Aerial/Satellite Imagery Retrieval

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Introduction

- The task is to output an aerial/satellite image of an area given by a bounding box

- The inputs are two lat/long coordinates that represent the bounding box
  - The first lat/long is the top left corner of the bounding box
  - The second lat/long is the bottom right corner of the bounding box

- The output image needs to be the maximum resolution possible by the Bing Maps tile system

Background

- The Bing Maps Tile System uses the Mercator projection and divides the world map into 4 quadrants
  - At each additional level, each quadrant divides into 4 additional quadrants
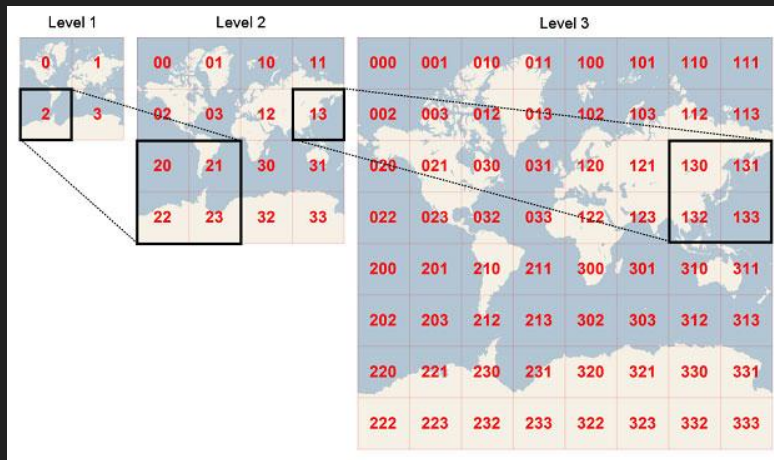
Background

- Each tile is 256 by 256 pixels, regardless of the level
  - For example, at level 3, the map is 8 by 8 tiles for a total of 2048 by 2048 pixels
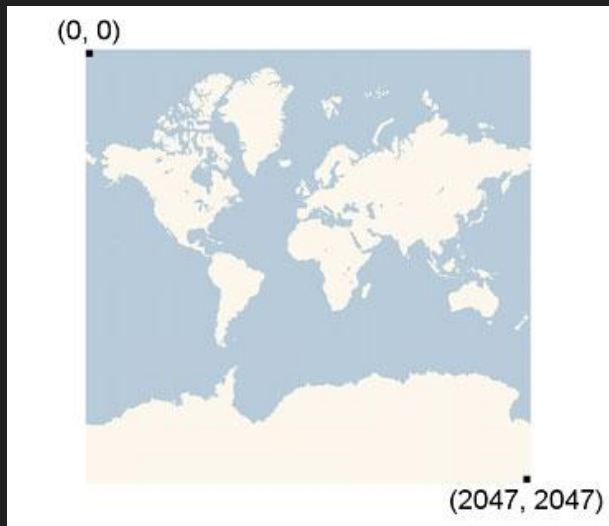
Approach

- The first step is to convert each lat/long coordinate into the pixel position on the maximum resolution image map

- The second step is to convert the pixel position into the tile position

- The third step is to convert the tile position into a quadrant key

- The fourth step is to download all images in the bounding box using its quadrant keys

- The last step is to stitch all tile images into one image

Approach

- The image from stitching all tiles together will be bigger than the bounding box

- To crop the image to the correct bounding box, we can use the pixel position that was calculated earlier as an offset

- On the next slide is an example of the crop
  - The two red dots are the lat/long coordinates for the bounding box
  - The blue lines indicate different tiles
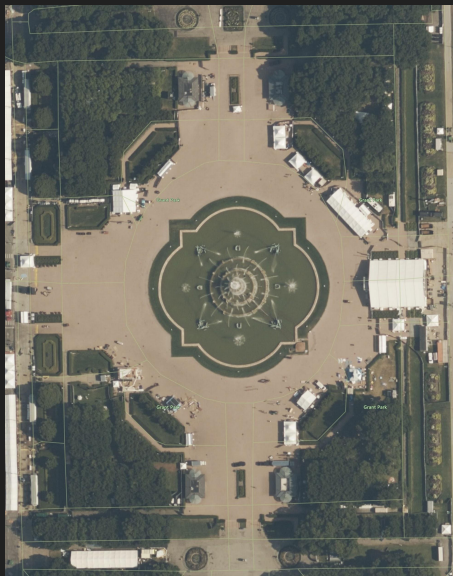
Approach

Before Cropping
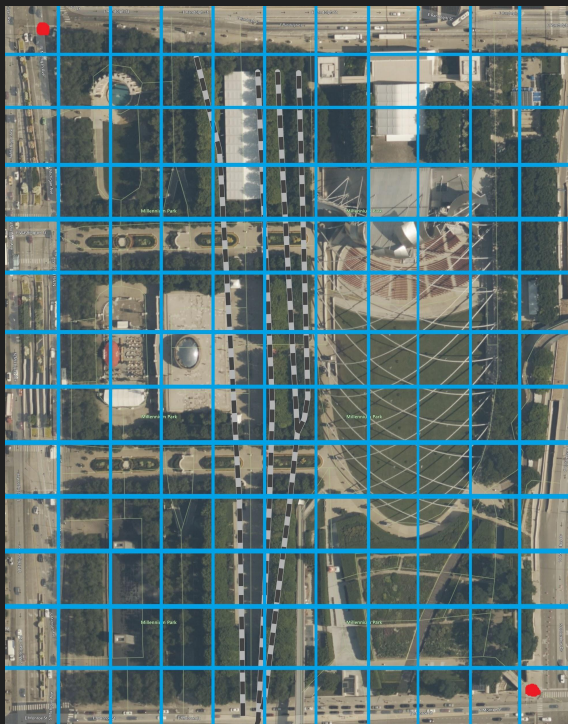
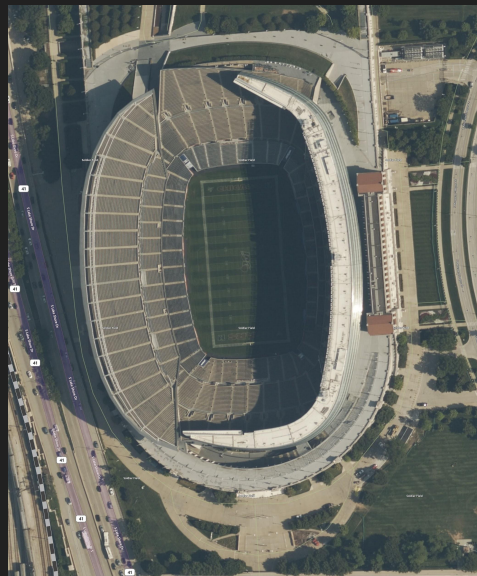After Cropping
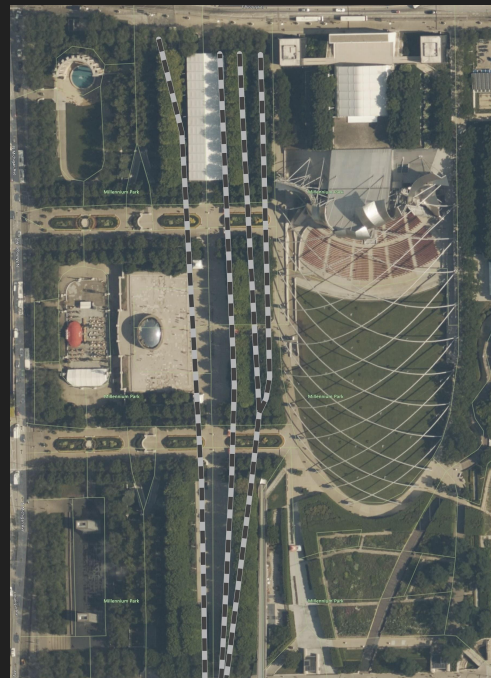
Results

Buckingham Fountain

41.87715, -87.62041
41.87441, -87.61754

Cloud Gate (The Bean)

41.88429, -87.62421
41.88095, -87.62099

Soldier Field

41.86386, -87.61861
41.86037, -87.61472

Results

Bahá'í House of Worship

42.07515, -87.68553
42.07379, -87.68311

Wrigley Field

41.94910, -87.65732
41.94723, -87.65369

White House

38.89872, -77.03937
38.89517, -77.03375

Conclusion

- Bing Map Tile System allows us to convert lat/long coordinates into tile quadrant keys

- Quadrant keys can be used to download specific tile images

- The Bing Map Tile System allows us to find a pixel offset of where a lat/long coordinate is on a tile
  - This offset can help us crop the final stitched image to perfectly match the bounding box

References

- Bing Maps Tile System Documentation
https://docs.microsoft.com/en-us/bingmaps/articles/bing-maps-tile-system