Homework 2

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1 Question 1

I have submitted my code on online judge, and successfully passed the test.

2 Question 2

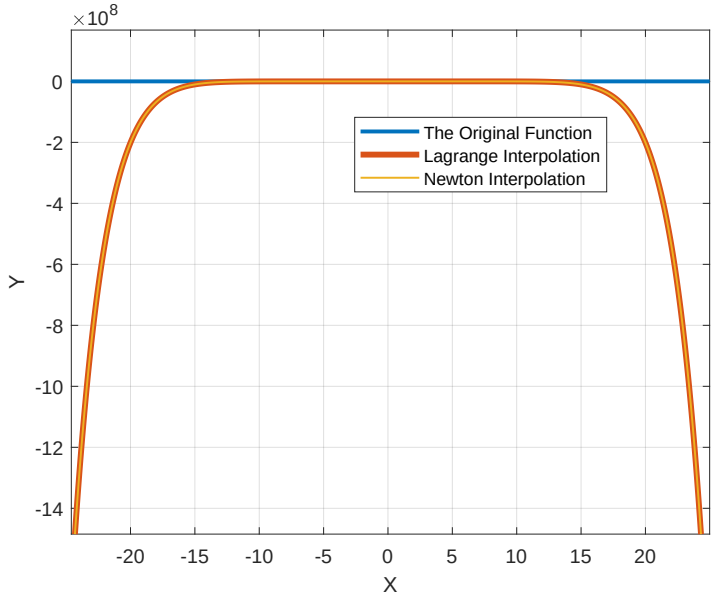
The time complexity of my Lagrange interpolation algorithm is $O(n^2)$,and the time complexity of Newton interpolation algorithm is $O(n^2)$ as well.

3 Question 3

To draw the curves, I choose the Matlab. I rewrite my code so that it can run on Matlab successfully.

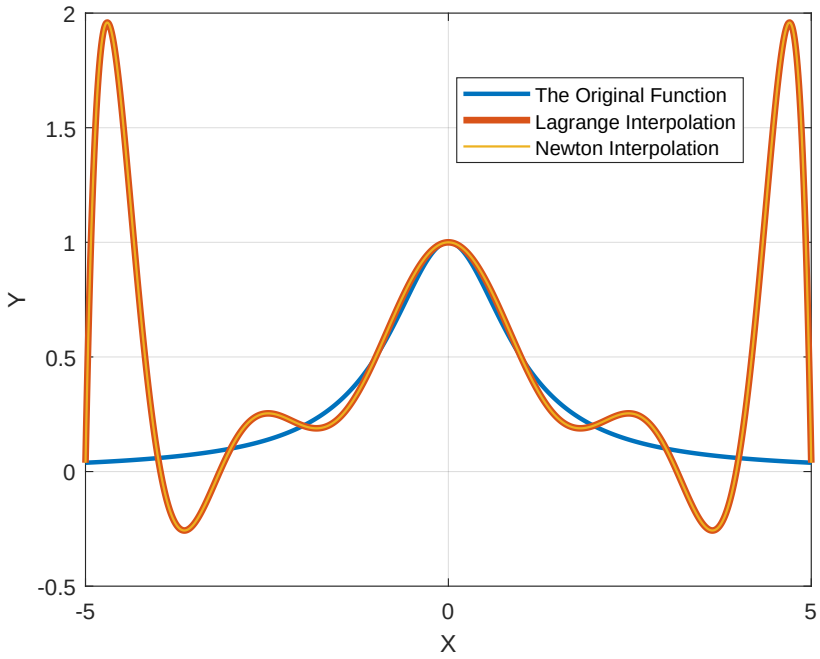
When drawing the curves, I found that the curves of Lagrange interpolation algorithm and the Newton interpolation algorithm are coincided. In fact, using the two methods will get the same results.To avoid this situation, I bolded one of the curves to make it easier to distinguish the two of them.

The curves in $[-25, 25]$:



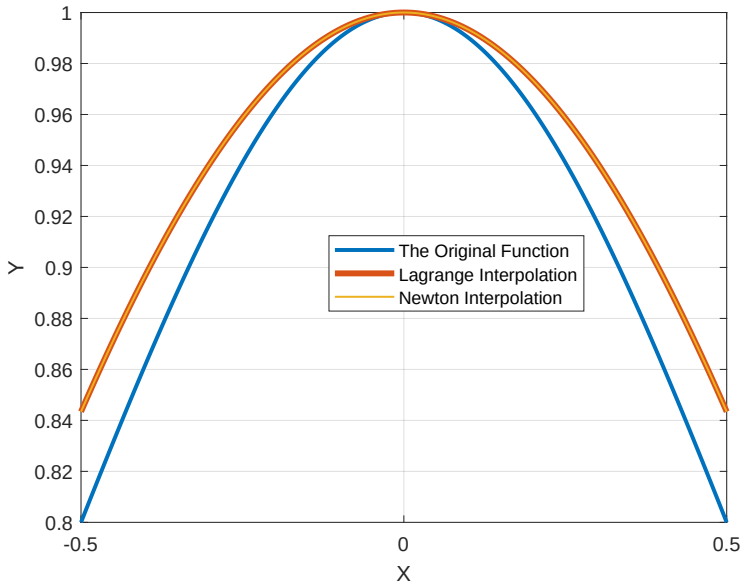
From the first figure, we can see that the three curves almost completely coincide within a certain range.

The curves in $[-5, 5]$:



From the second figure, we found that interpolating lines have many differences with the original line in details.

The curves in $[-0.5, 0.5]$:



From the third figure, we found that at smaller scales, the difference is more obvious.

Matlab Code

```
a=-5:1:5;
b=1./(1+a.^2);

h=1;

n=11;
answer_Newton=0;
x=-0.5:0.001:0.5;
answer_origin = 1./(1+x.^2);

answer_Lagrange=0;
for p = 1:n
    w=b(p);
    for t=1:n
        if p~=t
            w = w.*((x-a(t))./(a(p)-a(t)));
        end
    end
    answer_Lagrange = answer_Lagrange+w;
end

for k = 1:n
    s = 1;
        s = s.* b(1);
        for i = 1:k-1
            s = s./ h;
            s = s./ i;
            s = s.* (x - a(i));
        end
        answer_Newton = answer_Newton + s;
        for j = 1: n - 1
            b(j) = b(j+1)-b(j);
        end
end


plot(x,answer_origin,'linewidth',2);
hold on
plot(x,answer_Lagrange,'linewidth',3);
hold on
plot(x,answer_Newton,'linewidth',1);
```

```
grid on
xlabel('X');
ylabel('Y');
legend('The Original Function','Lagrange Interpolation','Newton
    Interpolation');
```