

Homework 7: Research and Investigate a Metric Form: Create a Video

You may work alone or in a group of up to 3 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 ASU Learn. If you are working in a group, one person selects the metric form and the other(s) select 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). You will create a video in your own words and your own writing or typing, but you may use pictures from elsewhere (with proper reference).

1. Write down a metric form (like $ds^2 = \dots$) for your topic and summarize in your own words what any variables stand for.
2. 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 a person who discovered or investigated it.
3. Search MathSciNet

<https://library.appstate.edu/find-resources/databases/subject/mathematical-sciences> for journal articles 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.

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 one geometric connection 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 in scholarly sources. Another would be to modify the Maple file <http://cs.appstate.edu/~sjg/class/4140/Wormhole.mw> to calculate curvatures.
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, or equivalent.

Create a video

Practice communication skills and review and solidify a concept from class as you create a short real-time video. Here, real-time communication includes real-time handwriting on a board or paper, or real-time manipulations on a computer, and real-time audio and video. Your face, voice, and other communication must be present in the video all at the same time, at all times, although you may begin with some text already there.

Start by introducing yourself and listing the topic you chose (first-come-first served on ASULearn). Pretend you are presenting to the class in real time, but these can be more polished since you can plan, re-record and make revisions if needed. As time allows, we may watch a few of these during class, so they should be aimed at your classmates.

Recording from a phone, computer, or tablet is the method I would expect many to use. Another option is the Library Technology Checkout Desk <https://library.appstate.edu/rooms-spaces/technology-checkout-desk>, which allows you to check out digital equipment, including camcorders. The library also has private study rooms with whiteboards that you can book and record in. If you want to borrow a marker for a whiteboard, I can lend that to you. Taping up paper and writing on that with a marker is another option. I can also help you film during office hours—for example we could set up my laptop to record you.

Upload your video to your school YouTube channel as follows:

1. First be sure that you are logged in to your school Gmail account.
2. Then upload your video at <https://www.youtube.com/upload>

Note: if you are uploading from a phone, you might need to first select YouTube, and then log in to your school account.

3. Change the privacy setting to **Unlisted** and copy the web address for the video.
4. Next send me the video link in the private forum on ASULearn <https://asulearn.appstate.edu/>

Rubric

- starts by introducing yourself and listing the topic you chose
- is in your own words, and own writing and typing, with the exception of pictures
- clear, correct, and responds to #1–7 in the Research portion above
- flows well and is professional
- includes real-time handwriting or manipulations, and at the same time, real-time audio and video of you making eye contact. Your face, voice, and other communication must be present in the video all at the same time, at all times, although you may begin with some text already there.
- (if working with a partner) subdivide the communication equally