ANIMATION AND SIMULATION 09

CS184: COMPUTER GRAPHICS AND IMAGING

March 31, 2020

1 Animation and Physical Simulation

1. What are keyframes and what do we do with them?

2. What is the difference between forward and inverse kinematics? What are some problems associated with the latter?

3. Recall the forward, or explicit Euler method, which uses the following update rules:

$$\boldsymbol{x}^{t+\Delta t} = \boldsymbol{x}^t + \Delta t \dot{\boldsymbol{x}}^t$$
$$\dot{\boldsymbol{x}}^{t+\Delta t} = \dot{\boldsymbol{x}}^t + \Delta t \ddot{\boldsymbol{x}}^t$$

   where $\boldsymbol{x}^t, \dot{\boldsymbol{x}}^t, \ddot{\boldsymbol{x}}^t$ respectively denote the position, velocity, and acceleration at time t.

   (a) Give some pros and cons of using the explicit Euler method.

   (b) Say we have a particle with mass 1 starting at position $\boldsymbol{x}^0 = (0, 1)$ with an initial velocity $\dot{\boldsymbol{x}}^0 = (-1, 0)$ and no initial acceleration. The particle is at one end of a

spring, whose other end is the origin $(0, 0)$, and whose spring constant is $k = 1$ and rest length is 1. Calculate particle's position at $t = 3$ using the explicit Euler method with timestep $\Delta t = 1$.