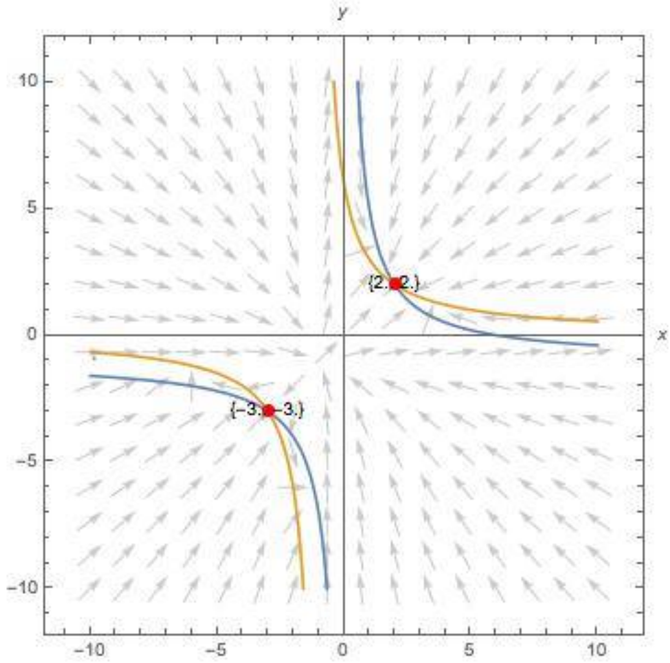
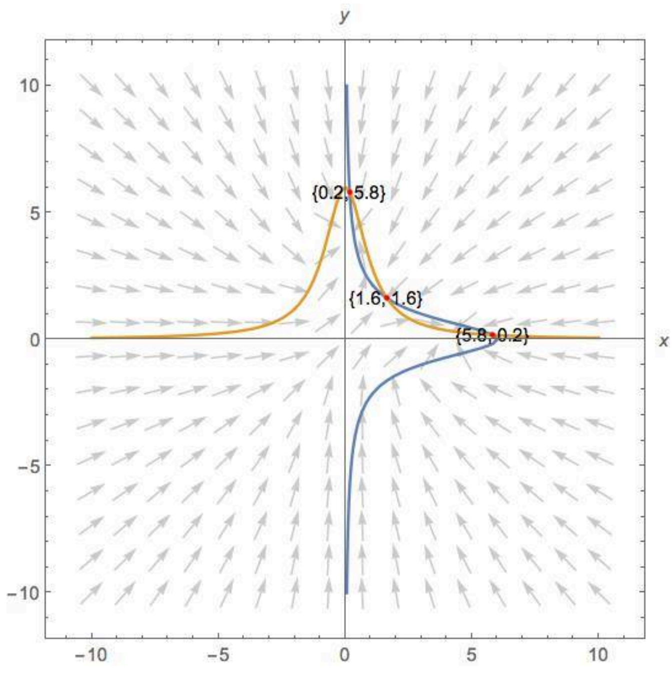
1.

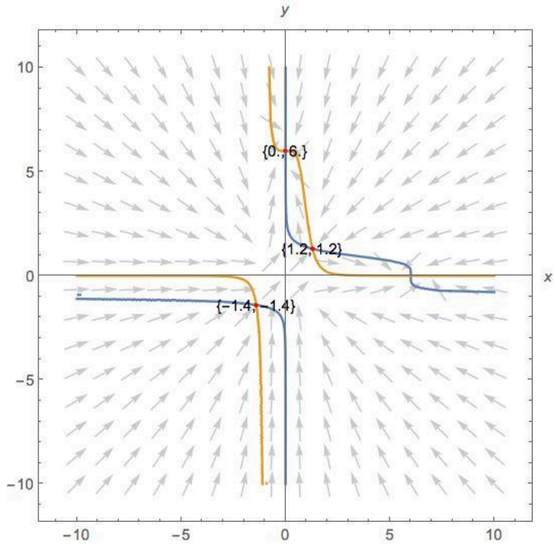
n=1 (2,2) stable



n=2 (0.2, 5.8), (5.8,0.2) stable/ (1.6,1.6) unstable



n=5 (0,6),(6,0) stable/ (1.2,1.2) unstable



1b.

$$\frac{dm}{dt} = \alpha_m\left(1 - Probability_{goff}\right) - \gamma_m[m]$$

$$\frac{dm}{dt} = \alpha_m\left(1 - Probabilty_{A_{unbound}} * Probabiluty_{P_{unbound}}\right) - \gamma_m[m]$$

$$\frac{dm}{dt} = \alpha_m\left(1 - \frac{[A]}{k1 + [A]} * \frac{[P]^2}{k2^2 + [P]^2}\right) - \gamma_m[m]$$

$$[m]_{ss} = \frac{\alpha_m}{\gamma_m}\left(\frac{[A]}{k1 + [A]} * \frac{[P]^2}{k2^2 + [P]^2}\right)$$

$$\frac{dP}{dt} = \frac{\alpha_m \alpha_p}{\gamma_m}\left(1 - \frac{[A]}{k1 + [A]} * \frac{[P]^2}{k2^2 + [P]^2}\right) - \gamma_p[P]$$

$$\frac{dP}{dt} = \frac{\alpha_m \alpha_p}{\gamma_m}\left(\frac{[A]}{k1 + [A]} + \frac{[P]^2}{k2^2 + [P]^2} - \frac{k1 * k2^2}{(k1 + [A])(k2^2 + [P]^2)}\right) - \gamma_p[P]$$

2b.

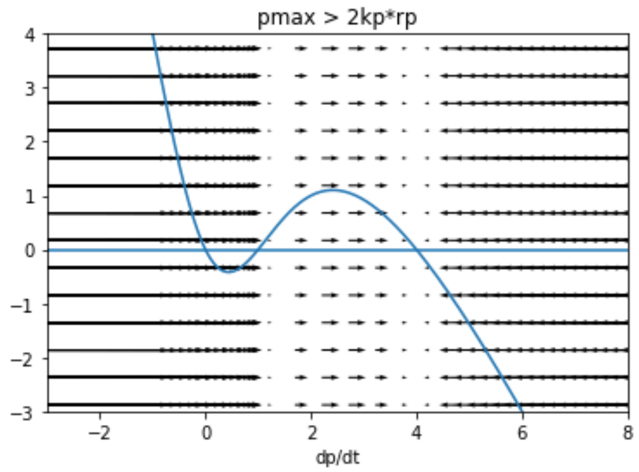
$$\frac{dP}{dt} = P_{max}\left(\frac{[P]^2}{k2^2 + [P]^2}\right) - \gamma_p[P] = 0$$

$$P_{max}\left(\frac{[P]^2}{k2^2 + [P]^2}\right) = \gamma_p[P]$$

$$\frac{dP}{dt} = 0 \rightarrow [P] = 0, \qquad \frac{P_{max} \pm \sqrt{{P_{max}}^2 - 4{\gamma_p}^2 k2^2}}{2\gamma_p}$$

When $P_{max} > 2\gamma_p k2$, 3 equilibrium points.

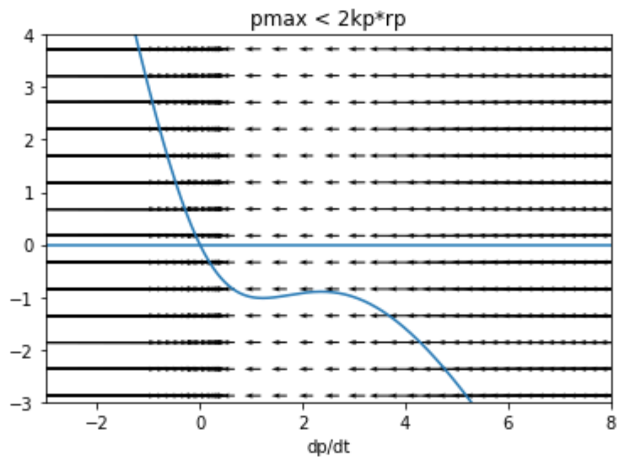
(k_2=kp)



`Pmax=10, k=2, rp=2`

>> 2 stable points, 1 unstable, which is P= $\frac{P_{max}-\sqrt{P_{max}{}^2-4\gamma_p{}^2k2^2}}{2\gamma_p}$.

When $P_{max} < 2\gamma_p k2$, 1 equilibrium point. only when P=0



`Pmax=10, k=3, rp=2`

>> P=0, stable point.

3a

$$A_{off} + I \xleftrightarrow[k_{AI}^-]{k_{AI}^+} A_{on}$$

$$R_{on} + I \xleftrightarrow[k_{RI}^-]{k_{RI}^+} A_{on}$$

3b.

$$g_0 + nA_{on} \xleftarrow[k_A^-]{k_A^+} \rightarrow g_A$$

$$g_0 + nR_{on} \xleftarrow[k_R^-]{k_R^+} \rightarrow g_R$$

$$[g_A]_{ss} = \frac{k_A^+}{k_A^-}[g_0][A]^n$$

$$[g_R]_{ss} = \frac{k_R^+}{k_R^-}[g_0][R]^n$$

$$\frac{g_A}{g_{TOT}} = \frac{\frac{k_A^+}{k_A^-}[g_0][A]^n}{[g_0] + \frac{k_A^+}{k_A^-}[g_0][A]^n + \frac{k_R^+}{k_R^-}[g_0][R]^n}$$

$$\frac{g_A}{g_{TOT}} = \frac{\frac{k_A^+}{k_A^-}[A]^n}{1 + \frac{k_A^+}{k_A^-}[A]^n + \frac{k_R^+}{k_R^-}[R]^n}$$

3c.

$$[A_{on}]_{ss} = \frac{k_{AI}^+}{k_{AI}^-}[A_{off}][I]$$

$$[R_{on}]_{ss} = \frac{k_{RI}^-}{k_{RI}^+}\frac{[R_{off}]}{[I]}$$

$$\frac{k_{AI}^+}{k_{AI}^-} = k_{AI}\,, \frac{k_{RI}^-}{k_{RI}^+} = k_{RI}^{-1}$$

$$\frac{g_A}{g_{TOT}} = \frac{k_A k_{AI}^n [A_{off}]^n [I]^n}{1 + k_A k_{AI}^n [A_{off}]^n [I]^n + k_R k_{RI}^{-n}\frac{[R_{off}]^n}{[I]^n}}$$

Although the paper mentioned the hill coefficient can combine up to multiplicatively, as it suggested, the final hill coefficient should be n*n; however, it's hard to derive from the above equation.