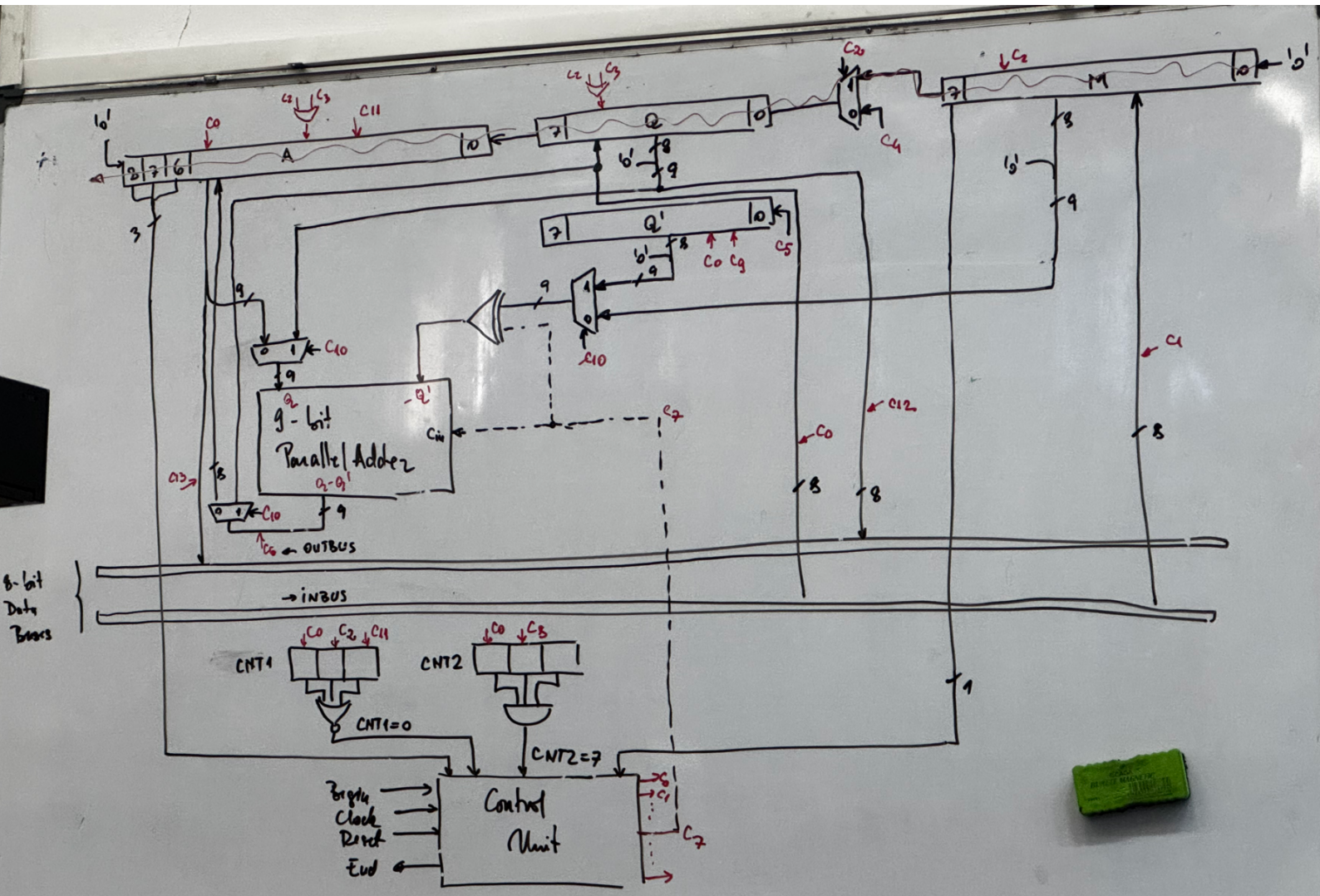
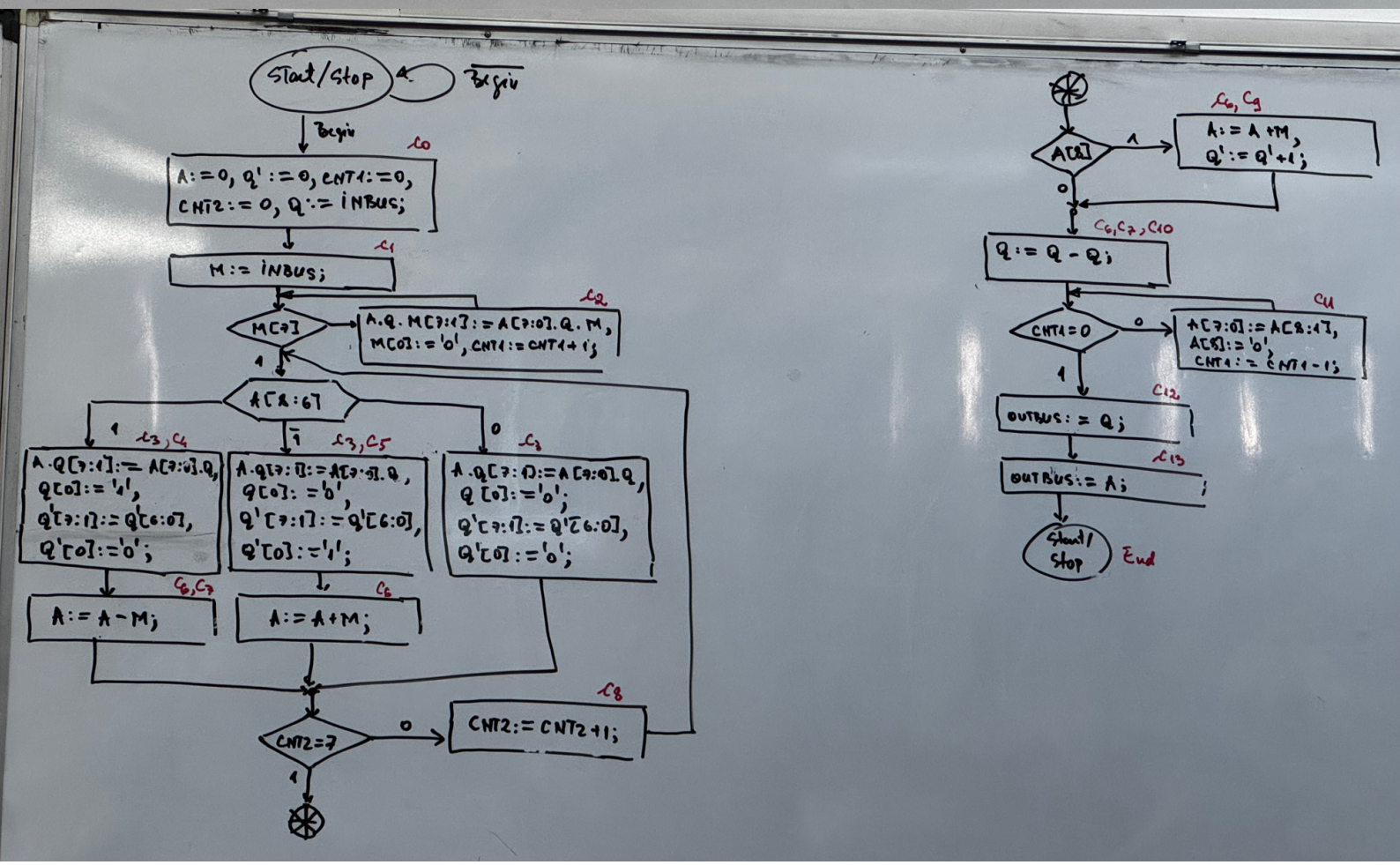
Radix 2 SRT


A
Q
Q'
M
9-bit Parallel Adder
CNT1
CNT2
CNT1=0
CNT2=7
INBUS
OUTBUS
8-bit Data Buses
Control Unit
Begin
Clock
Reset
End


Start/Stop
Begin
A:=0, Q':=0, CNT1:=0, CNT2:=0, Q:=INBUS;
M:=INBUS;
M[7]
A.Q.M[7:1]:=A[7:0].Q.M, M[0]:='0', CNT1:=CNT1+1;
A[8:6]
A.Q[7:1]:=A[7:0].Q, Q[0]:='1', Q'[7:1]:=Q'[6:0], Q'[0]:='0';
A.Q[7:1]:=A[7:0].Q, Q[0]:='0', Q'[7:1]:=Q'[6:0], Q'[0]:='1';
A.Q[7:0]:=A[7:0].Q, Q[0]:='0', Q'[7:1]:=Q'[6:0], Q'[0]:='0';
A:=A-M;
A:=A+M;
CNT2=7
CNT2:=CNT2+1;
A[8]
A:=A+M, Q':=Q'+1;
Q:=Q-Q';
CNT1=0
A[7:0]:=A[8:1], A[8]:='0', CNT1:=CNT1-1;
OUTBUS:=Q;
OUTBUS:=A;
Start/Stop
End

1.4.4. Radix-4 SRT

radix 2 $\quad r_{i+1} \leftarrow 2r_i - q_i b$

$q_i \in \{\bar{1}, 0, 1\}$

radix 4 $\quad r_{i+1} \leftarrow 4r_i - q_i b$

$q_i \in \{\bar{2}, \bar{1}, 0, 1, 2\}$

if $|r_i| < b$ then $|r_{i+1}| < b$

$r_i = b \rightarrow \quad 4b - q_i b \leq b$

$q_i = 2$

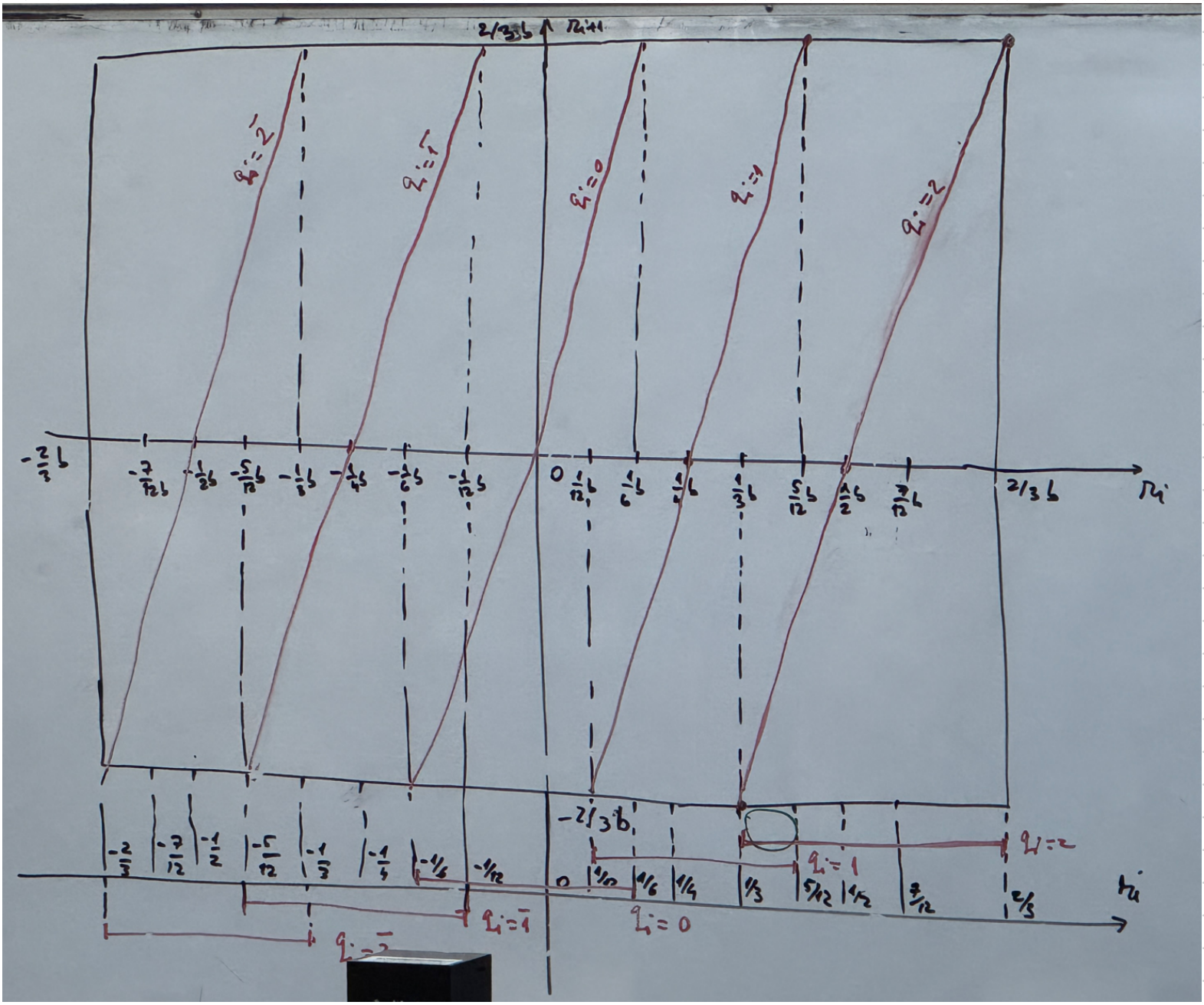
$\geq 2b$

Constraints: $|r_i| < \frac{2}{3} b$

$\Rightarrow |r_{i+1}| < \frac{2}{3} b$

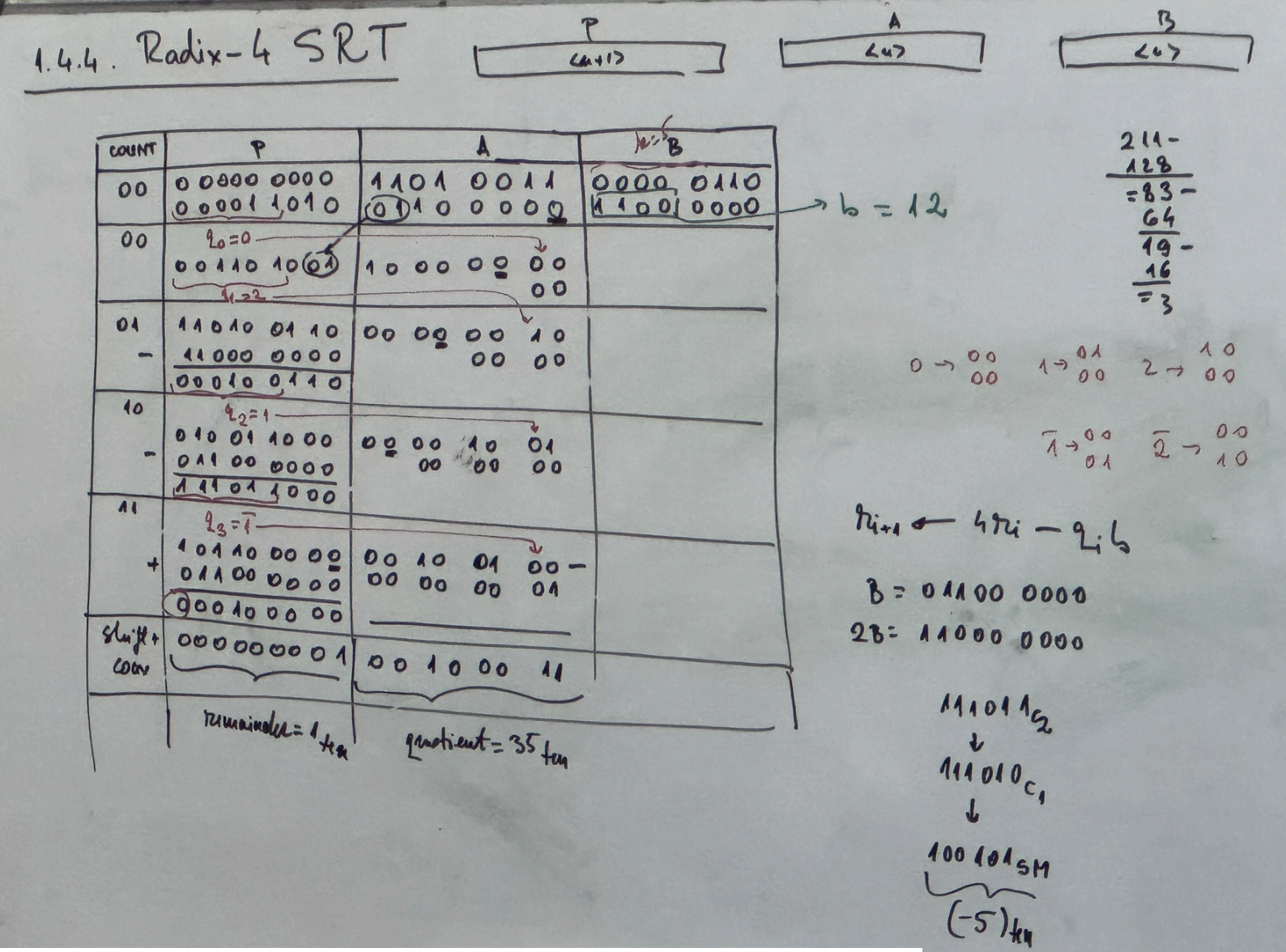
$r_i = \frac{2}{3} b \rightarrow \quad 4 \cdot \frac{2}{3} b - 2 b$

$\frac{8-6}{3} b \leq \frac{2}{3} b$



$0 \to \begin{matrix} 0 & 0 \\ 0 & 0 \end{matrix}$ $\quad 1 \to \begin{matrix} 0 & 1 \\ 0 & 0 \end{matrix}$ $\quad 2 \to \begin{matrix} 1 & 0 \\ 0 & 0 \end{matrix}$

$\overline{1} \to \begin{matrix} 0 & 0 \\ 0 & 1 \end{matrix}$ $\quad \overline{2} \to \begin{matrix} 0 & 0 \\ 1 & 0 \end{matrix}$



1 SRT-4

b	Range of P		q	b	Range of P		q
8	−12	−7	−2	12	−18	−10	−2
8	−6	−3	−1	12	−10	−4	−1
8	−2	1	0	12	−4	3	0
8	2	5	1	12	3	9	1
8	6	11	2	12	9	17	2
9	−14	−8	−2	13	−19	−11	−2
9	−7	−3	−1	13	−10	−4	−1
9	−3	2	0	13	−4	3	0
9	2	6	1	13	3	9	1
9	7	13	2	13	10	18	2
10	−15	−9	−2	14	−20	−11	−2
10	−8	−3	−1	14	−11	−4	−1
10	−3	2	0	14	−4	3	0
10	2	7	1	14	3	10	1
10	8	14	2	14	10	19	2
11	−16	−9	−2	15	−22	−12	−2
11	−9	−3	−1	15	−12	−4	−1
11	−3	2	0	15	−5	4	0
11	2	8	1	15	3	11	1
11	8	15	2	15	11	21	2

$211 \mid 6$
$18 \quad 35$
$= 31$
30
$= 1$

$213 \mid 5$
$20 \quad 42$
$= 13$
10
$= 3$

111001_{C2}
↓
111000_{C1}
↓
100111_{SM}

$213 -$
128
$= 85 -$
64
$21 -$
16
$= 5$

$(-7)_{ten}$

COUNT	P	A	B
00	0 0000 0000 0 0001 1010	1101 0101 1010 0000	0000 0101 1010 0000 → $b = (10)_{ten}$
00	$q_0 = 1$ 0 0110 1010 − 0101 0 0000 1 1100 1010	1 0 00 00 01 00	
01	$q_0 = \bar{1}$ 1 0010 1010 + 0101 0 0000 1 1100 1010	00 00 01 00 00 01	
10	$q_1 = \bar{1}$ 1 0010 1000 + 0101 0 0000 1 1100 1000	00 01 00 00 00 01 01	
11	$q_2 = \bar{1}$ 1 0010 0000 + 0101 0 0000 (1) 1100 0000	01 00 00 00 00 01 01 01	
corr +	0101 0 0000 0011 0 0000	01 00 00 00 − 00 01 01 10	
shift + corr	0 0000 0011 remainder $= (3)_{ten}$	0010 10 10 quotient $= (42)_{ten}$	

$B = 01010\ 0000$

2. Computer System Performance

2.1 Intro

* 1. Desktop Comp.
2. Servers
3. Embedded Systems

Performance → Time
- Memory (Space)
- Energy (Power)
- Dependability

Time ↔ Throughput

Exec. Time / Run Time

Desktop -> Run Time

Server -> Throughput

Embedded -> "computers as components"

-> Real Time Systems

(margem de pers. -> Deadline)

Worst Case Scenario

---

1 CPU and 10 Tasks (Seq.)

a) faster processor -> faster run time

↓

Implicit ∃! throughput

b) add a 2nd processor -> better throughput

↓

Implicit ∃! run time

$$\text{Performance}_X = \frac{1}{\text{Exec. time}_X}$$

Machine X is n times faster than Y

$$\frac{\text{Perf. } X}{\text{Perf. } Y} = \frac{\text{Exec. time } Y}{\text{Exec. time } X} = n$$

2.2. Benchmark Suites

spec.org

- Synthetic Benchmarks
- Toy Programs

} wrong tests

transitive !!!

if $A > B$ and $B > C \Rightarrow A > C$

$$SPEC = \sqrt[n]{\prod_{i=1}^{n} \frac{1}{\text{Exec. } i}}$$

$i = \overline{1,n}$ programs

+ Mașină de referință

$$SPEC_X = \sqrt[n]{\prod_{i=1}^{n} \frac{\text{Perf. } x\,i}{\text{Perf. Ref } i}} \quad \left(\frac{\text{Exec Ref } i}{\text{Exec } X\,i}\right)$$

SPEC Ratio X