
Globalno usavršavanje slučajne šume



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1. Uvod u temu

→ **Globalno usavršavanje**

Usavršavanje vektora u listovima

→ **Globalno obrezivanje**

Uklanjanje čvorova u stablima radi manjeg zauzeća memorije i bolje generalizacije



Refined-A vs Refined-E

- Maksimalna točnost modela
- Minimalno zauzeće memorije
- Razlika iteraciji zaustavljanja



Rezultati

Dataset	Performance (Error)					Compression Ratio	
	Error Scale	RF	ADF/ARF	refined-A	refined-E	refined-A	refined-E
(c) letter	10^{-2}	4.50 ± 0.13	3.76 ± 0.14	2.98 ± 0.15	4.33 ± 0.08	2.33	30.32
(c) usps	10^{-2}	6.21 ± 0.21	5.60 ± 0.16	5.10 ± 0.10	5.69 ± 0.15	2.86	15.14
(c) Char74k	10^{-2}	18.3 ± 0.15	16.9 ± 0.16	15.4 ± 0.10	18.0 ± 0.09	1.70	37.04
(c) MNIST	10^{-2}	3.14 ± 0.04	2.73 ± 0.05	2.05 ± 0.02	2.95 ± 0.03	6.29	76.92
(c) covtype	10^{-2}	16.4 ± 0.10	15.3 ± 0.11	4.11 ± 0.04	15.6 ± 0.08	1.68	166.67
(r) abalone	10^{-4}	2.11 ± 0.05	2.10 ± 0.03	2.10 ± 0.01	2.11 ± 0.03	12.65	16.67
(r) ailerons		2.01 ± 0.01	1.98 ± 0.01	1.75 ± 0.02	1.95 ± 0.02	33.13	124.82
(r) cpusmall		3.15 ± 0.05	2.95 ± 0.04	2.90 ± 0.05	3.02 ± 0.03	22.73	66.53
(r) cadata	10^4	5.50 ± 0.05	5.40 ± 0.05	5.05 ± 0.06	5.36 ± 0.05	36.14	62.50
(r) deltaelevators	10^{-3}	1.46 ± 0.04	1.46 ± 0.02	1.46 ± 0.03	1.46 ± 0.03	37.04	37.04

Usporedba rezultata

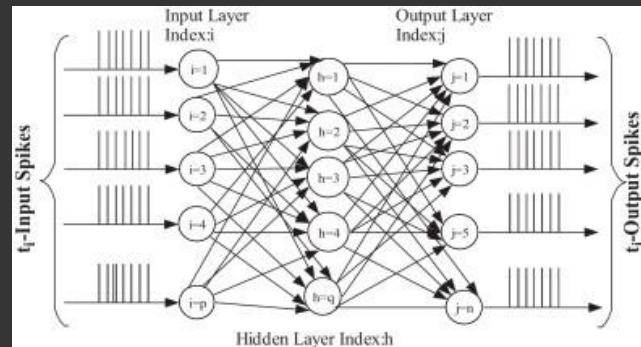
Rezultati rada	Refined-A error	Refined-E error	Compression Refined-E
MNIST	0.0205	0.0295	76.92
Letter	0.0298	0.0433	30.32
Cpusmall	2.9	3.02	66.53
Abalone	2.1	2.11	16.67

Naši rezultati	Refined-A error	Refined-E error	Compression Refined-E
MNIST	0.021	0.0299	47.14
Letter	0.0328	0.0432	21.45
Cpusmall	2.89	3.138	46.12
Abalone	2.22	2.26	10.13

Spiking neural networks

Tema za usporedbu

- Neuronske mreže na koje utječe duljina signala, a ne samo snaga
- Modeliranje vremenski ovisnih signala



Usporedba rezultata

Dataset	Performance (Error)					Compression Ratio	
	Error Scale	RF	ADF/ARF	refined-A	refined-E	refined-A	refined-E
(c) letter	10^{-2}	4.50±0.13	3.76±0.14	2.98±0.15	4.33±0.08	2.33	30.32
(c) usps	10^{-2}	6.21±0.21	5.60±0.16	5.10±0.10	5.69±0.15	2.86	15.14
(c) <i>Chor74k</i>	10^{-2}	18.3±0.15	16.9±0.16	15.4±0.10	18.0±0.09	1.70	37.04
(c) MNIST	10^{-2}	3.14±0.04	2.73±0.05	2.05±0.02	2.95±0.03	6.29	76.92
(c) cotype	10^{-2}	16.4±0.10	15.3±0.11	14.1±0.04	15.6±0.08	1.68	166.67
(r) abalone		2.11±0.05	2.10±0.03	2.10±0.01	2.11±0.03	12.65	16.67
(r) ailerons	10^{-4}	2.01±0.01	1.98±0.01	1.75±0.02	1.95±0.02	33.13	124.82
(r) cpusmall		3.15±0.05	2.95±0.04	2.90±0.05	3.02±0.03	22.73	66.53
(r) cadata	10^4	5.50±0.05	5.40±0.05	5.05±0.06	5.36±0.05	36.14	62.50
(r) deltaelevators	10^{-3}	1.46±0.04	1.46±0.02	1.46±0.03	1.46±0.03	37.04	37.04

Klasifikacija EMINIST seta

Refined-A

Accuracy = 83.0638% (15616/18800) (classification)
 iteracija: 11, error: 0.1694, len(W): 511995
 Minimalni error: 0.16856382978723405

Refined-E

Accuracy = 82.4628% (15503/18800) (classification)
 iteracija: 17, error: 0.1754, size: 0.1853
 Minimalni error: 0.1690957446808511

Data Sets	Contenders	Accuracy (%)	Setting	Control Rate (γ)	Epochs
MNIST	Deep SNN (O'Connor and Welling, 2016)	97.80	28×28-300-300-10 ♠	-	50
	Deep SNN-BP (Lee et al., 2016)	98.71	28×28-800-10	-	200
	SNN-EP ♥	97.63	28×28-500-10	-	25
	HM2-BP (Jin et al., 2018)	98.84 ± 0.02	28×28-800-10	-	100
	SNN-L (Rezaabad and Vishwanath, 2020)	98.23 ± 0.07	28×28-1000-R28-10	-	-
	SLAYER (Shrestha and Orchard, 2018)	98.39 ± 0.04	28×28-500-500-10	-	50
	SLAYER- U_1 ♣	98.53 ± 0.03	28×28-500-500-10	-	-
	SLAYER- U_2	98.59 ± 0.01	28×28-500-500-10	-	-
	BSNN (this work)	99.02 ± 0.04	28×28-500-500-10	-0.21	50
N-MNIST	SKIM (Cohen et al., 2016)	92.87	2*28×28-10000-10	-	-
	Deep SNN-BP	98.78	2*28×28-800-10	-	200
	HM2-BP	98.84 ± 0.02	2*28×28-800-10	-	60
	SLAYER	98.89 ± 0.06	2*28×28-500-500-10	-	50
	SLAYER- U_1	99.01 ± 0.01	2*28×28-500-500-10	-	-
	SLAYER- U_2	99.07 ± 0.02	2*28×28-500-500-10	-	-
	BSNN (this work)	99.24 ± 0.12	2*28×28-500-500-10	-0.49	50
Fashion-MNIST	HM2-BP	88.99	28×28-400-400-10	-	15
	SLAYER	88.61 ± 0.17	28×28-500-500-10	-	50
	SLAYER- U_1	90.53 ± 0.04	28×28-500-500-10	-	-
	SLAYER- U_2	90.61 ± 0.02	28×28-500-500-10	-	-
	ST-RSBN (Zhang and Li, 2019)	90.00 ± 0.13	28×28-400-R400-10 ◇	-	30
	BSNN (this work)	91.22 ± 0.06	28×28-500-500-10	-0.32	50
EMNIST	eRBP (Nefci et al., 2017)	78.17	28×28-200-200-47	-	30
	HM2-BP	84.43 ± 0.10	28×28-400-400-10	-	20
	SNN-L	83.75 ± 0.15	28×28-1000-R28-10	-	-
	SLAYER	85.73 ± 0.16	28×28-500-500-47	-	50
	SLAYER- U_2	86.62 ± 0.03	28×28-500-500-47	-	50
	BSNN (this work)	87.51 ± 0.23	28×28-500-500-47	-0.37	50

Usporedba rezultata

Rezultati rada	Accuracy
MNIST	99.02%
EMNIST	87.51%
Fashion-MNIST	91.22%

Naši rezultati	Refined-A accuracy	Refined-E accuracy
MNIST	97.9%	97.11%
EMNIST	83.06%	82.46%
Fashion-MNIST	89.61%	88.75%



Zaključak

→ **Bolji rezultati neuronske mreže**
Za očekivati

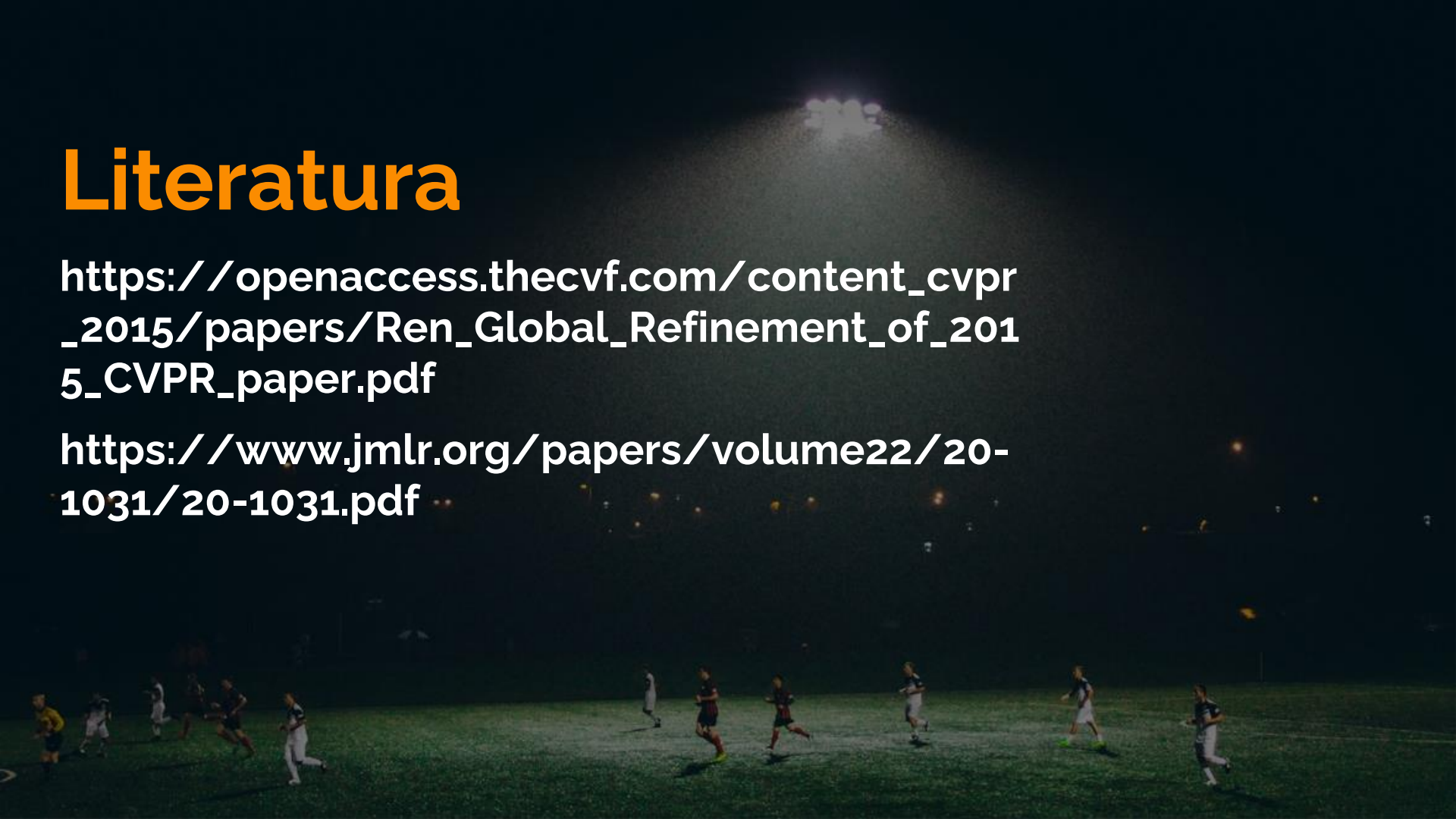
→ **Ne prevelike razlike uz manje
zauzeće memorije**
Poboljšane slučajne šume imaju
potencijala



Literatura

https://openaccess.thecvf.com/content_cvpr_2015/papers/Ren_Global_Refinement_of_2015_CVPR_paper.pdf

<https://www.jmlr.org/papers/volume22/20-1031/20-1031.pdf>





Hvala na pažnji!