

Bio-Inspired SAT

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Outline - Výsledky?

- Pouze základní modely EA
- Porovnání EA a Island Model
- Testování:
 - problém královen
 - náhodné problémy
 - SAT Competition - application

Použité EA

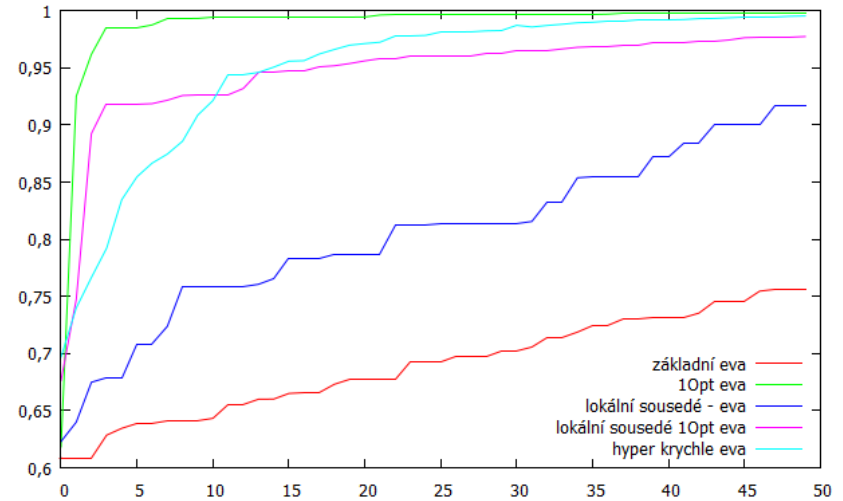
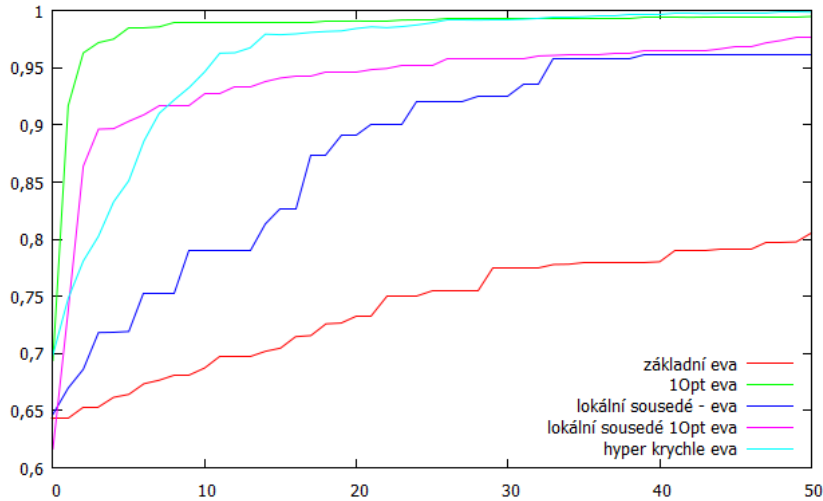
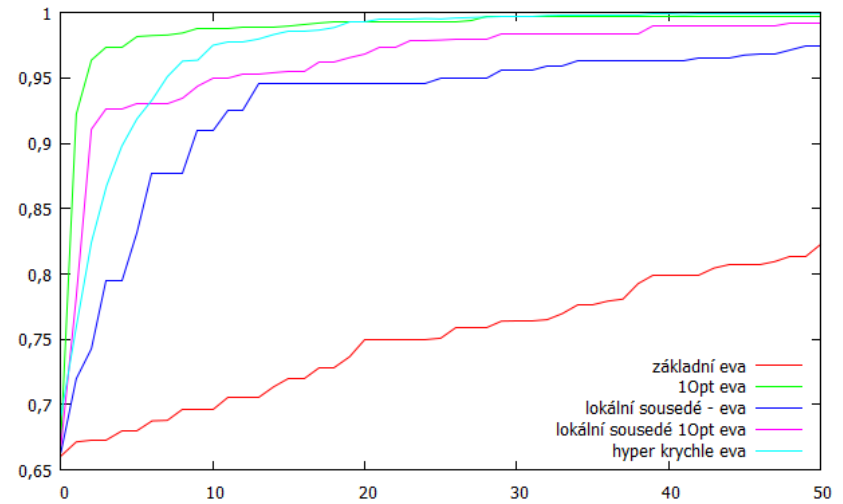
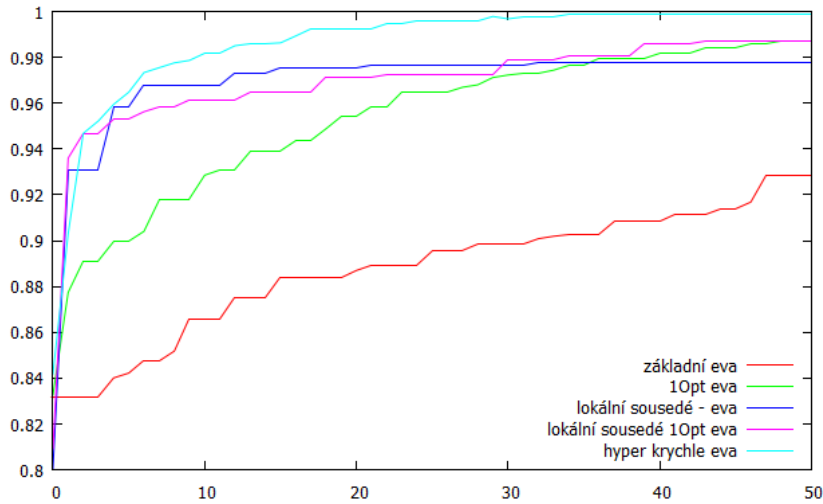
- Island Model
 - Základní GA
 - GA s 1-opt local search
 - GA s neighbourhood local search
 - GA s 1-opt a neighbourhood local search
 - Hyperkrychlový strom evolucí
- jednotková propagace s 2 literály
- fitness
- operátor při konvergenci

Problém královen

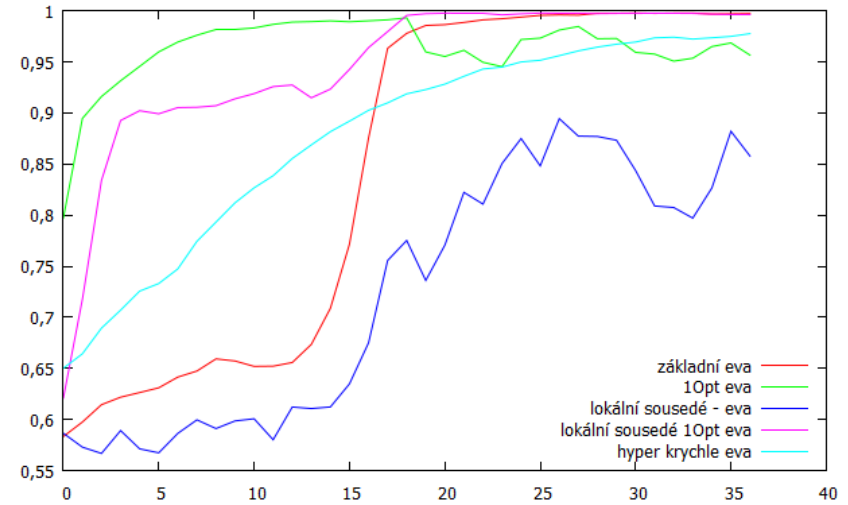
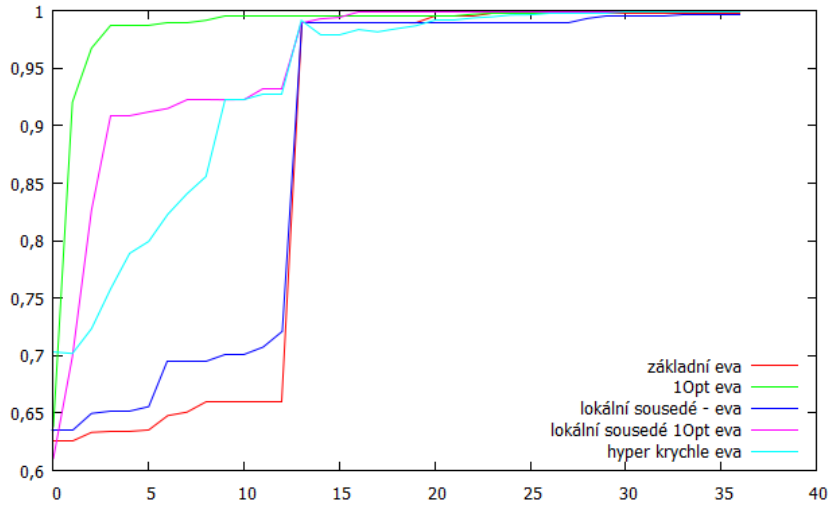
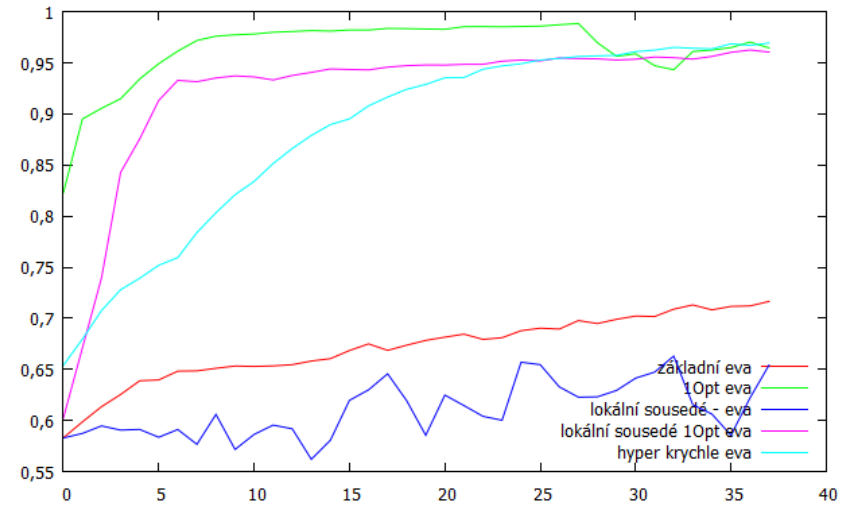
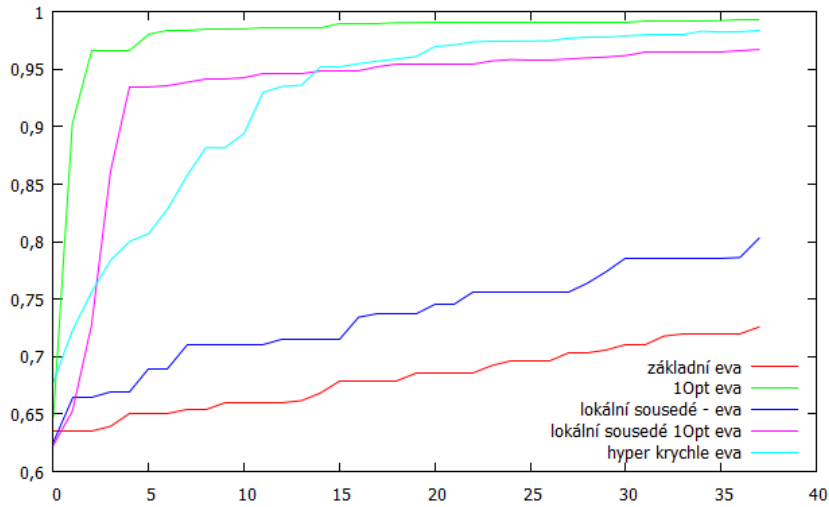
počet královen	počet neznámých	počet klazulí
10	90	938
12	144	2608
14	196	4200
16	256	6336
18	324	9096



Problém 10, 12, 14 a 16 královen



Problém 18 královen

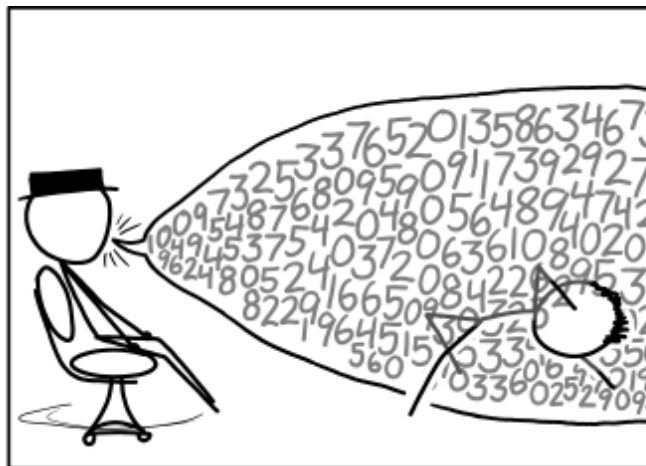


Náhodné problémy

CSP RB formát

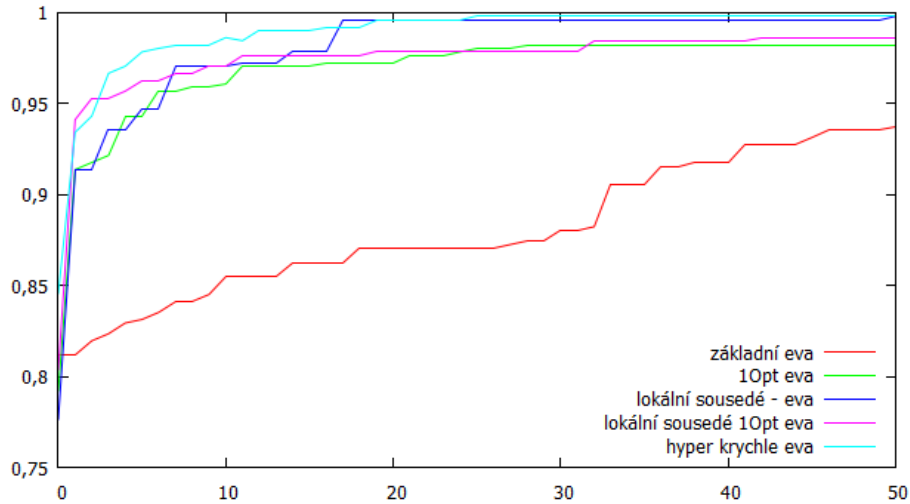
=> Sugar =>
CNF

Počet CSP neznámých	počet neznámých	počet klauzulí
10	60	510
12	84	862
14	112	1367
16	144	1964
18	180	2748
20	200	3475

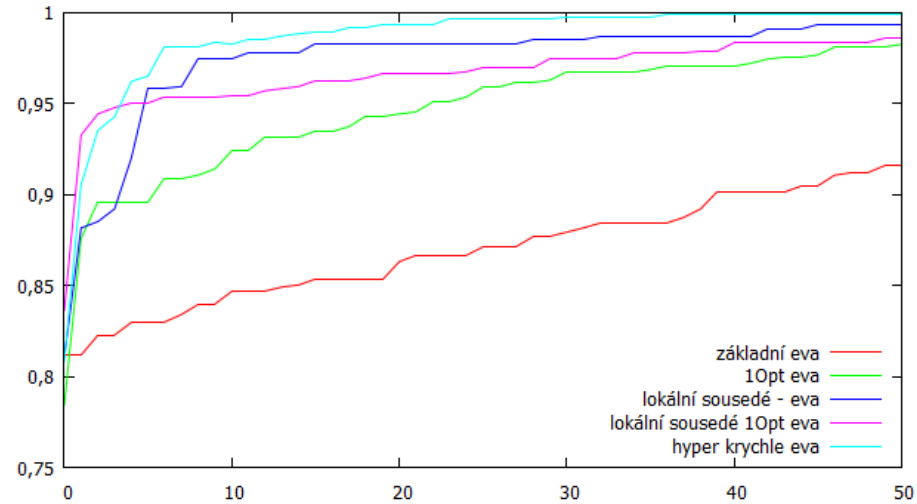


Srovnání EA - Random 10, 12, 14, 16

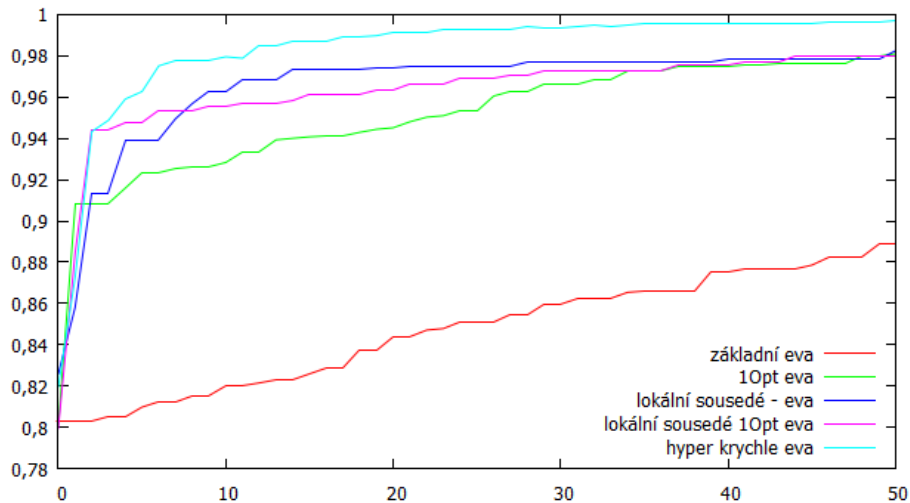
Random 10 - Best



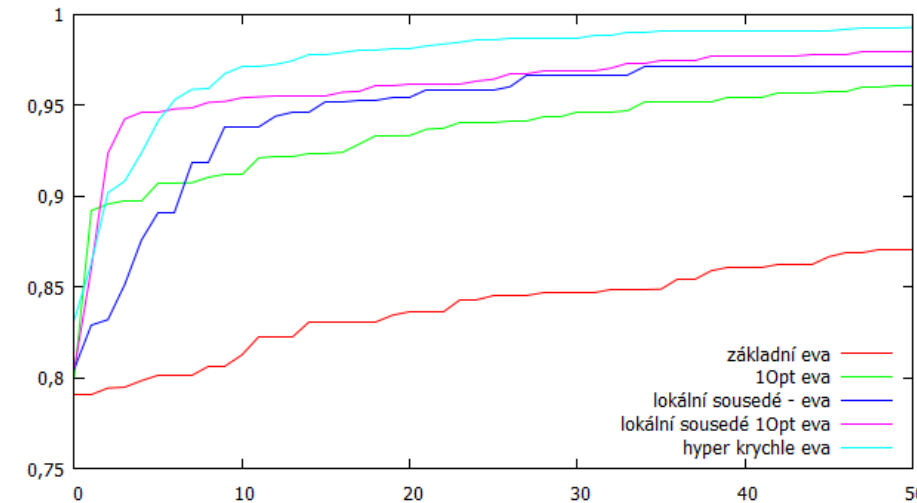
Random 12 - Best



Random 14 - Best

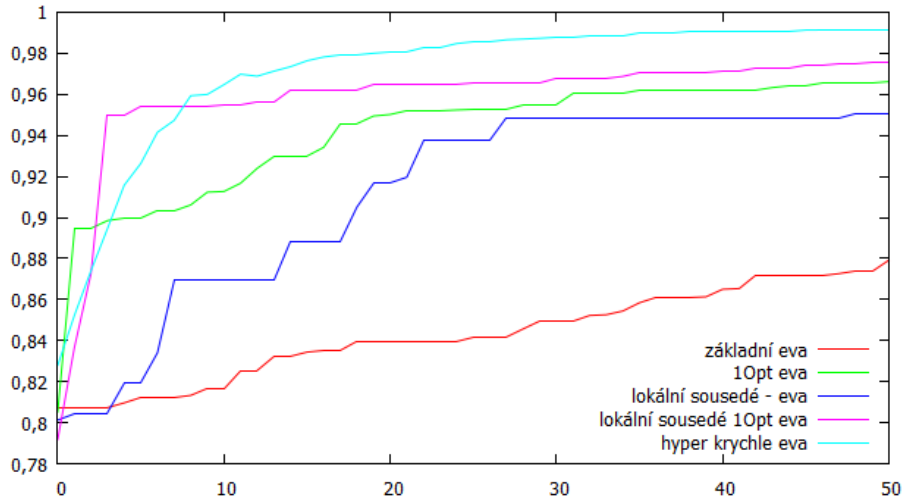


Random 16 - Best

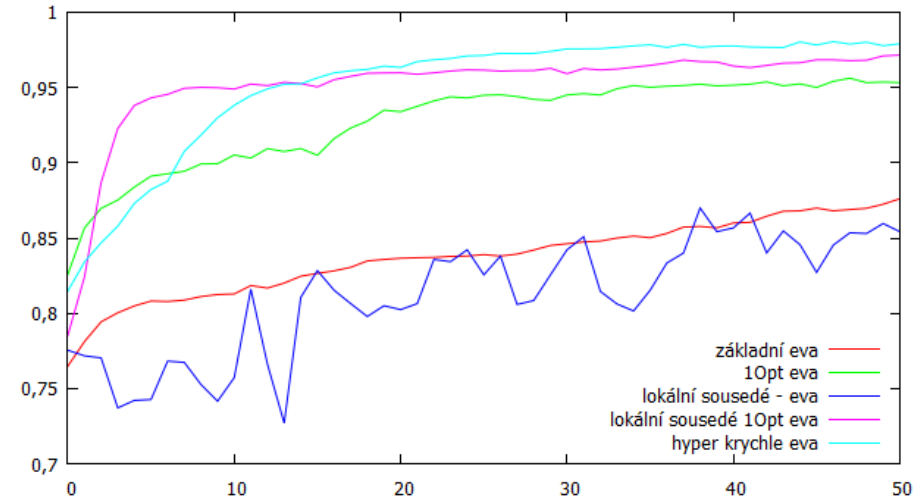


Srovnání EA - Random 18, 20

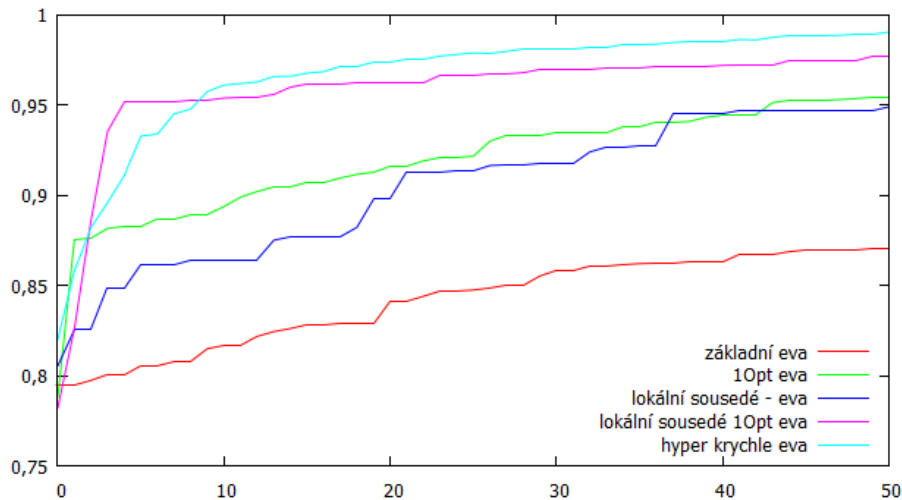
Random 18 - Best



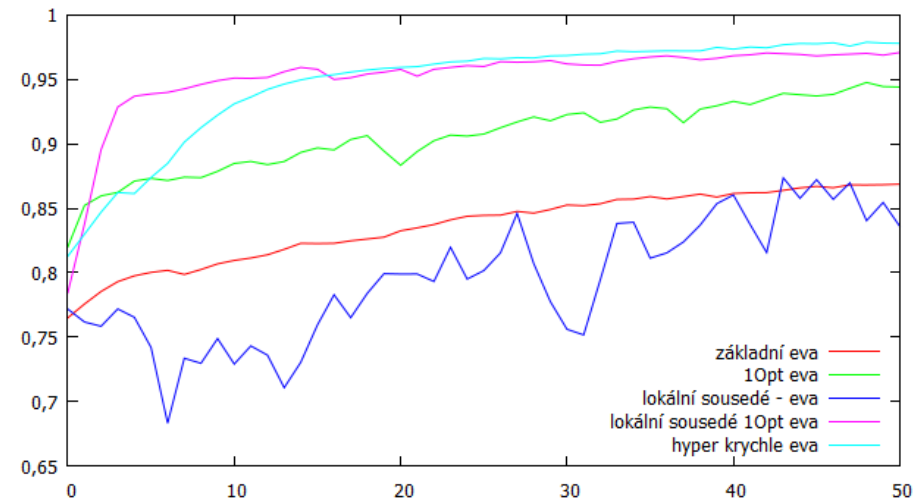
Random 18 - Average



Random 20 - Best

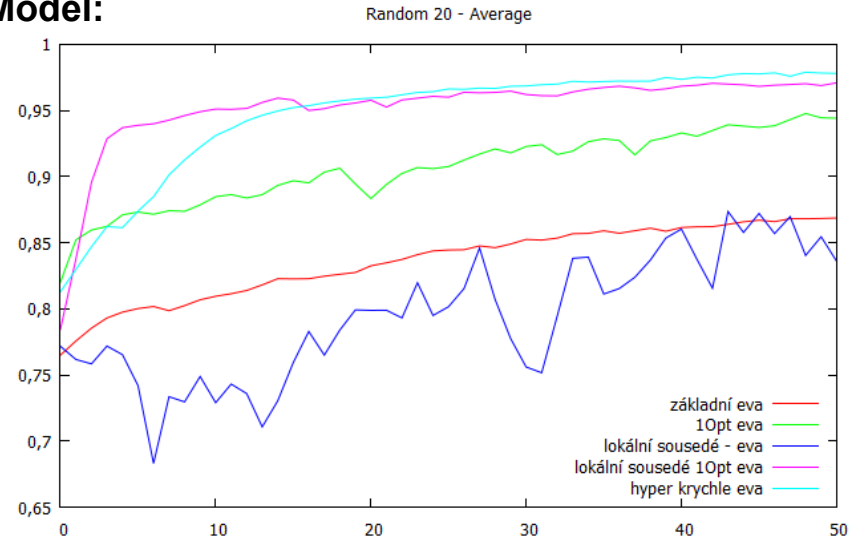
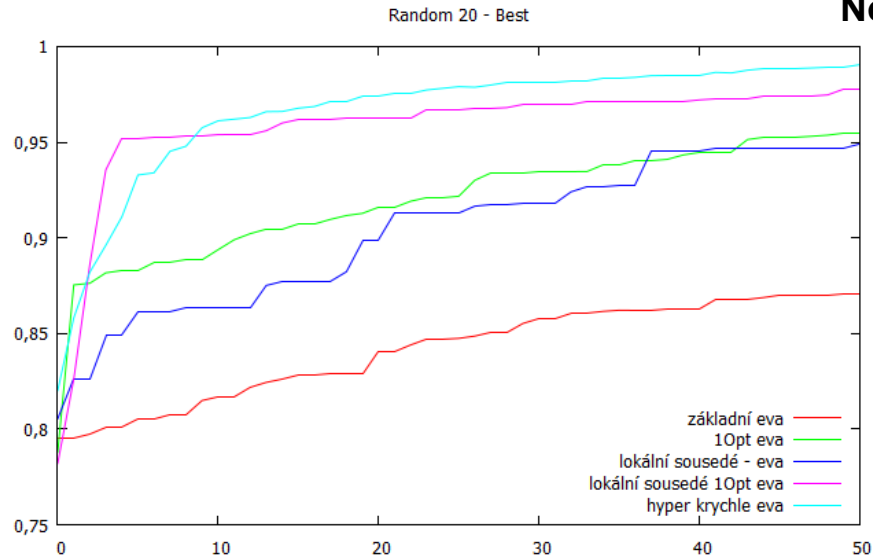


Random 20 - Average

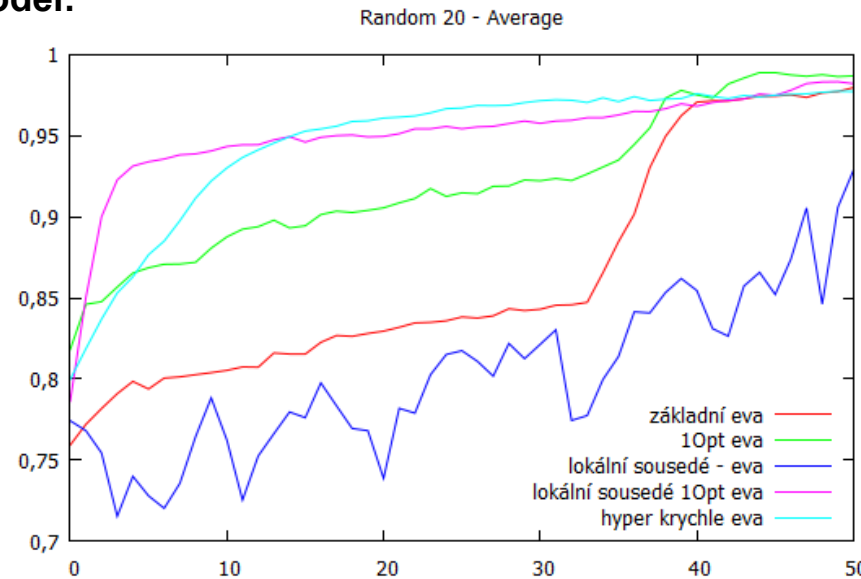
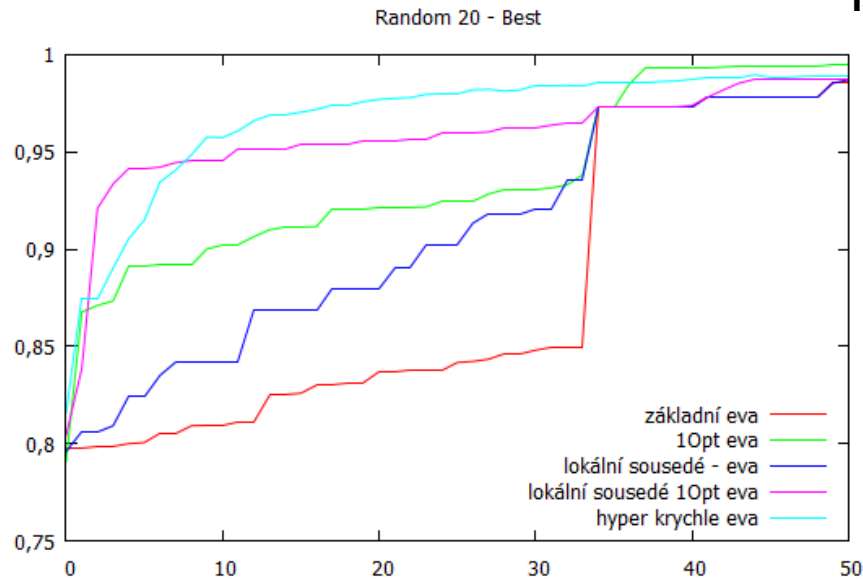


Srovnání EA s Island Model - Random 20

No-Island Model:

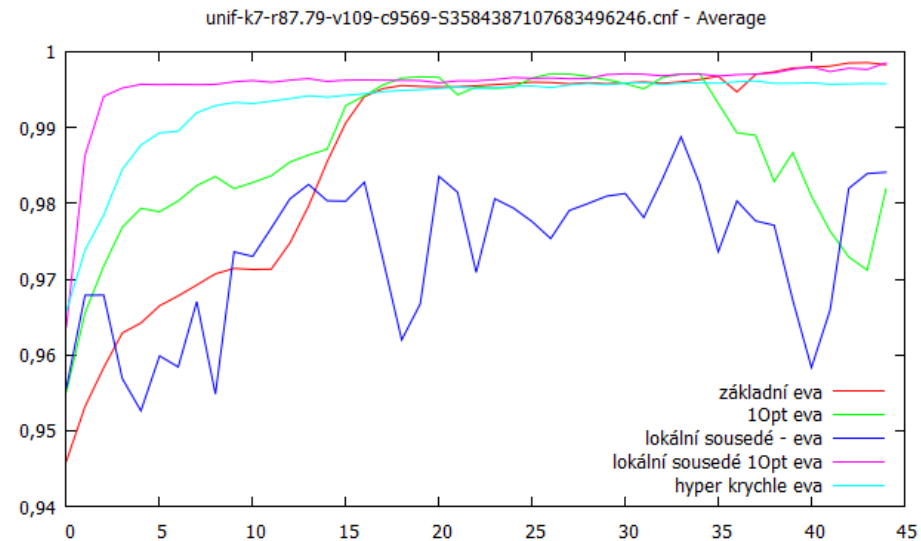
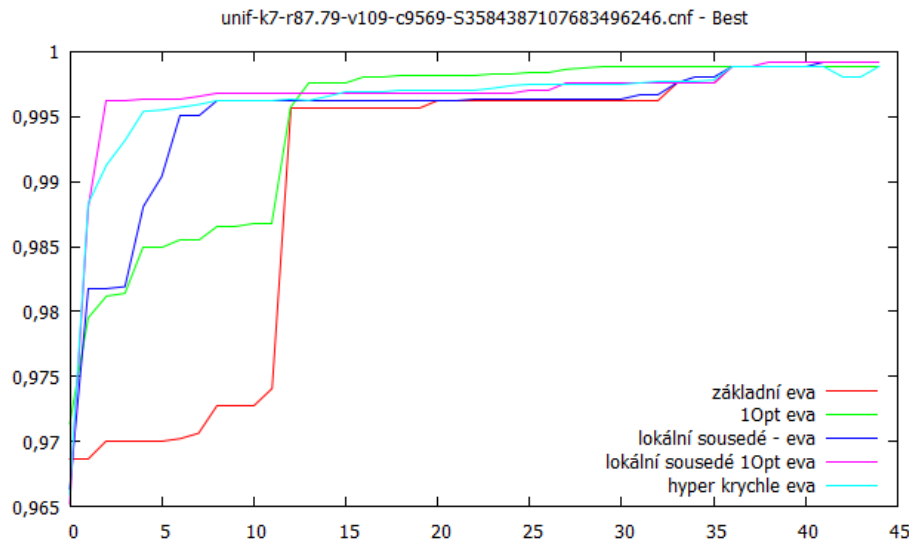


Island Model:



unif-k7-r87.79-v109-c9569-S3584387107683496246.cnf (SAT Competition 2013)

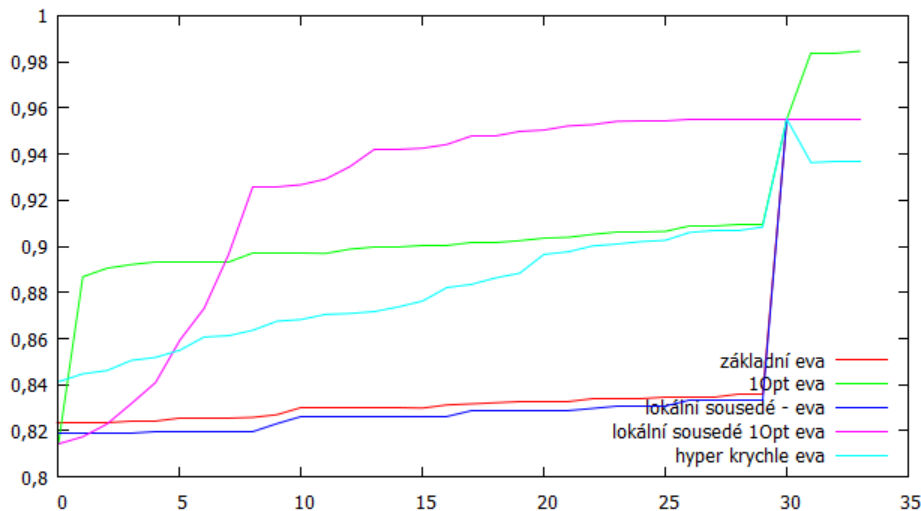
- uniform random 7-SAT generated instance with:
 - clause length: 7
 - number variables: 109
 - number clauses: 9569
 - clause to variable ratio: 87.79



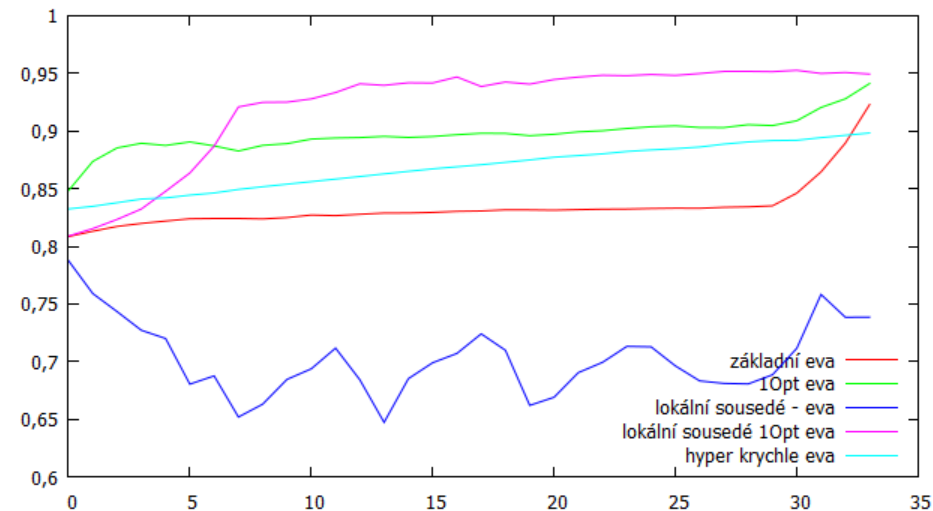
unif-k4-r9.931-v1790-c17776-S8404607880181269874.cnf (SAT Competition 2013)

- uniform random 4-SAT generated instance with:
 - clause length: 4
 - number variables: 1790
 - number clauses: 17776
 - clause to variable ratio: 9.931

unif-k4-r9.931-v1790-c17776-S8404607880181269874.cnf - Best



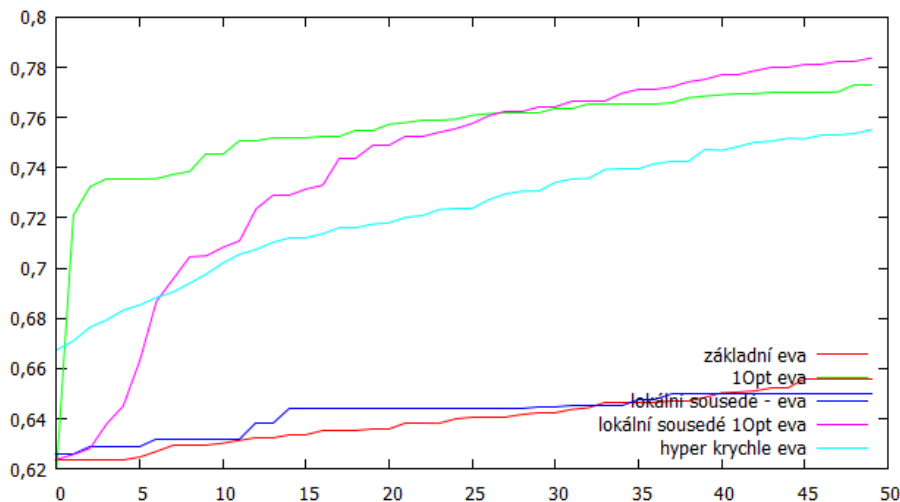
unif-k4-r9.931-v1790-c17776-S8404607880181269874.cnf - Average



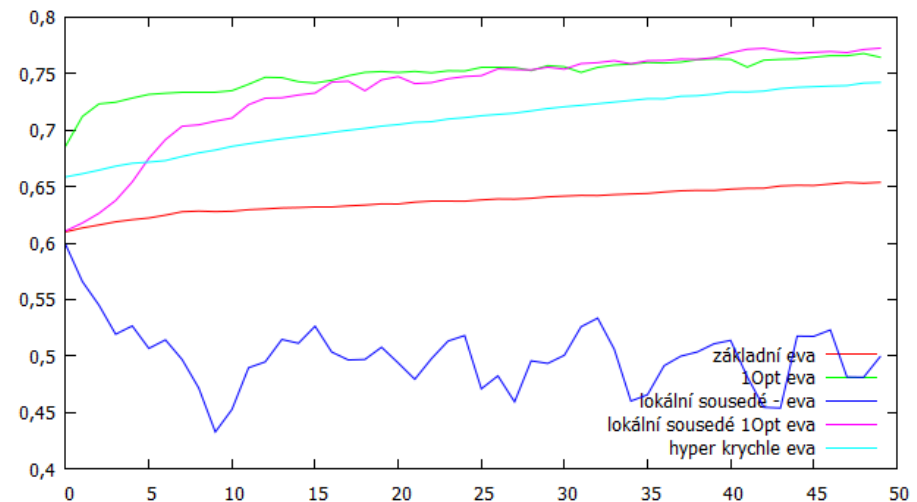
Application SAT - 6s165.cnf

- subcategories: hardware-verification; cec
- eval status: UNSAT
- # proměnných: **3 098**
- # klauzulí: **8 995**
- max. délka klauzule: 3

6s165.cnf - Best



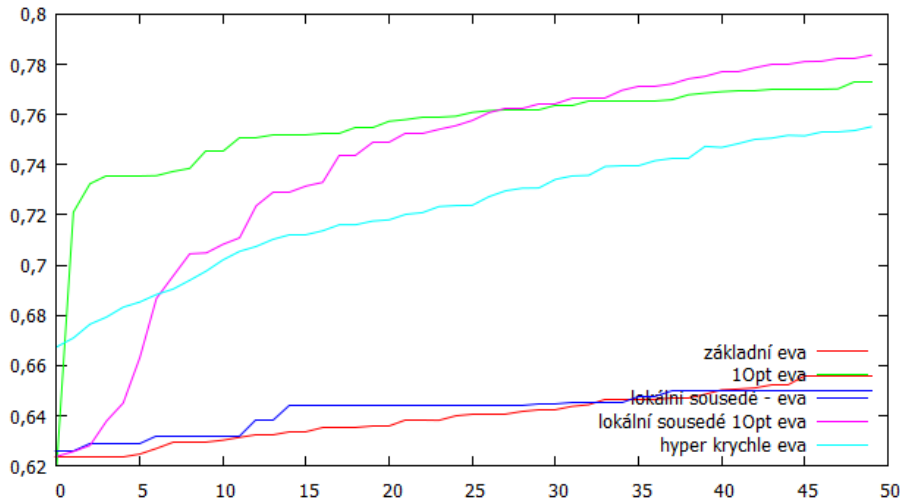
6s165.cnf - Average



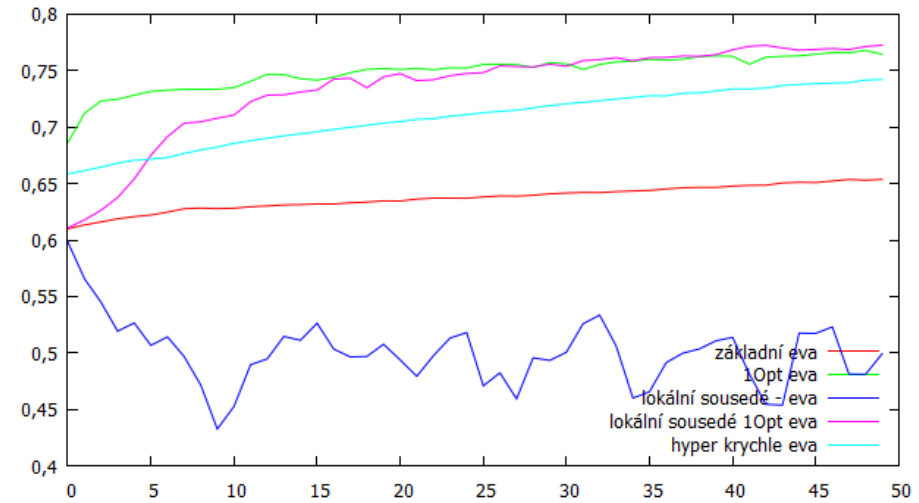
Application SAT - 6s165.cnf

Island Model:

6s165.cnf - Best

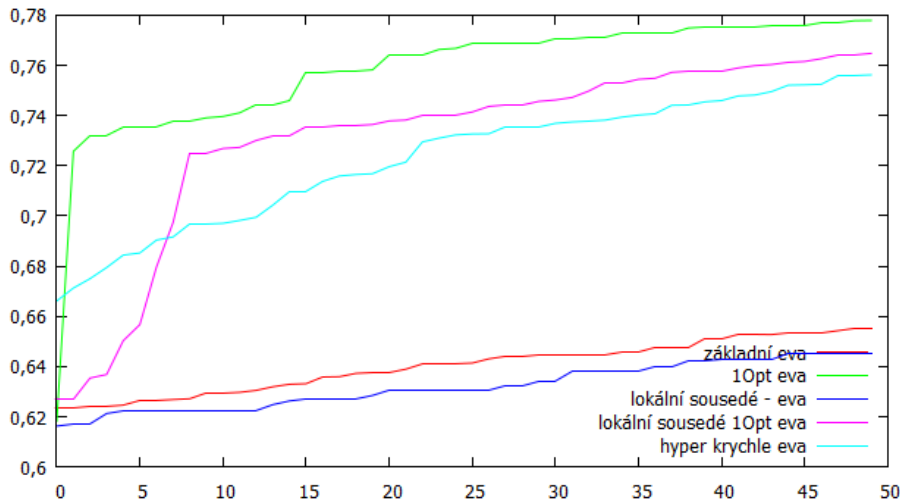


6s165.cnf - Average

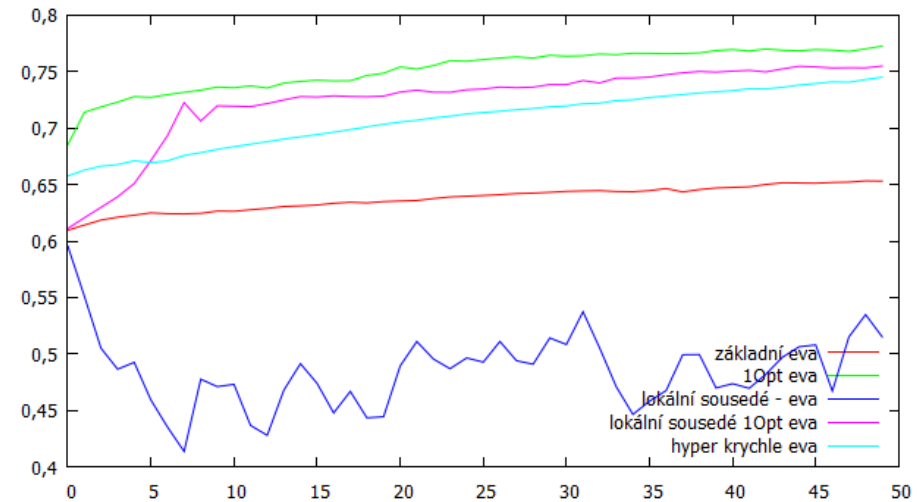


No-Island Model:

6s165.cnf - Best

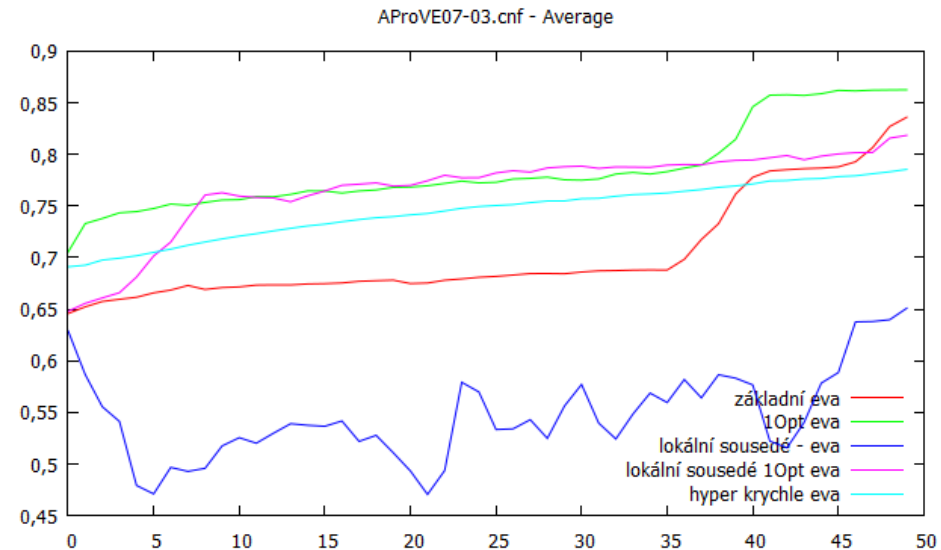
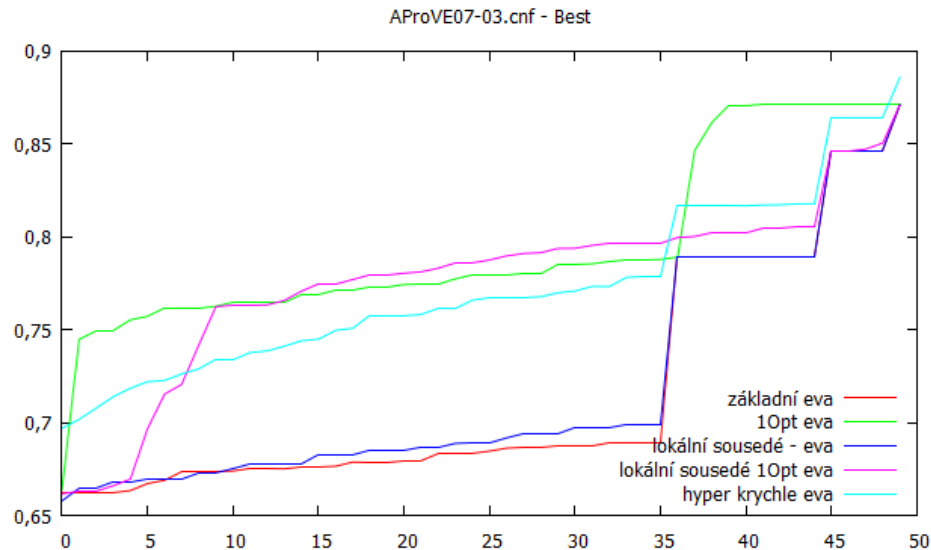


6s165.cnf - Average



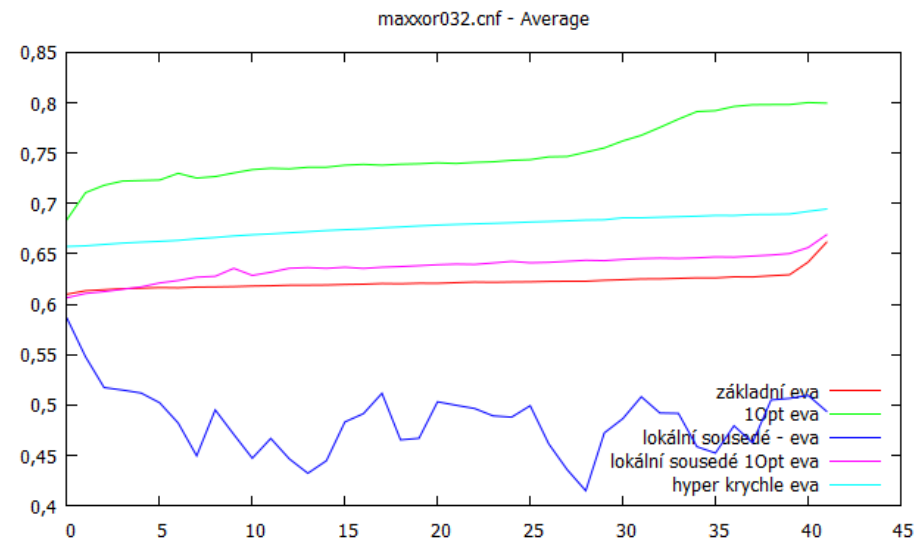
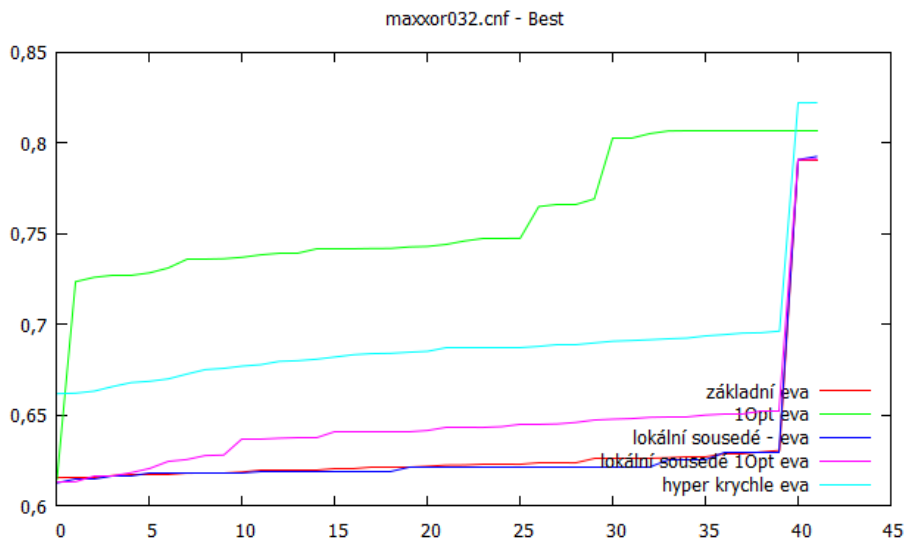
Application SAT - AProVE07-03.cnf

- subcategories: termination (industrial)
- eval status: UNSAT
- SC12 rating: hard
- # proměnných: **3 114**
- # klauzulí: **10 827**



Application SAT - maxxor032.cnf

- subcategories: software-verification; bit-verif
- eval status: UNSAT
- SC12 rating: hard
- # proměnných: **13 240**
- # klauzulí: **39 143**
- max. délka klauzule: 3



Závěr

- Local search pomáhá (memetic algorithm)
- Strom evolucí pomáhá
- EA bez specifických operátorů pro SAT najde suboptimální řešení (MAX-SAT) velice rychle

- Další vylepšení:
 - specifické operátory pro SAT
 - adaptace parametrů
 - cokoliv, co jsme dříve prezentovali...

Q & A