Máquinas de Turing:

1.

séptupla:

M = (Q, Σ, Γ, q0, B, F, δ(q, X) = (p, Y, S))

1. Q = {start, goEnd, writeEnd, returnStart, delimit, shift, endZero, endOne, review, done}
2. Σ = {0, 1, N, A}
3. Γ = {0, 1, N, A, _}
4. q0 = start
5. B = _
6. F = {done}
7. δ(q, X) = (p, Y, S) =
    δ(goEnd, 0) = (goEnd, 0, R)
    δ(goEnd, 1) = (goEnd, 1, R)

δ(goEnd, N) = (writeEnd, N, R)
δ(writeEnd, _) = (returnStart, 1, L)
δ(writeEnd, 0) = (returnStart, 1, L)
δ(writeEnd, 1) = (returnStart, 0, L)
δ(returnStart, 0) = (returnStart, 0, L)
δ(returnStart, 1) = (returnStart, 1, L)
δ(returnStart, N) = (returnStart, N, L)
δ(returnStart, A) = (returnStart, A, L)
δ(returnStart, _) = (start, _, R)
δ(start, 0) = (start, 0, R)
δ(start, A) = (start, a, R)
δ(start, N) = (shift, N, R)
δ(shift, 0) = (endZero, _, L)
δ(shift, 1) = (endOne, _, L)
δ(endOne, N) = (review, 1, L)
δ(endZero, N) = (review,0_, L)
δ(review, 0) = (review, 0, L)
δ(review, A) = (review, 1, L)
δ(review, _) = (done, _, R)
δ(delimit, 0) = (delimit, 0, R)
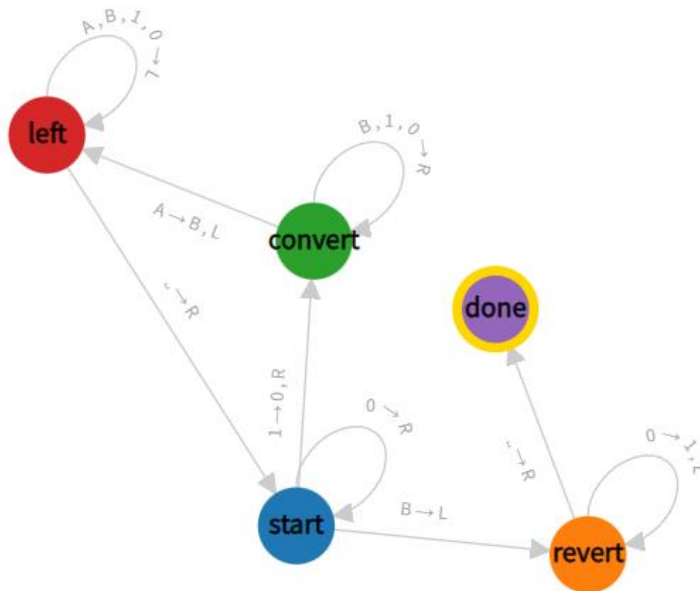δ(delimit, 1) = (delimit, 1, R)
δ(delimit, _) = (returnStart, N, L)

2.
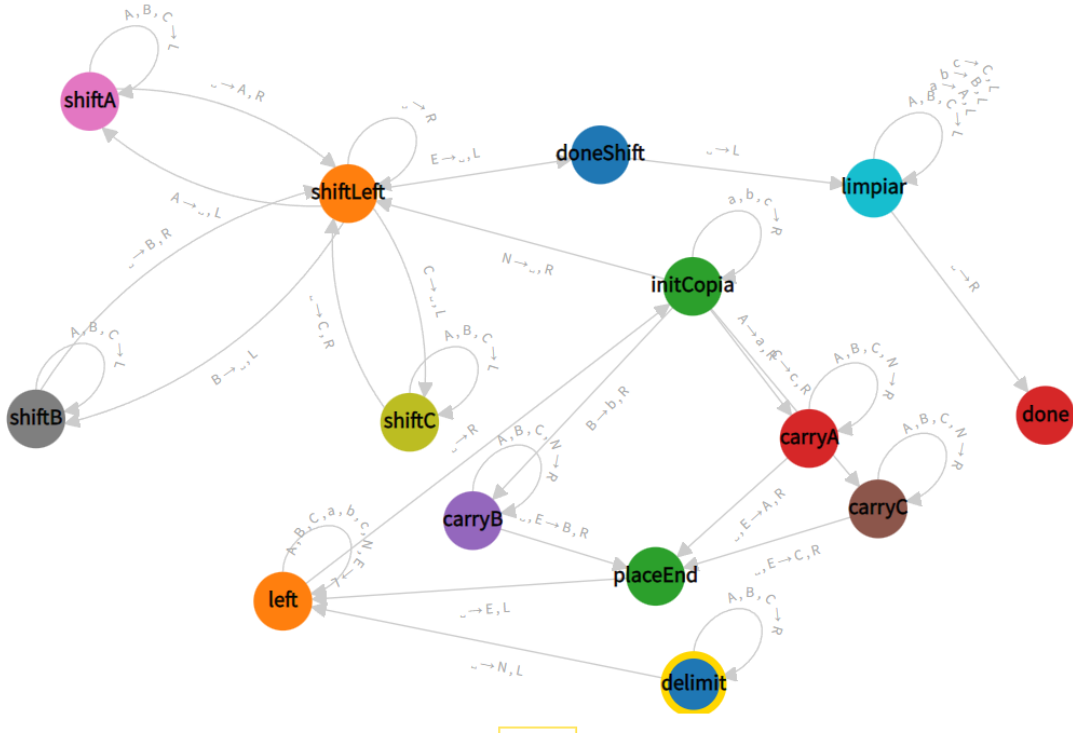
séptupla:

M = (Q, Σ, Γ, q0, B, F, δ(q, X) = (p, Y, S))

1. Q = {delimit, left, initCopia, carryA, carryB, carryC, placeEnd, shiftLeft, shiftC, shiftB, shiftA, doneShift, limpiar, done}
2. Σ = {A, a, B, b, C, c, N, E}
3. Γ = {A, a, B, b, C, c, N, E, _}
4. q0 = delimit
5. B = _
6. F = {done}
7. δ(q, X) = (p, Y, S) =

    δ(delimit, A) = (delimit, A, R)
    δ(delimit, B) = (delimit, B, R)
    δ(delimit, C) = (delimit, C, R)
    δ(delimit, _) = (left, N, L)
    δ(left, _) = (initCopia, _, R)

δ(left, A) = (left, A, L)
δ(left, B) = (left, B, L)
δ(left, C) = (left, C, L)
δ(left, a) = (left, a, L)
δ(left, b) = (left, b, L)
δ(left, c) = (left, c, L)
δ(left, N) = (left, N, L)
δ(left, E) = (left, E, L)
δ(initCopia, A) = (carryA, a, R)
δ(initCopia, C) = (carryC, c, R)
δ(initCopia, B) = (carryB, b, R)
δ(initCopia, N) = (shiftLeft, _, R)
δ(initCopia, a) = (initCopia, a, R)
δ(initCopia, b) = (initCopia, b, R)
δ(initCopia, c) = (initCopia, c, R)
δ(carryA, A) = (carryA, A, R)
δ(carryA, B) = (carryA, B, R)
δ(carryA, C) = (carryA, C, R)
δ(carryA, N) = (carryA, N, R)
δ(carryA, _) = (placeEnd, A, R)
δ(carryA, E) = (placeEnd, A, R)
δ(carryC, A) = (carryC, A, R)
δ(carryC, B) = (carryC, B, R)
δ(carryC, C) = (carryC, C, R)
δ(carryC, N) = (carryC, N, R)
δ(carryC, _) = (placeEnd, C, R)
δ(carryC, E) = (placeEnd, C, R)
δ(carryB, A) = (carryB, A, R)
δ(carryB, B) = (carryB, B, R)
δ(carryB, C) = (carryB, C, R)
δ(carryB, N) = (carryB, N, R)
δ(carryB, _) = (placeEnd, B, R)
δ(carryB, E) = (placeEnd, b, R)
δ(placeEnd, _) = (left, E, L)
δ(shiftLeft, _) = (shiftLeft, _, R)

δ(shiftLeft, C) = (shiftC, _, L)
δ(shiftLeft, B) = (shiftB, _, L)
δ(shiftLeft, A) = (shiftA, _, L)
δ(shiftLeft, E) = (doneShift, _, L)
δ(shiftA, A) = (shiftA, A, L)
δ(shiftA, B) = (shiftA, B, L)
δ(shiftA, C) = (shiftA, C, L)
δ(shiftA, _) = (shiftA, A, R)
δ(shiftB, A) = (shiftB, A, L)
δ(shiftB, B) = (shiftB, B, L)
δ(shiftB, C) = (shiftB, C, L)
δ(shiftB, _) = (shiftLeft, B, R)
δ(shiftC, A) = (shiftC, A, L)
δ(shiftC, B) = (shiftC, B, L)
δ(shiftC, C) = (shiftC, C, L)
δ(shiftC, _) = (shiftLeft, C, R)
δ(doneShift, _) = (limpiar, _, L)
δ(limpiar, A) = (limpiar, A, L)
δ(limpiar, B) = (limpiar, B, L)
δ(limpiar, C) = (limpiar, C, L)
δ(limpiar, a) = (limpiar, a, L)
δ(limpiar, b) = (limpiar, b, L)
δ(limpiar, c) = (limpiar, c, L)
δ(limpiar, _) = (done, _, R)

3.

séptupla:

M = (Q, Σ, Γ, q0, B, F, δ(q, X) = (p, Y, S))

1. Q = {start, revert, done, convert, left}
2. Σ = {0, 1, B, A}
3. Γ = {0, 1, B, A, _}
4. q0 = start
5. B = _
6. F = {done}
7. δ(q, X) = (p, Y, S) =

    δ(start, 0) = (start, 0, R)
    δ(start, 1) = (convert, 0, R)
    δ(start, B) = (revert, B, L)
    δ(convert, 0) = (convert, 0, R)
    δ(convert, 1) = (convert, 1, R)

δ(convert, B) = (convert, B, R)
δ(convert, A) = (left, B, L)
δ(left, 0) = (left, 0, L)
δ(left, 1) = (left, 1, L)
δ(left, A) = (left, A, L)
δ(left, B) = (left, B, L)
δ(left, _) = (start, _, R)
δ(revert, 0) = (revert, 1, L)
δ(revert, _) = (done, _, R)

Link a los códigos:
https://gist.github.com/fabianB30/5845eac82b9947bdd85dabdb863ede8b

Figura 1:

A) 7 atributos de la definición formal:
M = (Q, Σ, Γ, q0, B, F, δ(q, X) = (p, Y, S))
1.   Q = {q0, q1, q2, q3, q4, q5, q6, q7, q8, q9}
2.   Σ = {0, 1, 2, #, Y, X}
3.   Γ = {0, 1, 2, #, Y, X, □}
4.   q0 = q0
5.   B = □
6.   F = {q9}
7.   δ(q, X) = (p, Y, S) = δ(q0, 0) = (q1, X, R)
   = δ(q0, #) = (q8, #, R)
    =δ(q0, 1) = (q2, X, R)
   = δ(q0, 2) = (q3, X, R)
   = δ(q1, #) = (q4, #, R)
   = δ(q1, 2) = (q1, 2, R)
   = δ(q1, 1) = (q1, 1, R)
   = δ(q1, 0) = (q1, 0, R)
   = δ(q2, #) = (q6, #, R)
   = δ(q2, 2) = (q2, 2, R)
   = δ(q2, 1) = (q2, 1, R)

= δ(q2, 0) = (q2, 0, R)
= δ(q3, #) = (q7, #, R)
= δ(q3, 2) = (q3, 2, R)
= δ(q3, 1) = (q3, 1, R)
= δ(q3, 0) = (q3, 0, R)
= δ(q4, Y) = (q4, Y, R)
= δ(q4, 2) = (q5, 2, R)
= δ(q5, 1) = (q3, 1, L)
= δ(q5, 0) = (q3, 0, L)
= δ(q5, #) = (q3, #, L)
= δ(q5, Y) = (q3, Y, L)
= δ(q5, X) = (q0, X, R)
= δ(q6, Y) = (q6, Y, R)
= δ(q6, 1) = (q5, Y, L)
= δ(q7, 2) = (q5, Y, L)
= δ(q7, Y) = (q7, Y, R)
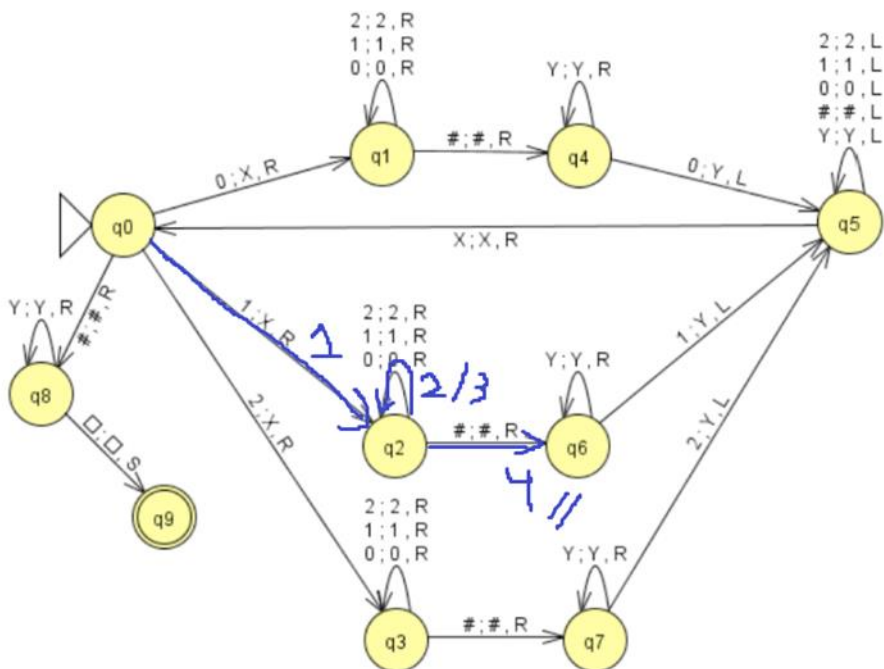= δ(q8, Y) = (q8, Y, R)
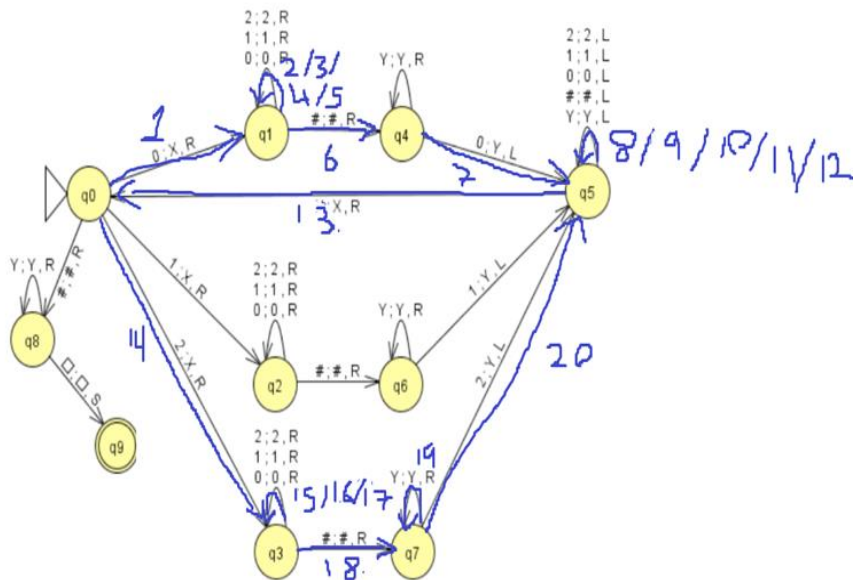= δ(q8, □) = (q9, □, S)

B) Simulaciones:
- 21#122
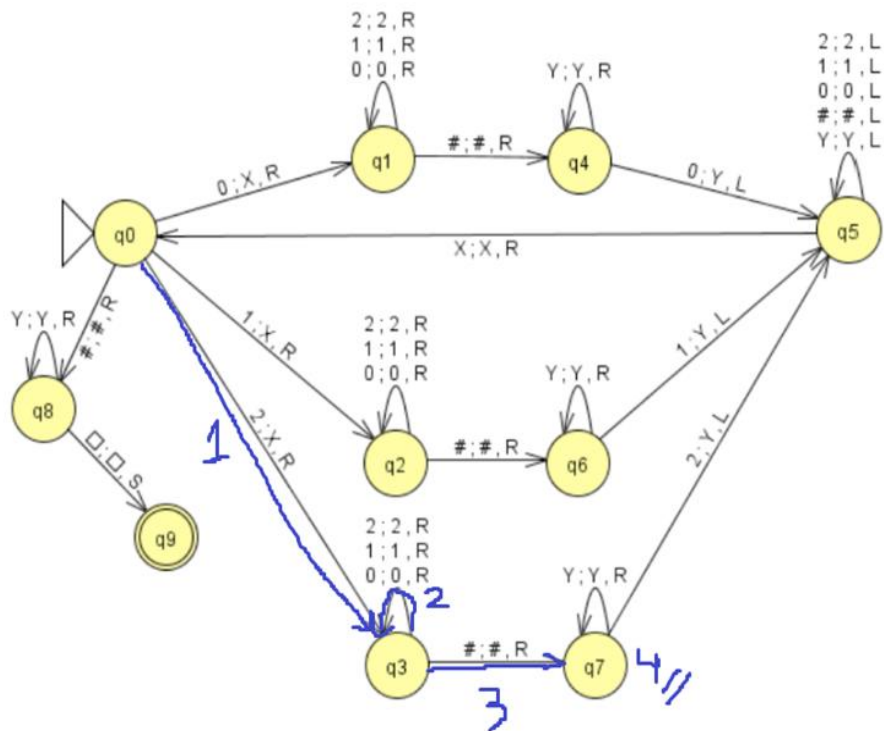
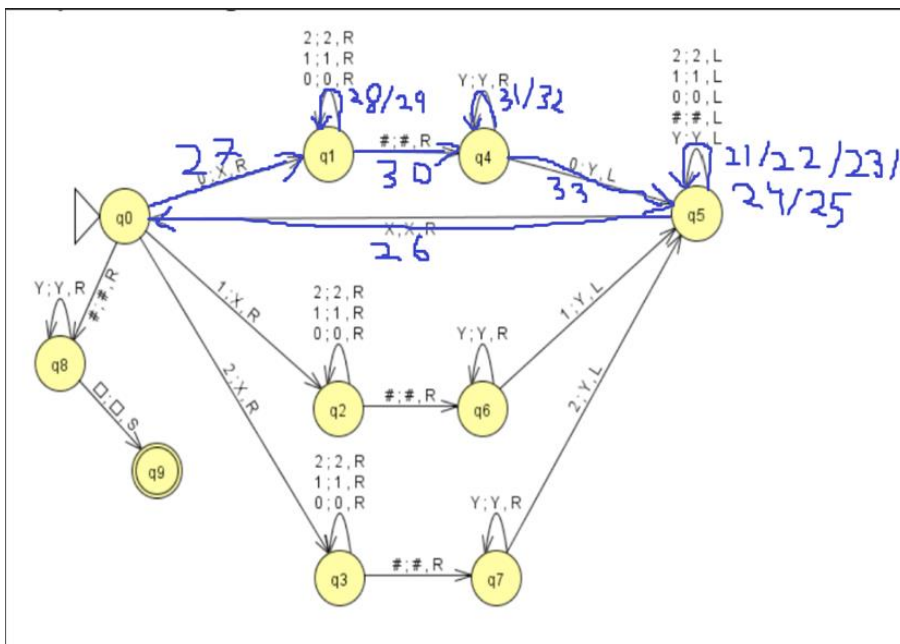Resultado final: "X1#122"

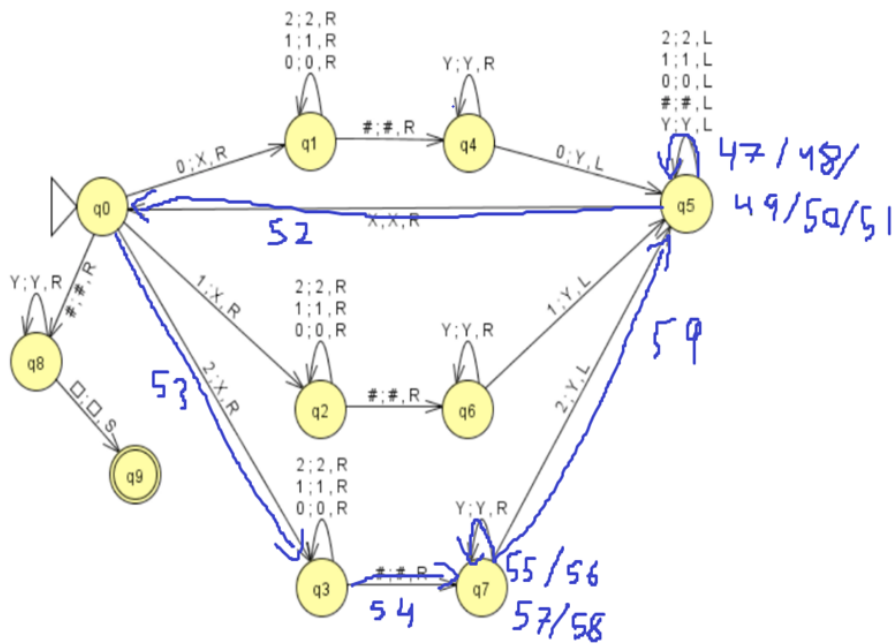- 121#021223

Resultado final: "X21#21223"

- 02012#02012

Resultado actual:
"XX012#YY012"

Resultado actual:
"XXX12#YYY12"

Top diagram labels:

2;2,R
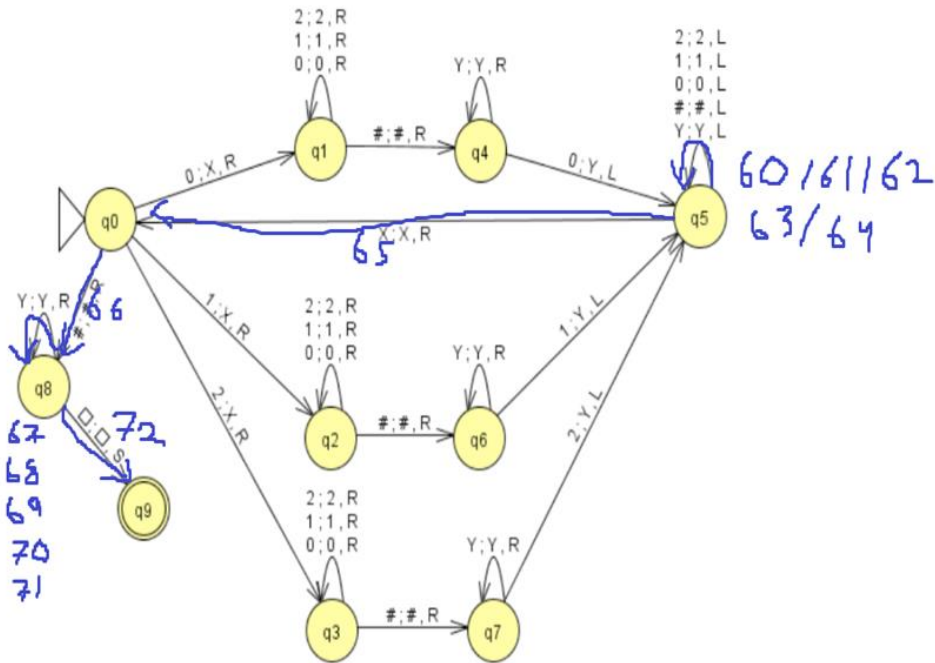1;1,R
0;0,R

Y;Y,R

2;2,L
1;1,L
0;0,L
#;#,L
Y;Y,L

q0 q1 q4 q5 q8 q9 q2 q6 q3 q7

0;X,R #;#,R 0;Y,L

34/35/36/37/38

39 X,X,R

Y;Y,R #;#,R

□;□,S

40 41

2;2,R
1;1,R
0;0,R

43/44/45

42 #;#,R

46

1;Y,L

2;Y,L

2;X,R

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R

Resultado actual: "XXXX2#YYYY2"

Bottom diagram labels:

2;2,R
1;1,R
0;0,R

Y;Y,R

2;2,L
1;1,L
0;0,L
#;#,L
Y;Y,L

q0 q1 q4 q5 q8 q9 q2 q6 q3 q7

0;X,R #;#,R 0;Y,L

47/48/49/50/51

52 X,X,R

Y;Y,R #;#,R

□;□,S

1;X,R

53 2;X,R

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R

1;Y,L

2;Y,L

59

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R 55/56

54 57/58
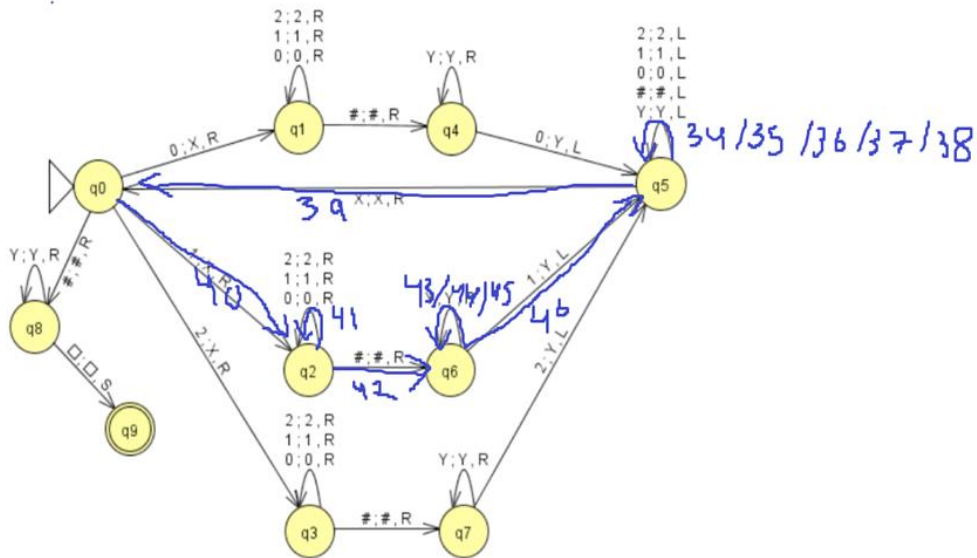
Resultado actual: "XXXXX#YYYYY"

Resultado final
"XXXXX#YYYYY"

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R

0;Y,L

2;2,L
1;1,L
0;0,L
#;#,L
Y;Y,L

60/61/62
63/64

0;X,R

X;X,R

65

Y;Y,R

66

1;X,R

2;2,R
1;1,R
0;0,R

Y;Y,R

1;Y,L

67
68
69
70
71

□;□,S   72

2;X,R

#;#,R

2;Y,L

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R

- 2012#02012

2;2,R
1;1,R
0;0,R

Y;Y,R

#;#,R

0;Y,L

2;2,L
1;1,L
0;0,L
#;#,L
Y;Y,L

Resultado final:
"X012#02012"

0;X,R

X;X,R

Y;Y,R

#;#,R

1;X,R

2;2,R
1;1,R
0;0,R

Y;Y,R

1;Y,L

□;□,S

2;X,R

2;2,R
1;1,R
0;0,R

2;Y,L

2/3/4

1

5

#;#,R

Y;Y,R
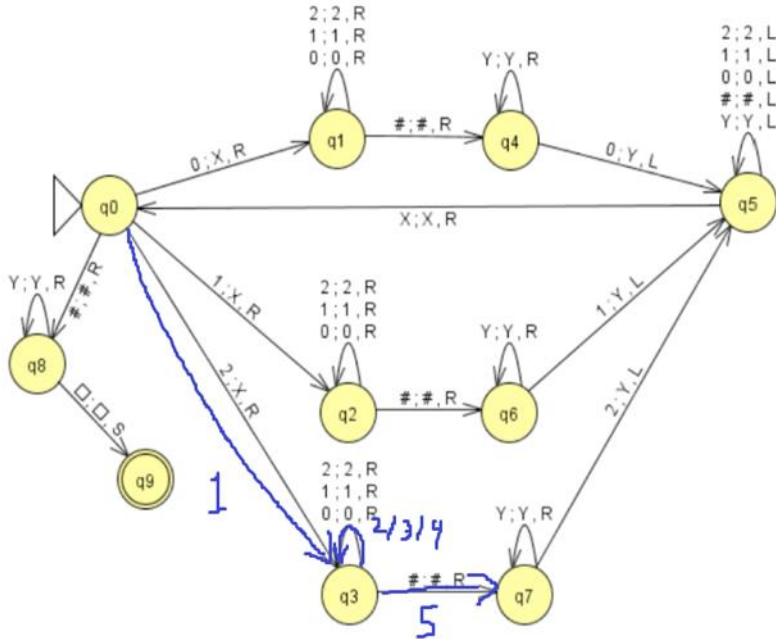
C) ¿Qué tipo de problema resuelve esta Máquina de Turing?

R/ Esta máquina de Turing se utiliza para confirmar que dos números dados en el formato "numero 1 # numero 2" con dígitos entre el 0 y el 2, sean el mismo número, para esto a la izquierda del "#" se convierte elemento por elemento los números a "X" y los compara convirtiendo del lado derecho los números en "Y", en caso de no ser el mismo número, la maquina se detendrá al convertir todos los dígitos en "X" o "Y" dejando dígitos sin convertir.

Ejemplos:
1. 21#21:
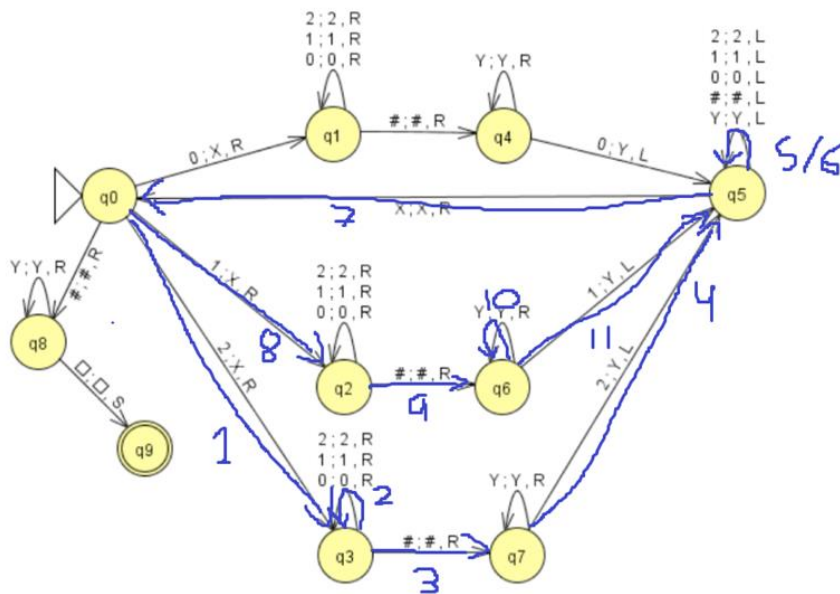
Resultado actual:
"XX#YY"

Resultado final:
"XX#YY"

2. 201#201

Resultado actual:
"XX1#YY1"

Resultado actual:
"XXX#YYY"

Resultado final:
"XXX#YYY"