

# ETH zürich

## Course Catalogue

### 252-1425-00L Geometry: Combinatorics and Algorithms

<b>Semester</b>	Autumn Semester 2017
<b>Lecturers</b>	<b>E. Welzl</b> , L. F. Barba Flores, M. Hoffmann, A. Pilz
<b>Periodicity</b>	yearly course
<b>Language of instruction</b>	English

<b>Catalogue data</b>	<b>Performance assessment</b>	<b>Learning materials</b>	<b>Courses</b>	<b>Restrictions</b>	<b>Offered in</b>
<a href="#">► Overview</a>					

<b>Abstract</b>	Geometric structures are useful in many areas, and there is a need to understand their structural properties, and to work with them algorithmically. The lecture addresses theoretical foundations concerning geometric structures. Central objects of interest are triangulations. We study combinatorial (Does a certain object exist?) and algorithmic questions (Can we find a certain object efficiently?)
<b>Objective</b>	The goal is to make students familiar with fundamental concepts, techniques and results in combinatorial and computational geometry, so as to enable them to model, analyze, and solve theoretical and practical problems in the area and in various application domains. In particular, we want to prepare students for conducting independent research, for instance, within the scope of a thesis project.
<b>Content</b>	Planar and geometric graphs, embeddings and their representation (Whitney's Theorem, canonical orderings, DCEL), polygon triangulations and the art gallery theorem, convexity in $\mathbb{R}^d$ , planar convex hull algorithms (Jarvis Wrap, Graham Scan, Chan's Algorithm), point set triangulations, Delaunay triangulations (Lawson flips, lifting map, randomized incremental construction), Voronoi diagrams, the Crossing Lemma and incidence bounds, line arrangements (duality, Zone Theorem, ham-sandwich cuts), 3-SUM hardness, counting planar triangulations.
<b>Lecture notes</b>	yes
<b>Literature</b>	Mark de Berg, Marc van Kreveld, Mark Overmars, Otfried Cheong, Computational Geometry: Algorithms and Applications, Springer, 3rd ed., 2008. Satyan Devadoss, Joseph O'Rourke, Discrete and Computational Geometry, Princeton University Press, 2011. Stefan Felsner, Geometric Graphs and Arrangements: Some Chapters from Combinatorial Geometry, Teubner, 2004. Jiri Matousek, Lectures on Discrete Geometry, Springer, 2002. Takao Nishizeki, Md. Saidur Rahman, Planar Graph Drawing, World Scientific, 2004.
<b>Prerequisites / Notice</b>	Prerequisites: The course assumes basic knowledge of discrete mathematics and algorithms, as supplied in the first semesters of Bachelor Studies at ETH. Outlook: In the following spring semester there is a seminar "Geometry: Combinatorics and Algorithms" that builds on this course. There are ample possibilities for Semester-, Bachelor- and Master Thesis projects in the area.

