LRNN: A Knowledge-Based Neural Network for Tackling Both Within-Project and Cross-Project Class-Imbalance Problems in Software Defect Prediction

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1 Explanation

This appendix provides the complete version of the appendix for the aforementioned paper. Due to space constraints, this appendix is not fully included in the published journal.

2 Appendix

The complete appendix includes 12 tables derived from three datasets—NASA, PROMISE, and AEEEM—that comprehensively demonstrate LRNN's ability to predict across projects. The main body of the paper provides a detailed discussion on dataset partitioning and the significance of evaluation metrics for the cross-project prediction problem.

Table 1: Precision on the NASA Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
jm1->cm1	0.6282	0.6443	0.6865	0.7176	0.6515	0.8571
kc3->cm1	0.6143	0.7176	0.6443	0.6732	0.7602	0.7312
mc2->cm1	0.6443	0.7022	0.7333	0.6861	0.6865	0.8258
pc5->cm1	0.6276	0.6617	0.7187	0.6515	0.6634	0.8563
other->cm1	0.6865	0.6861	0.6659	0.7007	0.6861	0.8268
Average	0.6402	0.6824	0.6897	0.6858	0.6895	**0.8194**
cm1->jm1	0.6081	0.6018	0.5941	0.5927	0.6135	0.6712
kc3->jm1	0.6194	0.6044	0.6097	0.5998	0.6099	0.6971
mc2->jm1	0.6043	0.5907	0.5818	0.6104	0.6415	0.6807
pc5->jm1	0.5998	0.6113	0.6002	0.5789	0.6527	0.6835
other->jm1	0.6109	0.5962	0.5967	0.5982	0.621	0.7136
Average	0.6085	0.6009	0.5965	0.596	0.6277	**0.6892**
cm1->kc3	0.6228	0.6592	0.6583	0.6473	0.6348	0.8133
jm1->kc3	0.5959	0.6126	0.6473	0.7472	0.6307	0.75
mc2->kc3	0.6083	0.662	0.6389	0.6789	0.6816	0.7754
pc5->kc3	0.6307	0.6225	0.6789	0.7105	0.6838	0.743
other->kc3	0.6488	0.6348	0.6225	0.6583	0.6393	0.771
Average	0.6213	0.6382	0.6492	0.6884	0.654	**0.7705**
cm1->mc2	0.8666	0.923	0.8429	0.8416	0.675	0.8361
jm1->mc2	0.923	0.6857	0.7982	0.8783	0.6388	0.7724
kc3->mc2	0.7727	0.7424	0.8252	0.8775	0.7596	0.7236
pc5->mc2	0.7152	0.6388	0.8566	0.8313	0.6857	0.7587
other->mc2	0.6857	0.8166	0.891	0.9046	0.8166	0.7729
Average	0.7926	0.7613	0.8428	**0.8667**	0.7151	0.7727
cm1->pc5	0.6471	0.6807	0.6576	0.6502	0.6484	0.9173
jm1->pc5	0.6443	0.672	0.6632	0.6604	0.6358	0.8979
kc3->pc5	0.6697	0.6805	0.6461	0.6778	0.6623	0.9062
mc2->pc5	0.6576	0.6383	0.6366	0.6523	0.6732	0.8898
other->pc5	0.6436	0.6822	0.6508	0.668	0.6359	0.8819
Average	0.6525	0.6707	0.6509	0.6617	0.6511	**0.8986**

Table 2: Recall on the NASA Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
jm1->cm1	0.6948	0.7061	0.7288	0.849	0.7548	0.8
kc3->cm1	0.6834	0.849	0.7061	0.8149	0.8717	0.7312
mc2->cm1	0.7061	0.7889	0.909	0.8262	0.7288	0.825
pc5->cm1	0.7321	0.8035	0.8977	0.7548	0.7175	0.8562
other->cm1	0.7288	0.8262	0.7662	0.8376	0.8262	0.825
Average	0.709	0.7947	0.8016	**0.8165**	0.7798	0.8075
cm1->jm1	0.6446	0.6491	0.6434	0.636	0.6405	0.6682
kc3->jm1	0.6184	0.6564	0.6504	0.6442	0.5784	0.6966
mc2->jm1	0.6445	0.6257	0.6176	0.6617	0.5989	0.68
pc5->jm1	0.6592	0.653	0.6492	0.5954	0.6147	0.68
other->jm1	0.6515	0.6475	0.6471	0.6407	0.635	0.7132
Average	0.6436	0.6463	0.6415	0.6356	0.6135	**0.6876**
cm1->kc3	0.7362	0.7875	0.7087	0.7417	0.6501	0.7749
jm1->kc3	0.6575	0.6373	0.7417	0.7472	0.749	0.7416
mc2->kc3	0.6703	0.7545	0.6959	0.7673	0.7216	0.7416
pc5->kc3	0.749	0.6831	0.7673	0.7344	0.8131	0.7333
other->kc3	0.7747	0.6501	0.6831	0.7087	0.7619	0.7583
Average	0.7175	0.7025	0.7193	0.7399	0.7391	**0.7499**
cm1->mc2	0.6666	0.8333	0.8523	0.8416	0.659	0.8026
jm1->mc2	0.8333	0.6969	0.786	0.8893	0.6515	0.7631
kc3->mc2	0.7727	0.7424	0.8284	0.8679	0.7045	0.7171
pc5->mc2	0.7348	0.6515	0.8601	0.8177	0.6969	0.75
other->mc2	0.6969	0.7878	0.9025	0.9156	0.7878	0.7434
Average	0.7409	0.7424	0.8459	**0.8664**	0.6999	0.7552
cm1->pc5	0.9186	0.9092	0.8861	0.893	0.9102	0.9134
jm1->pc5	0.9177	0.8984	0.8696	0.8957	0.9147	0.8942
kc3->pc5	0.9159	0.9273	0.8918	0.8996	0.8425	0.9038
mc2->pc5	0.9306	0.8981	0.8975	0.8759	0.8356	0.8846
other->pc5	0.9087	0.9095	0.902	0.8975	0.8624	0.875
Average	**0.9183**	0.9085	0.8894	0.8923	0.8731	0.8942

Table 3: F-measure on the NASA Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
jm1->cm1	0.6442	0.6626	0.7034	0.7512	0.6701	0.7916
kc3->cm1	0.6268	0.7512	0.6626	0.6912	0.7976	0.7312
mc2->cm1	0.6626	0.7301	0.7681	0.7102	0.7034	0.8248
pc5->cm1	0.6351	0.673	0.7473	0.6701	0.6823	0.8562
other->cm1	0.7034	0.7102	0.689	0.7301	0.7102	0.8247
Average	0.6544	0.7054	0.7141	0.7106	0.7127	**0.8057**
cm1->jm1	0.6166	0.6061	0.5936	0.5954	0.6222	0.6667
kc3->jm1	0.6189	0.6073	0.6179	0.6046	0.5873	0.6965
mc2->jm1	0.6115	0.596	0.5841	0.616	0.6116	0.6797
pc5->jm1	0.5934	0.6198	0.6029	0.584	0.6276	0.6785
other->jm1	0.6195	0.5955	0.5967	0.6032	0.6268	0.7131
Average	0.612	0.6049	0.599	0.6006	0.6151	**0.6869**
cm1->kc3	0.5892	0.6617	0.6752	0.6606	0.6415	0.7678
jm1->kc3	0.5989	0.6217	0.6606	0.7472	0.6068	0.7394
mc2->kc3	0.6166	0.6805	0.6546	0.7015	0.6973	0.7335
pc5->kc3	0.6068	0.6351	0.7015	0.7212	0.7012	0.7306
other->kc3	0.6429	0.6415	0.6351	0.6752	0.6247	0.7554
Average	0.6109	0.6481	0.6654	0.7011	0.6543	**0.7453**
cm1->mc2	0.673	0.8583	0.8443	0.8416	0.664	0.7975
jm1->mc2	0.8583	0.6886	0.7902	0.8761	0.6357	0.7611
kc3->mc2	0.7058	0.7424	0.8266	0.8717	0.7166	0.715
pc5->mc2	0.7017	0.6357	0.8581	0.8225	0.6886	0.7478
other->mc2	0.6886	0.7984	0.8913	0.9066	0.7984	0.7362
Average	0.7255	0.7447	0.8421	**0.8637**	0.7007	0.7515
cm1->pc5	0.7058	0.7441	0.7158	0.7078	0.7069	0.9132
jm1->pc5	0.7022	0.7333	0.72	0.72	0.6907	0.8939
kc3->pc5	0.7328	0.7463	0.7027	0.7396	0.7151	0.9037
mc2->pc5	0.7199	0.6933	0.691	0.7087	0.7246	0.8842
other->pc5	0.7007	0.7457	0.7093	0.7288	0.6879	0.8744
Average	0.7123	0.7325	0.7078	0.721	0.705	**0.8939**

Table 4: Accuracy on the NASA Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
jm1->cm1	0.7843	0.8039	0.8431	0.8431	0.7843	0.8
kc3->cm1	0.7647	0.8431	0.8039	0.7843	0.8823	0.7312
mc2->cm1	0.8039	0.8431	0.8431	0.8039	0.8431	0.825
pc5->cm1	0.745	0.7647	0.8235	0.7843	0.8235	0.8562
other->cm1	0.8431	0.8039	0.8039	0.8235	0.8039	0.825
Average	0.7882	0.8117	0.8235	0.8078	**0.8274**	0.8075
cm1->jm1	0.7343	0.7086	0.6893	0.7003	0.7509	0.6682
kc3->jm1	0.7775	0.704	0.7306	0.7104	0.7913	0.6966
mc2->jm1	0.7242	0.7132	0.6966	0.7159	0.8051	0.68
pc5->jm1	0.6755	0.7316	0.7022	0.7297	0.8079	0.6801
other->jm1	0.7325	0.6893	0.692	0.7113	0.7683	0.7132
Average	0.7288	0.7093	0.7021	0.7135	**0.7847**	0.6876
cm1->kc3	0.6521	0.7391	0.8043	0.7608	0.8043	0.775
jm1->kc3	0.7173	0.7826	0.7608	0.8695	0.6739	0.7416
mc2->kc3	0.7391	0.7826	0.7826	0.8043	0.826	0.7416
pc5->kc3	0.6739	0.7608	0.8043	0.8478	0.7826	0.7333
other->kc3	0.7173	0.8043	0.7608	0.8043	0.6956	0.7583
Average	0.6999	0.7739	0.7826	**0.8173**	0.7565	0.75
cm1->mc2	0.7647	0.8823	0.8461	0.8461	0.7058	0.8026
jm1->mc2	0.8823	0.7058	0.8	0.8769	0.647	0.7631
kc3->mc2	0.7058	0.7647	0.8307	0.8769	0.7647	0.7171
pc5->mc2	0.7058	0.647	0.8615	0.8307	0.7058	0.75
other->mc2	0.7058	0.8235	0.8923	0.9076	0.8235	0.7434
Average	0.7529	0.7647	0.8461	**0.8676**	0.7294	0.7552
cm1->pc5	0.9325	0.9505	0.9418	0.9371	0.9342	0.9134
jm1->pc5	0.9307	0.9476	0.9458	0.9424	0.9249	0.8942
kc3->pc5	0.9453	0.9493	0.9348	0.9499	0.9476	0.9038
mc2->pc5	0.9377	0.929	0.9278	0.94	0.9522	0.8846
other->pc5	0.9313	0.9511	0.9365	0.9458	0.9319	0.875
Average	0.9355	**0.9455**	0.9373	0.943	0.9382	0.8942

Table 5: Precision on the PROMISE Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
ivy->ant	0.7363	0.744	0.7512	0.7149	0.5687	0.8235
poi->ant	0.7103	0.6541	0.7514	0.7008	0.6176	0.8541
tomcat->ant	0.7311	0.6783	0.7227	0.7514	0.6416	0.9131
xerces->ant	0.6616	0.7447	0.7716	0.725	0.7076	0.8823
other->ant	0.7198	0.7302	0.7886	0.7632	0.6281	0.9411
Average	0.7118	0.7103	0.7571	0.7311	0.6327	**0.8828**
ant->ivy	0.6838	0.6071	0.8181	0.6838	0.6838	0.9224
poi->ivy	0.5625	0.65	0.9852	0.8181	0.8181	0.9099
tomcat->ivy	0.7343	0.5925	0.6256	0.9852	0.7343	0.9168
xerces->ivy	0.65	0.6256	0.65	0.7343	0.6363	0.9327
other->ivy	0.6071	0.6838	0.7343	0.65	0.5937	0.9554
Average	0.6475	0.6318	0.7626	0.7743	0.6932	**0.9274**
ant->poi	0.5629	0.6474	0.6814	0.816	0.4516	0.8083
ivy->poi	0.4531	0.6814	0.6474	0.5892	0.5892	0.8388
tomcat->poi	0.5892	0.6666	0.5892	0.7166	0.7166	0.8245
xerces->poi	0.7166	0.75	0.9677	0.6814	0.6814	0.8659
other->poi	0.6363	0.6228	0.816	0.7321	0.6321	0.8578
Average	0.5916	0.6736	0.7403	0.7071	0.6142	**0.8391**
ant->tomcat	0.6289	0.6192	0.6401	0.6107	0.6531	0.8776
ivy->tomcat	0.6192	0.5964	0.6289	0.5798	0.6302	0.8756
poi->tomcat	0.5863	0.6241	0.6192	0.523	0.6401	0.8647
xerces->tomcat	0.6047	0.6031	0.5495	0.5848	0.6471	0.8809
other->tomcat	0.6684	0.5903	0.6031	0.6531	0.5851	0.8986
Average	0.6215	0.6066	0.6082	0.5903	0.6311	**0.8795**
ant->xerces	0.8083	0.898	0.7155	0.7444	0.7031	0.8809
ivy->xerces	0.5961	0.6517	0.7444	0.7237	0.7155	0.8363
poi->xerces	0.7008	0.6687	0.6558	0.7467	0.671	0.893
tomcat->xerces	0.8223	0.7166	0.6701	0.6348	0.6911	0.8604
other->xerces	0.6541	0.7475	0.6517	0.6911	0.7753	0.8579
Average	0.7163	0.7365	0.6875	0.7081	0.7112	**0.8657**

Table 6: Recall on the PROMISE Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
ivy->ant	0.812	0.7289	0.8728	0.7735	0.5874	0.8235
poi->ant	0.7959	0.6885	0.82	0.7127	0.6786	0.8529
tomcat->ant	0.8343	0.727	0.8039	0.82	0.6581	0.9117
xerces->ant	0.7555	0.7593	0.8585	0.7512	0.7431	0.8823
other->ant	0.8263	0.7816	0.8058	0.8808	0.6501	0.9411
Average	0.8048	0.7371	0.8322	0.7876	0.6635	**0.8823**
ant->ivy	0.7878	0.7424	0.8181	0.7878	0.7878	0.9204
poi->ivy	0.6818	0.7727	0.8333	0.8181	0.8181	0.909
tomcat->ivy	0.803	0.7272	0.7575	0.8333	0.803	0.909
xerces->ivy	0.7727	0.7575	0.7727	0.803	0.6363	0.9318
other->ivy	0.7424	0.7878	0.803	0.7727	0.6212	0.9545
Average	0.7575	0.7575	0.7969	0.803	0.7333	**0.9249**
ant->poi	0.5977	0.7643	0.7816	0.816	0.4827	0.7972
ivy->poi	0.5	0.7816	0.7643	0.6149	0.6149	0.8378
tomcat->poi	0.6149	0.8965	0.6149	0.6494	0.6494	0.8243
xerces->poi	0.6494	0.9482	0.6666	0.7816	0.7816	0.8648
other->poi	0.862	0.7471	0.816	0.7988	0.6321	0.8513
Average	0.6448	0.8275	0.7287	0.7321	0.6321	**0.8351**
ant->tomcat	0.7708	0.7645	0.777	0.7583	0.7833	0.875
ivy->tomcat	0.7645	0.7458	0.7708	0.727	0.7062	0.875
poi->tomcat	0.6812	0.8291	0.7645	0.5333	0.777	0.8645
xerces->tomcat	0.6937	0.752	0.5979	0.7333	0.7125	0.875
other->tomcat	0.7895	0.7395	0.752	0.7833	0.6229	0.8958
Average	0.7399	0.7662	0.7324	0.707	0.7204	**0.8771**
ant->xerces	0.8083	0.8361	0.7305	0.7444	0.7527	0.8809
ivy->xerces	0.6027	0.6888	0.7444	0.7666	0.7305	0.8333
poi->xerces	0.775	0.725	0.6666	0.7083	0.6444	0.8928
tomcat->xerces	0.7722	0.7888	0.7027	0.6527	0.7166	0.8571
other->xerces	0.7111	0.7805	0.6888	0.7166	0.7944	0.8571
Average	0.7339	0.7638	0.7066	0.7177	0.7277	**0.8642**

Table 7: F-measure on the PROMISE Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
ivy->ant	0.7616	0.736	0.7807	0.7357	0.72	0.8235
poi->ant	0.7337	0.6666	0.7763	0.7064	0.72	0.8528
tomcat->ant	0.7577	0.695	0.7474	0.7763	0.7866	0.9116
xerces->ant	0.6708	0.7515	0.8013	0.7365	0.8266	0.8823
other->ant	0.7441	0.75	0.7967	0.795	0.7733	0.9411
Average	0.7336	0.7198	0.7805	0.75	0.7653	**0.8823**
ant->ivy	0.7187	0.6244	0.8181	0.7187	0.7187	0.9203
poi->ivy	0.5368	0.6825	0.8925	0.8181	0.8181	0.909
tomcat->ivy	0.7626	0.5999	0.6516	0.8925	0.7626	0.9086
xerces->ivy	0.6825	0.6516	0.6825	0.7626	0.6363	0.9317
other->ivy	0.6244	0.7187	0.7626	0.6825	0.6043	0.9545
Average	0.665	0.6554	0.7615	0.7749	0.708	**0.9248**
ant->poi	0.5714	0.6767	0.7142	0.816	0.4666	0.7954
ivy->poi	0.4754	0.7142	0.6767	0.5989	0.5989	0.8377
tomcat->poi	0.5989	0.6923	0.5989	0.6745	0.6745	0.8242
xerces->poi	0.6745	0.806	0.7333	0.7142	0.7142	0.8647
other->poi	0.6342	0.6444	0.816	0.7593	0.6321	0.8506
Average	0.5909	0.7067	0.7078	0.7126	0.6173	**0.8345**
ant->tomcat	0.6605	0.6474	0.6745	0.6351	0.6897	0.8747
ivy->tomcat	0.6474	0.6126	0.6605	0.5826	0.6554	0.8749
poi->tomcat	0.6039	0.6489	0.6474	0.5252	0.6745	0.8645
xerces->tomcat	0.6277	0.6235	0.5562	0.5922	0.6713	0.8745
other->tomcat	0.7062	0.6021	0.6235	0.6897	0.5983	0.8956
Average	0.6491	0.6269	0.6324	0.605	0.6578	**0.8768**
ant->xerces	0.8083	0.8618	0.7223	0.7444	0.7181	0.8809
ivy->xerces	0.5989	0.6617	0.7444	0.7391	0.7223	0.8329
poi->xerces	0.7116	0.6783	0.6606	0.7237	0.6546	0.8928
tomcat->xerces	0.7927	0.7319	0.6811	0.6415	0.7012	0.8568
other->xerces	0.6592	0.761	0.6617	0.7012	0.784	0.857
Average	0.7141	0.7389	0.694	0.71	0.716	**0.8641**

Table 8: Accuracy on the PROMISE Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
ivy->ant	0.84	0.8533	0.84	0.8266	0.72	0.8235
poi->ant	0.8133	0.7866	0.8533	0.8266	0.72	0.8529
tomcat->ant	0.8266	0.8	0.8266	0.8533	0.7866	0.9117
xerces->ant	0.7466	0.8533	0.8666	0.84	0.8266	0.8823
other->ant	0.8133	0.84	0.88	0.8533	0.7733	0.9411
Average	0.808	0.8266	0.8533	0.84	0.7653	**0.8823**
ant->ivy	0.8888	0.8055	0.9444	0.8888	0.8888	0.9204
poi->ivy	0.6944	0.8611	0.9722	0.9444	0.9444	0.909
tomcat->ivy	0.9166	0.7777	0.8333	0.9722	0.9166	0.909
xerces->ivy	0.8611	0.8333	0.8611	0.9166	0.8888	0.9318
other->ivy	0.8055	0.8888	0.9166	0.8611	0.8611	0.9545
Average	0.8333	0.8333	0.9055	0.9166	0.8999	**0.9249**
ant->poi	0.8125	0.8437	0.875	0.9375	0.875	0.7972
ivy->poi	0.9062	0.875	0.8437	0.8437	0.8437	0.8378
tomcat->poi	0.8437	0.8125	0.8437	0.9062	0.9062	0.8243
xerces->poi	0.9062	0.9062	0.9375	0.875	0.875	0.8648
other->poi	0.75	0.8125	0.9375	0.9062	0.875	0.8513
Average	0.8437	0.85	0.8875	**0.8937**	0.875	0.8351
ant->tomcat	0.8604	0.8488	0.872	0.8372	0.8837	0.875
ivy->tomcat	0.8488	0.8139	0.8604	0.779	0.8837	0.875
poi->tomcat	0.8372	0.8255	0.8488	0.8488	0.872	0.8645
xerces->tomcat	0.8604	0.8255	0.8255	0.7906	0.8953	0.875
other->tomcat	0.8953	0.8023	0.8255	0.8837	0.872	0.8958
Average	0.8604	0.8232	0.8464	0.8279	**0.8813**	0.8771
ant->xerces	0.8695	0.913	0.8043	0.826	0.7826	0.8809
ivy->xerces	0.7173	0.7391	0.826	0.8043	0.8043	0.8333
poi->xerces	0.7608	0.7391	0.7608	0.826	0.7826	0.8928
tomcat->xerces	0.8695	0.7826	0.7608	0.7391	0.7826	0.8571
other->xerces	0.7173	0.826	0.7391	0.7826	0.8478	0.8571
Average	0.7869	0.8	0.7782	0.7956	0.8	**0.8642**

Table 9: Precision on the AEEEM Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
JDT->EQ	0.659	0.7142	0.6888	0.6888	0.6136	0.9062
Lucene->EQ	0.613	0.5939	0.6636	0.7142	0.656	0.8869
Mylyn->EQ	0.6785	0.7161	0.6875	0.6277	0.7939	0.8545
PDE->EQ	0.5909	0.53	0.6192	0.6541	0.6818	0.923
other->EQ	0.6391	0.5909	0.7161	0.6488	0.6277	0.8095
Average	0.6361	0.629	0.675	0.6667	0.6746	**0.876**
EQ->JDT	0.812	0.8337	0.8714	0.8337	0.837	0.8028
Lucene->JDT	0.8045	0.8226	0.8476	0.8113	0.8113	0.7916
Mylyn->JDT	0.778	0.8563	0.8449	0.8263	0.8	0.8211
PDE->JDT	0.8226	0.8347	0.8856	0.8759	0.8015	0.7851
other->JDT	0.8347	0.864	0.837	0.8127	0.7766	0.8123
Average	0.8104	0.8423	**0.8573**	0.832	0.8053	0.8026
EQ->Lucene	0.5918	0.6376	0.5449	0.5599	0.7338	0.7333
JDT->Lucene	0.6153	0.6151	0.5727	0.5659	0.625	0.8418
Mylyn->Lucene	0.6217	0.5783	0.5918	0.5856	0.6109	0.8936
PDE->Lucene	0.5847	0.6088	0.5488	0.503	0.5783	0.9179
other->Lucene	0.642	0.5991	0.5659	0.5145	0.491	0.873
Average	0.6111	0.6078	0.5648	0.5458	0.6078	**0.8519**
EQ->Mylyn	0.5966	0.6367	0.6582	0.6649	0.5866	0.8464
JDT->Mylyn	0.6405	0.7012	0.6356	0.6573	0.6331	0.825
Lucene->Mylyn	0.6635	0.6969	0.6776	0.739	0.6163	0.832
PDE->Mylyn	0.652	0.6966	0.687	0.6225	0.6086	0.8385
other->Mylyn	0.6044	0.6443	0.6924	0.6555	0.6033	0.8268
Average	0.6314	0.6751	0.6702	0.6678	0.6096	**0.8337**
EQ->PDE	0.6681	0.7022	0.6487	0.6327	0.7529	0.7386
JDT->PDE	0.6806	0.6462	0.6286	0.6493	0.6911	0.6909
Lucene->PDE	0.6422	0.6607	0.6229	0.6562	0.7111	0.7619
Mylyn->PDE	0.6323	0.6864	0.6207	0.6487	0.6472	0.7259
other->PDE	0.6648	0.6493	0.6362	0.6264	0.6631	0.7902
Average	0.6576	0.669	0.6314	0.6427	0.6931	**0.7415**

Table 10: Recall on the AEEEM Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
JDT->EQ	0.648	0.7076	0.6961	0.6961	0.6057	0.8846
Lucene->EQ	0.6096	0.5961	0.6711	0.7076	0.6596	0.8846
Mylyn->EQ	0.673	0.7211	0.6557	0.6326	0.7057	0.8461
PDE->EQ	0.5846	0.5307	0.6192	0.6576	0.6692	0.923
other->EQ	0.623	0.5846	0.7211	0.6442	0.6326	0.8076
Average	0.6276	0.628	0.6726	0.6676	0.6546	**0.8692**
EQ->JDT	0.8521	0.866	0.8869	0.866	0.8442	0.7857
Lucene->JDT	0.7906	0.8482	0.8621	0.8303	0.8303	0.7857
Mylyn->JDT	0.8095	0.8908	0.7936	0.8263	0.8125	0.8095
PDE->JDT	0.8482	0.8551	0.8938	0.8759	0.8015	0.7619
other->JDT	0.8551	0.8293	0.8442	0.8194	0.7986	0.8095
Average	0.8311	**0.8579**	0.8561	0.8436	0.8174	0.7905
EQ->Lucene	0.7239	0.8229	0.6171	0.6406	0.802	0.7142
JDT->Lucene	0.8437	0.7473	0.6562	0.6484	0.7552	0.8404
Mylyn->Lucene	0.8072	0.6119	0.7239	0.7161	0.6875	0.8936
PDE->Lucene	0.7526	0.7916	0.5885	0.5052	0.6119	0.9148
other->Lucene	0.7031	0.6796	0.6484	0.5208	0.4817	0.8723
Average	0.7661	0.7307	0.6468	0.6062	0.6677	**0.8471**
EQ->Mylyn	0.6507	0.6468	0.7029	0.7059	0.6194	0.8461
JDT->Mylyn	0.6937	0.7712	0.7189	0.7624	0.6751	0.823
Lucene->Mylyn	0.7811	0.7525	0.7277	0.7116	0.5938	0.8307
PDE->Mylyn	0.6998	0.7181	0.7807	0.669	0.6724	0.8384
other->Mylyn	0.6568	0.725	0.7338	0.7468	0.6033	0.823
Average	0.6964	0.7227	0.7328	0.7191	0.6328	**0.8322**
EQ->PDE	0.7533	0.8046	0.7375	0.7119	0.6542	0.738
JDT->PDE	0.7334	0.7237	0.7179	0.7137	0.6246	0.6904
Lucene->PDE	0.6959	0.7078	0.7199	0.7315	0.6463	0.7619
Mylyn->PDE	0.7218	0.7057	0.6901	0.7375	0.6722	0.7259
other->PDE	0.7632	0.7137	0.7257	0.6841	0.68	0.7902
Average	0.7335	0.7311	0.7182	0.7157	0.6555	**0.7413**

Table 11: F-measure on the AEEEM Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
JDT->EQ	0.6046	0.7102	0.6898	0.6898	0.6071	0.883
Lucene->EQ	0.5753	0.5753	0.6616	0.7102	0.636	0.8844
Mylyn->EQ	0.636	0.7179	0.659	0.6278	0.713	0.8452
PDE->EQ	0.5437	0.5299	0.6192	0.6552	0.6726	0.923
other->EQ	0.5722	0.5437	0.7179	0.6458	0.6278	0.8074
Average	0.5864	0.6154	0.6695	0.6658	0.6513	**0.8686**
EQ->JDT	0.8262	0.8466	0.8785	0.8466	0.8405	0.7826
Lucene->JDT	0.797	0.8333	0.8542	0.8196	0.8196	0.7846
Mylyn->JDT	0.7896	0.8702	0.8133	0.8263	0.8057	0.8077
PDE->JDT	0.8333	0.8437	0.8895	0.8759	0.8015	0.7569
other->JDT	0.8437	0.844	0.8405	0.8159	0.7857	0.809
Average	0.818	0.8476	**0.8552**	0.8369	0.8106	0.7882
EQ->Lucene	0.5977	0.6618	0.5276	0.5577	0.7619	0.7083
JDT->Lucene	0.5949	0.6358	0.5798	0.5685	0.6499	0.8402
Mylyn->Lucene	0.6347	0.5893	0.5977	0.586	0.6317	0.8936
PDE->Lucene	0.5543	0.6099	0.5537	0.4978	0.5893	0.9147
other->Lucene	0.6639	0.6174	0.5685	0.5146	0.475	0.8722
Average	0.6091	0.6228	0.5655	0.5449	0.6216	**0.8458**
EQ->Mylyn	0.6086	0.6414	0.6753	0.6812	0.5963	0.8461
JDT->Mylyn	0.6584	0.7269	0.6555	0.6818	0.6482	0.8228
Lucene->Mylyn	0.6889	0.7186	0.6969	0.724	0.6027	0.8306
PDE->Mylyn	0.6695	0.7064	0.7159	0.6377	0.6229	0.8384
other->Mylyn	0.618	0.6659	0.7096	0.6795	0.6033	0.8225
Average	0.6487	0.6918	0.6906	0.6808	0.6147	**0.8321**
EQ->PDE	0.6885	0.7287	0.6636	0.6444	0.6843	0.7379
JDT->PDE	0.6994	0.6623	0.6345	0.6666	0.6454	0.6903
Lucene->PDE	0.658	0.6771	0.6188	0.6747	0.6685	0.7619
Mylyn->PDE	0.6401	0.695	0.6309	0.6636	0.6574	0.7258
other->PDE	0.6829	0.6666	0.6459	0.6398	0.6707	0.7902
Average	0.6738	0.6859	0.6387	0.6578	0.6653	**0.7412**

Table 12: Accuracy on the AEEEM Dataset

	DP-LSTM	DP-CNN	DP-Trans	PCA-NN	Rule learning	LRNN
JDT->EQ	0.606	0.7272	0.6969	0.6969	0.6363	0.8846
Lucene->EQ	0.5757	0.5757	0.6666	0.7272	0.6363	0.8846
Mylyn->EQ	0.6363	0.7272	0.6969	0.6363	0.7575	0.8461
PDE->EQ	0.5454	0.5454	0.6363	0.6666	0.6969	0.923
other->EQ	0.5757	0.5454	0.7272	0.6666	0.6363	0.8076
Average	0.5878	0.6242	0.6848	0.6787	0.6727	**0.8692**
EQ->JDT	0.85	0.87	0.9	0.87	0.87	0.7857
Lucene->JDT	0.84	0.86	0.88	0.85	0.85	0.7857
Mylyn->JDT	0.82	0.89	0.86	0.86	0.84	0.8095
PDE->JDT	0.86	0.87	0.91	0.9	0.84	0.7619
other->JDT	0.87	0.88	0.87	0.85	0.82	0.8095
Average	0.848	0.874	**0.884**	0.866	0.844	0.7905
EQ->Lucene	0.7714	0.8142	0.7142	0.7571	0.9142	0.7142
JDT->Lucene	0.7142	0.8142	0.7857	0.7714	0.8285	0.8404
Mylyn->Lucene	0.7857	0.8428	0.7714	0.7571	0.8428	0.8936
PDE->Lucene	0.6857	0.7571	0.8	0.7857	0.8428	0.9148
other->Lucene	0.8714	0.8285	0.7714	0.8142	0.7428	0.8723
Average	0.7657	0.8114	0.7685	0.7771	0.8342	**0.8471**
EQ->Mylyn	0.7807	0.8395	0.8395	0.8449	0.7914	0.8461
JDT->Mylyn	0.8235	0.8609	0.8021	0.8128	0.8235	0.823
Lucene->Mylyn	0.8128	0.8609	0.8502	0.8877	0.8449	0.8307
PDE->Mylyn	0.8342	0.8663	0.8449	0.8128	0.786	0.8384
other->Mylyn	0.7914	0.8128	0.8609	0.8181	0.8288	0.823
Average	0.8085	**0.8481**	0.8395	0.8353	0.8149	0.8322
EQ->PDE	0.7933	0.82	0.7666	0.7533	0.8666	0.738
JDT->PDE	0.82	0.7733	0.7333	0.7866	0.8466	0.6904
Lucene->PDE	0.7866	0.8066	0.7066	0.7866	0.8533	0.7619
Mylyn->PDE	0.74	0.8333	0.7466	0.7666	0.8066	0.7258
other->PDE	0.78	0.7866	0.7466	0.7666	0.82	0.7903
Average	0.784	0.804	0.7399	0.7719	**0.8386**	0.7413