switchGillespie.m

%% Gillespie function of a exclusive genetic switch

% used in HW2\_3Lin.m

function [t, X, E] = switchGillespie(X0, tlim)

%% reactiona and vectors

% There are 8 reactions; outcome of each is:

v = []; % (A, B, rA, rB)

v{1} = [1 0 0 0]; % \* reaction 1: --> A

v{2} = [0 1 0 0]; % \* reaction 2: --> B

v{3} = [-1 0 0 0]; % \* reaction 3: A -->

v{4} = [0 -1 0 0]; % \* reaction 4: B -->

v{5} = [-1 0 1 0]; % \* reaction 5: A --> rA

v{6} = [0 -1 0 1]; % \* reaction 6: B --> rB

v{7} = [1 0 -1 0]; % \* reaction 7: rA --> A

v{8} = [0 1 0 -1]; % \* reaction 8: rB --> B

%%

global gA gB dA dB alpha0 alpha1

S = length(X0); % number of species

t = zeros(1e6,1); %

X = zeros(1e6,S);

X(1, :) = X0;

point = 1; % keep track of points: a point can be any change in state

while t(point) < tlim

% rename the current states

A = X(point, 1);

B = X(point, 2);

rA = X(point, 3);

rB = X(point, 4);

% 1. calculate rate of each event

rates = [gA \* (1 - rB), ... % "off" when rB present

gB \* (1 - rA), ...

dA \* A, ...

dB \* B, ...

alpha0 \* A \* (1 - rA - rB), ... % "off" when rA or rB present

alpha0 \* B \*(1- rA - rB), ...

alpha1 \* rA,...

alpha1 \* rB ];

a0 = sum(rates, 2); % the rate that "any" event happens

% 2. inter event time

t(point+1) = t(point) + log(1/rand)/a0; % Calculating the interevent time.

% 3. witch event

eventID = datasample(1:8, 1, 'weight', rates);

% 4. update state

X(point+1, :) = X(point, :) + v{eventID}; % Updating the state.

% 5. update the point counter.

point = point + 1;

end

%%

% The last thing we do is get rid of the memory that was not use during the

% simulation and we are done.

t = t(1:point);

X = X(1:point,:);

script\_plot\_switchGillespie.m

% Scripts for making plots of the simulation results from switchGillespie.m

figure

mysubplot(7, 1, 0, ['Exclusive switch (', para2str(k), ') '])

mysubplot(7, 1, 1:2)

mystairs(t, x(:,1), 39); hold on

set(gca, 'xticklabel', [])

axis([0 tlim 0 X0(1)\*2.5])

ylabel('N\_A')

hline(X0(1));

mysubplot(7, 1, 3:4)

mystairs(t, x(:,2), 38); hold on

set(gca, 'xticklabel', [])

axis([0 tlim 0 X0(1)\*2.5])

ylabel('N\_B')

hline(X0(1));

mysubplot(7, 1, 5)

mystairs(t, x(:,3), 39);hold on

set(gca, 'xticklabel', [])

ylabel('r\_A')

axis([0 tlim 0 1])

mysubplot(7, 1, 6)

mystairs(t, x(:,4), 38); hold on

axis([0 tlim 0 1])

ylabel('r\_B')

xlabel('time')