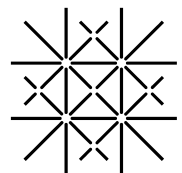# StreamTeam:
from Individual Sensing to Collaborative Action Analysis

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FH B

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Motivation

What can I do to prevent my team from receiving so many goals in the last 15 minutes of a match?

Source: https://fmdataba.com/19/s/312/vladimir-petkovic/

Game Analysis

- Game analysis is a big market
  in team sports

  – Mostly manual and tedious activities

  – Mostly off-line use

- Recently, sensor technology (e.g., smart
  shirts) and camera-based tracking systems
  have become
  widely adopted

Sources: • Opta
• SFISM
• https://chyronhego.com/

Today's Situation

- On-line analysis of single continuous sensor streams

  - Individuals are attached with sensors (e.g., GPS location, acceleration, etc.)

  - Sensor data used for simple analyses and the monitoring of individual players
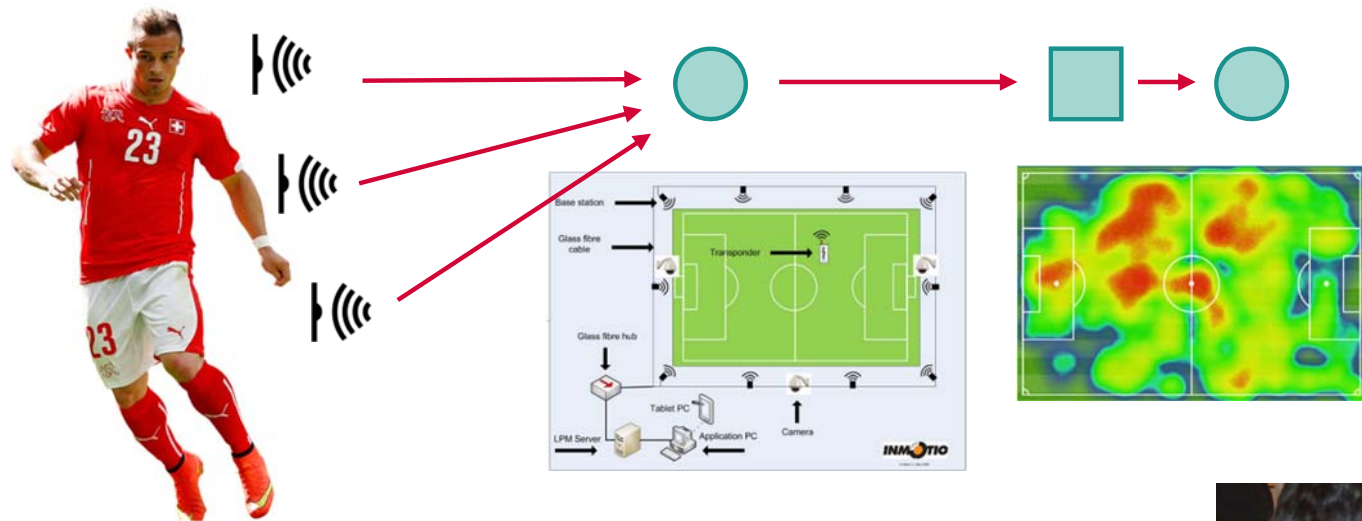
- Video analysis is still a time-consuming manual activity

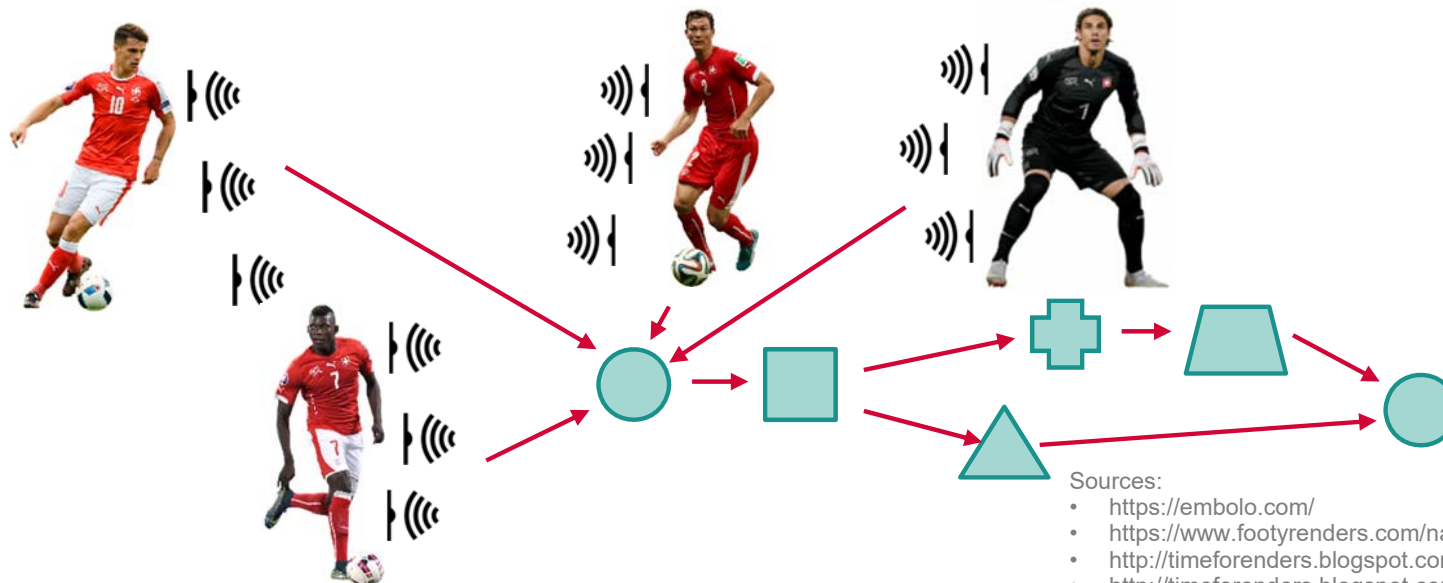Sources:
- https://www.bigdata-alliance.org/
- http://amine-renders.blogspot.com/2015/01/xherdan-shaqiri_17.html
- http://www.misterantonioverardi.com/category/esercizi-calcio/page/2/

Challenge I: Complex Team Event Detection ...

- Analyze the collective behavior of an entire team in real-time

- Complex team event detection, e.g.,
  - interactions between players (passes), actions (shots)
  - spatial / temporal arrangement of several players (static and dynamic)
  - compliance to tactics specifications, …

- Goal: Automatically annotate videos with (semantic) event meta data

Sources:
- https://embolo.com/
- https://www.footyrenders.com/nations/switzerland/yann-sommer-5/
- http://timeforenders.blogspot.com/2016/06/granit-xhaka.html
- http://timeforenders.blogspot.com/2014/06/stephan-lichtsteiner_20.html

# ... Challenge I: Complex Team Event Detection

- **From a Computer Science perspective**

  - Detection of complex team events in multiple continuous data streams in (near) real-time

  - Complex spatial and/or temporal interactions

  - Mobile sensors (individual players)

  - …

- **From a Sport Science perspective**

  - Which events are relevant for coaches?

  - How can complex team interactions be (algorithmically) specified, e.g., pressing, detection of formations, etc.?

  - …

Source: https://sportandtactics.wordpress.com
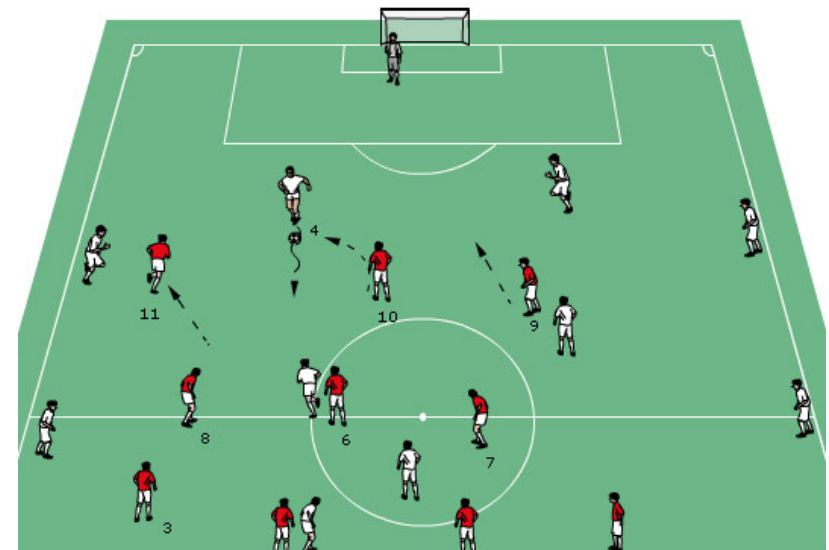
StreamTeam: Data Stream Analysis

- Real-Time Analysis: detect collective behavior of an entire team

  – Basis: data streams containing player and ball positions

  – Approach: using sophisticated stream processing workflows, i.e., combination of workers

- Real-time Visualization

  – Interactions between players (e.g., passes), actions (e.g., shots)

  – Spatial / temporal arrangement of several players (e.g., defense line)

  – Compliance to tactics specifications (e.g., pressing), …
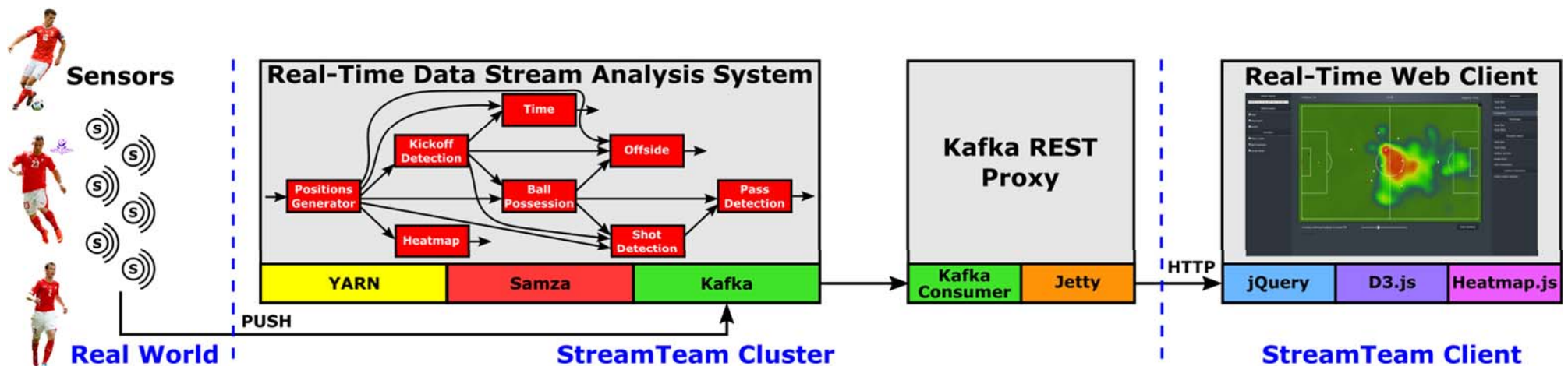
StreamTeam

Video: StreamTeam Football

https://youtu.be/wtMltMWFfn8   https://youtu.be/QNSwX84voh4

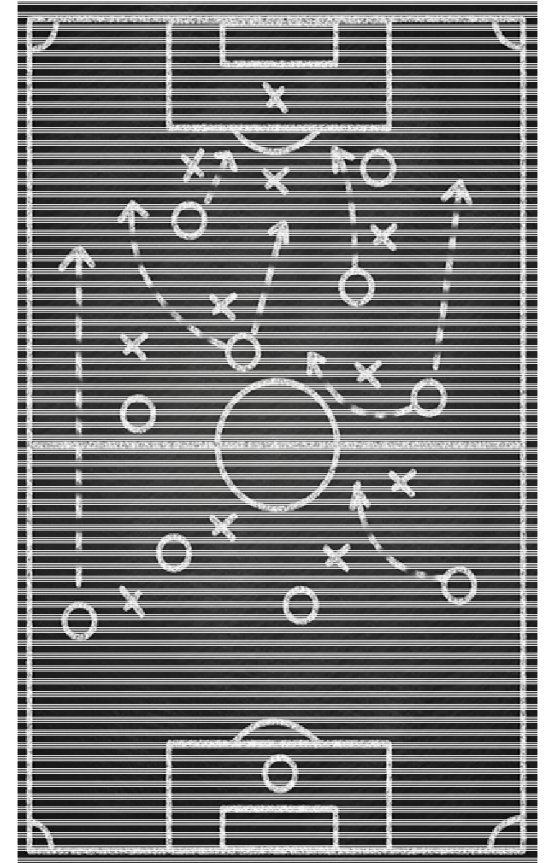# Challenge II: Video-based Game Analysis ...

- **Game analysis is predominantly visual**, based on video

- Provide novel and innovative approaches to help coaches and analysts to analyze a large number of games
  - e.g., all previous matches of the next opponent
  - Find video scenes showing special patterns in player interaction
  - Automatically compile quantitative surveys

Source: https://fmdataba.com/19/s/312/vladimir-petkovic/
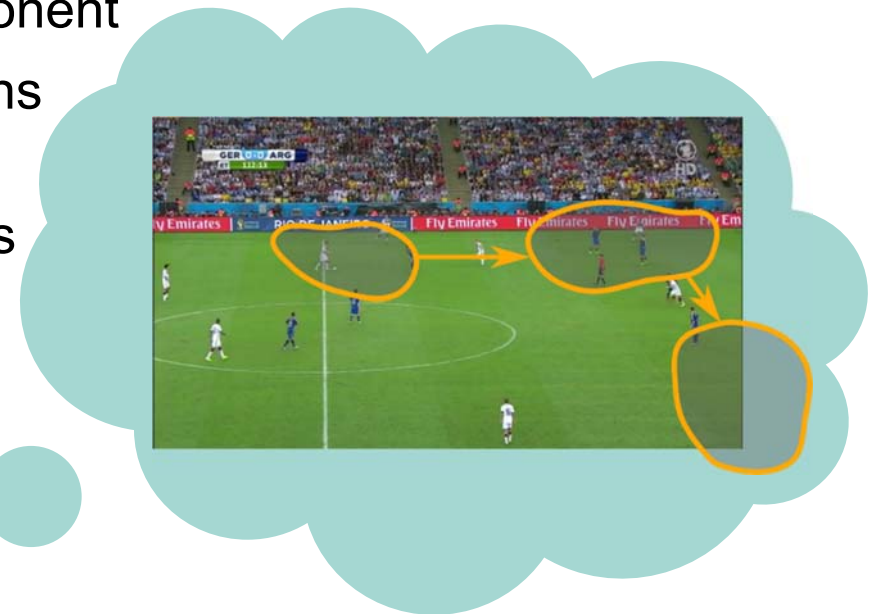
... Challenge II: Video-based Game Analysis

- From a Sport Science perspective
  - How do coaches analyze games?
  - How can video analysis be made as simple as sketching on a tactics board?
  - …

- From a Computer Science perspective
  - Sketch-based user interaction
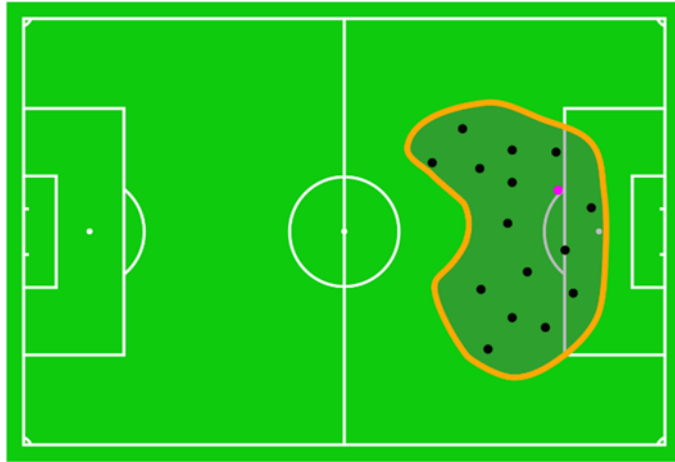 - Novel approaches to video retrieval
  - …

Source: https://www.pinterest.ch/pin/646688827720194015/

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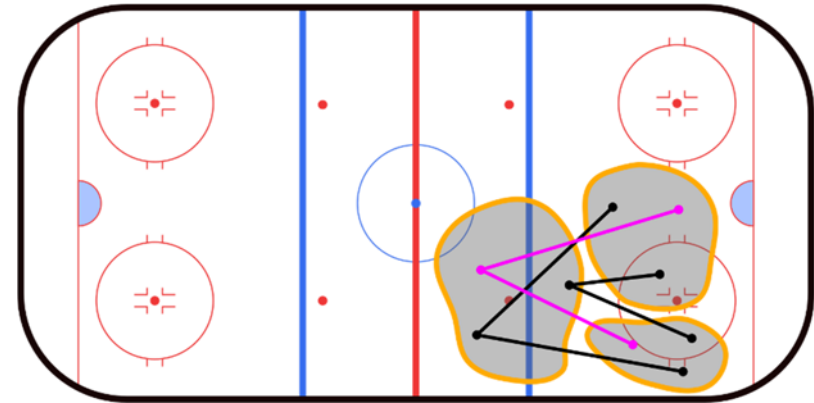
SportSense: Motion-based Queries

- Sketch- and motion-based search in video collections
  - Enables game analysts to query for scenes in an intuitive way
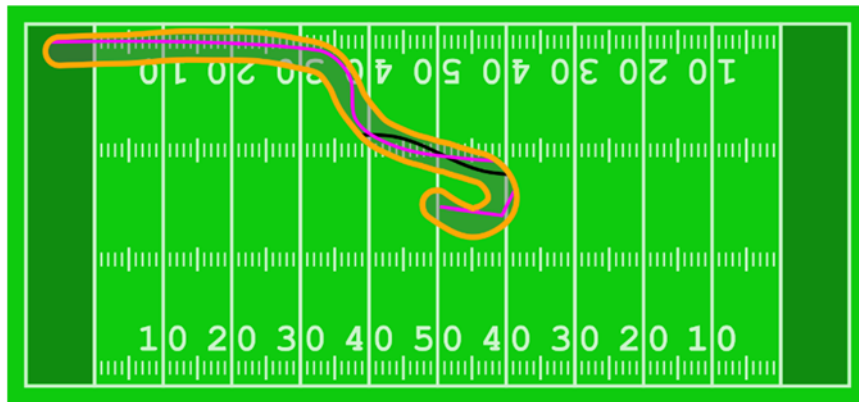 - Four spatio-temporal query types: based on video tags (= events)
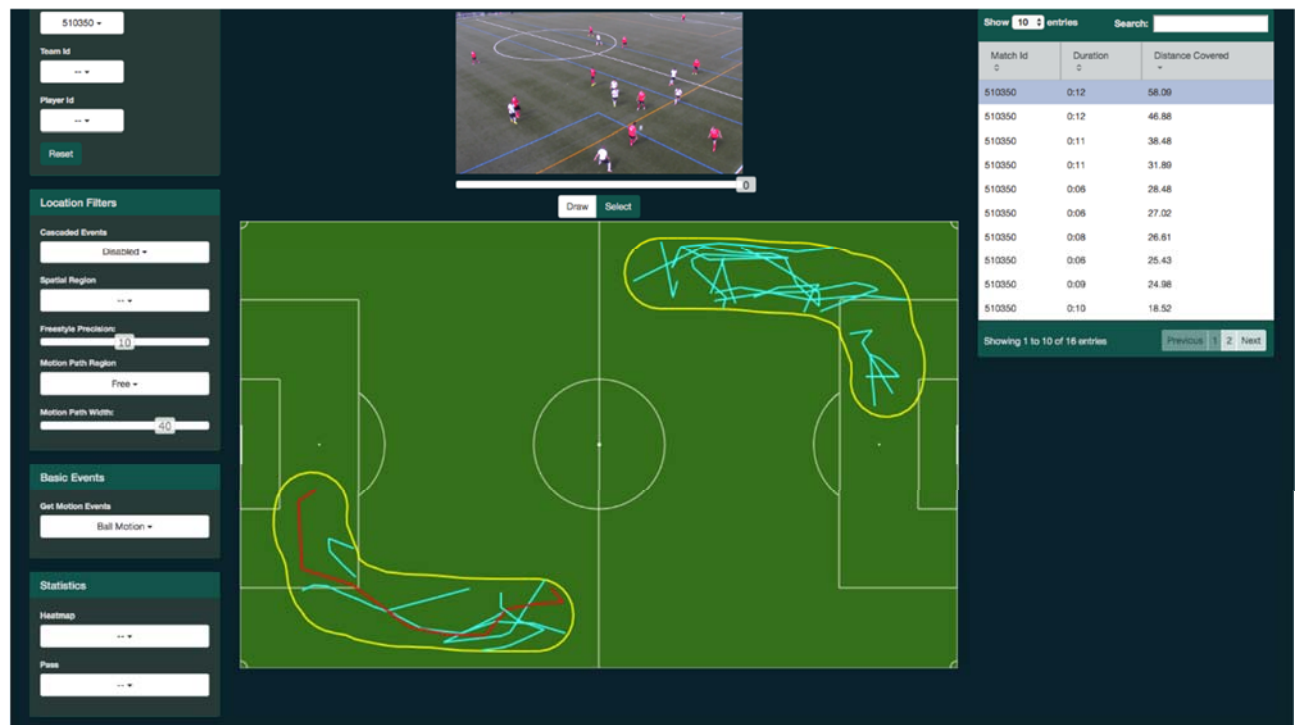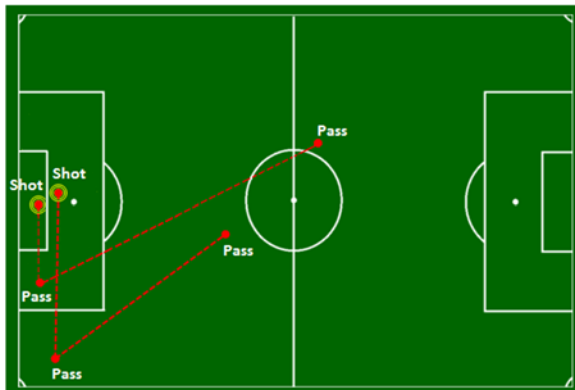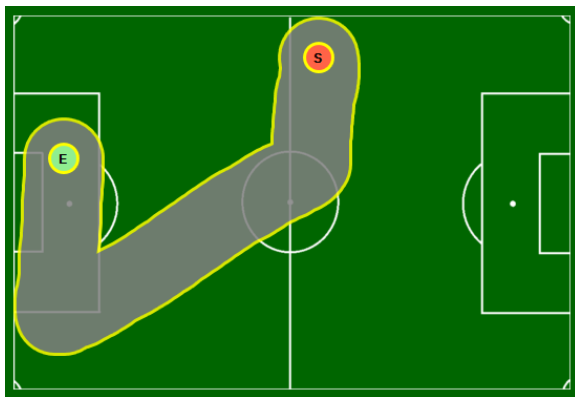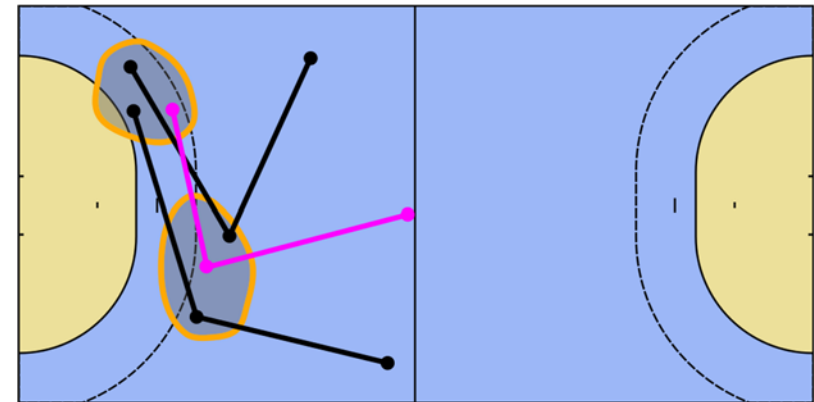
SportSense: Spatio-Temporal Query Types

Region Query

Forward Event Cascade Query

Motion Query

Reverse Event Cascade Query

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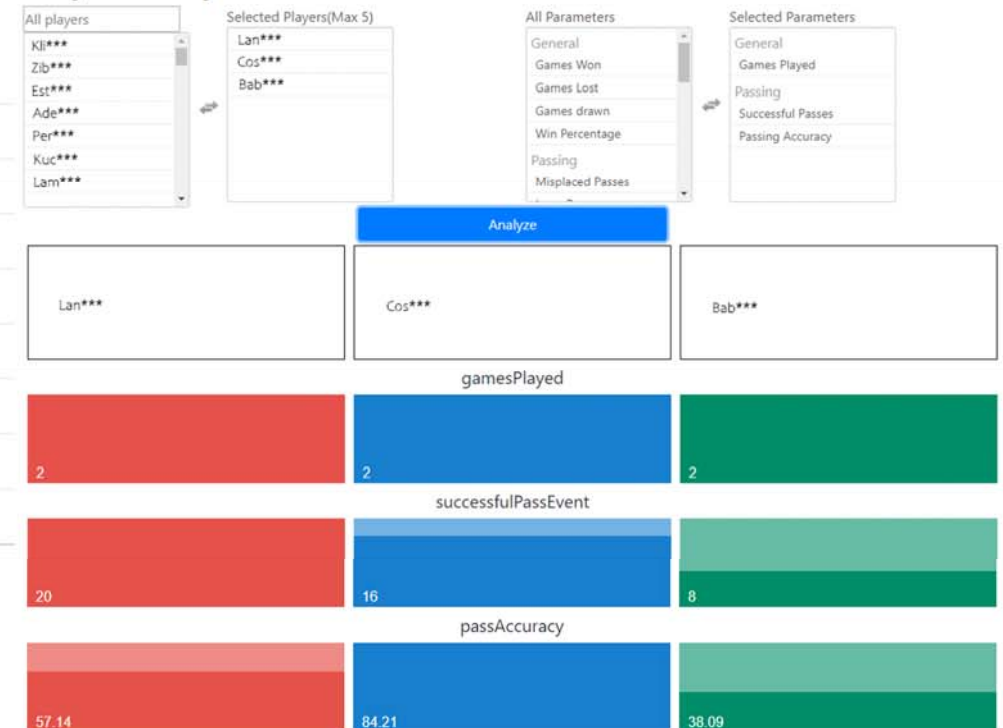Bern University of Applied Sciences

Demo: SportSense
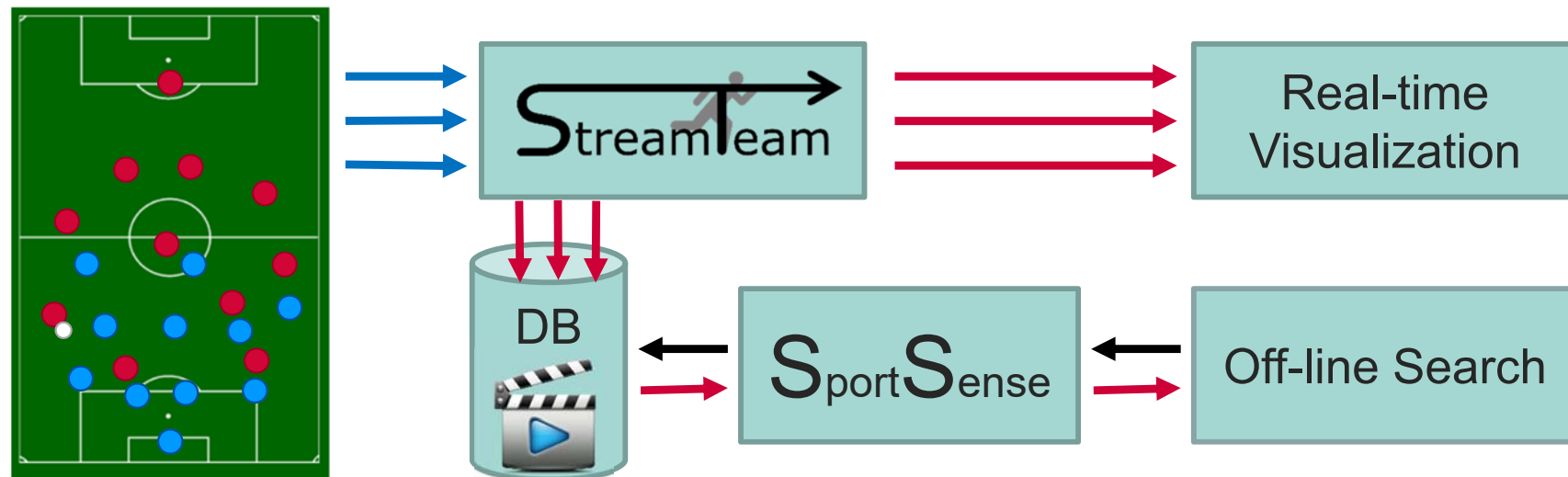
https://youtu.be/XUpWkQuUVXc
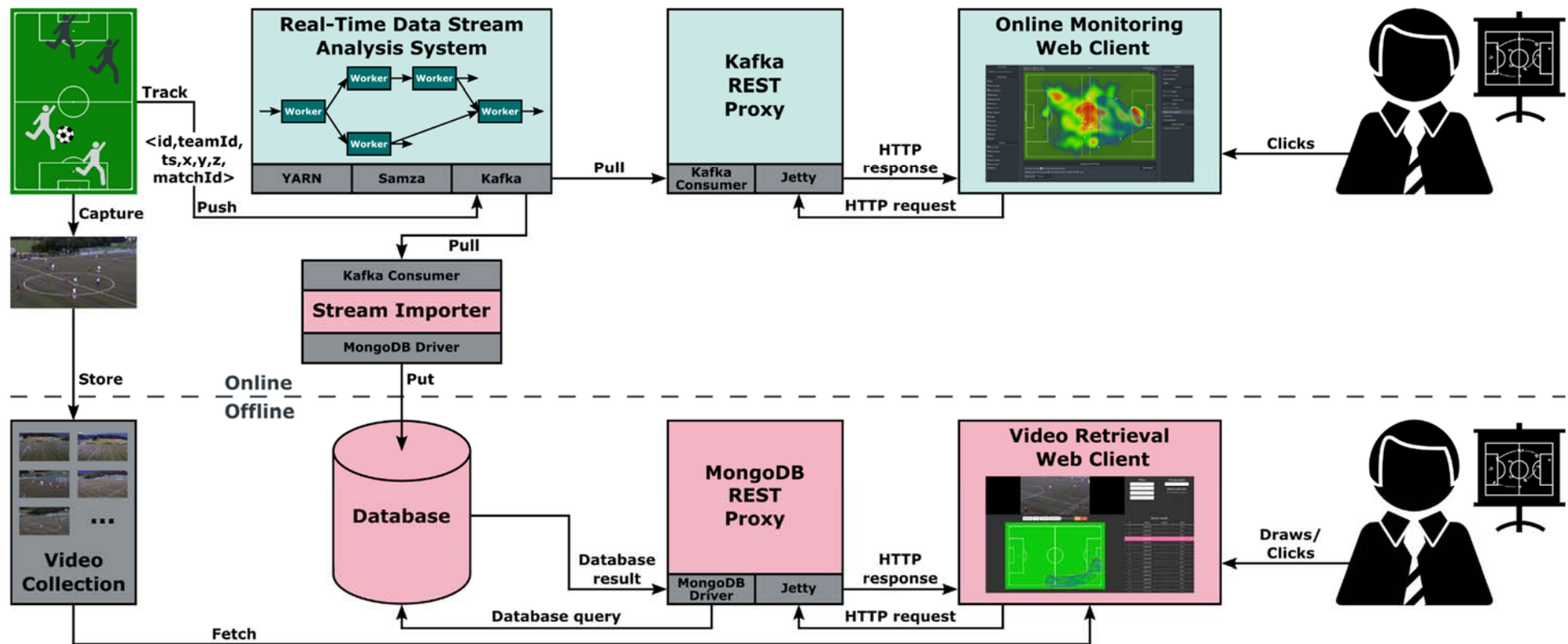
SportSense: Quantitative Analyzes
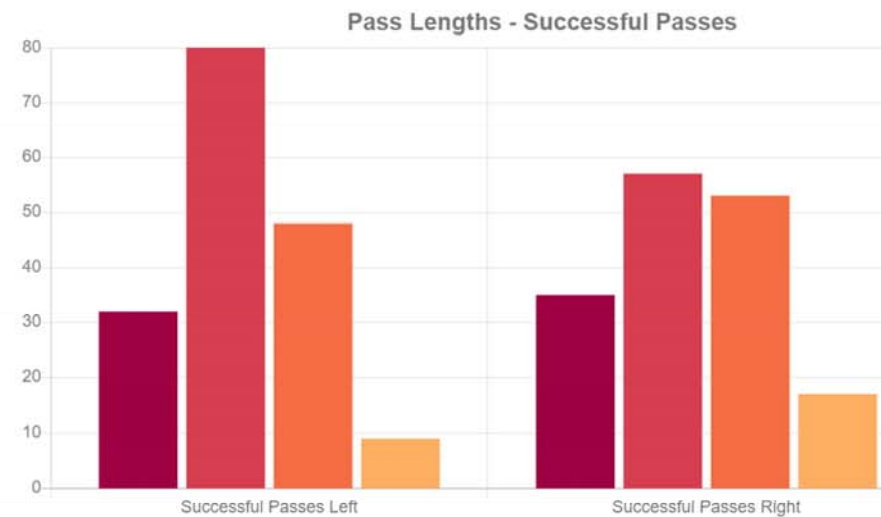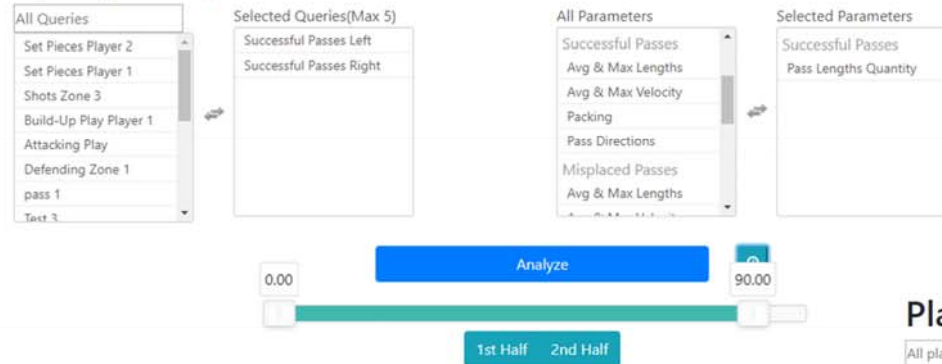
Challenge III:
Seamlessly Combine Stream Analysis and Search

- Goal: use automatically detected events as tagging data for video

- Make stream analysis and video-based search independent from the concrete application (type of sports)
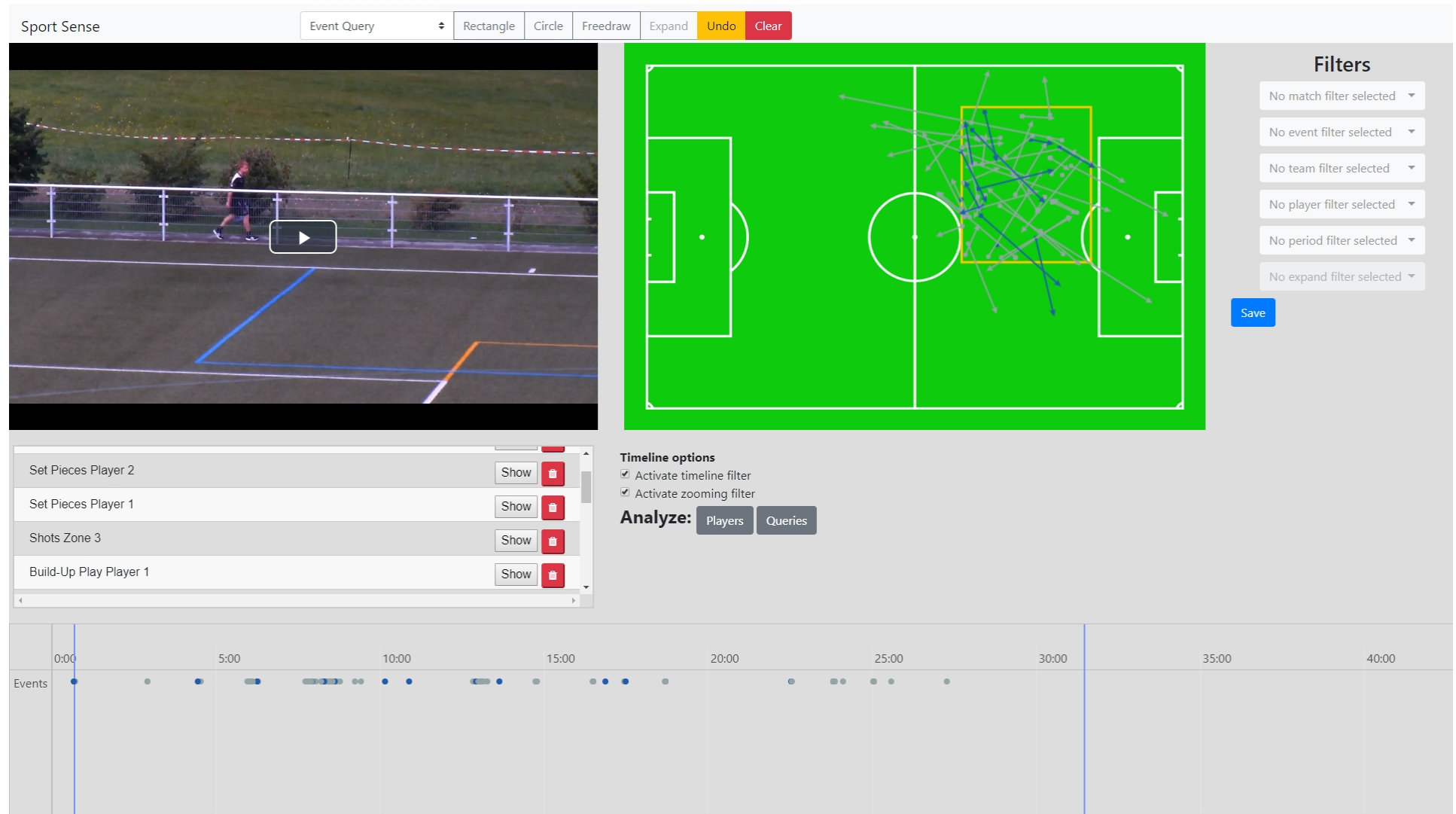
Integrated System

- Combine real-time analysis, online monitoring, and offline retrieval

Applications: Football

Applications: Ice Hockey

Applications: eSports

Project

- StreamTeam is an interdisciplinary project
  - Combines contributions from Sport Science and Computer Science
  - Start: September 2017

- Team
  - Sport Science: University of Applied Sciences Bern,
    Centre for Technologies in Sports and Medicine and
    Swiss Federal Institute of Sport Magglingen
    - Martin Rumo
    - Philipp Seidenschwarz (PhD student)
  - Computer Science: Databases & Information Systems Group,
    University of Basel
    - Lukas Probst (PhD student)
    - Heiko Schuldt

Summary and Outlook

- Status

  – Generic platform for event detection and retrieval developed

  – Wide visibility in the academic community and the general public / media

  – StreamTeam and SportSense published under an open source software license (AGPL)

  – Negotiations with potential licensees in progress

- Planned next steps

  – Extension to other types of sports (e.g., analysis of box play and shift lengths/compositions in ice hockey, etc.)

 – Applications to other disciplines beyond sports (e.g., rescue, emergency management)

Source: https://www.kqed.org/news/10685017/how-firefighters-learn-to-fight-wildfires-with-fire

References

[SJR+19]   P. Seidenschwarz, A. Jonsson, F. Rauschenbach, M. Rumo, L. Probst, H. Schuldt: *Combining Qualitative and Quantitative Analysis in Football with SportSense*. In: Proceedings of the 2nd International Workshop on Multimedia Content Analysis in Sports (ACM MMSports'19), Nice, France, October 2019.

[SRP+ 19]   P. Seidenschwarz, M. Rumo, L. Probst, H. Schuldt: *A Flexible Approach to Football Analytics: Assessment, Modeling and Implementation*. In: Proceedings of the 12th International Symposium on Computer Science in Sport, Moscow, Russia, July 2019.

[PRS+ 18]   L. Probst, F. Rauschenbach, H. Schuldt, P. Seidenschwarz, M. Rumo: *Integrated Real-Time Data Stream Analysis and Sketch-Based Video Retrieval in Team Sports.* In: Proceedings of the 2018 IEEE International Conference on Big Data (BigData'18), Seattle, WA, USA, December 2018.

[PaK + 18] L. Probst, I. Al Kabary, R. Lobo, F. Rauschenbach, H. Schuldt, P. Seidenschwarz, M. Rumo: *SportSense: User Interface for Sketch-Based Spatio-Temporal Team Sports Video Scene Retrieval* In: Proceedings of the IUI 2018 Workshop on User Interfaces for Spatial and Temporal Data Analysis (UISTDA'18), Tokyo, Japan, March 2018.

[PBS + 17] L. Probst, F. Brix, H. Schuldt, M. Rumo: Real-Time Football Analysis with StreamTeam. In: Proceedings of the 11th International Conference on Distributed and Event-based Systems (DEBS'17), Barcelona, Spain, 2017.

Analysis of Team Behavior in Sports
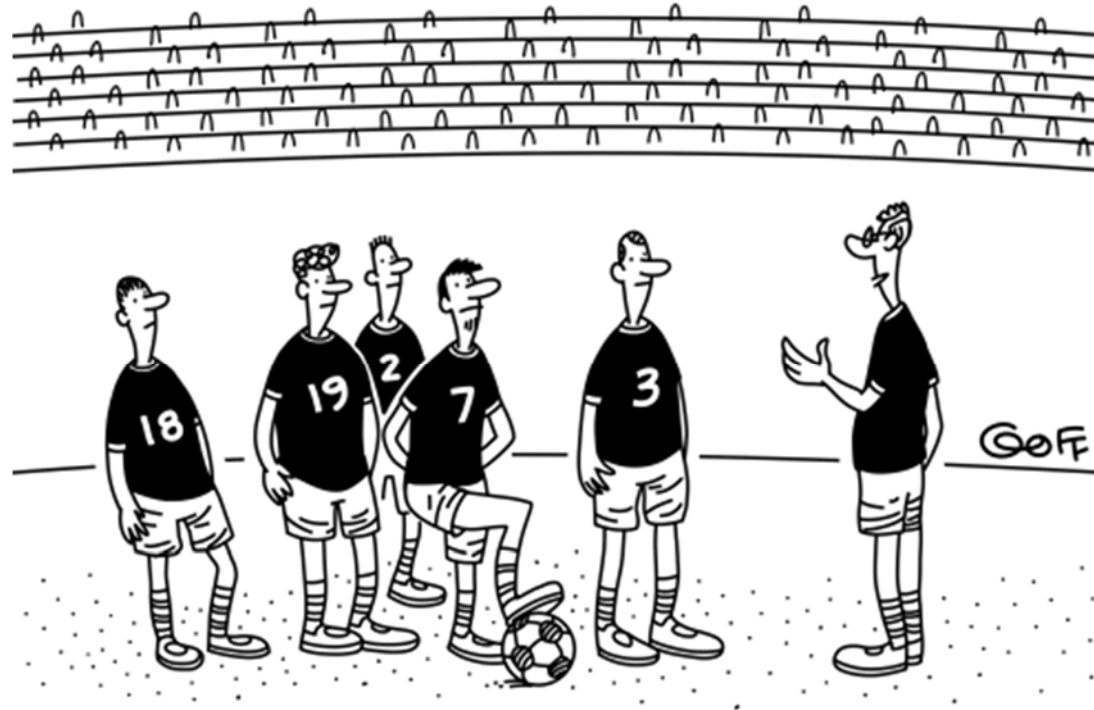
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contact: dbis-cs@unibas.ch

https://dbis.dmi.unibas.ch/research/projects/streamTeam/

https://dbis.dmi.unibas.ch/research/projects/sportsense-1/