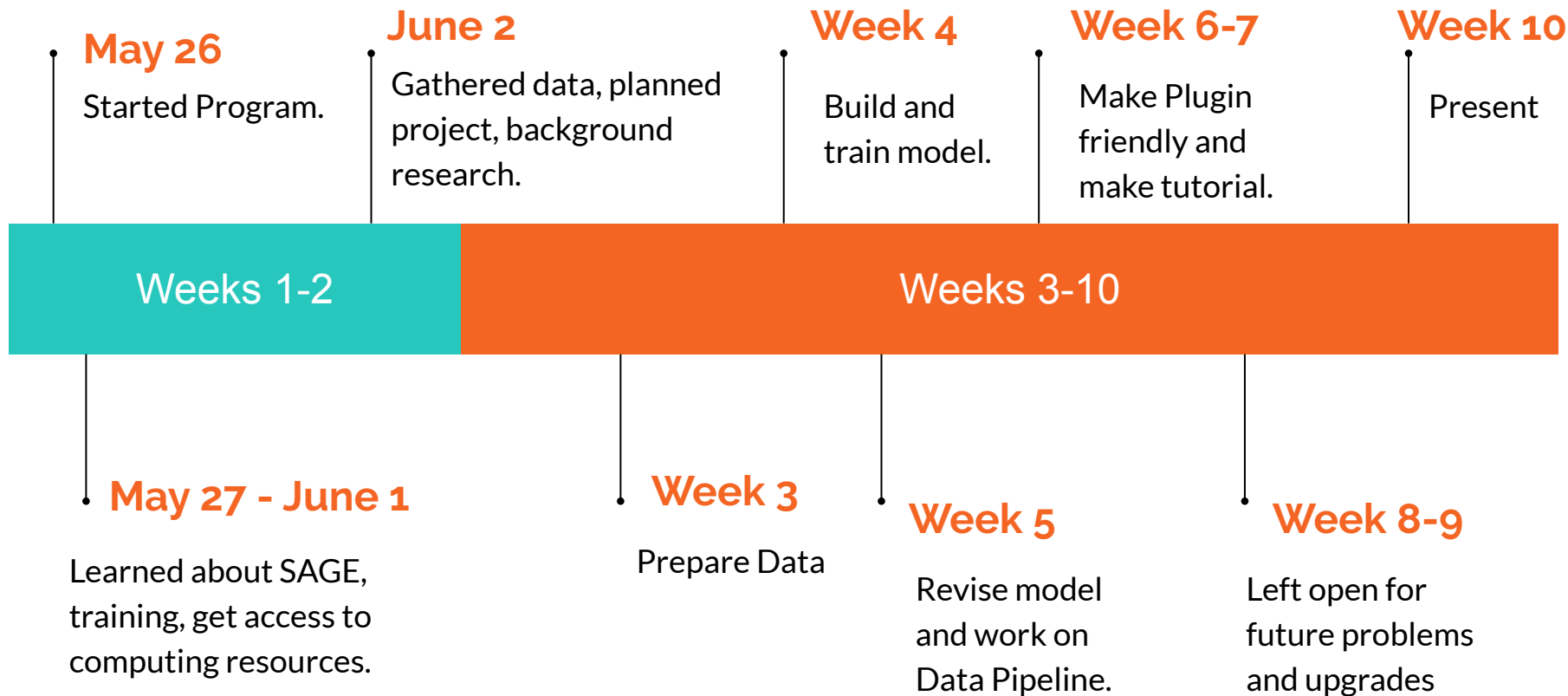

Argonne Summer 2020

Rick Nueve: Update Week 3 (Data Set)

Overview

- For ten weeks, I (Rick Nueve) am an intern at Argonne National Lab under the SAGE project.
- **MISSION STATEMENT:** My primary tasks are to design a Deep Learning model that uses images and FLIR images from a node, have the model be able to run on a node, and also to write a tutorial explaining to students how to make their programs be able to run on the nodes.

TimeLine



What was done between 5-11th of June?

1. Background research
2. Data set was made
3. Model proposal

1. Background Research

- Convergence of Edge Computing and Deep Learning: A Comprehensive Survey
- EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks
- Infrared and Visible Image Fusion using a Deep Learning Framework
- Shallow cumuli cover and its uncertainties from ground-based lidar–radar data and sky images
- OBSERVING CLOUDS IN 4D WITH MULTIVIEW STEREOGRAMMETRY
- Convolutional LSTM Network: A Machine Learning Approach for Precipitation Nowcasting
- Reflective all-sky thermal infrared cloud imager
- The Cumulus Parameterization Problem: Past, Present, and Future

2. Data Set

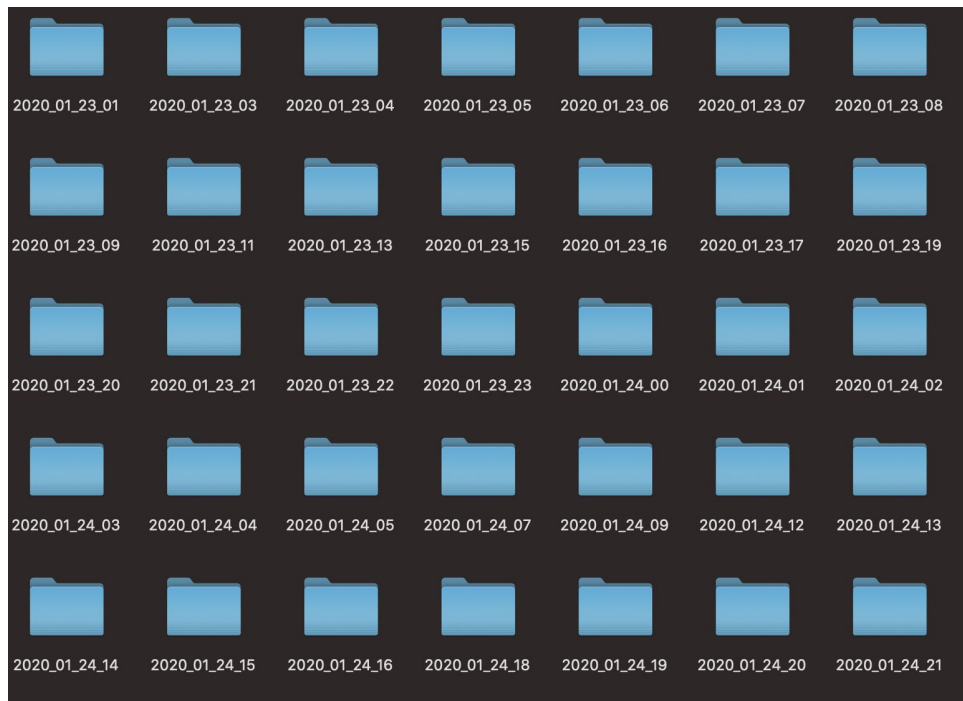
- How and where the data was fetched?

```
rsync -avPz --include="*/" --include="*:[0-5]0:01+00:00.jpg" --exclude='*'  
enueve@bebop.lcrc.anl.gov:/lcrc/project/waggle/public_html/private/training  
_data/aot_audio_and_images/good/001e06107d7f/* .
```

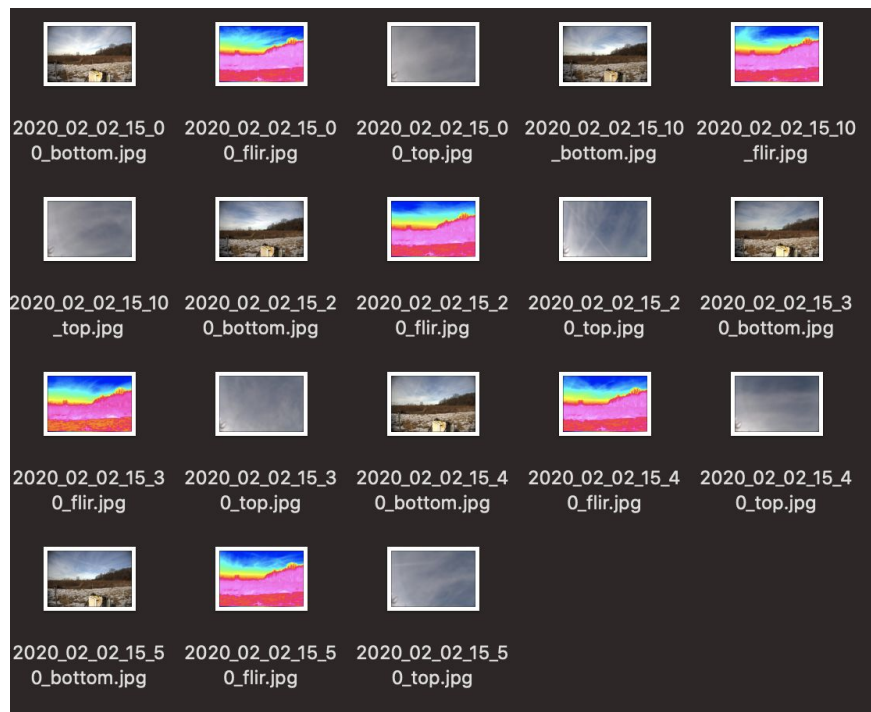
2. Data Set

- After cleaning the data, there is a total of 988 samples.
- A single sample corresponds to an hour period of photos where photos are taken every ten minutes.
- A single sample consists of 18 photos: 6 photos from the flir camera, 6 photos from the top facing camera, and 6 photos from the bottom facing camera.
- The final size of the dataset is 13.67 GB.

2. Example of sample



2. Example of sample



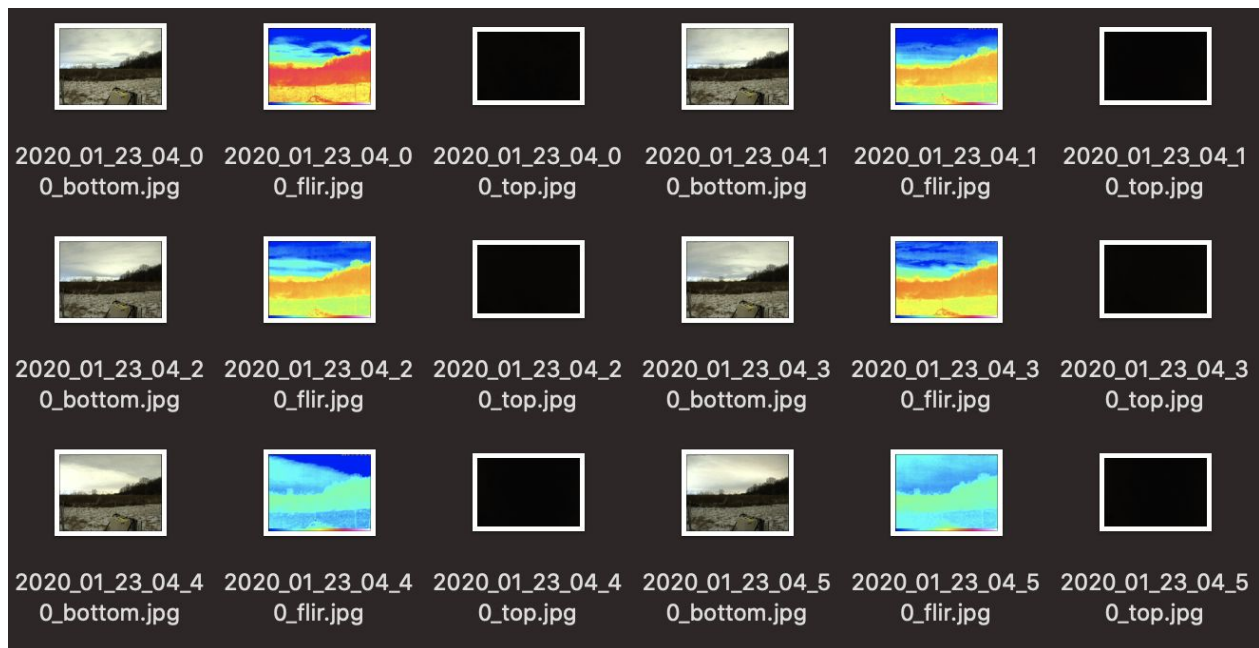
2. Target Values

- For each set of photos, I have the next hours corresponding weather information.
- The following are the values I have: Pasquill stability class, Average 60 m wind direction (scalar) (units: deg), Average 60 m wind speed (scalar) (units: m/s), Standard deviation of 60 m wind direction (units: deg), Average 60 m temperature (units: deg C), Average 10 m wind direction (scalar) (units: deg), Average 10 m wind speed (scalar) (units: m/s), Standard deviation of 10 m wind direction (units: deg), Average 10 m temperature (units: deg C), Average dew point temperature (units: deg C), Average relative humidity (units: %), Average temperature difference/100m (units: deg C/100m), Total precipitation (units: mm), Average solar radiation (units: Watts/m**2), Average net radiation (units: Watts/m**2), Average barometric pressure (units: kPa), Average water vapor pressure (units: kPa), Average 10 cm soil temperature (units: deg C), Average 100 cm soil temperature (units: deg C), Average 10 ft soil temperature (units: deg C).

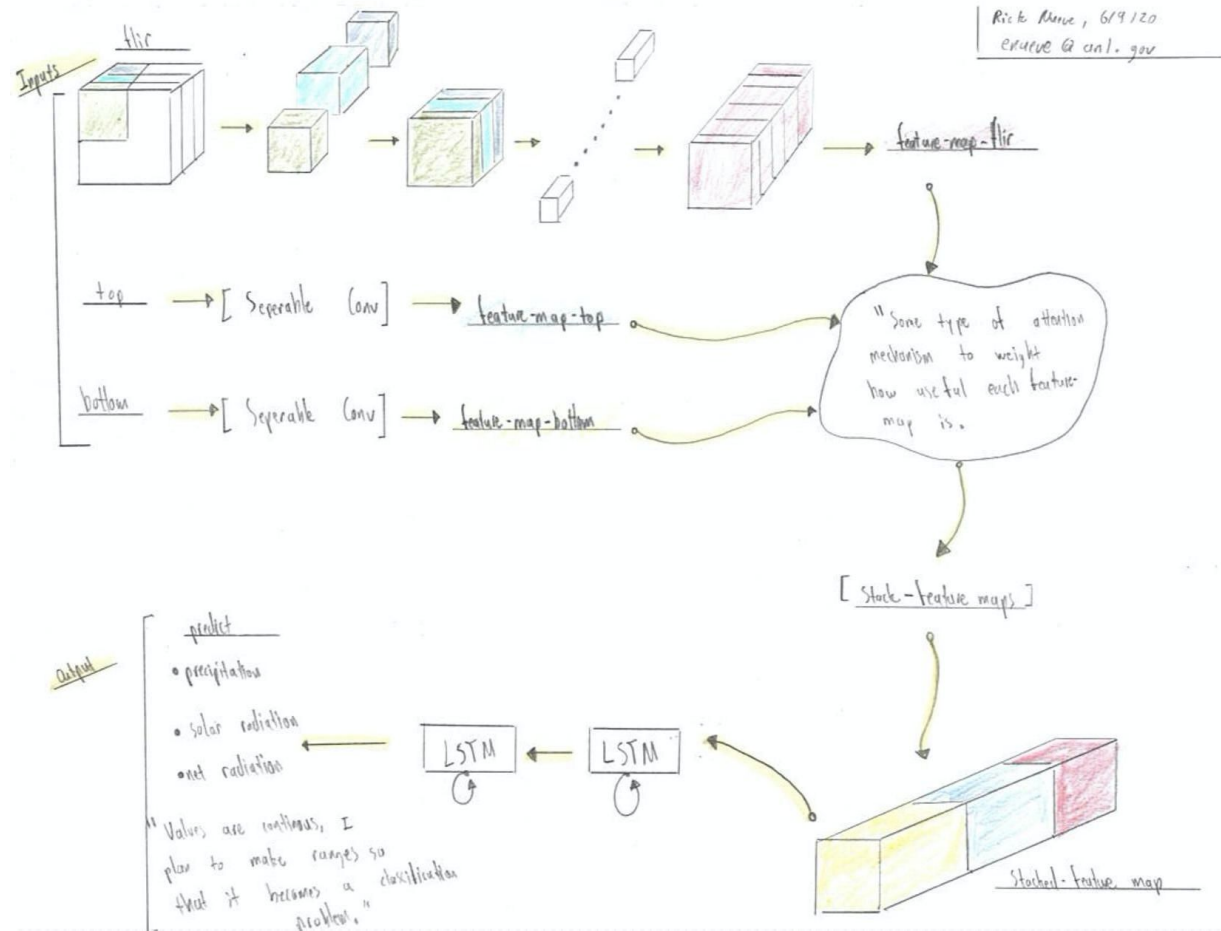
3. Aspects of the model

01	Edge Computing	<ul style="list-style-type: none">• Tf lite• Separable Convolutions (Mobile Net)• When deployed, data ideally is collected strictly sensors on the node.
02	Atmospheric Sciences	<ul style="list-style-type: none">• Clouds need to be an element of the model.• Nowcasting is a popular problem in weather forecasting.
03	Deep Learning	<ul style="list-style-type: none">• Uses multiple images as inputs• Will need to be able to forecast

3. Camera troubles



3. Model Diagram



3. Why this model?

- It's uses efficient separable convolutions which makes it edge computing friendly.
- It use flir images, top view, and bottom view images, as instructed.
- It has elements of clouds: top view of clouds, flir view of clouds, and the predicted values (precipitation or solar output) are traits of clouds.
- The complexity of the model is achievable for the limited time frame

Paper update

- I started the most important part of any paper, collecting quotes from other papers and the reference section.

1 Quotes from papers

It is important to remember that the objective of the Cumulus Parameterization Problem is to obtain a closed system for predicting weather and climate. [Ara04]

The goal of precipitation nowcasting is to predict the future rainfall intensity in a local region over a relatively short period of time. [Shi+15]

The problem I am working on is called a spatiotemporal sequence forecasting problem.[Shi+15]

The major drawback of FC-LSTM in handling spatiotemporal data is its usage of full connections in input-to-state and state-to-state transitions in which no spatial information is encoded.[Shi+15]

Convolutional Neural Networks (ConvNets) are commonly developed at a fixed resource budget, and then scaled up for better accuracy if more resources are available. [TL19]

References

- [Ara04] Akio Arakawa. “The Cumulus Parameterization Problem: Past, Present, and Future”. In: *Journal of Climate* 17.13 (2004), pp. 2493–2525. DOI: [https://doi.org/10.1175/1520-0442\(2004\)017<2493:RATCPP>2.0.CO;2](https://doi.org/10.1175/1520-0442(2004)017<2493:RATCPP>2.0.CO;2).
- [Shi+15] Xingjian Shi et al. *Convolutional LSTM Network: A Machine Learning Approach for Precipitation Nowcasting*. 2015. arXiv: 1506.04214 [cs.CV].
- [TL19] Mingxing Tan and Quoc V. Le. *EfficientNet: Rethinking Model Scaling for Convolutional Neural Networks*. 2019. arXiv: 1905.11946 [cs.LG].

Questions for the audience

1. What are your thoughts on the change of focus of cameras? (It reminds me of attention mechanisms could help with this issue)
2. Is there someone I could ask about this idea of weighting image inputs if one or more camera goes offline?
3. What are your thoughts on the model?
4. What are your thoughts on the target value of the model?

How to contact me

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