Probabilistic data structures and their applications in security and privacy

A course for PhD students, *Alma Mater Studiorum* Università di Bologna
October 2019 - DISI, via dell'Università 50, Cesena

Instructor: Luca Calderoni (DISI, Università di Bologna)

About the course

After a brief introduction to probability and hashing aspects, the course will focus on several probabilistic data structures. Each data structure will be widely discussed and exemplified. The detailed probabilistic models will be discussed as well.
The aforementioned primitives will be further applied to address several problems in the security and privacy domain. Specifically, the course includes a detailed discussion on the application of probabilistic data structures for network security, privacy by design and anonymity in location-based services.

Syllabus

- Course introduction and assessment modalities
- An introduction to probabilistic data structures
- Probability and hashing basics
- Membership queries (Bloom filter, quotient filter)
- Multiplicity queries (counting Bloom filter)
- Probabilistic data structures for network security
- Privacy metrics
- Privacy by design through probabilistic data structures
- Association queries (spatial Bloom filter, shifting Bloom filter)
- Privacy and security in location-based services

Learning and assessment modalities

The course is divided into four lectures as detailed in the following sections. It will be taught either in Italian or English at the preference of the attendees and depending on the balancing of the audience mother language. The final assessment consists in a written essay on a relevant topic, agreed with the instructor. In case the produced paper would be submitted for consideration to a scientific journal, students are allowed to write it in groups. A probabilistic data structure implementation may be also considered by the instructor as an assessment modality.

Teaching materials

Lecture notes and slides will be provided by the instructor, along with papers and a list of bibliographical references and additional material.

Lecture Schedule

- 10/10/2019, 10.00 - 12.30, Aula 2.13
- 10/10/2019, 14.30 - 17.00, Aula 2.13
- 17/10/2019, 10.00 - 12.30, Aula 2.13
- 17/10/2019, 14.30 - 17.00, Aula 2.13