Convelution Neural Networks on Mnist Dataset

Objective : Wokring with Keras and Experiment with Different Convelution Nueral Network Architectures.

Dataset : Mnist DataSet which is avialalbe in Keras Dataset by default.

Developer Details : PraveenAI

Source Details : Most of the code is extracted from my learnings with Keras https://keras.io/losses/ (https://keras.io/losses/) and Base Archictural Refference is from"https://github.com/keras-team/keras/blob/master/examples/mnist_cnn.py (https://github.com/keras-team/keras/blob/master/examples/mnist_cnn.py)"

In [0]:

```
import keras
from keras.models import Sequential
from keras.datasets import mnist
from keras.layers import Dense,Dropout,Flatten,Conv2D,MaxPool2D,MaxPooling2D
from keras.losses import categorical_crossentropy
```

Load Dataset

In [3]:

```
(x_train, y_train), (x_test, y_test) = mnist.load_data()
print("Number of training examples :", x_train.shape[0], "and each image is of shape (%
d, %d)"%(x_train.shape[1], x_train.shape[2]))
print("Number of training examples :", x_test.shape[0], "and each image is of shape (%d
, %d)"%(x_test.shape[1], x_test.shape[2]))
```

```
Downloading data from https://s3.amazonaws.com/img-datasets/mnist.npz
11493376/11490434 [==============================] - 0s 0us/step
Number of training examples : 60000 and each image is of shape (28, 28)
Number of training examples : 10000 and each image is of shape (28, 28)
```

Reshaping the Image to input to the Conv2D

In [0]:

```
#input image dimensions
img_rows, img_cols = x_train.shape[1], x_train.shape[2]
input_shape = (img_rows, img_cols, 1)                                  #(60000,28, 28, 1) i
nput the 1st layer Conv2d



#Conv2D Accepts 4-D array #(no row, x,y,z) = (60000,28, 28, 1)

x_train = x_train.reshape(x_train.shape[0], img_rows, img_cols, 1) #4d X_train
x_test  = x_test.reshape(x_test.shape[0], img_rows, img_cols, 1)   #4d x_train


x_train = x_train/255
x_test =  x_test/ 255
```

In [6]:

```
#dimensions of train and test
print('x_train shape:>> ', x_train.shape)
print('train samples:>> ', x_train.shape[0])
print('test samples :>> ', x_test.shape[0])
```

```
x_train shape:>>  (60000, 28, 28, 1)
train samples:>>  60000
test samples :>>  10000
```

Converting the labels to Categorical

In [0]:

```
# convert class vectors to binary class matrices
y_train = keras.utils.to_categorical(y_train, num_classes)
y_test = keras.utils.to_categorical(y_test, num_classes)
```

In [8]:

```
print(y_train.shape)
```

```
(60000, 10)
```

Initializing the CNN Params

In [0]:

```
batch_size = 128
num_classes = 10
epochs = 12
Total_SUMRY = {}
```

Plot Train Los and Test Loss Vs Epochs

In [0]:

```
%matplotlib inline
# https://gist.github.com/greydanus/f6eee59eaf1d90fcb3b534a25362cea4
# https://stackoverflow.com/a/14434334
# this function is used to update the plots for each epoch and error
import matplotlib.pyplot as plt
import numpy as np
import time

def plt_dynamic(x, vy, ty, ax, colors=['b']):
    ax.plot(x, vy, 'b', label="Validation Loss")
    ax.plot(x, ty, 'r', label="Train Loss")
    plt.legend()
    plt.grid()
    fig.canvas.draw()
```

Architecture 1 :64-28-12(3 Convlution Layers with 64,28,12 + Dense softmax)

3-CNN - relu , 1-Dense + relu activation + AdamOtpimizer

In [10]:

```
model_1 = Sequential()
model_1.add(Conv2D(64,kernel_size=(3,3),padding='same',activation='relu',input_shape=in
put_shape))
model_1.add(MaxPool2D(pool_size=(2, 2)))
model_1.add(Dropout(0.2))
model_1.add(Conv2D(28,kernel_size=(3,3),padding='same',activation='relu'))
model_1.add(Dropout(0.35))
model_1.add(Conv2D(12,kernel_size=(3,3),padding='same',activation='relu'))
model_1.add(Dropout(0.4))
model_1.add(Flatten())
model_1.add(Dense(num_classes,activation='softmax'))
model_1.summary()
```

```
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/tensorflow/
python/framework/op_def_library.py:263: colocate_with (from tensorflow.pyt
hon.framework.ops) is deprecated and will be removed in a future version.
Instructions for updating:
Colocations handled automatically by placer.
WARNING:tensorflow:From /usr/local/lib/python3.6/dist-packages/keras/backe
nd/tensorflow_backend.py:3445: calling dropout (from tensorflow.python.op
s.nn_ops) with keep_prob is deprecated and will be removed in a future ver
sion.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1
- keep_prob`.
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_1 (Conv2D)            (None, 28, 28, 64)        640
_________________________________________________________________
max_pooling2d_1 (MaxPooling2 (None, 14, 14, 64)        0
_________________________________________________________________
dropout_1 (Dropout)          (None, 14, 14, 64)        0
_________________________________________________________________
conv2d_2 (Conv2D)            (None, 14, 14, 28)        16156
_________________________________________________________________
dropout_2 (Dropout)          (None, 14, 14, 28)        0
_________________________________________________________________
conv2d_3 (Conv2D)            (None, 14, 14, 12)        3036
_________________________________________________________________
dropout_3 (Dropout)          (None, 14, 14, 12)        0
_________________________________________________________________
flatten_1 (Flatten)          (None, 2352)              0
_________________________________________________________________
dense_1 (Dense)              (None, 10)                23530
=================================================================
Total params: 43,362
Trainable params: 43,362
Non-trainable params: 0
_________________________________________________________________
```

In [13]:

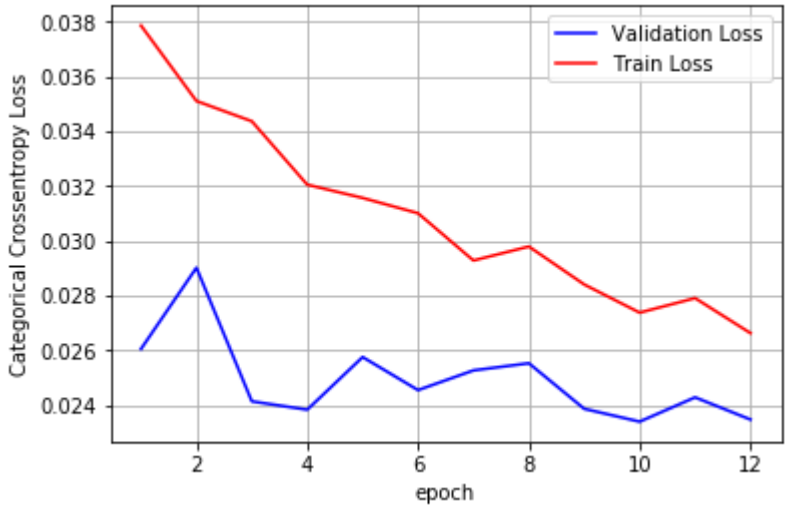
```
model_1.compile(loss=categorical_crossentropy,optimizer='adam',metrics=['accuracy'])
history = model_1.fit(x_train,y_train,batch_size=batch_size,epochs=epochs, verbose=1, v
alidation_data=(x_test, y_test))
```

```
Train on 60000 samples, validate on 10000 samples
Epoch 1/12
60000/60000 [==============================] - 157s 3ms/step - loss: 0.037
9 - acc: 0.9884 - val_loss: 0.0260 - val_acc: 0.9910
Epoch 2/12
60000/60000 [==============================] - 154s 3ms/step - loss: 0.035
1 - acc: 0.9888 - val_loss: 0.0290 - val_acc: 0.9902
Epoch 3/12
60000/60000 [==============================] - 149s 2ms/step - loss: 0.034
4 - acc: 0.9890 - val_loss: 0.0241 - val_acc: 0.9920
Epoch 4/12
60000/60000 [==============================] - 148s 2ms/step - loss: 0.032
0 - acc: 0.9894 - val_loss: 0.0238 - val_acc: 0.9922
Epoch 5/12
60000/60000 [==============================] - 146s 2ms/step - loss: 0.031
6 - acc: 0.9899 - val_loss: 0.0258 - val_acc: 0.9914
Epoch 6/12
60000/60000 [==============================] - 143s 2ms/step - loss: 0.031
0 - acc: 0.9903 - val_loss: 0.0245 - val_acc: 0.9923
Epoch 7/12
60000/60000 [==============================] - 143s 2ms/step - loss: 0.029
3 - acc: 0.9905 - val_loss: 0.0253 - val_acc: 0.9920
Epoch 8/12
60000/60000 [==============================] - 143s 2ms/step - loss: 0.029
8 - acc: 0.9903 - val_loss: 0.0255 - val_acc: 0.9902
Epoch 9/12
60000/60000 [==============================] - 143s 2ms/step - loss: 0.028
4 - acc: 0.9910 - val_loss: 0.0239 - val_acc: 0.9918
Epoch 10/12
60000/60000 [==============================] - 147s 2ms/step - loss: 0.027
4 - acc: 0.9914 - val_loss: 0.0234 - val_acc: 0.9921
Epoch 11/12
60000/60000 [==============================] - 148s 2ms/step - loss: 0.027
9 - acc: 0.9906 - val_loss: 0.0243 - val_acc: 0.9916
Epoch 12/12
60000/60000 [==============================] - 149s 2ms/step - loss: 0.026
6 - acc: 0.9911 - val_loss: 0.0235 - val_acc: 0.9925
```

In [16]:

```
score1_tst = model_1.evaluate(x_test, y_test, verbose=0)
print('Test score   :', score1_tst[0])
print('Test accuracy:', score1_tst[1])

score1_trn = model_1.evaluate(x_train, y_train, verbose=0)
print('Train accuracy:', score1_trn[1])


fig,ax = plt.subplots(1,1)
ax.set_xlabel('epoch') ; ax.set_ylabel('Categorical Crossentropy Loss')
x = list(range(1,epochs+1))
vy = history.history['val_loss']
ty = history.history['loss']
plt_dynamic(x, vy, ty, ax)

#["Model", "#ConvLayers", "size of Convnets","#Maxpool","size of Maxpool","#Dropout","D
ense","Test ACC","Train ACC"]
Total_SUMRY[1]=["Model1", "3", "64-28-12" ,"1","2","3","1",score1_trn[1],score1_tst[1]]
```

```
Test score   : 0.023471647653033143
Test accuracy: 0.9925
Train accuracy: 0.9976
```



Architecture 2 :60-40-28-14-8(5 Convlution Layers + 1 Dense softmax)

5-CNN - relu , 1-Dense + relu activation + AdamOtpimizer

In [32]:

```
model_2 = Sequential()
model_2.add(Conv2D(60,kernel_size=(3,3),padding='same',activation='relu',input_shape=in
put_shape))
model_2.add(Dropout(0.25))
model_2.add(MaxPooling2D(pool_size=(2,2)))


model_2.add(Conv2D(40,kernel_size=(3,3),padding='same',activation='relu'))
model_2.add(Dropout(0.35))
model_2.add(MaxPooling2D(pool_size=(2, 2)))

model_2.add(Conv2D(28,kernel_size=(3,3),padding='same',activation='relu'))
model_2.add(Dropout(0.5))
model_2.add(MaxPooling2D(pool_size=(2, 2)))


model_2.add(Conv2D(14,kernel_size=(3,3),padding='same',activation='relu'))
model_2.add(MaxPool2D(pool_size=(2, 2)))
model_2.add(Dropout(0.55))

model_2.add(Conv2D(8,kernel_size=(2,2),padding='same',activation='relu'))
model_2.add(Dropout(0.6))

model_2.add(Flatten())
model_2.add(Dense(num_classes,activation='softmax'))
model_2.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
conv2d_68 (Conv2D)           (None, 28, 28, 60)        600
_________________________________________________________________
dropout_60 (Dropout)         (None, 28, 28, 60)        0
_________________________________________________________________
max_pooling2d_62 (MaxPooling (None, 14, 14, 60)        0
_________________________________________________________________
conv2d_69 (Conv2D)           (None, 14, 14, 40)        21640
_________________________________________________________________
dropout_61 (Dropout)         (None, 14, 14, 40)        0
_________________________________________________________________
max_pooling2d_63 (MaxPooling (None, 7, 7, 40)          0
_________________________________________________________________
conv2d_70 (Conv2D)           (None, 7, 7, 28)          10108
_________________________________________________________________
dropout_62 (Dropout)         (None, 7, 7, 28)          0
_________________________________________________________________
max_pooling2d_64 (MaxPooling (None, 3, 3, 28)          0
_________________________________________________________________
conv2d_71 (Conv2D)           (None, 3, 3, 14)          3542
_________________________________________________________________
max_pooling2d_65 (MaxPooling (None, 1, 1, 14)          0
_________________________________________________________________
dropout_63 (Dropout)         (None, 1, 1, 14)          0
_________________________________________________________________
conv2d_72 (Conv2D)           (None, 1, 1, 8)           456
_________________________________________________________________
dropout_64 (Dropout)         (None, 1, 1, 8)           0
_________________________________________________________________
flatten_7 (Flatten)          (None, 8)                 0
_________________________________________________________________
dense_7 (Dense)              (None, 10)                90
=================================================================
Total params: 36,436
Trainable params: 36,436
Non-trainable params: 0
_________________________________________________________________
```

In [33]:

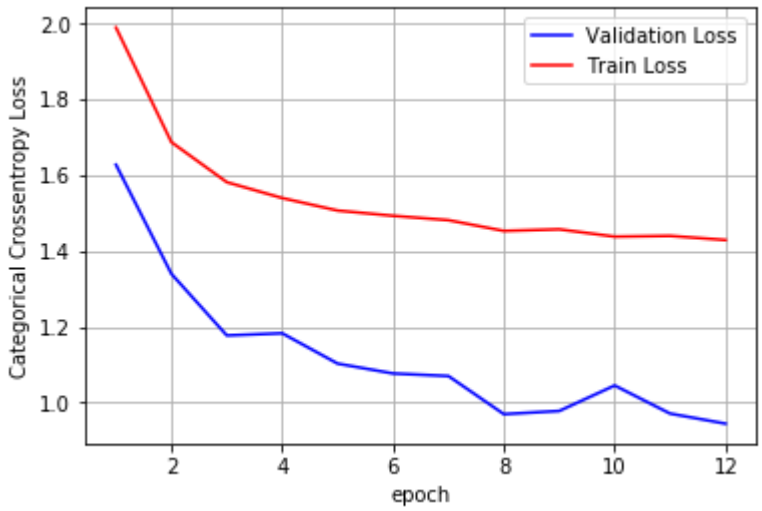
```
model_2.compile(loss=categorical_crossentropy,optimizer='adam',metrics=['accuracy'])
history = model_2.fit(x_train,y_train,batch_size=batch_size,epochs=epochs, verbose=1, v
alidation_data=(x_test, y_test))
```

```
Train on 60000 samples, validate on 10000 samples
Epoch 1/12
60000/60000 [==============================] - 167s 3ms/step - loss: 1.989
5 - acc: 0.2383 - val_loss: 1.6275 - val_acc: 0.6913
Epoch 2/12
60000/60000 [==============================] - 166s 3ms/step - loss: 1.687
1 - acc: 0.3619 - val_loss: 1.3396 - val_acc: 0.6544
Epoch 3/12
60000/60000 [==============================] - 167s 3ms/step - loss: 1.581
5 - acc: 0.3926 - val_loss: 1.1770 - val_acc: 0.6273
Epoch 4/12
60000/60000 [==============================] - 163s 3ms/step - loss: 1.539
6 - acc: 0.4046 - val_loss: 1.1827 - val_acc: 0.6150
Epoch 5/12
60000/60000 [==============================] - 163s 3ms/step - loss: 1.506
6 - acc: 0.4120 - val_loss: 1.1027 - val_acc: 0.6308
Epoch 6/12
60000/60000 [==============================] - 163s 3ms/step - loss: 1.492
7 - acc: 0.4139 - val_loss: 1.0767 - val_acc: 0.6341
Epoch 7/12
60000/60000 [==============================] - 164s 3ms/step - loss: 1.481
2 - acc: 0.4189 - val_loss: 1.0699 - val_acc: 0.6323
Epoch 8/12
60000/60000 [==============================] - 164s 3ms/step - loss: 1.452
9 - acc: 0.4274 - val_loss: 0.9694 - val_acc: 0.6576
Epoch 9/12
60000/60000 [==============================] - 164s 3ms/step - loss: 1.457
1 - acc: 0.4268 - val_loss: 0.9777 - val_acc: 0.6460
Epoch 10/12
60000/60000 [==============================] - 164s 3ms/step - loss: 1.437
8 - acc: 0.4304 - val_loss: 1.0450 - val_acc: 0.6159
Epoch 11/12
60000/60000 [==============================] - 165s 3ms/step - loss: 1.439
7 - acc: 0.4336 - val_loss: 0.9709 - val_acc: 0.6507
Epoch 12/12
60000/60000 [==============================] - 164s 3ms/step - loss: 1.428
9 - acc: 0.4387 - val_loss: 0.9443 - val_acc: 0.6492
```

In [36]:

```
score2_tst = model_2.evaluate(x_test, y_test, verbose=0)
print('Test score   :', score2_tst[0])
print('Test accuracy:', score2_tst[1])

score2_trn = model_2.evaluate(x_train, y_train, verbose=0)
print('Train score   :', score2_trn[0])
print('Train accuracy:', score2_trn[1])


fig,ax = plt.subplots(1,1)
ax.set_xlabel('epoch') ; ax.set_ylabel('Categorical Crossentropy Loss')

x = list(range(1,epochs+1))
vy = history.history['val_loss']
ty = history.history['loss']
plt_dynamic(x, vy, ty, ax)


#["Model", "#ConvLayers", "size of Convnets","#Maxpool","size of Maxpool","#Dropout","Dense","Test ACC","Train ACC"]
Total_SUMRY[2]=["Model2", "5", "60-40-28-14-8" ,"5","2-2-2-2","4","1",score2_trn[1],score2_tst[1]]
```

```
Test score   : 0.9442845161437988
Test accuracy: 0.6492
Train score   : 0.952399647585551
Train accuracy: 0.64605
```



Architecture 3 :80-70-50-30-20-16-4(5 Convlution Layers + 2 Dense softmax)

7-CNN - relu , 2-Dense + relu activation + AdamOtpimizer

In [37]:

```
model_3 = Sequential()
model_3.add(Conv2D(80,kernel_size=(5,5),padding='same',activation='relu',input_shape=in
put_shape))
model_3.add(MaxPool2D(pool_size=(3, 3)))

model_3.add(Conv2D(70,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(Dropout(0.35))


model_3.add(Conv2D(50,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(Dropout(0.35))

model_3.add(Conv2D(30,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(Dropout(0.4))

model_3.add(Conv2D(20,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(MaxPool2D(pool_size=(2, 2)))
model_3.add(Dropout(0.5))


model_3.add(Conv2D(16,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(Dropout(0.5))

model_3.add(Conv2D(8,kernel_size=(3,3),padding='same',activation='relu'))
model_3.add(Dropout(0.55))

model_3.add(Flatten())
model_3.add(Dense(100,activation='relu'))
model_3.add(Dropout(0.7))

model_3.add(Dense(num_classes,activation='softmax'))
model_3.summary()
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
conv2d_73 (Conv2D)           (None, 28, 28, 80)        2080      
_________________________________________________________________
max_pooling2d_66 (MaxPooling (None, 9, 9, 80)          0         
_________________________________________________________________
conv2d_74 (Conv2D)           (None, 9, 9, 70)          50470     
_________________________________________________________________
dropout_65 (Dropout)         (None, 9, 9, 70)          0         
_________________________________________________________________
conv2d_75 (Conv2D)           (None, 9, 9, 50)          31550     
_________________________________________________________________
dropout_66 (Dropout)         (None, 9, 9, 50)          0         
_________________________________________________________________
conv2d_76 (Conv2D)           (None, 9, 9, 30)          13530     
_________________________________________________________________
dropout_67 (Dropout)         (None, 9, 9, 30)          0         
_________________________________________________________________
conv2d_77 (Conv2D)           (None, 9, 9, 20)          5420      
_________________________________________________________________
max_pooling2d_67 (MaxPooling (None, 4, 4, 20)          0         
_________________________________________________________________
dropout_68 (Dropout)         (None, 4, 4, 20)          0         
_________________________________________________________________
conv2d_78 (Conv2D)           (None, 4, 4, 16)          2896      
_________________________________________________________________
dropout_69 (Dropout)         (None, 4, 4, 16)          0         
_________________________________________________________________
conv2d_79 (Conv2D)           (None, 4, 4, 8)           1160      
_________________________________________________________________
dropout_70 (Dropout)         (None, 4, 4, 8)           0         
_________________________________________________________________
flatten_8 (Flatten)          (None, 128)               0         
_________________________________________________________________
dense_8 (Dense)              (None, 100)               12900     
_________________________________________________________________
dropout_71 (Dropout)         (None, 100)               0         
_________________________________________________________________
dense_9 (Dense)              (None, 10)                1010      
=================================================================
Total params: 121,016
Trainable params: 121,016
Non-trainable params: 0
_________________________________________________________________
```

In [38]:

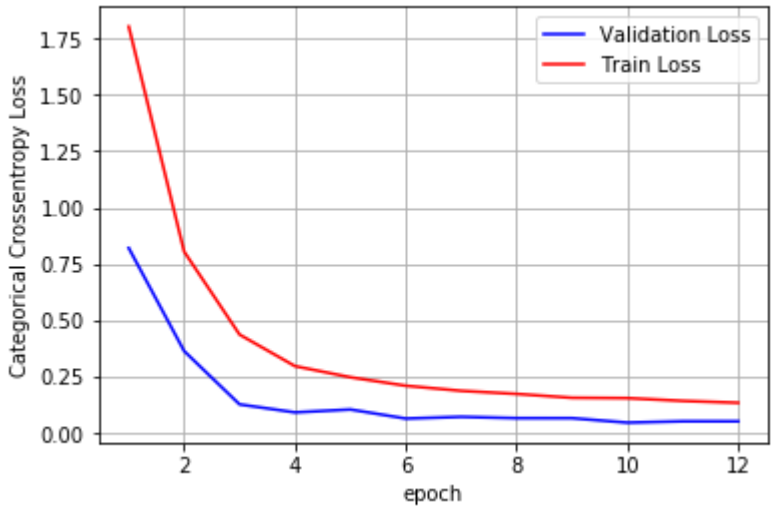
```
model_3.compile(loss=categorical_crossentropy,optimizer='adam',metrics=['accuracy'])
history = model_3.fit(x_train,y_train,batch_size=batch_size,epochs=epochs, verbose=1, v
alidation_data=(x_test, y_test))
```

```
Train on 60000 samples, validate on 10000 samples
Epoch 1/12
60000/60000 [==============================] - 210s 3ms/step - loss: 1.802
8 - acc: 0.3186 - val_loss: 0.8207 - val_acc: 0.6794
Epoch 2/12
60000/60000 [==============================] - 207s 3ms/step - loss: 0.804
8 - acc: 0.7117 - val_loss: 0.3639 - val_acc: 0.8787
Epoch 3/12
60000/60000 [==============================] - 207s 3ms/step - loss: 0.437
1 - acc: 0.8850 - val_loss: 0.1275 - val_acc: 0.9675
Epoch 4/12
60000/60000 [==============================] - 206s 3ms/step - loss: 0.297
2 - acc: 0.9278 - val_loss: 0.0920 - val_acc: 0.9773
Epoch 5/12
60000/60000 [==============================] - 206s 3ms/step - loss: 0.247
8 - acc: 0.9402 - val_loss: 0.1049 - val_acc: 0.9757
Epoch 6/12
60000/60000 [==============================] - 204s 3ms/step - loss: 0.210
2 - acc: 0.9494 - val_loss: 0.0647 - val_acc: 0.9836
Epoch 7/12
60000/60000 [==============================] - 204s 3ms/step - loss: 0.187
6 - acc: 0.9559 - val_loss: 0.0723 - val_acc: 0.9835
Epoch 8/12
60000/60000 [==============================] - 204s 3ms/step - loss: 0.173
9 - acc: 0.9582 - val_loss: 0.0665 - val_acc: 0.9830
Epoch 9/12
60000/60000 [==============================] - 204s 3ms/step - loss: 0.156
8 - acc: 0.9627 - val_loss: 0.0664 - val_acc: 0.9830
Epoch 10/12
60000/60000 [==============================] - 205s 3ms/step - loss: 0.155
2 - acc: 0.9633 - val_loss: 0.0466 - val_acc: 0.9877
Epoch 11/12
60000/60000 [==============================] - 202s 3ms/step - loss: 0.143
0 - acc: 0.9662 - val_loss: 0.0526 - val_acc: 0.9879
Epoch 12/12
60000/60000 [==============================] - 203s 3ms/step - loss: 0.134
6 - acc: 0.9692 - val_loss: 0.0526 - val_acc: 0.9869
```

In [41]:

```
score3_tst = model_3.evaluate(x_test, y_test, verbose=0)
print('Test score   :', score3_tst[0])
print('Test accuracy:', score3_tst[1])

score3_trn = model_3.evaluate(x_train, y_train, verbose=0)
print('Train score   :', score3_trn[0])
print('Train accuracy:', score3_trn[1])


fig,ax = plt.subplots(1,1)
ax.set_xlabel('epoch') ; ax.set_ylabel('Categorical Crossentropy Loss')

x = list(range(1,epochs+1))
vy = history.history['val_loss']
ty = history.history['loss']
plt_dynamic(x, vy, ty, ax)

#["Model", "#ConvLayers", "size of Convnets","#Maxpool","size of Maxpool","#Dropout","Dense","Test ACC","Train ACC"]
Total_SUMRY[3]=["Model3", "7", "80-70-50-30-20-16-4" ,"2","3-2","4","2",score3_trn[1],score3_tst[1]]
```

```
Test score   : 0.05256174960960634
Test accuracy: 0.9869
Train score   : 0.046337916914901384
Train accuracy: 0.9887833333333333
```



In [43]:

```
#http://zetcode.com/python/prettytable/
from prettytable import PrettyTable
x = PrettyTable()
x.field_names = ["Model", "#ConvLayers", "size of Convnets","#Maxpool","size of Maxpoo
l","Dropout","Dense","Test ACC","Train ACC"]
for i,j in enumerate(Total_SUMRY):
  x.add_row([Total_SUMRY[j][0],Total_SUMRY[j][1],Total_SUMRY[j][2],Total_SUMRY[j][3],To
tal_SUMRY[j][4],Total_SUMRY[j][5],Total_SUMRY[j][6],Total_SUMRY[j][7],Total_SUMRY[j][8
]])
  #print(Total_SUMRY[j][0]," = ",Total_SUMRY[j][1]," = ",Total_SUMRY[j][2]," = ",Total_
SUMRY[j][3]," = ",Total_SUMRY[j][4]," = ",Total_SUMRY[j][5]," = ",Total_SUMRY[j][6]," =
",Total_SUMRY[j][7])
print(x)
```

```
+--------+-------------+---------------------+----------+-----------------
+---------+-------+--------------------+-----------+
| Model  | #ConvLayers |   size of Convnets  | #Maxpool | size of Maxpool
| Dropout | Dense |      Test ACC      | Train ACC |
+--------+-------------+---------------------+----------+-----------------
+---------+-------+--------------------+-----------+
| Model1 |      3      |       64-28-12      |    1     |        2
|    3    |   1   |       0.9976       |   0.9925  |
| Model2 |      5      |    60-40-28-14-8    |    5     |     2-2-2-2
|    4    |   1   |      0.64605       |   0.6492  |
| Model3 |      7      | 80-70-50-30-20-16-4 |    2     |       3-2
|    4    |   2   | 0.9887833333333333 |   0.9869  |
+--------+-------------+---------------------+----------+-----------------
+---------+-------+--------------------+-----------+
```

Conclusion

We tried with three different combinations of ConvNets, Maxpools,Dropouts and Dense Layers.

We can understand too much of maxpooling is not helping so much, infact it is penalising the accuracy.

Model 1 and Model 3 are performing nearly the same.

Model 1 with 3 ConvNets and 2Maxpool is giving the best performance out of three architectures.