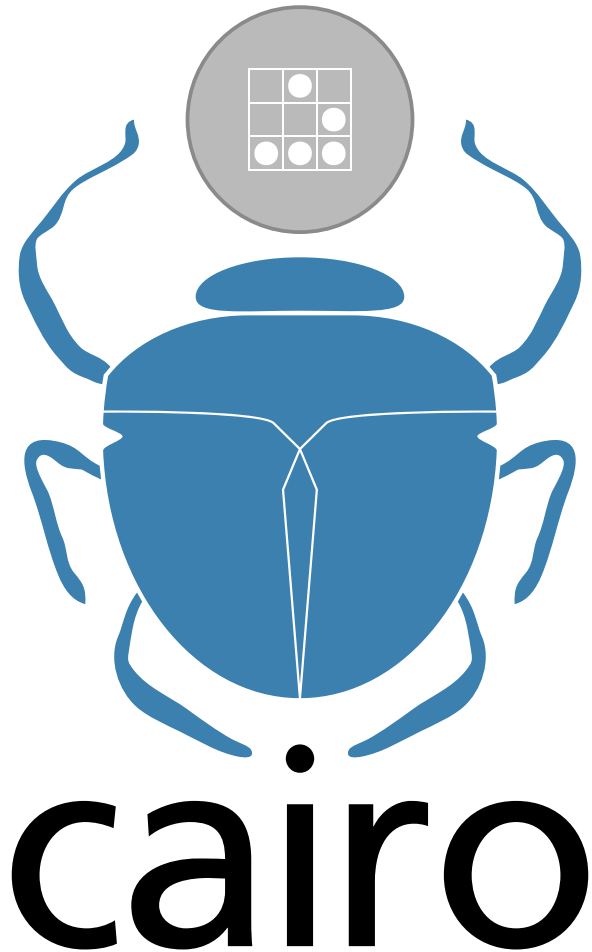


an insider's guide to cairo



carl worth
red hat, inc.





desktopcon

2005-07-19

<http://cairographics.org>

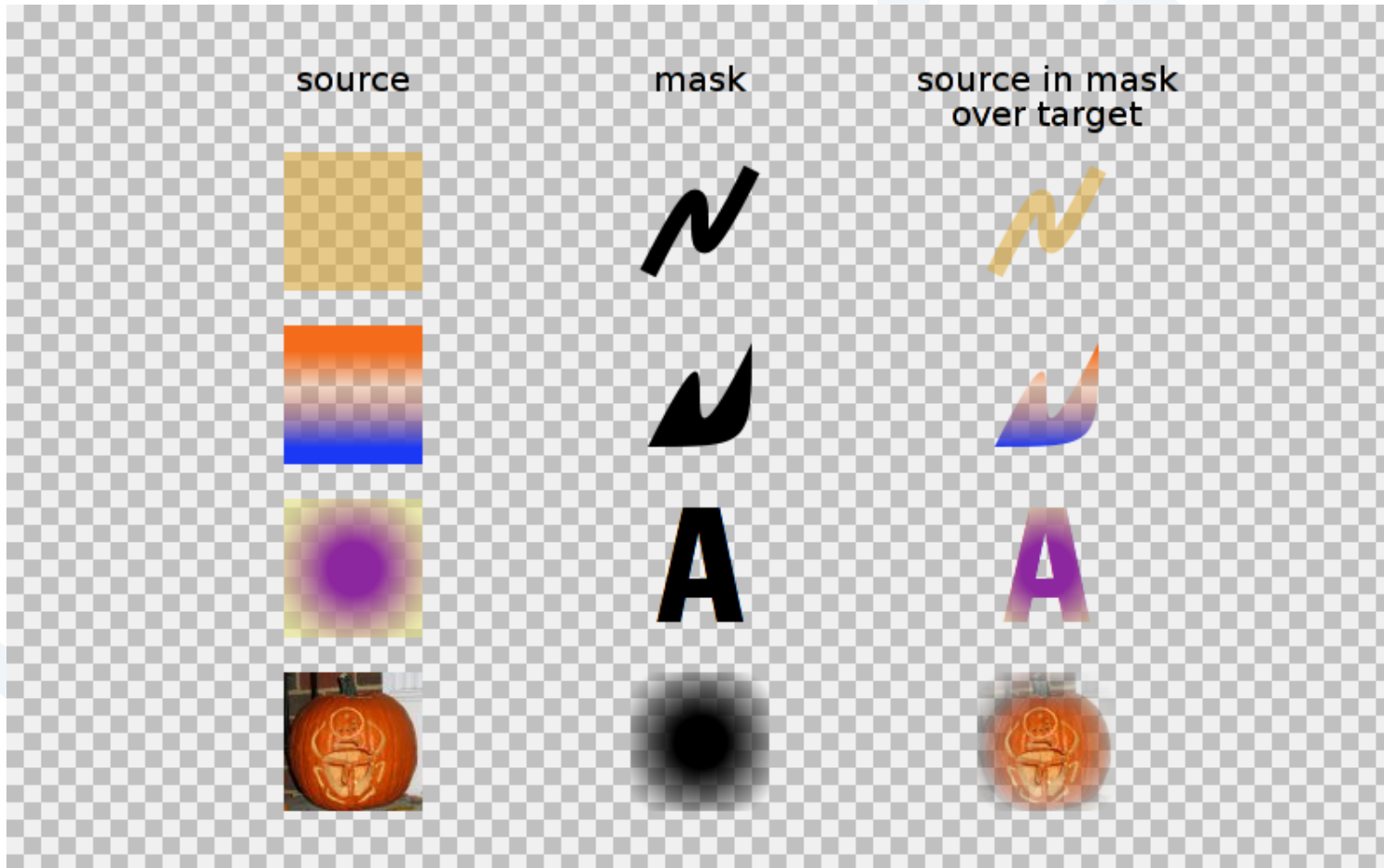


what is cairo

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



rendering model





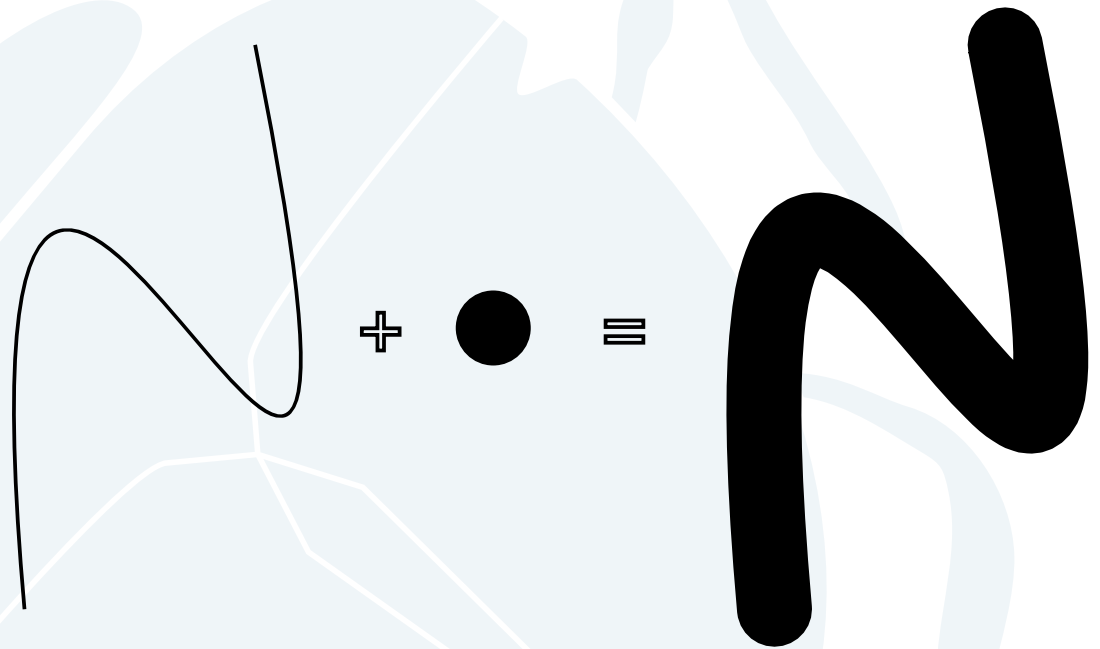
through the scarab's belly

 stroking

 tessellation

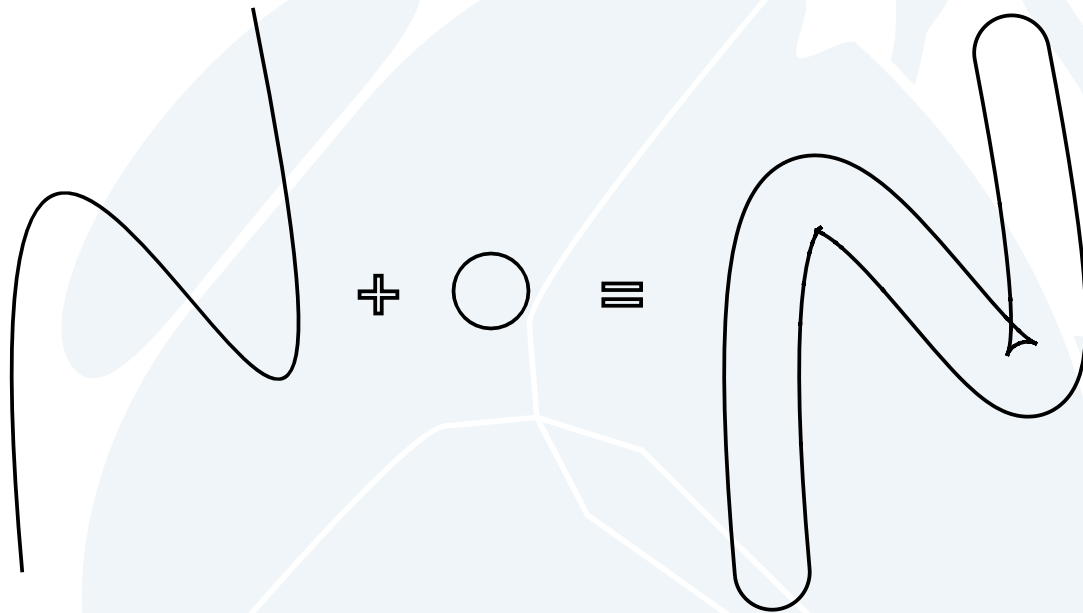
 rasterization

 compositing





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

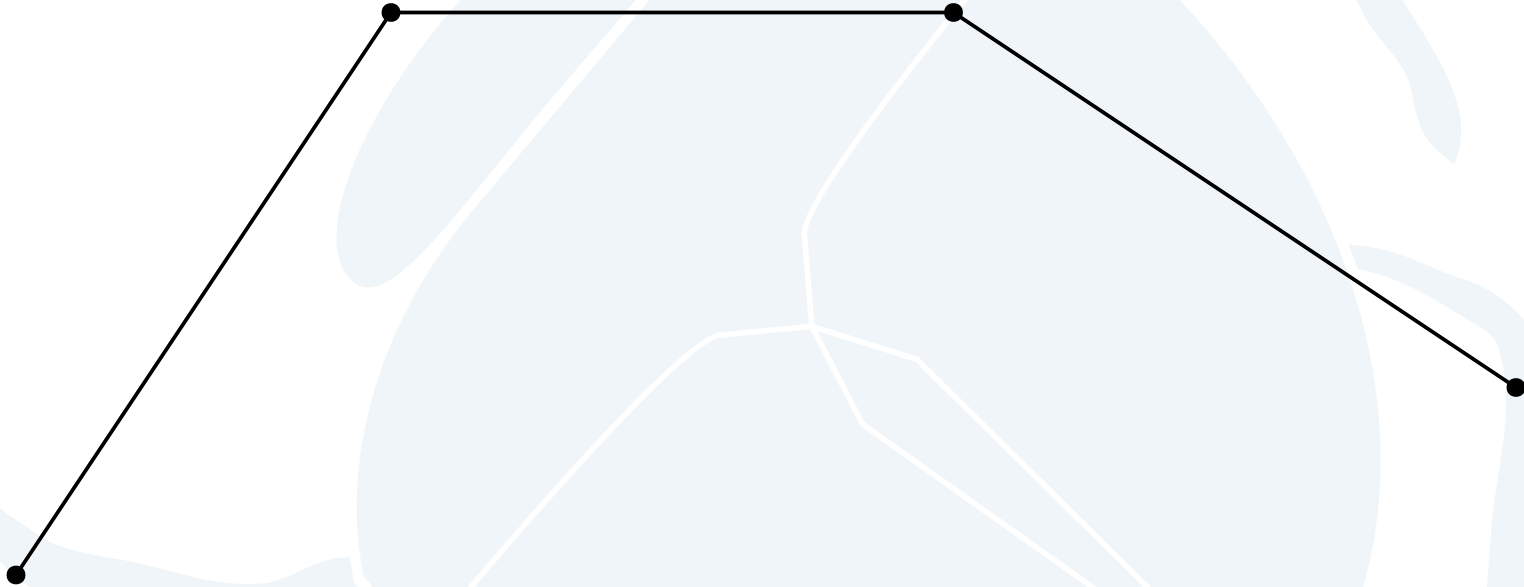


cubic Bezier splines

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

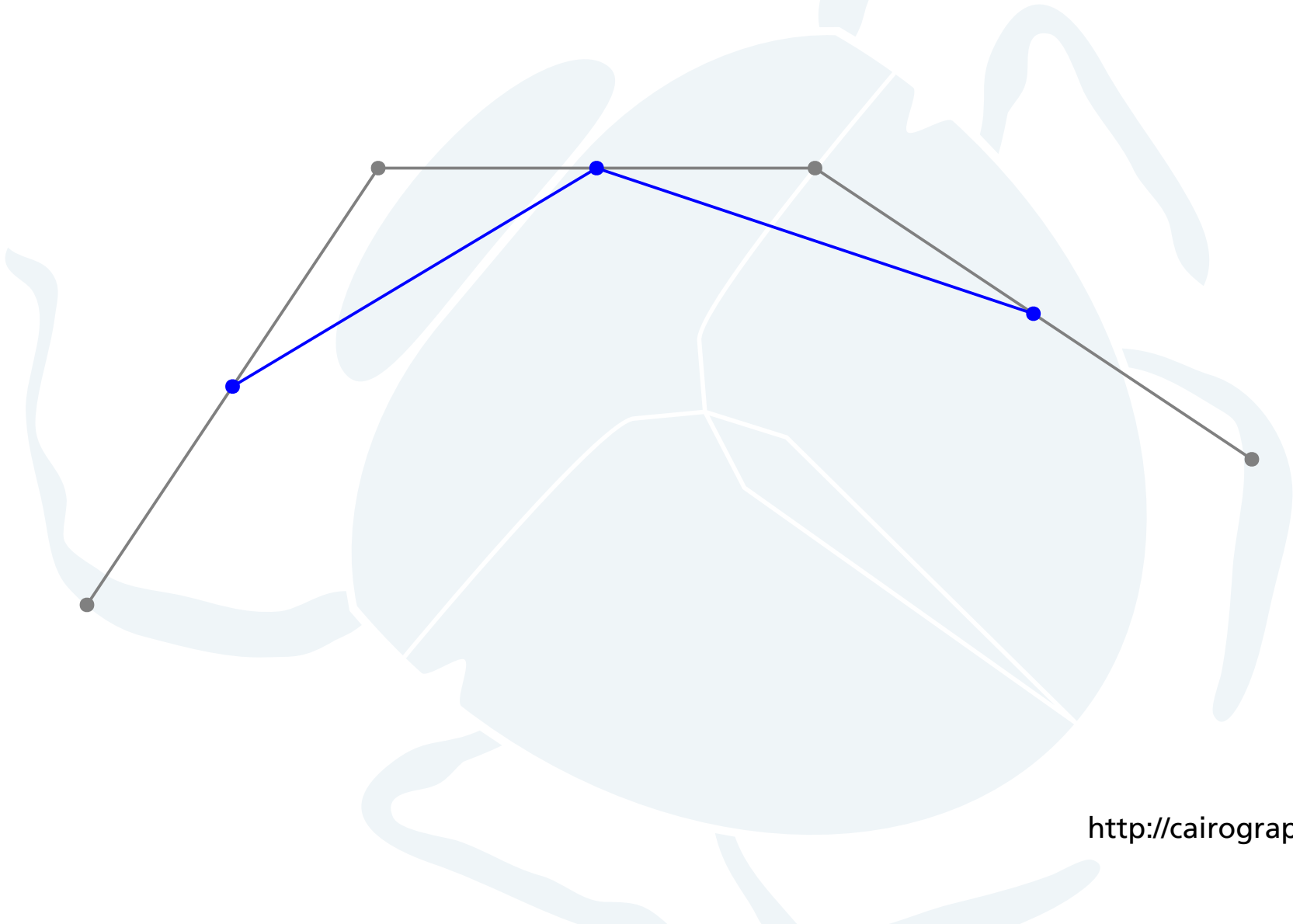


deCasteljau algorithm



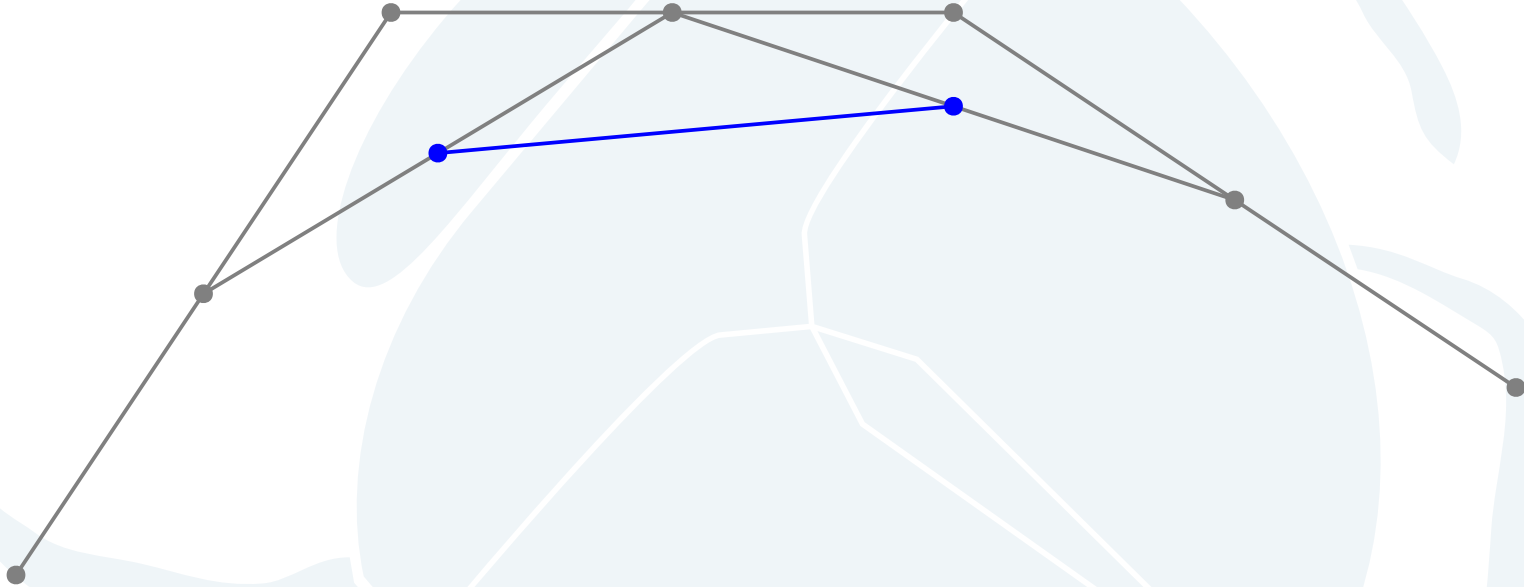


1) find 3 midpoints



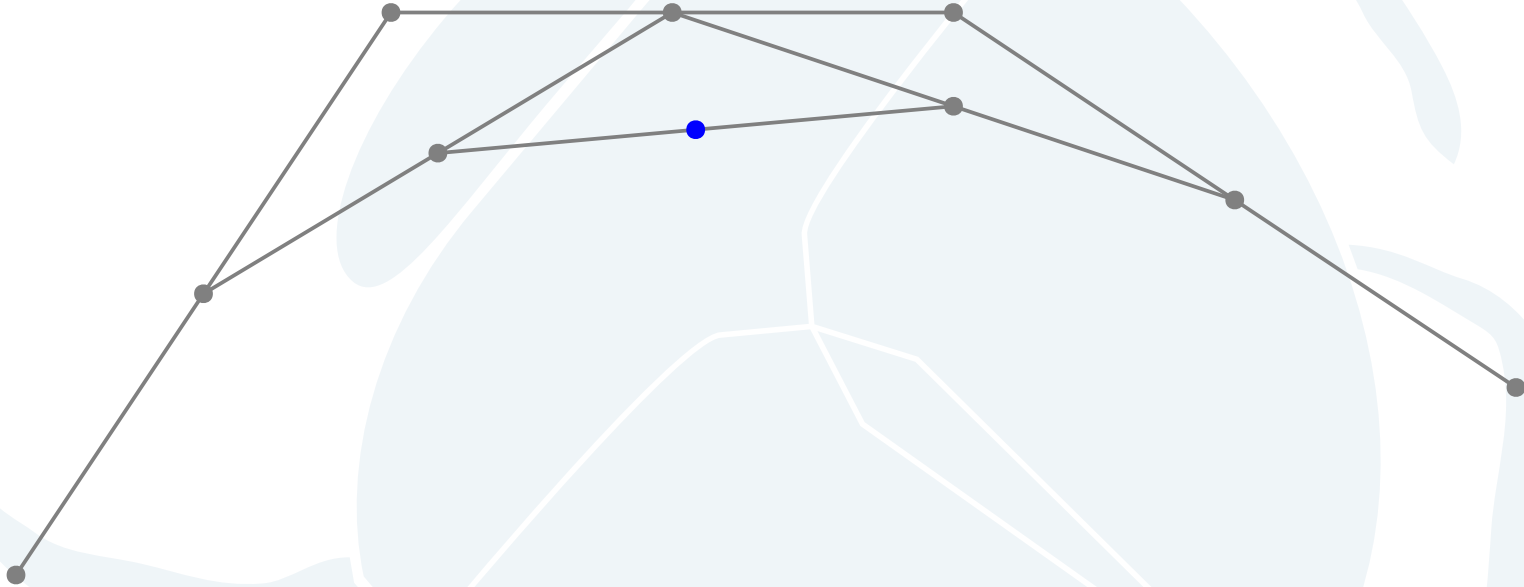


2) find 2 new midpoints



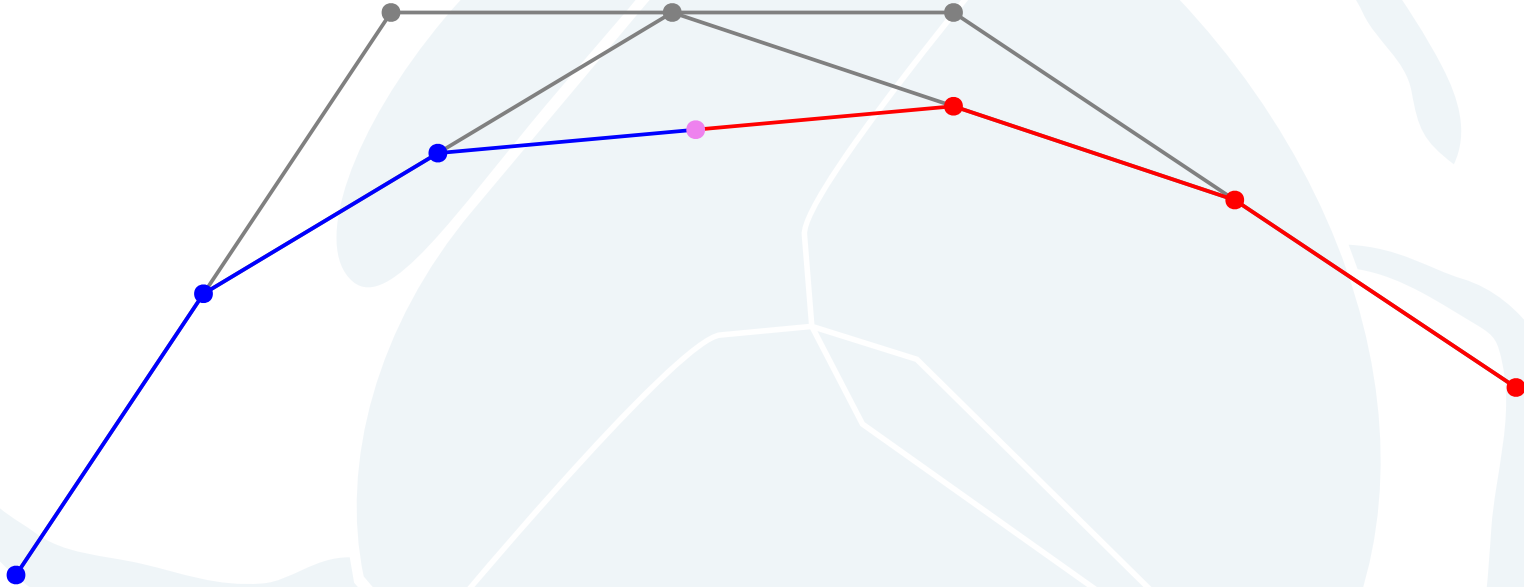


3) final midpoint is on spline





4) two sub-splines fall out





cairo an insider's guide

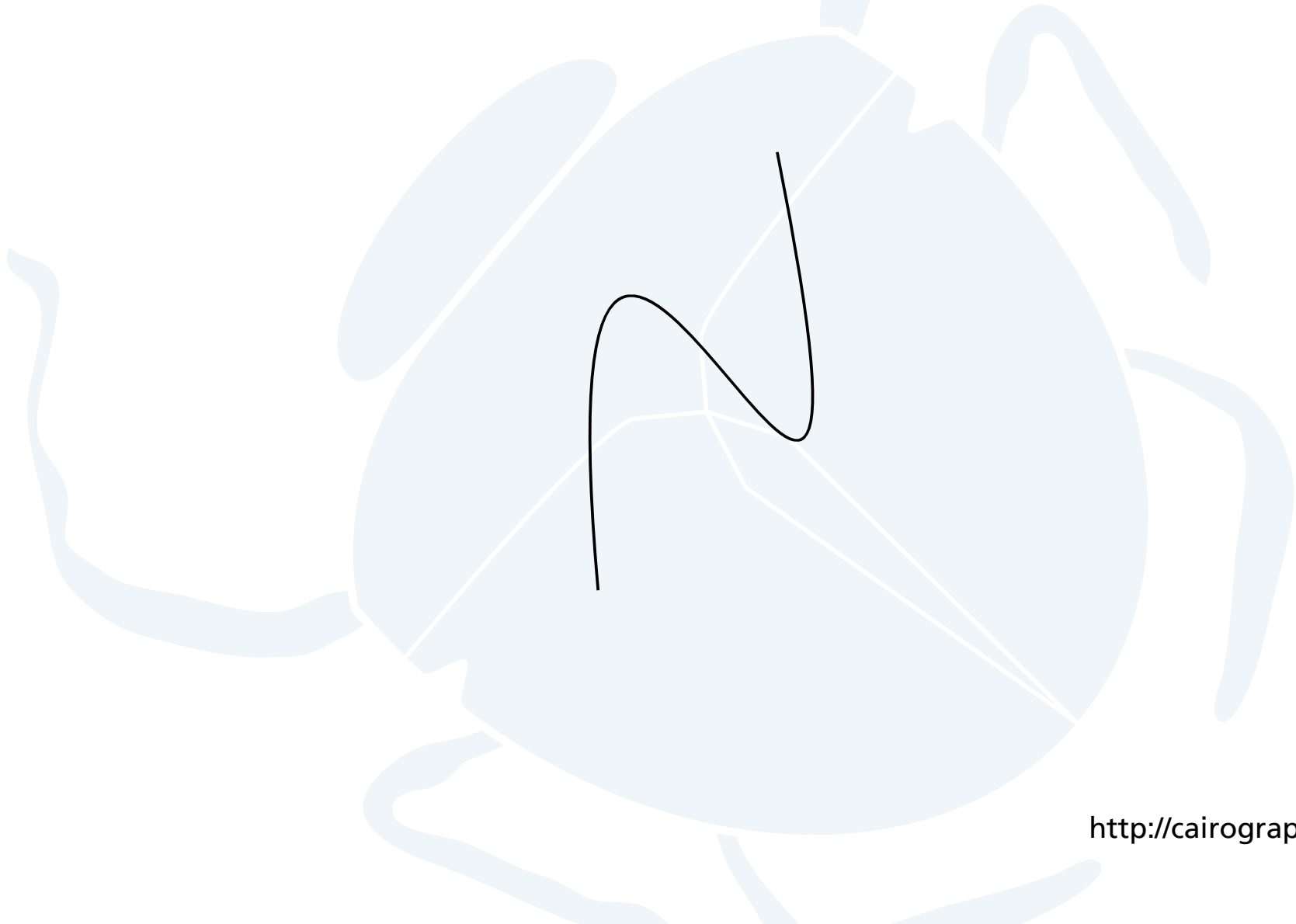


let's try stroking





let's try stroking

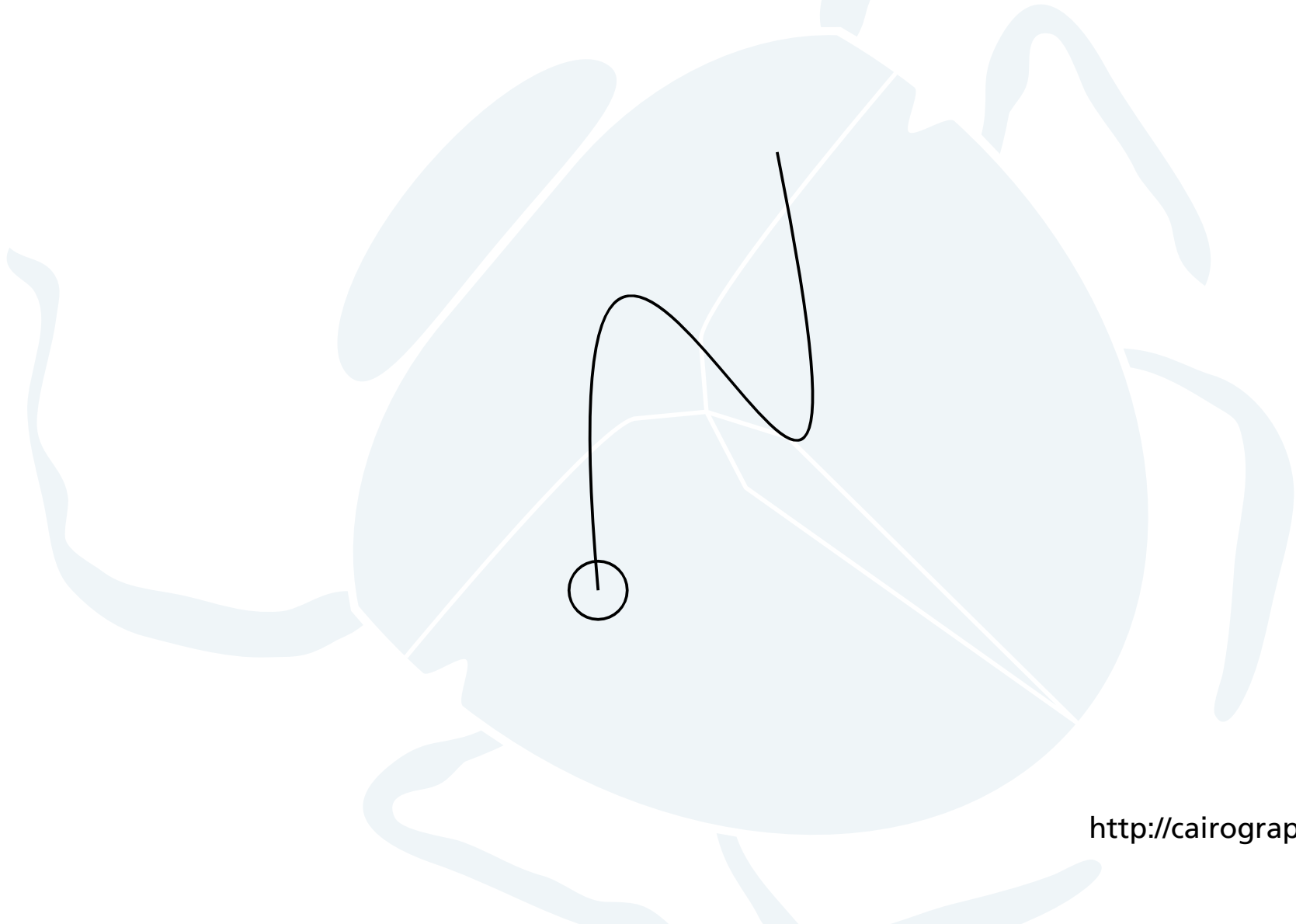




cairo an insider's guide



let's try stroking





cairo an insider's guide

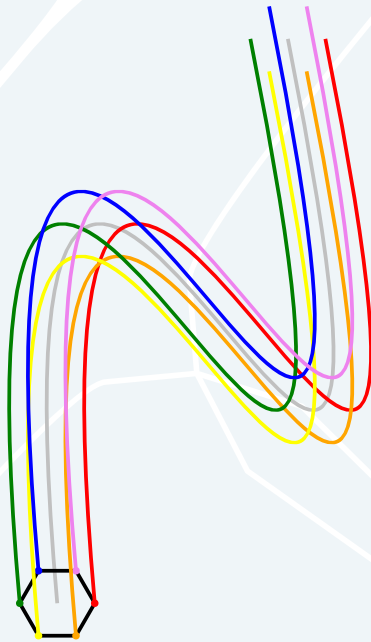


now simplify the pen



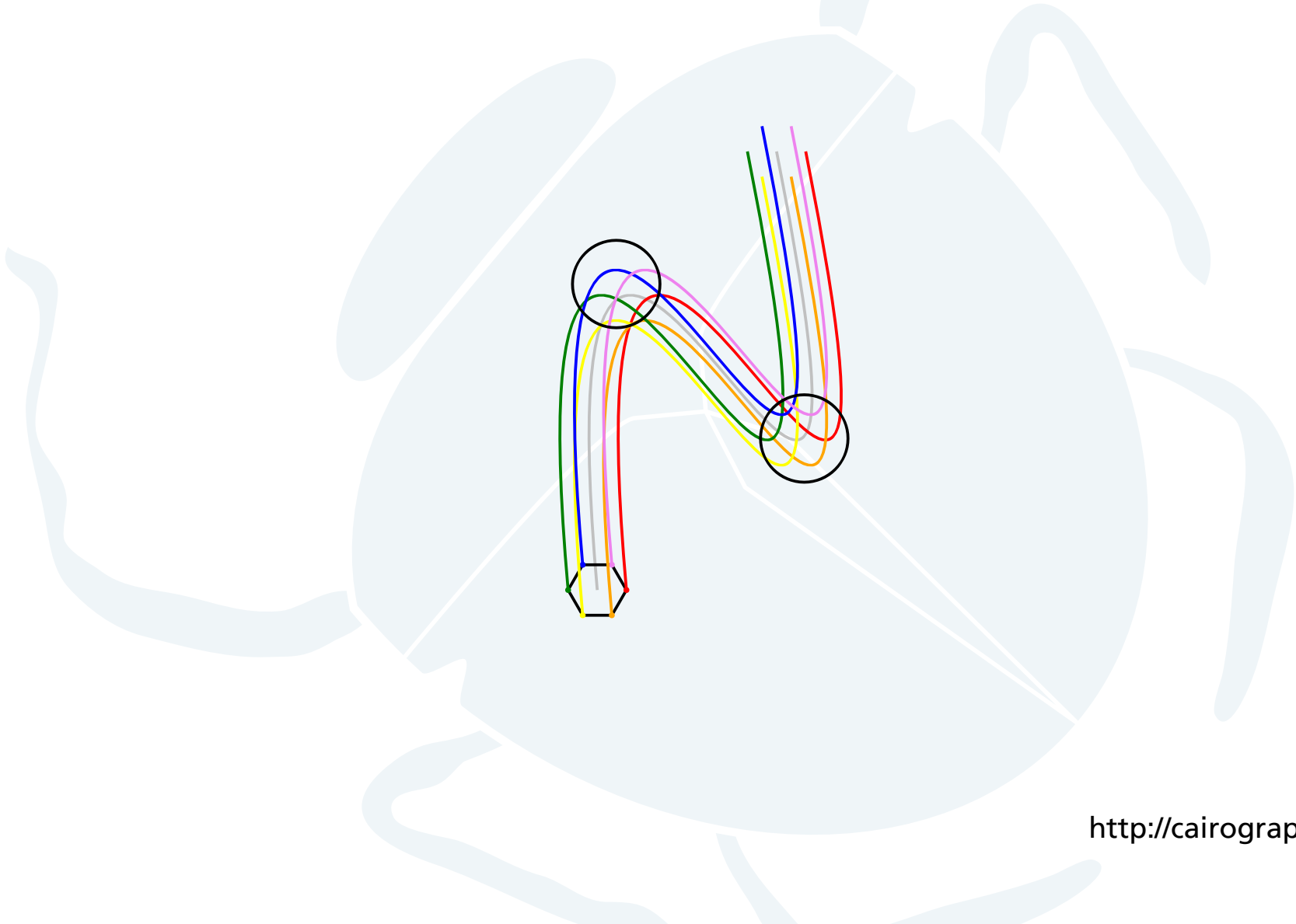


ooh, pretty colors





...but ugly lumps





cairo an insider's guide

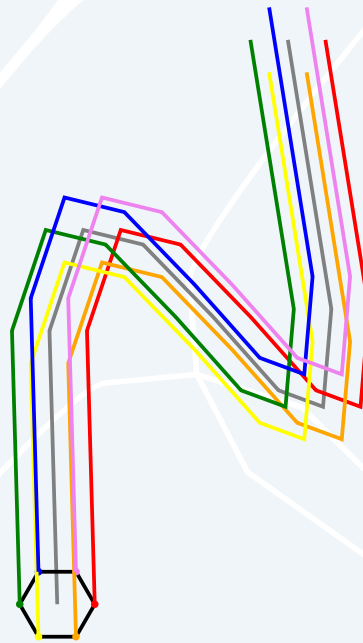


approximate the spline first



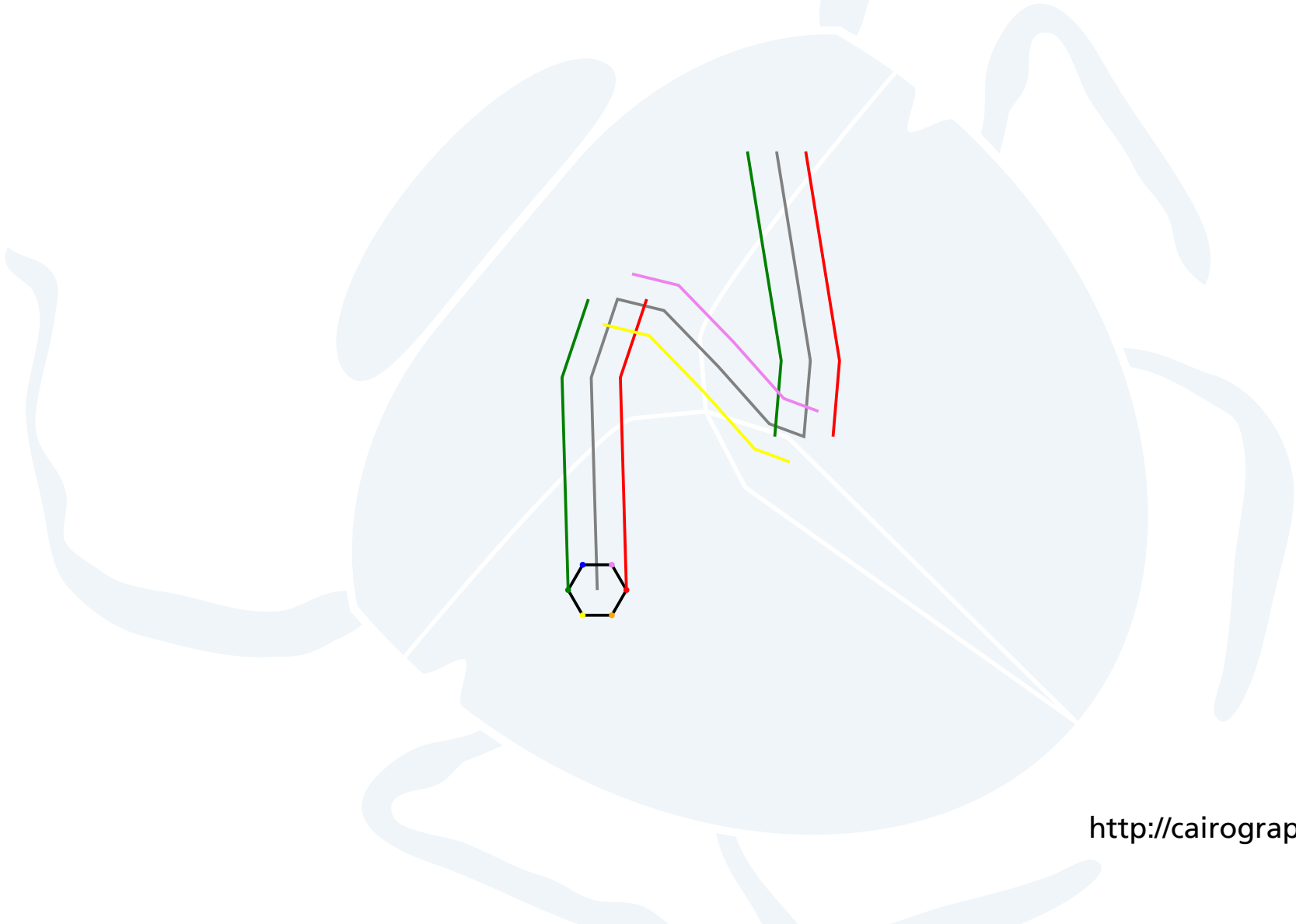


is this progress?



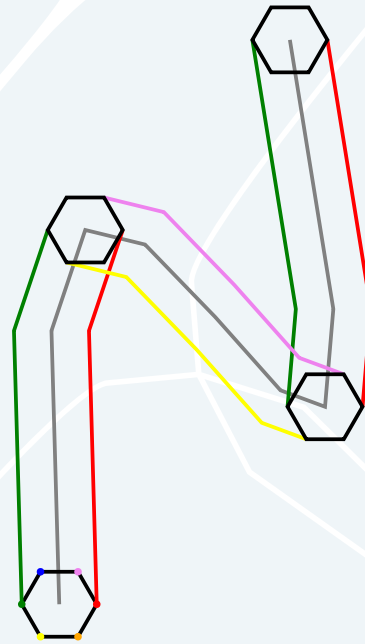


cleaning up...





...and add the pen





tessellation

 robust implementation is non-trivial

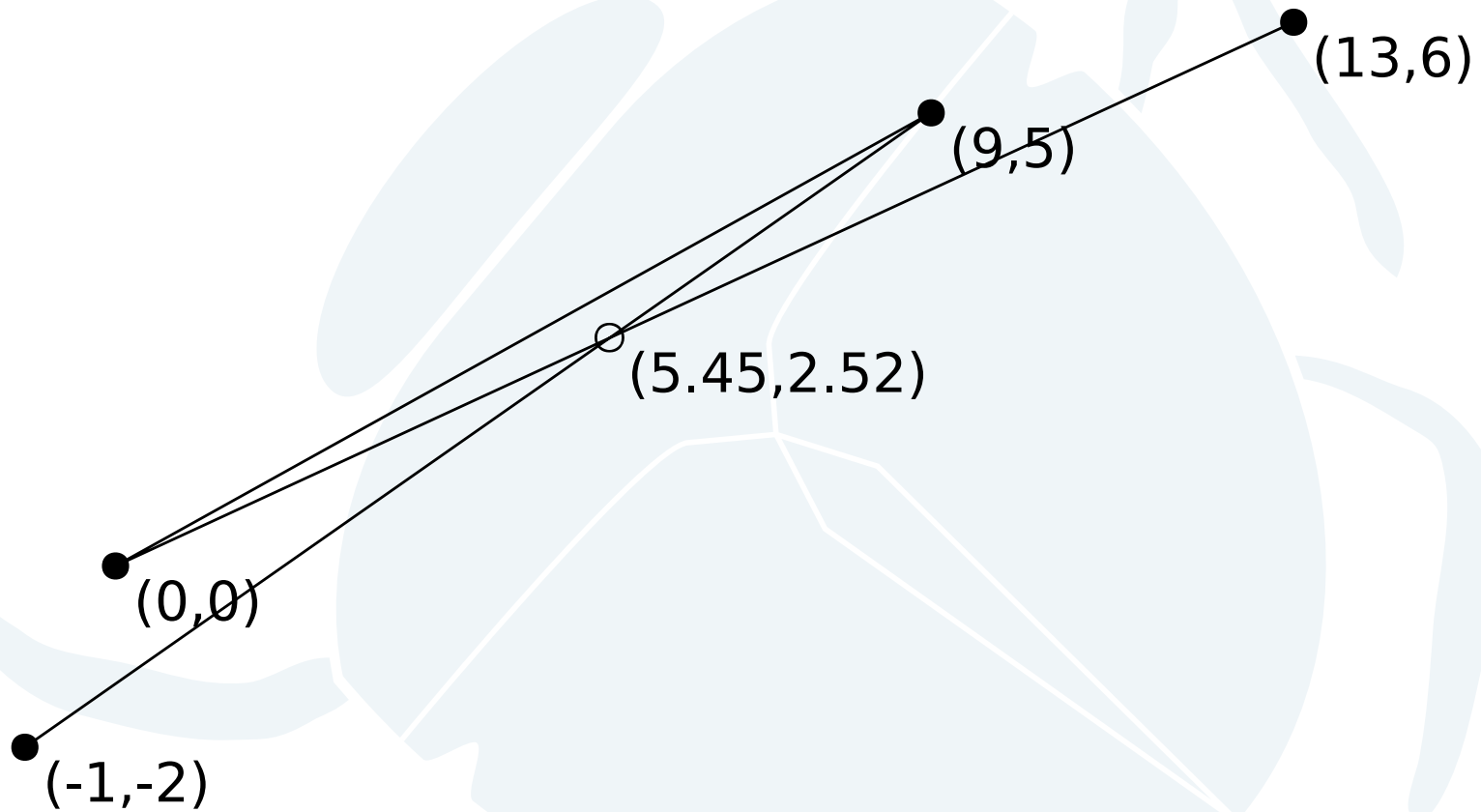
 John Hobby provides all the answers:

Practical Segment Intersection with Finite Precision Output. *Computation Geometry Theory and Applications*, 13(4), 1999.

 nickle prototype in progress

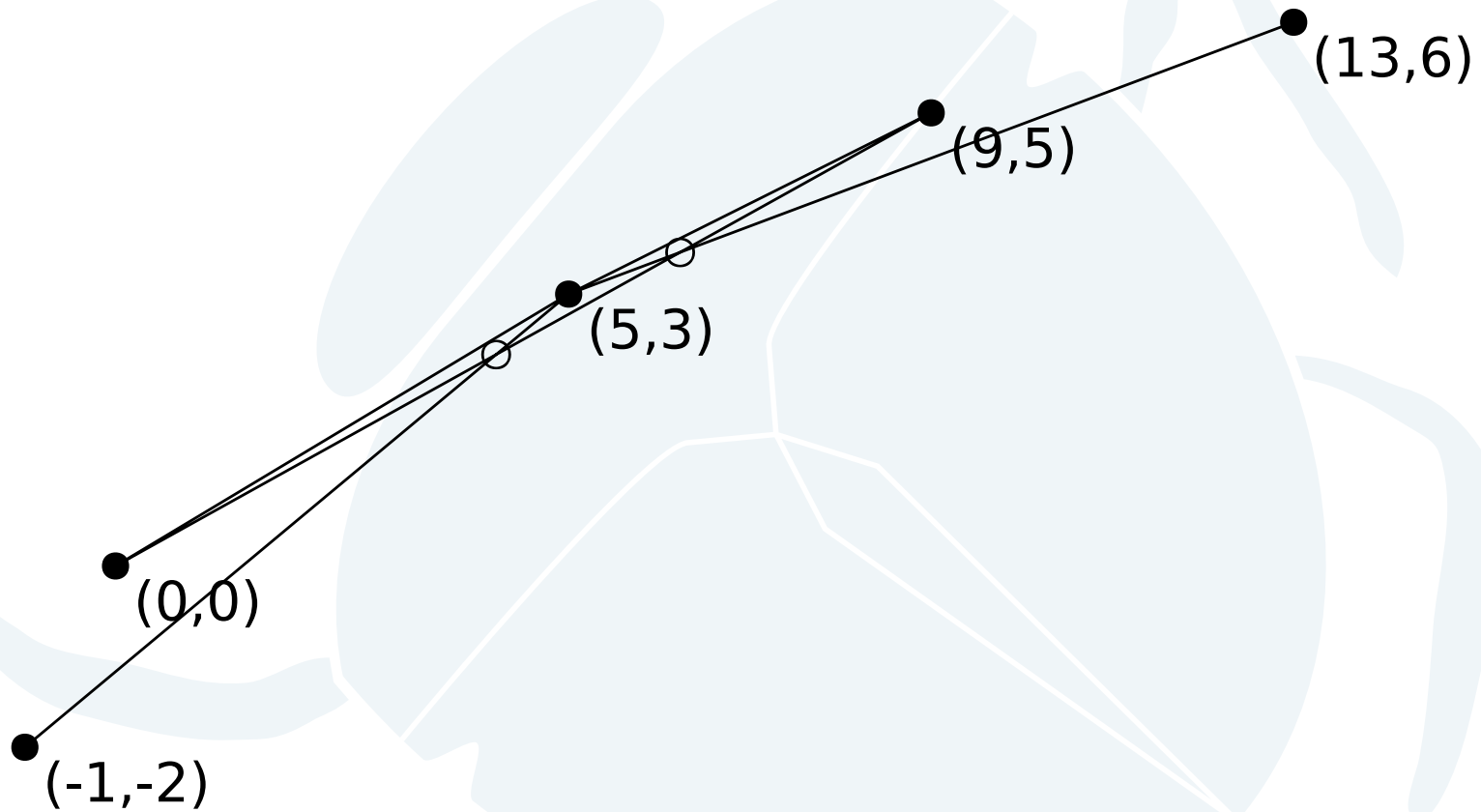


the corner case



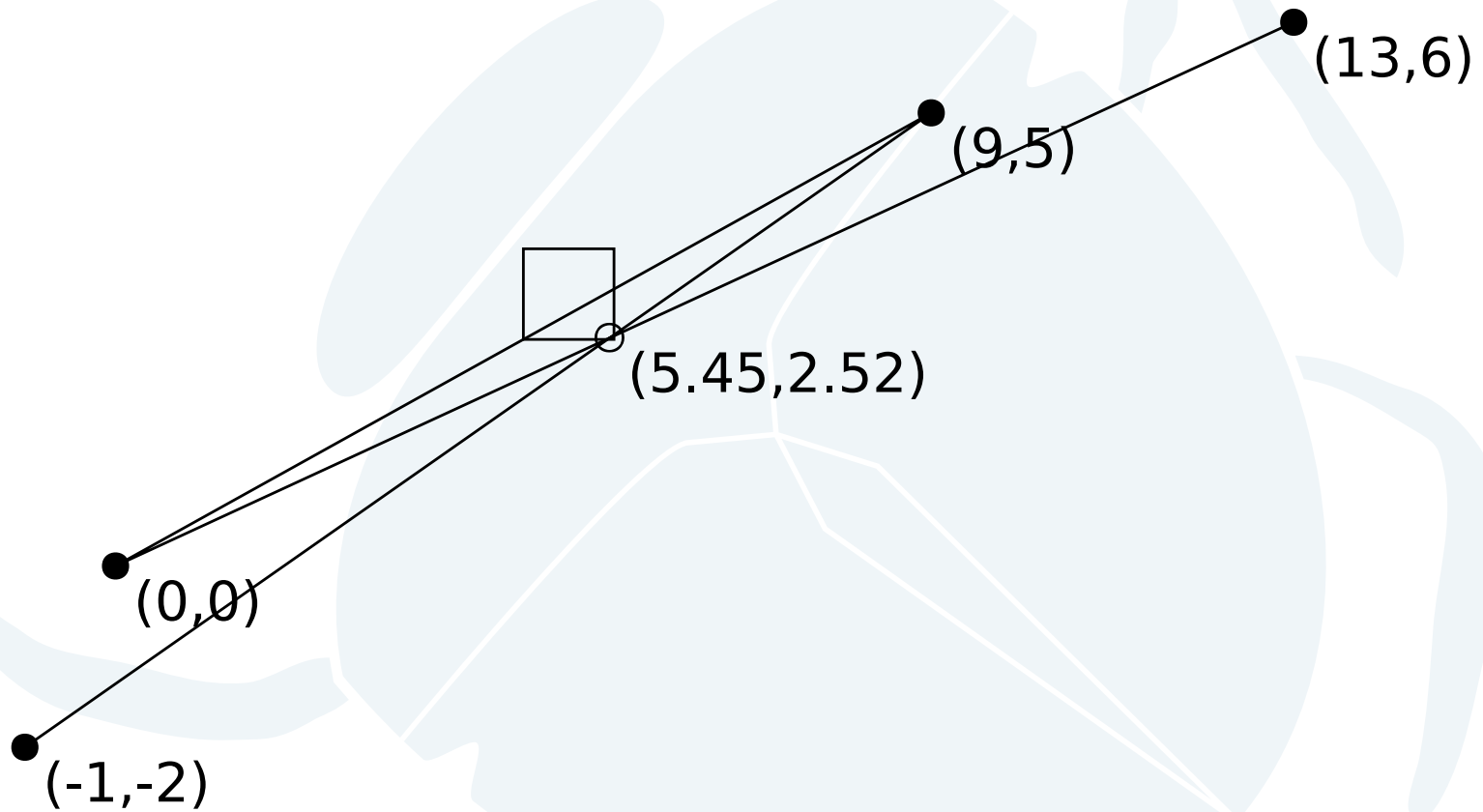


missed intersections





tolerance square








a correct result





rasterization/compositing

-  original software written in less than a day
-  now seeing much more attention
-  thanks to Søren, google, etc.