Algorithm 1: Place-relevant tag extraction and merge

Input: P - dataset, X - tag set, eps - radius, min_pts - minimum number of points, p_pro - minimum proportion, Δt - time threshold, min_user – minimum number of user, min_sim - minimum similarity

Output: X_p - the set of place tags, CH_x - the set of processed convex hulls

while $\exists x \in X$ where x is unprocessed **do**
  if $|P_x| < min\_pts$ **then**
    continue
  else
    $C_x \leftarrow$ TU_DJ_Cluster (P_x, eps, min_user, Δt)
    if $|C_x| == 0$ **then**
      continue
    else
      for $i = 0;\ i < |C_x|;\ c_x^i \in C_x;\ c_x^i = \left\{p_{xk}^{c_x^i} | k = 1,2,..,|c_x^i|\right\};\ p_{xk}^{c_i} \in P_x$ **do**
        if $|c_x^i|/|P_x| \geq p\_pro$ **then**
          MarkAsPlaceTag(x)
          CreateConvexHull(c_x^i)
          break
        end
      end
    end
  end
end
$CH_x \leftarrow$ the set of convex hulls; $X_p \leftarrow$ the set of place tags
for $m = 0;\ m < |CH_x|;\ ch_{x_m} \in CH_x$ **do**
  if ch_{x_m} is unprocessed **then**
    for $n = 0;\ n < |CH_x|;\ ch_{x_n} \in CH_x;\ m \neq n$ **do**
      if $Intersect(ch_{x_m}, ch_{x_n}) \neq \emptyset$ and $sim(x_m, x_n) \geq$ min_sim **then**
        Merge(ch_{x_m}, ch_{x_n})

25 **end**

26 **end**

27 **end**

28 **end**

Algorithm 2: Cluster extension

Input: P - dataset, CH'_x - convex hull generated by Algorithm 1, r – buffer radius
Output: C_x - the set of clusters

1 $CH_x^b \leftarrow$ CreateBuffer(CH'_x, r)

2 **while** $\exists p \in P$ where p is unprocessed **do**

3 **if** $\exists ch_x \in CH_x^b$ s.t. $Intersect(p, ch_x) \neq \emptyset$ **then**

4 **for** $i = 0;\ i < |X_p|;\ x_i \in X_p$ **do**

5 **if** $sim(x_i, x) \geq$ min_sim **then**

6 $p \leftarrow$ AssignToCluster(ch_x)

7 **break**

8 **else**

9 $p \leftarrow$ NoisePoint

10 **end**

11 **end**

12 **else**

13 $p \leftarrow$ NoisePoint

14 **end**

15 **end**

16 $C_x \leftarrow$ the set of clusters
