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Problem 3 Code

```
clear
close all

t = [0.5 1.1 1.6 2.1 2.6 3.2 3.7 4.2 4.7 5.3 5.8 6.3 6.8 7.4 7.9 8.4 8.9 9.5];
d = [1.3 1.8 2.9 4 8 15 26 42 65 96 137 191 259 343 447 520 600 650];
M = length(t);

fprintf('(a) Best Fit Coefficients\n')

% Linear fit
A = [      M      sum(t);
      sum(t) sum(t.^2)];
b = [sum(d);
      sum(d.*t)];
a = A\b;
fprintf('Linear Fit:\n')
a_0 = a(1)
a_1 = a(2)
d_linear = a_0 + a_1*t;

% Quadratic fit
A = [      M      sum(t) sum(t.^2);
      sum(t) sum(t.^2) sum(t.^3);
      sum(t.^2) sum(t.^3) sum(t.^4)];
b = [      sum(d);
      sum(d.*t);
      sum(d.*t.^2)];
a = A\b;
fprintf('Quadratic Fit:\n')
a_0 = a(1)
a_1 = a(2)
a_2 = a(3)
d_quad = a_0 + a_1*t + a_2*t.^2;

% Cubic fit
A = [      M      sum(t) sum(t.^2) sum(t.^3);
      sum(t) sum(t.^2) sum(t.^3) sum(t.^4);
      sum(t.^2) sum(t.^3) sum(t.^4) sum(t.^5);
      sum(t.^3) sum(t.^4) sum(t.^5) sum(t.^6)];
b = [sum(d);
      sum(d.*t);
      sum(d.*t.^2);
```

```

        sum(d.*t.^3)];
a = A\b;
fprintf('Cubic Fit:\n')
a_0 = a(1)
a_1 = a(2)
a_2 = a(3)
a_3 = a(4)
d_cube = a_0 + a_1*t + a_2*t.^2 + a_3*t.^3;

% Exponential Fit
A = [      M      sum(t);
      sum(t) sum(t.^2)];
b = [sum(log(d));
      sum(log(d).*t)];
a = A\b;
fprintf('Exponential Fit:\n')
a_0 = exp(a(1))
a_1 = a(2)
d_exp = a_0*exp(a_1*t);

```

(b) Plotting

```

fprintf(' \n')
fprintf('(b)')
linewidth = 2;
plot(t,d,'o','LineWidth',linewidth)
hold on
plot(t,d_linear,'LineWidth',linewidth)
plot(t,d_quad,'LineWidth',linewidth)
plot(t,d_cube,'LineWidth',linewidth)
plot(t,d_exp,'LineWidth',linewidth)
hold off
title('Curve Fitting for Data')
xlabel('Time (s)')
ylabel('Distance (in)')
legend('Raw data','Linear best fit','Quadratic best fit','Cubic best
fit','Exponential best fit','Location','northwest')
grid on
set(gca,'FontSize',14)

```

(c) Using Polyfit

```

fprintf(' \n')
fprintf('(c) Best Fit Coefficients Using Polyfit\n')
% Linear fit
a = polyfit(t,d,1);
fprintf('Linear Fit:\n')
a_0 = a(2)
a_1 = a(1)
% Quadratic fit
a = polyfit(t,d,2);
fprintf('Quadratic Fit:\n')
a_0 = a(3)

```

```
a_1 = a(2)
a_2 = a(1)
% Cubic fit
a = polyfit(t,d,3);
fprintf('Cubic Fit:\n')
a_0 = a(4)
a_1 = a(3)
a_2 = a(2)
a_3 = a(1)
% Exponential fit
a = polyfit(t,log(d),1);
fprintf('Exponential Fit:\n')
a_0 = exp(a(2))
a_1 = a(1)
```

(d) RMS Error

```
fprintf(' \n')
fprintf('(d) RMS Error of Each Fit\n')
% Linear fit
fprintf('Linear Fit:\n')
RMS_error = sqrt(sum((d-d_linear).^2)/M)
% Quadratic fit
fprintf('Quadratic Fit:\n')
RMS_error = sqrt(sum((d-d_quad).^2)/M)
% Cubic fit
fprintf('Cubic Fit:\n')
RMS_error = sqrt(sum((d-d_cube).^2)/M)
% Exponential fit
fprintf('Exponential Fit:\n')
RMS_error = sqrt(sum((d-d_exp).^2)/M)
```

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