Cell Fate, Differentiation & Attractor Landscapes — Hands-on

Understand how stable cell fates, differentiation trajectories and plasticity emerge from underlying gene regulatory and signaling networks. This module covers Boolean and ODE-based dynamical models of GRNs, attractors and basins of attraction, bifurcation analysis, stochasticity, and visualization of Waddington-like landscapes. You will implement in-silico perturbations, simulate differentiation/reprogramming scenarios, and generate publication-ready figures using Python, R and specialized tools.

Cell Fate, Differentiation & Attractor Landscapes

Help Desk · WhatsApp

Session Index

Session 1

Fee: Rs 8800 Apply Now

GRNs, Dynamical Systems & Cell Fate Concepts

Cell fate & gene regulatory networks (GRNs)

cell types & lineage trees **GRNs as dynamical systems** **feedback, multistability, hysteresis**

Dynamical systems foundations

state space & trajectories | fixed points, cycles, attractors | basins of attraction (intuitive view)

Toolchain & model formats

SBML-qual / SBML ODE | CellCollective / GINsim (overview) | Python/R for GRN dynamics

Session 2

Fee: Rs 11800 Apply Now

Boolean Dynamics, Attractors & Basins

Logical/Boolean modeling of GRNs

Boolean rules & update schemes | synchronous vs asynchronous | state transition graphs

Attractor analysis & cell types

fixed-point attractors | cyclic attractors | linking attractors to phenotypes

Tools & practical workflows

PyBoolNet / BoolNet | GINsim / CellCollective | basin size & robustness metrics

Session 3

Fee: Rs 14800 Apply Now

ODE/Stochastic Models & Waddington Landscapes

Continuous dynamics & fate transitions

ODE GRN models | bifurcations & saddle-node transitions | noise-driven switching (overview)

Energy/Waddington landscape concepts

potential landscapes (intuitive) | stable vs unstable manifolds | visualizing cell state manifolds

Toolchain & visualization

Python (SciPy, PyDSTool style workflows) **MATLAB / XPPAUT (bifurcation overview)** **2D/3D landscape and phase-plot figures**

Session 4

Fee: Rs 18800 Apply Now

Mini Capstone: In-Silico Differentiation & Reprogramming

Case study: modeling a simple differentiation system

Theory + Practical

In-silico perturbations & interventions

knockout/overexpression in GRNs **changing landscape shape** **reprogramming & transdifferentiation scenarios**

Deliverables

PDF/HTML report with attractor/landscape figures **Python/R notebooks or model files** **environment.yml / requirements.txt**