Algorithm 1 RangeQuery (query point q with radius r_q at time t_q, probability threshold ρ, A1R-tree node *node*)

1: $\epsilon_\rho \leftarrow \text{ZScoreLookUp}(\rho)$
2: $results \leftarrow \emptyset$
3: **if** *node* is a non-leaf node **then**
4:     **for** each node entry $e \in node$ **do**
5:         **if** $e.t^\vdash < t_q \leq e.t^\dashv$ **then**   ▷ temporal filtering
6:             $\text{RangeQuery}(q, r_q, t_q, e.cp)$
7: **else**
8:     **for** each node entry $e \in node$ **do**
9:         **if** $t_q = e.t^\dashv$ **then**   ▷ get a single record
10:             $rec \leftarrow \text{TrajHash}[e.traj\_id, e.loc\_id]$
11:         **else**   ▷ get two consecutive records
12:             $rec_1 \leftarrow \text{TrajHash}[e.traj\_id, e.loc\_id - 1]$
13:             $rec_2 \leftarrow \text{TrajHash}[e.traj\_id, e.loc\_id]$
14:             $rec \leftarrow \text{GetMidPoint}(rec_1, rec_2)$
15:         **if** $\|rec.\mu, q\| < r_q + \epsilon_\rho \cdot rec.\sigma$ **then** ▷ spatial filtering
16:             **if** $\text{PresenceProb}(rec, q, r_q, \rho) > \rho$ **then**
17:                 add rec to $results$