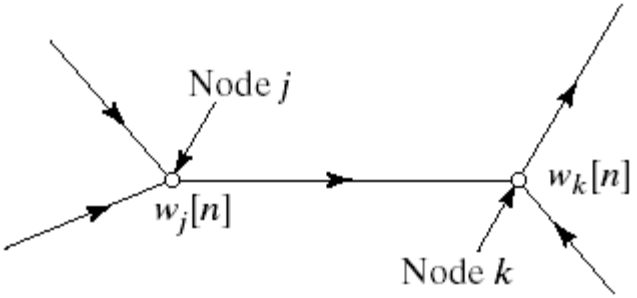
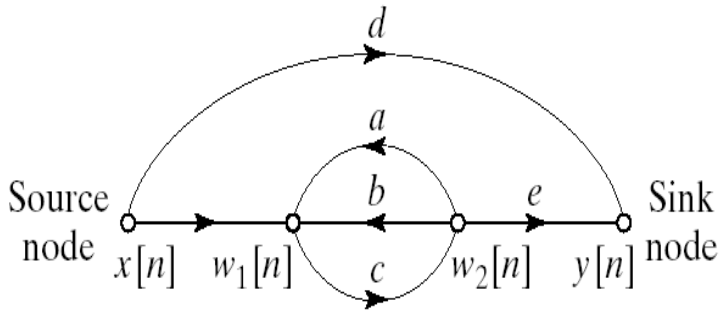
Signal flow graphs

Signal Flow Graph Representation

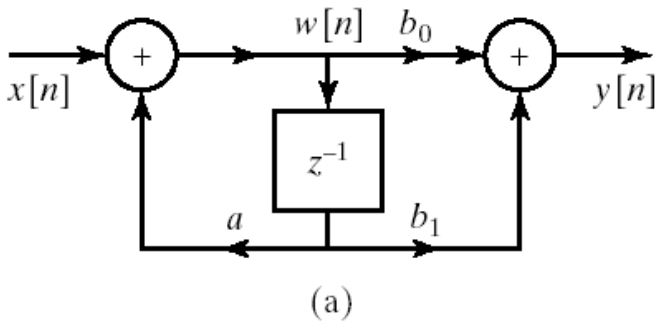
- Similar to block diagram representation
  - Notational differences
- A network of directed branches connected at nodes



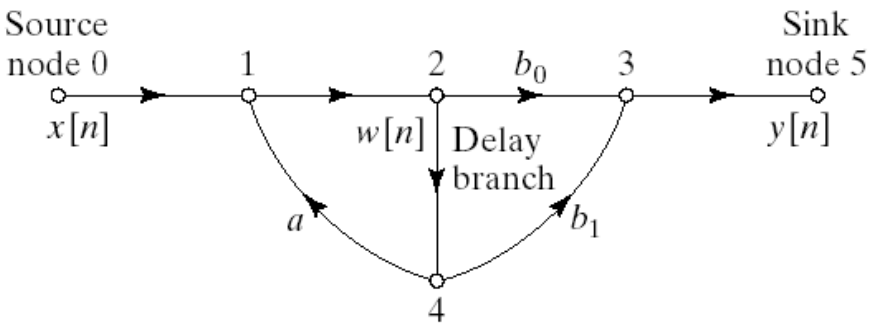


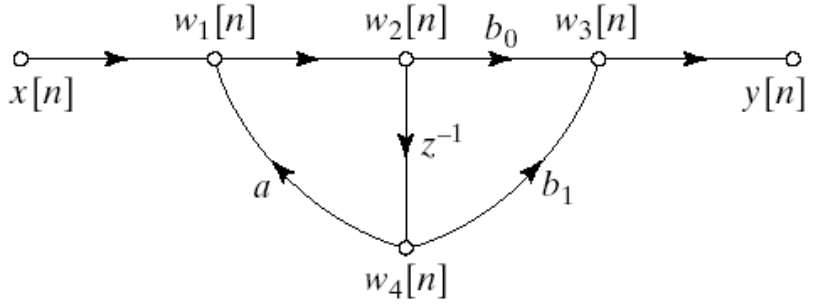
- Example representation of a difference equation

Example



(a)





Form I with signal

$$w_1[n] = a w_4[n] + x[n]$$

$$w_2[n] = w_1[n]$$

$$w_3[n] = b_0 w_2[n] + b_1 w_4[n]$$

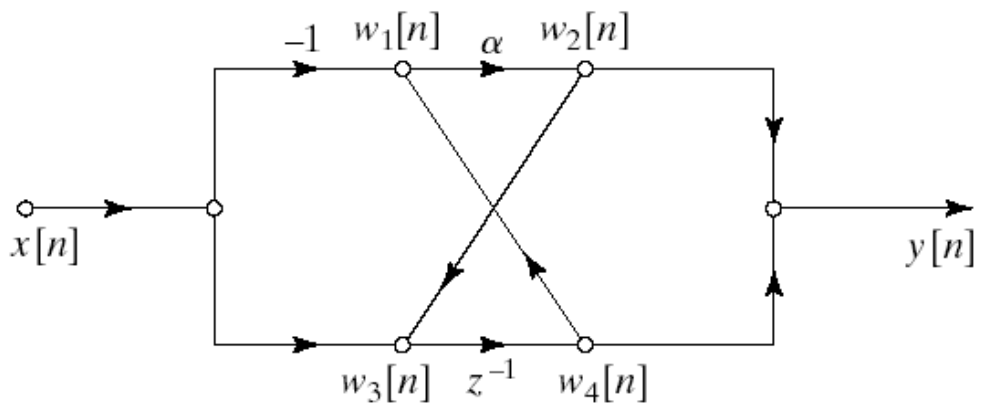
$$w_4[n] = w_2[n-1]$$

$$y[n] = w_3[n]$$

$$w_1[n] = a w_1[n-1] + x[n]$$

$$y[n] = b_0 w_1[n] + b_1 w_1[n-1]$$

Determination of System Function



$$w_1[n] = w_4[n] - x[n]$$
$$w_2[n] = \alpha w_1[n]$$
$$w_3[n] = w_2[n] + x[n]$$
$$w_4[n] = w_3[n-1]$$
$$y[n] = w_2[n] + w_4[n]$$

$$W_1(z) = W_4(z) - X(z)$$
$$W_2(z) = \alpha W_1(z)$$
$$W_3(z) = W_2(z) + X(z)$$
$$W_4(z) = W_3(z)z^{-1}$$
$$Y(z) = W_2(z) + W_4(z)$$

$$\longrightarrow \quad W_2(z) = \frac{\alpha X(z)(z^{-1} - 1)}{1 - \alpha z^{-1}}$$

$$W_4(z) = \frac{X(z)z^{-1}(1 - \alpha)}{1 - \alpha z^{-1}} \longrightarrow H(z) = \frac{Y(z)}{X(z)} = \frac{z^{-1} - \alpha}{1 - \alpha z^{-1}}$$

$$h[n] = \alpha^{n-1}u[n-1] - \alpha^{n+1}u[n]$$