

# Geometric Modeling

## Assignment sheet #2

### “Interpolation & Approximation”

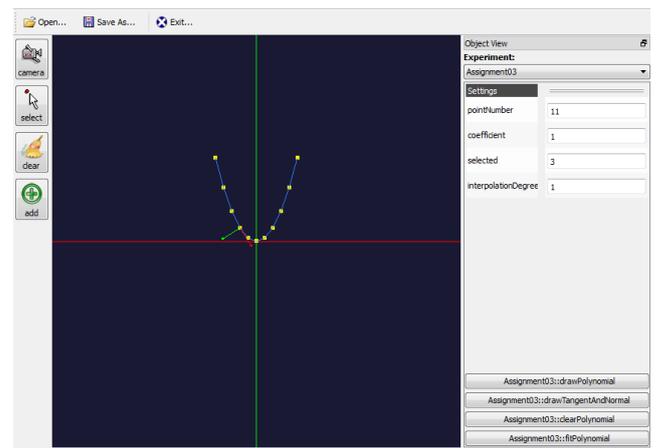
(due May 16/18th 2012 during the interviews)



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#### (1) Polynomial Interpolation [2+3+8 points]

- Create a new experiment with a GLGeometryViewer for 2D visualization. Add a button that inserts  $n$  distinct points to the viewport, which all lie on the parabola  $y=ax^2$ . Allow the user to set the value of  $n$  and  $a$  interactively. A reasonable default will be  $n=10$ ,  $a=1$ . You can restrict yourself to the interval  $[-2;2]$ .



- Add a button which renders an approximated *tangent* and *normal* at any selected point. You can select a point by specifying its index as a parameter. The index, of course, must lie in the  $[0;n)$  interval. Move points around to see how tangent and normal changes. Your tangent and normal should have a unit length.
- Add a button which interpolates the  $n$  points from (a) or any user specified points using a polynomial of suitable degree, i.e.  $a_0+a_1x^1+\dots+a_{n-1}x^{n-1}$ . Plot the polynomial in the viewport. Choose the range of the plot sufficiently large, so that you can observe the behavior of the polynomial in front of the first and behind the last point. Try various settings of  $n$  (e.g.,  $n=7$ ) and move around the points. How does the resulting polynomial change?  
Hints: Helpful math routines can be found in `DynamicLinearAlgebra.h`. You may approximate the polynomial by short lines to plot it. In case the solution is not feasible, indicate it with an error message and explain what happened.

#### (2) Polynomial Approximation [7 points]

- In the experiment from (1), add a button which approximates the  $n$  points using a polynomial of user-defined degree  $m$  in a least squares sense. A reasonable default will be  $m=2$ . You do not need to treat the case in which  $m$  is greater than the degree you would use for interpolation (just produce a useful error message). Try various settings of  $n$  and  $m$  and move around the points. Compare your results to an interpolation of the points.