

# ECE 461/661 Handout #31

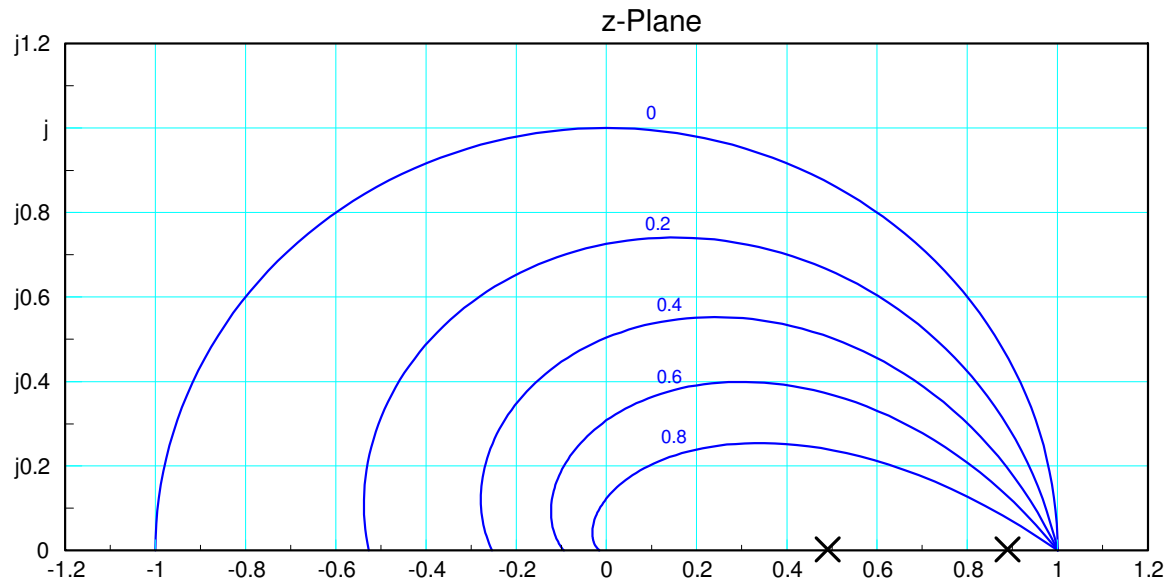
Root Locus in the z-Plane

Sketch the root locus of

$$G(z) = \left( \frac{0.2}{(z-0.9)(z-0.5)} \right)$$

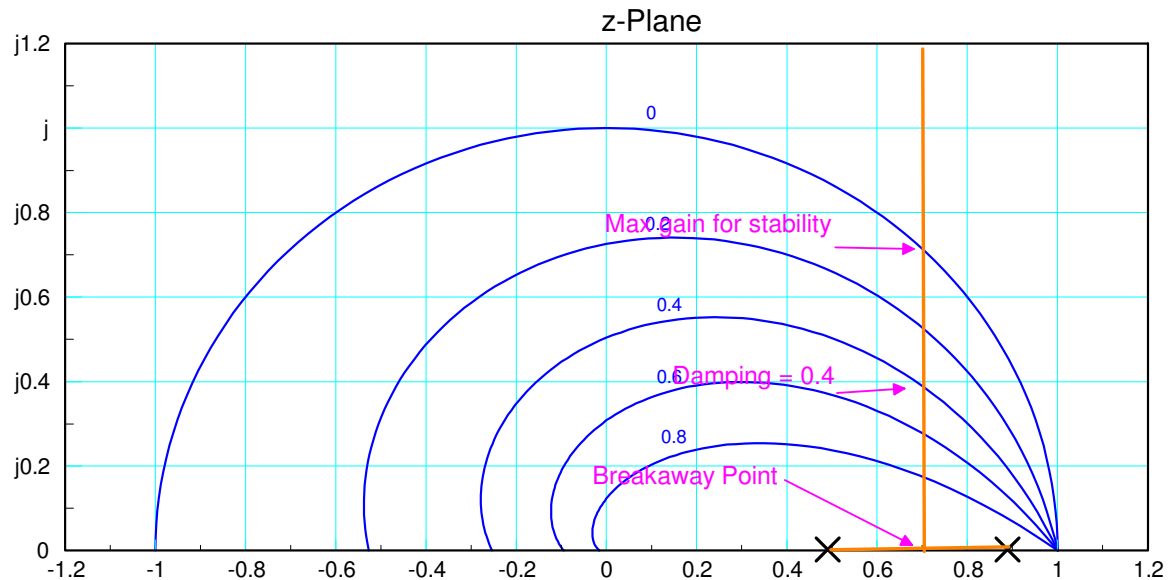
Find k for

- The breakaway point
- A damping ratio of 0.4
- The maximum gain for stability



Solution: Sketch the root locus of

$$G(z) = \left( \frac{0.2}{(z-0.9)(z-0.5)} \right)$$



Breakaway Point

$$z = 0.7 + j0$$

$$\left( \frac{0.2}{(z-0.9)(z-0.5)} \right)_{z=0.7} = 5 \angle 180^\circ$$

$$k = \frac{1}{5} = 0.2000$$

Damping Ratio = 0.7

$$z \approx 0.7 + j0.38$$

$$\left( \frac{0.2}{(z-0.9)(z-0.5)} \right)_{z=0.7+j0.38} = 1.0846 \angle 180^\circ$$

$$k = \frac{1}{1.0846} = 0.9220$$

Damping Ratio = 0 (max gain for stability)

$$z = 0.7 + j0.7141$$

$$\left( \frac{0.2}{(z-0.9)(z-0.5)} \right)_{z=0.7+j0.7141} = 0.3637 \angle 180^\circ$$

$$k = \frac{1}{0.3637} = 2.7597$$