Develop Your First Neural Network in Python With Keras Step-By-Step

by **Jason Brownlee** on May 24, 2016 in **Deep Learning**

Keras is a powerful easy-to-use Python library for developing and evaluating deep learning models.

It wraps the efficient numerical computation libraries Theano and TensorFlow and allows you to define and train neural network models in a few short lines of code.

In this post, you will discover how to create your first neural network model in Python using Keras.

Let's get started.

- **Update Feb/2017**: Updated prediction example so rounding works in Python 2 and Python 3.
- **Update Mar/2017**: Updated exam... Theano 0.9.0.

Develop Your First Neural Network in Python With Keras Step-By-Step
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Tutorial Overview

There is not a lot of code required, but we are going to step over it slowly so that you will know how to create your own models in the future.

The steps you are going to cover in this tutorial are as follows:

1. Load Data.
2. Define Model.
3. Compile Model.
4. Fit Model.
5. Evaluate Model.
6. Tie It All Together.

This tutorial has a few requirements:

1. You have Python 2 or 3 installed and configured.
2. You have SciPy (including NumPy) installed and configured.
3. You have Keras and a backend (Theano or TensorFlow) installed and configured.

If you need help with your environment, see the tutorial:

- How to Setup a Python Environment for Machine Learning and Deep Learning with Anaconda

Create a new file called **keras_first_network.py** and type or copy-and-paste the code into the file as you go.

1. Load Data

Whenever we work with machine learning algorithms that use a stochastic process (e.g. random numbers), it is a good idea to set the random number seed.

This is so that you can run the same code again and again and get the same result. This is useful if you need to demonstrate a result, compare algorithms using the same source of randomness or to debug a part of your code.

You can initialize the random number generator with any seed you like, for example:

```
1 from keras.models import Sequential
2 from keras.layers import Dense
3 import numpy
4 # fix random seed for reproducibility
5 numpy.random.seed(7)
```

Now we can load our data.

In this tutorial, we are going to use the Pima Indians onset of diabetes dataset. This is a standard machine learning dataset from the UCI Machine Learning repository. It describes patient medical record data for Pima Indians and whether they had an onset of diabetes within five years.

As such, it is a binary classification problem (onset of diabetes as 1 or not as 0). All of the input variables that describe each patient are numerical. This makes it easy to use directly with neural networks that expect numerical input and output values, and ideal for our first neural network in Keras.

Download the Pima Indian dataset from the UCI Machine Learning repository and place it in your local working directory, the same as your python file. Save it with the file name:

```
pima-indians-diabetes.csv
```

You can now load the file directly using the NumPy function **loadtxt()**. There are eight input variables and one output variable (the last column). Once loaded we can split the dataset into input variables (X) and the output class variable (Y).

```
# load pima indians dataset
dataset = numpy.loadtxt("pima-indians-diabetes.csv", delimiter=",")
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]
```

We have initialized our random number generator to ensure our results are reproducible and loaded our data. We are now ready to define our neural network model.

2. Define Model

Models in Keras are defined as a sequence of layers.

We create a Sequential model and add layers one at a time until we are happy with our network topology.

The first thing to get right is to ensure the input layer has the right number of inputs. This can be specified when creating the first layer with the **input_dim** argument and setting it to 8 for the 8 input variables.

How do we know the number of layers and their types?

This is a very hard question. There are heuristics that we can use and often the best network structure is found through a process of trial and error experimentation. Generally, you need a network large enough to capture the structure of the problem if that helps at all.

In this example, we will use a fully-connected network structure with three layers.

Fully connected layers are defined using the Dense class. We can specify the number of neurons in the layer as the first argument, the initialization method as the second argument as **init** and specify the activation function using the **activation** argument.

In this case, we initialize the network weights to a small random number generated from a uniform distribution ('**uniform**'), in this case between 0 and 0.05 because that is the default uniform weight initialization in Keras. Another traditional alternative would be '**normal'** for small random numbers generated from a Gaussian distribution.

We will use the rectifier ('**relu**') activation function on the first two layers and the sigmoid function in the output layer. It used to be the case that sigmoid and tanh activation functions were preferred for all layers. These days, better performance is achieved using the rectifier activation function. We use a sigmoid on the output layer to ensure our network output is between 0 and 1 and easy to map to either a probability of class 1 or snap to a hard classification of either class with a default threshold of 0.5.

We can piece it all together by adding each layer. The first layer has 12 neurons and expects 8 input variables. The second hidden layer has 8 neurons and finally, the output layer has 1 neuron to predict the class (onset of diabetes or not).

```
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, activation='relu'))
model.add(Dense(8, activation='relu'))
model.add(Dense(1, activation='sigmoid'))
```

3. Compile Model

Now that the model is defined, we can compile it.

Compiling the model uses the efficient

called backend) such as Theano or TensorFlow. The backend automatically chooses the best way to represent the network for training and making predictions to run on your hardware, such as CPU or GPU or even distributed.

When compiling, we must specify some additional properties required when training the network. Remember training a network means finding the best set of weights to make predictions for this problem.

We must specify the loss function to use to evaluate a set of weights, the optimizer used to search through different weights for the network and any optional metrics we would like to collect and report during training.

In this case, we will use logarithmic loss, which for a binary classification problem is defined in Keras as "**binary_crossentropy**". We will also use the efficient gradient descent algorithm "**adam**" for no other reason that it is an efficient default. Learn more about the Adam optimization algorithm in the paper "Adam: A Method for Stochastic Optimization".

Finally, because it is a classification problem, we will collect and report the classification accuracy as the metric.

```
1 # Compile model
2 model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
```

4. Fit Model

We have defined our model and compiled it ready for efficient computation.

Now it is time to execute the model on some data.

We can train or fit our model on our loaded data by calling the **fit()** function on the model.

The training process will run for a fixed number of iterations through the dataset called epochs, that we must specify using the **nepochs** argument. We can also set the number of instances that are evaluated before a weight update in the network is performed, called the batch size and set using the **batch_size** argument.

For this problem, we will run for a small number of iterations (150) and use a relatively small batch size of 10. Again[illegible]al and error.

```
# Fit the model
model.fit(X, Y, epochs=150, batch_size=10)
```

This is where the work happens on your CPU or GPU.

5. Evaluate Model

We have trained our neural network on the entire dataset and we can evaluate the performance of the network on the same dataset.

This will only give us an idea of how well we have modeled the dataset (e.g. train accuracy), but no idea of how well the algorithm might perform on new data. We have done this for simplicity, but ideally, you could separate your data into train and test datasets for training and evaluation of your model.

You can evaluate your model on your training dataset using the **evaluate()** function on your model and pass it the same input and output used to train the model.

This will generate a prediction for each input and output pair and collect scores, including the average loss and any metrics you have configured, such as accuracy.

```
# evaluate the model
scores = model.evaluate(X, Y)
print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))
```

6. Tie It All Together

You have just seen how you can easily create your first neural network model in Keras.

Let's tie it all together into a complete code example.

```
# Create your first MLP in Keras
from keras.models import Sequential
from keras.layers import Dense
import numpy
# fix random seed for reproducibility
numpy.random.seed(7)
# load pima indians dataset
dataset = numpy.loadtxt("pima-indians-diabetes.csv", delimiter=",")
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, act
model.add(Dense(8, activation='relu'
```

```
model.add(Dense(1, activation='sigmoid'))
# Compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
# Fit the model
model.fit(X, Y, epochs=150, batch_size=10)
# evaluate the model
scores = model.evaluate(X, Y)
print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))
```

Running this example, you should see a message for each of the 150 epochs printing the loss and accuracy for each, followed by the final evaluation of the trained model on the training dataset.

It takes about 10 seconds to execute on my workstation running on the CPU with a Theano backend.

```
...
Epoch 145/150
768/768 [==============================] - 0s - loss: 0.5105 - acc: 0.7396
Epoch 146/150
768/768 [==============================] - 0s - loss: 0.4900 - acc: 0.7591
Epoch 147/150
768/768 [==============================] - 0s - loss: 0.4939 - acc: 0.7565
Epoch 148/150
768/768 [==============================] - 0s - loss: 0.4766 - acc: 0.7773
Epoch 149/150
768/768 [==============================] - 0s - loss: 0.4883 - acc: 0.7591
Epoch 150/150
768/768 [==============================] - 0s - loss: 0.4827 - acc: 0.7656
 32/768 [>.............................] - ETA: 0s
acc: 78.26%
```

Note: If you try running this example in an IPython or Jupyter notebook you may get an error. The reason is the output progress bars during training. You can easily turn these off by setting **verbose=0** in the call to **model.fit()**.

7. Bonus: Make Predictions

The number one question I get asked is:

> *After I train my model, how can I use it to make predictions on new data?*

Great question.

We can adapt the above example and use it to generate predictions on the training dataset, pretending it is a new dataset

Making predictions is as easy as calling

a sigmoid activation function on the output layer, so the predictions will be in the range between 0 and 1. We can easily convert them into a crisp binary prediction for this classification task by rounding them.

The complete example that makes predictions for each record in the training data is listed below.

```
# Create first network with Keras
from keras.models import Sequential
from keras.layers import Dense
import numpy
# fix random seed for reproducibility
seed = 7
numpy.random.seed(seed)
# load pima indians dataset
dataset = numpy.loadtxt("pima-indians-diabetes.csv", delimiter=",")
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, init='uniform', activation='relu'))
model.add(Dense(8, init='uniform', activation='relu'))
model.add(Dense(1, init='uniform', activation='sigmoid'))
# Compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
# Fit the model
model.fit(X, Y, epochs=150, batch_size=10,  verbose=2)
# calculate predictions
predictions = model.predict(X)
# round predictions
rounded = [round(x[0]) for x in predictions]
print(rounded)
```

Running this modified example now prints the predictions for each input pattern. We could use these predictions directly in our application if needed.

```
[1.0, 0.0, 1.0, 0.0, 1.0, 0.0, 0.0, 1.0, 1.0, 0.0, 0.0, 1.0, 1.0, 1.0, 1.0, 0.0, 1.0,
```

Summary

In this post, you discovered how to create your first neural network model using the powerful Keras Python library for deep learning.

Specifically, you learned the five key steps in using Keras to create a neural network or deep learning model, step-by-step including:

1. How to load data.
2. How to define neural network in Ke

3. How to compile a Keras model using the efficient numerical backend.
4. How to train a model on data.
5. How to evaluate a model on data.

Do you have any questions about Keras or about this tutorial?
Ask your question in the comments and I will do my best to answer.

Related Tutorials

Are you looking for some more Deep Learning tutorials with Python and Keras?

Take a look at some of these:

- 5 Step Life-Cycle for Neural Network Models in Keras
- How to Grid Search Hyperparameters for Deep Learning Models in Python With Keras
- Time Series Prediction With Deep Learning in Keras
- Multi-Class Classification Tutorial with the Keras Deep Learning Library
- Regression Tutorial with the Keras Deep Learning Library in Python

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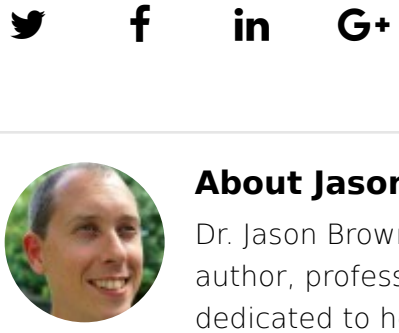

About Jason Brownlee

Dr. Jason Brownlee is a husband, proud father, academic researcher, author, professional developer and a machine learning practitioner. He is dedicated to helping developers get started and get good at applied machine learning.
Learn more.

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418 Responses to *Develop Your First Neural Network in Python With Keras Step-By-Step*

Saurav May 27, 2016 at 11:08 pm #

REPLY

The input layer doesn't have any activation function, but still activation="relu" is mentioned in the first layer of the model. Why?

Jason Brownlee May 28, 2016 at 6:32 am #

REPLY

Hi Saurav,

The first layer in the network here is technically a hidden layer, hence it has an activation function.

sam Johnson December 21, 2016 at 2:44 am #

REPLY

Why have you made it a hidden layer though? the input layer is not usually represented as a hidden layer?

Jason Brownlee December 21, 2016 at 8:41 am #

REPLY

Hi sam,

Note this line:

```
model.add(Dense(12, input_dim=8, init='uniform', activation='relu'))
```

It does a few things.

It defines the input layer as having 8 inputs.

It defines a hidden layer with 12 neurons, connected to the input layer that use relu activation function.

It initializes all weights using a sample of uniform random numbers.

Does that help?

Pavidevi May 17, 2017 at 2:31 am #

Hi Jason,

U have used two different activation functions so how can we know which activation function fit the model?

Jason Brownlee May 17, 2017 at 8:38 am #

Sorry, I don't understand the question.

Marco Cheung August 23, 2017 at 12:51 am #

Hi Jason,

I am interested in deep

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"It defines a hidden layer with 12 neurons, connected to the input layer that use relu activation function." I wonder how can we determine the number of neurons in order to achieve a high accuracy rate of the model?

Thanks a lot!!!

Jason Brownlee August 23, 2017 at 6:55 am #

Use trial and error. We cannot specify the "best" number of neurons analytically. We must test.

Ramzan Shahid November 10, 2017 at 4:32 am #

Sir, thanks for your tutorial. Would you like to make tutorial on stock Data Prediction through Neural Network Model and training this on any stock data. If you have on this so please share the link. Thanks

Jason Brownlee November 10, 2017 at 10:39 am #

I am reticent to post tutorials on stock market prediction given the random walk hypothesis of security prices: https://machinelearningmastery.com/gentle-introduction-random-walk-times-series-forecasting-python/

Geoff May 29, 2016 at 6:18 am #

REPLY

Can you explain how to implement weight regularization into the layers?

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Jason Brownlee June 15, 2016 at 5:50 am #

REPLY

Yep, see here:
http://keras.io/regularizers/

KWC June 14, 2016 at 12:08 pm #

REPLY

Import statements if others need them:

```
from keras.models import Sequential
from keras.layers import Dense, Activation
```

Jason Brownlee June 15, 2016 at 5:49 am #

REPLY

Thanks.

I had them in Part 6, but I have also added them to Part 1.

Aakash Nain June 29, 2016 at 6:00 pm #

REPLY

If there are 8 inputs for the first layer then why we have taken them as '12' in the following line :

model.add(Dense(12, input_dim=8, init='uniform', activation='relu'))

Jason Brownlee June 30, 2016 at 6:47 am #

REPLY

Hi Aakash.

The input layer is defined by the input_dim parameter, here set to 8.

The first hidden layer has 12 neurons.

Joshua July 2, 2016 at 12:04 am #

REPLY

I ran your program and i have an error:
ValueError: could not convert string to float:
what could be the reason for this, and how may I solve it.
thanks.
great post by the way.

Jason Brownlee July 2, 2016 at 6:20 am #

REPLY

It might be a copy-paste error. Perhaps try to copy and run the whole example listed in section 6?

cheikh brahim July 5, 2016 at 7:40 pm #

REPLY

thank you for your simple and useful example.

Jason Brownlee July 6, 2016 at 6:22 am #

REPLY

You're welcome cheikh.

Nikhil Thakur July 6, 2016 at 6:39 pm #

REPLY

Hello Sir, I am trying to use Keras for NLP , specifically sentence classification. I have given the model building part below. It's taking quite a lot time to execute. I am using Pycharm IDE.

```
batch_size = 32
nb_filter = 250
filter_length = 3
nb_epoch = 2
pool_length = 2
output_dim = 5
hidden_dims = 250

# Build the model

model1 = Sequential()
```

```
model1.add(Convolution1D(nb_filter, filter_length
,activation='relu',border_mode='valid',
input_shape=(len(embb_weights),dim), weights=[embb_weights]))

model1.add(Dense(hidden_dims))
model1.add(Dropout(0.2))
model1.add(Activation('relu'))

model1.add(MaxPooling1D(pool_length=pool_length))

model1.add(Dense(output_dim, activation='sigmoid'))

sgd = SGD(lr=0.1, decay=1e-6, momentum=0.9, nesterov=True)

model1.compile(loss='mean_squared_error',
optimizer=sgd,
metrics=['accuracy'])
```

Jason Brownlee July 7, 2016 at 7:31 am #

REPLY

You may want a larger network. You may also want to use a standard repeating structure like CNN->CNN->Pool->Dense.

See this post on using a CNN: http://machinelearningmastery.com/handwritten-digit-recognition-using-convolutional-neural-networks-python-keras/

Later, you may also want to try some stacked LSTMs.

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Andre Norman July 15, 2016 at 10:40 am #

REPLY

Hi Jason, thanks for the awesome example. Given that the accuracy of this model is 79.56%. From here on, what steps would you take to improve the accuracy?

Given my nascent understanding of Machine Learning, my initial approach would have been:

Implement forward propagation, then compute the cost function, then implement back propagation, use gradient checking to evaluate my network (disable after use), then use gradient descent.

However, this approach seems arduous compared to using Keras. Thanks for your response.

Jason Brownlee July 15, 2016 at 10:52 am #

REPLY

Hi Andre, indeed Keras makes working with neural nets so much easier. Fun even!

We may be maxing out on this problem, but here is some general advice for lifting performance.
– data prep – try lots of different views of the problem and see which is best at exposing the structure of the problem to the learning algorithm (data transforms, feature engineering, etc.)
– algorithm selection – try lots of algorithms and see which one or few are best on the problem (try on all views)
– algorithm tuning – tune well performing algorithms to get the most out of them (grid search or random search hyperparameter tuning)
– ensembles – combine predictions from multiple algorithms (stacking, boosting, bagging, etc.)

For neural nets, there are a lot of things to tune, I think there are big gains in trying different network topologies (layers and number of neurons per layer) in concert with training epochs and learning rate (bigger nets need more training).

I hope that helps as a start.

Andre Norman July 18, 2016 at 7:19 am #

REPLY

Awesome! Thanks Jason =)

Jason Brownlee July 18, 2016 at 8:03 am #

REPLY

You're welcome Andre.

quentin August 7, 2017 at 8:41 pm #

REPLY

Some interesting stuff here
https://youtu.be/vq2nnJ4g6N0

Jason Brownlee August 8, 2017 at 7:49 am #

REPLY

Thanks for sharing. What did you like about it?

Romilly Cocking July 21, 2016 at 12:31 am #

REPLY

Hi Jason, it's a great example but if anyone runs it in an IPython/Jupyter notebook they are likely to encounter an I/O error when running the fit step. This is due to a known bug in IPython.

The solution is to set verbose=0 like this

```
# Fit the model
model.fit(X, Y, nb_epoch=40, batch_size=10, verbose=0)
```

Jason Brownlee July 21, 2016 at 5:36 am #

REPLY

Great, thanks for sharing Romilly.

Anirban July 23, 2016 at 10:20 pm #

REPLY

Great example. Have a query though. How do I now give a input and get the output (0 or 1). Can you pls give the cmd for that.
Thanks

Jason Brownlee July 24, 2016 at 6:53 am #

REPLY

You can call model.predict() to get predictions and round on each value to snap to a binary value.

For example, below is a complete example showing you how to round the predictions and print them to console.

```
# Create first network with Keras
from keras.models import Sequential
from keras.layers import Dense
import numpy
# fix random seed for reproducibility
seed = 7
numpy.random.seed(seed)
# load pima indians dataset
dataset = numpy.loadtxt("pima-indians-diabetes.csv", delimiter=",")
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, init='uniform', activation='relu'))
model.add(Dense(8, init='uniform', activation='relu'))
model.add(Dense(1, init='uniform', activation='sigmoid'))
# Compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accura
# Fit the model
model.fit(X, Y, nb_epoch=150, batch_size=10,  verbose=2)
# calculate predictions
predictions = model.predict(X)
# round predictions
rounded = [round(x) for x in predictions]
print(rounded)
```

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Debanjan March 27, 2017 at 12:04 pm #

REPLY

Hi, Why you are not using any test set? You are predicting from the training set , I think.

Jason Brownlee March 28, 2017 at 8:19 am #

REPLY

Correct, it is just an example to get you started with Keras.

David June 26, 2017 at 12:24 am #

REPLY

Jason, I'm not quite understanding how the predicted values ([1.0, 0.0, 1.0, 0.0, 1.0,...) map to the real world problem. For instance, what does that first "1.0" in the results indicate?

I get that it's a prediction of 'true' for diabetes...but to which patient is it predicting that—the first in the list? So then the second result, "0.0," is the prediction for the second patient/row in the dataset?

Jason Brownlee June 26, 2017 at 6:08 am #

REPLY

Remember the original file has 0 and 1 values in the final class column where 0 is no onset of diabetes and 1 is an onset of diabetes.

We are predicting new values in this column.

We are making predictions for special rows, we pass in their medical info and predict the onset of diabetes. We just happen to do this for a number of rows at a time.

Rachel June 28, 2017 at 8:28 pm #

REPLY

Hi Jason,
Can I ask why you use the sam

Fit the model

model.fit(X, Y, epochs = 150, batch_size = 10, verbose = 2)

# calculate predictions
predictions = model.predict(X)

Rachel

Jason Brownlee June 29, 2017 at 6:34 am #

REPLY

It is all I have at hand. X means data matrix.

Replace X in predict() with Xprime or whatever you like.

Anirban July 23, 2016 at 10:52 pm #

REPLY

I am not able to get to the last epoch. Getting error before that:
Epoch 11/150
390/768 [==============>..............]Traceback (most recent call last):.6921

ValueError: I/O operation on closed file

I could resolve this by varying the epoch and batch size.

Now to predict a unknown value, i loaded a new dataset and used predict cmd as below :
dataset_test = numpy.loadtxt("pima-indians-diabetes_test.csv",delimiter=",") –has only one row

X = dataset_test[:,0:8]
model.predict(X)

But I am getting error :
X = dataset_test[:,0:8]

IndexError: too many indices for array

Can you help pls.

Thanks

Jason Brownlee July 24, 2(

REPLY

I see problems like this when you run from a notebook or from an IDE.

Consider running examples from the console to ensure they work.

Consider tuning off verbose output (verbose=0 in the call to fit()) to disable the progress bar.

REPLY

David Kluszczynski July 28, 2016 at 12:42 am #

Hi Jason!
Loved the tutorial! I have a question however.
Is there a way to save the weights to a file after the model is trained for uses, such as kaggle?
Thanks,
David

REPLY

Jason Brownlee July 28, 2016 at 5:47 am #

Thanks David.

You can save the network weights to file by calling model.save_weights("model.h5")

You can learn more in this post: http://machinelearningmastery.com/save-load-keras-deep-learning-models/

REPLY

Alex Hopper July 29, 2016 at 5:45 am #

Hey, Jason! Thank you for the awesome tutorial! I've use your tutorial to learn about CNN. I have one question for you... Supposing I want to use Keras to classicate images and I have 3 or more classes to classify, How could my algorithm know about this classes? You know, I have to code what is a cat, a dog and a horse. Is there any way to code this? I've tried it:

target_names = ['class 0(Cats)', 'class 1(Dogs)', 'class 2(Horse)']
print(classification_report(np.argmax(Y_test,axis=1), y_pred,target_names=target_names))

But my results are not classifying corre

precision recall f1-score support
class 0(Cat) 0.00 0.00 0.00 17
class 1(Dog) 0.00 0.00 0.00 14
class 2(Horse) 0.99 1.00 0.99 2526

avg / total 0.98 0.99 0.98 2557

Jason Brownlee July 29, 2016 at 6:41 am #

REPLY

Great question Alex.

This is an example of a multi-class classification problem. You must use a one hot encoding on the output variable to be able to model it with a neural network and specify the number of classes as the number of outputs on the final layer of your network.

I provide a tutorial with the famous iris dataset that has 3 output classes here: http://machinelearningmastery.com/multi-class-classification-tutorial-keras-deep-learning-library/

Alex Hopper August 1, 2016 at 1:22 am #

REPLY

Thank you.
I'll check it.

Jason Brownlee August 1, 2016 at 6:25 am #

REPLY

No problem Alex.

Anonymouse August 2, 2016 at 11:28 pm #

REPLY

This was really useful, thank you

I'm using keras (with CNNs) for sentiment classification of documents and I'd like to improve the performance, but I'm com[illegible] parameters in a non-arbitrary way. Co[illegible] help me go about this in a more syste[illegible]

or rules-of-thumb that could guide me.

Jason Brownlee August 3, 2016 at 8:09 am #

REPLY

I have a tutorial coming out soon (next week) that provide lots of examples of tuning the hyperparameters of a neural network in Keras, but limited to MLPs.

For CNNs, I would advise tuning the number of repeating layers (conv + max pool), the number of filters in repeating block, and the number and size of dense layers at the predicting part of your network. Also consider using some fixed layers from pre-trained models as the start of your network (e.g. VGG) and try just training some input and output layers around it for your problem.

I hope that helps as a start.

Shopon August 14, 2016 at 5:04 pm #

REPLY

Hello Jason , My Accuracy is : 0.0104 , but yours is 0.7879 and my loss is : -9.5414 . Is there any problem with the dataset ? I downloaded the dataset from a different site .

Jason Brownlee August 15, 2016 at 12:36 pm #

REPLY

I think there might be something wrong with your implementation or your dataset. Your numbers are way out.

mohamed August 15, 2016 at 9:30 am #

REPLY

after training, how i can use the trained model on new sample

Jason Brownlee August 15

REPLY

You can call model.predict(

See an above comment for a specific code example.

Omachi Okolo August 16, 2016 at 10:21 pm #

REPLY

Hi Jason,
i'm a student conducting a research on how to use artificial neural network to predict the business viability of potential software projects.
I intend to use python as a programming language. The application of ANN fascinates me but i'm new to machine learning and python. Can you help suggest how to go about this.
Many thanks

Jason Brownlee August 17, 2016 at 9:51 am #

REPLY

Consider getting a good grounding in how to work through a machine learning problem end to end in python first.

Here is a good tutorial to get you started:
http://machinelearningmastery.com/machine-learning-in-python-step-by-step/

Agni August 17, 2016 at 6:23 am #

REPLY

Dear Jeson, this is a great tutorial for beginners. It will satisfy the need of many students who are looking for the initial help. But I have a question. Could you please light on a few things: i) how to test the trained model using test dataset (i.e., loading of test dataset and applied the model and suppose the test file name is test.csv) ii) print the accuracy obtained on test dataset iii) the o/p has more than 2 class (suppose 4-class classification problem).
Please show the whole program to overcome any confusion.
Thanks a lot.

Jason Brownlee August 17, 2016 at 10:03 am #

REPLY

I provide an example elsew
to make predictions on new data ir

http://machinelearningmastery.com/5-step-life-cycle-neural-network-models-keras/

For an example of multi-class classification, you can see this tutorial: http://machinelearningmastery.com/multi-class-classification-tutorial-keras-deep-learning-library/

Doron Vetlzer August 17, 2016 at 9:29 am #

REPLY

I am trying to build a Neural Network with some recursive connections but not a full recursive layer, how do I do this in Keras?

Doron Vetlzer August 17, 2016 at 9:31 am #

REPLY

I could print a diagram of the network but what I want Basically is that each neuron in the current time frame to know only its own previous output and not the output of all the neurons in the output layer.

Jason Brownlee August 17, 2016 at 10:04 am #

REPLY

I don't know off hand Doron.

Doron Veltzer August 23, 2016 at 2:28 am #

REPLY

Thanks for replying though, have a good day.

Get Your Start in Machine Learning

sairam August 30, 2016 at 8:49 am #

REPLY

Hello Jason,

This is a great tutorial . Thanks for sharing.

I am having a dataset of 100 finger prints and i want to extract minutiae of 100 finger prints using python (Keras). Can you please advise where to start? I am really confused.

Jason Brownlee August 31, 2016 at 8:43 am #

REPLY

If your fingerprints are images, you may want to consider using convolutional neural networks (CNNs) that are much better at working image data.

See this tutorial on digit recognition for a start:
http://machinelearningmastery.com/handwritten-digit-recognition-using-convolutional-neural-networks-python-keras/

padmashri July 6, 2017 at 10:12 pm #

REPLY

Hi Jason
Thanks for this great tutorial, i am new to machine learning i went through your basic tutorial on keras and also handwritten-digit-recognition. I would like to understand how i can train a set of image data, for eg. the set of image data can be some thing like square, circle, pyramid.
pl. let me know how the input data needs to fed to the program and how we need to export the model.

Jason Brownlee July 9, 2017 at 10:30 am #

REPLY

Start by preparing a high-quality dataset.

CM September 1, 2016 at 4:23 pm #

REPLY

Hi Jason,

Thanks for the great article. But I had 1 query.

Are there any inbuilt functions in keras that can give me the feature importance for the ANN model?

If not, can you suggest a technique I can use to extract variable importance from the loss function? I am considering an approach similar to that used in RF which involves permuting the values of the selected variable and calculating the relative increase in loss.

Regards,
CM

Jason Brownlee September 2, 2016 at 8:07 am #

REPLY

I don't believe so CM.

I would suggest using a wrapper method and evaluate subsets of features to develop a feature importance/feature selection report.

I talk a lot more about feature selection in this post:
http://machinelearningmastery.com/an-introduction-to-feature-selection/

I provide an example of feature selection in scikit-learn here:
http://machinelearningmastery.com/feature-selection-machine-learning-python/

I hope that helps as a start.

Minesh Jethva May 15, 2017 at 7:49 pm #

REPLY

have you develop any progress for this approach? I also have same problem.

Get Your Start in Machine Learning

Kamal September 7, 2016 at 2:09 am #

REPLY

Dear Jason, I am new to Deep learning. Being a novice, I am asking you a technical question which may seem silly. My question is that- can we use features (for example length of the sentence etc.) of a sentence while classifying a sentence (suppose the o/p are +ve sentence and -ve sentence) using deep neural network?

Jason Brownlee September 7, 2016 at 10:27 am #

REPLY

Great question Kamal, yes you can. I would encourage you to include all such features and see which give you a bump in performance.

Saurabh September 11, 2016 at 12:42 pm #

REPLY

Hi, How would I use this on a dataset that has multiple outputs? For example a dataset with output A and B where A could be 0 or 1 and B could be 3 or 4 ?

Jason Brownlee September 12, 2016 at 8:30 am #

REPLY

You could use two neurons in the output layer and normalize the output variables to both be in the range of 0 to 1.

This tutorial on multi-class classification might give you some ideas: http://machinelearningmastery.com/multi-class-classification-tutorial-keras-deep-learning-library/

Tom_P September 17, 2016 at 1:47 pm #

REPLY

Hi Jason,
The tutorial looks really good but unfortunately I keep getting an error when importing Dense from keras.layers, I get the error : AttributeError: module 'theano' has no attribute 'gof'
I have tried reinstalling Theano but it h

Best wishes

Tom

Jason Brownlee September 18, 2016 at 7:57 am #

REPLY

Hi Tom, sorry to hear that. I have not seen this problem before.

Have you searched google? I can see a few posts and it might be related to your version of scipy or similar.

Let me know how you go.

shudhan September 21, 2016 at 5:54 pm #

REPLY

Hey Jason,

Can you please make a tutorial on how to add additional train data into the already trained model? This will be helpful for the bigger data sets. I read that warm start is used for random forest. But not sure how to implement as algorithm. A generalised version of how to implement would be good. Thank You!

Jason Brownlee September 22, 2016 at 8:08 am #

REPLY

Great question Shudhan!

Yes, you could save your weights, load them later into a new network topology and start training on new data again.

I'll work out an example in coming weeks, time permitting.

Joanna September 22, 2016 at 1:09 am #

REPLY

Hi Jason,
first of all congratulations for this amazing work that you have done!
Here is my question:
What about if my .csv file includes also both nominal and numerical attributes?
Should I change my nominal values to numerical?

Thank you in advance

Jason Brownlee September 22, 2016 at 8:19 am #

REPLY

Hi Joanna, yes.

You can use a label encoder to convert nominal to integer, and then even convert the integer to one hot encoding.

This post will give you code you can use:
http://machinelearningmastery.com/data-preparation-gradient-boosting-xgboost-python/

ATM October 2, 2016 at 5:47 am #

REPLY

A small bug:-
Line 25 : rounded = [round(x) for x in predictions]

should have numpy.round instead, for the code to run!
Great tutorial, regardless. The best i've seen for intro to ANN in python. Thanks!

Jason Brownlee October 2, 2016 at 8:20 am #

REPLY

Perhaps it's your version of Python or environment?

In Python 2.7 the round() function is built-in.

AC January 14, 2017 at 2:11

REPLY

> If there is comment for python3, should be better.
> #use unmpy.round instead, if using python3,

Jason Brownlee January 15, 2017 at 5:24 am #

REPLY

Thanks for the note AC.

Ash October 9, 2016 at 1:36 am #

REPLY

This is simple to grasp! Great post! How can we perform dropout in keras?

Jason Brownlee October 9, 2016 at 6:49 am #

REPLY

Thanks Ash.

You can learn about drop out with Keras here:
http://machinelearningmastery.com/dropout-regularization-deep-learning-models-keras/

Homagni Saha October 14, 2016 at 4:15 am #

REPLY

Hello Jason,
You are using model.predict in the end to predict the results. Is it possible to save the model somewhere in the harddisk and transfer it to another machine(turtlebot running on ROS for my instance) and then use the model directly on turtlebot to predict the results?
Please tell me how
Thanking you
Homagni Saha

Jason Brownlee October 14, 2016 at 9:07 am #

REPLY

Hi Homagni, great questior

Get Your Start in Machine Learning

Absolutely!

Learn exactly how in this tutorial I wrote:
http://machinelearningmastery.com/save-load-keras-deep-learning-models/

Rimi October 16, 2016 at 8:21 pm #

REPLY

Hi Jason,
I implemented you code to begin with. But I am getting an accuracy of 45.18% with the same parameters and everything.
Cant figure out why.
Thanks

Jason Brownlee October 17, 2016 at 10:29 am #

REPLY

There does sound like a problem there Rimi.

Confirm the code and data match exactly.

Ankit October 26, 2016 at 8:12 pm #

REPLY

Hi Jason,
I am little confused with first layer parameters. You said that first layer has 12 neurons and expects 8 input variables.

Why there is a difference between number of neurons, input_dim for first layer.

Regards,
Ankit

Jason Brownlee October 27, 2016 at 7:45 am #

REPLY

Hi Ankit,

The problem has 8 input variables and the first hidden layer has 12 neurons.
Inputs are the columns of data, the
whatever we design based on wha

the complexity of the problem. In this case, we have chosen 12 neurons for the first hidden layer.

I hope that is clearer.

Tom October 27, 2016 at 3:04 am #

REPLY

Hi,
I have a data , IRIS like data but with more colmuns.
I want to use MLP and DBN/CNNClassifier (or any other Deep Learning classificaiton algorithm) on my data to see how correctly it does classified into 6 groups.

Previously using DEEP LEARNING FOR J, today first time see KERAS.
does KERAS has examples (code examples) of DL Classification algorithms?

Kindly,
Tom

Jason Brownlee October 27, 2016 at 7:48 am #

REPLY

Yes Tom, the example in this post is an example of a neural network (deep learning) applied to a classification problem.

Rumesa October 30, 2016 at 1:57 am #

REPLY

I have installed theano but it gives me the error of tensorflow.is it mendatory to install both packages? because tensorflow is not supported on wndows.the only way to get it on windows is to install virtual machine

Jason Brownlee October 30, 2016 at 8:57 am #

REPLY

Keras will work just fine with Theano.

Just install Theano, and configure Keras to use the Theano backend.

More information about configuring
http://machinelearningmastery.com

keras/

Rumesa October 31, 2016 at 4:36 am #

REPLY

hey jason I have run your code but got the following error.Although I have aready installed theano backend.help me out.I just stuck.

Using TensorFlow backend.
Traceback (most recent call last):
File “C:\Users\pc\Desktop\first.py”, line 2, in
from keras.models import Sequential
File “C:\Users\pc\Anaconda3\lib\site-packages\keras__init__.py”, line 2, in
from . import backend
File “C:\Users\pc\Anaconda3\lib\site-packages\keras\backend__init__.py”, line 64, in
from .tensorflow_backend import *
File “C:\Users\pc\Anaconda3\lib\site-packages\keras\backend
\tensorflow_backend.py”, line 1, in
import tensorflow as tf
ImportError: No module named ‘tensorflow’
>>>

Jason Brownlee October 31, 2016 at 5:34 am #

REPLY

Change the backend used by Keras from TensorFlow to Theano.

You can do this either by using the command line switch or changing the Keras config file.

See the link I posted in the previous post for instructions.

Maria January 6, 2017 at 1:05 pm #

REPLY

Hello Rumesa!
Have you solved your problem? I have the same one. Everywhere is the same answer with keras.json file or enviriment variable but it doesn't work. Can you tell me what have worked for you?

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Jason Brownlee January 7, 2017 at 8:20 am #

REPLY

Interesting.

Maybe there is an issue with the latest version and a tight coupling to tensorflow? I have not seen this myself.

Perhaps it might be worth testing prior versions of Keras, such as 1.1.0?

Try this:

```
1 pip install --upgrade --no-deps keras==1.1.0
```

Alexon November 1, 2016 at 6:54 am #

REPLY

Hi Jason,

First off, thanks so much for creating these resources, I have been keeping an eye on your newsletter for a while now, and I finally have the free time to start learning more about it myself, so your work has been really appreciated.

My question is: How can I set/get the weights of each hidden node?

I am planning to create several arrays randomized weights, then use a genetic algorithm to see which weight array performs the best and improve over generations. How would be the best way to go about this, and if I use a "relu" activation function, am I right in thinking these randomly generated weights should be between 0 and 0.05?

Many thanks for your help 🙂
Alexon

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Jason Brownlee November 1, 2016 at 8:05 am #

REPLY

Thanks Alexon,

You can get and set the weights from a network.

You can learn more about how to do this in the context of saving the weights to file here:
http://machinelearningmastery.com/save-load-keras-deep-learning-models/

I hope that helps as a start, I'd love to hear how you go.

Alexon November 6, 2016 at 6:36 am #

REPLY

Thats great, thanks for pointing me in the right direction.
I'd be happy to let you know how it goes, but might take a while as this is very much a "when I can find the time" project between jobs 🙂

Cheers!

Arnaldo Gunzi November 2, 2016 at 10:17 pm #

REPLY

Nice introduction, thanks!

Jason Brownlee November 3, 2016 at 7:59 am #

REPLY

I'm glad you found it useful Arnaldo.

Abbey November 14, 2016 at 11:05 pm #

REPLY

Good day

I have a question, how can I represent a character as a vector that could be an input for the neural network to predict the word meaning and trained using LSTM

For instance, I have bf to predict boy f
predict tomorrow. I need to encode all

so that it can be train with RNN/LSTM to predict the output.

Thank you.

Kind Regards

Jason Brownlee November 15, 2016 at 7:54 am #

REPLY

Hi Abbey, You can map characters to integers to get integer vectors.

Abbey November 15, 2016 at 6:17 pm #

REPLY

Thank you Jason, if i map characters to integers value to get vectors using English Alphabets, numbers and special characters

The question is how will LSTM predict the character. Please example in more details for me.

Regards

Jason Brownlee November 16, 2016 at 9:27 am #

REPLY

Hi Abbey,

If your output values are also characters, you can map them onto integers, and reverse the mapping to convert the predictions back to text.

Abbey November 16, 2016 at 8:39 pm #

The output value of the characters encoding will be text

Abbey November 15, 2016 at 6:22 pm #

REPLY

Thank you, Jason, if I m
representation of the informal t
special characters

The question is how will LSTM predict the character or words that have close meaning to the input value. Please example in more details for me. I understand how RNN/LSTM work based on your tutorial example but the logic in designing processing is what I am stress with.

Regards

Ammar November 27, 2016 at 10:35 am #

REPLY

hi Jason,
i am trying to implement CNN one dimention on my data. so, i bluit my network.
the issue is:
def train_model(model, X_train, y_train, X_test, y_test):
X_train = X_train.reshape(-1, 1, 41)
X_test = X_test.reshape(-1, 1, 41)

numpy.random.seed(seed)
model.fit(X_train, y_train, validation_data=(X_test, y_test), nb_epoch=100, batch_size=64)
# Final evaluation of the model
scores = model.evaluate(X_test, y_test, verbose=0)
print("Accuracy: %.2f%%" % (scores[1] * 100))
this method above does not work and does not give me any error message.
could you help me with this please?

Jason Brownlee November 28, 2016 at 8:40 am #

REPLY

Hi Ammar, I'm surprised that there is no error message.

Perhaps run from the command line and add some print() statements to see exactly where it stops.

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KK November 28, 2016 at 6:55 pm #

REPLY

Hi Jason
Great work. I have another doubt. How can we apply this to text mining. I have a csv file containing review document and label. I want to apply classify the documents based on the text available. Can U do this favor.

Jason Brownlee November 29, 2016 at 8:48 am #

REPLY

I would recommend converting the chars to ints and then using an Embedding layer.

Alex M November 30, 2016 at 10:52 pm #

REPLY

Mr Jason, this is great tutorial but I am stack with some errors.

First I can't load data set correctly, tried to correct error but can't make it. (FileNotFoundError: [Errno 2] No such file or directory: 'pima-indians-diabetes.csv').

Second: While trying to evaluate the model it says (X is not defined) May be this is because uploading failed.

Thanks!

Jason Brownlee December 1, 2016 at 7:29 am #

REPLY

You need to download the file and place it in your current working directory Alex.

Does that help?

Alex M December 1, 2016 at 6:45 pm #

REPLY

Sir, it is now successful....
Thanks!

Jason Brownlee December 2, 2016 at 8:15 am #

REPLY

Glad to hear it Alex.

Bappaditya December 2, 2016 at 7:35 pm #

REPLY

Hi Jason,

First of all a special thanks to you for providing such a great tutorial. I am very new to machine learning and truly speaking i had no background in data science. The concept of ML overwhelmed me and now i have a desire to be an expert of this field. I need your advice to start from a scratch. Also i am a PhD student in Computer Engineering (computer hardware)and i want to apply it as a tool for fault detection and testing for ICs.Can you provide me some references on this field?

Jason Brownlee December 3, 2016 at 8:29 am #

REPLY

Hi Bappaditya,

My best advice for getting started is here:
http://machinelearningmastery.com/start-here/#getstarted

I believe machine learning and deep learning are good tools for use on problems in fault detection. A good place to find references is here
http://scholar.google.com

Best of luck with your project.

Alex M December 3, 2016 at 8:00 pm #

REPLY

Well as usual in our daily coding life errors happen, now I have this error how can I correct it? Thanks!

" ————————————————————————————
NoBackendError Traceback (most recent call last)
in ()
16 import librosa.display
17 audio_path = ('/Users/MA/Python N

—> 18 y, sr = librosa.load(audio_path)

C:\Users\MA\Anaconda3\lib\site-packages\librosa\core\audio.py in load(path, sr, mono, offset, duration, dtype)
107
108 y = []
–> 109 with audioread.audio_open(os.path.realpath(path)) as input_file:
110 sr_native = input_file.samplerate
111 n_channels = input_file.channels

C:\Users\MA\Anaconda3\lib\site-packages\audioread__init__.py in audio_open(path)
112
113 # All backends failed!
–> 114 raise NoBackendError()

NoBackendError:

"

That is the error I am getting just when trying to load a song into librosa…
Thanks!! @Jason Brownlee

Jason Brownlee December 4, 2016 at 5:30 am #

REPLY

Sorry, this looks like an issue with your librosa library, not a machine learning issue. I can't give you expert advice, sorry.

Alex M December 4, 2016 at 10:30 pm #

REPLY

Thanks I have managed to correct the error…

Happy Sunday to you all……

Jason Brownlee December 5, 2016 at 6:49 am #

REPLY

Glad to hear it Alex.

Lei December 4, 2016 at 10:52 pm #

REPLY

Hi, Jason, thank you for your amazing examples.
I run the same code on my laptop. But I did not get the same results. What could be the possible reasons?
I am using windows 8.1 64bit+eclipse+anaconda 4.2+theano 0.9.4+CUDA7.5
I got results like follows.

… …
Epoch 145/150

10/768 [……] – ETA: 0s – loss: 0.3634 – acc: 0.8000
80/768 [==>……] – ETA: 0s – loss: 0.4066 – acc: 0.7750
150/768 [====>……] – ETA: 0s – loss: 0.4059 – acc: 0.8067
220/768 [=======>……] – ETA: 0s – loss: 0.4047 – acc: 0.8091
300/768 [==========>……] – ETA: 0s – loss: 0.4498 – acc: 0.7867
380/768 [=============>……] – ETA: 0s – loss: 0.4595 – acc: 0.7895
450/768 [================>……] – ETA: 0s – loss: 0.4568 – acc: 0.7911
510/768 [==================>……] – ETA: 0s – loss: 0.4553 – acc: 0.7882
580/768 [=====================>……] – ETA: 0s – loss: 0.4677 – acc: 0.7776
660/768 [==========================>…..] – ETA: 0s – loss: 0.4697 – acc: 0.7788
740/768 [============================>..] – ETA: 0s – loss: 0.4611 – acc: 0.7838
768/768 [==============================] – 0s – loss: 0.4614 – acc: 0.7799
Epoch 146/150

10/768 [……] – ETA: 0s – loss: 0.3846 – acc: 0.8000
90/768 [==>……] – ETA: 0s – loss: 0.5079 – acc: 0.7444
170/768 [=====>……] – ETA: 0s – loss: 0.4500 – acc: 0.7882
250/768 [========>……] – ETA: 0s – loss: 0.4594 – acc: 0.7840
330/768 [==========>……] – ETA: 0s – loss: 0.4574 – acc: 0.7818
400/768 [==============>……] – ETA: 0s – loss: 0.4563 – acc: 0.7775
470/768 [=================>……] – ETA: 0s – loss: 0.4654 – acc: 0.7723
540/768 [====================>……] – ETA: 0s – loss: 0.4537 – acc: 0.7870
620/768 [=======================>……] – ETA: 0s – loss: 0.4615 – acc: 0.7806
690/768 [==========================>…] – ETA: 0s – loss: 0.4631 – acc: 0.7739
750/768 [==========

```
acc: 0.7733
768/768 [==============================] – 0s – loss: 0.4636 – acc:
0.7734
Epoch 147/150

10/768 [..............................] – ETA: 0s – loss: 0.3561 – acc: 0.9000
90/768 [==>...........................] – ETA: 0s – loss: 0.4167 – acc: 0.8556
170/768 [=====>......................] – ETA: 0s – loss: 0.4824 – acc: 0.8059
250/768 [========>.....................] – ETA: 0s – loss: 0.4534 – acc: 0.8080
330/768 [==========>...................] – ETA: 0s – loss: 0.4679 – acc: 0.7848
400/768 [==============>...............] – ETA: 0s – loss: 0.4590 – acc: 0.7950
460/768 [================>.............] – ETA: 0s – loss: 0.4619 – acc: 0.7913
530/768 [====================>.........] – ETA: 0s – loss: 0.4562 – acc:
0.7868
600/768 [======================>.......] – ETA: 0s – loss: 0.4497 – acc:
0.7883
680/768 [========================>....] – ETA: 0s – loss: 0.4525 –
acc: 0.7853
760/768 [============================>.] – ETA: 0s – loss: 0.4568 –
acc: 0.7803
768/768 [==============================] – 0s – loss: 0.4561 – acc:
0.7812
Epoch 148/150

10/768 [..............................] – ETA: 0s – loss: 0.4183 – acc: 0.9000
80/768 [==>...........................] – ETA: 0s – loss: 0.3674 – acc: 0.8750
160/768 [=====>......................] – ETA: 0s – loss: 0.4340 – acc: 0.8250
240/768 [========>.....................] – ETA: 0s – loss: 0.4799 – acc: 0.7583
320/768 [==========>...................] – ETA: 0s – loss: 0.4648 – acc: 0.7719
400/768 [==============>...............] – ETA: 0s – loss: 0.4596 – acc: 0.7775
470/768 [=================>............] – ETA: 0s – loss: 0.4475 – acc:
0.7809
540/768 [====================>.........] – ETA: 0s – loss: 0.4545 – acc:
0.7778
620/768 [========================>.....] – ETA: 0s – loss: 0.4590 – acc:
0.7742
690/768 [==========================>...] – ETA: 0s – loss: 0.4769 –
acc: 0.7652
760/768 [============================>.] – ETA: 0s – loss: 0.4748 –
acc: 0.7658
768/768 [==============================] – 0s – loss: 0.4744 – acc:
0.7669
Epoch 149/150
```

```
10/768 [.....] - ETA: 0s - loss: 0.3043 - acc: 0.9000
90/768 [==>.....] - ETA: 0s - loss: 0.4913 - acc: 0.7111
170/768 [=====>.....] - ETA: 0s - loss: 0.4779 - acc: 0.7588
250/768 [========>.....] - ETA: 0s - loss: 0.4794 - acc: 0.7640
320/768 [==========>.....] - ETA: 0s - loss: 0.4957 - acc: 0.7562
370/768 [============>.....] - ETA: 0s - loss: 0.4891 - acc: 0.7703
450/768 [================>.....] - ETA: 0s - loss: 0.4737 - acc: 0.7867
520/768 [====================>.....] - ETA: 0s - loss: 0.4675 - acc:
0.7865
600/768 [======================>.....] - ETA: 0s - loss: 0.4668 - acc:
0.7833
680/768 [========================>....] - ETA: 0s - loss: 0.4677 -
acc: 0.7809
760/768 [==========================>.] - ETA: 0s - loss: 0.4648 -
acc: 0.7803
768/768 [==============================] - 0s - loss: 0.4625 - acc:
0.7826
Epoch 150/150

10/768 [.....] - ETA: 0s - loss: 0.2751 - acc: 1.0000
100/768 [==>.....] - ETA: 0s - loss: 0.4501 - acc: 0.8100
170/768 [=====>.....] - ETA: 0s - loss: 0.4588 - acc: 0.8059
250/768 [========>.....] - ETA: 0s - loss: 0.4299 - acc: 0.8200
310/768 [==========>.....] - ETA: 0s - loss: 0.4298 - acc: 0.8129
380/768 [============>.....] - ETA: 0s - loss: 0.4365 - acc: 0.8053
460/768 [================>.....] - ETA: 0s - loss: 0.4469 - acc: 0.7957
540/768 [====================>.....] - ETA: 0s - loss: 0.4436 - acc:
0.8000
620/768 [========================>.....] - ETA: 0s - loss: 0.4570 - acc:
0.7871
690/768 [========================>....] - ETA: 0s - loss: 0.4664 -
acc: 0.7783
760/768 [==========================>.] - ETA: 0s - loss: 0.4617 -
acc: 0.7789
768/768 [==============================] - 0s - loss: 0.4638 - acc:
0.7773

32/768 [>.....] - ETA: 0s
448/768 [================>.....] - ETA: 0sacc: 79.69%
```


Jason Brownlee Decembe

Get Your Start in Machine Learning

REPLY

There is randomness in the learning process that we cannot control for yet.

See this post:
http://machinelearningmastery.com/randomness-in-machine-learning/

Nanya December 10, 2016 at 2:55 pm #

REPLY

Hello Jason Brownlee,Thx for sharing~
I'm new in deep learning.And I am wondering can what you dicussed here:"Keras" be used to build a CNN in tensorflow and train some csv fiels for classification.May be this is a stupid question,but waiting for you reply.I'm working on my graduation project for Word sense disambiguation with cnn,and just can't move on.Hope for your heip~Bese wishes!

Jason Brownlee December 11, 2016 at 5:22 am #

REPLY

Sorry Nanya, I'm not sure I understand your question. Are you able to rephrase it?

Anon December 16, 2016 at 12:51 am #

REPLY

I've just installed Anaconda with Keras and am using python 3.5.
It seems there's an error with the rounding using Py3 as opposed to Py2. I think it's because of this change: https://github.com/numpy/numpy/issues/5700

I removed the rounding and just used print(predictions) and it seemed to work outputting floats instead.

Does this look correct?

...
Epoch 150/150
0s – loss: 0.4593 – acc: 0.7839
[[0.79361773]
[0.10443526]
[0.90862554]
...,
[0.33652252]

[0.63745886]
[0.11704451]]

Jason Brownlee December 16, 2016 at 5:44 am #

REPLY

Nice, it does look good!

Florin Claudiu Mihalache December 19, 2016 at 2:37 am #

REPLY

Hi Jason Brownlee
I tried to modified your exemple for my problem (Letter Recognition ,http://archive.ics.uci.edu/ml/datasets/Letter+Recognition).
My data set look like http://archive.ics.uci.edu/ml/machine-learning-databases/letter-recognition/letter-recognition.data (T,2,8,3,5,1,8,13,0,6,6,10,8,0,8,0,8) .I try to split the data in input and ouput like this :

X = dataset[:,1:17]
Y = dataset[:,0]
but a have some error (something related that strings are not recognized) .
I tried to modified each letter whit the ASCII code (A became 65 and so on).The string error disappeared.
The program compiles now but the output look like this :

17445/20000 [==========================>....] – ETA: 0s – loss: -1219.4768 – acc:0.0000e+00
17605/20000 [==========================>....] – ETA: 0s – loss: -1219.4706 – acc:0.0000e+00
17730/20000 [==========================>....] – ETA: 0s – loss: -1219.4566 – acc:0.0000e+00
17890/20000 [==========================>....] – ETA: 0s – loss: -1219.4071 – acc:0.0000e+00
18050/20000 [==========================>...] – ETA: 0s – loss: -1219.4599 – acc:0.0000e+00
18175/20000 [==========================>...] – ETA: 0s – loss: -1219.3972 – acc:0.0000e+00
18335/20000 [==========================>...] – ETA: 0s – loss: -1219.4642 – acc:0.0000e+00
18495/20000 [==========
-1219.5032 – acc:0.0000e+00

18620/20000 [==========================>...] – ETA: 0s – loss: -1219.4391 – acc:0.0000e+00
18780/20000 [==========================>..] – ETA: 0s – loss: -1219.5652 – acc:0.0000e+00
18940/20000 [==========================>..] – ETA: 0s – loss: -1219.5520 – acc:0.0000e+00
19080/20000 [==========================>..] – ETA: 0s – loss: -1219.5381 – acc:0.0000e+00
19225/20000 [==========================>..] – ETA: 0s – loss: -1219.5182 – acc:0.0000e+00
19385/20000 [==========================>.] – ETA: 0s – loss: -1219.6742 – acc:0.0000e+00
19535/20000 [==========================>.] – ETA: 0s – loss: -1219.7030 – acc:0.0000e+00
19670/20000 [==========================>.] – ETA: 0s – loss: -1219.7634 – acc:0.0000e+00
19830/20000 [==========================>.] – ETA: 0s – loss: -1219.8336 – acc:0.0000e+00
19990/20000 [==========================>.] – ETA: 0s – loss: -1219.8532 – acc:0.0000e+00
20000/20000 [==============================] – 1s – loss: -1219.8594 – acc: 0.0000e+00
18880/20000 [==========================>..] – ETA: 0sacc: 0.00%

I do not understand why. Can you please help me

Anon December 26, 2016 at 6:44 am #

REPLY

What version of Python are you running?

Get Your Start in Machine Learning

karishma sharma December 22, 2016 at 10:03 am #

REPLY

Hi Jason,

Since the epoch is set to 150 and batch size is 10, does the training algorithm pick 10 training examples at random in each iteration, given that we had only 768 total in X. Or does it sample randomly after it has finished covering all.

Thanks

Jason Brownlee December 23, 2016 at 5:27 am #

REPLY

Good question,

It iterates over the dataset 150 times and within one epoch it works through 10 rows at a time before doing an update to the weights. The patterns are shuffled before each epoch.

I hope that helps.

Kaustuv January 9, 2017 at 4:57 am #

REPLY

Hi Jason
Thanks a lot for this blog. It really helps me to start learning deep learning which was in a planning state for last few months. Your simple enrich blogs are awsome. No questions from my side before completing all tutorials.
One question regarding availability of your book. How can I buy those books from India ?

Jason Brownlee January 9, 2017 at 7:53 am #

REPLY

All my books and training are digital, you can purchase them from here: http://machinelearningmastery.com/products

Stephen Wilson January 15, 2

REPLY

Hi Jason, firstly your work here is a fantastic resource and I am very thankful for the effort you put in.
I am a slightly-better-than-beginner at python and an absolute novice at ML, I wonder if you could help me classify my problem and find an angle to work at it from.

My data is thus:
Column Names: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Result
Values: 4, 4, 6, 6, 3, 2, 5, 5, 0, 0, 0, 0, 0, 0, 0, 4

I want to find the percentage chance of each Column Names category being the Result based off the configuration of all the values present from 1-15. Then if need be compare the configuration of Values with another row of values to find the same, Resulting in the total needed calculation as:

Column Names: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, Result
Values: 4, 4, 6, 6, 3, 2, 5, 5, 0, 0, 0, 0, 0, 0, 0, 4
Values2: 7, 3, 5, 1, 4, 8, 6, 2, 9, 9, 9, 9, 9, 9, 9

I apologize if my explanation is not clear, and appreciate any help you can give me thank you.

Jason Brownlee January 16, 2017 at 10:39 am #

REPLY

Hi Stephen,

This process might help you work through your problem:
http://machinelearningmastery.com/start-here/#process

Specifically the first step in defining your problem.

Let me know how you go.

Rohit January 16, 2017 at 10:37 pm #

REPLY

Thanks Jason for such a nice and concise example.

Just wanted to ask if it is possible to save this model in a file and port it to may be an Android or iOS device? If so, what are the libraries available for the same?

Thanks

Rohit

Jason Brownlee January 17, 2017 at 7:38 am #

REPLY

Thanks Rohit,

Here's an example of saving a Keras model to file:
http://machinelearningmastery.com/save-load-keras-deep-learning-models/

I don't know about running Keras on an Android or iOS device. Let me know how you go.

zaheer khan June 16, 2017 at 7:17 pm #

REPLY

Dear Jason, Thanks for sharing this article.
I am novice to the deep learning, and my apology if my question is not clear. my question is could we call all that functions and program from any .php,.aspx, or .html webpage. i mean i load the variables and other files selection from user interface and then make them input to this functions.

will be waiting for your kind reply.
thanks in advance.
zaheer

Jason Brownlee June 17, 2017 at 7:25 am #

REPLY

Perhaps, this sounds like a systems design question, not really machine learning.

I would suggest you gather requirements, assess risks like any software engineering project.

Hsiang January 18, 2017 at 3:35 pm #

REPLY

Hi, Jason

Thank you for your blog! It is wonderful!

I used tensorflow as backend, and imp
I did "source activate tensorflow" -> "
I can successfully use Keras and impor

However, it seems that such environment doesn't support pandas and sklearn.
Do you have any way to incorporate pandas, sklearn and keras?
(I wish to use sklearn to revisit the classification problem and compare the accuracy with the deep learning method. But I also wish to put the works together in the same interface.)

Thanks!

Jason Brownlee January 19, 2017 at 7:24 am #

REPLY

Sorry, I do not use notebooks myself. I cannot offer you good advice.

Hsiang January 19, 2017 at 12:53 pm #

REPLY

Thanks, Jason!
Actually the problem is not on notebooks. Even I used the terminal mode, i.e. doing "source activate tensorflow" only. It failed to import sklearn. Does that mean tensorflow library is not compatible with sklearn? Thanks again!

Jason Brownlee January 20, 2017 at 10:17 am #

REPLY

Sorry Hsiang, I don't have experience using sklearn and tensorflow with virtual environments.

Hsiang January 21, 2017 at 12:46 am #

Thank you!

Jason Brownlee January 21, 2017 at 10:34 am #

You're welcome Hsiang.

Get Your Start in Machine Learning

keshav bansal January 24, 2017 at 12:45 am #

REPLY

hello sir,
A very informative post indeed . I know my question is a very trivial one but can you please show me how to predict on a explicitly mentioned data tuple say
v=[6,148,72,35,0,33.6,0.627,50]
thanks for the tutorial anyway

Jason Brownlee January 24, 2017 at 11:04 am #

REPLY

Hi keshav,

You can make predictions by calling model.predict()

CATRINA WEBB January 25, 2017 at 9:06 am #

REPLY

When I rerun the file (without predictions) does it reset the model and weights?

Ericson January 30, 2017 at 8:04 pm #

REPLY

excuse me sir, i wanna ask you a question about this paragraph"dataset = numpy.loadtxt("pima-indians-diabetes.csv",delimiter=',')", i used the mac and downloaded the dataset,then i exchanged the text into csv file. Running the program

,hen i got:{Python 2.7.13 (v2.7.13:a06454b1afa1, Dec 17 2016, 12:39:47)
[GCC 4.2.1 (Apple Inc. build 5666) (dot 3)] on darwin
Type "copyright", "credits" or "license()" for more information.
>>>
========== RESTART: /Users/luowenbin/Documents/database_test.py ==========
Using TensorFlow backend.

Traceback (most recent call last):
File "/Users/luowenbin/Documents/database_test.py", line 9, in
dataset = numpy.loadtxt("pima-indian
File "/Library/Frameworks/Python.fram

/numpy/lib/npyio.py", line 985, in loadtxt
items = [conv(val) for (conv, val) in zip(converters, vals)]
File "/Library/Frameworks/Python.framework/Versions/2.7/lib/python2.7/site-packages
/numpy/lib/npyio.py", line 687, in floatconv
return float(x)
ValueError: could not convert string to float: book
>>> }
How can i solve this problem? give me a hand thank you!

Jason Brownlee February 1, 2017 at 10:22 am #

REPLY

Hi Ericson,

Confirm that the contents of "pima-indians-diabetes.csv" meet your expectation of a list of CSV lines.

Sukhpal February 7, 2017 at 9:00 pm #

REPLY

excuse me sir,when i run this code for my data set ,I encounter this problem...please help me finding solution to this problem
runfile('C:/Users/sukhpal/.spyder/temp.py', wdir='C:/Users/sukhpal/.spyder')
Using TensorFlow backend.
Traceback (most recent call last):

File "", line 1, in
runfile('C:/Users/sukhpal/.spyder/temp.py', wdir='C:/Users/sukhpal/.spyder')

File "C:\Users\sukhpal\Anaconda2\lib\site-packages\spyder\utils
\site\sitecustomize.py", line 866, in runfile
execfile(filename, namespace)

File "C:\Users\sukhpal\Anaconda2\lib\site-packages\spyder\utils
\site\sitecustomize.py", line 87, in execfile
exec(compile(scripttext, filename, 'exec'), glob, loc)

File "C:/Users/sukhpal/.spyder/temp.py", line 1, in
from keras.models import Sequential

File "C:\Users\sukhpal\Anaconda2\lib\site-packages\keras__init__.py", line 2, in
from . import backend

File "C:\Users\sukhpal\Anaconda2\lib\s

67, in
from .tensorflow_backend import *

File "C:\Users\sukhpal\Anaconda2\lib\site-packages\keras\backend
\tensorflow_backend.py", line 1, in
import tensorflow as tf

ImportError: No module named tensorflow

Jason Brownlee February 8, 2017 at 9:34 am #

REPLY

This is a change with the most recent version of tensorflow, I will investigate and change the example.

For now, consider installing and using an older version of tensorflow.

Will February 14, 2017 at 5:33 am #

REPLY

Great tutorial! Amazing amount of work you've put in and great marketing skills (I also have an email list, ebooks and sequence, etc). I ran this in Jupyter notebook… I noticed the 144th epoch (acc .7982) had more accuracy than at 150. Why is that?

P.S. i did this for the print: print(numpy.round(predictions))
It seems to avoid a list of arrays which when printing includes the dtype (messy)

Jason Brownlee February 14, 2017 at 10:07 am #

REPLY

Thanks Will.

The model will fluctuate in performance while learning. You can configure triggered check points to save the model if/when conditions like a decrease in train/validation performance is detected. Here's an example:
http://machinelearningmastery.com/check-point-deep-learning-models-keras/

Sukhpal February 14, 2017 at 3:5

REPLY

Please help me to find out this error
runfile('C:/Users/sukhpal/.spyder/temp.py', wdir='C:/Users/sukhpal/.spyder')ERROR: execution aborted

Jason Brownlee February 15, 2017 at 11:32 am #

REPLY

I'm not sure Sukhpal.

Consider getting code working from the command line, I don't use IDEs myself.

Kamal February 14, 2017 at 5:15 pm #

REPLY

please help me to find this error find this error
Epoch 194/195
195/195 [==============================] – 0s – loss: 0.2692 – acc: 0.8667
Epoch 195/195
195/195 [==============================] – 0s – loss: 0.2586 – acc: 0.8667
195/195 [==============================] – 0s
Traceback (most recent call last):

Jason Brownlee February 15, 2017 at 11:32 am #

REPLY

What was the error exactly Kamal?

Kamal February 15, 2017 at 3:24 pm #

REPLY

sir when i run the code on my data set
then it doesnot show overall accuracy although it shows the accuracy and loss for the whole iterations

Jason Brownlee February

Get Your Start in Machine Learning

REPLY

I'm not sure I understand your question Kamal, please you could restate it?

Val February 15, 2017 at 9:00 pm #

REPLY

Hi Jason, im just starting deep learning in python using keras and theano. I have followed the installation instructions without a hitch. Tested some examples but when i run this one line by line i get a lot of exceptions and errors once i run the "model.fit(X,Y, nb_epochs=150, batch_size=10"

Jason Brownlee February 16, 2017 at 11:06 am #

REPLY

What errors are you getting?

CrisH February 17, 2017 at 8:12 pm #

REPLY

Hi, how do I know what number to use for random.seed() ? I mean you use 7, is there any reason for that? Also is it enough to use it only once, in the beginning of the code?

Jason Brownlee February 18, 2017 at 8:38 am #

REPLY

You can use any number CrisH. The fixed random seed makes the example reproducible.

You can learn more about randomness and random seeds in this post: http://machinelearningmastery.com/randomness-in-machine-learning/

kk February 18, 2017 at 1:53 am #

REPLY

am new to deep learning and found this great tutorial. keep it up and look forward!!

Jason Brownlee February 18, 2017 at 8:41 am #

REPLY

Thanks!

Iqra Ameer February 21, 2017 at 5:20 am #

REPLY

HI, I have a problem in execution the above example as it. It seems that it's not running properly and stops at Using TensorFlow backend.

Epoch 147/150
768/768 [==============================] – 0s – loss: 0.4709 – acc: 0.7878
Epoch 148/150
768/768 [==============================] – 0s – loss: 0.4690 – acc: 0.7812
Epoch 149/150
768/768 [==============================] – 0s – loss: 0.4711 – acc: 0.7721
Epoch 150/150
768/768 [==============================] – 0s – loss: 0.4731 – acc: 0.7747
32/768 [>.....] – ETA: 0sacc: 76.43%

I am new in this field, could you please guide me about this error.
I also executed on another data set, it stops with the same behavior.

Jason Brownlee February 21, 2017 at 9:39 am #

REPLY

What is the error exactly? The example hangs?

Maybe try the Theano backend and see if that makes a difference. Also make sure all of your libraries are up to date.

Iqra Ameer February 22, 2017 at 5:47 am #

REPLY

Dear Jason,
Thank you so much for your valuable s

updated all my libraries, but again it hanged at:

768/768 [==============================] – 0s – loss: 0.4656 – acc: 0.7799
Epoch 149/150
768/768 [==============================] – 0s – loss: 0.4589 – acc: 0.7826
Epoch 150/150
768/768 [==============================] – 0s – loss: 0.4611 – acc: 0.7773
32/768 [>.....] – ETA: 0sacc: 78.91%

Jason Brownlee February 22, 2017 at 10:05 am #

REPLY

I'm sorry to hear that, I have not seen this issue before.

Perhaps a RAM issue or a CPU overheating issue? Are you able to try different hardware?

frd March 8, 2017 at 2:50 am #

REPLY

Hi!

Were you able to find a solution for that?

I'm having exactly the same problem

(…)
Epoch 149/150
768/768 [==============================] – 0s – loss: 0.4593 – acc: 0.7773
Epoch 150/150
768/768 [==============================] – 0s – loss: 0.4586 – acc: 0.7891
32/768 [>.....] – ETA: 0sacc: 76.69%

Bhanu February 23, 2017 at 1:51 pm

REPLY

Hello sir,

i want to ask wether we can convert this code to deep learning wid increasing number of layers..

Jason Brownlee February 24, 2017 at 10:12 am #

REPLY

Sure you can increase the number of layers, try it and see.

Ananya Mohapatra February 28, 2017 at 6:40 pm #

REPLY

hello sir,
could you please tell me how do i determine the no.of neurons in each layer, because i am using a different datset and am unable to know the no.of neurons in each layer

Jason Brownlee March 1, 2017 at 8:33 am #

REPLY

Hi Ananya, great question.

Sorry, there is no good theory on how to configure a neural net.

You can configure the number of neurons in a layer by trial and error. Also consider tuning the number of epochs and batch size at the same time.

Ananya Mohapatra March 1, 2017 at 4:42 pm #

REPLY

thank you so much sir. It worked ! 🙂

Jason Brownlee March 2, 2017 at 8:11 am #

REPLY

Glad to here it Ananya.

Jayant Sahewal February 28, 2

REPLY

Get Your Start in Machine Learning

Hi Jason,

really helpful blog. I have a question about how much time does it take to converge?

I have a dataset with around 4000 records, 3 input columns and 1 output column. I came up with the following model

```
def create_model(dropout_rate=0.0, weight_constraint=0, learning_rate=0.001, activation='linear'):
# create model
model = Sequential()
model.add(Dense(6, input_dim=3, init='uniform', activation=activation, W_constraint=maxnorm(weight_constraint)))
model.add(Dropout(dropout_rate))
model.add(Dense(1, init='uniform', activation='sigmoid'))
# Optimizer
optimizer = Adam(lr=learning_rate)
# Compile model
model.compile(loss='binary_crossentropy', optimizer=optimizer, metrics=['accuracy'])
return model

# create model
model = KerasRegressor(build_fn=create_model, verbose=0)
# define the grid search parameters
batch_size = [10]
epochs = [100]
weight_constraint = [3]
dropout_rate = [0.9]
learning_rate = [0.01]
activation = ['linear']
param_grid = dict(batch_size=batch_size, nb_epoch=epochs, dropout_rate=dropout_rate, \
weight_constraint=weight_constraint, learning_rate=learning_rate, activation=activation)
grid = GridSearchCV(estimator=model, param_grid=param_grid, n_jobs=-1, cv=5)
grid_result = grid.fit(X_train, Y_train)
```

I have a 32 core machine with 64 GB RAM and it does not converge even in more than an hour. I can see all the cores busy, so it is using all the cores for training. However, if I change the input neurons to 3 then it converges in around 2 minutes.

Keras version: 1.1.1
Tensorflow version: 0.10.0rc0
theano version: 0.8.2.dev-901275534c

It's using Tensorflow backend. Can you help me understand what is going on or point me in the right direction? Do you think switching to theano will help?

Best,
Jayant

REPLY

Jason Brownlee March 1, 2017 at 8:36 am #

This post might help you tune your deep learning model:
http://machinelearningmastery.com/improve-deep-learning-performance/

I hope that helps as a start.

REPLY

Animesh Mohanty March 1, 2017 at 9:21 pm #

hello sir,
could you please tell me how can i plot the results of the code on a graph . I made a few adjustments to the code so as to run it on a different dataset.

REPLY

Jason Brownlee March 2, 2017 at 8:16 am #

What do you want to plot exactly Animesh?

REPLY

Animesh Mohanty March 2, 2017 at 4:56 pm #

Accuracy vs no.of neurons in the input layer and the no.of neurons in the hidden layer

REPLY

param March 2, 2017 at 12:15 am #

sir can u plz explain
the different attributes used in this statement
print("%s: %.2f%%" % (model.metrics

param March 2, 2017 at 12:16 am #

REPLY

precisely,what is model.metrics_names

Jason Brownlee March 2, 2017 at 8:22 am #

REPLY

model.metrics_names is a list of names of the metrics collected during training.

More details here:
https://keras.io/models/sequential/

Jason Brownlee March 2, 2017 at 8:20 am #

REPLY

Hi param,

It is using string formatting. %s formats a string, %.2f formats a floating point value with 2 decimal places, %% includes a percent symbol.

You can learn more about the print function here:
https://docs.python.org/3/library/functions.html#print

More info on string formatting here:
https://pyformat.info/

Vijin K P March 2, 2017 at 4:01 am #

REPLY

Hi Jason,

It was an awesome post. Could you please tell me how to we decide the following in a DNN 1. number of neurons in the hidden layers
2. number of hidden layers

Thanks.
Vijin

Jason Brownlee March 2, 2

Get Your Start in Machine Learning

REPLY

Great question Vijin.

Generally, trial and error. There are no good theories on how to configure a neural network.

Vijin K P March 3, 2017 at 5:23 am #

REPLY

We do cross validation, grid search etc to find the hyper parameters in machine algorithms. Similarly can we do anything to identify the above parameters??

Jason Brownlee March 3, 2017 at 7:46 am #

REPLY

Yes, we can use grid search and tuning for neural nets.

The stochastic nature of neural nets means that each experiment (set of configs) will have to be run many times (30? 100?) so that you can take the mean performance.

More general info on tuning neural nets here:
http://machinelearningmastery.com/improve-deep-learning-performance/

More on randomness and stochastic algorithms here:
http://machinelearningmastery.com/randomness-in-machine-learning/

Bogdan March 2, 2017 at 11:48 pm #

REPLY

Jason, Please tell me about these lines in your code:

```
seed = 7
numpy.random.seed(seed)
```

What do they do? And why do they do it?

One more question is why do you call the last section Bonus:Make a prediction?
I thought this what ANN was created for. What the point if your network's output is just what you have already know?

Get Your Start in Machine Learning

Jason Brownlee March 3, 2017 at 7:44 am #

REPLY

They seed the random number generator so that it produces the same sequence of random numbers each time the code is run. This is to ensure you get the same result as me.

I'm not convinced it works with Keras though.

More on randomness in machine learning here:
http://machinelearningmastery.com/randomness-in-machine-learning/

I was showing how to build and evaluate the model in this tutorial. The part about standalone prediction was an add-on.

Sounak sahoo March 3, 2017 at 7:39 pm #

REPLY

what exactly is the work of "seed" in the neural network code? what does it do?

Jason Brownlee March 6, 2017 at 10:44 am #

REPLY

Seed refers to seeding the random number generator so that the same sequence of random numbers is generated each time the example is run.

The aim is to make the examples 100% reproducible, but this is hard with symbolic math libs like Theano and TensorFlow backends.

For more on randomness in machine learning, see this post:
http://machinelearningmastery.com/randomness-in-machine-learning/

Priya Sundari March 3, 2017 at 10:19 pm #

REPLY

hello sir
could you plz tell me what is the role of optimizer and binary_crossentropy exactly? it is written that optimizer is used to search through the weights of the network which weights are we talking about exactly?

Get Your Start in Machine Learning

Jason Brownlee March 6, 2017 at 10:48 am #

REPLY

Hi Priya,

You can learn more about the fundamentals of neural nets here: http://machinelearningmastery.com/neural-networks-crash-course/

Bogdan March 3, 2017 at 10:23 pm #

REPLY

If I am not mistaken, those lines I commented about used when we write

init = 'uniform'

?

Bogdan March 3, 2017 at 10:44 pm #

REPLY

Could you explain in more details what is the batch size?

Jason Brownlee March 6, 2017 at 10:50 am #

REPLY

Hi Bogdan,

Batch size is how many patterns to show to the network before the weights are updated with the accumulated errors. The smaller the batch, the faster the learning, but also the more noisy the learning (higher variance).

Try exploring different batch sizes and see the effect on the train and test performance over each epoch.

Mohammad March 7, 2017 at 6:50 am #

REPLY

Dear Jason
Firstly, thanks for your great tutorials.
I am trying to classify computer networks packets using first 500 bytes of every packet to identify its protocol. I am try
want to do binary classification and th

protocols. Here is my code but the accuracy which is like .63. how can I improve the performance? should I Use RNNs?
########
model=Sequential()
model.add(Convolution1D(64,10,border_mode='valid',
activation='relu',subsample_length=1, input_shape=(500, 1)))
#model.add(Convolution2D(32,5,5,border_mode='valid',input_shape=(1,28,28),))
model.add(MaxPooling1D(2))
model.add(Flatten())
model.add(Dense(200,activation='relu'))
model.add(Dense(1,activation='sigmoid'))
model.compile(loss='binary_crossentropy',
optimizer='adam',metrics=['accuracy'])
model.fit(train_set, y_train,
batch_size=250,
nb_epoch=30,
show_accuracy=True)
#x2= get_activations(model, 0,xprim)
#score = model.evaluate(t, y_test, show_accuracy = True, verbose = 0)
#print(score[0])

Jason Brownlee March 7, 2017 at 9:37 am #

REPLY

This post lists some ideas to try an lift performance:
http://machinelearningmastery.com/improve-deep-learning-performance/

Damiano March 7, 2017 at 10:13 pm #

REPLY

Hi Jason, thank you so much for this awesome tutorial. I have just started with python and machine learning.
I am joking with the code doing few changes, for example i have changed..

this:

# create model
model = Sequential()
model.add(Dense(250, input_dim=8, init='uniform', activation='relu'))
model.add(Dense(200, init='uniform',
model.add(Dense(200, init='uniform',

model.add(Dense(1, init='uniform', activation='sigmoid'))

and this:

model.fit(X, Y, nb_epoch=250, batch_size=10)

then i would like to pass some arrays for prediction so...

new_input = numpy.array([[3,88,58,11,54,24.8,267,22],[6,92,92,0,0,19.9,188,28], [10,101,76,48,180,32.9,171,63], [2,122,70,27,0,36.8,0.34,27], [5,121,72,23,112,26.2,245,30]])

predictions = model.predict(new_input)
print predictions # [1.0, 1.0, 1.0, 0.0, 1.0]

is this correct? In this example i used the same series of training (that have 0 class), but i am getting wrong results. Only one array is correctly predicted.

Thank you so much!

Jason Brownlee March 8, 2017 at 9:41 am #

REPLY

Looks good. Perhaps you could try changing the configuration of your model to make it more skillful?

See this post:
http://machinelearningmastery.com/improve-deep-learning-performance/

ANJI March 13, 2017 at 8:48 pm #

REPLY

hello sir,
could you please tell me to rectify my error below it is raised while model is training:

str(array.shape))
ValueError: Error when checking model input: expected convolution2d_input_1 to have 4 dimensions, but got array with shape (68, 28, 28).

Jason Brownlee March 14, 2017 at 8:17 am #

REPLY

It looks like you are workin

Consider trying this tutorial to get

http://machinelearningmastery.com/handwritten-digit-recognition-using-convolutional-neural-networks-python-keras/

Rimjhim March 14, 2017 at 8:21 pm #

REPLY

I want a neural that can predict sin values. Further from a given data set i need to determine the function(for example if the data is of tan or cos, then how to determine that data is of tan only or cos only)

Thanks in advance

Sudarshan March 15, 2017 at 11:19 pm #

REPLY

Keras just updated to Keras 2.0. I have an updated version of this code here: https://github.com/sudarshan85/keras-projects/tree/master/mlm/pima_indians

Jason Brownlee March 16, 2017 at 7:59 am #

REPLY

Nice work.

subhasish March 16, 2017 at 5:09 pm #

REPLY

hello sir,
can we use PSO (particle swarm optimisation) in this? if so can you tell how?

Jason Brownlee March 17, 2017 at 8:25 am #

REPLY

Sorry, I don't have an example of PSO for fitting neural network weights.

Ananya Mohapatra March 16

REPLY

hello sir,

what type of neural network is used in this code? as there are 3 types of Neural network that are… feedforward, radial basis function and recurrent neurak network.

REPLY

Jason Brownlee March 17, 2017 at 8:28 am #

A multilayer perceptron (MLP) neural network. A classic type from the 1980s.

REPLY

Diego March 17, 2017 at 3:58 am #

got this error while compiling..

sigmoid_cross_entropy_with_logits() got an unexpected keyword argument 'labels'

REPLY

Jason Brownlee March 17, 2017 at 8:30 am #

Perhaps confirm that your libraries are all up to date (Keras, Theano or TensorFlow)?

REPLY

Rohan March 20, 2017 at 5:20 am #

Hi Jason!

I am trying to use two odd frames of a video to predict the even one. Thus I need to give two images as input to the network and get one image as output. Can you help me with the syntax for the first model.add()? I have X_train of dimension (190, 2, 240, 320, 3) where 190 are the number of odd pairs, 2 are the two odd images, and (240,320,3) are the (height, width, depth) of each image.

REPLY

Herli Menezes March 21, 2017 at 8:33 am #

Hello, Jason,
Thanks for your good tutorial. Howeve
Warnings like these:

1 – Warning (from warnings module):
File "/usr/lib/python2.7/site-packages/keras/legacy/interfaces.py", line 86
' call to the Keras 2 API: ' + signature)
UserWarning: Update your Dense call to the Keras 2 API: Dense(12, activation="relu", kernel_initializer="uniform", input_dim=8)

2 - Warning (from warnings module):
File "/usr/lib/python2.7/site-packages/keras/legacy/interfaces.py", line 86
' call to the Keras 2 API: ' + signature)
UserWarning: Update your Dense call to the Keras 2 API: Dense(8, activation="relu", kernel_initializer="uniform")

3 – Warning (from warnings module):
File "/usr/lib/python2.7/site-packages/keras/legacy/interfaces.py", line 86
' call to the Keras 2 API: ' + signature)
UserWarning: Update your Dense call to the Keras 2 API: Dense(1, activation="sigmoid", kernel_initializer="uniform")

3 - Warning (from warnings module):
File "/usr/lib/python2.7/site-packages/keras/models.py", line 826
warnings.warn('The nb_epoch argument in fit '
UserWarning: The nb_epoch argument in fit has been renamed epochs`.

I think these are due to some package update..

But, the output of predictions was an array of zeros…
such as: [0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, 0.0, ….0.0]

I am running in a Linux Machine, Fedora 24,
Python 2.7.13 (default, Jan 12 2017, 17:59:37)
[GCC 6.3.1 20161221 (Red Hat 6.3.1-1)] on linux2

Why?

Thank you!

Jason Brownlee March 21, 2017 at 8:45 am # REPLY

These look like warnings re

They look like just warning and tha

I do not know why you are getting all zeros. I will investigate.

Ananya Mohapatra March 21, 2017 at 6:21 pm #

REPLY

hello sir,
can you please help me build a recurrent neural network with the above given dataset. i am having a bit trouble in building the layers...

Jason Brownlee March 22, 2017 at 7:56 am #

REPLY

Hi Ananya ,

The Pima Indian diabetes dataset is a binary classification problem. It is not appropriate for a Recurrent Neural Network as there is no sequence information to learn.

Ananya Mohapatra March 22, 2017 at 8:04 pm #

REPLY

sir so could you tell on which type of dataset would the recurrent neural network accurately work? i have the dataset of EEG signals of epileptic patients...will recurrent network work on this?

Jason Brownlee March 23, 2017 at 8:49 am #

REPLY

It may if it is regular enough.

LSTMs are excellent at sequence problems that have regularity or clear signals to detect.

Shane March 22, 2017 at 5:18 am #

REPLY

Hi Jason, I have a quick question related to an error I am receiving when running the code in the tutorial...

When I run

```
# Compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=
['accuracy'])
```

Python returns the following error:

sigmoid_cross_entropy_with_logits() got an unexpected keyword argument ‘labels’

Jason Brownlee March 22, 2017 at 8:09 am #

REPLY

Sorry, I have not seen this error Shane.

Perhaps check that your environment is up to date with the latest versions of the deep learning libraries?

Tejes March 24, 2017 at 1:04 am #

REPLY

Hi Jason,
Thanks for this awesome post.
I ran your code with tensorflow back end, just out of curiosity. The accuracy returned was different every time I ran the code. That didn’t happen with Theano. Can you tell me why?

Thanks in advance!

Jason Brownlee March 24, 2017 at 7:56 am #

REPLY

You will get different accuracy each time you run the code because neural networks are stochastic.

This is not related to the backend (I expect).

More on randomness in machine learning here:
http://machinelearningmastery.com/randomness-in-machine-learning/

Saurabh Bhagvatula March

REPLY

Hi Jason,

I'm new to deep learning and learning it from your tutorials, which previously helped me understand Machine Learning very well.
In the following code, I want to know why the number of neurons differ from input_dim in first layer of Nueral Net.
# create model
model = Sequential()
model.add(Dense(12, input_dim=8, init='uniform', activation='relu'))
model.add(Dense(8, init='uniform', activation='relu'))
model.add(Dense(1, init='uniform', activation='sigmoid'))

Jason Brownlee March 28, 2017 at 8:22 am #

REPLY

You can specify the number of inputs via "input_dim", you can specify the number of neurons in the first hidden layer as the first parameter to Dense().

Saurabh Bhagvatula March 28, 2017 at 4:15 pm #

REPLY

Thanx a lot.

Jason Brownlee March 29, 2017 at 9:05 am #

REPLY

You're welcome.

Nalini March 29, 2017 at 2:52 am #

REPLY

Hi Jason

while running this code for k fold cross validation it is not working.please give the code for k fold cross validation in binary class

Jason Brownlee March 29, 2017 at 9:10 am #

REPLY

Generally neural nets are t

Nevertheless, you can use a sklearn wrapper for a keras model and use it with any sklearn resampling method:
http://machinelearningmastery.com/evaluate-performance-machine-learning-algorithms-python-using-resampling/

trangtruong March 29, 2017 at 7:04 pm #

REPLY

Hi Jason, why i use function evaluate to get accuracy score my model with test dataset, it return result >1, i can't understand.

enixon April 3, 2017 at 3:08 am #

REPLY

Hey Jason, thanks for this great article! I get the following error when running the code above:

TypeError: Received unknown keyword arguments: {'epochs': 150}

Any ideas on why that might be? I can't get 'epochs', nb_epochs, etc to work...

Jason Brownlee April 4, 2017 at 9:07 am #

REPLY

You need to update to Keras version 2.0 or higher.

Get Your Start in Machine Learning

Ananya Mohapatra April 5, 2017 at 9:30 pm #

REPLY

def baseline_model():
# create model
model = Sequential()
model.add(Dense(10, input_dim=25, init='normal', activation='softplus'))
model.add(Dense(3, init='normal', activation='softmax'))
# Compile model
model.compile(loss='mean_squared_error', optimizer='adam', metrics=['accuracy'])
return model
sir here mean_square_error has been used for loss calculation. Is it the same as LMS algorithm. If not, can we use LMS , NLMS or RLS to calculate the loss?

Ahmad Hijazi April 5, 2017 at 10:19 pm #

REPLY

Hello Jason, thank you a lot for this example.

My question is, after I trained the model and an accuracy of 79.2% for example is obtained successfully, how can I test this model on new data?

for example if a new patient with new records appear, I want to guess the result (0 or 1) for him, how can I do that in the code?

Jason Brownlee April 9, 2017 at 2:36 pm #

REPLY

You can fit your model on all available training data then make predictions on new data as follows:

```
1 yhat = model.predict(X)
```

Perick Flaus April 6, 2017 at 12:16 am #

REPLY

Thanks Jason, how can we test if new patient will be diabetic or no (0 or 1) ?

Jason Brownlee April 9, 20

Get Your Start in Machine Learning

REPLY

Fit the model on all training data and call:

```
1 yhat = model.predict(X)
```

Gangadhar April 12, 2017 at 1:28 am #

REPLY

Dr Jason,

In compiling the model i got below error

TypeError: compile() got an unexpected keyword argument 'metrics'

unable to resolve the below error

Jason Brownlee April 12, 2017 at 7:53 am #

REPLY

Ensure you have the latest version of Keras, v2.0 or higher.

Omogbehin Azeez April 13, 2017 at 1:48 am #

REPLY

Hello sir,
Thank you for the post. A quick question, my dataset has 24 input and 1 binary output(170 instances, 100 epoch , hidden layer=6 and 10 batch, kernel_initializer='normal') . I adapted your code using Tensor flow and keras. I am having an accuracy of 98 to 100 percent. I am scared of over-fitting in my model. I need your candid advice. Kind regards sir

Jason Brownlee April 13, 2017 at 10:07 am #

REPLY

Yes, evaluate your model using k-fold cross-validation to ensure you are not tricking yourself.

Get Your Start in Machine Learning

Omogbehin Azeez April 14, 2017 at 1:08 am #

REPLY

Thank you sir

Sethu Baktha April 13, 2017 at 5:19 am #

REPLY

Hi Jason,
If I want to use the diabetes dataset (NOT Pima) https://archive.ics.uci.edu/ml/datasets/Diabetes to predict Blood Glucose which tutorials and e-books of yours would I need to start with.... Also, the data in its current format with time, code and value is it usable as is or do I need to convert the data in another format to be able to use it.

Thanks for your help

Jason Brownlee April 13, 2017 at 10:13 am #

REPLY

This process will help you frame and work through your dataset:
http://machinelearningmastery.com/start-here/#process

I hope that helps as a start.

Sethu Baktha April 13, 2017 at 10:25 am #

REPLY

Dr. Jason,
The data is time series(time based data) with categorical(20) with two numbers one for insulin level and another for blood sugar level... Each time series data does not have every categorical data... For example one category is blood sugar before breakfast, another category is blood sugar after breakfast, before lunch and after lunch... Some times some of these category data is missing... I read through the above link, but does not talk about time series, categorical data with some category of data missing what to do in those cases.... Please let me know if any of your books will help clarify these points?

Jason Brownlee April 14, 2017 at 8:43 am #

REPLY

Hi Sethu,

I have many posts on time series that will help. Get started here: http://machinelearningmastery.com/start-here/#timeseries

With categorical data, I would recommend an integer encoding perhaps followed by a one-hot encoding. You can learn more about these encodings here: http://machinelearningmastery.com/data-preparation-gradient-boosting-xgboost-python/

I hope that helps.

Omogbehin Azeez April 14, 2017 at 9:49 am #

REPLY

Hello sir,

Is it compulsory to normalize the data before using ANN model. I read it somewhere I which the author insisted that each attribute be comparable on the scale of [0,1] for a meaningful model. What is your take on that sir. Kind regards.

Jason Brownlee April 15, 2017 at 9:29 am #

REPLY

Yes. You must scale your data to the bounds of the activation used.

shiva April 14, 2017 at 10:38 am #

REPLY

Hi Jason, You are simply awesome. I'm one of the many who got benefited from your book "machine learning mastery with python". I'm working with a medical image classification problem. I have two classes of medical images (each class having 1000 images of 32*32) to be worked upon by the convolutional neural networks. Could you guide me how to load this data to the keras dataset? Or how to use my data while following your simple steps? kindly help.

Jason Brownlee April 15, 2

REPLY

Load the data as numpy arrays and then you can use it with Keras.

Omogbehin Azeez April 18, 2017 at 12:09 am #

REPLY

Hello sir,

I adapted your code with the cross validation pipelined with ANN (Keras) for my model. It gave me 100% still. I got the data from UCI (Chronic Kidney Disease). It was 400 instances, 24 input attributes and 1 binary attribute. When I removed the rows with missing data I was left with 170 instances. Is my dataset too small for (24 input layer, 24 hidden layer and 1 output layer ANN, using adam and kernel initializer as uniform)?

Jason Brownlee April 18, 2017 at 8:32 am #

REPLY

It is not too small.

Generally, the size of the training dataset really depends on how you intend to use the model.

Omogbehin Azeez April 18, 2017 at 11:10 pm #

REPLY

Thank you sir for the response, I guess I have to contend with the over-fitting of my model.

Padmanabhan Krishnamurthy April 19, 2017 at 6:26 pm #

REPLY

Hi Jason,

Great tutorial. Love the site 🙂
Just a quick query : why have you used adam as an optimizer over sgd? Moreover, when do we use sgd optimization, and what exactly does it involve?

Thanks

Jason Brownlee April 20, 2017 at 9:23 am #

REPLY

ADAM seems to consistently work well with little or no customization.

SGD requires configuration of at least the learning rate and momentum.

Try a few methods and use the one that works best for your problem.

Padmanabhan Krishnamurthy April 20, 2017 at 4:32 pm #

REPLY

Thanks 🙂

Omogbehin Azeez April 25, 2017 at 8:13 am #

REPLY

Hello sir,

Good day sir, how can I get all the weights and biases of the keras ANN. Kind regards.

Jason Brownlee April 26, 2017 at 6:19 am #

REPLY

You can save the network weights, see this post:
http://machinelearningmastery.com/save-load-keras-deep-learning-models/

You can also use the API to access the weights directly.

Shiva April 27, 2017 at 5:43 am #

REPLY

Hi Jason,
I am currently working with the IMDB sentiment analysis problem as mentioned in your book. Am using Anaconda 3 with Python 3.5.2. In an attempt to summarize the review length as you have mentioned in your book, When i try to execute the command:

result = map(len, X)
print("Mean %.2f words (%f)" % (numpy.mean(result), numpy.std(result)))

it returns the error: unsupported opera

kindly help with the modified syntax. looking forward...

Jason Brownlee April 27, 2017 at 8:47 am #

REPLY

I'm sorry to hear that. Perhaps comment out that line?
Or change it to remove the formatting and just print the raw mean and stdev values for you to review?

Elikplim May 1, 2017 at 1:58 am #

REPLY

Hello, quite new to Python, Numpy and Keras(background in PHP, MYSQL etc). If there are 8 input variables and 1 output varable(9 total), and the Array indexing starts from zero(from what I've gathered it's a Numpy Array, which is built on Python lists) and the order is [rows, columns], then shouldn't our input variable(X) be X = dataset[:,0:7] (where we select from the 1st to 8th columns, ie. 0th to 7th indices) and output variable(Y) be Y = dataset[:,8] (where we the 9th column, ie. 8th index)?

Jason Brownlee May 1, 2017 at 5:59 am #

REPLY

You can learn more about array indexing in numpy here:
https://docs.scipy.org/doc/numpy/reference/arrays.indexing.html

Jackie Lee May 1, 2017 at 12:47 pm #

REPLY

I'm having troubles with the predictions part. It saves ValueError: Error when checking model input: expected dense_1_input to have shape (None, 502) but got array with shape (170464, 502)

```
### MAKE PREDICTIONS ###
testset = numpy.loadtxt("right_stim_FD1.csv", delimiter=",")
A = testset[:,0:502]
B = testset[:,502]
probabilities = model.predict(A, batch_size=10, verbose=1)
predictions = float(round(a) for a in pr
accuracy = numpy.mean(predictions =
```

```
#round predictions
#rounded = [round(x[0]) for x in predictions]
print(predictions)
print("Prediction Accuracy: %.2f%%" % (accuracy*100))
```

Jason Brownlee May 2, 2017 at 5:55 am #

REPLY

It looks like you might be giving the entire dataset as the output (y) rather than just the output variable.

Anastasios Selalmazidis May 2, 2017 at 12:27 am #

REPLY

Hi there,

I have a question regarding deep learning. In this tutorial we build a MLP with Keras. Is this Deep Learning or is it just a MLP Backpropagation ?

Jason Brownlee May 2, 2017 at 5:59 am #

REPLY

Deep learning is MLP backprop these days:
http://machinelearningmastery.com/what-is-deep-learning/

Generally, deep learning refers to MLPs with lots of layers.

Eric T May 2, 2017 at 8:59 pm #

REPLY

Hi,
Would you mind if I use this code as an example of a simple network in a school project of mine?
Need to ask before using it, since I cannot find anywhere in this tutorial that you are OK with anyone using the code, and the ethics moment of my course requires me to ask (and of course give credit where credit is due).
Kind regards
Eric T

Jason Brownlee May 3, 2017 at 7:35 am #

REPLY

Yes it's fine but I take no responsibility and you must credit the source.

I answer this question in my FAQ:
http://machinelearningmastery.com/start-here/#faq

BinhLN May 7, 2017 at 3:11 am #

REPLY

Hi Jason
I have a problem
My Dataset have 500 record. But My teacher want my dataset have 100.000 record. I must have a new algorithm for data generation. Please help me

Dp May 11, 2017 at 2:26 am #

REPLY

Can you give a deep cnn code which includes 25 layers , in the first conv layer the filter sizs should be 39×39 woth a total lf 64 filters , in the 2nd conv layer , 21 ×21 with 32 filters , in the 3rd conv layer 11×11 with 64 filters , 4th Conv layer 7×7 with 32 layers . For a input size of image 256×256. Im Competely new in this Deep learning Thing but if you can code that for me it would be a great help. Thanks

Jason Brownlee May 11, 2017 at 8:33 am #

REPLY

Consider using an off-the-shelf model like VGG:
https://keras.io/applications/

Maple May 13, 2017 at 12:58 pm #

REPLY

I have to follow with the facebook metrics. But the result is very low. Help me. I changed the input but did not improve
http://archive.ics.uci.edu/ml/datasets/Facebook+metrics

Jason Brownlee May 14, 2017 at 7:24 am #

REPLY

I have a list of suggestions that may help as a start:
http://machinelearningmastery.com/improve-deep-learning-performance/

Alessandro May 14, 2017 at 1:01 am #

REPLY

Hi Jason,

Great Tutorial and thanks for your effort.

I have a question, since I am beginner with keras and tensorflow.
I have installed both of them, keras and tensorflow, the latest version and I have run your example but I get always the same error:

Traceback (most recent call last):
File "CNN.py", line 18, in
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
File "/Users/MacBookPro1/.virtualenvs/keras_tf/lib/python2.7/site-packages/keras
/models.py", line 777, in compile
**kwargs)
File "/Users/MacBookPro1/.virtualenvs/keras_tf/lib/python2.7/site-packages/keras
/engine/training.py", line 910, in compile
sample_weight, mask)
File "/Users/MacBookPro1/.virtualenvs/keras_tf/lib/python2.7/site-packages/keras
/engine/training.py", line 436, in weighted
score_array = fn(y_true, y_pred)
File "/Users/MacBookPro1/.virtualenvs/keras_tf/lib/python2.7/site-packages/keras
/losses.py", line 51, in binary_crossentropy
return K.mean(K.binary_crossentropy(y_pred, y_true), axis=-1)
File "/Users/MacBookPro1/.virtualenvs/keras_tf/lib/python2.7/site-packages/keras
/backend/tensorflow_backend.py", line 2771, in binary_crossentropy
logits=output)
TypeError: sigmoid_cross_entropy_with_logits() got an unexpected keyword argument
'labels'

Could you help? Thanks

Alessandro

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REPLY

Jason Brownlee May 14, 2017 at 7:30 am #

Ouch, I have not seen this error before.

Some ideas:
– Consider trying the theano backend and see if that makes a difference.
– Try searching/posting on the keras user group and slack channel.
– Try searching/posting on stackoverflow or cross validated.

Let me know how you go.

Alessandro May 14, 2017 at 9:44 am #

REPLY

Hi Jason,

I found the issue. The tensorflow installation was outdated; so I have updated it and everything
is working nicely.

Good night,
Alessandro

Jason Brownlee May 15, 2017 at 5:50 am #

REPLY

I'm glad to hear it Alessandro.

Sheikh Rafiul Islam May 25, 2017 at 3:36 pm #

REPLY

Thank you Mr. Brownlee for your wonderful easy to understand explanation

Jason Brownlee June 2, 2017 at 11:41 am #

REPLY

Thnaks.

WAZED May 29, 2017 at 12:31 am

REPLY

Hi Jason,
Thank you very much for your wonderful tutorial. I have a question regarding the metrices.Is there default way to declare metrices “Precision” and “Recall” in addtion with the “Accurace”.

Br
WAZED

REPLY

Jason Brownlee June 2, 2017 at 12:15 pm #

Yes, see here:
https://keras.io/metrics/

REPLY

chiranjib konwar May 29, 2017 at 4:30 am #

Hi Jason,

please send me a small note containing resources from where i can learn deep learning from scratch. thanks for the wonderful read you had prepared.

Thanks in advance

yes, my email id is chiranjib.konwar@gmail.com

REPLY

Jason Brownlee June 2, 2017 at 12:16 pm #

Here:
http://machinelearningmastery.com/start-here/#deeplearning

REPLY

Jeff June 1, 2017 at 11:48 am #

Why the NN have mistakes many times?

REPLY

Jason Brownlee June 2, 20

What do you mean exactly?

kevin June 2, 2017 at 5:53 pm #

REPLY

Hi Jason,

I seem to be getting an error when applying the fit method:

ValueError: Error when checking input: expected dense_1_input to have shape (None, 12) but got array with shape (767, 8)

I looked this up and the most prominent suggestion seemed to be upgrade keras and theno, which I did, but that didn't resolve the problem.

Jason Brownlee June 3, 2017 at 7:24 am #

REPLY

Ensure you have copied the code exactly from the post.

Hemanth Kumar K June 3, 2017 at 2:15 pm #

REPLY

hi Jason,
I am stuck with an error
TypeError: sigmoid_cross_entropy_with_logits() got an unexpected keyword argument 'labels'
my tensor flow and keras virsions are
keras: 2.0.4
Tensorflow: 0.12

Jason Brownlee June 4, 2017 at 7:46 am #

REPLY

I'm sorry to hear that, I have not seen that error before. Perhaps you could post a question to stackoverflow or the keras user group?

xena June 4, 2017 at 6:36 pm #

REPLY

can anyone tell me which neural network is being used here? Is it MLP??

Jason Brownlee June 5, 2017 at 7:40 am #

REPLY

Yes, it is a multilayer perceptron (MLP) feedforward neural network.

Nirmesh Shah June 9, 2017 at 11:00 pm #

REPLY

Hi Jason,

I have run this code successfully on PC with CPU.

If I have to run the same code n another PC which contains GPU, What line should I add to make it sure that it runs on the GPU

Jason Brownlee June 10, 2017 at 8:24 am #

REPLY

The code would stay the same, your configuration of the Keras backend would change.

Please refer to TensorFlow or Theano documentation.

Prachi June 12, 2017 at 7:30 pm #

REPLY

What if I want to train my neural which should detect whether the luggage is abandoned or not ? How do i proceed for it ?

Jason Brownlee June 13, 2017 at 8:18 am #

REPLY

This process will help you work through your predictive modeling problem end to end:
http://machinelearningmastery.com/start-here/#process

Get Your Start in Machine Learning

Ebtesam June 14, 2017 at 11:15 pm #

REPLY

Hi
I was build neural machine translation model but the score i was get is 0 i am not sure why

Jason Brownlee June 15, 2017 at 8:45 am #

REPLY

Here is a good list of things to try:
http://machinelearningmastery.com/improve-deep-learning-performance/

Sarvottam Patel June 20, 2017 at 7:31 pm #

REPLY

HHey Jason , first of all thank you very much from the core of my heart to make me understand this perfectly, I have an error after completing 150 iteration.

File “keras_first_network.py”, line 53, in
print(“\n%s: %.2f” %(model.metrics_names[1]*100))
TypeError: not enough arguments for format string

Sarvottam Patel June 20, 2017 at 8:05 pm #

REPLY

Sorry Sir my bad , actually I wrote it wrongly

Jason Brownlee June 21, 2017 at 8:12 am #

REPLY

Confirm that you have copied the line exactly:

```
1 print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))
```

Joydeep June 30, 2017 at 4:15 pm #

REPLY

Hi Dr Jason,

Get Your Start in Machine Learning

Thanks for the tutorial to get started using Keras.

I used the below snippet to directly load the dataset from the URL rather than downloading and saving as this makes the code more streamlined without having to navigate elsewhere.

# load pima indians dataset
datasource = numpy.DataSource().open("http://archive.ics.uci.edu/ml/machine-learning-databases/pima-indians-diabetes/pima-indians-diabetes.data")
dataset = numpy.loadtxt(datasource, delimiter=",")

REPLY

Jason Brownlee July 1, 2017 at 6:28 am #

Thanks for the tip.

REPLY

Yvette July 7, 2017 at 9:01 pm #

Thanks for this helpful resource!

REPLY

Jason Brownlee July 9, 2017 at 10:38 am #

I'm glad it helped.

REPLY

Andeep July 10, 2017 at 1:14 am #

Hi Dr Brownlee,

thank you very much for this great tutorial!
I would be grateful, if you could answer some questions:

1. What does the 7 in "numpy.random.seed(7)" means?

2. In my case I have 3 input neurons and 2 output neurons. Is the correct notation:
X = dataset[:,0:3]
Y = dataset[:,3:4] ?

3. The batch size means how many tra
I have thought we have to use the wh

case I would determine the batch size as the number of training data pairs I have achieved through experiments etc.. In your example, does the batch (sized 10) means that the computer always uses the same 10 training data in every epoch or are the 10 training data randomly chosen among all training data before every epoch?

4. When evaluating the model what does the loss means (e.g. in loss: 0.5105 – acc: 0.7396)?
Is it the sum of values of the error function (e.g. mean_squared_error) of the output neurons?

Jason Brownlee July 11, 2017 at 10:19 am #

REPLY

You can use any random seed you like, more here:
http://machinelearningmastery.com/reproducible-results-neural-networks-keras/

You are referring to the columns in your data. Your network will also need to be configured with the correct number of inputs and outputs (e.g. input and output layers).

Batch size is the number of samples in the dataset to work through before updating network weights. One epoch is comprised of one or more batches.

Loss is the term being optimized by the network. Here we use log loss:
https://en.wikipedia.org/wiki/Cross_entropy

Andeep July 16, 2017 at 7:43 am #

REPLY

Thank you for your response, Dr Brownlee !!

Jason Brownlee July 16, 2017 at 8:00 am #

REPLY

I hope it helps.

Patrick Zawadzki July 11, 201

REPLY

Is there anyway to see the rela

Get Your Start in Machine Learning

understand which inputs affect the output the most, or perhaps which pairs of inputs affect the output the most?

Maybe pairing this with unsupervised deep learning? I want to have less of a “black box” for the developed network if at all possible. Thank you for your great content!

Jason Brownlee July 11, 2017 at 10:34 am #

REPLY

Yes, try and RFE:
http://machinelearningmastery.com/feature-selection-machine-learning-python/

Bernt July 13, 2017 at 10:12 pm #

REPLY

Hi Jason,
Thank you for sharing your skills and competence.

I want to study the change in weights and predictions between each epoch run.
Have tried to use the model.train_on_batch method and the model.fit method with epoch=1 and batch_size equal all the samples.

But it seems like the model doesn't save the new updated weights.
I print predictions before and after I dont see a change in the evaluation scores.

Parts of the code is printed below.

Any idea?
Thanks.

```
# Compile model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])

# evaluate the model
scores = model.evaluate(X, Y)
print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))

# Run one update of the model trained run with X and compared with Y
model.train_on_batch(X, Y)

# Fit the model
model.fit(X, Y, epochs=1, batch_size=768)

scores = model.evaluate(X, Y)
print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))
```

Jason Brownlee July 14, 2017 at 8:29 am #

REPLY

Sorry, I have not explored evaluating a Keras model this way.

Perhaps it is a fault, I would recommend preparing the smallest possible example that demonstrates the issue and post to the Keras GitHub issues.

iman July 18, 2017 at 11:18 pm #

REPLY

Hi, I tried to apply this to the t

all 0.4. What do you suggest for:
# create model
model = Sequential()
model.add(Dense(12, input_dim=4, activation='relu'))
model.add(Dense(4, activation='relu'))
model.add(Dense(1, activation='sigmoid'))

model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
#'sgd'

model.fit(X, Y, epochs=15, batch_size=10)

Jason Brownlee July 19, 2017 at 8:26 am #

REPLY

This post will give you some ideas to list the skill of your model:
http://machinelearningmastery.com/improve-deep-learning-performance/

Camus July 19, 2017 at 2:14 am #

REPLY

Hi Dr Jason,
This is probably a stupid question but I cannot find out how to do it … and I am beginner on Neural Network.
I have relatively same number of inputs (7) and one output. This output can take numbers between -3000 and +3000.
I want to build a neural network model in python but I don't know how to do it.
Do you have an example with outputs different from 0-1.
Tanks in advance

Camus

Jason Brownlee July 19, 2017 at 8:28 am #

REPLY

Ensure you scale your data then use the above tutorial to get started.

Khalid Hussain July 21, 2017 a

REPLY

Hi Jason Brownlee

I am using the same data “pima-indians-diabetes.csv” but all predicted values are less then 1 and are in fraction which could not distinguish any class.

If I round off then all become 0.

I am using model.predict(x) function

You are requested to kindly guide me what I am doing wrong are how can I achieve correct predicted value.

Thank you

REPLY

Jason Brownlee July 22, 2017 at 8:36 am #

Consider you have copied all of the code exactly from the tutorial.

REPLY

Ludo July 25, 2017 at 6:59 pm #

Hello Jason,

Thanks you for your great example. I have some comments.

– Why you have choice “12” inputs hidden layers ? and not 24 / 32 .. it’s arbitary ?
– Same question about epochs and batch_size ?

This value are very sensible !! i have try with 32 inputs first layer , epchos=500 and batch_size=1000 and the result is very differents… i’am at 65% accurancy.

Thx for you help.
Regards.

REPLY

Jason Brownlee July 26, 2017 at 7:50 am #

Yes, it is arbitrary. Tune the parameters of the model to your problem.

REPLY

Almoutasem Bellah Rajab

Wow, you're still replying to comments more than a year later!!!... you're great,, thanks..

Jason Brownlee July 26, 2017 at 7:50 am #

REPLY

Yep.

Jane July 26, 2017 at 1:23 am #

REPLY

Thanks for your tutorial, I found it very useful to get me started with Keras. I've previously tried TensorFlow, but found it very difficult to work with. I do have a question for you though. I have both Theano and TensorFlow installed, how do I know which back-end Keras is using? Thanks again

Jason Brownlee July 26, 2017 at 8:02 am #

REPLY

Keras will print which backend it uses every time you run your code.

You can change the backend in the Keras configuration file (~/.keras/keras.json) which looks like:

```
{
    "image_data_format": "channels_last",
    "backend": "tensorflow",
    "epsilon": 1e-07,
    "floatx": "float32"
}
```

Get Your Start in Machine Learning

Masood Imran July 28, 2017 at 12:00 am #

REPLY

Hello Jason,

My understanding of Machine Learning or evaluating deep learning models is almost 0. But, this article gives me lot of information. It is explained in a simple and easy to understand language.

Thank you very much for this article. Would you suggest any good read to further explore Machine Learning or deep learning models please?

Jason Brownlee July 28, 2017 at 8:31 am #

REPLY

Thanks.

Yes, start right here:
http://machinelearningmastery.com/start-here/#deeplearning

Peggy August 3, 2017 at 7:14 pm #

REPLY

If I have trained prediction models or neural network function scripts. How can I use them to make predictions in an application that will be used by end users? I want to use python but it seems I will have to redo the training in Python again. Is there a way I can rewrite the scripts in Python without retraining and just call the function of predicting?

Jason Brownlee August 4, 2017 at 6:58 am #

REPLY

You need to train and save the final model then load it to make predictions.

This post will make it clear:
http://machinelearningmastery.com/train-final-machine-learning-model/

Shane August 8, 2017 at 2:38 pm #

REPLY

Jason, I used your tutorial to install everything needed to run this tutorial. I followed your tutorial and ran the resulting program successfully. Can you please describe what the output means? I would like to thank you for your very informative tutorials.

Shane August 8, 2017 at 2:39 pm #

REPLY

768/768 [==============================] – 0s – loss: 0.4807 – acc: 0.7826
Epoch 148/150
768/768 [==============================] – 0s – loss: 0.4686 – acc: 0.7812
Epoch 149/150
768/768 [==============================] – 0s – loss: 0.4718 – acc: 0.7617
Epoch 150/150
768/768 [==============================] – 0s – loss: 0.4772 – acc: 0.7812
32/768 [>.....] – ETA: 0s
acc: 77.99%

Jason Brownlee August 8, 2017 at 5:12 pm #

REPLY

It is summarizing the training of the model.

The final line evaluates the accuracy of the model's predictions – really just to demonstrate how to make predictions.

Jason Brownlee August 8, 2017 at 5:11 pm #

REPLY

Well done Shane.

Which output?

Bene August 9, 2017 at 1:02 am #

REPLY

Hello Jason, i really liked your Work and it helped me a lot with my first steps.

But i am not really familiar with the numpy stuff:

So here is my Question:

dataset = numpy.loadtxt("pima-indians-diabetes.csv", delimiter=",")
# split into input (X) and output (Y) variables
X = dataset[:,0:8]
Y = dataset[:,8]

I get that the numpy.loadtxt is extracting the information from the cvs File

but what does the stuff in the Brackets mean like X = dataset[:,0:8]

why the ":" and why , 0:8

its probably pretty dumb but i can't find a good explanation online 😀

thanks really much!

Jason Brownlee August 9, 2017 at 6:37 am #

REPLY

Good question Bene, it's called array slicing:
https://docs.scipy.org/doc/numpy/reference/arrays.indexing.html

Bene August 9, 2017 at 10:59 pm #

REPLY

That helped me out tank you Jason 🙂

Chen August 12, 2017 at 5:43 pm #

REPLY

Can I translate it to Chinese and put it to Internet in order to let other Chinese people can read your article?

Get Your Start in Machine Learning

Jason Brownlee August 13, 2017 at 9:46 am #

REPLY

No, please do not.

Deep Learning August 12, 2017 at 7:36 pm #

REPLY

It seems that using this line:

np.random.seed(5)

...is redundant i.e. the Keras output in a loop running the same model with the same configuration will yield a similar variety of results regardless if it's set at all, or which number it is set to. Or am I missing something?

Jason Brownlee August 13, 2017 at 9:52 am #

REPLY

Deep learning algorithms are stochastic (random within a range). That means that they will make different predictions/learn different things when the same model is trained on the same data. This is a feature:
http://machinelearningmastery.com/randomness-in-machine-learning/

You can fix the random seed to ensure you get the same result, and it is a good idea for tutorials to help beginners out:
http://machinelearningmastery.com/reproducible-results-neural-networks-keras/

When evaluating the skill of a model, I would recommend repeating the experiment n times and taking skill as the average of the runs. See here for the procedure:
http://machinelearningmastery.com/evaluate-skill-deep-learning-models/

Does that help?

Deep Learning August 14, 2017 at 3:08 am #

REPLY

Thanks Jason 🙂

I totally get what it should do, b[illegible] run the codes you have provide[illegible] with random seed set and the [illegible]

together. Then compare the result. At least the result I'm getting, is suggesting the effect is not there i.e. both sets of 10 times will have similar variation in the result.

REPLY

Jason Brownlee August 14, 2017 at 6:26 am #

It may suggest that the model is overprescribed and easily addresses the training data.

REPLY

Deep Learning August 14, 2017 at 3:12 am #

Nice post by the way > http://machinelearningmastery.com/evaluate-skill-deep-learning-models/

Thanks for sharing it. Been lately thinking about the aspect of accuracy a lot, it seems that at the moment it's a "hot mess" in terms of the way common tools do it out of the box. I think a lot of non PhD / non expert crowd (most people) will at least initially be easily confused and make the kinds of mistakes you point out in your post.

Thanks for all the amazing contributions you are making in this field!

REPLY

Jason Brownlee August 14, 2017 at 6:26 am #

I'm glad it helped.

REPLY

RATNA NITIN PATIL August 14, 2017 at 8:16 pm #

Hello Jason, Thanks for a wonderful tutorial.
Can I use Genetic Algorithm for feature selection??
If yes, Could you please provide the link for it???
Thanks in advance.

REPLY

Jason Brownlee August 15

Sure. Sorry, I don't have any examples.

Generally, computers are so fast it might be easier to test all combinations in an exhaustive search.

sunny1304 August 15, 2017 at 3:44 pm #

REPLY

Hi Json,
Thank you for your awesome tutorial.
I have a question for you.

Is there any guideline on how to decide on neuron number for our network.
for example you used 12 for thr 1st layer and 8 for the second layer.
how do you decide on that ?

Thanks

Jason Brownlee August 15, 2017 at 4:58 pm #

REPLY

No, there is no way to analytically determine the configuration of the network.

I use trial and error. You can grid search, random search, or copy configurations from tutorials or papers.

yihadad August 16, 2017 at 6:53 pm #

REPLY

Hi Json,
Thanks for a wonderful tutorial.

Run a model generated by a CNN it takes how much ram, cpu ?

Thanks

Jason Brownlee August 17, 2017 at 6:39 am #

REPLY

It depends on the data you
model.

Very large models could be 500MB of RAM or more.

REPLY

Ankur September 1, 2017 at 3:15 am #

Hi ,
Please let me know , how can i visualise the complete neural network in Keras.....

I am looking for the complete architecture – like number of neurons in the Input Layer, hidden layer , output layer with weights.

Please have a look at the link present below, here someone has created a beutiful visualisation/architecture using neuralnet package in R.
Please let me know, can we create such type of model in KERAS

https://www.r-bloggers.com/fitting-a-neural-network-in-r-neuralnet-package/

REPLY

Jason Brownlee September 1, 2017 at 6:50 am #

Use the Keras visualization API:
https://keras.io/visualization/

REPLY

ASAD October 17, 2017 at 3:23 am #

Hello ANKUR,,,, how are you?

you have try visualization in keras which is suggested by Jason Brownlee?
if you have tried then please send me code i am also trying but didnot work..

please guide me

REPLY

Adam September 3, 2017 at 1:45 am #

Thank you Dr. Brownlee for the great tutorial,

I have a question about your code:
is the argument metrics=['accuracy'] results of the neural network or is it ju

compiling?

thank you!!

Jason Brownlee September 3, 2017 at 5:48 am #

REPLY

No, it just prints out the accuracy of the model at the end of each epoch. Learn more about Keras metrics here: https://machinelearningmastery.com/custom-metrics-deep-learning-keras-python/

PottOfGold September 5, 2017 at 12:14 am #

REPLY

Hi Jason,

your work here is really great. It helped me a lot.
I recently stumbled upon one thing I cannot understand:

For the pimas dataset you state:
<>
When I look at the table of the pimas dataset, the examples are in rows and the features in columns, so your input dimension is the number of columns. As far as I can see, you don't change the table.

For neural networks, isn't the input normally: examples = columns, features=rows? Is this different for Keras? Or can I use both shapes? An if yes, what's the difference in the construction of the net?

Thank you!!

Jason Brownlee September 7, 2017 at 12:36 pm #

REPLY

No, features are columns, rows are instances or examples.

PottOfGold September 7, 2017 at 3:35 pm #

REPLY

Thanks! 🙂
I had a lot of discussions becau

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In Andrew Ng new Coursera course it's explained as examples = columns, features=rows, but he doesn't use Keras of course, but programms the neural networks from scratch.

Jason Brownlee September 9, 2017 at 11:38 am #

REPLY

I doubt that, I think you may have mixed it up. Columns are never examples.

PottOfGold October 6, 2017 at 6:26 pm #

Thats what I thought, but I looked it up in the notation for the new coursera course (deeplearning.ai) and there it says: m is the numer of examples in the dataset and n is the input size, where X superscript n x m is the input matrix …
But either way, you helped me! Thank you. 🙂

Lin Li September 16, 2017 at 1:50 am #

REPLY

Hi Jason, thank you so much for your tutorial, it helps me a lot. I need your help for the question below:
I copy the code and run it. Although I got the classification results, there were some warning messages in the process. As follows:

Warning (from warnings module):
File "C:\Users\llfor\AppData\Local\Programs\Python\Python35\lib\site-packages\keras\callbacks.py", line 120
% delta_t_median)
UserWarning: Method on_batch_end() is slow compared to the batch update (0.386946). Check your callbacks.

I don't know why, and cannot find any answer to this question. I'm looking forward to your reply. Thanks again!

Jason Brownlee Septembe

Get Your Start in Machine Learning

REPLY

Sorry, I have not seen this message before. It looks like a warning, you might be able to ignore it.

REPLY

Lin Li September 16, 2017 at 12:24 pm #

Thanks for your reply. I'm a start-learner on deep learning.I'd like to put it aside temporarily.

REPLY

Sagar September 22, 2017 at 2:51 pm #

Hi Jason,
Great article, thumbs up for that. I am getting this error when I try to run the file on the command prompt. Any suggestions. Thanks for you response.

##
C:\Work\ML>python keras_first_network.py
Using TensorFlow backend.
2017-09-22 10:11:11.189829: W C:\tf_jenkins\home\workspace\rel-win\M\windows\PY\
36\tensorflow\core\platform\cpu_feature_guard.cc:45] The TensorFlow library wasn't compiled to use AVX instructions, but these are available on your machine and could speed up CPU computations.
2017-09-22 10:11:11.190829: W C:\tf_jenkins\home\workspace\rel-win\M\windows\PY\
36\tensorflow\core\platform\cpu_feature_guard.cc:45] The TensorFlow library wasn't compiled to use AVX2 instructions, but these are available on your machine and could speed up CPU computations.
32/768 [>.....] – ETA: 0s
acc: 78.52%
##

REPLY

Jason Brownlee September 23, 2017 at 5:35 am #

Looks like warning messag

Sagar September 24, 2017 at 3:52 am #

REPLY

Thanks I got to know what the problem was. According to section 6 I had set verbose argument to 0 while calling "model.fit()". Now all the epochs are getting printed.

Jason Brownlee September 24, 2017 at 5:17 am #

REPLY

Glad to hear it.

Valentin September 26, 2017 at 6:35 pm #

REPLY

Hi Jason,

Thanks for the amazing article . Clear and straightforward.
I had some problems installing Keras but was advised to prefix
with tf.contrib.keras
so I have code like

model=tf.contrib.keras.models.Sequential()
Dense=tf.contrib.keras.layers.Dense

Now I try to train Keras on some small datafile to see how things work out:
1,1,0,0,8
1,2,1,0,4
1,0,0,1,5
1,0,1,0,7
0,1,0,0,8
1,4,1,0,4
1,0,2,1,1
1,0,1,0,7

The first 4 columns are inputs and the 5-th column is output.
I use the same code for training (adjust number of inputs) as in your article,
but the network only gets to 12.5% accuracy.
Any advise?

Thanks,
Valentin

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Jason Brownlee September 27, 2017 at 5:40 am #

REPLY

Thanks Valentin.

I have a good list of suggestions for improving model performance here:
http://machinelearningmastery.com/improve-deep-learning-performance/

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Priya October 3, 2017 at 2:28 pm #

REPLY

Hi Jason,

I tried replacing the pima data with random data as follows:

X_train = np.random.rand(18,61250)
X_test = np.random.rand(18,61250)
Y_train = np.array([0.0, 1.0, 1.0, 0.0, 1.0, 1.0, 1.0, 0.0, 1.0,
0.0, 1.0, 0.0, 0.0, 1.0, 0.0, 0.0, 0.0, 1.0,])
Y_test = np.array([1.0, 0.0, 0.0, 1.0, 1.0, 0.0, 1.0, 1.0, 1.0,
1.0, 0.0, 0.0, 0.0, 1.0, 0.0, 0.0, 1.0, 0.0,])

_, input_size = X_train.shape #put this in input_dim in the first dense layer

I took the round() off of the predictions so I could see the full value and then inserted my random test data in model.fit():

predictions = model.predict(X_test)
preds = [x[0] for x in predictions]
print(preds)

model.fit(X_train, Y_train, epochs=100, batch_size=10, verbose=2, validation_data=(X_test,Y_test))

I found something slightly odd; I expected the predicted values to be around 0.50, plus or minus some, but instead, I got this:

[0.49525392, 0.49652839, 0.49729034, 0.49670222, 0.49342978, 0.49490061, 0.49570397, 0.4962129, 0.49774086, 0.49475089, 0.4958384, 0.49506786, 0.49696651, 0.49869373, 0.49537542, 0.49613148, 0.49636957, 0.49723724]

which is near 0.50 but always less than 0.50. I ran this a few times with different random seeds, so it's not coincidental. Would you have any explanation for why it does this?

Thanks,
Priya

Jason Brownlee October 3, 2017 at 3:46 pm #

REPLY

Perhaps calculate the mean of your training data and compare it to the predicted value. It might be simple

Priya October 4, 2017 at 1:02 am #

REPLY

I found out I was doing predictions before fitting the model. (I suppose that would mean the network hadn't adjusted to the data's distribution yet.)

Saurabh October 7, 2017 at 5:59 am #

REPLY

Hello Jason,

I tried to train this model on my laptop, it is working fine. But I tried to train this model on google-cloud with the same instructions as in your example-5. But it is failing.
Can you just let me know, which changes are to required for the model, so that I can train this on cloud.

Jason Brownlee October 7, 2017 at 7:37 am #

REPLY

Sorry, I don't know about google cloud.

I have instructions here for running on AWS:
https://machinelearningmastery.com/develop-evaluate-large-deep-learning-models-keras-amazon-web-services/

tobegit3hub October 12, 2017 at 6:40 pm #

REPLY

Great post. Thanks for sharing.

Jason Brownlee October 13, 2017 at 5:45 am #

REPLY

You're welcome.

Manoj October 12, 2017 at 11:43 p

REPLY

Hi Jason,
Is there a way to store the model, once it is created so that I can use it for different input data sets as and when needed.

REPLY

Jason Brownlee October 13, 2017 at 5:48 am #

Yes, you can save it to file. See this tutorial:
https://machinelearningmastery.com/save-load-machine-learning-models-python-scikit-learn/

REPLY

Cam October 23, 2017 at 6:11 pm #

I get a syntax error for the

model.fit() line in this example. Is it due to library conflicts with theano and tensorflow if i have both installed?

REPLY

Jason Brownlee October 24, 2017 at 5:28 am #

Perhaps ensure your environment is up to date and that you copied the code exactly.

This tutorial can help with setting up your environment:
http://machinelearningmastery.com/setup-python-environment-machine-learning-deep-learning-anaconda/

REPLY

Cam October 24, 2017 at 2:11 pm #

Thanks, fixed!

REPLY

Jason Brownlee October 24, 2017 at 4:01 pm #

Glad to hear it.

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Diego Quintana October 25, 2017 at 7:37 am #

REPLY

Hi Jason, thanks for the example.

How would you predict a single element from X? X[0] raises a ValueError

ValueError: Error when checking : expected dense_1_input to have shape (None, 8) but got array with shape (8, 1)

Thanks!

Jason Brownlee October 25, 2017 at 3:56 pm #

REPLY

You can reshape it to have 1 row and 8 columns:

```
1 X = X.reshape((1,8))
```

This post will give you further advice:
https://machinelearningmastery.com/index-slice-reshape-numpy-arrays-machine-learning-python/

Shahbaz Wasti October 28, 2017 at 1:30 pm #

REPLY

Dear Sir ,
I have installed and configured the environment according to your directions but while running the program i have following error

“from keras.utils import np_utils”

Jason Brownlee October 29, 2017 at 5:50 am #

REPLY

What is the error exactly?

Zhengping October 30, 2017 at 12:12 am #

REPLY

Hi Jason, thanks for the great t
in your “Your First Machine Learning Pr

Get Your Start in Machine Learning

Now trying this one, getting stuck at the line “model = Sequential()” when the Interactive window throws: NameError: name ‘Sequential’ is not defined. tried to google, can’t find a solution. I did import Sequential from keras.models as in ur example code. copy pasted as it is. Thanks in advance for your help.

Zhengping October 30, 2017 at 12:14 am #

REPLY

I’m running ur examples in Anaconda 4.4.0 environment in visual studio community version. relevant packages have been installed as in ur earlier tutorials instructed.

Zhengping October 30, 2017 at 12:18 am #

REPLY

>> # create model
... model = Sequential()
...
Traceback (most recent call last):
File “”, line 2, in
NameError: name ‘Sequential’ is not defined
>>> model.add(Dense(12, input_dim=8, init=’uniform’, activation=’relu’))
Traceback (most recent call last):
File “”, line 1, in
AttributeError: ‘SVC’ object has no attribute ‘add’

Jason Brownlee October 30, 2017 at 5:39 am #

REPLY

This does not look good. Perhaps post the error to stack exchange or other keras support. I have a list of keras support sites here: https://machinelearningmastery.com/get-help-with-keras/

Jason Brownlee October 30, 2017 at 5:38 am #

REPLY

Looks like you need to inst
that:
https://machinelearningmastery.co

learning-deep-learning-anaconda/

Akhil October 30, 2017 at 5:04 pm #

REPLY

Ho Jason,

Thanks a lot for this wonderful tutorial.

I have a question:

I want to use your code to predict the classification (1 or 0) of unknown samples. Should I create one common csv file having the train (known) as well as the test (unknown) data. Whereas the 'classification' column for the known data will have a known value, 1 or 0, for the unknown data, should I leave the column empty (and let the code decide the outcome)?

Thanks a lot

Jason Brownlee October 31, 2017 at 5:29 am #

REPLY

Great question.

No, you only need the inputs and the model can predict the outputs, call model.predict(X).

Also, this post will give a general idea on how to fit a final model: https://machinelearningmastery.com/train-final-machine-learning-model/

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Guilherme November 3, 2017 at 1:26 am #

REPLY

Hi Jason,

This is really cool! I am blown away! Thanks so much for making it so simple for a beginner to have some hands on. I have a couple questions:

1) where are the weights, can I save and/or retrieve them?

2) if I want to train images with dogs and cats and later ask the neural network whether a new image has a cat or a dog, how do I get my input image to pass as an array and my output result to be "cat" or "dog"?

Thanks again and great job!

Jason Brownlee November 3, 2017 at 5:20 am #

REPLY

The weights are in the model, you can save them:
https://machinelearningmastery.com/save-load-keras-deep-learning-models/

Yes, you would save your model, then call model.predict() on the new data.

Michael November 5, 2017 at 8:33 am #

REPLY

Hi Jason,

Are you familiar with a python tool/package that can build neural network as in the tutorial, but suitable for data stream mining?

Thanks,
Michael

Jason Brownlee November 6, 2017 at 4:46 am #

REPLY

Not really, sorry.

bea November 8, 2017 at 1:58 am #

REPLY

Hi, there. Could you please clarify why exactly you've built your network with 12 neurons in the first layer?

"The first layer has 12 neurons and expects 8 input variables. The second hidden layer has 8 neurons and finally, the output layer has 1 neuron to predict the class (onset of diabetes or not)..."

Should'nt it have 8 neurons at the start?

Thanks

Jason Brownlee November 8, 2017 at 9:28 am #

REPLY

The input layer has 8, the first hidden layer has 12. I chose 12 through a little trial and error.

Guilherme November 9, 2017 at 12:54 am #

REPLY

Hi Jason,

Do you have or else could you recommend a beginner's level image segmentation approach that uses deep learning? For example, I want to train some neural net to automatically "find" a particular feature out of an image.

Thanks!

Jason Brownlee November 9, 2017 at 10:00 am #

REPLY

Sorry, I don't have image segmentation examples, perhaps in the future.

Andy November 12, 2017 at 6:56 pm #

REPLY

Hi Jason,

I just started my DL training a few weeks ago. According to what I learned in course, in order to train the parameters for the NN, we need to run the Forward and Backward propagation; however, looki

these propagation processes. Does it r

the parameters instead of using Forward and Backward propagation?

Thanks!

Jason Brownlee November 13, 2017 at 10:13 am #

REPLY

It is performing those operations under the covers for you.

Badr November 13, 2017 at 11:42 am #

REPLY

Hi Jason,

Can you explain why I got the following output:

ValueError Traceback (most recent call last)
in ()
—-> 1 model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'])
2 model.fit(X, Y, epochs=150, batch_size=10)
3 scores = model.evaluate(X, Y)
4 print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/keras/models.py in compile(self, optimizer, loss, metrics, sample_weight_mode, **kwargs)
545 metrics=metrics,
546 sample_weight_mode=sample_weight_mode,
–> 547 **kwargs)
548 self.optimizer = self.model.optimizer
549 self.loss = self.model.loss

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/keras/engine/training.py in compile(self, optimizer, loss, metrics, loss_weights, sample_weight_mode, **kwargs)
620 loss_weight = loss_weights_list[i]
621 output_loss = weighted_loss(y_true, y_pred,
–> 622 sample_weight, mask)
623 if len(self.outputs) > 1:
624 self.metrics_tensors.append(output_loss)

/Users/badrshomrani/anaconda/lib/pyt
in weighted(y_true, y_pred, weights, m

322 def weighted(y_true, y_pred, weights, mask=None):
323 # score_array has ndim >= 2
–> 324 score_array = fn(y_true, y_pred)
325 if mask is not None:
326 # Cast the mask to floatX to avoid float64 upcasting in theano

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/keras/objectives.py in binary_crossentropy(y_true, y_pred)
46
47 def binary_crossentropy(y_true, y_pred):
—> 48 return K.mean(K.binary_crossentropy(y_pred, y_true), axis=-1)
49
50

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/keras/backend/tensorflow_backend.py in binary_crossentropy(output, target, from_logits)
1418 output = tf.clip_by_value(output, epsilon, 1 – epsilon)
1419 output = tf.log(output / (1 – output))
-> 1420 return tf.nn.sigmoid_cross_entropy_with_logits(output, target)
1421
1422

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/tensorflow/python/ops/nn_impl.py in sigmoid_cross_entropy_with_logits(_sentinel, labels, logits, name)
147 # pylint: disable=protected-access
148 nn_ops._ensure_xent_args("sigmoid_cross_entropy_with_logits", _sentinel,
–> 149 labels, logits)
150 # pylint: enable=protected-access
151

/Users/badrshomrani/anaconda/lib/python3.5/site-packages/tensorflow/python/ops/nn_ops.py in _ensure_xent_args(name, sentinel, labels, logits)
1696 if sentinel is not None:
1697 raise ValueError("Only call `%s` with "
-> 1698 "named arguments (labels=..., logits=..., ...)" % name)
1699 if labels is None or logits is None:
1700 raise ValueError("Both labels and logits must be provided.")

ValueError: Only call `sigmoid_cross_entropy_with_logits` with named arguments (labels=..., logits=..., ...)

Jason Brownlee Novembe

REPLY

Perhaps double check you have the latest versions of the keras and tensorflow libraries installed?!

Badr November 14, 2017 at 10:50 am #

REPLY

keras was outdated

Jason Brownlee November 15, 2017 at 9:44 am #

REPLY

Glad to hear you fixed it.

Mikael November 22, 2017 at 8:20 am #

REPLY

Hi Jason, thanks for your short tutorial, helps a lot to actually get your hands dirty with a simple example.
I have tried 5 different parameters and got some interesting results to see what would happen. Unfortunately, I didnt record running time.

Test 1 Test 2 Test 3 Test 4 Test 5 Test 6 Test 7
number of layers 3 3 3 3 3 3 4
Train set 768 768 768 768 768 768 768
Iterations 150 100 1000 1000 1000 150 150
Rate of update 10 10 10 5 1 1 5
Errors 173 182 175 139 161 169 177
Values 768 768 768 768 768 768 768
% Error 23,0000% 23,6979% 22,7865% 18,0990% 20,9635% 22,0052% 23,0469%

I can't seem to see a trend here.. That could put me on the right track to adjust my hyperparameters.

Do you have any advice on that?

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Jason Brownlee November 22, 2017 at 11:17 am #

REPLY

Something is wrong. Here is a good list of things to try:
http://machinelearningmastery.com/improve-deep-learning-performance/

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Nikolaos November 28, 2017 at 10:58 am #

REPLY

Hi, I try to implement the above example with fer2013.csv but I receive an error, it is possible to help me to implement this correctly?

```
keras.models import Sequential
from keras.layers import Dense
import numpy
import numpy as np

# fix Random seed for reproducibility
numpy.random.seed(7)
Y = []
X = []
#load dataset
for line in open("fer2013.csv"):
    row = line.split(',')
    Y.append(int(row[0]))
    X.append([int(p) for p in row[1].split()])
X, Y = np.array(X) / 255.0, np.array(Y)
print(Y.shape)
print(X.shape)


#create model
model = Sequential()
model.add(Dense(12, input_dim=(35887, 2304), activation='tanh'))
model.add(Dense(8, activation='tanh'))
model.add(Dense(1, activation='sigmoid'))

#Compile Model
model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy']

#Fit Model
model.fit(X, Y, epochs=150, batch_size=1)

# evaluate the model
scores = model.evaluate(X, Y)
print("\n%s: %.2f%%" % (model.metrics_names[1], scores[1]*100))

# calculate predictions
predictions = model.predict(X)
# round predictions
rounded = [round(x[0]) for x in predictions]
print(rounded)
```

Jason Brownlee November 29, 2017 at 8:10 am #

REPLY

Sorry, I cannot debug your code.

What is the problem exactly?

Tanya December 2, 2017 at 12:06 am #

REPLY

Hello,
i have a a bit general question.
I have to do a forecasting for restaurant sales (meaning that I have to predict 4 meals based on a historical daily sales data), weather condition (such as temperature, rain, etc), official holiday and in-off-season. I have to perform that forecasting using neuronal networks.
I am unfortunately not a very skilled in python. On my computer I have Python 2.7 and I have install anaconda. I am trying to learn exercising with your codes, Mr. Brownlee. But somehow I can not run the code at all (in Spyder). Can you tell me what kind of version of python and anaconda I have to install on my computer and in which environment (jupiterlab,notebook,qtconsole, spyder, etc) I can run the code, so to work and not to give error from the very beginning?
I will be very thankful for your response
KG
Tanya

Jason Brownlee December 2, 2017 at 9:02 am #

REPLY

Perhaps this tutorial will help you setup and confirm your environment:
http://machinelearningmastery.com/setup-python-environment-machine-learning-deep-learning-anaconda/

I would also recommend running code from the command like as IDEs and notebooks can introduce and hide errors.

Eliah December 3, 2017 at 10:53 am #

REPLY

Hi Dr. Brownlee.

I looked over the tutorial and I had a question regarding reading the data from a binary file? For instance I working on solving the sliding tiled n-puzzle using neural networks, but I seem to have trouble to getting my data which is in a binary file and it generates the number of move required for the n-puzzle to be solve in. Am not sure if you have dealt with this before, but any help would be appreciated.

Jason Brownlee December 4, 2017 at 7:43 am #

REPLY

Sorry, I don't know about your binary file.

Perhaps after you load your data, you can convert it to a numpy array so that you can provide it to a neural net?

Eliah December 4, 2017 at 9:28 am #

REPLY

Thanks for the tip, I'll try it.

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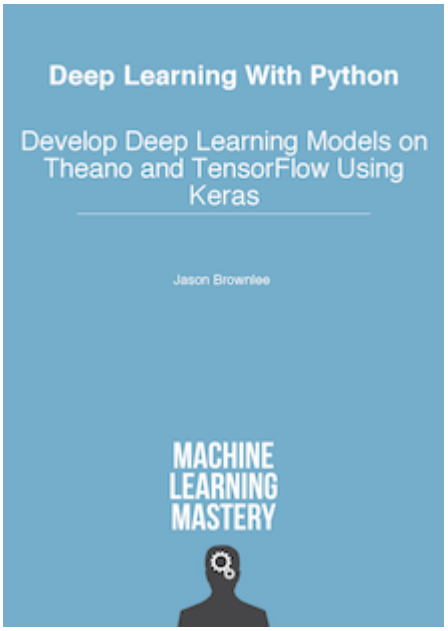

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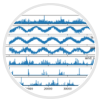

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