Geometry Problems
Typical ACM Instances

Elementary Geometry

- application of sine/cosine formulas
- spherical coordinates
- distances between lines, line segments, polygons, etc.
- area formulas

Algorithmic Geometry

- convex hull
- intersection testing
- iterative approach for maximising/minimising objective function
Traps and Tips

Traps
- numerical problems (rule of thumb: use double, not float)
- input contains collinear points?
- clockwise, counter clockwise or no order?
- slope becomes infinity?

Tips
- sometimes brute force is good enough (using an array)
- can you apply a sweep line algorithm?
- avoid array wrap-around by duplicating “wrapping” points

http://www.faqs.org/faqs/graphics/algorithms-faq/
http://mathworld.wolfram.com
http://www.ics.uci.edu/~eppstein/junkyard/
Floating Point Numbers

IEEE 754

- sign bit, biased exponent, significand (mantissa)
- float: 32 bit, sign 1, exponent 8, significand 23
- double 64 bit, sign 1, exponent 11, significand 52 bit
- long double, **nonstandard** 96bit storage but only 80bit precision, sign 1, exponent 15, significand 63
- comparing absolute and relative error: equal if $|a - b| < \epsilon$ or $b \in (1 \pm \epsilon)a$ or $a \in (1 \pm \epsilon)b$
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**Trivia**

- only subset of the reals. e.g. $\frac{1}{3}$ not representable
- rounding to nearest / even
- exponent = 11111 for NaN and $\infty$, exponent = 00000 for 0 and denormalized values ($m \cdot 2^{1-b}$, $b$ bias)
Convex Hull Algorithms

Convex Hull

- Graham Scan
- Quickhull
- Divide and Conquer
- Incremental
- Double-Chain
Closest Pair of Points

- voronoi diagram
- or (easier) divide and conquer
- sort points by x coordinate (array A)
- find closest pair in both $\frac{n}{2}$ parts around $A[n/2]$.
- assume recursive distance was $\delta$
- consider vertical strip of size $2\delta$ around $A[n/2]$
- find closest pair in vertical strip in linear time (→ blackboard)