TENSORFLOW ON IOS

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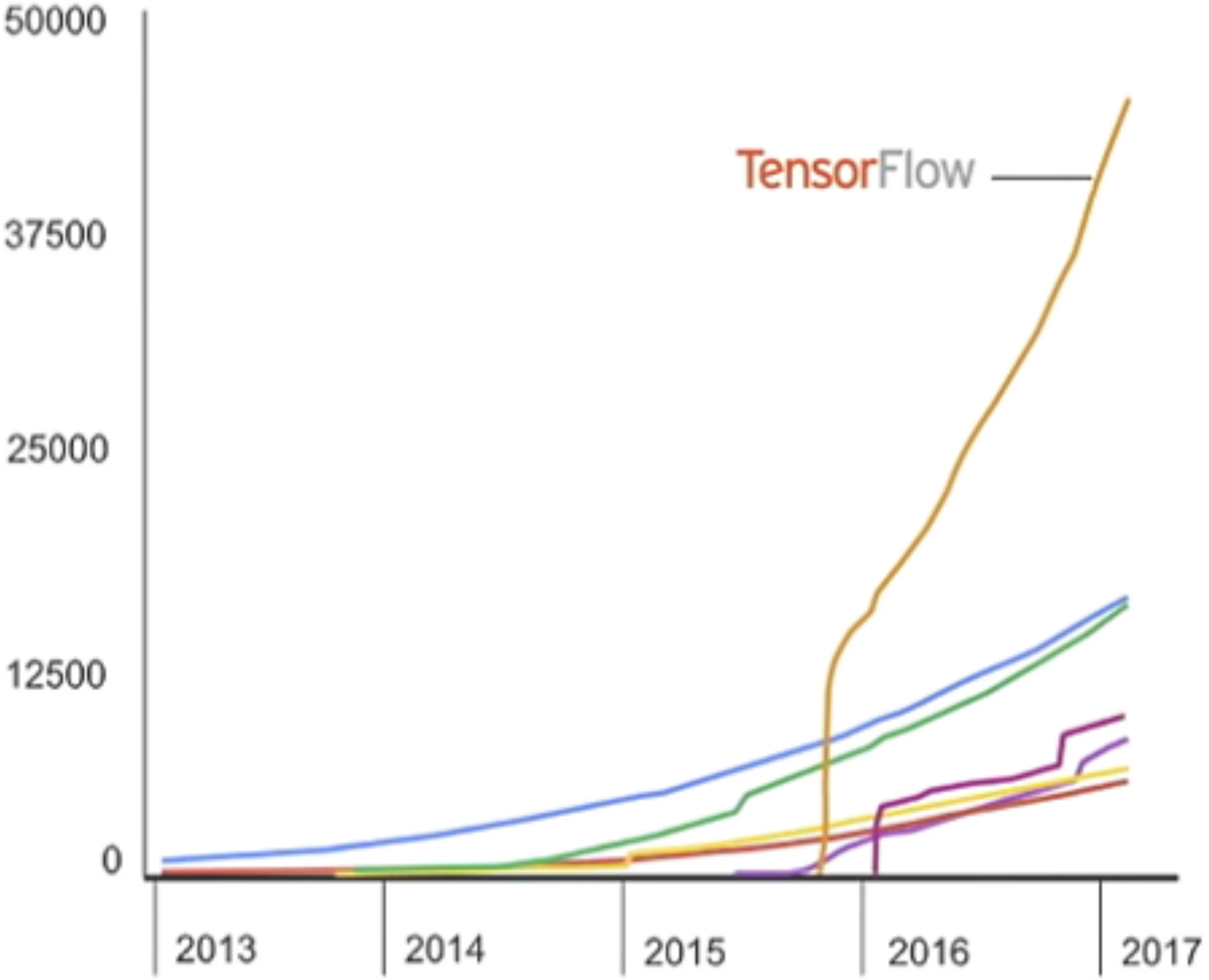
Git repo: https://github.com/h4x3rotab/emoji-tf-ios

机器学习框架

Caffe
Chainer
DL4J
Deeplearning4j
K
KERAS
Microsoft
CNTK
MatConvNet
MINERVA
mxnet
Purine
TensorFlow
theano
torch

WHY TENSORFLOW?



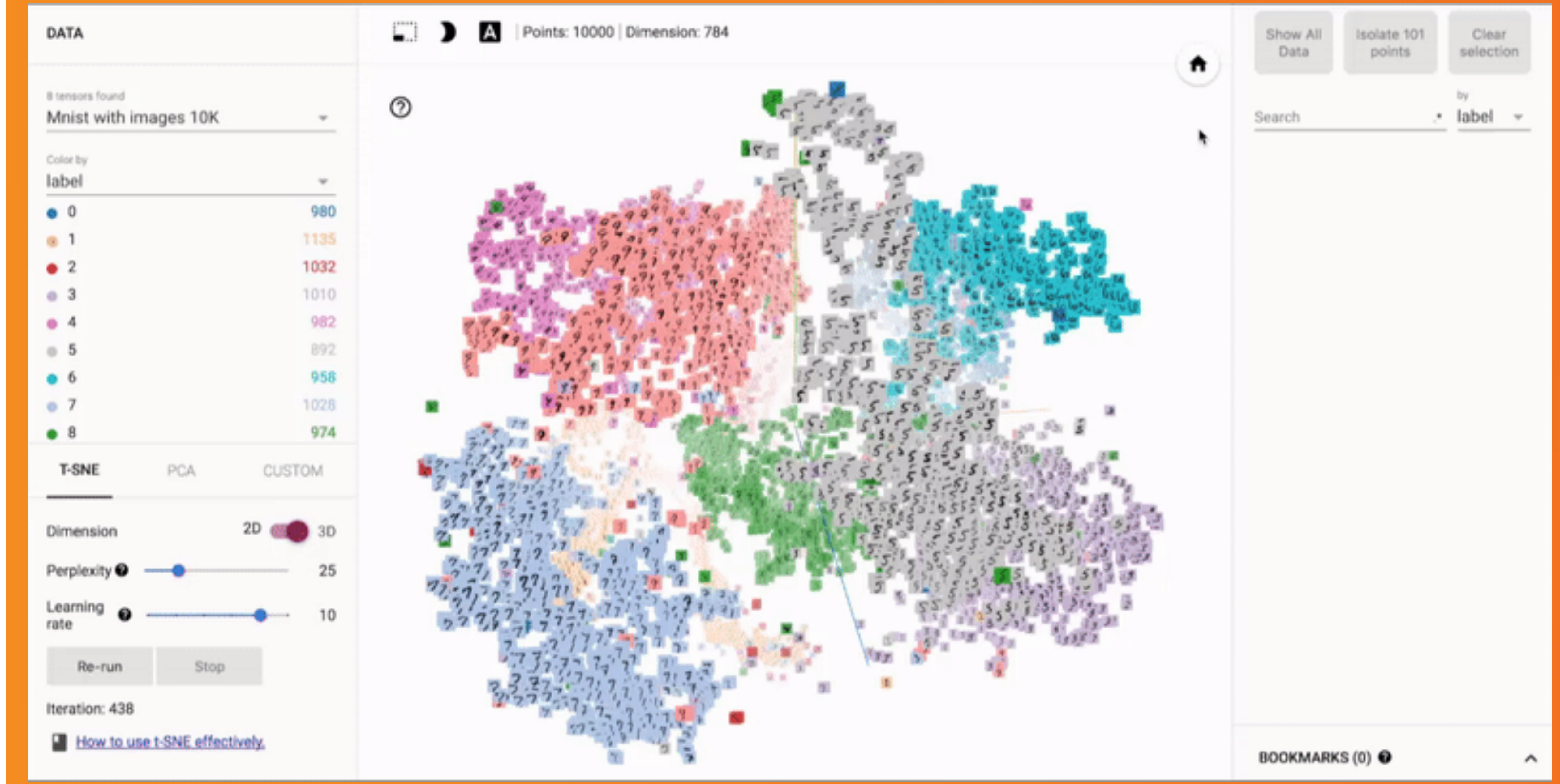
Framework	GitHub Star Count
🟧 TensorFlow	44508
🟦 scikit-learn	16191
🟩 Caffe	15690
🟪 CNTK	9383
🟪 MXNet	7896
🟨 Torch	6285
🟥 Theano	5568

WHY TENSORFLOW

- 全平台支持
  - 服务器集群
  - GPU、TPU加速
  - CPU
  - 移动端

WHY TENSORFLOW

- 全平台支持
- 丰富的调试工具
  - TensorBoard



DATA

8 tensors found: Mnist with images 10K

Color by: label

● 0	980
● 1	1135
● 2	1032
● 3	1010
● 4	982
● 5	892
● 6	958
● 7	1028
● 8	974

Dimension: 2D 3D

Perplexity: 25

Learning rate: 10

Iteration: 438

How to use t-SNE effectively.

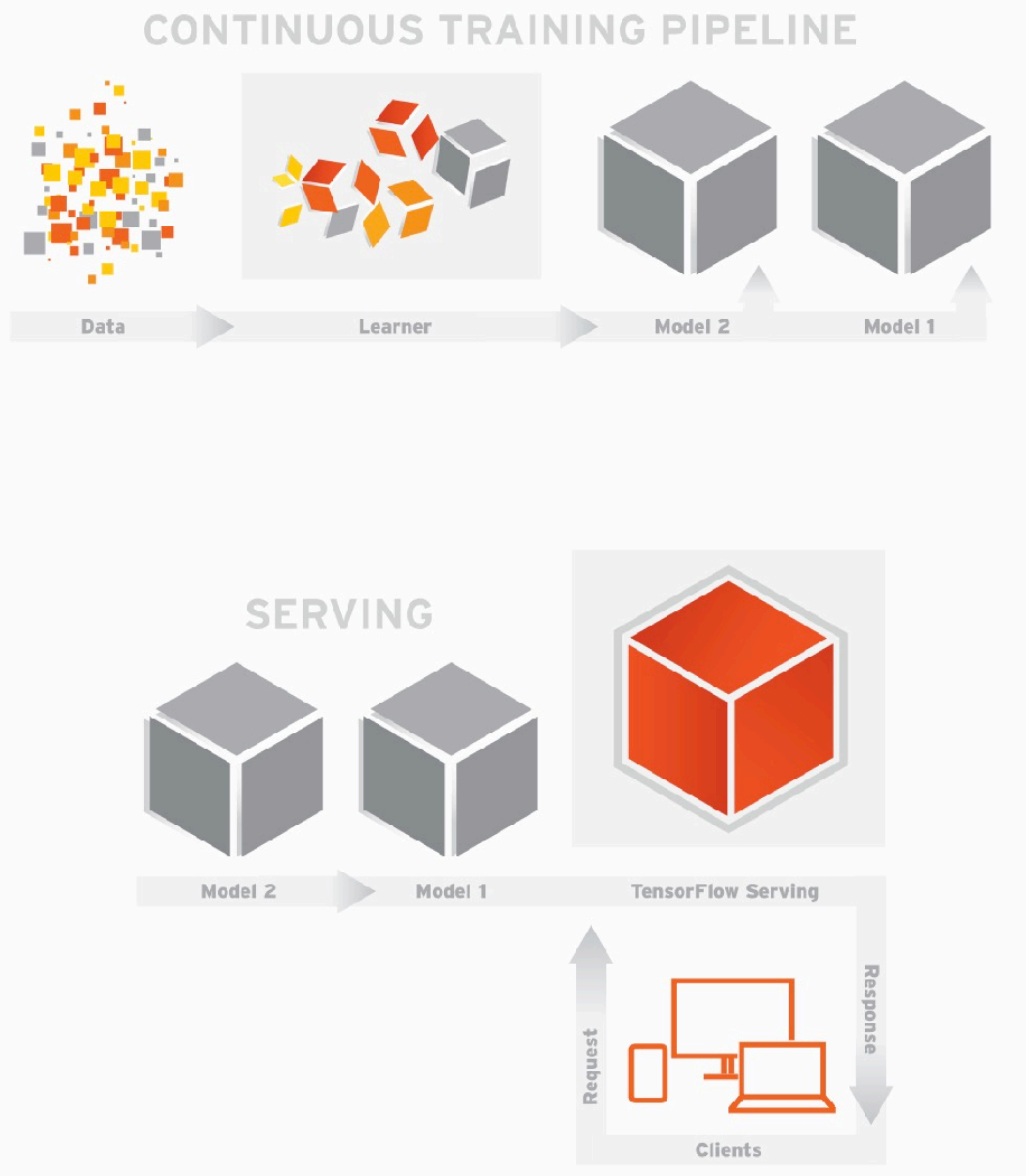
Points: 10000 | Dimension: 784

Search by label

BOOKMARKS (0)

WHY TENSORFLOW

- 全平台支持
- 丰富的调试工具
- 产品化
  - TensorFlow Serving
  - Google Cloud



WHY MOBILE?

牛奶

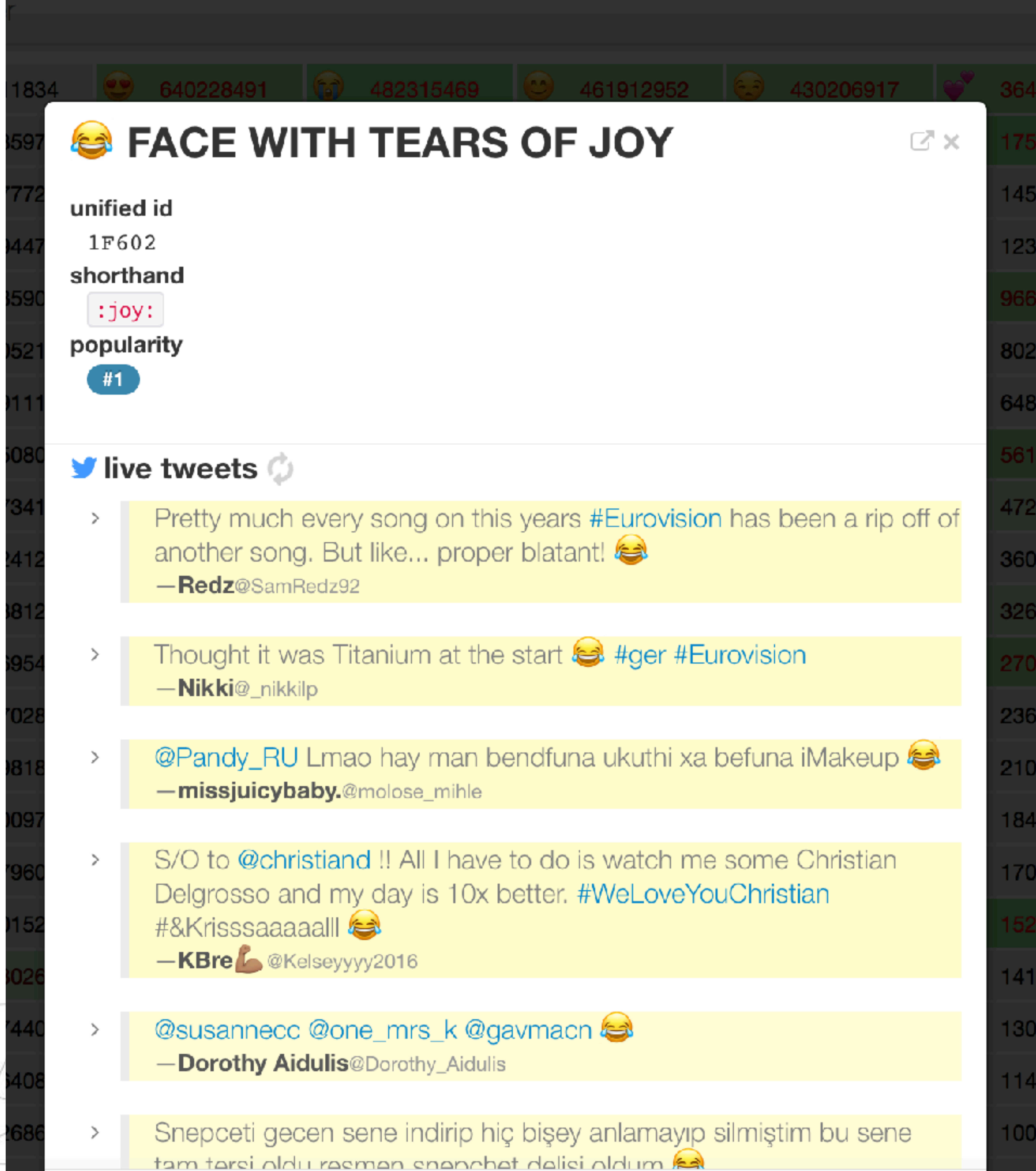
TENSORFLOW+ IOS

= ❤️

A TensorFlow Demo

PROBLEM

- Emoji输入法
  - 输入：一段短文本
  - 输出：预测合适的Emoji



😂 FACE WITH TEARS OF JOY

unified id

1F602

shorthand

`:joy:`

popularity

#1

live tweets

Pretty much every song on this years #Eurovision has been a rip off of another song. But like... proper blatant! 😂
—**Redz**@SamRedz92

Thought it was Titanium at the start 😂 #ger #Eurovision
—**Nikki**@_nikkilp

@Pandy_RU Lmao hay man bendfuna ukuthi xa befuna iMakeup 😂
—**missjuicybaby.**@molose_mihle

S/O to @christiand !! All I have to do is watch me some Christian Delgrosso and my day is 10x better. #WeLoveYouChristian #&Krisssaaaaalll 😂
—**KBre💪**@Kelseyyyy2016

@susannecc @one_mrs_k @gavmacn 😂
—**Dorothy Aidulis**@Dorothy_Aidulis

Snepceti gecen sene indirip hiç bişey anlamayıp silmiştim bu sene tam tersi oldu resmen snepchet delisi oldum 😂

PROBLEM

- Emoji输入法
  - 输入：一段短文本
  - 输出：预测合适的Emoji
- 有没有简单的办法…
  - 比如匹配关键字？

“Happy New Year”

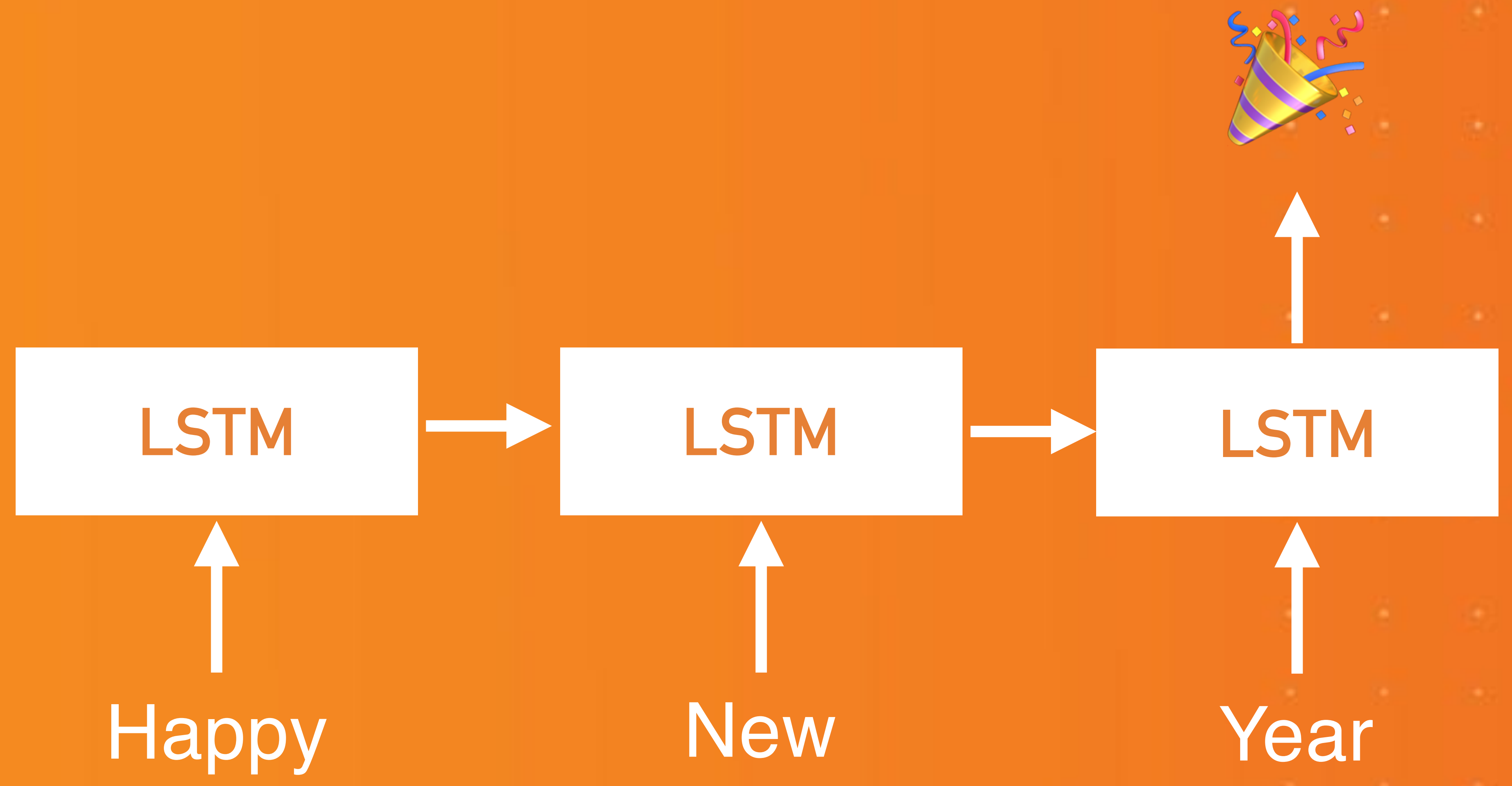
🎉

准备数据

- Twitter 2017年1月数据
  - 144字限制
  - 网络语言
- 预处理
  - 统计Top-100 Emoji
  - 100,000条英文推文

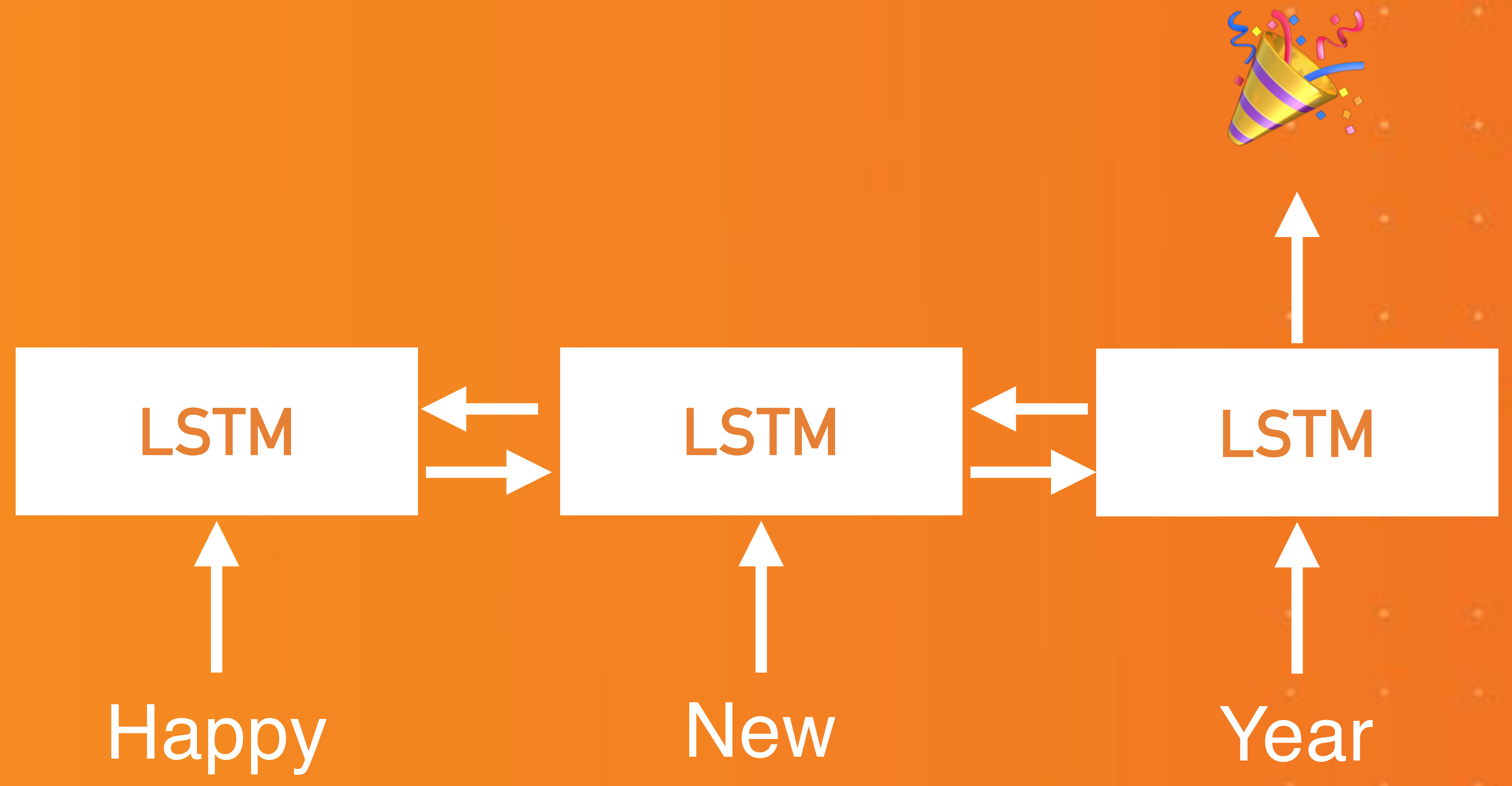
神经网络模型

- 基本思想：RNN
  - 接受任意长输入
  - 取最后一个输出作为结果
- LSTM
  - Long Short Term Memory
  - 一种适合文本的RNN



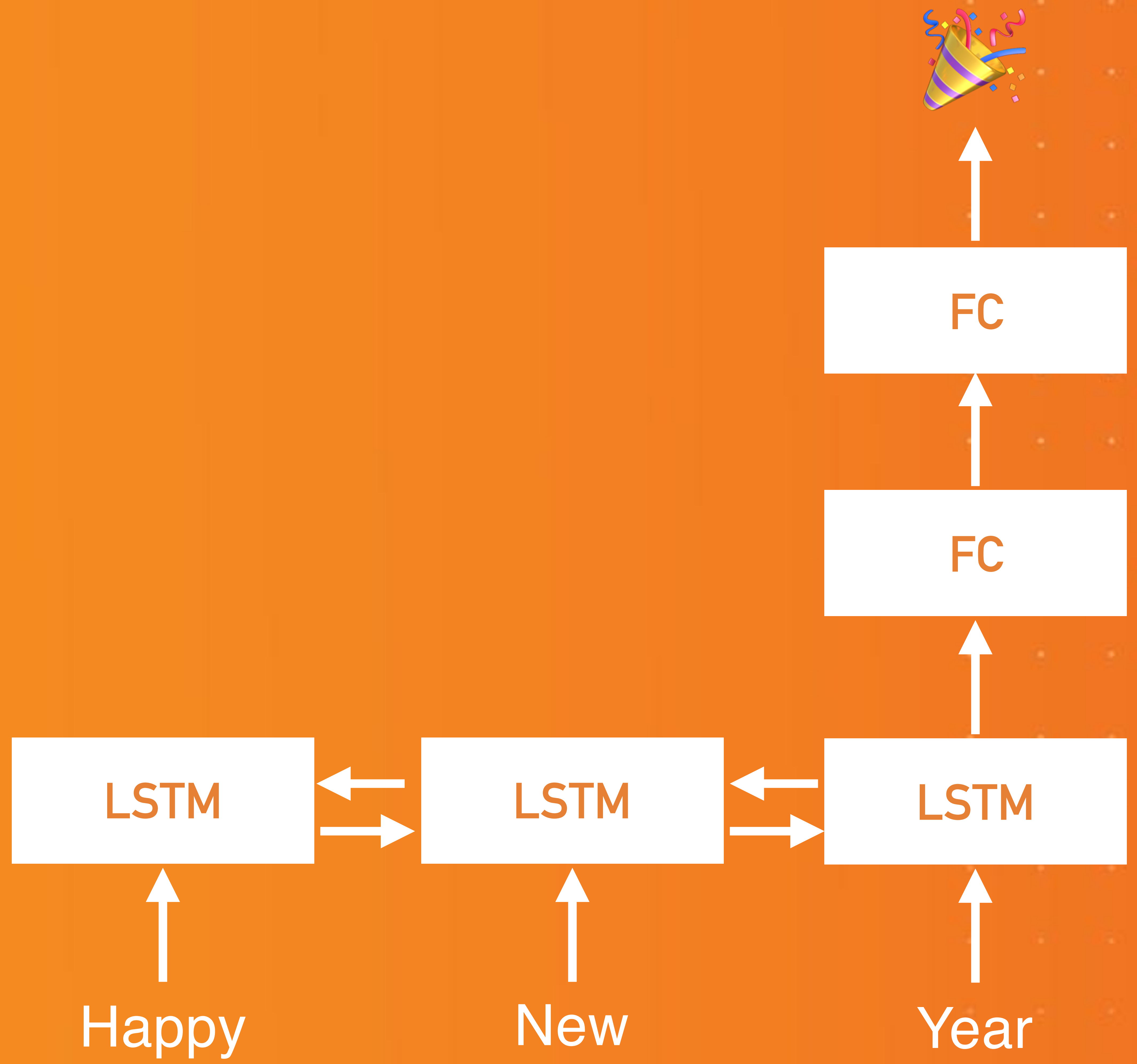
神经网络模型-改进

- 双向LSTM



神经网络模型-改进

- 双向LSTM
- 更深的网络



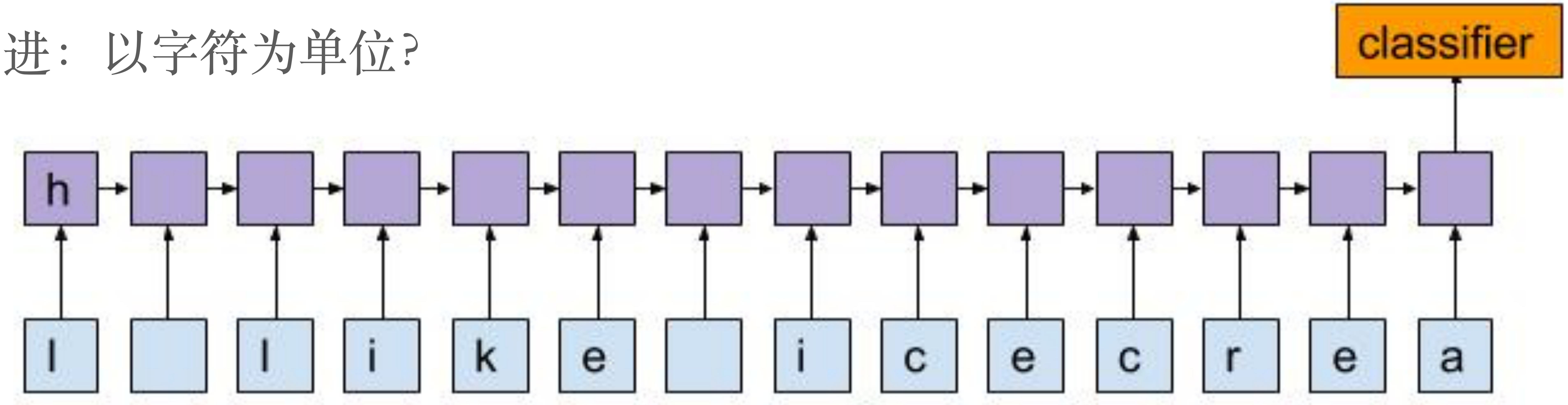
CHAR-CNN编码器

- 以词为单位的问题
  - 词典尺寸太大
  - 不规范用词：网络用语、拼写错误

$$100{,}000\ words * 128\ dimension * 4\ bytes = \mathbf{51.2MB}$$

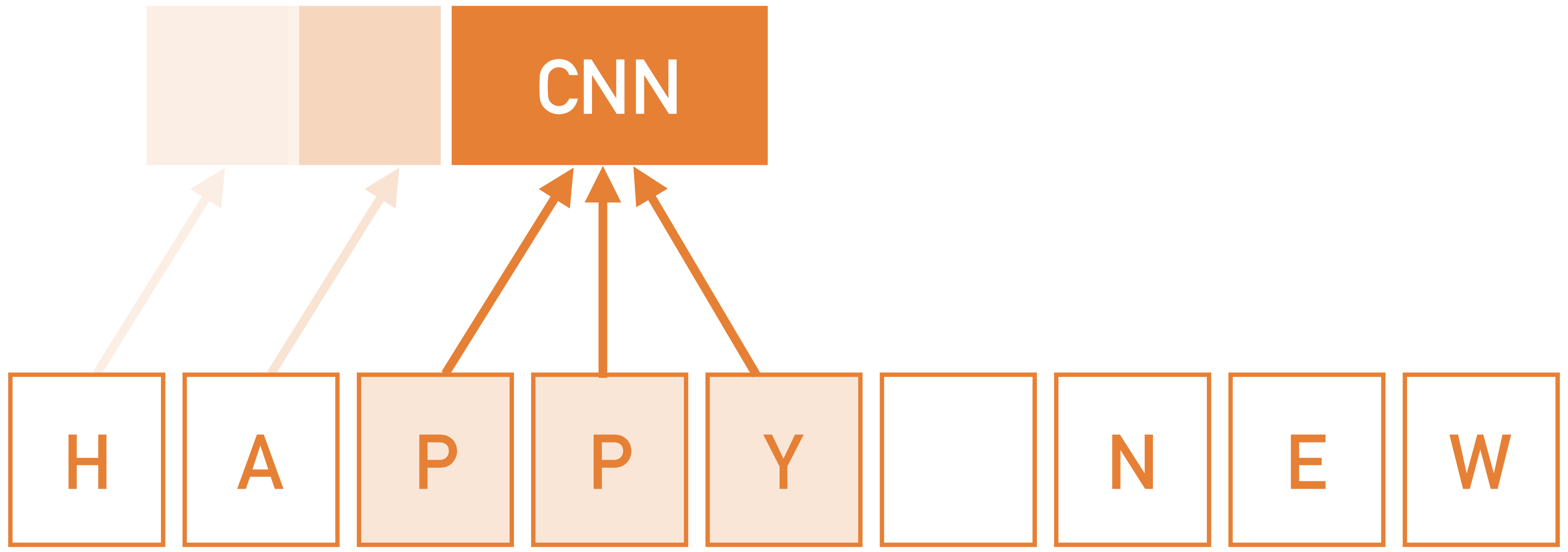
CHAR-CNN编码器

- 以词为单位的问题
  - 词典尺寸太大
  - 不规范用词：网络用语、拼写错误
  - 改进：以字符为单位？



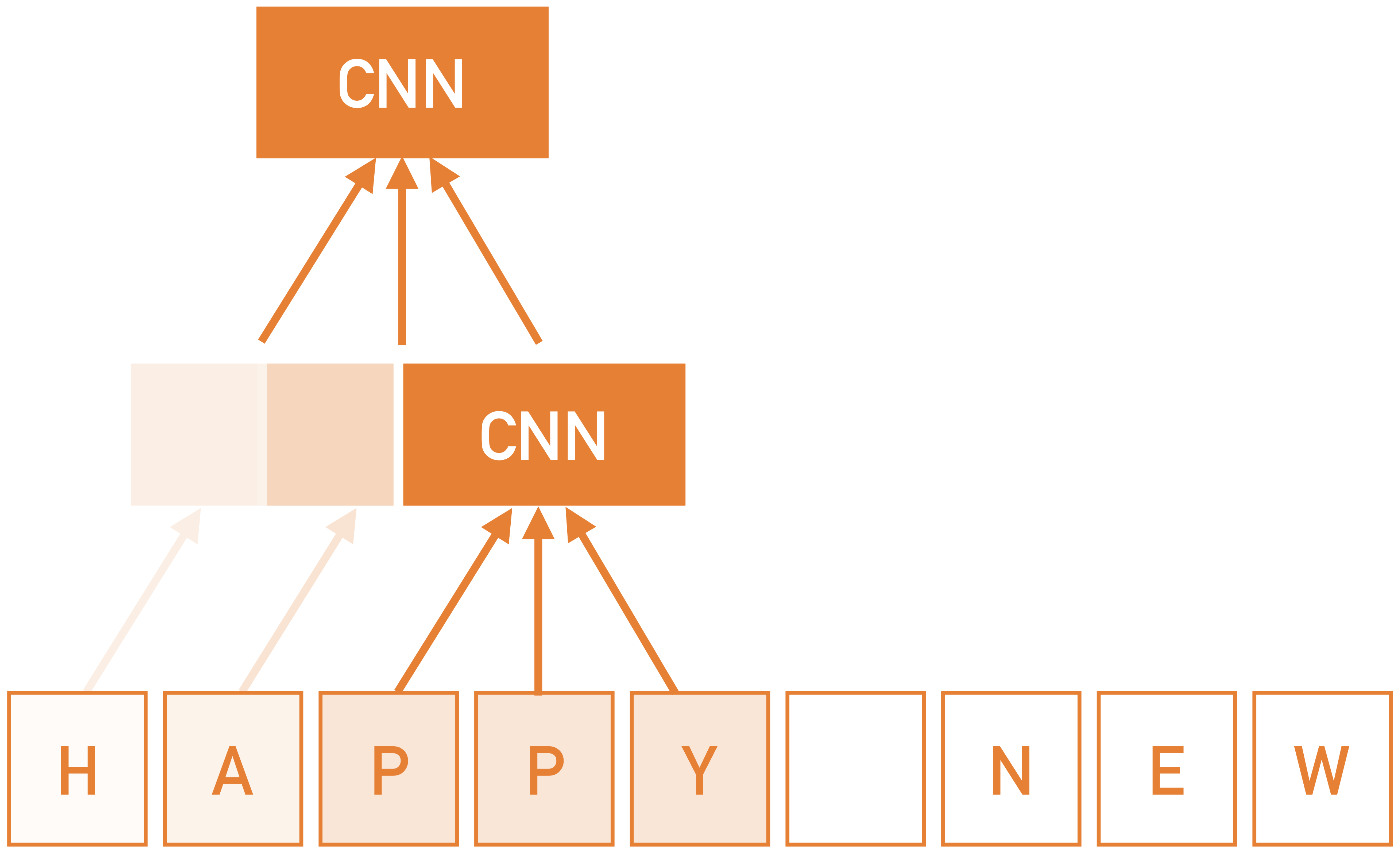
CHAR-CNN编码器

- 以词为单位的问题
- Char-CNN
  - 输入：字母序列
  - 卷积神经网络



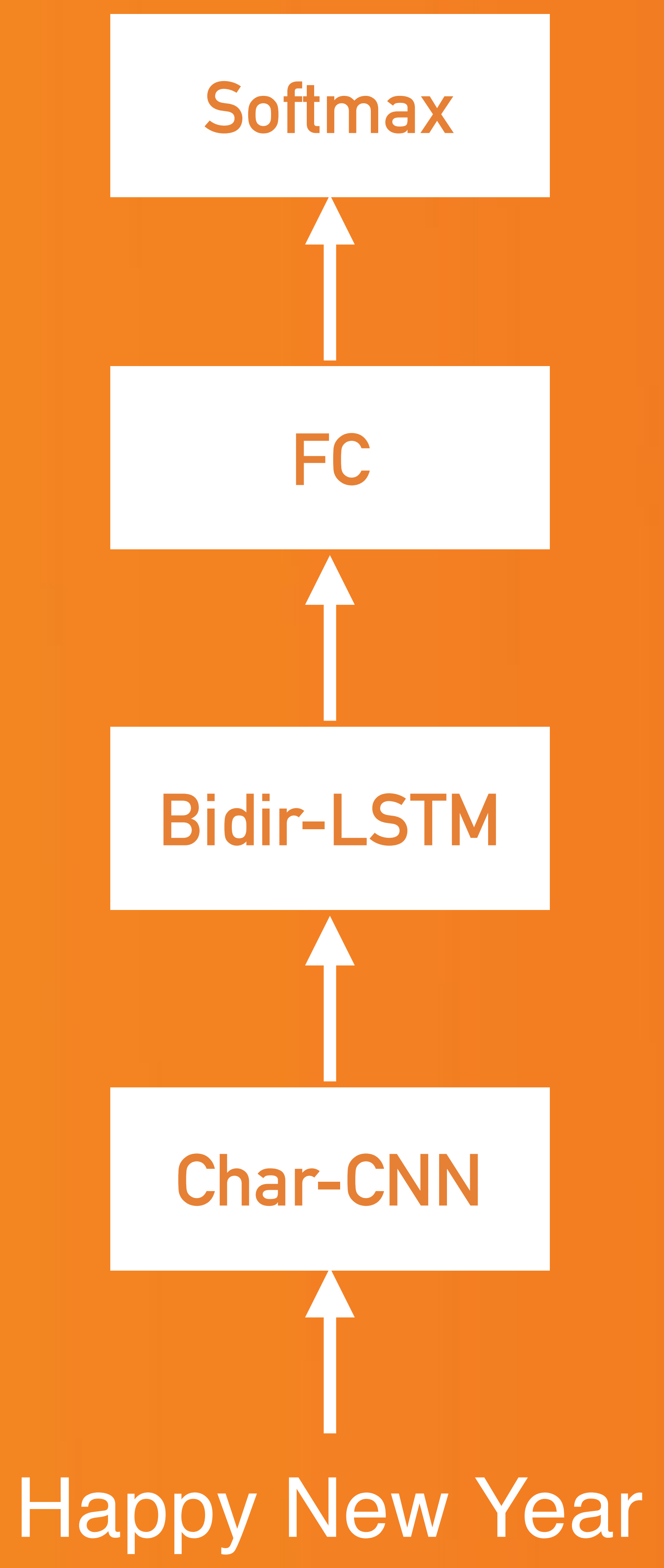
CHAR-CNN编码器

- 以词为单位的问题
- Char-CNN
  - 输入：字母序列
  - 卷积神经网络
  - 多层CNN：从字母到单词



神经网络模型

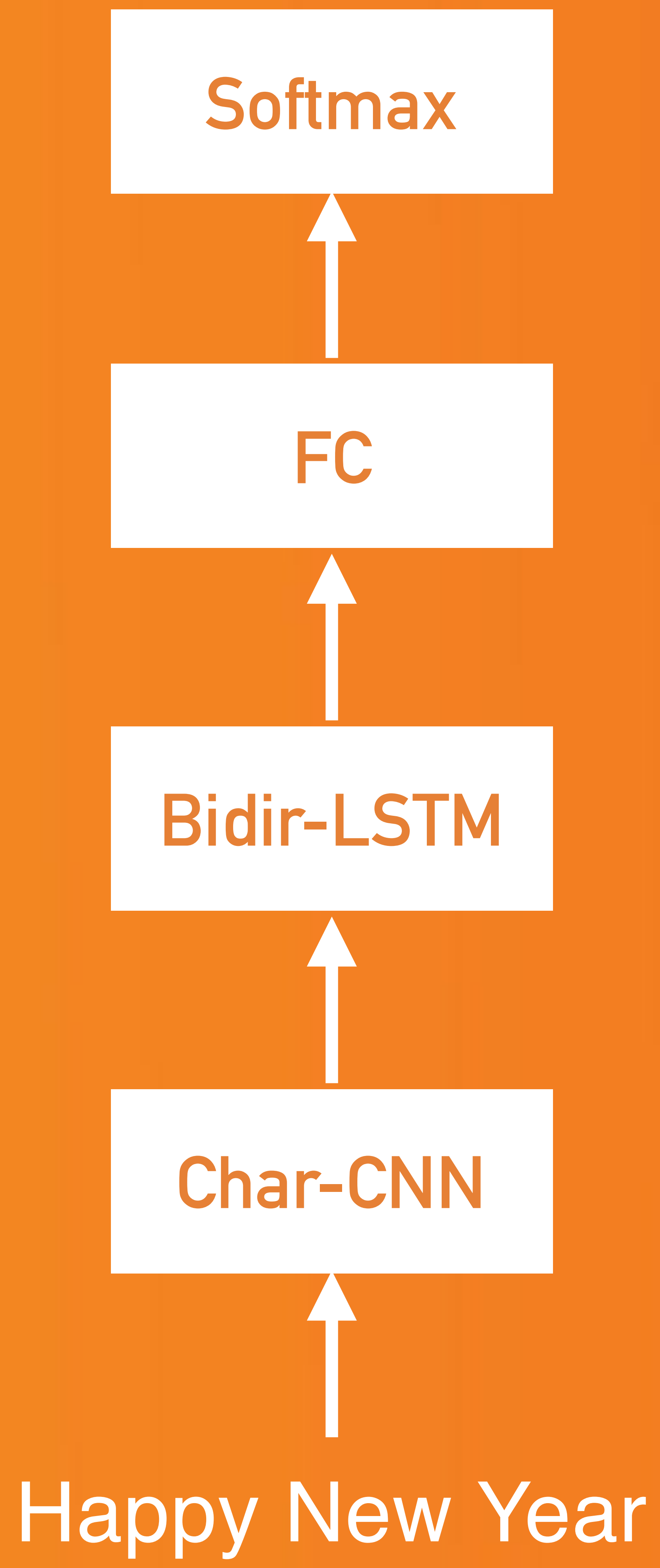
- ➤ 输入：字符序列
- ➤ Char-CNN 字符卷积网络
- ➤ 双向LSTM
- ➤ 隐含层
- ➤ 输出：预测Emoji



神经网络模型-KERAS实现

- Keras：一个对人类友好的TensorFlow前端API

http://keras.io



Softmax

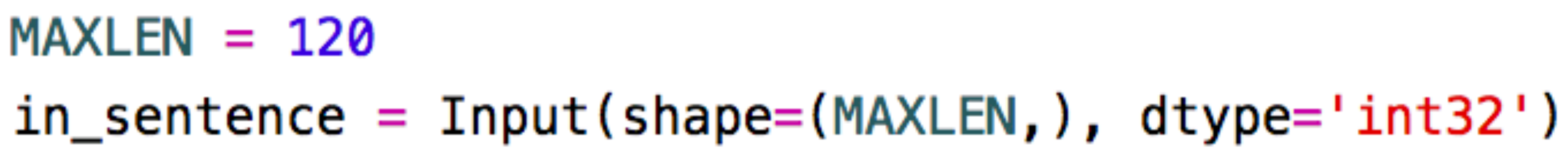
FC

Bidir-LSTM

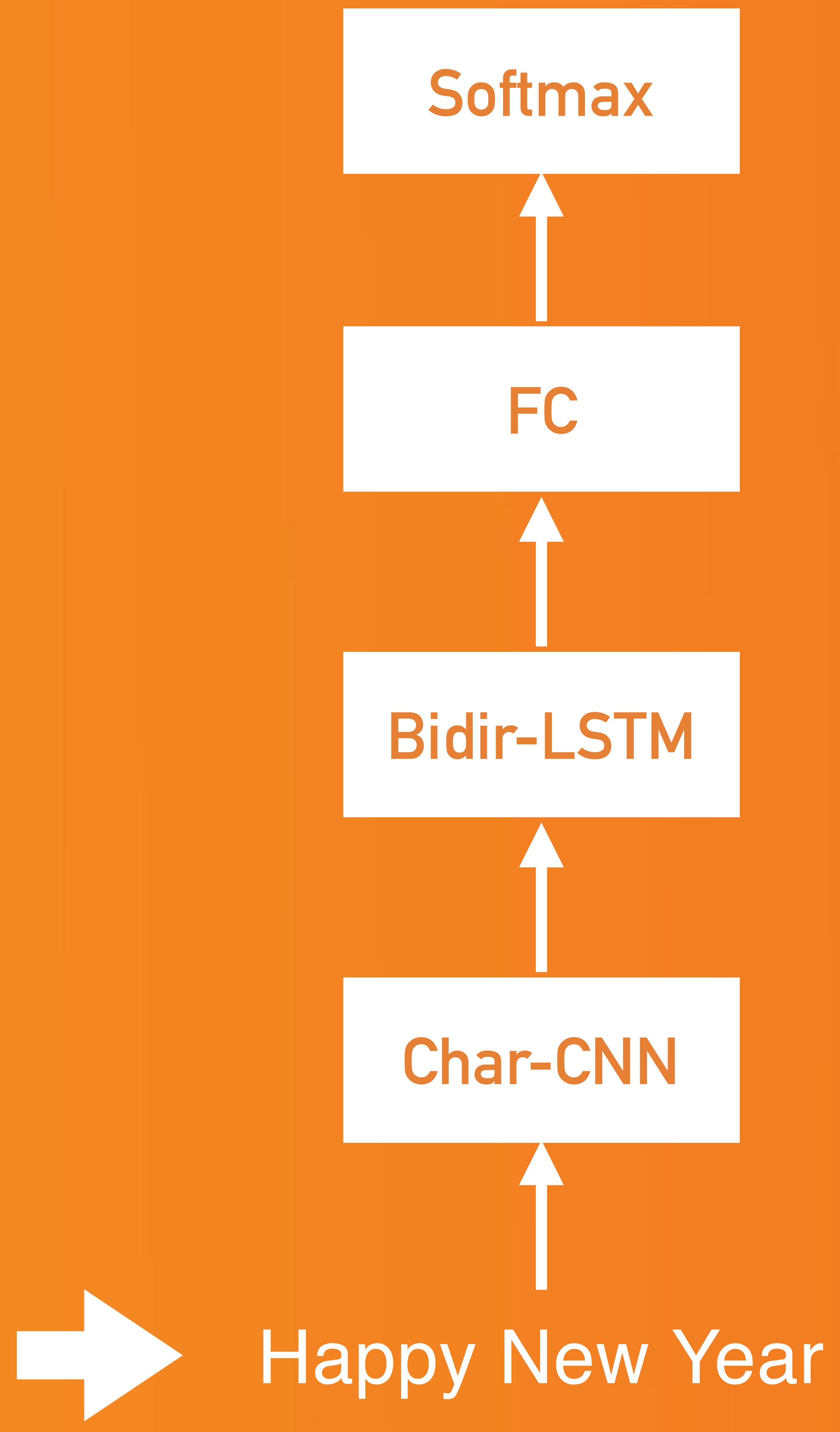
Char-CNN

Happy New Year

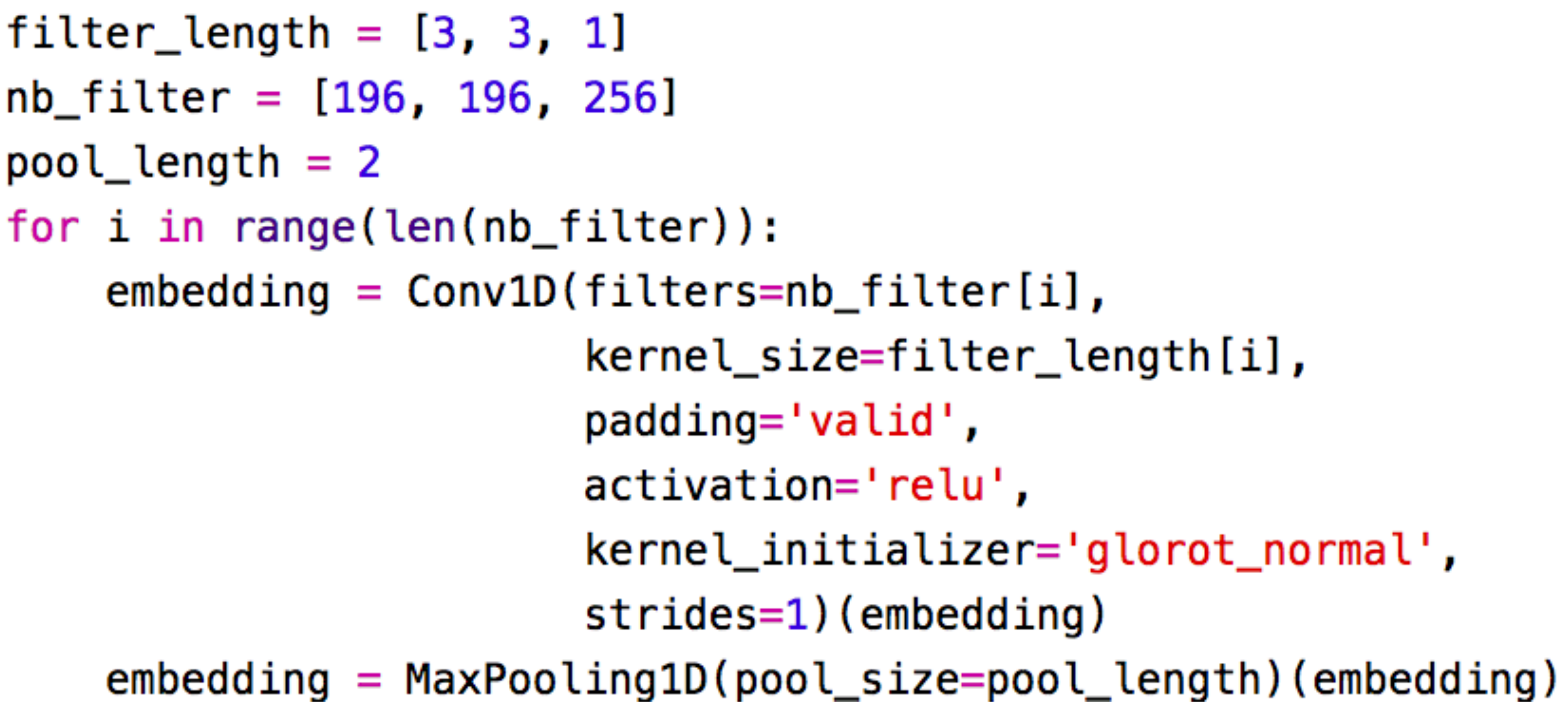
神经网络模型-KERAS实现



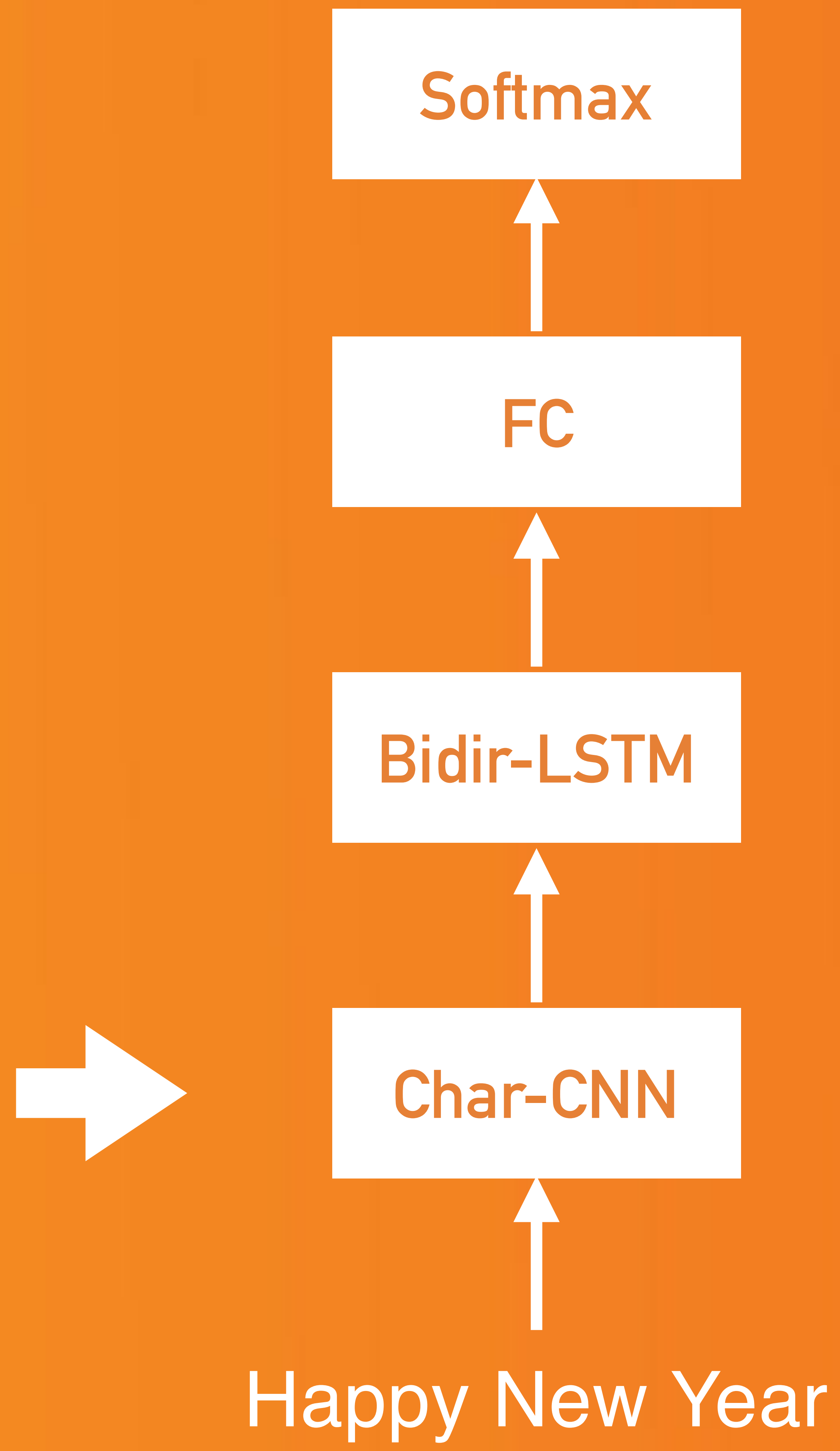
```
MAXLEN = 120
in_sentence = Input(shape=(MAXLEN,), dtype='int32')
```



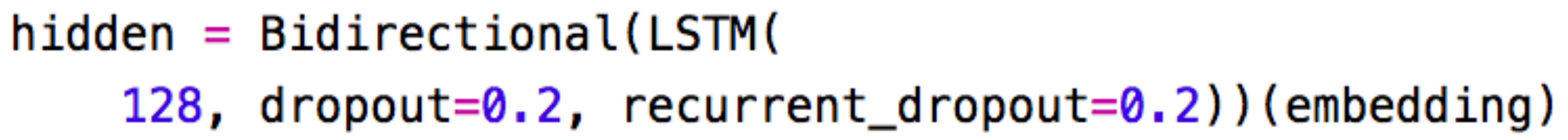
神经网络模型-KERAS实现



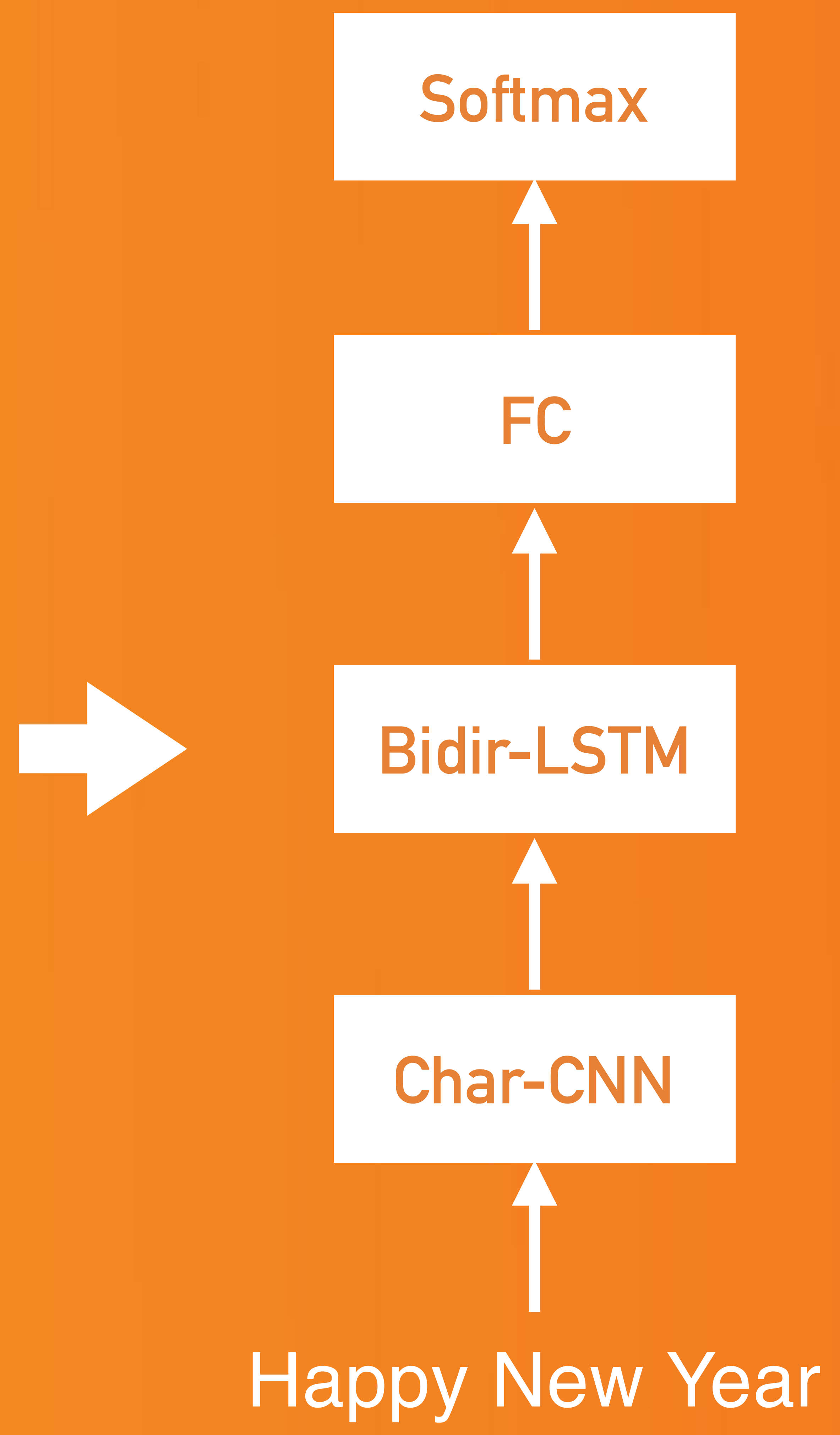
```
filter_length = [3, 3, 1]
nb_filter = [196, 196, 256]
pool_length = 2
for i in range(len(nb_filter)):
    embedding = Conv1D(filters=nb_filter[i],
                       kernel_size=filter_length[i],
                       padding='valid',
                       activation='relu',
                       kernel_initializer='glorot_normal',
                       strides=1)(embedding)
    embedding = MaxPooling1D(pool_size=pool_length)(embedding)
```



神经网络模型-KERAS实现



```
hidden = Bidirectional(LSTM(
    128, dropout=0.2, recurrent_dropout=0.2))(embedding)
```



Softmax

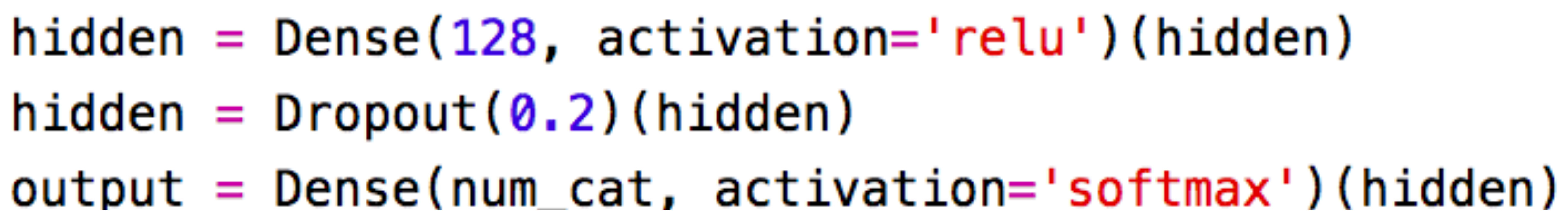
FC

Bidir-LSTM

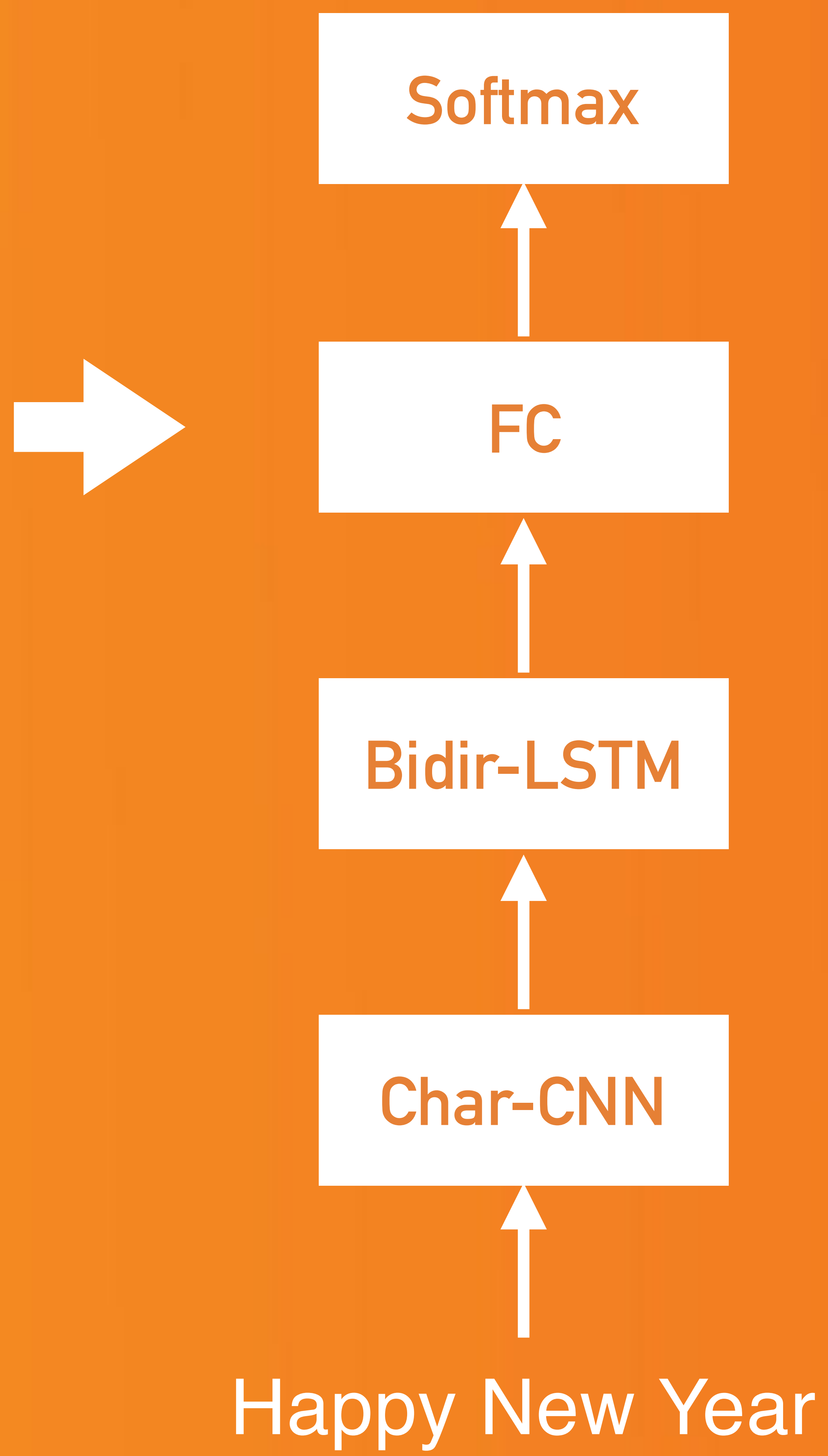
Char-CNN

Happy New Year

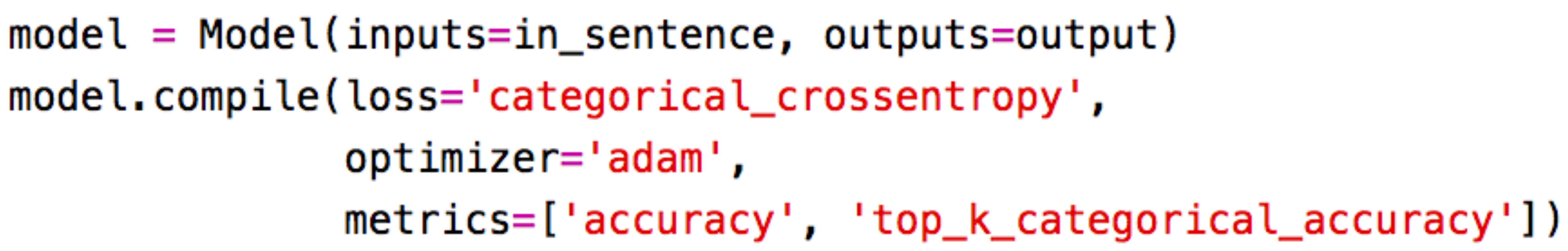
神经网络模型-KERAS实现



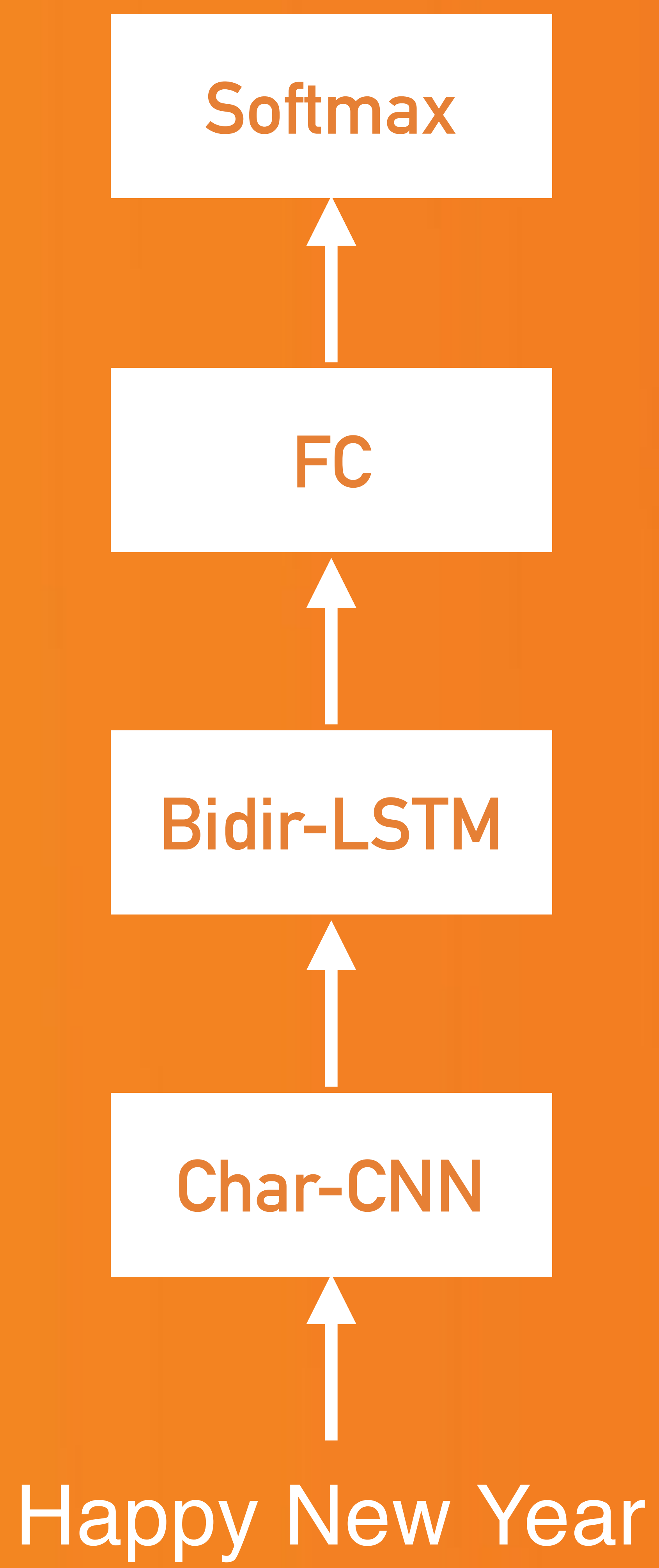
```
hidden = Dense(128, activation='relu')(hidden)
hidden = Dropout(0.2)(hidden)
output = Dense(num_cat, activation='softmax')(hidden)
```



神经网络模型-KERAS实现



```
model = Model(inputs=in_sentence, outputs=output)
model.compile(loss='categorical_crossentropy',
              optimizer='adam',
              metrics=['accuracy', 'top_k_categorical_accuracy'])
```



Softmax

FC

Bidir-LSTM

Char-CNN

Happy New Year

TensorBoard
SCALARS
IMAGES
AUDIO
GRAPHS
DISTRIBUTIONS
HISTOGRAMS
EMBEDDINGS
TEXT
Write a regex to create a tag group
3.90
3.80
3.70
3.60
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
val_top_k_categorical_accuracy
1
val_top_k_categorical_accuracy
0.420
0.410
0.400
0.390
0.380
0.370
0.360
0.350
0.340
0.330
0.320
0.310
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
STEP
RELATIVE
WALL
Write a regex to filter runs

□ Show data download links

☑ Ignore outliers in chart scaling

Tooltip sorting method: default

Smoothing 0.6

Horizontal Axis: RELATIVE

Runs

☑ ○ Graph

☑ ○ tb-chcnn-blstm

☑ ○ tb-chcnn-blstm-2fc

☑ ○ tb-chcnn-slim-blstm-2fc

☑ ○ tb-naive-embed-blstm

☑ ○ tb-naive-noembd

☑ ○ tb-naive-noembd-2lstm

☑ ○ tb-naive-noembd-blstm

	Name	Smoothed	Value	Step	Time	Relative
●	Graph	0.4088	0.4132	5.000	Sat May 6, 23:29:13	38m 57s

In [ ]:

```python
from keras.models import Model, load_model, model_from_config
from keras import backend as K
from tensorflow.contrib.session_bundle import exporter
from tensorflow.python import saved_model
import tensorflow as tf
```

In [ ]:

```python
sess = tf.Session()
K.set_session(sess)
K.set_learning_phase(0)  # all new operations will be in test mode from now on
```

In [ ]:

```python
orig_model = load_model('p5-40-test.hdf5')
weights = orig_model.get_weights()
model = model_from_config({
    'class_name': 'Model',
    'config': orig_model.get_config(),
})
model.set_weights(weights)
```

In [ ]:

```python
tf.train.write_graph(sess.graph_def, 'export/p5-40-test-serving', "graph-serving.pb", True)
```

In [ ]:

```python
saver = tf.train.Saver()
```

In [ ]:

```python
saver.save(sess, 'export/p5-40-test-serving/model-ckpt')
```

```
In [21]: run('I wanna go home and go to sleep')
Out[21]: ['😭', '😩', '🙄', '😂', '😔']

In [22]: run('happy new year! God Bless')
Out[22]: ['🎉', '❤', '🎈', '😊', '😘']

In [23]: run('HAPPY NEW YEAR here\'s to many more amazing memories')
Out[23]: ['🎉', '❤', '😘', '😊', '💕']

In [24]: run('day 1 of 365 thank you God for allowing me to see this day')
Out[24]: ['❤', '🙏', '😊', '😘', '💕']

In [26]: run('The art of knowing is knowing to "IGNORE". Good morning')
Out[26]: ['❤', '😊', '😍', '😘', '💕']
```

MOVE TO IOS

HOW TO

- 编译TensorFlow for iOS

```
tensorflow/contrib/makefile/build_all_ios.sh
```

HOW TO

- 编译TensorFlow for iOS
- 转换模型
  - 裁剪模型
  - 压缩权值（Quantization）

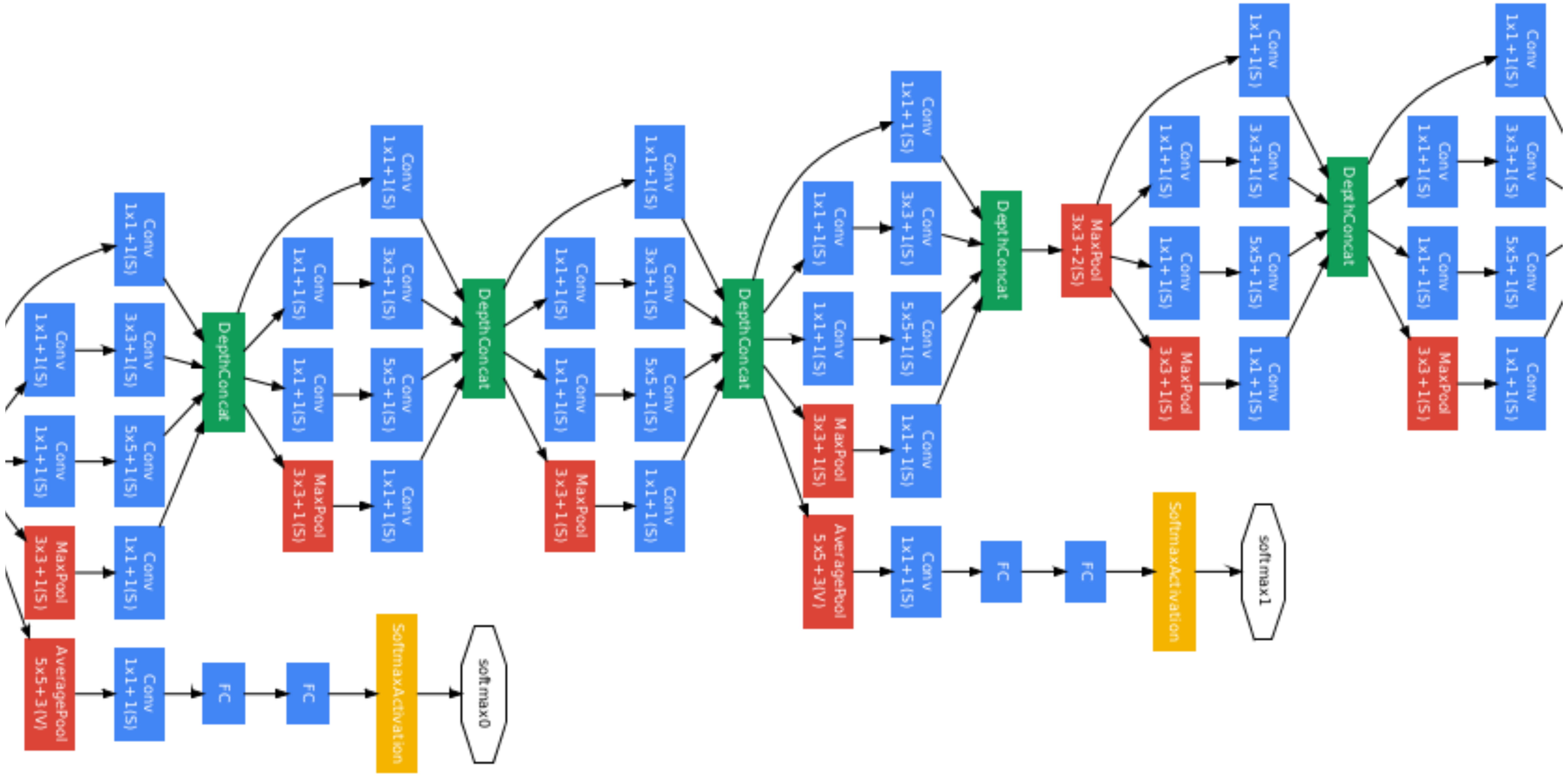
```
python3 -m tensorflow.python.tools
.freeze_graph \
  --input_graph="graph-serving.pb" \
  --input_checkpoint=“model.ckpt" \
  --output_graph="frozen.pb" \
  --output_node_names="dense_2/Softmax"
```

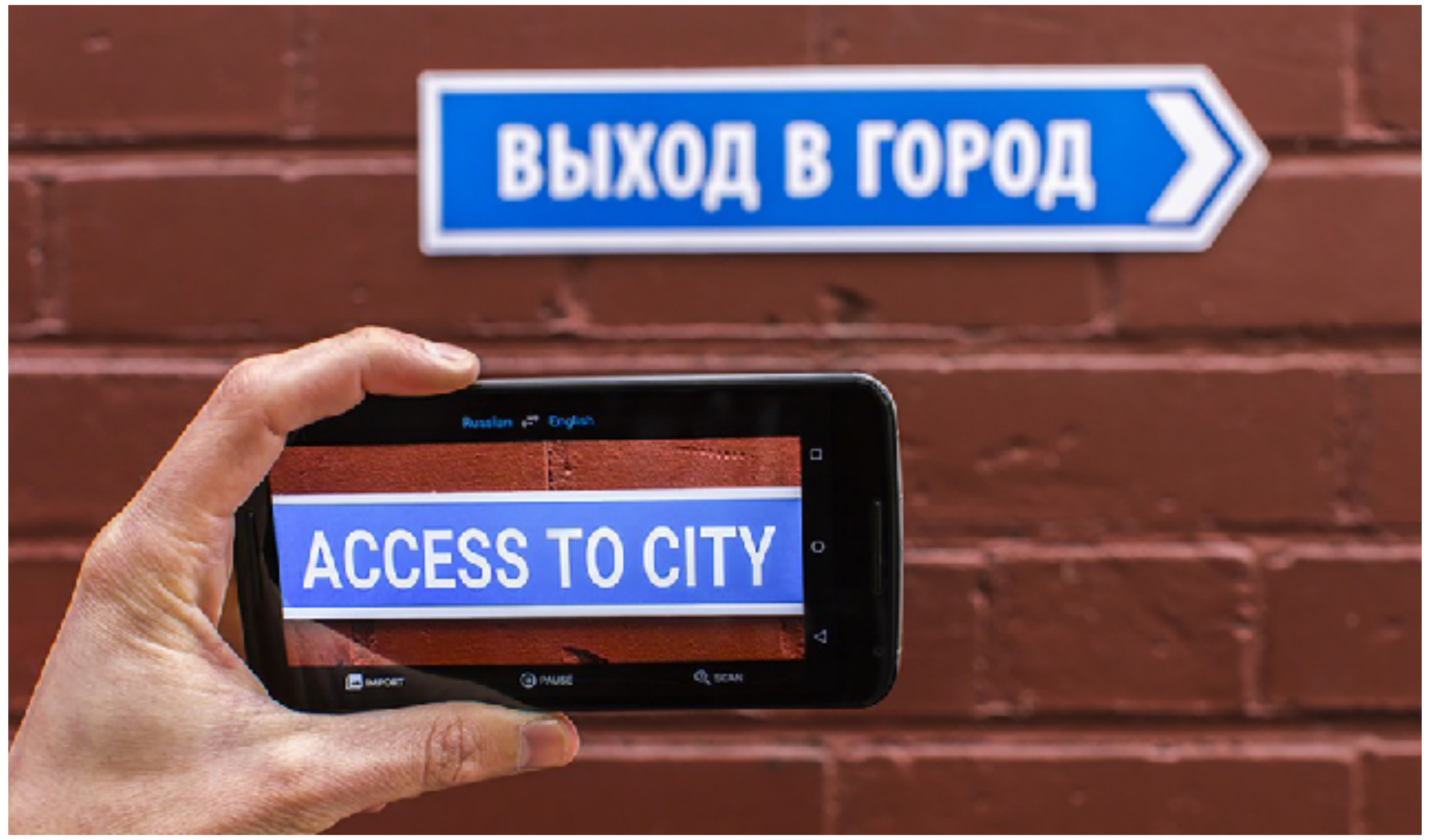
HOW TO

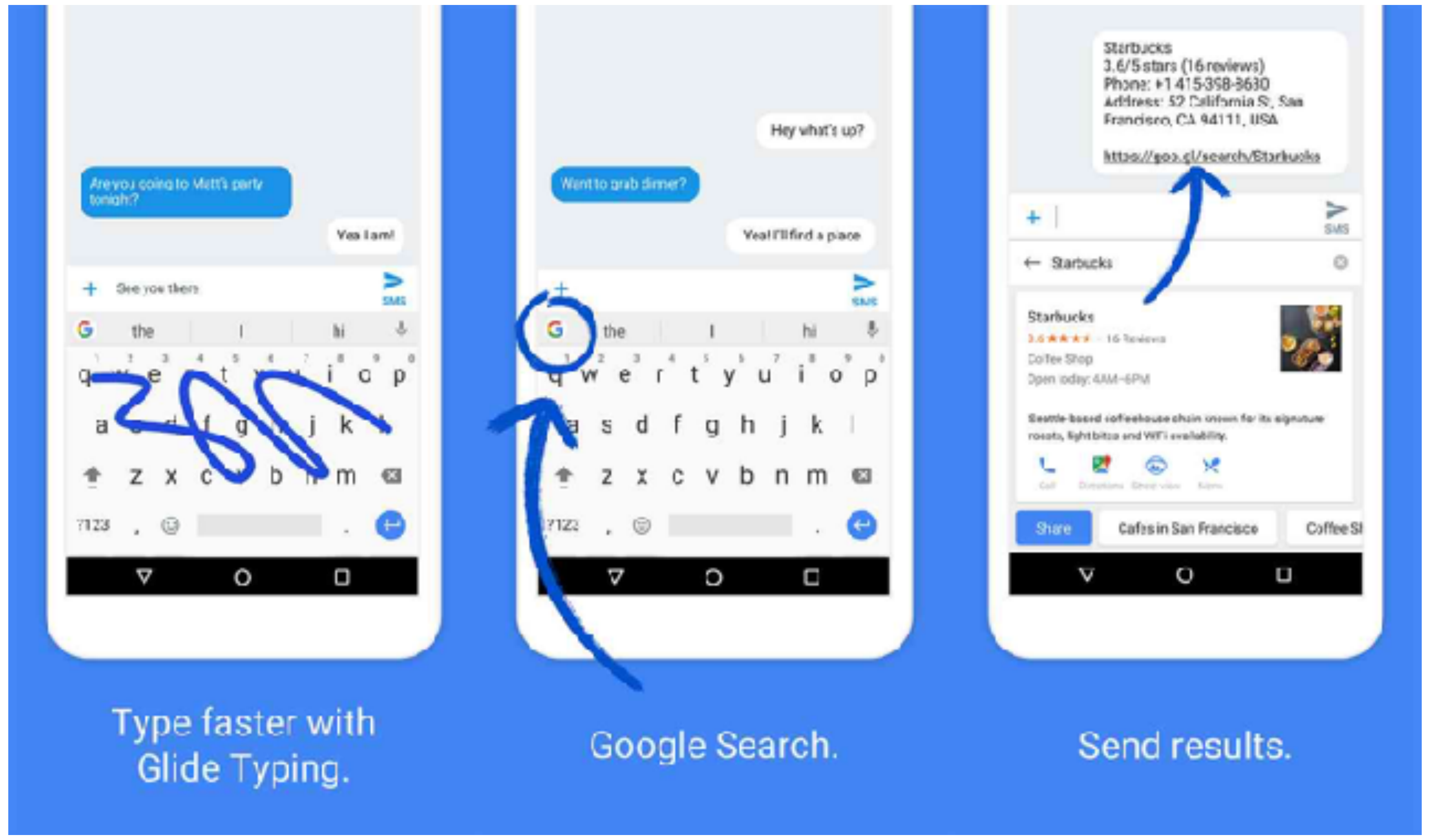
- 编译TensorFlow for iOS
- 转换模型
- 在iOS使用TensorFlow C++ API

```
tensorflow::Session* sess;
tensorflow::GraphDef graph;
PortableReadFileToProto(
    network_path, &graph);
tensorflow::NewSession(options,
    &session_pointer);
sess->Create(graph);
```

DEMO






Are you going to Matt's party tonight?

Yes I am!

See you there

Hey what's up?

Want to grab dinner?

Yeah I'll find a place

Starbucks
3.6/5 stars (16 reviews)
Phone: +1 415-358-3630
Address: 52 California St, San Francisco, CA 94111, USA
https://goo.gl/search/Starbucks

Type faster with Glide Typing.

Google Search.

Send results.

TensorFlow被用于诸多App: Google Translate, GBoard, Google Photo…

BINARY SIZE

- 默认编译12MB
- 全功能编译100+MB
- 最小化编译（InceptionV3）2MB

THE UGLY

- 缺少TensorFlow Serving
- 缺少GPU支持
- 一些遇到的坑
  - build_all_ios.sh
  - graph_optimizer.py
  - “No OpKernel found”错误

ENJOY AND MAKE YOUR APPS

h4x3rotab@gmail.com

Git repo: https://github.com/h4x3rotab/emoji-tf-ios