Exercise 1: Bacterial growth curve

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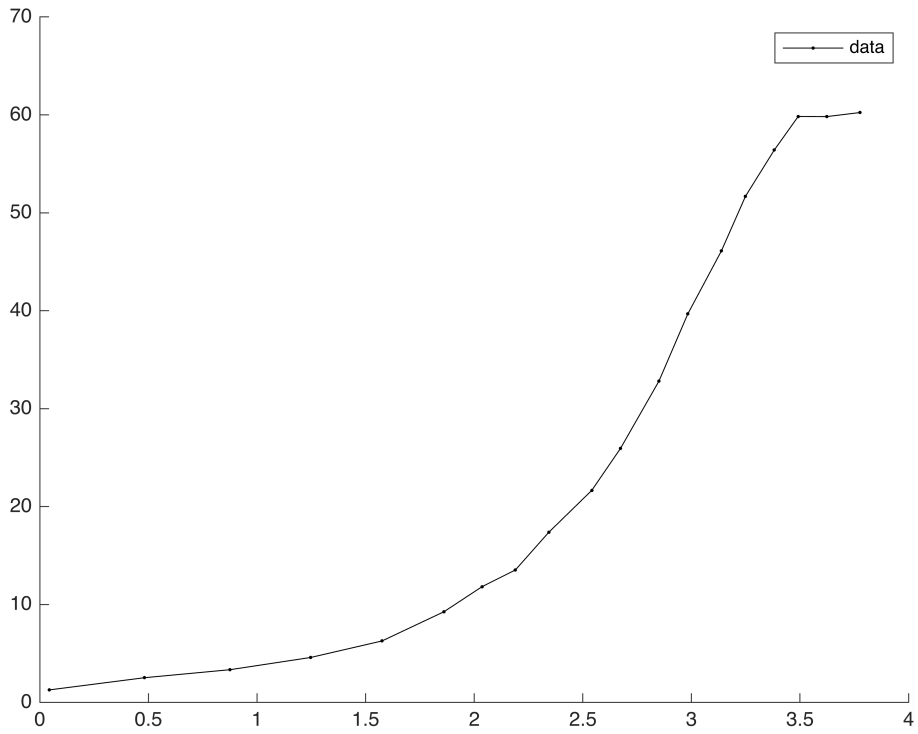
% From Wiki "Diauxie" reproduced from Monod's PhD thesis
% Bacterial growth (E. coli) on glucose and fructose

% Data
% Time (hours)        Optical density (proportional to mass)
x = [0.04406743301915    1.285584146987
0.48156559689    2.528863914313
0.875231685788    3.346749281098
1.247158005598    4.597079784344
1.575487274965    6.282205669359
1.860454518421    9.262316718449
2.036017842843    11.82408410292
2.189488861381    13.52801195039
2.343547441245    17.38241425363
2.541438096082    21.66221095741
2.673756906858    25.94905839711
2.850495353933    32.81177469313
2.983519238301    39.67919147975
3.138282891758    46.11416312992
3.249096957976    51.69364548839
3.381533281017    56.41058781925
3.491759785908    59.83959572195
3.622903474031    59.8254942501
3.776021955772    60.23913742411];
% Note: there is an offset on the OD (i.e. it does not necessarily start at
OD=0)

p = [];

%plot the data
t = x(:,1);
od = x(:,2);
figure; hold on;
p(1) = plot(t,od,'k.-', 'DisplayName', 'data'); legend(p);
```

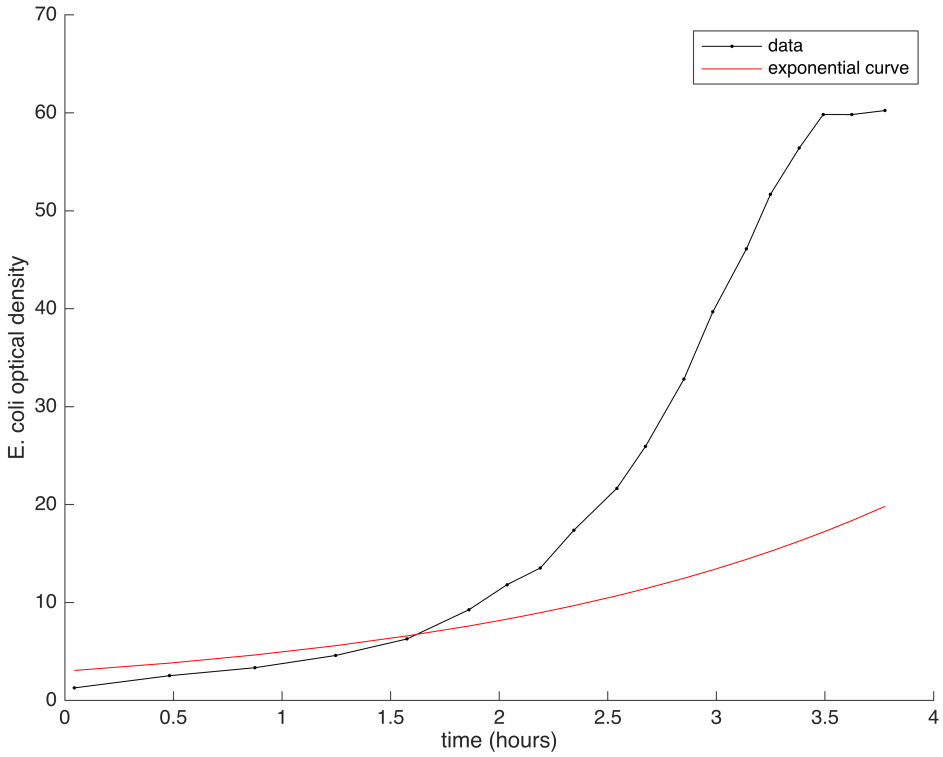



```
% Fit this data to an exponential curve
% You need to find an exponential function (with starting value f0 and time
% constant tau) that gives a "good" fit by eye. Just play with the
% parameters until you get something that looks OK.

% Here is a first guess

f0=3;
tau=2;
f = f0*exp(t/tau);
p(2) = plot(t,f,'r-', 'DisplayName', 'exponential curve');

xlabel('time (hours)');
ylabel('E. coli optical density');
legend(p);
```

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% The starting value clearly needs to be lower, and the rate of increase
% should be much faster; hence, tau must be lower.

f0=1;
tau=1;
f = f0*exp(t/tau);
p(3) = plot(t,f,'b-');

xlabel('time (hours)');
ylabel('E. coli optical density');
legend('data','exponential curve', 'attempt 1');
```

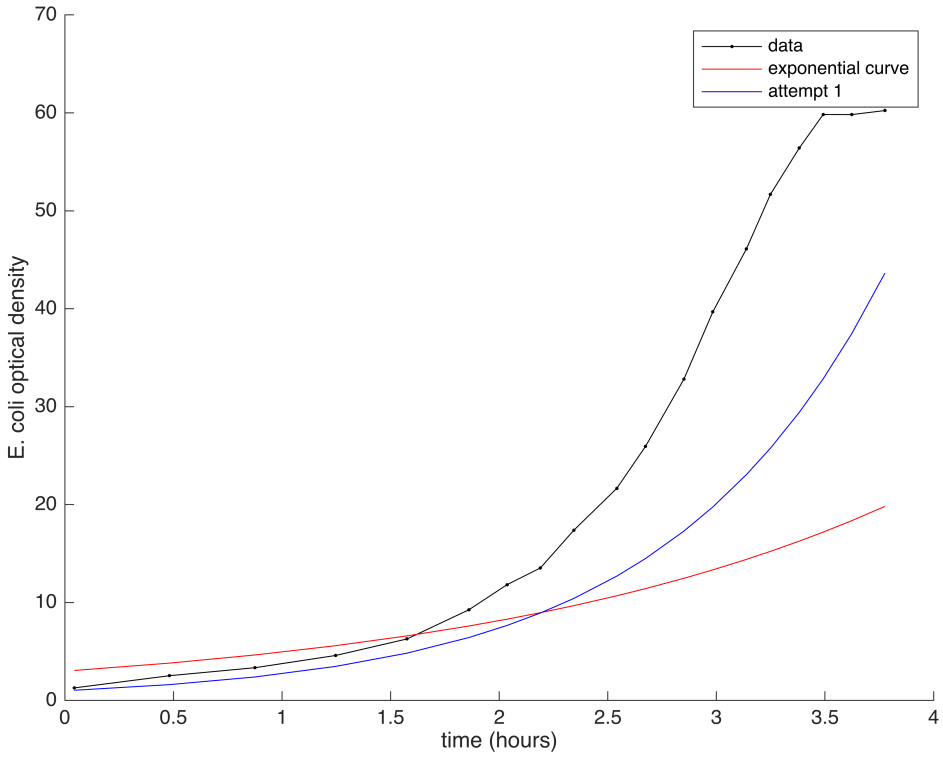


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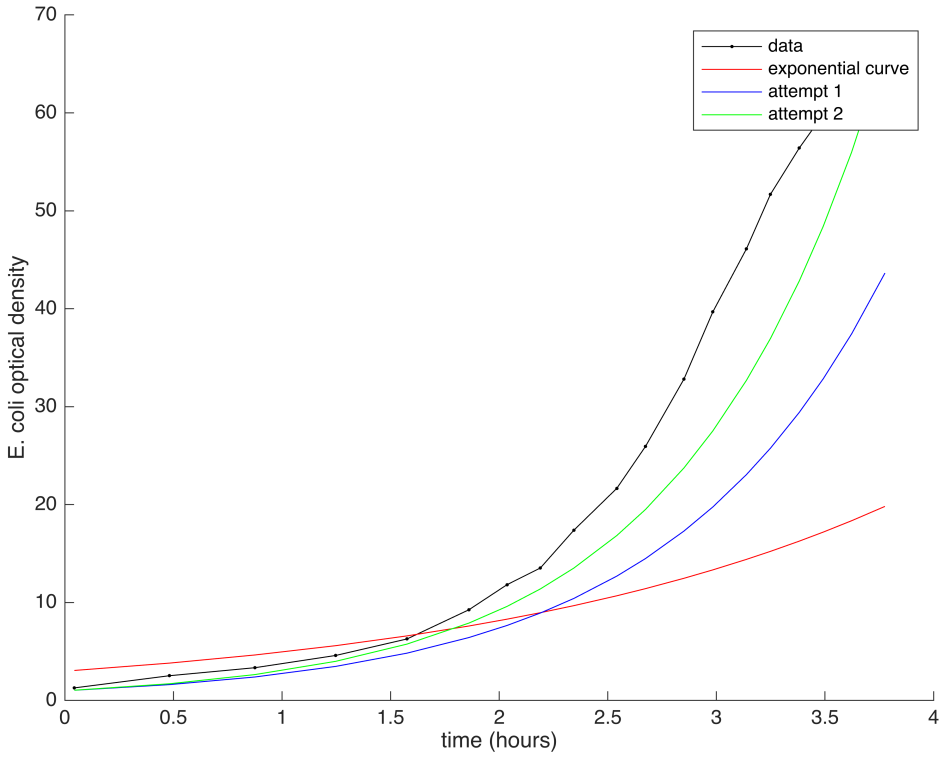
% tau needs to be decreased further.

f0=1;
tau=0.9;
f = f0*exp(t/tau);
p(4) = plot(t,f,'g-', 'DisplayName', 'attempt 2');

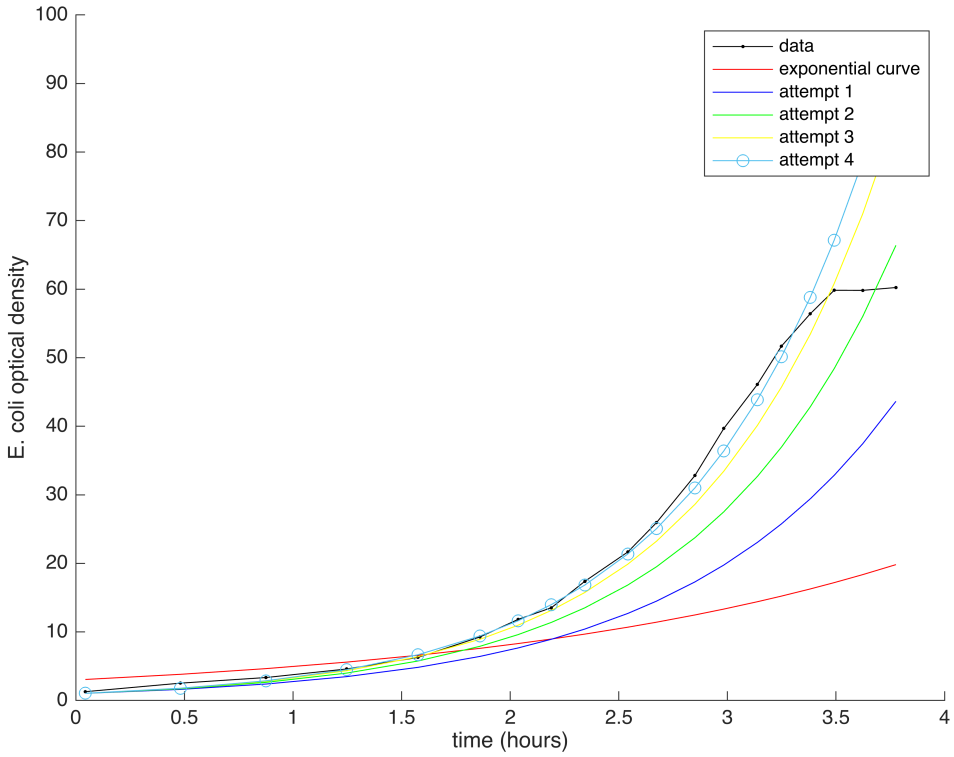
xlabel('time (hours)');
ylabel('E. coli optical density');
legend(p);
```




```
f0=1;
tau=0.85;
f = f0*exp(t/tau);
p(5) = plot(t,f,'y-', 'DisplayName', 'attempt 3');

xlabel('time (hours)');
ylabel('E. coli optical density');
legend(p);
f0=1;
tau=0.83;
f = f0*exp(t/tau);
p(6) = plot(t,f,'o-', 'DisplayName', 'attempt 4');

xlabel('time (hours)');
ylabel('E. coli optical density');
legend(p);
```

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f0=1;
tau=0.82;
f = f0*exp(t/tau);
p(6) = plot(t,f,'o-', 'DisplayName', 'attempt 5');

xlabel('time (hours)');
ylabel('E. coli optical density');
legend(p);
```

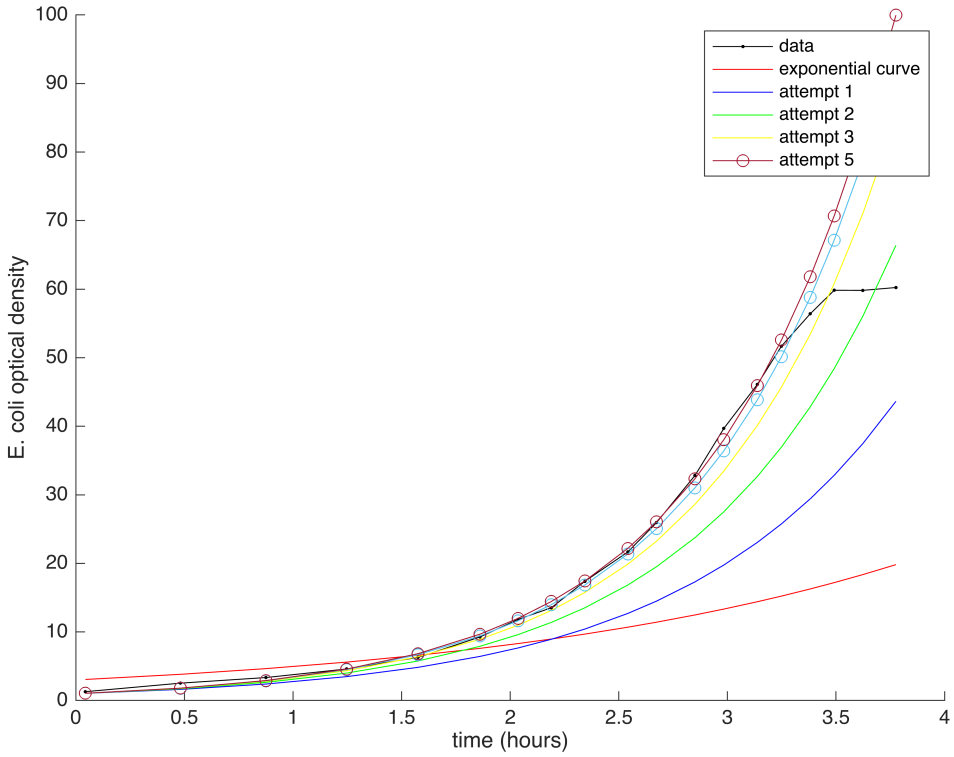

Hence, the parameters -- f0=1 and tau=0.82 -- seem to be a good fit for the given data.