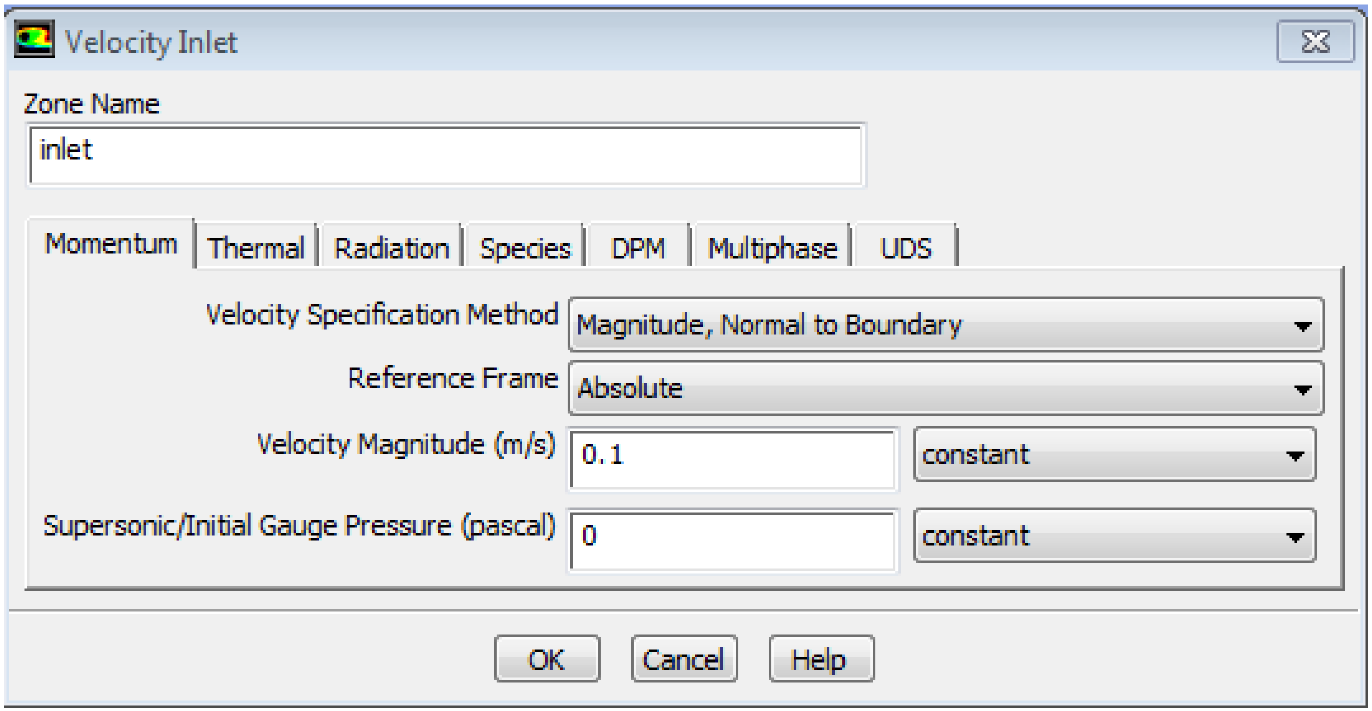
Boundary Conditions

Available BC types in Fluent

- Inlet
  - Velocity inlet
  - Pressure inlet
  - Mass flow inlet
  - Inlet vent
  - Intake fan
- Exit
  - Pressure outlet
  - Pressure far-field
  - Outflow
  - Exhaust fan
- Wall
  - Symmetric
  - Axisymmetric
  - Periodic

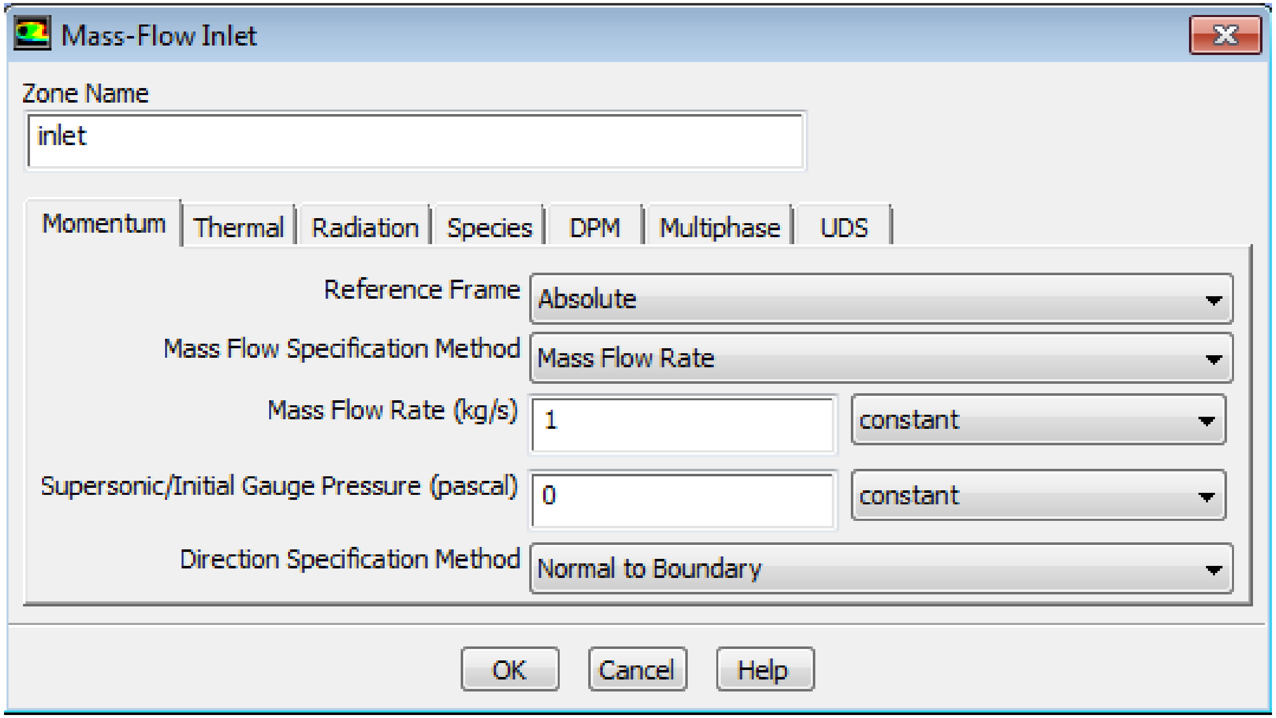
Velocity inlet

- Define the velocity and scalar properties of the flow at the boundary



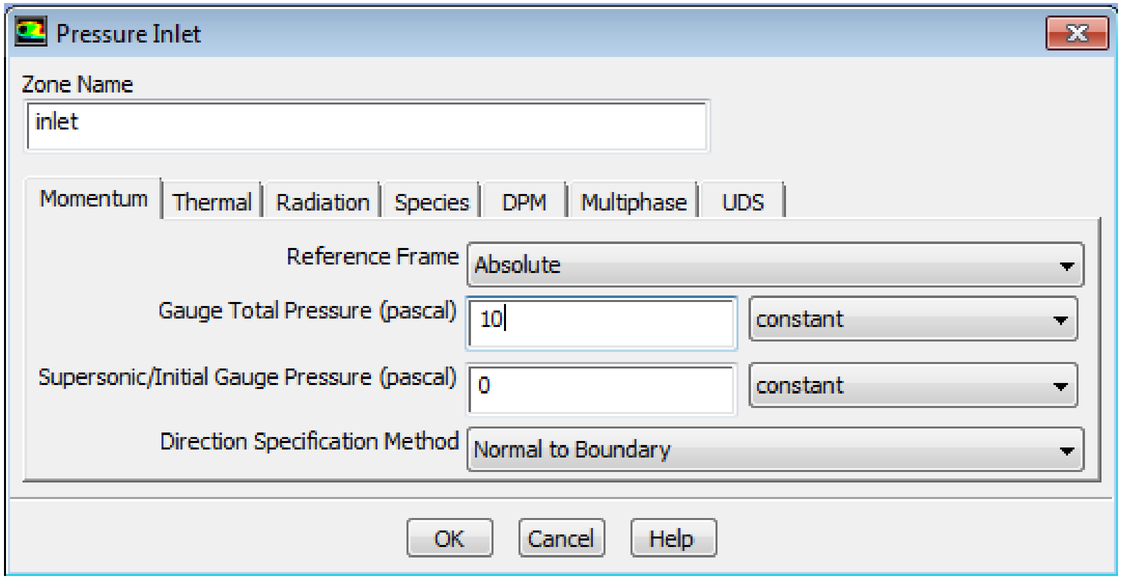
Mass flow inlet

- Define the mass flow rate for compressible flows at the boundary



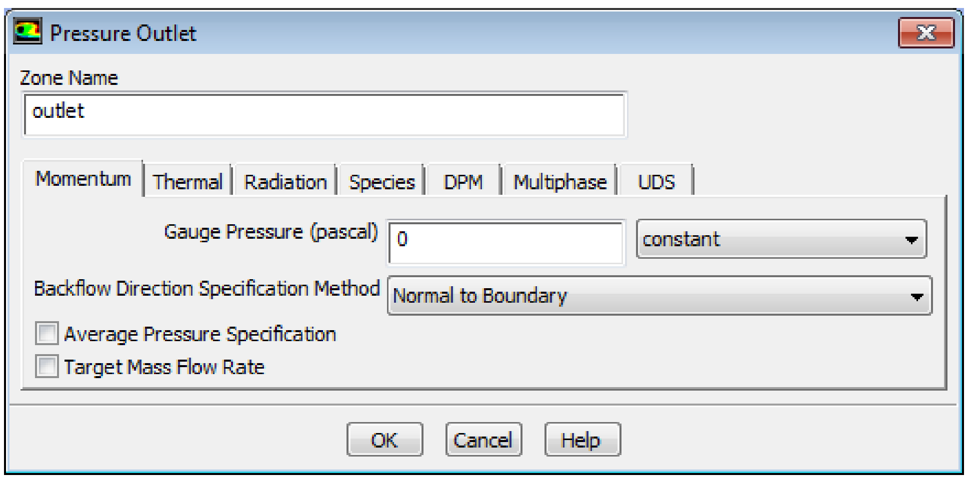
Pressure inlet

- Define the total pressure and other scalar properties at the boundary
- $p_{\text{total}} = p_{\text{static}} + 0.5\rho v^2$



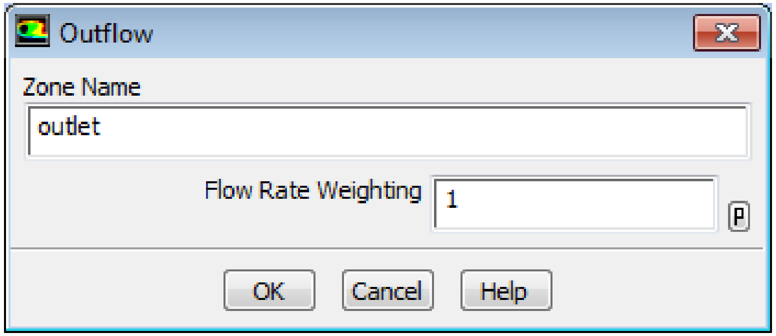
Pressure outlet

- Define the static pressure (and also other scalar variables, in case of backflow) at the boundary



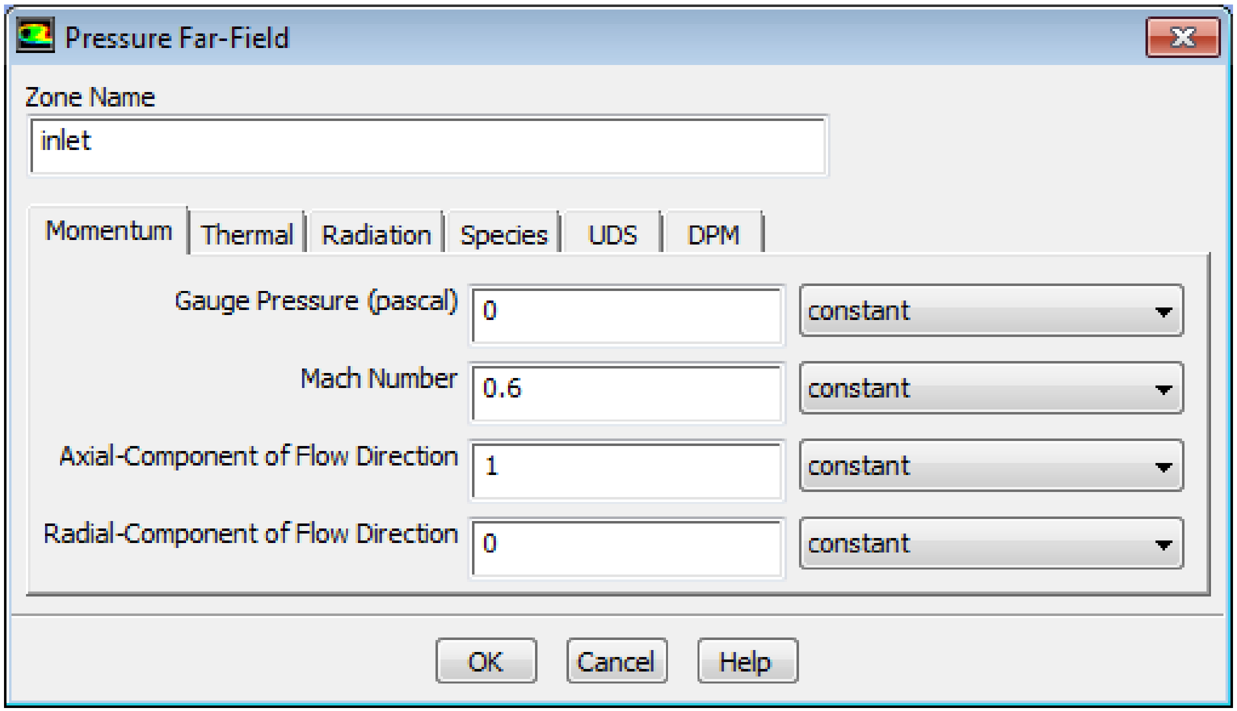
Outflow

- Assume zero streamwise gradient for all flow variables except pressure
- Not appropriate for compressible flows
- Cannot use with pressure inlet



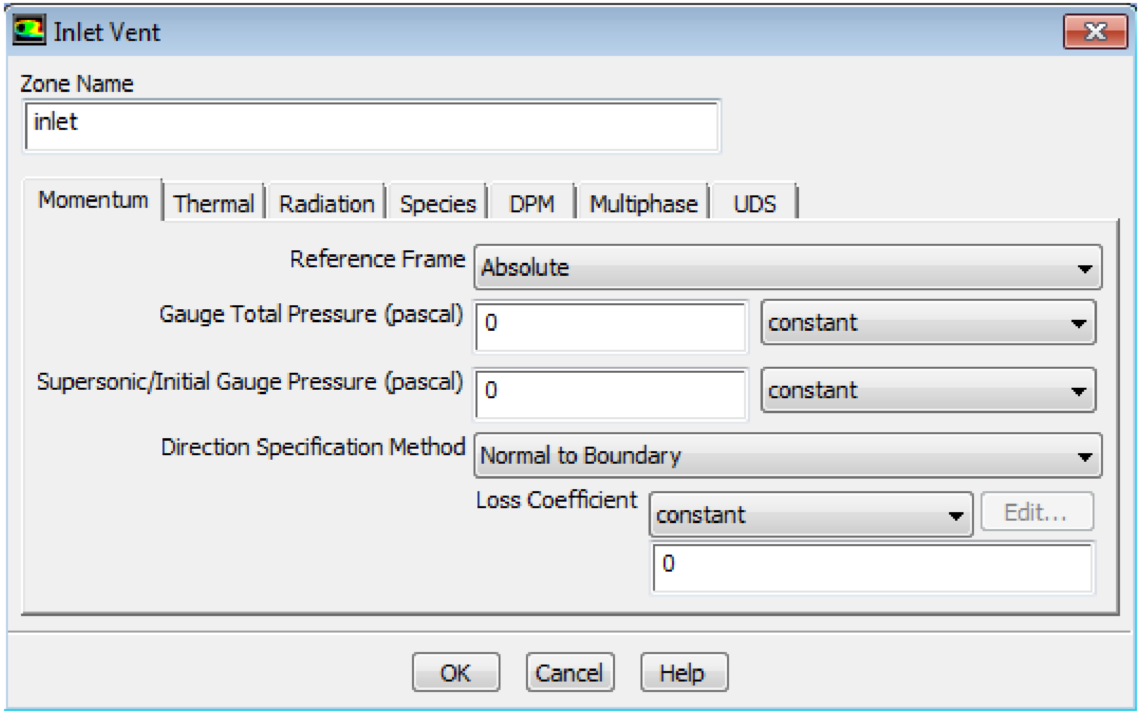
Pressure far-field

- Model a free-stream compressible flow at infinity



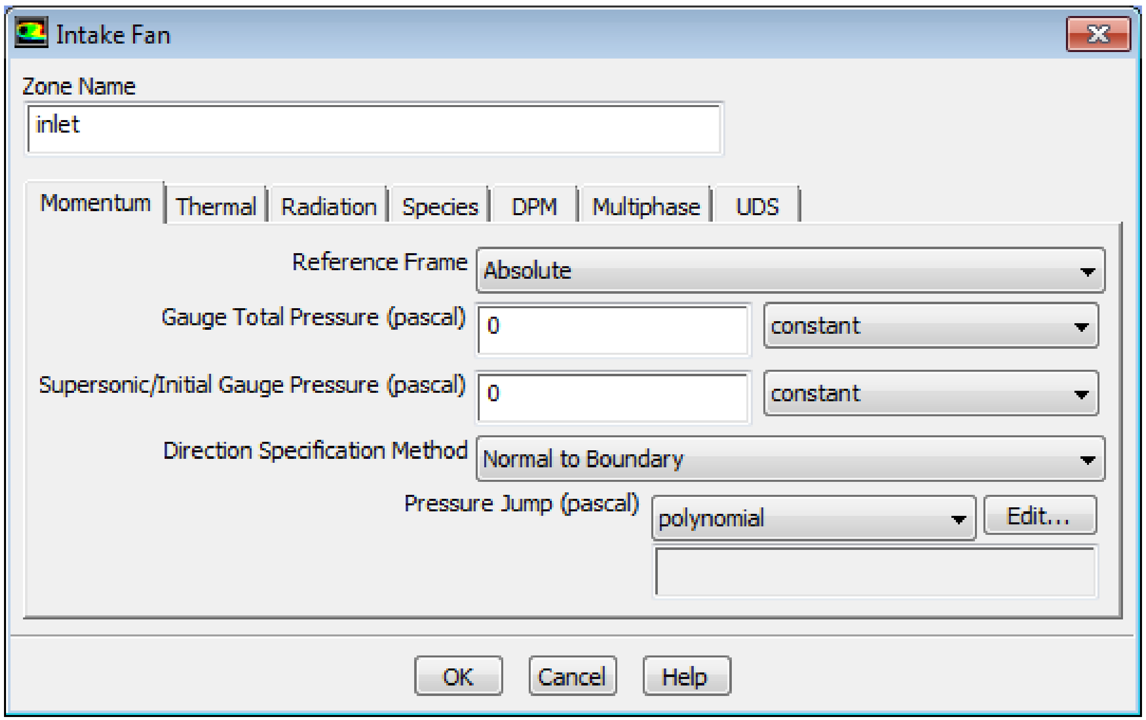
Inlet/outlet vent

- Model an inlet/outlet vent with a specified loss coefficient



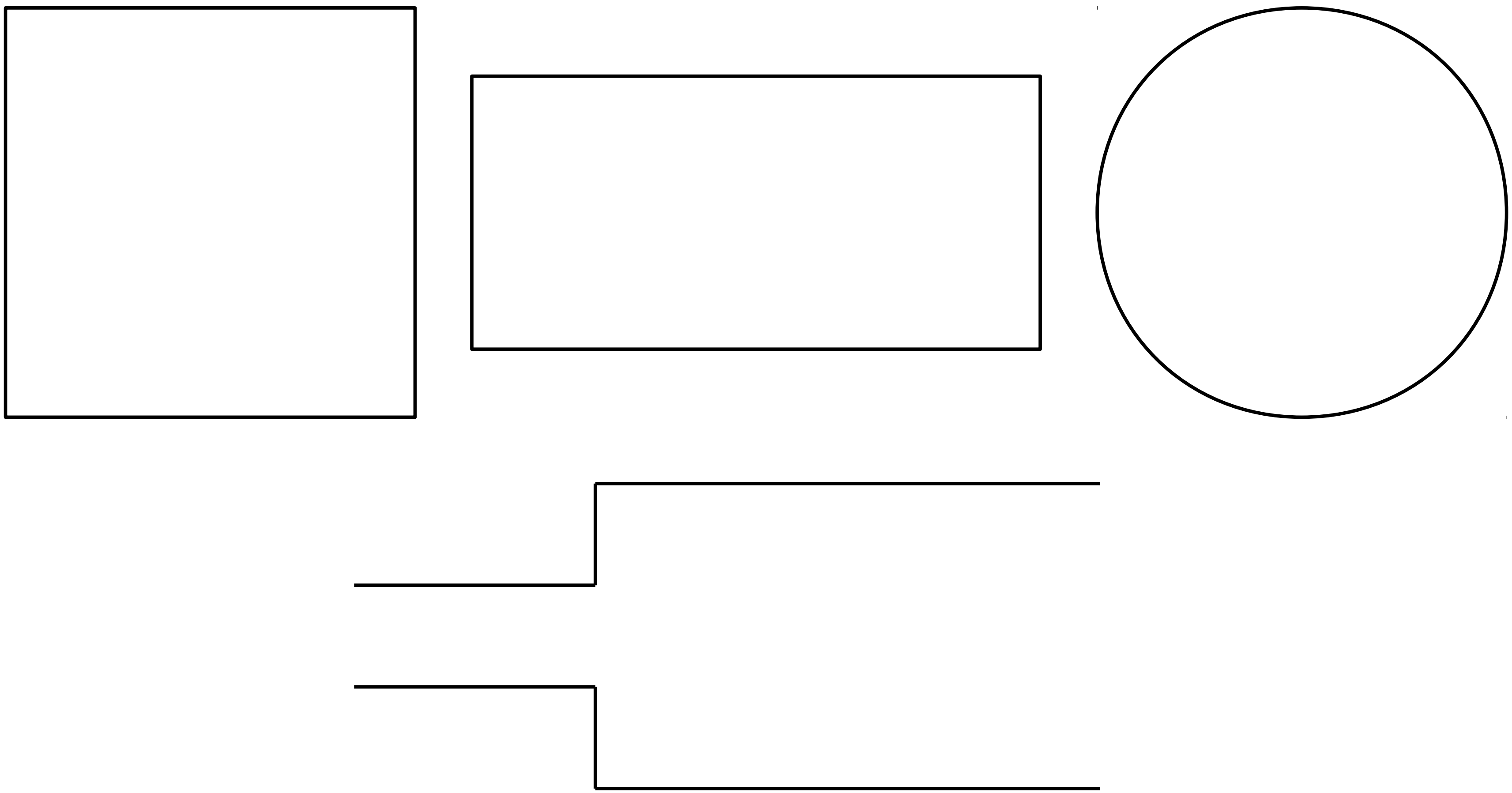
Intake/exhaust fan

- Model an external intake/exhaust fan with a specified pressure jump

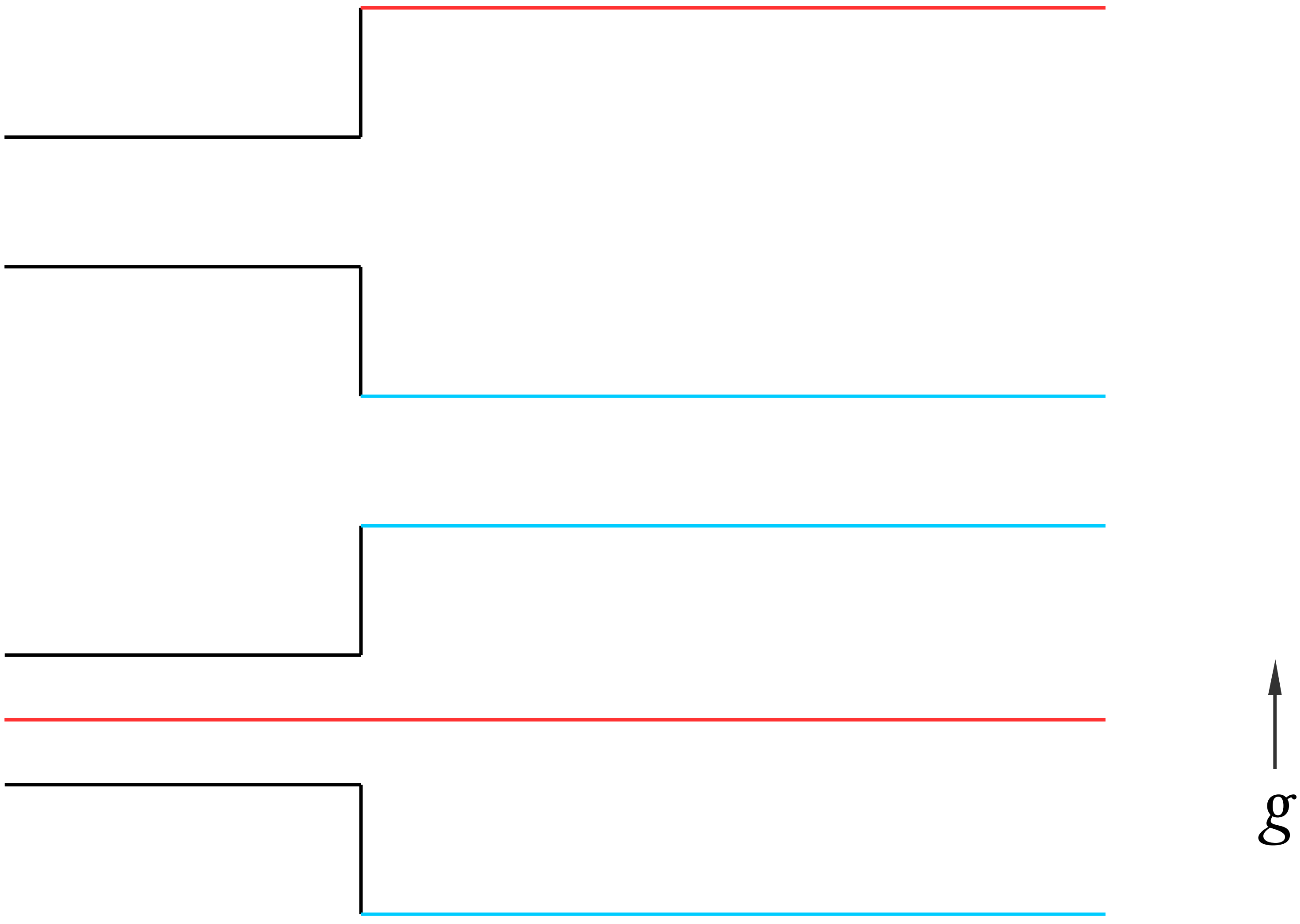


Symmetry BC

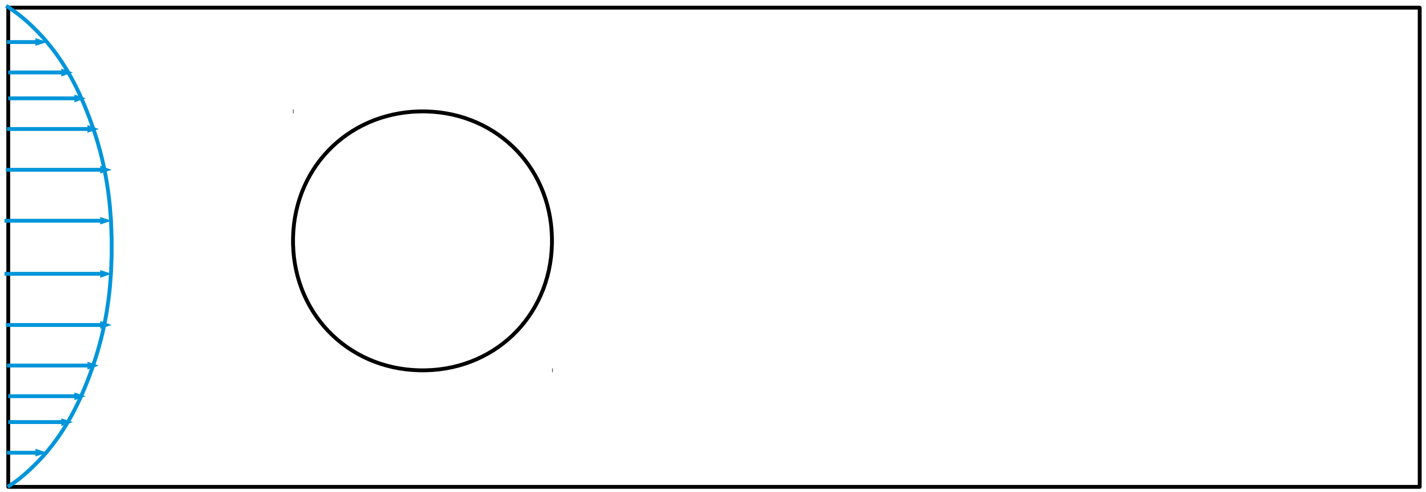
Are these domains symmetric?



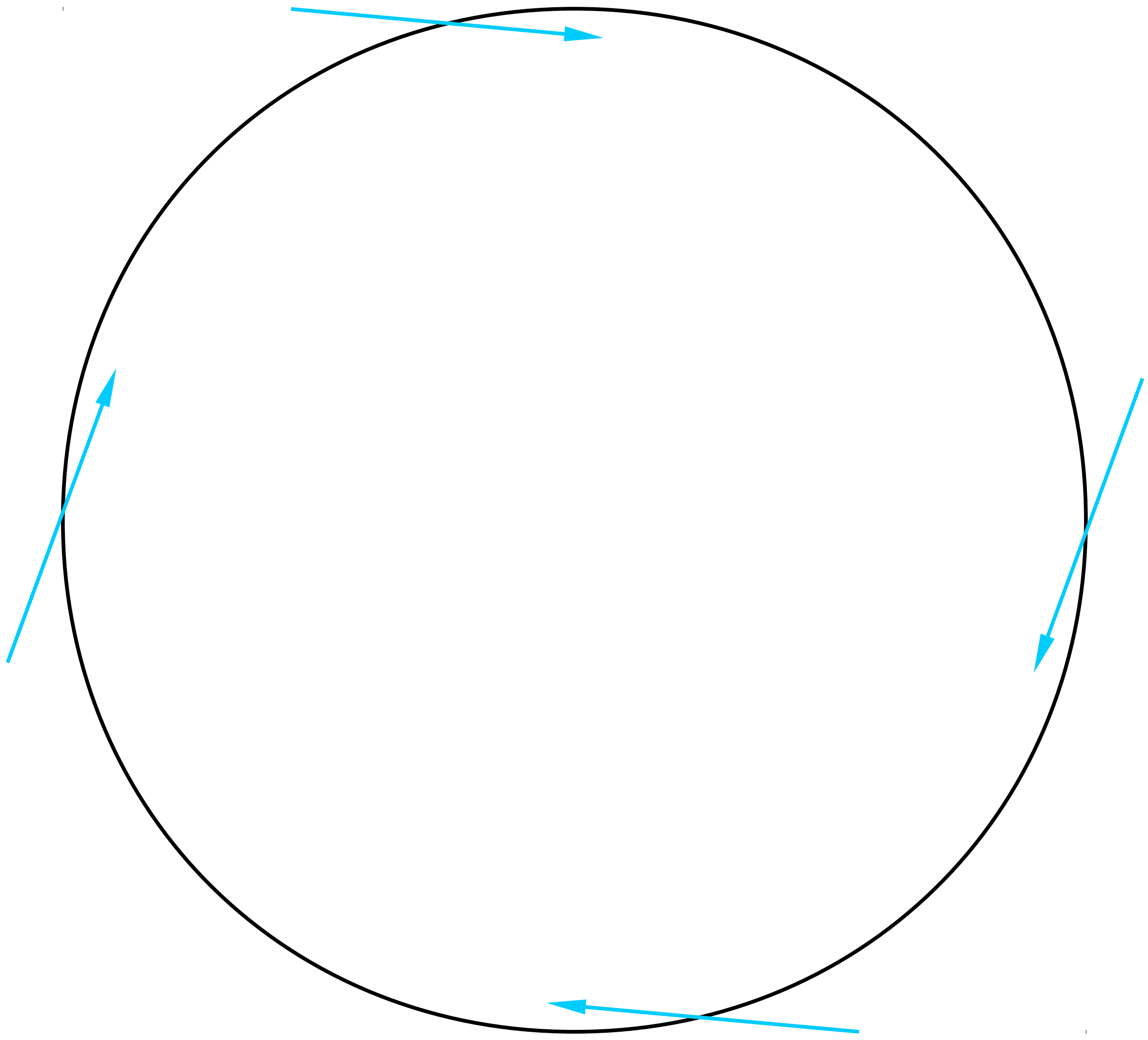
Are these domains symmetric?



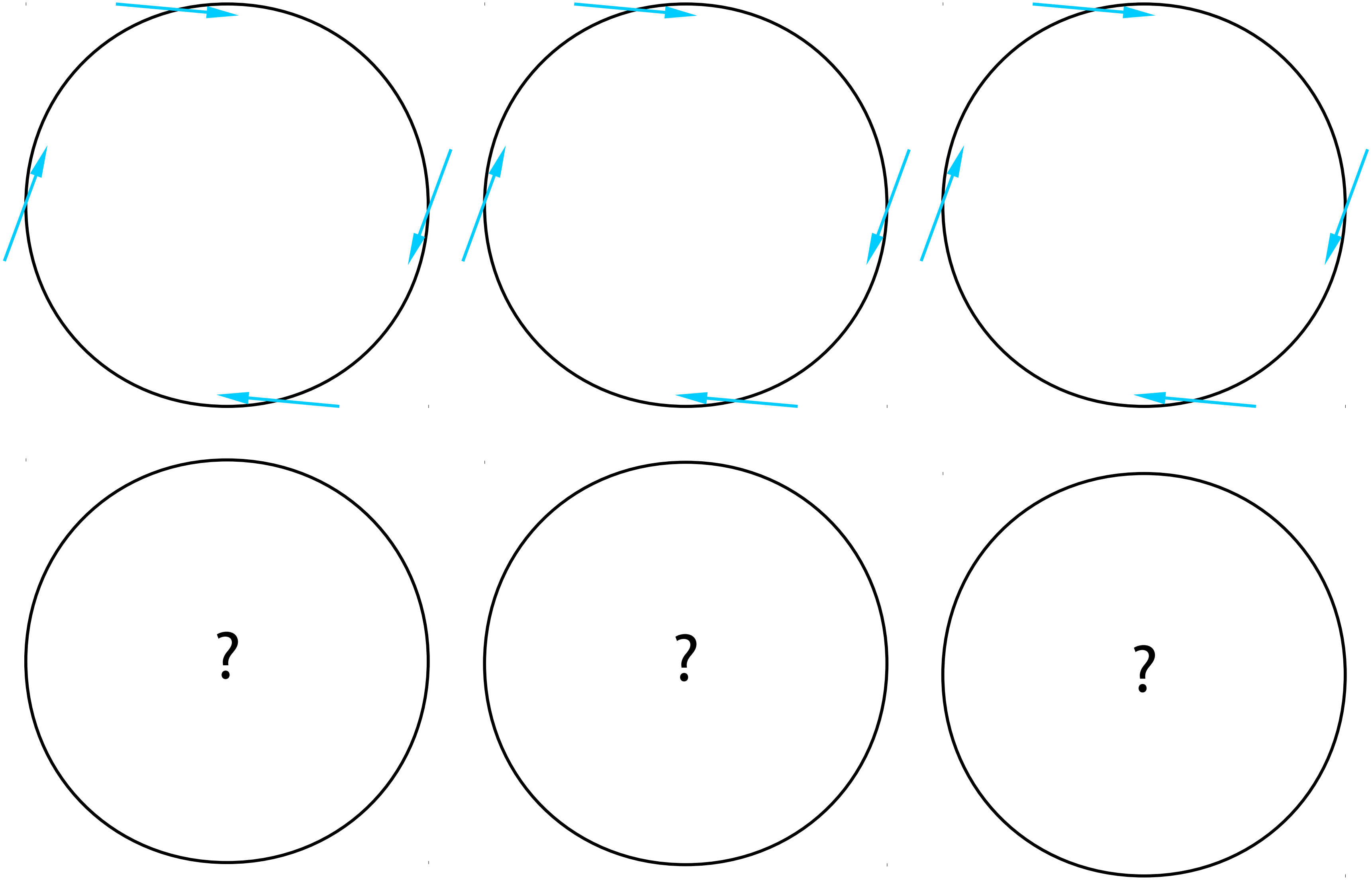
Are these domains symmetric?



How do we symmetrize this domain?



How do we symmetrize this domain?



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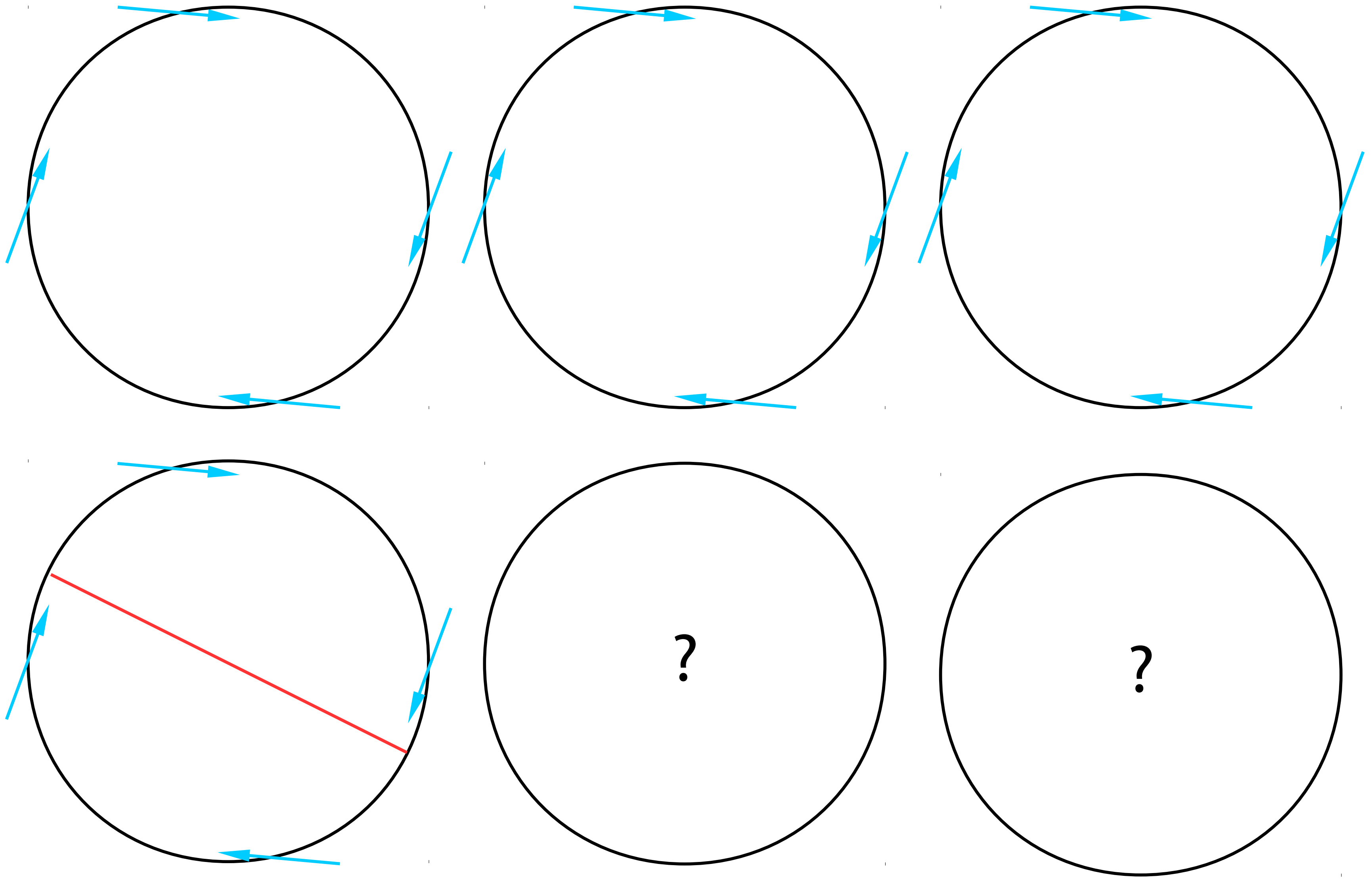
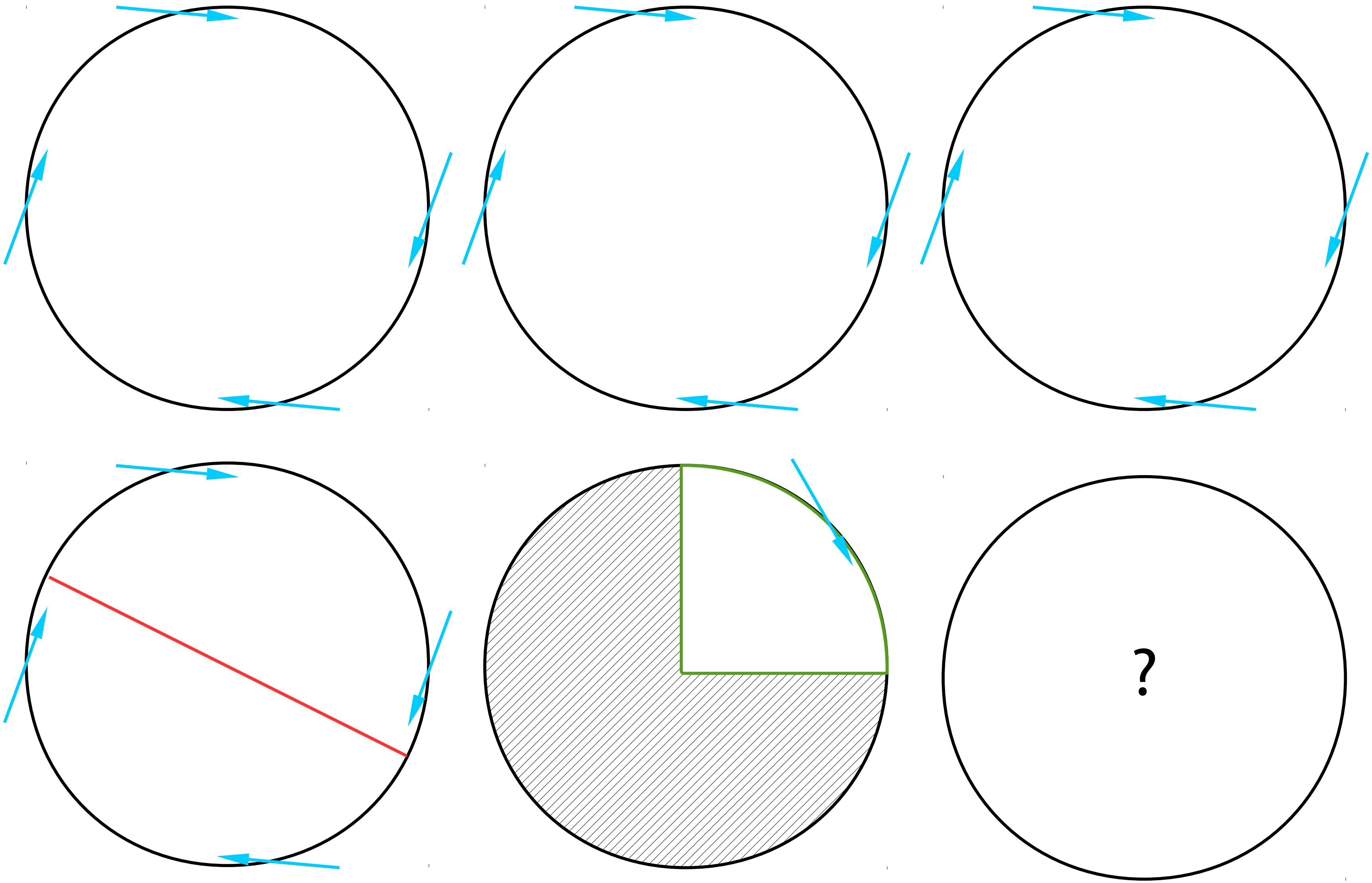


How do we symmetrize this domain?



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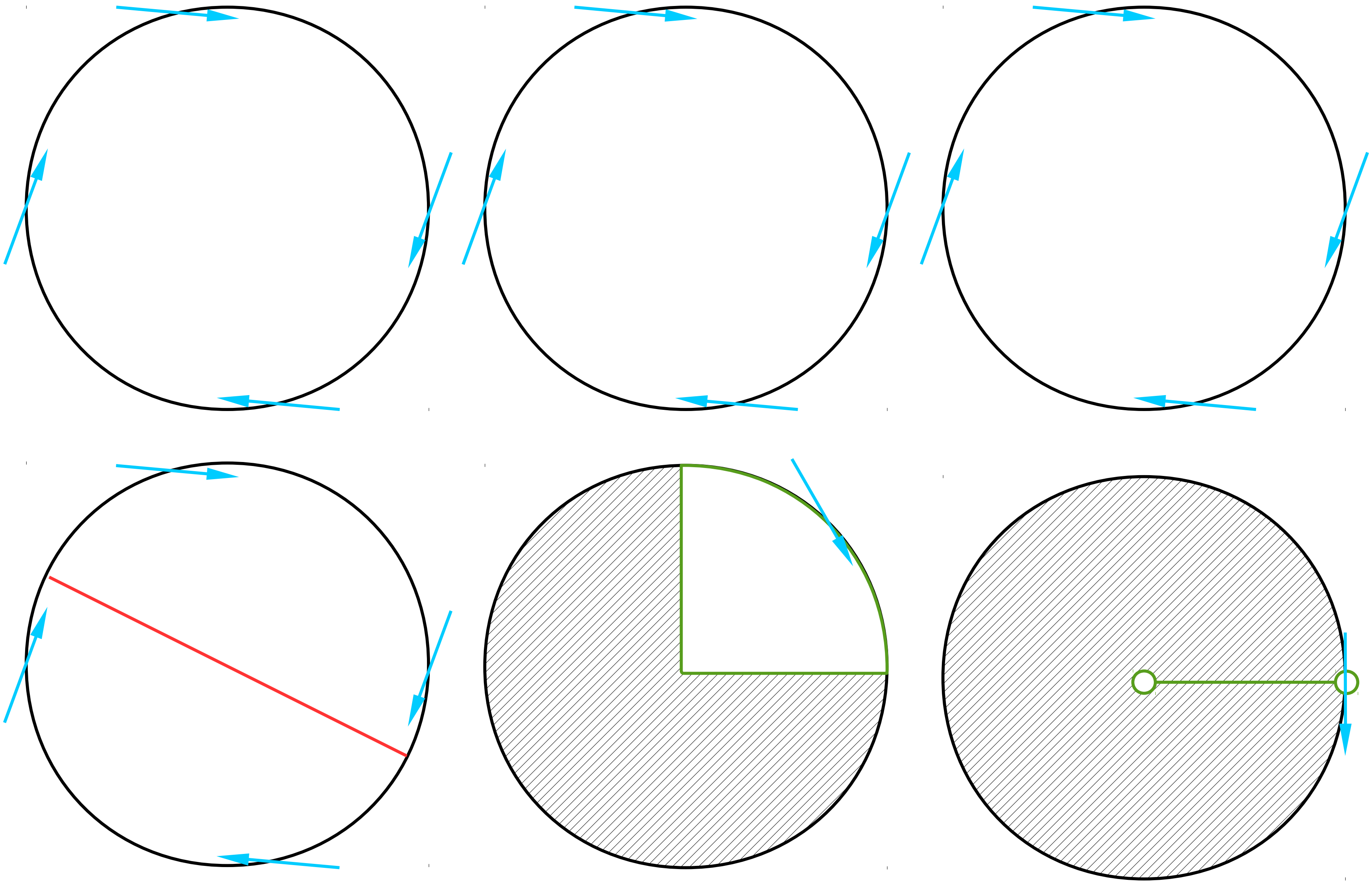

UDF C Macro Language

- `DEFINE_PROFILE`—specify profile condition on boundary face zone
- `DEFINE_TRANSIENT_PROFILE`—specify profile condition on boundary face zone as function of time
- `DEFINE_PROPERTY`—specify material property (density, viscosity, thermal conductivity, rate of strain, mixing laws, ...)
- `DEFINE_SOURCE`—specify custom source term (mass, momentum, energy, species mass fractions, radiation model, user-defined scalars); written for *single* cell

UDF: DEFINE_PROFILE

$$p(y) = 1.1 \times 10^5 - 0.1 \times 10^5 \left(\frac{y}{0.0745}\right)^2$$

```
/*********************************************************************
  UDF for specifying steady-state parabolic pressure profile boundary
  profile for a turbine vane
 *********************************************************************/

#include "udf.h"
DEFINE_PROFILE(pressure_profile,t,i)
{
  real x[ND_ND];
  real y;
  face_t f;
  begin_f_loop(f,t)
  /* this will hold the position vector */
  {
    F_CENTROID(x,f,t);
    y = x[1];
    F_PROFILE(f,t,i) = 1.1e5 - y*y/(.0745*.0745)*0.1e5;
  }
  end_f_loop(f,t)
}
```

UDF: DEFINE_PROPERTY

```
/**********************************************************************
  UDF that simulates solidification by specifying a temperature-
  dependent viscosity property
 **********************************************************************/
#include "udf.h"
DEFINE_PROPERTY(cell_viscosity,c,t)
{
  real mu_lam;
  real temp = C_T(c,t);
  if (temp > 288.)
    mu_lam = 5.5e-3;
  else if (temp > 286.)
    mu_lam = 143.2135 - 0.49725 * temp;
  else
    mu_lam = 1.;
  return mu_lam;
}
```

UDF: DEFINE_SOURCE

$$source = -0.5 C_2 \rho y \mid v_x \mid v_x$$

```
/*******************************************************************
  UDF for specifying an x-momentum source term in a spatially
  dependent porous media
 *******************************************************************/
#include "udf.h"
#define C2 100.0
DEFINE_SOURCE(xmom_source,c,t,dS,eqn)
{
  real x[ND_ND];
  real con, source;
  C_CENTROID(x,c,t);
  con = C2*0.5*C_R(c,t)*x[1];
  source = -con*fabs(C_U(c, t))*C_U(c,t);
  dS[eqn] = -2.*con*fabs(C_U(c,t));
  return source;
}
```