

## Program 2: Flight Data Analysis with Apache Storm

### Documentation:

#### **TopologyMain.java**

This is the main program file which handles the execution of the project. Creating ‘builder’ as TopologyBuilder and setting spout and bolts with it. The field grouping from HubIdentifier to AirlineSorter is ‘airport.city’, so that all flights data are collected per airport. Reading the input files from config.

#### **flightsDataReader.java :**

This is the spout which reads the flights data which is the format of ‘json’ and add it to list of flights. It consists of a utility function ‘dataNormalizer()’ which does data preparation. In the prepare function, dataNormalizer() is called and values are emitted for each flight. In declareOutputFields() function, all the string respective to flights are declared.

#### **HubIdentifier.java :**

```
prepare(Map conf, TopologyContext context)
```

This is the bolt in the storm topology which reads the airport data using a utility function ‘readAirportData()’ that manipulates the file and add top 40 airports in airport array.

```
execute(Tuple tuple, BasicOutputCollector collector)
```

In this method, we are fetching the flight details emitted by flight reader necessary to compare with airport’s latitude and longitude. For each airports, it will check for each flight that if the range of latitude and longitude is within 20miles, then the flight is either taking off or landing, emit the airport and flight details. The emitted values are then declared in the declareOutputFields() respectively.

#### **AirlineSorter.java :**

```
cleanup()
```

This the bolt in the project which outputs the value of each airport which is airport code with airport city name as there can be multiple airports in a particular city and each airport containing the flights represented by their call signs and their counts. I have also included the total time elapsed in milliseconds to measure the performance of the program varying with no of bolts and spouts.

```
execute(Tuple input, BasicOutputCollector collector)
```

In this method, we are fetching the airport and flight details emitted by hub identifier like airport city, code and flight call sign. It maintains a map of Map<String, Map<String, Integer>> i.e. for each airport with the flight details and their count.

**Airport.java :** Class with attributes *city, code, latitude, and longitude* for airport array.

## Source code:

Zip folder contains source code for:

1. Prog2
2. Lab4
3. Lab5

## Execution output:

### (1) Basic Implementation:

Refer to myoutput.txt file in the folder prog2 for the full output.

```
5683 [TopologyMain.main()] INFO backtype.storm.daemon.nimbus - Shut down master
5687 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down c376ea96-f58f-47d7-80b3-44051ccb4542:e45b55ae-dd87-4c28-932c-e83e15676a48
5688 [TopologyMain.main()] INFO backtype.storm.process-simulator - Killing process 49bd6c51-f4ff-4cb3-8ac8-30e1c5dfca99
5688 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shutting down worker Getting-Started-Topologie-1-1620435455 c376ea96-f58f-47d7-80b3-44051ccb45
42 1
5688 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620435455:4
5689 [Thread-16] INFO backtype.storm.util - Async loop interrupted!
5694 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620435455:4
5694 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620435455:3
5694 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
-- Flight Counter [airline-sorter-3] --
At Airport: DEN(Denver)
JZA: 1
UAL: 4
LOF: 1
FFT: 1
N85: 1
N52: 1
SWA: 5
AAL: 1
SKW: 3
total #flights = 18

At Airport: HOU(Houston)
N19: 1
N72: 1
SWA: 4
MLN: 1
total #flights = 7

At Airport: DFW(Dallas-Fort Worth)
UAL: 1
DLH: 1
ASH: 3
NKS: 1
BOE: 1
AAL: 6
SWA: 3
EMD: 1
SKW: 2
DAL: 2
QXE: 1
total #flights = 22

At Airport: SMF(Sacramento)
UAL: 1
SWA: 1
AAL: 1
SKW: 1
```

```
At Airport: SMF(Sacramento)
UAL: 1
SWA: 1
AAL: 1
SKW: 1
total #flights = 4
```

```
At Airport: IAD(Washington)
UAL: 5
RPA: 1
N73: 1
AAL: 1
N97: 1
DAL: 3
FFT: 1
EDV: 1
BAW: 1
ROU: 1
SWA: 1
EJA: 1
VIR: 1
total #flights = 19
```

```
At Airport: STL(St Louis)
N47: 1
BKN: 1
FFT: 1
N50: 1
N72: 1
N95: 1
SWA: 2
N20: 1
total #flights = 9
```

```
At Airport: PHL(Philadelphia)
DLH: 1
ENY: 1
GA3: 1
RPA: 1
ASH: 1
N92: 1
PJC: 1
SWA: 2
N22: 1
total #flights = 10
```

```
At Airport: BWI(Baltimore)
UAL: 1
```



```
At Airport: BWI(Baltimore)
UAL: 1
685: 1
ICL: 1
N30: 1
SWA: 1
JBU: 1
AAL: 2
LX3: 1
total #flights = 9
```

```
At Airport: SNA(Santa Ana)
UAL: 2
AIJ: 1
AAL: 2
JBU: 1
CPZ: 1
GTI: 1
SKW: 2
DAL: 1
total #flights = 11
```

```
At Airport: PDX(Portland)
N80: 1
N82: 1
N52: 2
N74: 1
N63: 1
N98: 1
N53: 2
N56: 1
DAL: 2
N89: 1
N44: 1
N19: 1
SWA: 2
SKW: 1
total #flights = 18
```

```
At Airport: LAS(Las Vegas)
N91: 2
EDG: 1
AAL: 2
CPZ: 1
N31: 1
N23: 2
DAL: 2
WJA: 1
```

```
At Airport: LAS(Las Vegas)
N91: 2
EDG: 1
AAL: 2
CPZ: 1
N31: 1
N23: 2
DAL: 2
WJA: 1
ASA: 1
N22: 1
N13: 1
N38: 1
NKS: 2
SWA: 1
SKW: 2
total #flights = 21
```

```
At Airport: SEA(Seattle)
```

```
DLH: 1
UAL: 1
N92: 1
N78: 1
N95: 1
N73: 1
N51: 1
AAL: 1
N97: 1
N23: 1
DAL: 1
N34: 1
N12: 1
N67: 1
ASA: 1
N36: 1
N16: 1
CAP: 1
N15: 1
N29: 1
N28: 1
QXE: 1
total #flights = 22
```

```
At Airport: RDU(Raleigh/Durham)
```

```
GJS: 1
N17: 1
N68: 1
NB2: 1
```



```
At Airport: RDU(Raleigh/Durham)
```

```
GJS: 1
N17: 1
N68: 1
NB2: 1
AAL: 1
N86: 1
N42: 1
N75: 1
DAL: 1
total #flights = 9
```

```
At Airport: BOS(Boston)
```

```
JZA: 1
CHH: 1
N63: 1
KAP: 3
SWA: 2
JBU: 1
total #flights = 9
```

```
At Airport: MSP(Minneapolis)
```

```
N57: 1
NKS: 1
N63: 1
N41: 1
N62: 1
SWA: 1
SKW: 6
DAL: 3
N78: 1
N33: 1
total #flights = 17
```

```
At Airport: BNA(Nashville)
```

```
N16: 1
JIA: 1
EDV: 1
total #flights = 3
```

```
At Airport: DCA(Washington)
```

```
UAL: 3
UCA: 1
FFT: 1
EDV: 1
BAW: 1
ROU: 1
SWA: 2
AAL: 2
```



```
At Airport: LGA(New York)
    UAL: 7
    AFL: 1
    N30: 1
    AAL: 1
    N32: 1
    DAL: 2
    SWR: 1
    ENY: 4
    N35: 1
    UCA: 1
    OPT: 1
    EDV: 2
    PWA: 1
    JBU: 1
    SWA: 2
    SKW: 1
    total #flights = 28
```

```
At Airport: TPA(Tampa)
    UAL: 1
    N70: 1
    AAL: 2
    N10: 1
    N20: 1
    N53: 1
    N23: 1
    DAL: 3
    N12: 1
    N25: 1
    ENY: 1
    CAP: 1
    FFT: 1
    AAY: 1
    SWA: 1
    EJA: 1
    total #flights = 19
```

```
At Airport: SLC(Salt Lake City)
    AAL: 1
    SWA: 1
    SKW: 2
    total #flights = 4
```

```
At Airport: OAK(Oakland)
    UAL: 4
    FFT: 1
    N81: 1
    FDX: 1
```



```
At Airport: OAK(Oakland)
    UAL: 4
    FFT: 1
    N81: 1
    FDX: 1
    JBU: 1
    SWA: 3
    AAL: 3
    DAL: 3
    ASA: 1
    total #flights = 18
```

```
At Airport: DTW(Detroit)
    GJS: 1
    JIA: 1
    EDV: 1
    N81: 1
    NKS: 1
    FDX: 1
    AAL: 1
    DAL: 3
    SKW: 2
    total #flights = 12
```

```
At Airport: IAH(Houston)
    DLH: 1
    UAL: 3
    NKS: 1
    BAW: 1
    AAL: 1
    AFR: 1
    ASQ: 1
    total #flights = 9
```

```
At Airport: MCI(Kansas City)
    ENY: 1
    N49: 1
    N40: 1
    N21: 1
    SWA: 3
    AAL: 1
    DAL: 1
    SKW: 1
    N44: 1
    total #flights = 11
```

```
At Airport: FLL(Fort Lauderdale)
    UAL: 1
```



```
At Airport: FLL(Fort Lauderdale)
  UAL: 1
  N81: 2
  N80: 1
  PTP: 1
  273: 1
  N27: 1
  810: 1
  JBU: 6
  SWA: 1
  SDU: 1
  N56: 1
  N52: 1
  N76: 1
  183: 1
  AAL: 3
  N31: 1
  DAL: 3
  N77: 2
  N99: 1
  N13: 1
  N35: 1
  N16: 2
  N38: 1
  N15: 2
  N37: 1
  N17: 1
  NKS: 2
total #flights = 41
```

```
At Airport: LAX(Los Angeles)
  N80: 1
  CMP: 1
  AAL: 7
  CPZ: 1
  KLM: 1
  DAL: 1
  CAL: 1
  N58: 1
  N13: 1
  N15: 1
  ANA: 1
  NKS: 1
  SWA: 2
  JBU: 1
  SKW: 1
total #flights = 22
```

```
At Airport: EWR(Newark)
```



```
At Airport: EWR(Newark)
  UAL: 11
  AFL: 1
  DAL: 1
  SWR: 1
  ENY: 4
  N35: 1
  UCA: 1
  EDV: 4
  NKS: 1
  PWA: 1
  JBU: 1
  SWA: 2
  EJA: 1
  SKW: 1
  ASQ: 1
total #flights = 32
```

```
At Airport: SFO(San Francisco)
  UAL: 4
  COO: 1
  FFT: 1
  N81: 2
  FDX: 1
  SWA: 3
  AAL: 3
  DAL: 3
  ASA: 1
total #flights = 19
```

```
At Airport: MCO(Orlando)
  DLH: 1
  N61: 1
  N83: 1
  N62: 1
  N84: 1
  ASA: 1
  N72: 1
  N25: 1
  ENY: 1
  N48: 1
  EDV: 1
  SWA: 4
  JBU: 1
  CON: 1
  N94: 1
  N51: 2
  AAL: 3
```



```
At Airport: MCO(Orlando)
DLH: 1
N61: 1
N83: 1
N62: 1
N84: 1
ASA: 1
N7Z: 1
N2S: 1
ENY: 1
N48: 1
EDV: 1
SWA: 4
JBU: 1
CON: 1
N94: 1
N51: 2
AAL: 3
DAL: 4
N11: 1
N14: 1
N37: 1
N18: 1
N39: 1
N17: 2
N19: 1
total #flights = 35
```

```
At Airport: CLE(Cleveland)
UAL: 1
LOF: 1
RPA: 1
N90: 1
PHM: 1
CGH: 1
SWA: 2
N98: 1
total #flights = 9
```

```
At Airport: ORD(Chicago)
LOT: 1
UAL: 5
RPA: 1
AIJ: 1
AAL: 2
SWA: 2
N21: 1
EJA: 3
SKW: 2
total #flights = 20
```



```
At Airport: ORD(Chicago)
LOT: 1
UAL: 5
RPA: 1
AIJ: 1
AAL: 2
SWA: 2
N21: 1
EJA: 3
SKW: 2
DAL: 1
ASQ: 1
total #flights = 20
```

```
At Airport: CLT(Charlotte)
N35: 1
JIA: 1
FDX: 1
AAL: 2
total #flights = 5
```

```
At Airport: MIA(Miami)
DLH: 1
UAL: 1
N80: 1
N61: 1
N62: 1
PTP: 1
273: 1
ENY: 1
810: 1
JBU: 5
SWA: 1
N50: 1
N52: 1
N51: 1
AVA: 1
AAL: 5
N76: 1
183: 1
DAL: 1
N99: 1
N13: 1
N35: 2
N38: 1
N16: 1
N15: 1
N37: 1
```



```
N35: 2
N38: 1
N16: 1
N15: 1
N37: 1
NKS: 2
GTI: 1
total #flights = 38

At Airport: HNL(Honolulu)
N48: 1
JAL: 1
BAD: 1
KAL: 1
N80: 1
N42: 1
N11: 2
N77: 1
total #flights = 9

At Airport: SAN(San Diego)
VOI: 1
UAL: 1
FFT: 1
N28: 1
RCH: 1
N95: 1
AAL: 3
SWA: 2
SKW: 3
DAL: 1
total #flights = 15

At Airport: JFK(New York)
UAL: 6
AFL: 1
N32: 1
DAL: 2
SWR: 1
ENY: 4
N35: 1
AUI: 1
EDV: 4
PWA: 1
JBU: 1
SWA: 1
SKW: 1
total #flights = 26
```

```
At Airport: PHX(Phoenix)
N81: 1
N70: 1
N83: 2
N60: 1
MSG: 1
N96: 1
AAL: 3
WJA: 1
N35: 3
N18: 1
N17: 1
ASH: 1
SWA: 6
OXF: 2
EJA: 2
NDU: 4
total #flights = 31

At Airport: ATL(Atlanta)
N13: 1
ROU: 1
SWA: 1
AAL: 1
DAL: 1
N89: 1
total #flights = 6

At Airport: MDW(Chicago)
LOT: 1
UAL: 5
ENY: 1
RPA: 1
AIJ: 1
SCX: 1
AAL: 2
SWA: 2
N21: 1
EJA: 2
SKW: 1
ASQ: 1
total #flights = 19

At Airport: AUS(Austin)
OPT: 1
FFT: 1
SWA: 1
AAL: 1
```

```

FFT: 1
SWA: 1
AAL: 1
EJA: 1
DAL: 1
total #flights = 6

Total elapsed time in 4656 milliSeconds
5725 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620435455:3
5725 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620435455:2
5725 [Thread-22] INFO backtype.storm.util - Async loop interrupted!
5730 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620435455:2
5730 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620435455:1
5734 [Thread-24] INFO backtype.storm.util - Async loop interrupted!
5744 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620435455:1
5745 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Terminating zmq context
5748 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Disconnecting from storm cluster state context
5748 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Waiting for heartbeat thread to die
5752 [Thread-27] INFO backtype.storm.util - Async loop interrupted!
5753 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
5753 [Thread-15] INFO backtype.storm.util - Async loop interrupted!
5762 [Thread-14] INFO backtype.storm.event - Event manager interrupted
5765 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shut down worker Getting-Started-Topologie-1-1620435455 c376ea96-f58f-47d7-80b3-44051ccb4542 1
5766 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shut down c376ea96-f58f-47d7-80b3-44051ccb4542:e45b55ae-dd87-4c28-932c-e83e15676a48
5766 [Thread-6] INFO backtype.storm.util - Async loop interrupted!
5766 [Thread-7] INFO backtype.storm.util - Async loop interrupted!
5767 [Thread-8] INFO backtype.storm.util - Async loop interrupted!
5767 [Thread-4] INFO backtype.storm.event - Event manager interrupted
5767 [Thread-5] INFO backtype.storm.event - Event manager interrupted
5770 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down supervisor ed5f495c-4c28-4041-b651-a6e4b1410835
5771 [Thread-11] INFO backtype.storm.util - Async loop interrupted!
5775 [Thread-12] INFO backtype.storm.util - Async loop interrupted!
5775 [Thread-13] INFO backtype.storm.util - Async loop interrupted!
5776 [Thread-9] INFO backtype.storm.event - Event manager interrupted
5776 [Thread-10] INFO backtype.storm.event - Event manager interrupted
5782 [TopologyMain.main()] INFO backtype.storm.testing - Shutting down in process zookeeper
5783 [TopologyMain.main()] INFO backtype.storm.testing - Done shutting down in process zookeeper
5783 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/0cb68eb-6ff6-47d4-9cb3-68328bbccc93
5784 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/2d3f7bce-17a5-45de-8a9c-aa0ea4a50a0e
5784 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/7391cc1f-bed3-4acf-ac61-7c9dff9f64e8
5785 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/5fc143b6-3c1a-4974-8fa5-3e3db6bbc3c4
[INFO]
[INFO] BUILD SUCCESS
[INFO]
[INFO] Total time: 10.664 s
[INFO] Finished at: 2021-05-07T17:57:42-07:00
[INFO]
[sagra15@cssmipi1h prog2]$ 

```

## (2) Multithreaded Execution:

Table 1

No	FlightDataReader	HubIdentifier	AirLineSorter	Time(ms)
1	1	1	2	4471
2	1	1	3	3965
3	1	2	1	4850
4	1	2	2	4802
5	1	2	3	4748
6	1	3	1	4812
7	1	3	2	4573
8	1	3	3	4266
9	2	1	1	4725
10	2	2	2	4444
11	2	2	3	4719
12	2	3	3	4690
13	3	1	3	4545
14	3	2	1	4749
15	3	3	1	4577
16	3	3	3	4758

Screenshots:

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.751 s
[INFO] Finished at: 2021-05-07T00:01:27-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 1
Total elapsed time in 4640 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.368 s
[INFO] Finished at: 2021-05-07T00:06:41-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 2
Total elapsed time in 4512 milliSeconds
Total elapsed time in 4471 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.216 s
[INFO] Finished at: 2021-05-07T00:09:43-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 3
Total elapsed time in 4222 milliSeconds
Total elapsed time in 4151 milliSeconds
Total elapsed time in 3965 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 7.962 s
[INFO] Finished at: 2021-05-07T00:12:20-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 2
Number of threads in AirlineSorter 1
Total elapsed time in 4850 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 6.021 s
[INFO] Finished at: 2021-05-07T00:14:00-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 2
Number of threads in AirlineSorter 2
Total elapsed time in 4829 milliSeconds
Total elapsed time in 4802 milliSeconds
[sagra15@cssmp1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.468 s
[INFO] Finished at: 2021-05-07T00:16:11-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 2
Number of threads in AirlineSorter 3
Total elapsed time in 4808 milliSeconds
Total elapsed time in 4780 milliSeconds
Total elapsed time in 4748 milliSeconds
[sagra15@cssmp1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.415 s
[INFO] Finished at: 2021-05-07T00:18:17-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 1
Total elapsed time in 4812 milliSeconds
[sagra15@cssmp1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 2.813 s
[INFO] Finished at: 2021-05-07T00:20:16-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 2
Total elapsed time in 4660 milliSeconds
Total elapsed time in 4573 milliSeconds
[sagra15@cssmp1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.742 s
[INFO] Finished at: 2021-05-07T00:23:15-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 3
Total elapsed time in 4511 milliSeconds
Total elapsed time in 4355 milliSeconds
Total elapsed time in 4266 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
INFO] BUILD SUCCESS
INFO] -----
INFO] Total time: 4.030 s
INFO] Finished at: 2021-05-07T00:25:56-07:00
INFO] -----
sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 2
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 2
Total elapsed time in 4784 milliSeconds
Total elapsed time in 4669 milliSeconds
[sagra15@cssmpi1h prog2]$
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 5.064 s
[INFO] Finished at: 2021-05-07T00:32:03-07:00
[INFO] -----
[[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 2
Number of threads in HubIdentifier 2
Number of threads in AirlineSorter 2
Total elapsed time in 4561 milliSeconds
Total elapsed time in 4444 milliSeconds
[sagra15@cssmpi1h prog2]$]

[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.221 s
[INFO] Finished at: 2021-05-07T00:34:37-07:00
[INFO] -----
[[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 2
Number of threads in HubIdentifier 2
Number of threads in AirlineSorter 3
Total elapsed time in 4752 milliSeconds
Total elapsed time in 4751 milliSeconds
Total elapsed time in 4719 milliSeconds
[sagra15@cssmpi1h prog2]$]
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time:  5.432 s
[INFO] Finished at: 2021-05-07T00:37:59-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 2
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 2
Total elapsed time in 4591 milliSeconds
Total elapsed time in 4511 milliSeconds
[sagra15@cssmp1h prog2]$ █
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time:  6.085 s
[INFO] Finished at: 2021-05-07T00:43:41-07:00
[INFO] -----
[[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 3
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 3
Total elapsed time in 4648 milliSeconds
Total elapsed time in 4614 milliSeconds
Total elapsed time in 4545 milliSeconds
[sagra15@cssmp1h prog2]$ █
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time:  9.660 s
[INFO] Finished at: 2021-05-07T00:48:48-07:00
[INFO] -----
[[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 3
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 1
Total elapsed time in 4577 milliSeconds
[sagra15@cssmp1h prog2]$ █
```

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time:  3.141 s
[INFO] Finished at: 2021-05-07T00:49:35-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 3
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 2
Total elapsed time in 4594 milliSeconds
Total elapsed time in 4503 milliSeconds
[sagra15@cssmp1h prog2]$ █
```

```

[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.107 s
[INFO] Finished at: 2021-05-07T00:50:29-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 3
Number of threads in HubIdentifier 3
Number of threads in AirlineSorter 3
Total elapsed time in 4761 milliSeconds
Total elapsed time in 4758 milliSeconds
Total elapsed time in 4758 milliSeconds
[sagra15@cssmp1h prog2]$ 

```

### (3) Additional feature(s):

- More descriptive outputs: Sort call signs, (airline company code such as AAL and UAL) in terms of the number of flights per airport and added airlines names.

Refer to outputADDITIONAL.txt file in the folder prog2 for the full output.

```

timize" true, "topology.max.task.parallelism" nil, "FlightsFile" "src/main/resources/flights.txt"
1344 [Thread-51] INFO backtype.storm.daemon.worker - Worker 5ee361b6-76ab-4bec-b495-2372aa7a024c for storm Getting-Started-Topologie-1-1620432921 on 1ba7b450-
ae3a-4b7a-a788-13056aa9ac7f:1 has finished loading
5889 [TopologyMain.main()] INFO backtype.storm.daemon.nimbus - Shutting down master
5895 [TopologyMain.main()] INFO backtype.storm.daemon.nimbus - Shut down master
5900 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down 1ba7b450-ae3a-4b7a-a788-13056aa9ac7f:5ee361b6-76ab-4bec-b495-2372aa7a024c
5901 [TopologyMain.main()] INFO backtype.storm.process-simulator - Killing process 45212287-91fd-4020-9d93-7b8564aa7610
5901 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shutting down worker Getting-Started-Topologie-1-1620432921 1ba7b450-ae3a-4b7a-a788-13056aa9ac
7f 1
5901 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:4
5902 [Thread-16] INFO backtype.storm.util - Async loop interrupted!
5907 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:4
5907 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:3
5907 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
-- Flight Counter [airline-sorter-3] --
At Airport: DEN(Denver)
    SWA (Southwest Airlines): 5
    UAL (United Airlines): 4
    SKW (SkyWest Airlines): 3
    JZA (Jazz Aviation): 1
    N85 (Alexandria Field): 1
    AAL (American Airlines): 1
    N52 (Jaars-Townsend): 1
    FFT (Frontier Airlines): 1
    LOF (Trans States Airlines): 1
    total #flights = 18

At Airport: HOU(Houston)
    SWA (Southwest Airlines): 4
    MLN (Melilla): 1
    N19 (aztec municipal ): 1
    N72 (Warwick Municipal): 1
    total #flights = 7

At Airport: DFW(Dallas-Fort Worth)
    AAL (American Airlines): 6
    SWA (Southwest Airlines): 3
    ASH (Mesa Airlines): 3
    DAL (Delta Air Lines): 2
    SKW (SkyWest Airlines): 2
    BOE (Boeing): 1
    EMD (Eaglemed (Ballard Aviation)): 1
    QXE (Horizon Air): 1
    UAL (United Airlines): 1
    DLH (Duluth International): 1
    NKS (Spirit Airlines): 1
    total #flights = 22

At Airport: SMF(Sacramento)

```

```

At Airport: SMF(Sacramento)
SWA (Southwest Airlines): 1
UAL (United Airlines): 1
AAL (American Airlines): 1
SKW (SkyWest Airlines): 1
total #flights = 4

At Airport: IAD(Washington)
UAL (United Airlines): 5
DAL (Delta Air Lines): 3
RPA (Republic Airlines): 1
EJA (NetJets): 1
VIR (Virgin Atlantic): 1
BAW (British Airways ): 1
AAL (American Airlines): 1
SWA (Southwest Airlines): 1
N73 (Beech 300 Super King Air): 1
ROU (rouge airline): 1
EDV (Endeavor Air): 1
N97 (Hiatt): 1
FFT (Frontier Airlines): 1
total #flights = 19

At Airport: STL(St Louis)
SWA (Southwest Airlines): 2
BKN (Blackwell Tonkawa Municipal): 1
N47 (Pottstown Municipal): 1
N95 (N95): 1
N20 (Ine): 1
N72 (Warwick Municipal): 1
FFT (Frontier Airlines): 1
N50 (Bridgeton): 1
total #flights = 9

At Airport: PHL(Philadelphia)
SWA (Southwest Airlines): 2
RPA (Republic Airlines): 1
ASH (Mesa Airlines): 1
ENY (Envoy Air): 1
N22 (GAF Nomad ): 1
DLH (Duluth International): 1
PJC (Zelienople Municipal): 1
GAJ (Yamagata): 1
N92 (Lansys): 1
total #flights = 10

At Airport: BWI(Baltimore)
AAL (American Airlines): 2

```

```

At Airport: BWI(Baltimore)
AAL (American Airlines): 2
SWA (Southwest Airlines): 1
N30 (Cherry Ridge): 1
685 (Wauchula): 1
UAL (United Airlines): 1
LXJ (Bombardier Business Jet Solutions): 1
JBU (Jetblue): 1
ICL (Municipal airport): 1
total #flights = 9

At Airport: SNA(Santa Ana)
UAL (United Airlines): 2
AAL (American Airlines): 2
SKW (SkyWest Airlines): 2
DAL (Delta Air Lines): 1
GTI (Atlas Air): 1
AIJ (Mexico City International): 1
CPZ (Compass Airlines): 1
JBU (Jetblue): 1
total #flights = 11

At Airport: PDX(Portland)
N52 (Jaars-Townsend): 2
SWA (Southwest Airlines): 2
DAL (Delta Air Lines): 2
N53 (Stroudsburg-Pocono): 2
N19 (aztec municipal ): 1
N56 (Great Valley ): 1
N80 (Municipal Airport Dedication): 1
N44 (Sky Acres): 1
N89 (Joseph Y. Resnick): 1
N63 (Meadow Brook Field): 1
N82 (Wurtsboro): 1
N74 (Penns Cave): 1
N98 (Boyne City Municipal): 1
SKW (SkyWest Airlines): 1
total #flights = 18

At Airport: LAS(Las Vegas)
AAL (American Airlines): 2
DAL (Delta Air Lines): 2
N91 (Novair): 2
N23 (Sidney Muni): 2
SKW (SkyWest Airlines): 2
NKS (Spirit Airlines): 2
WJA (Woja): 1
N13 (Bloomsburg): 1

```

```
At Airport: LAS(Las Vegas)
  AAL (American Airlines): 2
  DAL (Delta Air Lines): 2
  N91 (Novair): 2
  N23 (Sidney Muni): 2
  SKW (SkyWest Airlines): 2
  NKS (Spirit Airlines): 2
  WJA (Woja): 1
  N13 (Bloomsburg): 1
  CPZ (Compass Airlines): 1
  N22 (GAF Nomad ): 1
  EDG (Weid Ahp): 1
  N38 (Wellsboro Johnston): 1
  SWA (Southwest Airlines): 1
  ASA (Alaska Airlines, Inc.): 1
  N31 (Kutztown): 1
  total #flights = 21
```

```
At Airport: SEA(Seattle)
  N28 (G GERALD): 1
  AAL (American Airlines): 1
  N95 (N95): 1
  N70 (Pennridge): 1
  CAP (Civil Air Patrol): 1
  N51 (Solberg-Hunterdon): 1
  N15 (Kingston): 1
  N36 (Wotje): 1
  N34 (Chattanooga): 1
  N92 (Laneys): 1
  DAL (Delta Air Lines): 1
  QXE (Horizon Air): 1
  N73 (Beech 300 Super King Air): 1
  ASA (Alaska Airlines, Inc.): 1
  N29 (Magdalena): 1
  UAL (United Airlines): 1
  N12 (Lakewood): 1
  N23 (Sidney Muni): 1
  N97 (Hiatt): 1
  N67 (Wings): 1
  DLH (Duluth International): 1
  N16 (Centre Airpark): 1
  total #flights = 22
```

```
At Airport: RDU(Raleigh/Durham)
  DAL (Delta Air Lines): 1
  N42 (Shippensburg): 1
  N60 (N60): 1
  N82 (Wurtsboro): 1
  AAL (American Airlines): 1
```



```
At Airport: RDU(Raleigh/Durham)
  DAL (Delta Air Lines): 1
  N42 (Shippensburg): 1
  N60 (N60): 1
  N82 (Wurtsboro): 1
  AAL (American Airlines): 1
  GJS (GoJet Airlines): 1
  N75 (Beech 300 Super King Air): 1
  N17 (Vaughn Muni): 1
  N86 (Spanish Springs): 1
  total #flights = 9
```

```
At Airport: BOS(Boston)
  KAP (Cape Air): 3
  SWA (Southwest Airlines): 2
  CHH (Hainan Airlines): 1
  N63 (Meadow Brook Field): 1
  JZA (Jazz Aviation): 1
  JBU (Jetblue): 1
  total #flights = 9
```

```
At Airport: MSP(Minneapolis)
  SKW (SkyWest Airlines): 6
  DAL (Delta Air Lines): 3
  SWA (Southwest Airlines): 1
  N33 (Anic Airways): 1
  N63 (Meadow Brook Field): 1
  N62 (New Hanover): 1
  N41 (New Garden): 1
  N57 (New Garden): 1
  N78 (Beech 300 Super King Air): 1
  NKS (Spirit Airlines): 1
  total #flights = 17
```

```
At Airport: BNA(Nashville)
  JIA (PSA Airlines): 1
  EDV (Endeavor Air): 1
  N16 (Centre Airpark): 1
  total #flights = 3
```

```
At Airport: DCA(Washington)
  UAL (United Airlines): 3
  SWA (Southwest Airlines): 2
  DAL (Delta Air Lines): 2
  AAL (American Airlines): 2
  EJA (NetJets): 1
  ROU (rouge airline): 1
  VIR (Virgin Atlantic): 1
```



```

At Airport: DCA(Washington)
UAL (United Airlines): 3
SWA (Southwest Airlines): 2
DAL (Delta Air Lines): 2
AAL (American Airlines): 2
EJA (NetJets): 1
ROU (rouge airline): 1
VIR (Virgin Atlantic): 1
EDV (Endeavor Air): 1
BAW (British Airways ): 1
N22 (GAF Nomad ): 1
FFT (Frontier Airlines): 1
UCA (CommutAir): 1
total #flights = 17

At Airport: LGA(New York)
UAL (United Airlines): 7
ENY (Envoy Air): 4
DAL (Delta Air Lines): 2
SWA (Southwest Airlines): 2
EDV (Endeavor Air): 2
AAL (American Airlines): 1
JBU (JetBlue): 1
UCA (CommutAir): 1
SWR (Swiss International ): 1
AFL (Aeroflot ): 1
N30 (Cherry Ridge): 1
N32 (Blue Swan): 1
PWA (Priester Aviation): 1
N35 (Punxsutawney Municipal ): 1
SKW (SkyWest Airlines): 1
OPT (Flight Options): 1
total #flights = 28

At Airport: TPA(Tampa)
DAL (Delta Air Lines): 3
AAL (American Airlines): 2
EJA (NetJets): 1
N25 (Blue Heron): 1
ENY (Envoy Air): 1
N70 (Pennridge): 1
N20 (Ine): 1
CAP (Civil Air Patrol): 1
AAY (Allegiant Air): 1
SWA (Southwest Airlines): 1
UAL (United Airlines): 1
N12 (Lakewood): 1
N23 (Sidney Muni): 1

```



```

At Airport: SLC(Salt Lake City)
SKW (SkyWest Airlines): 2
SWA (Southwest Airlines): 1
AAL (American Airlines): 1
total #flights = 4

At Airport: OAK(Oakland)
UAL (United Airlines): 4
DAL (Delta Air Lines): 3
SWA (Southwest Airlines): 3
AAL (American Airlines): 3
ASA (Alaska Airlines, Inc.): 1
JBU (JetBlue): 1
N81 (Hammonton Municipal): 1
FDX (FedEx Express): 1
FFT (Frontier Airlines): 1
total #flights = 18

At Airport: DTW(Detroit)
DAL (Delta Air Lines): 3
SKW (SkyWest Airlines): 2
JIA (PSA Airlines): 1
EDV (Endeavor Air): 1
AAL (American Airlines): 1
N81 (Hammonton Municipal): 1
GJS (GoJet Airlines): 1
FDX (FedEx Express): 1
NKS (Spirit Airlines): 1
total #flights = 12

At Airport: IAH(Houston)
UAL (United Airlines): 3
ASQ (ExpressJet): 1
AAL (American Airlines): 1
BAW (British Airways ): 1
DLH (Duluth International): 1
AFR (Air France ): 1
NKS (Spirit Airlines): 1
total #flights = 9

At Airport: MCI(Kansas City)
SWA (Southwest Airlines): 3
N40 (Sky Manor): 1
N44 (Sky Acres): 1
N49 (Clarion Hotel Seattle ): 1
DAL (Delta Air Lines): 1
ENY (Envoy Air): 1
AAL (American Airlines): 1

```



```
At Airport: MCI(Kansas City)
    SWA (Southwest Airlines): 3
    N40 (Sky Manor): 1
    N44 (Sky Acres): 1
    N49 (Clarion Hotel Seattle ): 1
    DAL (Delta Air Lines): 1
    ENY (Envoy Air): 1
    AAL (American Airlines): 1
    N21 (Holly Ridge/Topsail Island ): 1
    SKW (SkyWest Airlines): 1
    total #flights = 11
```

```
At Airport: FLL(Fort Lauderdale)
    JBU (JetBlue): 6
    DAL (Delta Air Lines): 3
    AAL (American Airlines): 3
    N77 (Nordic Regional Airlines): 2
    N15 (Kingston): 2
    N81 (Hammonton Municipal): 2
    N16 (Centre Airpark): 2
    NKS (Spirit Airlines): 2
    N76 (Beechcraft 8300 King Air): 1
    N52 (Jaars-Townsend): 1
    810 (Trans-Canada Air Lines): 1
    N38 (Wellsboro Johnston): 1
    273 (American Airlines): 1
    SWA (Southwest Airlines): 1
    N37 (Monticello Airport): 1
    N35 (Punxsutawney Municipal ): 1
    PTP (Pointe-à-Pitre): 1
    SDU (n/a): 1
    N13 (Bloomsburg): 1
    N17 (Vaughn Muni): 1
    N99 (Brandywine Airport): 1
    183 (Nepal Airlines): 1
    N80 (Municipal Airport Dedication): 1
    UAL (United Airlines): 1
    N27 (n/a): 1
    N31 (Kutztown): 1
    N50 (Bridgeton): 1
    total #flights = 41
```

```
At Airport: LAX(Los Angeles)
    AAL (American Airlines): 7
    SWA (Southwest Airlines): 2
    ANA (Nippon Airways): 1
    N13 (Bloomsburg): 1
    N58 (Tiger Field): 1
```



```
At Airport: LAX(Los Angeles)
    AAL (American Airlines): 7
    SWA (Southwest Airlines): 2
    ANA (Nippon Airways): 1
    N13 (Bloomsburg): 1
    N58 (Tiger Field): 1
    CPZ (Compass Airlines): 1
    JBU (JetBlue): 1
    N15 (Kingston): 1
    KLM (Royal Dutch Airlines): 1
    N80 (Municipal Airport Dedication): 1
    CMP (Copa Airlines): 1
    DAL (Delta Air Lines): 1
    CAL (Cargo Airlines): 1
    SKW (SkyWest Airlines): 1
    NKS (Spirit Airlines): 1
    total #flights = 22
```

```
At Airport: EWR(Newark)
    UAL (United Airlines): 11
    ENY (Envoy Air): 4
    EDV (Endeavor Air): 4
    SWA (Southwest Airlines): 2
    EJA (Netjets): 1
    JBU (JetBlue): 1
    UCA (CommutAir): 1
    DAL (Delta Air Lines): 1
    ASQ (ExpressJet): 1
    SWR (Swiss International ): 1
    AFL (Aeroflot ): 1
    PWA (Priester Aviation): 1
    N35 (Punxsutawney Municipal ): 1
    SKW (SkyWest Airlines): 1
    NKS (Spirit Airlines): 1
    total #flights = 32
```

```
At Airport: SFO(San Francisco)
    UAL (United Airlines): 4
    DAL (Delta Air Lines): 3
    SWA (Southwest Airlines): 3
    AAL (American Airlines): 3
    N81 (Hammonton Municipal): 2
    COO (Cotonou Cadjehoun): 1
    ASA (Alaska Airlines, Inc.): 1
    FDX (FedEx Express): 1
    FFT (Frontier Airlines): 1
    total #flights = 19
```

```
At Airport: MCO(Orlando)
```



```
At Airport: MCO(Orlando)
    SWA (Southwest Airlines): 4
    DAL (Delta Air Lines): 4
    AAL (American Airlines): 3
    N51 (Solberg-Hunterdon): 2
    N17 (Vaughn Muni): 2
    JBU (JetBlue): 1
    N48 (Horsham Valley Airways): 1
    N84 (National Airlines): 1
    N37 (Monticello Airport): 1
    N94 (Carlisle Airport): 1
    N14 (Lumberton): 1
    EDV (Endeavor Air): 1
    N7Z (Nordic Regional Airlines): 1
    N11 (HAWKER BEECHCRAFT): 1
    N25 (Blue Heron): 1
    ENY (Envoy Air): 1
    N19 (aztec municipal ): 1
    N18 (Turkish Airlines): 1
    CON (Continental Oil): 1
    ASA (Alaska Airlines, Inc.): 1
    N62 (New Hanover): 1
    N61 (Hinshaw): 1
    N39 (Meyers Heliport): 1
    N83 (National Airlines): 1
    DLH (Duluth International): 1
    total #flights = 35
```

```
At Airport: CLE(Cleveland)
    SWA (Southwest Airlines): 2
    N90 (BOMBARDIER): 1
    RPA (Republic Airlines): 1
    UAL (United Airlines): 1
    PHM (Petroleum Helicopters): 1
    N98 (Boyne City Municipal): 1
    LOF (Trans States Airlines): 1
    CGH (Sao Paulo Congonhas Airport): 1
    total #flights = 9
```

```
At Airport: ORD(Chicago)
    UAL (United Airlines): 5
    EJA (NetJets): 3
    SWA (Southwest Airlines): 2
    AAL (American Airlines): 2
    SKW (SkyWest Airlines): 2
    ASQ (ExpressJet): 1
    DAL (Delta Air Lines): 1
    RPA (Republic Airlines): 1
    LOT (Polish Airlines): 1
```

```
At Airport: ORD(Chicago)
    UAL (United Airlines): 5
    EJA (NetJets): 3
    SWA (Southwest Airlines): 2
    AAL (American Airlines): 2
    SKW (SkyWest Airlines): 2
    ASQ (ExpressJet): 1
    DAL (Delta Air Lines): 1
    RPA (Republic Airlines): 1
    LOT (Polish Airlines): 1
    AIJ (Mexico City International): 1
    N21 (Holly Ridge/Topsail Island ): 1
    total #flights = 20
```

```
At Airport: CLT(Charlotte)
    AAL (American Airlines): 2
    JIA (PSA Airlines): 1
    N35 (Punxsutawney Municipal ): 1
    FDX (FedEx Express): 1
    total #flights = 5
```

```
At Airport: MIA(Miami)
    JBU (JetBlue): 5
    AAL (American Airlines): 5
    N35 (Punxsutawney Municipal ): 2
    NKS (Spirit Airlines): 2
    N76 (Beechcraft B300 King Air): 1
    AVA (Ava Airways): 1
    GTI (Atlas Air): 1
    N52 (Jaars-Townsend): 1
    N15 (Kingston): 1
    N51 (Solberg-Hunterdon): 1
    810 (Trans-Canada Air Lines): 1
    N38 (Wellsboro Johnston): 1
    273 (American Airlines): 1
    SWA (Southwest Airlines): 1
    DAL (Delta Air Lines): 1
    N37 (Monticello Airport): 1
    PTP (Pointe-à-Pitre): 1
    ENY (Envoy Air): 1
    N13 (Bloomsburg): 1
    N99 (Brandywine Airport): 1
    I83 (Nepal Airlines): 1
    N80 (Municipal Airport Dedication): 1
    N62 (New Hanover): 1
    UAL (United Airlines): 1
    N61 (Hinshaw): 1
    DLH (Duluth International): 1
```

```
At Airport: MIA(Miami)
    JBU (JetBlue): 5
    AAL (American Airlines): 5
    N35 (Punxsutawney Municipal ): 2
    NKS (Spirit Airlines): 2
    N76 (Beechcraft B300 King Air): 1
    AVA (Ava Airways): 1
    GTI (Atlas Air): 1
    N52 (Jaars-Townsend): 1
    N15 (Kingston): 1
    N51 (Solberg-Hunterdon): 1
    810 (Trans-Canada Air Lines): 1
    N38 (Wellsboro Johnston): 1
    273 (American Airlines): 1
    SWA (Southwest Airlines): 1
    DAL (Delta Air Lines): 1
    N37 (Monticello Airport): 1
    PTP (Pointe-a-Pitre): 1
    ENY (Envoy Air): 1
    N13 (Bloomsburg): 1
    N99 (Brandywine Airport): 1
    183 (Nepal Airlines): 1
    N80 (Municipal Airport Dedication): 1
    N62 (New Hanover): 1
    UAL (United Airlines): 1
    N61 (Hinshaw): 1
    DLH (Duluth International): 1
    N16 (Centre Airpark): 1
    N50 (Bridgeton): 1
    total #flights = 38
```

```
At Airport: HNL(Honolulu)
    N11 (HAWKER BEECHCRAFT): 2
    KAL (Korean Air): 1
    BAD (8AD): 1
    N42 (Shippensburg): 1
    N77 (Nordic Regional Airlines): 1
    JAL (Japan Airlines): 1
    N48 (Horsham Valley Airways): 1
    N80 (Municipal Airport Dedication): 1
    total #flights = 9
```

```
At Airport: SAN(San Diego)
    AAL (American Airlines): 3
    SKW (SkyWest Airlines): 3
    SWA (Southwest Airlines): 2
    DAL (Delta Air Lines): 1
    N28 (G GERALD): 1
    UAL (United Airlines): 1
```

```
At Airport: SAN(San Diego)
    AAL (American Airlines): 3
    SKW (SkyWest Airlines): 3
    SWA (Southwest Airlines): 2
    DAL (Delta Air Lines): 1
    N28 (G GERALD): 1
    UAL (United Airlines): 1
    N95 (N95): 1
    VOI (Volaris): 1
    FFT (Frontier Airlines): 1
    RCH (Air Mobility Command): 1
    total #flights = 15
```

```
At Airport: JFK(New York)
    UAL (United Airlines): 6
    ENY (Envoy Air): 4
    EDV (Endeavor Air): 4
    DAL (Delta Air Lines): 2
    JBU (Jetblue): 1
    AUI (Ukraine International Airlines): 1
    SWA (Southwest Airlines): 1
    SWR (Swiss International ): 1
    AFL (Aeroflot ): 1
    N32 (Blue Swan): 1
    PWA (Priester Aviation): 1
    N35 (Punxsutawney Municipal ): 1
    SKW (SkyWest Airlines): 1
    total #flights = 25
```

```
At Airport: PHX(Phoenix)
    SWA (Southwest Airlines): 6
    NDU (University of North Dakota): 4
    AAL (American Airlines): 3
    N35 (Punxsutawney Municipal ): 3
    OXF (Oxford Airlines): 2
    EJA (Netjets): 2
    N83 (National Airlines): 2
    WJA (Woja): 1
    ASH (Mesa Airlines): 1
    N60 (N60): 1
    MSQ (Minsk International 2): 1
    N96 (Bellefonte Airport-N96): 1
    N70 (Pennridge): 1
    N17 (Vaughn Muni): 1
    N18 (Turkish Airlines): 1
    N81 (Hammonton Municipal): 1
    total #flights = 31
```

```
At Airport: ATL(Atlanta)
```

```

At Airport: ATL(Atlanta)
    SWA (Southwest Airlines): 1
    DAL (Delta Air Lines): 1
    N89 (Joseph Y. Resnick): 1
    ROU (rouge airline): 1
    N13 (Bloomsburg): 1
    AAL (American Airlines): 1
    total #flights = 6

At Airport: MDW(Chicago)
    UAL (United Airlines): 5
    SWA (Southwest Airlines): 2
    EJA (NetJets): 2
    AAL (American Airlines): 2
    ASQ (ExpressJet): 1
    RPA (Republic Airlines): 1
    LOT (Polish Airlines): 1
    ENY (Envoy Air): 1
    SCX (Sun Country Airlines): 1
    AIJ (Mexico City International): 1
    N21 (Holly Ridge/Topsail Island): 1
    SKW (SkyWest Airlines): 1
    total #flights = 19

At Airport: AUS(Austin)
    SWA (Southwest Airlines): 1
    DAL (Delta Air Lines): 1
    EJA (NetJets): 1
    AAL (American Airlines): 1
    OPT (Flight Options): 1
    FFT (Frontier Airlines): 1
    total #flights = 6

Total elapsed time in 4762 milliseconds
5963 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:3
5963 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:2
5964 [Thread-22] INFO backtype.storm.util - Async loop interrupted!
5970 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:2
5970 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:1
5970 [Thread-24] INFO backtype.storm.util - Async loop interrupted!
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shut down task Getting-Started-Topologie-1-1620432921:1
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Terminating zmq context
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Disconnecting from storm cluster state context
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Waiting for heartbeat thread to die
5981 [Thread-27] INFO backtype.storm.util - Async loop interrupted!
5982 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
5982 [Thread-15] INFO backtype.storm.util - Async loop interrupted!
5985 [Thread-14] INFO backtype.storm.event - Event manager interrupted
5987 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shut down worker Getting-Started-Topologie-1-1620432921 1ba7b450-ae3a-4b7a-a788-13056aa9ac7f 1

```

```

DAL (Delta Air Lines): 1
EJA (NetJets): 1
AAL (American Airlines): 1
OPT (Flight Options): 1
FFT (Frontier Airlines): 1
total #flights = 6

Total elapsed time in 4762 milliseconds
5963 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:3
5963 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:2
5964 [Thread-22] INFO backtype.storm.util - Async loop interrupted!
5970 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:2
5970 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shutting down task Getting-Started-Topologie-1-1620432921:1
5970 [Thread-24] INFO backtype.storm.util - Async loop interrupted!
5980 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1620432921:1
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Terminating zmq context
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Disconnecting from storm cluster state context
5980 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Waiting for heartbeat thread to die
5981 [Thread-27] INFO backtype.storm.util - Async loop interrupted!
5982 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
5982 [Thread-15] INFO backtype.storm.util - Async loop interrupted!
5985 [Thread-14] INFO backtype.storm.event - Event manager interrupted
5987 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shut down worker Getting-Started-Topologie-1-1620432921 1ba7b450-ae3a-4b7a-a788-13056aa9ac7f 1
5987 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shut down 1ba7b450-ae3a-4b7a-a788-13056aa9ac7f:f5ee361b6-76ab-4bec-b495-2372aa7a024c
5987 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down supervisor 1ba7b450-ae3a-4b7a-a788-13056aa9ac7f
5991 [Thread-6] INFO backtype.storm.util - Async loop interrupted!
6001 [Thread-7] INFO backtype.storm.util - Async loop interrupted!
6001 [Thread-8] INFO backtype.storm.util - Async loop interrupted!
6002 [Thread-4] INFO backtype.storm.event - Event manager interrupted
6004 [Thread-5] INFO backtype.storm.event - Event manager interrupted
6009 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down supervisor d4341436-88a0-4376-aa8f-c2912f28d39c
6010 [Thread-11] INFO backtype.storm.util - Async loop interrupted!
6010 [Thread-12] INFO backtype.storm.util - Async loop interrupted!
6023 [Thread-13] INFO backtype.storm.util - Async loop interrupted!
6023 [Thread-9] INFO backtype.storm.event - Event manager interrupted
6023 [Thread-10] INFO backtype.storm.event - Event manager interrupted
6025 [TopologyMain.main()] INFO backtype.storm.testing - Shutting down in process zookeeper
6027 [TopologyMain.main()] INFO backtype.storm.testing - Done shutting down in process zookeeper
6027 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/0dc14bb1-8405-42d9-9bbf-548613a668b6
6027 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/f222d3b9-3e46-41df-974b-f7db8a659c12
6028 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/19f98d1e-9237-4f9c-b8c8-f1c9e2c20b821
6028 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/8eee3e59-4231-4639-b24c-23b320d55db4
[INFO] -----
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 10.796 s
[INFO] Finished at: 2021-05-07T17:15:28-07:00
[INFO] -----
[sagra15@cssmp1h prog2]$ 

```



## Discussions:

### Execution performance

Observation: Refer to Table1

I tried various combinations of threads for the spouts and bolts mentioned in the above table and calculated the total time elapsed for each combination. Here is my observation:

1. I noticed keeping the value 1 for flightDataReader and varying the values for hub and airline gives minor differences in the time taken in milliseconds. As per the above table, combination (1,1,3) gives the fastest execution of the program. But If I run the program again for the same combination, I do not find the same output for the time(see below).

First run:

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 4.216 s
[INFO] Finished at: 2021-05-07T00:09:43-07:00
[INFO] -----
[sagra15@cssmpi1h prog2]$ ./run.sh > out.txt
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 3
Total elapsed time in 4222 milliSeconds
Total elapsed time in 4151 milliSeconds
Total elapsed time in 3965 milliSeconds
[sagra15@cssmpi1h prog2]$
```

Second run:

```
[INFO] BUILD SUCCESS
[INFO] -----
[INFO] Total time: 3.890 s
[INFO] Finished at: 2021-05-07T11:43:12-07:00
[INFO] -----
[[sagra15@cssmpi1h prog2]$ ./run.sh > out
Number of threads in FlightDataReader 1
Number of threads in HubIdentifier 1
Number of threads in AirlineSorter 3
Total elapsed time in 4669 milliSeconds
Total elapsed time in 4615 milliSeconds
Total elapsed time in 4518 milliSeconds
[sagra15@cssmpi1h prog2]$ mvn package
```

2. Keeping the value of flightDataReader to 2 and 3 with various combination of hub and airline does not give the correct output of the program because it double or triples the values of expected output based on the number of spout given.

### **Summary:**

Summarizing the above observation, the performance of the execution varies with the increasing the number of bolts. But in this program, I noticed only slight difference in the numbers with respect to time.

### Additional features

I have added the first feature on the recommended list that is more descriptive outputs. I have added these new changes in each:

1. TopologyMain: I have added a new file in the resources folder named 'AirlineCode.txt' which maintains the name of airlines based on their call-sign. I am reading this file in the topology as the third argument in config like flight.txt.
2. HubIdentifier: Like reading airport data in prepare method, I am reading flight code info using a utility function 'readFlightCodeInfo()' which manipulates the file and stores the data into HashMap. In the execute function, before emitting the normal call-sign of flights, I am appending the airline code with the airline name fetched from the mapping between flight call-sign and AirlineCode.txt.
3. AirlineSorter: In method cleanup(), I have added the code to sort the flight count in the descending order using a utility function, sortByValue() which sorts the hashmap on the basis of values using comparator class in java collections.

-- Flight Counter [airline-sorter-3] --

At Airport: DEN(Denver)

```
SWA (Southwest Airlines): 5
UAL (United Airlines): 4
SKW (SkyWest Airlines): 3
JZA (Jazz Aviation): 1
N85 (Alexandria Field): 1
AAL (American Airlines): 1
N52 (Jaars-Townsend): 1
FFT (Frontier Airlines): 1
LOF (Trans States Airlines): 1
total #flights = 18
```

### Limitations

1. If we want to update a running topology, the only option currently is to kill the current topology and resubmit a new one. A planned feature is to implement a storm swap command that swaps a running topology with a new one, ensuring minimal downtime and no chance of both topologies processing tuples at the same time.
2. This program does not run cluster execution as it needs installation ZeroMQ and JZMQ and changes in pom.xml

### Possible Improvements

1. Better usage of data structure may decrease the execution time.
2. We can display more flight information in the output making use of flight.txt.
3. We can use airport\_org.txt which has airport important information with passengers details of 2011 and 2012.
4. This program can be more scalable in terms of threading between spouts and bolts.
5. We can also put this project into cluster mode execution to see how it is performing.
6. Changing the value in spout flightDataReader thread should not change the output of the program. Multithreading should be done in the spout to resolve this.

## Lab Session 4:

### Output:

```
[sagra15@cssmpi2h lab4]$ ls
activemq.xml      jndi.properties      Session.class
BytesMessage.class lab4_note.txt      StreamMessage.class
Chat.class         lab4_note.txt~     TemporaryQueue.class
Chat.java          MapMessage.class   TemporaryTopic.class
Connection.class   Message.class     TextMessage.class
ConnectionConsumer.class MessageConsumer.class Topic.class
ConnectionFactory.class MessageListener.class TopicConnection.class
ConnectionMetaData.class MessageProducer.class TopicConnectionFactory.class
DeliveryMode.class ObjectMessage.class TopicPublisher.class
Destination.class QueueBrowser.class TopicSession.class
ExceptionListener.class Queue.class     TopicSubscriber.class
jetty.xml          ServerSession.class
JMSEception.class ServerSessionPool.class

[sagra15@cssmpi2h lab4]$ java -cp ../../activemq-all-5.9.0.jar:. Chat TopicCF to
pic1 Mary
log4j:WARN No appenders could be found for logger (org.apache.activemq.transport
.WireFormatNegotiator).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more in
fo.
This is only a test
okay
Kelvin: I joined you for chats
John: Hi EveryONE
[]

[sagra15@cssmpi2h lab4]$ vim Chat.java
[sagra15@cssmpi2h lab4]$ vim jndi.properties
[sagra15@cssmpi2h lab4]$ java -cp ../../activemq-all-5.9.0.jar:. Chat TopicCF to
pic1 John
log4j:WARN No appenders could be found for logger (org.apache.activemq.transport
.WireFormatNegotiator).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more in
fo.
Mary: This is only a test
Mary: okay
Kelvin: I joined you for chats
Hi EveryONE
[]

[sagra15@cssmpi2h lab4]$ vim Chat.java
[sagra15@cssmpi2h lab4]$ vim jndi.properties
[sagra15@cssmpi2h lab4]$ java -cp ../../activemq-all-5.9.0.jar:. Chat TopicCF to
pic1 Kelvin
log4j:WARN No appenders could be found for logger (org.apache.activemq.transport
.WireFormatNegotiator).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more in
fo.
[I joined you for chats
John: Hi EveryONE
|exit
[sagra15@cssmpi2h lab4]$ 

[sagra15@cssmpi2h lab4]$ vim Chat.java
[sagra15@cssmpi2h lab4]$ vim jndi.properties
[sagra15@cssmpi2h lab4]$ java -cp ../../activemq-all-5.9.0.jar:. Chat TopicCF to
pic1 John
log4j:WARN No appenders could be found for logger (org.apache.activemq.transport
.WireFormatNegotiator).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more in
fo.
Mary: This is only a test
Mary: okay
Kelvin: I joined you for chats
Hi EveryONE
|exit
[sagra15@cssmpi2h lab4]$ 
```

```

sammy@sagra15:~/cssmp12h$ ./css533_lab4/apache-activemq-5.9.0/bin --ss...
17.9.x86_64
Heap sizes: current=1048576k frees=1846838k max=1048576k
JVM args: -Xmx1G -Xmx1G -Djava.util.logging.config.file=logging.properties -Dhawkio.realm=activevm -Dhawkio.role=admin -Dhawkio.rolePrincipalClasses=org.apache.hawk.HawkioRolePrincipal,DjinniSecurityRole -Djava.security.manager=false -Djava.home=/home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/conf -Dactivemq.home=/home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/conf; -Dactivemq.classpath=/home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/liboptional;/home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/lib/web;/home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/lib/extras] 
ACTIVEMQ_HOME: /home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0
ACTIVEMQ_BASE: /home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0
ACTIVEMQ_CONF: /home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/conf
ACTIVEMQ_DATA: /home/NETID/sagra15/css533_lab4/apache-activemq-5.9.0/data
Connecting to pid: 82247
Stopping broker: localhost
.....
[FINISHED
[sagra15@cssmp12h bin]$ 

sammy@sagra15:~/cssmp12h$ ./css533_lab4/apache-activemq-5.9.0/example...
connection.class Message.class TextMessage.class
connectionConsumer.class MessageConsumer.class Topic.class
connectionData.class MessageProducer.class TopicConnection.class
connectionData.class ObjectMessage.class TopicConnectionFactory.class
DeliveryMode.class QueueBrowser.class TopicSession.class
destination.class Queue.class TopicSubscriber.class
exceptionListener.class QueueSession.class
jetty.xml ServerSession.class
JMSEception.class ServerSessionPool.class
[sagra15@cssmp12h lab4]$ vim Chat.java
[sagra15@cssmp12h lab4]$ vim jndi.properties
[sagra15@cssmp12h lab4]$ java -cp ../../activemq-all-5.9.0.jar:. Chat TopicCF to
nici1 John
log4j:WARN No appenders could be found for logger (org.apache.activemq.transport.WireFormatNegotiator).
log4j:WARN Please initialize the log4j system properly.
log4j:WARN See http://logging.apache.org/log4j/1.2/faq.html#noconfig for more in
fo.
Very: This is only a test
Very: okay
Kelvin: I joined you for chats
Hi Everyone
exit
[sagra15@cssmp12h lab4]$ 

```

## Lab Session 5:

### Output:

```

... ssh -Y sagra15@cssmp12h.uwb.edu ... .../bin - ssh sagra15@cssmp12h.uwb.edu ...
sagra15@cssmp12h apache-storm-1.2.2$ ls
conf examples external extlib extlib-daemon lib LICENSE log4j2 logs
NOTICE public README_markdown RELEASE SECURITY.md toolbar
sagra15@cssmp12h apache-storm-1.2.2$ cd bin/
sagra15@cssmp12h bin$ ls
light_bash storm storm.cmd storm-config.cmd storm-kafka-monitor storm.ps1
storm.py
sagra15@cssmp12h bin$ ./storm nimbus
1] 24219
sagra15@cssmp12h bin$ Running: /etc/alternatives/jre/bin/java -server -Ddaemon.nimbus=true -Dstorm.options=-Dstorm.home=/home/NETID/sagra15/Storm/apache-storm-1.2.2 -Dstorm.log.dir=/home/NETID/sagra15/Storm/apache-storm-1.2.2/logs -Djava.library.path=/usr/local/lib:/opt/local/lib:/usr/lib -Dstorm.conf.file=/etc/alternatives/jre/bin/storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/extlib/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/conf -Xmx128m -Dlogfile.name=nimbus.log -DLog4jContextSelector=org.apache.logging.log4j.core.async.AsyncLoggerContextSelector -Dlog4j.configurationFile=/home/NETID/sagra15/Storm/apache-storm-1.2.2/log4j2/cluster.xml org.apache.storm.daemon.nimbus
sagra15@cssmp12h bin$ ./storm supervisor
2] 24231
sagra15@cssmp12h bin$ Running: /etc/alternatives/jre/bin/java -server -Ddaemon.nimbus=true -Dstorm.options=-Dstorm.home=/home/NETID/sagra15/Storm/apache-storm-1.2.2 -Dstorm.log.dir=/home/NETID/sagra15/Storm/apache-storm-1.2.2/logs -Djava.library.path=/usr/local/lib:/opt/local/lib:/usr/lib -Dstorm.conf.file=/etc/alternatives/jre/bin/storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/extlib/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/conf -Xmx256m -Dlogfile.name=supervisor.log -DLog4j.configurationFile=/home/NETID/sagra15/Storm/apache-storm-1.2.2/log4j2/cluster.xml org.apache.storm.daemon.supervisor.Supervisor
sagra15@cssmp12h bin$ ./storm ui
3] 24298
sagra15@cssmp12h bin$ Running: /etc/alternatives/jre/bin/java -server -Ddaemon.nimbus=true -Dstorm.options=-Dstorm.home=/home/NETID/sagra15/Storm/apache-storm-1.2.2 -Dstorm.log.dir=/home/NETID/sagra15/Storm/apache-storm-1.2.2/logs -Djava.library.path=/usr/local/lib:/opt/local/lib:/usr/lib -Dstorm.conf.file=/etc/alternatives/jre/bin/storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/extlib/*;/home/NETID/sagra15/Storm/apache-storm-1.2.2/conf -Xmx768m -Dlogfile.name=ui.log -DLog4jContextSelector=org.apache.logging.log4j.core.async.AsyncLoggerContextSelector -Dlog4j.configurationFile=/home/NETID/sagra15/Storm/apache-storm-1.2.2/log4j2/cluster.xml org.apache.storm.ui.core
sagra15@cssmp12h bin$ 

```

```

[[sagra15@cssmp1h bin]$ cd ~/Storm/applications/examples-ch02-getting_started-master
[[sagra15@cssmp1h examples-ch02-getting_started-master]$ mvn package
[INFO] Scanning for projects...
[INFO]
< storm.book:Getting-Started >
[INFO] Building Getting-Started 0.0.1-SNAPSHOT
[INFO] [ jar ]-
[INFO]
[INFO] --- maven-resources-plugin:2.6:resources (default-resources) @ Getting-Started ---
[WARNING] Using platform encoding (UTF-8 actually) to copy filtered resources, i.e. build is platform dependent!
[INFO] Copying 1 resource
[INFO]
[INFO] --- maven-compiler-plugin:2.3.2:compile (default-compile) @ Getting-Started ---
[WARNING] File encoding has not been set, using platform encoding UTF-8, i.e. build is platform dependent!
[INFO] Compiling 2 source files to /home/NETID/sagra15/Storm/applications/examples-ch02-getting_started-master/target/classes
[INFO]
[INFO] --- maven-resources-plugin:2.6:testResources (default-testResources) @ Getting-Started ---
[WARNING] Using platform encoding (UTF-8 actually) to copy filtered resources, i.e. build is platform dependent!
[INFO] skip non existing resourceDirectory /home/NETID/sagra15/Storm/applications/examples-ch02-getting_started-master/src/test/resources
[INFO]
[INFO] --- maven-compiler-plugin:2.3.2:testCompile (default-testCompile) @ Getting-Started ---
[INFO] No sources to compile
[INFO]
[INFO] --- maven-surefire-plugin:2.12.4:test (default-test) @ Getting-Started ---
[INFO] No tests to run.
[INFO]
[INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ Getting-Started ---
[INFO] Building jar: /home/NETID/sagra15/Storm/applications/examples-ch02-getting_started-master/target/Getting-Started-0.0.1-SNAPSHOT.jar
[INFO]
[INFO] BUILD SUCCESS
[INFO]
[INFO] Total time:  2.276 s
[INFO] Finished at: 2021-04-29T12:36:08-07:00
[INFO]
-- Word Counter [word-counter-1] --
but: 1
very: 1
storm: 3
test: 1
application: 1
are: 1
is: 2
simple: 1
powerfull: 1
great: 2
and: 1
really: 1
1582 [TopologyMain.main()] INFO backtype.storm.daemon.task - Shut down task Getting-Started-Topologie-1-1619725125:1
1582 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Terminating zmq context
1582 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Disconnecting from storm cluster state context
1582 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Waiting for heart beat thread to die
1582 [Thread-27] INFO backtype.storm.util - Async loop interrupted!
1582 [Thread-28] INFO backtype.storm.util - Async loop interrupted!
1582 [Thread-15] INFO backtype.storm.util - Async loop interrupted!
1582 [Thread-14] INFO backtype.storm.event - Event manager interrupted
1585 [TopologyMain.main()] INFO backtype.storm.daemon.worker - Shut down worker Getting-Started-Topologie-1-1619725125 50d60703-9fd4-4cbc-9425-5141c0ac592e 4
1585 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shut down 50d60703-9fd4-4cbc-9425-5141c0ac592e
1586 [TopologyMain.main()] INFO backtype.storm.daemon.supervisor - Shutting down storm supervisor log file 50d60703-9fd4-4cbc-9425-5141c0ac592e
1586 [Thread-11] INFO backtype.storm.util - Async loop interrupted!
1586 [Thread-12] INFO backtype.storm.util - Async loop interrupted!
1586 [Thread-13] INFO backtype.storm.util - Async loop interrupted!
1586 [Thread-9] INFO backtype.storm.event - Event manager interrupted
1587 [Thread-10] INFO backtype.storm.event - Event manager interrupted
1588 [TopologyMain.main()] INFO backtype.storm.testing - Shutting down processes zookeeper
1590 [TopologyMain.main()] INFO backtype.storm.testing - Done shutting down in process zookeeper
1590 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/47e5e9d-1965-4ebe-808d-7445f51487d3
1590 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/a3696ab-197e-4ef1-9cb5-77a678b4d342
1590 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/3ea64661-10bb-4b5c-8ee6-b2174c188b2
1609 [TopologyMain.main()] INFO backtype.storm.testing - Deleting temporary path /tmp/134af0eb-08ff-4232-94bf-4327f5992233
[INFO]
[INFO] BUILD SUCCESS

```

The screenshot shows the Storm UI interface with several tabs open:

- Cluster Summary:** Shows basic cluster statistics: Version 1.2.2, 1 Supervisor, 0 Used slots, 4 Free slots, 4 Total slots, 0 Executors, and 0 Tasks.
- Nimbus Summary:** Shows the Nimbus summary table with one entry for the host csmp1h.uwb.edu, port 28027, status Leader, version 1.2.2, and up time 7m 36s.
- Topology Summary:** Shows the topology summary table with no data available.
- Supervisor Summary:** Shows the supervisor summary table with one entry for the host csmp1h.uwb.edu (log), ID 19ec7740-bb9f-4a63-a8aa-c8d02c8b9b89, uptime 7m 13s, slots 4, used slots 0, avail slots 4, used mem 0 MB, and version 1.2.2.
- Nimbus Configuration:** Shows the nimbus configuration table with three entries: backpressure.disruptor.high.watermark (Value: 0.9), backpressure.disruptor.low.watermark (Value: 0.4), and backpressure.znode.timeout.secs (Value: 30).

A screenshot of a web browser displaying an error page. The address bar at the top shows the URL "cssmphi1h.uwb.edu:28026/index.html". The main content area features a large circular icon with a stylized 'A' inside. Below the icon, the text "This site can't be reached" is displayed in large, bold, black font. Underneath, it says "cssmphi1h.uwb.edu refused to connect." A "Try:" section lists two items: "Checking the connection" and "Checking the proxy and the firewall". At the bottom, the error code "ERR\_CONNECTION\_REFUSED" is shown. On the left, there is a "Details" button, and on the right, a blue "Reload" button.