Week 4: Named Entity Recognition (Cont.)

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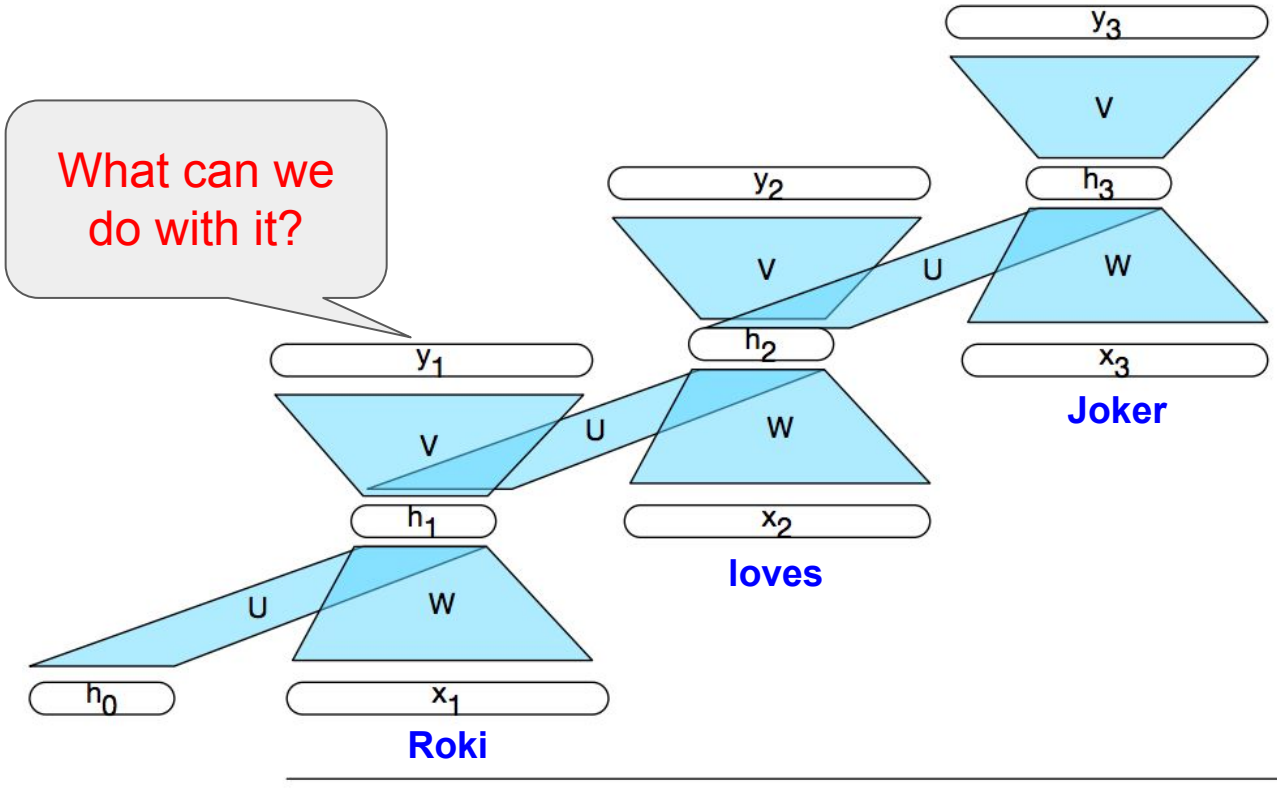
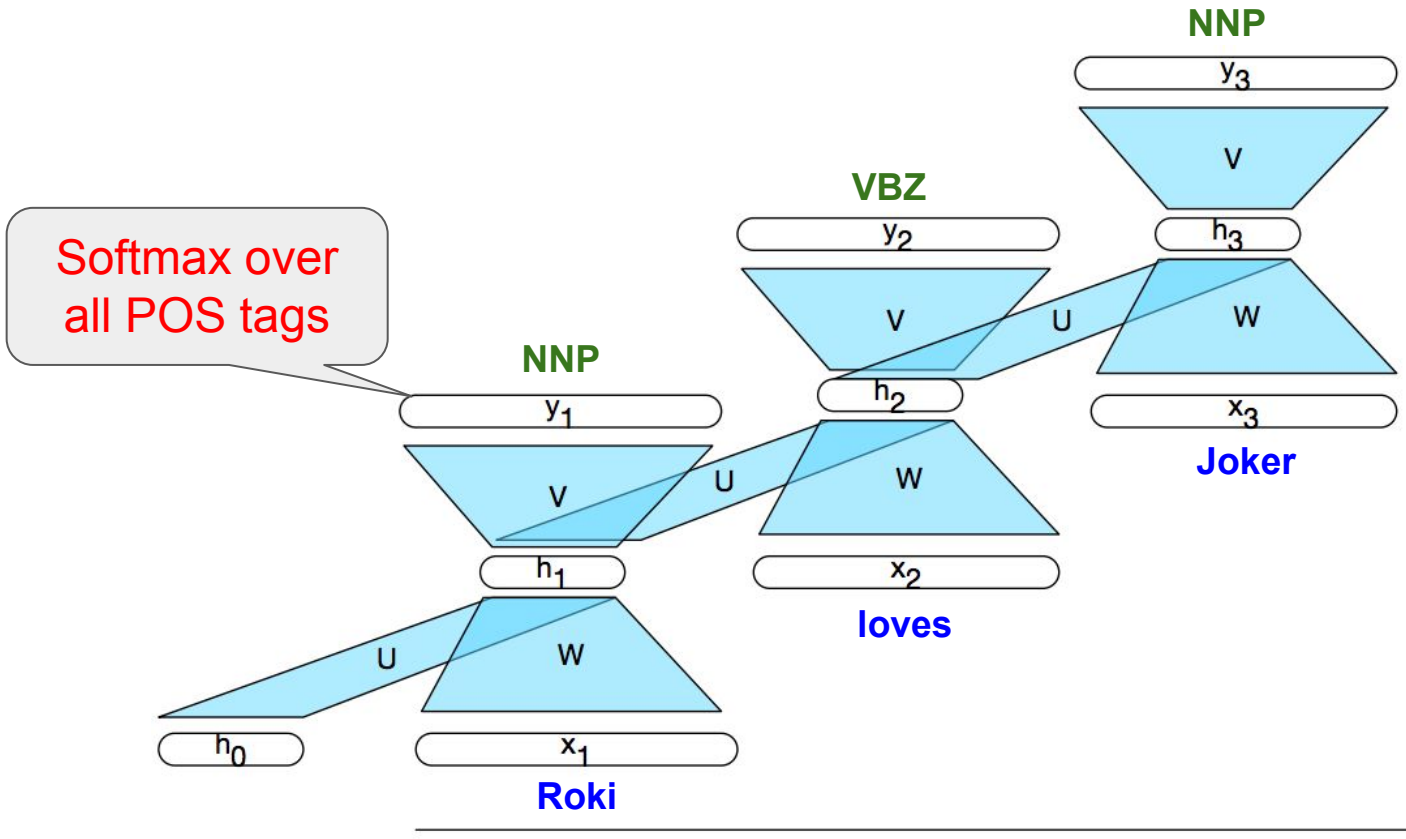
slides courtesy of NaCTeM

Sequence processing with recurrent neural networks

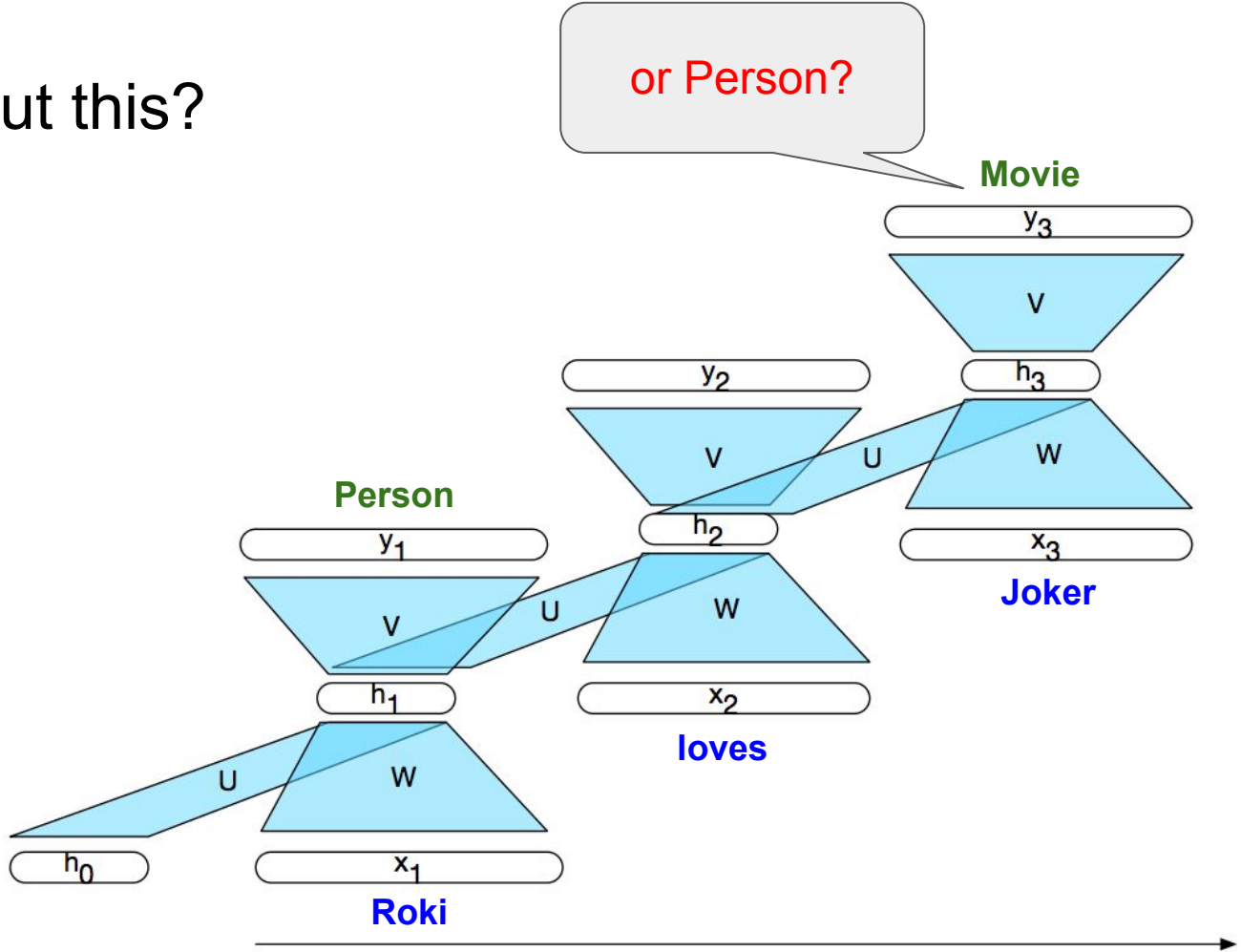
Look back to RNN



Part-of-speech tagging



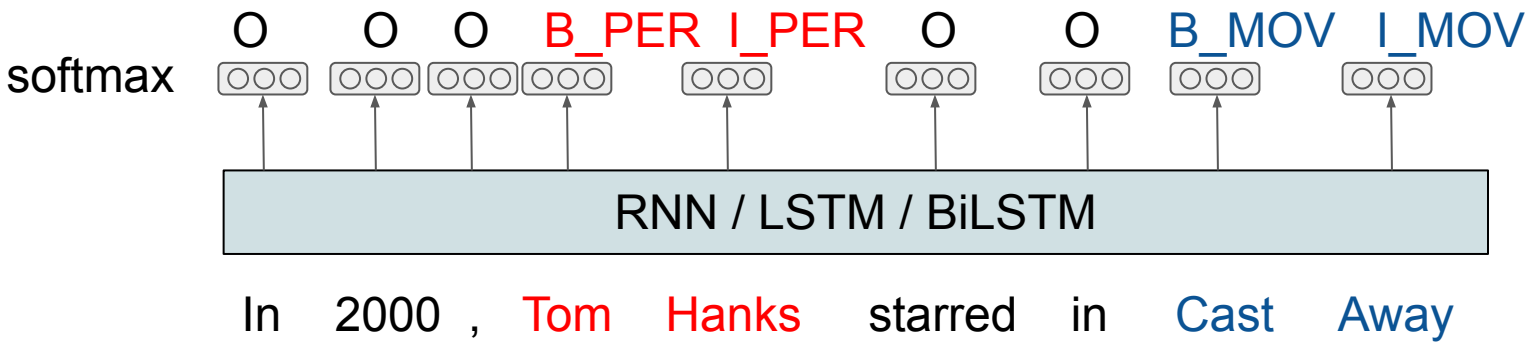
How about this?



Local approach using softmax

- Predicting tags independently

$$Pr(tag|token) = softmax(\mathbf{W}\mathbf{h}_{token} + \mathbf{b})$$



- Why do we use a recurrent net?

Local approach using softmax (cont.)

- Predicting tags independently

$$Pr(tag|token) = softmax(\mathbf{W}\mathbf{h}_{token} + \mathbf{b})$$

- Training a local model is to minimize negative log likelihood

$$L(\theta) = \sum_{S \in D} \sum_{(tag,token) \in S} -\log Pr(tag|token)$$

where D is a training set (a set of tagged sentences)

Global approach

- Predicting all tags at once

$$Pr(tag_{1:n}|token_{1:n}) = \frac{\exp\{f(tag_{1:n}, token_{1:n})\}}{\sum_{tag'_{1:n} \in T} \exp\{f(tag'_{1:n}, token_{1:n})\}}$$

- Training a local model is to minimize negative log likelihood

$$L(\theta) = \sum_{(tag_{1:n}, token_{1:n}) \in D} -\log Pr(tag_{1:n}|token_{1:n}; \theta)$$

Global approach (Cont.)

- Using linear-chain CRF
- The feature function can be replaced:

From a BiLSTM

$$f(tag_i, tag_{i-1}, token_i) = \mathbf{W}\mathbf{h}_i + \mathbf{b}$$

Local vs global approaches

- For sequence labelling tasks, e.g., POS and NER, global approaches are better than local ones
- Why?
  - An I tag can only appear after an I or a B (never an O)
  - There are often more Os than Bs and Is, ...

CRF vs. Neural networks

CRF

- Feature engineering
- Do not need pre-trained vectors
- Models are roughly interpretable
- *Perform well with datasets that have many NE categories(*)*

Neural networks

- Do not need features
- Need pre-trained vectors from big language models
- Models use implicit features (created by hidden layers) → not easy to interpret
- *Perform not so well with datasets that have many NE categories(*)*

(*) This observation is only based on my personal experiences

Summary

- There are several approaches to NER, global approach is better than local one
- CRF, a traditional approach to NER, usually produces state-of-the-art performance, but we need feature engineering
- Neural networks have more advantages in terms of feature engineering but they have limitations in interpretability and resources.