```
% Part D: Verify Euclidian Projection.
x = transpose([3, 2]);
v0 = transpose([-2, -4]);
v = transpose([-2, 5]);

[y, r] = proj_cvx(x, v0, v, 2);
```

```
Calling SDPT3 4.0: 3 variables, 1 equality constraints
------------------------------------------------------------

 num. of constraints =  1
 dim. of socp   var  =  3,   num. of socp blk  =  1
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-----------------------------------------------------------------
 0|0.000|0.000|9.5e-01|1.3e+00|3.4e+01| 9.146713e+00  0.000000e+00| 0:0:00| chol  1  1
 1|1.000|0.836|2.1e-07|2.6e-01|5.3e+00| 9.676653e+00  9.494304e+00| 0:0:00| chol  1  1
 2|1.000|1.000|3.7e-07|5.0e-03|3.2e-01| 7.137307e+00  6.885179e+00| 0:0:00| chol  1  1
 3|0.990|0.990|6.5e-09|5.5e-04|3.4e-03| 6.873512e+00  6.877649e+00| 0:0:00| chol  1  1
 4|0.989|0.989|2.6e-09|5.5e-05|3.7e-05| 6.870758e+00  6.871483e+00| 0:0:00| chol  1  1
 5|0.989|0.989|7.5e-11|6.1e-07|4.1e-07| 6.870728e+00  6.870736e+00| 0:0:00| chol  1  1
 6|0.991|0.999|9.1e-13|6.5e-10|4.7e-09| 6.870728e+00  6.870728e+00| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
-----------------------------------------------------------------
 number of iterations   =  6
 primal objective value =  6.87072752e+00
 dual   objective value =  6.87072752e+00
 gap := trace(XZ)       = 4.72e-09
 relative gap           = 3.20e-10
 actual relative gap    = -2.84e-10
 rel. primal infeas (scaled problem)   = 9.06e-13
 rel. dual     "        "       "      = 6.49e-10
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 9.7e+00, 3.7e-01, 1.4e+00
 norm(A), norm(b), norm(C) = 3.7e+00, 2.0e+01, 2.0e+00
 Total CPU time (secs)  = 0.09
 CPU time per iteration = 0.02
 termination code       =  0
 DIMACS: 9.1e-13  0.0e+00  6.5e-10  0.0e+00  -2.8e-10  3.2e-10
-----------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +6.87073
```

```
fprintf("Projected vector y under l2: ");
```

```
Projected vector y under l2:
```

```
disp(y)
```

```
   -3.3793
   -0.5517
```

```
% Part E: Solving for l1 and l-infinity projections.

x = transpose([3, 2]);
v0 = transpose([-2, -4]);
v = transpose([-2, 5]);

[y, r] = proj_cvx(x, v0, v, 1);
```

```
Calling SDPT3 4.0: 4 variables, 1 equality constraints
------------------------------------------------------------

 num. of constraints =  1
 dim. of socp   var  =  4,   num. of socp blk  =  2
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-----------------------------------------------------------------
 0|0.000|0.000|9.5e-01|1.6e+00|5.5e+01| 1.493652e+01  0.000000e+00| 0:0:00| chol  1  1
 1|1.000|0.790|2.1e-07|3.8e-01|1.3e+01| 1.461784e+01  1.099215e+01| 0:0:00| chol  1  1
 2|1.000|1.000|3.9e-07|5.9e-03|1.1e+00| 8.474405e+00  7.437095e+00| 0:0:00| chol  1  1
 3|0.989|0.989|1.5e-08|6.4e-04|1.2e-02| 7.411687e+00  7.407734e+00| 0:0:00| chol  1  1
 4|0.989|0.989|3.0e-09|6.5e-05|1.3e-04| 7.400128e+00  7.400817e+00| 0:0:00| chol  1  1
 5|0.989|0.989|8.3e-11|7.1e-07|1.5e-06| 7.400001e+00  7.400009e+00| 0:0:00| chol  1  1
 6|0.993|1.000|9.4e-13|1.7e-11|1.9e-08| 7.400000e+00  7.400000e+00| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
-----------------------------------------------------------------
 number of iterations   =  6
 primal objective value =  7.40000002e+00
 dual   objective value =  7.40000000e+00
 gap := trace(XZ)       = 1.86e-08
 relative gap           = 1.17e-09
 actual relative gap    = 1.16e-09
 rel. primal infeas (scaled problem)   = 9.43e-13
 rel. dual     "        "       "      = 1.66e-11
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 1.0e+01, 4.0e-01, 1.8e+00
 norm(A), norm(b), norm(C) = 3.7e+00, 2.0e+01, 2.4e+00
 Total CPU time (secs)  = 0.09
 CPU time per iteration = 0.01
 termination code       =  0
 DIMACS: 9.4e-13  0.0e+00  2.0e-11  0.0e+00  1.2e-09  1.2e-09
-----------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +7.4
```

```
fprintf("Projected vector y under l1: ");
```

```
Projected vector y under l1:
```

```
disp(y)
```

```
   -4.4000
    2.0000
```

```
x = transpose([3, 2]);
v0 = transpose([-2, -4]);
v = transpose([-2, 5]);

[y, r] = proj_cvx_infty(x, v0, v);
```

```
Calling SDPT3 4.0: 6 variables, 2 equality constraints
------------------------------------------------------------

 num. of constraints =  2
 dim. of socp   var  =  4,   num. of socp blk  =  2
 dim. of linear var  =  2
*****************************************************************
   SDPT3: Infeasible path-following algorithms
*****************************************************************
 version  predcorr  gam  expon  scale_data
    NT      1      0.000   1        0
it pstep dstep pinfeas dinfeas  gap      prim-obj      dual-obj    cputime
-----------------------------------------------------------------------
 0|0.000|0.000|9.5e-01|5.9e+00|6.1e+02| 3.504542e+01  0.000000e+00| 0:0:00| chol  1  1
 1|1.000|0.884|1.1e-07|7.5e-01|1.3e+02| 4.747492e+01  6.702049e+00| 0:0:00| chol  1  1
 2|1.000|1.000|3.2e-07|8.3e-03|1.7e+01| 2.144067e+01  4.385268e+00| 0:0:00| chol  1  1
 3|0.962|0.765|4.6e-08|2.6e-03|9.2e-01| 6.013615e+00  5.130942e+00| 0:0:00| chol  1  1
 4|0.971|0.979|3.0e-08|1.4e-04|3.2e-02| 5.310529e+00  5.280517e+00| 0:0:00| chol  1  1
 5|0.988|0.988|6.2e-10|9.8e-06|3.7e-04| 5.286002e+00  5.285759e+00| 0:0:00| chol  1  1
 6|0.989|0.989|6.8e-12|1.1e-07|4.0e-06| 5.285717e+00  5.285715e+00| 0:0:00| chol  1  1
 7|0.993|0.995|4.9e-14|5.9e-10|5.6e-08| 5.285714e+00  5.285714e+00| 0:0:00|
  stop: max(relative gap, infeasibilities) < 1.49e-08
-----------------------------------------------------------------------
 number of iterations   =  7
 primal objective value =  5.28571433e+00
 dual   objective value =  5.28571428e+00
 gap := trace(XZ)       = 5.57e-08
 relative gap           = 4.81e-09
 actual relative gap    = 4.16e-09
 rel. primal infeas (scaled problem)   = 4.95e-14
 rel. dual     "        "       "      = 5.90e-10
 rel. primal infeas (unscaled problem) = 0.00e+00
 rel. dual     "        "       "      = 0.00e+00
 norm(X), norm(y), norm(Z) = 1.1e+01, 4.0e-01, 1.3e+00
 norm(A), norm(b), norm(C) = 4.4e+00, 2.0e+01, 2.4e+00
 Total CPU time (secs)  = 0.20
 CPU time per iteration = 0.03
 termination code       =  0
 DIMACS: 4.9e-14  0.0e+00  7.1e-10  0.0e+00  4.2e-09  4.8e-09
-----------------------------------------------------------------------

------------------------------------------------------------
Status: Solved
Optimal value (cvx_optval): +5.28571
```

```
fprintf("Projected vector y under l_infinity: ");
```

```
Projected vector y under l_infinity:
```

```
disp(y)
```

```
    -2.2857
    -3.2857
```

```
function [y, r] = proj_cvx(x, v0, v, nrm)
    objtv = @(y) norm(x-y, nrm);
    cvx_begin
        variable y(2)
        variable t(1)
        minimize(objtv(y))
        subject to
        v0 + t*v == y
    cvx_end
    r = objtv(y);
end

function [y, r] = proj_cvx_infty(x, v0, v)
    objtv = @(y) max(abs((x-y)));
    cvx_begin
        variable y(2)
        variable t(1)
        minimize(objtv(y))
        subject to
        v0 + t*v == y
    cvx_end
    r = objtv(y);
end
```