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% MAE 384 PART 2 INTERPOLATION
clc;

% Parameters
beta = 0.3; gamma = 0.1;
S0 = 990; I0 = 10; R0 = 0;
h = 2; T = 100;

% Initialize variables
tModel = 0:h:T;
S = zeros(size(tModel));
I = zeros(size(tModel));
R = zeros(size(tModel));
S(1) = S0; I(1) = I0; R(1) = R0;

% SIR Model with h = 2
for k = 1:length(tModel)-1
    dS = -beta * S(k) * I(k) / (S(k) + I(k) + R(k));
    dI = beta * S(k) * I(k) / (S(k) + I(k) + R(k)) - gamma * I(k);
    dR = gamma * I(k);

    S(k+1) = S(k) + h * dS;
    I(k+1) = I(k) + h * dI;
    R(k+1) = R(k) + h * dR;
end

% Interpolation
tOdd = 1:2:T-1; % Odd days
S_int_linear = interp1(tModel, S, tOdd, 'linear');
I_int_linear = interp1(tModel, I, tOdd, 'linear');
R_int_linear = interp1(tModel, R, tOdd, 'linear');

% Quadratic Interpolation
S_int_quad = interp1(tModel, S, tOdd, 'pchip');
I_int_quad = interp1(tModel, I, tOdd, 'pchip');
R_int_quad = interp1(tModel, R, tOdd, 'pchip');

% L2 Error Calculation
tFine = 0:1:T; % Fine grid
SFine = spline(tModel, S, tFine);
IFine = spline(tModel, I, tFine);
RFine = spline(tModel, R, tFine);

S_err_linear = sqrt(mean((SFine(tOdd) - S_int_linear).^2));
I_err_linear = sqrt(mean((IFine(tOdd) - I_int_linear).^2));
R_err_linear = sqrt(mean((RFine(tOdd) - R_int_linear).^2));

S_err_quad = sqrt(mean((SFine(tOdd) - S_int_quad).^2));
I_err_quad = sqrt(mean((IFine(tOdd) - I_int_quad).^2));
R_err_quad = sqrt(mean((RFine(tOdd) - R_int_quad).^2));

% Display Results
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fprintf('Linear Interpolation Errors:\nS: %.4f, I: %.4f, R: %.4f\n',
S_err_linear, I_err_linear, R_err_linear);
fprintf('Quadratic Interpolation Errors:\nS: %.4f, I: %.4f, R: %.4f\n',
S_err_quad, I_err_quad, R_err_quad);
```

```
Linear Interpolation Errors:
S: 16.3931, I: 8.9491, R: 14.3096
Quadratic Interpolation Errors:
S: 16.4077, I: 8.9701, R: 14.3157
```

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