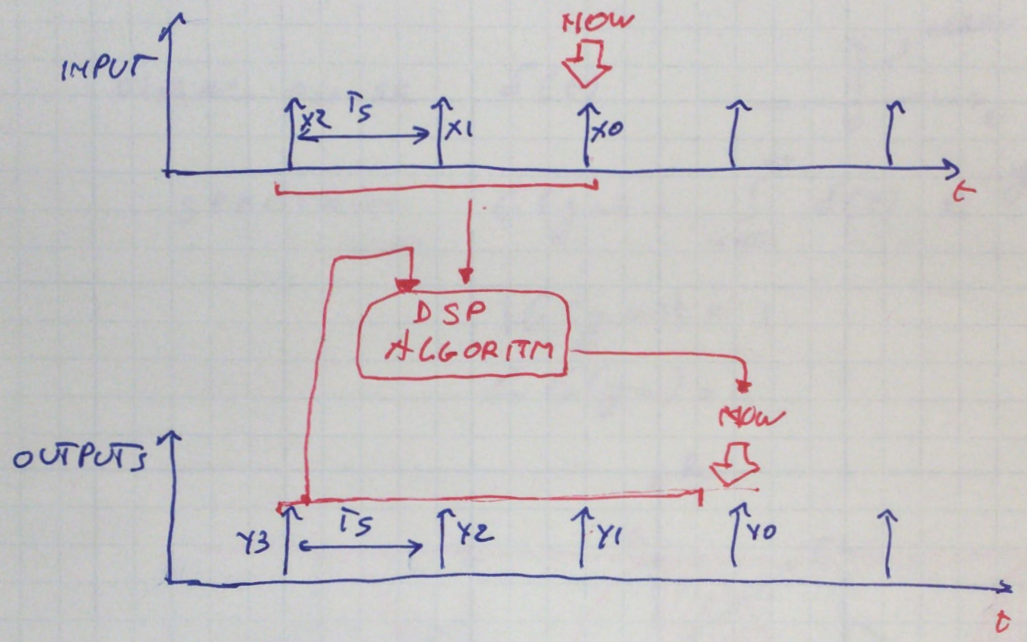


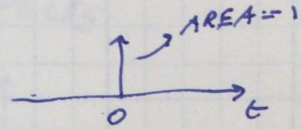

```
VOID DSP (INPUT X0,
          X1,
          X2,
          Y1,
          Y2,
          Y3,
          OUTPUT *Y0);
```

```
INT  X0, X1, X2;
INT  Y1, Y2, Y3, Y0;

VOID TICK() {
    X2 = X1;
    X1 = X0;
    X0 = ADC_OUTPUT();
    DSP(X0, X1, X2, Y1, Y2, Y3, &Y0);
    Y3 = Y2;
    Y2 = Y1;
    Y1 = Y0;
    DAC_INPUT(Y0);
}
```

DISCRETE TIME FOURIER TRANSFORM

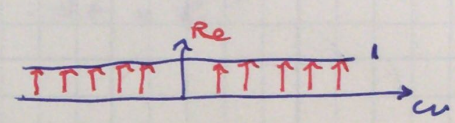
DIRAC PULSE $\delta(t)$

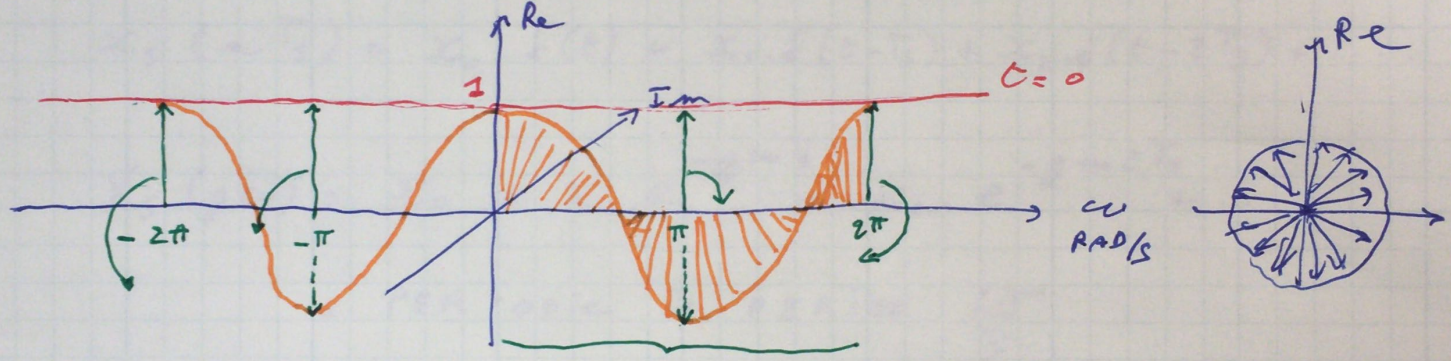


SPECTRUM $G(j\omega) = \int_{-\infty}^{\infty} \delta(t) \cdot e^{-j\omega t} \cdot dt = e^{-j\omega \cdot 0} = 1$

$|G(j\omega)| = 1$

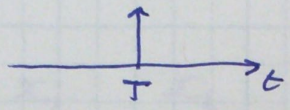
$\angle G(j\omega) = 0$





TIME-SHIFTED DIRAC IMPULSE

$\delta(t-T)$



SPECTRUM $\quad G(j\omega) = \int_{-\infty}^{\infty} \delta(t-T) \cdot e^{-j\omega t} \cdot dt = e^{-j\omega T}$

SAMPLED-DATA SIGNAL

$$x_s(nT_s) = x_0 \cdot \delta(t) + x_1 \cdot \delta(t-T_s) + x_2 \cdot \delta(t-2T_s) + \dots$$

$$X_s(j\omega) = x_0 + x_1 e^{-j\omega T_s} + x_2 \cdot e^{-j\omega 2T_s} + \dots$$

= PERIODIC W PERIOD $\frac{2\pi}{T_s}$

DTFT

$$X(e^{j\omega}) = \sum_{-\infty}^{\infty} x(n) \cdot e^{-jn\omega}$$

$i : 0..15$

$\left[a * \sin\left(\frac{i}{16} * 2\pi\right) + b \right.$

Z-TRANSFORM.

$$z \equiv e^{sT} = e^{(\sigma + j\omega).T}$$

$x(n)$: $x_0 \quad x_1 \quad x_2 \quad x_3 \ldots$

$$G(z) = x_0 + x_1 . z^{-1} + x_2 . z^{-2} + x_3 . z^{-3} + \ldots$$

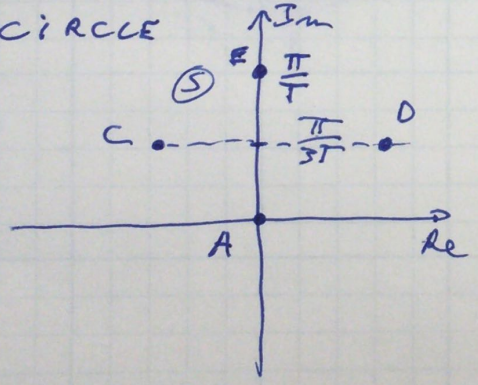
EXAMPLE: UNIT STEP. $u(n)$: $1 \Leftrightarrow n \geq 0$ ..... |||||||→

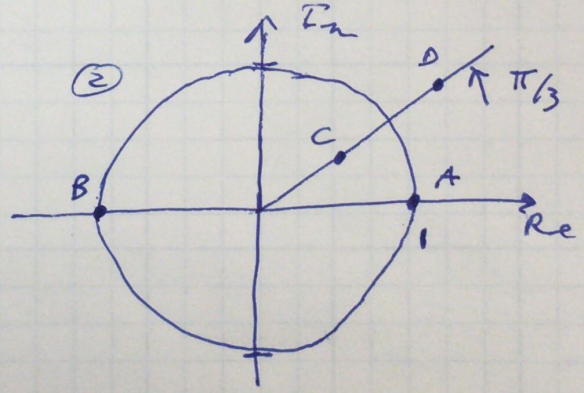
0 OTHERWISE

$$U(z) = 1 + z^{-1} + z^{-2} + z^{-3} + \ldots$$

$$U(z) = \frac{1}{1 - z^{-1}}$$

UNIT CIRCLE





$$G(z) = 1 - z^{-8}$$

$$G(z) = \frac{z^8 - 1}{z^8}$$

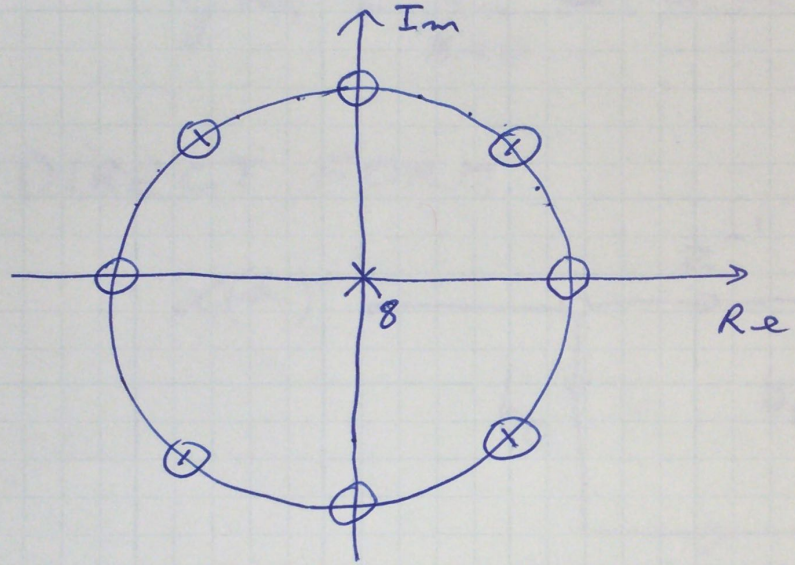
→ ZEROES

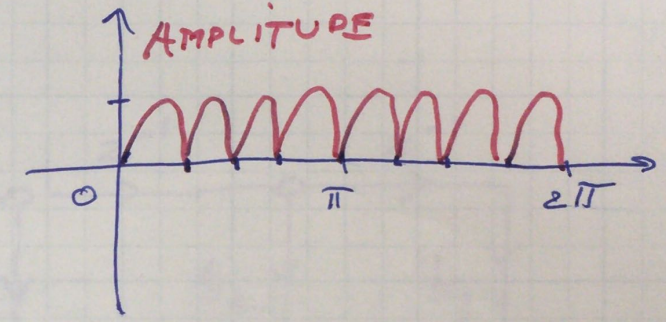
→ ZEROES

$$z^8 = 1 \leftrightarrow z = \sqrt[8]{1}$$

$$z_i = e^{j\frac{i\pi}{4}} \qquad i : 0..7$$

$$z^8 = 0 \leftrightarrow z = 0$$





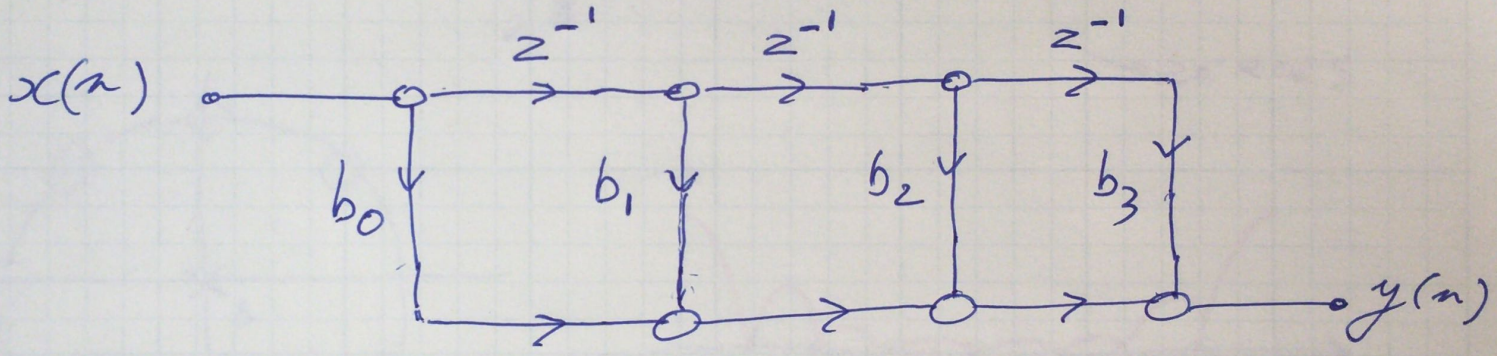
(c)

FIR FILTERS.

$$H(z) = \sum_{n=0}^{M} b(n) \cdot z^{-n} \qquad Y(z) = H(z) \cdot X(z)$$

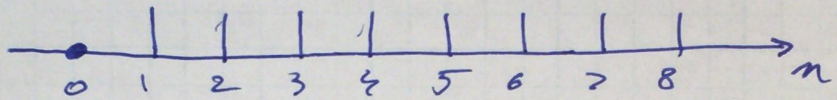
$$y(n) = \sum_{k=0}^{M} b(k) \cdot x(n-k)$$

DIRECT FORM.



FIR DESIGN EXAMPLE.

$$G(z) = z^{-1} + z^{-2} + z^{-3} + z^{-4} + z^{-5} + z^{-6} + z^{-7} + z^{-8}$$



$$G(z) = \frac{z^1 + z^2 + z^3 + z^4 + z^5 + z^6 + z^7 + z^8}{z^8}$$

→ ZEROES

→ ZEROES