# Class 02: Accumulated Change: Numbers and Graphs

## Calculus II

**College of the Atlantic. January 12, 2023**



Figure 1: A unicorn. Image from `https://freesvg.org/unicorn-for-coloring`

1. Now let $u(t)$ denote the *rate* at which the unicorn biomass is changing, in units of kg/month, where $t$ is measured in months since January 1, 2023. Values for $u(t)$ are shown in the table below. This is a different island than the one in the previous problem. On this island, the biomass of unicorns on January 1 was 400 kg.

   | $x$ | $u(x)$ |
   |-----|--------|
   | 0   | 30     |
   | 2   | 40     |
   | 4   | 55     |
   | 6   | 55     |
   | 8   | 60     |
   | 10  | 70     |
   | 12  | 75     |

   (a) What is the biomass[1] of the unicorns after two months?
   (b) What is the biomass of the unicorns after four months?
   (c) What is the biomass of the unicorns after one year?
   (d) Muse on the difference between your upper and lower estimates.

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[1]You can't determine this exactly. (Why??) Instead, you can come up with an upper and lower estimate.

2. Soy milk is leaking from a storage tank in COA's dining hall. The rate of leakage is shown on the graph.

(a) Come up with an upper estimate for the total amount of soy milk that has been released into the environment. Use $\Delta t = 2$.

(b) Come up with a lower estimate for the total amount of soy milk that has been released into the environment. Use $\Delta t = 2$.

(c) Represent these upper and lower estimates on the graph.

(d) Show how you would represent upper and lower estimates using $\Delta t = 1$. Do not calculate numerical values for the estimates.
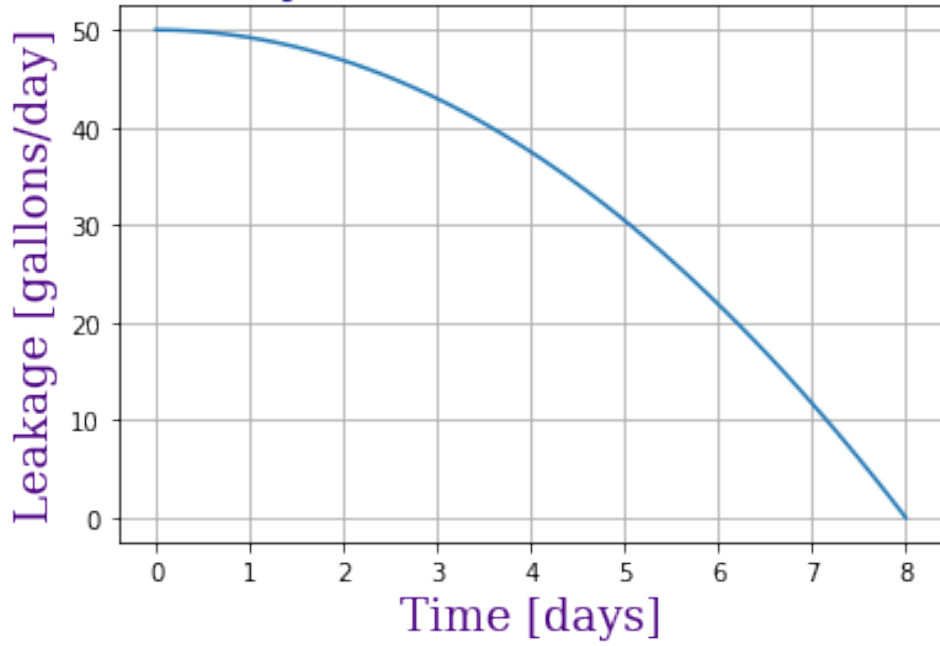
(e) Suppose you needed to know how much soy milk was released into the environment to within 4 gallons. What $\Delta t$ would you choose?

(f) Suppose that instead of having a graph, you had a formula for $s(t)$. How would you write the formula for the upper estimate for the total amount of soy milk released into the environment?

(g) What is the formula for the lower estimate for the total amount of soy milk released?

(h) What happens if you subtract the upper estimate from the lower estimate?

Soy Milk Disaster at TAB



Soy Milk Disaster at TAB