SPL – III Project Proposal

Single-Cell RNA-seq Analysis

Course: Software Project Lab – III

Course No: SE – 801

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1. Broad Domain

Bioinformatics is a vast multidisciplinary field that has developed computational tools to analyze and manage constantly growing amounts of biological data.
Biological data can be described as molecular sequence information and experimented content of genome and gene product analyses . Bioinformatics targets to develop methodology and analysis tools to explore large volumes of biological data, helping to store, organize, systematize, annotate, visualize, query, mine, understand, and interpret complex data volumes. It uses conventional, modern computer science and cloud computing, statistics, and mathematics, as well as pattern recognition, reconstruction, machine learning, simulation and iterative approaches, and molecular modeling/folding algorithms.

2. Project Specification:

Single-cell RNA-seq has enabled gene expression to be studied at an unprecedented resolution. The promise of this technology is attracting a growing user base for single-cell analysis methods.. The great potential of this technology has motivated computational biologists to develop a range of analysis tools .This project aims to make a computational biological data analysis tool.

3.Project Overview:

The main focus of this project is to develop a system for computational single cell RNA sequencing analysis. The following methods will be applied to develop the system-

I. Preprocessing
   A. Quality Control
   B. Normalization
   C. Data Correction
   D. Feature Selection
   E. Dimensionality Reduction

II. Single cell RNA sequencing
   A. Projection
   B. Gene Expression
   C. Heatmap
   D. Bubble plot
   E. Differential Expression
   F. Trajectory

III. Post Processing
    A. Use file system
    B. Make the tool more efficient and faster

4. Motivation:

Bioinformatics provides central, globally accessible databases that enable scientists to submit, search and analyse information. It offers analysis software for data studies and comparisons and provides tools for modelling, visualising, exploring and interpreting data.
Current biological and medical labs use methods that produce extremely large data sets, which cannot be analyzed by hand - for instance sequencing human genomes. Thus modern biological and medical research and development cannot be done without bioinformatics.
In addition, bioinformatics plays an important role in biomedical research. Research work in the area of genetic diseases and medical genomics is rapidly increasing and the future of personalized medicine depends on bioinformatics approaches.

5.Challenges:

- The way single-cell transcriptomics are entering the realm of big data.
- Technical and scientific challenges which are unique to the processing and analysis of large numbers of cells.
- Opportunities opened through big data driven statistical confidence and machine learning performance.
- optimized to improve computation and memory efficiency .
- There is a lack of cross-disciplinary collaboration to more effectively utilize the advantage of single-cell analysis.

6. Timeline

The proposed timeline of this project is given below

Weeks	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Requirement Analysis	X	X	X									
Literature Review		X	X	X	X	X	X	X				
Implementation			X	X	X	X	X	X	X	X	X	
Result Analysis								X	X	X	X	X
Documentation			X	X				X	X	X	X	X

Reference:

1. Single-Cell Analysis in Biotechnology, Systems Biology, and Biocatalysis:https://www.researchgate.net/publication/223981252_Single-Cell_Analysis_in_Biotechnology_Systems_Biology_and_Biocatalysis
2. Advances And Future Perspectives In Single Cell Analysis:https://www.pmwcintl.com/session/advances-and-future-perspectives-in-single-cell-analysis_2020sv/
3. Eleven grand challenges in single-cell data science: https://genomebiology.biomedcentral.com/articles/10.1186/s13059-020-1926-6
4. What is Bioinformatics? Scope and Career opportunities: https://www.careerindia.com/courses/unique-courses/what-is-bioinformatics-scope-career-opportunities-012034.htmll