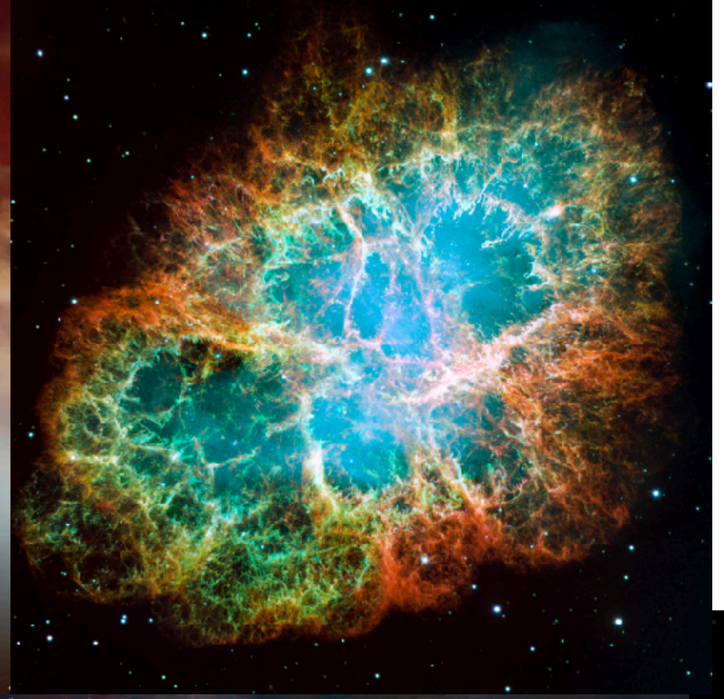
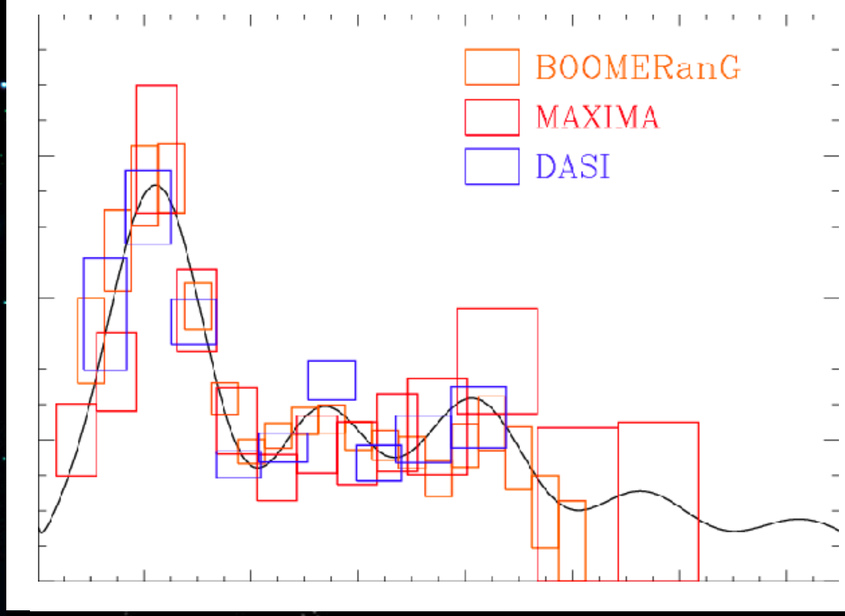
AST1501 - Introduction to Research

Jo Bovy

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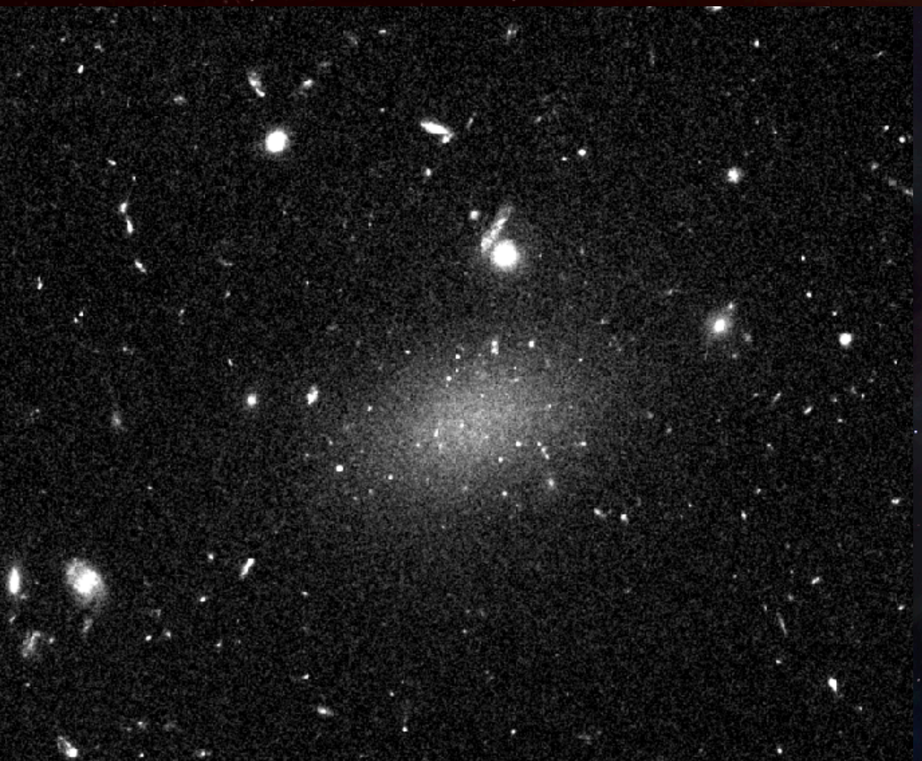
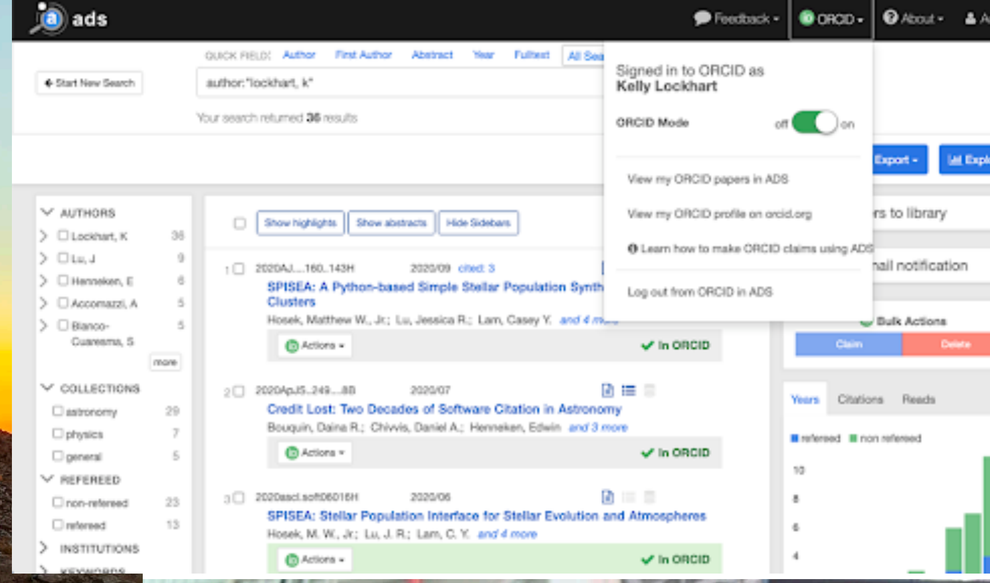
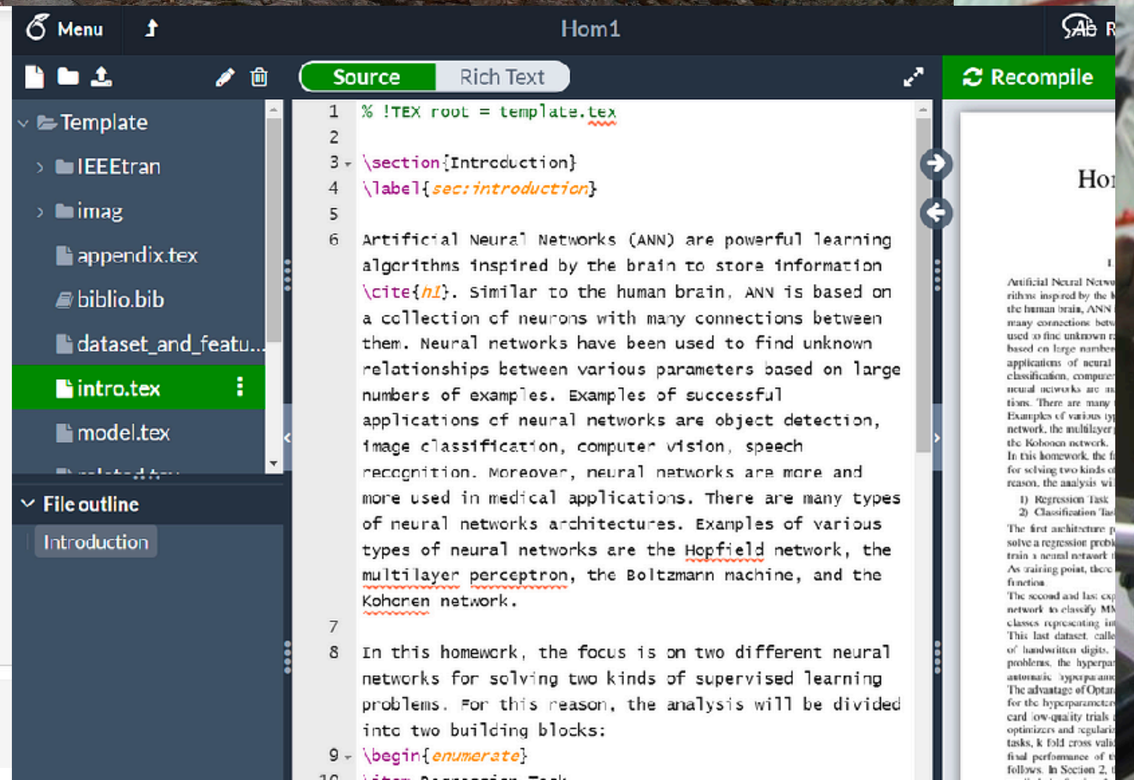




```
    crop_size = units.Quantity((100,100), units.pixel)

    ## what I want to do
    # open the header and image data
    # create the file object with header info and data:
    #       CCD_TEMP
    #       EXP_TIME
    #       PICTTYPE
    #       img_data.shape <- to verify the proper geometry
    #       CROP(data)
    #.      min, max, mean, std_dev

    # Let's create the crop

    img_crop = Cutout2D(img_data, crop_center, crop_size)

# and write the required header and data into a sample dict

    img_sample = {  'PICTTYPE'  : img_header[0].header['PICTTYPE'],
                    'ff_geometry' : img_data.shape,
                    'crop_geometry' : img_crop.shape,
                    'EXPTIME' : img_header[0].header['EXPTIME'],
                    'CCD-TEMP' : img_header[0].header['CCD-TEMP'],
                    'min' : np.min(img_crop.data),
                    'max' : np.max(img_crop.data),
                    'mean' : np.mean(img_crop.data),
                    'std_dev' : np.std(img_crop.data),
                    'data' : img_crop.data
                    }

    #join it to the main data_set, keyed off file name

    data_set[file.split('/')[1]] = img_sample

# let's show one of the crops.
```



Course structure

AST1501 Course structure

- Two parts:
    - Weekly meetings for Fall term and Winter term —> intro to research
    - Research project with supervisor in research group
- High-level goals:
    - Introduce you to research groups in the department
    - Gain research experience
    - Learn a variety of skills and tools for doing research

Research project

Research project

- Goal of 1501/1500 series is to introduce you to the breadth and variety of research done in the department
- Expected to work on two projects in different areas of astrophysics and/or with different techniques (theory/data-analysis/observation/ instrumentation/…)
- One main goal is to find a thesis supervisor —> 1501/1500 supervisors need to be graduate faculty
    - Postdocs/non-grad faculty can be co-supervisors
    - But need graduate faculty as main supervisor

How to find a supervisor

For both 1501/1500

- Faculty intros in this course: ~25 min. research overview, most during the Fall term, some during the Winter term
- Jamboree
- Email professors to set up meetings and discuss possible projects
- You might want to attend different group meetings (can facilitate)
- Other
- Deadline Oct 10 for 1501, Mar 18 for 1500

Stages of the research project

- You should be working on a well-defined, contained research project that can get to an interesting result in ~8 months
    - Ideally has possible extensions into PhD research (but not necessary!)
- First goal: understand background and motivation, come up with plan
    - —> Research proposal/presentation due Oct/Nov.
- Then work on research, providing occasional updates to me and during a mid-project update (late Jan)
- Finally, write up research as proto-paper and present final results (Mar/Apr)
- 1500 will repeat this procedure, but in condensed May-August timeline

Main project deadlines

All submission deadlines are at 5pm of the day listed below.

1501

- **Project supervisor**: Oct. 10
- **Project proposal**:
  - First draft: Oct. 31
  - Peer feedback: Nov. 12
  - Revised draft: Nov. 14
  - Presentations: Late November, early December
- **Mid-project two-slide update**: End of January
- **Abstract for final talk**: Feb. 25
- **Final project**:
  - First draft: Mar. 20
  - Peer feedback: Apr. 1
  - Revised draft: Apr. 3
  - Presentations: Mid-April

Grading scheme

- Participation in class and department events (colloquia, TASTY, etc.): 25%
- Project proposal: 20%, breakdown:
  - First draft: 5%
  - Peer feedback: 5%
  - Revised draft: 5%
  - Presentations: 5%
- Monthly check-ins: 10%
- Two-slide mid-term updates: 15%
- Final project: 30%, breakdown:
  - First draft: 8%
  - Peer feedback: 7%
  - Revised draft: 5%
  - Presentations: 10%

Intro to research

Introduction to research

- Other main part of 1501 is a set of lectures/activities introducing you to research skills and tools
- Topics covering: literature, coding, writing papers, writing proposals, writing feedback on other's work, version control, making website, …
    - Please suggest additional topics
- Some guest lectures
- Will largely involve in-class work with no assignments (but related to research-project goals)

Some logistics

Logistics

- All info on course website: https://github.com/jobovy/AST1501-Intro-to-Research
- Meeting times:
    - Fall: Tue/Thu 3-4pm in AB113
    - Winter: likely the same
- Slack channel: #ast1501-2024-2025 on the Astro@UofT slack —> main communication channel
- Course schedule there under development, please check for updates

Course schedule

Fall term:

Date	Topic	Deliverable	Material(s)
Sept. 10	Intro	-	slides
Sept. 12	The business of being a graduate student	-	slides
Sept. 17	Faculty intros: Ting Li, Adam Hincks	-	
Sept. 19	Faculty intros	-	
Sept. 24	Intro to writing in astronomy	-	slides
Sept. 26	Faculty intros	-	
Oct. 1	Intro to computing in astro I	-	git and GitHub intro, GitHub education benefits, slides
Oct. 3	Library resources (NuRee Lee)	-	

Oct. 8	Faculty intros	-	
Oct. 10	Intro to computing in astro II	**Project supervisor**	slides
Oct. 15	Intro to computing in astro IIII	-	slides
Oct. 17	Faculty intros	-	
Oct. 22	How to write a good research application	-	slides
Oct. 24	Proposal co-writing session	-	
Oct. 29	**No class, reading week**	-	
Oct. 31	**No class, reading week**	**Draft project proposal**	-
Nov. 5	Faculty intros	-	
Nov. 7	How to write a good research application	-	slides
Nov. 12	How to access astronomical data	**Peer feedback on proposal**	slides
Nov. 14	Faculty intros	**Revised proposal**	
Nov. 19	Writing workshop (Dan Newman)	-	

Topics poll

- LaTeX and overleaf
- Python:
  - basics
  - Numerical computing in Python with numpy
  - Scientific computing in Python with scipy
  - Hardware-accelerated computing in Python with numba/cython/jax/pytorch/…
  - Setting up a reproducible environment
- Version control
- Stats? Astrostats in Winter 2025
- Web development
- Remote computing on clusters, ssh, job-based (MPI)
- Your topic here