Presentation by Team Thoplo

Improving Field Mapping Task-Splitting Algorithms

A Query-Based Approach for Spatial Professionals

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Hackathon Participation

Field mapping task splitting algorithm development

Presenting our algorithm which minimizes the need to cross rivers and major highways during field mapping and divides building into clusters, with the aim to address the challenges faced by field validators.

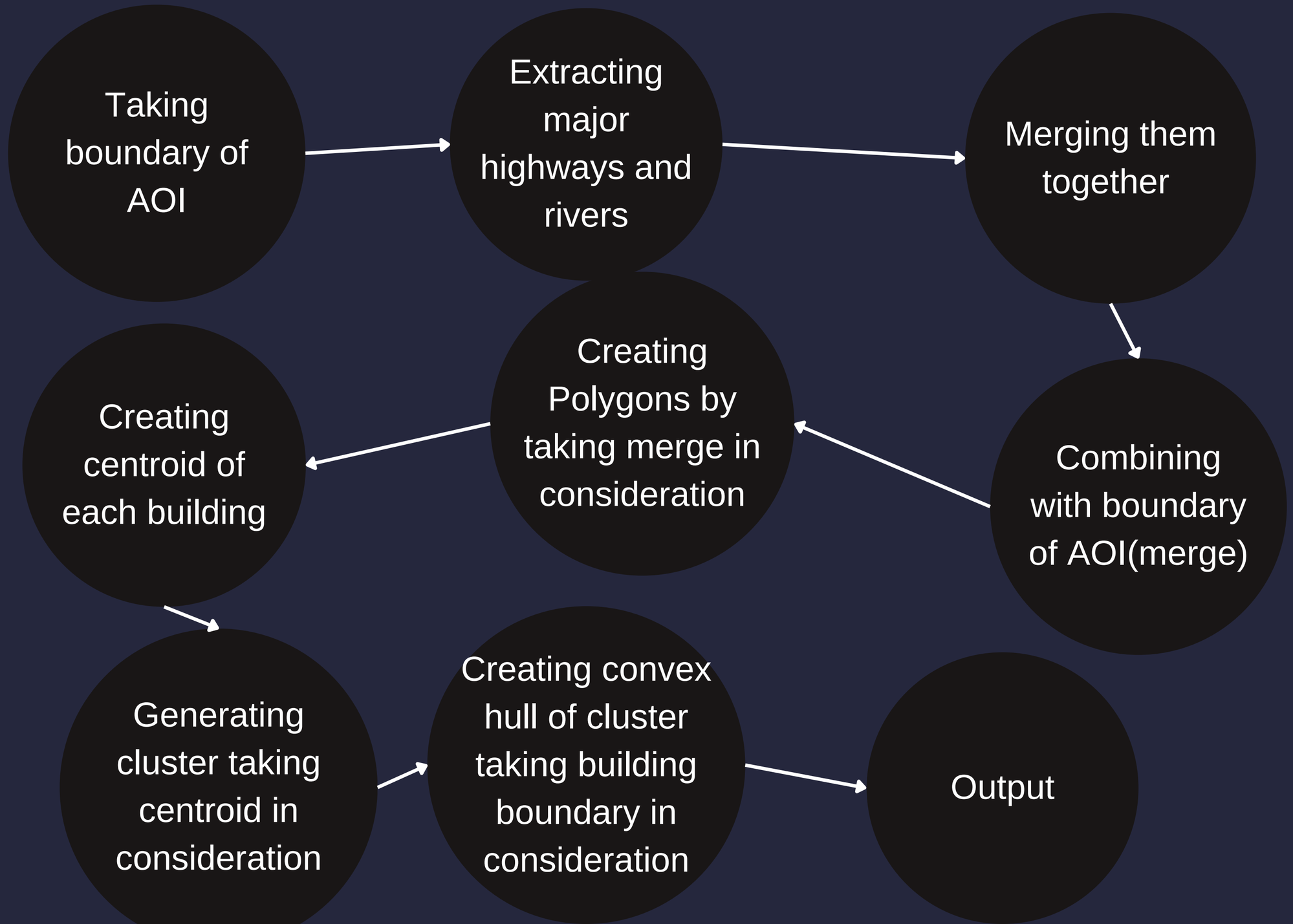
Key Features

To highlight the key features of our algorithm, such as minimizing the need to cross rivers and major highways during field mapping and dividing building clusters by equal numbers.

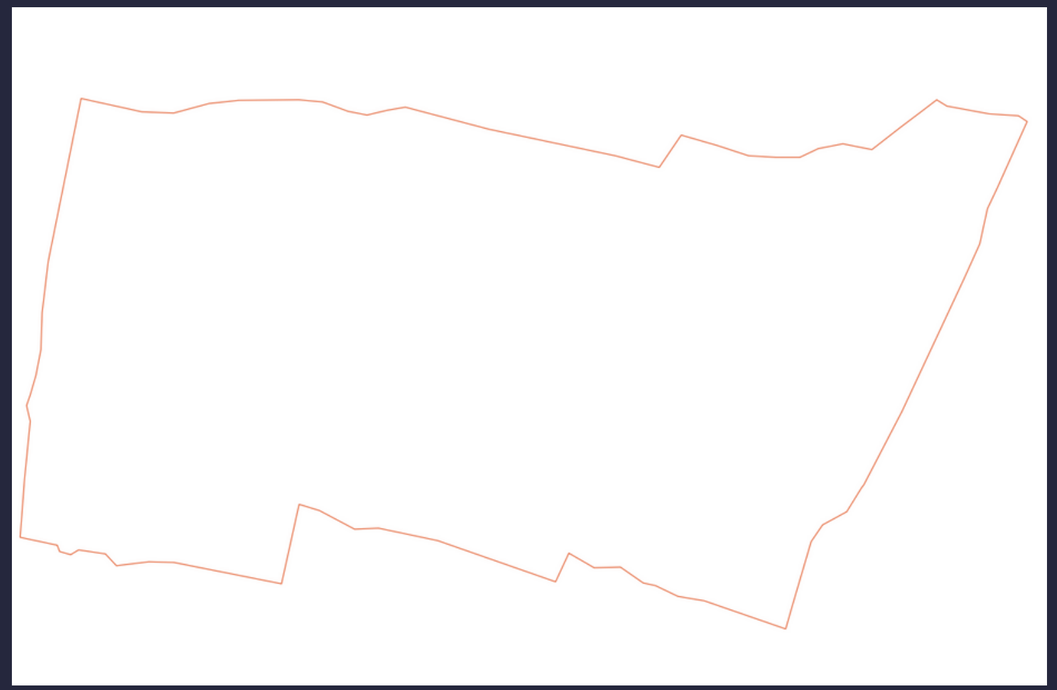
- Considers natural barriers like river and artificial barrier like major highways
- Algorithm reduces the need to cross rivers and major highways during field mapping.
- The algorithm is specifically designed to be used in highly dense areas to validate buildings

Algorithm Explanation

FLOWCHART

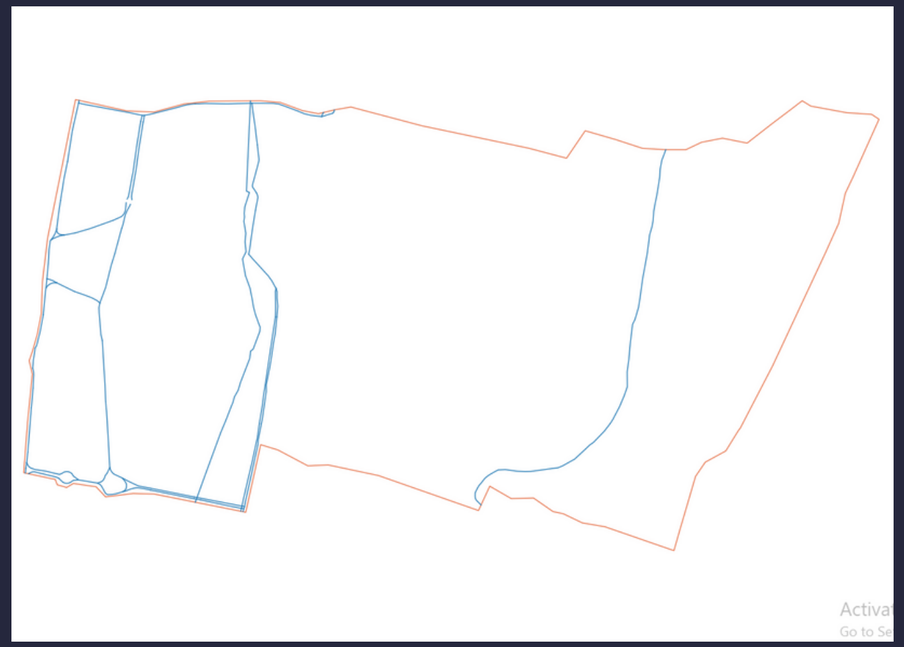

Taking boundary of AOI
Extracting major highways and rivers
Merging them together
Combining with boundary of AOI(merge)
Creating Polygons by taking merge in consideration
Creating centroid of each building
Generating cluster taking centroid in consideration
Creating convex hull of cluster taking building boundary in consideration
Output

Taking the boundary of AOI



```
WITH boundary AS (
    SELECT ST_Boundary(geom) AS geom
    FROM islington_aoi
),
```

Extracting Individual Lines of major highway and rivers and merging

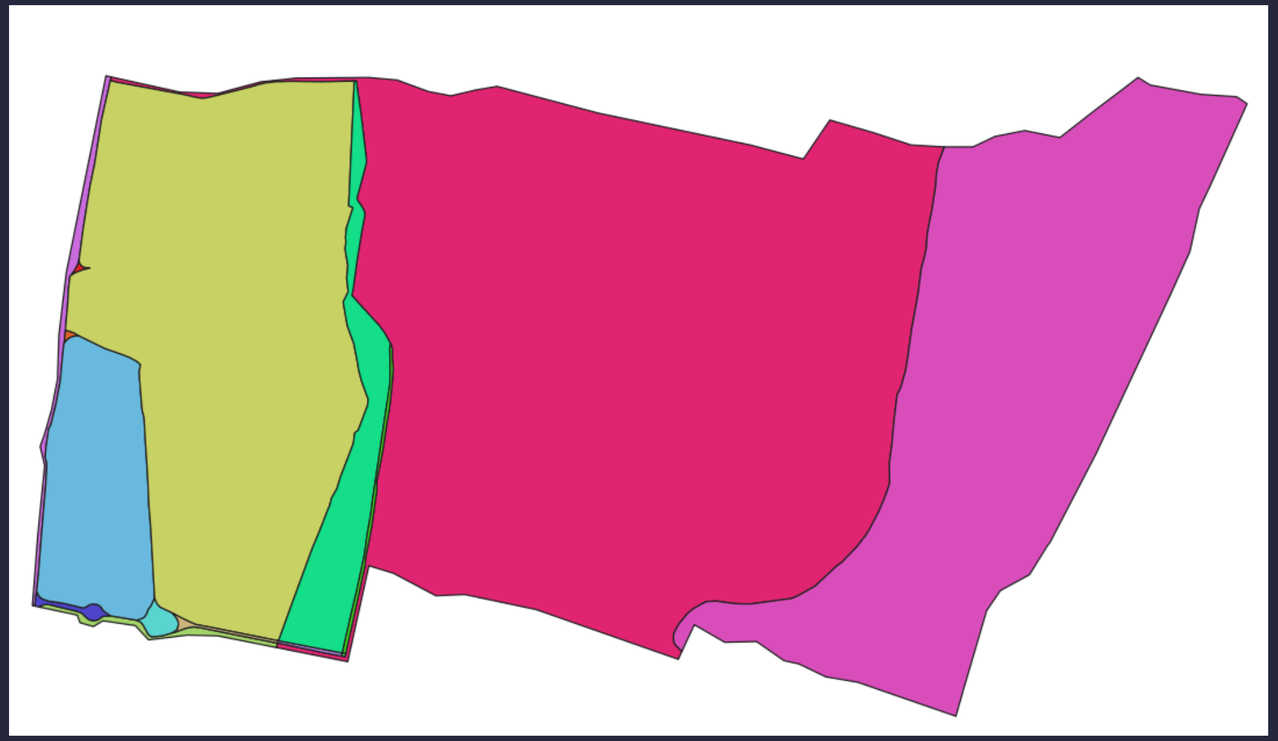


```
splitlines AS (
  SELECT ST_Intersection(a.geom, l.geom) AS geom
  FROM islington_aoi a, islington_lines l
  WHERE ST_Intersects(a.geom, l.geom)
  AND (tags->>'highway' = 'primary' OR tags->>'waterway' = 'river')
),
merged AS (
  SELECT ST_LineMerge(ST_Union(splitlines.geom)) AS geom
  FROM splitlines
)
```

Changing bounding lines to polygon

Divided AOI into 'minimaps'

In order to avoid forcing field mappers to cross any major highways or rivers, we deemed their lines to be "boundary" lines.



```
comb AS (
  SELECT ST_Union(boundary.geom, merged.geom) AS geom
  FROM boundary, merged
)
  SELECT (ST_Dump(ST_Polygonize(comb.geom))).geom AS geom
  FROM comb
```

Creating centroid of each building polygon

```
buildings AS (
  SELECT *
  FROM islington_polygons
  WHERE tags->>'building' IS NOT NULL
),
polbuild AS(
SELECT buildings.geom
FROM buildings
JOIN polygons ON st_contains(polygons.geom, buildings.geom)
WHERE polygons.geom IN (
    SELECT polygons.geom
    FROM polygons
    ORDER BY polygons.geom
  OFFSET 13 LIMIT 1
))
SELECT  st_centroid(geom) AS geom
FROM polbuild
```

Dividing Buildings into Clusters

Inside each 'mini-map'/section, we created centroid of all building polygon which were used to apply k-means clustering.

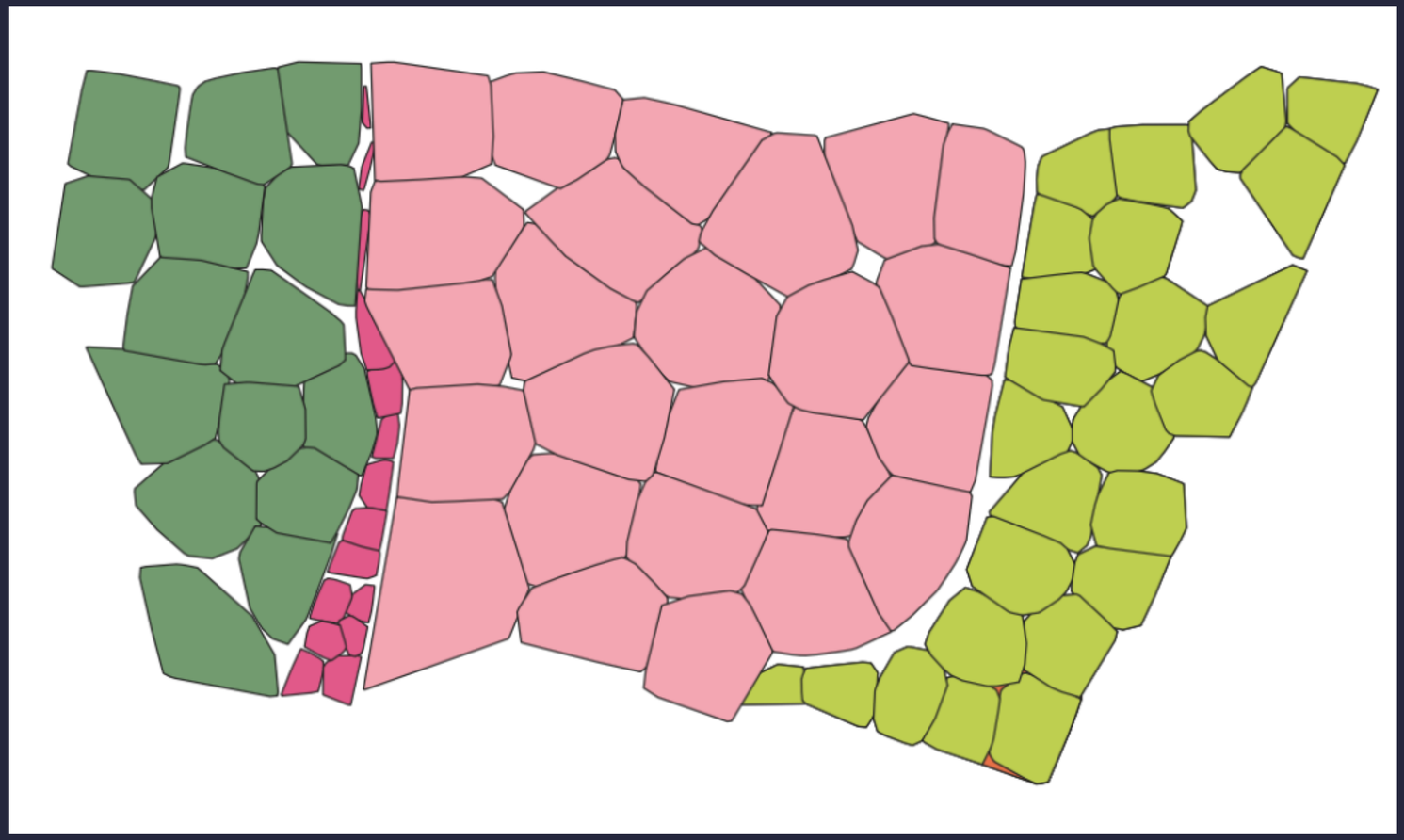
We have created 10 clusters per section for now but it can be made dynamic according to population density or other parameters.

```
clusters AS (
  SELECT ST_ClusterKMeans(geom, 10) OVER () AS cid, geom
  FROM polbuild
)
select polbuild.geom,cid from polbuild join clusters on
st_contains( polbuild.geom, clusters.geom) group by cid, polbuild.geom;
```

Drawing boundary of task area

```
polycluster AS(
select polbuild.geom,cid from polbuild join clusters on
 st_contains( polbuild.geom, clusters.geom) group by cid, polbuild.geom),
 polyboundary AS (
  SELECT ST_ConvexHull(ST_Collect(polycluster.geom)) AS geom
  FROM polycluster group by cid
)
SELECT polyboundary.geom
FROM polyboundary;
```

Outputs:



Limitations

- Number of clusters generated using k-means clustering is not dynamic.
- Lack of proper utilization of spatial indexing.
- Only a portion of the Area of Interest (AoI) has been divided into field mapping blocks.
- Mapping blocks are not 100% effective; portions of buildings can lie in multiple blocks.
- Effectiveness of the technique is not significant in sparsely populated areas.

Thank You