Programming 2

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Interpolation Polynomial Function

Newton Polynomial

```
void NewtonMethod(vector<double> a,vector<double> b)
{
  int n=size(a);
  vector<Comparable> xn;
  vector<Comparable> fn;
  vector<Comparable> A;
  for(int i=0;i<n;i++)
  {
    xn.push_back(a[i]);
    fn.push_back(b[i]);
  }

  A.push_back(fn[0]);
  int m=0;
  int temp=n;
  while(temp!=0)
  {
    m=m+temp;
    temp=temp-1;
  }
```

```
    int l=0;
    temp=2;
    if(n==1)
    {
      A.push_back(fn[0]);
    }
    else
    {
      while(temp!=n)
      {
l=l+1;
temp=temp+1;
      }

      int h=0;
      int k=n-1;
      int count=0;
      for(int i=n;i<m;i++)
      {
double tempf;
if(count!=k)
{
  tempf=(fn[i-l-1]-fn[i-l-2])/(xn[count+h+1]-xn[count]);
  fn.push_back(tempf);
  if(count==0)
  {
    A.push_back(tempf);
  }
  count=count+1;
}
else
{
```

```
  count=0;
  k=k-1;
  l=l-1;
  h=h+1;
  tempf=(fn[i-l-1]-fn[i-l-2])/(xn[count+h+1]-xn[count]);
  fn.push_back(tempf);
  if(count==0)
  {
    A.push_back(tempf);
  }
  count=count+1;
}
      }

      int n_p=size(A);
      Comparable p;
      cout<<A[0];
      for(int i=1;i<n_p;i++)
      {
        cout<<showpos<<A[i];
for(int j=0;j<i;j++)
{
  cout<<"(x"<<showpos<<-xn[j]<<")";
}
      }
      cout<<endl;
    }
  }
```

Hermite Polynomial

```
void Hermite(vector<double> x, vector<double> y, vector<double> z)
{
  f.resize(x.size()+1);
  for(int i=0;i<=x.size();i++)
  {
    f[i].resize(x.size()+1);
  }

  for(int i=0;i<x.size();i++)
  {
    f[i][0]=y[i];
  }

  for(int i=0;i<x.size();i++)
  {
    ans.push_back(x[i]);
  }

  for (int i=1;i<x.size();i=i+2)
  {
    f[i][1]=z[i];
  }

  for (int i=2;i<x.size();i=i+2)
  {
    f[i][1]=(f[i][0]-f[i-1][0])/(x[i]-x[i-2]);
  }

  for (int i=2;i<x.size();i++)
  {
    for (int j=i;j<x.size();j++)
    {
```

```
f[j][i]=(f[j][i-1]-f[j-1][i-1])/(x[j]-x[j-i]);
      }
    }

    cout<<noshowpos<<f[0][0];
    for (int i=1;i<f.size();i++)
    {
      cout<<showpos<<f[i][i];
      for (int j=0;j<i;j++)
      {
cout<<"(x"<<showpos<<-x[j]<<")";
      }
    }
    cout<<endl;
  }
```

Question

B :

Plot $f(x) = \frac{1}{1+x^2}$, for $x \in [-5, 5]$, using $x_i = -5 + 10\frac{i}{n}$, $i = 0, 1, ..., n$, $n = 2, 4, 6, 8$.

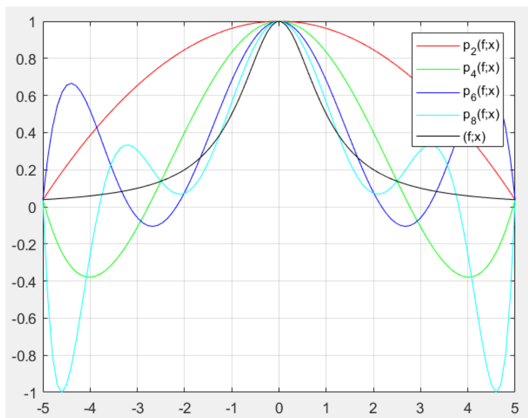

图 1: Runge Phenomenon

C :

Plot $f(x) = \frac{1}{1+25x^2}$, for $x \in [-1, 1]$, using $x_k = \cos\frac{2k-1}{2n}\pi$, $k = 1, 2, ..., n$, $n = 5, 10, 15, 20$.

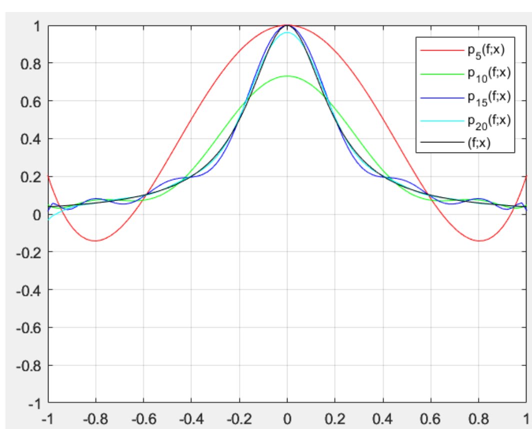

图 2: Chebyshev Interpolation

D :

(a)From 图3 and 图4, Position of the car and its speed for t=10s are 742.503 and 48.248.

(b)The car ever exceeds the 81 feet per second speed limit when t=12.

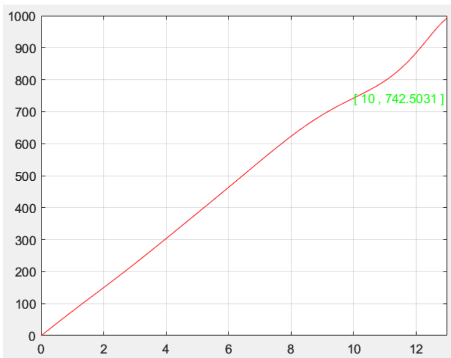

图 3: Position

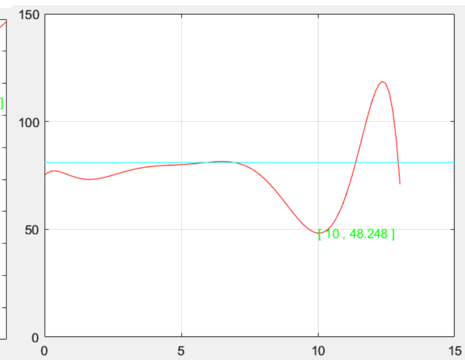

图 4: Speed

E :

(a)

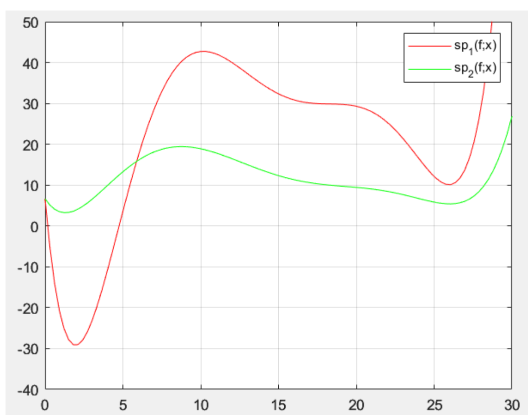

图 5: Runge Phenomenon

(b)The two samples of larvae will die after another 15 days.