BDA - Lab 3 : Machine Learning

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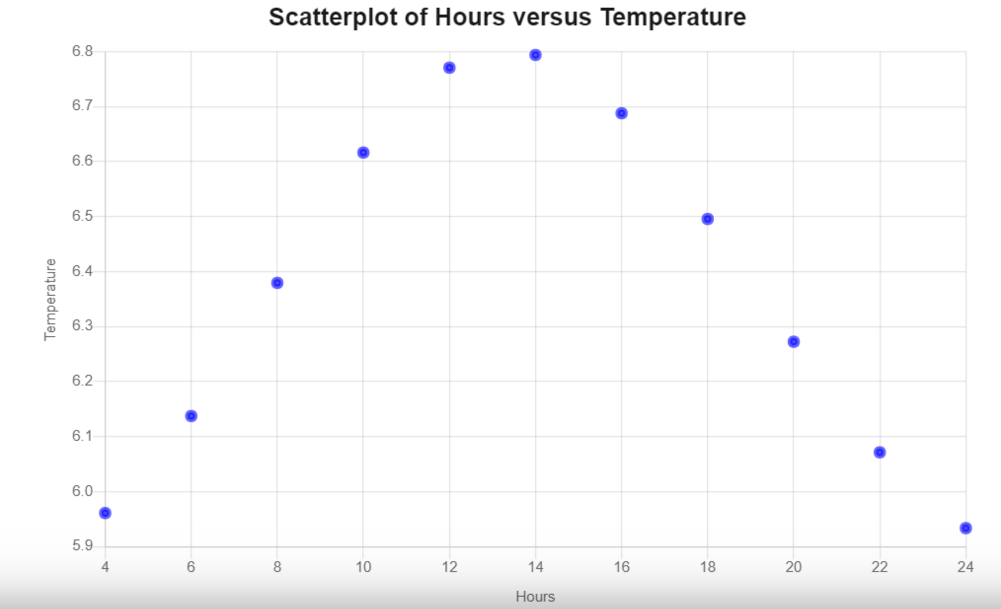
In [ ]:

```
from __future__ import division
from math import radians, cos, sin, asin, sqrt, exp
from datetime import datetime
from pyspark import SparkContext
import sys

# Set up Spark Context
sc = SparkContext(appName = "BDA Lab3")

# Methods Section

def is_leap_year(year):
    return (year % 4 == 0 and year % 100 != 0) or year % 400 == 0

def haversine(lon1, lat1, lon2, lat2):
    """
    Calculate the great circle distance between two points
    on the earth (specified in decimal degrees)
    """
    # convert decimal degrees to radians
    lon1, lat1, lon2, lat2 = map(radians, [lon1, lat1, lon2, lat2])
    # haversine formula
    dlon = lon2 - lon1
    dlat = lat2 - lat1
    a = sin(dlat/2)**2 + cos(lat1) * cos(lat2) * sin(dlon/2)**2
    c = 2 * asin(sqrt(a))
    km = 6367 * c
    return km

def date_diff(date1,date2):
    date1 = datetime.strptime(date1, "%Y-%m-%d")
    date2 = datetime.strptime(date2, "%Y-%m-%d")
    diff = abs(date1 - date2).days
    ret = 1 if diff<=2190 else 0
    return ret


def date_distance (date1, date2):
    """
    Calculates the number of days between the dates from
    data and the prediction date.

    Algorithm keeps track about the shortest distance between
    the 2 dates, considering the leap years as well.
    """
    date1 = datetime.strptime(date1, "%Y-%m-%d")
    year = date1.year
    date2 = datetime.strptime(date2, "%Y-%m-%d").replace(year=year)

    if is_leap_year(year):
        fix_year = datetime.strptime(str(year)+'-01'+'-01', "%Y-%m-%d")
        date_diff = (date1 - fix_year).days
        pred_diff = (date2 - fix_year).days
        diff = abs(pred_diff - date_diff)
        dif = diff if diff<183 else 366 - diff
    else:
        fix_year = datetime.strptime(str(year)+'-01'+'-01', "%Y-%m-%d")
        date_diff = (date1 - fix_year).days
        pred_diff = (date2 - fix_year).days
        diff = abs(pred_diff - date_diff)
        diff = diff if diff<182 else 365 - diff

    return diff

def time_distance(time1, time2):
    """
    Calculates the time differences in Hours
    """
    time1 = datetime.strptime(time1, '%H:%M:%S').hour
    time2 = datetime.strptime(time2, '%H:%M:%S').hour
    diff = abs(time1- time2)
    diff = diff if diff<=12 else 24 - diff
    return diff


def gaussian_kernel(distance, h):
    """
    Gaussian Kernel
    """
    return(exp(-((distance**2)/h)))



def k_sum (k1,k2,k3):
    return k1+k2+k3

def k_prod(k1, k2, k3):
    return k1 * k2 * k3


# Kernel Parameters
h_distance = 300000 # Up to you
h_date = 1000 # Up to you
h_time = 31 # Up to you

#
a = 58.4274 # Up to you
b = 14.826 # Up to you
date = "2013-07-04" # Up to you

rdd_tempReadings = sc.textFile("file:///home/x_kesma/Lab1/input_data/temperature-readin
gs.csv") \
                            .map(lambda line: line.split(";"))
# Trim data till given date and time
rdd_tempReadings = rdd_tempReadings.filter(lambda line: (line[1]<date) & (date_diff(lin
e[1],date)!=0))

rdd_stations = sc.textFile("file:///home/x_kesma/Lab1/input_data/stations.csv")\
                            .map(lambda line: line.split(";"))

tempReadings = rdd_tempReadings.map(lambda line: (line[0],(line[1],line[2], float(line[
3]))))
stations = rdd_stations.map(lambda line: (line[0],(line[3],line[4])))

# Distance Between Stations:
dist_stations = stations.map(lambda line: (line[0],\
                                           gaussian_kernel(haversine(float(line[1][1]),
\
                                                                     float(line[1][0]),
\
                                                                     b,a),\
                                                           h_distance)))

dict_dist_stations = sc.broadcast(dist_stations.collectAsMap())

# Date Distances:
dist_dates = tempReadings.map(lambda line:(line[0],(line[1][1],line[1][2],gaussian_kern
el(date_distance(line[1][0], date),\

h_date))))

# Combine Geo-distance and Date distance

dist_Station_dates_join = dist_dates.map(lambda line: (line[0],(line[1][0],line[1][2],\
                                                                dict_dist_stations.valu
e[line[0]],\
                                                                line[1][1])))#.cache()

sumOut = []
prodOut = []
i = 0
#24,22,20,18,16,14,12,10,8,6,4
times = ["00:00:00", "22:00:00", "20:00:00", "18:00:00", "16:00:00", "14:00:00",\
             "12:00:00", "10:00:00", "08:00:00", "06:00:00", "04:00:00"]
for time in times:
    print("Executing for - {}".format(time))
    kMatrix = dist_Station_dates_join.map(lambda line:(line[0],(line[1][1],line[1][2],\
                                                                gaussian_kernel(time_di
stance(line[1][0],time),h_time),\
                                                                line[1][3] )))

    kTransform = kMatrix.map(lambda line: (k_sum(line[1][0],line[1][1],line[1][2]),\
                                           k_prod(line[1][0],line[1][1],line[1][2]), li
ne[1][3]))
    totalSum = kTransform.map(lambda line: (line[0] * line[2],line[0])).reduce(lambda a
,b: (a[0]+b[0],a[1]+b[1]))
    prodSum  = kTransform.map(lambda line: (line[1] * line[2],line[1])).reduce(lambda a
,b: (a[0]+b[0],a[1]+b[1]))
    sumOut.append(totalSum[0]/totalSum[1])
    prodOut.append(prodSum[0]/prodSum[1])
    print(sumOut)
    print(prodOut)
    i = i+1


with open("/home/x_kesma/Lab1/input_data/results/BDA_LAB3/Output.txt", "w") as output:
    output.write(str(sumOut))
    output.write("\n")
    output.write(str(prodOut))

sys.exit(0)
```

Result:

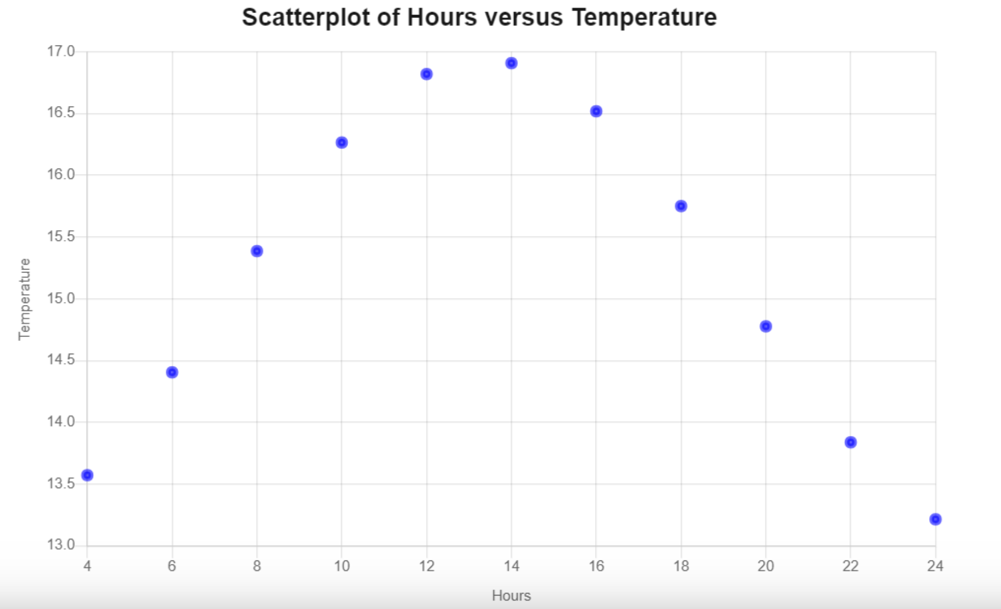
Sum of Kernels: [5.93366287206746, 6.071460586739478, 6.272508775348385, 6.495681068923899, 6.687857955604679, 6.793800389977985, 6.770658221493563, 6.616436685920447, 6.379472539603611, 6.137476539006086, 5.961064016641998]

Highest temperature observed at 14:00 - 6.793800389977985



Product Of Kernels: [13.214303350649812, 13.837661264208363, 14.776440763847974, 15.749926630659463, 16.517560476009848, 16.907384219646037, 16.818710257003158, 16.264490516499457, 15.385649093723485, 14.404241617759448, 13.571464771209166]

Highest temperature observed at 14:00 - 16.907384219646037


Scatterplot of Hours versus Temperature
Temperature
Hours