

```
>> demo_Polynomial_Dictionary_Learning_Uber
```

```
Starting to train the dictionary
```

```
solving the quadratic problem with YALMIP...
```

```
num. of constraints = 3
dim. of socp var = 4, num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.
```

```
*** convert ublk to linear blk
```

```
***** ✓
*****
```

```
SDPT3: homogeneous self-dual path-following algorithms
```

```
***** ✓
*****
```

```
version predcorr gam expon
HKM 1 0.000 1
```

```
it pstep dstep pinfeas dinfeas gap mean(obj) cputime kap tau theta ✓
-----
```

```
0|0.000|0.000|5.0e-01|3.5e+00|2.3e+04| 5.859116e+02| 0:0:00|2.3e+04|1.0e+00|1.0e+00| ✓
chol 1 1
1|0.901|0.901|4.9e-02|3.4e-01|2.6e+03| 4.221328e+02| 0:0:00|3.3e+02|1.1e+00|1.1e-01| ✓
chol 1 1
2|0.780|0.780|1.1e-02|7.4e-02|4.4e+02| 8.134312e+01| 0:0:00|9.0e+00|1.4e+00|2.9e-02| ✓
chol 1 1
3|0.994|0.994|2.0e-04|1.4e-03|7.3e+00|-3.743893e+01| 0:0:00|4.1e+00|1.5e+00|6.0e-04| ✓
chol 1 1
4|0.982|0.982|5.1e-06|2.3e-04|1.7e-01|-3.973967e+01| 0:0:00|1.2e-01|1.6e+00|1.6e-05| ✓
chol 1 1
5|0.951|0.951|4.3e-07|9.6e-05|1.8e-02|-3.976679e+01| 0:0:00|1.7e-03|1.7e+00|1.4e-06| ✓
chol 1 1
6|1.000|1.000|4.7e-08|3.6e-05|2.3e-03|-3.976747e+01| 0:0:00|1.4e-04|1.8e+00|1.6e-07| ✓
chol 1 1
7|1.000|1.000|1.3e-08|1.4e-05|3.2e-04|-3.976752e+01| 0:0:00|2.9e-05|1.8e+00|2.5e-08| ✓
chol 1 1
8|1.000|1.000|1.8e-08|5.7e-06|4.5e-05|-3.976753e+01| 0:0:00|4.7e-06|1.9e+00|3.5e-09| ✓
chol 1 1
9|1.000|1.000|5.1e-08|2.3e-06|6.6e-06|-3.976753e+01| 0:0:00|7.1e-07|1.9e+00|0.0e+00| ✓
chol 1 1
10|1.000|1.000|2.4e-07|2.3e-06|2.4e-07|-3.976754e+01| 0:0:00|1.1e-07|1.9e+00|0.0e+00|
```

```
Stop: relative gap < infeasibility
```

```
-----
number of iterations = 10
primal objective value = -3.97675312e+01
dual objective value = -3.97675275e+01
gap := trace(XZ) = 6.57e-06
relative gap = 1.61e-07
actual relative gap = -4.60e-08
rel. primal infeas = 5.06e-08
rel. dual infeas = 2.28e-06
norm(X), norm(y), norm(Z) = 1.4e+00, 4.0e+01, 7.7e+00
norm(A), norm(b), norm(C) = 1.6e+02, 1.0e+00, 5.7e+01
Total CPU time (secs) = 0.08
CPU time per iteration = 0.01
```

```

termination code      = -1
DIMACS errors: 5.1e-08  0.0e+00  2.3e-06  0.0e+00  -4.6e-08  8.2e-08
-----

```

```
ans =
```

```
39.7675
```

```

num. of constraints = 3
dim. of socp var   = 4,   num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.

```

```

*** convert ublk to linear blk
*****
SDPT3: homogeneous self-dual path-following algorithms
*****
version  predcorr  gam  expon
HKM      1      0.000  1
it pstep dstep pinfeas dinfeas gap      mean(obj)      cputime      kap      tau      theta
-----
0|0.000|0.000|1.0e+00|1.4e+10|8.3e+15| 2.288992e+14| 0:0:00|8.3e+16|1.0e+00|1.0e+00| ✓
chol 1 1
1|1.000|1.000|8.2e-02|1.1e+09|1.7e+15| 3.277388e+14| 0:0:00|5.3e+15|9.5e-01|7.6e-02| ✓
chol
SMW too ill-conditioned, switch to LU factor, 1.2e+35.
switch to LU factor lu 1 1
2|0.994|0.994|1.0e-02|1.4e+08|5.2e+14| 1.767447e+14| 0:0:00|1.8e+14|9.3e-01|9.3e-03| ✓
lu 1 1
3|0.964|0.964|4.2e-04|5.9e+06|1.9e+13| 5.713521e+12| 0:0:00|2.5e+12|9.8e-01|4.1e-04| ✓
lu 1 1
4|0.982|0.982|1.1e-05|1.5e+05|4.8e+11| 7.173418e+10| 0:0:00|1.5e+11|1.0e+00|1.1e-05| ✓
lu 1 1
5|0.972|0.972|4.6e-07|6.3e+03|2.3e+10| 9.942428e+08| 0:0:00|2.4e+09|1.0e+00|4.8e-07| ✓
lu 1 1
6|0.990|0.990|1.1e-08|1.6e+02|6.0e+08| 3.243649e+07| 0:0:00|1.4e+08|1.1e+00|1.2e-08| ✓
lu 1 1
7|0.992|0.992|5.9e-10|8.8e+00|4.4e+07| 3.653226e+05| 0:0:00|7.6e+06|1.1e+00|6.9e-10| ✓
lu 1 1
8|1.000|1.000|9.7e-11|5.6e-01|3.0e+06| 8.045225e+03| 0:0:00|4.5e+05|1.1e+00|4.4e-11| ✓
lu 1 1
9|0.989|0.989|3.5e-10|1.1e-02|3.3e+04| 1.557511e+02| 0:0:00|3.5e+04|1.1e+00|8.5e-13| ✓
lu 1 1
10|0.989|0.989|4.7e-10|2.1e-04|3.7e+02|-2.513767e+00| 0:0:00|9.5e+02|1.1e+00|1.6e-14| ✓
lu 1 1
11|0.986|0.986|6.2e-11|4.8e-06|5.2e+00|-6.579615e+00| 0:0:00|2.4e+01|1.1e+00|3.6e-16| ✓
lu 1 1
12|0.877|0.877|8.2e-10|1.7e-06|2.4e+00|-6.192570e+00| 0:0:00|3.2e+00|1.1e+00|7.0e-17| ✓
lu 1 1
13|0.668|0.668|6.7e-10|1.6e-06|2.7e+00|-5.997959e+00| 0:0:00|1.1e+00|1.1e+00|4.9e-17| ✓
lu 1 1

```

```

14|0.890|0.890|3.9e-11|1.5e-06|3.5e-01|-6.541953e+00| 0:0:00|1.5e-01|1.1e+00|6.4e-18| ✓
lu 1 1
15|0.680|0.680|1.4e-09|1.5e-06|3.0e-01|-6.550295e+00| 0:0:00|5.1e-02|1.1e+00|4.5e-18| ✓
lu 1 1
16|0.913|0.913|1.4e-10|1.5e-06|2.8e-02|-6.616171e+00| 0:0:00|7.3e-03|1.1e+00|4.6e-19| ✓
lu 2 1
17|0.715|0.715|5.2e-09|1.5e-06|2.2e-02|-6.617663e+00| 0:0:00|2.3e-03|1.1e+00|3.1e-19| ✓
lu 1 2
18|0.917|0.917|5.2e-10|1.5e-06|1.9e-03|-6.622455e+00| 0:0:00|3.9e-04|1.1e+00|3.0e-20| ✓
lu 2 2
19|0.734|0.734|2.1e-08|1.5e-06|1.4e-03|-6.622252e+00| 0:0:00|1.2e-04|1.1e+00|2.8e-20| ✓
lu 2 2
20|0.922|0.922|1.6e-09|1.5e-06|1.2e-04|-6.622924e+00| 0:0:00|2.2e-05|1.1e+00|1.1e-21| ✓
lu 3 2
21|0.928|0.928|8.1e-08|1.5e-06|7.2e-05|-6.624140e+00| 0:0:00|2.7e-06|1.1e+00|0.0e+00| ✓
lu 2 2
22|0.979|0.979|4.5e-09|1.5e-06|7.4e-06|-6.622855e+00| 0:0:00|7.2e-07|1.1e+00|2.6e-21| ✓
lu 2 5
23|1.000|1.000|3.1e-08|1.5e-06|2.7e-06|-6.622429e+00| 0:0:00|7.3e-08|1.1e+00|1.3e-20| ✓
lu 2 3
24|1.000|1.000|2.3e-08|1.5e-06|1.2e-07|-6.622566e+00| 0:0:00|2.5e-08|1.1e+00|9.4e-21|
Stop: relative gap < infeasibility

```

```

-----
number of iterations    = 24
primal objective value = -6.62278297e+00
dual   objective value = -6.62292639e+00
gap := trace(XZ)       = 7.39e-06
relative gap           = 9.69e-07
actual relative gap    = 1.01e-05
rel. primal infeas     = 4.54e-09
rel. dual   infeas     = 1.46e-06
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 8.2e+11, 7.3e+11, 5.7e+01
Total CPU time (secs)   = 0.19
CPU time per iteration = 0.01
termination code        = -1
DIMACS errors: 4.5e-09  0.0e+00  1.5e-06  0.0e+00  1.0e-05  5.2e-07
-----

```

ans =

6.6229

Iteration 2 Total error is: 0.045565

```

num. of constraints = 3
dim. of socp var   = 4,   num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.

```

```

*** convert ublk to linear blk
*****
SDPT3: homogeneous self-dual path-following algorithms
*****

```

```

version  predcorr  gam  expon
HKM      1      0.000  1
it pstep dstep pinfeas dinfeas gap      mean(obj)      cputime      kap      tau      theta
-----
-----
0|0.000|0.000|1.0e+00|7.6e+09|7.6e+15| 2.081488e+14| 0:0:00|7.6e+16|1.0e+00|1.0e+00| ✓
chol 1 1
1|1.000|1.000|5.7e-02|4.5e+08|1.1e+15| 2.603269e+14| 0:0:00|3.4e+15|9.6e-01|5.7e-02| ✓
chol
SMW too ill-conditioned, switch to LU factor, 6.5e+34.
switch to LU factor lu 1 1
2|0.972|0.972|6.2e-03|4.8e+07|2.5e+14| 9.328039e+13| 0:0:00|1.1e+14|9.7e-01|6.1e-03| ✓
lu 1 1
3|0.981|0.981|1.6e-04|1.2e+06|5.6e+12| 1.443049e+12| 0:0:00|1.3e+12|1.0e+00|1.6e-04| ✓
lu 1 1
4|0.984|0.984|3.7e-06|2.8e+04|1.3e+11| 1.728639e+10| 0:0:00|5.4e+10|1.0e+00|3.8e-06| ✓
lu 1 1
5|0.961|0.961|1.9e-07|1.5e+03|7.9e+09| 4.902486e+08| 0:0:00|7.7e+08|1.1e+00|2.1e-07| ✓
lu 1 1
6|0.994|0.994|3.4e-09|2.5e+01|1.4e+08| 6.272982e+06| 0:0:00|6.9e+07|1.1e+00|3.6e-09| ✓
lu 1 1
7|0.992|0.992|1.9e-10|1.3e+00|1.0e+07| 6.933222e+04| 0:0:00|2.4e+06|1.1e+00|1.9e-10| ✓
lu 1 1
8|1.000|1.000|5.6e-11|8.3e-02|7.3e+05| 1.914057e+03| 0:0:00|1.1e+05|1.1e+00|1.2e-11| ✓
lu 1 1
9|0.989|0.989|8.5e-11|1.6e-03|8.0e+03| 4.929587e+01| 0:0:00|8.6e+03|1.1e+00|2.3e-13| ✓
lu 1 1
10|0.989|0.989|5.9e-11|3.0e-05|8.8e+01|-5.982101e+00| 0:0:00|2.4e+02|1.1e+00|4.4e-15| ✓
lu 1 1
11|0.931|0.931|2.0e-11|2.8e-06|6.4e+00|-6.547418e+00| 0:0:00|1.9e+01|1.1e+00|3.4e-16| ✓
lu 1 1
12|0.208|0.208|6.7e-11|2.7e-06|8.7e+00|-5.614877e+00| 0:0:00|1.5e+01|1.1e+00|3.2e-16| ✓
lu 1 1
13|0.964|0.964|2.9e-12|1.5e-06|4.3e-01|-6.562103e+00| 0:0:00|7.4e-01|1.1e+00|1.6e-17| ✓
lu 1 1
14|0.967|0.967|3.2e-11|1.5e-06|4.0e-01|-6.526707e+00| 0:0:00|3.4e-02|1.1e+00|6.1e-18| ✓
lu 1 1
15|0.906|0.906|2.6e-12|1.5e-06|4.0e-02|-6.614650e+00| 0:0:00|6.7e-03|1.1e+00|6.6e-19| ✓
lu 1 1
16|0.899|0.899|5.8e-11|1.5e-06|2.2e-02|-6.618832e+00| 0:0:00|1.0e-03|1.1e+00|3.2e-19| ✓
lu 1 1
17|0.901|0.901|1.9e-11|1.5e-06|2.3e-03|-6.623652e+00| 0:0:00|2.9e-04|1.1e+00|3.6e-20| ✓
lu 2 2
18|0.713|0.713|3.8e-10|1.5e-06|1.6e-03|-6.623803e+00| 0:0:00|9.9e-05|1.1e+00|2.5e-20| ✓
lu 1 1
19|0.920|0.920|4.1e-11|1.5e-06|1.4e-04|-6.624174e+00| 0:0:00|2.2e-05|1.1e+00|2.3e-21| ✓
lu 2 2
20|0.749|0.749|1.4e-09|1.5e-06|9.8e-05|-6.624164e+00| 0:0:00|6.7e-06|1.1e+00|2.1e-21| ✓
lu 2 2
21|0.918|0.918|5.8e-11|1.5e-06|8.6e-06|-6.624206e+00| 0:0:00|1.4e-06|1.1e+00|1.7e-22| ✓
lu 2 2
22|0.725|0.725|1.3e-09|1.5e-06|6.2e-06|-6.624223e+00| 0:0:00|4.5e-07|1.1e+00|0.0e+00| ✓
lu 2 2
23|0.987|0.987|3.1e-10|1.5e-06|7.9e-07|-6.624213e+00| 0:0:00|6.5e-08|1.1e+00|0.0e+00| ✓

```

```

lu 2 2
24|1.000|1.000|2.8e-11|1.5e-06|2.6e-07|-6.624214e+00| 0:0:00|7.7e-09|1.1e+00|0.0e+00|
lack of progress in infeas
-----
number of iterations      = 24
primal objective value    = -6.62420259e+00
dual   objective value    = -6.62420858e+00
gap := trace(XZ)          = 8.55e-06
relative gap              = 1.12e-06
actual relative gap       = 4.21e-07
rel. primal infeas        = 5.82e-11
rel. dual   infeas        = 1.46e-06
norm(X), norm(Y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 4.5e+11, 6.7e+11, 5.7e+01
Total CPU time (secs)     = 0.20
CPU time per iteration    = 0.01
termination code          = -9
DIMACS errors: 5.8e-11  0.0e+00  1.5e-06  0.0e+00  4.2e-07  6.0e-07
-----

ans =

    6.6242

Iteration    3    Total error is: 0.045565

num. of constraints = 3
dim. of socp var   = 4,    num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.

*** convert ublk to linear blk
*****
SDPT3: homogeneous self-dual path-following algorithms
*****
version predcorr gam expon
HKM      1      0.000  1
it pstep dstep pinfeas dinfeas gap      mean(obj)      cputime      kap      tau      theta
-----
0|0.000|0.000|1.0e+00|7.0e+09|5.4e+14| 1.489830e+13| 0:0:00|5.4e+15|1.0e+00|1.0e+00| ✓
chol 1 1
1|0.985|0.985|9.0e-03|1.6e+08|3.4e+13| 1.196424e+13| 0:0:00|7.0e+13|1.0e+00|2.3e-02| ✓
chol
SMW too ill-conditioned, switch to LU factor, 1.6e+33.
switch to LU factor lu 1 1
2|0.155|0.155|6.0e-03|1.5e+08|4.4e+13| 1.362906e+13| 0:0:00|6.3e+13|9.6e-01|2.1e-02| ✓
lu 1 1
3|0.824|0.824|2.5e-03|5.4e+07|2.6e+13| 8.459635e+12| 0:0:00|1.5e+13|9.1e-01|7.0e-03| ✓
lu 1 1
4|0.959|0.959|2.5e-04|3.2e+06|1.6e+12| 4.686325e+11| 0:0:00|3.5e+11|9.4e-01|4.3e-04| ✓
lu 1 1
5|0.980|0.980|9.3e-06|9.4e+04|4.4e+10| 6.117189e+09| 0:0:00|1.1e+10|9.7e-01|1.3e-05| ✓

```

```

lu 1 1
6|0.970|0.970|4.7e-07|4.1e+03|2.1e+09| 8.169689e+07| 0:0:00|1.8e+08|1.0e+00|6.0e-07| ✓
lu 1 1
7|0.986|0.986|1.8e-08|1.3e+02|6.7e+07| 4.579088e+06| 0:0:00|9.7e+06|1.1e+00|2.0e-08| ✓
lu 1 1
8|0.991|0.991|1.3e-09|7.5e+00|4.8e+06| 5.266546e+04| 0:0:00|7.6e+05|1.1e+00|1.2e-09| ✓
lu 1 1
9|1.000|1.000|6.8e-10|4.8e-01|3.3e+05| 1.032038e+03| 0:0:00|4.9e+04|1.1e+00|7.4e-11| ✓
lu 1 1
10|0.989|0.989|1.7e-09|9.3e-03|3.7e+03| 1.799277e+01| 0:0:00|3.8e+03|1.1e+00|1.4e-12| ✓
lu 1 1
11|0.989|0.989|2.2e-09|1.8e-04|4.1e+01|-6.033924e+00| 0:0:00|1.0e+02|1.1e+00|2.8e-14| ✓
lu 1 1
12|0.986|0.986|1.6e-10|4.1e-06|5.8e-01|-6.616672e+00| 0:0:00|2.7e+00|1.1e+00|6.1e-16| ✓
lu 1 1
13|0.852|0.852|1.5e-10|1.6e-06|2.9e-01|-6.573271e+00| 0:0:00|4.2e-01|1.1e+00|1.4e-16| ✓
lu 1 1
14|0.587|0.587|1.6e-10|1.5e-06|3.5e-01|-6.543777e+00| 0:0:00|1.8e-01|1.1e+00|1.0e-16| ✓
lu 1 1
15|0.906|0.906|2.6e-13|1.3e-06|3.9e-02|-6.614621e+00| 0:0:00|2.1e-02|1.1e+00|1.2e-17| ✓
lu 1 1
16|0.707|0.707|2.3e-10|1.3e-06|3.3e-02|-6.615224e+00| 0:0:00|6.5e-03|1.1e+00|7.8e-18| ✓
lu 1 1
17|0.910|0.910|2.9e-11|1.3e-06|3.2e-03|-6.622517e+00| 0:0:00|9.0e-04|1.1e+00|8.2e-19| ✓
lu 1 1
18|0.697|0.697|9.4e-10|1.3e-06|2.5e-03|-6.622662e+00| 0:0:00|3.0e-04|1.1e+00|5.6e-19| ✓
lu 1 1
19|0.919|0.919|8.2e-11|1.3e-06|2.2e-04|-6.623238e+00| 0:0:00|4.8e-05|1.1e+00|5.3e-20| ✓
lu 1 2
20|0.728|0.728|3.6e-09|1.3e-06|1.6e-04|-6.623247e+00| 0:0:00|1.5e-05|1.1e+00|3.7e-20| ✓
lu 1 1
21|0.918|0.918|3.4e-10|1.3e-06|1.4e-05|-6.623289e+00| 0:0:00|2.7e-06|1.1e+00|3.2e-21| ✓
lu 2 2
22|0.730|0.730|1.5e-08|1.3e-06|1.0e-05|-6.623305e+00| 0:0:00|8.3e-07|1.1e+00|0.0e+00| ✓
lu 1 2
23|0.988|0.988|3.0e-09|1.3e-06|1.3e-06|-6.623288e+00| 0:0:00|1.1e-07|1.1e+00|1.7e-21| ✓
lu 2 2
24|1.000|1.000|1.4e-08|1.3e-06|4.2e-07|-6.623276e+00| 0:0:00|1.3e-08|1.1e+00|6.4e-21|
Stop: relative gap < infeasibility

```

```

-----
number of iterations    = 24
primal objective value  = -6.62331862e+00
dual   objective value  = -6.62329203e+00
gap := trace(XZ)        = 1.04e-05
relative gap            = 1.36e-06
actual relative gap     = -1.87e-06
rel. primal infeas      = 1.50e-08
rel. dual   infeas      = 1.31e-06
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 4.2e+11, 4.8e+10, 5.7e+01
Total CPU time (secs)   = 0.14
CPU time per iteration  = 0.01
termination code        = -1
DIMACS errors: 1.5e-08  0.0e+00  1.3e-06  0.0e+00  -1.9e-06  7.3e-07
-----

```

ans =

6.6233

Iteration 4 Total error is: 0.045565

num. of constraints = 3
dim. of socp var = 4, num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.

*** convert ublk to linear blk

***** ✓

SDPT3: homogeneous self-dual path-following algorithms

***** ✓

version predcorr gam expon

HKM 1 0.000 1

it pstep dstep pinfeas dinfeas gap mean(obj) cputime kap tau theta

----- ✓

0|0.000|0.000|1.0e+00|9.7e+09|5.4e+14| 1.476501e+13| 0:0:00|5.4e+15|1.0e+00|1.0e+00| ✓

chol 1 1

1|0.987|0.987|1.2e-02|2.0e+08|3.3e+13| 1.183026e+13| 0:0:00|5.8e+13|1.0e+00|2.1e-02| ✓

chol

SMW too ill-conditioned, switch to LU factor, 4.7e+33.

switch to LU factor lu 1 1

2|0.445|0.445|2.4e-03|1.8e+08|5.6e+13| 1.559176e+13| 0:0:00|4.0e+13|8.8e-01|1.6e-02| ✓

lu 1 1

3|0.936|0.936|1.7e-04|1.3e+07|4.2e+12| 1.269479e+12| 0:0:00|8.8e+11|9.3e-01|1.3e-03| ✓

lu 1 1

4|0.977|0.977|1.8e-05|4.4e+05|1.4e+11| 1.920291e+10| 0:0:00|2.9e+10|9.7e-01|4.4e-05| ✓

lu 1 1

5|0.979|0.979|9.3e-07|1.4e+04|4.9e+09| 2.442735e+08| 0:0:00|1.0e+09|1.0e+00|1.5e-06| ✓

lu 1 1

6|0.945|0.945|7.9e-08|1.0e+03|3.4e+08| 2.107108e+07| 0:0:00|1.7e+07|1.1e+00|1.2e-07| ✓

lu 1 1

7|0.991|0.991|5.5e-09|5.3e+01|2.4e+07| 2.551547e+05| 0:0:00|3.3e+06|1.1e+00|5.9e-09| ✓

lu 1 1

8|1.000|1.000|1.1e-09|3.3e+00|1.7e+06| 5.637122e+03| 0:0:00|2.4e+05|1.1e+00|3.8e-10| ✓

lu 1 1

9|1.000|1.000|2.0e-09|2.6e-01|1.3e+05| 5.352244e+02| 0:0:00|1.7e+04|1.1e+00|3.0e-11| ✓

lu 1 1

10|0.988|0.988|1.4e-09|5.1e-03|1.5e+03| 4.572854e+00| 0:0:00|1.4e+03|1.1e+00|5.8e-13| ✓

lu 1 1

11|0.989|0.989|1.3e-09|9.7e-05|1.7e+01|-6.456347e+00| 0:0:00|4.0e+01|1.1e+00|1.1e-14| ✓

lu 1 1

12|0.915|0.915|1.4e-10|9.2e-06|1.5e+00|-6.591270e+00| 0:0:00|3.9e+00|1.1e+00|1.0e-15| ✓

lu 1 1

13|0.193|0.193|1.2e-10|8.8e-06|2.0e+00|-6.406001e+00| 0:0:00|3.1e+00|1.1e+00|9.9e-16| ✓

lu 1 1

14|0.965|0.965|3.3e-12|4.4e-07|9.2e-02|-6.609308e+00| 0:0:00|1.5e-01|1.1e+00|4.7e-17| ✓

lu 1 1

```

15|0.969|0.969|2.0e-10|1.9e-07|7.5e-02|-6.603998e+00| 0:0:00|6.7e-03|1.1e+00|1.6e-17| ✓
lu 1 1
16|0.936|0.936|1.7e-11|1.3e-07|4.9e-03|-6.621156e+00| 0:0:00|1.1e-03|1.1e+00|1.2e-18| ✓
lu 1 1
17|1.000|1.000|3.4e-10|1.3e-07|1.2e-03|-6.622025e+00| 0:0:00|5.3e-05|1.1e+00|2.6e-19| ✓
lu 1 1
18|0.944|0.944|1.9e-10|1.3e-07|7.1e-05|-6.622321e+00| 0:0:00|1.4e-05|1.1e+00|1.7e-20| ✓
lu 2 2
19|0.971|0.971|4.5e-09|1.3e-07|3.3e-05|-6.622325e+00| 0:0:00|1.1e-06|1.1e+00|8.8e-21| ✓
lu 2 2
20|0.968|0.968|2.5e-09|1.3e-07|4.8e-06|-6.622340e+00| 0:0:00|3.4e-07|1.1e+00|0.0e+00| ✓
lu 2 2
21|1.000|1.000|1.1e-08|1.3e-07|1.7e-06|-6.622349e+00| 0:0:00|4.6e-08|1.1e+00|0.0e+00| ✓
lu 2 2
22|0.981|0.981|8.1e-09|1.3e-07|1.9e-07|-6.622329e+00| 0:0:00|1.7e-08|1.1e+00|3.6e-21| ✓
lu 2 3
23|1.000|1.000|3.4e-08|1.3e-07|5.3e-08|-6.622302e+00| 0:0:00|1.8e-09|1.1e+00|1.5e-20|
Stop: relative gap < infeasibility

```

```

-----
number of iterations    = 23
primal objective value = -6.62232081e+00
dual   objective value = -6.62233815e+00
gap := trace(XZ)       = 1.86e-07
relative gap           = 2.43e-08
actual relative gap    = 1.22e-06
rel. primal infeas     = 8.09e-09
rel. dual   infeas     = 1.31e-07
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 5.7e+11, 4.7e+10, 5.7e+01
Total CPU time (secs)   = 0.19
CPU time per iteration = 0.01
termination code        = -1
DIMACS errors: 8.1e-09  0.0e+00  1.3e-07  0.0e+00  1.2e-06  1.3e-08
-----

```

ans =

6.6223

Iteration 5 Total error is: 0.045565

```

num. of constraints = 3
dim. of socp var   = 4,   num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.

```

```

*** convert ublk to linear blk

```

```

*****

```

```

SDPT3: homogeneous self-dual path-following algorithms

```

```

*****

```

```

version predcorr gam expon

```

```

HKM      1      0.000  1

```

```

it pstep dstep pinfeas dinfeas gap      mean(obj)      cputime      kap      tau      theta

```



```

----- ✓
-----
0|0.000|0.000|1.0e+00|2.0e+10|2.7e+16| 7.523877e+14| 0:0:00|2.7e+17|1.0e+00|1.0e+00| ✓
chol 1 1
1|1.000|1.000|5.2e-02|1.1e+09|3.7e+15| 9.004412e+14| 0:0:00|1.1e+16|9.7e-01|5.1e-02| ✓
chol
SMW too ill-conditioned, switch to LU factor, 6.6e+35.
switch to LU factor lu 1 1
2|0.956|0.956|4.9e-03|9.9e+07|6.2e+14| 2.343388e+14| 0:0:00|3.1e+14|1.0e+00|4.9e-03| ✓
lu 1 1
3|0.985|0.985|1.0e-04|2.1e+06|1.2e+13| 2.866593e+12| 0:0:00|4.6e+12|1.0e+00|1.0e-04| ✓
lu 1 1
4|0.985|0.985|2.3e-06|4.7e+04|2.8e+11| 3.356693e+10| 0:0:00|1.4e+11|1.0e+00|2.4e-06| ✓
lu 1 1
5|0.963|0.963|1.2e-07|2.4e+03|1.6e+10| 1.048706e+09| 0:0:00|2.0e+09|1.1e+00|1.3e-07| ✓
lu 1 1
6|0.993|0.993|2.0e-09|4.0e+01|2.8e+08| 1.238808e+07| 0:0:00|1.5e+08|1.1e+00|2.1e-09| ✓
lu 1 1
7|0.992|0.992|1.3e-10|2.0e+00|2.1e+07| 1.363357e+05| 0:0:00|5.0e+06|1.1e+00|1.1e-10| ✓
lu 1 1
8|1.000|1.000|8.5e-11|1.2e-01|1.4e+06| 3.626076e+03| 0:0:00|2.3e+05|1.1e+00|6.5e-12| ✓
lu 1 1
9|0.989|0.989|1.4e-10|2.3e-03|1.6e+04| 7.993606e+01| 0:0:00|1.7e+04|1.1e+00|1.2e-13| ✓
lu 1 1
10|0.989|0.989|1.2e-10|4.4e-05|1.7e+02|-5.551390e+00| 0:0:00|4.7e+02|1.1e+00|2.4e-15| ✓
lu 1 1
11|0.947|0.947|5.7e-11|3.1e-06|9.4e+00|-6.548841e+00| 0:0:00|3.0e+01|1.1e+00|1.5e-16| ✓
lu 1 1
12|0.204|0.204|2.5e-09|2.9e-06|1.3e+01|-5.229433e+00| 0:0:00|2.4e+01|1.1e+00|1.4e-16| ✓
lu 1 1
13|0.954|0.954|8.4e-11|1.5e-06|8.6e-01|-6.494494e+00| 0:0:00|1.4e+00|1.1e+00|8.5e-18| ✓
lu 1 2
14|0.794|0.794|1.0e-09|1.5e-06|9.2e-01|-6.408251e+00| 0:0:00|3.0e-01|1.1e+00|4.8e-18| ✓
lu 1 1
15|0.860|0.860|1.0e-10|1.5e-06|1.6e-01|-6.585427e+00| 0:0:00|5.2e-02|1.1e+00|8.3e-19| ✓
lu 2 1
16|0.584|0.584|2.3e-09|1.5e-06|1.4e-01|-6.588195e+00| 0:0:00|2.3e-02|1.1e+00|6.4e-19| ✓
lu 2 1
17|0.925|0.925|1.5e-10|1.5e-06|1.2e-02|-6.619828e+00| 0:0:00|3.1e-03|1.1e+00|5.7e-20| ✓
lu 2 2
18|0.762|0.762|7.8e-09|1.5e-06|8.4e-03|-6.620893e+00| 0:0:00|8.3e-04|1.1e+00|3.3e-20| ✓
lu 2 2
19|0.912|0.912|6.0e-10|1.5e-06|7.9e-04|-6.622367e+00| 0:0:00|1.5e-04|1.1e+00|3.9e-21| ✓
lu 2 2
20|0.712|0.712|2.2e-08|1.5e-06|5.9e-04|-6.621337e+00| 0:0:00|4.9e-05|1.1e+00|1.1e-20| ✓
lu 2 2
21|0.922|0.922|3.9e-09|1.5e-06|4.9e-05|-6.622380e+00| 0:0:00|9.1e-06|1.1e+00|1.8e-21| ✓
lu 2 3
22|0.736|0.736|2.8e-09|1.5e-06|3.6e-05|-6.622709e+00| 0:0:00|2.8e-06|1.1e+00|0.0e+00| ✓
lu 2 2
23|0.987|0.987|9.8e-10|1.5e-06|4.6e-06|-6.622538e+00| 0:0:00|3.8e-07|1.1e+00|4.3e-22| ✓
lu 2 2
24|1.000|1.000|9.3e-10|1.5e-06|1.5e-06|-6.622551e+00| 0:0:00|4.4e-08|1.1e+00|3.0e-22| ✓
lu 2 3
25|0.989|0.989|6.1e-10|1.5e-06|1.3e-07|-6.622550e+00| 0:0:00|1.4e-08|1.1e+00|3.1e-22|

```

Stop: relative gap < infeasibility

```
-----
number of iterations    = 25
primal objective value = -6.62248679e+00
dual   objective value = -6.62258833e+00
gap := trace(XZ)        = 4.56e-06
relative gap           = 5.99e-07
actual relative gap    = 7.13e-06
rel. primal infeas     = 9.82e-10
rel. dual   infeas     = 1.46e-06
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 1.2e+12, 2.4e+12, 5.7e+01
Total CPU time (secs)   = 0.22
CPU time per iteration = 0.01
termination code        = -1
DIMACS errors: 9.8e-10  0.0e+00  1.5e-06  0.0e+00  7.1e-06  3.2e-07
-----
```

ans =

6.6226

Iteration 6 Total error is: 0.045565

```
num. of constraints = 3
dim. of socp var = 4, num. of socp blk = 1
dim. of linear var = 116
18 linear variables from unrestricted variable.
```

*** convert ublk to linear blk

***** ✓

SDPT3: homogeneous self-dual path-following algorithms

***** ✓

version predcorr gam expon

HKM 1 0.000 1

it pstep dstep pinfeas dinfeas gap mean(obj) cputime kap tau theta

----- ✓

0|0.000|0.000|1.0e+00|8.0e+09|8.5e+15| 2.326516e+14| 0:0:00|8.5e+16|1.0e+00|1.0e+00| ✓

chol 1 1

1|1.000|1.000|5.9e-02|4.6e+08|1.2e+15| 2.881390e+14| 0:0:00|3.7e+15|9.7e-01|5.6e-02| ✓

chol

SMW too ill-conditioned, switch to LU factor, 7.7e+34.

switch to LU factor lu 1 1

2|0.968|0.968|6.0e-03|4.8e+07|2.6e+14| 9.748507e+13| 0:0:00|1.1e+14|9.8e-01|5.8e-03| ✓

lu 1 1

3|0.983|0.983|1.4e-04|1.1e+06|5.5e+12| 1.373508e+12| 0:0:00|1.4e+12|1.0e+00|1.4e-04| ✓

lu 1 1

4|0.984|0.984|3.3e-06|2.6e+04|1.3e+11| 1.637793e+10| 0:0:00|5.4e+10|1.0e+00|3.4e-06| ✓

lu 1 1

5|0.961|0.961|1.7e-07|1.4e+03|7.7e+09| 4.837192e+08| 0:0:00|7.7e+08|1.1e+00|1.9e-07| ✓

lu 1 1

6|0.994|0.994|2.9e-09|2.3e+01|1.4e+08| 5.977524e+06| 0:0:00|6.9e+07|1.1e+00|3.2e-09| ✓

```

lu 1 1
7|0.992|0.992|1.3e-10|1.2e+00|1.0e+07| 6.588955e+04| 0:0:00|2.3e+06|1.1e+00|1.6e-10| ✓
lu 1 1
8|1.000|1.000|3.5e-11|7.5e-02|7.0e+05| 1.837676e+03| 0:0:00|1.1e+05|1.1e+00|1.0e-11| ✓
lu 1 1
9|0.989|0.989|8.0e-11|1.4e-03|7.7e+03| 4.601736e+01| 0:0:00|8.3e+03|1.1e+00|2.0e-13| ✓
lu 1 1
10|0.989|0.989|5.5e-11|2.8e-05|8.5e+01|-6.032172e+00| 0:0:00|2.3e+02|1.1e+00|3.8e-15| ✓
lu 1 1
11|0.920|0.920|2.2e-11|2.9e-06|7.3e+00|-6.501196e+00| 0:0:00|2.1e+01|1.1e+00|3.4e-16| ✓
lu 1 1
12|0.186|0.186|2.4e-10|2.8e-06|9.6e+00|-5.570990e+00| 0:0:00|1.7e+01|1.1e+00|3.2e-16| ✓
lu 1 1
13|0.966|0.966|6.0e-12|1.5e-06|4.5e-01|-6.559499e+00| 0:0:00|7.9e-01|1.1e+00|1.5e-17| ✓
lu 1 1
14|0.969|0.969|1.6e-10|1.5e-06|3.6e-01|-6.534711e+00| 0:0:00|3.4e-02|1.1e+00|5.1e-18| ✓
lu 1 1
15|0.942|0.942|1.4e-11|1.5e-06|2.1e-02|-6.618431e+00| 0:0:00|5.3e-03|1.1e+00|3.4e-19| ✓
lu 1 1
16|1.000|1.000|2.7e-10|1.5e-06|4.4e-03|-6.622506e+00| 0:0:00|2.4e-04|1.1e+00|6.0e-20| ✓
lu 2 1
17|0.963|0.963|1.4e-10|1.5e-06|1.7e-04|-6.623573e+00| 0:0:00|4.9e-05|1.1e+00|2.7e-21| ✓
lu 2 2
18|1.000|1.000|2.7e-09|1.5e-06|2.9e-05|-6.623648e+00| 0:0:00|1.9e-06|1.1e+00|0.0e+00| ✓
lu 2 2
19|1.000|1.000|6.6e-10|1.5e-06|7.9e-07|-6.623622e+00| 0:0:00|2.8e-07|1.1e+00|0.0e+00| ✓
lu 2 2
20|1.000|1.000|4.7e-10|1.5e-06|6.0e-08|-6.623618e+00| 0:0:00|9.4e-09|1.1e+00|0.0e+00|
Stop: relative gap < infeasibility

```

```

-----
number of iterations    = 20
primal objective value = -6.62363197e+00
dual   objective value = -6.62361192e+00
gap := trace(XZ)       = 7.86e-07
relative gap           = 1.03e-07
actual relative gap    = -1.41e-06
rel. primal infeas     = 6.55e-10
rel. dual   infeas     = 1.46e-06
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 4.7e+11, 7.5e+11, 5.7e+01
Total CPU time (secs)   = 0.16
CPU time per iteration = 0.01
termination code        = -1
DIMACS errors: 6.6e-10  0.0e+00  1.5e-06  0.0e+00  -1.4e-06  5.5e-08
-----

```

ans =

6.6236

Iteration 7 Total error is: 0.045565

```

num. of constraints = 3
dim. of socp var   = 4,   num. of socp blk = 1
dim. of linear var = 116

```

18 linear variables from unrestricted variable.

*** convert ublk to linear blk

***** ✓

SDPT3: homogeneous self-dual path-following algorithms

***** ✓

version predcorr gam expon

HKM 1 0.000 1

it pstep dstep pinfeas dinfeas gap mean(obj) cputime kap tau theta

----- ✓

0|0.000|0.000|1.0e+00|1.6e+10|2.7e+16| 7.472471e+14| 0:0:00|2.7e+17|1.0e+00|1.0e+00| ✓

chol 1 1

1|1.000|1.000|4.9e-02|8.1e+08|3.5e+15| 8.751508e+14| 0:0:00|9.9e+15|9.7e-01|4.8e-02| ✓

chol

SMW too ill-conditioned, switch to LU factor, 5.2e+35.

switch to LU factor lu 1 1

2|0.948|0.948|4.2e-03|6.9e+07|4.7e+14| 1.806886e+14| 0:0:00|2.6e+14|1.0e+00|4.2e-03| ✓

lu 1 1

3|0.986|0.986|8.3e-05|1.4e+06|8.5e+12| 2.171508e+12| 0:0:00|4.6e+12|1.0e+00|8.6e-05| ✓

lu 1 1

4|0.985|0.985|1.9e-06|3.1e+04|2.1e+11| 2.513364e+10| 0:0:00|1.2e+11|1.0e+00|1.9e-06| ✓

lu 1 1

5|0.964|0.964|8.9e-08|1.5e+03|1.2e+10| 7.772680e+08| 0:0:00|1.7e+09|1.1e+00|9.7e-08| ✓

lu 1 1

6|0.991|0.991|3.9e-09|6.3e+01|8.2e+08| 8.737606e+06| 0:0:00|1.3e+08|1.1e+00|4.2e-09| ✓

lu 1 1

7|1.000|1.000|2.7e-10|3.8e+00|5.6e+07| 1.453670e+05| 0:0:00|8.3e+06|1.1e+00|2.5e-10| ✓

lu 1 1

8|1.000|1.000|1.1e-10|3.0e-01|4.4e+06| 1.478082e+04| 0:0:00|5.6e+05|1.1e+00|2.0e-11| ✓

lu 1 1

9|0.989|0.989|6.5e-11|5.8e-03|5.0e+04| 2.338941e+02| 0:0:00|4.8e+04|1.1e+00|3.8e-13| ✓

lu 1 1

10|0.989|0.989|6.8e-11|1.1e-04|5.5e+02|-3.173611e+00| 0:0:00|1.4e+03|1.1e+00|7.3e-15| ✓

lu 1 1

11|0.963|0.963|4.8e-11|5.0e-06|2.1e+01|-6.499209e+00| 0:0:00|6.6e+01|1.1e+00|3.3e-16| ✓

lu 1 2

12|0.243|0.243|6.7e-09|4.5e-06|2.8e+01|-3.452766e+00| 0:0:00|5.0e+01|1.1e+00|3.0e-16| ✓

lu 1 1

13|0.938|0.938|2.5e-10|4.2e-07|3.1e+00|-6.105801e+00| 0:0:00|3.8e+00|1.1e+00|2.6e-17| ✓

lu 1 1

14|0.724|0.724|1.6e-09|2.8e-07|3.1e+00|-5.925267e+00| 0:0:00|1.1e+00|1.1e+00|1.6e-17| ✓

lu 1 1

15|0.870|0.870|2.9e-10|1.5e-07|5.0e-01|-6.510324e+00| 0:0:00|1.7e-01|1.1e+00|2.6e-18| ✓

lu 2 2

16|0.625|0.625|5.0e-09|1.5e-07|4.2e-01|-6.520670e+00| 0:0:00|6.9e-02|1.1e+00|1.9e-18| ✓

lu 2 2

17|0.917|0.917|3.7e-10|1.5e-07|3.9e-02|-6.614531e+00| 0:0:00|9.7e-03|1.1e+00|1.9e-19| ✓

lu 2 2

18|0.738|0.738|1.7e-08|1.5e-07|2.9e-02|-6.617447e+00| 0:0:00|2.9e-03|1.1e+00|1.2e-19| ✓

lu 2 2

19|0.916|0.916|1.5e-09|1.5e-07|2.6e-03|-6.622997e+00| 0:0:00|5.0e-04|1.1e+00|1.3e-20| ✓

lu 2 3

```

20|0.826|0.826|6.1e-08|1.5e-07|1.8e-03|-6.620137e+00| 0:0:00|1.1e-04|1.1e+00|3.2e-20| ✓
lu 2 2
21|0.933|0.933|7.1e-10|1.5e-07|1.2e-04|-6.623632e+00| 0:0:00|2.3e-05|1.1e+00|8.8e-22| ✓
lu 3 3
22|1.000|1.000|7.7e-08|1.5e-07|7.2e-05|-6.627543e+00| 0:0:00|1.3e-06|1.1e+00|0.0e+00| ✓
lu 3 2
23|1.000|1.000|2.8e-08|1.5e-07|1.3e-05|-6.625122e+00| 0:0:00|6.6e-07|1.1e+00|0.0e+00| ✓
lu 2 3
24|1.000|1.000|2.4e-08|1.5e-07|7.8e-07|-6.624918e+00| 0:0:00|1.3e-07|1.1e+00|0.0e+00| ✓
lu 3 3
25|1.000|1.000|2.3e-08|1.5e-07|3.8e-08|-6.624885e+00| 0:0:00|8.1e-09|1.1e+00|0.0e+00|
Stop: relative gap < infeasibility

```

```

-----
number of iterations    = 25
primal objective value = -6.62613509e+00
dual   objective value = -6.62369997e+00
gap := trace(XZ)       = 7.82e-07
relative gap           = 1.03e-07
actual relative gap    = -1.71e-04
rel. primal infeas     = 2.36e-08
rel. dual   infeas     = 1.46e-07
norm(X), norm(y), norm(Z) = 2.4e+01, 7.3e+01, 4.9e+01
norm(A), norm(b), norm(C) = 9.7e+11, 2.4e+12, 5.7e+01
Total CPU time (secs)   = 0.19
CPU time per iteration = 0.01
termination code        = -1
DIMACS errors: 2.4e-08  0.0e+00  1.5e-07  0.0e+00  -1.7e-04  5.5e-08
-----

```

ans =

6.6237

Iteration 8 Total error is: 0.045565

The total representation error of the testing signals is: 0.12734

>>