Grain Harvesting Optimization

Objective
Use combine-collected data to analyze crop fields and develop an algorithm to optimally harvest any given field.

Motivating Questions
- What variables are integral in optimizing a path?
- How do we consider a path to be optimal?
- Are crops traditionally harvested in a specific manner we can add to our algorithm?

Early Methodology
- Combines collect the following data:
  - Time stamps of every operation
  - Latitude/longitude coordinates
  - Elevation measured in feet
  - Owner/Operation ID to distinguish between fields

Field Size Estimation
- Calculating the area of a field is important to determine optimization space
- Conversions from latitude/longitude to pixels to kilometers

Further Methodology & Deliverables
Tableau Dashboard
- Interactive application for farmers to better understand the shape, size, and topography of their field(s)
  - Each field contains a vector orientations of headings, an elevation gradient, and color-coded operations

Google OR-Tools Path Algorithm
- Black and white field representation as input (white = harvesting area)
  - OpenCV library used to contour field and insert grid layout
  - Google OR-Tools functions optimize on shortest distance and elevation climbed

Conclusions
Next Steps and Future Goals
- Test Different Algorithmic Approaches
  - Bin-Packing: Harvest must be packed into a finite number of bins, minimizing the number of bins
  - Linear Programming: Use linear objective function to decompose problem into 2 dimensions and find an optimal outcome
  - Add customizations to Path Algorithm allowing farmers to customize route
- Consolidate Tableau and OR-Tools into single application for ease of use

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