Solutions for Homework14

Emre Arapcic-Uvak
Vedad Siljic

Abstract

In this document we will show the solutions for problems represented in the given homework for this week.

Contents

1 Task 1

1.1 Problem

In the given graph which represents the movement of a car, answer the following:

- Between which point and point the car accelerate, and between which points it decelerate?
- What is the distance traveled at point C? and what is it at point F?
- Indicate line segments with 0 acceleration, does that mean the car is not moving? Explain.
- What are the values of acceleration and deceleration of the car at each segment?

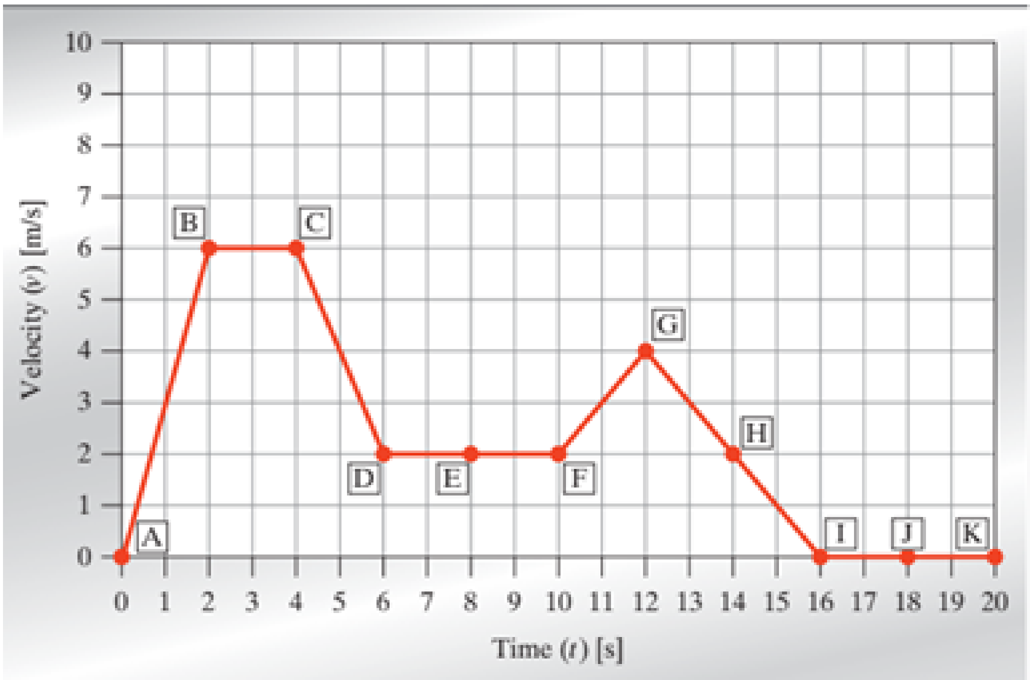

Figure 1: Velocity-Time of the car

1.2 Solution

1. The car accelerates at points:
   - $A \to B$
   - $F \to G$

   And it decelerates at points:
   - $C \to D$
   - $G \to I$ $(G \to H$ & $H \to I)$

2. To get the distance we can just find the integral from point A (0) to whatever points we want. So to see what the distance traveled at point C is we just have to evaluate

$$\int_A^C v * dt = \int_A^B v * dt + \int_B^C v * dt$$

which is just the area under the graph so from $A \to B$ we have a right triangle with sides 1×6 which means that the area from that triangle is $\frac{6}{2} = 3$, and from $B \to C$ we have a rectangle with sides

2×6 so in total the area of the rectangle is 12 meaning that the distanced traveled from $A \rightarrow C$ is $3 + 12 = 15m$. To find out the distance traveled from $A \rightarrow F$ we have to solve the following integral:

$$\int_A^F v * dt = \int_A^C v * dt + \int_C^B v * dt + \int_D^F v * dt$$

Since we already know that $\int_A^C v * dt = 15m$ we just have to find the other two integrals, which at the end end up being $15 + \frac{2*4}{2} + 2 * 2 + 2 * 4 = 15 + 4 + 4 + 8 = 31m$

3. The line segments with 0 acceleration are
   - $B \rightarrow C$
   - $I \rightarrow K$ ($I \rightarrow J$ & $J \rightarrow K$)

   This does NOT mean that the car isn't moving, this just means that the velocity of the car isn't changing or in other words

$$\frac{dv}{dt} = 0$$

4.

LINE SEGMENT	ACCELERATION VALUE $\left[\frac{m}{s^2}\right]$
$A \rightarrow B$	3
$B \rightarrow C$	0
$C \rightarrow D$	-2
$D \rightarrow E$	0
$E \rightarrow F$	0
$F \rightarrow G$	1
$G \rightarrow H$	-1
$H \rightarrow I$	-1
$I \rightarrow J$	0
$J \rightarrow K$	0

2 Task 2

2.1 Problem

An environmental engineer has obtained a bacteria culture from a municipal water sample and allowed the bacteria to grow. The initial count of Bacteria is A, and their growth formula with time being in hours is given by:

$$B = B_0 e^{Ct}$$

A: is the summation of your birthday digits divided by 0.5
C: is the summation of your IUS ID number divided by 50.

- What is B_0? And what is its value?
- After how many hours, the amount of Bacteria would be 100000?
- Pick up 4 to 5 points in time and draw the graph of Bacteria growth. (This is done by pen and pencil)
- Use Octave to plot the graph of bacteria growth

2.2 Solution

$$A = \frac{1+4+1+2+2+0+0+2}{0.5} = \frac{12}{0.5} = 24$$
$$C = \frac{2+2+0+3+0+2+2+8+9}{50} = \frac{28}{50} = 0.56$$

1. B_0 is the initial amount of bacteria in our system and since our variable A represents the initial count of bacteria we can conclude that $A = B_0$.

2. To figure this out we simply have to figure out the following equation:

$$24 * e^{0.56*t} = 100000$$

$$0.56 * t * \ln 24 * e = \ln 100000$$
$$0.56 * t = \frac{\ln 100000}{\ln 24 * e}$$
$$t = \log_{24*e} 100000 * \frac{1}{0.56}$$
$$t \approx 4.9207[h]$$

3. Using the following code:

```
% Clear previous junk
clear all;
clc;

% Set up needed variables
A = 24;
C = 0.56;
t = linspace(0,20,10000);

% Calculate bacterial growth
B = A.*exp(C.*t);

% Plot the graph
plot(t,B, 'r*');
grid on;legend("Number of ...
    bacteria");xlabel("Time");ylabel("Bacteria");title("Bacterial growth");
```

We get the following graph

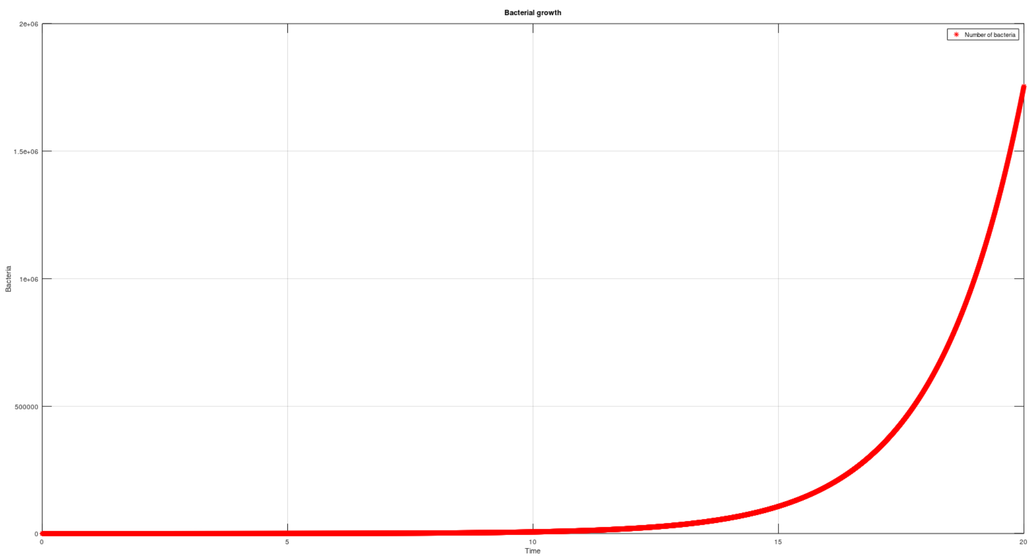

Figure 2: Bacterial growth plot

3 Task 3

3.1 Problem

3.2 Solution

4 Task 4

4.1 Problem

1. Consider the following loop:

```
[r,c]=size(D);
j=c;

i=1;
while j > 0
    T(i,1)=D(i,i); T(i,2)=D(i,j);
    i=i+1; j=j-1;
end
```

   If we were to run the code and generate the following value for T, T = [2 11; 7 16]. What is D

2. What is the output of $M4$ if M = [1 3 2; 6 0 2]

```
[rows,cols]=size(M);
for r=1:1:2*rows
  for c=1:1:2*cols
    M4(r,c)=c;
  end
end
```

4.2 Solution

1. If we take a good look at the code we can spot that the first element is always going to be the element on the main diagonal line of the matrix, and the 2nd element will always be the element of the inverse diagonal of the matrix so if we get T = [2 11; 7 16]. D must be:

$$D = \begin{bmatrix} 2 & 7 \\ 16 & 11 \end{bmatrix}$$

2. All this code does is take the number of rows and columns, afterwards if makes loops that repeat twice the number of rows and columns. So for a 2×3. We would have in total 24 itterations. The final output would be:

$$M4 = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \\ 1 & 2 & 3 & 4 & 5 & 6 \end{bmatrix}$$

5 Task 5

5.1 Problem

5.2 Solution

6 Task 6

6.1 Problem

6.2 Solution

7 Task 7

7.1 Problem

7.2 Solution

8 Task 8

8.1 Problem

8.2 Solution

9 Task 9

9.1 Problem

9.2 Solution

10 Task 10

10.1 Problem

10.2 Solution