Лабораторная работа №9

Задание 3

```
A = [0 1 0 0;
-1 0 0 0;
0 0 0 8;
0 0 -8 0]
```

```
A = 4×4
     0     1     0     0
    -1     0     0     0
     0     0     0     8
     0     0    -8     0
```

```
B = [0; 7; 0; 6]
```

```
B = 4×1
     0
     7
     0
     6
```

```
C = [0 4 1 0]
```

```
C = 1×4
     0     4     1     0
```

Определяем собственные числа

```
eig(A)
```

```
ans = 4×1 complex
   0.0000 + 1.0000i
   0.0000 - 1.0000i
   0.0000 + 8.0000i
   0.0000 - 8.0000i
```

Выберем различные значения желаемой степени устойчивости α

```
a_1 = 7
```

```
a_1 = 7
```

```
a_2 = 2
```

```
a_2 = 2
```

```
a_3 = 0.05
```

```
a_3 = 0.0500
```

Далее решаем неравенства Ляпунова

```
x_0 = [1; 1; 1; 1]
```

```
x_0 = 4×1
     1
     1
     1
```

1

```
%m = 25

cvx_begin sdp
variable Q(4, 4)
variable Y(4, 1)
variable P(4, 4)
variable Y1(1, 4)
variable m
minimize m
Q > 0.00001*eye(4);
```

```
Warning: The use of strict inequalities in CVX is strongly discouraged,
    because solvers treat them as non-strict inequalities. Please
    consider using ">=" instead.
Warning: This linear matrix inequality appears to be unsymmetric. This is
very likely an error that will produce unexpected results. Please check
the LMI; and, if necessary, re-enter the model.
```

```
%P > 0.00001*eye(4);
A'*Q + Q*A + 2*a_1*Q + C'*Y'+Y*C <= 0;
```

```
Warning: This linear matrix inequality appears to be unsymmetric. This is
very likely an error that will produce unexpected results. Please check
the LMI; and, if necessary, re-enter the model.
```

```
%P*A' + A*P + 2*a_3*P + Y1'*B' + B*Y1 <= 0;
%[P x_0;
%    x_0' 1] > 0;
%[P Y1';
%    Y1 m] > 0;
cvx_end
```

```
Calling SDPT3 4.0: 41 variables, 6 equality constraints
------------------------------------------------------------

 num. of constraints =  6
 dim. of sdp    var  =  8,   num. of sdp  blk  =  2
 dim. of free   var  = 21 *** convert ublk to lblk
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
   HKM      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-------------------------------------------------------------------
 0|0.000|0.000|2.7e+02|1.2e+02|7.7e+04| 1.151733e-09  0.000000e+00| 0:0:00| chol  1  1
 1|0.965|0.964|9.3e+00|4.6e+00|6.6e+02|-3.857426e+00  1.862748e-03| 0:0:00| chol  1  1
 2|0.870|0.351|1.2e+00|3.0e+00|1.7e+02|-7.914104e+01  1.936250e-03| 0:0:00| chol  1  1
 3|0.646|0.035|4.3e-01|3.6e+00|1.1e+04|-3.513564e+04  1.959128e-03| 0:0:00| chol  1  1
 4|0.022|0.165|4.2e-01|3.8e+00|1.9e+04|-4.864785e+04  1.904988e-02| 0:0:00| chol  1  1
 5|0.580|0.108|1.8e-01|4.2e+00|2.1e+05|-3.814597e+05  2.254190e-02| 0:0:00| chol  1  1
 6|1.000|0.091|3.9e-06|4.6e+00|2.2e+06|-3.119315e+06  2.381233e-02| 0:0:00| chol  1  1
 7|1.000|0.163|5.8e-05|4.6e+00|1.3e+07|-1.848686e+07  2.156442e-02| 0:0:00| chol  1  1
 8|1.000|0.290|5.8e-05|3.3e+00|2.4e+07|-1.053246e+08  1.324770e-02| 0:0:00| chol  1  1
 9|1.000|0.166|6.9e-05|3.5e+00|1.0e+09|-3.193491e+09  1.176636e-02| 0:0:00| chol  1  1
10|1.000|0.149|6.8e-05|3.8e+00|2.3e+10|-5.466024e+10  1.131426e-02| 0:0:00| chol  1  1
11|1.000|0.104|2.9e-04|4.2e+00|3.6e+11|-6.202336e+11  7.706254e-03| 0:0:00| chol  2  2
```

```
12|1.000|0.103|3.7e-04|4.6e+00|3.3e+12|-4.654872e+12  9.027782e-03| 0:0:00| chol  2  2
13|1.000|0.234|6.4e-03|3.5e+00|8.6e+12|-2.688518e+13  5.290227e-03| 0:0:00| chol  2  2
14|1.000|0.218|2.3e-02|2.7e+00|1.3e+13|-4.768620e+14  5.149214e-03| 0:0:00| chol  2  2
15|1.000|0.022|1.5e-01|3.5e+00|2.4e+17|-8.007600e+17  5.012716e-03| 0:0:00|
  sqlp stop: dual problem is suspected of being infeasible
------------------------------------------------------------------
 number of iterations   = 15
 residual of dual infeasibility
 certificate X          = 1.89e-19
 reldist to infeas.    <= 2.70e-21
 Total CPU time (secs)  = 0.16
 CPU time per iteration = 0.01
 termination code       =  2
 DIMACS: 1.5e-01  0.0e+00  4.2e+00  0.0e+00  -1.0e+00  3.0e-01
------------------------------------------------------------------

------------------------------------------------------------
Status: Unbounded
Optimal value (cvx_optval): -Inf
```

```
%m
```

И находим матриу реглятора K:

```
%K = Y1*inv(P)
L = inv(Q)*Y
```

```
L = 4×1
  325.6983
  -69.1668
  225.0600
  -11.3606
```

Далее определим корни матрицы A+BK:

```
LC = eig(A+L*C)
```

```
LC = 4×1 complex
 -16.3460 +21.3989i
 -16.3460 -21.3989i
  -9.4576 + 5.0751i
  -9.4576 - 5.0751i
```

```
%BK = eig(A+B*K)
```