Final Project: Deeper Exploration into Data Sets

The Final Project will give you the opportunity to apply your data exploration and Python coding skills to a larger data set than those we saw in the Problem Sets and will allow you the freedom to pose your own questions (or questions we suggest!) to interrogate the data as a neuroscience researcher!

How do neuroscientists really explore data?

Neuroscientists often approach data sets with specific questions and hypotheses in mind. Once the researcher has a question and hypothesis, he or she can employ computational tools to see if the data support the hypothesis. Often, regardless of whether or not the hypothesis is supported, the researcher will formulate new questions based on what the data show. The researcher may be able to use the same data set to address the new question, or the question may require additional experiments to collect new data.

For this final project, we'd like you to take the leap from performing guided explorations to looking at the data on your own to address a question of your choosing. We know that this might be a big step for some of you. We will provide you with some suggested questions and a bit guidance for each of the problem set extension projects. You should expect this project to take more time than the prior problem sets. There are no videos to watch in this unit so you will have more time to focus on your work!

For those of you who are more comfortable with your programming skills or who are just feeling ambitious, you are encouraged to develop your own questions or try out one of the open-access data sets we will point you to. We have intentionally made this project open-ended to allow you to design a project that you will enjoy as you perform your own neuroscience research!

Group work is encouraged!

Neuroscientists do not work in isolation – and you don't need to either! For this project, we'd love for you to find a partner or small group where you can explore data together. For more information about working in a group, see the Group FAQ in the Unit 5 syllabus.

To complete this project, you will

- Select a data set for exploration
- Formulate a question to guide your exploration
- Write your own code to examine the data and attempt to answer your question
- Create figures to illustrate your findings
- Present your results!

At the end of this project, you will

- Complete a peer assessment submission presenting the findings of your data exploration. (To receive credit for the project, you must complete your peer evaluations by the evaluation due date.)

- Be done with Exploring Neural Data!

Things to keep in mind while you are working on this project

- You will be starting pretty much from scratch in terms of the coding for this project. Remember to refer back to the problem sets for help structuring your code. Ask for help in the discussion forums if you need it!
- Writing out your plan on paper will serve as a good guide as you code up your project.
- The presentation of your results is a crucial part of this project. Researchers must communicate their results in order to have an impact. Be sure to allocate time to create your project submission!

Choosing a data set

We have provided you with several options to choose from when it comes to data sets. **Additional documentation for all of these options is available on the Unit 5 syllabus.**

Three of the data sets are extensions of the data you worked with in Problem Sets 2 – 4:

- 62 simultaneously recorded neurons during the motor cortex reaching task (building on Problem Set 2)
- Looking at how experience can change search behavior and alters responses of visual neurons (building on Problem Set 3).
- A full night of data (including multiple channels of EEG, EOG, and EMG) gathered both before and after sleep deprivation from four subjects (building on Problem Set 4)

Other options for the final project include selecting from the multiple data sets at the following open-access sites:

- Collaborative Research in Computational Neuroscience
- National Sleep Research Resource

Please note that choosing an open-access data set will require additional effort on your part. You will need to familiarize yourself with the ways in which the data were collected and the dataset formats (which may not match what we worked with in the class).

Working on your project

Once you have selected a data set, please read the provided documentation and formulate your question. Then you (or your group) are off on your own! (But remember, you're never really alone! Please post questions and concerns in the discussion forums!)

Project submission:

For this project, your final submission is open-ended as well. The purpose of the submission is to present your results. You can think of it as if you were writing a short journal article on your findings or if you were presenting your results at a neural data conference.

You choose the format of your submission. You may want to make a video (for example, one with slides of your figures and your narration), you may want to submit a written report (in the style of a journal article), or you may find another creative outlet to show us your discovery.

Videos should be a maximum of 12 minutes in length (8-10 is a great target length) and written work should be 4-6 pages. For videos, you will need to host the video on the web (e.g. on YouTube or Vimeo) and post the link. Papers can be uploaded as PDFs.

Your submission should include the following (see the rubric below for more details as to how these will be scored.):

- Briefly tell us what data you were looking at
- Describe the question(s) you were trying to answer
- Show us what you found! What interesting things did you discover in the data? (This should be the main focus. You'll want to include more than one figure here!)

  We realize that you may not find anything novel, or that your project may not even work! All of that is perfectly fine. As long as your discovery leads you to ask more questions, it's an interesting finding to us!
- Tell us at least one interesting programming trick you used to discover what you found. This "trick" may vary with your level of programming experience. Tell us something you tried out that was new to you!
- Tell us what problems you encountered or what you really wanted to do, but couldn't
- What would you do next to follow up on your discoveries?

Assessment Rubric:

You will be assessed as follows:

> The data set is well described in the student's own words. The experiment and discussion of the data collection were clearly and concisely presented, and could be understood by others who had no prior knowledge of the data set.
>
> > 0: There was no description of the data set.
> >
> > 1: A description of the data set was provided but it was completely unrelated to the questions addressed in this project.
> >
> > 2: Either the description of the experiment or the discussion of data collection methods were missing from the presentation.
> >
> > 3: The project included a description of the experiment and discussion of the data collection, but it was either presented in a complicated fashion or did not contain enough detail to understand the methods.

4: The description of the experiment and discussion of the data collection were presented well, but would be difficult to understand if you did not have prior knowledge of the data set.

5: The description of the experiment and discussion of the data collection were presented in a clear and concise manner and could likely be understood by those who had no prior knowledge of the data set.

The project's question is clearly presented in a concise manner. The question should make sense for the data set, and the results should address the question.

0: There was no discussion of the questions addressed by the project.

1: Questions addressed by the project were discussed, but they were unrelated to the findings of the project.

2: The questions addressed by the project were presented in a manner that was difficult to understand and cannot be addressed by the provided data set.

3: The questions addressed by the project were presented in a clear and concise manner, but cannot be addressed by the provided data set.

4: The questions addressed by the project can be addressed by analyzing the data set, but were presented in a manner that was difficult to understand.

5: The questions addressed by the project were presented in a clear and concise manner and can be addressed by analyzing the data set.

The provided figures are well formatted, easy to understand, and support your findings.

0: No figures were included.

1: The majority of provided figures do not include properly labeled axes with units, descriptive titles, or are not presented in a clear fashion and the figures do not support the findings of the project.

2: All provided figures include properly labeled axes, descriptive titles and are presented in a clear, easy to understand fashion, but the figures do not support the findings of the project.

3: Only one figure was provided. It had properly labeled axes with units, descriptive titles, and was presented in a clear, easy to understand fashion. The figure supports the findings of the project.

4: The majority of the figures provided include properly labeled axes with units, descriptive titles, and are presented in a clear, easy to understand fashion

(although there may be some errors/omissions or lack of clarity). The figures support the findings of the project.

5: Multiple figures are provided and all figures include properly labeled axes with units, descriptive titles and are presented in a clear, easy to understand fashion. The figures support the findings of the project.

The interpretation of the data is clear and concise. It should be consistent with the figures and related to the question posed by the project.

0: There is no description of the results.

1: The results are described in the project, but they are not clearly presented, inconsistent with any figures, and not related to the proposed questions.

2: The described results relate to the proposed question, but may not be consistent with the figures or clearly described.

3: The described results are consistent with the figures, but do not relate to the proposed questions and are not clearly described.

4: The described results are consistent with the figures and relate to the proposed questions, but are not clearly described.

5: Results were described in a clear and concise manner, are consistent with the figures, and relate to the proposed questions.

The project should describe at least one programming trick that was new to the student. (The trick does not need to be novel in general – just new to the student. An expert programmer might include something clever that they did.) It may be a new function, a new way to graph, or a new way to use syntax to achieve the results. We want to hear how you are continuing to expand your programming skills! The "trick" should be clearly described and related to the overall findings of the project.

0: No programming tricks were included in the project.

1: At least one programming tricks is included, but it is not clearly described and is not related to the findings.

2: At least one programming trick is included. It is either not clearly described or includes no explanation of how it relates to the findings.

3: At least one programming trick is clearly described. The description includes how it relates to the findings.

We know this process won't be completely smooth, so we expect at least one problem or stumbling block along your way, regardless of whether or not it was solved. The problem should be described clearly and include an explanation as to how the resolution did or would contribute to the findings.

0: No problems were included in the project.

1: At least one problem is included, but it is not clearly described and is not related to the findings.

2: At least one problem is included. It is either not clearly described or includes no explanation of how resolving the problem might have contributed to the findings.

3: At least one problem is clearly described. The description includes how resolving the problem might have contributed to the findings.

We want to know where the project should go next. The follow-up analysis should be clearly described and related to the current findings of the project.

0: No follow-up analysis was included.

1: A follow-up analysis is included, but it is not clearly described and is not related to the findings of the project.

2: A follow-up analysis is included. It is either not clearly described or includes no explanation of how the analysis relates to the findings of the project.

3: A follow-up analysis is clearly proposed. The proposal includes how this analysis relates to the findings of the project.

Overall, the project should be presented clearly.

0: The project is missing or entirely unrelated to the course.

1: Overall, the project was not presented in a clear manner.

2: While the project presentation was mostly clear, there were several parts that were difficult to understand.

3: Overall, the project presentation was clear.

Which data set was used for this project?

1: Donoghue Multi-Electrode Motor Cortex

1: Carskadon Sleep EEG

1: Sheinberg Visual Processing

1: Data from Collaborative Research in Computational Neuroscience

1: Data from National Sleep Research Resource

1: Other

Did you learn something new from this project? Let the student know if you learned something new or interesting from the project. This question is not scored, but an answer is required.

The project will be scored out of 33 total points.