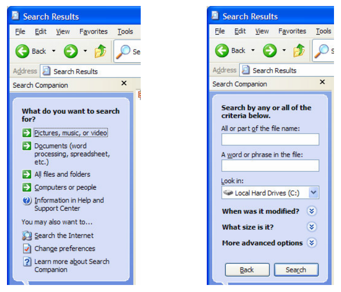
Lecture 17: Output Models 2

UI Hall of Shame or Hall of Fame?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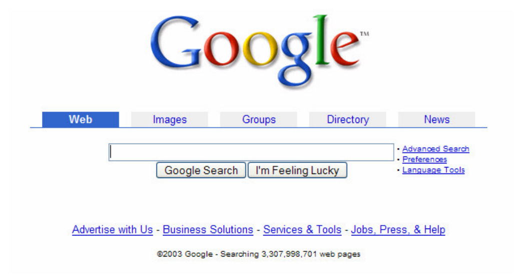
UI Hall of Fame or Shame?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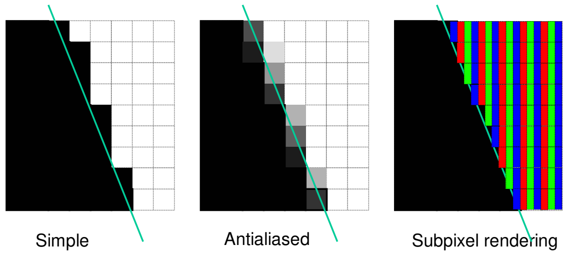
Today's Topics

- Antialiasing
- Alpha compositing
- Transforms
- Clipping
- Painting tricks

Transparency

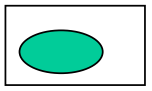
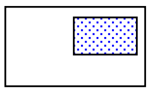
- **Alpha** is a pixel's transparency
  - from 0.0 (transparent) to 1.0 (opaque)
  - 32-bit RGBA pixels: each pixel has red, green, blue, and alpha values
- Uses for alpha
  - Antialiasing
  - Nonrectangular images
  - Translucent components

Antialiasing and Subpixel Rendering



Alpha Compositing

- Compositing rules control how source and destination pixels are combined
- Source
  - Image
  - Stroke drawing calls
- Destination
  - Drawing surface

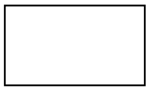
Porter-Duff Alpha Compositing Rules

Source pixel: Rs, Gs, Bs, As
Dest pixel: Rd, Gd, Bd, Ad

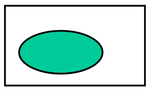
1. Premultiply RGB by A
   {RGB}s = {RGB}rs * As
   {RGB}d = {RGB}rd * Ad
2. Compute weighted combination of source and dest pixel
   {RGB}d = {RGB}s*fs + {RGB}d*fd
   Ad = As*fs + Ad*fd
   for some weights fs, fd
3. Postdivide RGB by A
   {RGB}d = {RGB}d / Ad if Ad != 0

Simple Copying

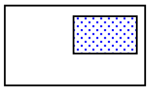
- clear (fs=0, fd=0)
  - {RGB}d = 0
  - Ad = 0



- src (fs=1, fd=0)
  - {RGB}d = {RGB}s
  - Ad = As

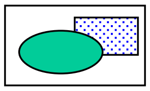


- dst (fs=0, fd=1)
  - {RGB}d = {RGB}d
  - Ad = Ad

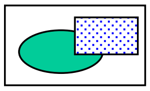


Layering

- src over dst
  - {RGBA}d = {RGBA}s + {RGBA}d*(1-As)

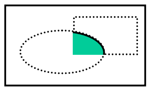


- dst over src
  - {RGBA}d = {RGBA}d + {RGBA}s*(1-Ad)

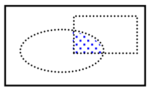


Masking

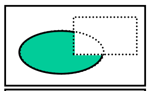
- src in dst
  - {RGBA}d = {RGBA}s*Ad



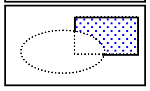
- dst in src
  - {RGBA}d = {RGBA}d*As



- src out dst
  - {RGBA}d = {RGBA}s*(1-Ad)



- dst out src
  - {RGBA}d = {RGBA}d*(1-As)



Other Masking

- src atop dst = src over dst − src out dst
  - {RGBA}d = {RGBA}s*Ad + {RGBA}d*(1-As)
- dst atop src = dst over src − dst out src
  - {RGBA}d = {RGBA}s*(1-Ad) + {RGBA}d*As
- src xor dst = src out dst + dst out src
  - {RGBA}d = {RGBA}s*(1-Ad) + {RGBA}d*(1-As)

Coordinate Transforms

- Translation
  - moves origin by dx, dy
- Scaling
  - multiplies x by sx and y by sy
- Rotation
  - rotates by theta around an axis point x, y
- Use coordinate transforms to make drawing easier

Component Model Effects

- Changing Graphics passed to children
  - Transforms: rotation, zooming
  - Clipping: setting new clipping regions
- Wrapping Graphics passed to children
  - Intercept child calls and modify or capture them
- Painting onto offscreen images and then transforming the images
  - Blur, shimmer, masking
- Using components as rubber stamps
  - Table, list, and tree cell renderers

Scene Graphs

- Traditional 2D toolkits are too limited for many graphical effects
  - View hierarchy is a tree (can't share views)
  - Parents must enclose descendents (and clip them)
  - Parents translate children, but don't otherwise transform them
- Piccolo toolkit (designed for zooming user interfaces)
  - View hierarchy is actually a **graph**
  - Components can translate, rotate, scale
  - Parents transform but **don't clip** their children by default
  - Input events and repaint requests are transformed too