

COMPSCI/MATH 290-04

Lecture 3: Line Segment Intersection,
Circumcenters



Announcements

- More Slides Now
- Mini Assignment 1 Part 1 Due Sunday
 - Submit README
 - Part 2 Changed to 2D!
 - Refresh Page



Announcements

- Piazza

<http://www.piazza.com/duke/spring2016/compsci29004/home>

- Ditching Daily BQOTD

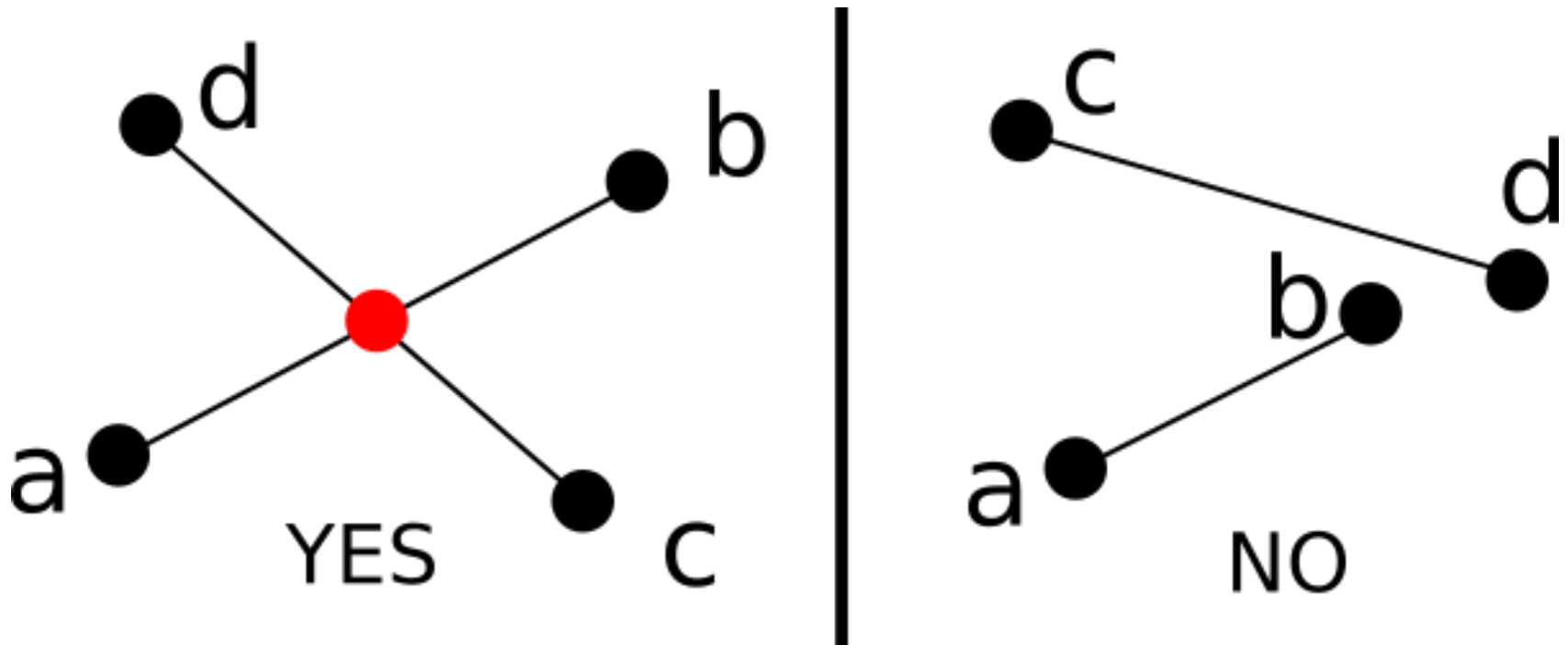


Lecture Topics

- **Line Segment Intersection**
- Triangle Circumcenter
- JSON / Visual Debugging



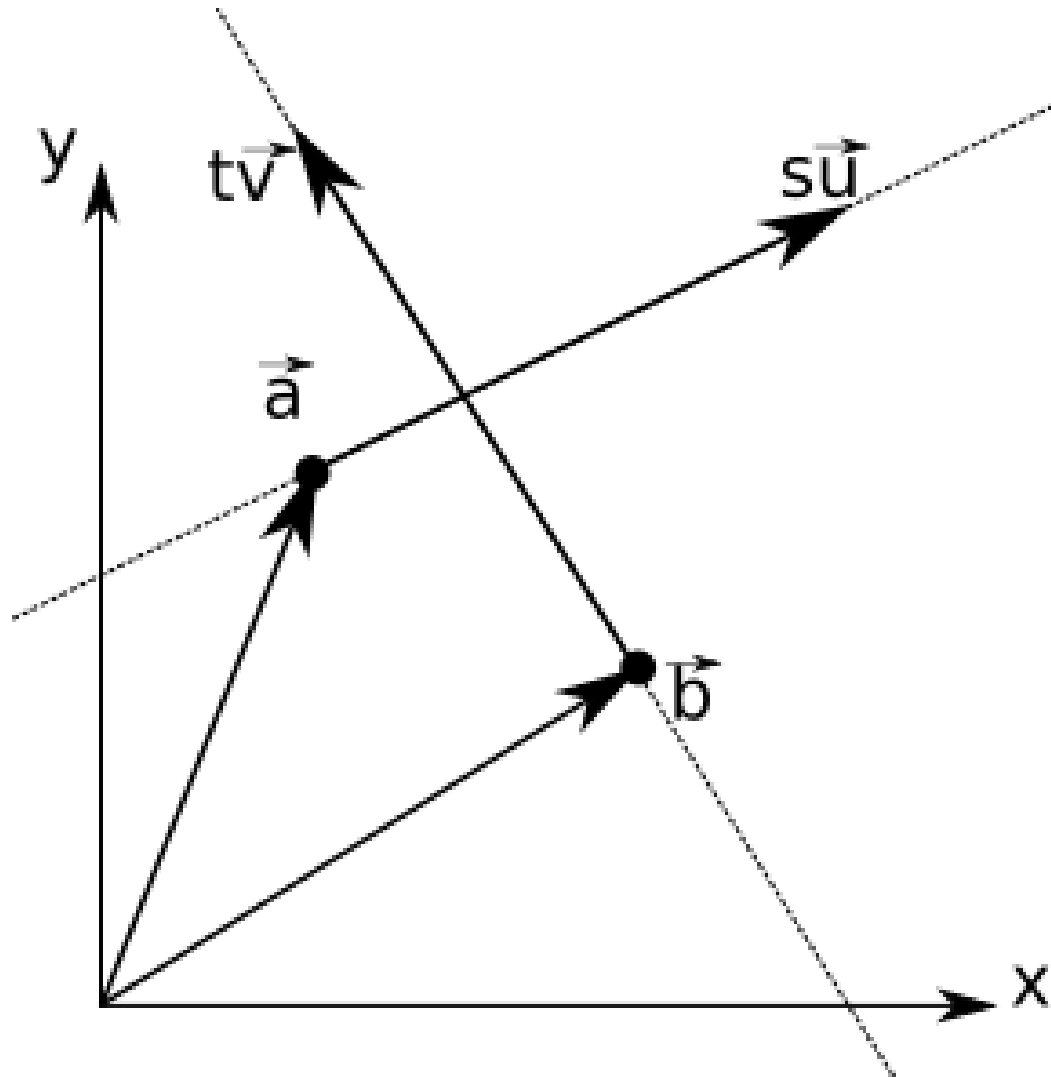
Line Segment Intersection



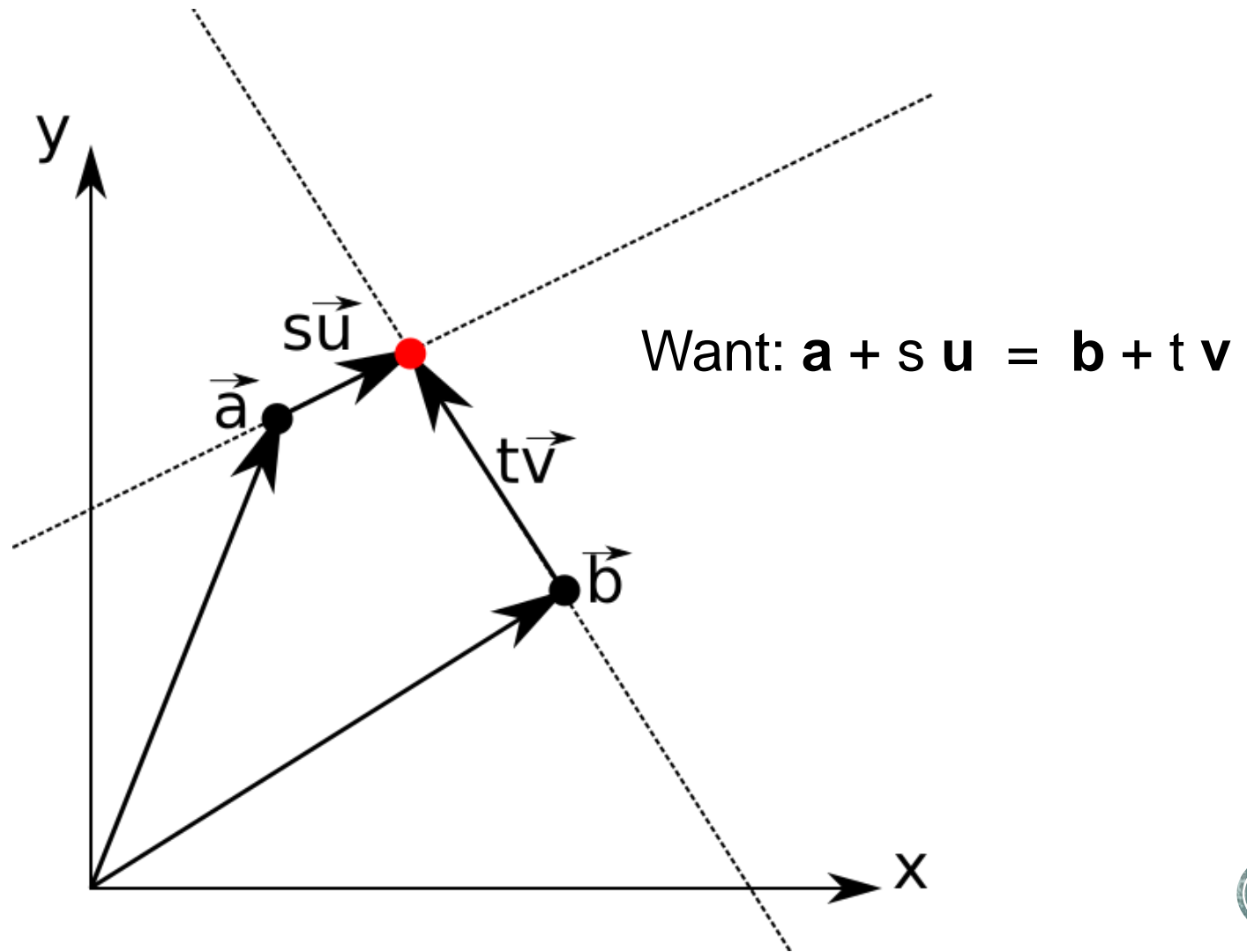
Let's do lines first.....



Parametric Form of Lines



Parametric Form of Lines



System of Equations

Want: $\mathbf{a} + s \mathbf{u} = \mathbf{b} + t \mathbf{v}$

This means

$$(1) \mathbf{a}_x + s \mathbf{u}_x = \mathbf{b}_x + t \mathbf{v}_x$$

$$(2) \mathbf{a}_y + s \mathbf{u}_y = \mathbf{b}_y + t \mathbf{v}_y$$



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Put variables on left side together

$$(1) s \mathbf{u}_x - t \mathbf{v}_x = \mathbf{b}_x - \mathbf{a}_x$$

$$(2) s \mathbf{u}_y - t \mathbf{v}_y = \mathbf{b}_y - \mathbf{a}_y$$



Cramer's Rule (Board)

$$(1) \quad su_x - tv_x = b_x - a_x$$

$$(2) \quad su_y - tv_y = b_y - a_y$$

What happens if lines parallel?



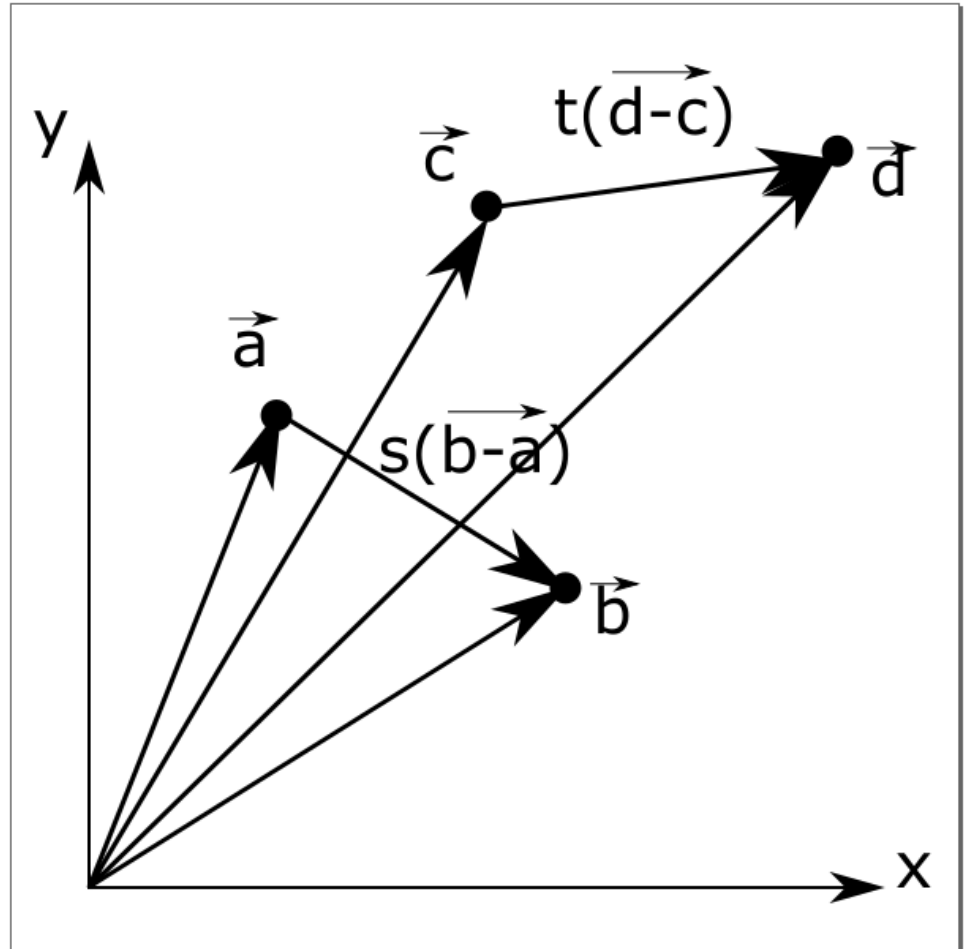
Line Segments

$$\mathbf{a} + s(\mathbf{b}-\mathbf{a}) = \mathbf{b} + t(\mathbf{d}-\mathbf{c})$$

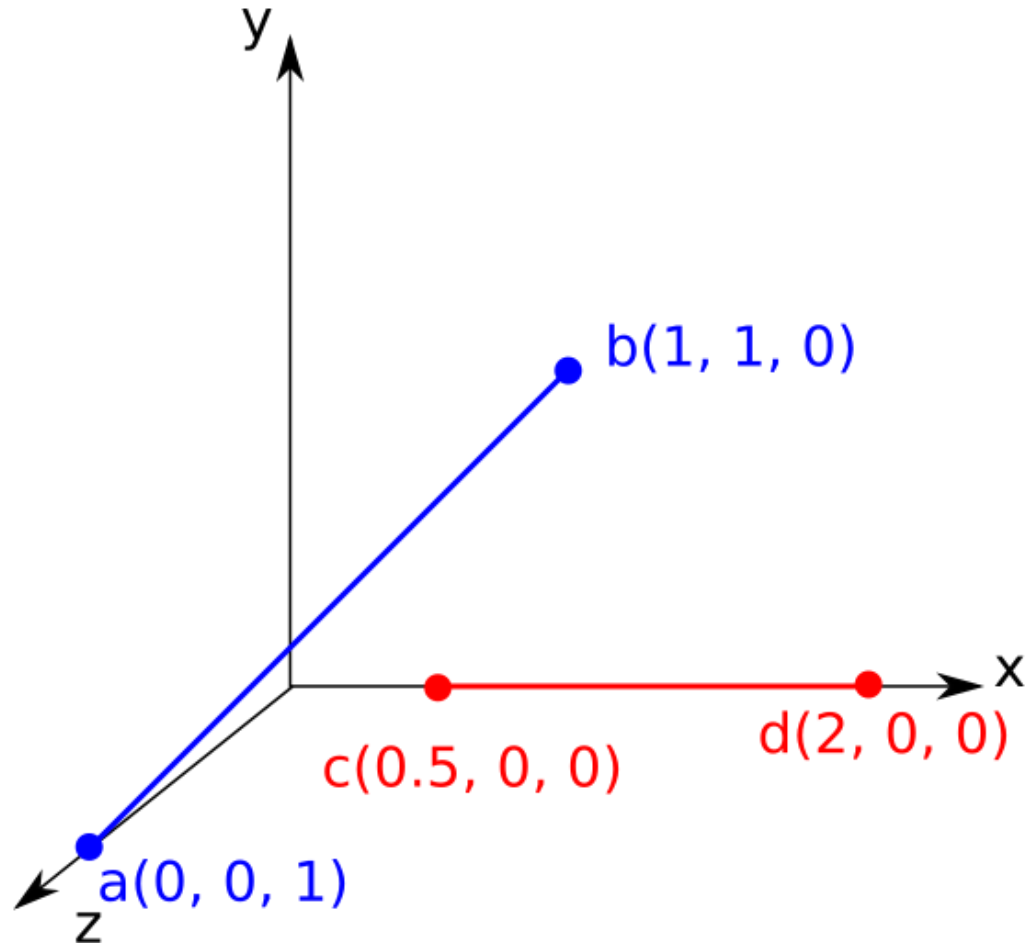
Need

$$0 \leq t \leq 1$$

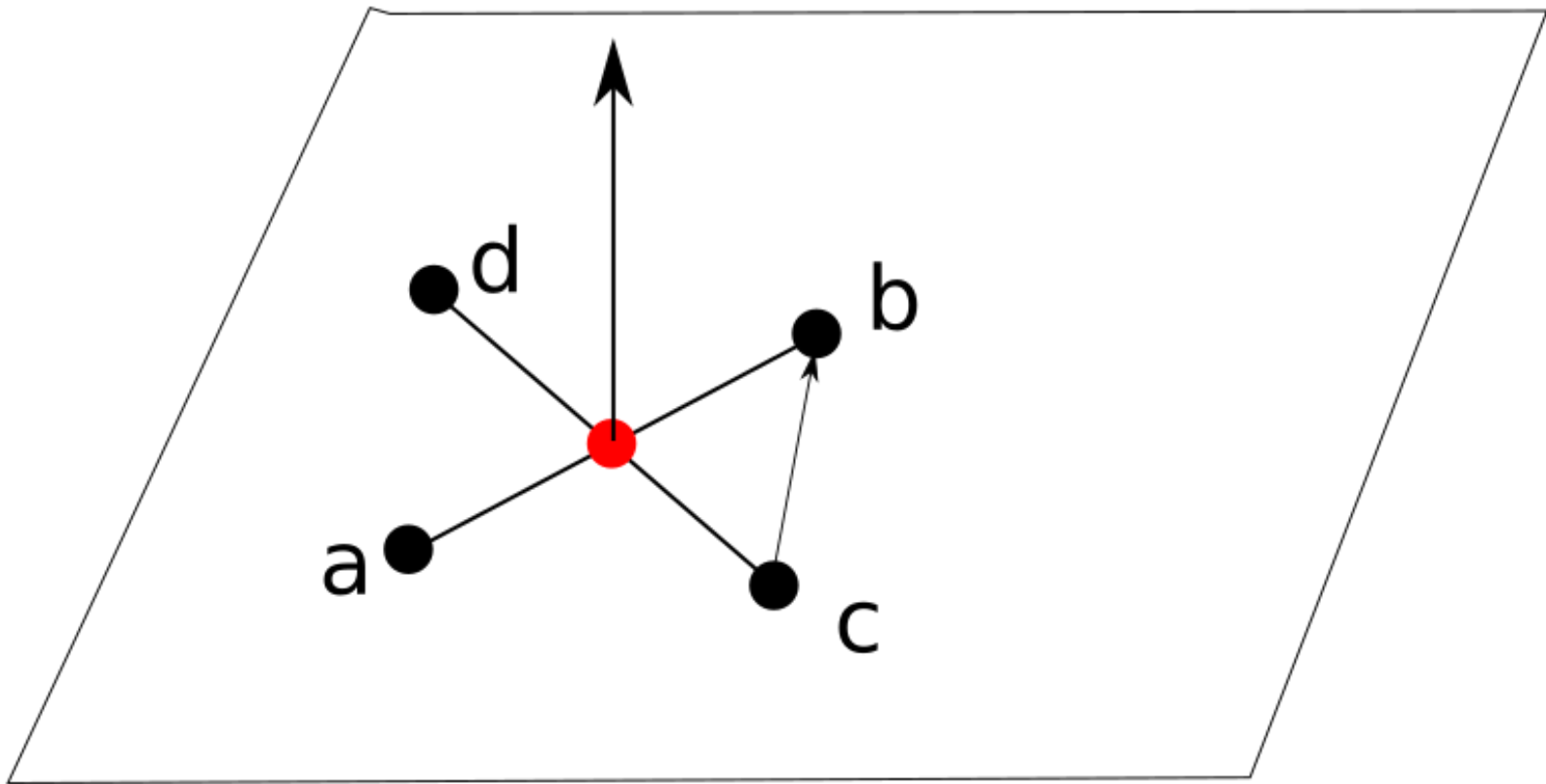
$$0 \leq s \leq 1$$



3D Extensions: Skew Lines



Detecting Skew Lines



$$y = mx + b??$$

- What if vertical line?
- What if very close to vertical line?

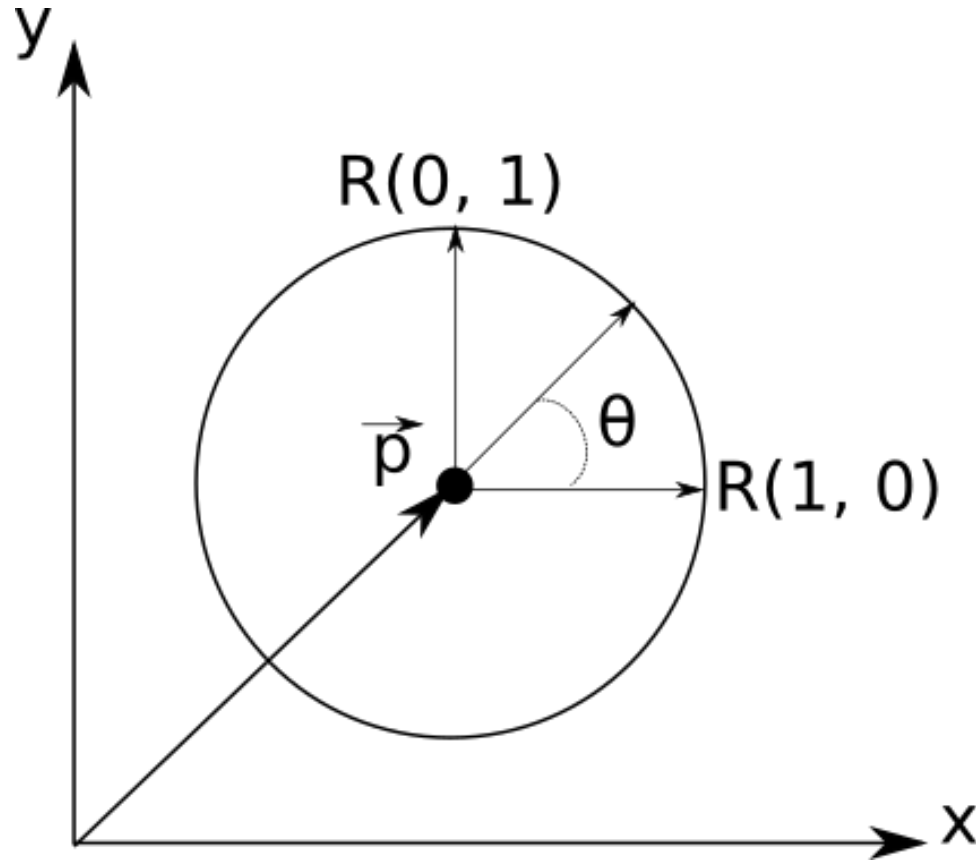


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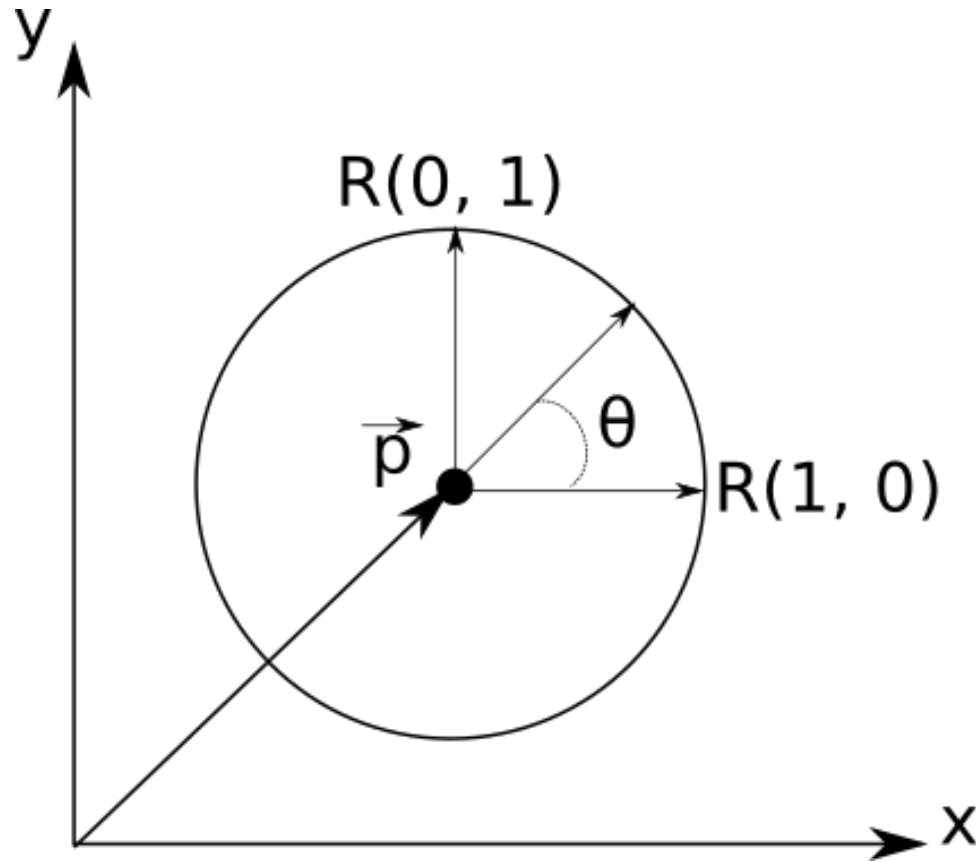
Circles in The Plane



$$\vec{p} + R(1, 0)\cos(\theta) + R(0, 1)\sin(\theta)$$



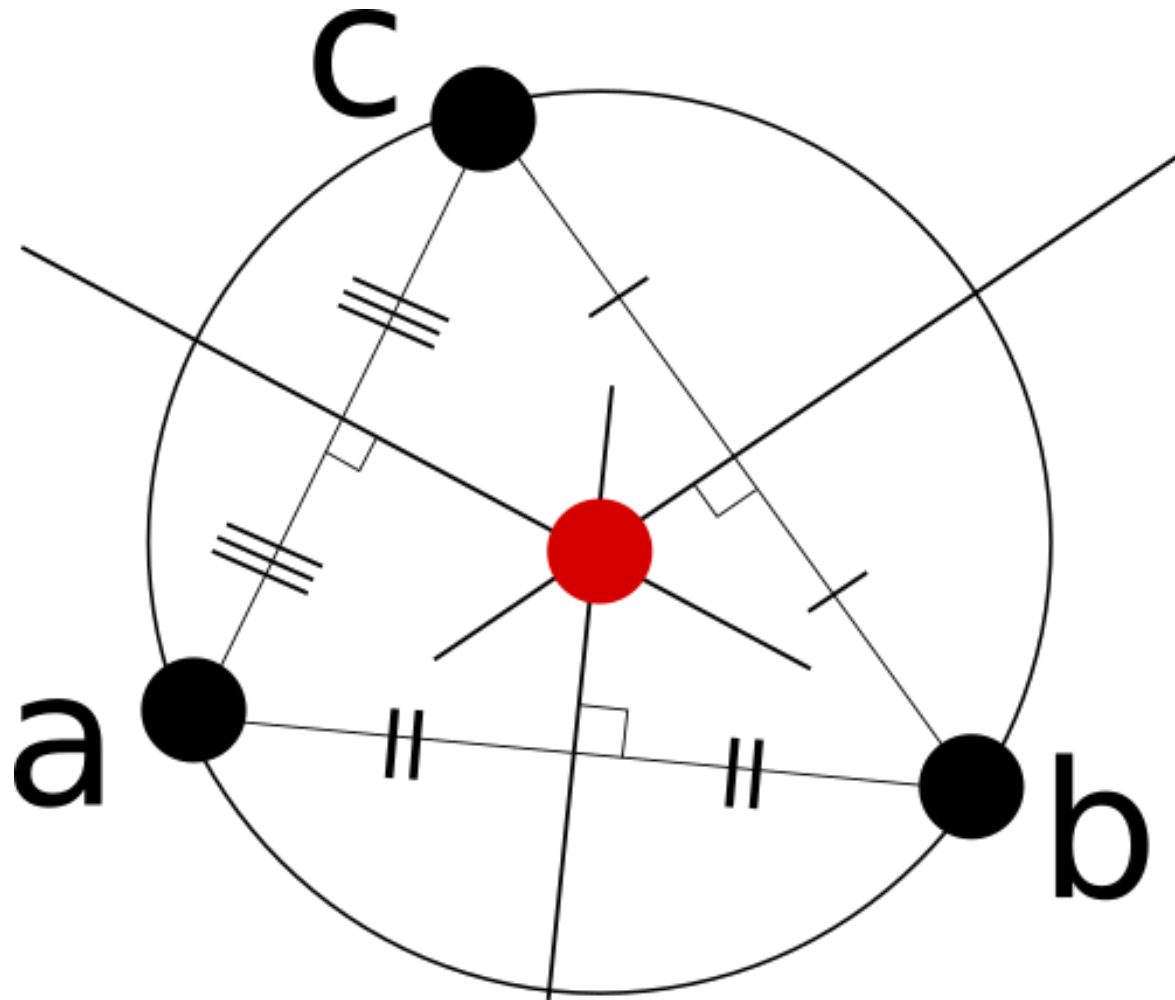
Circles in The Plane



How many **degrees of freedom**?



Triangle Circumcenters



Demo: Circumcenter Discovery



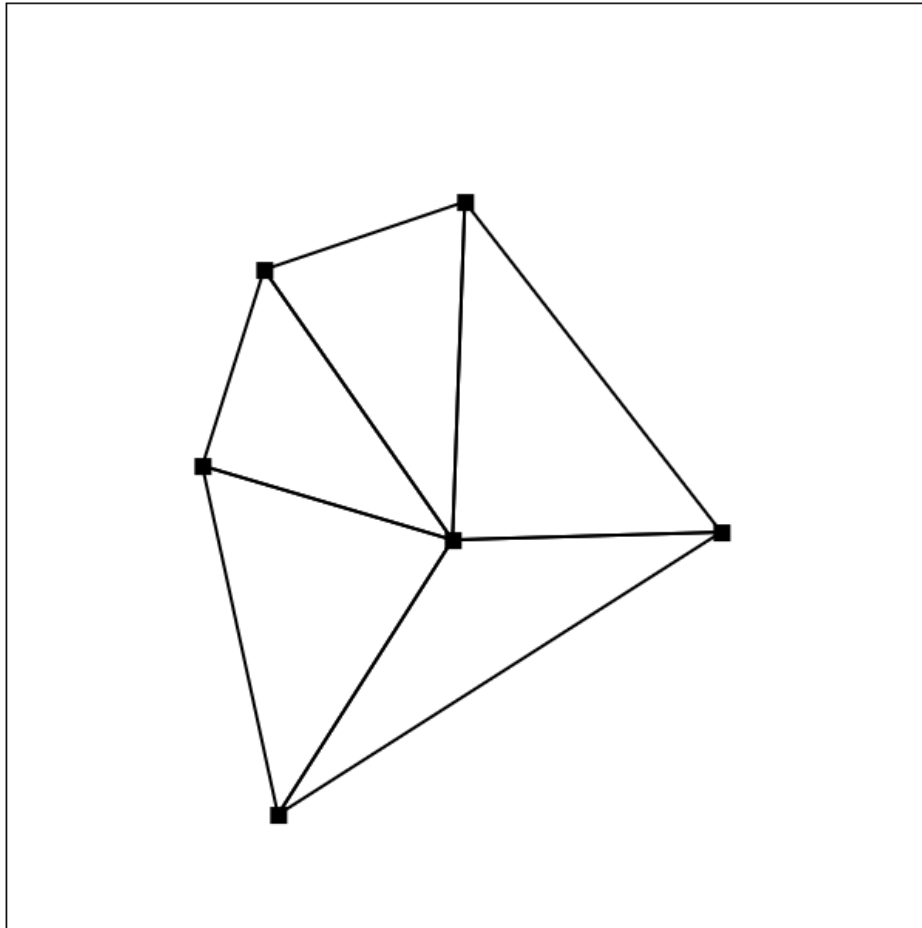
Raffle Point Question

- Draw a triangle whose circumcenter is outside of the triangle



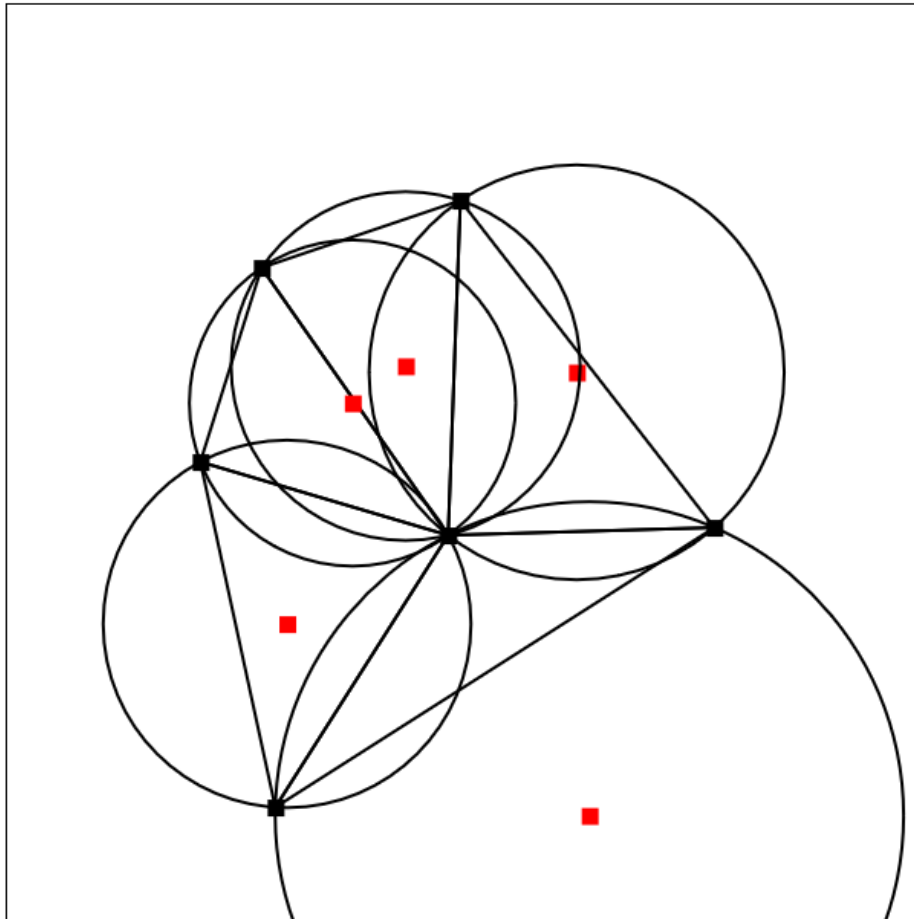
Delaunay Triangulation

- Triangulation such that every circumcenter is empty



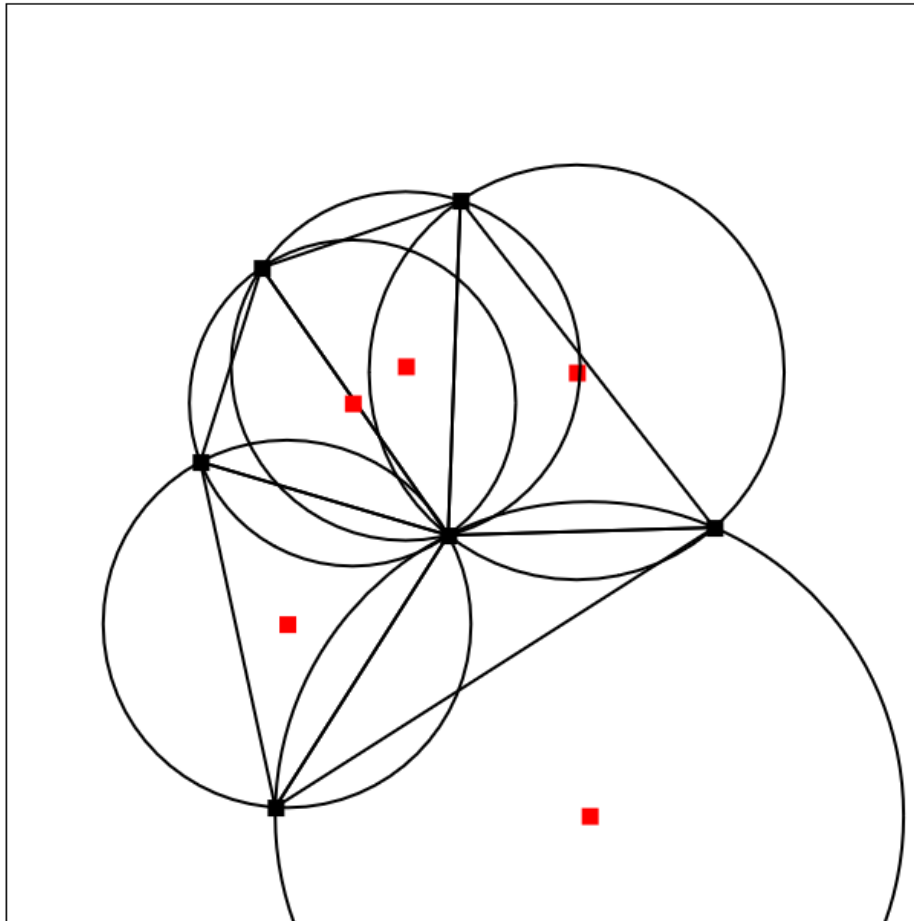
Delaunay Triangulation

- Triangulation such that every circumcenter is empty



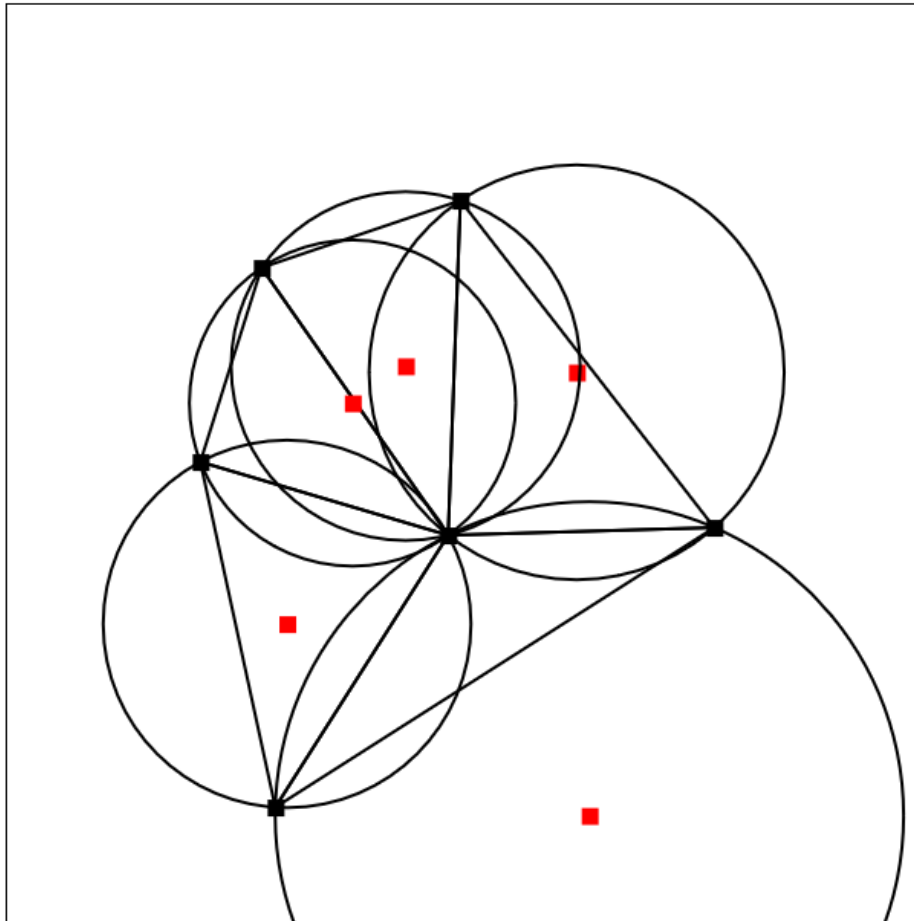
Delaunay Triangulation

- Brute Force Algorithm??



Demo

- Brute Force Algorithm??



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JSON Interactive Demo

