

Hirak Sarkar

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OBJECTIVE

I am interested in designing and deploying efficient workflows to process raw sequences (such as RNA-seq) and alongside applying machine learning techniques to analyze and extract information from heterogeneous, large-scale public datasets (such as SRA).

EDUCATION

Stony Brook University (SBU)

Ph.D in Computer Science (3.99/4)

Stony Brook, NY

2014-2019(exp)

Indian Statistical Institute

M.Tech in Computer Science (1st class Hons.)

Calcutta, India

2011-2013

West Bengal University of Technology

(Kalyani Govt. Engg. College)

B.Tech in Computer Science (8.88/10)

Calcutta, India

2007-2011

EXPERIENCE

COMBINE-Lab (Stony Brook University)

Research Assistant (<https://github.com/COMBINE-lab>)

Jan 2015-Present

- Application of machine learning methods for publicly available massive genomic databases. (Python, sklearn, C++)
 - Available public databases are full of mislabeled samples which makes the downstream analysis extremely difficult. To mitigate the difficulty, we aim to build a workflow that can automatically learn the metadata features from a set of well-annotated databases. The project involves writing the modules for processing, cleaning and designing suitable learning algorithms.
- Development of graph based k-mer mapper, Pufferfish (C++)
 - Genome sequences (string in the order of gigabytes) are difficult to index and search in limited memory. Building a fast query efficient and memory efficient genome index is a challenging task. We used a minimum perfect hash based, rank-select algorithm to store the de-Bruijn graph based genome index which enables fast query of nucleotide sequences with manageable memory overhead. [[bioRxiv'17](#)]
- Developed an intermediate solution for accurate mapping of read sequences. (C++)
 - Alignments involve rigorous dynamic programming and therefore are costly. Mapping of reads are fast yet not accurate, to carry best of the both worlds we developed a selective-alignment based algorithm, implemented in C++, which achieved quantification accuracy comparable with complete aligners (Bowtie2, STAR), yet get to do so with almost half the time requirement. [[bioRxiv'17](#)]
- Development of compression algorithm for raw RNA-seq reads, Quark (C++)
 - We developed a semi-reference based compression scheme, which achieves state-of-the-art compression ratio. In this scheme the reference is needed while compressing the reads although it is not required at the decompression end, therefore enabling the compressed format completely self-sufficient. [[Bioinformatics'17](#)]
- Developed alignment free methods for sequence reads. (C++)
 - We developed *RapMap*, an ultra fast mapper, which builds an index over the transcriptomic sequence by using a suffix array and hash table. While comparing with alignment-based quantification tools, it achieved similar results and do so in substantially less time. [[ISMB'16](#)]
- Graph based clustering for novel organisms. (C++, Python)
 - We proposed equivalence class graph, an intermediate representation of isoform level expression and able to cluster isoforms in a *de-novo* setting.

Collaboration with Siepel-Lab (Cold Spring Harbor Lab)

June 2016-Aug 2016

- Developed probabilistic graphical model for inferring transcription rate from multi-assay dataset.
 - With the rise of different assays for the same biological specimen, it is possible to look into the cellular processes

at multiple resolution. We looked into the GRO-seq (a protocol developed in Cornell) and RNA-seq read datasets from the same sample and designed a probabilistic graphical model to estimate regulation rate and degradation rate.

Collaboration with Wings Lab (Stony Brook University)

Aug 2017-Present

- Data driven inference models for spectrum sensing. Implementing deep learning based solution to the problem of intrusion detection.

PUBLICATION

Conferences and Journals

- A space and time-efficient index for the compacted colored de Bruijn graph, by Fatemeh Almodaresi*, **Hirak Sarkar***, Rob Patro. [[bioRxiv'17](#)]
- Towards selective-alignment: Bridging the accuracy gap between alignment-based and alignment-free transcript quantification, by **Hirak Sarkar***, Mohsen Zakeri*, Laraib Malik, Rob Patro. [*Submitted to Bioinformatics'17*, [bioRxiv'17](#)]
- Quark enables semi-reference-based compression of RNA-seq data by **Hirak Sarkar** and Rob Patro. [*Bioinformatics'17*, [bioRxiv'16](#)].
- Fast, Lightweight Clustering of de novo Transcriptomes using Fragment Equivalence Classes by Avi Srivastava*, **Hirak Sarkar***, Laraib Malik and Rob Patro. [*RECOMB-seq'16*, [arXiv'16](#)]
- RapMap: A Rapid, Sensitive and Accurate Tool for Mapping RNA-seq Reads to Transcriptomes by Avi Srivastava, **Hirak Sarkar**, Nitish Gupta and Rob Patro. [*ISMB'16* (acceptance rate: 17%), *Bioinformatics'16*, [bioRxiv'16](#)]
- Voronoi Game on Graphs (Extended version) by S. Bandyopadhyay, A. Banik, S. Das and **H. Sarkar**. [Journal of Theoretical Computer Science- [TCS'15](#), *WALCOM'13*].

Posters:

- Pufferfish: A fast graph-based indexing and query strategy for large genomic sequences by Fatemeh Almodaresi*, **Hirak Sarkar***, Rob Patro, Poster presented in *WABI'17*.
- Joint probabilistic model for multiple steps of gene regulation by **Hirak Sarkar**, Yi-Fei Huang and Adam Siepel, Poster presented in *BioData'16*.

AWARDS

- Awarded Research Assistantship, SBU. (2016-present)
- Awarded Special CS Chair Fellowship. (\$10K) from *SBU*
- Awarded Post-Graduate Scholarship from *Govt. Of India*.
- Awarded NUS Research Scholarship, NUS. (Jan'14-June'14)
- Received First Prize for Software Competition (IEM), Calcutta. (2011)

RELEVANT COURSES

- Artificial Intelligence, Computational Biology, Analysis of Algorithms, Fundamental of Networks. (at Stony Brook University)
- Machine Learning & Pattern Recognition, Image Processing, Stochastic Processes, Optimization Algorithms, Graph Theory. (at Indian Statistical Institute)

SKILLS

- Programming: *C++*, *Python*, *R*
- Data analysis: *Jupyter*, *Pandas*
- Machine Learning Tools: *sklearn*, *tensorflow*

REFERENCE

- Prof Robert Patro, (Assistant Professor, Department of Computer Science, Stony Brook University)
- Prof Adam Siepel, (Professor, Watson School of Biological Sciences, Chair, Simons Center for Quantitative Biology, Cold Spring Harbor Laboratory)