# LaTeX example question answers

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## Contents

# 1 Questions

1. Solve the following for x:

$$(x-3)^2 + 4x = 3x^2 + 7$$

2. Find the product of the following matrices A and B:

$$A = \begin{pmatrix} 3 & 4 & 2 \\ 1 & -1 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 2 & -1 \\ 4 & 0 \\ 6 & -2 \end{pmatrix}$$

3. It is given that:

$$\frac{dx}{dt} = 10 - 4x$$

   Find an expression for $x(t)$ and plot the value for $0 \le t \le 5$ if $x(0) = 1$.

4. Write a function to calculate the nth Fibonacci Number using the programming language of your choice.

# 2 Answers

1.

$$(x-3)^2 + 4x = 3x^2 + 7$$
$$x^2 - 6x + 9 + 4x = 3x^2 + 7$$
$$2x^2 + 2x - 2 = 0$$
$$x^2 + x - 1 = 0$$
$$x = \frac{-1 \pm \sqrt{1^2 - 4 \times 1 \times -1}}{2}$$
$$= \frac{-1 \pm \sqrt{5}}{2}$$

2.

$$A = \begin{pmatrix} 3 & 4 & 2 \\ 1 & -1 & 0 \end{pmatrix} \quad B = \begin{pmatrix} 2 & -1 \\ 4 & 0 \\ 6 & -2 \end{pmatrix}$$

$$AB = \begin{pmatrix} 3 \times 2 + 4 \times 0 + 2 \times 6 & 3 \times -1 + 4 \times 0 + 2 \times -2 \\ 1 \times 2 - 1 \times 4 + 0 \times 6 & 1 \times -1 - 1 \times 0 + 0 \times -2 \end{pmatrix}$$
$$= \begin{pmatrix} 34 & -7 \\ -2 & -1 \end{pmatrix}$$

3.

$$\frac{dx}{dt} = 10 - 4x$$

$$\frac{dx}{10 - 4x} = dt$$

$$\int \frac{dx}{10 - 4x} = \int dt$$

$$-\frac{1}{4}\ln(10 - 4x) = t + C$$

$$\ln 10 - 4x = -4(t + C)$$

$$10 - 4x = e^{-4(t+C)}$$

$$4x = 10 - e^{-4(t+C)}$$

$$x = 2.5 - \frac{1}{4}e^{-4(t+C)}$$

$$= 2.5 - Ae^{-4t}$$

When $t = 0$, $x = 1$.

$$1 = 2.5 - Ae^0 = 2.5 - A$$

$$\therefore A = 1.5$$

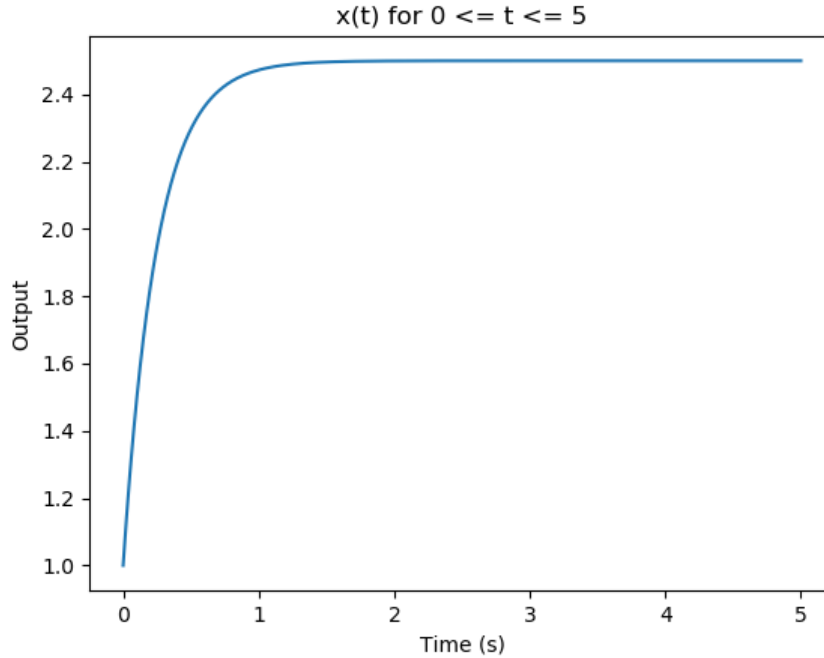$$\therefore x = 2.5 - 1.5e^{-4t}$$

This is shown in figure 1:



Figure 1: Plot of x

4. The Fibonacci sequence is defined by $F_0 = 0$, $F_1 = 1$ and $F_n = F_{n-1} + F_{n-2}$ (Wikipedia (2018)):

```
def fib(n):
    if n <= 0:
        return 0
    elif n == 1:
        return 1
    else:
        return fib(n-1) + fib(n-2)
```

## 3 Random Features

Things to do today:

- Run workshop

- Eat lunch

- Finish assignment

## References

Wikipedia (2018), 'Fibonacci number'.
  **URL:** *https://en.wikipedia.org/wiki/Fibonacci_number*