Discrete Convolution

Lab 3

Spring 2021

1 Purpose

Become familiar with convolution and its properties using Python.

2 Deliverables Overview

2.1 Part 1

- Code for **Task 1**.
- Plots for **Task 2**.

2.2 Part 2

- Code for **Task 1**.
- Plots for **Task 2**, **Task 3**, and **Task 4**.

As usual, plots and equations need to be thoroughly discussed in your report.

3 Part 1

3.1 Purpose

Use the step and ramp functions developed in **Lab 2** to write functions to use in the rest of this lab.

3.2 Deliverables

1. Code for the user-defined functions from **Task 1** to be included in the **Methodology** section of your report.
2. Plots from **Task 2** to be included in the **Results** section of your report.

3.3 Tasks

Consider the RLC circuit in figure 1.

1. Create the following signals with user-defined functions.

$$f_1(t) = u(t-2) - u(t-9)$$

$$f_2(t) = e^{-t}u(t)$$

$$f_3(t) = r(t-2)\left[u(t-2) - u(t-3)\right] + r(4-t)\left[u(t-3) - u(t-4)\right]$$

2. Plot the three functions in a single figure (separate subplots) from $0 \leq t \leq 20$ with time steps small enough to achieve appropriate resolution.

4 Part 2

4.1 Purpose

Create code to perform the convolution of two functions. Verfiy this code with Python's built-in convolution tools.

4.2 Deliverables

- Code from **Task 1** of your user-defined convolution, to be included in the **Methodology** section of your report.
- Plots from **Task 2**, **Task 3**, and **Task 4** to be included in the **Results** section of your report.

4.3 Tasks

1. Write your own code to perform convolution. Describe the functionality of your code thoroughly using comments. Use the `scipy.signal.convolve()` function to verify your code before submitting. *Note: Recall the duration of a convolution is the sum of the duration of each function convolved. Adjust your plot window sizes accordingly. Hint: You will not need to use the integrate function, think back to how you first learned integrals.*
2. Plot the convolution of f_1 and f_2.
3. Plot the convolution of f_2 and f_3.
4. Plot the convolution of f_1 and f_3.

5 Questions

1. Did you work alone or with classmates on this lab? If you collaborated to get to the solution, what did that process look like?
2. What was the most difficult part of this lab for you, and what did your problem-solving process look like?

3. Did you approach writing the code with analytical or graphical convolution in mind? Why did you chose this approach?

4. Leave any feedback on the clarity of lab tasks, expectations, and deliverables.