ProperCliqueFinder

March 18, 2018

In [1]:
```
from RRR import *
from rankProject import *
from cliqueProject import *

n = 5

H = np.array(
    [[0, 1, 1, 1, 1],
    [1, 0, 1, 0, 0],
    [1, 1, 0, 0, 0],
    [1, 0, 0, 0, 0],
    [1, 0, 0, 0, 0]])

A = semiDefProject(np.random.rand(n, n))

print A
```

```
[[ 0.0977954   0.20007082  0.37633023  0.27575513  0.80630665]
 [ 0.20007082  0.29747995  0.58781062  0.71678341  0.51112758]
 [ 0.37633023  0.58781062  0.97270573  0.42570297  0.72869828]
 [ 0.27575513  0.71678341  0.42570297  0.17682844  0.91038598]
 [ 0.80630665  0.51112758  0.72869828  0.91038598  0.93183113]]
```

In [5]:
```
n = 125
from graphReader import getGraph
H = getGraph()
```

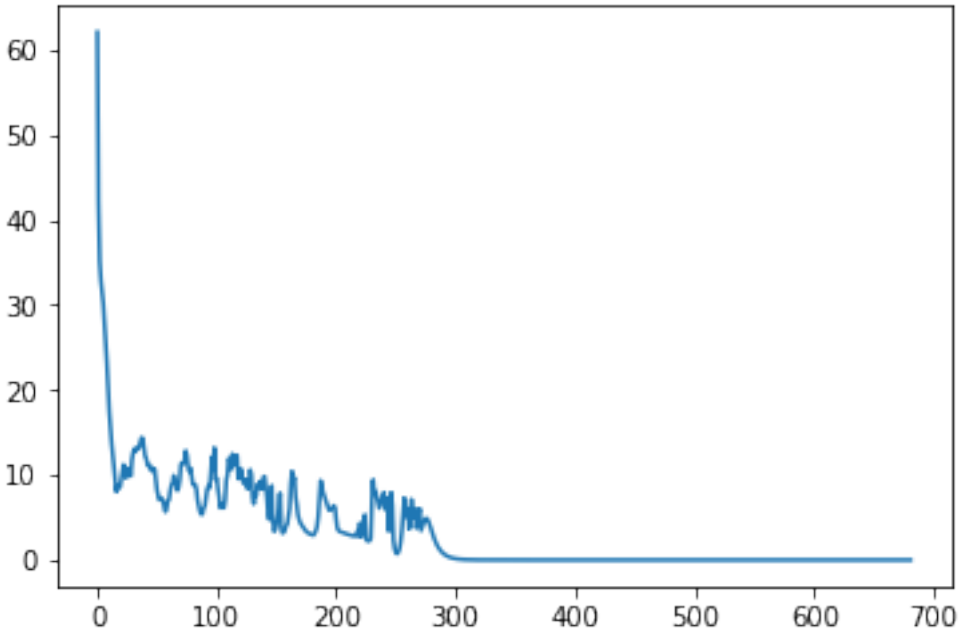
In [6]:
```
def verifyClique(c, H):
    r = 1
    for i in range(len(c)):
        for j in range(i+ 1, len(c)):
            r = r*H[c[i], c[j]]
    return r
```

In [7]:
```
k = 34

A = semiDefProject(np.random.rand(n, n))
```

```
        Y, errors, sols = RRR(A,
                              lambda x: cliqueProject(x, k, H),
                              lambda x: rankProject(x, 1, False),
                              0.5, 1e-12, 10000, True)
```

In [10]:
```
plt.plot(errors)
plt.show()
```



In [13]:
```
print extractClique(sols)
print verifyClique(extractClique(sols), H)
print len(extractClique(sols))
```

```
[  4   6   8  10  12  18  28  30  33  34  39  43  44  48  49  51  54  65
  66  67  69  76  79  90  95  97  98 102 103 109 113 116 121 124]
1.0
34
```

This is the best result so far. The other notebook is thrashing for $k = 35$, and could barely do $k = 33$.

Let's see if it is possible to get better.

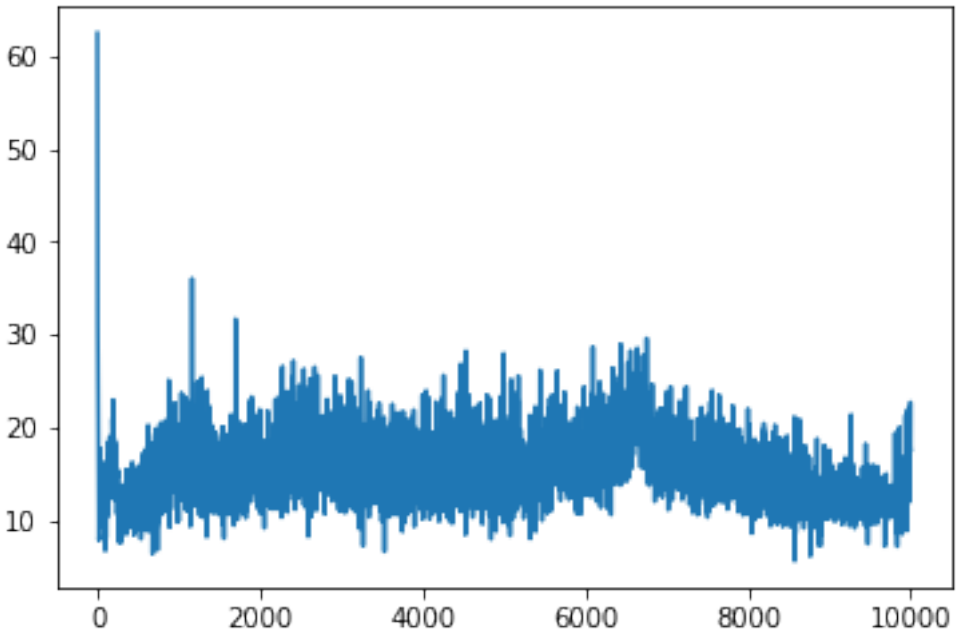
In [14]:
```
k = 35

A = semiDefProject(np.random.rand(n, n))
```

```
        Y, errors, sols = RRR(A,
                              lambda x: cliqueProject(x, k, H),
                              lambda x: rankProject(x, 1, False),
                              0.5, 1e-12, 10000, True)
```

```
Warning: maximum iterations exceeded, no convergence
```

```
In [15]: plt.plot(errors)
         plt.show()
```



So, $k = 35$ is a genuinely difficult problem, it would appear.
Let's do the same loop as the other notebook. One or the other might converge.

```
In [24]: while(True):
             Y, errors2, sols = RRR(Y,
                              lambda x: cliqueProject(x, k, H),
                              lambda x: rankProject(x, 1, False),
                              0.5, 1e-12, 1000, True)
             errors += errors2
             if errors[-1] < 1e-4:
                 break
```

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    ---------------------------------------------------------------------------

    KeyboardInterrupt                         Traceback (most recent call last)

    <ipython-input-24-413345873064> in <module>()
      3                     lambda x: cliqueProject(x, k, H),
      4                     lambda x: rankProject(x, 1, False),
----> 5                     0.5, 1e-12, 1000, True)
      6     errors += errors2
      7     if errors[-1] < 1e-4:


    /home/atbolsh/VeitElserModule/HW4/RRR.pyc in RRR(v, proj1, proj2, beta, cutoff, maxIter,
     14     while norm(error) > cutoff and i < maxIter:
     15         i += 1
---> 16         error = RRR_error(v, proj1, proj2)
     17         v = v + beta*error
     18         if errors:


    /home/atbolsh/VeitElserModule/HW4/RRR.pyc in RRR_error(v, proj1, proj2)
      4
      5 def RRR_error(v, proj1, proj2):
----> 6     b = proj2(v)
```

```
      7     a = proj1(2*b - v)
      8     return a - b

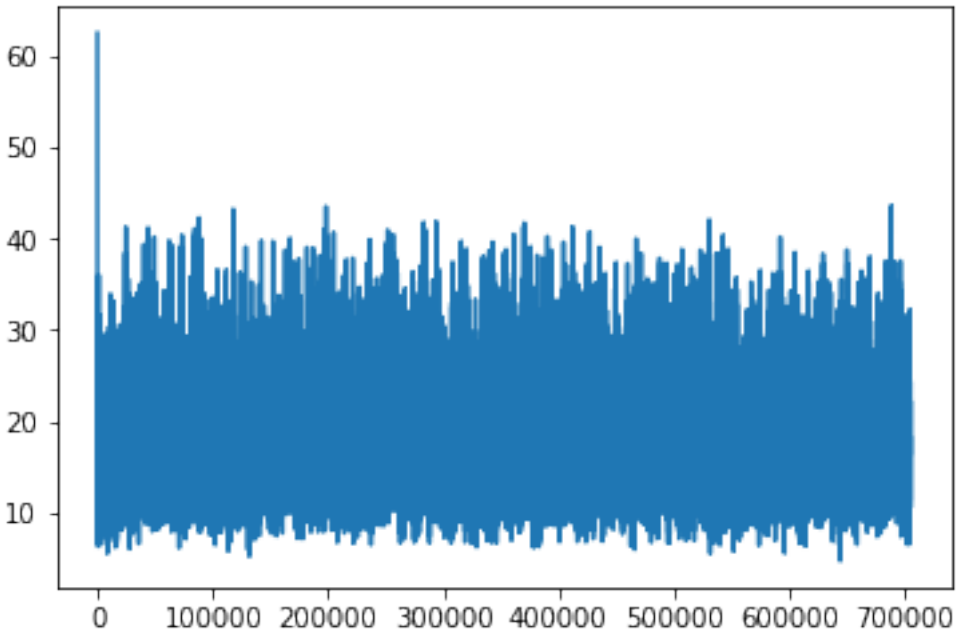

    <ipython-input-24-413345873064> in <lambda>(x)
      2     Y, errors2, sols = RRR(Y,
      3                     lambda x: cliqueProject(x, k, H),
----> 4                     lambda x: rankProject(x, 1, False),
      5                     0.5, 1e-12, 1000, True)
      6     errors += errors2


    /home/atbolsh/VeitElserModule/HW4/rankProject.pyc in rankProject(X, rank, unitary, sG)
     14    l = np.shape(X)[0]
     15    M = semiDefProject(X)
---> 16    vals, x = eig(M)
     17    if sG:
     18       x = np.sign(x)


    /home/atbolsh/anaconda2/lib/python2.7/site-packages/numpy/linalg/linalg.pyc in eig(a)
   1132         _raise_linalgerror_eigenvalues_nonconvergence)
   1133     signature = 'D->DD' if isComplexType(t) else 'd->DD'
-> 1134     w, vt = _umath_linalg.eig(a, signature=signature, extobj=extobj)
   1135
   1136     if not isComplexType(t) and all(w.imag == 0.0):


    KeyboardInterrupt:
```

In [25]:
```
plt.plot(errors)
plt.show()
```




```
In [21]: q = [  4,  6,   8,  10,  12,  18,  28,  30,  33,  34 , 39 , 43,  44,  48,
              49,  51,  54,  65, 66,  67,  69,  76,  79,  90,  95,  97,  98, 102, 103, 109, 113,

          for u in range(125):
              if u not in q:
                  r = q + [u]
                  if verifyClique(r, H) > 0.9:
                      print r
                      break

In [23]: verifyClique(q, H)

Out[23]: 1.0

In [26]: s = [x + 1 for x in q]
          print s

[5, 7, 9, 11, 13, 19, 29, 31, 34, 35, 40, 44, 45, 49, 50, 52, 55, 66, 67, 68, 70, 77, 80, 91, 96
```

The above represents the longest clique I could find, size 34. I could not find anything at 35 despite a night of letting the machine run.