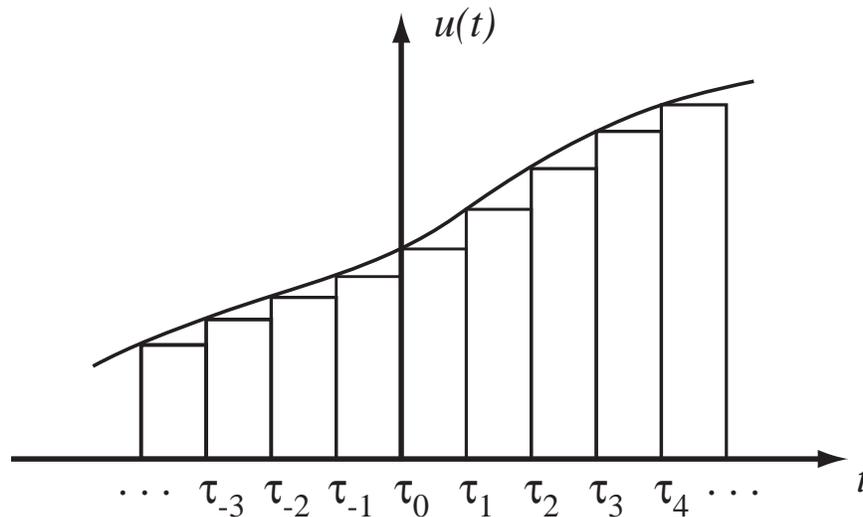


# Approximation by Pulses

Consider representing the smooth function,  $u(t)$ , as a sum of pulses, rather than as a sum of steps, as in Duhamel's Integral, as shown below:



Find an (approximate) expression for  $u(t)$ , as a summation of scaled and delayed pulses.

$$u(t) = \sum_{n=-\infty}^{\infty} ?$$

Hint: Express each pulse in terms of the unit step,  $\sigma(\cdot)$ .

# Approximation by Pulses

My confidence that I have the correct answer is:

1. 100%
2. 80%
3. 60%
4. 40%
5. 20%
6. 0%

# Approximation by Pulses

The correct answer is

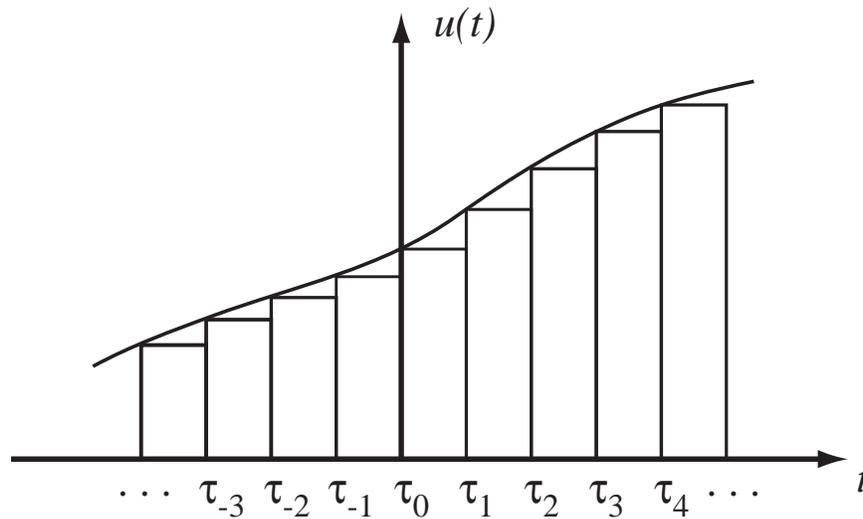
$$u(t) \approx \sum_{n=-\infty}^{\infty} u(\tau_n) [\sigma(t - \tau_n) - \sigma(t - \tau_{n+1})]$$

My answer

1. Was completely correct
2. Was mostly correct, with one or two minor errors
3. Had many errors
4. Was completely incorrect

# General Response

Consider the input  $u(t)$  to a system  $G$ , with step response  $g_s(t)$ . The input  $u(t)$  is represented as a sum of pulses, as shown below:



The input signal is approximated as

$$u(t) \approx \sum_{n=-\infty}^{\infty} u(\tau_n) [\sigma(t - \tau_n) - \sigma(t - \tau_{n+1})]$$

Find an (approximate) expression for  $y(t)$ , in terms of the step response  $g_s$ .

$$y(t) = \sum_{n=-\infty}^{\infty} ?$$

# General Response

My confidence that I have the correct answer is:

1. 100%
2. 80%
3. 60%
4. 40%
5. 20%
6. 0%

# General Response

The correct answer is

$$y(t) \approx \sum_{n=-\infty}^{\infty} u(\tau_n) [g_s(t - \tau_n) - g_s(t - \tau_{n+1})]$$

My answer

1. Was completely correct
2. Was mostly correct, with one or two minor errors
3. Had many errors
4. Was completely incorrect

# Integration by Parts of Duhamel's Integral

Earlier, we found that the response of an LTI system to a signal  $u(t)$  which is zero for  $t < 0$  is

$$y(t) = u(0)g_s(t) + \int_0^\infty \frac{du(\tau)}{d\tau} g_s(t - \tau) d\tau$$

Use integration by parts to eliminate the derivative of  $u(\cdot)$  in the integral. My confidence that I have the correct answer is:

1. 100%
2. 80%
3. 60%
4. 40%
5. 20%
6. 0%

# Integration by Parts of Duhamel's Integral

Earlier, we found that the response of an LTI system to a signal  $u(t)$  which is zero for  $t < 0$  is

$$y(t) = u(0)g_s(t) + \int_0^\infty \frac{du(\tau)}{d\tau} g_s(t - \tau) d\tau$$

Using integration by parts to eliminate the derivative of  $u(\cdot)$  in the integral, we have that

$$\begin{aligned} y(t) &= - \int_0^\infty u(\tau) \frac{dg_s(t - \tau)}{d\tau} d\tau \\ &= \int_0^\infty u(\tau) g'_s(t - \tau) d\tau \end{aligned}$$

My answer

1. Was completely correct
2. Was mostly correct, with one or two minor errors
3. Had many errors
4. Was completely incorrect

# Time Spent on Unified

The average time I spent on Unified each week, **EXCLUDING** lectures, recitation, and system problem lectures, was

1. 6 hours or less
2. 8 hours
3. 10 hours
4. 12 hours
5. 14 hours
6. 16 hours
7. 18 hours
8. 20 hours
9. 22 hours
0. 24 hours or more

Please make sure your answer is an average over the term, not the time spent during the last week or during the worst week in Unified.

# Time Spent on Unified

The average number of class hours I attended each week was

1. 2 or fewer
2. 3
3. 4
4. 5
5. 6
6. 7
7. 8
8. 9
9. 10
0. 11

# Friday Quiz Review

How many of the post-quiz review sessions have you attended?

1. One
2. Two
3. Three
4. None

# General Feedback

Please comment on

1. Any aspect of Unified that needs improvement,  
or
2. Any aspect of Unified that you think works  
especially well