cours

FPGA

29 - 10 - 2024

E E P R O M

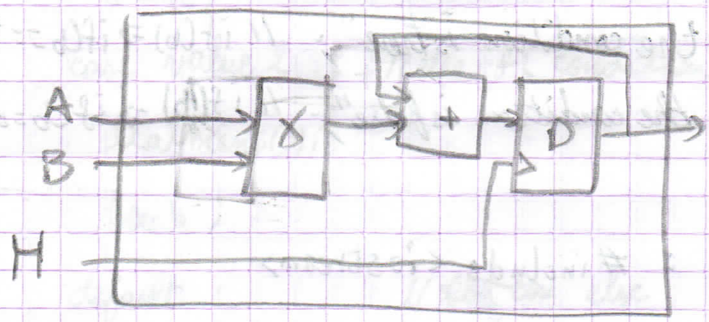
- Errealisable
- Electrical
- Programmable
- Read
- Only
- Memory

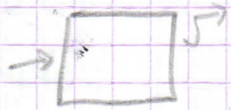
$M = 2^{N}$

unité MAC

Multiplication et accumulation

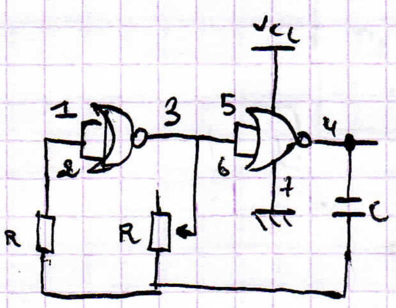
$$y(k) = \sum_{n=0}^{N} A(n)\, B(n)$$





$$T = (R_1 + R_2)\, C \underbrace{\ln\left(\frac{E + V_0}{E - V_0}\right)}_{\simeq 2.2}$$

$f_{NE555_{max}} = 2 MHz$



$F \simeq \frac{\overset{\tau}{\widetilde{RC}}}{2.2}$ Hz

POO cours

Les instruction

```
# include <iostream>
int main {
    bool b= true; //2eme ittiration b=false
    if (b) std::cout <<" the condition is true"; // if(b) => if(b == treu)
    else std::cout << " the condition is false"; // if(!b) => if(b==false)
}
```

Les operateur logiques : #include <iostream>

```
int main {
    bool a = treu;
    bool b = treu;
    if(a && b) {    // And => && ; Or => ||
        std::cout << " the entire condition is true";
    } else {
        std::cout << "the entire condition is false";
    }
}
```

Les opérateurs de comparaison :

if(x==y) => si x égale à y

x>=y => " x superieur ou égale à y

x<=y => " x inferieur ou " à y

x>y => " x superieur à y

x<y => " x inferieur à y

x&&y => ~~x et y~~ x et y

x||y => x ou y

Instruction Switch

```
switch (condition) {
  case value 1 :       // if ( condition == value 1)
    Statment(s);
    break;
  case value 2 :  // else if ( condition == value 2)
    Statment(s);
    break;
  default :            // else
    Statment(s);
    break;
}
```

Example !

```
# include <iostream>
int main() {
  int x=3;
  switch (x) {
    case 1:
      std::cout << "the value is 1";
      break;
    case 2:
      std::cout << "the value is 2";
      break;
    case 3:
      std::cout << "the value is 3";
      break;
    default:
      std::cout << "the value is neather 1,2 nor 3";
      break;
  }
}
```

for Loop

```
#include <iostream>
int main() {
  for (int i=0; i<10; i++) {
    std::cout << " i= " << i << '\n';
  }
}
```

les fonctions →

```
# include <iostream>
int mysquare (int x);
int main {
  int result = mysquare(2);
  std::cout <<"numbre 2 square is:" <<result;
}
int mysquare (int x){
  return x*x;
}
```

```
# include <iostream>
int mysum (int x, int y);
int main {
  int result = my sum (5,10);
  std::cout <<"The sum is: " << result;
}
int mysum (int x, int y) {
  return x+y;
}
```

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SAB//TAS

- non-recursive systems:

$$y(n) = \sum_{i=-\infty}^{+\infty} h_i(x(i)) = h(n) * x(n)$$

→ the output y depends only on the input signal x

- Recursive System

$$\sum_{i=0}^{N-1} y(n-i)\, b_i = \sum_{j=0}^{M-1} x(n-j)\, a_j$$

$$\Rightarrow y(n)\, b_0 = \sum_{j=0}^{M-1} x(n-j)\, a_j - \sum_{i=1}^{N-1} y(n-i)\, b_i$$

$$y(n) = \sum_{j=0}^{M-1} \frac{a_j}{b_0} x(n-j) - \sum_{i=1}^{N-1} \frac{b_i}{b_0} y(n-i)$$

$$\frac{a_j}{a_0} = A_j$$

$$\frac{b_i}{a_0} = B_i$$

$$y(n) = \sum_{j=0}^{M-1} A_j\, x(n-j) - \sum_{i=1}^{N-1} B_j\, y(n-i)$$

→ Recursive Systems are described by the following equations:

$$\sum_{i=0}^{M-1} a_i\, y(n-i) = \sum_{k=0}^{N-1} b\, x(n-k)$$

$$\Rightarrow y(n) = -\sum_{i=1}^{M-1} A_i\, y(n-i) + \sum_{k=0}^{N-1} B_j\, x(n-k)$$

which ~~have~~ have the following transfer function ((System function))

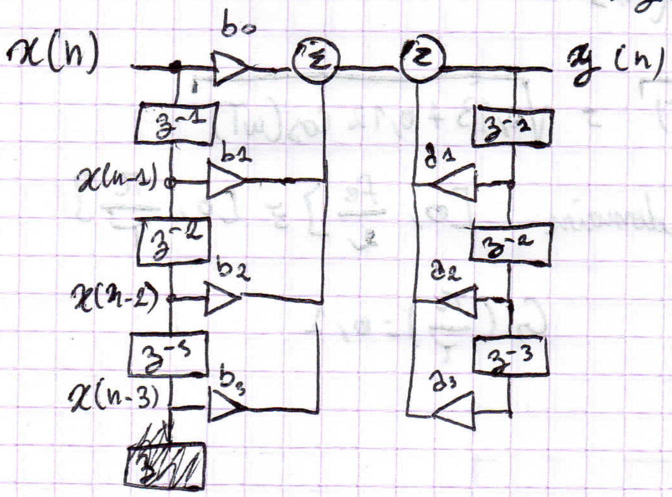
$$H(z) = \frac{Y(z)}{X(z)} = \frac{\sum_{k=0}^{N-1} b_k z^{-k}}{1 + \sum_{i=1}^{M-1} a_i z^{-i}}$$

$$* \text{ if } z = e^{2j\pi f} \Rightarrow \overset{TF}{H(f)} = H(z)_{\text{for } z = e^{2\pi j f}} \quad RF$$

$$\text{So: } H(f) = \frac{\sum_{k=0}^{N-1} b_k e^{-2\pi f j k}}{1 + \sum_{i=0}^{M-1} a_i e^{-2\pi f j i}}$$

- Design Structure ((realization)):

Example $M = 4$, $L = 8 \Rightarrow y(n) = b_0 x(n) + b_1 x(n-1) + b_2 x(n-2) + b_3 x(n-3) - a_1 y(n-1) - a_2 y(n-2) - a_3 y(n-3)$



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SAN Cours

- $G(z) = \dfrac{1}{z - 0{,}8} = \dfrac{S(z)}{X(z)} = \dfrac{z^{-1}}{1 - z^{-1}(0{,}8)}$

$X(z) \longrightarrow \boxed{G(z)} \longrightarrow S(z)$

$\Rightarrow S(z)(1 - 0{,}8 z^{-1}) = X(z) z^{-1}$

$S(z) = X(z) z^{-1} - 0{,}8 z^{-1} S(z)$

$\Rightarrow s(k) = x(k-1) - 0{,}8\, s(k-1)$; $s(\infty) = \lim_{k \to +\infty} (s(k)) = \lim_{z \to 1} (1 - z^{-1}) S(z)$

$= \lim_{z \to 1} (1 - z^{-1}) X(z) G(z)$

$s(k) = \{ s(0), s(1), s(2), \ldots, s(\infty) \}$

- Détermination de courbe de la réponse fréquentielle du système

$s(n) = 0{,}5\, e(n-1) + 0{,}2\, e(n)$

$e(n) \longrightarrow \boxed{G(z)} \longrightarrow s(n)$

$S(z) = 0{,}5 z^{-1} E(z) + 0{,}2 E(z)$

$G(z) = \dfrac{S(z)}{E(z)} = 0{,}5 z^{-1} + 0{,}2$

- On remplace z par $e^{j\omega T}$ pour obtenir la TF de $g(n)$

$G(e^{j\omega T}) = 0{,}5\, e^{-j\omega T} + 0{,}2$

$$= 0,5\left(\cos(\omega T) - j\sin(\omega T)\right) + 0,2$$

$$= \left[0,5\cos(\omega T) + 0,2\right] - j\left[\sin(\omega T)\right]$$

$$|G(e^{j\omega T})| = \sqrt{\left[0,5\cos(\omega T) + 0,2\right]^2 + \sin^2(\omega T)} = \sqrt{0,13 + 0,12\cos(\omega T)}$$

on travaille dans le domain $\left[0, \frac{fe}{2}\right] = \left[0, \frac{\pi}{T}\right]$

$G(0) = 0,5$; $G\left(\frac{\pi}{T}\right) = 0,1$