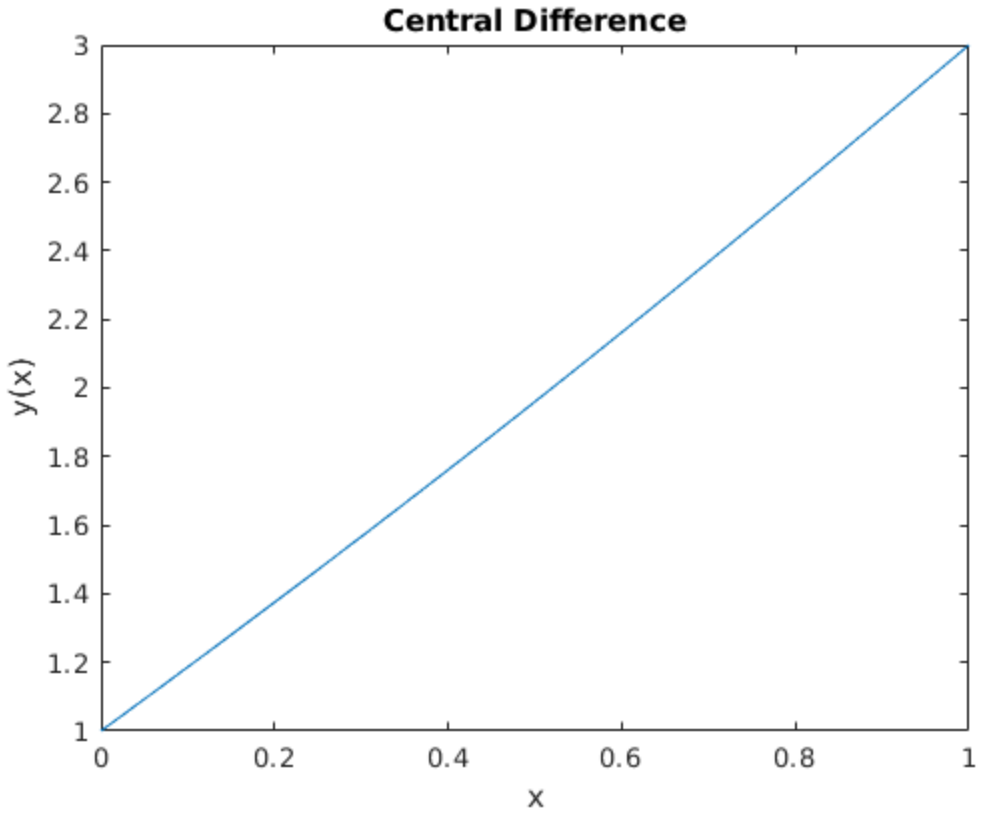
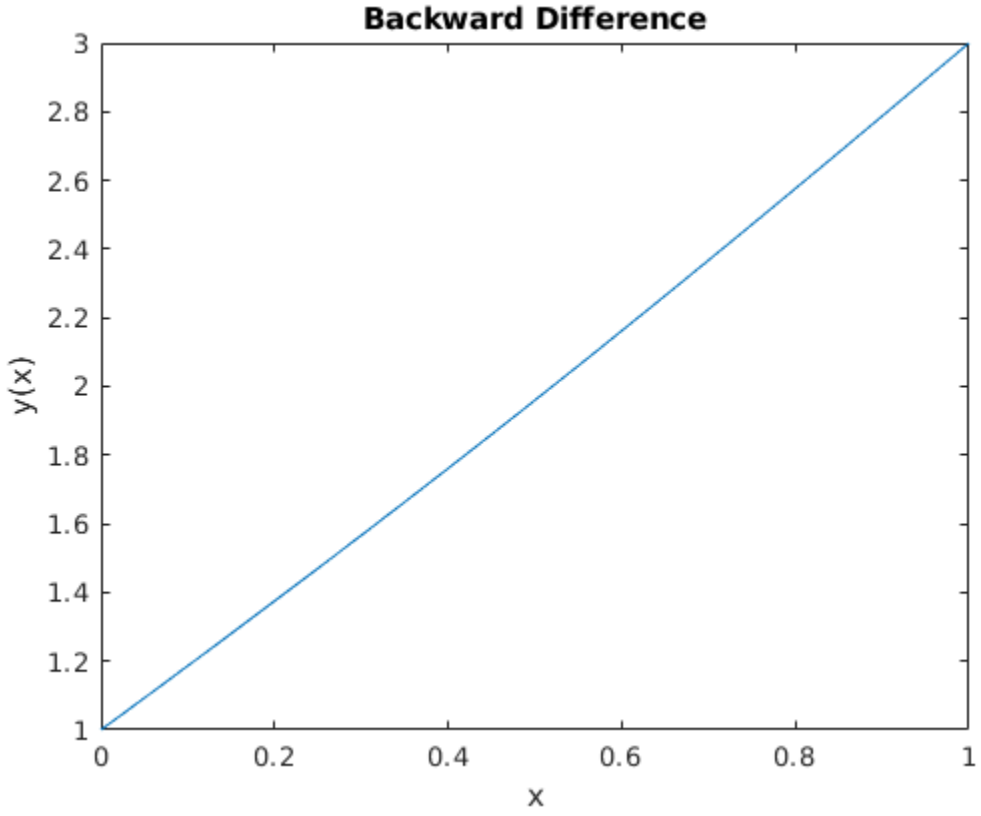
```
clear all;
clc;
p = @(x) -(x+1);
q = @(x) cos(x);
r = @(x) -exp(x);
a = 0;
b = 1;
h = 1/400;
alpha = 1;
beta = 3;
fprintf('Q1(a)\n');
fprintf('The plot for solution using Central difference for the first
 order derivative is\n');
central_diff(a,b,h,alpha,beta,p,q,r,1);
fprintf('The plot for solution using Backward difference for the first
 order derivative is\n');
backward_diff(a,b,h,alpha,beta,p,q,r,2);
fprintf('The plot for solution using Forward difference for the first
 order derivative is\n');
forward_diff(a,b,h,alpha,beta,p,q,r,3);
%(b)
p = @(x) -2;
q = @(x) -1;
r = @(x) -x;
a = 0;
b = 1;
h = 0.01;
alpha = 0;
beta = 0;
fprintf('Q1(b)\n');
fprintf('The plot for solution using Central difference for the first
 order derivative is\n');
central_diff(a,b,h,alpha,beta,p,q,r,4);
fprintf('The plot for solution using Backward difference for the first
 order derivative is\n');
backward_diff(a,b,h,alpha,beta,p,q,r,5);
fprintf('The plot for solution using Forward difference for the first
 order derivative is\n');
forward_diff(a,b,h,alpha,beta,p,q,r,6);

% functions

function y = central_diff(a,b,h,alpha,beta,p,q,r,fig_no)
t = [a:h:b];
n = length(t);
y = zeros(1,n);
y(1) = alpha;
y(n) = beta;

A = zeros(n-2,n-2);
b = zeros(n-2,1);
% i = 2
```

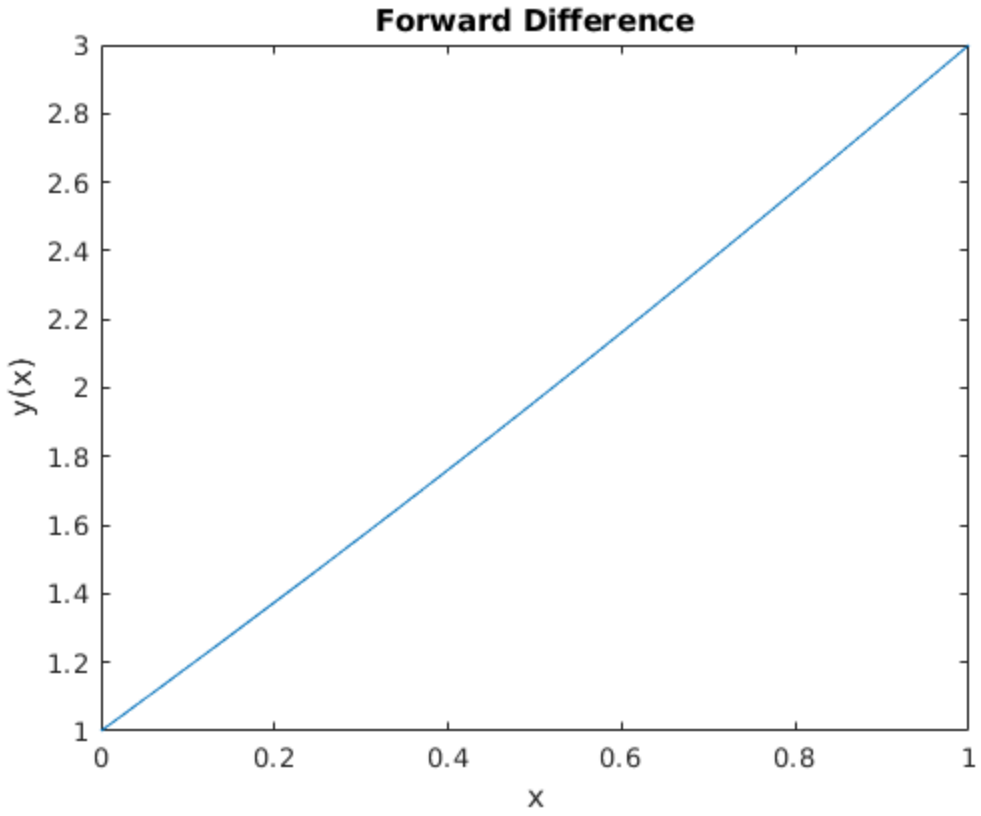
```
A(1,1) = (2/h^2 + q(t(2)));
A(1,2) = (-1/h + p(t(2))/2)/h;
b(1) = r(t(2)) - y(1)*(-1/h - p(t(1))/2)/h;
%i = n
A(n-2,n-3) = (-1/h - p(t(n-1))/2)/h;
A(n-2,n-2) = (2/h^2 + q(t(n-1)));
b(n-2) = r(t(n-1)) - y(n)*(-1/h + p(t(n-1))/2)/h;

for i=3:n-2
    A(i-1,i-2) =  (-1/h - p(t(i))/2)/h;
    A(i-1,i-1) = (2/h^2 + q(t(i)));
    A(i-1,i) = (-1/h + p(t(i))/2)/h;
    b(i-1) = r(t(i));
end
y(2:n-1) = A\b;
y(2:n-1) = A\b;
figure(fig_no);
plot(t,y);
xlabel('x');
ylabel('y(x)');
title('Central Difference');

end
function y = backward_diff(a,b,h,alpha,beta,p,q,r,fig_no)
t = [a:h:b];
n = length(t);
y = zeros(1,n);
y(1) = alpha;
y(n) = beta;

A = zeros(n-2,n-2);
b = zeros(n-2,1);
% i = 2
A(1,1) = (2/h^2 + p(t(2))/h + q(t(2)));
A(1,2) = -1/h^2;
b(1) = r(t(2)) - y(1)*(-1/h - p(t(1)))/h;
%i = n
A(n-2,n-3) = (-1/h - p(t(n-1)))/h;
A(n-2,n-2) = (2/h^2 + p(t(n-1))/h + q(t(n-1)));
b(n-2) = r(t(n-1)) - y(n)*(-1/h^2);

for i=3:n-2
    A(i-1,i-2) =  (-1/h - p(t(i)))/h;
    A(i-1,i-1) = (2/h^2 + p(t(i))/h + q(t(i)));
    A(i-1,i) = -1/h^2;
    b(i-1) = r(t(i));
end
y(2:n-1) = A\b;
y(2:n-1) = A\b;
figure(fig_no);
plot(t,y);
xlabel('x');
ylabel('y(x)');
title('Backward Difference');
```

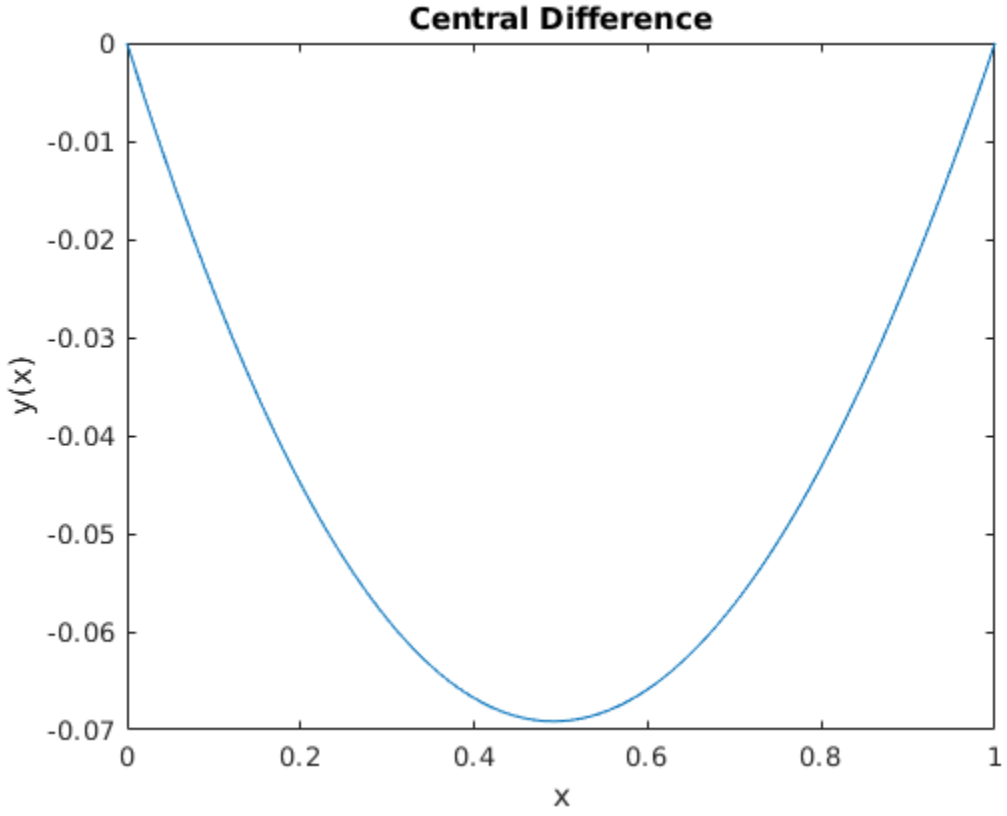
```
end
function y = forward_diff(a,b,h,alpha,beta,p,q,r,fig_no)
t = [a:h:b];
n = length(t);
y = zeros(1,n);
y(1) = alpha;
y(n) = beta;

A = zeros(n-2,n-2);
b = zeros(n-2,1);
% i = 2
A(1,1) = (2/h^2 - p(t(2))/h + q(t(2)));
A(1,2) = (-1/h + p(t(2)))/h;
b(1) = r(t(2)) - y(1)*(-1/h^2);
%i = n
A(n-2,n-3) = -1/h^2;
A(n-2,n-2) = (2/h^2 - p(t(n-1))/h + q(t(n-1)));
b(n-2) = r(t(n-1)) - y(n)*(-1/h + p(t(n-1)))/h;

for i=3:n-2
    A(i-1,i-2) =  -1/h^2;
    A(i-1,i-1) = (2/h^2 - p(t(i))/h + q(t(i)));
    A(i-1,i) = (-1/h + p(t(i)))/h;
    b(i-1) = r(t(i));
end
y(2:n-1) = A\b;
figure(fig_no);
plot(t,y);
xlabel('x');
ylabel('y(x)');
title('Forward Difference');

end
```

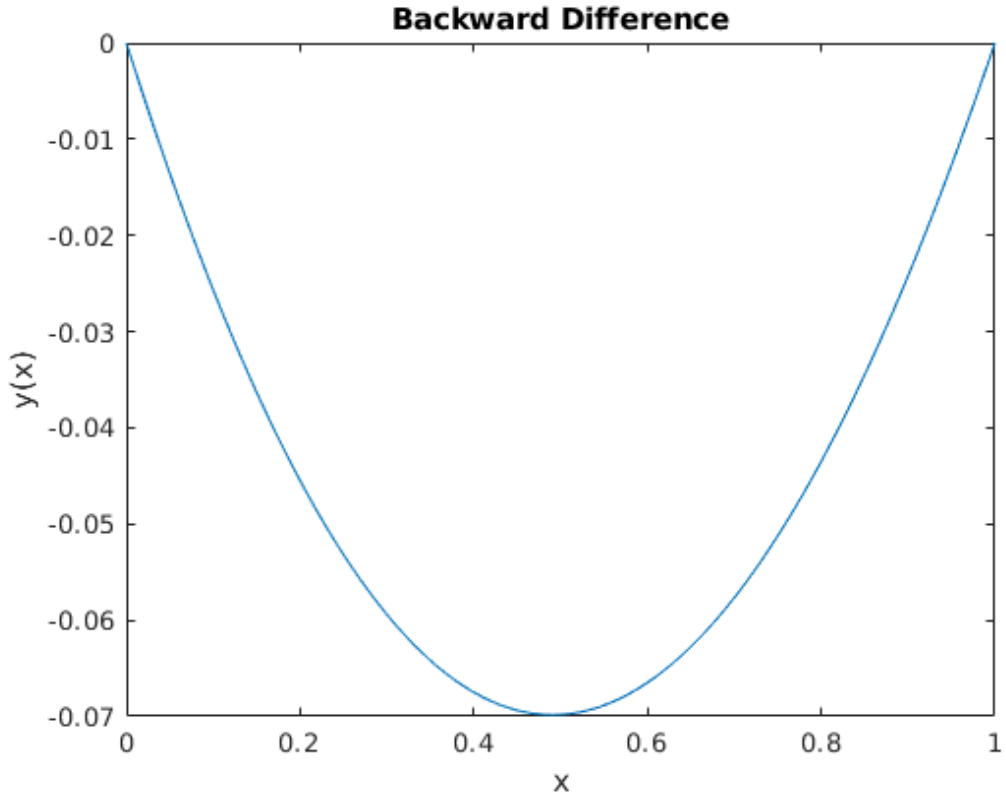
```
Q1(a)
The plot for solution using Central difference for the first order
 derivative is
The plot for solution using Backward difference for the first order
 derivative is
The plot for solution using Forward difference for the first order
 derivative is
Q1(b)
The plot for solution using Central difference for the first order
 derivative is
The plot for solution using Backward difference for the first order
 derivative is
The plot for solution using Forward difference for the first order
 derivative is
```

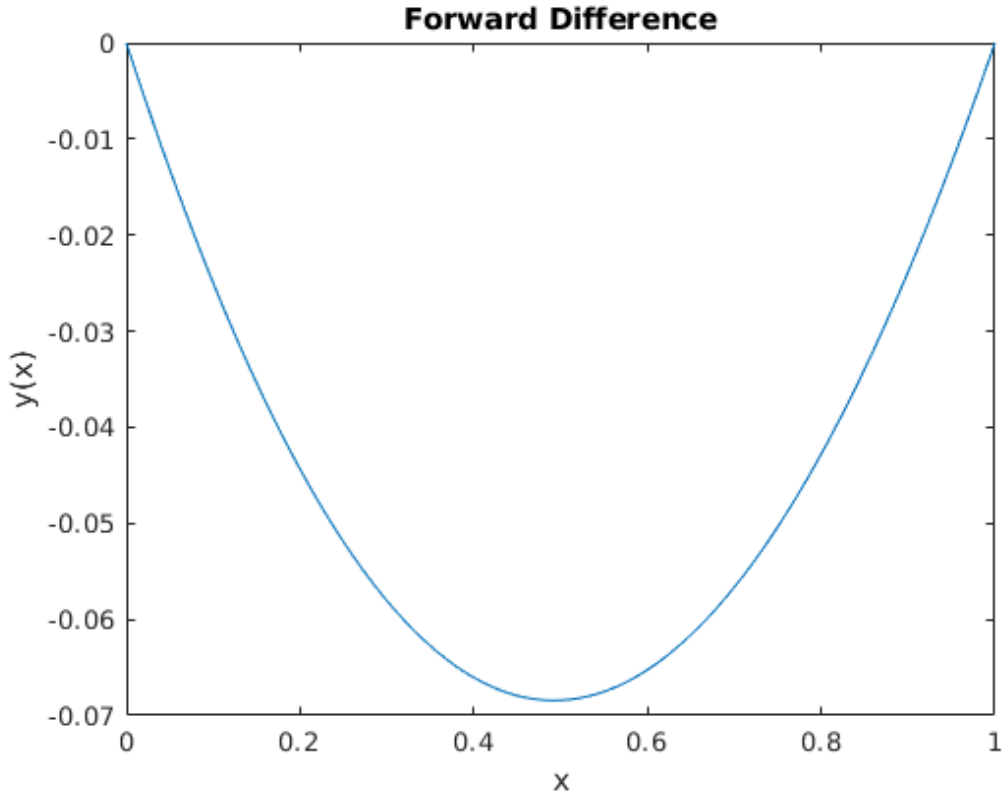

Central Difference
y(x)
x
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
0.2
0.4
0.6
0.8
1


Backward Difference
y(x)
x
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
0.2
0.4
0.6
0.8
1


Forward Difference
3
2.8
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
y(x)
0
0.2
0.4
0.6
0.8
1
x


Central Difference
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
y(x)
0
0.2
0.4
0.6
0.8
1
x


Backward Difference
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
y(x)
0
0.2
0.4
0.6
0.8
1
x


Forward Difference
0
-0.01
-0.02
-0.03
-0.04
-0.05
-0.06
-0.07
y(x)
0
0.2
0.4
0.6
0.8
1
x

Published with MATLAB® R2018b