Modest 5c: Teachers

- Piet Hut (Art of Comp. Science: www.artcompsci.org)
- Jun Makino (Art of Comp. Science: www.artcompsci.org)
- Douglas Hegie (The Gravitational Million-Body Problem)
- Steve Mc Millan (Starlab: www.ids.ias.edu/~starlab)
- Peter Teuben (Nemo: http://bima.astro.umd.edu/nemo/)
- Simon P. Zwart (Starlab)
- Bill Paxton(Stellar Evolution)
- James Lombardi (Make Me A Star MMAS)

Modest 5c: Program

- 08:00-11:00: Work
- 11:00-12:00: Talks
- 12:00-16:00: Work
- 16:00-17:00: Discussion
- 17:00-19:00: Work

Modest 5c: Results

- Install software (Nemo, Starlab, partiview)
- Learning about existing codes
- Various projects (20)
- Wiki page (www.science.uva.nl/sites/modesta/wiki/index.php/List_of_projects)

Modest 5c: Nemo

"NEMO is an extendible Stellar Dynamics Toolbox, following the Open-Source Software model. It has various programs to create, integrate, analyze and visualize N-body and SPH like systems, following the pipe and filter architecture. In addition there are various tools to operate on images, tables and orbits, including FITS files to export/import to/from other astronomical data reduction packages. A large growing fraction of NEMO has been contributed by a growing list of authors. The source code consist of a little under 1000 files and 150,000 lines of code, mostly C, and some C++ and Fortran. We also advertise other software packages , which work on similar problems."

Nemo

- http://bima.astro.umd.edu/nemo
- Collection of 250+ programs running under standard Unix Shell, each performing a small task controlled by a set of parameters
- It has various groups of programs for creating initial data, integrating and plotting data
  - N-body group: it consists of programs to create N-body systems (spherical, disk), methods to compute the gravitational field (softened Newtonian, hierarchical) and time integrators (leapfrog, Runge-Kutta).
  - Orbit group: it consists of programs to calculate an individual orbit in a static potential and analyze it. For example in an N-body system, the system can be freezed at a certain time and the path of a single body can be calculated in the gravitational potential.
  - Image group: it consists of programs to create images from snapshots

Nemo: Initial data

- Plummer model: mkplummer
- Cube: mkcube
- Spiral: mkspiral
- mkbaredisk, mkdisk etc.

Nemo: Integrators

- firstn
- nbody0, nbody00: Direct N-body integrator. Each particle has its own integration time step. Interactions per time step: O (N*N). Appendix 4B of Binney & Tremaine (1987)
- nbody1,2,4,6: Aarseth 2004
- nbody6++: an MPI version of nbody6
- hackcode1,3: hierarchical N-body code with equal timesteps. It uses adaptive Eulerian tree to reduce the number of interactions per time step to O(Nlog(N)). J. Barnes and P. Hut, Nature 324, 446

Nemo: Plotting

- xyzview
- snap3d
- Partiview: an out-of-Nemo package

Starlab

“Starlab is a software package for simulating the evolution of dense stellar systems and analyzing the resultant data. It is a collection of loosely coupled programs (``tools'') linked at the level of the UNIX operating system. The tools share a common data structure and can be combined in arbitrarily complex ways to study the dynamics of star clusters and galactic nuclei.”

Starlab: features

• Three- and four-body automated scattering packages, constructed around a time-symmetrized Hermite integration scheme.

• A collection of initialization and analysis routines for use with general N-body systems.

• A general Kepler package for manipulation of two-body orbits.

• N-body integrators incorporating both 2nd-order leapfrog and 4th-order Hermite integration algorithms.

• Kira, a general N-body integrator incorporating recursive coordinate transformations, allowing uniform treatment of hierarchical systems of arbitrary complexity within a general N-body framework (versions 2.1 and above).

• SeBa, a stellar and binary evolution package, allowing to follow in time the evolution of any star or binary from arbitrary start conditions. The package is fully implemented within kira in a comprehensive and transparent fashion (versions 3.0 and above).

Starlab:

- Starlab: www.ids.ias.edu/~starlab/
- Starlab tools: www.ids.ias.edu/~starlab/tools/
- Kira integrator: www.ids.ias.edu/~starlab/kira/
- SeBa: www.ids.ias.edu/~starlab/seba/
- Starlab classes and libraries: www.ids.ias.edu/~starlab/libraries

Starlab: Initial data

- Plummer model: *makeplummer,a dd_plummer*
- King model: *makeking*
- Cube: *makecube*
- Disk: *makedisk*
- Etc
- *makemass* gives to the particles a mass distribution

Starlab: Integrators

- *leapfrog:* Integrates using the leapfrog method
- *kira*: It is a fourth-order, individual-timestep ``Hermite'' predictor-corrector scheme (Makino and Aarseth 1992)
- *SeBa*: It gives the evolution of single stars or binaries and togeather with *kira* they can give the dynamical and stellar evolution of a cluster

Starlab: plotting etc

- *xstarplot*, *xstarplot22*, *starplot*
- other:
  - *scatter3*: performs 3-body scattering experiments
  - *sigma3*: calculates cross sections for 3-body scattering experiments
  - etc