

## CSE 511 – Project Phase 2

### Group15

#### Group Members

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The goal of this project is to perform spatial Hot Spot Analysis. We do this by implementing two different hot spot analysis tasks – Hot Zone Analysis & Hot Cell Analysis.

#### **Problem Description:**

Hot Zone Analysis: This task checks which rectangle has the greatest number of points within it. A rectangle with a greater number of points inside it will be considered ‘hotter.’

Hot Cell Analysis: In this task we use the spatio-temporal big data to identify statistically significant spatial hotspots by using spatial statistics. We calculate the heat of each cell using the Get-Ord  $G_i^*$  statistic.

## Testing our code:

Below are the steps to run the code and test its functionality:

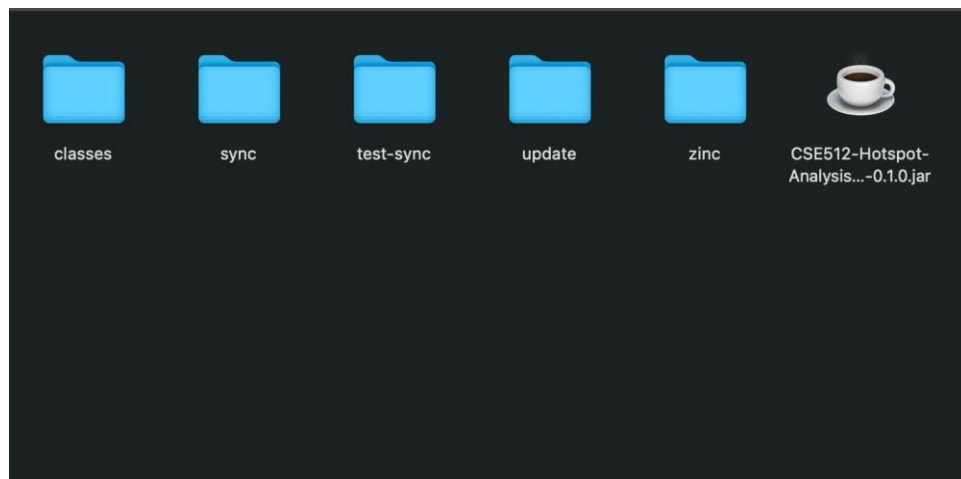
1. We installed all the prerequisites and verify the installation of spark by running the command “spark-shell”. Now we followed the below steps for executing the project:
2. Open the terminal and go to the path where the project has been placed.
3. Then run the command “sbt clean assembly” as shown in the screenshot:

```
You have one mail:
- CSE511-Project-Hotspot-Analysis git:(main) * sbt clean assembly
[info] welcome to sbt 1.8.2 (OpenJDK Java 13)
[info] loading settings for project cse511-project-hotspot-analysis-build from plugins.sbt ...
[info] loading project definition from /Users/vishrutjha/Documents/ASU/CSE 511 DPS/ASU_CSE_511_DPS_Project_Group_15_Spring_22/Phase 2/CSE511-Project-Hotspot-Analysis/project
[info] loading settings for project root from build.sbt ...
[info] set current project to CSE512-Hotspot-Analysis-Template (in build file:/Users/vishrutjha/Documents/ASU/CSE512-Hotspot-Analysis/ASU_CSE_511_DPS_Project_Group_15_Spring_22/Phase2/CSE511-Project-Hotspot-An
alysis/)
[success] Total time: 8 s, completed Apr 24, 2022, 3:51:22 PM
[info] compiling 5 Scala sources to /Users/vishrutjha/Documents/ASU/CSE 511 DPS/ASU_CSE_511_DPS_Project_Group_15_Spring_22/Phase 2/CSE511-Project-Hotspot-Analysis/target/scala-2.13/classes ...
[warn] there was one deprecation warning; re-run with -deprecation for details
[warn] one warning found
[info] including: scala-library-2.13.11.jar
[info] Checking every *.class/*.jar file's SHA-1.
[info] Merging files...
[warn] Merging META-INF/MANIFEST.MF with strategy 'discard'
[warn] Strategy 'discard' was applied to a file
[info] SHA-1: 388e9a4c88a0c0a4e2c0f9e0e0f72d2e027b
[warn] Ignored unknown package option fixTimestamp(Some(1202384000000))
[success] Total time: 6 s, completed Apr 24, 2022, 3:51:28 PM
```

On successfully running the command we get a folder named ‘target’. Inside the target folder the jar file is generated.

4. On running the above command we will have our jar file inside the Scala folder. Below is the screenshot.

Path: Target->Scala->.jar File



5. We now copy the jar file and paste it in the root folder.

6. After this we run the command below to test the implementation:

**~/CSE511-Project-Hotspot-Analysis/target/scala-2.11/CSE512-Hotspot-Analysis-Template-assembly-0.1.0.jar test/output hotzoneanalysis src/resources/point\_hotzone.csv  
src/resources/zone-hotzone.csv hotcellanalysis  
src/resources/yellow\_trip\_sample\_100000.csv**

Below are the screenshots of the run:

```
~/CSE511-Project-Hotspot-Analysis $! java -jar test/output hotzoneanalysis src/resources/point_hotzone.csv src/resources/zone-hotzone.csv hotcellanalysis src/resources/yellow_trip_sample_100000.csv
INFO correct 'test/output' to 'test/output@' [yes]?
WARNING: An illegal reflective access operation has occurred
WARNING: Illegal reflective access by org.apache.spark.unsafe.Platform (file:/opt/homebrew/Cellar/apache-spark/3.2.1/libexec/jars/spark-unsafe_2.12-3.2.1.jar) to constructor java.nio.DirectByteBuffer(long, int)
WARNING: Please consider reporting this to the maintainers of org.apache.spark.unsafe.Platform
WARNING: Use --illegal-access=warn to enable warnings of further illegal reflective access operations
WARNING: All illegal access operations will be denied in a future release
22/04/24 15:55:19 WARN NativeCodeLoader: Unable to load native-hadoop library for your platform... using builtin-java classes where applicable
Using Spark's default log4j profile: org/apache/spark/log4j-defaults.conf
22/04/24 15:55:19 INFO SparkContext: Running Spark version 3.2.1
22/04/24 15:55:19 INFO ResourceUtils: =====
22/04/24 15:55:19 INFO ResourceUtils: No custom resources configured for spark.driver.
22/04/24 15:55:19 INFO ResourceUtils: =====
22/04/24 15:55:19 INFO SparkContext: Submitted application: CSE512-HotspotAnalysis-GROUP-15
22/04/24 15:55:19 INFO ResourceProfile: Default ResourceProfile created, executor resources: Map(cores -> name: cores, amount: 1, script: , vendor: , memory -> name: memory, amount: 1024, script: , vendor: , offheap -> name: offheap, amount: 0, script: , vendor: ), task resources: Map(cpus -> name: cpus, amount: 1.0)
22/04/24 15:55:19 INFO ResourceProfile: Limiting Resource is cpu
22/04/24 15:55:19 INFO ResourceProfileManager: Added ResourceProfile id: 0
22/04/24 15:55:19 INFO SecurityManager: Changing view acls to: viashrutjha
22/04/24 15:55:19 INFO SecurityManager: Changing modify acls to: viashrutjha
22/04/24 15:55:19 INFO SecurityManager: Changing view acls groups to:
22/04/24 15:55:19 INFO SecurityManager: Changing modify acls groups to:
22/04/24 15:55:19 INFO SecurityManager: SecurityManager: authentication disabled; ui acls disabled; users with view permissions: Set(viashrutjha); groups with view permissions: Set(); users with modify permissions: Set(viashrutjha); groups with modify permissions: Set()
22/04/24 15:55:19 INFO Utils: Successfully started service 'sparkDriver' on port 64167.
22/04/24 15:55:19 INFO BlockManager: Registering MapOutputTracker
22/04/24 15:55:19 INFO SparkEnv: Registering BlockManagerMaster
22/04/24 15:55:19 INFO BlockManagerMasterEndpoint: Using org.apache.spark.storage.DefaultTopologyMapper for getting topology information
22/04/24 15:55:19 INFO BlockManagerMasterEndpoint: BlockManagerMasterEndpoint up
22/04/24 15:55:19 INFO SparkEnv: Registering BlockManagerMasterHeartbeat
22/04/24 15:55:19 INFO DiskBlockManager: Created local directory at /private/var/folders/2g/y10_kgm4338FWw320364d0000gn/T/blockmgr-4d803276-0b09-44e3-b0ef-b18dc46b5b1e
22/04/24 15:55:19 INFO MemoryStore: MemoryStore started with capacity 434.4 MiB
22/04/24 15:55:19 INFO SparkEnv: Registering OutputCommitCoordinator
22/04/24 15:55:19 WARN Utils: Service 'SparkUI' could not bind to port 4040. Attempting port 4041.
22/04/24 15:55:19 INFO Utils: Successfully started service 'SparkUI' on port 4041.
```

```
22/04/24 15:53:24 INFO BlockManager: Initialized BlockManager: BlockManagerId(driver, 192.168.0.229, 64204, None)

_c0] _c1] _c2]_c3] _c4] _c5] _c6] _c7] _c8] _c9] _c10] _c11] _c12] _c13] _c14] _c15]
VTS[2009-01-23 22:14:00]2009-01-23 22:20:00] 5.0500000000000000E-05[73.704615000000... null>null](-73.985718000000... CASh(4.0000000000000000) 0.5>null] 0 014.5000000000000000
VTS[2009-01-26 07:20:00]2009-01-26 07:31:00] 1 3.75(-74.000417000000... null>null](-73.979170000000... CASh(1.0000000000000000) 10.0] 0>null] 0 10.0]
VTS[2009-01-12 22:43:00]2009-01-12 22:48:00] 1 1.25(-73.764415000000... null>null](-73.958150000000... CASh(5.7000000000000000) 0.5>null] 0 016.2000000000000000
CMT[2009-01-17 23:00:01]2009-01-17 23:13:150] 1 1.5(-73.704300000000... null>null](-73.9512004075... Cash(7.7000000000000000) 0>null] 0 017.7000000000000000
VTS[2009-01-11 22:17:00]2009-01-11 22:43:00] 1 6.71(-73.871120000000... null>null](-73.958340000000... CASh(18.0000000000000000) 0.5>null] 0 019.3000000000000000
VTS[2009-01-09 08:22:00]2009-01-09 08:41:00] 1 4.0000000000000000E-05[73.708072000000... null>null](-73.982470000000... Credit(15.3000000000000000) 0.5>null] 2 017.3000000000000000
VTS[2009-01-04 19:20:00]2009-01-04 19:31:00] 5 0.6(-73.792270000000... null>null](-73.989700000000... CASh(3.2000000000000000) 0>null] 0 013.2000000000000000
CMT[2009-01-10 23:03:30]2009-01-10 23:11:15] 1 5(-73.907720000000... null>null](-73.971430000000... Cash(1.0000000000000000) 10] 0>null] 0 10]
VTS[2009-01-03 07:00:00]2009-01-03 07:20:00] 1 7.6000000000000000E-05[73.694430000000... null>null](-73.951350000000... CASh(0.0000000000000000) 20.0] 0>null] 0 20.0]
VTS[2009-01-18 18:14:00]2009-01-18 18:02:00] 110.5600000000000000E-05[73.981470000000... null>null](-73.978560000000... Credit(4.9000000000000000) 0>null] 2 016.9000000000000000
CMT[2009-01-23 21:27:27]2009-01-23 21:02:150] 1 3.2000000000000000E-05[74.0003000000... null>null](-73.960830000000... Credit(17.0000000000000000) 0>null]12.6000000000000000 020.4000000000000000
VTS[2009-01-16 19:01:00]2009-01-16 19:08:00] 5 1.4000000000000000E-05[73.987200000000... null>null](-73.987140000000... CASh(6.0000000000000000) 1>null] 0 017.0000000000000000
VTS[2009-01-10 12:43:00]2009-01-10 12:52:00] 1 2.25(-73.7004474075... null>null](-73.989490000000... CASh(1.9000000000000000) 0>null] 0 018.9000000000000000
CMT[2009-01-24 15:14:00]2009-01-16 15:34:00] 1 7.3700000000000000E-05[73.961130000000... null>null](-73.951470000000... CASh(15.3000000000000000) 0>null] 0 015.3000000000000000
VTS[2009-01-13 23:05:00]2009-01-14 00:04:00] 5 2.40(-73.708040000000... null>null](-73.987180000000... CASh(8.0000000000000000) 0.5>null] 0 018.5000000000000000
VTS[2009-01-16 09:22:00]2009-01-16 09:26:00] 210.7000000000000000E-05[73.708040000000... null>null](-73.950470000000... CASh(4.0000000000000000) 0>null] 0 014.0000000000000000
CMT[2009-01-21 18:00:00]2009-01-21 19:04:23] 213.2000000000000000E-05[73.924420000000... null>null](-73.956700000000... Cash(0.0000000000000000) 11.9] 0>null] 0 11.9]
VTS[2009-01-15 13:30:00]2009-01-15 13:42:00] 10.9000000000000000E-05[73.708500000000... null>null](-73.970920000000... Cash(7.4000000000000000) 0>null] 0 017.4000000000000000
VTS[2009-01-01 09:18:18]2009-01-01 09:24:00] 110.7100000000000000E-05[73.702030000000... null>null](-73.981930000000... CASh(4.9000000000000000) 0>null] 0 014.9000000000000000

only showing top 20 rows

| X | Y | Z |
|---|---|---|
| -7399 | 4076 | 23 |
| -7401 | 4071 | 24 |
| -7397 | 4079 | 12 |
| -7399 | 4076 | 17 |
| -7398 | 4076 | 11 |
| -7396 | 4078 | 9 |
| -7400 | 4072 | 4 |
| -7400 | 4072 | 15 |
| -7400 | 4072 | 3 |
| -7399 | 4073 | 18 |
| -7401 | 4074 | 23 |
| -7399 | 4077 | 16 |
| -7400 | 4074 | 16 |
| -7397 | 4071 | 24 |
| -7399 | 4075 | 13 |
| -7396 | 4077 | 14 |
| -7393 | 4074 | 23 |
| -7397 | 4071 | 29 |
| -7399 | 4075 | 18 |
| -7399 | 4076 | 9 |

only showing top 20 rows
```