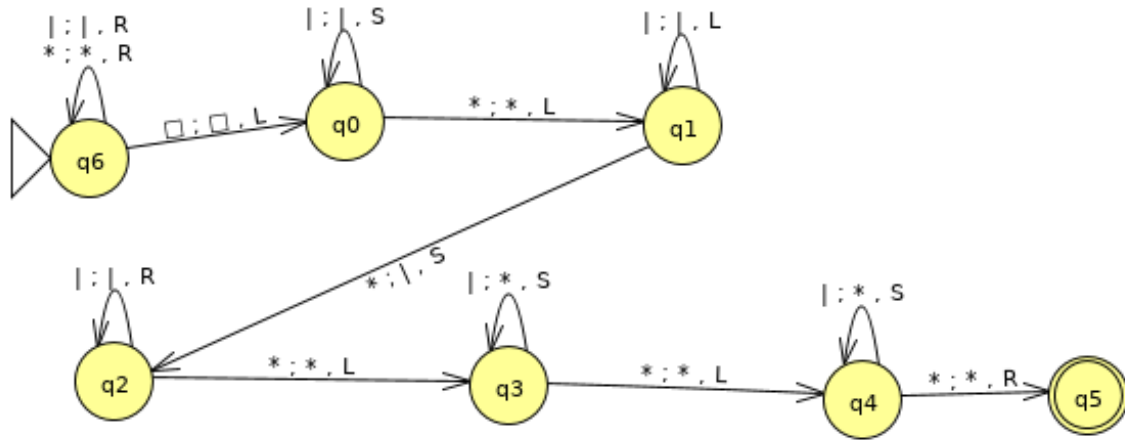# Theory of automata and Formal languages

Fernando Javier López Cerezo
Practice 3

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Problem 1

In exercise 1 we are asked to define a TM that computes the addition of two numbers. This is my proposal:

Problem 2

In exercise 2 we are asked to define a recursive function for the sum of three values. My proposal is addition3 $= \langle\langle\pi_1^1|\sigma(\pi_3^3)\rangle|\sigma(\pi_4^4)\rangle$. We can check it works in the following example:

```
octave:1> evalrecfunction('addition3',1,2,3)
addition3(1,2,3)
<<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>|$\sigma$($\Pi^4_4$)>(1,2,3)
<<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>|$\sigma$($\Pi^4_4$)>(1,2,2)
<<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>|$\sigma$($\Pi^4_4$)>(1,2,1)
<<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>|$\sigma$($\Pi^4_4$)>(1,2,0)
<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>(1,2)
<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>(1,1)
<$\Pi^1_1$|$\sigma$($\Pi^3_3$)>(1,0)
$\Pi^1_1$(1) = 1
$\sigma$($\Pi^3_3$)(1,0,1)
$\Pi^3_3$(1,0,1) = 1

$\sigma$(1) = 2
$\sigma$($\Pi^3_3$)(1,1,2)
$\Pi^3_3$(1,1,2) = 2

$\sigma$(2) = 3
$\sigma$($\Pi^4_4$)(1,2,0,3)
$\Pi^4_4$(1,2,0,3) = 3

$\sigma$(3) = 4
$\sigma$($\Pi^4_4$)(1,2,1,4)
$\Pi^4_4$(1,2,1,4) = 4

$\sigma$(4) = 5
$\sigma$($\Pi^4_4$)(1,2,2,5)
$\Pi^4_4$(1,2,2,5) = 5

$\sigma$(5) = 6
ans =   6
```

3

Exercise 3 asks us to write a WHILE program that computes the sum of three numbers. My proposal is the following:

```
Sum3 =(3 ,s )
s:
    while  X2  ≠  0  do
        X1  :=  X1  +  1
        X2  :=  X2  -  1;
    od

    while  X3  ≠  0  do
        X1  :=  X1  +  1
        X3  :=  X3  -  1;
    od
```