Big Data Analytics
732A54
Lab 3

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Exercise 1

Output

Question

Minimums (u '1966 ',-49.4) (u '1999 ',-49.0) (u '1978 ',-47.7) (u '1987 ',-47.3) (u '1967 ',-45.4) (u '2014 ',-42.5) (u '1977 ',-42.5) (u '2002 ',-42.2) (u '1976 ',-42.2) (u '1982 ',-42.2)

Maximums (u '2014 ',34.4) (u '2010 ',34.4) (u '1989 ',33.9) (u '1982 ',33.8) (u '1968 ',33.7) (u '1991 ',32.7) (u '2006 ',32.7) (u '1988 ',32.6) (u '2011 ',32.5) (u '1961 ',31.0)

a)

Minimums (u '1966 ',(u '179950 ',-49.4)) (u '1999 ',(u '192830 ',-49.0)) (u '1978 ',(u '155940 ',-47.7)) (u '1987 ',(u '123480 ',-47.3)) (u '1967 ',(u '166870 ',-45.4)) (u '1979 ',(u '112170 ',-44.0)) (u '1965 ',(u '189780 ',-44.0)) (u '1981 ',(u '166870 ',-44.0)) (u '2001 ',(u '112530 ',-44.0)) (u '1972 ',(u '167860 ',-37.5))

Maximums (u '1986 ',(u '76470 ',33.2)) (u '1970 ',(u '103080 ',33.2)) (u '1956 ',(u '145340 ',33.0)) (u '2000 ',(u '62400 ',33.0)) (u '1959 ',(u '65160 ',32.8)) (u '1966 ',(u '151640 ',33.5)) (u '2002 ',(u '78290 ',33.3)) (u '1983 ',(u '98210 ',33.3)) (u '1964 ',(u '76430 ',31.2)) (u '1971 ',(u '65130 ',31.2)) (u '1972 ',(u '98200 ',31.2))

b)

Running time for sequential execution on the temperatures-big.csv

Real	User	Sys
15m11.000s	14m31.339s	0m21.987s

Running time for parallel execution on the temperatures-big.csv

Real
9mins, 7sec

Code

Initialization

```
def exercise01():
data = sc.textFile("../data/temperature-readings.csv")

observations = data.map(lambda line: line.split(";")) \
```

```
.filter(lambda observation:
(int(observation[1][:4]) >= 1950 and
    int(observation[1][:4]) <= 2014)) \
.cache()

exercise01question(observations)
exercise01a(observations)
```

Question

```
def exercise01question(observations):
temperatures = observations.map(lambda observation:
(observation[1][:4], float(observation[3])))

min_temperatures = temperatures.reduceByKey(min) \
.sortBy(ascending=True,
keyfunc=lambda (year, temp): temp)

max_temperatures = temperatures.reduceByKey(max) \
.sortBy(ascending=False,
keyfunc=lambda (year, temp): temp)

min_temperatures.repartition(1).saveAsTextFile("../nsc_result/1_qa")
max_temperatures.repartition(1).saveAsTextFile("../nsc_result/1_qb")
```

a)

```
def exercise01a(observations):
station_temperatures = observations.map(lambda observation:
(observation[1][:4],
            (observation[0], float(observation[3]))))

min_temperatures_station = station_temperatures.reduceByKey(
lambda (station1, temp1), (station2, temp2):
(station1, temp1)
if temp1 < temp2 else
(station2, temp2)) \
.sortBy(ascending=True,
keyfunc=lambda (year, (station, temp)): temp)

max_temperatures_station = station_temperatures.reduceByKey(
lambda (station1, temp1), (station2, temp2):
(station1, temp1)
if temp1 > temp2 else
(station2, temp2)) \
.sortBy(ascending=False,
```

```
keyfunc=lambda (year, (station, temp)): temp)


min_temperatures_station.repartition(1).saveAsTextFile("../nsc_result/1_aa")
max_temperatures_station.repartition(1).saveAsTextFile("../nsc_result/1_ab")
```

b)

```
from collections import defaultdict

def exercise01_seq():
with open('../data/temperature-readings-small.csv', 'rb') as infile:
year_temp = defaultdict(list)
for line in infile:
values = line.split(";")
year = int(values[1][:4])
temp = float(values[3])

year_temp[year].append(temp)

for year in year_temp:
print(year, min(year_temp[year]), max(year_temp[year]))
```

Exercise 2

Output

a)

(u '2000 -09 ',63837) (u '1985 -06 ',44839) (u '2012 -11 ',255) (u '1986 -07 ',55741) (u '1958 -08 ',25613) (u '1975 -01 ',22) (u '1989 -11 ',1126) (u '1972 -08 ',53918) (u '1993 -09 ',19915) (u '1957 -09 ',12572)

b)

(u '1982 -08 ',326) (u '1965 -07 ',349) (u '1988 -06 ',322) (u '2006 -08 ',309) (u '1986 -04 ',260) (u '1989 -01 ',23) (u '2007 -03 ',201) (u '1955 -04 ',81) (u '2008 -11 ',106) (u '1994 -03 ',89)

Code

Initialization

```
def exercise02():
data = sc.textFile("../data/temperature-readings.csv")

observations = data.map(lambda line: line.split(";")) \
.filter(lambda observation:
         (int(observation[1][:4]) >= 1950 and
             int(observation[1][:4]) <= 2014)) \
.cache()

exercise02a(observations)
exercise02b(observations)
```

a)

```
def exercise02a(observations):
temperatures = observations.map(lambda observation:
(observation[1][:7], (float(observation[3]), 1))) \
.filter(lambda (month, (temp, count)): temp > 10)
reading_counts = temperatures.reduceByKey(lambda (temp1, count1), (temp2, count2):
(temp1, count1 + count2)) \
.map(lambda (month, (temp, count)):
(month, count))

reading_counts.repartition(1).saveAsTextFile("../nsc_result/2_a")
```

b)

```
def exercise02b(observations):
station_temperatures = observations.map(lambda observation:
(observation[1][:7],
(observation[0], float(observation[3])))) \
.filter(lambda (month, (station, temp)): temp > 10)

year_station = station_temperatures.map(
lambda (month, (station, temp)): (month, (station, 1))).distinct()
reading_counts = year_station.reduceByKey(
lambda (station1, count1), (station2, count2):
(station1, count1 + count2)) \
.map(lambda (month, (station, count)): (month, count))

reading_counts.repartition(1).saveAsTextFile("../nsc_result/2_b")
```

Exercise 3

Output

((u '1978 -08 ',u '137100 ') ,14.516129032258062) ((u '1984 -12 ',u '81060 ') ,3.285483870967741) ((u '1976 -03 ',u '162880 ') ,-7.824193548387097) ((u '1981 -10 ',u '123070 ') ,1.1741935483870969) ((u '1967 -03 ',u '92100 ') ,2.9016129032258067) ((u '1994 -12 ',u '72120 ') ,2.4387096774193546) ((u '1983 -07 ',u '105450 ') ,18.220967741935482) ((u '1963 -05 ',u '81630 ') ,11.143548387096773) ((u '1985 -08 ',u '106580 ') ,14.7741935483871) ((u '1969 -08 ',u '74240 ') ,18.375806451612902)

Code

```
def exercise03():
data = sc.textFile("../data/temperature-readings.csv")

observations = data.map(lambda line: line.split(";"))
observations = observations.filter(lambda observation:
                                    (int(observation[1][:4]) >= 1960 and
                                     int(observation[1][:4]) <= 2014))

station_day_temperatures = observations.map(
lambda observation:
((observation[1], observation[0]),
(float(observation[3]), float(observation[3]))))

station_day_minmax_temps = station_day_temperatures.reduceByKey(
lambda
(mintemp1, maxtemp1),
(mintemp2, maxtemp2):
(min(mintemp1, mintemp2),
max(maxtemp1, maxtemp2)))

station_month_avg_temps = station_day_minmax_temps.map(
lambda ((day, station), (mintemp, maxtemp)):
          ((day[:7], station), (sum((mintemp, maxtemp)), 2))) \
.reduceByKey(lambda (temp1, count1), (temp2, count2):
              (temp1 + temp2, count1 + count2)) \
.map(lambda ((month, station), (temp, count)):
      ((month, station), temp / float(count)))

station_month_avg_temps.repartition(1).saveAsTextFile("../nsc_result/3")
```

Exercise 4

Output

(97510 ,(30.0 ,103.99999999999999)) (75250 ,(30.0 ,101.8)) (52350 ,(30.0 ,101.6))
(71420 ,(30.0 ,106.3))

Code

```
def exercise04():
temperature_data = sc.textFile("../data/temperature-readings.csv").cache()
precipitation_data = sc.textFile("../data/precipitation-readings.csv").cache()

temp_obs = temperature_data.map(lambda line: line.split(";")) \
.map(lambda obs: (int(obs[0]), float(obs[3]))) \
.filter(lambda (station, temp):
         temp >= 25 and temp <= 30 ) \
.reduceByKey(max)

precip_obs = precipitation_data.map(lambda line: line.split(";")) \
.map(lambda obs: ((obs[1], int(obs[0])), float(obs[3]))) \
.reduceByKey(lambda precip1, precip2: precip1 + precip2) \
.map(lambda ((day, station), precip):
      (station, precip)) \
.filter(lambda (station, precip):
         precip >= 100 and precip <= 200) \
.reduceByKey(max)

combined = temp_obs.join(precip_obs)

combined.repartition(1).saveAsTextFile("../nsc_result/4")
```

Exercise 5

Output

(u '2003 -12 ',10.087096774193547) (u '1997 -04 ',5.190000000000001) (u '1996 -12 ',7.65483870967742) (u '2014 -09 ',12.920000000000003) (u '1997 -01 ',1.1193548387096772) (u '2014 -04 ',8.469999999999999) (u '2011 -01 ',6.800000000000001) (u '2001 -12 ',6.809677419354839) (u '1999 -04 ',10.909999999999998) (u '2010 -05 ',12.999999999999998)

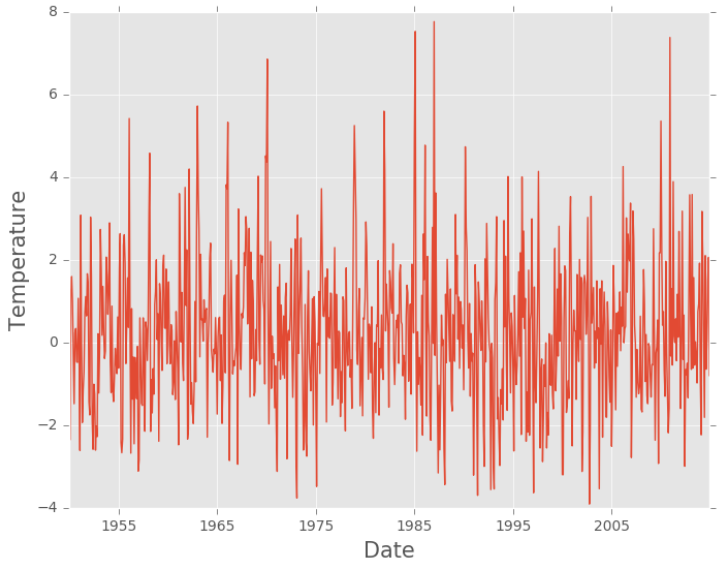
Code

```
def exercise05():
station_data = sc.textFile("../data/stations-Ostergotland.csv")

stations = station_data.map(lambda line: line.split(";")) \
.map(lambda obs: int(obs[0])) \
.distinct().collect()
stations = {station: True for station in stations}

precipitation_data = sc.textFile("../data/precipitation-readings.csv")

precipitation_daily = precipitation_data.map(lambda line: line.split(";")) \
.filter(lambda obs: stations.get(int(obs[0]), False)) \
.map(lambda obs: (obs[1], float(obs[3]))) \
.reduceByKey(lambda precip1, precip2:
             precip1 + precip2)

precipitation_avg_month =  precipitation_daily.map(lambda (day, precip):
                                                   (day[:7], (precip, 1))) \
.reduceByKey(lambda (precip1, count1),
             (precip2, count2):
             (precip1 + precip2,
                      count1 + count2)) \
.map(lambda (month, (precip, count)):
      (month, precip / float(count)))

precipitation_avg_month.repartition(1).saveAsTextFile("../nsc_result/5")
```

Exercise 6

Output

(u ’1950 -01 ’,-2.004831334118534) (u ’1950 -02 ’,2.3479898859946133) (u ’1950 -03 ’,2.4922107271847125) (u ’1950 -04 ’,1.6006931589915459) (u ’1950 -05 ’,0.9823519404632854) (u ’1950 -06 ’,-0.21623225609516084) (u ’1950 -07 ’,-1.4771426774150633) (u ’1950 -08 ’,0.24151715090320636) (u ’1950 -09 ’,0.3431793985584335) (u ’1950 -10 ’,-0.46052051524713367)



Code

Data

```
def exercise06():
station_data = sc.textFile("../data/stations-Ostergotland.csv")

stations = station_data.map(lambda line: line.split(";")) \
.map(lambda obs: int(obs[0])) \
.distinct().collect()
stations = {station: True for station in stations}

temperature_data = sc.textFile("../data/temperature-readings.csv")

temperature_data_filtered = temperature_data.map(
lambda line: line.split(";")) \
.filter(lambda obs:
```

```
        (stations.get(int(obs[0]), False) and
                    int(obs[1][:4]) >= 1950 and
                    int(obs[1][:4]) <= 2014))

month_avg_temp = temperature_data_filtered.map(lambda obs:
                                               ((obs[1], int(obs[0])),
                                                (float(obs[3]), float(obs[3])))) \
.reduceByKey(lambda (mint1, maxt1), (mint2, maxt2):
             (min(mint1, mint2), max(maxt1, maxt2))) \
.map(lambda ((day, station), (mint, maxt)):
     (day[:7], (mint + maxt, 2))) \
.reduceByKey(lambda (temp1, count1), (temp2, count2):
             (temp1 + temp2, count1 + count2)) \
.map(lambda (month, (temp, count)):
     (month, temp / float(count)))

month_longterm_avg_temp = month_avg_temp.filter(lambda (month, temp):
                                                int(month[:4]) <= 1980) \
.map(lambda (month, temp):
     (month[-2:], (temp, 1))) \
.reduceByKey(lambda (temp1, count1), (temp2, count2):
             (temp1 + temp2, count1 + count2)) \
.map(lambda (month, (temp, count)):
     (month, temp / float(count)))

month_temp = {month: temp for month, temp in month_longterm_avg_temp.collect()}

month_avg_temp = month_avg_temp.map(lambda (month, temp):
                                    (month, abs(temp) - abs(month_temp[month[-2:]]))) \
.sortBy(ascending=True, keyfunc=lambda (month, temp): month)

month_avg_temp.repartition(1).saveAsTextFile("../nsc_result/6")
```

Plot

```
import matplotlib.pyplot as plt

from datetime import datetime

def exercise06_plot():
    plt.style.use('ggplot')
    chars_remove = set(["(", ")", " ", "u", "'"])

    avg_year_month = []
    avg_temp = []
```

```
    with open("../nsc_result/6/part-00000", "r") as file:
        for line in file:
            elements = ''.join([char for char in line
                                if char not in chars_remove]).split(",")
            year_month = datetime.strptime(elements[0].strip(), "%Y-%m")
            temp = float(elements[1])

            avg_year_month.append(year_month)
            avg_temp.append(temp)

    plt.plot(avg_year_month, avg_temp)
    plt.xlabel("Date", size=15)
    plt.ylabel("Temperature", size=15)
    plt.savefig('images/fig.png')
    return 'images/fig.png'
return exercise06_plot()
```