Assignment 2 (Part A)

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Implementation language: Python

(1) Accuracies with two-way message passing:

Data-Tree.dat (1)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.60053619	0.04761905	-9.25923147	0.064
OCR + Trans	0.67560322	0.15476190	-9.01790500	0.320
OCR + Trans + Skip	0.67560322	0.15476190	-9.01790500	0.337
OCR + Trans + Skip + Pair-skip	0.67560322	0.16666667	-8.94724050	0.384

Data-TreeWS.dat (1)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.57836645	0.08152174	-10.34165409	0.162
OCR + Trans	0.65894040	0.15217391	-10.09264356	0.833
OCR + Trans + Skip	0.66225166	0.15760870	-10.07006613	1.605
OCR + Trans + Skip + Pair-skip	0.66335541	0.16304348	-10.05308643	1.755

Data-Loops.dat (1)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.53956835	0.03571429	-10.81867159	0.022
OCR + Trans	0.56115108	0.07142857	-10.68964844	0.126
OCR + Trans + Skip	0.56115108	0.07142857	-10.68964844	0.133
OCR + Trans + Skip + Pair-skip	0.56834532	0.07142857	-10.63426627	0.440

Data-LoopsWS.dat (1)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.60030864	0.08461538	-10.37799949	0.114
OCR + Trans	0.66049383	0.11538462	-10.10468248	0.602
OCR + Trans + Skip	0.65586420	0.10769231	-10.06989875	1.235
OCR + Trans + Skip + Pair-skip	0.66358025	0.10769231	-10.14943788	1.856

(2) Comparison of two-way message passing and belief propagation using full model (eps used for loopy BP: 10e-10)

Data-Tree.dat (2)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.67560322	0.16666667	-8.94724050	0.384
Loopy BP	0.67560322	0.16666667	-8.94724050	8.656

Data-TreeWS.dat (2)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.66335541	0.16304348	-10.05308643	1.755
Loopy BP	0.66556291	0.15760870	-10.06001206	43.588

Data-Loops.dat (2)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.56834532	0.07142857	-10.63426627	0.440
Loopy BP	0.56834532	0.07142857	-10.63556823	6.680

Data-LoopsWS.dat (2)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.66358025	0.10769231	-10.14943788	1.856
Loopy BP	0.68209877	0.16153846	-10.07198178	81.696

(3) Accuracies on MAP variant of two-way message passing:

Data-Tree.dat (3)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.60053619	0.04761905	-9.25923147	0.068
OCR + Trans	0.72386059	0.34523810	-8.93503578	0.332
OCR + Trans + Skip	0.72386059	0.34523810	-8.93503578	0.324
OCR + Trans + Skip + Pair-skip	0.77211796	0.52380952	-8.78150451	0.379

Data-TreeWS.dat (3)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.57836645	0.08152174	-10.34165409	0.153
OCR + Trans	0.68763797	0.29347826	-10.03789049	0.816
OCR + Trans + Skip	0.70198675	0.34782609	-10.02301700	1.553
OCR + Trans + Skip + Pair-skip	0.76821192	0.50000000	-10.04161537	1.676

Data-Loops.dat (3)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.53956835	0.03571429	-10.81867159	0.026
OCR + Trans	0.59712230	0.14285714	-10.69325448	0.133
OCR + Trans + Skip	0.59712230	0.14285714	-10.69325448	0.134
OCR + Trans + Skip + Pair-skip	0.55395683	0.17857143	-10.65909955	0.416

Data-LoopsWS.dat (3)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
OCR	0.60030864	0.08461538	-10.37799949	0.110
OCR + Trans	0.74382716	0.34615385	-10.02886130	0.572
OCR + Trans + Skip	0.75154321	0.45384615	-10.01431641	1.152
OCR + Trans + Skip + Pair-skip	0.77006173	0.55384615	-10.38882779	1.791

(4) Comparison of loopy BP and message passing (MAP variants):

Data-Tree.dat (4)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.77211796	0.52380952	-8.78150451	0.379
Loopy BP	0.77211796	0.52380952	-8.78150451	6.976

Data-TreeWS.dat (4)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.76821192	0.50000000	-10.04161537	1.676
Loopy BP	0.75386313	0.47282609	-10.15713184	688.331

Data-Loops.dat (4)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.55395683	0.17857143	-10.65909955	0.416
Loopy BP	0.55395683	0.17857143	-10.79228177	6.092

Data-LoopsWS.dat (4)

	Character Accuracy	Word Accuracy	Log - Likelihood	Time Taken (s)
Message Passing	0.77006173	0.55384615	-10.38882779	1.791
Loopy BP	0.79629630	0.57692308	--10.48715876	770.446

Observations:

1. Adding sophistication largely increases the accuracy of inference, which matches expectations.
2. Loopy belief propagation gives the same results as clique tree message passing on data-tree.dat and data-loops.dat, which is expected as their underlying graph is a tree.
3. Loopy belief propagation outperforms message passing on data-loopsWS.dat, even though belief propagation is an approximate method.
4. MAP inference outperforms marginal product inference, which matches expectations.
5. MAP inference using loopy BP does not converge in some cases in treeWS.dat and loopyWS.dat, but it again outperforms its message passing counterpart.