CptS 442/542 (Computer Graphics)
Unit 4: Geometry in Computer Graphics

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Motivation

Geometry is used in *every* aspect of computer graphics. In a sense, computer graphics is an expresion of geometry. We also need to recognize a complicated geometry ...

- hair
- skin
- wood grain
- bread
- forests

... in order to fake it!

What We'll Cover Today

- scalars
- points
- lines
- segments
- rays
- planes

This includes what you've been using in PA02 (and a bit more).

Dimensionality can be any positive integer, but in graphics ...

In case you're wondering, we don't need vectors, curves, surfaces, or volumes (solids), and will cover them in later units.

Scalars

- What are they?
- How do we represent them in a program?

Points

- "*n*-tuples" of scalar coordinates
  - *n* is dimensionality (0, 3, -2)
  - depend on origin of coordinate system
- How do we represent them mathematically?
- How do we draw them on a display?
  - Do they need tessellation?
  - What problems can arise?

Lines I

- What are they?
- How do we represent them mathematically?
  - slope-intercept

$$y = mx + b$$

  - parametric

$$P(t) = O + D\,t \quad -\infty < t < +\infty$$

  - implicit

$$a\,x + b\,y + c = 0$$

  - intersecting planes

Lines II

- How do we draw them on a display?
  - Do they need tessellation?
  - What problems can arise?

Line Segments I

- What are they?
- How do we represent them mathematically?
  - endpoints
  - parametric $p(t) =$ (1 - t) p0 + t p1

    0 <= t <= 1 defines segment

    $\equiv$ `lerp(p0, p1, t)`

Line Segments II

- How do we represent them on a display?
  - Do they need tessellation?
  - What problems can arise?

Rays

- What are they?
- How do we represent them mathematically?
  - parametric (Note that this gets us into vectors.)
- How do we represent them on a display?
  - Do they need tessellation?
  - What problems can arise?

Planes I

- What are they?
- How do we represent them mathematically?
  - implicit

$$ax + by + cz = d$$

  - parametric

$$O + Du + Ev = P(u, v)$$

  - point-normal (later)

Planes II

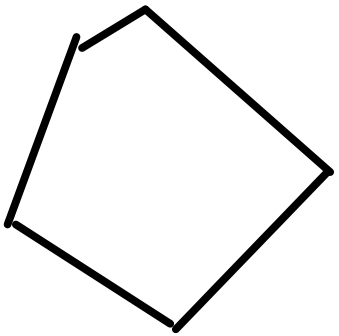
- How do we represent them on a display?
  - Do they need tessellation?
  - What problems can arise?

(Note that this gets us into vectors.)

Polygons I

- What are they?

- How do we represent them mathematically?



Polygons II

- How do we represent them on a display?
  - Do they need tessellation?
  - What problems can arise?