N-body techniques for astrophysics:

Lecture 1 (~1 hour):
Definition of an N-body simulation, examples of numerical solvers (Euler, Leapfrog); concept of computational complexity; N-body units

Lecture 2 (~4 hours):
Direct N-body codes for collisional systems (Hermite scheme, block time-step algorithm, regularization, stellar evolution recipes, special purpose hardware, graphics processing units); examples of direct N-body codes (STARLAB, Nbody6, ..)

Lecture 3 (~3 hours):
N-body methods for collisionless systems (softening, tree codes, particle mesh and fast multipole codes, high performance computing architectures); examples of codes (ChaNGa)

Lecture 4 (~3 hours):
Algorithms for gas (smoothed particle hydrodynamics, mesh codes, adaptive mesh refinement codes); Examples of codes for collisionless systems without and with gas (ChanGa, RAMSES, …)

Lecture 5 (~2 hours):
Sub-grid physics (star formation, supernovae, radiative transfer)

Lecture 6 (1 hour):
Initial conditions for N-body simulations (random sampling of a distribution function, examples)

Lecture 7 (2 hours, teacher: Mario Spera):
Regularization in N-body codes; HiGPUs