IFA_CS_1

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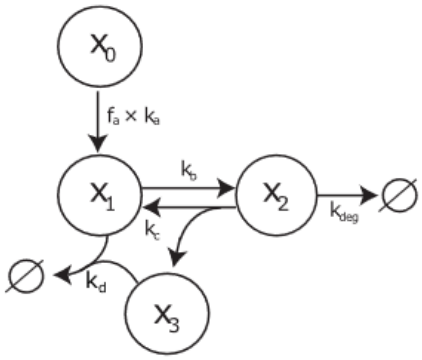

	Ka	Kb	Kc	Kd	Kdeg
x1	1	-1	1	-1	0
x2	0	1	-1	0	-1
x3	0	0	1	-1	0

$$k_b = c_b \cdot X_1$$
$$k_c = c_c \cdot X_2$$
$$k_{deg} = c_{deg} \cdot X_2$$
$$k_d = c_d \cdot X_1 \cdot X_3$$

Homework 2 (Modelling (pen & paper), 2 points)
You are given the following stoichiometric matrix S:

	r_1	r_2	r_3	r_4
x_1	1	-1	0	0
x_2	-1	0	-1	0
x_3	0	1	0	1
x_4	-1	1	1	0

and the following propensity functions (= reaction rate functions) $r_1 \dots r_4$.

$$\begin{aligned} r_1 &= \frac{\mathrm{k_a}}{\mathrm{K_D}\left(1+\frac{x_4}{\mathrm{K_I}}\right)} \cdot x_2 \cdot x_4 \\ r_2 &= \mathrm{k_b} \cdot x_1 \\ r_3 &= \mathrm{k_c} \cdot x_2 \\ r_4 &= \mathrm{k_d} \end{aligned}$$

Write down the corresponding system of ordinary differential equations (ODEs).

$$\frac{d}{dt}x_1 = r_1 - r_2$$
$$\frac{d}{dt}x_2 = -r_1 - r_3$$
$$\frac{d}{dt}x_3 = r_2 + r_4$$
$$\frac{d}{dt}x_4 = -r_1 + r_2 + r_3$$

$$\frac{d}{dt}x_1 = \frac{k_a}{K_D(1+\frac{x_4}{K_I})} \cdot x_2 \cdot x_4 - k_b \cdot x_1$$
$$\frac{d}{dt}x_2 = -\frac{k_a}{K_D(1+\frac{x_4}{K_I})} \cdot x_2 \cdot x_4 - k_c \cdot x_2$$
$$\frac{d}{dt}x_3 = k_b \cdot x_1 + k_d$$
$$\frac{d}{dt}x_4 = -\frac{k_a}{K_D(1+\frac{x_4}{K_I})} \cdot x_2 \cdot x_4 + k_b \cdot x_1 + k_c \cdot x_2$$

Homework 3 (Modelling (pen & paper), 2 points)
You have used the following ODE-system in your research:

$$\begin{aligned} \frac{\mathrm{d}}{\mathrm{d}t}x_1 &= x_2 \cdot \mathrm{k_a} - x_1\left(\mathrm{k_{cat}} \cdot x_3 + \mathrm{k_b}\right) \\ \frac{\mathrm{d}}{\mathrm{d}t}x_2 &= x_1\left(\mathrm{k_{cat}} \cdot x_3 + \mathrm{k_b}\right) - x_2\left(\mathrm{k_{deg}} + \mathrm{k_a}\right) \\ \frac{\mathrm{d}}{\mathrm{d}t}x_3 &= \lambda - x_1 \cdot \mathrm{k_{cat}} \cdot x_3. \end{aligned}$$

$$\frac{d}{dt}x_1 = x_2 \cdot k_a - x_1(k_{cat} \cdot x_3 + k_b)$$
$$= x_2 \cdot k_a - x_1 \cdot k_{cat} \cdot x_3 - x_1 \cdot k_b$$
$$= r_4 - r_1 - r_3$$

$$\frac{d}{dt}x_2 = x_1(k_{cat} \cdot x_3 + k_b) - x_2(k_{deg} + k_a)$$
$$= x_1 \cdot k_{cat} \cdot x_3 + x_1 \cdot k_b - x_2 \cdot k_{deg} - x_2 \cdot k_a$$
$$= r_1 + r_3 - r_5 - r_2$$

$$\frac{d}{dt}x_3 = \lambda - x_1 \cdot k_{cat} \cdot x_3$$
$$= r_6 - r_1$$

$$r_1 = x_1 \cdot k_{cat} \cdot x_3$$
$$r_2 = x_2 \cdot k_a$$
$$r_3 = x_1 \cdot k_b$$
$$r_4 = x_2 \cdot k_a$$
$$r_5 = x_2 \cdot k_{deg}$$
$$r_6 = \lambda$$

r1	r2	r3	r4	r5	r6	
-1	0	-1	1	0	0	x1
1	-1	1	0	1	0	x2
-1	0	0	0	0	1	x3