# In-Class Work: Mini-Project III

I will start class with showing the complete implementation of the Nagel-Schreckenberg traffic flow model which is in

```
~kvollmay/share.dir/inclass2023.dir/traffic9.py
```

And will show a few of the resulting spacetime diagrams.

Today you will work again in groups of two on assigned mini-projects (see below to which group and project you belong). All of you will do analysis using the Nagel-Schreckenberg traffic flow model.

We define the mean velocity at time $t$ as

$$v_{\mathrm{av}}(t) = \frac{1}{N} \sum_{i=0}^{N-1} v_i(t) \qquad (1)$$

## Mini-Project III.1 (Wuji and Chris)

Copy into your working directory `~kvollmay/share.dir/inclass2023.dir/traffic10_miniIII1.py`

**III 1a:**

Look at this program and confirm that it determines $v_{\mathrm{av}}(t)$.

**III 1b:**

Run this program for `PDEC=0.0`, `VMAX=4` and for `PCAR=0.1` (and `MAXTIMESTEPS=300`). Look at the result.

**III 1c:**

Run this program also for the following `PCAR=0.2, 0.3, 0.4, 0.6, 0.8`.

**III 1d:**

Make one figure $v_{\mathrm{av}}(t)$ with all investigated `PCAR`. Today is not enough time for making talk slides, instead your result for today is one figure. So for your group this means $v_{\mathrm{av}}(t)$ for `PDEC=0.0` and all investigated `PCAR`. Label your result with what it shows. Put your graph (eps-file or xmgrace-file) into your `~/share.dir` and give read permission. We will all look at your result and try to interpret (just words are fine) your results.

**III 1e: (if time)**

If you have time left, you may want to also determine

$$j_{\mathrm{av}}(t) = c \star v_{\mathrm{av}}(t) \qquad (1)$$

where $c$ is the concentration of cars, which is the (number of cars) devided by the (ROADLENGTH). Print a third column with $j_{\mathrm{av}}(t)$ for the different values of PCAR as before and make a figure of $j_{\mathrm{av}}(t)$ with again all different PCAR curves in one figure.

## Mini-Project III.2 (Gwynne and Amin)

Copy into your working directory `~kvollmay/share.dir/inclass2023.dir/traffic10_miniIII1.py`

**III 2a:**

Look at this program and confirm that it determines $v_{\rm av}(t)$.

**III 2b:**

Run this program for `PDEC=0.25`, `VMAX=4` and for `PCAR=0.1` (and `MAXTIMESTEPS=300`). Look at the result.

**III 2c:**

Run this program also for the following `PCAR=0.2, 0.3, 0.4, 0.6, 0.8`.

**III 2d:**

Make one figure $v_{\rm av}(t)$ with all investigated `PCAR`. Today is not enough time for making talk slides, instead your result for today is one figure. So for your group this means $v_{\rm av}(t)$ for `PDEC=0.25` and all investigated `PCAR`. Label your result with what it shows. Put your graph (eps-file or xmgrace-file) into your `~/share.dir` and give read permission. We will all look at your result and try to interpret (just words are fine) your results.

**III 2e: (if time)**

If you have time left, you may want to also determine

$$j_{\rm av}(t) = c \star v_{\rm av}(t) \quad (1)$$

where $c$ is the concentration of cars, which is the (number of cars) devided by the (ROADLENGTH). Print a third column with $j_{\rm av}(t)$ for the different values of PCAR as before and make a figure of $j_{\rm av}(t)$ with again all different PCAR curves in one figure.

## Mini-Project III.3 (Will and Michael)

Copy into your working directory `~kvollmay/share.dir/inclass2023.dir/traffic11_miniIII3.py`

**III 3a:** You will see from the previous groups that $\text{v}_{\rm av}(t)$ equilibrates after some time to some value $v_{\rm eq}$ around which $v_{\rm av}$ fluctuates. Your group will determine the average of the long time limit of $v_{\rm av}(t)$ as function of $c$. Confirm that `traffic11_miniIII3.py` indeed determines

$$v_{\rm eq}(c) = \frac{1}{(t_{\rm tot} - t_{\rm eq})} \sum_{t>t_{\rm eq}}^{t_{\rm tot}} v_{\rm av}(t) \qquad . \qquad (6)$$

We now want to see how $v_{\rm eq}$ depends on the concentration of cars

$$c = \texttt{nocars/double(ROADLENGTH)} \qquad . \qquad (7)$$

There is no need to understand the theoretical values. I will explain them if there will be enough time in class.

**III 3b:**

Run this program for `PDEC=0.0`. This will take a few minutes. Look at the result.

**III 3c:**

Ensure to keep `PDEC=0.0` (this is specific to your group) and run the program three times to get results for `VMAX=3` and `VMAX=4` and `VMAX=5`.

**III 3d:**

Make one figure $v_{\rm eq}(c)$ with all investigated `VMAX`. Today is not enough time for making talk slides, instead your result for today is one figure. So for your group this means $v_{\rm eq}(c)$ for

PDEC=0 and all investigated VMAX. Label your result with what it shows. Put your graph (eps-file or xmgrace-file) into your ~/share.dir and give read permission. We will all look at your result and try to interpret (just words are fine) your results.

**III 3e: (if time)**

If you have time, you may include the theoretical curve. (I will discuss this in class.)

**III 3f: (if time)**

Now use PDEC=0.25 and run the program again for VMAX=3 and VMAX=4 and VMAX=5. Make another figure with these three curves. (There is no theory for this)