,125,130],
     'dropout': [0.1,.05,0]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t12 =
ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM,params=p12,experiment_name='12',disable_progress_bar=False,print_params=True)
```

```
  0%|          | 0/12 [00:00<?, ?it/s]
```

```
{'dropout': 0.1, 'n_hidden': 115}
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:541: The name tf.placeholder is deprecated. Please us
e tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:4432: The name tf.random_uniform is deprecated. Pleas
e use tf.random.uniform instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:148: The name tf.placeholder_with_default is
deprecated. Please use tf.compat.v1.placeholder_with_default instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3733: calling dropout (from
tensorflow.python.ops.nn_ops) with keep_prob is deprecated and will be removed in a future
version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
```

```
lstm_1 (LSTM)                (None, 115)               57500
_________________________________________________________________
dropout_1 (Dropout)          (None, 115)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 696
=================================================================
Total params: 58,196
Trainable params: 58,196
Non-trainable params: 0
_________________________________________________________________
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/optimizers.py:793: The name t
f.train.Optimizer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3576: The name tf.log is deprecated. Please use tf.ma
th.log instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1033: The name tf.assign_add is deprecated. Please us
e tf.compat.v1.assign_add instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1020: The name tf.assign is deprecated. Please use tf
.compat.v1.assign instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:190: The name tf.get_default_session is deprecated. P
lease use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:207: The name tf.global_variables is deprecated. Plea
se use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:216: The name tf.is_variable_initialized is
deprecated. Please use tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:223: The name tf.variables_initializer is deprecated.
Please use tf.compat.v1.variables_initializer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:107: The name tf.reset_default_graph is deprecated. P
lease use tf.compat.v1.reset_default_graph instead.


  8%|▉         | 1/12 [09:20<1:42:50, 560.96s/it]

{'dropout': 0.1, 'n_hidden': 120}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 120)               62400
_________________________________________________________________
dropout_1 (Dropout)          (None, 120)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 726
=================================================================
Total params: 63,126
Trainable params: 63,126
Non-trainable params: 0
_________________________________________________________________

 17%|█▋        | 2/12 [18:25<1:32:39, 555.92s/it]

{'dropout': 0.1, 'n_hidden': 125}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
=================================================================
lstm_1 (LSTM)                 (None, 125)               67500
_________________________________________________________________
dropout_1 (Dropout)           (None, 125)               0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 756
=================================================================
Total params: 68,256
Trainable params: 68,256
Non-trainable params: 0
_________________________________________________________________
```

```
 25%|██▌       | 3/12 [28:42<1:26:08, 574.29s/it]
```

```
{'dropout': 0.1, 'n_hidden': 130}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 130)               72800
_________________________________________________________________
dropout_1 (Dropout)           (None, 130)               0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 786
=================================================================
Total params: 73,586
Trainable params: 73,586
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 4/12 [39:53<1:20:27, 603.44s/it]
```

```
{'dropout': 0.05, 'n_hidden': 115}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 115)               57500
_________________________________________________________________
dropout_1 (Dropout)           (None, 115)               0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 696
=================================================================
Total params: 58,196
Trainable params: 58,196
Non-trainable params: 0
_________________________________________________________________
```

```
 42%|████      | 5/12 [49:46<1:10:01, 600.17s/it]
```

```
{'dropout': 0.05, 'n_hidden': 120}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 120)               62400
_________________________________________________________________
dropout_1 (Dropout)           (None, 120)               0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 726
=================================================================
Total params: 63,126
Trainable params: 63,126
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|█████     | 6/12 [58:59<58:35, 585.94s/it]
```

```
{'dropout': 0.05, 'n_hidden': 125}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
```

```
lstm_1 (LSTM)                 (None, 125)               67500
_________________________________________________________________
dropout_1 (Dropout)           (None, 125)               0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 756
=================================================================
Total params: 68,256
Trainable params: 68,256
Non-trainable params: 0
_________________________________________________________________
```

```
 58%|█████▊    | 7/12 [1:09:21<49:45, 597.03s/it]
```

```
{'dropout': 0.05, 'n_hidden': 130}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 130)               72800
_________________________________________________________________
dropout_1 (Dropout)          (None, 130)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 786
=================================================================
Total params: 73,586
Trainable params: 73,586
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 8/12 [1:20:30<41:14, 618.62s/it]
```

```
{'dropout': 0, 'n_hidden': 115}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 115)               57500
_________________________________________________________________
dropout_1 (Dropout)          (None, 115)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 696
=================================================================
Total params: 58,196
Trainable params: 58,196
Non-trainable params: 0
_________________________________________________________________
```

```
 75%|███████▌  | 9/12 [1:29:58<30:09, 603.28s/it]
```

```
{'dropout': 0, 'n_hidden': 120}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 120)               62400
_________________________________________________________________
dropout_1 (Dropout)          (None, 120)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 726
=================================================================
Total params: 63,126
Trainable params: 63,126
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎ | 10/12 [1:39:19<19:41, 590.62s/it]
```

```
{'dropout': 0, 'n_hidden': 125}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 125)               67500
```

```
lstm_1 (LSTM)                (None, 125)               67500
_________________________________________________________________
dropout_1 (Dropout)          (None, 125)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 756
=================================================================
Total params: 68,256
Trainable params: 68,256
Non-trainable params: 0
_________________________________________________________________
```

```
 92%|█████████ | 11/12 [1:49:48<10:02, 602.26s/it]
```

```
{'dropout': 0, 'n_hidden': 130}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 130)               72800
_________________________________________________________________
dropout_1 (Dropout)          (None, 130)               0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 786
=================================================================
Total params: 73,586
Trainable params: 73,586
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 12/12 [2:01:06<00:00, 625.00s/it]
```

In [0]:

```
print (t12.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.193071	0.937897	0.234547	0.923824	0.10	115
1	30	0.181182	0.943790	0.147256	0.944423	0.10	120
2	30	0.212689	0.925204	0.267440	0.904975	0.10	125
3	30	0.202970	0.923844	0.171337	0.933152	0.10	130
4	30	0.389932	0.789665	0.388207	0.797318	0.05	115
5	30	0.363179	0.859927	0.387026	0.860474	0.05	120
6	30	0.303743	0.893472	0.368476	0.875437	0.05	125
7	30	0.269691	0.900272	0.217916	0.921104	0.05	130
8	30	0.135911	0.949683	0.123179	0.952779	0.00	115
9	30	0.160289	0.943336	0.169015	0.937038	0.00	120
10	30	0.173481	0.936083	0.154281	0.942285	0.00	125
11	30	0.292276	0.898005	0.349568	0.850175	0.00	130

So far we have tried several combination of n_hidden and dropout and the best model is with **n_hidden = 115 & dropout= 0** The values is

round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
30	0.135911	0.949683	0.123179	0.952779	0.00	115

So for single layer model we have achieved our task as it is pretty close to 96% as per the assignment

Now lets perform the same task for two layered LSTM

In [0]:

```
def HAR_LSTM2(X_train, Y_train, X_test, Y_test, params):

    model2 = Sequential()
    model2.add(LSTM(params['n_hidden'], input_shape=(timesteps, input_dim),return_sequences = True)
)
    model2.add(Dropout(params['dropout']))
    model2.add(LSTM(params['n_hidden']))
    model2.add(Dropout(params['dropout']))
    model2.add(Dense(n_classes, activation='sigmoid'))
    model2.summary()
    model2.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
```

```
    history2 = model2.fit(X_train, Y_train,validation_data = (X_test, Y_test),batch_size=40,epochs=
30,verbose=0)
    return history2, model2
```

In [0]:

```
p2_1 = {'n_hidden':[20,30,40],
     'dropout': [0.25,0.35]}

p2_2 = {'n_hidden':[20,30,40],
     'dropout': [0.45,0.55]}

p2_3 = {'n_hidden':[20,30,40],
     'dropout': [0.65,0.75]}

p2_4 = {'n_hidden':[50,60,70],
     'dropout': [0.25,0.35]}

p2_5 = {'n_hidden':[50,60,70],
     'dropout': [0.45,0.55]}
```

In [0]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t13 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM2,params=p2_1,experiment_name='model2_1',disable_pr
ogress_bar=False,print_params=True)
```

```
  0%|          | 0/6 [00:00<?, ?it/s]
```

```
{'dropout': 0.25, 'n_hidden': 20}
Model: "sequential_4"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_6 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_4 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_7 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_5 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_2 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
_________________________________________________________________
```

```
 17%|█▋        | 1/6 [08:35<42:59, 515.92s/it]
```

```
{'dropout': 0.25, 'n_hidden': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
```

```
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 2/6 [18:06<35:29, 532.40s/it]
```

```
{'dropout': 0.25, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|████      | 3/6 [28:04<27:36, 552.11s/it]
```

```
{'dropout': 0.35, 'n_hidden': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|█████▎    | 4/6 [36:33<17:57, 538.95s/it]
```

```
{'dropout': 0.35, 'n_hidden': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
```

```
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎ | 5/6 [46:00<09:07, 547.45s/it]
```

```
{'dropout': 0.35, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 6/6 [56:02<00:00, 563.95s/it]
```

In [0]:

```
print (t13.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.549964	0.656392	0.638225	0.652934	0.25	20
1	30	0.151043	0.945150	0.176032	0.939953	0.25	30
2	30	0.207792	0.931550	0.255067	0.905752	0.25	40
3	30	0.681467	0.655485	0.656454	0.658181	0.35	20
4	30	0.279739	0.913871	0.386851	0.848037	0.35	30
5	30	0.137708	0.945150	0.158519	0.946366	0.35	40

In [18]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t14 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM2,params=p2_2,experiment_name='model2_2',disable_pr
ogress_bar=False,print_params=True)
```

```
  0%|          | 0/6 [00:00<?, ?it/s]
```

```
{'dropout': 0.45, 'n_hidden': 20}
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:541: The name tf.placeholder is deprecated. Please us
e tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:4432: The name tf.random_uniform is deprecated. Pleas
e use tf.random.uniform instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:148: The name tf.placeholder_with_default is
deprecated. Please use tf.compat.v1.placeholder_with_default instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3733: calling dropout (from
tensorflow.python.ops.nn_ops) with keep_prob is deprecated and will be removed in a future
version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
_________________________________________________________________
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/optimizers.py:793: The name t
f.train.Optimizer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3576: The name tf.log is deprecated. Please use tf.ma
th.log instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1033: The name tf.assign_add is deprecated. Please us
e tf.compat.v1.assign_add instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1020: The name tf.assign is deprecated. Please use tf
.compat.v1.assign instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:190: The name tf.get_default_session is deprecated. P
lease use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:207: The name tf.global_variables is deprecated. Plea
se use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:216: The name tf.is_variable_initialized is
deprecated. Please use tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:223: The name tf.variables_initializer is deprecated.
Please use tf.compat.v1.variables_initializer instead.
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:107: The name tf.reset_default_graph is deprecated. P
lease use tf.compat.v1.reset_default_graph instead.


 17%|▉         | 1/6 [08:26<42:14, 506.98s/it]

{'dropout': 0.45, 'n_hidden': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________

 33%|███       | 2/6 [17:53<34:58, 524.72s/it]

{'dropout': 0.45, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________

 50%|████▌     | 3/6 [27:50<27:19, 546.49s/it]

{'dropout': 0.55, 'n_hidden': 20}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
```

```
_________________________________________________________________

 67%|██████▋   | 4/6 [36:14<17:47, 533.82s/it]

{'dropout': 0.55, 'n_hidden': 30}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________

 83%|████████▎ | 5/6 [45:38<09:02, 542.74s/it]

{'dropout': 0.55, 'n_hidden': 40}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________

100%|██████████| 6/6 [55:53<00:00, 564.39s/it]
```

In [19]:

```
print (t14.data)
```

	round_epochs	val_loss	val_acc	loss	acc	dropout	n_hidden
0	30	0.535799	0.753400	0.616080	0.729304	0.45	20
1	30	0.281774	0.893019	0.253964	0.922658	0.45	30
2	30	0.197427	0.932910	0.230404	0.934124	0.45	40
3	30	0.327668	0.874887	0.433183	0.808978	0.55	20
4	30	0.412715	0.797824	0.524392	0.766809	0.55	30
5	30	0.136556	0.953309	0.181004	0.942285	0.55	40

In [20]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
```

```
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t15 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM2,params=p2_3,experiment_name='model2_3',disable_pr
ogress_bar=False,print_params=True)
```

```
  0%|          | 0/6 [00:00<?, ?it/s]
```

```
{'dropout': 0.65, 'n_hidden': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
_________________________________________________________________
```

```
 17%|█▋        | 1/6 [08:29<42:25, 509.20s/it]
```

```
{'dropout': 0.65, 'n_hidden': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███▎      | 2/6 [17:50<34:59, 524.95s/it]
```

```
{'dropout': 0.65, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|████▉     | 3/6 [27:44<27:17, 545.69s/it]
```

```
{'dropout': 0.75, 'n_hidden': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 20)           2400
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 20)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                3280
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 5,806
Trainable params: 5,806
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 4/6 [36:41<18:05, 542.89s/it]
```

```
{'dropout': 0.75, 'n_hidden': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎ | 5/6 [46:43<09:20, 560.76s/it]
```

```
{'dropout': 0.75, 'n_hidden': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 40)           8000
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 40)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                12960
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 21,206
Trainable params: 21,206
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 6/6 [57:15<00:00, 582.11s/it]
```

In [21]:

```
print (t15.data)
```

```
   round_epochs  val_loss   val_acc      loss       acc  dropout  n_hidden
0            30  0.748448  0.552131  0.844831  0.520793     0.65        20
1            30  0.767729  0.547144  0.792430  0.541586     0.65        30
```

2	30	0.398223	0.782865	0.505868	0.771279	0.65	40
3	30	0.759821	0.623753	0.848751	0.548581	0.75	20
4	30	0.627152	0.657298	0.725223	0.631170	0.75	30
5	30	0.739763	0.550317	0.761245	0.537505	0.75	40

In [0]:

```
def HAR_LSTM3(X_train, Y_train, X_test, Y_test, params):

    model3 = Sequential()
    model3.add(LSTM(params['n_hidden1'], input_shape=(timesteps, input_dim),return_sequences = True
))
    model3.add(Dropout(params['dropout1']))
    model3.add(LSTM(params['n_hidden2']))
    model3.add(Dropout(params['dropout2']))
    model3.add(Dense(n_classes, activation='sigmoid'))
    model3.summary()
    model3.compile(loss='categorical_crossentropy', optimizer='adam', metrics=['accuracy'])
    history3 = model3.fit(X_train, Y_train,validation_data = (X_test, Y_test),batch_size=40,epochs=
30,verbose=0)
    return history3, model3
```

In [0]:

```
p_3_1 = {'n_hidden1':[30],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.25],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_2 = {'n_hidden1':[30],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.35],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_3 = {'n_hidden1':[30],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.45],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_4 = {'n_hidden1':[30],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.55],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_5 = {'n_hidden1':[30],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.65],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_6 = {'n_hidden1':[40],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.25],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_7 = {'n_hidden1':[40],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.35],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_8 = {'n_hidden1':[40],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.45],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_9 = {'n_hidden1':[40],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.55],'dropout2': [0.25,0.35
,0.45,0.55,0.65]}
p_3_10 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.65],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
p_3_11 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.25],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
p_3_12 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.35],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
p_3_13 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.45],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
p_3_14 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.55],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
p_3_15 = {'n_hidden1':[50],'n_hidden2':[20,30,40,50,60,70],'dropout1': [0.65],'dropout2': [0.25,0.3
5,0.45,0.55,0.65]}
```

In [30]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t13 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM3,params=p_3_1,experiment_name='model3_1',disable_p
rogress_bar=False,print_params=True)
```

```
  0%|          | 0/30 [00:00<?, ?it/s]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_3"
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_5 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_5 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_6 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_6 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_3 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
  3%|▌          | 1/30 [10:07<4:53:46, 607.80s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
  7%|▉          | 2/30 [20:31<4:45:54, 612.67s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 10%|▏         | 3/30 [31:25<4:41:10, 624.83s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
```

```
=================================================================
lstm_1 (LSTM)                 (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)           (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                 (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)           (None, 50)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 13%|█         | 4/30 [42:43<4:37:40, 640.78s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)           (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                 (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)           (None, 60)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 17%|█▋        | 5/30 [53:53<4:30:44, 649.80s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)           (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                 (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)           (None, 70)                0
_________________________________________________________________
dense_1 (Dense)               (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 20%|██        | 6/30 [1:05:50<4:27:56, 669.87s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                 (None, 128, 30)           4800
```

```
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 23%|██        | 7/30 [1:14:56<4:02:34, 632.81s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 27%|██        | 8/30 [1:24:19<3:44:15, 611.63s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 30%|███       | 9/30 [1:34:05<3:31:27, 604.19s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
```

```
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 10/30 [1:45:01<3:26:34, 619.73s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 37%|███       | 11/30 [1:56:41<3:23:48, 643.58s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 40%|████      | 12/30 [2:08:49<3:20:41, 668.99s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
```

```
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 43%|████      | 13/30 [2:18:15<3:00:47, 638.09s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 47%|████      | 14/30 [2:27:57<2:45:40, 621.26s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|████      | 15/30 [2:38:02<2:34:06, 616.41s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
```

```
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 53%|█████     | 16/30 [2:48:53<2:26:15, 626.84s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|█████▋    | 17/30 [3:00:26<2:20:04, 646.52s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 60%|██████    | 18/30 [3:12:46<2:14:54, 674.53s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
```

```
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 63%|██████    | 19/30 [3:22:23<1:58:20, 645.51s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 20/30 [3:32:35<1:45:53, 635.39s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 70%|███████   | 21/30 [3:42:52<1:34:27, 629.78s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
```

```
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 73%|███████   | 22/30 [3:53:53<1:25:13, 639.20s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 77%|███████   | 23/30 [4:05:34<1:16:44, 657.77s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 80%|████████  | 24/30 [4:18:10<1:08:43, 687.18s/it]
```

```
{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
```

Trainable params: 9,000
Non-trainable params: 0
____

83%|████████ | 25/30 [4:27:46<54:28, 653.78s/it]

{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
____
Layer (type)   Output Shape   Param #
===
lstm_1 (LSTM)   (None, 128, 30)   4800
____
dropout_1 (Dropout)   (None, 128, 30)   0
____
lstm_2 (LSTM)   (None, 30)   7320
____
dropout_2 (Dropout)   (None, 30)   0
____
dense_1 (Dense)   (None, 6)   186
===
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
____

87%|████████▋ | 26/30 [4:37:45<42:29, 637.29s/it]

{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
____
Layer (type)   Output Shape   Param #
===
lstm_1 (LSTM)   (None, 128, 30)   4800
____
dropout_1 (Dropout)   (None, 128, 30)   0
____
lstm_2 (LSTM)   (None, 40)   11360
____
dropout_2 (Dropout)   (None, 40)   0
____
dense_1 (Dense)   (None, 6)   246
===
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
____

90%|█████████ | 27/30 [4:48:00<31:32, 630.70s/it]

{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
____
Layer (type)   Output Shape   Param #
===
lstm_1 (LSTM)   (None, 128, 30)   4800
____
dropout_1 (Dropout)   (None, 128, 30)   0
____
lstm_2 (LSTM)   (None, 50)   16200
____
dropout_2 (Dropout)   (None, 50)   0
____
dense_1 (Dense)   (None, 6)   306
===
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0

```
_________________________________________________________________

 93%|█████████ | 28/30 [4:59:31<21:37, 648.76s/it]

{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________

 97%|█████████▋ | 29/30 [5:11:40<11:12, 672.82s/it]

{'dropout1': 0.25, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________

100%|██████████| 30/30 [5:24:27<00:00, 701.21s/it]
```

In [35]:

```
print (t13.data)
print ("############")
reporting13 = ta.Reporting(t13)
print(reporting13.data.columns)
```

```
    round_epochs  val_loss   val_acc  ...  dropout2  n_hidden1  n_hidden2
0             30  0.669050  0.722121  ...      0.25         30         20
1             30  0.148767  0.943336  ...      0.25         30         30
2             30  0.137279  0.946510  ...      0.25         30         40
3             30  0.184937  0.935177  ...      0.25         30         50
4             30  0.235827  0.915684  ...      0.25         30         60
5             30  0.140976  0.947869  ...      0.25         30         70
6             30  0.448976  0.797371  ...      0.35         30         20
7             30  0.201816  0.920218  ...      0.35         30         30
8             30  0.321066  0.895286  ...      0.35         30         40
```

```
9             30  0.271972  0.915684  ...      0.35         30         50
10            30  0.131506  0.943790  ...      0.35         30         60
11            30  0.161015  0.940163  ...      0.35         30         70
12            30  0.361689  0.792384  ...      0.45         30         20
13            30  0.402538  0.803264  ...      0.45         30         30
14            30  0.147716  0.947416  ...      0.45         30         40
15            30  0.299628  0.894379  ...      0.45         30         50
16            30  0.197804  0.919764  ...      0.45         30         60
17            30  0.142753  0.933364  ...      0.45         30         70
18            30  0.321207  0.917951  ...      0.55         30         20
19            30  0.692608  0.655485  ...      0.55         30         30
20            30  0.448261  0.783318  ...      0.55         30         40
21            30  0.408622  0.790118  ...      0.55         30         50
22            30  0.570129  0.691296  ...      0.55         30         60
23            30  0.143345  0.945150  ...      0.55         30         70
24            30  0.699274  0.709429  ...      0.65         30         20
25            30  0.743536  0.639166  ...      0.65         30         30
26            30  0.258689  0.932457  ...      0.65         30         40
27            30  0.499329  0.736627  ...      0.65         30         50
28            30  0.640124  0.664551  ...      0.65         30         60
29            30  0.756909  0.647325  ...      0.65         30         70

[30 rows x 9 columns]
############
<keras.engine.sequential.Sequential object at 0x7fbfc0984e48>
```

In [19]:

```
import talos as ta
import warnings

with warnings.catch_warnings():
    warnings.filterwarnings("ignore",category=DeprecationWarning)

t16 = ta.Scan(x=X_train,y=Y_train,model=HAR_LSTM3,params=p_3_2,experiment_name='model3_2',disable_p
rogress_bar=False,print_params=True)
```

```
  0%|          | 0/30 [00:00<?, ?it/s]
```

```
{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 20}
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:541: The name tf.placeholder is deprecated. Please us
e tf.compat.v1.placeholder instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:4432: The name tf.random_uniform is deprecated. Pleas
e use tf.random.uniform instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:148: The name tf.placeholder_with_default is
deprecated. Please use tf.compat.v1.placeholder_with_default instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3733: calling dropout (from
tensorflow.python.ops.nn_ops) with keep_prob is deprecated and will be removed in a future
version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 - keep_prob`.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
```

```
_________________________________________________________________
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/optimizers.py:793: The name t
f.train.Optimizer is deprecated. Please use tf.compat.v1.train.Optimizer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:3576: The name tf.log is deprecated. Please use tf.ma
th.log instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/tensorflow_core/python/ops/math_grad.py:1424: where (from
tensorflow.python.ops.array_ops) is deprecated and will be removed in a future version.
Instructions for updating:
Use tf.where in 2.0, which has the same broadcast rule as np.where
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1033: The name tf.assign_add is deprecated. Please us
e tf.compat.v1.assign_add instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:1020: The name tf.assign is deprecated. Please use tf
.compat.v1.assign instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:190: The name tf.get_default_session is deprecated. P
lease use tf.compat.v1.get_default_session instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:207: The name tf.global_variables is deprecated. Plea
se use tf.compat.v1.global_variables instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:216: The name tf.is_variable_initialized is
deprecated. Please use tf.compat.v1.is_variable_initialized instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:223: The name tf.variables_initializer is deprecated.
Please use tf.compat.v1.variables_initializer instead.

WARNING:tensorflow:From /usr/local/lib/python3.6/dist-
packages/keras/backend/tensorflow_backend.py:107: The name tf.reset_default_graph is deprecated. P
lease use tf.compat.v1.reset_default_graph instead.


  3%|▌          | 1/30 [09:20<4:31:04, 560.86s/it]

{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________

  7%|▉          | 2/30 [19:11<4:25:57, 569.90s/it]

{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
```

```
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 10%|          | 3/30 [29:23<4:22:07, 582.49s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 13%|          | 4/30 [40:40<4:24:36, 610.63s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 17%|          | 5/30 [52:26<4:26:26, 639.47s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.25, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
```

Trainable params: 33,906
Non-trainable params: 0
____

20%|██ | 6/30 [1:04:58<4:29:13, 673.05s/it]

{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
____
Layer (type) Output Shape Param #
===
lstm_1 (LSTM) (None, 128, 30) 4800
____
dropout_1 (Dropout) (None, 128, 30) 0
____
lstm_2 (LSTM) (None, 20) 4080
____
dropout_2 (Dropout) (None, 20) 0
____
dense_1 (Dense) (None, 6) 126
===
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
____

23%|██ | 7/30 [1:14:36<4:07:05, 644.61s/it]

{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
____
Layer (type) Output Shape Param #
===
lstm_1 (LSTM) (None, 128, 30) 4800
____
dropout_1 (Dropout) (None, 128, 30) 0
____
lstm_2 (LSTM) (None, 30) 7320
____
dropout_2 (Dropout) (None, 30) 0
____
dense_1 (Dense) (None, 6) 186
===
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
____

27%|██ | 8/30 [1:24:49<3:52:54, 635.19s/it]

{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
____
Layer (type) Output Shape Param #
===
lstm_1 (LSTM) (None, 128, 30) 4800
____
dropout_1 (Dropout) (None, 128, 30) 0
____
lstm_2 (LSTM) (None, 40) 11360
____
dropout_2 (Dropout) (None, 40) 0
____
dense_1 (Dense) (None, 6) 246
===
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
____

30%|███ | 9/30 [1:35:21<3:41:59, 634.27s/it]

{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 50}

```
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 33%|███       | 10/30 [1:46:47<3:36:32, 649.63s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 37%|███▋      | 11/30 [1:58:45<3:32:13, 670.19s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 40%|████      | 12/30 [2:11:24<3:29:03, 696.86s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
```

```
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 43%|████      | 13/30 [2:21:16<3:08:30, 665.33s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 47%|████      | 14/30 [2:31:49<2:54:51, 655.74s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 50%|█████     | 15/30 [2:42:32<2:42:56, 651.75s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
```

```
Non-trainable params: 0
_________________________________________________________________
```

```
 53%|█████     | 16/30 [2:54:03<2:34:51, 663.68s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 57%|█████▋    | 17/30 [3:05:58<2:27:08, 679.15s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.45, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 60%|██████    | 18/30 [3:18:33<2:20:21, 701.79s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 20}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 63%|██████    | 19/30 [3:28:19<2:02:16, 666.99s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 30}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

```
 67%|██████▋   | 20/30 [3:38:28<1:48:15, 649.53s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 40}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

```
 70%|███████   | 21/30 [3:48:56<1:36:28, 643.12s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 50}
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

```
 73%|███████▎  | 22/30 [4:00:21<1:27:26, 655.86s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 60}
```

```
WARNING:tensorflow:Large dropout rate: 0.55 (>0.5). In TensorFlow 2.x, dropout() uses dropout rate
instead of keep_prob. Please ensure that this is intended.
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 77%|███████▋  | 23/30 [4:12:19<1:18:40, 674.32s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.55, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
 80%|████████  | 24/30 [4:24:53<1:09:50, 698.41s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 20}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 20)                4080
_________________________________________________________________
dropout_2 (Dropout)          (None, 20)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 126
=================================================================
Total params: 9,006
Trainable params: 9,006
Non-trainable params: 0
_________________________________________________________________
```

```
 83%|████████▎  | 25/30 [4:34:38<55:21, 664.29s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 30}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
```

```
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 30)                7320
_________________________________________________________________
dropout_2 (Dropout)          (None, 30)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 186
=================================================================
Total params: 12,306
Trainable params: 12,306
Non-trainable params: 0
_________________________________________________________________
```

87%|████████ | 26/30 [4:44:53<43:18, 649.59s/it]

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 40}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 40)                11360
_________________________________________________________________
dropout_2 (Dropout)          (None, 40)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 246
=================================================================
Total params: 16,406
Trainable params: 16,406
Non-trainable params: 0
_________________________________________________________________
```

90%|████████ | 27/30 [4:55:13<32:02, 640.76s/it]

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 50}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 50)                16200
_________________________________________________________________
dropout_2 (Dropout)          (None, 50)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 306
=================================================================
Total params: 21,306
Trainable params: 21,306
Non-trainable params: 0
_________________________________________________________________
```

93%|████████ | 28/30 [5:06:43<21:50, 655.35s/it]

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 60}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 60)                21840
_________________________________________________________________
dropout_2 (Dropout)          (None, 60)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 366
=================================================================
```

```
Total params: 27,006
Trainable params: 27,006
Non-trainable params: 0
_________________________________________________________________
```

```
 97%|█████████▋| 29/30 [5:18:44<11:15, 675.12s/it]
```

```
{'dropout1': 0.35, 'dropout2': 0.65, 'n_hidden1': 30, 'n_hidden2': 70}
Model: "sequential_1"
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 128, 30)           4800
_________________________________________________________________
dropout_1 (Dropout)          (None, 128, 30)           0
_________________________________________________________________
lstm_2 (LSTM)                (None, 70)                28280
_________________________________________________________________
dropout_2 (Dropout)          (None, 70)                0
_________________________________________________________________
dense_1 (Dense)              (None, 6)                 426
=================================================================
Total params: 33,506
Trainable params: 33,506
Non-trainable params: 0
_________________________________________________________________
```

```
100%|██████████| 30/30 [5:31:32<00:00, 702.90s/it]
```

In [31]:

```
print (t16.data)
```

```
    round_epochs  val_loss   val_acc  ...  dropout2  n_hidden1  n_hidden2
0             30  0.371702  0.810063  ...      0.25         30         20
1             30  0.169048  0.943336  ...      0.25         30         30
2             30  0.159836  0.932004  ...      0.25         30         40
3             30  0.165138  0.938803  ...      0.25         30         50
4             30  0.174891  0.922937  ...      0.25         30         60
5             30  0.147778  0.939710  ...      0.25         30         70
6             30  0.400641  0.773799  ...      0.35         30         20
7             30  0.387033  0.805530  ...      0.35         30         30
8             30  0.154402  0.943336  ...      0.35         30         40
9             30  0.139102  0.946510  ...      0.35         30         50
10            30  0.308922  0.864007  ...      0.35         30         60
11            30  0.124542  0.952856  ...      0.35         30         70
12            30  0.169123  0.939257  ...      0.45         30         20
13            30  0.473252  0.697643  ...      0.45         30         30
14            30  0.232896  0.932004  ...      0.45         30         40
15            30  0.497632  0.783318  ...      0.45         30         50
16            30  0.339531  0.887126  ...      0.45         30         60
17            30  0.370026  0.815956  ...      0.45         30         70
18            30  0.944083  0.450136  ...      0.55         30         20
19            30  0.623931  0.666364  ...      0.55         30         30
20            30  0.313481  0.875793  ...      0.55         30         40
21            30  0.598161  0.751587  ...      0.55         30         50
22            30  0.303635  0.875340  ...      0.55         30         60
23            30  0.157457  0.934270  ...      0.55         30         70
24            30  0.560996  0.705349  ...      0.65         30         20
25            30  0.351882  0.786038  ...      0.65         30         30
26            30  0.621902  0.673164  ...      0.65         30         40
27            30  0.278725  0.912965  ...      0.65         30         50
28            30  0.352447  0.860381  ...      0.65         30         60
29            30  0.359918  0.806437  ...      0.65         30         70

[30 rows x 9 columns]
```

CONCLUSION

So there are 1000s of model which we can try , but now we can stop here becuase we have got model which is hitting 95% accuracy with 2 Layer LSTM

Model parameters

``` {'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 70}

So for Single Layer LSTM Best parameters we got is

``` round_epochs val_loss val_acc loss acc dropout n_hidden 30 0.135911 0.949683 0.123179 0.952779 0.00 115

So for double LSTM best parameter we got is

{'dropout1': 0.35, 'dropout2': 0.35, 'n_hidden1': 30, 'n_hidden2': 70}