Homework 7: Research and Investigate a Metric Form

You may work alone or in a group of up to 2 people and turn in one per group.

Metric forms will be assigned on a **first come-first-served** basis in the choice selection feature on ASULearn. If you are working in a group, one person selects the metric form and the other selects the option "working with someone else who already selected our topic."

- Alcubierre metric or warp drive metric
- anti-de Sitter metric
- de Sitter metric for special relativity
- Eddington-Finkelstein coordinates
- Friedmann-Lemaître-Robertson-Walker (FLRW) metric
- Gödel metric
- Gullstrand-Painlevé coordinates
- Kerr metric
- Kerr-Newman rotating charged black hole metric
- Kruskal-Szekeres coordinates
- Lemaître coordinates
- Minkowski metric/space
- Reissner-Nordström metric
- Rindler coordinates
- Schwarzschild metric
- Taub-NUT metric
- Weyl-Lewis-Papapetrou coordinates
- Wormhole metric
- Other interesting metric forms may be approved

Research

Explore the following via researching and (keep track of ALL your references for #7).

1. Write down a metric form for your topic (like $ds^2 = ...$) and summarize what any variables stand for.

2. If it was named for a person or people, then summarize in your own words the related people who it was named for. Include full names as well as dates and look up where the people were from.

   If it was not named for anyone, then research related people who discovered or investigated it, and provides dates and where they were from.

3. Search MathSciNet

   https://library.appstate.edu/find-resources/databases/subject/mathematical-sciences

   for a journal article related to your metric. Note that if Gödel metric is your topic, you'll want to include "metric" in the title, but for the others you'll have better luck by searching with only the names(s), like anti-de Sitter instead of anti-de Sitter metric. Choose one article you find interesting and write down the full bibliographic reference from the MathSciNet database. You may search in physics or other databases if you prefer.

4. Summarize in your own words at least one physically interesting feature that relates to your topic, like perhaps connections to a concept like black holes, electric charge, energy, event horizon, heat, lightcones, mass, momentum, singularities, spin...

5. If you haven't already brought one in for the preceding question, then find one or two pictures that relate to your topic and summarize it in your own words. Wikipedia and Google images are a good place to search, but be sure to reference the original site (Google images is a database - it does not contain the images).

6. Summarize in your own words at least two geometric connections of your metric form to differential geometry, like perhaps null geodesics, timelike geodesics, curvatures, or other connections. One option be to research differential geometry connections. Another would be to modify the Maple file `http://cs.appstate.edu/~sjg/class/4140/Wormhole.mw` to calculate curvatures (if so, you'll need to modify and then execute the commands in Details of the Computations section too).

7. Give proper credit to your references for pictures and content. If you used Wikipedia for anything other than pictures, try to find the original scholarly sources.

8. You will turn in all of the above as a single pdf on ASULearn under 4/23 hw 7 submit a pdf. You can use software like CamScanner or similar to create the pdf. If you are working in a group then one of you submits the pdf (be sure both your names are on it).

   In addition, prepare a short informal forum posting for your classmates based on the following components:

   - the title of your posting lists the name of your metric
   - the metric form or a link to a webpage that shows the metric form
   - one person from #2 and where they were from
   - one physically interesting feature from #4
   - one geometric connection of your metric form to differential geometry from #6

   If you work in a group then you should try and post some different information than your partner did. Submit it in the think-pair-share forum activity for #8 from hw 7.

9. Then respond to at least one of your classmates postings, who selected a different metric than you did, in a meaningful way. You might pose questions, extend ideas, or compare and contrast their metric to yours. Another option would be for you to do some additional research on their metric and report what you found.