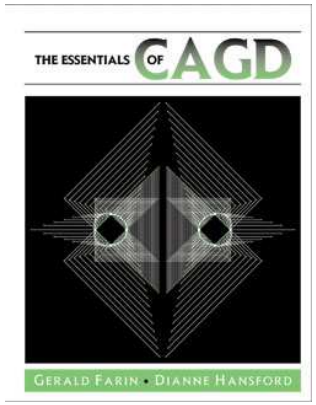
The Essentials of CAGD

Chapter 14: Hunting Geometry Bugs

Gerald Farin & Dianne Hansford

CRC Press, Taylor & Francis Group, An A K Peters Book
www.farinhansford.com/books/essentials-cagd



Outline

1. Introduction to Hunting Geometry Bugs
2. Hunting Geometry Bugs

Introduction to Hunting Geometry Bugs

Identify some common programming errors

Provide tips for fixing these errors

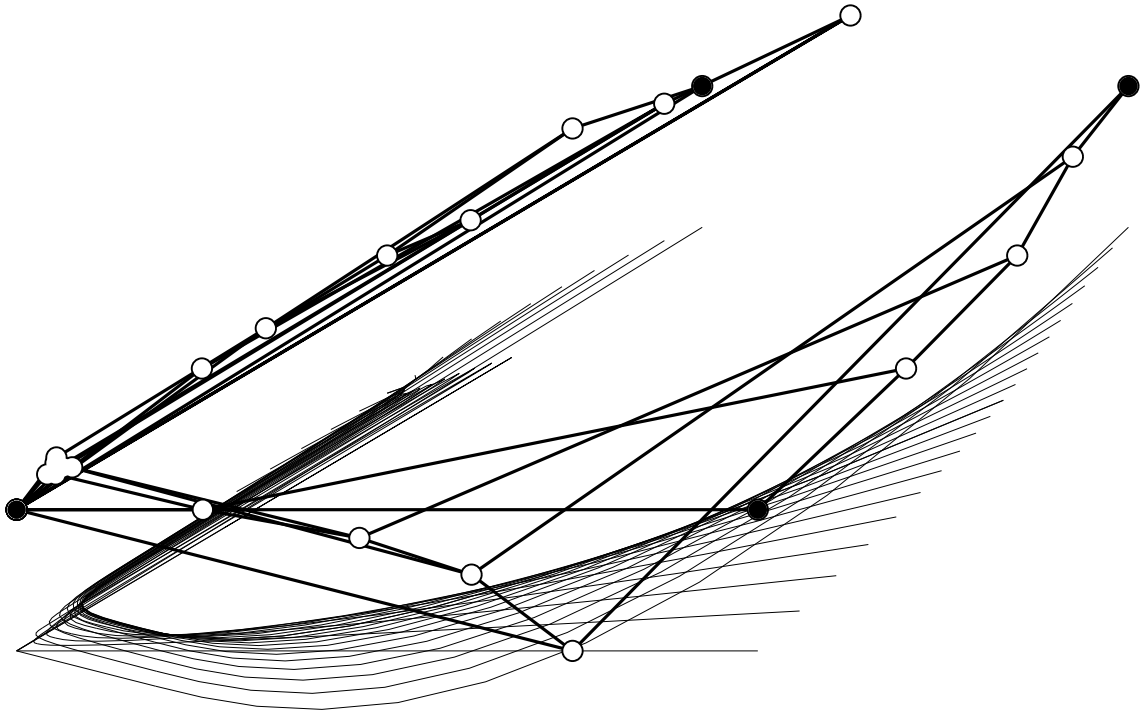


Figure: a bug

Hunting Geometry Bugs

Equality check:

```
if (x == y) return;
```

Assume that `x` and `y` are reals and the result of some computation

Computation produces roundoff $\Rightarrow$ Unlikely they will be equal

Solution:

```
if (fabs(x - y) < tol) return;
```

Value of `tol` depends on application

Positive or negative check needs care as well:
– Values close to zero unreliable and need special attention
`if (x < 0)` might be better as `if x < -tol`

Hunting Geometry Bugs

Test case size:

Do not test code on real data sets that involve hundreds or thousands of input numbers
– Difficult to determine correctness
– Debug time lengthened

Solution:
Create trivial and simple test cases
– Result known

Debug it thoroughly, and then move on to larger data sets

Hunting Geometry Bugs

Smart test cases:

In many curve or surface algorithms *linear input* data result in *linear output*

Example:
All control points of a Bézier or B-spline curve are collinear then the resulting curve is a straight line
– Test program on linear data sets
– Straight lines (or planes) reproduced?

Surface algorithms:
– Test simple examples
– Gradually increase their complexity
$z = 0, \quad z = 1, \quad z = x, \quad z = 2x, \quad z = x^2, \quad z = x^2 + y^2$, etc.

Hunting Geometry Bugs

Scale and translation invariance:

Geometry code should work if data set is translated to a different location

Run code on a simple data set
Then run it on the same set, but translated by some amount

Hunting Geometry Bugs

Barycentric combinations:

If code does not produce affinely invariant results:
A likely source for this is the use of *non-barycentric combinations*

Barycentric combination: in a linear combination of points the sum of the coefficients must be one