$$Y = \frac{U \cdot G}{1 + HG}$$

$$Y = \frac{U}{1 + HG} \cdot G$$

$$W = \frac{U}{1 + HG}$$

$W = ?$

$W = U + (-HWG)$
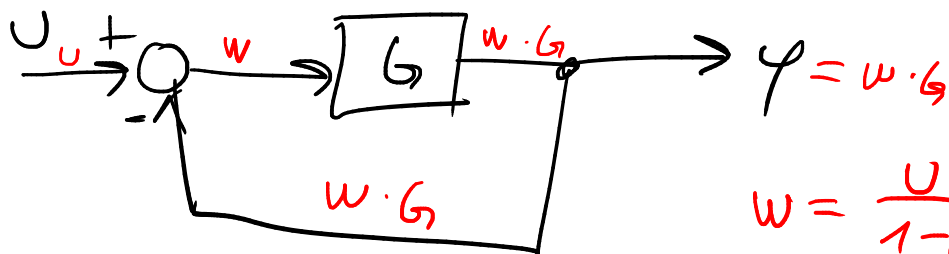
$W = U - HWG$

$W + HWG = U$

$W(1 + HG) = U$

Top diagram:

$$U_U \xrightarrow{+} \bigcirc \xrightarrow{W} \boxed{G} \xrightarrow{w \cdot G} \quad y = w \cdot G$$

feedback: $w \cdot G$

$$w = U + w \cdot G$$
$$w - w \cdot G = U$$
$$w(1-G) = U$$

$$w = \frac{U}{1-G}$$

$$y = \frac{U}{1-G} \cdot G$$

Middle-left diagram:

$$\bigcirc \rightarrow \boxed{G} \xrightarrow{U \cdot G} \bigcirc$$

$$y = \boxed{U \cdot G}$$
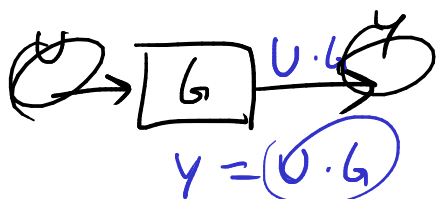
$$T.R.F = \frac{IN}{OUT}$$
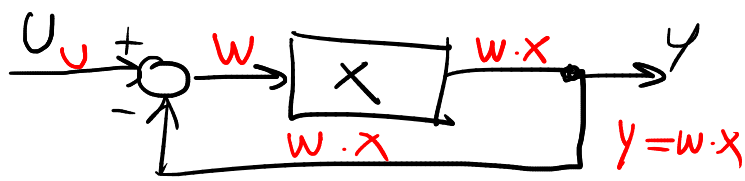
$$U \cdot G = \frac{Ux}{1+x} \quad / 1+x$$

$$U \cdot G \cdot (1+x) = Ux$$

$$\cancel{U}G + \cancel{U}Gx = \cancel{U}x$$

$$G + Gx = x \Rightarrow G = x - Gx$$

Bottom-right diagram:

$$U_U \xrightarrow{+} \bigcirc \xrightarrow{W} \boxed{x} \xrightarrow{w \cdot x} y$$

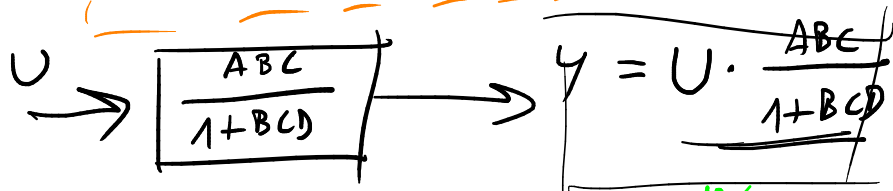feedback: $w \cdot x$

$$y = w \cdot x$$

$$w = U + (-w \cdot x)$$
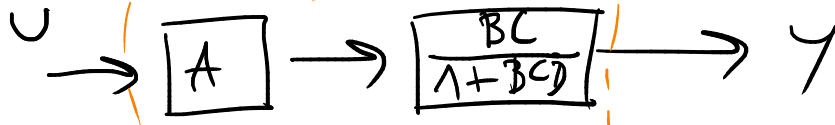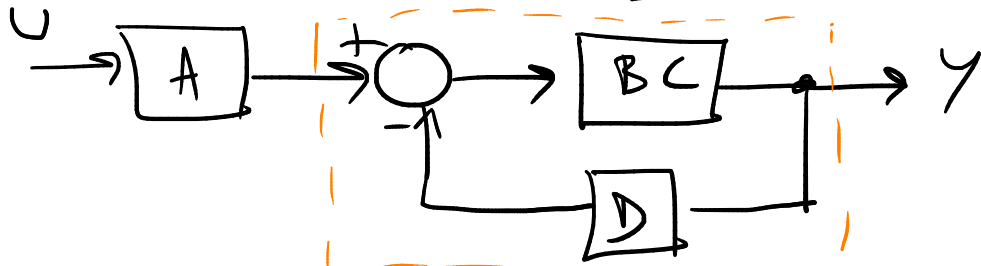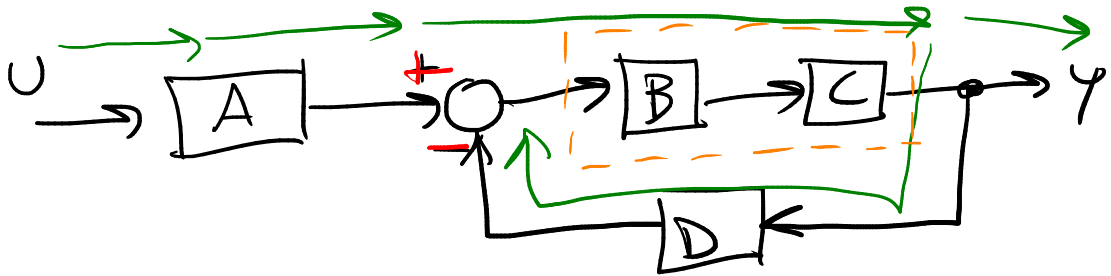$$w = U - wx$$
$$w + wx = U$$
$$w(1+x) = U$$
$$w = \frac{U}{1+x}$$

$$\Rightarrow x = \boxed{\frac{G}{1-G}}$$

$$y = \frac{U}{1+x} \cdot x$$

$$y = \frac{Ux}{1+x}$$

$$G = x(1-G) \quad /(1-G)^{-1}$$

U → [A] → $+$ ⊕ $-$ → [B] → [C] → Y

with feedback [D]

U → [A] → $+$ ⊕ $-$ → [BC] → Y

with feedback [D]

U → [A] → $\dfrac{BC}{1+BCD}$ → Y

U → $\boxed{\dfrac{ABC}{1+BCD}}$ → $Y = U \cdot \dfrac{ABC}{1+BCD}$

$$G = \frac{Y}{U} = \frac{U \cdot \frac{ABC}{1+BCD}}{U} = \frac{ABC}{1+BCD}$$

TRF

$Y = QBD$
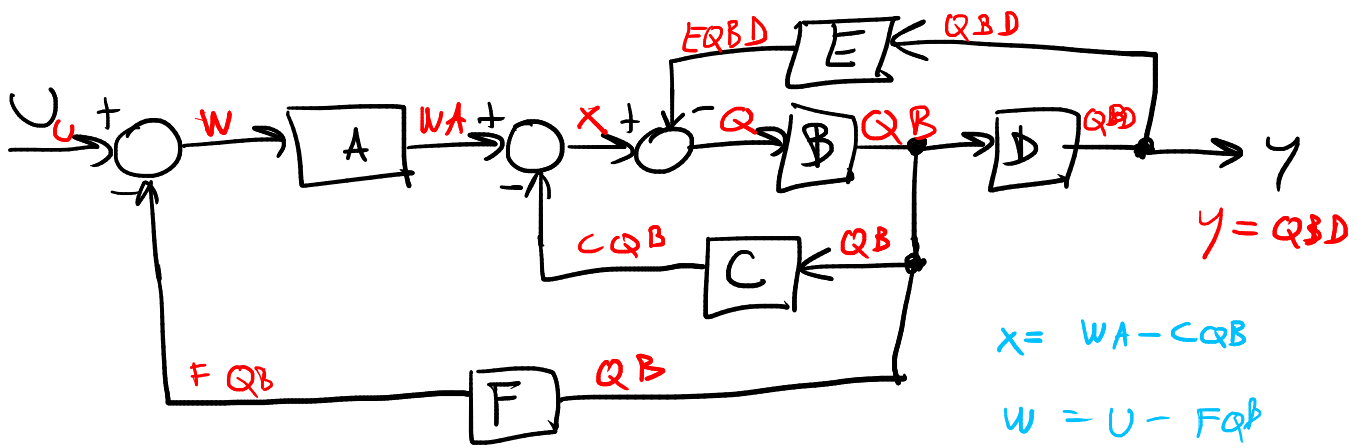
$X = WA - CQB$

$W = U - FQB$

$Q = X - EQBD$

$Q = WA - CQB - EQBD$

$Q = (U - FQB) \cdot A - CQB - EQBD$

$Q = UA - FQBA - CQB - EQBD$

$Q = UA - Q(FBA - CB - EBD)$

$Q + Q(FBA - CB - EBD) = UA$

$Q + QFBA - QCB - QEBD = UA$