Single-Cell Genomics Data Processing Training Course

Professional Development Training Course Outline

Category	Biotechnology and Pharmaceutical Development	**Duration**	10 Days
Base Fee	$4,000 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Single-Cell Genomics has revolutionized the way we understand cellular diversity, enabling researchers to investigate gene expression, mutations, and interactions at the individual cell level. Single-Cell Genomics Data Processing Training Course equips participants with the practical skills and theoretical knowledge required to analyze and interpret single-cell RNA-seq, ATAC-seq, and other genomic data. With a hands-on approach to data processing, this course covers the entire pipeline from data preprocessing, quality control, normalization, and clustering to advanced analysis techniques such as differential expression and trajectory analysis.

Through expert-led instruction and real-world case studies, the course introduces the latest tools and algorithms used in single-cell genomics. Participants will gain proficiency in key technologies such as single-cell RNA sequencing, single-cell transcriptomics, and bioinformatics pipelines, providing them with a comprehensive foundation to manage large genomic datasets and draw actionable insights from single-cell data.

Programme Curriculum

Single-Cell Genomics Data Processing Training Course

Introduction

Single-cell genomics has emerged as a revolutionary field in **molecular biology** and **biomedical research**, providing unprecedented resolution to explore cellular heterogeneity. Unlike traditional bulk sequencing methods that average gene expression across millions of cells, single-cell analysis captures the unique molecular profile of individual cells, revealing rare cell populations, transient cell states, and complex

developmental trajectories. This shift from population-level to single-cell-level analysis is fundamentally transforming our understanding of health and disease, from **cancer biology** and **immunology** to **neurodegenerative disorders**. The sheer volume and complexity of the resulting datasets, however, pose significant computational and bioinformatics challenges, making proficiency in data processing and analysis an essential skill for modern life scientists.

Single-Cell Genomics Data Processing Training Course is designed to empower researchers, clinicians, and data scientists with the foundational and advanced skills necessary to navigate the single-cell genomics data landscape. Through a blend of theoretical lectures, hands-on practical sessions, and real-world case studies, participants will learn the complete **single-cell RNA-seq (scRNA-seq)** workflow, from raw data to biological insights. The curriculum focuses on cutting-edge **bioinformatics tools**, **computational methods**, and best practices for **data quality control**, **normalization**, **dimensionality reduction**, and **cell clustering**. By the end of this course, you will be equipped to independently perform complex single-cell data analyses, interpret results, and contribute to groundbreaking discoveries in your field.

Course Duration

10 days

Course Objectives

1. Master the fundamentals of **single-cell sequencing technologies** and experimental design.
2. Gain proficiency in **raw data preprocessing** and quality control metrics for scRNA-seq.
3. Implement robust **normalization and scaling** techniques to account for technical noise.
4. Apply advanced **dimensionality reduction** algorithms like UMAP and t-SNE for data visualization.
5. Perform effective **batch effect correction** to integrate multiple datasets.
6. Execute unsupervised **cell clustering** to identify distinct cell populations.
7. Conduct **differential gene expression analysis** to find marker genes.
8. Annotate and classify cell types based on known biological markers and signatures.
9. Uncover **cell-to-cell communication** networks using interaction analysis tools.
10. Explore **developmental trajectories** and infer cell lineage relationships with pseudotime analysis.
11. Develop skills in reproducible research using scripting languages like **R** and **Python**.
12. Critically evaluate and interpret published single-cell genomics studies.
13. Prepare and visualize publication-quality figures from single-cell data.

Target Audience

1. PhD students and postdoctoral researchers in genomics, molecular biology, immunology, and neuroscience.
2. Bioinformaticians seeking to specialize in single-cell data analysis.
3. Research scientists in academia and industry.
4. Clinical researchers and pathologists integrating genomics into their work.
5. Genomics core facility staff.
6. Undergraduates with a strong background in molecular biology and programming.
7. Data scientists with an interest in biological applications.
8. Computational biologists new to single-cell data.

Course Modules

Module 1: Introduction to Single-Cell Genomics

- The Single-Cell Revolution
- Overview of scRNA-seq Workflows
- : Droplet-based (10x Genomics) vs. plate-based methods.
- Data Structure and Challenges
- **Case Study**: Bulk vs. Single-Cell Transcriptomics: Key differences and applications.

Module 2: Experimental Design & Data Acquisition

- Best Practices for Single-Cell Experiments
- Choosing the Right Technology.
- Sequencing Metrics and Quality.
- Processing raw sequencing data from 10x Genomics.
- **Case Study:** Designing an scRNA-seq experiment to profile the tumor microenvironment in breast cancer.

Module 3: Foundational Data Preprocessing

- Data Loading and Object Creation:
- Identifying and filtering low-quality cells and genes.
- Common QC Metrics: UMI counts, gene counts, and mitochondrial gene percentage.
- Identifying and removing artificial cell multiplets.
- **Case Study:** Data Normalization- Accounting for library size differences.

Module 4: Dimensionality Reduction & Visualization

- The Curse of Dimensionality
- Principal Component Analysis (PCA)
- Non-Linear Dimensionality Reduction
- Interactive Visualization
- **Case Study**: Visualizing heterogeneity in a healthy human lung cell atlas to identify rare cell types.

Module 5: Unsupervised Cell Clustering

- The Concept of Clustering.
- Clustering Algorithms
- Resolution and Granularity
- Interpreting Clusters
- **Case Study:** Clustering single-cell data from a developing embryo to map out cell lineage.

Module 6: Cell Type Annotation & Marker Genes

- Identifying genes that uniquely define each cluster.
- Statistical methods for finding significant gene changes.
- Using known marker genes to assign biological identities to clusters.
- Utilizing reference atlases and machine learning.
- **Case Study:** Annotating immune cell populations in a single-cell dataset from a viral infection model.

Module 7: Batch Effect Correction & Data Integration

- Understanding Batch Effects.
- Integration Methods: Harmony, Seurat, and Scanorama.
- Assessing whether biological and technical variation are properly resolved.

- Combining datasets for a unified analysis.
- **Case Study:** Integrating scRNA-seq data from multiple patients with Alzheimer?ÇÖs disease to identify conserved disease-associated cell states.

Module 8: Trajectory Inference & Pseudotime Analysis

- Reconstructing a continuous biological process.
- Ordering cells along a developmental or differentiation path.
- Trajectory Inference Tools: Monocle, Slingshot, and CellRank.
- Identifying dynamically expressed genes along a trajectory.
- **Case Study**: Inferring the differentiation pathway of hematopoietic stem cells into mature blood cell types.

Module 9: Cell-Cell Communication Analysis

- Identifying potential communication pairs.
- Common Tools: CellChat, NicheNet, and OmniPath.
- Visualizing Interaction Networks.
- Interpreting Communication Patterns
- **Case Study**: Mapping immune cell interactions within the tumor microenvironment to understand cancer progression.

Module 10: Multi-Omics and Advanced Topics

- Single-Cell ATAC-seq (scATAC-seq): Profiling chromatin accessibility.
- : Combining scRNA-seq and scATAC-seq data.
- Mapping gene expression in a tissue context.
- Exploring a wide range of bioinformatics resources.
- **Case Study:** Integrating scRNA-seq and spatial transcriptomics to understand tissue organization in a developing organ.

Module 11: Reproducible Research & Scripting

- Hands-on tutorials for data analysis.
- Using popular frameworks for single-cell data.
- Tracking code changes and collaborating effectively.
- Documenting and sharing your analysis.
- **Case Study**: Writing efficient code for large datasets.

Module 12: Project-Based Case Study

- Defining a research question based on a real-world dataset.
- Data Acquisition and Processing.
- Applying all learned techniques to a full project.
- Drawing biological conclusions from the data.
- **Case Study**: Presenting findings to peers for feedback.

Module 13: Single-Cell Data Interpretation & Publication

- Interpreting Complex Datasets
- Best Practices for Visualization
- Communicating single-cell analyses for publication.

- Data privacy and responsible use of genomic data.
- **Case Study**: Understanding the single-cell genomics publication landscape.

Module 14: Practical Tools and Resources

- The gold-standard R package for single-cell analysis.
- The Python equivalent for efficient data processing.
- Key data structures in R and Python.
- Accessing and utilizing publicly available scRNA-seq data (e.g., Human Cell Atlas).
- **Case Study**: Introduction to analyzing large datasets on HPC clusters.

Module 15: Single-Cell Genomics Career Pathways

- Roles in academia, biotech, and pharmaceuticals.
- Building a Single-Cell Portfolio
- Networking in the Field: Connecting with experts and collaborators.
- Staying Current: Following the latest developments and tools.
- Final Q&A and Certification: Answering questions and receiving course completion certificates.

Training Methodology

This course employs a **blended learning approach**, combining live-online lectures, hands-on practical sessions, and a project-based learning model.

- Interactive Lectures.
- Hands-on Practicals.
- Case Study-Driven Learning.
- Project-Based Assessment.
- Collaborative Learning.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	04 Dec 2026	Online	$2,000
23 Nov 2026	04 Dec 2026	Physical	$3,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$6,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$9,000
23 Nov 2026	04 Dec 2026	Physical	$12,000
23 Nov 2026	04 Dec 2026	Physical	$12,000

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