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text]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"nhfsl18rSqjn","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"4cf45330-2dbc-41aa-94ee-591fffb8552c"},"source":["idx[:10]"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["[42, 44, 31, 32, 27, 29, 31, 0, 0, 0]"]},"metadata":{"tags":[]},"execution\_count":8}]},{"cell\_type":"code","metadata":{"id":"r6Fk8lcASqjo","colab":{"base\_uri":"https://localhost:8080/","height":35},"outputId":"973d1ec6-0026-40cb-884d-7c0be09e8ee9"},"source":["''.join(indices\_char[i] for i in idx[:50])"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["'preface\\n\\n\\nsupposing that truth is a woman--what th'"]},"metadata":{"tags":[]},"execution\_count":9}]},{"cell\_type":"markdown","metadata":{"id":"pXrsCFcTs-R0"},"source":["## RNN with 3 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12,....."],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"MkkwRSjVSqjw","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"5690627c-2cfe-44b5-fe8d-b8d52e5d1a99"},"source":["# Stack -> List to Array\n","\n","x1 = np.stack(c1\_inp[:-2]) # array([ 0, 3, 6, 9, .....\n","x1"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["array([42, 32, 31, ..., 35, 45, 32])"]},"metadata":{"tags":[]},"execution\_count":13}]},{"cell\_type":"code","metadata":{"id":"\_lvt548ySqjx"},"source":["x2 = np.stack(c2\_inp[:-2]) # array([ 1, 4, 7, 10, .....\n","x3 = np.stack(c3\_inp[:-2]) # array([3, 6, 9, .....\n","\n","y = np.stack(c4\_inp[:-2])"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"-7Hb8IHRSqj0","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"60c42111-fa6f-4a4c-dad4-25e17d84a7d4"},"source":["x1[:4], x2[:4], 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(200297,))"]},"metadata":{"tags":[]},"execution\_count":18}]},{"cell\_type":"markdown","metadata":{"id":"kCNfN8wfrjDw"},"source":["### Input and Embedding Layer"]},{"cell\_type":"code","metadata":{"id":"GS6bHfXgSqj6"},"source":["emb\_size = 42 # hyper-parameter"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"hfs68n3MSqj8"},"source":["def embedding\_input(name, n\_in, n\_out):\n"," inp = Input(shape=(1,), dtype='int64', name=name)\n"," emb = Embedding(n\_in, n\_out, input\_length=1)(inp)\n"," return inp, Flatten()(emb)"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"Q9a0aNUCSqj-"},"source":["c1\_in, c1 = embedding\_input('c1', characters\_size, emb\_size)\n","c2\_in, c2 = embedding\_input('c2', characters\_size, emb\_size)\n","c3\_in, c3 = embedding\_input('c3', characters\_size, emb\_size)"],"execution\_count":null,"outputs":[]},{"cell\_type":"markdown","metadata":{"id":"J312NMrBSqj\_"},"source":["### Model Creation"]},{"cell\_type":"markdown","metadata":{"id":"TbjTJxbaL4Yc"},"source":["![RNN](https://i.imgur.com/wW0YuUn.jpg)\n","\n","\n","\n"]},{"cell\_type":"code","metadata":{"id":"sH\_\_wFQeSqkB"},"source":["n\_hidden = 256"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"ZjvfHLNjSqkD"},"source":["dense\_in = Dense(n\_hidden, activation='relu')\n","dense\_hidden = Dense(n\_hidden, activation='tanh')"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"nh8Kxu4WSqkF"},"source":["c1\_dense = dense\_in(c1) # wx"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"pDzPcJSASqkG"},"source":["hidden\_2 = dense\_hidden(c1\_dense) # a1\n","c2\_dense = dense\_in(c2) # wx2\n","c2\_hidden = add([c2\_dense, hidden\_2]) # a1 and wx2"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"IKYJcLsRSqkH"},"source":["c3\_dense = dense\_in(c3) # wx3\n","hidden\_3 = dense\_hidden(c2\_hidden)\n","c3\_hidden = add([c3\_dense, hidden\_3])"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"-an8ndVeSqkJ"},"source":["dense\_out = Dense(characters\_size, activation='softmax')"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"h-5iGKfGSqkL"},"source":["c4\_out = dense\_out(c3\_hidden)"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"LUpcODv8SqkO"},"source":["model = Model([c1\_in, c2\_in, c3\_in], c4\_out)"],"execution\_count":null,"outputs":[]},{"cell\_type":"markdown","metadata":{"id":"CdD0WKPcGnvd"},"source":["### Model Compiling and Training"]},{"cell\_type":"code","metadata":{"id":"WTruP6b8SqkP","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"77c9e1c2-9fdc-4122-bc4c-f1e982de89f0"},"source":["model.compile(loss='sparse\_categorical\_crossentropy', optimizer='adam')\n","model.optimizer.lr=0.000001\n","model.summary()"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Model: \"model\"\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","Layer (type) Output Shape Param # Connected to \n","==================================================================================================\n","c3 (InputLayer) [(None, 1)] 0 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","c2 (InputLayer) [(None, 1)] 0 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","c1 (InputLayer) [(None, 1)] 0 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","embedding\_2 (Embedding) (None, 1, 42) 2478 c3[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","embedding\_1 (Embedding) (None, 1, 42) 2478 c2[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","embedding (Embedding) (None, 1, 42) 2478 c1[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","flatten\_2 (Flatten) (None, 42) 0 embedding\_2[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","flatten\_1 (Flatten) (None, 42) 0 embedding\_1[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","flatten (Flatten) (None, 42) 0 embedding[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","dense (Dense) (None, 256) 11008 flatten[0][0] \n"," flatten\_1[0][0] \n"," flatten\_2[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","dense\_1 (Dense) (None, 256) 65792 dense[0][0] \n"," add[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","add (Add) (None, 256) 0 dense[1][0] \n"," dense\_1[0][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","add\_1 (Add) (None, 256) 0 dense[2][0] \n"," dense\_1[1][0] \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","dense\_2 (Dense) (None, 59) 15163 add\_1[0][0] \n","==================================================================================================\n","Total params: 99,397\n","Trainable params: 99,397\n","Non-trainable params: 0\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n"],"name":"stdout"}]},{"cell\_type":"code","metadata":{"id":"HdpcLrkhSqkR","colab":{"base\_uri":"https://localhost:8080/","height":170},"outputId":"9ef43753-c6a3-4f09-a529-997dafb7b656"},"source":["model.fit([x1, x2, x3], y, batch\_size=64, epochs=4)"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Epoch 1/4\n","3130/3130 [==============================] - 10s 3ms/step - loss: 4.0488\n","Epoch 2/4\n","3130/3130 [==============================] - 10s 3ms/step - loss: 3.9515\n","Epoch 3/4\n","3130/3130 [==============================] - 10s 3ms/step - loss: 3.7481\n","Epoch 4/4\n","3130/3130 [==============================] - 10s 3ms/step - loss: 3.4440\n"],"name":"stdout"},{"output\_type":"execute\_result","data":{"text/plain":["<tensorflow.python.keras.callbacks.History at 0x7fba20650898>"]},"metadata":{"tags":[]},"execution\_count":34}]},{"cell\_type":"markdown","metadata":{"id":"WJFQKa4HSqkS"},"source":["### Test Model"]},{"cell\_type":"code","metadata":{"id":"Nax90v4fSqkU"},"source":["def three\_chars\_next\_char(inp):\n"," idxs = [char\_indices[c] for c in inp]\n"," arrs = [np.array(i)[np.newaxis] for i in idxs]\n"," p = model.predict(arrs)\n"," i = np.argmax(p)\n"," return characters[i]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":35},"id":"EEcySNmqhdTv","outputId":"d6350d96-6be8-4467-adc6-9d79b4b17b8e"},"source":["three\_chars\_next\_char('par')"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["' '"]},"metadata":{"tags":[]},"execution\_count":34}]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":35},"id":"T8DJlycNhknV","outputId":"41c7b947-1d59-4073-b484-a13ed0c8122f"},"source":["three\_chars\_next\_char('tho')"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["' '"]},"metadata":{"tags":[]},"execution\_count":36}]},{"cell\_type":"markdown","metadata":{"id":"xr5iCXdfSqk4"},"source":["## RNN with 8 characters, using Keras"]},{"cell\_type":"markdown","metadata":{"id":"WadbhWugs6J1"},"source":["### Create inputs"]},{"cell\_type":"code","metadata":{"id":"br7TcjlBSqkX"},"source":["char\_seq\_len=8"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"Ea5fIIaMSqkZ"},"source":["c\_in\_seq = [[idx[i+n] for i in range(0, len(idx)-1-char\_seq\_len, char\_seq\_len)]\n"," for n in range(char\_seq\_len)]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"Yoxj1MzjSqkb"},"source":["c\_out\_seq = [idx[i+char\_seq\_len] for i in range(0, len(idx)-1-char\_seq\_len, char\_seq\_len)]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"PuZqRkgzSqkd"},"source":["xs = [np.stack(c[:-2]) for c in c\_in\_seq]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"VvRrQj\_gSqke","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"0dc9d304-8fdd-4cc4-e966-66fdb995cdee"},"source":["len(xs), xs[0].shape, xs[1].shape"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["(8, (75110,), (75110,))"]},"metadata":{"tags":[]},"execution\_count":19}]},{"cell\_type":"code","metadata":{"id":"x3oGkUdISqkh"},"source":["y = np.stack(c\_out\_seq[:-2])"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"iYk0T9KeSqkj","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"99d9709b-3ed8-46dd-a691-143c538b19eb"},"source":["y[:10]"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["array([ 0, 35, 1, 45, 40, 46, 1, 41, 30, 45])"]},"metadata":{"tags":[]},"execution\_count":49}]},{"cell\_type":"markdown","metadata":{"id":"ZERICajtn4xZ"},"source":["### Model Building"]},{"cell\_type":"code","metadata":{"id":"TvAZnMBtSqk7"},"source":["model=Sequential([\n"," Embedding(characters\_size, emb\_size, input\_length=char\_seq\_len),\n"," SimpleRNN(n\_hidden, activation='relu'),\n"," Dense(characters\_size, activation='softmax')\n"," ])"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"nR7RoBmISqk9","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"1aa1e173-c40f-4175-8b7f-5fd4f30e1112"},"source":["model.summary()\n","\n","# weights for SimpleRNN layer = recurrent\_weights + input\_weights + biases\n","# weights is 76544 = 256 \* 256 + 256 \* 42 + 256\n","\n","# 42 because of embedding size."],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Model: \"sequential\"\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","Layer (type) Output Shape Param # \n","=================================================================\n","embedding\_3 (Embedding) (None, 8, 42) 2478 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","simple\_rnn (SimpleRNN) (None, 256) 76544 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","dense\_3 (Dense) (None, 59) 15163 \n","=================================================================\n","Total params: 94,185\n","Trainable params: 94,185\n","Non-trainable params: 0\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n"],"name":"stdout"}]},{"cell\_type":"code","metadata":{"id":"nrNLBmu7Sqk-"},"source":["model.compile(loss='sparse\_categorical\_crossentropy', optimizer='adam')"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"EBbjXW\_0-7YS","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"5549e9f4-8a41-4005-caa6-f67b2ea64067"},"source":["xs"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["[array([42, 0, 35, ..., 45, 44, 34]),\n"," array([44, 0, 40, ..., 46, 38, 31]),\n"," array([31, 45, 33, ..., 35, 30, 1]),\n"," array([32, 47, 1, ..., 27, 1, 35]),\n"," array([27, 42, 46, ..., 40, 27, 40]),\n"," array([29, 42, 34, ..., 1, 45, 30]),\n"," array([31, 41, 27, ..., 49, 1, 35]),\n"," array([ 0, 45, 46, ..., 41, 46, 29])]"]},"metadata":{"tags":[]},"execution\_count":56}]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/"},"id":"IBAqf-oSmyRw","outputId":"338190c6-14e5-4859-ee44-b9d4660920b0"},"source":["model.fit([np.array(xs).T], y, batch\_size=64, epochs=8)"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Epoch 1/8\n","1174/1174 [==============================] - 10s 8ms/step - loss: 2.7880\n","Epoch 2/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 2.0950\n","Epoch 3/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.8716\n","Epoch 4/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.7416\n","Epoch 5/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.6412\n","Epoch 6/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.5717\n","Epoch 7/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.5171\n","Epoch 8/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.4663\n"],"name":"stdout"},{"output\_type":"execute\_result","data":{"text/plain":["<tensorflow.python.keras.callbacks.History at 0x7ff452ab20f0>"]},"metadata":{"tags":[]},"execution\_count":57}]},{"cell\_type":"markdown","metadata":{"id":"KR8Ky2S7p7Fp"},"source":["### Model Testing"]},{"cell\_type":"code","metadata":{"id":"V0i8ZJK4SqlD"},"source":["def eight\_chars\_next\_char(inp):\n"," idxs = [char\_indices[c] for c in inp]\n"," arrs = np.array(idxs)[np.newaxis,:]\n"," p = model.predict(arrs)[0]\n"," return characters[np.argmax(p)]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":35},"id":"PkHKLUlSnGhB","outputId":"027c09f1-e6e6-4c92-d6f0-fe30dd5bf5a8"},"source":["eight\_chars\_next\_char('this is ')"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["'t'"]},"metadata":{"tags":[]},"execution\_count":59}]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":35},"id":"xNDypCTLnI16","outputId":"948b526c-8f98-425a-992d-b789ec53b8ff"},"source":["eight\_chars\_next\_char('part of ')"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["'t'"]},"metadata":{"tags":[]},"execution\_count":60}]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/","height":35},"id":"HpmeC2XvnI4H","outputId":"f2f5185a-051a-47b4-de30-137b82ca8064"},"source":["eight\_chars\_next\_char('queens a')"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"application/vnd.google.colaboratory.intrinsic+json":{"type":"string"},"text/plain":["'n'"]},"metadata":{"tags":[]},"execution\_count":61}]},{"cell\_type":"markdown","metadata":{"id":"JmqtSf7jQT1\_"},"source":["## Sequence to Sequence -- Returning sequence, using Keras"]},{"cell\_type":"markdown","metadata":{"id":"kO-oBIvXQYy6"},"source":["### Creating Inputs and Outputs\n"]},{"cell\_type":"code","metadata":{"id":"ElH-d7H5QkKy"},"source":["c\_out\_seq = [[idx[i+n] for i in range(1, len(idx)-char\_seq\_len, char\_seq\_len)]\n"," for n in range(char\_seq\_len)]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"OUVFwgqPQp4G"},"source":["ys = [np.stack(c[:-2]) for c in c\_out\_seq]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"q9YQK7Ykn0yT","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"11970462-089c-4b58-9730-87208957e2ec"},"source":["ys"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["[array([44, 0, 40, ..., 46, 38, 31]),\n"," array([31, 45, 33, ..., 35, 30, 1]),\n"," array([32, 47, 1, ..., 27, 1, 35]),\n"," array([27, 42, 46, ..., 40, 27, 40]),\n"," array([29, 42, 34, ..., 1, 45, 30]),\n"," array([31, 41, 27, ..., 49, 1, 35]),\n"," array([ 0, 45, 46, ..., 41, 46, 29]),\n"," array([ 0, 35, 1, ..., 44, 34, 27])]"]},"metadata":{"tags":[]},"execution\_count":42}]},{"cell\_type":"code","metadata":{"id":"-XVAF-coj4h8","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"82ce9213-c49c-4760-cbc4-098f85fbc7d1"},"source":["xs"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["[array([42, 0, 35, ..., 45, 44, 34]),\n"," array([44, 0, 40, ..., 46, 38, 31]),\n"," array([31, 45, 33, ..., 35, 30, 1]),\n"," array([32, 47, 1, ..., 27, 1, 35]),\n"," array([27, 42, 46, ..., 40, 27, 40]),\n"," array([29, 42, 34, ..., 1, 45, 30]),\n"," array([31, 41, 27, ..., 49, 1, 35]),\n"," array([ 0, 45, 46, ..., 41, 46, 29])]"]},"metadata":{"tags":[]},"execution\_count":43}]},{"cell\_type":"code","metadata":{"id":"ZZiZiMzljDZB"},"source":["x\_rnn=np.stack(np.squeeze(xs), axis=1)\n","y\_rnn=np.atleast\_3d(np.stack(ys, axis=1))"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"Wn53jSAgjDW9","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"cb3d1426-7607-4993-cab3-083bd0700c44"},"source":["x\_rnn.shape, y\_rnn.shape"],"execution\_count":null,"outputs":[{"output\_type":"execute\_result","data":{"text/plain":["((75110, 8), (75110, 8, 1))"]},"metadata":{"tags":[]},"execution\_count":33}]},{"cell\_type":"markdown","metadata":{"id":"ZaAHBA\_0h6vw"},"source":["### Model Building"]},{"cell\_type":"code","metadata":{"id":"WPx0wDrgiY6k"},"source":["model=Sequential([\n"," Embedding(characters\_size, emb\_size, input\_length=char\_seq\_len),\n"," SimpleRNN(n\_hidden, return\_sequences=True, activation='relu'),\n"," TimeDistributed(Dense(characters\_size, activation='softmax')),\n"," ])"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"id":"0lnxulizi9Kt","colab":{"base\_uri":"https://localhost:8080/"},"outputId":"86cb9203-53bc-4af3-bd18-cdc04ebd706e"},"source":["model.summary()"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Model: \"sequential\"\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","Layer (type) Output Shape Param # \n","=================================================================\n","embedding (Embedding) (None, 8, 42) 2478 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","simple\_rnn (SimpleRNN) (None, 8, 256) 76544 \n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n","time\_distributed (TimeDistri (None, 8, 59) 15163 \n","=================================================================\n","Total params: 94,185\n","Trainable params: 94,185\n","Non-trainable params: 0\n","\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\n"],"name":"stdout"}]},{"cell\_type":"code","metadata":{"id":"qvM76yj8i\_we"},"source":["model.compile(loss='sparse\_categorical\_crossentropy', optimizer='adam')"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/"},"id":"i9YXImZDjyXf","outputId":"9886382a-929c-4763-ba61-98bc5bd79b5f"},"source":["model.fit(x\_rnn, y\_rnn, batch\_size=64, epochs=8)"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["Epoch 1/8\n","1174/1174 [==============================] - 12s 8ms/step - loss: 2.6136\n","Epoch 2/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.9550\n","Epoch 3/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.8316\n","Epoch 4/8\n","1174/1174 [==============================] - 10s 8ms/step - loss: 1.7772\n","Epoch 5/8\n","1174/1174 [==============================] - 10s 9ms/step - loss: 1.7383\n","Epoch 6/8\n","1174/1174 [==============================] - 10s 9ms/step - loss: 1.7156\n","Epoch 7/8\n","1174/1174 [==============================] - 10s 8ms/step - loss: 1.6956\n","Epoch 8/8\n","1174/1174 [==============================] - 9s 8ms/step - loss: 1.6837\n"],"name":"stdout"},{"output\_type":"execute\_result","data":{"text/plain":["<tensorflow.python.keras.callbacks.History at 0x7f4672c67588>"]},"metadata":{"tags":[]},"execution\_count":34}]},{"cell\_type":"markdown","metadata":{"id":"0DIB7lFKQaP0"},"source":["### Model Testing"]},{"cell\_type":"code","metadata":{"id":"JIOXvXCfluMl"},"source":["def get\_seq2seq(inp):\n"," idxs = [char\_indices[c] for c in inp]\n"," arr = np.array(idxs)[np.newaxis,:]\n"," p = model.predict(arr)[0]\n"," print(list(inp))\n"," return [characters[np.argmax(o)] for o in p]"],"execution\_count":null,"outputs":[]},{"cell\_type":"code","metadata":{"colab":{"base\_uri":"https://localhost:8080/"},"id":"btDJZCb2j9YC","outputId":"22249bf7-632d-4759-b310-695e7c1cec94"},"source":["get\_seq2seq(' this is')"],"execution\_count":null,"outputs":[{"output\_type":"stream","text":["[' ', 't', 'h', 'i', 's', ' ', 'i', 's']\n"],"name":"stdout"},{"output\_type":"execute\_result","data":{"text/plain":["['t', 'h', 'e', 's', ' ', 'a', 's', ' ']"]},"metadata":{"tags":[]},"execution\_count":36}]}]}