

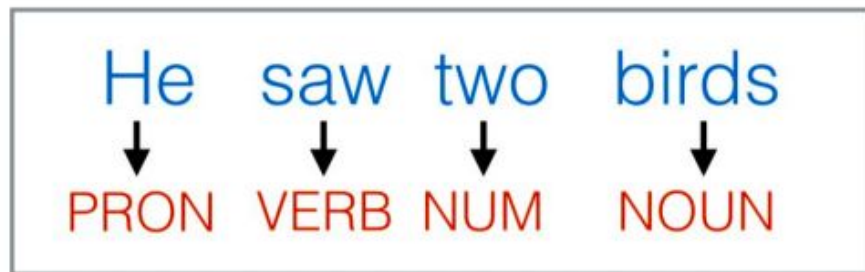
11-737 Multilingual NLP

Assignment 1

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Task: Multilingual Parts-of-Speech Tagging

- Parts-of-speech: Lexical Categories or Word Classes or Tags



- Input: a sentence
- Output: a sequence of POS tags

Assignment goals

- Practical introduction to multilingual parts-of-speech (POS) tagging
- Investigate challenges related to the limited availability of labeled data
- Be familiarized with deep learning frameworks (PyTorch), computing resources (AWS), and multilingual datasets

Requirements

Machine with a GPU

- AWS
- Your own computer

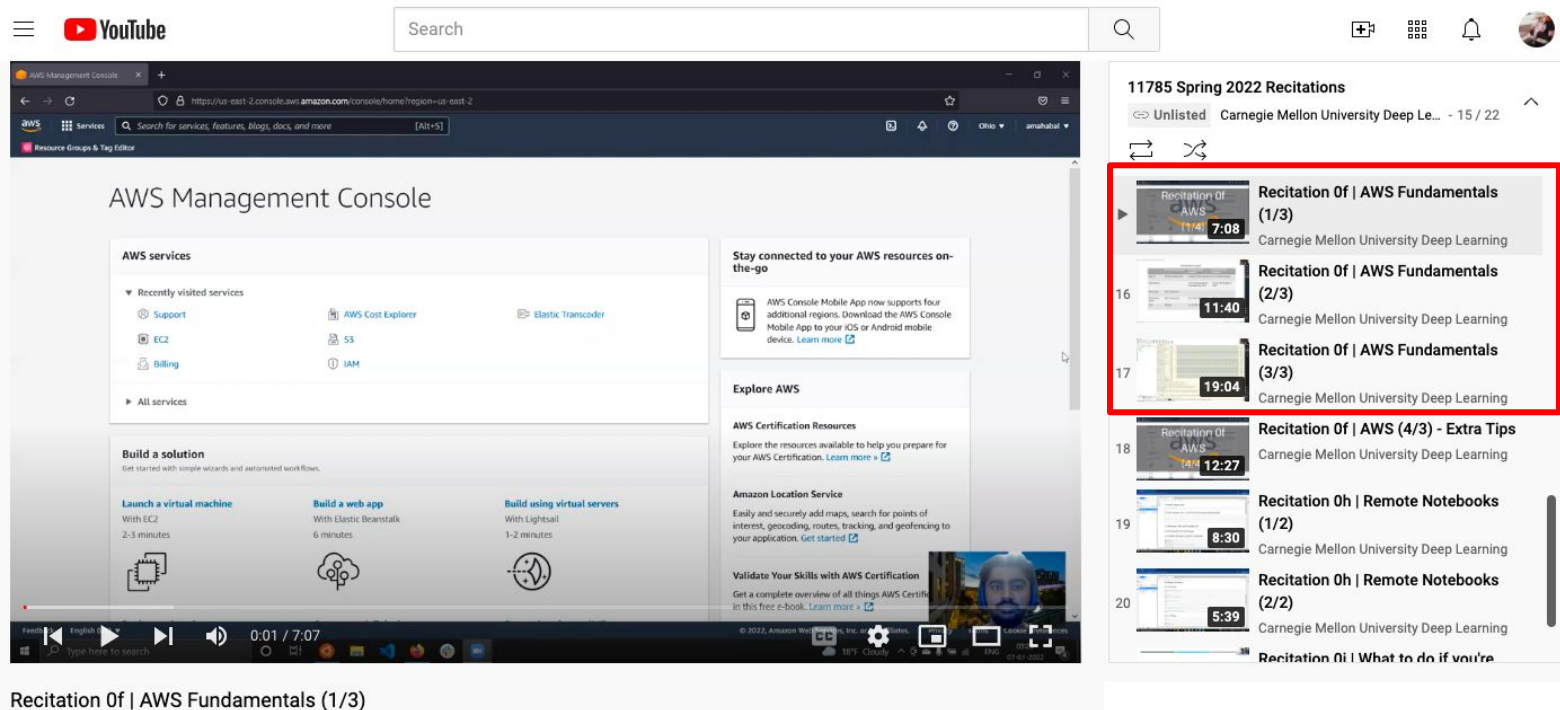
Software/package/libraries

- Conda
- Numpy
- Python=3.8
- PyTorch=1.10.1
- Torchtext=0.11.1

Using AWS

- Request AWS Credit (instructions on Piazza)
- All students should have and use an AWS account using their @andrew.cmu.edu email, and should join AWS educate on this account: <https://aws.amazon.com/education/awseducate/>
- The assignment is completely doable without a GPU, but *strongly* recommended
 - Training time without GPU can range from 45s - 5 mins per epoch
- Make sure to stop the AWS instance when you're not using it!

AWS Setup



The screenshot shows a YouTube video player with the AWS Management Console as the video content. The video is titled "Recitation 0f | AWS Fundamentals (1/3)" and is part of a series of 22 videos. The video player interface includes a search bar, a list of videos, and a red box highlighting the first three videos in the series.

Recitation 0f | AWS Fundamentals (1/3)

Link: <https://www.youtube.com/watch?v=Gx5eLtOY10g&list=PLp-0K3kfddPwLUIWMDjMoVfNcVbnjG9m3&index=15>

Credits to Intro to DL instructor Prof. Bhiksha Raj and the TAs Ameya Mahabaleswarkar and Zhe Chen

assign1.zip ([link](#))

assign1

├─ config.json

├─ data/

├─ saved_models/

├─ main.py

├─ model.py

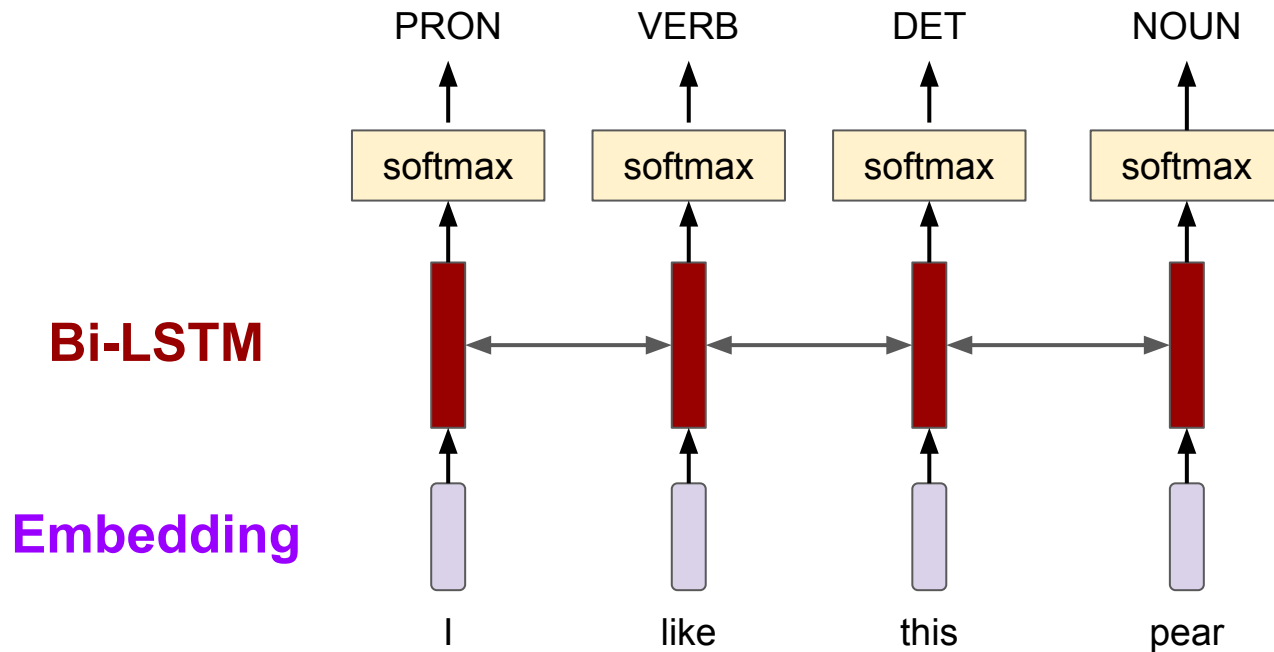
└─ udpos.py

Training Data

- 6 languages: en, es, cs, ar, af, lt, hy, ta
 - Germanic: English (en), Afrikaans (af)
 - Slavic: Czech (cs)
 - Romance: Spanish (es)
 - Semitic: Arabic (ar)
 - Baltic: Lithuanian (lt)
 - Armenian: Armenian (hy)
 - Dravidian: Tamil (ta)

```
DPA  PROPN
:      PUNCT
Iraqi  ADJ
authorities  NOUN
announced  VERB
that  SCONJ
they  PRON
had  AUX
busted  VERB
up  ADP
3  NUM
terrorist  ADJ
cells  NOUN
operating  VERB
in  ADP
Baghdad  PROPN
.  PUNCT
```


Baseline Model - BiLSTM



Code Organization - **config.json**

```
assign1
├─ config.json
├─ data/
├─ saved_models/
├─ main.py
├─ model.py
└─ udpos.py
```

```
{
  "embedding_dim": 100,
  "hidden_dim": 128,
  "n_layers": 2,
  "bidirectional": true,
  "dropout": 0.25,
  "batch_size": 128,
  "max_epoch": 10,
  "min_freq": 2
}
```

Code Organization - **udpos.py**

assign1

└─ config.json

└─ data/

└─ saved_models/

└─ main.py

└─ model.py

└─ **udpos.py**

```
def UDPOS(root, split):  
    if split == 'valid':  
        split = 'dev'  
  
    path = os.path.join(  
        root,  
        _find_match(f'{split}.conll', os.listdir(root))  
    )  
    data = list(_create_data_from_iob(path))  
    return _RawTextIterableDataset('UDPOS', len(data), iter(data))
```

Code Organization - **model.py**

assign1

├─ config.json

├─ data/

├─ saved_models/

├─ main.py

├─ **model.py**

└─ udpos.py

```
class BiLSTMPOSTagger(nn.Module):
```

```
    def __init__( ... ):
```

```
        self.embedding = nn.Embedding( ... )
```

```
        self.lstm = nn.LSTM( ... )
```

```
        self.fc = nn.Linear( ... )
```

```
        self.dropout = nn.Dropout(dropout)
```

```
    def forward(self, text):
```

```
        embedded = self.dropout(self.embedding(text))
```

```
        outputs, (hidden, cell) = self.lstm(embedded)
```

```
        predictions = self.fc(self.dropout(outputs))
```

```
        return predictions
```

Code Organization

assign1

├─ config.json

├─ data/

├─ saved_models/

├─ **main.py**

├─ model.py

└─ udpos.py

- Load data
- Build the vocabularies
- Pack samples into a batch
- Train the model

main.py

load the data from the specific path

```
train_data, valid_data, test_data = UDPOS(  
    os.path.join('data', args.lang),  
    split=('train', 'valid', 'test'),  
)
```

building the vocabulary for both text and the labels

```
vocab_text = torchtext.vocab.build_vocab_from_iterator(  
    (line for line, label in train_data), min_freq=params['min_freq'],  
    specials=['<unk>', '<PAD>']  
)  
vocab_text.set_default_index(vocab_text['<unk>'])  
vocab_tag = torchtext.vocab.build_vocab_from_iterator(  
    (label for line, label in train_data),  
    specials=['<unk>', '<PAD>']  
)  
vocab_tag.set_default_index(vocab_text['<unk>'])
```

main.py

functions that convert words/tags to indices

```
def transform_text(x):
```

```
    return [vocab_text[token] for token in x]
```

```
def transform_tag(x):
```

```
    return [vocab_tag[tag] for tag in x]
```

function that pack (text, label) pairs into a batch

```
def collate_batch(batch):
```

```
    tag_list, text_list = [], []
```

```
    for (line, label) in batch:
```

```
        text_list.append(torch.tensor(transform_text(line), device=device))
```

```
        tag_list.append(torch.tensor(transform_tag(label), device=device))
```

```
    return (
```

```
        pad_sequence(text_list, padding_value=vocab_text['<PAD>'],
```

```
        pad_sequence(tag_list, padding_value=vocab_tag['<PAD>'])
```

```
)
```

main.py

iterators that generate batch with `collate_batch`

```
train_dataloader = DataLoader(  
    train_data, batch_size=params['batch_size'],  
    shuffle=True, collate_fn=collate_batch  
)  
valid_dataloader = DataLoader(  
    valid_data, batch_size=params['batch_size'],  
    shuffle=False, collate_fn=collate_batch  
)  
test_dataloader = DataLoader(  
    test_data, batch_size=params['batch_size'],  
    shuffle=False, collate_fn=collate_batch  
)
```


main.py - Training

```
for epoch in range(params['max_epoch']):  
    train_loss, train_acc = train( ... )  
    valid_loss, valid_acc = evaluate( ... )  
  
    # save the model if valid_loss is better  
    if valid_loss < best_valid_loss:  
        best_valid_loss = valid_loss  
        torch.save( ... )
```

main.py - Training

```
def train( ... ):
    for batch in iterator:
        text = batch[0]
        tags = batch[1]

        optimizer.zero_grad()

        predictions = model(text)
        predictions = predictions.view(-1, predictions.shape[-1])
        tags = tags.view(-1)
        loss = criterion(predictions, tags)

        loss.backward()
        optimizer.step()
```

Submission

- Your submission consists of two parts: Code and a write-up
 - Put all your code in a folder named **code** including instructions on how to run if you have implemented additional code
 - Include your trained models in **code/save_models/**.
 - Rename the write-up as **writeup.pdf**
 - Compress both on them as **assign1.tar.gz**
- This file must be submitted to Canvas (link on the course website)

Grading

- Run the model on the provided English UD data and reproduce the results on its test set: **B**
- Train and reproduce the results on the given multilingual datasets and reproduce desired results: **B+**
- Report with detailed analysis: **A-**
 - Performance across language family, typology, datasize
 - Hyperparameter tuning: config.json
 - Error analysis across tag types: does the model perform better or worse on certain kinds of tags?
- Non-trivial extension which leads to improvement in scores: **A, A+**
 - Add a CNN input layer to capture character level features.
 - Pre-train the model parameters with a language modeling objective
 - Add multilingual pre-trained embeddings (Polyglot, mBERT) to your model

Additional Help

Office Hours

Ting-Rui Chiang (Wednesday 11 AM -12 PM):

<https://cmu.zoom.us/j/9409145401?pwd=SXhDRE1lamJtNXJzbWhrUXV1cjRtUT09>

Athiya Deviyani (Thursday 3-4 PM): <https://cmu.zoom.us/my/athiya>

Contact

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