

IMPLE #2

$$x[n] \rightarrow \underbrace{A_1(z)}_{\text{}} - \underbrace{A_2(z)}_{\text{}} \rightarrow y[n]$$

$$H(z) = \left( \frac{1}{1-p_1 z^{-1}} \right) \left( \frac{1}{1-p_2 z^{-1}} \right)$$

$$= \frac{1}{1 - (p_1 + p_2)z^{-1} + p_1 p_2 z^{-2}}$$

$$Y(z) = X(z) + (p_1 + p_2)z^{-1} Y(z) - p_1 p_2 z^{-2} Y(z)$$

IMPLEMENTATION #1

$$y[n] = x[n] + (p_1 + p_2)y[n-1] - p_1 p_2 y[n-2]$$

IMPLEMENTATION #2

$$v[n] = x[n] + p_1 v[n-1]$$

$$y[n] = v[n] + p_2 y[n-2]$$

BETTER IN ALL OTHER CASES

b/c

$$\text{STABLE} \Leftrightarrow |p_1| < 1$$

$$|p_2| < 1$$

IMPLEME. #1

$$x[n] \rightarrow \underbrace{H(z)}_{\text{}} \rightarrow y[n]$$

BETTER IF

$$p_2 = p_1^*$$

b/c

 $p_1 + p_2$  IS REAL $p_1 p_2$  IS REAL

WRITTEN EXAMPLE

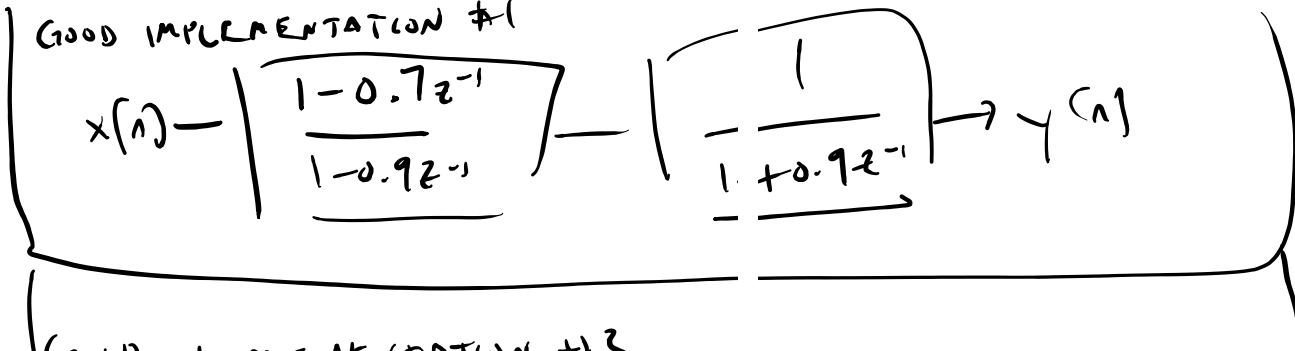
$$H(z) = \frac{1 - 0.7z^{-1}}{1 - 0.81z^{-2}} = \frac{1 - 0.7z^{-1}}{(1 - 0.9z^{-1})(1 + 0.9z^{-1})}$$

$$1 - x^2 = (1 + jx)(1 - jx) = 1 + jx - jx - (jx)^2 = 1 + x^2$$

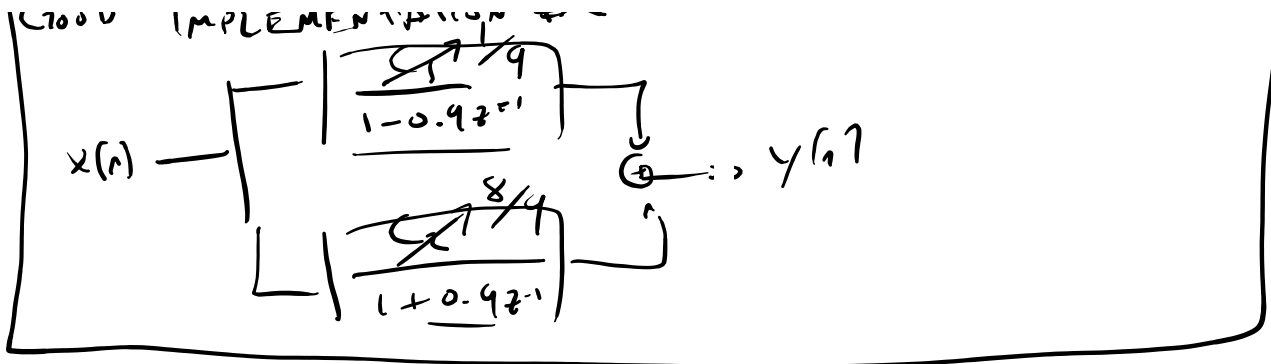
$$(1+x)(1-x) = 1+x-x-x^2 = 1-x^2$$

EASIER TO CODE

GOOD IMPLEMENTATION #1



GOOD IMPLEMENTATION #2



EASIER TO FIND  $g(n)$  BY HAND

$$\frac{1 - 0.7z^{-1}}{(1 - 0.9z^{-1})(1 + 0.9z^{-1})} = \frac{C_1}{1 - 0.9z^{-1}} + \frac{C_2}{1 + 0.9z^{-1}}$$

SOLVE FOR  $C_1$ : MULTIPLY BY  $(1-0.7z^{-1})$ , SET  $z=0.9$

$$\frac{1-0.7z^{-1}}{1+0.9z^{-1}} = C_1 + C_2 \frac{1-0.9z^{-1}}{1+0.9z^{-1}} \quad \text{IF } z=0.9$$

$$\frac{1-\frac{0.7}{0.9}}{1+\frac{0.9}{0.9}} = C_1 = \frac{2/9}{2} = \frac{1}{9}$$

SOLVE FOR  $C_2$ : MULTIPLY BY  $(1+0.9z^{-1})$ , SET  $z=-0.9$

$$\frac{1-0.7z^{-1}}{1-0.9z^{-1}} = C_1 \frac{1+0.9z^{-1}}{1-0.9z^{-1}} + C_2$$

$$\frac{1-\frac{0.7}{-0.9}}{1-\frac{0.9}{-0.9}} = C_2 = \frac{16/9}{2} = \frac{8}{9}$$

$$G(z) = \frac{1-0.7z^{-1}}{1-0.81z^{-2}} = \frac{1/9}{1-0.9z^{-1}} + \frac{8/9}{1+0.9z^{-1}}$$

$$g[n] = \frac{1}{9} (0.9)^n u[n] + \frac{8}{9} (-0.9)^n u[n]$$

$$\frac{1}{9} + \frac{1}{9} (0.9)^n u[n]$$

Handwritten musical notation on a five-line staff. The time signature is 8/4, written vertically on the left. The notation consists of a series of notes on the upper staff and a corresponding series of notes on the lower staff, connected by vertical stems. The notes on the upper staff are mostly quarter notes, while the notes on the lower staff include some eighth notes.

Handwritten musical notation on a five-line staff. The notation includes a circled note on the upper staff with an upward-pointing arrow above it. To the right of this circled note is the handwritten text "g(^)". Below the circled note, there is a series of notes on the lower staff, some of which are connected by a slur. A double equals sign "=" is written to the left of the staff.