GG3 - AUTONOMOUS EPHEMERIS PREDICTION USING NAVIGATION RECEIVERS

- GradientAscent - 9

Salient Features of FAS

- Flexible as compared to other deep learning approaches
- It is a generic model (Doesn’t have to be tuned for different parameters)
- Handles inconsistent timeline in input data
- Handles seasonality and anomalies in data
- Generates output even for 1 Day input data

predicted_prn_5_1 - Sheet1

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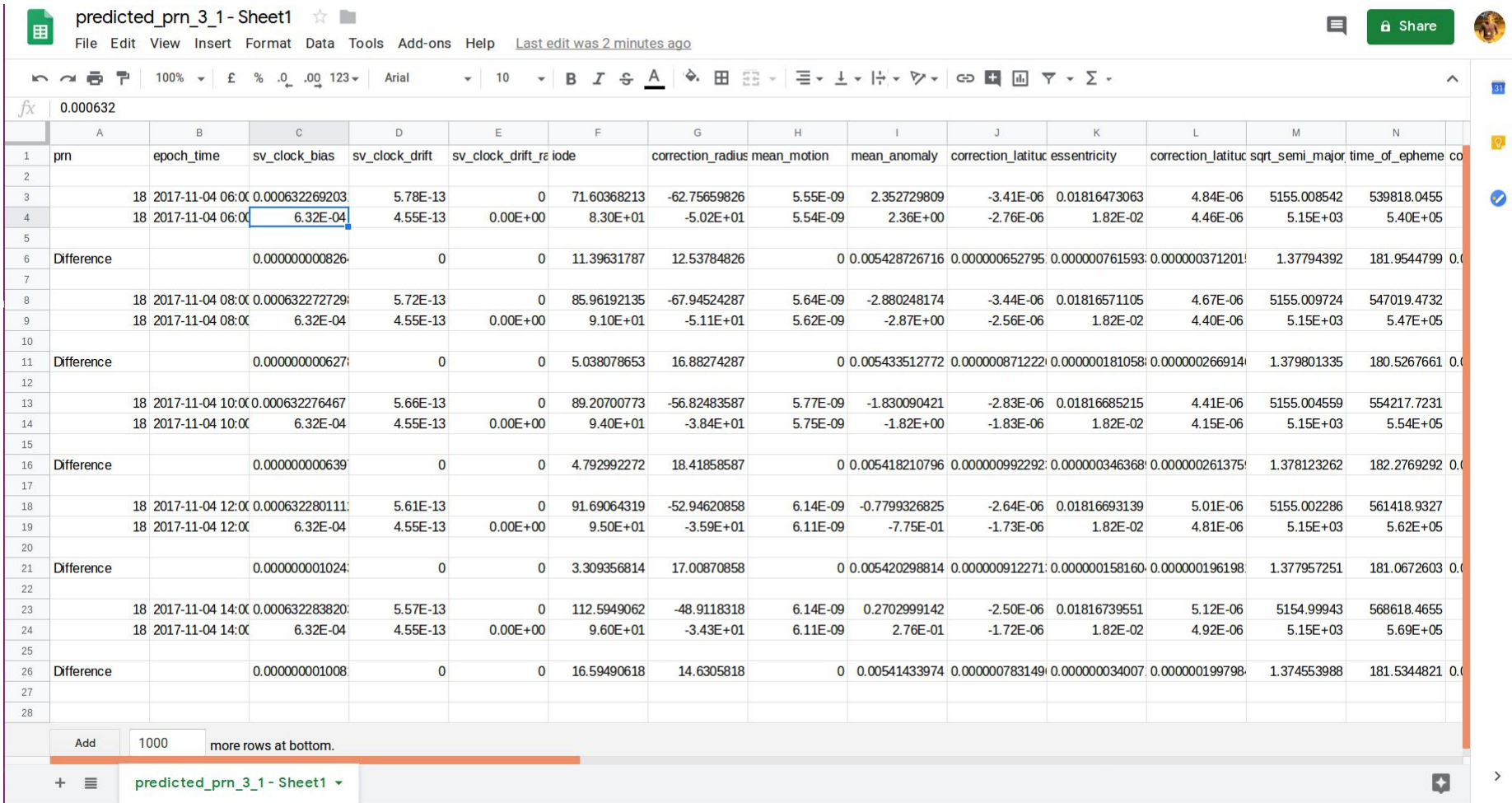
fx prn

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	prn	epoch_time	sv_clock_bias	sv_clock_drift	sv_clock_drift_ra	iode	correction_radius	mean_motion	mean_anomaly	correction_latituc	essentricity	correction_latituc	sqrt_semi_major	time_of_epheme	co
2															
3	2	2017-11-30 02:0(	0.000267997518	-9.89E-12	0	3.295421271	31.76731834	4.94E-09	-3.060212845	1.73E-06	0.01735524215	5.31E-06	5153.625338	290151.1662	
4	2	2017-11-30 02:0(	2.68E-04	-9.89E-12	0.00E+00	3.00E+00	2.98E+01	4.91E-09	-2.08E+00	1.59E-06	1.74E-02	5.66E-06	5.15E+03	3.53E+05	
5															
6	Difference		0.000000000134	0	0	0.2954212709	2.01731834	0	0.9792778181	0.000000135283	0.000000808725	0.000000354308	0.0030341543	62648.83376	0.(
7															
8	2	2017-11-30 04:0(	0.000267926010	-9.89E-12	0	9.627165223	43.20044016	5.24E-09	-2.031179722	2.53E-06	0.01735528316	5.89E-06	5153.626586	313070.8438	
9	2	2017-11-30 04:0(	2.68E-04	-9.89E-12	0.00E+00	4.80E+01	3.81E+01	5.18E-09	-1.03E+00	2.23E-06	1.74E-02	6.37E-06	5.15E+03	3.60E+05	
10															
11	Difference		0.000000000127	0	0	38.37283478	5.137940162	0	1.000358415	0.000000301805	0.000000864633	0.000000473947	0.00149242012	46929.1562	0.(
12															
13	2	2017-11-30 06:0(	0.000267855270	-9.89E-12	0	15.12269769	42.07915776	5.32E-09	-1.01959845	2.25E-06	0.01735490622	6.24E-06	5153.624643	334000.8591	
14	2	2017-11-30 06:0(	2.68E-04	-9.89E-12	0.00E+00	8.30E+01	3.48E+01	5.26E-09	1.94E-02	1.91E-06	1.74E-02	6.64E-06	5.15E+03	3.67E+05	
15															
16	Difference		0	0	0	67.87730231	7.266657758	0	1.038965049	0.000000344955	0.000000891778	0.000000403776	0.000709308650	33199.14089	0.(
17															
18	2	2017-11-30 19:5(	0.000267360349	-9.89E-12	0	-29.63483611	49.67203669	5.19E-09	-0.1485604375	2.51E-06	0.01735589085	7.01E-06	5153.623428	461910.8198	
19	2	2017-11-30 19:5(	2.67E-04	-9.89E-12	0.00E+00	4.00E+00	3.58E+01	5.08E-09	1.09E+00	1.83E-06	1.74E-02	7.86E-06	5.15E+03	4.18E+05	
20															
21	Difference		0.000000001386	0	0	33.63483611	13.89078669	0.000000000108	1.233645167	0.000000672674	0.000001533556	0.000000846702	0.00431069084	44326.81985	0.(
22															
23	2	2017-11-30 21:5(	0.000267289721	-9.89E-12	0	-30.55762191	44.71907733	4.91E-09	0.8681006706	2.12E-06	0.01735589484	6.63E-06	5153.629579	478662.5245	
24	2	2017-11-30 21:5(	2.67E-04	-9.89E-12	0.00E+00	5.00E+00	3.56E+01	4.84E-09	2.14E+00	1.67E-06	1.74E-02	7.47E-06	5.15E+03	4.25E+05	
25															
26	Difference		0.000000001539	0	0	35.55762191	9.156577328	0	1.26718008	0.000000453057	0.000001597850	0.000000838967	0.0013018071	53878.52453	0.(
27															
28	2	2017-12-01 00:0(	0.000267218559	-9.89E-12	0	-31.24119417	51.61672748	4.85E-09	0.6476641422	2.74E-06	0.0173549873	6.52E-06	5153.627742	373190.9466	
29	2	2017-12-01 00:0(	2.67E-04	-9.89E-12	0.00E+00	6.00E+00	4.12E+01	4.78E-09	-3.10E+00	2.15E-06	1.74E-02	7.38E-06	5.15E+03	4.32E+05	
30															

predicted_prn_5_1 - Sheet1



predicted_prn_3_1 - Sheet1

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fx 0.000632

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	
1	prn	epoch_time	sv_clock_bias	sv_clock_drift	sv_clock_drift_ra	iode	correction_radius	mean_motion	mean_anomaly	correction_latituc	essentricity	correction_latituc	sqrt_semi_major	time_of_epheme	co
2															
3	18	2017-11-04 06:0(	0.000632269203	5.78E-13	0	71.60368213	-62.75659826	5.55E-09	2.352729809	-3.41E-06	0.01816473063	4.84E-06	5155.008542	539818.0455	
4	18	2017-11-04 06:0(	6.32E-04	4.55E-13	0.00E+00	8.30E+01	-5.02E+01	5.54E-09	2.36E+00	-2.76E-06	1.82E-02	4.46E-06	5.15E+03	5.40E+05	
5															
6	Difference		0.000000000826	0	0	11.39631787	12.53784826	0	0.005428726716	0.000000652795	0.000000761593	0.000000371201	1.37794392	181.9544799	0.(
7															
8	18	2017-11-04 08:0(	0.000632727293	5.72E-13	0	85.96192135	-67.94524287	5.64E-09	-2.880248174	-3.44E-06	0.01816571105	4.67E-06	5155.009724	547019.4732	
9	18	2017-11-04 08:0(	6.32E-04	4.55E-13	0.00E+00	9.10E+01	-5.11E+01	5.62E-09	-2.87E+00	-2.56E-06	1.82E-02	4.40E-06	5.15E+03	5.47E+05	
10															
11	Difference		0.000000000627	0	0	5.038078653	16.88274287	0	0.005433512772	0.000000871222	0.000000181058	0.000000266914	1.379801335	180.5267661	0.(
12															
13	18	2017-11-04 10:0(	0.000632276467	5.66E-13	0	89.20700773	-56.82483587	5.77E-09	-1.830090421	-2.83E-06	0.01816685215	4.41E-06	5155.004559	554217.7231	
14	18	2017-11-04 10:0(	6.32E-04	4.55E-13	0.00E+00	9.40E+01	-3.84E+01	5.75E-09	-1.82E+00	-1.83E-06	1.82E-02	4.15E-06	5.15E+03	5.54E+05	
15															
16	Difference		0.000000000639	0	0	4.792992272	18.41858587	0	0.005418210796	0.000000992292	0.000000346368	0.000000261375	1.378123262	182.2769292	0.(
17															
18	18	2017-11-04 12:0(	0.000632280111	5.61E-13	0	91.69064319	-52.94620858	6.14E-09	-0.7799326825	-2.64E-06	0.01816693139	5.01E-06	5155.002286	561418.9327	
19	18	2017-11-04 12:0(	6.32E-04	4.55E-13	0.00E+00	9.50E+01	-3.59E+01	6.11E-09	-7.75E-01	-1.73E-06	1.82E-02	4.81E-06	5.15E+03	5.62E+05	
20															
21	Difference		0.000000001024	0	0	3.309356814	17.00870858	0	0.005420298814	0.000000912271	0.000000158160	0.000000196198	1.377957251	181.0672603	0.(
22															
23	18	2017-11-04 14:0(	0.000632283820	5.57E-13	0	112.5949062	-48.9118318	6.14E-09	0.2702999142	-2.50E-06	0.01816739551	5.12E-06	5154.99943	568618.4655	
24	18	2017-11-04 14:0(	6.32E-04	4.55E-13	0.00E+00	9.60E+01	-3.43E+01	6.11E-09	2.76E-01	-1.72E-06	1.82E-02	4.92E-06	5.15E+03	5.69E+05	
25															
26	Difference		0.000000001008	0	0	16.59490618	14.6305818	0	0.00541433974	0.000000783149	0.000000034007	0.000000199798	1.374553988	181.5344821	0.(
27															
28															

Add 1000 more rows at bottom.

predicted_prn_3_1 - Sheet1

```
     2.10           N: GPS NAV DATA                         RINEX VERSION / TYPE
Convert v1.7.0                          08-May-18 09:05     PGM / RUN BY / DATE
    0.1211D-07 -0.7451D-08 -0.1192D-06  0.5960D-07          ION ALPHA
    0.9626D+05 -0.3277D+05 -0.1966D+06  0.1966D+06          ION BETA
     .279396772385D-08  .355271367880D-14   405504     1973 DELTA-UTC: A0,A1,T,W
    18                                                      LEAP SECONDS
                                                            END OF HEADER
  12 17 11 30 02 00 00.0  0.0003625981581427391  -1.70530256582e-12  0.000000000000e+00
       107.00000319695023  -76.31605485534337  4.0215288062138 83e-09  2.534432827390e+00
       -4.057160024332629e-06  0.006617026285572857  6.023231305994772e-06  5.153684907734e+03
       352797.5775868568  -7.067894731528501e-08  -1.5313029558336004  -1.014777631176e-07
       0.9878014838228273  278.8088929663703  0.907610701476305  -7.884314952802e-09
       -4.40688384313311e-10  1.0  1977.0110433351294  0.000000000000e+00
       0.5034602241876274  0.0  -1.25728547573e-08  1.043582591856e+02
       258064.85895569343  0.0
  12 17 11 30 03 59 44.0  0.0003625 8635194029876  -1.70530256582e-12  0.000000000000e+00
       66.25000608065083  -86.10433809504296  4.133865818169284e-09  -2.700850411814e+00
       -4.3936740088303664e-06  0.0066190788608932885  6.088550045503128e-06  5.153677815405e+03
       359987.4022571082  4.329877347365081e-08  -1.5303228486016731  -1.240228663633e-07
       0.9877969012798825  280.8338888288545  0.9075878672542834  -7.932939950855e-09
       -3.85213784036921 54e-10  1.0  1977.0068511359855  0.000000000000e+00
       0.023663580534991777  0.0  -1.25728547573e-08  6.318625073025e+01
       279329.8134114439  0.0
  12 17 11 30 06 00 00.0  0.0003625743424524591  -1.70530256582e-12  0.000000000000e+00
       68.84391797762703  -86.19369642632861  4.159640679418777e-09  -1.648286092851e+00
       -4.392137781274841e-06  0.006619084329648681  6.322714852970951e-06  5.153682256344e+03
       367192.85370019026  1.0821811001101712e-07  -1.529373563068226  -4.767178316558e-08
       0.9877958369671005  279.95438906836864  0.9075394846332651  -7.963098638590e-09
       -3.582538404818684e-10  1.0  1977.00679986243  0.000000000000e+00
       -0.10306272329432707  0.0  -1.25728547573e-08  6.577974607024e+01
       296805.2308823807  0.0
  12 17 11 30 22 00 00.0  0.0003587295682112691  -1.70530256582e-12  0.000000000000e+00
       69.90443986592987  -103.05645757585832  4.184066621477928e-09  -4.771669587551e-01
       -5.274273032771718e-06  0.006557569436303526  4.683768048369456e-06  5.096651706966e+03
       705547.4458626938  -1.453221299979987e-07  -1.3825989856585343  1.636932801649e-09
       0.9757475988041906  359.51725270578066  0.8996829734825028  -8.028594869489e-09
       -5.550040542000467e-10  1.0  1958.0963485164104  0.000000000000e+00
       -0.12604565408108742  0.0  -1.25728547573e-08  6.896115921480e+01
       373844.40593075957  0.0
```

jupyter pickel Last Checkpoint: a few seconds ago (autosaved)

Logout

File Edit View Insert Cell Kernel Help

Trusted Python 3

Run Code

```
0:00:00
```

In [14]:
```
model2 = Prophet()
```

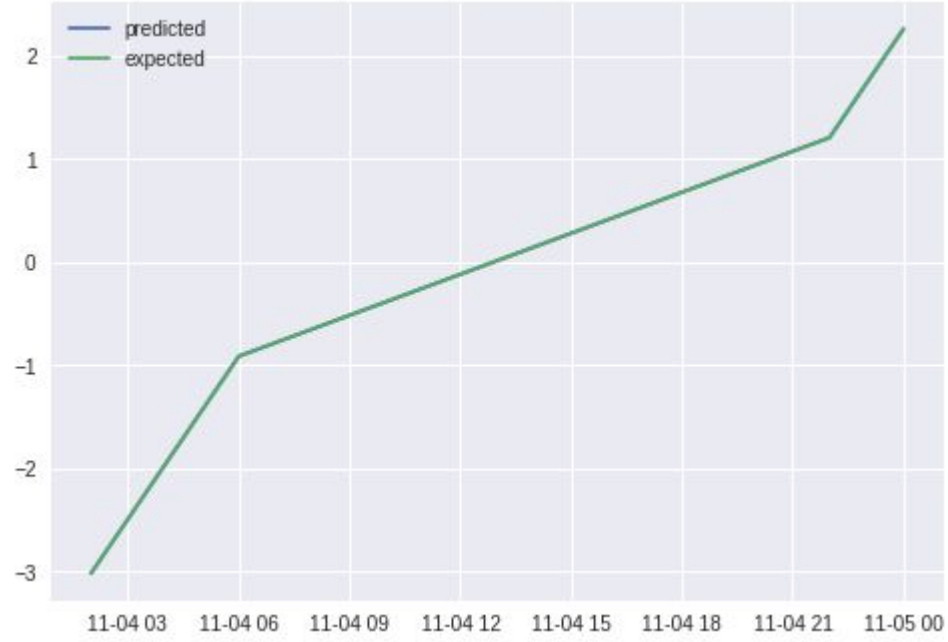
In [16]:
```
with open("file_name", "rb") as f:
    model2= pickle.load(f)
```

In [19]:
```
a = datetime.datetime.now().replace(microsecond=0)
forcast = model2.predict(future)
forcast['yhat']
b = datetime.datetime.now().replace(microsecond=0)
print("Time taken: ")
print(b-a)
```

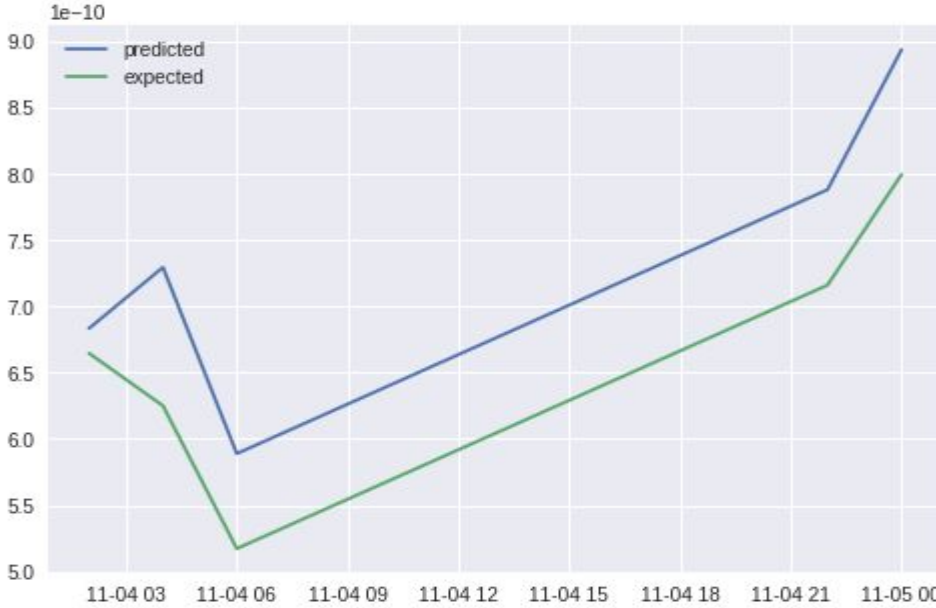
```
Time taken:
0:00:01
```

In [ ]:

Mean Anomaly

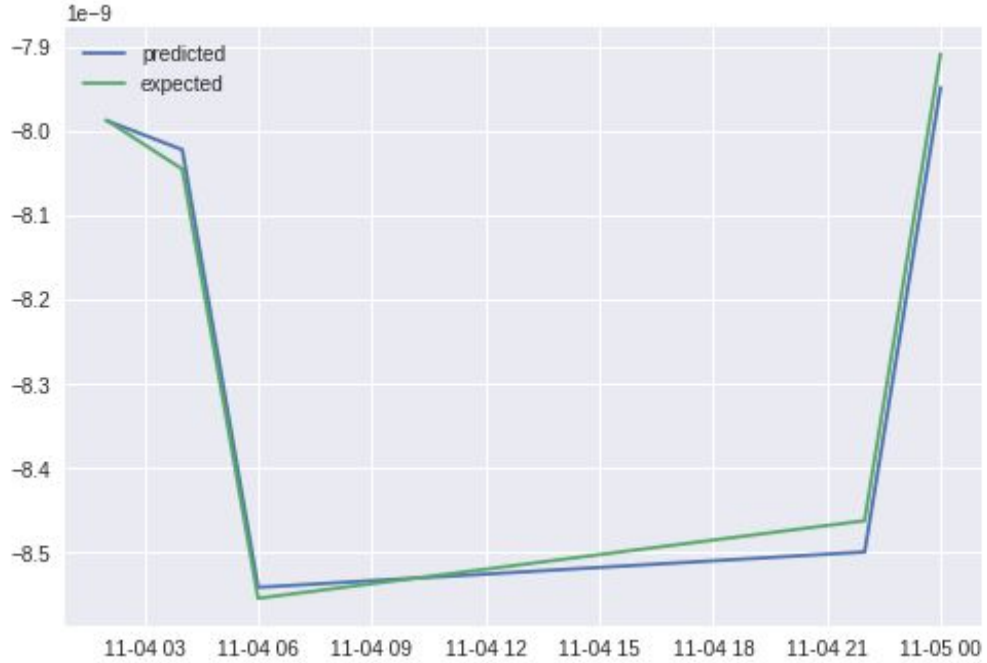


Mean Motion



OMEGA

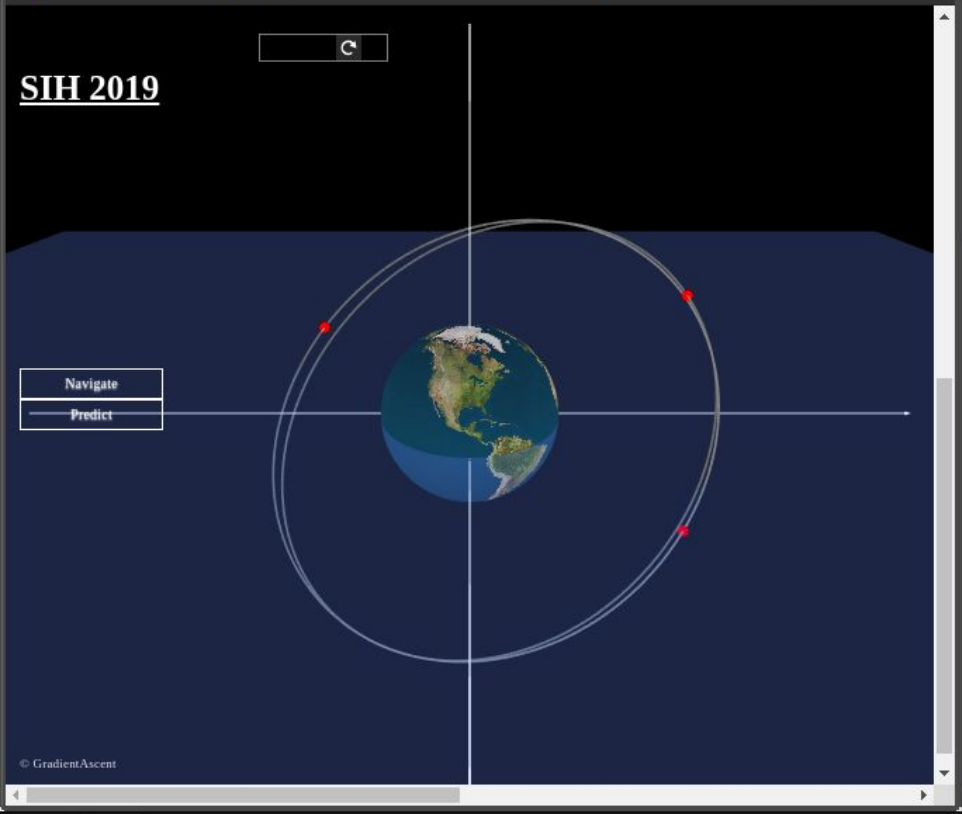
Omega Dot



Activities Google Chrome Sun 8:48 AM

localhost/orbital_trim.html

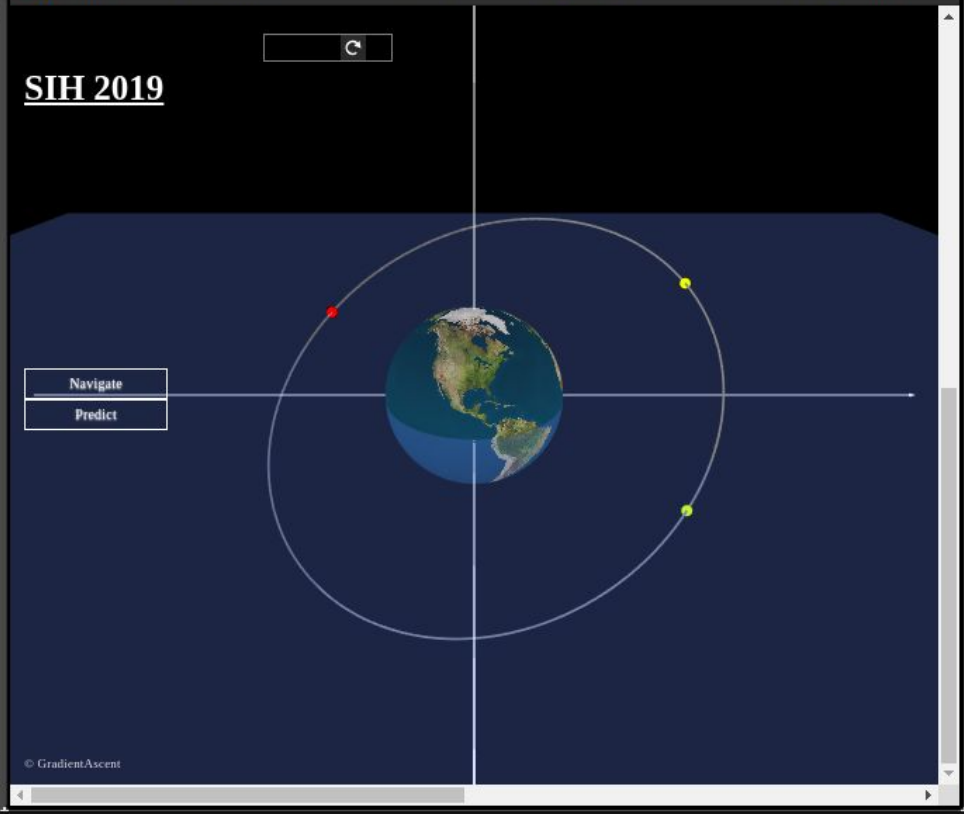
Apps GSoC Apply AI GSoC Competitive Other bookmarks



ISR SIH csv fin Inb SIH

localhost/orbital_trim.html

Apps GSoC Apply AI GSoC Competitive Other bookmarks



Computational Analysis

- Currently, we are using Google's Colab for training our model.
- It takes about 50 seconds for the model to train on Intel Zeon where only two cores are allocated for an instance on Colab
- Flask web app for predicting data in csv format from csv input takes about 60 seconds to produce results for 1 day.
- csv to .N(RINEX) format conversion parser takes about 1-1.5 seconds.

Challenges

- Handling trade-off between accuracy and amount of input data.
- Integrating the model with Flask for making an end-to-end system.
- Optimizing the time required by the end-to-end system to produce .N file as output when .N file is the given input.
- Minimizing the errors involved in predicting results for 2:1 data(2 days input and 3rd day prediction).