Teoría de Autómatas y Lenguajes Formales

Práctica 3: Máquina de Turing, Funciones Recursivas y Lenguaje WHILE

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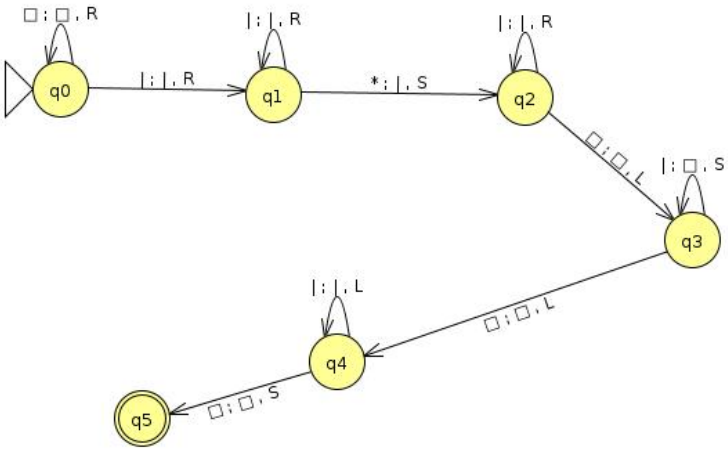
1 Exercise 1

Define the TM solution of exercise 3.4 of the problem list and test its correct behaviour.



After testing its behaviour with JFLAP, we can confirm that it works correctly. However, there's one thing to notice. In the transition from q1 to q2 the instruction reads a * symbol when it should read the blank symbol. It proved imposible to me to test the behaviour of the TM using a blank symbol as a separator, as I couldn't write it in any way, so I replaced it with a * symbol.

Another thing to note is that this TM starts and finishes to the left of the first input string.

Matrix definition of this TM:

$$\begin{bmatrix} q0 & * & r & q0 \\ q0 & | & r & q1 \\ q1 & * & | & q2 \\ q1 & | & r & q1 \\ q2 & * & l & q3 \\ q2 & | & r & q2 \\ q3 & * & l & q4 \\ q3 & | & * & q3 \\ q4 & * & h & q4 \\ q4 & | & l & q4 \end{bmatrix}$$

2 Exercise 2

Define a recursive function for the sum of three values.

$<< \pi_1^1 | \sigma(\pi_3^3) > | \sigma(\pi_4^4) >$

```
>> evalrecfunction('add_3',1,2,3)
add₃(1,2,3)
<<π¹₁|σ(π³₃)>|σ(π⁴₄)>(1,2,3)
<<π¹₁|σ(π³₃)>|σ(π⁴₄)>(1,2,2)
<<π¹₁|σ(π³₃)>|σ(π⁴₄)>(1,2,1)
<<π¹₁|σ(π³₃)>|σ(π⁴₄)>(1,2,0)
<π¹₁|σ(π³₃)>(1,2)
<π¹₁|σ(π³₃)>(1,1)
<π¹₁|σ(π³₃)>(1,0)
π¹₁(1) = 1
σ(π³₃)(1,0,1)
π³₃(1,0,1) = 1

σ(1) = 2
σ(π³₃)(1,1,2)
π³₃(1,1,2) = 2

σ(2) = 3
σ(π⁴₄)(1,2,0,3)
π⁴₄(1,2,0,3) = 3

σ(3) = 4
σ(π⁴₄)(1,2,1,4)
π⁴₄(1,2,1,4) = 4

σ(4) = 5
σ(π⁴₄)(1,2,2,5)
π⁴₄(1,2,2,5) = 5

σ(5) = 6
ans =  6
```

3 Exercise 3

Implement a WHILE program that computes the sum of three values.

while $X1 \neq 0$ **do**
  $X1 := X1 - 1;$
  $X4 := X4 + 1$
od
while $X2 \neq 0$ **do**
  $X2 := X2 - 1;$
  $X4 := X4 + 1$
od
while $X3 \neq 0$ **do**
  $X3 := X3 - 1;$
  $X4 := X4 + 1$
od
X1 := X4;