ASTR 400B Research Assignment 7: Final Report

Due: May 6 2020, midnight

This is the outline for the Final Report, which is worth 30% of your final grade.

Relative to Assignment 6, the new components are instructions for: Abstract, Conclusions and Acknowledgements sections. there are two bold faced additions in other sections though.

Make sure to read through the entire assignment instructions.

1 General Expectations for the Final Report

- The report must be written in LaTeX using ApJ formatting. You can find templates on overleaf.
- The final report is not to exceed 5 pages in ApJ format (not including figures) but must be at least 3 pages (not including figures).
- Note, plagiarism will result in a grade of 0. This includes copying figure captions verbatim from papers or writing down word for word comments I might have made in your drafts.
- Proofread the text! Grammar is part of the grade for the final report.
- All papers must be properly cited using BibTex. See the video tutorial on the class dropbox. Citations must appear as a bibliography at the end of the document. There must be at minimum 3 refereed papers cited.
- Follow the below outline (section headings and content guidelines). This is how I will grade your paper. Each heading refers to a heading or component that is expected in your report.

2 The Report Outline

The below is the same as in Assignment 6. However, you are now required to complete two more sections: Abstract, Conclusions and Acknowledgements (listed towards the end).

2.1 Title

Include a descriptive title that relates to the question you are trying to answer. Below the title, you must include your name and the submission date.

2.2 Keywords

The ApJ LaTeX template allows "keywords" to be defined. Your report must include **at least 5 keywords** selected from the below list. You must list these at the top of the report (ideally in the keywords location in the ApJ template file).

When you first use a keyword you must *define* it. A definition can be an equation.

Proper Motion •Local Group •Stellar Disk •Stellar Bulge •Major Merger •Minor Merger •Dry Merger •Dynamical Friction •Jacobi Radius •Tidal Stripping/Sharing •Quenching •Late Type Galaxy •Early Type Galaxy •Spiral Galaxy •Elliptical Galaxy •Flocculent Spiral •Tidal Tails •Tidal Bridge •Hierarchical Growth •Cold Dark Matter Theory •Hernquist Profile •Satellite Galaxy •Dark Matter Halo •Red Sequence •Blue Cloud •Green Valley •Rotation Curve •Dispersion Supported •Velocity Dispersion •Virial Equilibrium •Virial Radius •Gravitationally Bound •Galaxy Interaction •Galaxy Merger •Merger Remnant •Kennicutt-Schmidt Relation •Star Formation Main Sequence •Star Burst •Local Standard of Rest Velocity •Disky/Boxy Isodensity Contours •Rapid/Slow Rotator.

2.3 Section: Introduction

Edit your introduction based on the comments you received from Prof. Besla. Your Introduction must be written in the style of an introduction to a paper. The introduction is expected to be at minimum 1 page in ApJ format. You must follow the below outline

1. **Paragraph 1:** Introduce your topic (as defined under "assigned topics" in the instructions for Assignment 2). This does not mean write "My project is to ..". Instead, if your topic were e.g. the evolution of SMBHs, you would write "Super Massive Black Holes (SMBHs) are believed to reside in the center of massive galaxies" . I.e. **define** the topic and associated concepts (e.g. dark matter halos, tidal tails, Local Group - see keywords).

2. **Paragraph 2:** Explain why your topic matters to our understanding of galaxy evolution. You must define the terms "galaxy" and "galaxy evolution" (Lecture 1, Willman & Strader 2012 AJ).

3. **Paragraph 3:** Explain what we currently know about your chosen topic. Papers must be cited in this paragraph. A figure must be referenced within the text to help explain something learned about the topic.

4. **Figure 1:** The figure should be a paper from a refereed journal paper that illustrates something we have learned about the topic. The figure must have a caption that includes the paper citation and describes everything that is plotted. This **cannot be verbatim** from the original paper. The caption must finish with the punchline for the figure - what should the reader take away from the figure?

5. **Paragraph 4:** What are the open questions in your chosen topic area (as defined in Paragraph 1)? One of these open questions must relate to your specific project. How are people trying to solve these questions? You must include citations.

2.4 Section: This Project

1. **This may seem like an awkward section that would flow better in the introduction. This doesn't matter and is more for clarity in the grading scheme. Please keep this as a separate section.**

2. **Paragraph 1:** Introduce your **specific** project. (e.g. "In this paper, we will study the change in position of the SMBHs of the Milky Way and M31's throughout the future collision and eventual merger of these two galaxies"). This isn't supposed to be general. Be as specific as you can be.

3. **Paragraph 2:** Which of the open questions (paragraph 4 of the intro) does this project address?

4. **Paragraph 3:**Why is this open question an important problem to solve for our understanding of Galaxy Evolution? How will your study help us to address the open question?

2.5 Section: Methodology

1. **Paragraph 1:** Start with an introduction to the simulations you are using. You must reference the paper (van der Marel, Besla 2012) and describe what is meant by an "N-body" simulation.

2. **Paragraph 2:** Overview your approach. Discuss a figure (Figure 2) to explain what you are trying to do.

3. **Figure 2:** This figure can be from a published paper or can be a detailed diagram you created to describe your logic. The figure must have a caption, follow guidelines listed for Figure 1.

4. **Paragraph 3:** Describe the calculations your code will compute. You must include all relevant equations and describe the meaning behind every parameter in the equation (e.g. The circular speed is defined as $V_c^2 = GM/r$, where M is the Mass of the host galaxy ($M_\odot$) and r is the Galactocentric radius (kpc)). Note that the reference for the Hernquist profile is Hernquist 1990 ApJ 356.

5. **Paragraph 4:**: Describe the plots you will need to create and explain why those plots will answer your question. Note that you must create at least two figures. One can be generated entirely by code from Homeworks or In Class Labs (e.g. phase diagrams, density plots). The other figure must be generated by code that includes one new function or routine that YOU created BY YOURSELF.

6. Note: You do not need to describe in detail what your code is doing - this must be done in the code itself (see Code Requirements). However, you can include a figure to describe a flow chart for your code logic if that helps to explain your methodology.

7. **Paragraph 5:** Describe your hypothesis for what you think you will find. Explain your motivation for this hypothesis.

2.5.1 Code Requirements

1. **At the top of your code you must describe the topic, the question you are pursuing and an overview of what the code does.**
2. Code MUST BE DOCUMENTED, with each step outlined and all parameters defined. This is a major part of the code grade.
3. Equations must have references to papers if applicable.
4. Code can be largely based on Homework Assignments and In Class Labs, but there **must be at least one function or routine that you created by yourself.**. Indicate this new code in the code documentation.
5. Your code(s) must generate 2 figures.
6. Code must be uploaded to Github

2.6 Section: Results

Here is where you will report on what your code produced. There must be two Figures in this section that were generated by your code.

1. **Paragraphs 1 and 2:** Describe each of the two figures (Figures 3, 4) that you have created from your code. One paragraph per figure. **End each paragraph with the main take away result.**
2. **Figure 3:** This figure can be generated entirely by code from Homeworks or In Class Labs (e.g. phase diagrams, density plots).
3. **Figure 4:** This figure must be generated by code that includes one new function or routine that YOU created BY YOURSELF.
4. Each figure must have a detailed caption where everything plotted is explained, including axis labels. Include in the caption a punchline for each figure that explains what the reader should take away.

2.7 Section: Discussion

1. **Paragraph 1:** Summarize one result from the previous section.
    - Does this result agree or disagree with your hypothesis?
    - How does this result relate to existing work in the literature?
    - What is the importance/meaning of this result for our understanding of galaxy evolution?
2. **Subsequent Paragraphs:** Repeat the above if you have a 2nd results (etc.)

2.8 Abstract:

This should be at the beginning of your document. In latex you would use:
"backslash"begin{abstract}
text
"backslash"end{abstract}

Follow the below guidelines:

1. A sentence that defines your topic
2. A sentence that says why your topic is important
3. A sentence that says what question you are exploring
4. A sentence about why that question is important.
5. For each finding: A sentence that states what you found.
6. A concluding sentence(s) about what each finding means.

2.9 Section: Conclusions

1. Paragraph 1: Summarize your introduction - basically lines (1-4) of the abstract.
2. Paragraph 2: Highlight one key finding, what it means and whether this agreed or disagreed with your hypothesis. Add more paragraphs per finding.
3. Last Paragraph: Comment on future directions - what other things could you do to explore the topic further? Or to improve your code?

2.10 Section: Acknowledgements

This is where you should acknowledge the folks who helped you to trouble shoot and write your code. You must also acknowledge the Software that you used. Examples include:

1. Astropy (Astropy Collaboration et al. 2013; Price-Whelan et al. 2018 doi: 10.3847/1538-3881/aabc4f)
2. matplotlib Hunter (2007),DOI: 10.1109/MCSE.2007.55
3. numpy van der Walt et al. (2011), DOI : 10.1109/MCSE.2011.37
4. scipy Jones et al. (2001–),Open source scientific tools for Python. http://www.scipy.org/
5. ipython Perez & Granger (2007), DOI : 10.1109/MCSE.2007.53