

Calculate Azimuth, Elevation and frequency Doppler shift using Python

Calculate azimuth, elevation, and frequency Doppler shift for NOAA 19 (id 33591 from <https://db.satnogs.org>) weather satellite and store data in txt file. Please calculate all the parameters for closest fly of the NOAA 19 over the Brno, Czechia. Satellite positioning data (TLE) about NOAA 19 could be downloaded from here: <https://www.celestrak.com/NORAD/elements/noaa.txt>

GPS position of Brno:

Latitude: 49° 11' 42.216" N

Longitude: 16° 36' 24.6132" E

The GPS coordinates could be converted to skyfield format using following link:

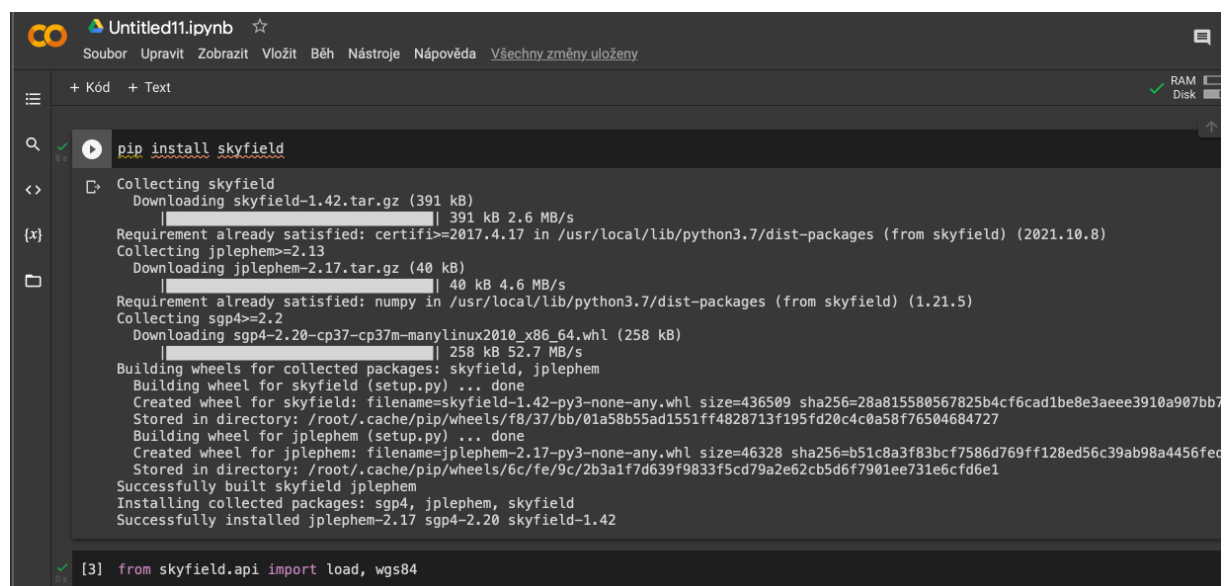
<https://www.pgc.umn.edu/apps/convert/>

The task will be developed and delivered in Google Colab (<https://colab.research.google.com>). It's highly recommended to use Skyfield Python library (<https://rhodesmill.org/skyfield/>), which can predict AZ/EL/Doppler shift based on TLE data. The frequency Doppler shift will be calculated for 137,2 MHz. Stored data in txt file will have following format:

d/m/r h:m:s:ms AZ EL Frequency shift

Hint:

1. Each student could login to google colab using VUTlogin
2. Google Colab is not familiar with skyfield library, therefore it has to be installed:



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Untitled11.ipynb
Soubor Upravit Zobrazit Vložit Běh Nástroje nápověda Všechny změny uloženy

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pip install skyfield

Collecting skyfield
  Downloading skyfield-1.42.tar.gz (391 kB)
    |#####| 391 kB 2.6 MB/s
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (from skyfield) (2021.10.8)
Collecting jplephem>=2.13
  Downloading jplephem-2.17.tar.gz (40 kB)
    |#####| 40 kB 4.6 MB/s
Requirement already satisfied: numpy in /usr/local/lib/python3.7/dist-packages (from skyfield) (1.21.5)
Collecting sgp4>=2.2
  Downloading sgp4-2.20-cp37-cp37m-manylinux2010_x86_64.whl (258 kB)
    |#####| 258 kB 52.7 MB/s
Building wheels for collected packages: skyfield, jplephem
  Building wheel for skyfield (setup.py) ... done
  Created wheel for skyfield: filename=skyfield-1.42-py3-none-any.whl size=436509 sha256=28a815580567825b4cf6cad1be8e3aeee3910a907bb7
  Stored in directory: /root/.cache/pip/wheels/f8/37/bb/01a58b55ad1551ff4828713f195fd20c4c0a58f76504684727
  Building wheel for jplephem (setup.py) ... done
  Created wheel for jplephem: filename=jplephem-2.17-py3-none-any.whl size=46328 sha256=b51c8a3f83bcf7586d769ff128ed56c39ab98a4456fec
  Stored in directory: /root/.cache/pip/wheels/6c/fe/9c/2b3a1f7d639f9833f5cd79a2e62cb5d6f7901ee731e6cfd6e1
Successfully built skyfield jplephem
Installing collected packages: sgp4, jplephem, skyfield
Successfully installed jplephem-2.17 sgp4-2.20 skyfield-1.42

[3] from skyfield.api import load, wgs84
```