Numerical Analysis Lab2

2020032306 송민경

2.

	k1	k2	k3	k4	w0	w1
h=0.05	-0.050000	-0.047531	-0.047652	-0.045348	1.000000	0.952381
0.10	-0.045351	-0.043218	-0.043317	-0.041320	0.952381	0.909091
0.15	-0.041322	-0.039465	-0.039548	-0.037805	0.909091	0.869565
0.20	-0.037807	-0.036181	-0.036250	-0.034721	0.869565	0.833333
0.25	-0.034722	-0.033291	-0.033349	-0.031999	0.833333	0.800000
0.30	-0.032000	-0.030733	-0.030782	-0.029585	0.800000	0.769231
0.35	-0.029586	-0.028459	-0.028501	-0.027434	0.769231	0.740741
0.40	-0.027435	-0.026428	-0.026465	-0.025510	0.740741	0.714286
0.45	-0.025510	-0.024607	-0.024639	-0.023781	0.714286	0.689655
0.50	-0.023781	-0.022968	-0.022996	-0.022222	0.689655	0.666667
0.55	-0.022222	-0.021488	-0.021512	-0.020811	0.666667	0.645161
0.60	-0.020812	-0.020146	-0.020167	-0.019531	0.645161	0.625000
0.65	-0.019531	-0.018926	-0.018944	-0.018365	0.625000	0.606061
0.70	-0.018365	-0.017813	-0.017830	-0.017301	0.606061	0.588235
0.75	-0.017301	-0.016796	-0.016811	-0.016326	0.588235	0.571429
0.80	-0.016327	-0.015863	-0.015876	-0.015432	0.571429	0.555556
0.85	-0.015432	-0.015006	-0.015018	-0.014609	0.555556	0.540541
0.90	-0.014609	-0.014217	-0.014227	-0.013850	0.540541	0.526316
0.95	-0.013850	-0.013488	-0.013498	-0.013149	0.526316	0.512821
1.00	-0.013149	-0.012814	-0.012823	-0.012500	0.512821	0.500000
1.05	-0.012500	-0.012189	-0.012197	-0.011898	0.500000	0.487805
1.10	-0.011898	-0.011609	-0.011616	-0.011338	0.487805	0.476190
1.15	-0.011338	-0.011070	-0.011076	-0.010817	0.476190	0.465116
1.20	-0.010817	-0.010567	-0.010572	-0.010331	0.465116	0.454545
1.25	-0.010331	-0.010097	-0.010102	-0.009876	0.454545	0.444444
1.30	-0.009877	-0.009658	-0.009663	-0.009452	0.444444	0.434783
1.35	-0.009452	-0.009247	-0.009252	-0.009054	0.434783	0.425532
1.40	-0.009054	-0.008862	-0.008866	-0.008681	0.425532	0.416667
1.45	-0.008681	-0.008501	-0.008504	-0.008330	0.416667	0.408163
1.50	-0.008330	-0.008161	-0.008164	-0.008000	0.408163	0.400000
1.55	-0.008000	-0.007841	-0.007844	-0.007689	0.400000	0.392157
1.60	-0.007689	-0.007539	-0.007542	-0.007396	0.392157	0.384615
1.65	-0.007396	-0.007255	-0.007258	-0.007120	0.384615	0.377359
1.70	-0.007120	-0.006986	-0.006989	-0.006859	0.377359	0.370370
1.75	-0.006859	-0.006732	-0.006735	-0.006612	0.370370	0.363636
1.80	-0.006612	-0.006492	-0.006494	-0.006378	0.363636	0.357143
1.85	-0.006378	-0.006264	-0.006266	-0.006156	0.357143	0.350877
1.90	-0.006156	-0.006048	-0.006050	-0.005945	0.350877	0.344828
1.95	-0.005945	-0.005843	-0.005845	-0.005745	0.344828	0.338983
2.00	-0.005745	-0.005649	-0.005650	-0.005556	0.338983	0.333333

2.

	k1	k2	k3	k4	w0	w1
h=0.1	-0.100000	-0.090250	-0.091179	-0.082596	1.000000	0.909091
0.2	-0.082645	-0.075302	-0.075941	-0.069414	0.909091	0.833334
0.3	-0.069445	-0.063778	-0.064231	-0.059152	0.833334	0.769231
0.4	-0.059172	-0.054708	-0.055038	-0.051007	0.769231	0.714286
0.5	-0.051020	-0.047441	-0.047688	-0.044435	0.714286	0.666667
0.6	-0.044445	-0.041531	-0.041719	-0.039056	0.666667	0.625000
0.7	-0.039063	-0.036659	-0.036805	-0.034597	0.625000	0.588236
0.8	-0.034602	-0.032597	-0.032711	-0.030861	0.588236	0.555556
0.9	-0.030864	-0.029173	-0.029265	-0.027698	0.555556	0.526316
1.0	-0.027701	-0.026262	-0.026336	-0.024998	0.526316	0.500000
1.1	-0.025000	-0.023766	-0.023826	-0.022674	0.500000	0.476191
1.2	-0.022676	-0.021609	-0.021658	-0.020660	0.476191	0.454546
1.3	-0.020661	-0.019733	-0.019774	-0.018903	0.454546	0.434783
1.4	-0.018904	-0.018091	-0.018125	-0.017360	0.434783	0.416667
1.5	-0.017361	-0.016645	-0.016675	-0.015999	0.416667	0.400000
1.6	-0.016000	-0.015366	-0.015391	-0.014792	0.400000	0.384616
1.7	-0.014793	-0.014229	-0.014251	-0.013717	0.384616	0.370371
1.8	-0.013717	-0.013214	-0.013232	-0.012755	0.370371	0.357143
1.9	-0.012755	-0.012304	-0.012319	-0.011890	0.357143	0.344828
2.0	-0.011891	-0.011484	-0.011498	-0.011111	0.344828	0.333333

3. 2)

```
implicit real*8(a-h, o-z)
dimension A(1024, 1024), p(1024), q(1024), xnew(1024), &
x(1024), r(1024), b(1024)
nx = 32
N = nx**2
tol = 1.e-8
data x/1024*0./
do i = 1, N
  if(i > 1) a(i, i-1) = -1.
  if(i < N) a(i, i+1) = -1
  if(i+nx  <= N) a(i, i+nx) = -1.
  if(i-nx >=1) a(i, i-nx) = -1
  a(i, i) = 4.5
  b(i) = cos(i+0.5)
enddo
p = b
r = b
call matvec(A, p, q, N)
rho = dot_product(r, r)
alpha = rho/dot_product(p, q)
x = x + alpha*p
r = r - alpha*q
r0 = sqrt(dot_product(b, b))
do k = 2, N/2
  rho0 = rho
  rho = dot_product(r, r)
  beta = rho/rho0
  p = r + beta*p
  call matvec(A, p, q, N)
  alpha = rho/dot_product(p, q)
  x = x + alpha*p
  r = r - alpha*q
  rn = dot_product(r, r)
  error = sqrt(rn/r0)
  write(*, *) k, rn, error
  if(error < tol) goto 300
```

```
      enddo

300   continue
            write(*, *) x(1), x(2), x(N-1), x(N)
      stop
      end
      subroutine matvec(A, x, y, N)
            implicit real*8(a-h, o-z)
      dimension A(N, *), x(*), y(*)
      do i = 1, N
        y(i) = 0.
        do j = 1, N
          y(i) = y(i) + A(i,j)*x(j)
        enddo
      enddo
      return
      end
```

2) Result

```
 2   1.1053738703419571          0.22102010406394906
 3  0.20735558830425369          9.5727133434201736E-002
 4   4.0205486219384683E-002     4.2152160698108745E-002
 5   7.0286519478240236E-003     1.7624353738663112E-002
 6   1.6514979648255660E-003     8.5431140338101241E-003
 7   4.7989218687286548E-004     4.6052055733052160E-003
 8   2.0105159398927039E-004     2.9807869917960203E-003
 9   8.4142613174156654E-005     1.9283469698418154E-003
10   2.9226574826844186E-005     1.1364913715302461E-003
11   9.7040309593116191E-006     6.5486724520995028E-004
12   3.2951260591238805E-006     3.8160424643428499E-004
13   1.2565972789934757E-006     2.3565422982806513E-004
14   4.9351597716764323E-007     1.4768207662557738E-004
15   1.8778727473666905E-007     9.1098297691911474E-005
16   6.5863369987792446E-008     5.3950957412099724E-005
17   2.2076002328949685E-008     3.1234704209806312E-005
18   8.4002558802844624E-009     1.9267414462583300E-005
```

19	3.4305415880409289E-009	1.2312848228088327E-005
20	1.2785822506232976E-009	7.5169475091354332E-006
21	4.2256705716697056E-010	4.3214053019595904E-006
22	1.4643652258256721E-010	2.5439108378385822E-006
23	5.7764178786059956E-011	1.5977413820448304E-006
24	2.1806329022986759E-011	9.8167665273431707E-007
25	7.3443561717848126E-012	5.6971026823776056E-007
26	2.6074130933283237E-012	3.3945491635577335E-007
27	1.1434607098317016E-012	2.2479559939505651E-007
28	4.1290627101836978E-013	1.3508369182379652E-007
29	1.5073767698714791E-013	8.1618402658318863E-008
30	5.4973169414503298E-014	4.9289290894695457E-008
31	2.0806826384968993E-014	3.0323554227208665E-008
32	8.0104391290513366E-015	1.8815048591246413E-008
33	2.9018311987735669E-015	1.1324349249608845E-008
34	1.1201706858552616E-015	7.0358939299116064E-009

-0.16227354189609317 -0.42303156759582916 0.25294043995108778
0.37603840772234071

=> x(1) = -0.16227354189609317, x(1024) = 0.37603840772234071