Starry Night: Locating Stars from Pictures

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Goals

- Be able to place date/time/location of a photo taken of the night sky from that point
- Using machine learning, be able to easily identify the stars in the pictures with those contained in a star database
- Knowing the positioning of the stars, work backwards and find earth location capable of seeing that subset of stars
- Extra: With our machine learning algorithm, be able to detect astronomical anomalies such as asteroids, or use it to eliminate bad data when deviations from expected are seen.

Method

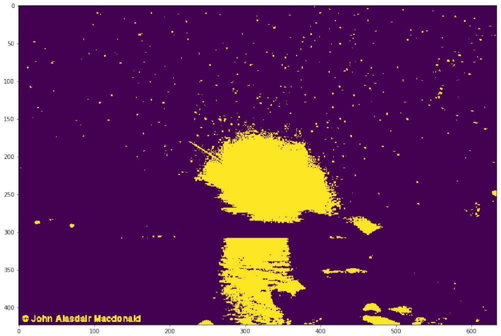
We assumed a clear night, with a camera of 8 megapixels, FOV 10 degrees.

Step 1: Identify all stars in an image as bright spots

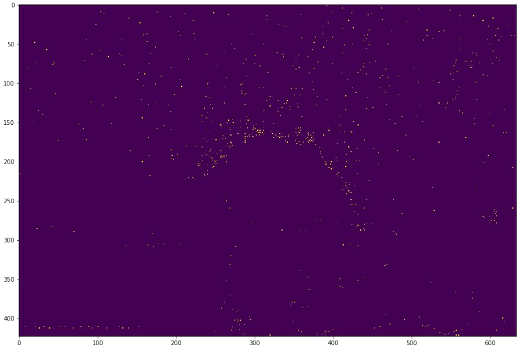
Step 2: Find a database of stars against which to compare our observed values

Original Image

Greyscale



Thresholding for all light sources



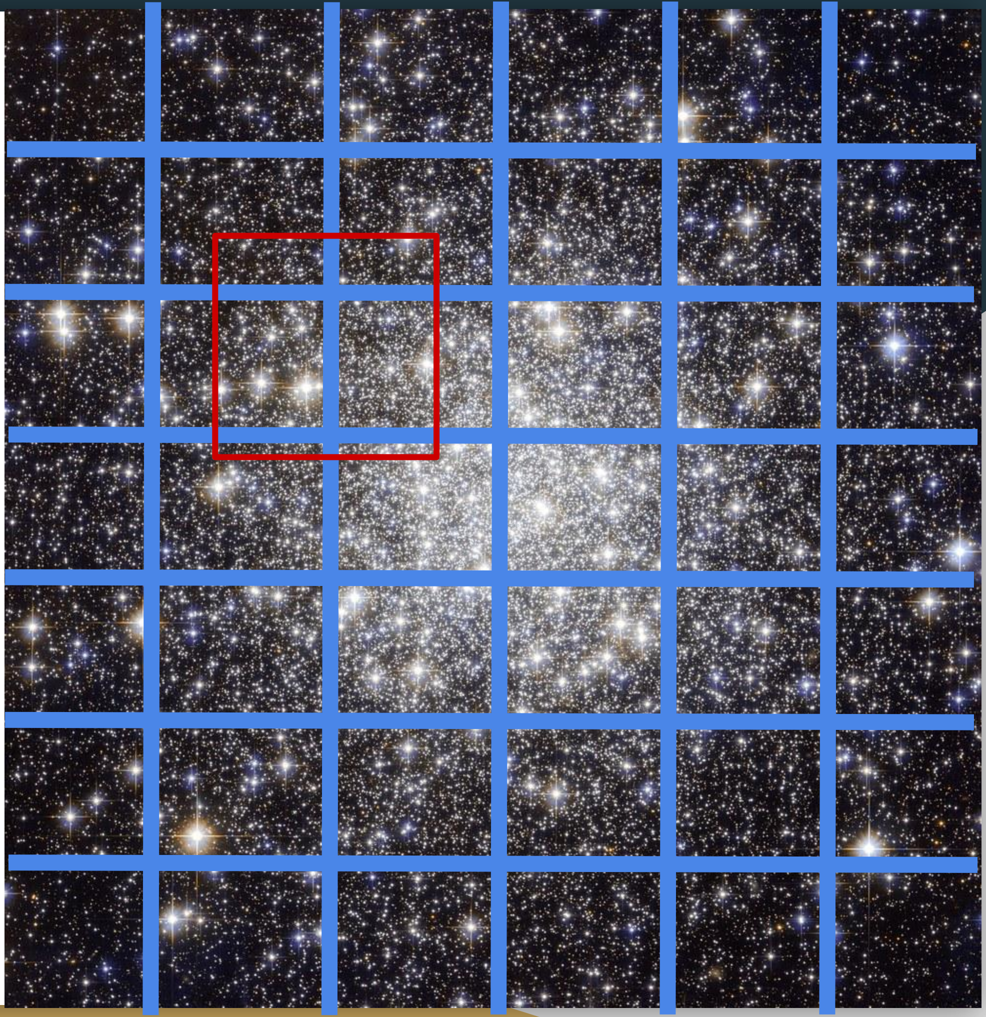
Filtering for stars

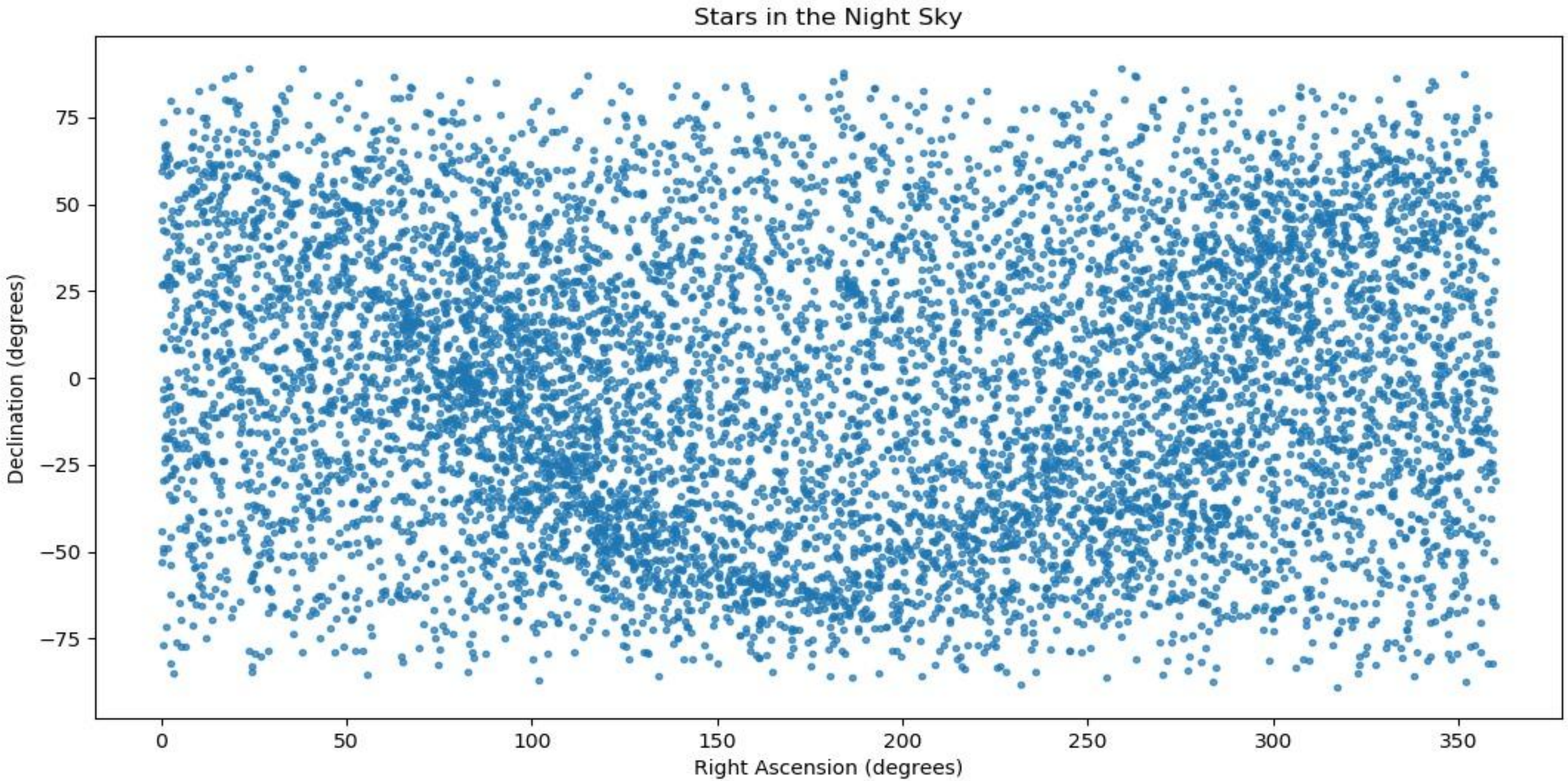
Step 3: The most difficult part

How do we compare our small picture with the entirety of the night sky?

Teach an AI, of course!

We instructed our AI by feeding back samples of our mastermap of the night sky, then training it on skewed versions of those same samples in order to account for imperfect photos. Finally, we tested it against sample data taken from stellarium to see if it would be able to accurately place our photo in the night sky





Our master map against which we compare all our data. Each point represents a star, the x-axis is the right ascension (looking east or west), and y-axis is declination (looking above the horizon).

Workflow

Photo of night sky

Identify Stars

Measure distances between stars

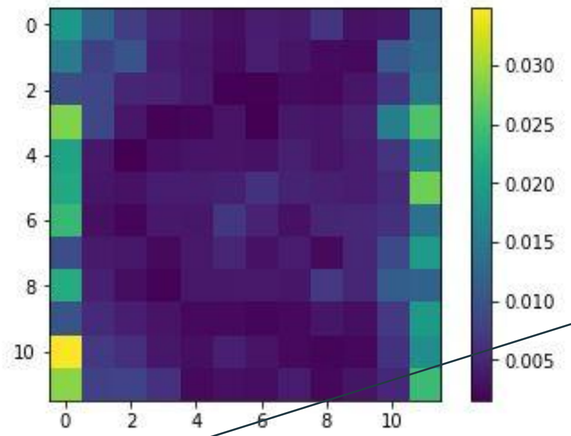
Feed image into AI

See probability map of locations

Using distance, find best candidate

???

Profit!



Actual location of image in night sky

(9, 11)

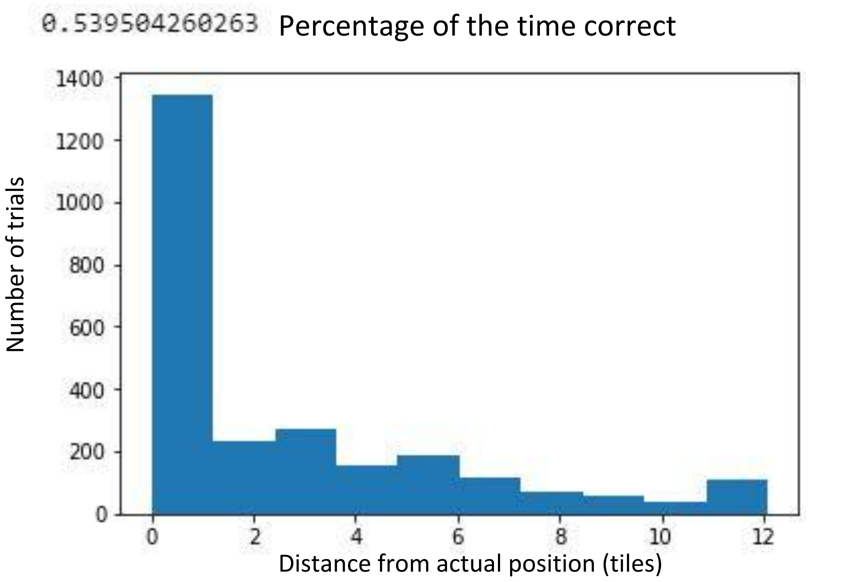
11.045361017187261

Distance between predicted and actual

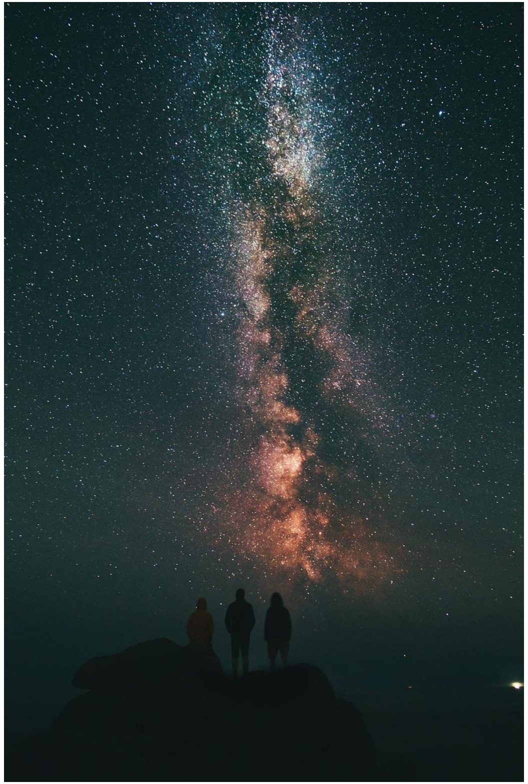
Results

Our AI, on 2,500 training samples, was correct in placing the position in the night sky (segmented into 144 pieces) 50% of the time!

Most errors were very small, with most that were missing the mark falling within two boxes of our actual position.



Setbacks



Our goals changed about 6 hours in, as we realized that creating the AI to identify the subset of stars would be a huge venture and to be able to walk backwards from our given subset to find an earth location could only come once we'd actually made our AI work.

Given that this was everyone's first time working with machine learning, we had a hard time learning while doing, especially when even the terminology to explain the concepts was foreign to us.

For most of us it was our first time coding as a group, and working with other people's code. Different coding styles led to bottlenecks of trying to make ourselves be understood in order to continue working

Moving Forward

What else could we do with this code?

- Develop the AI to be able to map any input image of the night sky, no matter the noise or interfering signals
- Keep track of all the stars in order to name the stars in the pictures, and identify constellations
- Expand the use of the image recognition AI to MRIs and brain scans, being able to accurately name every body part in a scan
- Finish the initial project of finding earth date/time/location of picture
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