Combining Global Models for Parsing Universal Dependencies

Tianze Shi            Felix G. Wu            Xilun Chen            Yao Cheng
Cornell University

Highlights
• Global transition-based models
• Bi-LSTM-powered compact features
• Delexicalized syntactic transfer
• High efficiency, low resource demand

I. UDPipe Pre-process
Sentence delimited + Word tokenized

UDPipe
Raw Text

II. Feature Extraction

Universal  dependency  parsing
Bi-directional LSTM

III. Unlabeled Parsing

Re parsing by Eisner’s (Sage and Lavie, 2006)

Eisner’s
Arc-eager Global
Arc-hybrid Global

Bi-LSTM features

* Shi, Huang and Lee (2017, EMNLP)

IV. Arc Labeling

Multi-layer perceptron
concat(  

head  modifier )

Official Ranking
Big Treebanks 2
Small Treebanks 1
PUD Treebanks 2
Surprise Languages 1
Overall 2

Efficiency

Runtime (Hours) *

Stanford (Stanford) 16.27 4.64 8.88 5.96
C2L2 (Ithaca) 26.17 2.44 12.11 8.76
IMS (Stuttgart) 74.42 12.1 8.88 8.76
HIT-SCIR (Harbin) 72.11 12.1 8.88 8.76
LATTICE (Paris) 70.93 12.1 8.88 8.76

* Not Benchmark Results

Global Transition-base Parsing

• $O(n^3)$ Exact decoders
• Large-margin global training
• Dynamic programming (Huang and Sagae, 2010; Kuhlmann, Gómez Rodríguez and Satta, 2011)

Compact Feature Set

Eisner’s

Arc-eager

Arc-hybrid

Scoring function: deep bi-affine (Dozat and Manning, 2017)

Parsing Small Treebanks

Train on: {fr, fr_partut, fr_sequoia}

Test Treebank

Train on: {fr, fr_partut, fr_sequoia} All tasks

Combined model

Train on: {fr, fr_partut, fr_sequoia} All tasks

Test Treebank

fr 84.09
fr_partut 79.53
fr_sequoia 84.65
Combined 87.57 85.57 82.80

Word representation

concat(  

UPOS tag  Bag of Morphology tags )

Max pooling

Morphology tags

Ensemble Results

LAS    76.30 75.00 74.42 72.11 70.93
CPUs 4 2 12 1 8
RAM 16 64 8 32

Test Treebank

fr 84.09
fr_partut 79.53
fr_sequoia 84.65
Combined 87.57 85.57 82.80

* UAS results on dev set, using gold segmentation

Test Treebank

fr 84.09
fr_partut 79.53
fr_sequoia 84.65
Combined 87.57 85.57 82.80

Parsing Surprise Languages

Target  Source  Ranking
Buryat  Hindi  2
Upper Sorbian  Czech  1
Kurmanji  Persian  1
North Sámi  Finnish  1
Average 1

Acknowledgements

TS was supported by a Google focused research grant. FW was supported by Kilian Q. Weinberger with IIS-1550179, IIS-1525919, IIS-1618134 grants from National Science Foundation. YC was supported by DARPA DEFT Grant FA8750-13-2-0015. We thank Lillian Lee for her helpful input and support throughout the shared task. And we thank the two anonymous reviewers for their valuable comments.