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_3*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|1.9e+01|1.2e+02|7.6e+04| 1.151562e-09  0.000000e+00| 0:0:00| chol  1  1
 1|1.000|0.690|1.4e-04|3.7e+01|5.8e+03|-3.996753e+00  2.114563e-05| 0:0:00| chol  1  1
 2|1.000|0.907|1.5e-04|3.5e+00|1.8e+02|-7.311278e+00  1.955106e-06| 0:0:00| chol  1  1
 3|1.000|0.181|2.3e-05|3.6e+00|2.0e+02|-2.360179e+02  1.587137e-06| 0:0:00| chol  1  1
 4|1.000|0.223|3.5e-05|2.8e+00|2.1e+02|-4.023365e+03  1.223228e-06| 0:0:00| chol  1  1
 5|1.000|0.023|2.1e-06|3.5e+00|2.0e+06|-6.448467e+06  1.194653e-06| 0:0:00| chol  1  1
 6|1.000|0.004|1.1e-04|4.3e+00|7.2e+07|-1.195940e+08  7.475224e-07| 0:0:00| chol  1  1
 7|1.000|0.053|7.8e-06|4.9e+00|7.0e+08|-8.562726e+08  1.180751e-06| 0:0:00| chol  1  1
 8|1.000|0.322|1.9e-05|3.3e+00|1.0e+09|-4.265991e+09  5.323317e-07| 0:0:00| chol  1  1
 9|1.000|0.171|1.8e-05|3.5e+00|3.9e+10|-1.229234e+11  5.575711e-07| 0:0:00| chol  1  1
10|1.000|0.070|2.0e-05|4.1e+00|1.1e+12|-2.099016e+12  6.223356e-07| 0:0:00| chol  1  2
11|1.000|0.132|3.6e-04|4.3e+00|1.1e+13|-1.762831e+13  3.557674e-07| 0:0:00| chol  2  2
```

```
12|1.000|0.126|1.6e-02|4.6e+00|8.7e+13|-1.191202e+14  4.665500e-07| 0:0:00| chol  2  2
13|1.000|0.336|7.6e-03|3.1e+00|1.0e+14|-6.789586e+14  2.082412e-07| 0:0:00| chol  2  2
  stop: primal infeas has deteriorated too much, 1.7e-01
14|1.000|0.114|7.6e-03|3.1e+00|1.0e+14|-6.789586e+14  2.082412e-07| 0:0:00|
  prim_inf,dual_inf,relgap = 7.58e-03, 3.06e+00, 1.50e-01
  sqlp stop: dual problem is suspected of being infeasible
------------------------------------------------------------------
 number of iterations   = 14
 residual of dual infeasibility
 certificate X          = 1.88e-06
 reldist to infeas.    <= 3.82e-08
 Total CPU time (secs)  = 0.13
 CPU time per iteration = 0.01
 termination code       =  2
 DIMACS: 3.5e-05  0.0e+00  3.4e+00  0.0e+00  -1.0e+00  5.2e-02
------------------------------------------------------------------

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

```
%m
```

И находим матриу реглятора K:

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

```
L = 4×1
    0.2086
   -0.5418
   -1.1200
   -0.4154
```

Далее определим корни матрицы A+BK:

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

```
LC = 4×1 complex
  -1.0617 + 0.8574i
  -1.0617 - 0.8574i
  -0.5818 + 8.0303i
  -0.5818 - 8.0303i
```

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