



Named Entity Recognition with Bidirectional Recursive Neural Networks

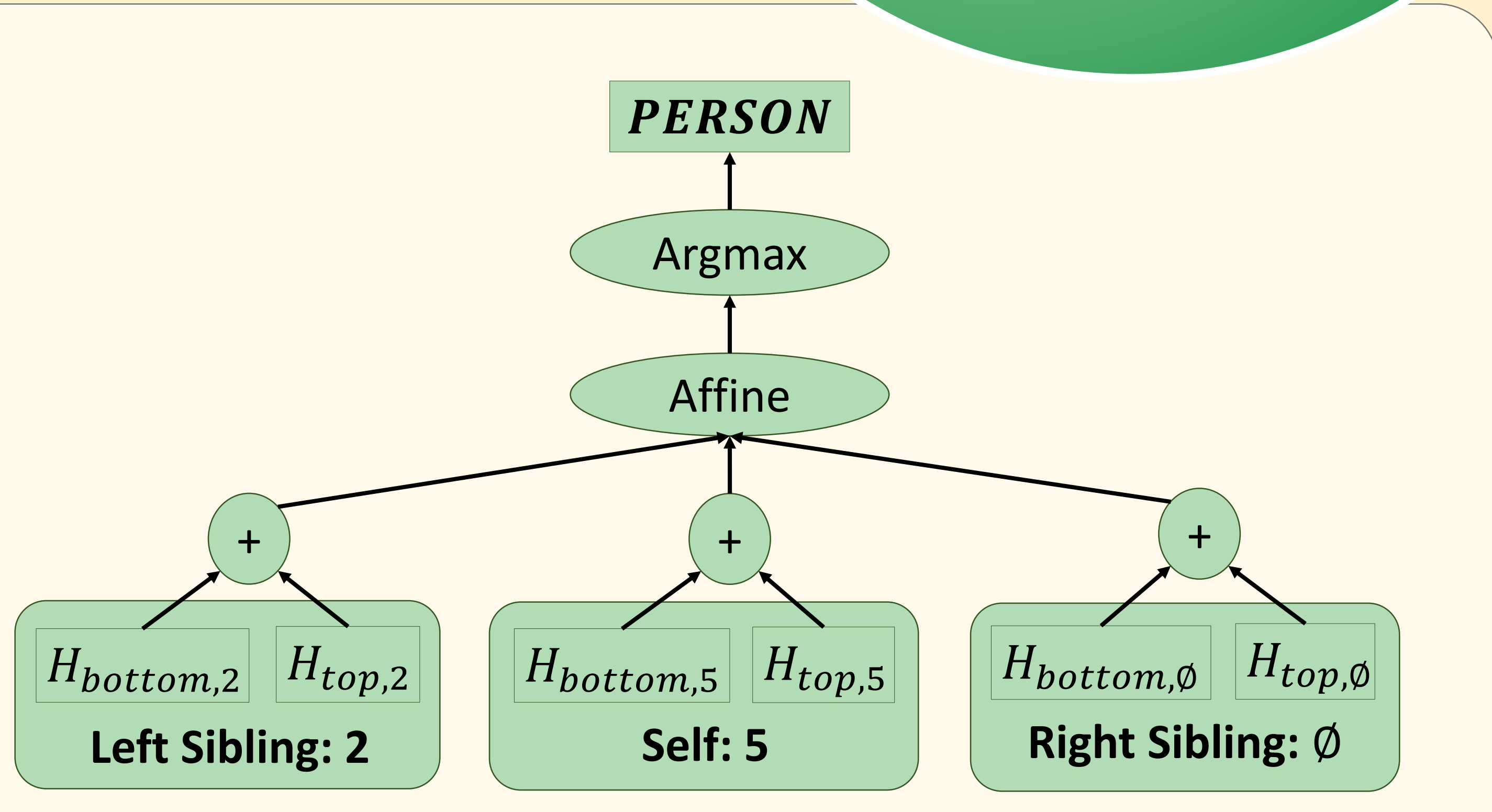
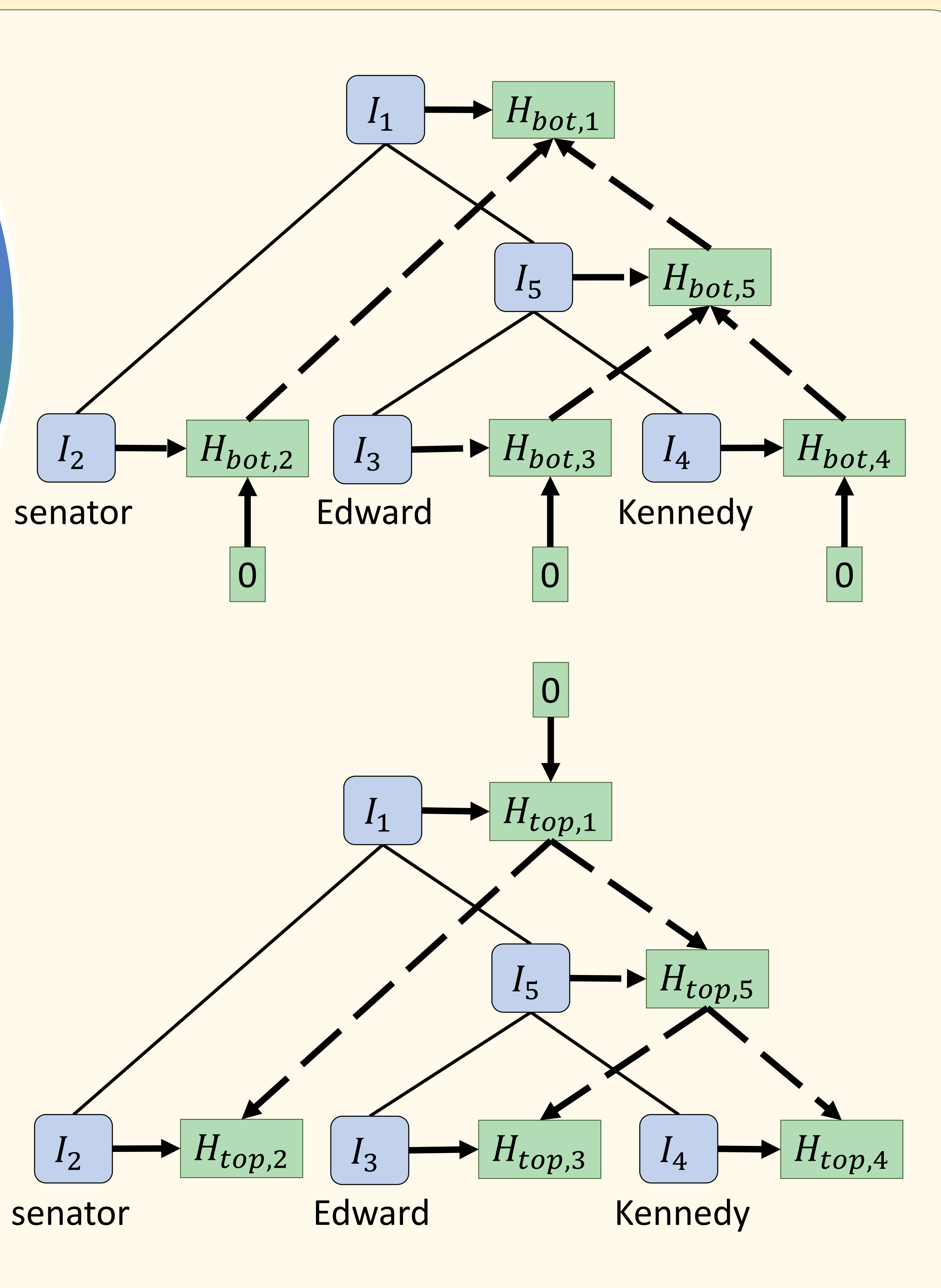
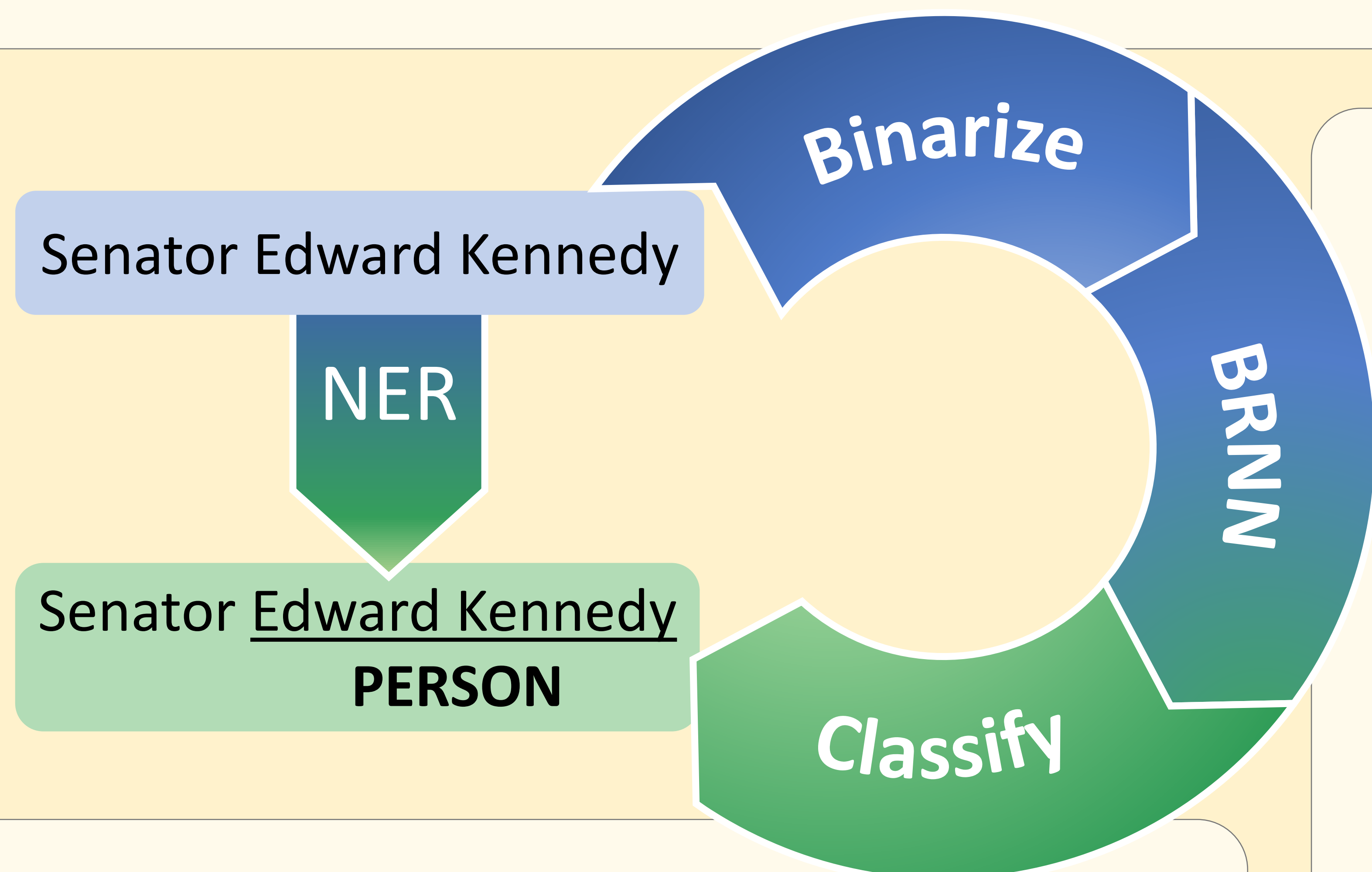
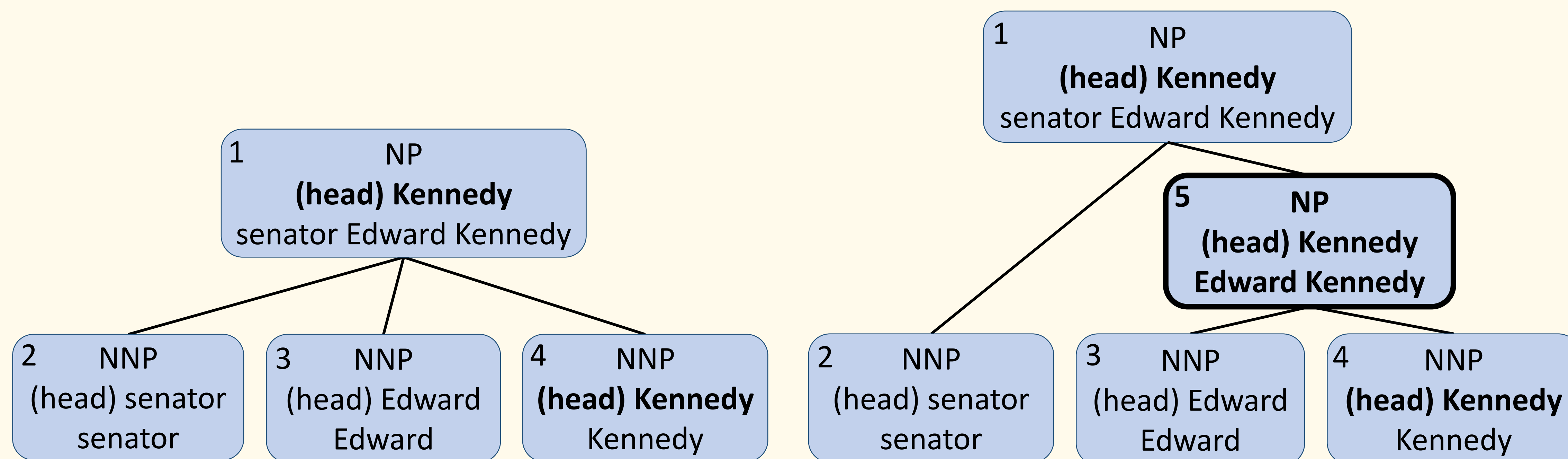
Peng-Hsuan Li
National Taiwan University

Ruo-Ping Dong
National Tsing Hua University

Yu-Siang Wang
National Taiwan University

Ju-Chieh Chou
National Taiwan University

Wei-Yun Ma
Academia Sinica



Introduction

To leverage linguistic structures for Named Entity Recognition, we propose an end-to-end model that uses readily available constituency parse trees for NER. Because constituents correspond to tree nodes, their dependent hidden states can be computed by our **Bidirectional Recursive Neural Networks (BRNN)**.

Model

$$H_{bot,i} = ReLU \left(\left(I_i \parallel \sum_{c \in C} H_{bot,c} \right) W_{bot} + b_{bot} \right)$$

$$H_{top,i} = ReLU \left((I_i \parallel H_{top,p}) W_{top} + b_{top} \right)$$

$$H_x = H_{bot,x} + H_{top,x}, x \in \{i, l, r\}$$

$$O_i = (H_i \parallel H_l \parallel H_r) W_{out} + b_{out}$$

i : self node, I_i : raw features, C : child nodes, p : parent node, l : left sibling, and r : right sibling.

Experiments on OntoNotes 5.0

Split	Tokens	NEs	Constituent NEs
Train	1,088,503	81,828	93.3% → 97.3%
Validate	147,724	11,066	92.8% → 97.0%
Test	152,728	11,257	92.9% → 97.2%

Model	Parser	Precision	Recall	F1
BRNN-CNN	gold	88.9	88.9	88.92
BRNN	gold	89.5	88.3	88.91
BRNN-CNN	auto	88.0	86.5	87.21
BRNN	auto	88.0	86.2	87.10
Bidirectional Tree-LSTM	auto	87.3	86.2	86.74
Sequential Recurrent NN	-	84.5	84.4	84.40
Finkel and Manning (2009)	gold	84.04	80.86	82.42
Durrett and Klein (2014)	-	85.22	82.89	84.04
Chiu and Nichols (2016)	-	-	-	86.41