# My research plans and interests

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# Myself

# About Myself

- I got my master's degree from SPbU in 2021,
- I have scientific ties with ULB (Brussels), BMS (Berlin),
- I also possess decent teaching experience.

Today I am going to be talking about
the research areas that I pursue.

# Voronoi Diagrams: Known Results

# Chan's structure

One might not want to know where the vertices and the edges of a Voronoi diagram are. Instead, they might be interested to, given a query point $q$, specify the cell $f$ such that $q \in f$.

This is known as the *Implicit Voronoi Diagram* problem. There is a data structure (called *Chan's structure)* devised to solve it and several related problems really fast.

# Number of changes

It has been proved that when a new site is added to a Voronoi diagram, there is $O(\sqrt{n})$ combinatorial changes (additions and deletions of edges) that the diagram undergoes.

What is more, this remains true for a diagram one of whose sites is a line.

# Sublinear algorithm

An algorithm is known that implements the combinatorial changes a Voronoi diagram undergoes when a site is inserted.

The algorithm works in time $O(n^{3/4})$. There still remains a gap between $O(n^{3/4})$ and $O(n^{1/2})$.

# Voronoi Diagrams: Pending Results

# Planned to be done

- Close the gap between $O(n^{3/4})$ and $O(n^{1/2})$:
  find an optimal-time algorithm or prove that the optimal
  time bound is actually greater.

- Generalize the techniques that are applied
  to Voronoi diagrams over other metrics.

# Nets: Known Results

# Gluing tree

*The gluing tree* is a way to describe how the boundary of a polygon is glued to itself to form the surface of a convex polyhedron.

Using gluing trees allowed for showing that there is a polygon (a star, namely) with $2n$ vertices that can be glued into a convex polyhedron in $\Omega(2^n)$ combinatorially distinct ways.

# Other regular polygons

For $n = 5$, $n = 5$, $n > 6$ it is known how many (and which exactly) various polyhedra can be glued if several congruent regular $n$-gons are taken.

Even the gluings that are not edge-to-edge are listed for $n > 6$ *(why is that?)*.

# Nets: Pending Results

# Planned to be done

Any gluing of triangles or hexagons that produces
a convex polyhedron can be interpreted as a drawing
of a set of polygons whose vertices align
with the triangular grid with
additional properties imposed.

This allows for an easy upper bound on the number of gluings.
To find a lower bound, though, one has to assemble
a series of polyhedra that can be glued.

# PCB

# PCB

Inspired by industrial projects, the problem of connecting $n$ pairs of points in a metric space composed of several layers, the turns of the paths being restricted to $45°$, seems to be NP-hard.

# Planned to be done

- Find a polynomial time approximation algorithm for the PCB routing problem.
- Find weights for the parameters such that the corresponding multicriterion optimisation problem outputs results that are applicable in practice.
- Find algorithms that count in obstacles, static or posed by the previous paths.

# Conclusion

# Contribution

The corresponding results could be the cornerstones of the corresponding fields. They make us closer to finding constructive solutions to the Alexandrov's problem and help plan routes and process geodesic data faster and better.

The problem of PCB routing is tightly connected with several projects that need feasible routing algorithms to work with.