**Math 4329** **Worksheet 07**

Name: _____

## Polynomial Interpolation

The following task in the worksheet is to demonstrate a practical application of the polynomial interpolation and the preference of splines over other polynomial interpolation techniques. Your task is to compute the Lagrange polynomial and the spline polynomial.

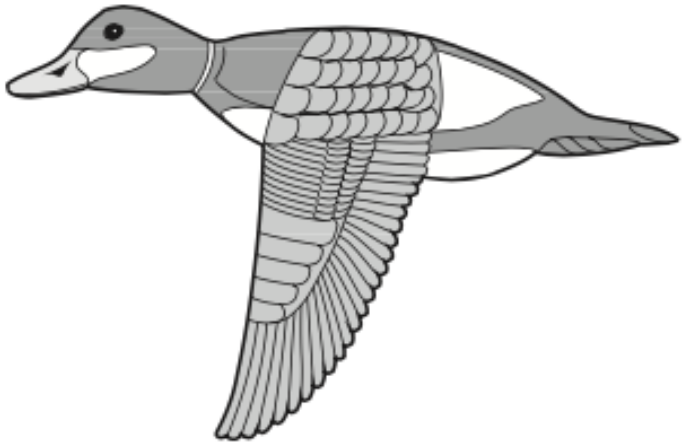


Figure 1: Our objective is to approximate the top curve of this duck. We use the following data to fit a curve:

| $x$ | 0.9 | 1.3 | 1.9 | 2.1 | 2.6 | 3.0 | 3.9 | 4.4 | 4.7 | 5.0 | 6.0 | 7.0 | 8.0 | 9.2 | 10.5 | 11.3 | 11.6 | 12.0 | 12.6 | 13.0 | 13.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $f(x)$ | 1.3 | 1.5 | 1.85 | 2.1 | 2.6 | 2.7 | 2.4 | 2.15 | 2.05 | 2.1 | 2.25 | 2.3 | 2.25 | 1.95 | 1.4 | 0.9 | 0.7 | 0.6 | 0.5 | 0.4 | 0.25 |

Figure 2: When we use existing higher order polynomials (Lagrange or Newton's divided difference), we observe the following behavior:

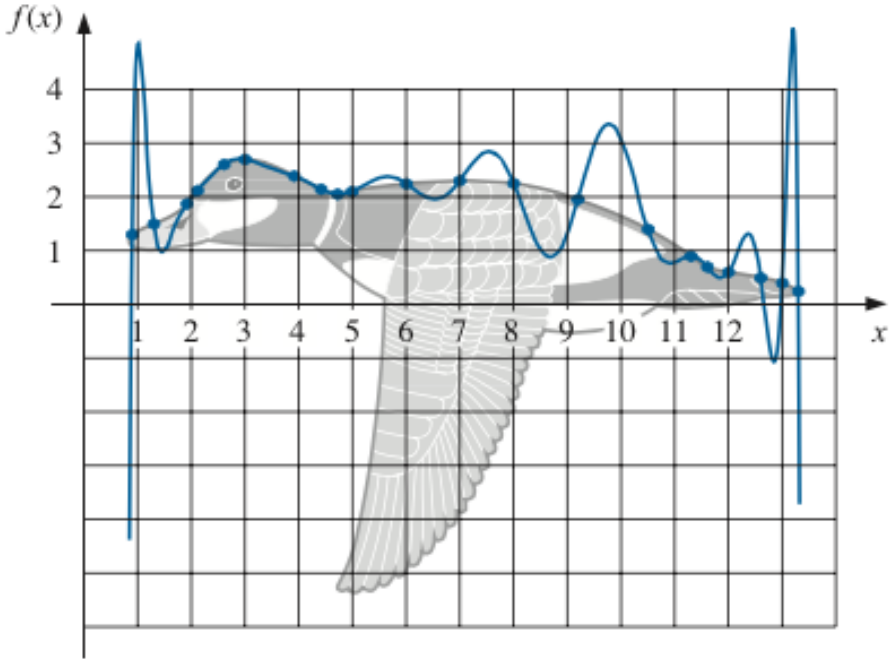
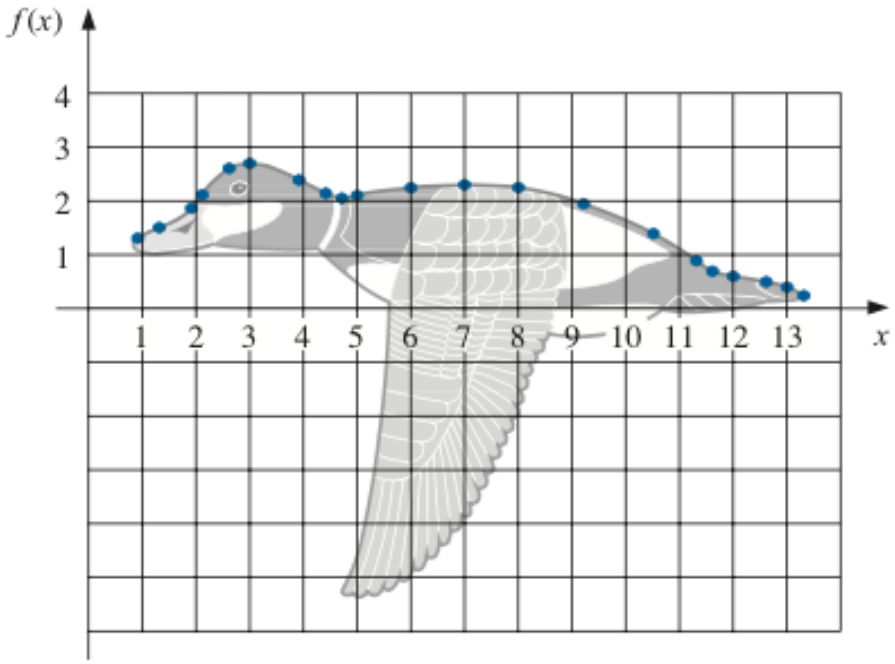



Figure 3: This oscillatory behavior is unavoidable and to overcome this we need to use splines.




| $x$ | 0.9 | 1.3 | 1.9 | 2.1 | 2.6 | 3.0 | 3.9 | 4.4 | 4.7 | 5.0 | 6.0 | 7.0 | 8.0 | 9.2 | 10.5 | 11.3 | 11.6 | 12.0 | 12.6 | 13.0 | 13.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $f(x)$ | 1.3 | 1.5 | 1.85 | 2.1 | 2.6 | 2.7 | 2.4 | 2.15 | 2.05 | 2.1 | 2.25 | 2.3 | 2.25 | 1.95 | 1.4 | 0.9 | 0.7 | 0.6 | 0.5 | 0.4 | 0.25 |

Figure 4: Polynomial Interpolation using Splines