Argonne Summer 2020

A project plan for Rick Nueve

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.

Who is this “Rick” you speak of?

- I am a recent graduate of the class of 2020 from Northern Illinois University with a major in Mathematics focused in Statistics.
- My research background is in Deep Learning. I have worked with an array of Deep Learning models for tasks such as NLP, facial recognition, GNN node classification, and time-series classification.
- I hope to do my graduate thesis in the field of Quantum Probability.
- I desire to learn better ways to encode time-series in Deep Learning models.
- I hypothesize that Quantum Stochastic Integrals, a topic in Quantum Probability, could be used to create state of the art Recurrent Networks.

What is currently known

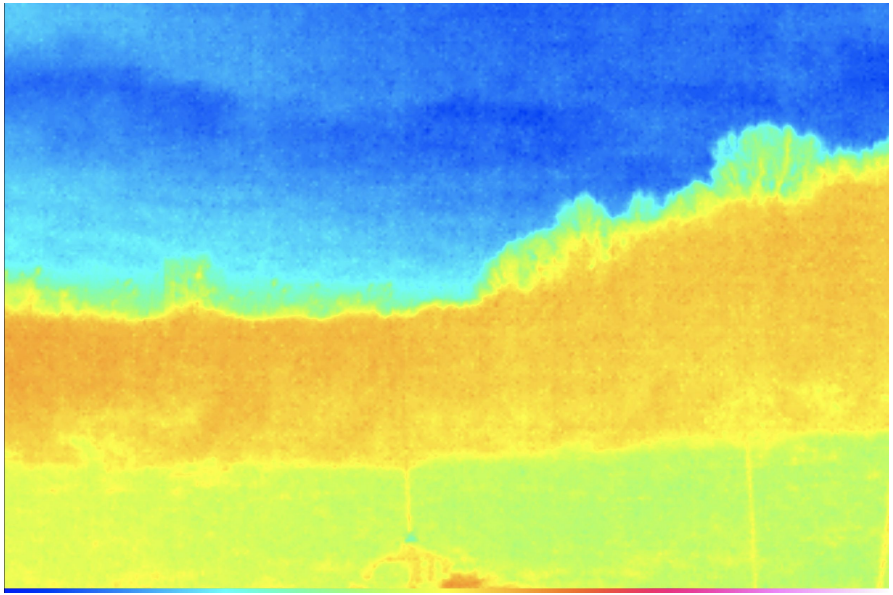
- I know that I will design a program that uses Deep Learning, which uses at least normal images and FLIR images as inputs.
- I currently have eight full weeks left in the program.
- *I want to make a short paper out of this research project.*

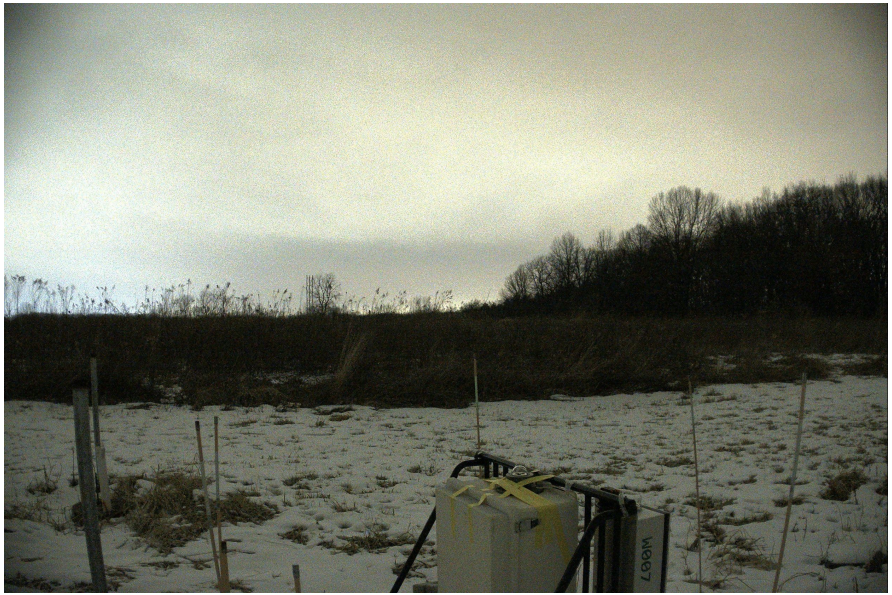
Current information about the data

- Currently, I have access to the images and FLIR images from the node “001e06107d7f“ located on the Argonne Laboratory property.
- The cameras on the node take pictures every minute.
- I have access to images from January 23, 2020 to the present.

Node: 001e06107d7f

Example of Images





Current information about the data

- I also have hourly weather data from another sensor located on the Argonne property dating back from January 2020 to April 2020.
- I possibly may be able to get the temperature values of each pixel from the FLIR images. However, I can't guarantee that can happen. That will be only possible if the camera had particular settings enabled where the raw thermal values were being saved.

Example of Weather Data

**Currently being formatted.*

1 jan 2020

	60	m			10 m					10 cm		1 m	10 ft						
	AIR	WIND		WIND	SIGMA	REL	DEW	AIR	WIND	WIND	SIGMA	SOIL	SOIL	SOIL	BAROM	GLOB	NET	PRCP	z/L	STABL
TIME	TEMP	SPEED		DIR	DIR	HUM	POINT	TEMP	SPEED	DIR	DIR	TEMP	TEMP	TEMP	PRESS	RAD	RAD	TOTL		CLASS
CST	C	cm/s		deg	deg	%	C	C	cm/s	deg	deg	C	C	C	kPa	W/m2	W/m2	mm		
100	-3.7	612.		263	7.9	89.	-5.2	-3.6	428.	262.	11.1	2.1	5.6	9.6	98.69	0	-53	0.0	0.00	D
200	-4.3	489.		259	7.7	91.	-5.7	-4.2	357.	258.	10.6	2.1	5.6	9.6	98.67	0	-52	0.0	0.02	*D
300	-4.8	454.		252	6.3	92.	-6.2	-4.8	308.	253.	7.8	2.1	5.6	9.6	98.69	0	-46	0.0	0.01	D
400	-5.2	517.		248	5.9	94.	-6.4	-5.3	345.	249.	7.6	2.0	5.6	9.6	98.67	0	-40	0.0	0.00	D
500	-5.5	548.		251	5.0	93.	-6.9	-5.6	372.	254.	7.7	2.0	5.6	9.6	98.66	0	-38	0.0	0.00	D
600	-5.7	574.		249	6.4	93.	-7.1	-5.8	384.	251.	8.0	2.0	5.6	9.6	98.65	0	-35	0.0	0.00	D
700	-5.8	578.		235	7.9	94.	-7.3	-6.1	359.	241.	8.2	1.9	5.6	9.6	98.65	0	-33	0.0	0.00	D
800	-5.3	474.		215	5.9	97.	-6.6	-5.8	284.	210.	11.1	1.9	5.6	9.6	98.62	41	-12	0.0	0.00	D
900	-4.6	452.		203	9.5	94.	-5.6	-4.6	330.	202.	11.4	1.9	5.6	9.6	98.67	235	28	0.0	-0.01	C
1000	-3.2	493.		197	9.8	88.	-4.5	-2.9	420.	199.	12.8	1.9	5.6	9.6	98.71	413	131	0.0	-0.10	B
1100	-1.2	577.		198	10.5	79.	-3.6	-0.7	513.	200.	11.6	1.8	5.6	9.6	98.72	479	181	0.0	-0.10	C
1200	1.0	694.		205	9.0	64.	-4.3	1.6	570.	207.	12.2	1.8	5.6	9.6	98.63	461	208	0.0	-0.04	C
1300	2.8	759.		206	9.3	58.	-3.7	3.4	611.	208.	12.6	1.8	5.6	9.6	98.54	444	227	0.0	-0.02	D
1400	3.9	795.		205	9.2	59.	-2.5	4.5	612.	208.	13.6	1.8	5.6	9.6	98.44	380	204	0.0	-0.01	D
1500	4.8	787.		191	9.8	62.	-1.2	5.3	605.	194.	12.6	1.8	5.6	9.6	98.38	272	143	0.0	-0.01	D
1600	5.1	821.		189	9.1	64.	-0.5	5.4	590.	193.	12.1	1.7	5.6	9.6	98.35	130	44	0.0	0.00	D
1700	4.4	793.		186	9.7	72.	0.3	4.5	535.	193.	12.7	1.7	5.6	9.6	98.28	16	-30	0.0	0.00	D
1800	4.0	787.		193	9.2	76.	0.5	4.1	528.	201.	12.7	1.7	5.6	9.6	98.23	0	-34	0.0	0.00	D
1900	4.1	842.		192	9.8	75.	0.4	4.2	547.	199.	13.2	1.7	5.6	9.6	98.17	0	-38	0.0	0.00	D
2000	4.6	912.		192	9.5	71.	0.1	4.6	610.	199.	12.1	1.7	5.6	9.6	98.14	0	-34	0.0	0.00	D
2100	4.9	916.		195	10.0	65.	-0.8	4.9	615.	201.	12.5	1.6	5.6	9.6	98.13	0	-38	0.0	0.00	D
2200	5.1	917.		198	9.5	61.	-1.4	5.1	634.	201.	12.2	1.6	5.6	9.6	98.12	0	-40	0.0	0.00	D
2300	4.6	864.		201	9.5	62.	-1.7	4.7	610.	206.	12.9	1.6	5.6	9.6	98.10	0	-42	0.0	0.00	D
2400	4.5	873.		203	9.4	62.	-1.9	4.5	617.	205.	12.5	1.6	5.6	9.6	98.06	0	-43	0.0	0.00	D
Mean	0.2	688.			8.2	77.	-3.4	0.3	491.		11.5	1.8	5.6	9.6	98.46	120	23	0.0^	-0.01	
Vecto	r Wind	625.		209				446.	212.											

What I currently don’t know

- I don’t know what value the Deep Learning model should predict!
- I don’t know what kind of model would be of use to the scientific community.
- However, I do have some starting ideas.

Current Ideas

IDEA 1: Have images and FLIR images go into a CNN-LSTM model and try to forecast future precipitation. The target values would be whether or not there was rain or snow in the next period (ex: hour, day, … etc).

Pro: The data preparation of the photos would be limited.

Con: I don't know how informative just the two photos would be for predicting future weather precipitation.

Current Ideas

IDEA 2: Have images and FLIR images go into a FCN and classify where on the screen snow and clouds are located.

Pros: The model itself would be easy to make. I have images from the months January and February with snow and images from March and April that have clouds.

Cons: The data preparation would be extremely time consuming. I would most likely have to use a paid service that does the labeling due to my limited time.

Let's talk about that paper. (Rick needs to get into Grad School)

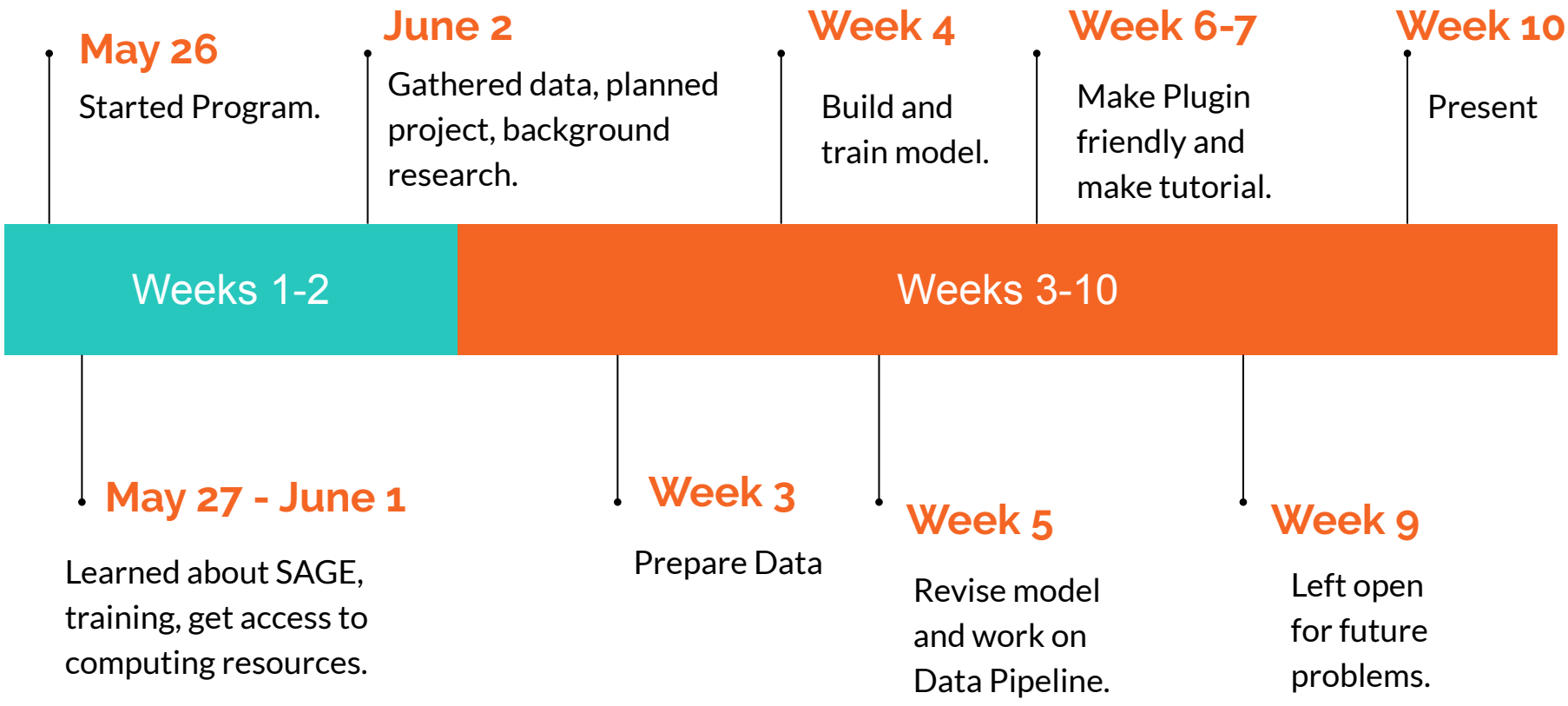
- The paper's topic is Edge Computing, Atmospheric Science, and Deep Learning.
- I personally don't have experience at this time in Edge Computing or Atmospheric Science. These are areas where guidance would be greatly appreciated.
- Any suggestions for conferences would be greatly appreciated.
- Some conferences I've found that might fit this kind of topic are:
    - International Conference on Edge Computing
    - Conference on Artificial Intelligence for Environmental Science
    - PAISE 2021? (I hear they have great workshop leaders!)

Link to view paper: https://www.overleaf.com/read/bygrxjcgxdbd (currently blank)

Questions for the audience

1. What are your overall thoughts on the project?
2. What additional uses could the FLIR images provide?
3. How could this project be of use to the Atmospheric Science community?
4. Do people have any current knowledge or resources about the topic of Deep Learning for Atmospheric Sciences?
5. What kind of value should the Deep Learning model predict/classify?
6. If I went down the path of using an FCN for semantic classification, how could I go about getting sample images labeled?
7. How can I get started learning about how to make a docker image for a node?
8. Any ideas on how to get this project structured for the goals of a publication?

TimeLine


May 26
Started Program.
June 2
Gathered data, planned project, background research.
Week 4
Build and train model.
Week 6-7
Make Plugin friendly and make tutorial.
Week 10
Present
Weeks 1-2
Weeks 3-10
May 27 - June 1
Learned about SAGE, training, get access to computing resources.
Week 3
Prepare Data
Week 5
Revise model and work on Data Pipeline.
Week 9
Left open for future problems.

How to contact me

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Also, check out my portfolio at: https://realestrick-c137.github.io/EnriqueNueve.github.io/index.html# .