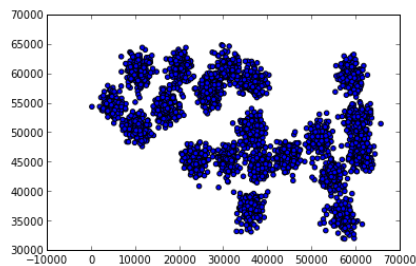


erisebilecegi bir yerde olmalı. Biz bu veriyi, `centers.csv` adli bir dosyaya koymaya karar verdik, bu dosya tek makina ortamında bilinen bir dizinde (mesela `/tmp`), çok makinalı ortamda ise HDFS üzerinde herkesin erisebilecegi bir yerde olmalı.

Paralel K-Means için tek bir esle-indirge isletimi yeterli değil, bu algoritma dongulu / ozyineli (iterative) bir algoritma, 5,10,20 kez islemesi gerekebilir. Her dongu (indirgeme) sonunda yeni kume merkezleri hesaplanacak, bu merkezler eski `centers.csv` yerini alacak ve islem tekrar baslayacak.

Simdi ham veriyi gosterelim,

```
from pandas import *
df1 = read_csv("synthetic.txt", sep=" ")
plt.scatter(df1.ix[:,0], df1.ix[:,1])
plt.savefig('kmeans_1.png')
```



```
from mrjob.job import MRJob
from mrjob.protocol import PickleProtocol
import numpy as np, sys
import pandas as pd
import os, random

def euc_to_clusters(x,y):
    return np.sqrt(np.sum((x-y)**2, axis=1))

class MRKMeans(MRJob):
    INTERNAL_PROTOCOL = PickleProtocol

    def __init__(self, *args, **kwargs):
        super(MRKMeans, self).__init__(*args, **kwargs)
        self.centers_ = pd.read_csv("/tmp/centers.csv", header=None, sep=" ")
        self.k = 15

    def mapper(self, key, line):
        point = np.array(map(np.float, line.split(' ')))
        c = np.argmin(euc_to_clusters(np.array(self.centers_), point))
        yield(c, point)

    def reducer(self, key, tokens):
        new_centers = np.zeros((1,2))
        counts = 0
        for val in tokens:
```

```

        new_centers += val
        counts += 1
    yield('final', (key, new_centers[0] / counts))

def reduce_all_centers(self, key, values):
    new_centers = np.zeros((self.k, 2))
    self.f=open("/tmp/centers.csv", "w")
    for (cluster, val) in values:
        print cluster, val
        new_centers[cluster] = val
    for row in new_centers:
        self.f.write(" ".join(map(str, row)))
        self.f.write("\n")
    self.f.close()

def steps(self):
    return [self.mr (mapper=self.mapper, reducer=self.reducer),
            self.mr (reducer=self.reduce_all_centers)]

if __name__ == '__main__':
    for i in range(15): MRKMeans.run()

```

reduce_all_centers cagrısı tum indirgeyiciler her kume icin yeni orta noktayı hesaplayıp onu yayınladıktan (emit) sonra, tum yeni merkezlerin gelecegi yer.

Komut satirından tek makina icin Hadoop'suz isletelim,

```

! sort --random-sort synthetic.txt > /tmp/synthetic.txt
! head -15 /tmp/synthetic.txt > /tmp/centers.csv
! python kmeans.py synthetic.txt

```

```

/usr/local/lib/python2.7/dist-packages/pytz/__init__.py:29: UserWarning: Module _yaml
  from pkg_resources import resource_stream
using configs in /home/burak/.mrjob.conf
creating tmp directory /tmp/kmeans.burak.20131202.234454.312709
writing to /tmp/kmeans.burak.20131202.234454.312709/step-0-mapper_part-00000
Counters from step 1:
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234454.312709/step-0-mapper-sorted
> sort /tmp/kmeans.burak.20131202.234454.312709/step-0-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234454.312709/step-0-reducer_part-00000
Counters from step 1:
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234454.312709/step-1-mapper_part-00000
Counters from step 2:
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234454.312709/step-1-mapper-sorted
> sort /tmp/kmeans.burak.20131202.234454.312709/step-1-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234454.312709/step-1-reducer_part-00000
10 [ 33655.97916667  59869.70138889]
13 [ 10318.87456446  55430.98780488]
9 [ 21286.26027397  59328.61187215]
0 [ 34297.27789474  43563.19789474]
1 [ 56490.3362069   37260.18103448]

```

```

2 [ 56217.97297297  43823.02702703]
3 [ 56453.07407407  34324.16666667]
4 [ 22960.27741935  45942.7483871 ]
5 [ 61346.1443299   47761.37113402]
6 [ 58466.11940299  60120.6641791 ]
7 [ 51691.66477273  48608.63636364]
8 [ 60189.47019868  53209.15231788]
11 [ 62427.68  44841.88]
12 [ 27699.59813084  56743.19626168]
14 [ 41850.40925267  47055.58362989]
Counters from step 2:
  (no counters found)
Moving /tmp/kmeans.burak.20131202.234454.312709/step-1-reducer_part-00000 -> /tmp/kme
Streaming final output from /tmp/kmeans.burak.20131202.234454.312709/output
removing tmp directory /tmp/kmeans.burak.20131202.234454.312709
using configs in /home/burak/.mrjob.conf
using configs in /home/burak/.mrjob.conf
creating tmp directory /tmp/kmeans.burak.20131202.234456.597838
creating tmp directory /tmp/kmeans.burak.20131202.234456.597838
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper_part-00000
Counters from step 1:
Counters from step 1:
  (no counters found)
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper-sorted
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper-sorted
> sort /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper_part-00000
> sort /tmp/kmeans.burak.20131202.234456.597838/step-0-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-reducer_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-0-reducer_part-00000
Counters from step 1:
Counters from step 1:
  (no counters found)
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper_part-00000
Counters from step 2:
Counters from step 2:
  (no counters found)
  (no counters found)
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper-sorted
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper-sorted
> sort /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper_part-00000
> sort /tmp/kmeans.burak.20131202.234456.597838/step-1-mapper_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-reducer_part-00000
writing to /tmp/kmeans.burak.20131202.234456.597838/step-1-reducer_part-00000
10 [ 34190.76071429  59473.68214286]
13 [  9524.38372093  55188.34689922]
9 [ 19288.00425532  59048.12340426]
0 [ 34495.96781609  42837.15862069]
1 [ 56603.56756757  37301.28378378]
2 [ 54698.1862069   43080.47586207]
3 [ 56850.95180723  34689.86746988]
4 [ 23627.50314465  45589.86792453]

```

```

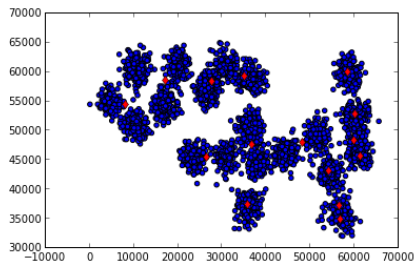
5 [ 60775.48039216  47705.81372549]
6 [ 58623.54054054  59894.10135135]
7 [ 51384.90184049  49124.60736196]
8 [ 60238.23021583  52723.48920863]
11 [ 61762.52830189  45110.81132075]
12 [ 27191.86813187  57337.64835165]
14 [ 41387.76223776  47391.7972028 ]
...

```

```

import pandas as pd
df1 = pd.read_csv("synthetic.txt", sep=" ", header=None)
plt.scatter(df1.ix[:,0], df1.ix[:,1])
plt.hold(True)
df2 = pd.read_csv("/tmp/centers.csv", sep=" ", header=None)
plt.plot(df2.ix[:,0], df2.ix[:,1], 'rd')
plt.savefig('kmeans_2.png')

```



K-Means'i 20 kere islettik. Eger istenirse (hatta daha iyi olur) dongu bir `while` icine konur ve bitis icin "stabilite sartı" aranır. Stabilite yeni kume merkezinin eskisinden "cok fazla degisik olup olmadigi" sartidir, degisim yoksa artik sonucu bulmusuz demektir, daha fazla donguye gerek kalmayacaktır. Biz donguyu 20 kere donguyu islettik, (bu problem icin) yeterli oldu.

K-Means isini bitirdikten sonra elde edilen sonuclari okuyabiliriz. Nihai kume merkezleri `/tmp/centers.csv` icinde. Bu merkezleri alip, ham veri uzerinde kirmizi nokta olarak gosteriyoruz.

veriyi 20-30 makinaya dagitarak parca parca isleyip kumelemeniz mumkundur. Endustride son zamanlarda habire duyulan Buyuk Veri (Big Data) olayi iste bu.