22.1) Recurrent Neural Network (RNN): Long Short-Term Memory (LSTM)

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August 2019

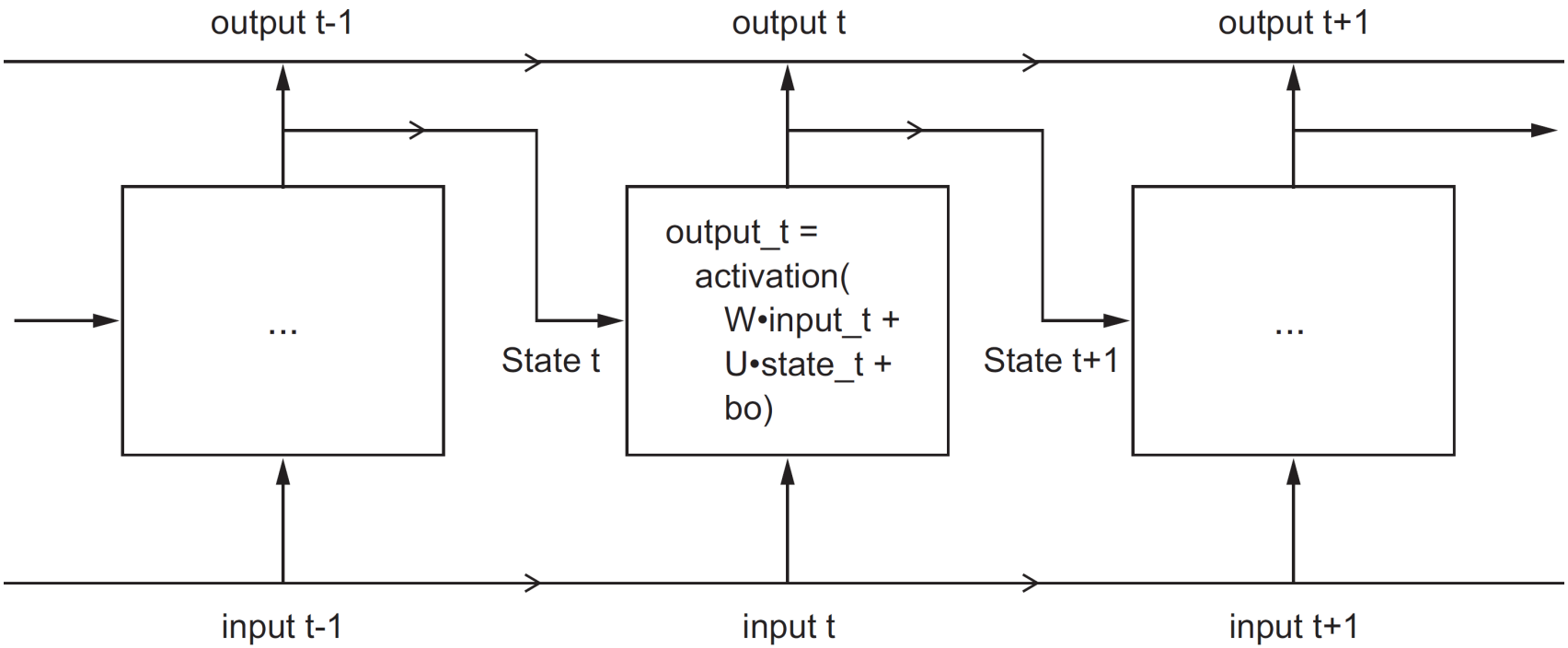
Reference

Chollet (2018): Ch 6.2

https://www.manning.com/books/deep-learning-with-python

https://github.com/fchollet/deep-learning-with-python-notebooks/blob/master/6.2-understanding-recurrent-neural-networks.ipynb

Simple Recurrent Neural Network (RNN)



Chollet (2018: 198)

```
state_t = 0
for input_t in input_sequence:
    output_t = activation(dot(W, input_t) + dot(U, state_t) + b)
    state_t = output_t
```

from keras.layers import SimpleRNN

```
from keras.models import Sequential
from keras.layers import Embedding, SimpleRNN

model = Sequential()
model.add(Embedding(10000, 32))
model.add(SimpleRNN(32))
model.summary()
```

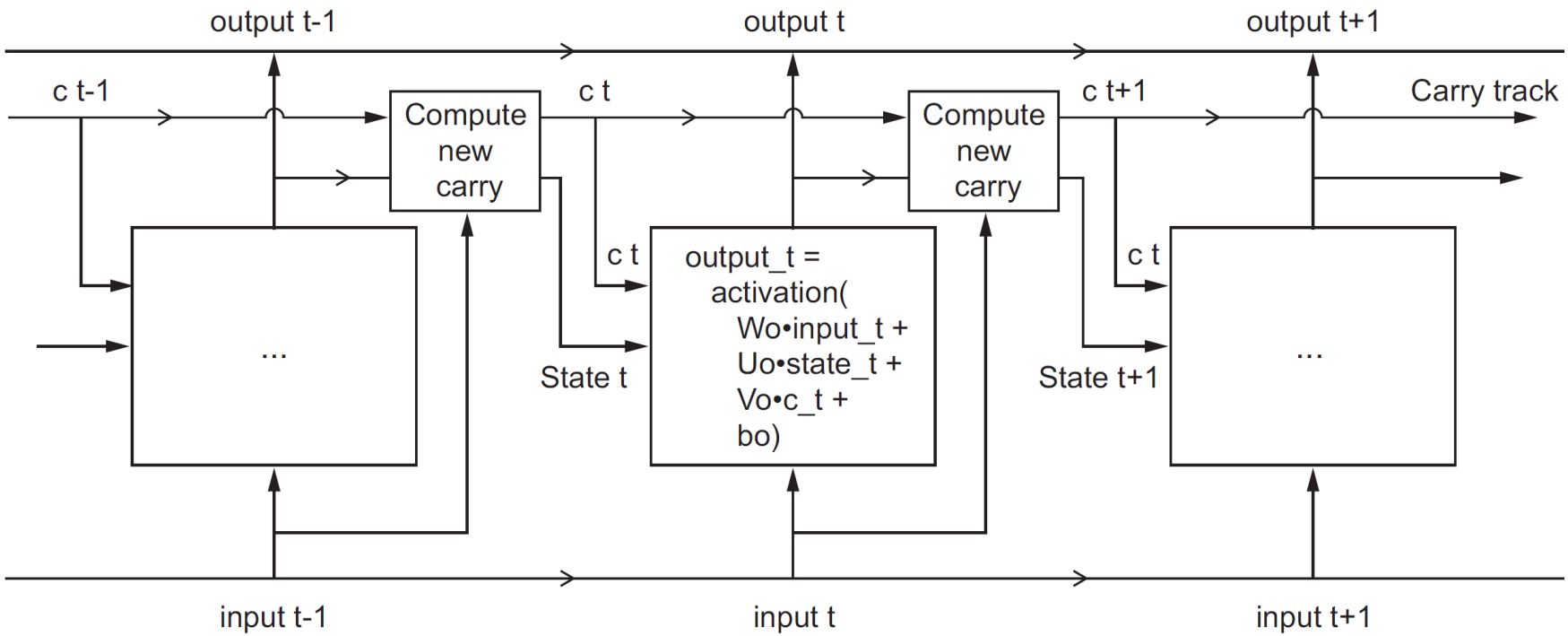
```
Layer (type)                 Output Shape              Param #
=================================================================
embedding_1 (Embedding)      (None, None, 32)          320000
_________________________________________________________________
simple_rnn_1 (SimpleRNN)     (None, 32)                2080
=================================================================
Total params: 322,080
```

recurrent_weights + input_weights + biases

num_units*num_units + num_features*num_units + biases

$$(32 * 32) + (32 * 32) + 32 = 2080$$

Long Short-Term Memory (LSTM): Carry Track



Chollet (2018: 204)

```
from keras.datasets import imdb
from keras.preprocessing import sequence
```

```
max_features = 10000  # number of words to consider as features
maxlen = 500  # cut texts after this number of words (among top max_features most com
batch_size = 32

print('Loading data...')
(input_train, y_train), (input_test, y_test) = imdb.load_data(num_words=max_features)
print(len(input_train), 'train sequences')
print(len(input_test), 'test sequences')

print('Pad sequences (samples x time)')
input_train = sequence.pad_sequences(input_train, maxlen=maxlen)
input_test = sequence.pad_sequences(input_test, maxlen=maxlen)
print('input_train shape:', input_train.shape)
print('input_test shape:', input_test.shape)
```

```
25000 train sequences
25000 test sequences
Pad sequences (samples x time)
input_train shape: (25000, 500)
input_test shape: (25000, 500)
```

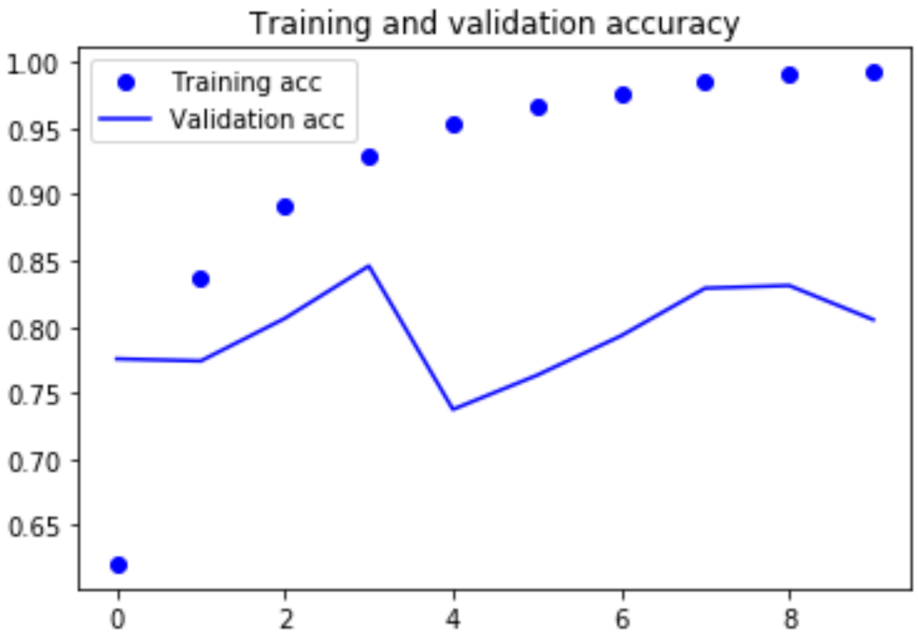
Embedding and Simple RNN Layer

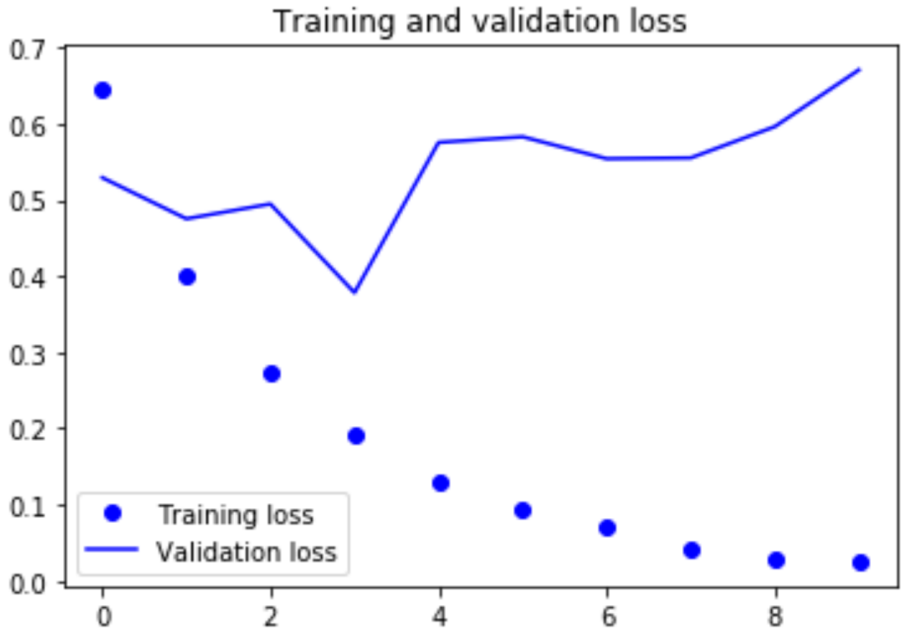
```
from keras.layers import Dense

model = Sequential()
model.add(Embedding(max_features, 32))
model.add(SimpleRNN(32))
model.add(Dense(1, activation='sigmoid'))

model.compile(optimizer='rmsprop',
  loss='binary_crossentropy', metrics=['acc'])
history = model.fit(input_train, y_train,
                    epochs=10,
                    batch_size=128,
                    validation_split=0.2)
```

Validation Accuracy 85%





Long Short-Term Memory (LSTM) Layer

```
from keras.layers import LSTM

model = Sequential()
model.add(Embedding(max_features, 32))
model.add(LSTM(32))
model.add(Dense(1, activation='sigmoid'))

model.compile(optimizer='rmsprop',
              loss='binary_crossentropy',
              metrics=['acc'])
history = model.fit(input_train, y_train,
                    epochs=10,
                    batch_size=128,
                    validation_split=0.2)
```

Validation Accuracy 89%