Globalno usavršavanje slučajne šume

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1. Uvod u temu

➔ **Globalno usavršavanje**
Usavršavanje vektora u listovima

➔ **Globalno obrezivianje**
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	Error Scale	Performance (Error)				Compression Ratio	
		RF	ADF/ARF	refined-A	refined-E	refined-A	refined-E
(c) letter	10^{-2}	4.50 ± 0.13	3.76 ± 0.14	$\mathbf{2.98\pm0.15}$	4.33 ± 0.08	2.33	**30.32**
(c) usps	10^{-2}	6.21 ± 0.21	5.60 ± 0.16	$\mathbf{5.10\pm0.10}$	5.69 ± 0.15	2.86	**15.14**
(c) Char74k	10^{-2}	18.3 ± 0.15	16.9 ± 0.16	$\mathbf{15.4\pm0.10}$	18.0 ± 0.09	1.70	**37.04**
(c) MNIST	10^{-2}	3.14 ± 0.04	2.73 ± 0.05	$\mathbf{2.05\pm0.02}$	2.95 ± 0.03	6.29	**76.92**
(c) covtype	10^{-2}	16.4 ± 0.10	15.3 ± 0.11	$\mathbf{4.11\pm0.04}$	15.6 ± 0.08	1.68	**166.67**
(r) abalone		2.11 ± 0.05	$\mathbf{2.10\pm0.03}$	$\mathbf{2.10\pm0.01}$	2.11 ± 0.03	12.65	**16.67**
(r) ailerons	10^{-4}	2.01 ± 0.01	1.98 ± 0.01	$\mathbf{1.75\pm0.02}$	1.95 ± 0.02	33.13	**124.82**
(r) cpusmall		3.15 ± 0.05	2.95 ± 0.04	$\mathbf{2.90\pm0.05}$	3.02 ± 0.03	22.73	**66.53**
(r) cadata	10^{4}	5.50 ± 0.05	5.40 ± 0.05	$\mathbf{5.05\pm0.06}$	5.36 ± 0.05	36.14	**62.50**
(r) deltaelevators	10^{-3}	$\mathbf{1.46\pm0.04}$	$\mathbf{1.46\pm0.02}$	$\mathbf{1.46\pm0.03}$	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
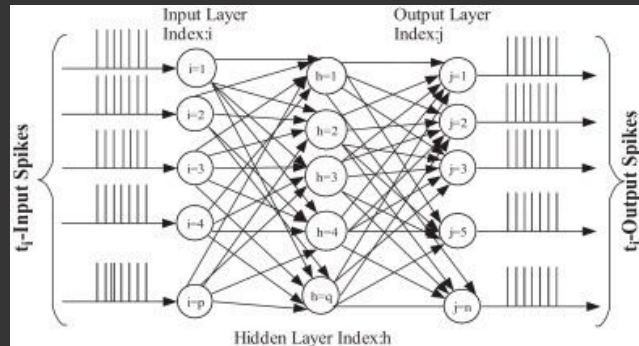
Usporedba rezultata

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) 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^{-1}	16.4±0.10	15.3±0.11	**4.11±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±0.05	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 = 89.61% (8961/10000) (classification)
iteracija: 11, error: 0.1039, len(W): 130826
Minimalni error: 0.10159999999999991
```

Refined-E

```
Accuracy = 88.75% (8875/10000) (classification)
iteracija: 15, error: 0.1125, size: 0.2288
Minimalni error: 0.10040000000000004
```

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-RSBP (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 (Neftci 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%

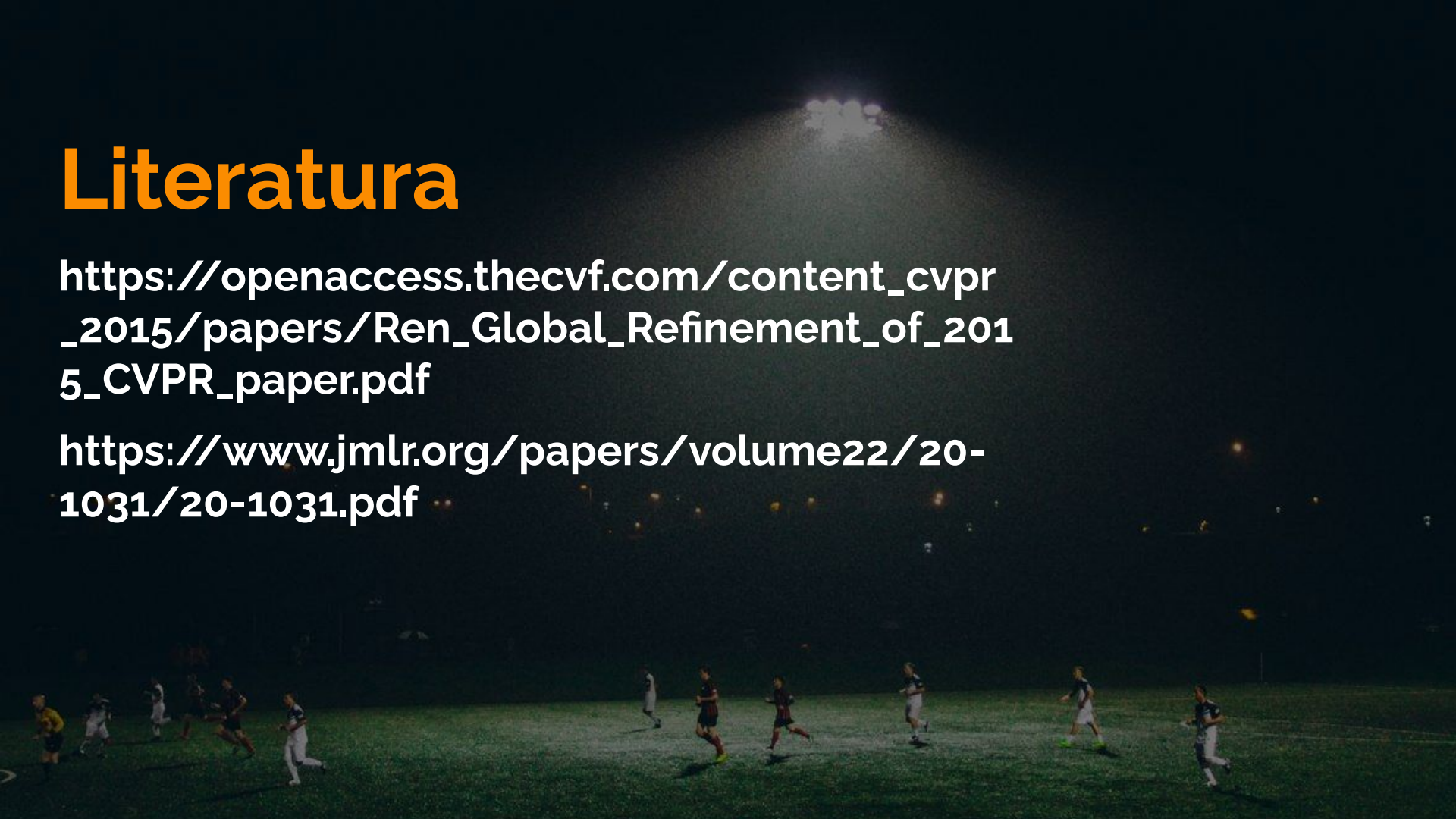| Naši rezultati	Refined-A accuracy	Refined-E accuracy
MNIST	97.9%	97.11%
EMNIST	83.06%	82.46%
Fashion-MNIST	89.61%	88.75%

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!