Answers to theory questions LB

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1 Pros and cons of LB

1.1 Pros

- Explicit update rule, no system of equations to solve.
  - Done by doing a trick. Introduce a new distribution function and see that the sum over states give the same global quantities.
- Easy to parallelize.
  - Each cell only depend locally on the neighbouring cells in the streaming step and only on itself in the collision.
- Simulating mesoscale
  - Unlike NS, LB looks at distributions of "bunches" of particles. May catch behaviour too fine for NS to detect.
- Can handle multiphase flows relatively easy.
  - Usually done by modifying the collision operator.

1.2 Cons

- Explicit update rule
  - Need small timesteps.
  - Finite propagation speed of information.
- Only using a square grid can be limiting.

2 Convective-/viscous term

Consider the boltzmann equation,

$$\frac{\delta f}{\delta t} + \vec{v} \cdot \nabla f = -\Delta(f - f^{eq}), \tag{1}$$

and the BGK approximation

$$i\Delta(f - f^{eq}) = -\frac{1}{\tau}(f - f^{eq}) \tag{2}$$

3 Linear LBM to non-linear NSE

4 Conservation of mass and momentum in the collision rule

5 Conservation of mass and momentum in the streaming rule