

HW 16

1	21/40	times only 1 type
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~~19/40 times at least~~

2 types

output not: $(1,0)$ $(0,1)$ $(0,0)$
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HW 17

$$1 \quad \frac{dy}{dt} = -(x-1)(x-4)(x-7)(x-8)$$

$$0 = -(x-1)(x-4)(x-7)(x-8)$$

$$x = 1, 4, 7, 8$$

- 8 stable

$\begin{array}{c|c} +8 & \nearrow \\ \hline 7 & \searrow \end{array}$
 $\Rightarrow 7$ unstable

$\Rightarrow 4$ stable

$\Rightarrow$ 1 unstable

1

$$2. J = \begin{pmatrix} \frac{-3}{(1+y+z)} & \frac{3x}{(1+y+z)^2} & \frac{3x}{(1+y+z)^2} \\ \frac{3y}{(1+x+z)^2} & \frac{-3}{(1+x+z)} & \frac{3y}{(1+x+z)^2} \\ \frac{3z}{(1+x+y)^2} & \frac{3z}{(1+x+y)^2} & \frac{-3}{(1+x+y)} \end{pmatrix}$$

$$\frac{dy}{dt} = 1 - \frac{3x}{1+y+z} = 0$$

$$3x = 1 + y + z$$

$$3y = 1 + x + 2$$

$$3z = 1 + x + y$$

$$(x, y, z) = (1, 1, 1)$$

$(x, y, z) = (1, 1, 1)$
 $J = \begin{bmatrix} -1 & 1/3 & 1/3 \\ 1/3 & -1 & 1/3 \\ 1/3 & 1/3 & -1 \end{bmatrix}$

$$J = \begin{bmatrix} -1 & 1/3 & 1/3 \\ 1/3 & -1 & 1/3 \\ 1/3 & 1/3 & -1 \end{bmatrix}$$

3

$$J = \begin{bmatrix} \frac{-1}{1+y+z} & \frac{x}{(1+y+z)^2} & \frac{x}{(1+y+z)^2} \\ \frac{y}{(1+x+z)^2} & \frac{-1}{1+x+z} & \frac{y}{(1+x+z)^2} \\ \frac{z}{(1+x+y)^2} & \frac{z}{(1+x+y)^2} & \frac{-1}{1+x+y} \end{bmatrix}$$

$$\frac{dx}{dt} = 1 - \frac{x}{1+y+z} = 0$$

$$x = 1 + y + z$$

$$1 = x - y - z$$

$$1 = -x + y - z$$

$$1 = -x - y + z$$

$$z = -2z$$

$$z = -1$$

$$z = -2x$$

$$x = -1$$

$$z = -2y$$

$$y = -1$$

$$(x, y, z)$$

$$= (-1, -1, -1)$$

$$J = \begin{bmatrix} 1 & -1 & -1 \\ -1 & 1 & -1 \\ -1 & -1 & 1 \end{bmatrix} \quad \lambda = -1, 2, 2$$

Not all eigenvalues neg.
 $\Rightarrow (-1, -1, -1)$ unstable

$$4 \text{ ChemoStat}(N, C, 2, 5)$$

$$= \left(\frac{2CN}{C+1} - N, -\frac{CN}{C+1} - C + 5 \right)$$

$$SSSg(\text{ChemoStat}(N, C, 2, 5), [N, C]) = \emptyset$$

$$SSg(\text{ChemoStat}(N, C, 2, 5), [N, C]) = [C0, 2.5]$$