1 Create Roadmap from states

Definition 1.1. p_i: ith trajectory, extracted from a $10N_i$ seconds video, comprised by N_i states.

Definition 1.2. $p_i(n)$: nth state on the mth trajectory, in 30 dimensions.

Definition 1.3. $v_i(n)$: approximating velocity of $p_i(n)$.

$$v_i(n) = \begin{cases} p_i(n+1) - p_i(n), & n = 0 \\ p_i(n) - p_i(n-1), & n = N_i \\ \frac{1}{2}[p_i(n+1) - p_i(n-1)], & otherwise \end{cases} \tag{1}$$

Definition 1.4. K: the total number of states.

$$K = \sum_{i=0}^{I} \sum_{n=0}^{N_i} 1 \tag{2}$$

Definition 1.5. L_i: the total length of states.

$$L_i = \sum_{0}^{i} N_i \tag{3}$$

Definition 1.6. connection matrix M: record links and strength of links between different states, in the shape of $K \times K$.

$$M_{u,v} = \begin{cases} 1, & u+1 = v \, and \, v \neq Li \\ 0, & otherwise \end{cases} \tag{4}$$

Definition 1.7. to simplify the symbols in the matrix, we will replace $p_{i(n)}$, $v_{i(n)}$ by s_u

$$s_u = [p_{i(n)}, v_{i(n)}] \tag{5}$$

Definition 1.8. $C_{u,v}$: the L2 norm between s_u and s_v

$$C_{u,v} = \|s_u - sv\| \tag{6}$$

Process 1.1. Hierarchical clustering: we will search *batch* pair of states with minimum C value, then calculate unions of these pairs, and for each pair, we will replace them by a new state. The new state will preserve all the connection of original states.

Definition 1.9. $Dp_{u,v}$: the position difference between s_u and s_v

$$Dp_{u,v} = s_v[1] - (s_u[0] + s_u[1]) \tag{7}$$

Definition 1.10. $Dv_{u,v}$: the velocity difference between s_u and s_v

$$Dv_{u,v} = s_v[1] - s_u[1] \tag{8}$$

Process 1.2. Probabilistic Connection: accroding to D_p and D_v values of any state s_u and s_v, discriminator can output possibility by how much it subject the distribution of original data and assign it to $M_{u,v}$.

Process 1.3 remove isolated states: for any state s_u, if it has no connection states, we will remove it recursively.

2 Prediction and Planning

Definition 2.1. initial state: at first, initial state s_{init} will be chosen randomly from all the states

Definition 2.2. next state s_{next} will be sampled by the possibility of $\frac{M_{init,next}}{\sum_{i=0}^{K} M_{init,i}}$

Definition 2.3. Routes r_u: a set of metaroutes start from s_u, comprised by metaroutes$r_{u,i}$

Definition 2.4. Metaroute $r_{u,i}$: a route comprised of 120 states sampled from state s_u, m means the number of metaroute in r_n

Definition 2.5. $Q_{u,i}$ is used to calculate sampling probability a metaroute $r_{u,i}$, Q is calculated by the number of frames that gaze is being detected, and sampled by softmax . $x \sim U(0,1)$.

$$Policy = \begin{cases} sample\ a\ new\ r_{n,m}, & x < 0.2 \\ select\ r_{n,m}\ from\ r_n, & x \geq 0.2 \end{cases} \tag{9}$$