



INTRODUCTION TO PROTEOGENOMICS

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INTENDED AUDIENCE : Biotechnology or Engineering background students having interest in latest technologies, (BE/B.Tech) Biotechnology. Students with science or engineering background but course is open to all.

INDUSTRY SUPPORT : Thermofisher Scientific, Illumina

COURSE OUTLINE :

Cancer research has been significantly aided by advancements in proteogenomics technologies, where proteomics information derived from mass spectrometry is used to complement genomics using next generation sequencing. With the recent advent of Cancer Moonshot Project, the critical role that proteogenomics can play in improving cancer patient treatment is increasingly being recognized. This course will utilize advanced genomic and proteomic technologies and their data from high-quality human biospecimens to identify potentially actionable therapeutic molecular targets. This course is a part of a workshop by experts in the fields of proteomics and proteogenomics in cancer research from the Broad Institute of MIT and Harvard and Indian Institute of Technology Bombay. The course will comprise interactive lectures with case studies, hands-on sessions and demonstrations on proteogenomics aimed at accelerated understanding of cancer and will cover the principles of proteogenomics followed by experimental sessions, where proteomics data using LC-MS/MS will be processed and analyzed. The next step will be to integrate the proteomics data with genomics data, from The Cancer Genome Atlas for the proteogenomics analysis. Lectures and demonstrations on different computational methods will be performed for statistical data analysis of proteogenomics data.

ABOUT INSTRUCTOR :

Prof. Sanjeeva Srivastava Dr. Sanjeeva Srivastava is a Professor and group head of proteomics laboratory at the Indian Institute of Technology, Bombay. He obtained his Ph.D. from the University of Alberta and post-doc from the Harvard Medical School in the area of proteomics, stress physiology and has specialized expertise in applications of data enabled sciences in global health, developing country and resource limited settings. He joined IIT Bombay in 2009 as an Assistant Professor and currently working as Professor. Current research in his group centers on biomarker and drug target discovery and deciphering the protein interaction networks in complex human diseases (gliomas) and infectious diseases (malaria) using high throughput proteomics, protein microarrays and mass spectrometry. Dr. Srivastava is an active contributor to global proteomics science and innovation. He serves on the Executive Council of Human Proteome Organization (HUPO) and Proteomics Society, India (PSI). He has organized three successful international conferences & workshops at IIT Bombay PSI-2014, Targeted Proteomics International Symposium in 2015 and 2018. He has published four special issues as editor, Proteomics in India for Journal of Proteomics; Proteomics Research in India for Nature India, Protein Arrays for Proteomics and Neglected Tropical Infectious Diseases for Proteomics Clinical Applications. Having an extensive teaching experience at IITB and experience of conducting proteomics courses at CSHL, New York provided him with the background to increase proteomics education for the global community. One of his special contributions has been the development of e-learning resources (MOOC mass spectrometry and interactomics courses; Virtual Proteomics Laboratory). He has made first ever proteomics documentaries Proteomics: Translating the Code of Life and Human Proteome Project (HPP). He has directed HUPO Perspective in Proteomics video interview series, which is hosted on HUPO website. Recently we have signed a MOU on clinical proteogenomics cancer research with National Cancer Institute, along with Tata Memorial Centre and India has now become 12th country to join the International Cancer Proteome Consortium (ICPC). Dr. Srivastava continues to develop proteomics & omics science and innovation together with and for the next generation of keen students, researchers and the research and education commons in Asia and global OMICS community. Click here to view Faculty Profile: <http://www.bio.iitb.ac.in/~sanjeeva/> About the Instructor: <https://youtu.be/sb4faypvWwk>

COURSE PLAN :

Week 1: Proteogenomics overview- Part I, Proteogenomics overview- Part II, Introduction to Genomics- Part I : Gene sequencing and mutations Introduction to Genomics-Part II : Sequence Part III : Transcriptome, SL1 : Advancement in Cancer Genomics, SL2: Advancement in Cancer Genomics

Week 2: Introduction to Genomics IV : Epigenome, Introduction to Genomics : cBioPortal, Genotype, Gene expression & Phenotype - Part I & II, An overview of NGS technology, SH1: NGS-Sequencing by synthesis, SH2: NGS- Sequencing by synthesis

Week 3: Introduction to Proteomics, Proteomics: Sample Prep & Protein Quantification, Proteomics: Sample Prep & Protein Quantification (Hands-on), Introduction to MS-based Proteomics- Part I 7 II, SL 3: Applications of NGS – Ion Torrent, SL4: Applications of NGS – Ion Torrent

Week 4: Introduction to MS-based Proteomics- Part I&II (Hands-on), I Data analysis: Normalization, Data analysis: Batch Correction and Missing values, Data analysis: Statistical Tests, SH3: NGS- Ion Torrent, SH4: NGS- Ion Torrent

Week 5 : Machine learning and Clustering, Hypothesis testing, ProTIGY- Part I & II, Proteogenomics approach to unravel proteoforms, SL5 &SL6 : Genomic Analysis using Droplet PCR,

Week 6: Workflow to Automated Data Processing, Introduction to Fire Cloud, Fire Cloud and Data Model, Bioinformatics solutions for 'Big Data' Analysis- Part I & II, SH5: Genomic Analysis using Droplet PCR, SH6: Genomic Analysis using Droplet PCR

Week 7: Data Science infrastructure management- Part I,II & III, DIA-SWATH Atlas-Part I&II, SL7: Introduction to Targeted Proteomics, SH7: Data Analysis using Skyline

Week 8: Human Protein Atlas-Part I Clinical, Human Protein Atlas-Part II, Affinity based proteomics & HPA, Clinical Considerations for OMICS-Part I, Considerations for OMICS- Part II, SL8: Proteomics: PTMs, SL9: Clinical Proteomics

Week 9: Introduction to Proteogenomics-Part I & II Sequence centric proteogenomics, Gene Variant Analysis, Proteomics in Clinical studies,SH8: ProTIGY

Week 10: Supervised Machine learning- Predictive Analysis Part I, Supervised Machine learning- Predictive Analysis Part II, Supervised Machine learning- Marker Selection, Gene Set Analysis using WebGestalt- Part I, Gene Set Analysis using WebGestalt- Part II, SH9: Supervised Machine Learning

Week 11: Biological Network Analysis- Part I, Biological Network Analysis- Part II, Mutation and Signaling - Part I, Mutation and Signaling- Part II, Pathway Enrichment,SH10: Pathway Enrichment and Network Analysis

Week 12: Gene Set Enrichment Analysis (GSEA), Pathway enrichment: GSEA, Linked Omics, Linked Omics (Hands-on), Proteogenomics Conclusions, SL10: Topics in Proteogenomics- Malaria and Cancer case study