Minkowski Decomposition

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16 March 2022

Contents

Project Definition

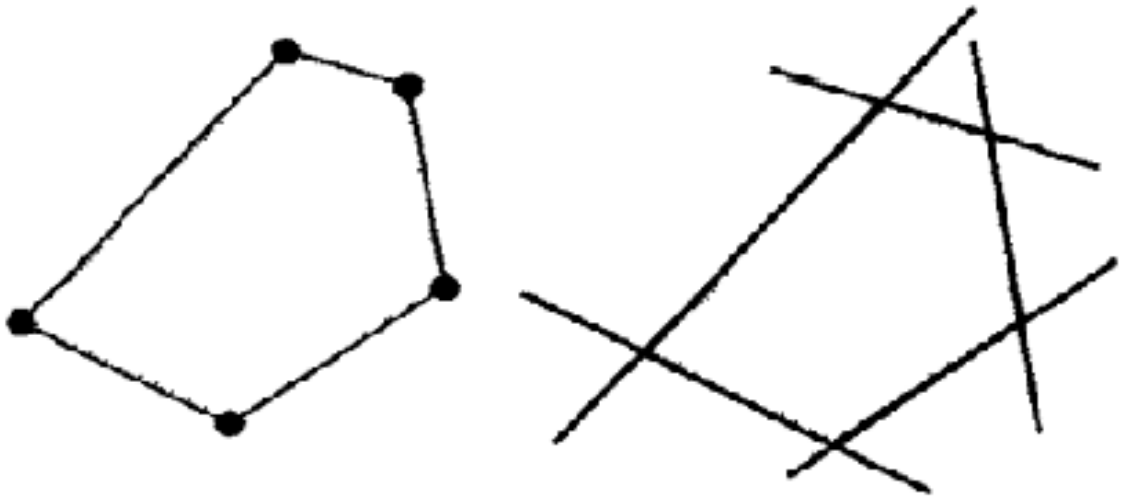
In this project, we compute all possible Minkowski summands of an input polytope

We are seeking a pair of polytopes whose Minkowski sum equals the input polytope. we compute instead all possible Minkowski summands.

Project Definition

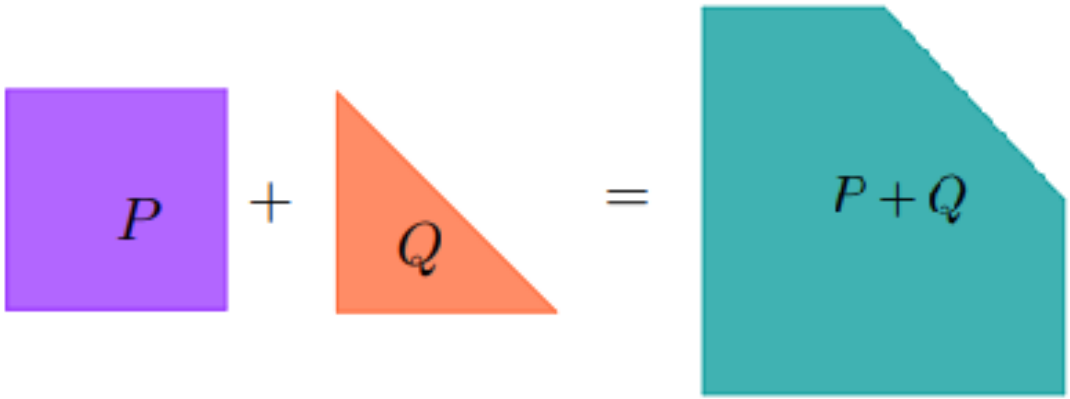
What is a Polytope

A polytope $P \in R^d$ is the bounded intersection of finitely many closed halfspaces.



[M.Z94].

What is the Minkowski Sum?



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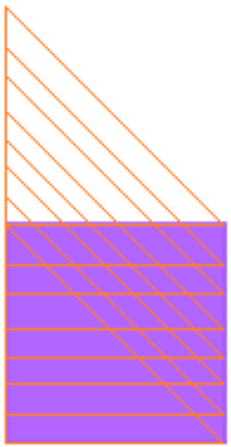
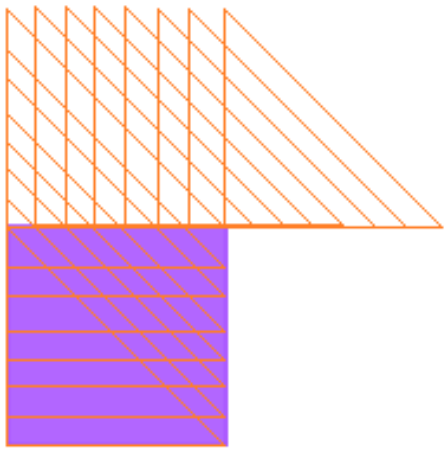
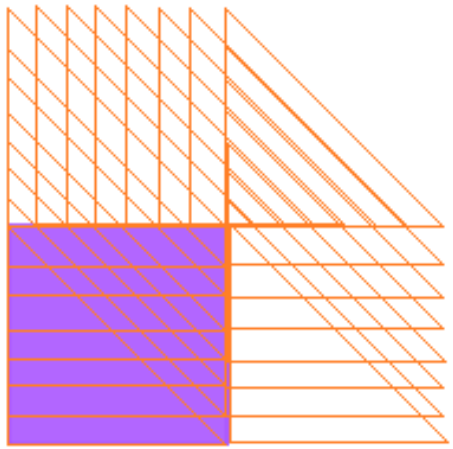
The Minkowski sum of two polytopes $P, Q \subset R^d$ is defined as $P + Q = \{x + y : x \in P, y \in Q\}$.

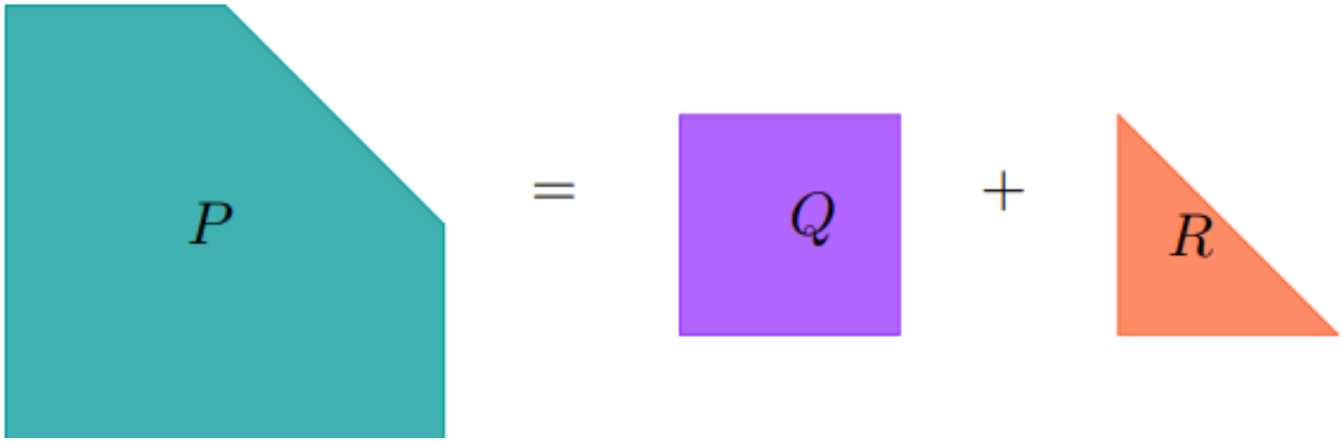
Project Definition







What is the Minkowski Decomposition?
Basically, inverse operation of Minkowski Sum



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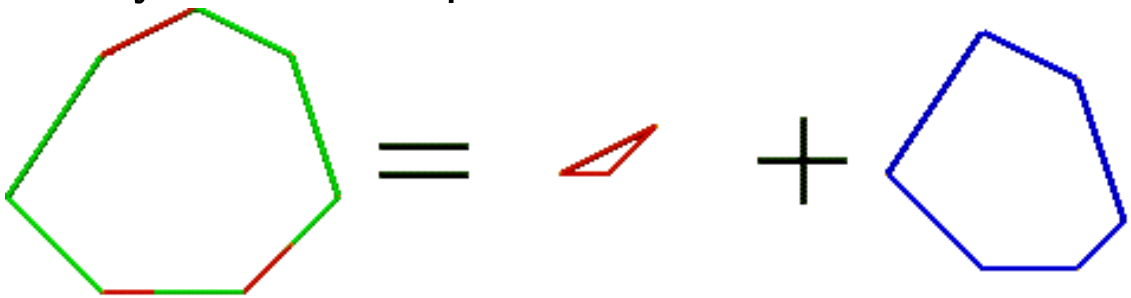
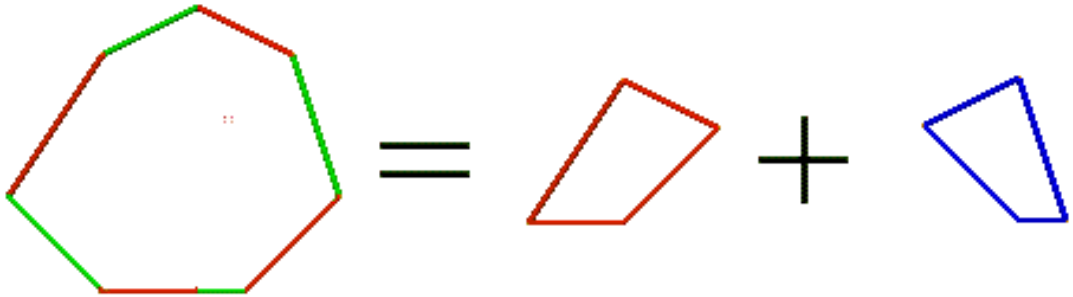
But this operation may have multiple solutions, and we are looking





for all solutions.

Project Design

-Analyze the existing algorithm.

-Detect which parts are causing the slowdown

-Optimize slow parts

Project Requirements

Comprehensive-deep study of polytopes

A detailed analysis of the algorithm and the implementation optimizations.

Comparison of your implementation with existing ones

A Julia implementation of the method with proper documentation

Success Criteria

Perform Minkowski decomposition of polytopes in 3D in less than 5 seconds.

Perform Minkowski decomposition of polytopes in 10 dimensions in less than 30 minutes.

References I

- Günter M.Ziegler, *Lectures on polytopes,revised first edition*, Springer, 1994.
- Büşra Sert, *A study on the chamber complex*, 2019.