# SAT-X Unsolved Problems Benchmarks

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***Abstract*—A set of unsolved and recent solved problems benchmarks for SAT Competition 2022, this problemas are created with SAT-X python library https://github.com/maxtuno/SATX, that is a solver free advanced version of PEQNP python library presented on SAT Competition 2021 [1].**

## I. Introduction

To solve some problems like the sum of three cubes for 33, 42, or 3 (large representation), a large amount of computing power was required, then is very interesting try to solve this with SAT Solvers.

## II. Methods

### A. Descriptions of problems

*1) 3D perfect Euler briks:*

- $a^2 + b^2 = p^2$
- $a^2 + c^2 = q^2$
- $b^2 + c^2 = r^2$
- $a^2 + b^2 + c^2 = s^2$

*2) 4D Euler briks:*

- $a^2 + b^2 = p^2$
- $a^2 + c^2 = q^2$
- $b^2 + c^2 = r^2$
- $a^2 + d^2 = s^2$
- $b^2 + d^2 = t^2$
- $c^2 + d^2 = u^2$

*3) 4D perfect Euler bricks:*

- $a^2 + b^2 = p^2$
- $a^2 + c^2 = q^2$
- $b^2 + c^2 = r^2$
- $a^2 + d^2 = s^2$
- $b^2 + d^2 = t^2$
- $c^2 + d^2 = u^2$
- $a^2 + b^2 + c^2 + d^2 = v^2$

*4) Brocard's problem:* $n! + 1 = m^2, n > 7$, This problem is presented on 16, 32 bits format.

*5) H31 - The smallest (in H) open equation [2]:* $y(x^3 - y) = z^3 + 3$, This problem is presented on 80 and 128, 256 bits format.

*6) Sum of three cubes:* $x^3 + y^3 + z^3 == k, k \in \{3, 33, 42, 165, 906, 114, 390, 579, 627, 633, 732, 921, 975\}$, This problem is for known solutions for $3, 33, 42$, to compare with large scale computation needed to solve, and search for unknown solutions over actual solutions. For un solved values is presented on $3 * 80$ and $3 * 128$ bits format.

## References

[1] Balyo , T , Froleyks , N , Heule , M , Iser , M , Järvisalo , M Suda , M (eds) 2021 , Proceedings of SAT Competition 2021 : Solver and Benchmark Descriptions . Department of Computer Science Report Series B , vol. B-2021-1 , Department of Computer Science, University of Helsinki , Helsinki .

[2] Grechuk, B. (2021). Diophantine equations: a systematic approach.