n-body

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N-body gravity Equation

$$\vec{f}_{ij} = \frac{G\, m_i m_j\, \vec{r}_{ij}}{|\vec{r}_{ij}|^3} \qquad \vec{r}_{ij} = \vec{x}_j - \vec{x}_i$$

$$\vec{f} = m\vec{a}$$

$$\vec{a}_i = \frac{\sum_j^n \vec{f}_{ij}}{m_i} = G\sum_j^n \frac{m_j\, \vec{r}_{ij}}{|\vec{r}_{ij}|^3}$$

$$\vec{v} = \frac{d\vec{x}}{dt} \qquad \vec{a} = \frac{d\vec{v}}{dt}$$

- We want to model $\vec{x}_i(t)$
- We will step through time (t) in increments of h and update $\vec{v}_i(t)$ and $\vec{x}_i(t)$ with $\vec{a}_i$

$$\vec{v}(t+h) \approx \vec{v}(t) + h \cdot \vec{a}$$

$$\vec{x}(t+h) \approx \vec{x}(t) + \vec{v}(t)\cdot h + \tfrac{1}{2}\vec{a}\,h^2$$