

HW3 Joohyun Lee

1. a)

Make a "Simulation" instance



Add 3 particles with orbital elements initialization



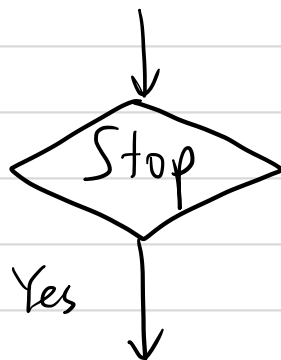
Compute initial positions and velocities



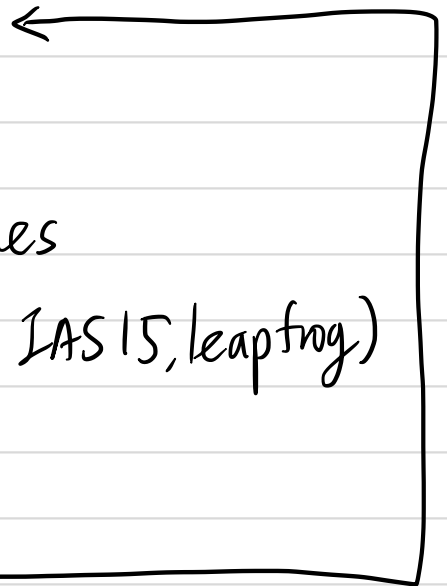
Adaptively choose timestep



Advance time and evolve particles
using numerical integrator (e.g. IAS15, leapfrog)



No



End of the simulation

b) Name	order of accuracy	suitable problem	tunable parameters
IAS15	15	generic force problem, close encounter	minimum timestep
WHFAST	2	Keplerian system with perturbations	symplectic correctors timestep
Gragg-Bulirsch -Stoer		short integrations	error at each timestep minimum/maximum timestep
SABA	varies (tunable) default: 4		order of accuracy
JANUS	default: 6		order of accuracy length/velocity scale
Embedded Operator Splitting	varies (tunable)		order of accuracy
Leapfrog	2		
Symplectic Epicycle Integrator	2		epicycle/orbital frequency

c) (1) Leapfrog

read particle data



Part 1

compute new position (parallelized)

$$\vec{r} = \vec{r}_0 + \vec{v} \frac{1}{2} \Delta t$$



advance time by $\frac{1}{2} \Delta t$

read particle data



Part 2

compute new velocity (parallelized)

$$\vec{v} = \vec{v}_0 + \vec{a} \frac{1}{2} \Delta t$$



compute new position (parallelized)

$$\vec{r} = \vec{r}_0 + \vec{v} \frac{1}{2} \Delta t$$



advance time by $\frac{1}{2} \Delta t$

(2) SEI

Initialize

get epicyclic/orbit rotation angle

advance vertical position/velocity

Integrator



advance orbital plane position/velocity

Initialize



Part 1

advance each particle (parallelized)

using Integrator

Initialize



Part 2

update each particle velocity (parallelized)

$$\vec{v} = \vec{v}_0 + \vec{a} \, \Delta t$$



advance each particle (parallelized)

using Integrator