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Coding Activities
Workflow for Instructor

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Overview
Most activities have a *ReadMe_Instructor.txt* file that provides basic instructions. Anyone wanting to use these activities should not hesitate to contact me with questions (current email at https://jesscg.github.io/).

Activities 1 to 6 focus on basic programming skills for working with RStudio, while exposing students to Cartesian coordinates. These activities are short (30-45 minutes). Instructors are encouraged to run through the activities themselves, ahead of the class, to make sure all steps are understood clearly and any supporting material is printed or obtained. Overall, it is a good idea to keep an intact copy of the R scripts for reference, in case students inadvertently modify commands.

Activities 7 through 10, and the UnitConversion activity will work similarly to the ones completed prior, but will start working towards analyzing wave images. Generally, these activities will take more time (60-120 minutes), and may need to be adapted to the mathematical skills of the students. Instructors are encouraged to complete activities ahead of time to determine how much background students will need and whether some questions should be removed. The students will already possess most of the RStudio skills necessary, so goals are centered on understanding waves, as well as programming, better. The Unit Conversion activity is not numbered because it can be completed at any time (before Activity 10), and the concept may need to be explained a few times.

Process_WaveTankData.R is a semi-automated script that encompasses all wave-related coding activities. It allows students to see how developing computer scripts can allow for more efficient repeated measurements. A presentation by students at the Ocean Discover Institute is included with this activity to see how data may be presented at the end of the project.

Unit Conversion Activity
Wave measurements will be done in RStudio, using what we will call graphing units. These measurements then need to be converted to physical units such as meters.

Suggestions:
- Introducing the topic of unit conversion early may be useful (centimeters to meters, days to hours to minutes to seconds).
- Students could take a picture of their group that includes a meter, which could be printed to show the idea that the meter can be used to measure objects in the picture, even if it is not a meter long on the picture.

Activity 7
This activity focuses on measuring characteristics associated with a wave (wavelength, amplitude, water depth), using a picture from the wave tank.

Suggestions:
- Double-check that the students are lining up the bottom ruler with the front of the tank

Activity 8
This activity focuses on plotting equations and doing calculations in RStudio. A linear wave equation is used for students to better understand what happens when they change the values of amplitude, wavelength, water height or phase shift.

Suggestions:
- It would be useful for students to draw what effects each parameter has on the wave in their notebooks. This could be revisited as a group at the end of class. Arrows can be used to show if the parameter was increased or decreased, and to show how it modifies the wave.

Activity 9
In this activity, students overlay their theoretical wave from Activity 8 on frames of waves that are 1/10 second apart (10 frames per second). The crests of the waves are identified and followed to calculate wave propagation speed.

Suggestions:
- Students may need help to know how to calculate speed. This could be covered prior to the RStudio activity (e.g. miles per hour in a car)

Activity 10
Activity 10 does not use RStudio, so it could be done in groups or with everyone at the same time. The Unit Conversion activity will need to have been completed prior to Activity 10 because the equations only work in meters. This activity lays the foundation for making predictions about other waves in the tank.

Suggestions:
- Explain to students that we have equations for deep water waves and shallow water waves, but there are also water depths when the wave are neither fully deep water waves nor shallow water waves. This is why the equations do not cover the full range of depths.

ProcessingWaveTankData Activity
This script combines all of the activities carried out this term into a more streamlined process, where students don't need to perform any calculations. It is worth emphasizing the advantage of programming to the students: once you took the time to test your calculations, you can simply have RStudio repeat them for you!

Suggestions:
- Have the students run through the code using the wave they previously analyzed and their notes. This shows the use of their notebook: if they have everything written down, they should be able to breeze through the analysis.
- Now that they can repeat their analysis in much less time, have them use the code to analyze the new data.
- Developing instructions for the code could be a good communication activity. Each group could be asked to develop a set of instructions for one section of the code and use them to walk the instructor through the code in front of the class. The students could use their previous instruction sheets for inspiration.