Item 7: Conclusions and Reflections

7.A - Jinshui Wang

1. What technical information did you learn?
    a. Symbolic regression is the way to develop this machine learning project. I learned that the principle of symbolic regression and how to use it to train and predict data. One advantage of symbolic regression is that it can establish symbolic models without calculating prior knowledge(make it easy to build models).

2. What non-technical information did you learn?
    a. I learned some experience about the development process of the project and team communication. Learn more about how to work with others.

3. What have you learned about project work?
    a. Our project is about studying the population growth rates of species in the Intertidal zone of the Oregon Ocean. I learned about Marine species like mussels as a function of their own abundance versus the abundance of other species, temperature, time.

4. What have you learned about project management?
    a. We used Jira to manage the progress of our projects. A project management software(like Jira) is really good for tracking team processes .

5. What have you learned about working in teams?
    a. Communication is the most important thing in teamwork. Keeping teammates informed of Progress and obstacles can help each member keep up with the team's progress.

6. If you could do it all over, what would you do differently?
    a. I would be more deeply involved in adjusting the symbolic regression model. Symbolic regression is difficult to extract a simple and meaningful relational model from a large number of highly correlated predictive variables. Therefore, in the end, we need to use the model to cross-verify and predict the data results. In Addition, it has been pointed out in some studies that ecological analyses often include random effects to explain complex correlation ecological structures. I would do layered modeling again and include random effects in the sign regression to get a more accurate model.

7.B - Nour Rahal-Arabi

1. What technical information did you learn?
    a. I gained large amounts of experience and familiarity with gplearn, a python library providing symbolic regression implementations and utilities. Additionally, I learned about the intricacies of symbolic regression itself, including use cases, applications, and algorithms.

2. What non-technical information did you learn?
    a. I was exposed to different ecological research methods and the current state of species relationships on the Oregon coast. Our project partner is a researcher in the field of ecology, and as such provided the biological perspective on our project.

3. What have you learned about project work?
    a. Oftentimes, project goals, objectives, and expected outcomes are not necessarily predetermined or known. As was the case with our project, many of our research questions and goals stemmed from work that had been completed the previous week; it was very much an iterative process in terms of determining our desired knowledge/regression relationships.

4. What have you learned about project management?
    a. Communication on deliverables and project roles is essential for the success of any project. Our team utilized Jira and Discord in order to delegate weekly tasks and ensure timely delivery of our project goals; as such, I learned how to use these packages to facilitate project work.

5. What have you learned about working in teams?
    a. I further cemented my belief that consistent coordination and communication on progress, nuances, questions, and overall team chemistry will significantly increase the prospects for team success. Our team was successful in large part due to our willingness to maintain active lines of communication amongst ourselves, our TA, and our project partner.

6. If you could do it all over, what would you do differently?
    a. I would ensure that I spent far more time learning the ins and outs of gplearn - specifically the different symbolic regression parameters - before beginning the main phase of work on the project. I found that I spent a fair amount of time experimenting with and learning about the package while attempting to facilitate deliverables simultaneously.

7.C - Markus Bauer

1. What technical information did you learn?
    a. I learned a lot about machine learning practices and specifically about the symbolic regression technique. I had previous experience working with other types of regression but I had not learned about symbolic regression, which is different from traditional regressions as it does not assume prior models. By learning and working with symbolic regression, I became more familiar with typical machine learning practices and gained experience with genetic programming.

2. What non-technical information did you learn?
    a. Since our project was related to the field of ecology, I became familiar with intertidal marine species and learned a little about their population dynamics. This specifically included which species significantly impacted others.

3. What have you learned about project work?
    a. I learned that project work is doable, if not easier, virtually. Due to COVID, we began the project with strictly online meetings instead of in person. However, this actually increased our productivity and helped us get more work done. It's an interesting thing to consider since it seems that this is how work is now. In addition, I learned that project planning needs to have flexibility. The plan and timeline that we created at the beginning of the year was different than what actually happened due to our unfamiliarity with the topics we were working with. As a result, we began to plan on a more week to week basis, planning the next sprint when an old one was finished rather than planning a lot of them at once. This is something that is probably done in most work settings.

4. What have you learned about project management?
    a. I learned that the correct project management tools can make a significant difference and make project management a lot easier. During this project, I got familiar with working with JIRA which helped document our weekly sprints and backlogs. Using this made it easy to keep track of what work needed to be done and who was assigned what parts of the project.

5. What have you learned about working in teams?
    a. I learned that good teamwork relies more on consistent communication than anything else. Machine learning was a part of CS that many of us were not familiar with, however, working together with consistent meetings and communication via Discord allowed us to not only learn a lot about the topics we were working with, but also led to some quality work that our project partner was pleased with. In addition, good communication makes collaboration more enjoyable. Our team had good communication and worked enthusiastically together which made me appreciate them more and the overall process more pleasant.

6. If you could do it all over, what would you do differently?
    a. I would try to do more background research on ecology. Since our project was attempting to uncover ecological principles, more context on population dynamics would allow us to have a better understanding of the results we were getting from the regressor. Rather than having to wait for our weekly meeting with the stakeholder to understand the results from an ecological perspective, I could instead conceive one myself. I would also try to focus on having a deeper understanding of how the regressor parameters behaved prior to testing. Although we knew what each parameter controlled, the specific behavior of each parameter was uncovered as we conducted our testing. Being able to understand the behaviors beforehand would've saved us more time and allowed us to emphasize insights into the data.

7.D - Samson Mont

1. What technical information did you learn?
    a. I expanded on my previous knowledge and experience with machine learning by working with symbolic regression; the fine details of this machine learning technique comprised nearly all of my work on this project which allowed me to make great strides in this regard. I also made a fair amount of progress in understanding and appreciating the complexities of ecological systems and their related population dynamics.

2. What non-technical information did you learn?
    a. If I am being completely honest, no new or valuable non-technical skills were developed or even improved from what I could tell. The team was cohesive so we didn't need to problem solve in that way, everyone pulled weight, no major hiccups in project development occurred, and the technical writing and presentations this class required was repetitive at best. Nothing new or valuable was learned from these assignments to me personally.

3. What have you learned about project work?
    a. The biggest thing that I learned about project work is how much documentation and presentations bog down many different project's development. During Fall term it felt like no actual development could occur due to cookie cutter documentation templates that poorly matched our project stealing hours of work for many documents we didn't even look at for the remaining 6 months. During winter term, the weeks of presentations caused the project to come to a standstill while we worked on the assigned task. If we were assigned to produce documentation and presentations that were additive to the project, such as explorations of the dataset, explorations into the GPLearn Symbolic Regressor Package, or writings about other techniques for creating population dynamics, the amount of progress we could have made would have been much higher. I understand with a class this size the need for rubrics to grade quickly and efficiently, but I felt like I wasted most of my – and my teammates' time by writing for a grade rather than for applicable and meaningful knowledge into the specific nuances of our project.

4. What have you learned about project management?
    a. Similar to part 3, I found that project management can be overbearing and unnercersary and should be varied with the type of project. The bulk of our project was minor tweaks to the parameters, dataset tuning, and equation display; unironically creating a Gantt chart and assigning tasks was the most difficult part of the entire project. I can only speak for myself here, but the Gantt Chart proved to be entirely useless to me due to the nature and volatility of this style of project.

5. What have you learned about working in teams?
    a. Good teammates make all the difference. Too many times I have been assigned teams of individuals who put in little to no effort which leads to a terrible experience. Although I have many qualms with my experience in capstone, my team is not one of them. They

made the class tolerable and everyone pulled their weight. I am pleased to have had the opportunity to work with these 4 individuals and know that they will go on to do great work in their respective future careers.

6. If you could do it all over, what would you do differently?
    a. I wouldn't change anything, as the things that I would change are outside of my power to do so. I would say that I would have loved to put more time into the project, but I put in all the time I could spare, and then some, to make notable progress within the symbolic regressor model and finish the other capstone tasks.

7.B - Madelyn Smith

1. What technical information did you learn?
    a. I expanded on my previous knowledge and experience on conducting literature reviews, reading research papers, and managing references over time using Zotero. While reading, I also grew in my understanding and appreciation of ecological research and the value of modeling population dynamics.

2. What non-technical information did you learn?
    a. If anything, I really grew on my knowledge of how to conduct research and manage references using Zotero, but I'm not sure whether that is considered technical.

3. What have you learned about project work?
    a. It is important to work together across tasks. We were great at splitting up the work and delegating tasks, but I think I would have gotten much more out of this project if we collaborated more and discussed our individual contributions more.

4. What have you learned about project management?
    a. I enjoyed creating the gantt chart as this was the first time I used one. I also think the hardest part of project management is accurately predicting the scope of tasks when going into a project with no prior knowledge or experience.

5. What have you learned about working in teams?
    a. I had a great team, and they taught me the importance of meeting regularly. I also learned how difficult it is for me to stay engaged when I don't see my teammates in person.

6. If you could do it all over, what would you do differently?
    a. I would meet with my team in person throughout the year. I think it's much easier to engage and collaborate in person. I would also try to work with my teammates more on their technical tasks to maximize my growth.