- Starting with known pulsating systems (58 but need to add with letters in source numbers)
- Began with writing functions to help automate the process, but can transition to a goal of 1-3 sources in-depth per day
- Esp. if at 2 sources/day, push non-periodicity to later
  - E.g. actually fitting flares; looking for correlations (such as amplitude of flares or relating color-mag to LC)
  - So in first round: color-mag diagram, searching for periodicities on different scales and evidence of changing periodicities
  - But still can note potential patterns that aren't directly related to periodicity
- But also take time to optimize automation (e.g. notice some procedure was helpful → function that can be used for others) and document
- General documentation notes
  - Idea: **neat notebook per source**
    - After analysis of object, clean up notebook and transfer anything generally useful to module
    - Make sure well-commented and notes written in markdown pointing out features
    - If not a lot, >1 source in a notebook?
  - Top: outline and summary
  - Also put **each summary in one document** (Google Doc or Overleaf)
  - Discuss features to aggregate into table
  - Save any figures while going? Perhaps LC with I and V; LC at different scales, and color-mag? Or can just re-run when needed
- Current procedure
  - Three automated cells
    - 3 panel plot with I and V LCs; zooms in twice (1000s of days → several 100 → few times orbital period)
    - Initial periodicity search
      - Sometimes very helpful in immediately picking out patterns, sometimes not
      - Includes some detrending, but always with multiple windows
      - Essentially looks for trends on the scales listed above, and can potentially identify evolving periodicity
    - Color-mag plot: just Iint vs V-Iint; axes s.t. positive correlation is redder when brighter
      - Will be interesting look at different slopes and ranges and amount of scatter
      - Currently prints correlation coefficient but should *add best lit line*
  - More periodicity searches using other functions
    - E.g. search for periodicity in chunks of LC determined by dense regions without large gaps
    - E.g. search in OII,OIII,OIV separately
    - Automatically run periodograms and then show phase-folded data using peaks (above some threshold) found in periodogram
    - (carefully) detrend with filter and/or just subtracting line of best fit from some region
  - Periodicity search and confirmation using LC itself
    - Can you space lines by orbital period, other period, and see that they predict flares etc. well?
      - Other interesting features/(quasi-)periodicities? Do they look similar to orbital period flares?
  - Then go back and outline, annotate, summarize better (but of course add notes and comments while still in progress)
  - Add summary to this or other summary doc
  - Add/re-format any new useful functions to ogle.py
  - Push new notebook and updated module to GitHub repo
- To-dos for code etc.
  - Try to automatically identify local peaks (really minima) in LC (maybe with scipy.signal)
  - Decide whether or not to pursue objects/class(es)
  - Try out flare-fitting autoGUI

Source 2 Summary (Source2.ipynb)
- The known orbital period of the system is 84 days. There is dramatic super-orbital modulation (covering 1.1 magnitudes in I mag), which repeats (two peaks, two troughs within the ~7000 days), but it is not symmetrical. The automatic zoom-in (in Sec. 1) shows the small-amplitude peaks suggestive of the orbital period.
- There is nothing much to take away from the autopd function. The best periods on chunks of the LC are clustered between 80 and 100 days.
- There is a strong correlation between I and V-I (my norm is to flip the I mag axis so the appearance of positive correlation in the plot is indicative of redder when brighter).
- I do further periodogram/phase-folding searches. I focus on using chunks of the LC that do not include large (here: >20 day, but argument can be changed) sampling gaps. In particular, the finddense function also identifies the chunk with the most points. In this chunk, the best period is 6.79 days. The multiphase function can output both a periodogram and phase-folded LCs using the peaks in the periodogram above some threshold (default 20 sigma). The 6.79 day fold is compelling. Throughout the full LC, there are suggestions of a ~6-7 day period but further statistical work would be necessary to back this up. In particular, the periodograms don't always return the same precise value, and the sampling is not always good enough to be convincing of such a period. Either way, such a periodicity is likely not important in considering the full system. Within this dense region (inds 783 to 938), the 84 day period also looks good, but the wide periodogram peak in that vicinity is at 79 days. The difference in the fold is trivial.
- I plot the LC chunks with their periodograms inset. This method could've been conducive for noticing some connection between the shape of the LC and the periodogram result, though nothing jumped out. There is variation, but most show narrow peaks at low values (5-7) as well as wide, high-powered ones around the orbital periods and often local peaks at 50+/- 10 days. The two following plots are helpful, showing best period vs. time (and then the second also includes light grey points showing the second best period) with the power of the peaks shown by color. You can see clustering around the orbital period and around 6.8 days. All the remaining points have lower powers and may be factors of the orbital period (e.g. ~42 days).
- In general, the difficulty with this source comes from the fact that the flares/indications of orbital period have amplitudes that are not much greater to the other variability. As such, there are often other similar-looking features (shown in Sec. 3).
- In the final part of Sec. 2 I see if detrending helps any of the searching (not really as far as I can tell). With the chunks of the LC, I do both the filter window detrending and just fit a line as another method of detrending. I do periodogram searches closer to the orbital period and phase-fold using the orbital period.
- Searching with a higher max period and with more of the full LC gives periods of 300-400 days. However, the value given is inconsistent and I believe it just has to do with the sampling of the LC (clusters of observations in this timeframe). This part can be checked, but I also don't notice any features indicating this periodicity.
- In Section 3, I use the LC itself to look for periodicity. This part can be skipped; it's quite long because small chunks have to be used to identify the 84 day flaring by-eye. The important info is summarized in Sec. 4. There is good indication of the success of the orbital period, although there are sometimes comparable "flares" outside of this periodicity. **Further study of flare amplitudes is necessary**.
- Section 4 shows the LC (in chunks for ease) in single plots, with lines spaced by 84 days. The first couple subplots illustrate the effect of propagation example errors on the first flare center and on the orbital period. The last few subplots just use lines rather than shading, since, at that point, the errors all merge together.
- **The last part of the LC (last two subplots) in Sec. 4 is of particular interest and may require more investigation**. In particular, the flares in the second to last chunk have high amplitudes, and are all earlier than predicted. On the other hand, the following subplot predictions are *early*. This means that just a slight propagation of error on the 84 day period (e.g. that it's actually lower) does not help both problems). I explore this a bit more, but not in depth quantitatively.
    - It may be worth it to fit these flares, but it may be difficult in many cases. However, I can work on developing a method of measuring the amplitude and the surrounding variability.
    - One possibility is that the orbital period periodicity is consistent and slightly higher than 84 (or that the initial center needs to be shifted but I think the former). The flares in the second to last panel may just have a different shape s.t. I'm calling the center the wrong thing. They have steep increases and then more of a normal shape, so maybe they too are actually occurring *after* the prediction, which would be consistent with the final subplot as well.

I then try out using objects and classes rather than just methods. This path is a possibility and may be "better coding" but I don't see it as being significantly more efficient, especially when there are just 1-3 objects per notebook anyway. I should consider, though, if I want to be consistent with variables and then just duplicate notebooks. I'll see if anything in this notebook done in several cells is generalizable and should be added to ogle.py

Galleries of ~30 of the sources can be found at the end of the notebook, in groups of ten. They just show the I band LC for each next to its color-mag diagram. Most are of course redder when brighter, but there will definitely be more interesting features to analyze in other diagrams. As patterns emerge on that end, I can develop more functions for the color-mag analysis.