

APPENDIX A

Microsoft Visual C

Microsoft Visual C is the program was used for compare the rate of convergece of P-iteration, W-iteration and ST-iteration. The example code of program are following:

i) The code of programm for compare the rate of convergence of P-iteration and W-iteration to a fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

```
ConsoleApplication1.Program - | func(double x)
{
    class Program
    {
        static double func(double x)
        {
            double func;
            func = (x*x + 3) / 4;
            return func;
        }
        static void Main(string[] args)
        {
            double n,i,m,j,k,p,x,y,z,a,b,c,r,s,t,d,e,f,y,u,w,g,b,l;
            n=m=i=j=k=p=1;
            a = 1 / n;
            b = 1 / 2*n;
            c = 1 / 2*n;
            x=t=w = 2;

            while (i <= 20)
            {
                a = 1 / (2 * n);
                b = 1 / (2 * n);
                c = 1 / (2 * n);
                z = (1 - c) * x + c * func(x);
                y = (1 - b) * z + b * func(z);
                x = (1 - a) * func(z) + a * func(y);
                i++;
                n++;
                Console.WriteLine(x);
            } Console.WriteLine(); Console.WriteLine(); Console.WriteLine(); Console.WriteLine();
        }
    }
}

ConsoleApplication1.Program - | func(double x)

while (j <= 20)
{
    d = 1 / (2 * m);
    e = 1 / (2 * m);
    f = 1 / (2 * m);
    r = (1 - f) * t + f * func(t);
    s = (1 - e) * func(t) + e * func(r);
    t = (1 - d) * func(r) + d * func(s);
    j++;
    m++;
    Console.WriteLine(t);
    Console.WriteLine(Math.Abs(t - func(t)));
} Console.WriteLine(); Console.WriteLine(); Console.WriteLine(); Console.WriteLine();
Console.ReadKey();
}
```

We can change the function from $f(x) = \frac{x^2+3}{4}$ to be $f(x) = \frac{x^2+9}{10}$ and $f(x) = \sqrt{x+6}$ by change func on line 7.

ii) The code of programm for compare the rate of convergence of P-iteration and ST-iteration to a fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

```

file:///D:/FixedPt/ConsoleApplication1/ConsoleApplication1/bin/Debug/Conso...
1.57312059402466
1.32009974598799
1.1687376379531
1.00520700524722
1.04199952353343
1.02047765541418
1.00994902108379
1.00483360389513
1.00235171798544
1.0011463768199
1.00055990365344
1.00027395825596
1.00013426394257
1.00006589556176
1.00003238171913
1.00001593035321
1.00000784470967
1.00000386640062
1.00000190710657
1.0000009413405

1.54623460769653
0.19852424218692
1.2819023480351
0.121083940560623
1.1375936035978
0.0640638018611435
1.06509357013648
0.0314874918499615
1.03043841621111
0.0149875838101945
1.01422024459309
0.00705956845747302
1.00666780796783
0.00332278906813865
1.00314247074816
0.00156876659348026
1.00148867353262
0.000743782729087039
1.00070856136599
0.000354155168191594
1.00033865611452
0.000169299385271549
1.00016244445756
0.12156317311352E-05
1.00007816363104
3.90802881309327E-05
1.00003771200383
1.88556463645018E-05
1.00001823811643
9.11897505639914E-06
1.000008838552
4.41925647187702E-06
1.00000429119975

```

Figure A.1: The result of programm for compare the rate of convergence of P-iteration and W-iteration to a fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

```

{
class Program
{
    static double func(double x)
    {
        double func;
        func = (x*x + 3) / 4;
        return func;
    }
    static void Main(string[] args)
    {
        double n,i,m,j,k,p,x,y,z,a,b,c,r,s,t,d,e,f,v,u,w,g,h,l;
        n=m=i=j=k=p = 1;
        a = 1 / n;
        b = 1 / 2*n;
        c = 1 / 2*n;
        x=t=w = 2;

        while (i <= 20)
        {
            a = 1 / (2 * n);
            b = 1 / (2 * n);
            c = 1 / (2 * n);
            z = (1 - c) * x + c * func(x);
            y = (1 - b) * z + b * func(z);
            x = (1 - a) * func(z) + a * func(y);
            i++;
            n++;
            Console.WriteLine(x);
        } Console.WriteLine(); Console.WriteLine(); Console.WriteLine(); Console.WriteLine();
    }
}

```



```

        while (j <= 20)
        {
            d = 1 / (2 * m);
            e = 1 / (2 * m);
            f = 1 / (2 * m);
            r = (1 - f) * t + f * func(t);
            s = (1 - e) * func(t) + e * func(func(r));
            t = (1 - d) * func(r) + d * func(func(s));
            j++;
            m++;
            Console.WriteLine(t);
            Console.WriteLine(Math.Abs(t - func(t)));
        }
        Console.WriteLine(); Console.WriteLine(); Console.WriteLine(); Console.WriteLine();
        Console.ReadKey();
    }
}

```

```

file:///D:/FixedPt/ConsoleApplication1/ConsoleApplication1/bin/Debug/Conso...
1.57312059402466
1.32009974598799
1.1687376379531
1.08520700524722
1.04199952353343
1.02047765541418
1.00994902108379
1.00483360389513
1.00235171798544
1.0011463768199
1.00055990365344
1.00027395825596
1.00013426394257
1.00006589556176
1.00003238171913
1.00001593035321
1.00000784470967
1.00000386640062
1.00000190710657
1.0000009413405

1.42592481572707
0.1676094207005
1.18833667821118
0.0853006630156865
1.08307369201437
0.0398115364309595
1.03680439940034
0.0180635587463636
1.0164747899456
0.0081695402968629
1.00746261307804
0.00371738389053156
1.00341811247173
0.00170613536264619
1.00158074637176
0.000789748496105913
1.00073698124456
0.000368354836941975
1.00034593127729
0.000172935721531209
1.00016329954523
8.16431059291745E-05
1.00007745634571
3.87266729828806E-05
1.00003688902723
1.84441734145668E-05
1.00001763019513
8.815019858055E-06
1.00000045152938
4.22574683289767E-06
1.00000406225249
2.0311221198277E-06
1.00000195711214

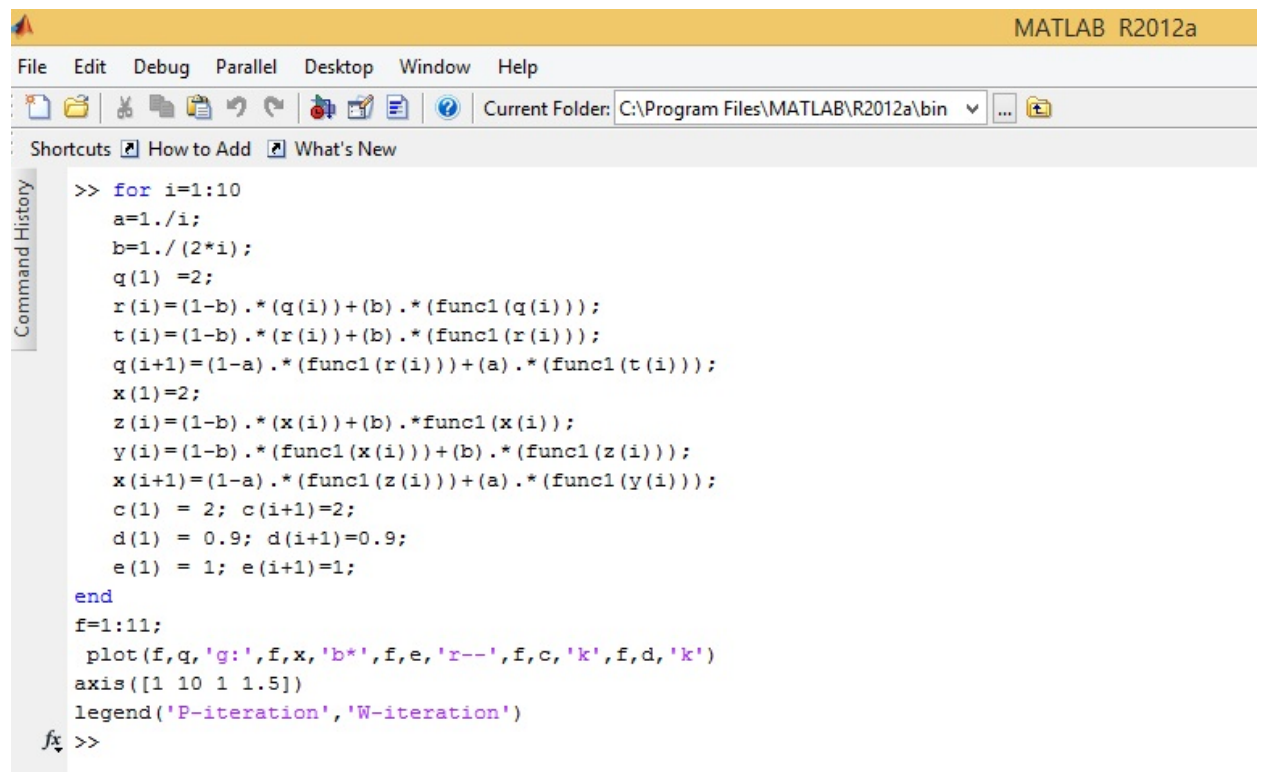
```

Figure A.2: The result of program for compare the rate of convergence of ST-iteration and W-iteration to a fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

APPENDIX B

Matlab

Programm Matlab was used for plot graphs of comparing the rate of convergece of P-iteration, W-iteration and ST-iteration. The example code of program are following:



```
MATLAB R2012a
File Edit Debug Parallel Desktop Window Help
Current Folder: C:\Program Files\MATLAB\R2012a\bin
Shortcuts How to Add What's New
Command History
>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1)=2;
    r(i)=(1-b).*(q(i))+b.*(func1(q(i)));
    t(i)=(1-b).*(r(i))+b.*(func1(r(i)));
    q(i+1)=(1-a).*(func1(r(i)))+(a).*(func1(t(i)));
    x(1)=2;
    z(i)=(1-b).*(x(i))+b.*func1(x(i));
    y(i)=(1-b).*(func1(x(i)))+(b).*(func1(z(i)));
    x(i+1)=(1-a).*(func1(z(i)))+(a).*(func1(y(i)));
    c(1)=2; c(i+1)=2;
    d(1)=0.9; d(i+1)=0.9;
    e(1)=1; e(i+1)=1;
end
f=1:11;
plot(f,q,'g:',f,x,'b*',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 1 1.5])
legend('P-iteration','W-iteration')
fx >>
```

Figure B.1: To compare the rate of convergence between P-iteration and W-iteration to the fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

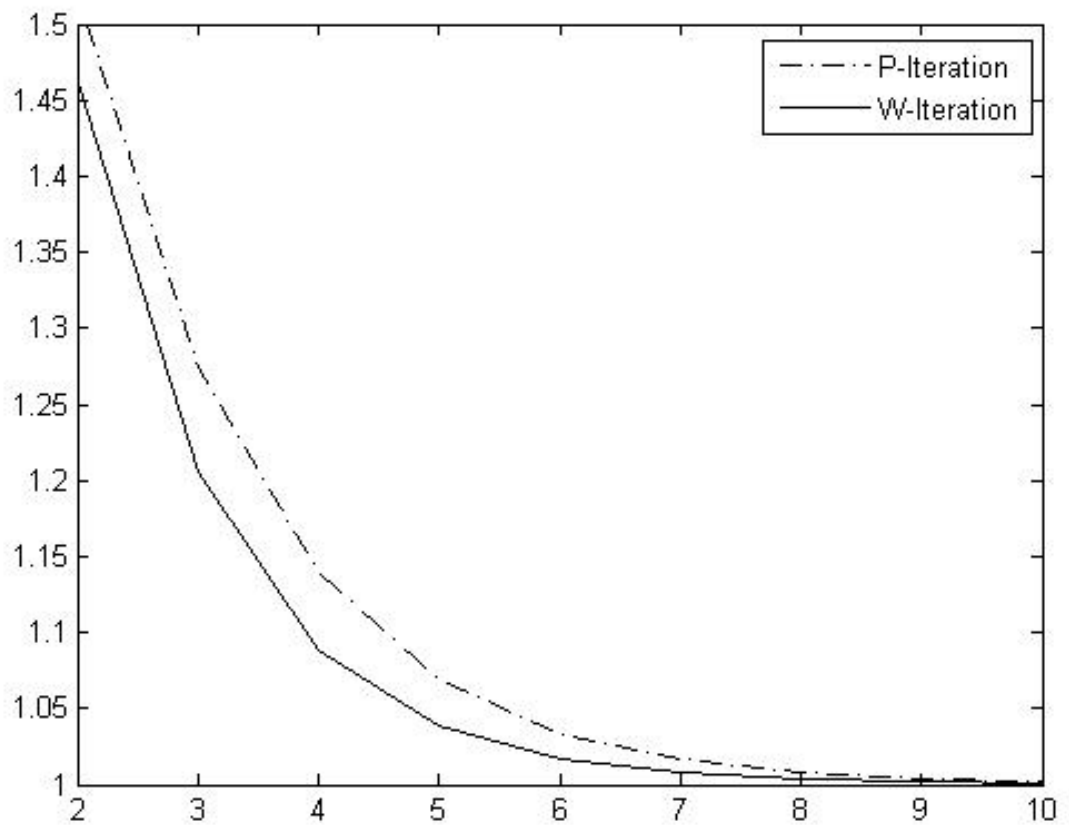


Figure B.2: The comparison graph of the convergence between P-iteration and W-iteration to the fixed point $p = 1$ of f .

The image shows the MATLAB R2012a Command Window with a script for comparing the convergence rates of P-iteration and W-iteration. The script is as follows:

```

>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1)=2;
    r(i)=(1-b).*(q(i))+b.*(func2(q(i)));
    t(i)=(1-b).*(r(i))+b.*(func2(r(i)));
    q(i+1)=(1-a).*(func2(r(i)))+(a).*(func2(t(i)));
    x(1)=2;
    z(i)=(1-b).*(x(i))+b.*func2(x(i));
    y(i)=(1-b).*(func2(x(i)))+(b).*(func2(z(i)));
    x(i+1)=(1-a).*(func2(z(i)))+(a).*(func2(y(i)));
    c(1)=2; c(i+1)=2;
    d(1)=0.9; d(i+1)=0.9;
    e(1)=1; e(i+1)=1;
end
f=1:11;
plot(f,q,'g:',f,x,'b*',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 1 1.5])
legend('P-iteration','W-iteration')
fx >>

```

Figure B.3: To compare the rate of convergence between P-iteration and W-iteration to the fixed point $p = 1$ of $f(x) = \frac{x^2+9}{10}$.

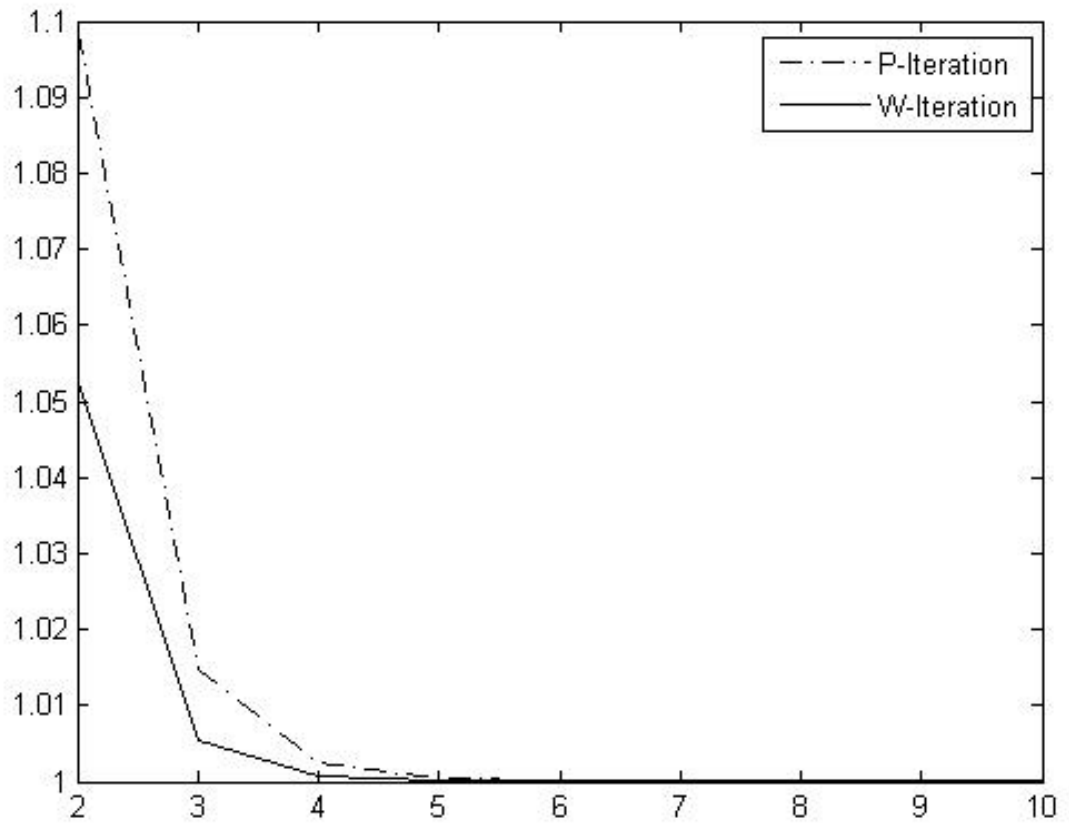


Figure B.4: The comparison graph of the convergence between P-iteration and W-iteration to the fixed point $p = 1$ of f .

The image shows the MATLAB R2012a Command History window. The title bar reads 'MATLAB R2012a'. The menu bar includes 'File', 'Edit', 'Debug', 'Parallel', 'Desktop', 'Window', and 'Help'. The toolbar shows various icons for file operations and execution. The 'Current Folder' is set to 'C:\Program Files\MATLAB\R2012a\bin'. Below the toolbar, there are links for 'Shortcuts', 'How to Add', and 'What's New'. The Command History window displays the following code:

```

>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1) =4;
    r(i)=(1-b).*(q(i))+(b).*(func3(q(i)));
    t(i)=(1-b).*(r(i))+(b).*(func3(r(i)));
    q(i+1)=(1-a).*(func3(r(i)))+(a).*(func3(t(i)));
    x(1)=4;
    z(i)=(1-b).*(x(i))+(b).*(func3(x(i)));
    y(i)=(1-b).*(func3(x(i)))+(b).*(func3(z(i)));
    x(i+1)=(1-a).*(func3(z(i)))+(a).*(func3(y(i)));
    c(1) = 4; c(i+1)=4;
    d(1) = 2.9; d(i+1)=2.9;
    e(1) = 3; e(i+1)=3;
end
f=1:11;
plot(f,q,'g:',f,x,'b*',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 3 3.1])
legend('P-iteration','W-iteration')
>>
fx >>

```

Figure B.5: To compare the rate of convergence between P-iteration and W-iteration to the fixed point $p = 3$ of $f(x) = \sqrt{x+6}$.

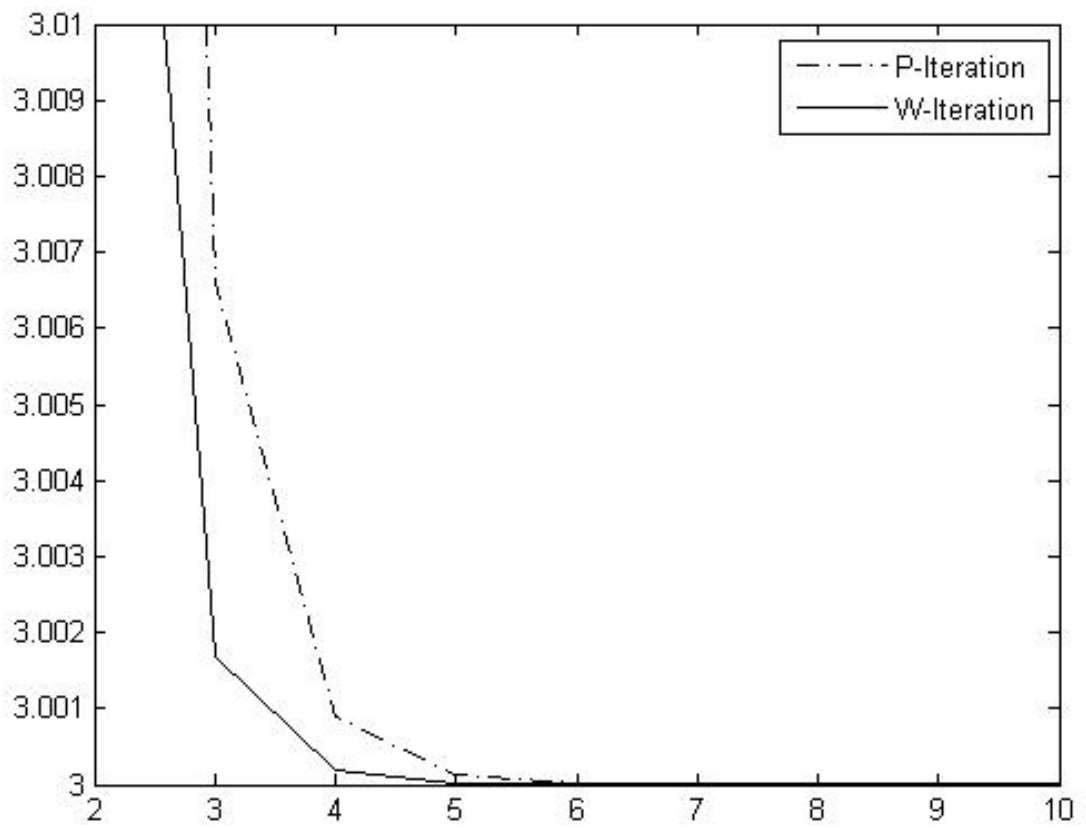


Figure B.6: The comparison graph of the convergence between P-iteration and W-iteration to the fixed point $p = 3$ of f .

The image shows the MATLAB R2012a Command History window. The title bar reads 'MATLAB R2012a'. The menu bar includes 'File', 'Edit', 'Debug', 'Parallel', 'Desktop', 'Window', and 'Help'. The toolbar contains icons for file operations and a 'Current Folder' dropdown set to 'C:\Program Files\MATLAB\R2012a\bin'. Below the toolbar are links for 'Shortcuts', 'How to Add', and 'What's New'. The Command History window displays the following MATLAB code:

```

>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1) =2;
    r(i)=(1-b).*(q(i))+(b).*(func1(q(i)));
    t(i)=(1-b).*(r(i))+(b).*(func1(r(i)));
    q(i+1)=(1-a).*(func1(r(i)))+(a).*(func1(t(i)));
    x(1)=2;
    z(i)=(1-b).*(x(i))+(b).*(func1(x(i)));
    y(i)=(1-b).*(func1(x(i)))+(b).*(func1(func1(z(i))));
    x(i+1)=(1-a).*(func1(z(i)))+(a).*(func1(func1(y(i))));
    c(1) = 2; c(i+1)=2;
    d(1) = 0.9; d(i+1)=0.9;
    e(1) = 1; e(i+1)=1;
end
f=1:11;
plot(f,q,'g',f,x,'b*',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 1 1.5])
>> legend('P-iteration','ST-iteration')
fx >> |

```

Figure B.7: To compare the rate of convergence between P-iteration and ST-iteration to the fixed point $p = 1$ of $f(x) = \frac{x^2+3}{4}$.

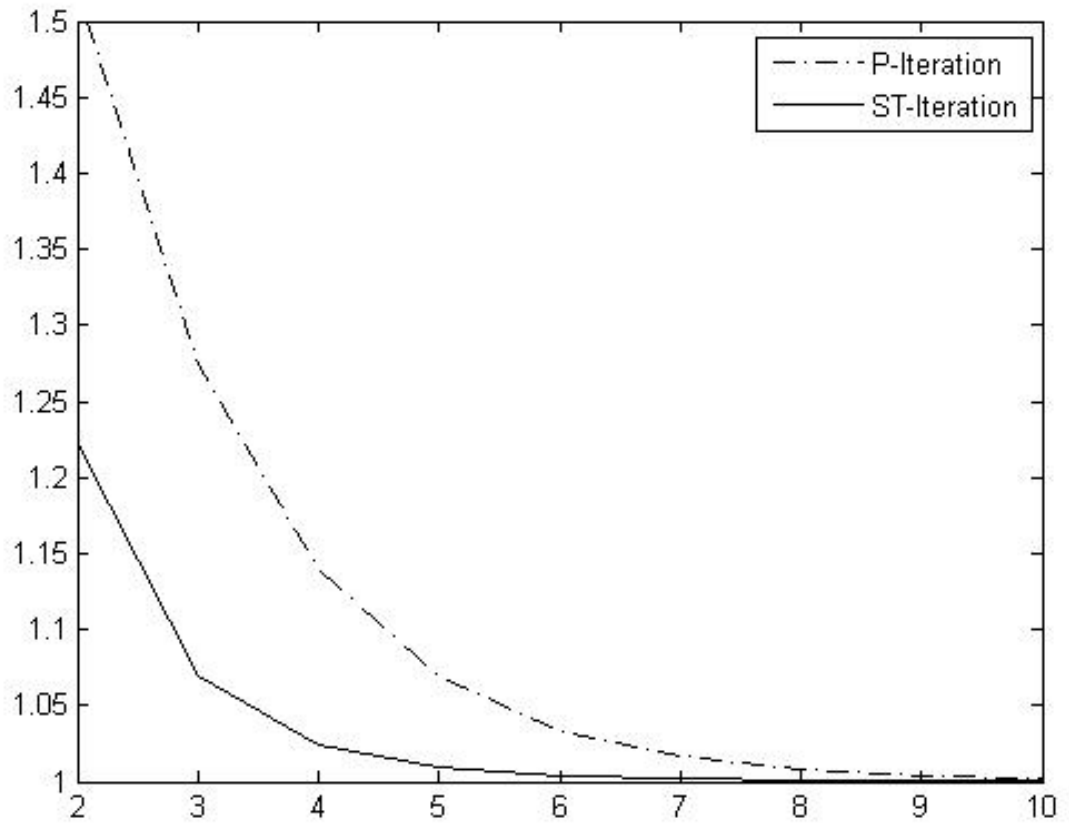


Figure B.8: The comparison graph of the convergence between P-iteration and ST-iteration to the fixed point $p = 1$ of f .

The image shows a MATLAB R2012a Command Window with the following code:

```

>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1) =2;
    r(i)=(1-b).*(q(i))+(b).*(func2(q(i)));
    t(i)=(1-b).*(r(i))+(b).*(func2(r(i)));
    q(i+1)=(1-a).*(func2(r(i)))+(a).*(func2(t(i)));
    x(1)=2;
    z(i)=(1-b).*(x(i))+(b).*(func1(x(i)));
    y(i)=(1-b).*(func2(x(i)))+(b).*(func2(func2(z(i))));
    x(i+1)=(1-a).*(func2(z(i)))+(a).*(func2(func2(y(i))));
    c(1) = 2; c(i+1)=2;
    d(1) = 0.9; d(i+1)=0.9;
    e(1) = 1; e(i+1)=1;
end
f=1:11;
plot(f,q,'g',f,x,'b*',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 1 1.1])
legend('P-iteration','ST-iteration')
fx >> |

```

Figure B.9: To compare the rate of convergence between P-iteration and ST-iteration to the fixed point $p = 1$ of $f(x) = \frac{x^2+9}{10}$.

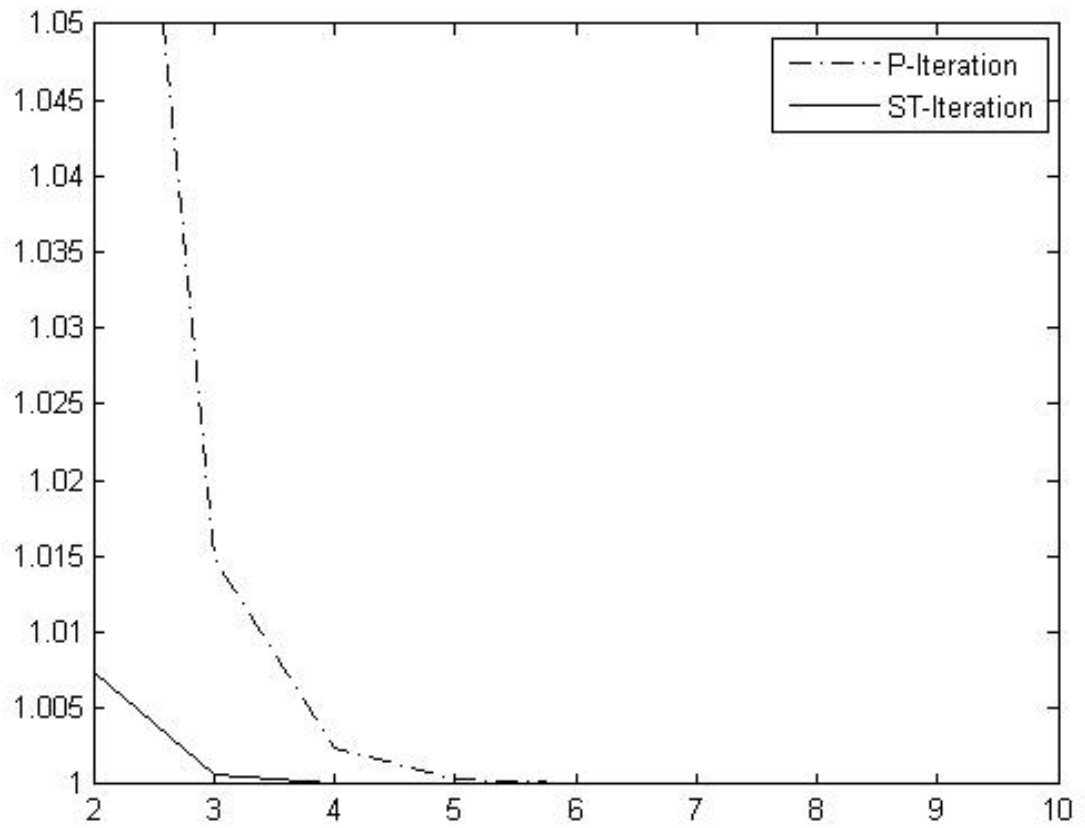


Figure B.10: The comparison graph of the convergence between P-iteration and ST-iteration to the fixed point $p = 1$ of f .

The image shows a screenshot of the MATLAB R2012a Command Window. The window title is "MATLAB R2012a". The menu bar includes "File", "Edit", "Debug", "Parallel", "Desktop", "Window", and "Help". The current folder is "C:\Program Files\MATLAB\R2012a\bin". The Command Window contains the following MATLAB code:

```

>> for i=1:10
    a=1./i;
    b=1./(2*i);
    q(1) =4;
    r(i)=(1-b).*(q(i))+(b).*(func3(q(i)));
    t(i)=(1-b).*(r(i))+(b).*(func3(r(i)));
    q(i+1)=(1-a).*(func3(r(i)))+(a).*(func3(t(i)));
    x(1)=4;
    z(i)=(1-b).*(x(i))+(b).*(func3(x(i)));
    y(i)=(1-b).*(func3(x(i)))+(b).*(func3(func3(z(i))));
    x(i+1)=(1-a).*(func3(z(i)))+(a).*(func3(func3(y(i))));
    c(1) = 4; c(i+1)=4;
    d(1) = 2.9; d(i+1)=2.9;
    e(1) = 3; e(i+1)=3;
end
f=1:11;
plot(f,q,'g',f,x,'b+',f,e,'r--',f,c,'k',f,d,'k')
axis([1 10 3 3.06])
legend('P-iteration','ST-iteration')
fx >> |

```

Figure B.11: To compare the rate of convergence between P-iteration and ST-iteration to the fixed point $p = 3$ of $f(x) = \sqrt{x} + 6$.

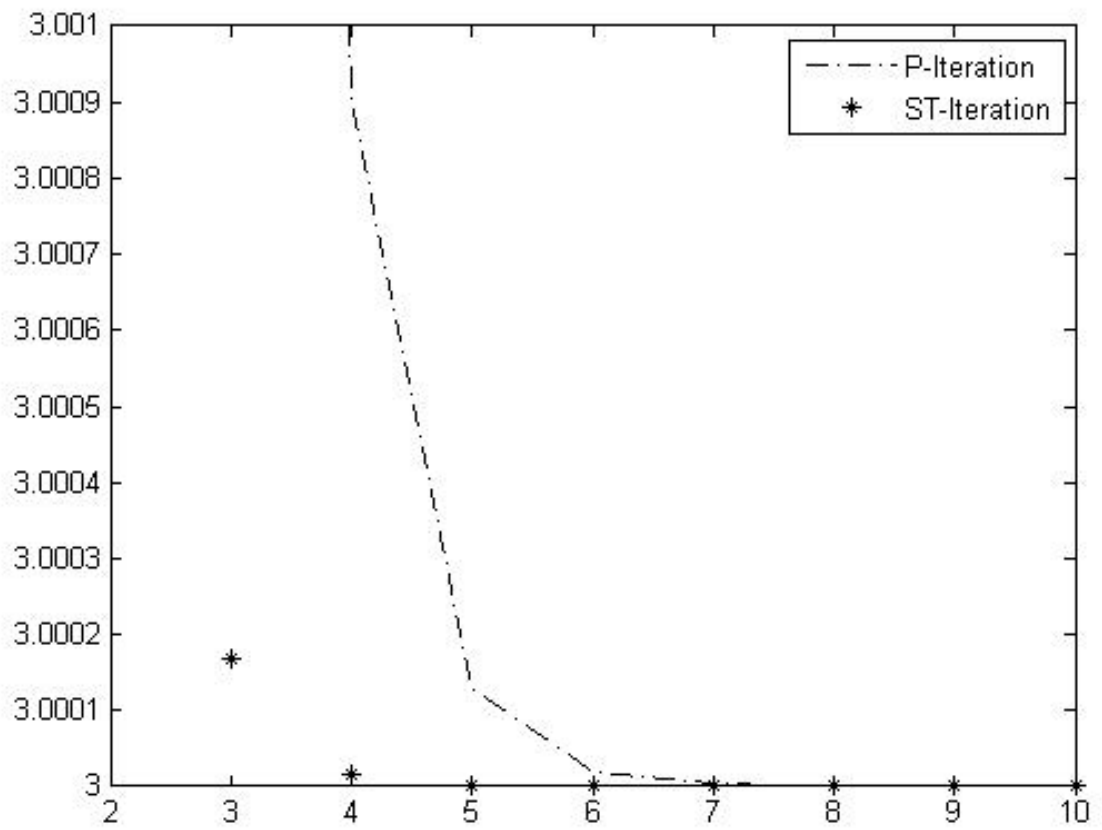
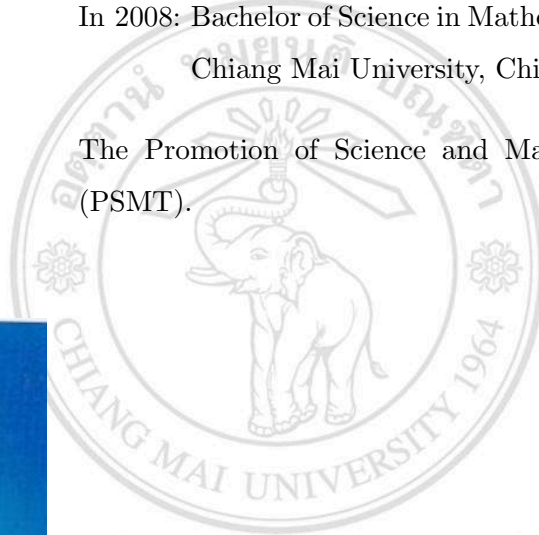


Figure B.12: The comparison graph of the convergence between P-iteration and ST-iteration to the fixed point $p = 3$ of f .

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