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Physics 39907 Computational Physics
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Computational Project

The project consists of four parts, which follow the typical way research is conducted in physics:

(1) *Proposal:* A key aspect of research is obtaining funding for a project. This is typically achieved by submitting a proposal to a funding agency like the National Science Foundation. For this project you only have to convince me. The proposal should be a pdf with the following sections:
- *Statement of Problem:* Brief statement of the problem you will solve.
- *Scientific Merit:* Why is the problem important or interesting?
- *Method:* Outline of how you will solve the problem.
- *Proof of Concept:* Any concrete evidence that demonstrated the method will work. This could be a small or simplified example calculation or a reference to a similar calculation.

(2) *Computation:* Here you develop your method and codes to do the computations and make figures to demonstrate the results.

(3) *10 minute talk:* Once you have done your research, it is important to let others know about your work. On the last day of class you will present your work using electronic slides. These could be made in LaTeX, PowerPoint, Keynote, or any other presentation software. We will follow the format of the American Physical Society March Meeting, the largest meeting of physicists. The talk should be 10 minutes, with 2 minutes for question. You will turn in your slides with the paper. Here are some guidelines for preparing the slides:
- You must have a title slide that has a short, but descriptive title with your name and affiliation (e.g., The City College of New York, Physics Department).
- Give a motivation for the project.
- Generally it takes at least one-minute to discuss a slide. So for a 10 minute talk plan for about 10 slides.
- One idea per slide.
- Spend more time on results than methods.
- No extra words. You should have a specific reason for each word on a slide. Long list will distract the listener.
- Curate your ideas. Quality over quantity: Include only details needed to explain the most important ideas well.
- A picture is worth a thousand words.
- Figures should be BIG. They should fill the page if possible. They should have clear labels. Any numbers on the slides should be large enough to read. Eliminate numbers that are not needed.
- Order your ideas to aid understanding of the results not the process that lead to the results.
- A conclusion slide is useful to make sure you did not miss anything important and to summarize the most important results.
- Future directions slide suggest next steps for your project.

Here are a few tips for giving the talk:
- Practice, but do not memorize the talk. Use the slides as cue cards.
- When you are giving the talk, and you realize you forgot something. Do not worry or apologise, the audience does not know that you skipped something. Say something like "Let me also point out..." then go back to the point you missed.

- Keep the audience in mind. Look toward the audience, but not at any individual.
- Have a way in mind to give a definitive end to the talk. For example, "Thanks for your attention."

(4) *Paper:* Publication of your results is the final goal of research. This is just a written form of your presentation. Here you will bring everything together into a short (no more than 4 pages) paper in the style of Physical Review Letters, one of the most prestigious physics journals. The full style can be found in this LaTeXtemplate https://www.overleaf.com/latex/templates/revtex-4-dot-2-template-and-sample/yydsrzvrqrzs. A simple example pdf and source tex and bib files can be found here: https://gibbs.ccny.cuny.edu/teaching/f2023/PSets/minPRL/. Here is an example of an actual article: Jamming of Deformable Particles [pdf]. Here are some guidelines for each section of the paper:

- *Abstract:* The abstract is a short explanation of your paper. It should include a brief (one sentence) motivation for the research; your results including any numbers you measured with units and error estimates; any brief description of any novel methods.
- *Introduction:* Broad overview of the problem, why the problem is interesting, relevant prior studies, and a detailed statement of the problem.
- *Methods:* Detailed explanation of your methods. This is not a cookbook recipe, but a theoretical explanation. It should contain all relevant information needed for another physicist to reproduce your work.
- *Figures:* One figure per page is a good starting point, but a figure could contain multiple panels. The figures should tell a story. From the figures and the captions, the reader should be able understand the main idea of your paper.
- *Results:* State and discuss your results by reference to the figures but fill in details. Sometimes this section is called "Discussion", or "Results" and "Discussion" are separated into two sections.
- *Conclusions:* The conclusions should summarize the main message of the paper and put the results in context for future work.
- *Acknowledgements:* Anyone you want to thank.
- *References:* List of references. If you use a bib file as in the simple example this section will be generated for you.