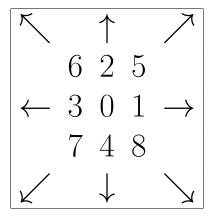
Lattice Boltzmann Slide 1/8

### Geometry D2Q9



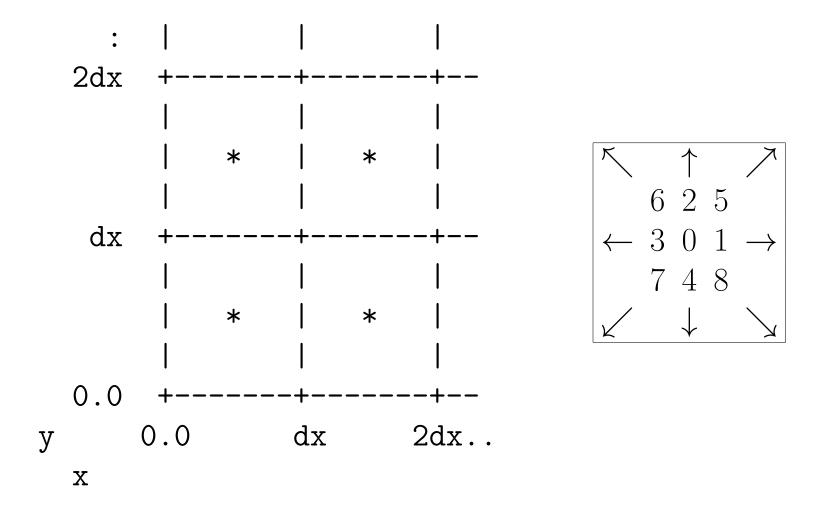
#### Lattice Boltzmann

- No explicit Calculus in the method.
- Straightforward to parallelize.

Lattice Boltzmann Slide 2/8

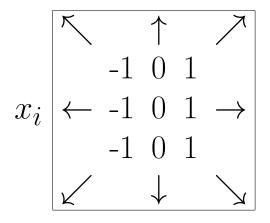
# Grid

Lattice Boltzmann Slide 3/8



Lattice Boltzmann Slide 4/8

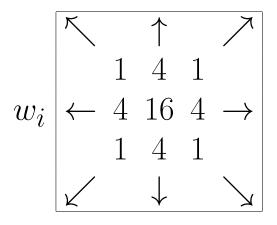
#### Vectors



$$y_i \leftarrow \begin{array}{c|c} \uparrow & \uparrow \\ 1 & 1 & 1 \\ \leftarrow & 0 & 0 & 0 \\ & -1 & -1 & -1 \\ \swarrow & \downarrow & \searrow \end{array}$$

Lattice Boltzmann Slide 5/8

### Weights



$$\hat{w}_{i} \leftarrow \frac{1}{36} \frac{1}{9} \frac{1}{36} \\
\leftarrow \frac{1}{9} \frac{4}{9} \frac{1}{9} \rightarrow \\
= \frac{1}{36} \frac{1}{9} \frac{1}{36} \\
\leftarrow \frac{1}{36} \frac{1}{9} \frac{1}{36} \rightarrow \\
= \frac{1}{36} \frac{1}{9} \frac{1}{9} \rightarrow \\$$

Lattice Boltzmann

## Parameters, for example

$$\bullet \Delta x = 0.004$$

• 
$$\nu = 0.0025$$

$$\bullet \omega = 1.5$$

$$\bullet$$
  $c = \Delta x / \Delta t$ 

$$\bullet \ \sigma = 5/12$$

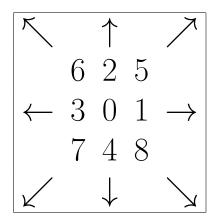
$$\bullet \lambda = 1/3$$

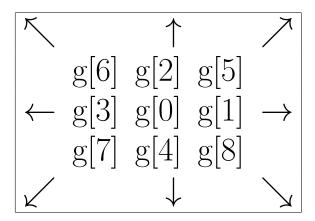
Parallel Computing

Slide 6/8

Lattice Boltzmann Slide 7/8

#### Distribution, g





- $\bullet$  At first just read all the g's from our gfield.txt file.
- In this case the grid size  $LX \times LY$  is  $250 \times 250$ .

Lattice Boltzmann Slide 8/8

#### Flow Field

• Velocity components sum over each g.

$$v_x = \sum_{i} (cx_i g_i)$$
$$v_y = \sum_{i} (cy_i g_i)$$

• Incompressible. Pressure also a sum.

$$p = \frac{c^2}{4\sigma} \cdot \left( \frac{1.5\hat{w}_0(v \cdot v)}{c^2} + \sum_{i \neq 0} g_i \right)$$