SUPPLEMENTARY MATERIAL FOR *WEAKLY-SUPERVISED ANOMALY DETECTION WITH ADAPTIVE SCORE DISTRIBUTION DISCRIMINATION*

We provide additional information on Overlap Area Calculation (Section 3.3.2), Model Performance (Section 4.3.1), and Exploration of AD Loss Functions on Real-world Datasets (Section 4.4.1).

.1 Experimental Results of Selecting Intersection Points

We demonstrate the experimental results of different intersection point selection strategies in Table 1. The detection performance of a randomly selected intersection point is very close to that of ensembling all the calculated intersection points w.r.t. different ratios of labeled anomalies $\gamma_l = 5\%$, $\gamma_l = 10\%$ and $\gamma_l = 20\%$. This is due to the fact that the calculation of the overlap area repeats many times (epochs×batchsize), which is essentially similar to the average results of the ensemble strategy. Moreover, random sampling of the intersection points can improve computational efficiency since the overlap area only needs to be estimated once in a training batch.

Table 1: AUC-ROC and AUC-PR results of different intersection point selection strategies. MLP-Overlap corresponds to the default strategy that randomly chooses one of the intersection points for estimating the overlap area via Eq.10. MLP-Overlap-E refers to the ensemble strategy by taking the average of the overlap areas calculated based on each intersection point.

(a) AUC-ROC results.

	$\gamma_l = 5\%$	$\gamma_l = 10\%$	$\gamma_l = 20\%$
MLP-Overlap	0.847±0.145	0.880±0.132	0.893±0.133
MLP-Overlap-E	0.849±0.146	0.879±0.132	0.894±0.131

(b) AUC-PR results.

	$\gamma_l = 5\%$	$\gamma_l = 10\%$	$\gamma_l = 20\%$
MLP-Overlap	0.623±0.291	0.674±0.286	0.696±0.288
MLP-Overlap-E	0.626±0.291	0.673±0.285	0.694±0.287

.2 Complete Experimental Results of Model Performance

We show the detailed results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 5\%$, $\gamma_l = 10\%$ and $\gamma_l = 20\%$ in Table 2~7. The best performing method(s) is marked in **bold**.

Table 2: AUC-ROC results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 5\%$.

Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.548	0.560	0.525	0.552	**0.576**	0.528	0.486	0.492	0.506	0.497	0.547	0.532	0.483	0.500	0.501	0.515
annthyroid	0.828	0.783	0.502	0.769	0.818	0.803	0.805	0.822	0.882	0.798	0.903	0.914	0.761	0.872	0.922	**0.985**
Cardiotocography	0.692	0.684	0.514	0.575	0.807	0.898	**0.911**	0.908	0.874	0.818	0.791	0.883	0.627	0.884	0.842	0.835
fault	0.569	0.444	0.485	0.628	**0.704**	0.694	0.696	0.683	0.645	0.671	0.657	0.668	0.502	0.665	0.657	0.656
http	0.999	0.981	0.509	0.980	0.998	0.999	0.999	0.999	**1.000**	0.000	0.999	0.999	0.835	**1.000**	0.999	**1.000**
landsat	0.483	0.571	0.501	0.514	0.854	0.584	0.776	0.779	0.833	0.767	0.802	0.816	0.671	0.735	**0.864**	**0.864**
letter	0.635	0.526	0.468	0.673	0.703	0.629	0.590	0.582	0.591	0.557	0.562	0.566	**0.752**	0.634	0.513	0.560
magic.gamma	0.732	0.648	0.498	0.580	0.819	0.799	0.827	0.832	0.840	0.646	0.818	0.842	0.695	0.824	0.812	**0.843**
mammography	0.861	0.909	0.520	0.781	0.915	0.919	0.924	0.919	0.912	0.853	0.919	**0.931**	0.748	0.867	0.900	0.921
mnist	0.803	0.846	0.523	0.705	0.862	0.917	**0.949**	0.925	0.823	0.935	0.869	0.925	0.586	0.720	0.916	0.870
musk	0.999	0.952	0.550	0.781	0.917	0.915	**1.000**	**1.000**	**1.000**	0.998	0.927	**1.000**	0.426	**1.000**	0.999	0.989
optdigits	0.674	0.612	0.522	0.384	0.934	0.986	**1.000**	0.999	0.995	0.966	0.988	0.999	0.654	0.994	0.977	0.916
PageBlocks	0.894	0.913	0.522	0.654	**0.934**	0.912	0.864	0.883	0.896	0.785	0.895	0.890	0.714	0.910	0.842	0.888
pendigits	0.955	0.910	0.485	0.707	0.965	0.997	0.996	0.993	0.995	0.958	0.997	**0.999**	0.682	0.994	0.989	0.984
satellite	0.699	0.750	0.503	0.722	0.883	0.807	0.853	0.852	0.852	0.766	0.834	**0.910**	0.740	0.907	0.874	0.880
satimage-2	**0.992**	0.966	0.525	0.969	0.981	0.986	0.991	0.989	0.970	0.921	0.967	0.988	0.367	0.973	0.942	0.932
shuttle	**0.996**	0.995	0.508	0.744	0.990	0.989	0.979	0.978	0.981	0.976	0.980	0.982	0.973	0.979	0.976	0.977
skin	0.684	0.391	0.500	0.542	0.995	0.919	0.951	0.954	0.982	**0.999**	0.978	0.987	0.998	0.994	0.993	0.965
SpamBase	0.633	0.660	0.500	0.534	0.690	0.838	0.902	0.909	0.876	0.748	0.768	0.841	0.598	0.769	0.870	**0.917**
speech	0.498	0.510	0.549	0.481	0.531	0.582	0.604	0.631	0.589	0.587	0.475	0.624	0.532	0.581	0.551	**0.648**
thyroid	0.981	0.979	0.521	0.919	0.941	0.990	0.994	**0.995**	0.981	0.863	0.818	0.988	0.387	0.954	0.980	0.968
vowels	0.765	0.440	0.407	0.792	0.767	0.812	0.847	0.891	0.860	0.777	0.665	**0.916**	0.646	0.787	0.735	0.823
Waveform	0.693	0.723	0.495	0.545	0.691	0.763	0.806	0.809	0.764	**0.882**	0.626	0.780	0.563	0.765	0.772	0.814
Wilt	0.427	0.395	0.502	0.388	0.799	0.529	0.689	0.695	0.922	0.894	0.819	0.945	0.795	**0.950**	0.658	0.910
yeast	0.382	0.387	0.477	0.449	0.512	0.467	0.625	0.627	0.611	0.625	0.610	0.619	0.530	**0.642**	0.583	0.627

Table 3: AUC-ROC results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 10\%$.

Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.548	0.560	0.525	0.556	**0.574**	0.546	0.510	0.514	0.523	0.487	0.531	0.519	0.476	0.496	0.506	0.524
annthyroid	0.828	0.783	0.502	0.733	0.884	0.824	0.826	0.834	0.939	0.880	0.897	0.968	0.905	0.932	**0.990**	**0.990**
Cardiotocography	0.692	0.684	0.514	0.578	0.868	0.916	**0.931**	**0.931**	0.927	0.849	0.835	0.920	0.689	0.928	0.893	0.885
fault	0.569	0.444	0.485	0.631	**0.728**	0.720	0.724	0.719	0.695	0.692	0.674	0.695	0.570	0.721	0.694	0.699
http	0.999	0.981	0.509	0.785	0.999	**1.000**	0.999	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	0.829	**1.000**	**1.000**	**1.000**
landsat	0.483	0.571	0.501	0.522	**0.897**	0.561	0.779	0.789	0.878	0.805	0.805	0.839	0.743	0.836	0.891	0.891
letter	0.635	0.526	0.468	0.673	0.723	**0.753**	0.699	0.713	0.694	0.699	0.613	0.656	0.749	0.720	0.612	0.636
magic.gamma	0.732	0.648	0.498	0.611	0.847	0.809	0.827	0.833	0.870	0.688	0.841	0.874	0.755	0.871	0.834	**0.879**
mammography	0.861	0.909	0.520	0.774	0.907	0.925	0.926	0.924	0.931	0.793	0.918	**0.935**	0.812	0.932	0.908	0.919
mnist	0.803	0.846	0.523	0.707	0.916	0.966	**0.974**	0.963	0.915	0.957	0.940	0.962	0.753	0.911	0.947	0.939
musk	0.999	0.952	0.550	0.879	0.968	0.971	**1.000**	**1.000**	**1.000**	0.997	**1.000**	**1.000**	0.654	**1.000**	0.996	0.995
optdigits	0.674	0.612	0.522	0.383	0.979	0.993	**1.000**	0.998	0.996	0.928	0.982	0.999	0.652	**1.000**	0.985	0.903
PageBlocks	0.894	0.913	0.522	0.681	**0.945**	0.925	0.863	0.880	0.919	0.829	0.939	0.927	0.777	0.919	0.894	0.897
pendigits	0.955	0.910	0.485	0.713	0.993	0.996	0.995	0.995	0.995	0.981	0.992	**0.999**	0.761	**0.999**	0.997	0.981
satellite	0.699	0.750	0.503	0.726	0.909	0.807	0.851	0.849	0.899	0.840	0.852	**0.919**	0.759	0.910	0.908	0.891
satimage-2	**0.992**	0.966	0.525	0.969	0.986	0.989	0.988	0.986	0.954	0.959	0.971	0.978	0.801	0.987	0.974	0.949
shuttle	**0.996**	0.995	0.508	0.650	0.992	0.987	0.979	0.980	0.982	0.983	0.985	0.982	0.981	0.979	0.981	0.979
skin	0.684	0.391	0.500	0.516	0.997	0.910	0.951	0.954	0.992	**0.999**	0.992	0.996	0.998	0.993	0.995	0.985
SpamBase	0.633	0.660	0.500	0.538	0.801	0.861	0.915	0.928	0.921	0.812	0.862	0.916	0.677	0.893	0.914	**0.951**
speech	0.498	0.510	0.549	0.481	0.538	0.541	0.659	0.689	0.616	0.668	0.512	0.647	0.548	0.614	0.610	**0.698**
thyroid	0.981	0.979	0.521	0.920	0.965	0.994	**0.996**	**0.996**	0.994	0.974	0.897	0.988	0.698	**0.996**	0.993	0.995
vowels	0.765	0.440	0.407	0.794	0.805	0.896	0.926	0.942	0.925	0.906	0.899	**0.964**	0.674	0.952	0.753	0.917
Waveform	0.693	0.723	0.495	0.545	0.765	0.846	0.881	0.884	0.836	**0.887**	0.728	0.854	0.666	0.786	0.863	0.774
Wilt	0.427	0.395	0.502	0.391	0.918	0.597	0.691	0.698	0.944	0.950	0.876	0.969	0.890	**0.988**	0.685	0.942
yeast	0.382	0.387	0.477	0.448	0.576	0.460	0.638	0.644	0.648	0.663	0.649	0.639	0.596	**0.682**	0.655	0.642

Table 4: AUC-ROC results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 20\%$.

Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.548	0.560	0.525	0.550	0.591	0.532	0.522	0.520	0.525	0.504	**0.596**	0.544	0.495	0.535	0.526	0.515
annthyroid	0.828	0.783	0.502	0.781	0.930	0.825	0.825	0.835	0.951	0.955	0.941	0.970	0.957	0.958	**0.992**	0.989
Cardiotocography	0.692	0.684	0.514	0.583	0.913	0.930	0.946	0.945	0.942	0.896	0.894	0.946	0.778	**0.948**	0.930	0.933
fault	0.569	0.444	0.485	0.633	**0.749**	0.743	0.733	0.738	0.698	0.669	0.718	0.673	0.642	0.745	0.713	0.717
http	0.999	0.981	0.509	0.783	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
landsat	0.483	0.571	0.501	0.538	**0.921**	0.560	0.789	0.782	0.899	0.872	0.846	0.806	0.806	0.884	0.913	0.901
letter	0.635	0.526	0.468	0.675	0.751	**0.806**	0.748	0.767	0.739	0.717	0.677	0.683	0.739	0.779	0.705	0.720
magic.gamma	0.732	0.648	0.498	0.662	0.874	0.812	0.827	0.831	0.874	0.746	0.828	0.881	0.803	**0.889**	0.858	0.860
mammography	0.861	0.909	0.520	0.755	0.934	0.932	0.927	0.925	0.945	0.856	0.934	**0.948**	0.864	0.946	0.923	0.934
mnist	0.803	0.846	0.523	0.705	0.959	**0.984**	**0.984**	0.983	0.969	0.967	0.965	0.982	0.846	0.980	0.968	0.979
musk	0.999	0.952	0.550	0.891	0.996	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	0.752	**1.000**	**1.000**	**1.000**
optdigits	0.674	0.612	0.522	0.385	0.997	0.996	**1.000**	**1.000**	0.998	0.987	**1.000**	0.999	0.777	**1.000**	0.998	0.999
PageBlocks	0.894	0.913	0.522	0.775	**0.959**	0.929	0.885	0.897	0.935	0.901	0.948	0.949	0.905	0.933	0.925	0.933
pendigits	0.955	0.910	0.485	0.718	0.999	0.996	0.997	0.997	0.998	0.993	0.996	**1.000**	0.923	0.999	0.997	0.993
satellite	0.699	0.750	0.503	0.739	0.932	0.806	0.856	0.849	0.903	0.867	0.866	0.928	0.836	**0.937**	0.935	0.914
satimage-2	0.992	0.966	0.525	0.971	0.992	0.992	**0.993**	**0.993**	0.969	0.959	0.977	0.986	0.912	0.988	0.969	0.974
shuttle	**0.996**	0.995	0.508	0.757	0.992	0.987	0.979	0.979	0.983	0.987	0.987	0.984	0.982	0.980	0.984	0.978
skin	0.684	0.391	0.500	0.499	0.998	0.903	0.951	0.955	0.995	0.999	0.983	0.998	0.999	**1.000**	0.996	0.976
SpamBase	0.633	0.660	0.500	0.544	0.887	0.889	0.913	0.931	0.938	0.868	0.886	0.946	0.807	0.945	0.928	**0.953**
speech	0.498	0.510	0.549	0.482	0.559	0.611	0.713	**0.740**	0.624	0.643	0.598	0.694	0.584	0.685	0.678	0.734
thyroid	0.981	0.979	0.521	0.918	0.986	0.996	**0.997**	**0.997**	0.994	0.983	0.996	0.996	0.879	**0.997**	0.993	**0.997**
vowels	0.765	0.440	0.407	0.798	0.871	0.971	0.970	0.979	0.977	0.953	0.961	0.995	0.837	**0.996**	0.976	0.991
Waveform	0.693	0.723	0.495	0.546	0.811	0.898	**0.909**	0.903	0.880	0.899	0.765	0.885	0.700	0.839	0.885	0.885
Wilt	0.427	0.395	0.502	0.479	0.960	0.646	0.689	0.696	0.954	0.981	0.876	0.970	0.922	**0.991**	0.732	0.976
yeast	0.382	0.387	0.477	0.458	0.644	0.459	0.663	0.666	0.646	0.703	0.663	0.672	0.660	0.699	**0.705**	0.650

Table 5: AUC-PR results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 5\%$.

Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.036	0.036	0.042	0.038	**0.058**	0.041	0.042	0.045	0.046	0.043	0.040	0.048	0.037	0.040	0.035	0.036
annthyroid	0.336	0.260	0.078	0.359	0.402	0.400	0.425	0.458	0.541	0.482	0.609	0.602	0.363	0.575	0.658	**0.799**
Cardiotocography	0.441	0.436	0.254	0.345	0.602	0.760	0.767	**0.776**	0.708	0.610	0.652	0.720	0.433	0.736	0.649	0.691
fault	0.418	0.317	0.355	0.477	0.531	0.543	0.557	**0.565**	0.514	0.501	0.527	0.525	0.425	0.521	0.495	0.538
http	0.808	0.158	0.022	0.648	0.659	0.833	0.869	0.845	0.982	0.003	0.847	0.898	0.805	**1.000**	0.867	**1.000**
landsat	0.199	0.262	0.210	0.210	0.617	0.322	0.448	0.447	0.572	0.502	0.575	0.537	0.407	0.497	**0.682**	0.633
letter	0.098	0.076	0.165	0.141	0.176	0.148	0.158	0.159	0.201	0.134	0.109	0.137	**0.342**	0.169	0.118	0.126
magic.gamma	0.648	0.551	0.357	0.449	0.709	0.730	0.725	0.755	0.771	0.535	0.732	0.774	0.548	0.750	0.703	**0.792**
mammography	0.195	0.414	0.055	0.127	0.510	0.592	**0.610**	0.603	0.427	0.418	0.545	0.546	0.372	0.469	0.528	0.589
mnist	0.286	0.329	0.127	0.196	0.544	0.717	**0.784**	0.738	0.617	0.670	0.643	0.760	0.286	0.496	0.644	0.554
musk	0.970	0.343	0.105	0.464	0.597	0.653	**1.000**	**1.000**	**1.000**	0.961	0.895	**1.000**	0.246	**1.000**	0.974	0.951
optdigits	0.047	0.035	0.032	0.028	0.510	0.951	**0.991**	0.989	0.966	0.708	0.961	0.987	0.260	0.960	0.811	0.625
PageBlocks	0.469	0.517	0.146	0.346	0.714	0.678	0.654	0.679	0.642	0.539	**0.719**	0.680	0.456	0.696	0.602	0.638
pendigits	0.283	0.216	0.032	0.185	0.716	0.955	0.928	0.922	0.952	0.760	0.954	**0.980**	0.367	0.970	0.890	0.908
satellite	0.662	0.662	0.323	0.666	0.782	0.795	0.828	0.825	0.768	0.663	0.763	0.861	0.628	**0.869**	0.805	0.838
satimage-2	0.913	0.629	0.034	0.523	0.671	0.899	0.908	0.912	0.918	0.560	0.912	**0.930**	0.161	0.880	0.885	0.790
shuttle	**0.975**	0.957	0.081	0.464	0.954	0.974	0.968	0.967	0.962	0.956	0.967	0.966	0.959	0.966	0.953	0.960
skin	0.257	0.156	0.204	0.223	0.950	0.555	0.660	0.673	0.866	**0.994**	0.832	0.905	0.984	0.950	0.963	0.793
SpamBase	0.496	0.528	0.400	0.409	0.584	0.774	0.846	0.863	0.836	0.657	0.754	0.806	0.550	0.748	0.813	**0.889**
speech	0.021	0.019	0.049	0.017	0.024	0.045	0.052	0.057	0.042	0.044	0.027	**0.060**	0.040	0.046	0.037	0.054
thyroid	0.574	0.526	0.068	0.466	0.464	0.753	0.880	**0.888**	0.814	0.487	0.581	0.852	0.108	0.777	0.737	0.814
vowels	0.193	0.039	0.105	0.244	0.150	0.345	0.384	0.431	0.438	0.289	0.283	**0.602**	0.336	0.354	0.336	0.386
Waveform	0.063	0.064	0.032	0.043	0.180	0.121	0.135	0.177	0.182	**0.216**	0.156	0.181	0.141	0.154	0.182	0.190
Wilt	0.043	0.042	0.054	0.045	0.188	0.065	0.087	0.089	0.381	0.545	0.390	0.494	0.380	0.582	0.082	**0.633**
yeast	0.293	0.305	0.333	0.314	0.348	0.338	0.437	0.439	0.436	0.445	0.429	0.438	0.391	**0.467**	0.409	0.447

Table 6: AUC-PR results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 10\%$.

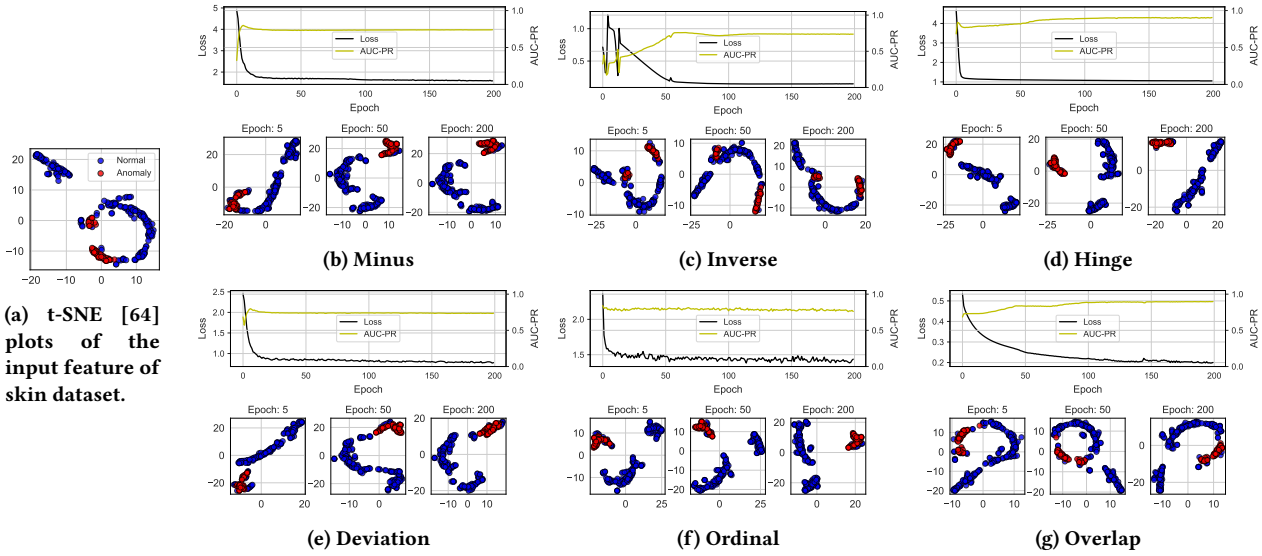
Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.036	0.036	0.042	0.039	**0.068**	0.052	0.047	0.052	0.049	0.044	0.041	0.046	0.036	0.037	0.037	0.042
annthyroid	0.336	0.260	0.078	0.327	0.506	0.437	0.459	0.476	0.660	0.615	0.574	0.729	0.591	0.674	**0.835**	0.833
Cardiotocography	0.441	0.436	0.254	0.347	0.708	0.799	0.805	**0.817**	0.784	0.676	0.710	0.779	0.501	0.799	0.695	0.755
fault	0.418	0.317	0.355	0.480	0.560	0.577	0.586	**0.596**	0.542	0.521	0.543	0.537	0.490	0.575	0.538	0.567
http	0.808	0.158	0.022	0.451	0.829	0.928	0.891	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	0.801	**1.000**	**1.000**	**1.000**
landsat	0.199	0.262	0.210	0.215	0.704	0.357	0.454	0.486	0.632	0.568	0.516	0.597	0.474	0.614	**0.719**	0.708
letter	0.098	0.076	0.165	0.142	0.183	0.209	0.153	0.170	0.225	0.167	0.140	0.144	**0.305**	0.190	0.139	0.142
magic.gamma	0.648	0.551	0.357	0.473	0.754	0.748	0.718	0.748	0.817	0.594	0.758	0.822	0.622	0.819	0.735	**0.839**
mammography	0.195	0.414	0.055	0.127	0.562	0.606	**0.621**	0.606	0.515	0.370	0.520	0.566	0.475	0.573	0.565	0.544
mnist	0.286	0.329	0.127	0.198	0.678	**0.847**	0.846	0.820	0.752	0.737	0.737	0.844	0.443	0.781	0.724	0.799
musk	0.970	0.343	0.105	0.733	0.835	0.886	**1.000**	**1.000**	**1.000**	0.972	**1.000**	**1.000**	0.405	**1.000**	0.983	0.988
optdigits	0.047	0.035	0.032	0.027	0.811	0.973	0.994	0.991	0.979	0.713	0.961	0.992	0.323	**0.995**	0.885	0.746
PageBlocks	0.469	0.517	0.146	0.349	0.747	0.719	0.645	0.662	0.666	0.616	**0.774**	0.695	0.526	0.695	0.689	0.711
pendigits	0.283	0.216	0.032	0.186	0.893	0.963	0.914	0.914	0.955	0.881	0.946	**0.985**	0.427	0.980	0.946	0.865
satellite	0.662	0.662	0.323	0.653	0.829	0.789	0.830	0.828	0.846	0.749	0.772	**0.877**	0.636	0.872	0.829	0.851
satimage-2	0.913	0.629	0.034	0.527	0.868	0.910	0.897	0.886	0.911	0.851	0.907	**0.919**	0.525	0.916	0.873	0.877
shuttle	**0.975**	0.957	0.081	0.363	0.964	0.971	0.968	0.967	0.966	0.971	0.970	0.971	0.967	0.968	0.961	0.965
skin	0.257	0.156	0.204	0.212	0.971	0.532	0.658	0.675	0.937	**0.989**	0.945	0.959	0.982	0.944	0.970	0.904
SpamBase	0.496	0.528	0.400	0.411	0.701	0.802	0.857	0.879	0.884	0.745	0.834	0.886	0.635	0.868	0.862	**0.934**
speech	0.021	0.019	0.049	0.017	0.025	0.056	0.065	0.068	**0.085**	0.066	0.044	0.065	0.064	0.067	0.061	0.072
thyroid	0.574	0.526	0.068	0.475	0.606	0.870	**0.903**	0.883	0.870	0.750	0.810	0.882	0.368	0.895	0.840	0.893
vowels	0.193	0.039	0.105	0.247	0.192	0.477	0.646	0.705	0.676	0.506	0.501	**0.770**	0.410	0.676	0.418	0.711
Waveform	0.063	0.064	0.032	0.043	**0.263**	0.146	0.160	0.189	0.221	0.245	0.195	0.248	0.137	0.218	0.232	0.220
Wilt	0.043	0.042	0.054	0.046	0.387	0.077	0.087	0.089	0.436	0.663	0.462	0.611	0.492	**0.831**	0.090	0.752
yeast	0.293	0.305	0.333	0.313	0.392	0.349	0.434	0.440	0.443	**0.489**	0.462	0.439	0.429	0.486	0.472	0.443

Table 7: AUC-PR results of model comparison on 25 real-world datasets w.r.t. $\gamma_l = 20\%$.

Dataset	Typical						MLP			AutoEncoder			ResNet		Transformer	
	Iforest	ECOD	Deep SVDD	GAN omaly	Deep SAD	REPEN	DevNet	PReNet	MLP-Overlap	FEAWAD (Sup)	FEAWAD (Weak)	AE-Overlap	ResNet	ResNet-Overlap	FTT	FTT-Overlap
ALOI	0.036	0.036	0.042	0.038	**0.069**	0.046	0.047	0.045	0.045	0.051	0.047	0.044	0.040	0.052	0.041	0.039
annthyroid	0.336	0.260	0.078	0.372	0.624	0.441	0.457	0.478	0.677	0.703	0.622	0.739	0.704	0.748	**0.858**	0.818
Cardiotocography	0.441	0.436	0.254	0.354	0.793	0.830	**0.838**	0.837	0.826	0.743	0.768	0.835	0.600	**0.838**	0.794	0.828
fault	0.418	0.317	0.355	0.485	0.582	**0.610**	0.581	0.604	0.510	0.517	0.570	0.520	0.536	0.592	0.548	0.565
http	0.808	0.158	0.022	0.451	0.891	0.928	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**	**1.000**
landsat	0.199	0.262	0.210	0.228	**0.763**	0.389	0.528	0.487	0.688	0.695	0.563	0.523	0.587	0.680	0.753	0.745
letter	0.098	0.076	0.165	0.143	0.197	0.276	0.216	0.260	0.239	0.206	0.195	0.175	**0.344**	0.268	0.197	0.211
magic.gamma	0.648	0.551	0.357	0.518	0.799	0.746	0.720	0.743	0.817	0.674	0.726	0.826	0.684	**0.850**	0.767	0.819
mammography	0.195	0.414	0.055	0.119	0.600	0.617	0.614	0.613	0.513	0.477	0.618	0.600	0.510	0.602	0.601	**0.629**
mnist	0.286	0.329	0.127	0.195	0.810	**0.908**	0.871	0.888	0.850	0.808	0.786	0.883	0.598	0.902	0.798	0.872
musk	0.970	0.343	0.105	0.752	0.981	0.994	**1.000**	**1.000**	**1.000**	0.999	**1.000**	**1.000**	0.592	**1.000**	**1.000**	0.999
optdigits	0.047	0.035	0.032	0.028	0.961	0.989	0.996	0.994	0.987	0.887	0.993	0.992	0.517	**0.999**	0.967	0.982
PageBlocks	0.469	0.517	0.146	0.395	**0.787**	0.724	0.672	0.692	0.696	0.725	0.785	0.752	0.720	0.710	0.708	0.738
pendigits	0.283	0.216	0.032	0.188	0.984	0.973	0.933	0.940	0.982	0.919	0.965	**0.990**	0.733	0.986	0.969	0.958
satellite	0.662	0.662	0.323	0.646	0.874	0.790	0.832	0.829	0.854	0.794	0.801	0.888	0.741	**0.903**	0.870	0.882
satimage-2	0.913	0.629	0.034	0.535	0.906	0.923	**0.928**	0.919	0.926	0.877	0.926	0.920	0.752	0.927	0.907	0.911
shuttle	**0.975**	0.957	0.081	0.415	0.967	0.972	0.967	0.967	0.966	0.973	0.971	0.972	0.968	0.969	0.964	0.969
skin	0.257	0.156	0.204	0.202	0.981	0.513	0.658	0.679	0.954	0.988	0.871	0.988	0.990	**0.998**	0.974	0.857
SpamBase	0.496	0.528	0.400	0.416	0.811	0.838	0.858	0.885	0.905	0.814	0.854	0.923	0.759	0.928	0.879	**0.938**
speech	0.021	0.019	0.049	0.017	0.027	**0.160**	0.101	0.117	0.084	0.075	0.074	0.070	0.119	0.108	0.063	0.104
thyroid	0.574	0.526	0.068	0.475	0.785	0.866	0.911	0.898	0.859	0.751	0.871	0.897	0.574	0.891	**0.916**	0.914
vowels	0.193	0.039	0.105	0.253	0.341	0.833	0.807	0.838	0.825	0.654	0.803	0.921	0.621	0.925	0.757	**0.941**
Waveform	0.063	0.064	0.032	0.043	**0.335**	0.185	0.217	0.227	0.282	0.286	0.224	0.310	0.192	0.282	0.328	0.265
Wilt	0.043	0.042	0.054	0.053	0.573	0.087	0.086	0.088	0.476	0.799	0.537	0.579	0.590	**0.874**	0.110	0.822
yeast	0.293	0.305	0.333	0.318	0.445	0.349	0.462	0.467	0.438	**0.535**	0.477	0.476	0.493	0.509	0.514	0.453

.3 Additional Results of AD Loss Function Exploration

In addition to the main paper that demonstrates the embedding variations on the vowels dataset in Section 4.4.1, here we provide another example of the skin dataset, as shown in Figure 1. Compared to the other loss functions, our proposed Overlap loss better retains the ringlike shape in the embedding of input feature while achieving satisfactory detection performance.



(a) t-SNE [64] plots of the input feature of skin dataset.

(b) Minus (c) Inverse (d) Hinge

(e) Deviation (f) Ordinal (g) Overlap

Figure 1: Training loss along with the AUC-PR performance on testing set of different loss function based AD models, where the skin dataset is specified for comparison. The transformed embeddings of the input feature are demonstrated, which corresponds to 5, 50, and 200 training epochs, respectively.