Algorithmic Geometry
Preparing Math Students as 21st Century Computational Thinkers

PI: Pierre Bierre, Spatial Thoughtware
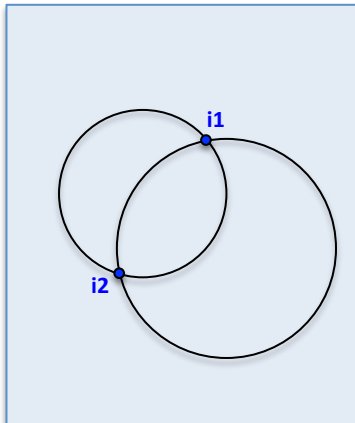pierre@AlgoGeom.org

Will the advanced Math-CS skills that undergird high tech society will be passed along to the few, or the many? 9-12 is the pivot-point. This project has preliminary results showing that college-prep seniors can learn interdisciplinary Math-CS concepts and practices underlying spatial software apps, and apply them creatively and effectively to solve novel, "wicked-difficult" geometric problems.

The approach combines intensive sketching, vector math, pseudocoding, Java programming and computer-graphics testing of algorithms.   Students commit their new math knowhow to software as it is being learned – a major paradigm shift from 20th century math. The math has been reshaped for ease-of-algorithm-writing. Learning to program is part of the math. No previous programming experience is needed. The current prerequisite is Pre-Calculus.

If dissemination / scale-up challenges can be surmounted, the payoff in coming years will be feeding the CS-STEM college pipeline with a cadre of undergrads equipped with advanced 3D problem-solving and simulation knowhow.   Imagine the impact on scientific/engineering productivity of broadly disseminating a college-prep math foundation retooled for algorithmic problem-solving.
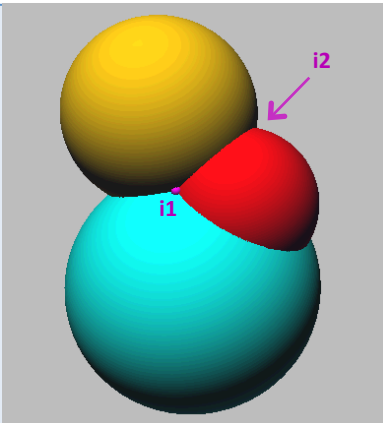
With algorithmic thinking, high-school *standard geometry content* advances to this level
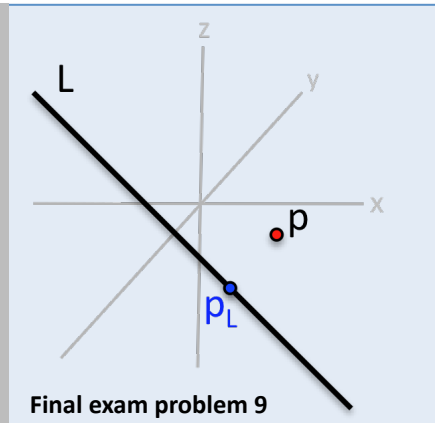
Given: Cir1, Cir2
Compute: **i1, i2**

Given: Sph1, Sph2, Sph3
Compute: **i1, i2**

Given: Line3D L, point **p**
Compute: **p$_L$** (closest point to **p** on L)

Final exam problem 9

Relevance:	robotics	Apollo navigation	shortest distance applications
	distance triangulation	GPS positioning	

Results: 10 students (7 girls, 3 boys) finished a 1-year pilot in a CA public school. To measure creative, algorithmic problem-solving, Final Exam problem 9 was omitted from the syllabus. All 10 students solved the problem in under 2-hours.   AlgoGeom students presented 3D Graphics and Robot Arm projects at CS4HS@Cal 2011.   Lawrence Livermore NL supported the Year-1 pilot.   Year-2 Pilot with 18 students is underway 2011-12.

Opportunity: Welcome to our BHAG! Current needs: sustainable funding model, academic partner(s), Math-credentialed teachers, and standardized test R&D collaborators.   Working together, we're on the road to CS-STEM math education innovation and excellence.