AerE 546 **Homework 6** 11/3/15

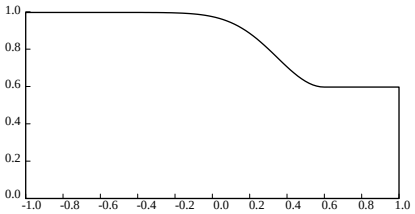
Due in two weeks

Exercise 1, *Grid generation*

Write a code to generate a grid by the two surface method, ensuring orthogonality at the walls (see notes on BlackBoard).

a) Generate an H-grid for the geometry given in equation (1) (see figure). The grid size should be on the order of 50×50, but you can choose the exact value to see the grid clearly.

$$\left.\begin{array}{ll} \text{Lower wall: } y = 0, & -1 \le x \le 1 \\ \text{Upper wall: } y = 1 - 0.4e^{-8(0.6-x)^2} & -1 \le x \le 0.6 \\ \qquad\qquad y = 0.6, & 0.6 \le x \le 1.0 \end{array}\right\} \quad (1)$$



b) Generate an O-grid, of size N_θ =51, $N_r = 30$, between the surfaces (ellipse and circle)
$x_{in} = \cos(\theta)$, $y_{in} = 0.3\sin(\theta)$ and
$x_{out} = 3\cos(\theta)$, $y_{out} = 3\sin(\theta)$, $0 \le \theta < 2\pi$

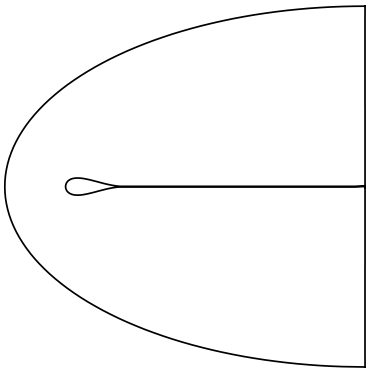
c) Generate a 101×51, C-grid between the surfaces (half ellipse and airfoil)

$x_{out} = 1.8 - 1.5\cos(\theta)$, $y_{out} = 0.75\sin(\theta)$, $-\pi/2 \le \theta < \pi/2$

x_{in} lies between 0.55 and 1.8
(E.g. $x_{in} = 0.55 + 1.25[(2i - I - 1))/(I-1)]^2$ where I is odd.)

$y_{in} = 0$, for $0.8 < x < 1.8$

$y_{in} = \pm 4(0.8 - x)^2\sqrt{x - 0.55}$, with 2 values + and −, for each $0.55 < x < 0.8$



Hand in plots of each grid. Submit the algorithm part of your code, including how $(x, y)_{in}$ and $(x, y)_{out}$ are defined.

Exercise 2, *Metrics*

Write a code to evaluate the metrics (see lecture notes). Start the code by reading the grid as an array of x and y coordinates. To test your code, compute $u = -\partial_y \Psi$ for $\Psi = \sin(\pi y)\sin(\pi x)$ using the chain rule $\partial_y \Psi = (\partial\xi/\partial y)\partial_\xi \Psi + (\partial\eta/\partial y)\partial_\eta \Psi$.

- Illustrate your test by providing a contour plot of $u(x, y)$ in the duct geometry of the previous problem.
- Submit your code