

# Paper

Use the following description of a scientific paper as guideline for the two papers of your main project. The first paper should include the title, the “introduction/background”, the “model/method” and the “references”, which are cited in these parts of the paper. In the second and final paper you will write the complete paper (revisit the sections of the first paper for changes.) For both papers use a more formal writing style than you will use in your oral presentation.

**Audience:** Your audience will be juniors and seniors who most likely do not have your background. Include therefore all information which is necessary to understand your project.

## **Examples:**

- D. Chowdhury, L. Santen and A. Schadschneider, “Vehicular Traffic: A System of Interacting particles Driven Far From Equilibrium,” *Curr. Sci. India* **77**, 411 (1999).
- all scientific papers you have read for your project.

## **Contents:**

- Title
- Author(s), Address
- Abstract: An abstract is a summary of what you did and your results. The abstract is for a reader who might not have time to read the rest of your paper or who decides depending on your abstract if she or he reads the whole paper. The abstract should be understandable without the rest of the paper and should contain: the system you study, the model, the method and the results.
- Text: The following text should be understandable by itself. Reference any information which you used from other sources or which includes details not necessary for the reader’s understanding.
  - Introduction/Background<sup>1</sup>:  
This section might give some historical background and/or necessary background information. You might talk about other models than the one you use. The Introduction also serves as a motivation for why your project is of specific interest and importance. The main purpose of the introduction is to put your project into context and to give a general description of your project. For a more specific description of this section for your project, see my comments to your bibliographies. You might end your introduction with an outline of the rest of the paper.

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<sup>1</sup>Sometimes this is split into two sections

- Model:  
In this section you describe your model exactly. This includes for example the dimension of your system, whether you use a lattice and all applied rules (as e.g. the steps in the Nagel-Schreckenberg traffic flow model). In principle, after reading your description any reader should be able to write the program with exactly the same model as yours. For a more specific description what this section should contain for your projects, use my comments to your bibliography/model.
- Theory:  
You may not need this section. This is a section one uses if there are analytical calculations possible. For theoreticians this is the main section. <sup>2</sup>
- Simulation:<sup>3</sup>  
This section includes the method you use. For the second paper you will include in this section a specification of all parameters used in your simulation. Your description needs to specify all details which are necessary to reproduce your simulation results, for example for the game of life you specify the initial configuration, the number of time steps, the lattice size, and the boundary conditions. <sup>4</sup>
- Results:  
This section describes the results of your project. It can include tables, formulae and figures. Tables and figures should have captions. Figure captions should have text which is a one-liner summary of what the figure shows. All formulae should be numbered.
- Conclusions/Discussion:  
In this section you draw conclusions of your results and you might include what one could do in future work.
- References:  
This is the bibliography of all references to which you refer in the text.

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<sup>2</sup>**Deb**, you should include here what can be proven about prime numbers. How is density defined? Hich predictions about e.g. density of prime numbers can be proven and or have been tested numerically. **John**, you should present the exact solution to the two-body problem. **Evan**, you might want to present the theory for specific cases of the prisoner’s dilemma extensions when analytic calculations are possible (infinite number of players).

<sup>3</sup>This section is often combined with the section “Model.”

<sup>4</sup>**John**, in your case you will need to explain molecular dynamics simulations, in specific the Euler step or Runge-Kutta step for  $N$  particles in  $d$  dimensions. **Garrett** in your case the specifics of the numerical integration/iteration need to be explained. **Rob & Kerry** if you plan to use artificial intelligence, you will have to explain the basic concepts and methods here.