Università degli Studi di Roma “Tor Vergata”
Dipartimento di Ingegneria Civile e Ingegneria Informatica

Project 2

Corso di Sistemi e Architetture per Big Data
A.A. 2016/17

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Project delivery

- Submission deadline:
  - July 14th, 2017
  - After the deadline, the maximum achievable score will be decreased by 2 points for each week of delay
- What to deliver:
  - Link to cloud storage or repository containing the project code
  - Slides of your presentation (max. **15 minutes** per group), to be delivered after the presentation
- Team
  - 2/3 students per team

Dataset

- You will use a real dataset from the DEBS Grand Challenge 2013: Soccer monitoring (http://debs.org/?p=41)
- Data originates from a number of wireless sensors embedded in the shoes and a ball used during a soccer match and spans the whole duration of the game
- The real-time analytics includes the continuous computation of statistics of relevance to spectators as well as trainers and team managers

DEBS GC 2013 dataset

- Available from http://lafayette.tosm.ttu.edu/debs2013/grandchallenge/full-game.gz
- Data:
  - collected on the Nuremberg Stadium in Germany
  - from sensors located near the players' shoes (1 sensor per leg) and in the ball (1 sensor)
  - the goalkeeper is equipped with two additional sensors, one at each hand
- Sensors in the players' shoes and hands produce data with 200Hz frequency
- Sensor in the ball produces data with 2000Hz frequency
- The total data rate reaches roughly 15.000 position events per second

DEBS 2013 dataset

The event schema is:

sid, ts, x, y, z, |v|, |a|, vx, vy, vz, ax, ay, az

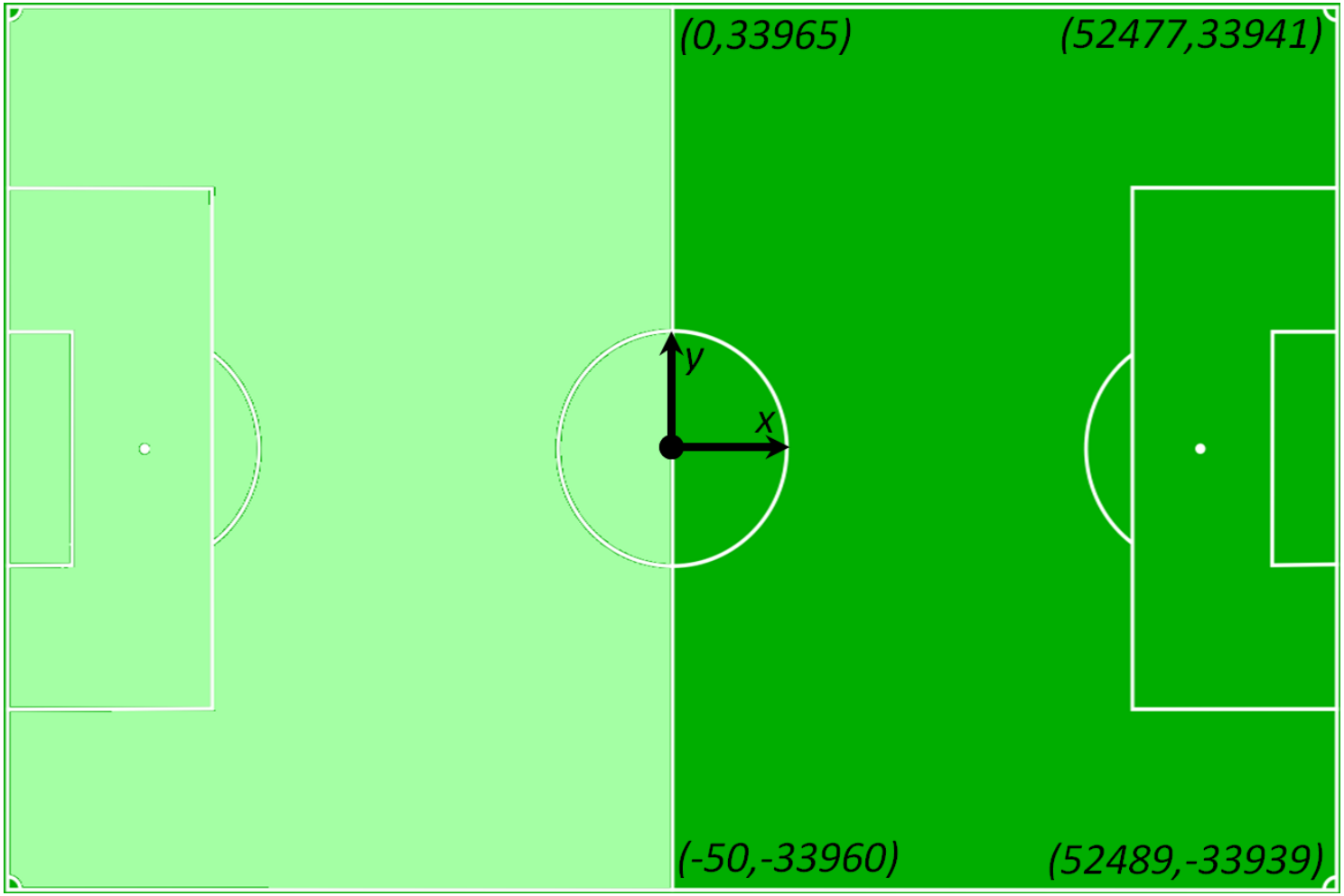
where

- sid is a sensor id which produced the position event
- ts is a timestamp in picoseconds (start of the game: 10753295594424116; end of the game: 14879639146403495);
- x, y, z describe the position of the sensor in mm (the origin is the middle of a full size football field)
- |v| (in µm/s), vx, vy, vz describe speed magnitude and direction by a vector with size of 10,000. The speed of the object in x-direction in SI-units (m/s) is calculated by

$$v_x = |v| * vx * 10^{-4} * 10^{-6}$$

- |a| (in µm/s^2), ax, ay, az describe the absolute acceleration and its constituents in 3 dimensions (the acceleration in m/s^2 is calculated similar to that of the velocity)

DEBS 2013 dataset



DEBS 2013 dataset

In addition to sensor data:

- Separate data stream for referee events
  - Includes the time when a game was paused and the time when a game was resumed. Moreover, referee events contain the time and player_ids for substitutions.
- Mapping between player ids and team ids as well as between sensor id and player id is provided in the metadata file.

Other details:

- Game played on a half-size field with teams of 8 players each
- Game duration: two halves of 30 minutes each
- We assume that data arrives at the system under test without any delays, nor omissions

General requirements for the project

- Use a DSP framework of your choice among:
  - Apache Storm
  - Apache Spark Streaming
  - Apache Flink
  - Twitter Heron

- Include in your report the queries' response time (latency) on your reference architecture

Query #1

- Goal: analyze the running performance of each of the players currently participating in the game

- Output: the aggregate running statistics

ts_start, ts_stop, player_id, total distance, avg speed

- The aggregate running statistics must be calculated using three different time windows:
  - 1 minute
  - 5 minutes
  - entire match

Query #2

- Goal: analyze the running performance of every player participating in the game

- Output 2: top-5 players by average speed

ts_start, ts_stop, player_id_1, avg_speed_1, player_id_2, avg_speed_2, player_id_3, avg_speed_3, …

- The aggregate running statistics must be calculated using three different time windows:
  - 1 minute
  - 5 minutes
  - entire match

Query #3

- Goal: calculate statistics for how long each of the players spent in which region of the field
- We define a grid with 8 rows along the x-axis and 13 columns along the y-axis of equal size (grid of 104 cells)
- Provide, for each player, the percentage of time that the player spent in each cell over two different time windows: 10 minutes and the whole game duration

- Output 3: Percentage spent in each cell of the field

ts, player_id, cell_id1, percent_time_in_cell1,
cell_id2, percent_time_in_cell2,
cell_id3, percent_time_in_cell3, ...

Group composed of 1 student

- Solve queries #1 and #2

Optional part A

- Compulsory for group composed of 3 students
- Implement one of the queries (suggested query 2) using a different DSP framework
- Include in the report the query times achieved using the second DSP framework (running on your reference architecture) and compare the results achieved by the two DSP frameworks

Optional part B

- Compare the results achieved by your implementation with that achieved by another group that has used another DSP framework
  - For example, if your group uses Spark Streaming, compare your results with those achieved by another group that uses Storm
- Use the same reference architecture for comparing the frameworks
- Include in the report the comparison results