Data Stream Processing and Analytics

Spring Semester 2019

Course Info

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Announcements and course updates

- Course Website and Moodle
  - https://www.systems.ethz.ch/courses/spring2019/dspa/
  - Slides and all other material will be available there
  - Assignments will be submitted in Moodle: https://moodle-app2.let.ethz.ch/course/view.php?id=10535
- Contact
  - Vasiliki Kalavri kalavriv@inf.ethz.ch
  - Zaheer Chothia (TA): zchothia@inf.ethz.ch
  - Please include **DSPA-2019** in the e-mail subject
- Announcements will be sent to you by e-mail and published at the website

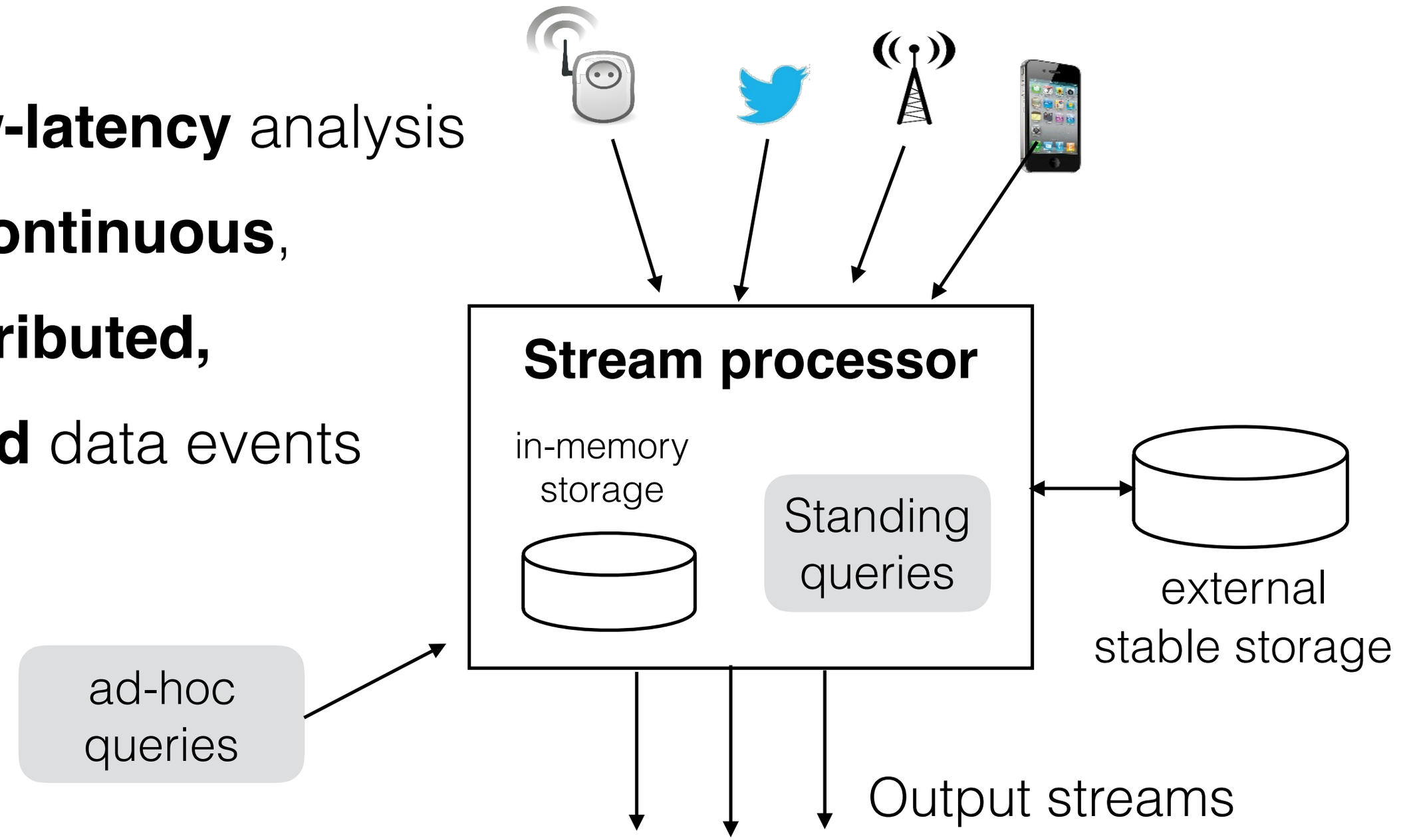
What is this course about?

Low-latency analysis

of **continuous**,

distributed,

rapid data events



Example streams and applications

Sensor measurements

- anomaly detection, incident risk calculation

Financial transactions

- fraud detection, stock trading

Location and traffic data

- report train system status, find optimal routes

Web logs

- online recommendations, personalization

Network packets

- intrusion detection, load balancing

Online social interactions

- trending topics, sentiment analysis

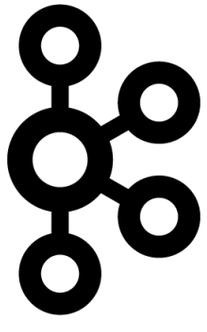
Topics

- Systems
  - Architecture and design
  - Scalability and elasticity
  - Fault-tolerance and processing guarantees
  - State management
- Algorithms
  - Windowing semantics and optimizations
  - Basic data stream mining
  - Complex event processing
- Streaming applications and use-cases

Tools

Apache Flink: flink.apache.org

Apache Kafka: kafka.apache.org



Apache Beam: beam.apache.org

Google Cloud Platform: cloud.google.com

Timely Dataflow: github.com/TimelyDataflow/timely-dataflow

Outcomes

At the end of the course, you will hopefully:

- know **when** to use stream processing and **how** to use the available tools, their features and guarantees
- have a solid understanding of how **stream processing systems work** and what affects their **performance**
- be aware of **problems** you might face when building streaming pipelines, **trade-offs** you need to consider, and **tricky bits** of streaming apps

Scope

- Theory and practice, old & new
  - the first stream processors were invented almost 15+ years ago
  - virtually none of those systems is used today
  - many of their concepts and ideas are, often *rebranded*
  - modern stream processors have to deal with new challenges

Course Structure

1. Lectures
   - Mondays 10-12
   - ~15’-20’ discussion on topics of previous week
   - Introduction of new topics
   - Guest lectures from stream processing experts

2. Exercise Sessions
   - Mondays 13-15
   - Seminar-style: review and discuss research papers
   - Hands-on: analyze streaming data, use and compare streaming tools

3. Semester Project
   - In teams of 2 students
   - Implement, test, and evaluate an end-to-end stream processing application
   - Choose tools and design architecture as you like

Semester Project

1. Choose your teammate (or let them choose you!)
   - let me know if you cannot find a teammate and I will match you
2. Choose your system
   1. Apache Flink: Java, high-level API, component-heavy, fast (Exercise Session #1 - Feb 18)
   2. Timely Dataflow: Rust, low-level API, lightweight, super-fast (Exercise Session #2 - Feb 25)
3. Send me an e-mail with subject "**DSPA Semester Project 2019**" and the above information to register your project by **01-Mar-2019**

Semester Project

- Development on gitlab (https://gitlab.inf.ethz.ch)
- Deliverables
  - code with comments
  - documentation
  - tests
  - written reports
- Milestones
  - Design document [**18-March-2019]**
  - Midterm progress report [**29-Apr-2019**]
  - Final report [**1-June-2019**]

Milestone 1: Design document

<u>One per team,</u> max **<u>2 pages, 18-Mar-2019</u>**

Briefly describe **what** you are planning to build and **how** you are planning to build it.

Briefly argue **why** this design solves the problem and describe its advantages.

<u>Answer the following</u>:

- Where does your application read input from? How does this choice affect latency and semantics (order)?

- Where does your application output results? How are these results shown to the user?

- What is your stream processor of choice? What features guided your choice?

- Will you use other auxiliary systems / tools, e.g. for intermediate data?

Milestone 2: Midterm report

<u>One per team,</u> max **<u>2 pages, 29-April-2019</u>**

Briefly describe:

- your progress so far

- any divergence from your original plan

- challenges and issues faced and how you solved them or planning to solve them

- outstanding tasks and timeline for completion

Milestone 3: Final report

One per student, max 4 pages, 01-June-2019

Briefly describe:

- high-level architecture and functionality of your application

- usage instructions, i.e. how can I use what you built? What result shall I expect? How can I run tests to verify correctness?

- your individual contribution, i.e. how did you and your partner split the work?

- reflect on what you would do differently if you could build this all over again

- mention anything you found fun, interesting, surprising while working on this project

Grading Scheme

- No Exam
- Participation in class: 10%

Look out for this symbol!

- Weekly assignments (reviews and hands-on): 50%
- Semester project (code and reports): 40%

You are here to *learn*, I am here to help you.

Ask questions!

Speak up if you don't understand. I can explain it again :-)

Make **suggestions**, send me **feedback**.