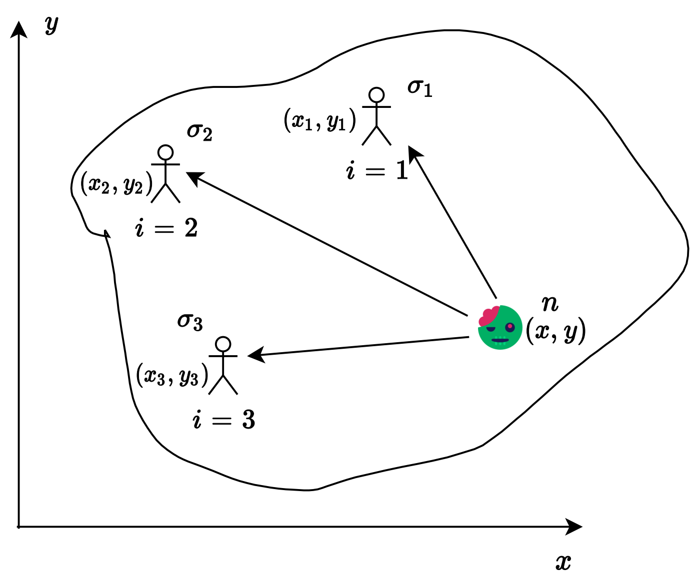
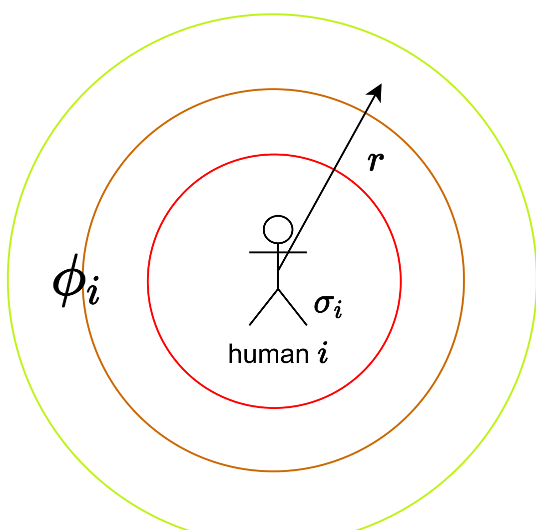
ZOMBIES STRATEGY



Zombies move around guided by the smell of humans. The **direction they choose** in each iteration of the simulation **is given** then **by humans' position distribution combined with their smell**. The better nose a zombie has, the more sensitive it is to humans who are closer to him. Mathematical formulation of this rule is similar to gravitational potential formalism. In a way, **zombies are moving inertly within the field of gravitational-like potential generated by humans. They always go in the direction of gradient (fastest growth) of that field.**

Pseudo-gravitational potential ϕ_i generated by a human i with smell parameter σ_i perceived by a zombie with nose parameter $\mathbf{n}$ as a function of distance r



!note: $\mathbf{n}$ parameter ranges $(1, \infty)$ and is constant for a zombie. The bigger value, the more sensitive nose

$$\phi_i = \frac{\sigma_i}{r^{\mathbf{n}}}$$

Total value of that potential is a superposition of potentials generated by all humans. If the number of all humans is H and distance between zombie and human i is d_i then formula for resultant potential is the following:

$$\phi = \sum_{i=1}^{\mathrm{H}} \phi_i = \sum_{i=1}^{\mathrm{H}} \left(\frac{\sigma_i}{d_i^{\mathbf{n}}} \right)$$

To calculate the direction chosen by a zombie in each iteration we need to know direction of gradient vector $\vec{\gamma}$ of the potential field ϕ. The gradient is given by the following formula:

$$\vec{\gamma} = \nabla \phi = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y} \right) \sum_{i=1}^{\mathrm{H}} \left(\frac{\sigma_i}{d_i^{\mathbf{n}}} \right) = \left(\frac{\partial}{\partial x} \sum_{i}^{\mathrm{H}} \left(\frac{\sigma_i}{\sqrt{(x - x_i)^2 + (y - y_i)^2}^{\mathbf{n}}} \right), \frac{\partial}{\partial y} \sum_{i}^{\mathrm{H}} \left(\frac{\sigma_i}{\sqrt{(x - x_i)^2 + (y - y_i)^2}^{\mathbf{n}}} \right) \right)$$

$$\vec{\gamma} = - \left(\sum_{i=1}^{\mathrm{H}} \frac{\mathbf{n} \cdot \sigma_i (x - x_i)}{d_i^{\mathbf{n}+2}}, \sum_{i=1}^{\mathrm{H}} \frac{\mathbf{n} \cdot \sigma_i (y - y_i)}{d_i^{\mathbf{n}+2}} \right)$$

After calculating gradient of the potential field generated by all humans combined we need to get a unit vector of this gradient and multiply it be scalar value of zombie's velocity v. It's going to be the vector of displacement of the zombie in this iteration of the simulation

$$\hat{\gamma} = \frac{\vec{\gamma}}{|\vec{\gamma}|}$$

$$\vec{r} = v \cdot \hat{\gamma}$$