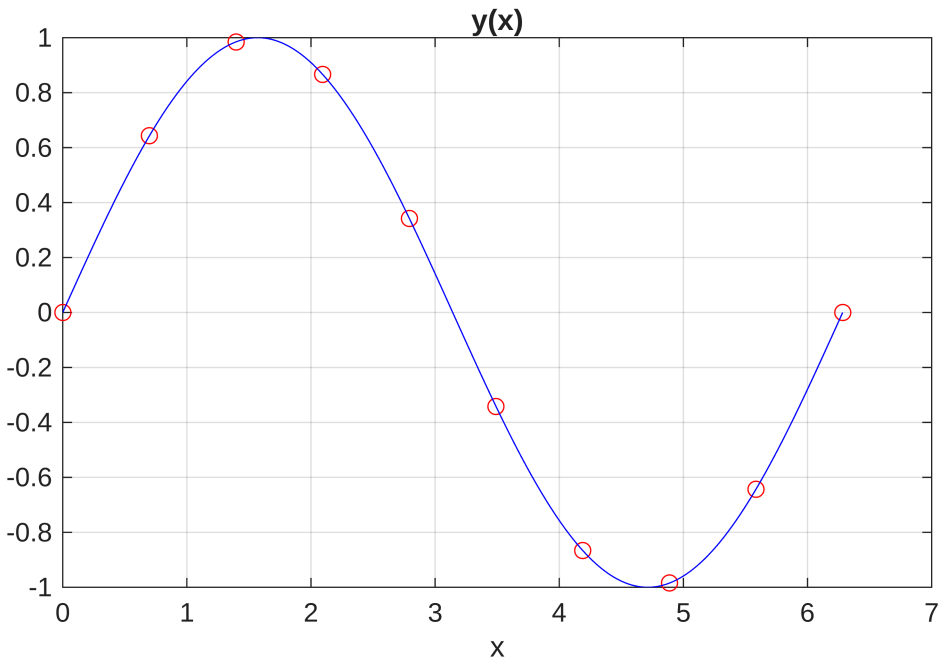
```
% interp_intro.m
% Wprowadzenie do zagadnienia interpolacji
clear all; close all;

% Funkcja interpolowana wielomianem i jej parametry
N = 10;                     % liczba znanych punktow funkcji, u nas sinus()
xmax = 2*pi;                % maksymalna wartosc argumentu funkcji
%xmax = 5*2*pi;                % maksymalna wartosc argumentu funkcji
xp = 0 : xmax/(N-1) : xmax; % wartosci argumentow dla znanych wartosci
funkcji
xd = 0 : 0.001 : xmax;      % wartosci argumentow w punktach interpolacji
yp = sin( xp );             % znane wartosci
yd = sin( xd );             % wartosci w punktach interpolacji - do
sprawdzenia
figure;
plot( xp, yp, 'ro', xd, yd, 'b-'); xlabel('x'); title('y(x)'); grid;
```




```
% Wspolczynniki wielomianu y(x) = a0 + a1*x^1 + a2*x^2 + ... + aP*x^P
P = N-1; % rzad wielomianu: 0 (a0), 1 (a0 + a1*x), 2 (a0 + a1*x +
a2*x^2), ...
a = polyfit( xp, yp, P ),   % obliczenie wsp. wielomianu interpolujacego
```

```
a = 1×10
   -0.0000    0.0001   -0.0006    0.0017    0.0040    0.0071   -0.1738    0.0040 ···
```

```
% Interpolacja funkcji w zadanych punktach xi
xi = xd;                    % argumenty punktow interpolacji
yi = polyval(a,xi);         % wartosci w punktach interpolacji
```

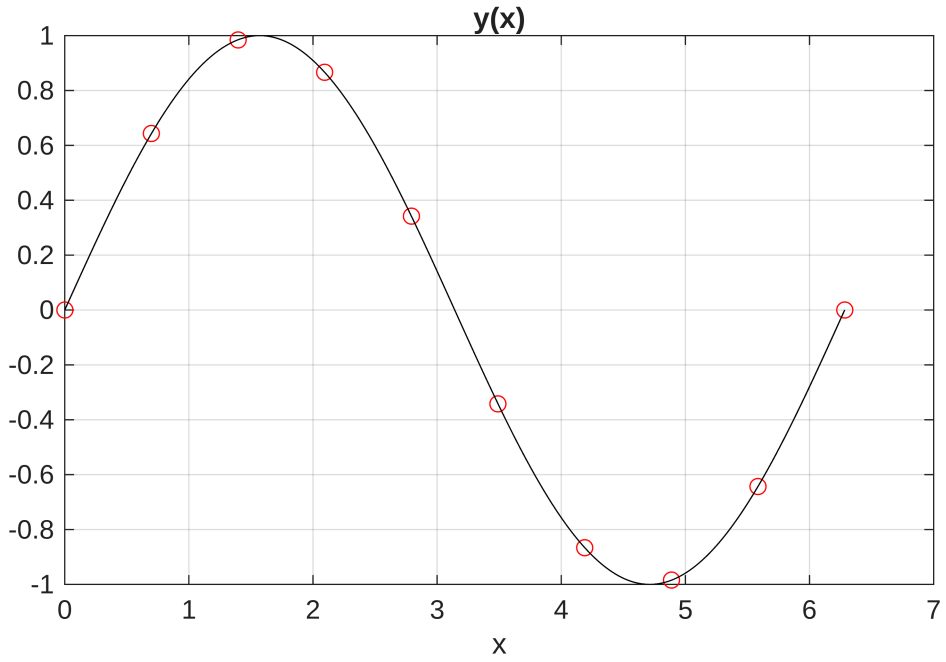
```
a = a(end:-1:1),            % w Matlabie wsp. sa zapisywane od najwyzszej
potegi
```

```
a = 1×10
    0.0000    0.9991    0.0040   -0.1738    0.0071    0.0040    0.0017   -0.0006 ···
```

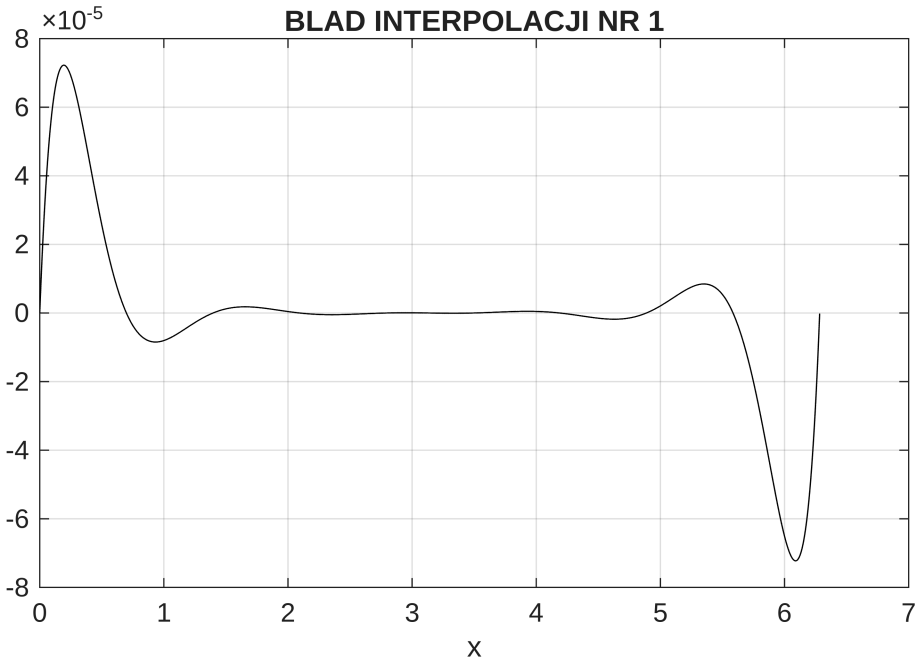
```
yi_moje = zeros(1,length(xi));
for k = 1 : N               % sami obliczamy wartosci w punktach interpolacji
    yi_moje = yi_moje + a(k) * xi.^(k-1);
end
max_abs_err = max( abs( yi - yi_moje) )
```

```
max_abs_err =
6.9625e-14
```

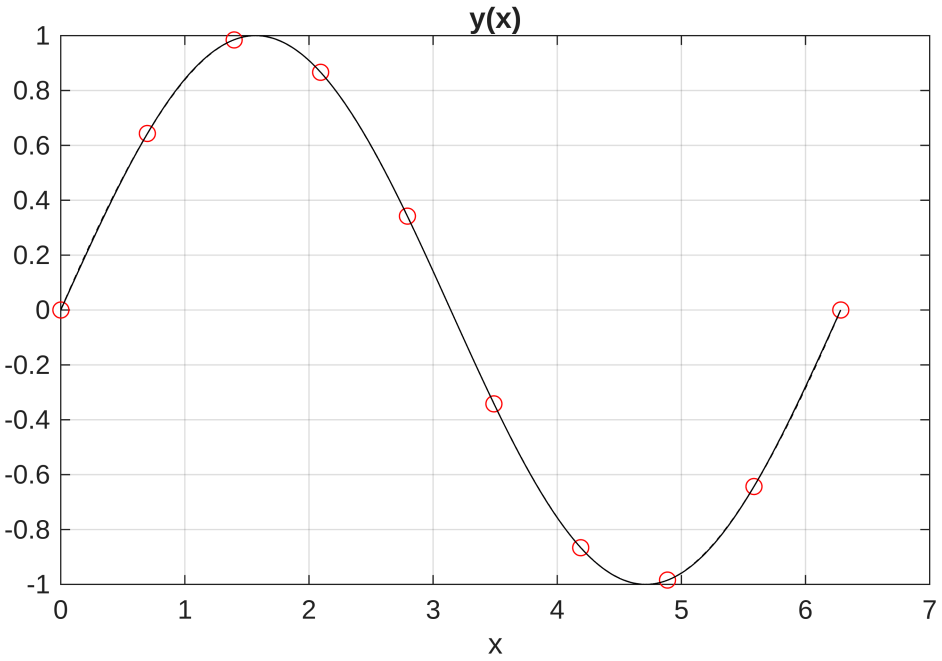
```
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-' ); xlabel('x'); title('y(x)');
grid;
```



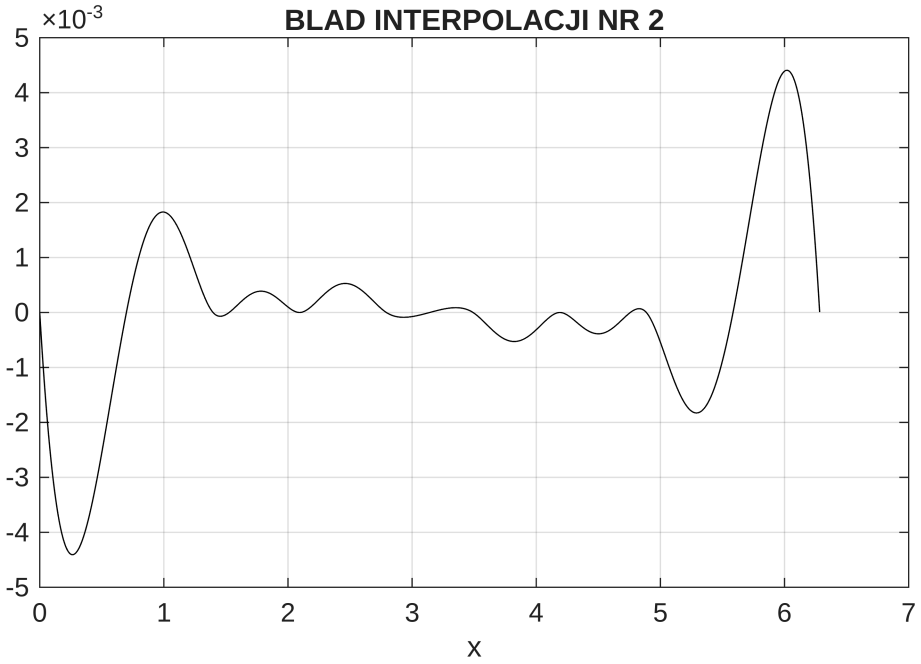

```
figure;
plot( xd, yd-yi, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 1'); grid;
```




```
% Funkcja interpolacji w Matlabie - interp1()
% 'linear'   - (default) linear interpolation
% 'nearest'  - nearest neighbor interpolation
% 'next'     - next neighbor interpolation
% 'previous' - previous neighbor interpolation
% 'spline'   - piecewise cubic spline interpolation (SPLINE)
% 'pchip'    - shape-preserving piecewise cubic interpolation
% 'cubic'    - cubic convolution interpolation for uniformly-spaced
yis = interp1( xp, yp, xi, 'spline' );
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-', xi,yis,'k--' );
xlabel('x'); title('y(x)'); grid;
```




```
figure;
plot( xd, yd - yis, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 2');
grid;
```



y = pi/4

```
disp("============================")
```

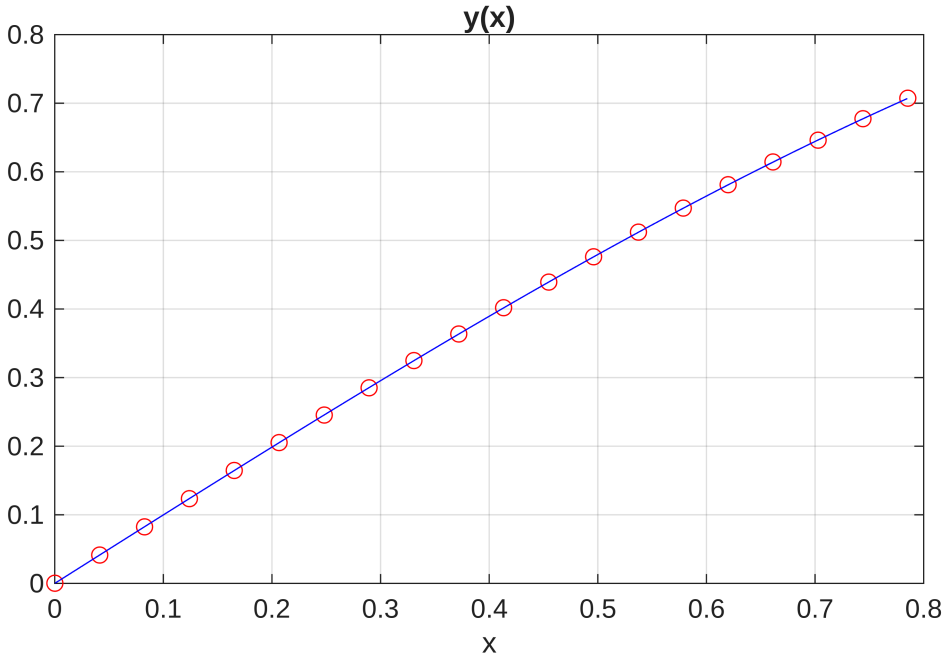
```
============================
```

```
disp("y = pi/4")
```

```
y = pi/4
```

```
% interp_intro.m
% Wprowadzenie do zagadnienia interpolacji
clear all;

% Funkcja interpolowana wielomianem i jej parametry
N = 20;                     % liczba znanych punktow funkcji, u nas sinus()
xmax = pi/4;                % maksymalna wartosc argumentu funkcji
xp = 0 : xmax/(N-1) : xmax; % wartosci argumentow dla znanych wartosci
funkcji
xd = 0 : 0.001 : xmax;      % wartosci argumentow w punktach interpolacji
yp = sin( xp );             % znane wartosci
yd = sin( xd );             % wartosci w punktach interpolacji - do
sprawdzenia
figure;
plot( xp, yp, 'ro', xd, yd, 'b-'); xlabel('x'); title('y(x)'); grid;
```




```
% Wspolczynniki wielomianu y(x) = a0 + a1*x^1 + a2*x^2 + ... + aP*x^P
P = N-1; % rzad wielomianu: 0 (a0), 1 (a0 + a1*x), 2 (a0 + a1*x +
a2*x^2), ...
a = polyfit( xp, yp, P ),   % obliczenie wsp. wielomianu interpolujacego
```

```
Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of
the polynomial, or try centering and scaling as described in HELP POLYFIT.
a = 1×20
   -0.0036    0.0270   -0.0935    0.1993   -0.2929    0.3144   -0.2553    0.1600 ···
```

```
% Interpolacja funkcji w zadanych punktach xi
xi = xd;                    % argumenty punktow interpolacji
```

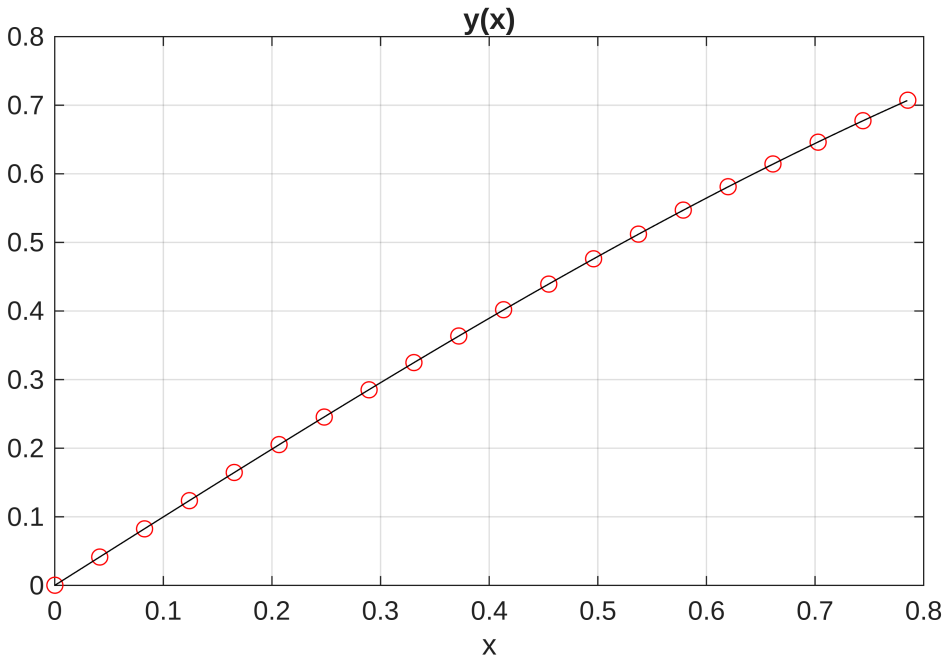
```
yi = polyval(a,xi);          % wartosci w punktach interpolacji
a = a(end:-1:1),             % w Matlabie wsp. sa zapisywane od najwyzszej
potegi
```

```
a = 1×20
    0.0000    1.0000    0.0000   -0.1667    0.0000    0.0083    0.0001   -0.0006 ···
```

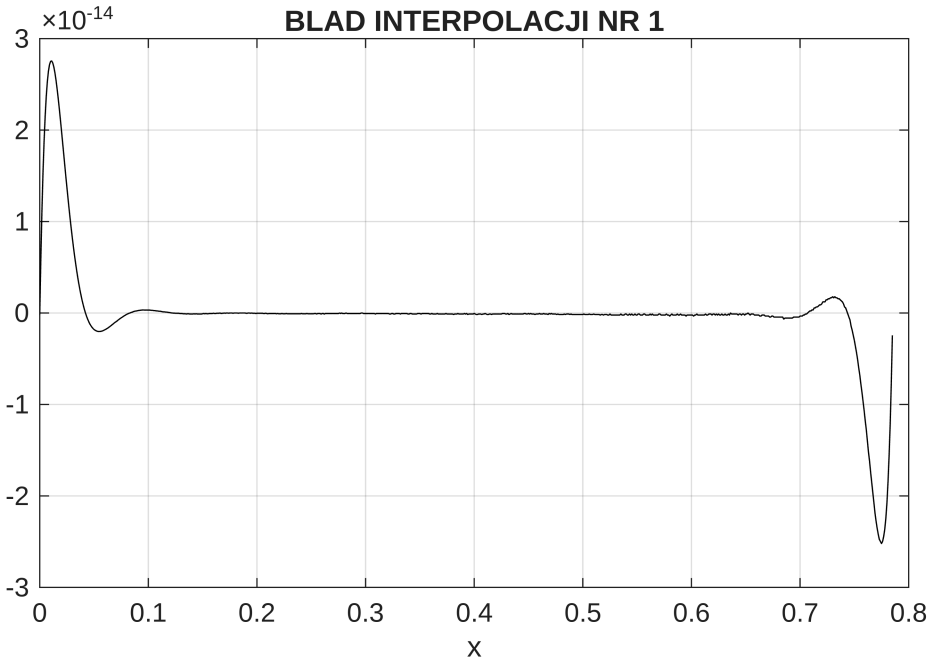
```
yi_moje = zeros(1,length(xi));
for k = 1 : N              % sami obliczamy wartosci w punktach interpolacji
    yi_moje = yi_moje + a(k) * xi.^(k-1);
end
max_abs_err = max( abs( yi - yi_moje) ),
```

```
max_abs_err =
5.5511e-16
```

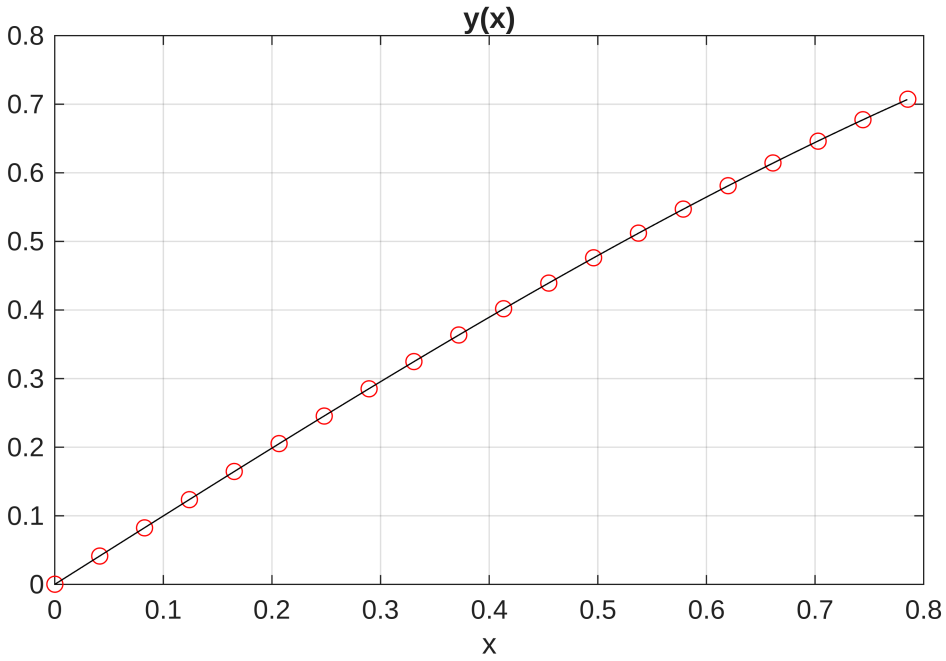
```
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-' ); xlabel('x'); title('y(x)');
grid;
```



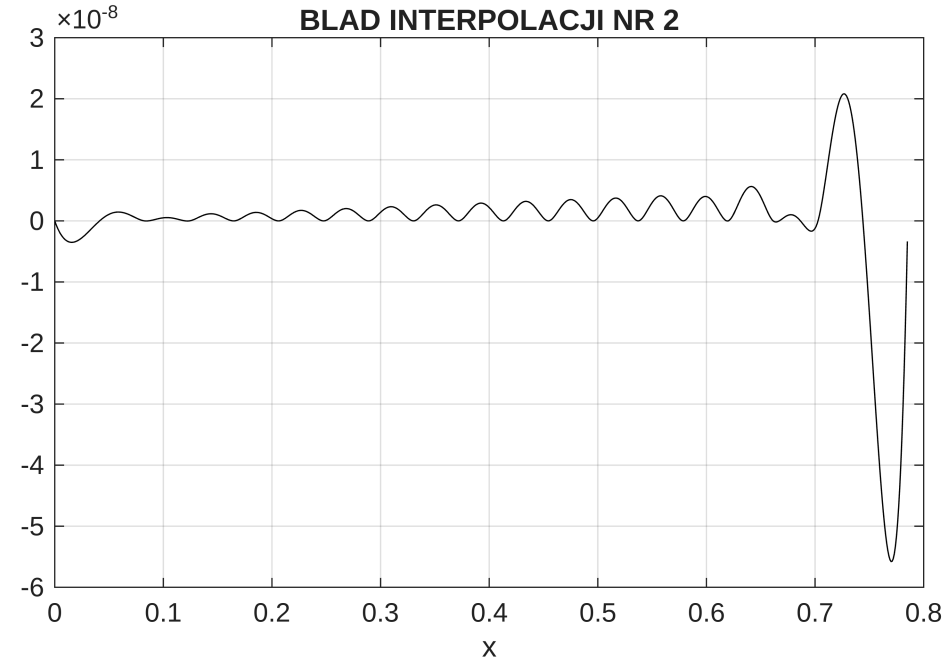

```
figure;
plot( xd, yd-yi, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 1'); grid;
```




```
% Funkcja interpolacji w Matlabie - interp1()
% 'linear'   - (default) linear interpolation
% 'nearest'  - nearest neighbor interpolation
% 'next'     - next neighbor interpolation
% 'previous' - previous neighbor interpolation
% 'spline'   - piecewise cubic spline interpolation (SPLINE)
% 'pchip'    - shape-preserving piecewise cubic interpolation
% 'cubic'    - cubic convolution interpolation for uniformly-spaced
yis = interp1( xp, yp, xi, 'spline' );
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-', xi,yis,'k--' );
xlabel('x'); title('y(x)'); grid;
```




```
figure;
plot( xd, yd - yis, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 2');
grid;
```



y = 5*2pi

```
disp("============================")
```

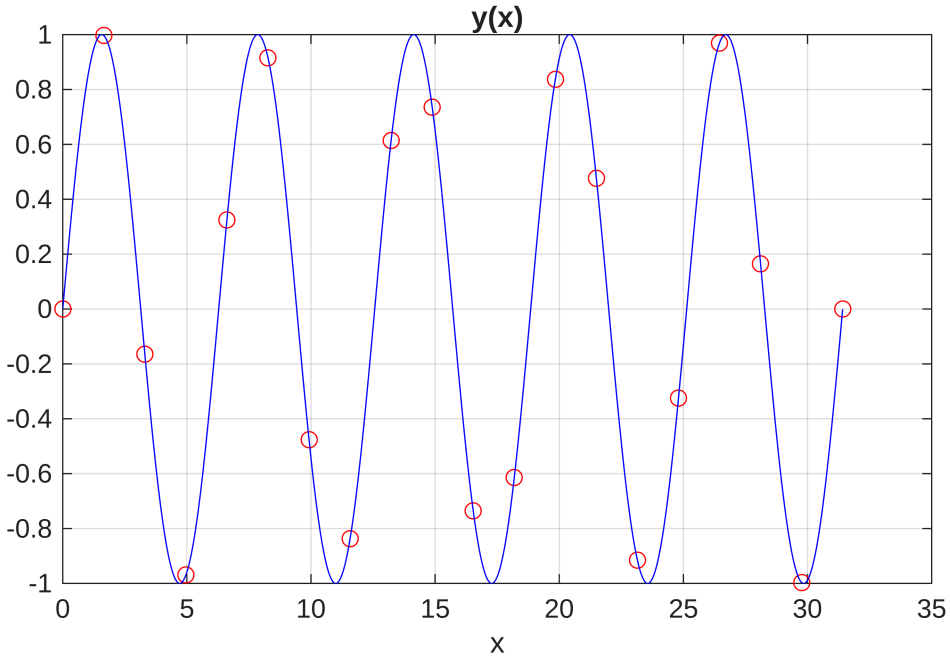
```
============================
```

```
disp("y = 5*2pi")
```

```
y = 5*2pi
```

```
% interp_intro.m
% Wprowadzenie do zagadnienia interpolacji
clear all;

% Funkcja interpolowana wielomianem i jej parametry
N = 20;                       % liczba znanych punktow funkcji, u nas sinus()
xmax = 5*2*pi;                  % maksymalna wartosc argumentu funkcji
xp = 0 : xmax/(N-1) : xmax; % wartosci argumentow dla znanych wartosci
funkcji
xd = 0 : 0.001 : xmax;      % wartosci argumentow w punktach interpolacji
yp = sin( xp );             % znane wartosci
yd = sin( xd );             % wartosci w punktach interpolacji - do
sprawdzenia
figure;
plot( xp, yp, 'ro', xd, yd, 'b-'); xlabel('x'); title('y(x)'); grid;
```




```
% Wspolczynniki wielomianu y(x) = a0 + a1*x^1 + a2*x^2 + ... + aP*x^P
P = N-1; % rzad wielomianu: 0 (a0), 1 (a0 + a1*x), 2 (a0 + a1*x +
a2*x^2), ...
a = polyfit( xp, yp, P ),   % obliczenie wsp. wielomianu interpolujacego
```

```
Warning: Polynomial is badly conditioned. Add points with distinct X values, reduce the degree of
the polynomial, or try centering and scaling as described in HELP POLYFIT.
a = 1×20
    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000 ···
```

```
% Interpolacja funkcji w zadanych punktach xi
xi = xd;                    % argumenty punktow interpolacji
```

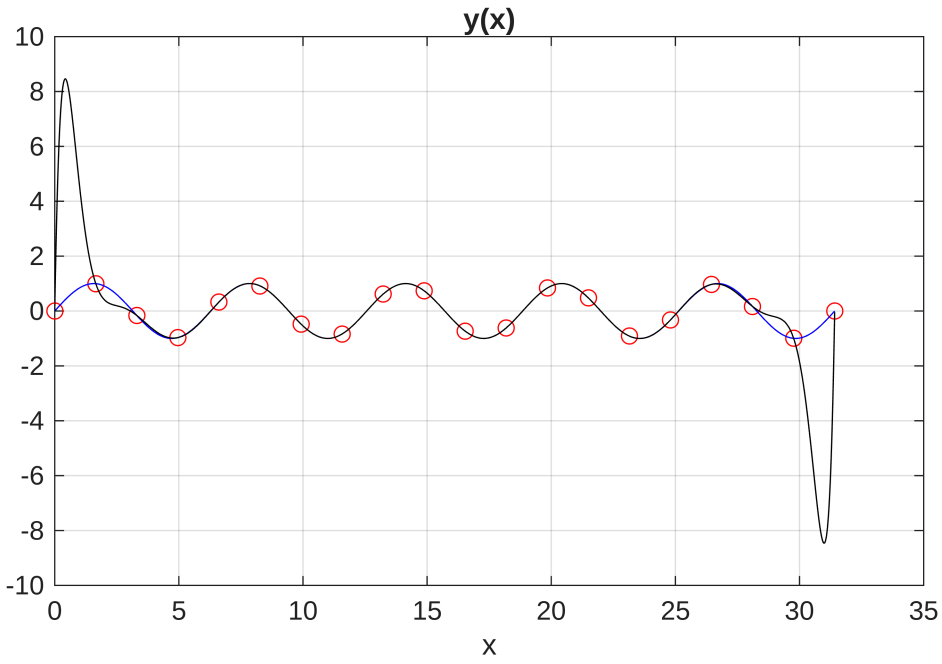
```
yi = polyval(a,xi);          % wartosci w punktach interpolacji
a = a(end:-1:1),             % w Matlabie wsp. sa zapisywane od najwyzszej
potegi
```

```
a = 1×20
    0.0003   51.2357 -108.0701  101.3056  -56.0350   20.5956   -5.3793    1.0406 ···
```

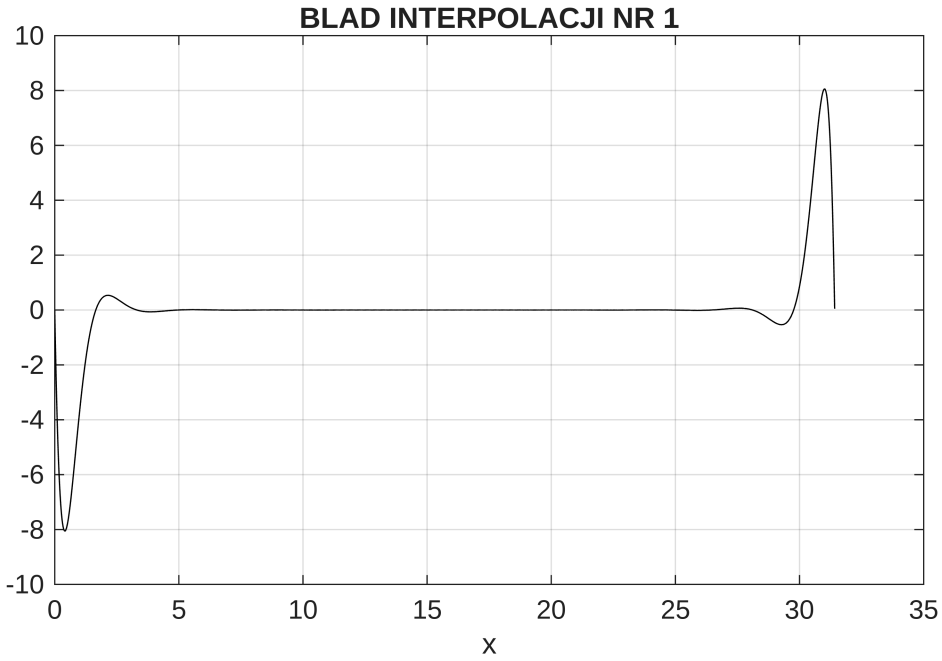
```
yi_moje = zeros(1,length(xi));
for k = 1 : N               % sami obliczamy wartosci w punktach interpolacji
    yi_moje = yi_moje + a(k) * xi.^(k-1);
end
max_abs_yi = max( abs( yi - yi_moje) ),
```

```
max_abs_yi =
0.0032
```

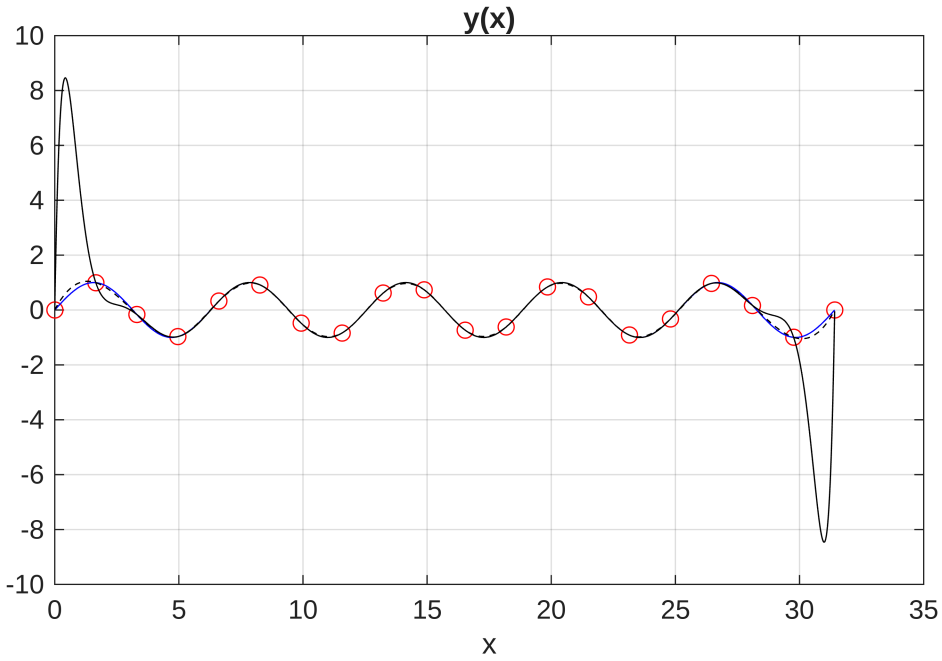
```
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-' ); xlabel('x'); title('y(x)');
grid;
```



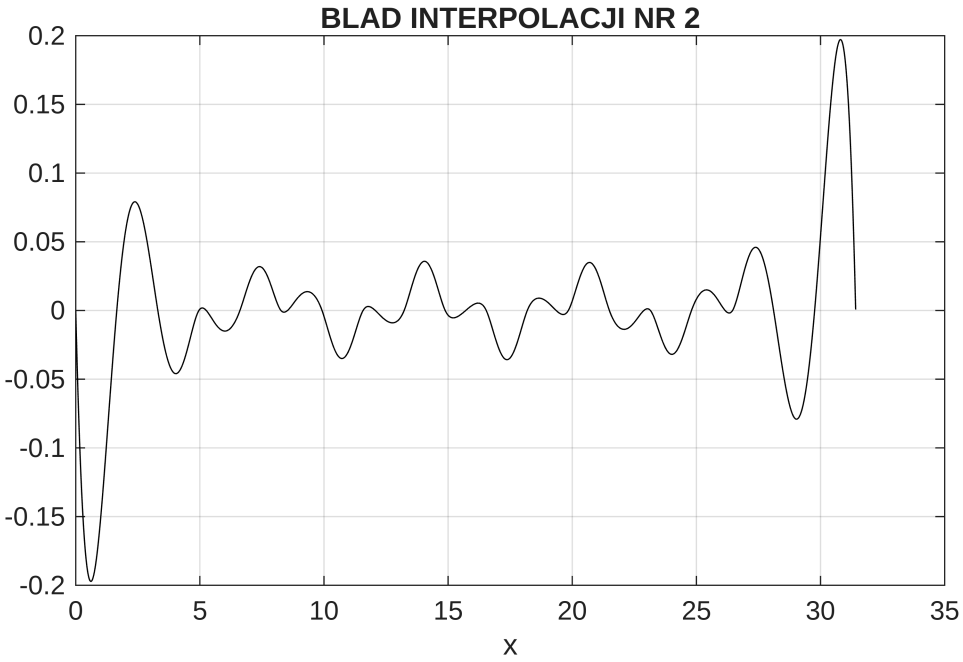

```
figure;
plot( xd, yd-yi, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 1'); grid;
```




```
% Funkcja interpolacji w Matlabie - interp1()
% 'linear'   - (default) linear interpolation
% 'nearest'  - nearest neighbor interpolation
% 'next'     - next neighbor interpolation
% 'previous' - previous neighbor interpolation
% 'spline'   - piecewise cubic spline interpolation (SPLINE)
% 'pchip'    - shape-preserving piecewise cubic interpolation
% 'cubic'    - cubic convolution interpolation for uniformly-spaced
yis = interp1( xp, yp, xi, 'spline' );
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-', xi,yis,'k--' );
xlabel('x'); title('y(x)'); grid;
```




```
figure;
plot( xd, yd - yis, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 2');
grid;
```




```

```

y = log10(x)

```
disp("============================")
```

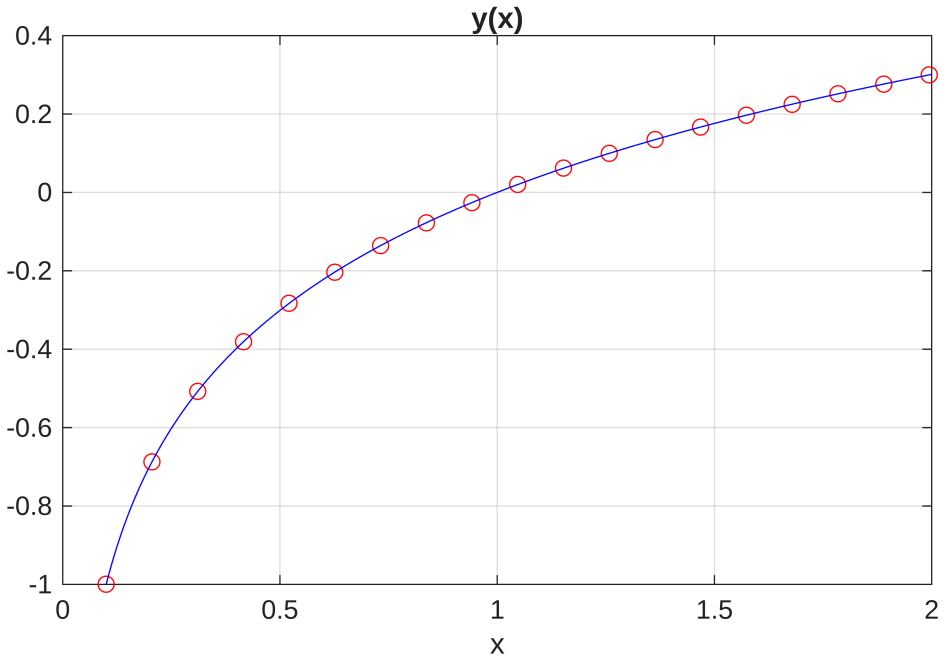
```
============================
```

```
disp("y = log10(x)")
```

```
y = log10(x)
```

```
% interp_intro.m
% Wprowadzenie do zagadnienia interpolacji
clear all;

% Funkcja interpolowana wielomianem i jej parametry
N = 20; % liczba znanych punktow funkcji, u nas sinus()
xmin = 0.1;
xmax = 2;                % maksymalna wartosc argumentu funkcji
xp = xmin : xmax/(N-1) : xmax; % wartosci argumentow dla znanych wartosci
funkcji
xd = xmin : 0.001 : xmax;      % wartosci argumentow w punktach interpolacji
yp = log10( xp );              % znane wartosci
yd = log10( xd );              % wartosci w punktach interpolacji - do
sprawdzenia
figure;
plot( xp, yp, 'ro', xd, yd, 'b-'); xlabel('x'); title('y(x)'); grid;
```




```
% Wspolczynniki wielomianu y(x) = a0 + a1*x^1 + a2*x^2 + ... + aP*x^P
P = N-1; % rzad wielomianu: 0 (a0), 1 (a0 + a1*x), 2 (a0 + a1*x +
a2*x^2), ...
a = polyfit( xp, yp, P ),   % obliczenie wsp. wielomianu interpolujacego
```

```
Warning: Polynomial is not unique; degree >= number of data points.
a = 1×20
10^4 ×
   -0.0000    0.0009   -0.0082    0.0431   -0.1538    0.3894   -0.7080    0.8967 ···
```

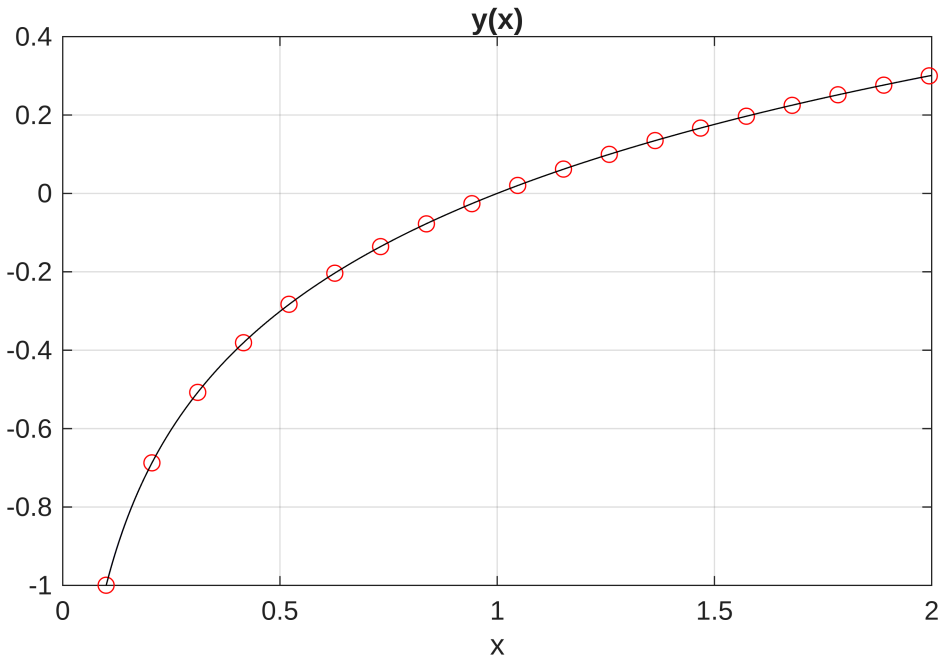
```
% Interpolacja funkcji w zadanych punktach xi
xi = xd;                    % argumenty punktow interpolacji
yi = polyval(a,xi);         % wartosci w punktach interpolacji
a = a(end:-1:1),            % w Matlabie wsp. sa zapisywane od najwyzszej
potegi
```

```
a = 1×20
10^4 ×
   -0.0002    0.0013   -0.0081    0.0398   -0.1451    0.3925   -0.7927    1.1840 ···
```

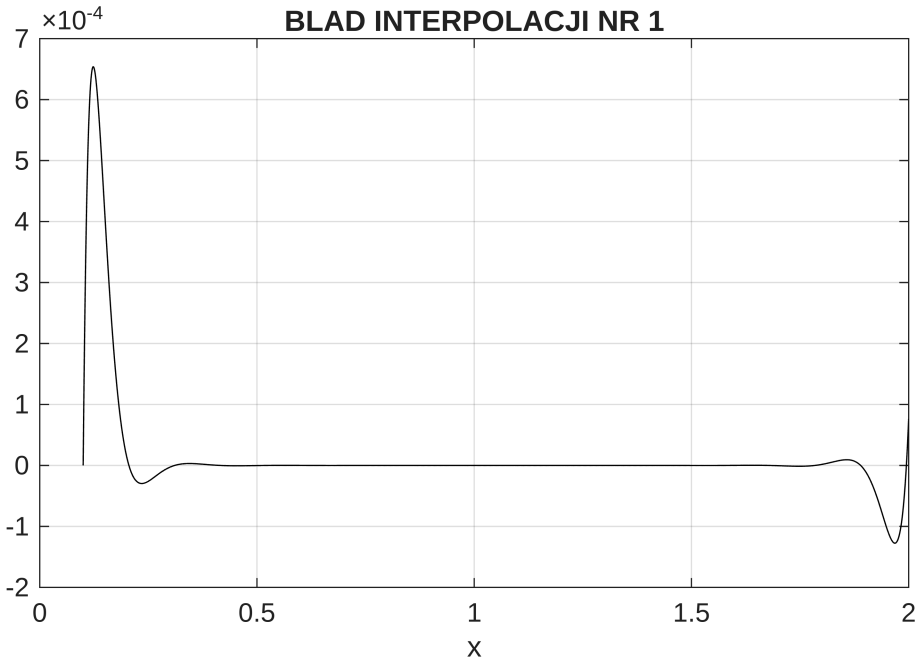
```
yi_moje = zeros(1,length(xi));
for k = 1 : N               % sami obliczamy wartosci w punktach interpolacji
    yi_moje = yi_moje + a(k) * xi.^(k-1);
end
max_abs_yi = max( abs( yi - yi_moje) ),
```

```
max_abs_yi =
1.6302e-08
```

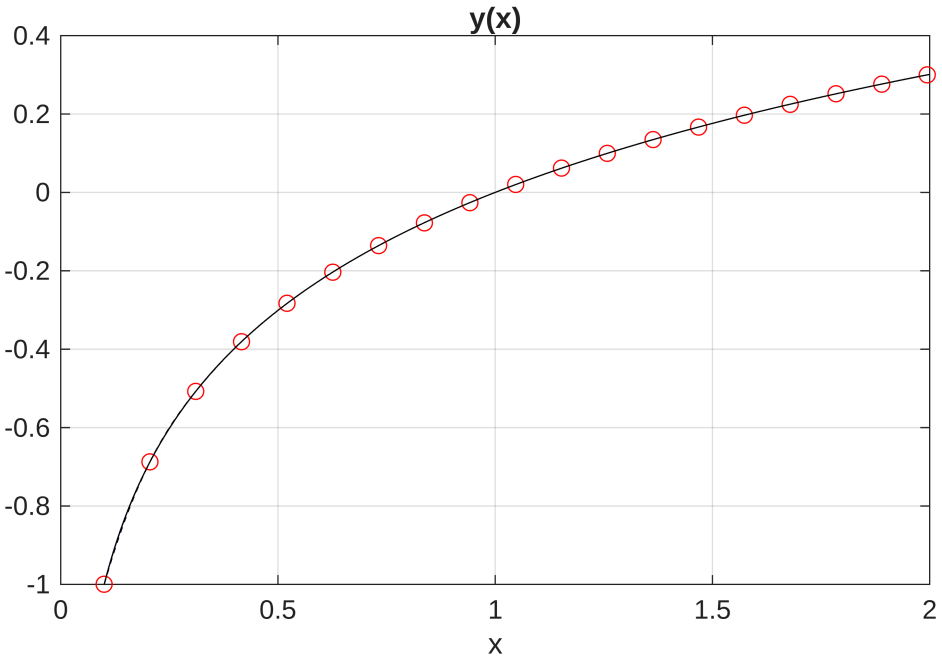
```
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-' ); xlabel('x'); title('y(x)');
grid;
```



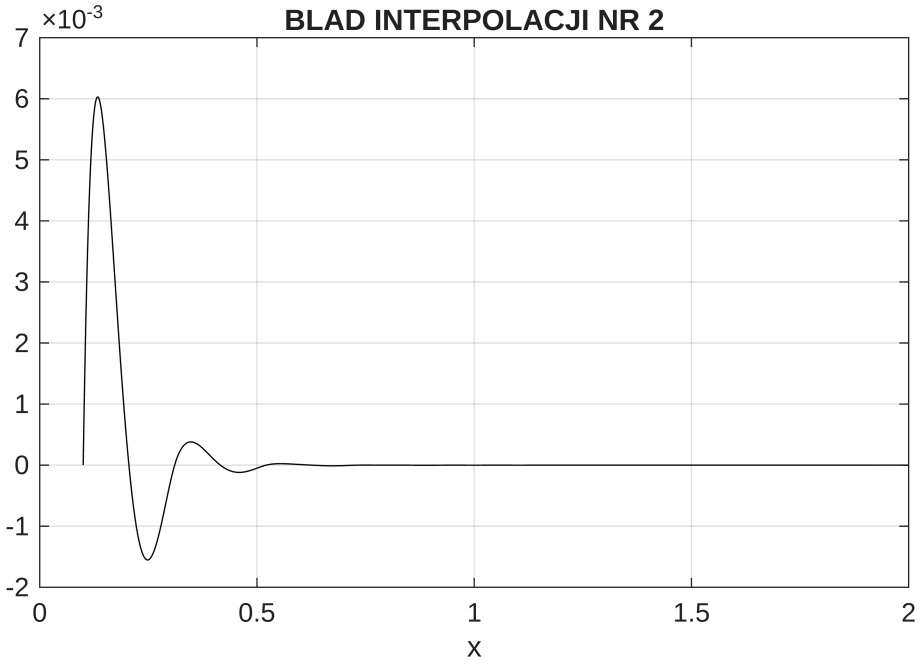

```
figure;
plot( xd, yd-yi, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 1'); grid;
```




```
% Funkcja interpolacji w Matlabie - interp1()
% 'linear'   - (default) linear interpolation
% 'nearest'  - nearest neighbor interpolation
% 'next'     - next neighbor interpolation
% 'previous' - previous neighbor interpolation
% 'spline'   - piecewise cubic spline interpolation (SPLINE)
% 'pchip'    - shape-preserving piecewise cubic interpolation
% 'cubic'    - cubic convolution interpolation for uniformly-spaced
yis = interp1( xp, yp, xi, 'spline' );
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-', xi,yis,'k--' );
xlabel('x'); title('y(x)'); grid;
```




```
figure;
plot( xd, yd - yis, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 2');
grid;
```




```

```

y = exp(x)

```
disp("============================")
```

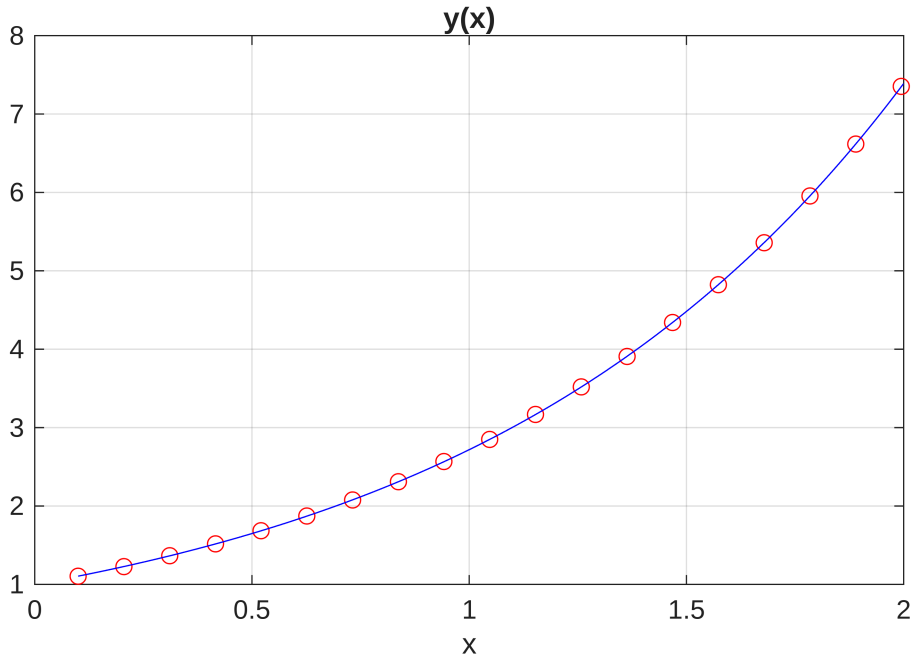
```
============================
```

```
disp("y = exp(x)")
```

```
y = exp(x)
```

```
% interp_intro.m
% Wprowadzenie do zagadnienia interpolacji
clear all;

% Funkcja interpolowana wielomianem i jej parametry
N = 20; % liczba znanych punktow funkcji, u nas sinus()
xmin = 0.1;
xmax = 2;                % maksymalna wartosc argumentu funkcji
xp = xmin : xmax/(N-1) : xmax; % wartosci argumentow dla znanych wartosci
funkcji
xd = xmin : 0.001 : xmax;      % wartosci argumentow w punktach interpolacji
yp = exp( xp );             % znane wartosci
yd = exp( xd );             % wartosci w punktach interpolacji - do
sprawdzenia
figure;
plot( xp, yp, 'ro', xd, yd, 'b-'); xlabel('x'); title('y(x)'); grid;
```




```
% Wspolczynniki wielomianu y(x) = a0 + a1*x^1 + a2*x^2 + ... + aP*x^P
P = N-1; % rzad wielomianu: 0 (a0), 1 (a0 + a1*x), 2 (a0 + a1*x +
a2*x^2), ...
a = polyfit( xp, yp, P ),   % obliczenie wsp. wielomianu interpolujacego
```

```
Warning: Polynomial is not unique; degree >= number of data points.
a = 1×20
    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000    0.0000   -0.0000 ···
```

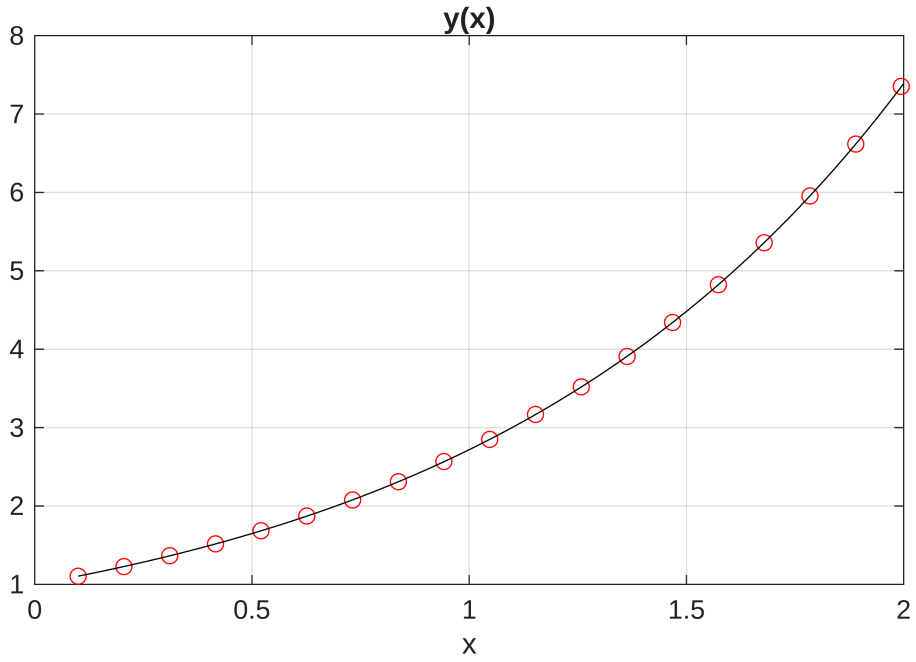
```
% Interpolacja funkcji w zadanych punktach xi
xi = xd;                    % argumenty punktow interpolacji
yi = polyval(a,xi);         % wartosci w punktach interpolacji
a = a(end:-1:1),            % w Matlabie wsp. sa zapisywane od najwyzszej
potegi
```

```
a = 1×20
    1.0000    1.0000    0.5000    0.1667    0.0417    0.0083    0.0014    0.0002 ···
```

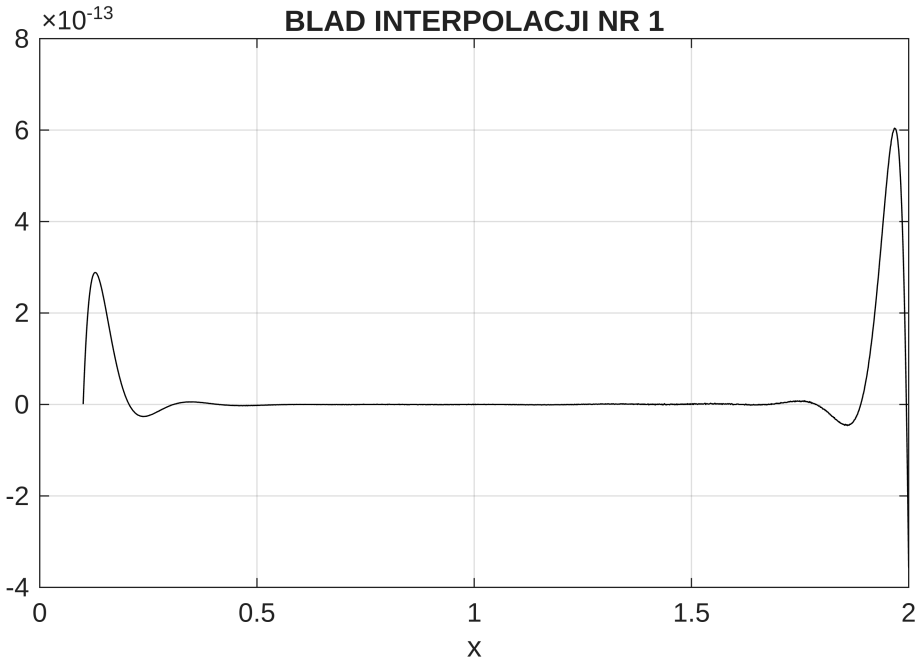
```
yi_moje = zeros(1,length(xi));
for k = 1 : N              % sami obliczamy wartosci w punktach interpolacji
    yi_moje = yi_moje + a(k) * xi.^(k-1);
end
max_abs_yi = max( abs( yi - yi_moje) ),
```

```
max_abs_yi =
3.5527e-15
```

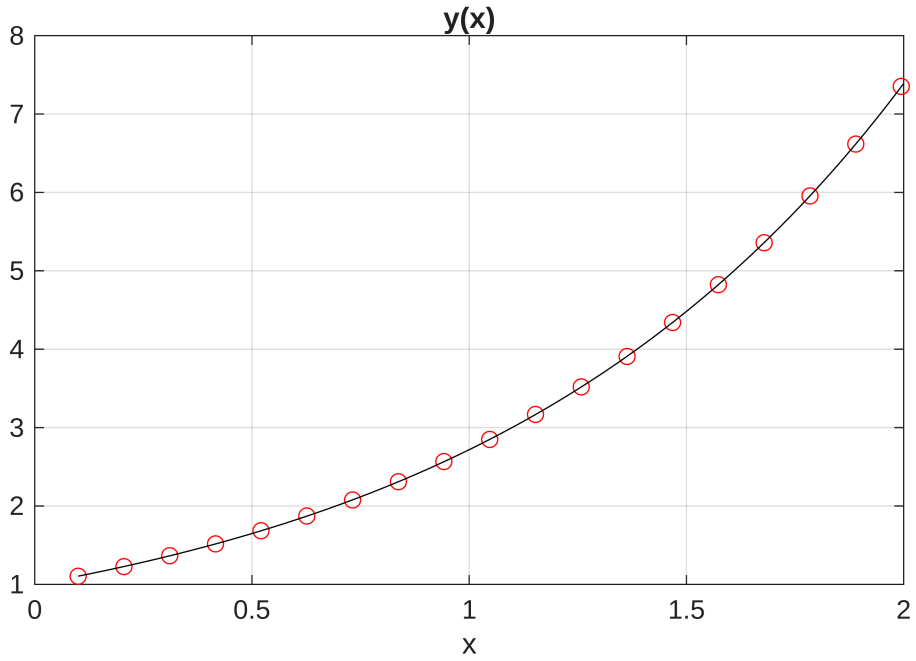
```
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-' ); xlabel('x'); title('y(x)');
grid;
```




```
figure;
plot( xd, yd-yi, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 1'); grid;
```




```
% Funkcja interpolacji w Matlabie - interp1()
% 'linear'   - (default) linear interpolation
% 'nearest'  - nearest neighbor interpolation
% 'next'     - next neighbor interpolation
% 'previous' - previous neighbor interpolation
% 'spline'   - piecewise cubic spline interpolation (SPLINE)
% 'pchip'    - shape-preserving piecewise cubic interpolation
% 'cubic'    - cubic convolution interpolation for uniformly-spaced
yis = interp1( xp, yp, xi, 'spline' );
figure;
plot( xp,yp,'ro', xd,yd,'b-', xi,yi,'k-', xi,yis,'k--' );
xlabel('x'); title('y(x)'); grid;
```




```
figure;
plot( xd, yd - yis, 'k-' ); xlabel('x'); title('BLAD INTERPOLACJI NR 2');
grid;
```