MIDTERM 3
ASSIGNMENT 4

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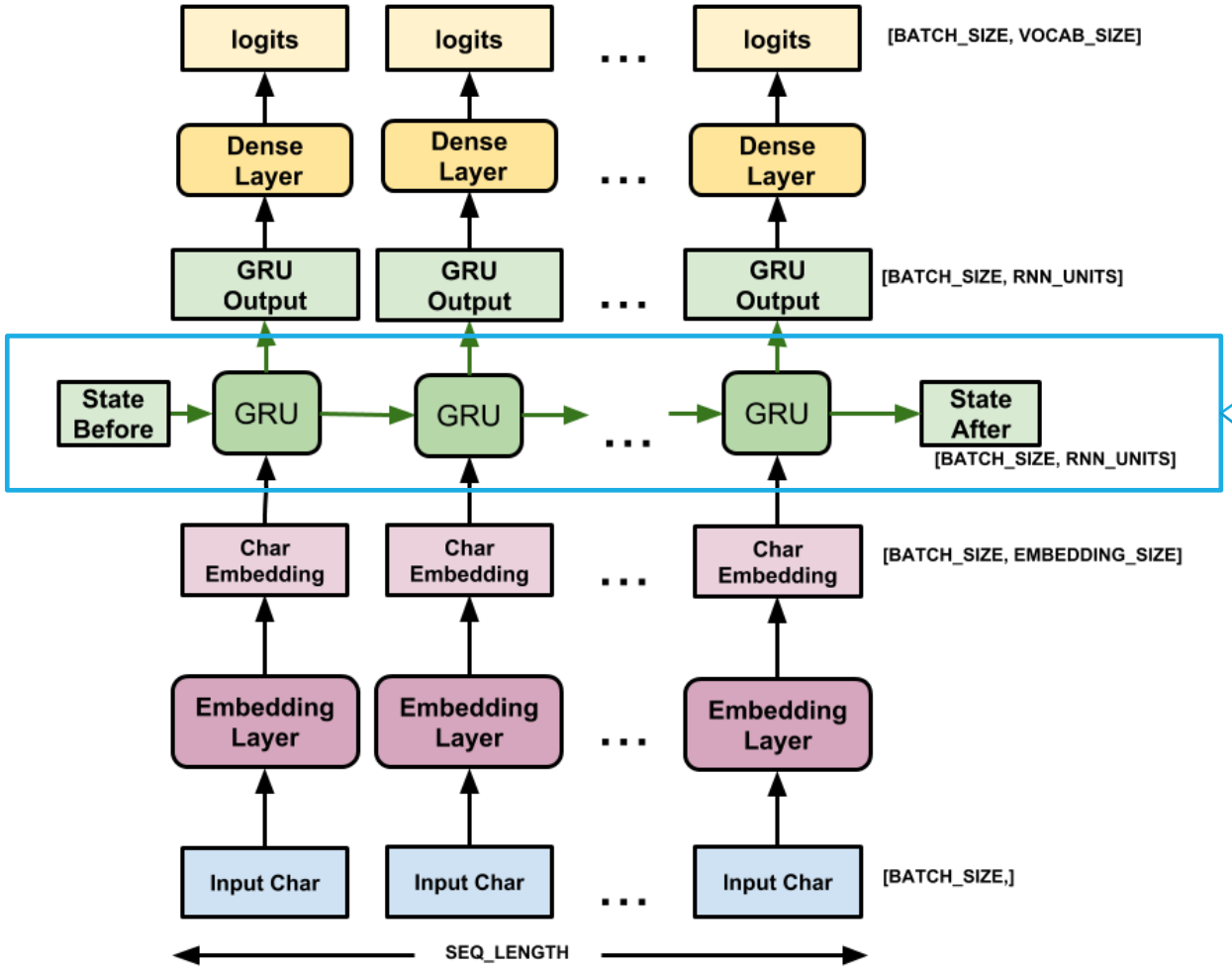
DanteAI

Beatrice luci di riva,
e vedel ch'i' rimati li vidici fere.
E che suo calda in cio solondo.
Ma per che di salieme stenseggia;
e quella parea
che sane e diri,
son v'arrimo i sentere d'unghe
nel tutto 'hi cosa il cortare!

CHAR-RNN - ARCHITECTURE



Could vary between:

- *Vanilla RNN*
- *GRU*
- *LSTM*

Use more than one layer of recurrent units

CHAR-RNN - CODE

```python
class CharRNN(nn.Module):
    def __init__(self, input_size, hidden_size, output_size, model="gru", n_layers=1,
     dropout=0, gpu=True, batch_size=32, chunk_len=30, learning_rate=0.001, optimizer="adam"):
        super(CharRNN, self).__init__()
        self.model = model.lower()
        self.input_size = input_size
        self.hidden_size = hidden_size
        self.output_size = output_size
        self.n_layers = n_layers
        self.gpu = gpu
        self.batch_size = batch_size
        self.chunk_len = chunk_len
        self.optimizer = optimizer

        self.encoder = nn.Embedding(input_size, hidden_size)

        if self.model == "gru":
            self.rnn = nn.GRU(hidden_size, hidden_size, n_layers, dropout=dropout)
        elif self.model == "lstm":
            self.rnn = nn.LSTM(hidden_size, hidden_size, n_layers, dropout=dropout)
        elif self.model == "rnn":
            self.rnn = nn.RNN(hidden_size, hidden_size, n_layers, dropout=dropout)

        self.decoder = nn.Linear(hidden_size, output_size)

        if self.optimizer == "adam":
            self.optimizer = torch.optim.Adam(self.parameters(), lr=learning_rate)
        elif self.optimizer == "rms":
            self.optimizer = torch.optim.RMSprop(self.parameters(), lr=learning_rate)
        self.criterion = nn.CrossEntropyLoss()
        if self.gpu:
            self.cuda()

    def forward(self, input, hidden):
        batch_size = input.size(0)
        encoded = self.encoder(input)
        output, hidden = self.rnn(encoded.view(1, batch_size, -1), hidden)
        output = self.decoder(output.view(batch_size, -1))
        return output, hidden
```

```python
def train(self,inp, target, validation):
    self.zero_grad()
    loss = 0
    accuracy = 0
    hidden = self.init_hidden(self.batch_size)
    if self.cuda:
        if self.model == "gru" or self.model == "rnn":
            hidden = hidden.cuda()
        else:
            hidden = (hidden[0].cuda(), hidden[1].cuda())
    for c in range(self.chunk_len):
        output, hidden = self(inp[:, c], hidden)
        _, predicted = torch.max(output.view(self.batch_size, -1).data, 1)
        accuracy += (predicted == target[:, c]).sum().item()
        loss += self.criterion(output.view(self.batch_size, -1), target[:, c])
    if not validation:
        loss.backward()
        self.optimizer.step()
    currentLoss = loss.item()/(self.chunk_len*predicted.size(0))
    currentAcc = accuracy/(self.chunk_len*predicted.size(0))
    return currentLoss, currentAcc
```

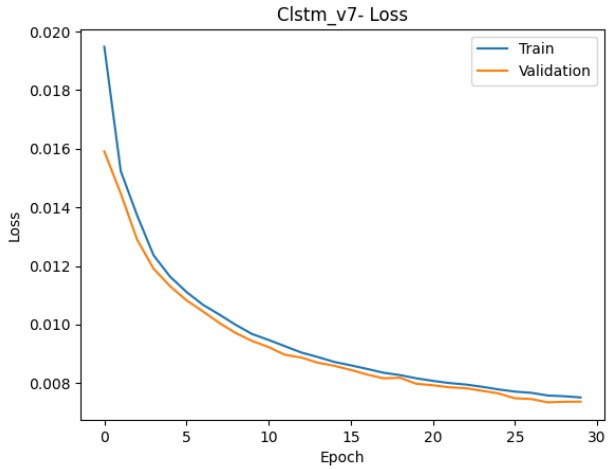
Test one character at the time for a batch

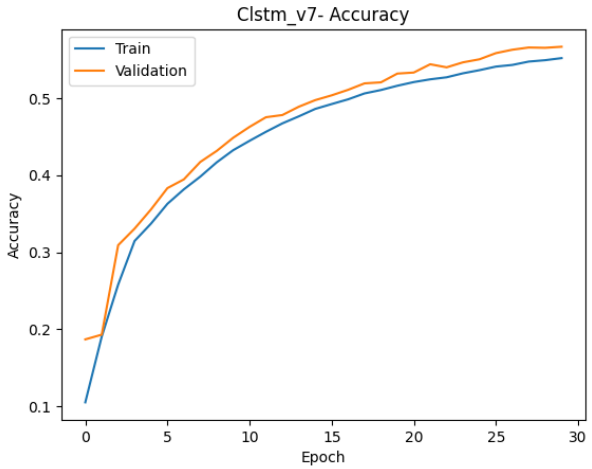
In this implementation *teacher forcing* is always present

CHAR-RNN: CLINTON RESULTS

Model architecture:

- *"n_epochs": 30,*
- *"hidden_size": 1024,*
- *"n_layers": 1,*
- *"dropout": 0.3,*
- *"learning_rate": 0.01,*
- *"chunk_len": 300,*
- *"batch_size": 200*





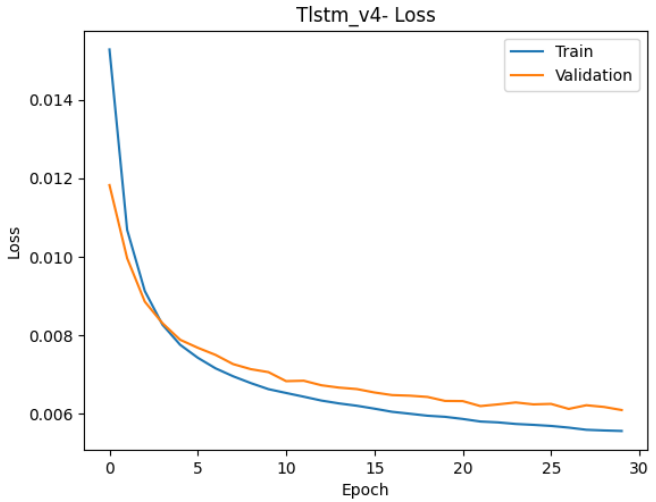
I believe in beginning. And where we've got to stand what Donald Trump says it take it was really be disturbing Americans, and I don't know imagine a responsibility. So that's why we are in the time, includes out. So make unify outsides and coming to work and steady that inclusively to the ends today. We've got to go once and especially young to pay back here's 7 p.m.

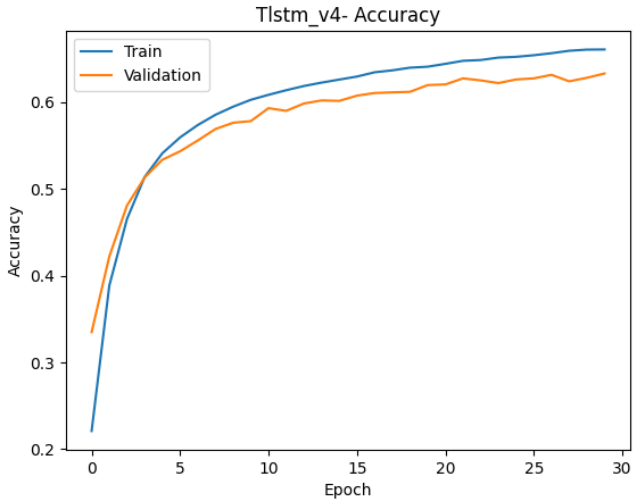
I think about it. That's what this is find the wonderving out and our people and we women's right children and build a case to figure way and the next time we all key a business, Donald Trump, voting. And I believe -- and maybe we want to a woman. Let's owe in the opportunities with them to make it be able to go to get history of the way, but so classifigation to deleadership and a kind of the reasons, indiversity to acknown before we're going to rejects but me by their best frontly an a lot of a take it a single day maybe.

CHAR-RNN: TRUMP RESULTS

Model architecture:

- *"n_epochs": 30,*
- *"hidden_size": 1024,*
- *"n_layers": 2,*
- *"dropout": 0.5,*
- *"learning_rate": 0.001,*
- *"chunk_len": 300,*
- *"batch_size": 200*





I believe the most incredible state, think of it. No work so close and violent warming into the White House. We are going to reduce the arena, and we started winning again, and all over the presidents who can have the great people or that the people lost this very compleated, then you have the money with them in, our country are not having to say it. I want to do things in the United States.

I think that was a bad devaluation of terrorism into the military. And you could not let it come an aid through the rook Mosul in continue is to be very rich. This is a mess of the massive space. She was supposed to do it to be with one of the most different country. And that's what I say it, it was doing grews and we have an endorsements. They go down a two million much of our Second Amendment, then we remember in this room come in and said that believe me, that's why I put him to be somebbed your country.

CHAR-RNN – CLINTON & TRUMP Q&A

We can try to ask at each model about their opponent and see what they think

TRUMP

Hillary Clinton's policies have been shot in the oil. And I can't believe we're going to do this. We are going to end government correct. I wanted to save our communities. She unlast you ever seen this is the star of checking, electric child in this room and the favorite men or gone for each other and they just have to come in. You're so home to secret attacks for these communities. And our country leval is a very dingration of what then any other country, and you know what it is?

CLINTON

Donald Trump said is still all about all of the power or a State House we are up to stay to defend it will work together. Because it there's an it anybody who are we stands that when Donald Trump is it. I -- I promise and inclusive, but I guever been have done more not college again, that would here at the biggest every day better who the law really ways of those major speak happy to figure out and order Michigan is to live up and another, we have his advocating for those just to put the world, not just those freed.

CHAR-RNN – KERAS MODELS GENERATION

Training the model over ***more structured data*** there is an improvement in the performance.

The model rapidly adapts to the structure

Looking for a model to solve your task? Just ask for it!
(Attention: they might not compile)

```
generate.py .\Save\keras_models_task_Kv3.pt --prime_str "<Classification>"
```

```
<Classification>
model = keras.Sequential([
keras.Input(shape=(image_size, image_size, image_channels)),
layers.Conv2D(width, kernel_size=3, strides=1, activation="relu"),
layers.Flatten(),
layers.Dense(width, activation="softmax"),
])
```

```
<Classification>
model = keras.Sequential([
layers.Dense(1024, activation='relu'),
layers.Dropout(0.2),
layers.Dense(128, activation='leaky_relu'),
layers.Dense(512, activation='relu'),
layers.Dense(256, activation='leaky_relu'),
layers.Dropout(0.2),
layers.Dense(256, activation='relu'),
layers.Dense(5, activation='softmax"),
])
```

```
generate.py .\Save\keras_models_task_Kv3.pt --prime_str "<Regression>"
```

```
<Regression>
model = keras.Sequential([
layers.Conv2D(4, (5, 5), activation="relu", input_shape=(28, 28)),
tf.keras.layers.Dense(16, activation='tanh'),
layers.Dense(64, activation='tanh'),
layers.Dense(64, activation='tanh'),
layers.Dense(64, activation='tanh'),
layers.Dense(64, activation='tanh'),
layers.Dense(1)
])
```

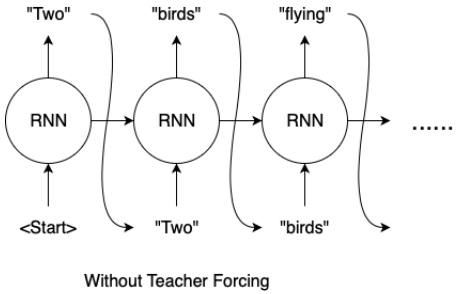
```
<Regression>
model = keras.Sequential([
keras.Input(shape=(latent_dim,)),
layers.Dense(8 * 8 * 128),
layers.Reshape((8, 8, 128)),
layers.Conv2DTranspose(64, kernel_size=4, strides=2, padding="same"),
layers.LeakyReLU(alpha=0.2),
layers.MaxPooling2D(pool_size=(2, 2)),
layers.Conv2D(64, kernel_size=(3, 3), activation="relu"),
layers.MaxPooling2D(pool_size=(2, 2)),
layers.Flatten(),
layers.Dropout(0.5),
layers.Dense(num_classes, activation="softmax"),
])
```

CHAR-RNN – VANISHING TEACHER FORCING

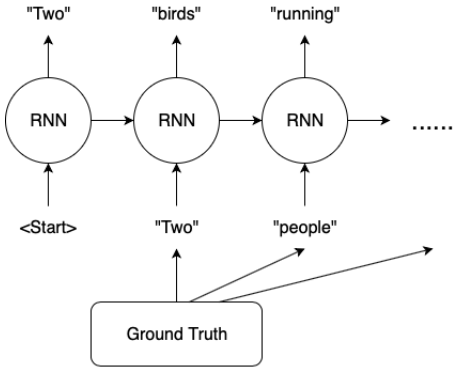
Default implementation used *teacher forcing* by default during all the training.

What happens if we try to remove the use of the teacher input and feed as next input the previously predicted character?

Removing completely teacher forcing would lead to models that do not perfom well, highly instable and slow to converge



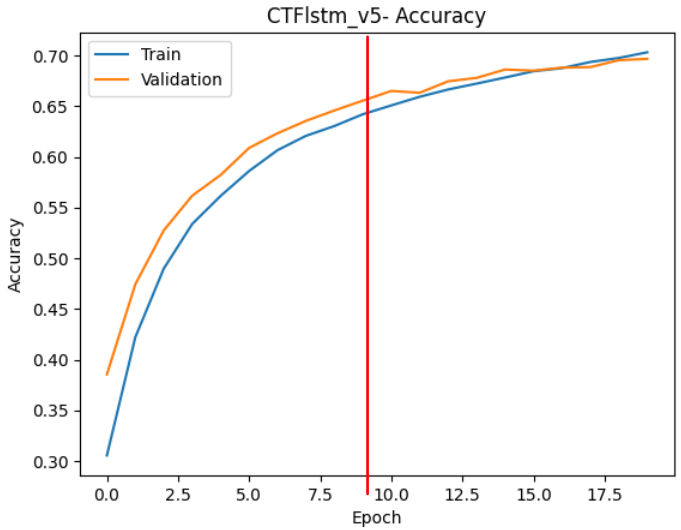
Without Teacher Forcing



With Teacher Forcing

Dynamically update teacher forcing ratio

- Start with high probability
- Decrease after each epoch



I think about our lives. He said when you deserve to vote, but lot our economy, not just stiffed the costs of terrorism was secretically for all of you have a big corporations of people without your promise, together, we can matter