***Verification Tests***

**Test 1: Parabola**

This test is to verify that the coefficients, c0..cN, used by the Chebyshev polynomials are calculated properly by the subprogram cheb\_fit.

For the polynomial , we chose values a=1, b=2, and c=3. Table 1 shows the coefficient values for N=2 that were calculated by hand (or rather, in Maple, as shown below) and through our subprogram cheb\_fit. As can be seen, the values calculated by cheb\_fit are approximately equal to the coefficients calculated in Maple, thus verifying cheb\_fit functions properly.

Calculation of coefficients in Maple:

**> **

**> **

**> **

**> **

**> **

**> **

**> **

**> **



**> **



**> **



|  |  |  |
| --- | --- | --- |
| ***Table 1 – Comparison of coefficients (f(x)=x^2+2\*x+3, N=2)*** | | |
| *coefficient* | *cheb\_fit* | *Maple* |
| c0 | 3.5 | 3.5 |
| c1 | 2.0 | 2.0 |
| c2 | 0.5 | 0.5 |

Figure 1 below shows the polynomial function according to the actual function and the Chebyshev approximation for N=[2, 3, 4, 10]. Figure 2 depicts the absolute difference between the functions at all evaluated points. As can be seen, the Chebyshev approximation is very accurate.

*Figure 1 – Actual function values and Chebyshev approximations for parabola at various values of N*

*Figure 2 – Difference difference between actual and Chebyshev approximation for the parabola at various N values*

**Test 2: Hyperbolic Tangent**

This test verifies that the actual values for f(x)=tanh(x) are sufficiently equal to the Chebyshev approximation values.

Figure 3 shows the actual function and the Chebyshev approximation for for N=[2, 3, 4, 10]. As it appears, the values are all approximately equal for every value of x between -1 and 1. Figure 4 depicts the absolute difference between the functions at all evaluated points. As N increases, the difference between the actual value and the approximated values start to follow the functional form of sin(c\*x). As N increases and the x values approach -1, -0.5, +0.5, and +1, the difference between the actual and approximated values decreases quite rapidly. This shows that for functions such as f(x)=tanh(x), high N should be used.

*Figure 3 – Actual function values and Chebyshev approximations for hyperbolic tangent at various values of N*

*Figure 4 – Absolute difference between actual and Chebyshev approximation for f(x)=tanh(x) at various N values*