Assignment 1

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***Abstract*—This document contains the solution for Ex. 3.37 of Discrete-Time Signal Processing by Oppenheim and Wilsky.**

Problem 1. Consider a sequence $x[n]$ for which z-transform is

$$X(z) = \frac{\frac{1}{3}}{1 - \frac{1}{2}z^{-1}} + \frac{\frac{1}{4}}{1 + \frac{1}{3}z^{-1}} \tag{0.1}$$

and for which region of convergence includes the unit circle. Determine $x[0]$ using initial-value theorem.

Solution: The initial value theorem of Z-transform states that:

$$x(n) \overset{\text{Z}}{\longleftrightarrow} X(z) \tag{0.2}$$

Where, $x(n)$ is casual sequence. Then,

$$x(0) = \lim_{n\to 0} x(n) = \lim_{z\to\infty} X(z) \tag{0.3}$$

So,

$$x(0) = \lim_{z\to\infty} X(z) \tag{0.4}$$

$$= \lim_{z\to\infty} \frac{\frac{1}{3}}{1 - \frac{1}{2}z^{-1}} + \frac{\frac{1}{4}}{1 + \frac{1}{3}z^{-1}} \tag{0.5}$$

$$= \frac{1}{3} + \frac{1}{4} = \frac{7}{12} \tag{0.6}$$