

Homework 2016-03-11

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Problem 1.

Display the error of Gauss-Legendre Formula.

Proof. 0.1 The code is shown as follows.

```
1 function [ point, weight ] = gauss_coefficient_legendre( order )
2 % Calculate the coefficients of gauss integral formula with legendre
3 % polynomial.
4
5 b = 0.5 ./ sqrt(1 - (2 * (1:order)) .^ (-2));
6 [v, lambda] = eig(diag(b, 1) + diag(b, -1));
7 [point, i] = sort(diag(lambda));
8 weight = 2 * v(1, i) .^ 2;
9
10 end
```

```
1 function [ value ] = gauss_integral( func, order )
2 % GAUSS-INTEGRAL Calculate the intergral of func in [0, 1] with
3 % Gauss-Legendre Formula.
4 if order == 1
5     value = feval(func, 0.5);
6     return
7 end
8 [point, weight] = gauss_coefficient_legendre(order - 1);
9 transfered_point = point * 0.5 + 0.5;
10 value = weight * feval(func, transfered_point) * 0.5;
11
12 end
```

```
1 % get function
2 function func = get_func( n )
3     func = @(x)(x .^ n);
```

```
1 % homework 4
2 clear all;
3 result_matrix = zeros(7, 6);
4 for n = 1:7
5     func = get_func(n);
6     result_matrix(n, 1) = integral(func, 0, 1);
7     for order = 1:5
8         func = get_func(n);
9         result_matrix(n, order + 1) = gauss_integral(func, order);
```

```

10     end
11 end
12 nlist = 1:5;
13 figure(1);
14 for i = 1 : 7
15     plot(nlist, result_matrix(i, 2:6) - result_matrix(i, 1));
16     hold on
17 end
18 title('The error of Gauss-Legendre formula ');
19 legend('x^1 ', 'x^2 ', 'x^3 ', 'x^4 ', 'x^5 ', 'x^6 ', 'x^7 ', 'Location ', 'Best ');

```

0.2 The result is shown as follows.

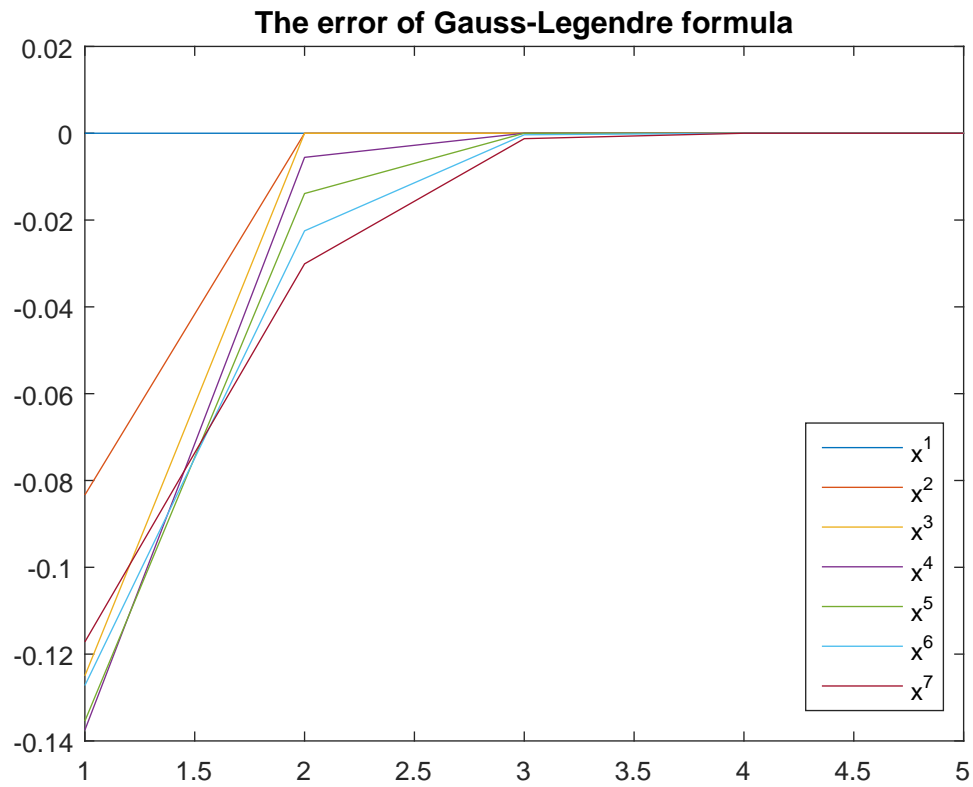


Figure 1: The relationship of error with order

□