

Verificarea rețelelor neuronale folosind alpha_beta_crown și NeuralSat pentru benchmark-ul cGan al competiției VNN-Comp 2023

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Cuprins

- 1 Rețele neuronale în simularea provocărilor reale
- 2 Analiza modului de funcționare a rețelei neuronale
- 3 Caracterizarea setului de date cGAN
- 4 Configurare tool-uri
- 5 Interpretare rezultate
- 6 Concluzii

Rețele neuronale în simularea provocarilor reale

- Instrument important în abordarea problemelor complexe
- Benchmark-ul cGAN al competiției VNN-Comp 2023
- Soluție inovatoare pentru simularea și anticiparea obstacolelor

Rețele neuronale în simularea provocarilor reale



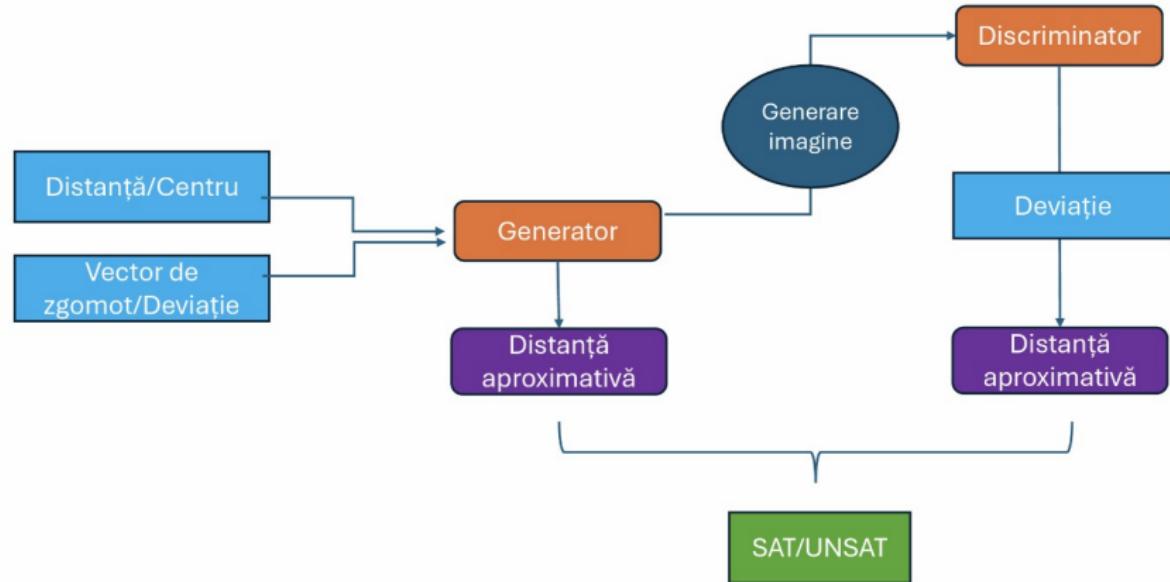
Rețele neuronale în simularea provocarilor reale



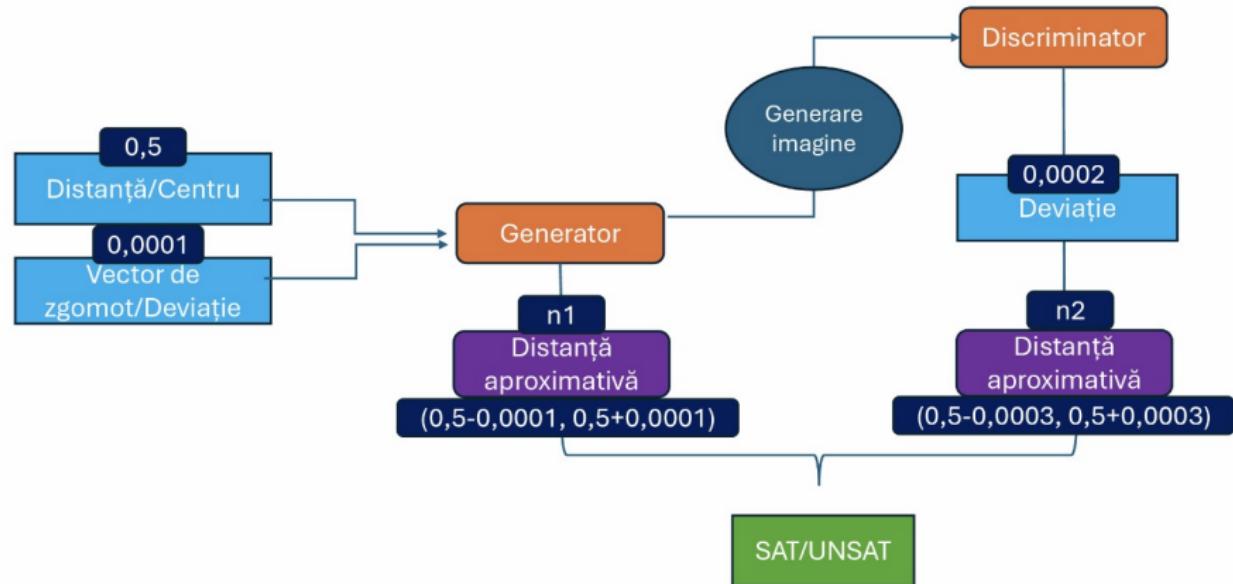
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Analiza modului de functionare a rețelei neuronale



Analiza modului de functionare a retelei neuronale



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Caracterizarea setului de date

- verificare corectitudine rețele neuronale
- fisiere .onnx
- fisiere .vnnlib
- denumire sugestivă

Caracterizarea setului de date



Figure: Exemple de imagini

Caracterizarea setului de date

```
; Input constraints:  
(assert (<= X_0 0.5314396619796753))  
(assert (>= X_0 0.5114396810531616))  
(assert (<= X_1 -0.9800000190734863))  
(assert (>= X_1 -1.0))  
(assert (<= X_2 0.649070680141449))  
(assert (>= X_2 0.6290706396102905))  
(assert (<= X_3 1.0))  
(assert (>= X_3 0.9800000190734863))  
(assert (<= X_4 1.0))  
(assert (>= X_4 0.9800000190734863))  
  
; Output constraints:  
(assert (or  
        (and (>= Y_0 0.5364396572113037))  
        (and (<= Y_0 0.5064396858215332)))  
))
```

Figure: Exemplu fisier .vnnlib

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Instalatré si configurare tool-uri

- alpha-beta-CROWN
- NeuralSAT
- Pasi de instalare
- Dificultati întâlnite la instalare/installare
- Avantaje si dezavantaje

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Interpretare alpha_beta_crown

Benchmark	neural network specification (VNNLIB)	time to prepare in	result (sat/unsat)	time to
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	26,44	sat	7,45
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,3	sat	7,43
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,33	sat	7,44
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	27,55	unsat	11,41
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	26,35	sat	7,45
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	27,73	unsat	13,74
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,47	sat	7,43
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,32	sat	7,47
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	33,85	unsat	19,36
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	31,78	unsat	14,53
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,51	sat	7,42
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,36	sat	7,46
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	34,95	unsat	15,68
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	32,42	unsat	15,29
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,68	sat	7,44
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	24,32	sat	7,47
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	30,62	unsat	11,61
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	26,45	sat	7,45
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	29,63	unsat	10,79

Interpretare alpha_beta_crown

Benchmark	neural network (ONNX)	specification (VNNLIB)	(sat/uns)	verify (s)
cgan	onnx/cGAN_imgSz32_nCh_1.onnx	Ch_1_prop_0_input_eps _0.010_output_eps_0.01	sat	439,915
		Ch_1_prop_1_input_eps _0.020_output_eps_0.02	sat	445,147
cgan	onnx/cGAN_imgSz32_nCh_1.onnx	Ch_1_prop_2_input_eps _0.020_output_eps_0.02	sat	437,929
		Ch_1_prop_3_input_eps _0.020_output_eps_0.02	unsat	1,111,230
cgan	onnx/cGAN_imgSz32_nCh_3.onnx	Ch_3_prop_0_input_eps _0.015_output_eps_0.02	sat	442,455
		Ch_3_prop_1_input_eps _0.010_output_eps_0.01	unsat	1,671,046
cgan	onnx/cGAN_imgSz32_nCh_3.onnx	Ch_3_prop_2_input_eps _0.010_output_eps_0.01	sat	431,144
		Ch_3_prop_3_input_eps _0.010_output_eps_0.01	sat	440,774
cgan	onnx/cGAN_imgSz64_nCh_1.onnx	Ch_1_prop_0_input_eps _0.010_output_eps_0.01	unsat	3,027,740
		Ch_1_prop_1_input_eps		



Interpretare NeuralSat

Benchmark	neural network specification (VNNLIB)	result (sat/unsat)	time (s)
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.175
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.1374
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.1265
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	13.556
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	4.4321
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	60.97
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.2055
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.2699
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	161.19
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	173.99
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	4.5526
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.3379
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	159.68
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	175.24
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.3113
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	4.4743
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	22.692
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	sat	3.2353
cgan	vnncomp2023_b vnncomp2023_benchmarks/benchmarks.vnnlib	unsat	24.717

Interpretare NeuralSat

Benchmark	neural network specification (VNNLIB)	time to prep	result	(time to ve
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0034071	sat	4.158001
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0033035	sat	4.106946
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.003291	sat	4.10079
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032714	unsat	20.07418
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0031186	sat	4.090722
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032382	unsat	813.1756
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032333	sat	4.062533
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.003409	sat	4.093121
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0033277	unknow	13.63448
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032063	unknow	12.82675
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032947	sat	4.101576
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032143	sat	4.076541
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0031813	unknow	13.49435
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032802	unknow	14.10427
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0033333	sat	4.106288
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0032893	sat	4.119278
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0033436	unsat	25.97133
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.003407	sat	4.069863
cgan	vnncomp2023_b vnncomp2023_benchmarks/bench	0.0035312	error	5.86911

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