an insider’s guide to cairo

carl worth
red hat, inc.
desktopcon
2005-07-19
http://cairographics.org
what is cairo

- 2D drawing library
- display and print output
- multiple backends
- architected for acceleration

http://cairographics.org
### Rendering Model

<table>
<thead>
<tr>
<th>Source</th>
<th>Mask</th>
<th>Source in Mask Over Target</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1.png" alt="Source Image" /></td>
<td><img src="image2.png" alt="Mask Image" /></td>
<td><img src="image3.png" alt="Combined Image" /></td>
</tr>
<tr>
<td><img src="image4.png" alt="Source Image" /></td>
<td><img src="image5.png" alt="Mask Image" /></td>
<td><img src="image6.png" alt="Combined Image" /></td>
</tr>
<tr>
<td><img src="image7.png" alt="Source Image" /></td>
<td><img src="image8.png" alt="Mask Image" /></td>
<td><img src="image9.png" alt="Combined Image" /></td>
</tr>
<tr>
<td><img src="image10.png" alt="Source Image" /></td>
<td><img src="image11.png" alt="Mask Image" /></td>
<td><img src="image12.png" alt="Combined Image" /></td>
</tr>
</tbody>
</table>

[http://cairographics.org](http://cairographics.org)
through the scarab’s belly

- stroking
- tessellation
- rasterization
- compositing

N + • = N
stroking
is stroking that hard?

- postscript doesn’t always get it right
- inkscape doesn’t always get it right
is stroking that hard?

postscript doesn’t always get it right

inkscape doesn’t always get it right

cairo doesn’t always get it right
cubic Bezier splines

- well understood primitive
- many pleasing properties:
  - easily decomposed
  - bounded by convex hull of control points
- but cannot represent circular arcs exactly

http://cairographics.org
deCastlejau algorithm
1) find 3 midpoints
2) find 2 new midpoints
3) final midpoint is on spline
4) two sub-splines fall out
let’s try stroking
let’s try stroking
let’s try stroking
now simplify the pen
ooh, pretty colors
...but ugly lumps
approximate the spline first
is this progress?
cleaning up...
...and add the pen
tessellation

robust implementation is non-trivial

John Hobby provides all the answers:


nickle prototype in progress
the corner case
rasterization/compositing

original software written in less than a day

now seeing much more attention

thanks to Søren, google, etc.