

QBFGALLERY 2023



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QBF Evaluations at a Glance

The QBF Community has solver evaluation events every 1-2 years.

Short history:

- 2003 first QBFEval
- 2004–2010 annual QBFEval
- 2013, 2014 QBF Gallery
- 2015–2020 annual QBFEval
- 2022 QBFEval
- 2023 QBFGallery

The QBFGallery 2023

Tracks:

- Prenex Conjunctive Normal Form (PCNF)
- Non-Prenex Conjunctive Normal Form (NPCNF)
- Dependency Quantified Boolean Formulas (DQBF)

Experiments:

- Competition runs (new sets for P(N)CNF)
- Preprocessing runs
- Normal-Form Transformation
- Crafted Instances

Setup: AMD EPYC 7313 (3.7 GHz), limits: 900s, 8GB

Overview Participating Solvers

Solver	Configs	Track	Submitted	Authors
Cage	3	PCNF	✓	L. Tentrup, M. Rabe
Cquesto	1	PNCNF		M. Janota
DepQBF	2	PCNF	✓	F. Lonsing
GhostQ	2	PNCNF		W. Klieber
DQBDD	1	DQBF		J. Sic
DynQBf	1	PCNF		G. Charwat
HQS	2	DQBF	✓	R. Wimmer, C. Scholl
MiniQ	3	PCNF, PNCNF	✓	F. Slivovsky
Pedant	1	PCNF, DQBF	✓	F. Reichl, F. Slivovsky
Rareqs	1	PCNF		M. Janota
QFun	1	PNCNF		M. Janota
Quabs	3	PNCNF	✓	L. Tentrup
Qute	1	PCNF, PNCNF		F. Slivovsky

Further Participating Tools

Formula generators for Crafted Instances

- B. Böhm, T. Peitl
- S. Heisinger

Preprocessors

- F. Lonsing: QRATPre
- A. Biere, F. Lonsing, M. Seidl: Bloqger
- C. Scholl, R. Wimmer: HQSPre

Submitted Benchmarks: PCNF

Submitted by	Family	Number
Heisinger	Nested Counterfactual	20
Shaik	Matrix Multiplication	44
Shaik	Grid Games	24
Shaik	Generalized TTT	55
Shaik	Organic Synthesis (2022)	218
Bryan	Linear Domino (2022)	44
Schwarzova	pattern finding	114

Submitted Benchmarks: PNCNF

Submitted by	Family	Number
Heisinger	Nested Counterfactual	20
Shaik	Matrix Multiplication	44
Shaik	Grid Games	24
Shaik	Generalized TTT	55
Han	Hyper-properties	27
Jordan	Transitive Closure	10
Jordan	Hawdiger Conjecture	79
Reichl	Circuit Minimization	160




Benchmark Selection

- **Prenex CNF:** 377 formulas
 - 7 new families
 - 130 new formulas
 - 247 old formulas

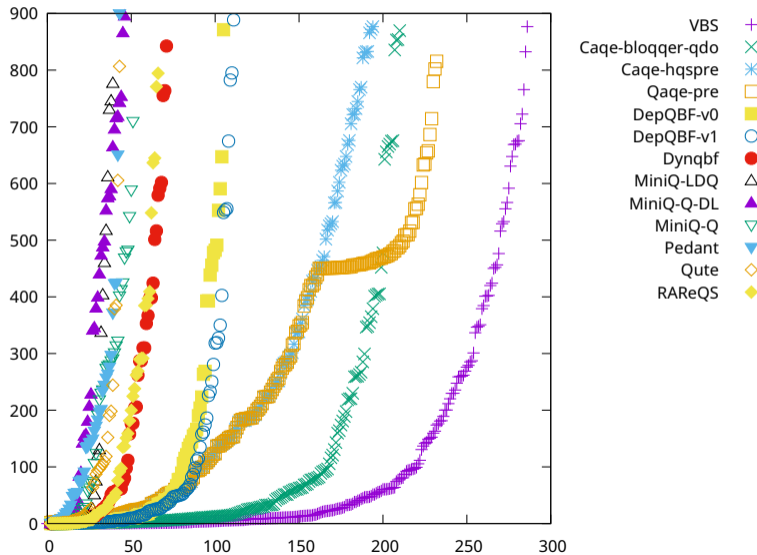
- **Non-Prenex CNF:** 391 formulas
 - 8 new families
 - 200 new formulas
 - 191 formulas from 2022

- **Dependency QBF:** 354 formulas
 - benchmark set from 2022
 - no new submissions of benchmarks




Results PCNF

Place	Solver	# Solved	# Unique
	Cage-Pre	231	4
	DepQBF V1	110	0
	DynQBF	70	16
	Virtual Best Solver	288	41

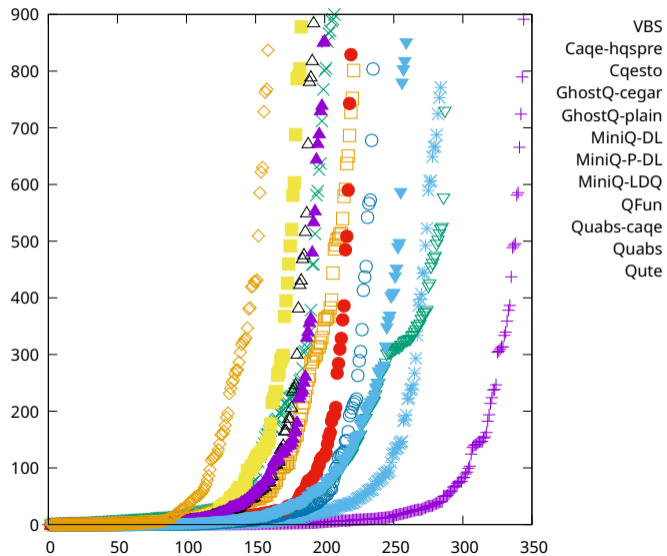
Results PCNF






Results PNCNF

Place	Solver	# Solved	# Unique
	Quabs	286	0
	Cqesto	283	9
	MiniQ-DL	34	0
	Virtual Best Solver	345	17

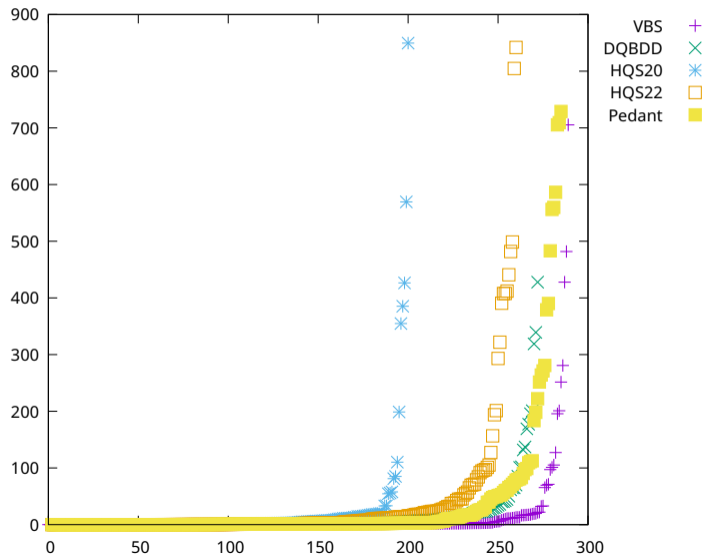
Results PNCNF



Results DQBF

Place	Solver	# Solved	# Unique
	Pedant	284	10
	DQBDD	271	2
	HQS22	259	2
	Virtual Best Solver	291	14

Results DQBF



Conclusions

Summary

- Many new benchmarks for P(N)CNF
- Few new solvers
- Little activity in DQBF

Future Work

- Certification
- Impact of normal form transformation/preprocessing
- Benchmarks for DQBF