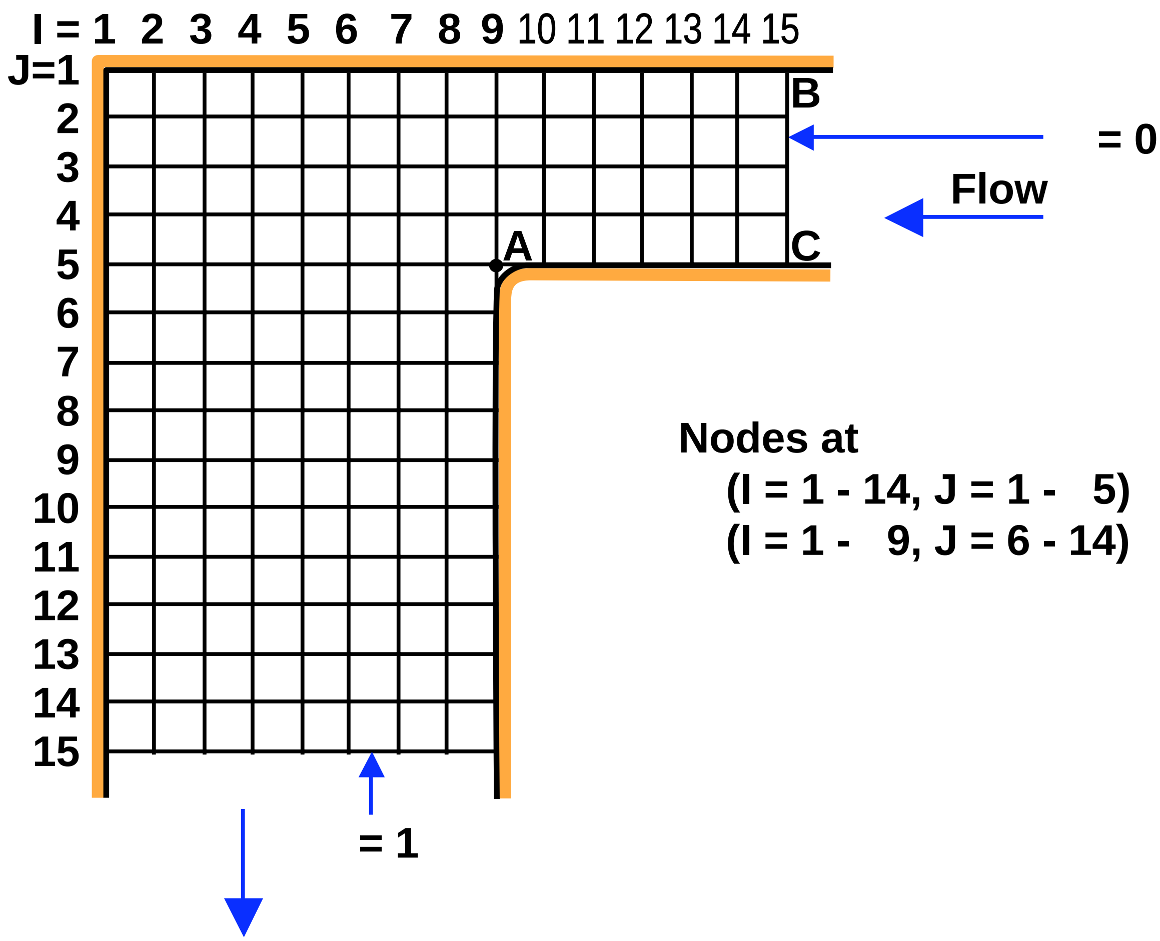
Problem 134B

Obtain a numerical solution to the planar, potential flow around a bend using the grid sketched below.



The upstream and downstream boundaries to be used are $\phi = 0$ and $\phi = 1$ respectively. You are not required use any special procedures to treat the singular behaviour near the projecting corner. You are advised to use an iterative method with over-relaxation and, by trial and error, to find an effective value of the over-relaxation factor which improves the convergence of the iterative process. Find:

(a) The velocity potential at all of the nodes and, in particular, the node A.

(b) If the volume averaged velocity, U, at inlet (BC) is unity find the velocity distributions along both the interior and exterior walls. It is best to evaluate the velocity at points on the walls midway between the nodes.

(c) If the pressure coefficient is defined as $(p - p_B)/\frac{1}{2}\rho U^2$ where p is the pressure, p_B is the pressure at the point B and ρ is the fluid density, find the pressure coefficient along both the interior and exterior walls. It is best to evaluate the pressures at the same points at which the velocities were evaluated.