Detecting Meteors Within Spectrographs With Machine Learning

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What do I Propose to do?

- My project proposes to introduce a machine learning model to identify and mark meteors within spectrographs that can be continuously trained with new data so that accuracy can be continually improved.

Why am I Proposing this?

- There is no accurate automated method for detecting meteors within spectrographs that are generated by BRAMS (Belgian RAdio Meteor Stations).
  - There is an OpenCV implementation that was created but it has not been maintained for over 2 years and its accuracy and effectiveness are unknown (it is also not well known).
- Large amounts of data are collected by BRAMS daily, roughly one spectrograph per minute per location, with roughly 30 locations within Belgium.
  - This data needs to be processed so that analysis can be conducted. By decreasing data processing times, more analysis can be done.

What has Already Been Done?

- This problem has already been solved! (Calders, 2019)
  - A feature detection algorithm has already been made, this can help guide my machine learning model implementation.
- Color salience has been shown to improve accuracy or feature detection. (Weijer & Bagdanov, 2006)
  - By attributing weight values to different colors, specifically those representing activity within spectrographs, meteors can be more accurately detected.
- Extensive research has been conducted on low end hardware efficiency for running real-time image processing. (Rosten & Drummond, 2006; Khan, Bennamoun, Sohel & Togneri, 2014)
  - This research can help propel a machine learning model's efficiency when run on cost effective hardware.

What do I Already Have?

- Machines for development and model training
- Access to a Kubernetes Cluster to run Kubeflow Pipelines
- Access to the Kubeflow Pipelines team for assistance with Kubeflow Pipelines
- Access to resources to learn Keras/Tensorflow and to create a machine learning model

What do I Need?

- Access to a large data set
  - Ideally this data set will already have meteors identified for each spectrograph
- Knowledge on how to use Keras/Tensorflow to create a machine learning model

What are Some Expected Roadblocks?

- Lack of data
- Data format
- Time
- Lack of knowledge regarding Keras/Tensorflow
- Motivation

Alternative Solutions

- Another solution would be to implement an OpenCV based feature detection algorithm
  - This would not provide a new medium for detecting meteors within spectrographs
  - Large improvements in efficiency can be made over the current implementation that was created by Stijn Calders (Calders, 2019)

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