2D Computer Graphics

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Summer 2020

IMPA

Vector Graphics

Typical vector graphics

Warnock and Wyatt [1982], PS, PDF, SVG, (RVG)

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List of *layers* to be painted one over the other

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Outline can be primitive

- Circle, triangle, box, etc

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Most often, outline is defined by a *path*

- Paths are generalizations of polygons

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Shape is filled or stroked

- Interior of filled shape is defined by *even-odd* or *non-zero* fill rule
- Interior of stroked shape is defined by distance to outline

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Paint can be constant for all points

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Paint can be constant for all points

Paint can also vary spatially

- Linear gradient

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Paint can also vary spatially

- Linear gradient
- Radial gradient

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Paint can be constant for all points

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- Linear gradient
- Radial gradient
- Mesh gradient

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Paint can be constant for all points

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- Linear gradient
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- Mesh gradient
- Pattern

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Paint can also vary spatially

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- Radial gradient
- Mesh gradient
- Pattern
- Texture

PostScript

PostScript Language Reference. Adobe Systems Incorporated, third edition, 1999

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Full (primitive) programming language for describing pictures!

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Right-handed coordinate system

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Several types of gradients

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Much safer and easier for implementers than PostScript!

SVG

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Screen-space filters

RVG

Our format!

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Full (modern) programming language for describing pictures!

- Based on Lua

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Go over samples

- Window and Viewport
- Scene and Elements
- Shapes and Paints
- Transformations

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Go over RVG driver

Rasterization

Basic loop *pseudocode*

```
T = windowviewport(window, viewport)
-- compute colors for each pixel
for x, y in image:pixels()
  for shape, paint in xformed_scene:elements()
    if shape:transformed(T):contains(x, y)
      image:set_pixel(x, y, paint:transformed(T):color(x, y))
    end
  end
end
```

Inside-outside test is the tricky part

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Go over PNG driver

Basic shapes

Triangles

- How to represent? How to transform?
- Inside-out test
  - Signs
  - Barycentric coordinates (canonic triangle)
  - Intersection count

Basic shapes

Triangles

- How to represent? How to transform?
- Inside-out test
  - Signs
  - Barycentric coordinates (canonic triangle)
  - Intersection count

Polygons

- How to represent? How to transform?
- Inside-out test
  - Even-odd, non-zero
  - Intersection count with implicit lines

Basic shapes

Circles

- How to represent? How to transform?
- Inside-out test
- How to find transformed center?
- How to find transformed bounding-box?

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Assignment 1

- Go over PNG driver

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J. Warnock and D. K. Wyatt. A device independent graphics imaging model for use with raster devices. *Computer Graphics (Proceedings of ACM SIGGRAPH 1982)*, 16(3):313–319, 1982.