Pre-class assignment # 14

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PHY-905-002, Computational Astrophysics and Astrostatistics
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This assignment is due the evening of Sunday March 14, 2021. Turn in all materials via GitHub.

Reading:

1. Chapter 7 ("Euler Equations: Theory") of Mike Zingale's Computational Hydrodynamics Tutorial, which you can find in the pre-class assignment for Day 8. Focus on Sections 7.1 and 7.2, and ensure that you understand where each equation comes from using a ideal gas (constant γ) equation of state. Skim Section 7.3 and make sure you get the general concept.
2. Wikipedia page on the Rankine-Hugoniot jump conditions. This is a really useful resource for understanding how we derive the jump in conditions across shocks from both first principles and the Euler equations.

Your assignment: Work through the derivations in Sections 7.1 and 7.2 and make sure you understand the math, using an ideal gas law (constant γ) equation of state as needed. Answer the following questions in `ANSWERS.md`, and be prepared to discuss those answers in class:

1. Why might we want to use both the conserved form and primitive form of the Euler equations? In other words, what might each set of equations potentially tell us?
2. How are the Euler equations similar to the linear advection equation and/or Burgers' equation, and how are they different?
3. What's the point of all of the linear algebra in this chapter? In other words, what does it tell you about the Euler equations and how they propagate information?
4. What are the types of waves that are in the Riemann problem for the Euler equations? How does your answer differ from Burgers' equation? (And how does this relate to the previous question, about linear algebra?)
5. What, if anything, do you want to know more about the Euler equations after working through this chapter?
6. What are at least two questions that you have from the readings that you'd like us to address in class?

Handing it in: Submit via GitHub as usual. Include anything necessary, including code, plots, and your answers to the questions about the readings (in the file `ANSWERS.md`) as part of your assignment.