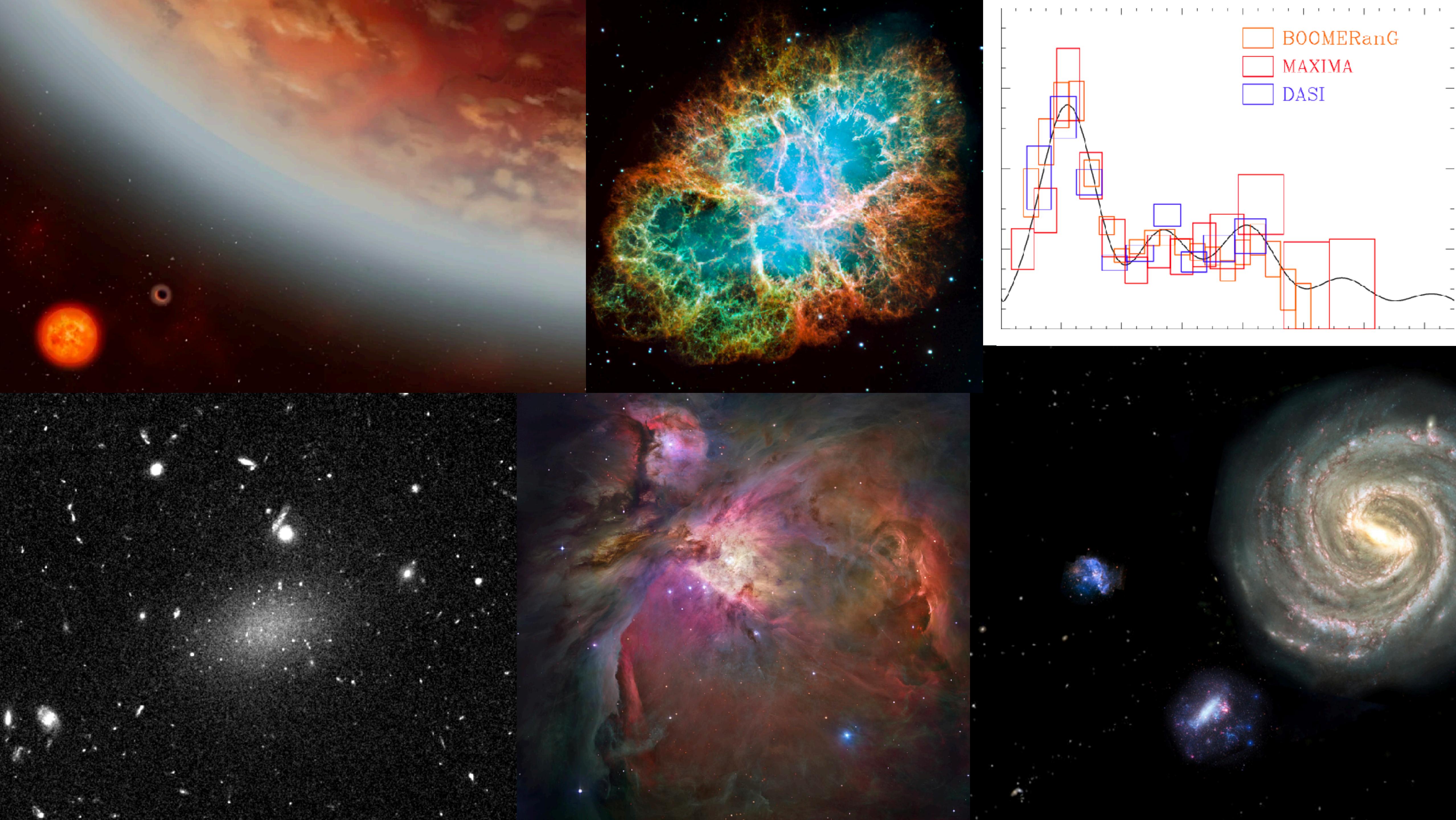


AST1501 - Introduction to Research

Jo Bovy





```

crop_center = ((img_data.shape[0] / 4), (img_data.shape[1] / 4))
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.

```

The screenshot shows the Overleaf LaTeX editor interface. The top navigation bar includes 'Menu' and 'Hom1'. Below the menu are standard file operations: New, Open, Save, and Delete. The tabs 'Source' (selected) and 'Rich Text' are present. On the left, a file tree shows a 'Template' folder containing 'IEEEtran' and 'imag', and files 'appendix.tex', 'biblio.bib', 'dataset_and_featu...', 'intro.tex' (highlighted in green), and 'model.tex'. A 'File outline' sidebar shows 'Introduction' under a tree. The main workspace displays the LaTeX code source:

```
1 % !TEX root = template.tex
2
3 \section{Introduction}
4 \label{sec:introduction}
5
6 Artificial Neural Networks (ANN) are powerful learning
algorithms inspired by the brain to store information
\cite{hl}. Similar to the human brain, ANN is based on
a collection of neurons with many connections between
them. Neural networks have been used to find unknown
relationships between various parameters based on large
numbers of examples. Examples of successful
applications of neural networks are object detection,
image classification, computer vision, speech
recognition. Moreover, neural networks are more and
more used in medical applications. There are many types
of neural networks architectures. Examples of various
types of neural networks are the Hopfield network, the
multilayer perceptron, the Boltzmann machine, and the
Kohonen network.
7
8 In this homework, the focus is on two different neural
networks for solving two kinds of supervised learning
problems. For this reason, the analysis will be divided
into two building blocks:
9 \begin{enumerate}
10 \item Regression Task
```

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- > Lockhart, K 36
- > Lu, J 9
- > Henneken, E 6
- > Accomazzi, A 5
- > Blanco-Guarnesma, S 5

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1 2020AJ....160..143H 2020/09 cited: 3
SPISEA: A Python-based Simple Stellar Population Synthesis Clusters
Hosek, Matthew W., Jr.; Lu, Jessica R.; Lam, Casey Y. and 4 more

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2 2020ApJS...249...38 2020/07
Credit Lost: Two Decades of Software Citation in Astronomy
Bouquin, Daina R.; Chivvis, Daniel A.; Henneken, Edwin and 3 more

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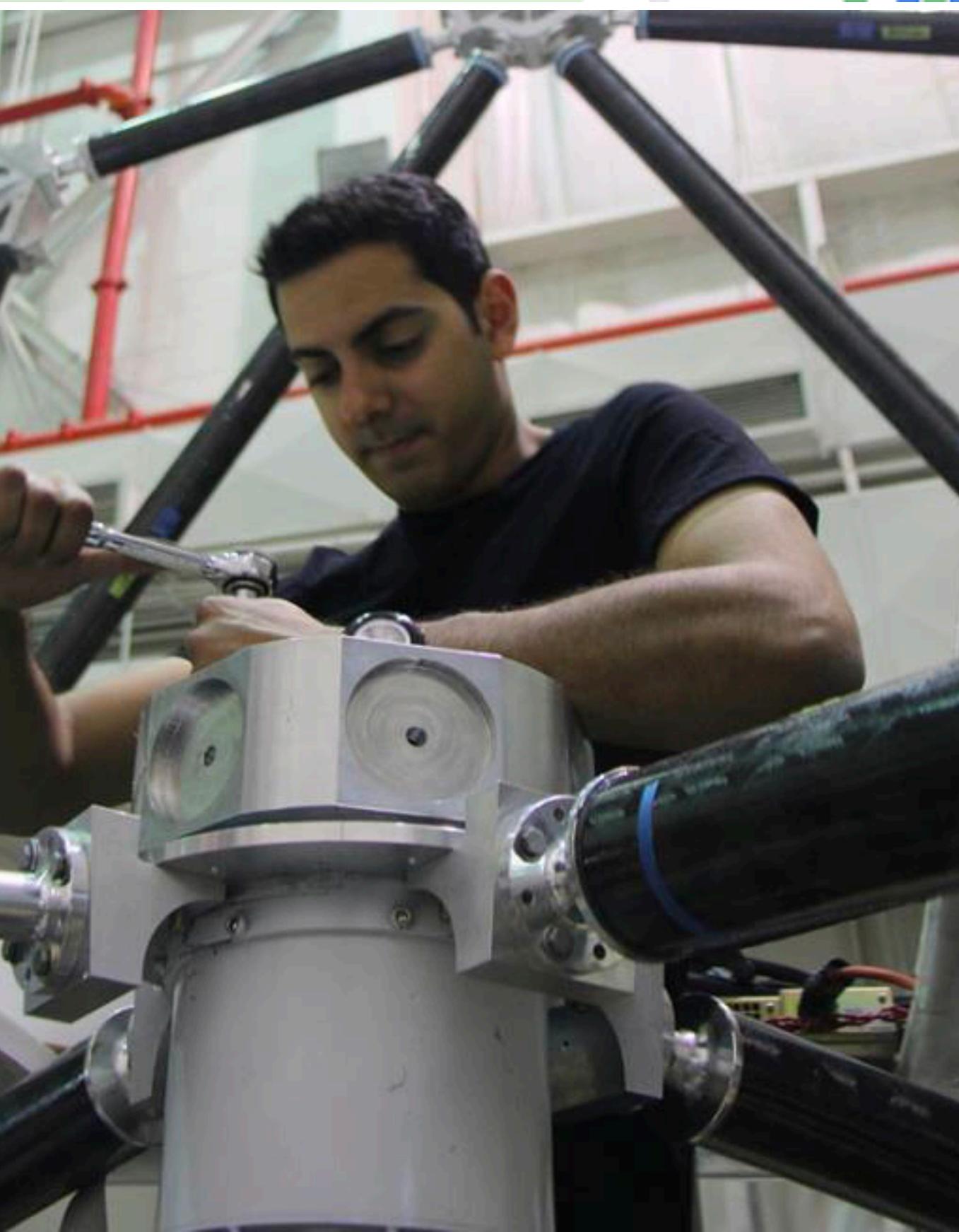
3 2020ascl.soft06016H 2020/06
SPISEA: Stellar Population Interface for Stellar Evolution and Atmospheres
Hosek, M. W., Jr.; Lu, J. R.; Lam, C. Y. and 4 more

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Years Citations Reads

■ referred ■ non-referred





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/jbovy/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. 6	Feedback	-	

Oct. 8	Faculty intros	-	
Oct. 10	Intro to computing in astro II	Project supervisor	slides
Oct. 15	Intro to computing in astro III	-	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