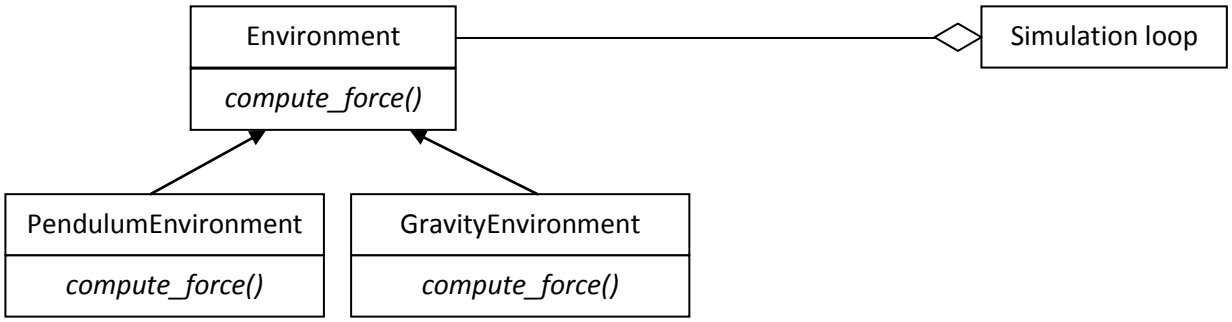
# Exercise 4

Modify the solution of the exercise 3 as follows:

1. Add the support of different environments. The user should be able to pass the name of the environment to the program as a command line argument; and this environment should be used to compute the forces acting on the particles. There are the following environments:
    a. Pendulum: the environment from the exercise 3 (springs and Earth's gravity).
    b. Gravity: there are no springs and no Earth's gravity. Instead, the total force acting on each particle is computed as the sum of gravitational forces of all other particles. That means, each particle is moving in the gravitational field produced by all other particles.

    This results in the following design of the program:




2. Add the support of initial velocities. The initial velocities are stored in the input file, which has the following format:
    $x_1$ $y_1$ $v_{x1}$ $v_{y1}$ $m_1$
    $x_2$ $y_2$ $v_{x2}$ $v_{y2}$ $m_2$
    …
    $x_N$ $y_N$ $v_{xN}$ $v_{yN}$ $m_N$
    where $(v_{xi},v_{yi})$ is the initial velocity of the i-th particle.
3. The number of steps per frame, the time step, and the input file name should be passed using the command line. This results in the following command line format:
    Exercise4 <integrator> <environment> <steps-per-frame> <time-step> <input-file>
    where
    a. <integrator> can take values "Euler", "Runge-Kutta-2", or "Runge-Kutta-4".
    b. <environment> can take values "pendulum" or "gravity".
4. For the gravity environment and the input file gravity.txt, the recommended number of steps per frame is 10 and the recommended time step is 5000 s.
5. All these changes should result in a particle simulation program, in which the user can switch between different environments and different integrators without recompiling, and in which it is easy to add a new environment or a new integrator.