Replicating and Extending "*Because Their Treebanks Leak*": Graph Isomorphism, Covariants, and Parser Performance

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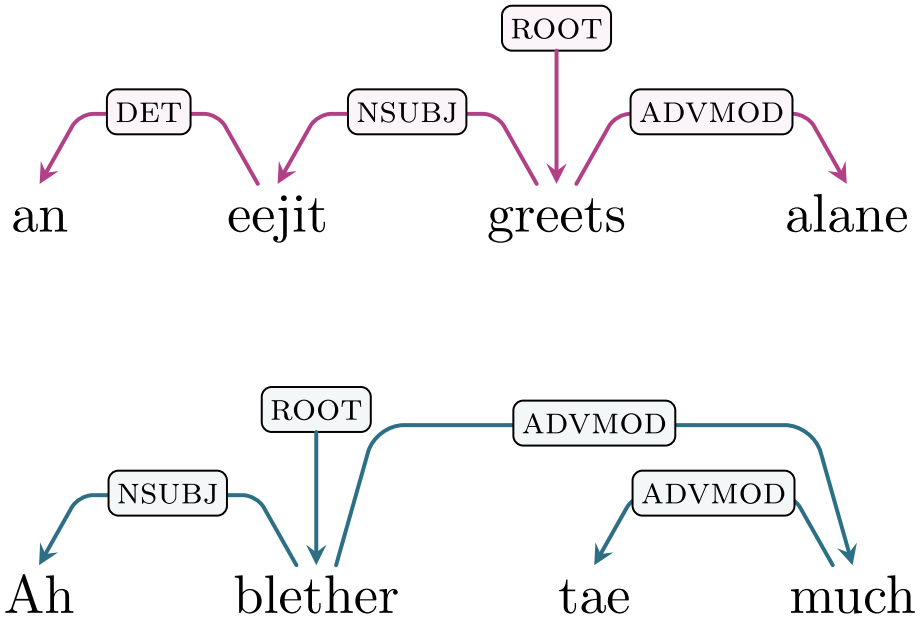
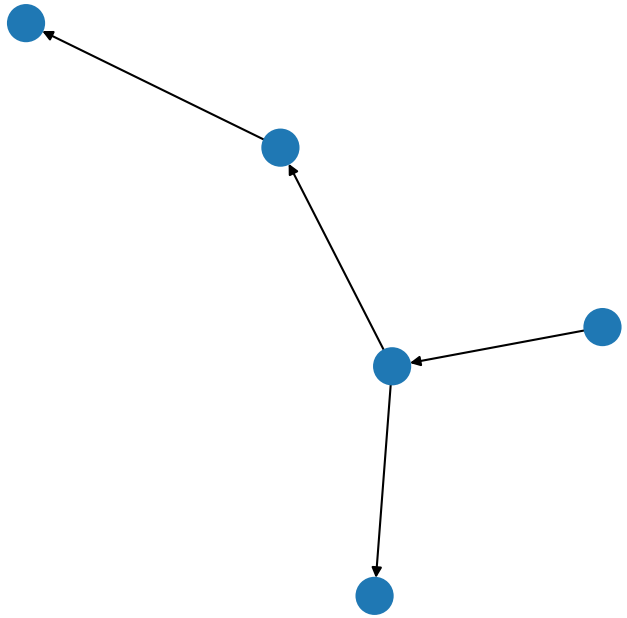
Directed Unlabelled Graph Isomorphism (DUG)

Dependency trees



Directed unlabelled graph



Data and Systems

All use Universal Dependency treebanks

- CoNLL18 - best performing systems, 33 treebanks
- UDPipe 1.2 - transition-based NN, 94 treebanks (UD v2.5)
- UDPipe 2.0 - graph-based NN, competitive, 90 treebank (UD v2.7)

Explained variance from LR fit

	Original			10 Seeds		
	CoNLL18	UDPipe 1.2	UDPipe 2.0	CoNLL18	UDPipe 1.2	UDPipe 2.0
Training size	0.014	0.100	0.060	-0.019	-0.346	-0.005
+ DUG	0.228	0.061	0.097	-0.004	-0.553	0.091
+ $\langle L_{test} \rangle$	0.195	0.169	0.146	-0.007	-0.370	0.140
All	-0.078	0.157	0.086	-0.413	-0.138	0.106

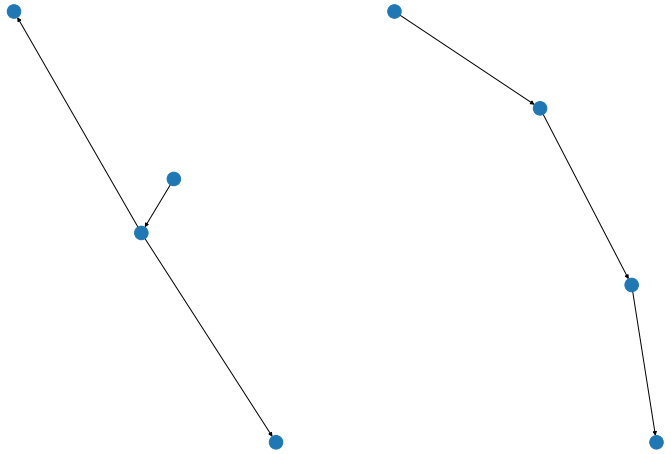
Better with log

	CoNLL18	UDPipe 1.2	UDPipe 2.0
log-size	0.055	0.319	0.126
+ DUG	0.132	0.410	0.277
+ $\langle L_{test} \rangle$	0.106	0.452	0.294
All	-0.184	0.412	0.229

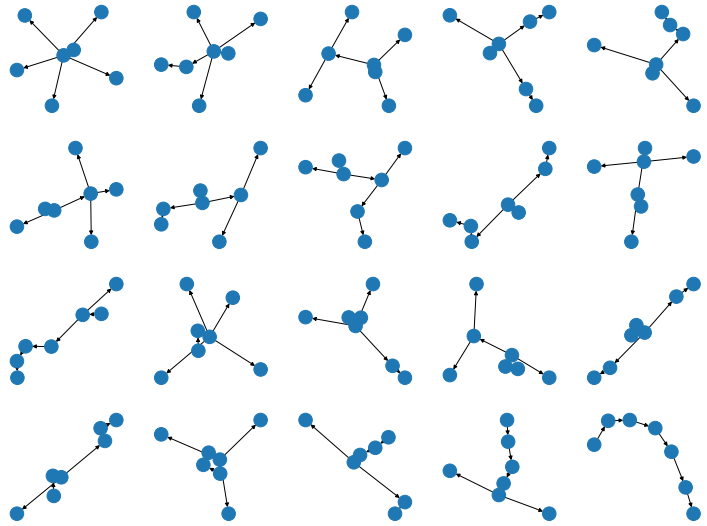
10 seeds CV (3 splits)

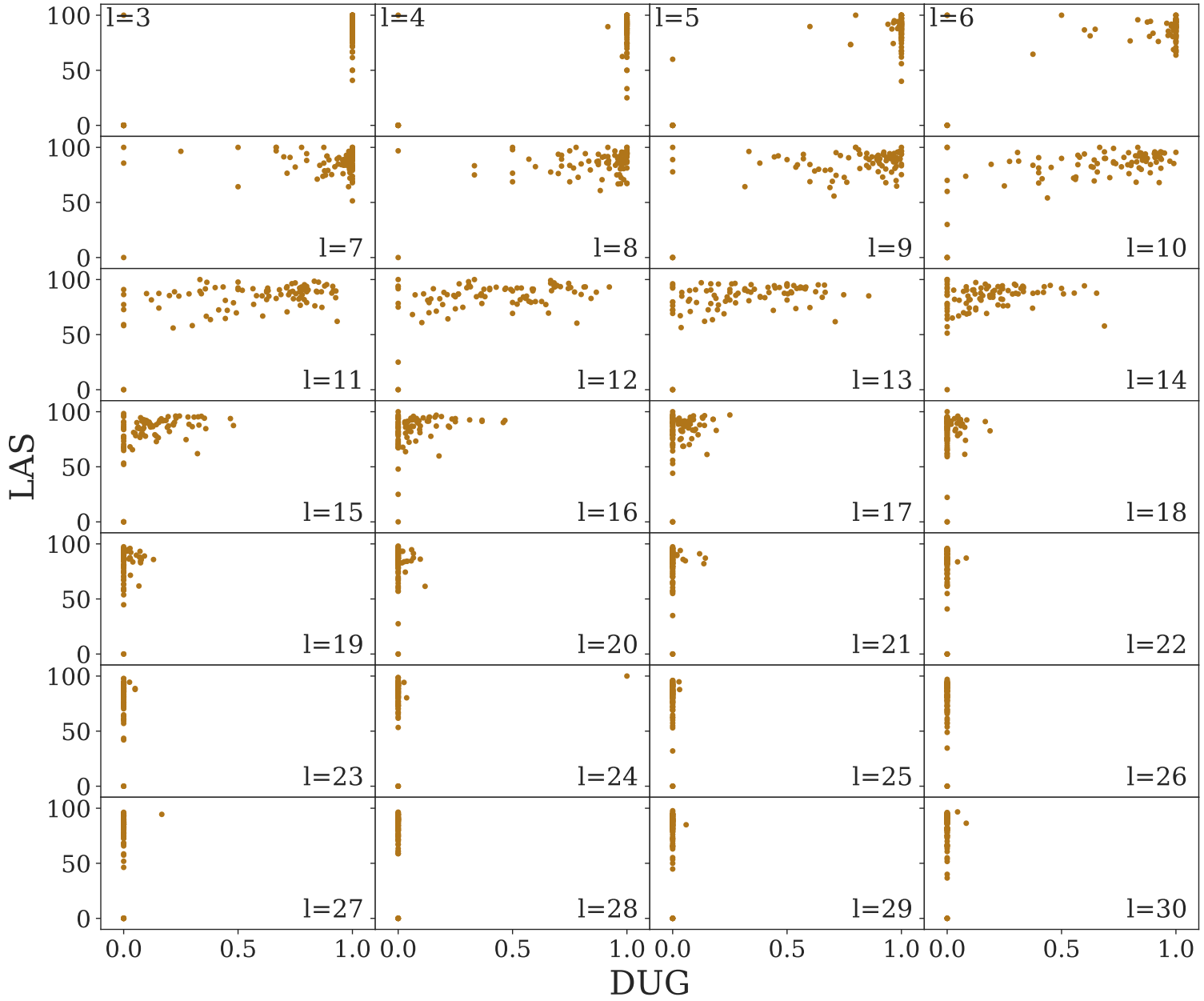
Isomorphisms

Sentences with 3 tokens



Sentences with 6 tokens




l=3
l=4
l=5
l=6
l=7
l=8
l=9
l=10
l=11
l=12
l=13
l=14
l=15
l=16
l=17
l=18
l=19
l=20
l=21
l=22
l=23
l=24
l=25
l=26
l=27
l=28
l=29
l=30
100
50
0
0.0
0.5
1.0
LAS
DUG

DUG Coefficients

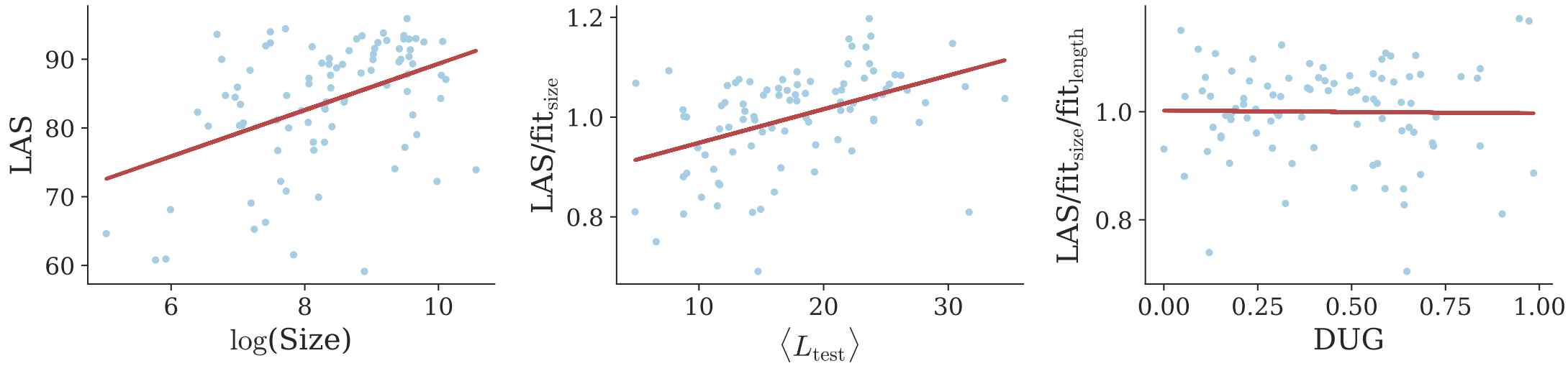
	CoNLL18	UDPipe 1.2	UDPipe 2.0
LAS	-0.13 (p=0.458)	-0.13 (p=0.213)	-0.18 (p=0.083)
Training size	0.44 (p=0.011)	0.42 (p<0.001)	0.46 (p<0.001)
$\langle L_{test} \rangle$	-0.96 (p<0.001)	-0.91 (p<0.001)	-0.92 (p<0.001)

Spearman's ρ

Partial Coefficients

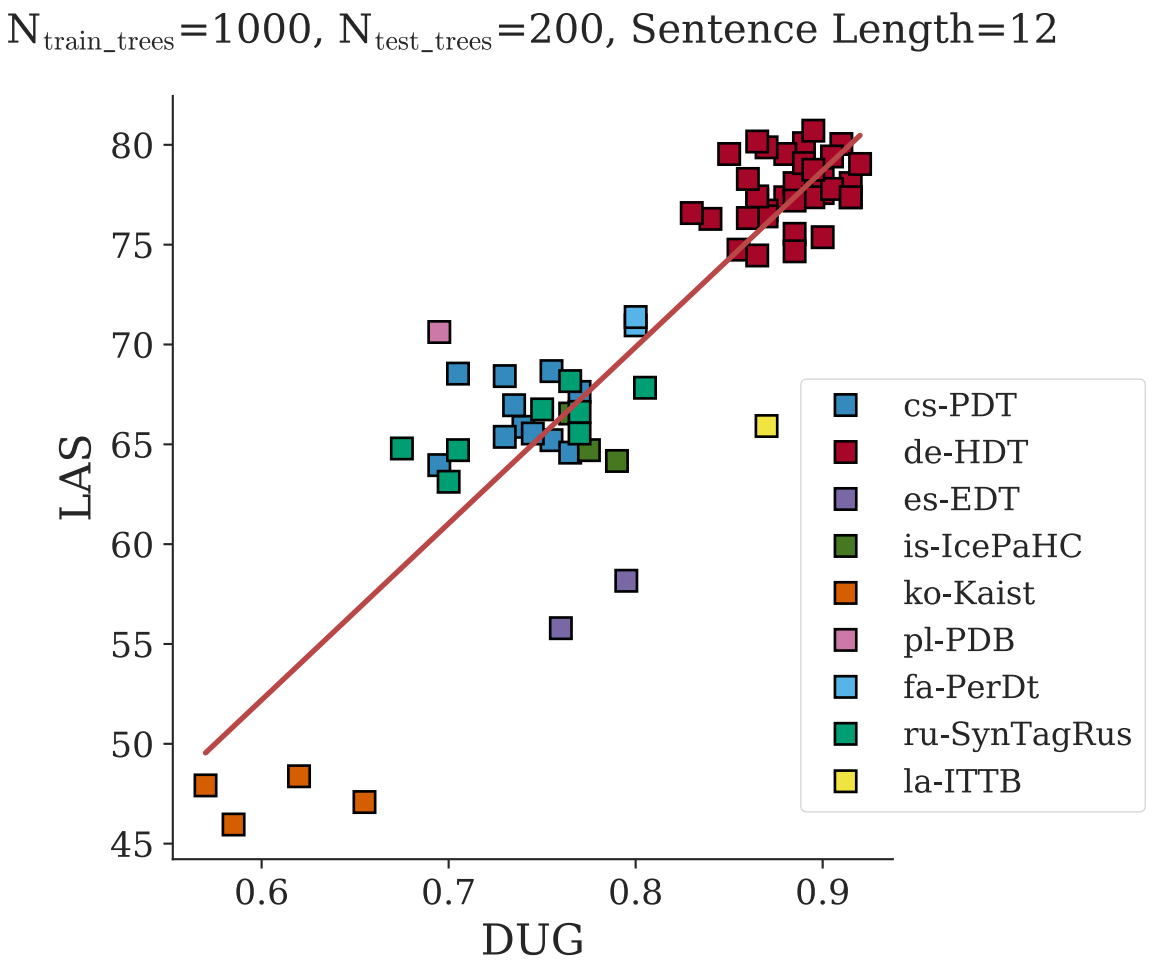
	CoNLL18	UDPipe 1.2	UDPipe 2.0
DUG	-0.13 (p=0.458)	-0.13 (p=0.213)	-0.18 (p=0.083)
Training size	-0.44 (p=0.010)	-0.50 (p<0.001)	-0.46 (p<0.001)
$\langle L_{test} \rangle$	0.18 (p=0.329)	-0.13 (p=0.213)	0.21 (p=0.049)
both	-0.27 (p=0.126)	0.01 (p=0.915)	-0.12 (p=0.245)

Background removal



Controlled experiment

- Find treebanks with sufficient number of sentences with 12 tokens (>1200).
- Create unique splits of 1000 training instances and 200 test.
- Train UDPipe 1.2 models for each.
- Measure LAS and DUG for each split.
- Spearman's ρ: 0.82 ($p<0.001$)



End