ProPML: Probability Partial Multi-label Learning (Supplementary Materials)

1 ADDITIONAL RESULTS

In this section, we present additional results that were not included in the main paper.

Parameter λ. An important parameter of our loss function, presented as Eq. (1) in the main paper, is the parameter λ, which determines how hard we will penalize the model for incorrect predictions of negative labels. For real-world datasets, this parameter was set to 0.1, 0.57, 0.7, and 0.07 for MIRFlickr, Music-emotion, Music-style, and YeastCC, respectively. For the synthetic data, we set the following values for the parameters (q, λ): Bibtex (50, 0.025), (100, 0.39), (150, 0.022); Birds (50, 0.09), (100, 0.021), (150, 0.043); Enron: (50, 0.02), (100, 0.03), (150, 0.034); Medical (50, 0.07), (100, 0.8), (150, 0.39); Scene (50, 0.8), (100, 0.3), (150, 0.45). The behavior of the metric values depending on the value of the λ parameter for these data is shown in Figure 1.

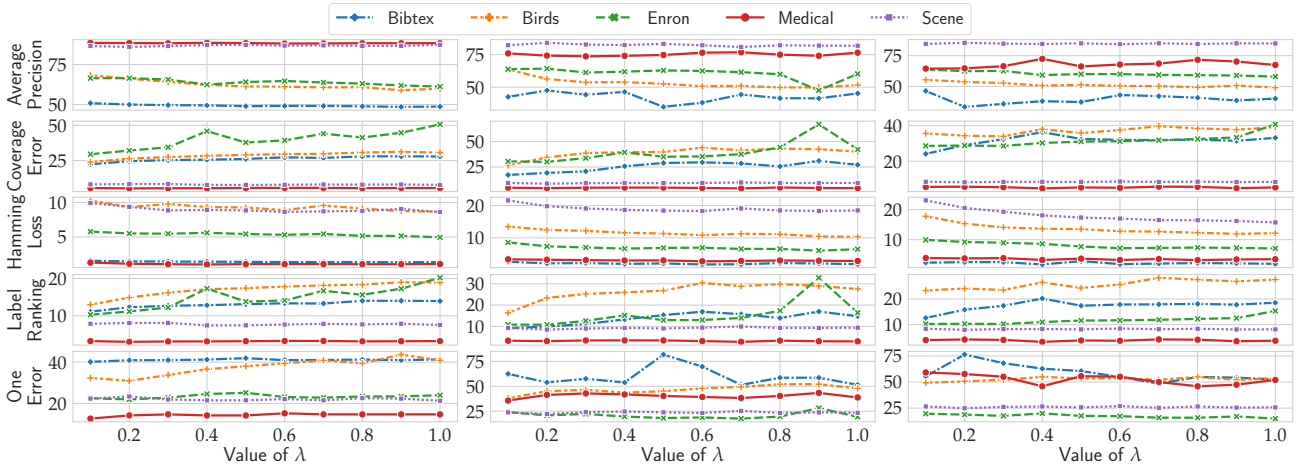

Figure 1: Results for five artificial datasets depending on the value of the λ coefficient from the ProPML loss and false to true label ratio $q = 50\%, 100\%, 150\%$ (here, left, center, and right side, respectively). For all measures, the lower value, the better.

Artificial datasets. In Table 1, we show the results of Hamming loss, label ranking, and one error metrics from the experiments performed on artificial datasets. The results confirm the effectiveness of our method, which mostly obtains the highest or the second-highest scores.

Table 1: Mean results with standard deviations from five ProPML cross-validation runs on the small artificial datasets for three false to true label ratios $q = 50\%$, 100%, or 150%. For all measures, the lower value, the better. The best result is shown in bold, and the second best is in bold italic.

	Method	Hamming loss			Label ranking			One error		
		$q = 50\%$	$q = 100\%$	$q = 150\%$	$q = 50\%$	$q = 100\%$	$q = 150\%$	$q = 50\%$	$q = 100\%$	$q = 150\%$
Bibtex	CPLST	53.36 (0.20)	54.30 (0.25)	54.91 (0.27)	***9.80 (0.69)***	***9.12 (0.56)***	***8.74 (0.45)***	42.19 (0.58)	***50.62 (1.34)***	***51.55 (1.12)***
	ML-kNN	99.78 (0.00)	99.73 (0.01)	99.72 (0.01)	21.20 (0.32)	21.36 (0.42)	21.66 (0.41)	62.16 (0.71)	65.29 (0.81)	66.13 (0.93)
	PAR-MAP	2.18 (0.07)	2.15 (0.05)	2.21 (0.09)	31.06 (0.30)	31.69 (0.13)	31.95 (0.27)	76.21 (1.60)	77.92 (0.88)	78.57 (0.53)
	PAR-VLS	***1.50 (0.05)***	**1.46 (0.06)**	**1.50 (0.04)**	38.38 (0.64)	46.71 (0.77)	47.38 (0.71)	63.12 (0.83)	68.06 (1.77)	72.60 (1.16)
	PML-NI	1.69 (0.02)	***1.65 (0.02)***	***1.58 (0.03)***	**9.40 (0.67)**	**8.81 (0.55)**	**8.44 (0.45)**	***41.97 (0.66)***	**50.05 (1.18)**	**50.86 (1.29)**
	ProPML (our)	**1.34 (0.08)**	1.72 (0.09)	1.91 (0.09)	12.04 (0.58)	11.42 (0.57)	14.78 (0.53)	**41.21 (1.39)**	53.21 (1.33)	53.41 (1.06)
Birds	CPLST	52.97 (0.65)	56.32 (1.10)	57.55 (1.66)	19.68 (1.33)	20.29 (0.54)	20.37 (1.24)	51.30 (7.18)	56.38 (6.61)	58.68 (4.22)
	ML-kNN	97.11 (0.38)	95.34 (0.59)	94.60 (0.58)	18.31 (2.12)	18.81 (2.00)	18.72 (2.30)	51.30 (7.28)	60.40 (3.26)	60.41 (3.28)
	PAR-MAP	12.27 (0.57)	11.71 (0.53)	11.93 (0.67)	23.79 (2.10)	25.98 (2.92)	26.12 (1.90)	61.27 (5.70)	69.22 (3.43)	70.64 (3.08)
	PAR-VLS	**8.71 (0.47)**	**8.82 (0.58)**	**10.24 (0.52)**	23.56 (1.24)	32.28 (3.83)	33.30 (3.78)	43.59 (5.39)	***44.73 (8.48)***	***49.01 (5.47)***
	PML-NI	***8.88 (0.35)***	***10.55 (0.91)***	***10.31 (0.94)***	***14.65 (1.67)***	***15.30 (1.22)***	**15.78 (1.40)**	***41.02 (3.91)***	53.25 (6.14)	53.25 (6.70)
	ProPML (our)	10.27 (0.46)	18.18 (0.98)	21.45 (1.68)	**14.43 (1.45)**	**13.48 (2.00)**	***17.43 (2.03)***	**36.18 (3.31)**	**37.31 (4.48)**	**42.16 (4.41)**
Enron	CPLST	51.48 (0.46)	52.55 (0.50)	53.55 (0.53)	20.51 (0.60)	17.55 (0.90)	17.79 (0.69)	44.94 (1.93)	53.29 (2.47)	56.64 (1.57)
	ML-kNN	96.61 (0.17)	95.91 (0.10)	95.58 (0.10)	***9.27 (0.33)***	**9.75 (0.25)**	***10.01 (0.31)***	***30.55 (3.99)***	***38.54 (1.51)***	***40.13 (1.65)***
	PAR-MAP	**5.94 (0.28)**	***6.37 (0.05)***	**6.37 (0.05)**	11.11 (0.19)	11.44 (0.12)	11.48 (0.14)	32.90 (6.49)	49.77 (2.01)	49.77 (2.01)
	PAR-VLS	***5.95 (0.11)***	6.45 (0.14)	***6.42 (0.10)***	27.26 (1.25)	24.97 (0.97)	24.83 (1.14)	36.02 (2.46)	60.34 (3.19)	59.70 (3.10)
	PML-NI	5.99 (0.05)	**6.34 (0.19)**	6.74 (0.15)	11.58 (0.79)	***10.40 (0.62)***	10.18 (0.38)	32.31 (1.85)	38.90 (2.16)	41.89 (1.47)
	ProPML (our)	7.07 (0.54)	9.08 (0.51)	11.79 (0.74)	**8.80 (0.40)**	***10.40 (0.41)***	**9.77 (0.15)**	**22.79 (1.97)**	**24.90 (2.11)**	**23.91 (1.78)**
Medical	CPLST	48.12 (1.12)	49.61 (1.26)	49.88 (1.56)	6.35 (2.02)	5.95 (2.02)	6.65 (1.63)	27.20 (3.60)	49.39 (3.95)	49.39 (4.21)
	ML-kNN	98.41 (0.07)	98.07 (0.06)	98.07 (0.04)	3.95 (0.31)	4.67 (0.38)	4.76 (0.42)	24.23 (1.26)	40.49 (2.64)	41.62 (3.37)
	PAR-MAP	3.04 (0.08)	3.02 (0.20)	3.10 (0.11)	8.00 (0.29)	11.08 (0.40)	11.07 (0.60)	47.14 (2.02)	48.06 (3.23)	48.78 (2.60)
	PAR-VLS	1.78 (0.11)	***2.09 (0.14)***	***2.42 (0.24)***	11.97 (0.53)	28.72 (0.63)	27.47 (1.79)	22.90 (1.99)	35.49 (2.89)	39.17 (3.25)
	PML-NI	**1.05 (0.03)**	**1.73 (0.06)**	**1.84 (0.08)**	**1.56 (0.45)**	**2.12 (0.33)**	**2.37 (0.32)**	**12.27 (0.36)**	**25.56 (1.50)**	**28.32 (0.78)**
	ProPML (our)	***1.13 (0.07)***	2.55 (0.09)	2.46 (0.31)	***2.25 (0.49)***	***3.11 (0.47)***	***3.16 (0.47)***	***13.81 (1.90)***	***33.64 (1.89)***	***34.55 (6.43)***
Scene	CPLST	57.30 (0.59)	64.61 (0.47)	66.38 (0.47)	10.69 (1.89)	10.86 (1.13)	10.67 (1.16)	28.04 (3.04)	34.98 (2.53)	34.23 (2.60)
	ML-kNN	87.76 (0.76)	84.21 (0.33)	84.15 (0.28)	***7.99 (0.63)***	***9.05 (0.70)***	9.14 (0.83)	22.97 (2.27)	26.75 (2.06)	27.21 (2.28)
	PAR-MAP	***10.00 (0.63)***	**10.60 (0.61)**	**10.49 (0.65)**	8.55 (0.91)	9.20 (0.63)	***8.99 (0.59)***	24.97 (1.61)	27.05 (1.38)	26.71 (1.45)
	PAR-VLS	11.11 (0.36)	14.26 (0.47)	14.07 (0.59)	9.51 (0.72)	9.56 (0.67)	9.34 (0.69)	***22.89 (1.50)***	***25.63 (0.72)***	***24.89 (0.88)***
	PMLNI	12.06 (0.58)	14.92 (1.17)	16.29 (0.63)	9.66 (1.78)	10.22 (1.21)	10.16 (1.13)	26.21 (3.05)	33.73 (3.37)	33.44 (2.73)
	ProPML (our)	**7.69 (0.50)**	***12.46 (0.43)***	***12.84 (0.43)***	**6.70 (0.82)**	**7.07 (0.77)**	**6.99 (0.63)**	**18.57 (1.53)**	**22.93 (1.88)**	**23.14 (1.54)**