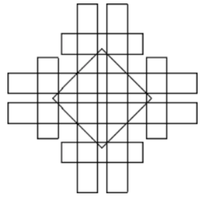
CG:SHOP



# Computational Geometry: Solving Hard Optimization Problems (CG:SHOP)

## CG Challenge 2025

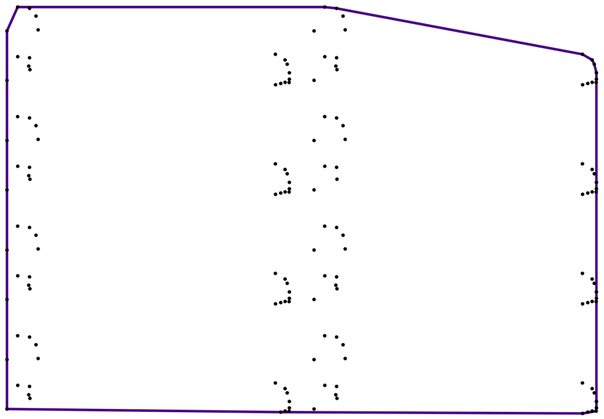
**Sándor P. Fekete, Dominik Krupke,**
**Phillip Keldenich, Stefan Schirra**

Supported by:
DFG

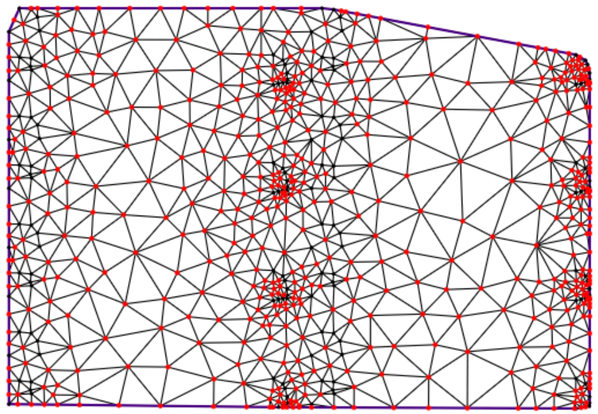
# Minimum Non-Obtuse Triangulations

CG:SHOP

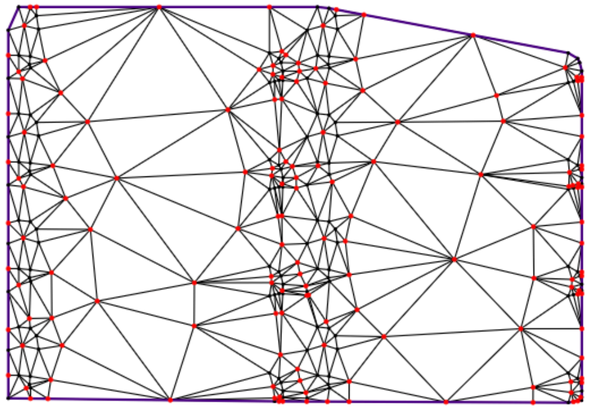
**Given:**



**Wanted (1):**



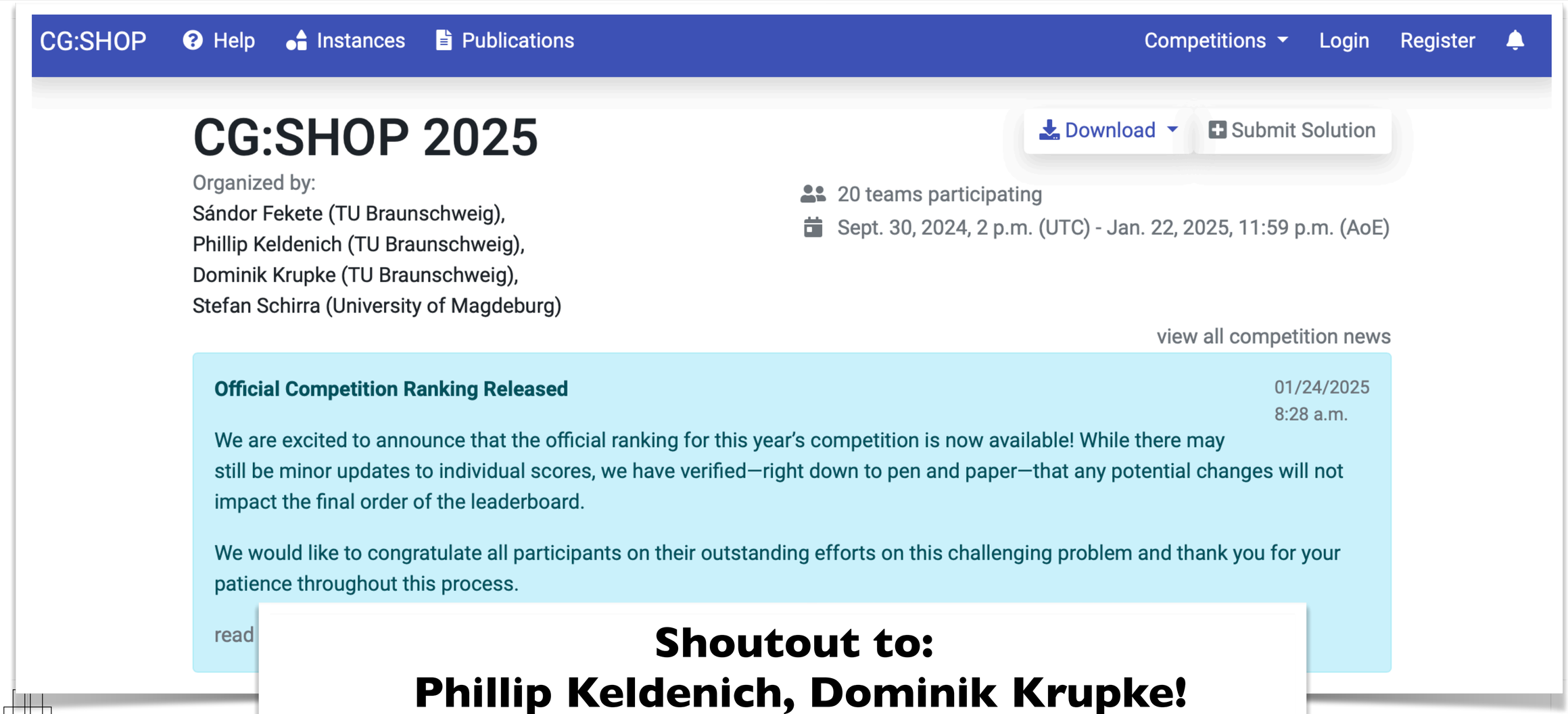
**Wanted (2):**



Proposed by Mikkel Abrahamsen, Copenhagen

# Contest Setup

CG:SHOP

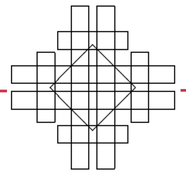



**Shoutout to:**
**Phillip Keldenich, Dominik Krupke!**

# Results

CG:SHOP

| Rank | Team Name | Score | # feasible | Junior | Comment |
|---|---|---|---|---|---|
| 1 | Naughty NOTers | 149.813 | 150 | | |
| 2 | Gwamegi | 139.769 | 150 | ✓ | |
| 3 | KITriangle | 85.482 | 147 | ✓ | |
| 4 | Obtuse Terminators | 80.756 | 114 | ✓ | |
| 5 | <anonymous> | 61.541 | 81 | ✓ | |
| 6 | die-obtuse | 55.596 | 54 | ✓ | |
| 7 | cheetos | 25.973 | 0 | ✓ | |
| 8 | Delaunay Baseline | 25.935 | 0 | | *Delaunay Triang. as reference* |



# Results

CG:SHOP

## Computing High-Quality Non-Obtuse Triangulations

**Mikkel Abrahamsen**
University of Copenhagen, Denmark

**Florestan Brunck**
University of Copenhagen, Denmark

**Jacobus Conradi**
University of Bonn, Germany

**Benedikt Kolbe**
University of Bonn, Germany

**André Nusser**
Université Côte d'Azur, CNRS, Inria, France

## Incremental algorithm and local search for minimum non-obtuse triangulations

**Taehoon Ahn**
Graduate School of Artificial Intelligence, Pohang University of Science and Technology, Pohang, Korea

**Jaegun Lee**
Department of Computer Science and Engineering, Pohang University of Science and Technology, Pohang, Korea

**Byeonguk Kang**
Department of Computer Science and Engineering, Pohang University of Science and Technology, Pohang, Korea

**Hwi Kim**



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# Overall Situation

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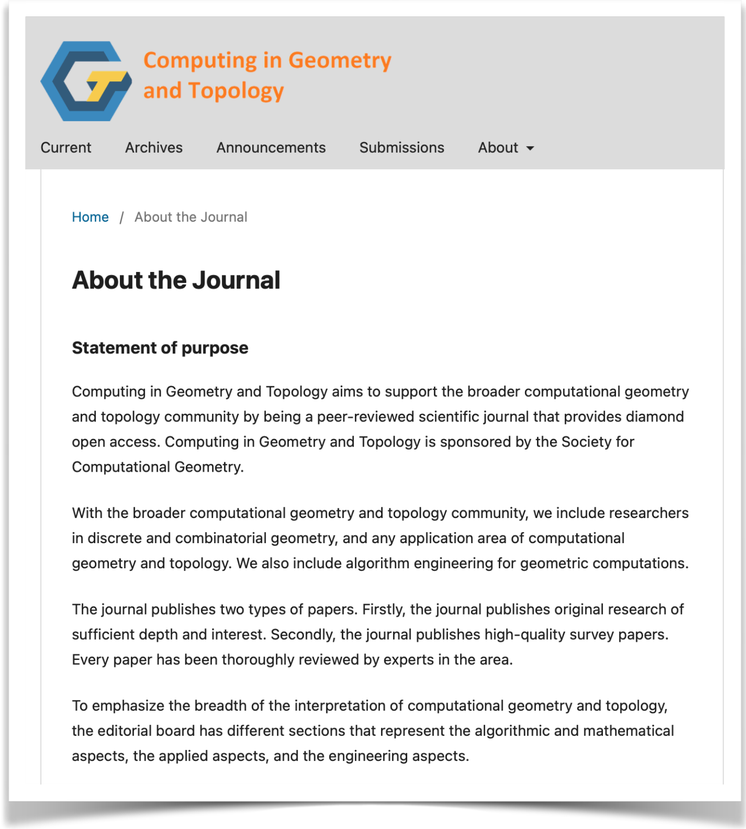
- Advisory Board:
  - Bill Cook
  - Andreas Fabri
  - Dan Halperin
  - Michael Kerber
  - Philipp Kindermann
  - Joe Mitchell
  - Kevin Verbeek

- Special issues 2019, 2021, 2022, 2023, 2024
- Problem for 2026!
- Renewal looks good - stay tuned!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German Research Foundation

# Collection

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API

## Maximum Polygon Packing

Optimal packing a set of objects into a given container.

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## Minimum Convex Partition

Partition a point set into a smallest set of convex faces.

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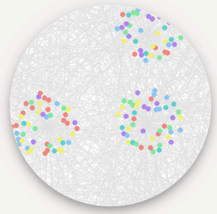
## Multi Agent Path Finding

Compute a set of feasible trajectories a given set of robots and targets.

LEARN MORE

## Minimum Coverage by Convex Polygons

Compute a minimum coverage of a polygon by convex polygons.



## Minimum Partition into Plane Subgraphs

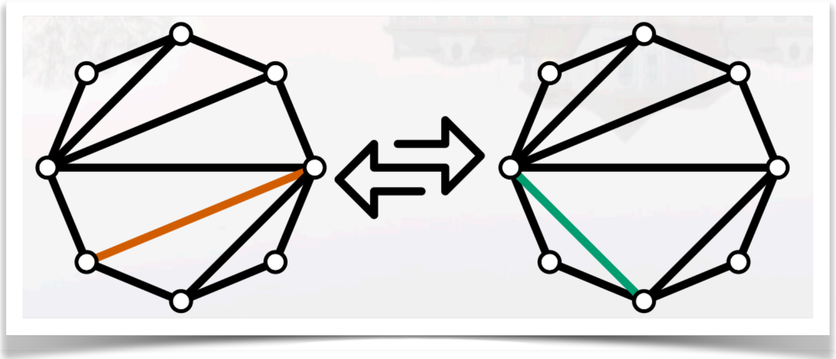
Partition a graph into minimum plane subgraphs.

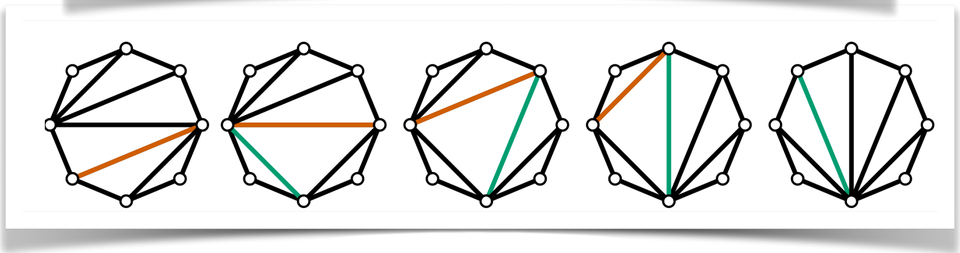
## Minimum Non-Obtuse Triangulation

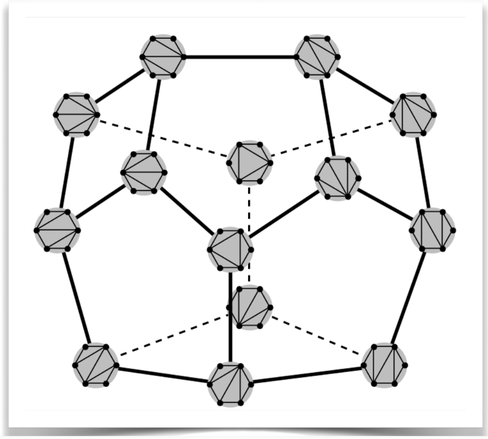
Find a feasible non-obtuse triangulation using a minimum number of Steiner points

# Challenge 2026: Flipping Triangulations

CG:SHOP





- Computing the flip distance between two triangulations of a **planar point set** is
  - NP-complete [Pilz 2012] and [Lubiw, Pathak 2012]
  - APX-hard [Pilz, 2014] (reduction from Vertex Cover), i.e., no polynomial-time algorithm to approximate the flip distance by $1+\varepsilon$, $\varepsilon \geq 0.36$ exists
  - fixed-parameter tractable for flip distance $k$: $O^*(k \cdot 32^k)$ [Feng, Li, Meng, Wang 2021], for convex sets $O^*(3.82^k)$ [Li, Xia 2025]
- Computing the flip distance between two triangulations of a **simple polygon** is NP-complete [A., Mulzer, Pilz, 2015] reduction from Rectilinear Steiner Arborescence



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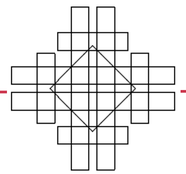
# Thank you!





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