CGAL
The Computational Geometry Algorithms Library

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Outline

1. CGAL
   - Introduction
   - Literature
CGAL: Mission

“Make the large body of geometric algorithms developed in the field of computational geometry available for industrial applications”

CGAL Project Proposal, 1996
Some of CGAL Content

- Bounding Volumes
- Polyhedral Surfaces
- Boolean Operations
- Triangulations
- Voronoi Diagrams
- Mesh Generation
- Subdivision
- Simplification
- Parametrisation
- Streamlines
- Ridge Detection
- Neighbor Search
- Kinetic Data Structures
- Envelopes
- Arrangements
- Intersection Detection
- Minkowski Sums
- PCA
- Polytope Distance
- QP Solver
Some CGAL Commercial Users

- Cadence
- Pulsic
- VDRC
- ProtoMold
- Exa Corporation
- Toshiba
- Ohio State University
- NOESIS
- Whoofsky Software
- Industrial Research Limited
- Orbotech
- BAE Systems
- Agilent Technologies
- QinetiQ
- Leica Geosystems
- SAFE Software
- Safe Software
- Videon
- Weathernews
- TruePosition
- BT
- IFP Energy
- BSAP
- Midland Valley
- Total
- Schaefer Mayfield
- Dassault Systemes
- ECL
- MPC
- St. Jude Medical
- MathWorks
- Themetopic Picture Company
- Archi
- RR Data
- True Position
- Archi
CGAL Facts

- Written in C++
- Follows the *generic programming* paradigm
- Development started in 1995
- Active European sites:
  1. INRIA Sophia Antipolis
  2. MPII Saarbrücken
  3. Tel Aviv University
  4. ETH Zürich (Plageo)
  5. University of Crete and FO.R.T.H.
  6. INRIA Nancy
  7. Université Claude Bernard de Lyon
  8. ENS Paris
  9. University of Eindhoven
  10. University of California, San Francisco
  11. University of Athens
CGAL History

<table>
<thead>
<tr>
<th>Year</th>
<th>Version Released</th>
<th>Other Milestones</th>
</tr>
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<tbody>
<tr>
<td>1996</td>
<td></td>
<td>CGAL founded</td>
</tr>
<tr>
<td>1998</td>
<td>July 1.1</td>
<td></td>
</tr>
<tr>
<td>1999</td>
<td></td>
<td>Work continued after end of European support</td>
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<tr>
<td>2001</td>
<td>Aug 2.3</td>
<td>Editorial Board established</td>
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<tr>
<td>2002</td>
<td>May 2.4</td>
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<tr>
<td>2003</td>
<td>Nov 3.0</td>
<td>GEOMETRY FACTORY founded</td>
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<tr>
<td>2004</td>
<td>Dec 3.1</td>
<td></td>
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<tr>
<td>2006</td>
<td>May 3.2</td>
<td></td>
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<tr>
<td>2007</td>
<td>Jun 3.3</td>
<td></td>
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<td>2009</td>
<td>Jan 3.4, Oct 3.5</td>
<td></td>
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<tr>
<td>2010</td>
<td>Mar 3.6, Oct 3.7</td>
<td>CGAL participated in Google Summer of Code</td>
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<tr>
<td>2011</td>
<td></td>
<td>CGAL applies to participate in GSoC</td>
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CGAL in Numbers

900,000  lines of C++ code
10,000  downloads per year not including Linux distributions
3,500  pages manual
3,000  subscribers to cgal-announce list
1,000  subscribers to cgal-discuss list
120  packages
60  commercial users
25  active developers
6  months release cycle
7  Google’s page rank for cgal.org.com
2  licenses: Open Source and commercial
CGAL Properties

- **Reliability**
  - Explicit degeneracy handling.
  - Exact Geometric Computation (EGC) adherence.

- **Flexibility**
  - Open library.
  - Depends on other libraries (e.g., **Boost, GMP, MPFR, QT, & CORE**).
  - Modular structure. Separation between geometry and topology.
  - Adaptable to user code.
  - Extensible, e.g., data structures can be extended.

- **Ease of Use**
  - Didactic and exhaustive Manuals.
  - Follows standard concepts (e.g., C++ and STL).
  - Smooth learning-curve.

- **Efficiency**
  - Follows the generic-programming paradigm.
  - Polymorphism is resolved at compile time.
CGAL Structure

Basic Library

Algorithms and Data Structures
- e.g., Triangulations, Surfaces, and Arrangements

Kernel

Elementary geometric objects
Elementary geometric computations on them

Support Library

Configurations, Assertions,...

Visualization

Files
I/O
Number Types
Generators...

CGAL
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1 CGAL
   • Introduction
   • Literature
A. Fabri, G.-J. Giezeman, L. Kettner, S. Schirra, and S. Schönherr.
On the design of CGAL a computational geometry algorithms library.

A. Fabri and S. Pion.
A generic lazy evaluation scheme for exact geometric computations.

M. H. Overmars.
Designing the computational geometry algorithms library CGAL.

The CGAL Project.
CGAL *User and Reference Manual*.