
STATISTICAL STRUCTURED PREDICTION

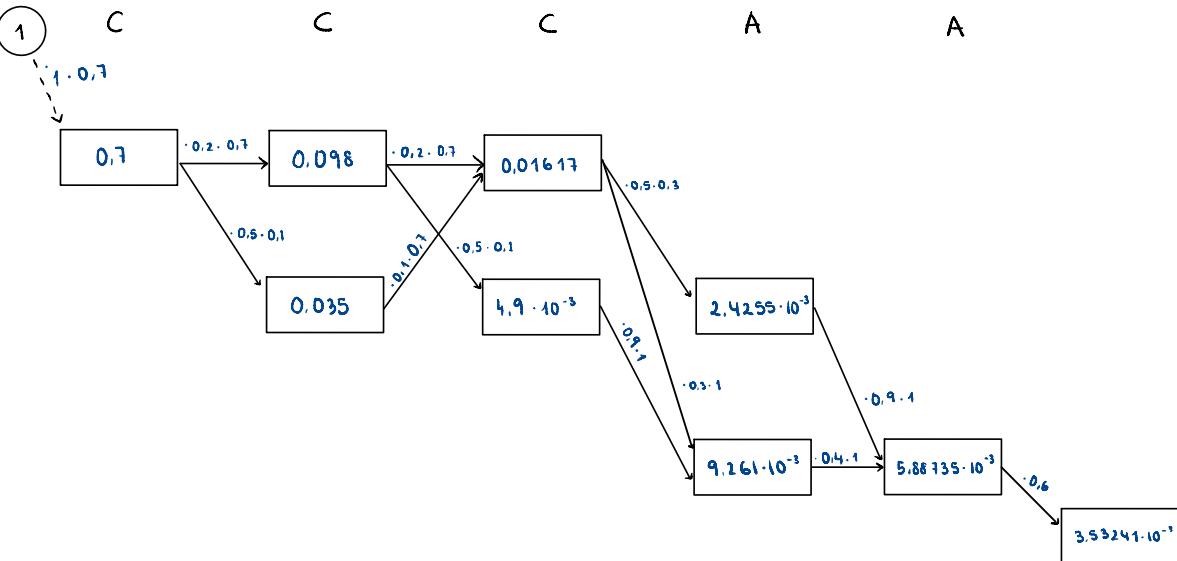
Question set (Part 2)

January 2024

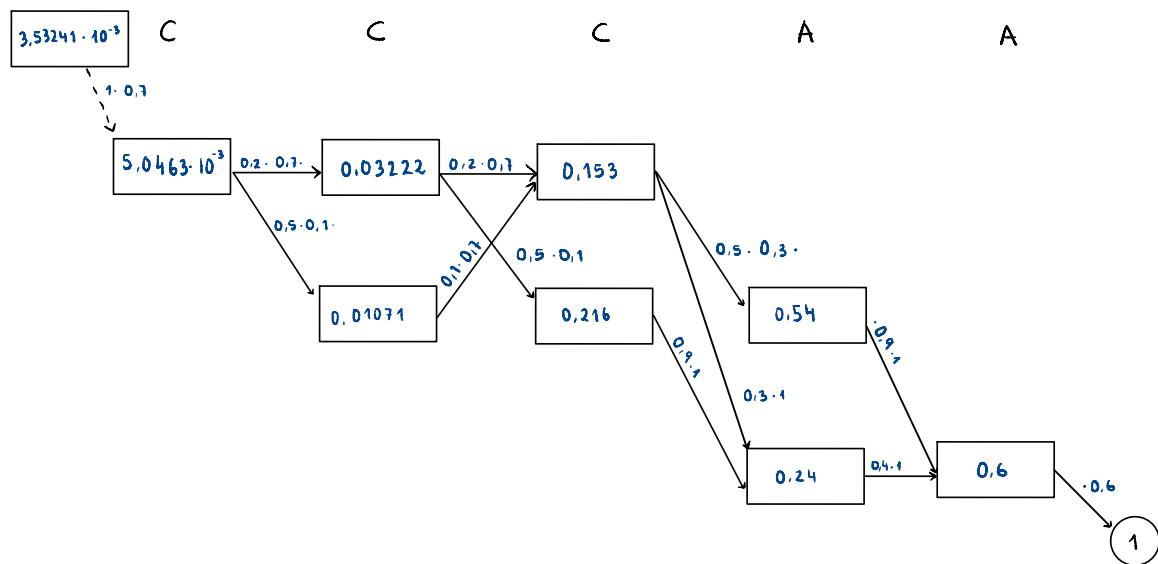
Anna Llinares Llinares

MIARFID - UPV 2023

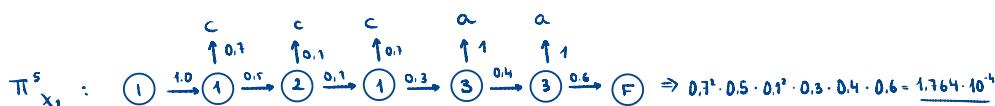
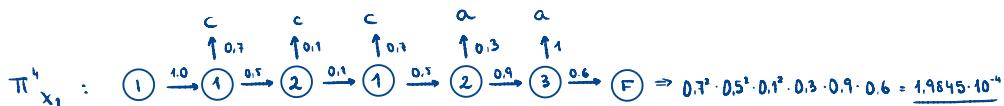
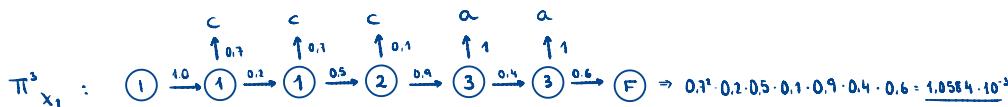
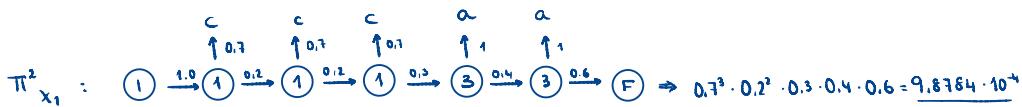
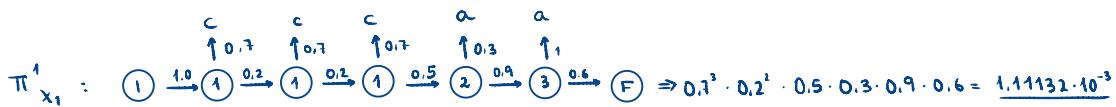
1) a) FORWARD



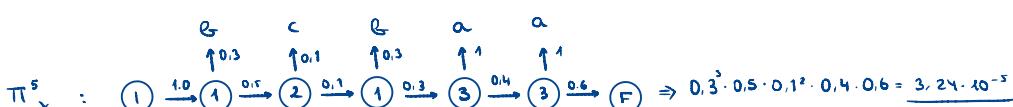
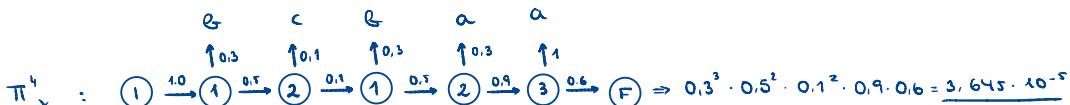
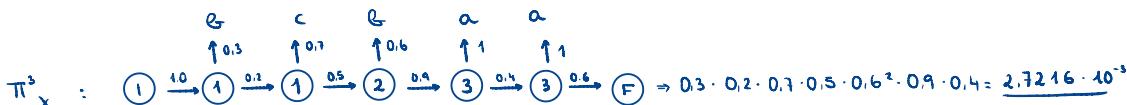
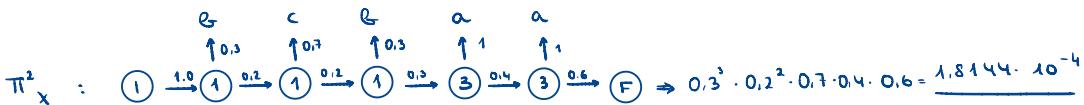
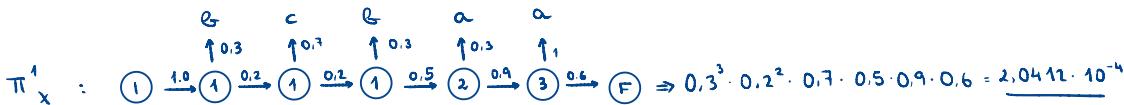
b) BACKWARD



c) Definimos la cadena cccaa



Definimos la cadena $bcbaa$



	$I \rightarrow 1$	$I \rightarrow 2$	$I \rightarrow 3$
$c c c a a$	$\left\{ \begin{array}{l} 1 \cdot 1,11132 \cdot 10^{-3} \\ 1 \cdot 9,8784 \cdot 10^{-4} \\ 1 \cdot 1,0584 \cdot 10^{-3} \\ 1 \cdot 1,9845 \cdot 10^{-4} \\ 1 \cdot 1 \cdot 1,764 \cdot 10^{-4} \\ \hline 3,53241 \cdot 10^{-3} \end{array} \right.$	○	○
$b c b a a$	$\left\{ \begin{array}{l} 1 \cdot 2,0412 \cdot 10^{-4} \\ 1 \cdot 1,8144 \cdot 10^{-4} \\ 1 \cdot 2,7216 \cdot 10^{-3} \\ 1 \cdot 3,645 \cdot 10^{-5} \\ 1 \cdot 3,24 \cdot 10^{-5} \\ \hline 3,17601 \cdot 10^{-3} \end{array} \right.$	○	○

$$\bar{q}_I(I,1) = \frac{3,53241 \cdot 10^{-3} + 3,17601 \cdot 10^{-3}}{(3,53241 \cdot 10^{-3} + 0 + 0) + (3,17601 \cdot 10^{-3} + 0 + 0)} = 1$$

$$\bar{q}_I(I,2) = \frac{0}{(3,53241 \cdot 10^{-3} + 0 + 0) + (3,17601 \cdot 10^{-3} + 0 + 0)} = 0$$

$$\bar{q}_I(I,3) = \frac{0}{(3,53241 \cdot 10^{-3} + 0 + 0) + (3,17601 \cdot 10^{-3} + 0 + 0)} = 0$$

	$1 \rightarrow 1$	$1 \rightarrow 2$	$1 \rightarrow 3$	$1 \rightarrow F$
ccc oaa	$\left\{ \begin{array}{l} 1 \cdot 1.11132 \cdot 10^{-3} \\ + 2 \cdot 9.8784 \cdot 10^{-4} \\ 1 \cdot 1.0584 \cdot 10^{-3} \\ \hline 5.25672 \cdot 10^{-3} \end{array} \right.$	$\left\{ \begin{array}{l} 1 \cdot 1.11132 \cdot 10^{-3} \\ + 1 \cdot 1.0584 \cdot 10^{-3} \\ + 2 \cdot 1.9845 \cdot 10^{-4} \\ 1 \cdot 1.764 \cdot 10^{-4} \\ \hline 2.74302 \cdot 10^{-3} \end{array} \right.$	$\left\{ \begin{array}{l} 1 \cdot 9.8784 \cdot 10^{-4} \\ + 1 \cdot 1.764 \cdot 10^{-4} \\ \hline 1.16424 \cdot 10^{-3} \end{array} \right.$	0

	$1 \rightarrow 1$	$1 \rightarrow 2$	$1 \rightarrow 3$	$1 \rightarrow F$
bcb oaa	$\left\{ \begin{array}{l} 2 \cdot 2.0412 \cdot 10^{-4} \\ + 2 \cdot 1.8144 \cdot 10^{-4} \\ 1 \cdot 2.7216 \cdot 10^{-3} \\ \hline 3.49272 \cdot 10^{-3} \end{array} \right.$	$\left\{ \begin{array}{l} 1 \cdot 2.0412 \cdot 10^{-4} \\ + 1 \cdot 2.7216 \cdot 10^{-3} \\ + 2 \cdot 3.645 \cdot 10^{-5} \\ 1 \cdot 3.24 \cdot 10^{-5} \\ \hline 3.03102 \cdot 10^{-3} \end{array} \right.$	$\left\{ \begin{array}{l} 1 \cdot 1.8144 \cdot 10^{-4} \\ + 1 \cdot 3.24 \cdot 10^{-5} \\ \hline 2.1384 \cdot 10^{-4} \end{array} \right.$	0

$$\bar{q}_f(1,1) = \frac{5.25672 \cdot 10^{-3} + 3.49272 \cdot 10^{-3}}{(5.25672 \cdot 10^{-3} + 2.74302 \cdot 10^{-3} + 1.16424 \cdot 10^{-3}) + (3.49272 \cdot 10^{-3} + 3.03102 \cdot 10^{-3} + 2.1384 \cdot 10^{-4})} =$$

$$= \frac{8.74944 \cdot 10^{-3}}{0.01590156} = 0.55$$

$$\bar{q}_f(1,2) = \frac{2.74302 \cdot 10^{-3} + 3.03102 \cdot 10^{-3}}{(5.25672 \cdot 10^{-3} + 2.74302 \cdot 10^{-3} + 1.16424 \cdot 10^{-3}) + (3.49272 \cdot 10^{-3} + 3.03102 \cdot 10^{-3} + 2.1384 \cdot 10^{-4})} =$$

$$= \frac{5.770404 \cdot 10^{-3}}{0.01590156} = 0.36$$

$$\bar{q}_f(1,3) = \frac{1.16424 \cdot 10^{-3} + 2.1384 \cdot 10^{-4}}{(5.25672 \cdot 10^{-3} + 2.74302 \cdot 10^{-3} + 1.16424 \cdot 10^{-3}) + (3.49272 \cdot 10^{-3} + 3.03102 \cdot 10^{-3} + 2.1384 \cdot 10^{-4})} =$$

$$= \frac{1.37808 \cdot 10^{-3}}{0.01590156} = 0.09$$

$$\bar{q}_f(1,F) = \frac{0}{(5.25672 \cdot 10^{-3} + 2.74302 \cdot 10^{-3} + 1.16424 \cdot 10^{-3}) + (3.49272 \cdot 10^{-3} + 3.03102 \cdot 10^{-3} + 2.1384 \cdot 10^{-4})} = 0$$

$2 \rightarrow 1$

$$\text{ccc aa} \left\{ \begin{array}{l} 1 \cdot 1,9845 \cdot 10^{-4} \\ + 1 \cdot 1,764 \cdot 10^{-4} \\ \hline 3,7485 \cdot 10^{-4} \end{array} \right.$$

 $2 \rightarrow 2$

0

 $2 \rightarrow 3$

$$\left. \begin{array}{l} 1 \cdot 1,11132 \cdot 10^{-3} \\ + 1 \cdot 1,0584 \cdot 10^{-3} \\ + 1 \cdot 1,9845 \cdot 10^{-4} \\ \hline 2,36817 \cdot 10^{-3} \end{array} \right.$$

 $2 \rightarrow F$

0

 $2 \rightarrow 1$

$$\text{bcGaa} \left\{ \begin{array}{l} 1 \cdot 3,645 \cdot 10^{-5} \\ + 1 \cdot 3,24 \cdot 10^{-5} \\ \hline 6,885 \cdot 10^{-5} \end{array} \right.$$

 $2 \rightarrow 2$

0

 $2 \rightarrow 3$

$$\left. \begin{array}{l} 1 \cdot 2,0412 \cdot 10^{-4} \\ + 1 \cdot 2,7216 \cdot 10^{-3} \\ + 1 \cdot 3,645 \cdot 10^{-5} \\ \hline 2,96217 \cdot 10^{-3} \end{array} \right.$$

 $2 \rightarrow F$

0

$$\bar{q}(2,1) = \frac{3,7485 \cdot 10^{-4} + 6,885 \cdot 10^{-5}}{(3,7485 \cdot 10^{-4} + 0 + 2,36817 \cdot 10^{-3}) + (6,885 \cdot 10^{-5} + 0 + 2,96217 \cdot 10^{-3})} =$$

$$= \frac{4,437 \cdot 10^{-4}}{5,77404 \cdot 10^{-3}} = 0,08$$

$$\bar{q}(2,2) = \frac{0}{(3,7485 \cdot 10^{-4} + 0 + 2,36817 \cdot 10^{-3}) + (6,885 \cdot 10^{-5} + 0 + 2,96217 \cdot 10^{-3})} =$$

$$= \frac{0}{5,77404 \cdot 10^{-3}} = 0$$

$$\bar{q}(2,3) = \frac{2,36817 \cdot 10^{-3} + 2,96217 \cdot 10^{-3}}{(3,7485 \cdot 10^{-4} + 0 + 2,36817 \cdot 10^{-3}) + (6,885 \cdot 10^{-5} + 0 + 2,96217 \cdot 10^{-3})} =$$

$$= \frac{5,32944 \cdot 10^{-3}}{5,77404 \cdot 10^{-3}} = 0,92$$

$$\bar{q}(2,F) = \frac{0}{(3,7485 \cdot 10^{-4} + 0 + 2,36817 \cdot 10^{-3}) + (6,885 \cdot 10^{-5} + 0 + 2,96217 \cdot 10^{-3})} = 0$$

$3 \rightarrow 1$	$3 \rightarrow 2$	$3 \rightarrow 3$	$3 \rightarrow F$
$\{$ $c c c a a$	0	0	$\begin{array}{r} 1 \cdot 9,8784 \cdot 10^{-4} \\ + 1 \cdot 1,0584 \cdot 10^{-3} \\ 1 \cdot 1,764 \cdot 10^{-4} \\ \hline 2,22264 \cdot 10^{-3} \end{array}$ $\begin{array}{r} 1 \cdot 1,8144 \cdot 10^{-4} \\ + 1 \cdot 2,7216 \cdot 10^{-3} \\ 1 \cdot 3,24 \cdot 10^{-5} \\ \hline 2,93544 \cdot 10^{-3} \end{array}$
$b c b a a$	$\{$	$3 \rightarrow 1$	$3 \rightarrow 2$
		0	$\begin{array}{r} 1 \cdot 2,0412 \cdot 10^{-4} \\ + 1 \cdot 1,8144 \cdot 10^{-4} \\ + 1 \cdot 2,7216 \cdot 10^{-3} \\ 1 \cdot 3,645 \cdot 10^{-5} \\ 1 \cdot 3,24 \cdot 10^{-5} \\ \hline 3,17601 \cdot 10^{-3} \end{array}$

$$\bar{q}_f(3,1) = \frac{0}{(0+0+2,22264 \cdot 10^{-3}+0)+(0+0+2,93544 \cdot 10^{-3}+0)} =$$

$$\bar{q}_f(3,2) = \frac{0}{(0+0+2,22264 \cdot 10^{-3}+0)+(0+0+2,93544 \cdot 10^{-3}+0)} =$$

$$\bar{q}_f(3,3) = \frac{2,22264 \cdot 10^{-3} + 2,93544 \cdot 10^{-3}}{(0+0+2,22264 \cdot 10^{-3}+3,53241 \cdot 10^{-3})+(0+0+2,93544 \cdot 10^{-3}+3,17601 \cdot 10^{-3})} =$$

$$= \frac{5,15808 \cdot 10^{-3}}{0,0118665} = 0,43$$

$$\bar{q}_f(3,F) = \frac{3,53241 \cdot 10^{-3} + 3,17601 \cdot 10^{-3}}{(0+0+2,22264 \cdot 10^{-3}+3,53241 \cdot 10^{-3})+(0+0+2,93544 \cdot 10^{-3}+3,17601 \cdot 10^{-3})} =$$

$$= \frac{6,70842 \cdot 10^{-3}}{0,0118665} = 0,57$$

$$\begin{array}{c}
 \text{ccc a a} \\
 \left\{ \begin{array}{c} a \\ \uparrow \\ 1 \end{array} \right. \quad \left. \begin{array}{c} b \\ \uparrow \\ 1 \end{array} \right. \quad \left. \begin{array}{c} c \\ \uparrow \\ 1 \end{array} \right. \\
 \left. \begin{array}{c} 0 \\ | \end{array} \right. \quad \left. \begin{array}{c} 0 \\ | \end{array} \right. \quad \left. \begin{array}{c} 0 \\ | \end{array} \right. \\
 + \quad + \quad + \\
 \begin{array}{c}
 \begin{array}{c} a \\ \uparrow \\ 1 \end{array} \quad \begin{array}{c} b \\ \uparrow \\ 1 \end{array} \quad \begin{array}{c} c \\ \uparrow \\ 1 \end{array} \\
 \left\{ \begin{array}{c} 0 \\ | \end{array} \right. \quad \left. \begin{array}{c} 2 \cdot 2,0412 \cdot 10^{-4} \\ 2 \cdot 1,8144 \cdot 10^{-4} \\ 1 \cdot 2,7216 \cdot 10^{-3} \\ 2 \cdot 3,645 \cdot 10^{-5} \\ 2 \cdot 3,24 \cdot 10^{-5} \\ \hline 3,63042 \cdot 10^{-3} \end{array} \right. \quad \begin{array}{c} 1 \cdot 2,0412 \cdot 10^{-4} \\ 1 \cdot 1,8144 \cdot 10^{-4} \\ 1 \cdot 2,7216 \cdot 10^{-3} \\ \hline 3,10716 \cdot 10^{-3} \end{array}
 \end{array}
 \end{array}$$

$$\bar{e}(a,1) = \frac{0}{(0+0+9,16398 \cdot 10^{-3}) + (0+3,63042 \cdot 10^{-3} + 3,10716 \cdot 10^{-3})} = 0$$

$$\begin{aligned}
 \bar{e}(b,1) &= \frac{3,63042 \cdot 10^{-3}}{(0+0+9,16398 \cdot 10^{-3}) + (0+3,63042 \cdot 10^{-3} + 3,10716 \cdot 10^{-3})} = \\
 &= \frac{3,63042 \cdot 10^{-3}}{0,01890156} = 0,23
 \end{aligned}$$

$$\begin{aligned}
 \bar{e}(c,1) &= \frac{9,16398 \cdot 10^{-3} + 3,10716 \cdot 10^{-3}}{(0+0+9,16398 \cdot 10^{-3}) + (0+3,63042 \cdot 10^{-3} + 3,10716 \cdot 10^{-3})} = \\
 &= \frac{0,01227114}{0,01890156} = 0,77
 \end{aligned}$$

$$\begin{array}{r}
 a \\
 \uparrow \\
 2 \\
 \\
 \left\{ \begin{array}{l} 1 \cdot 1.111132 \cdot 10^{-3} \\ 1 \cdot 1.9845 \cdot 10^{-4} \\ \hline 1.30977 \cdot 10^{-3} \end{array} \right. \\
 \\
 b \\
 \uparrow \\
 2 \\
 \\
 0 \\
 \\
 c \\
 \uparrow \\
 2 \\
 \\
 \left\{ \begin{array}{l} 1 \cdot 1.0584 \cdot 10^{-3} \\ 1 \cdot 1.9845 \cdot 10^{-4} \\ 1 \cdot 1.7645 \cdot 10^{-4} \\ \hline 1.73333 \cdot 10^{-3} \end{array} \right.
 \end{array}$$

a \uparrow 2 b \uparrow 2 c \uparrow 2	$1 \cdot 2,0412 \cdot 10^{-4}$ $1 \cdot 3,645 \cdot 10^{-5}$ <hr/> $2,4057 \cdot 10^{-4}$	$1 \cdot 2,7216 \cdot 10^{-3}$ $1 \cdot 3,645 \cdot 10^{-5}$ <hr/> $6,855 \cdot 10^{-5}$
--	---	--

$$\begin{aligned}\bar{e}(a,2) &= \frac{1,30977 \cdot 10^{-3} + 2,4057 \cdot 10^{-4}}{(1,30977 \cdot 10^{-3} + 0 + 1,4333 \cdot 10^{-3}) + (2,4057 \cdot 10^{-4} + 2,7216 \cdot 10^{-3} + 6,855 \cdot 10^{-5})} \\ &= \frac{1,55034 \cdot 10^{-3}}{5,77379 \cdot 10^{-3}} = 0,27\end{aligned}$$

$$\bar{e}(a,2) = \frac{2,7216 \cdot 10^{-3}}{(1,30977 \cdot 10^{-3} + 0 + 1,4333 \cdot 10^{-3}) + (2,4057 \cdot 10^{-4} + 2,7216 \cdot 10^{-3} + 6,855 \cdot 10^{-5})} =$$

$$= \frac{2,7216 \cdot 10^{-3}}{5,77379 \cdot 10^{-3}} = 0,47$$

$$\bar{e}(a,2) = \frac{1,4333 \cdot 10^{-3} + 6,855 \cdot 10^{-5}}{(1,30977 \cdot 10^{-3} + 0 + 1,4333 \cdot 10^{-3}) + (2,4057 \cdot 10^{-4} + 2,7216 \cdot 10^{-3} + 6,855 \cdot 10^{-5})} =$$

$$= \frac{1.50185 \cdot 10^{-3}}{5.77379 \cdot 10^{-3}} = 0.26$$

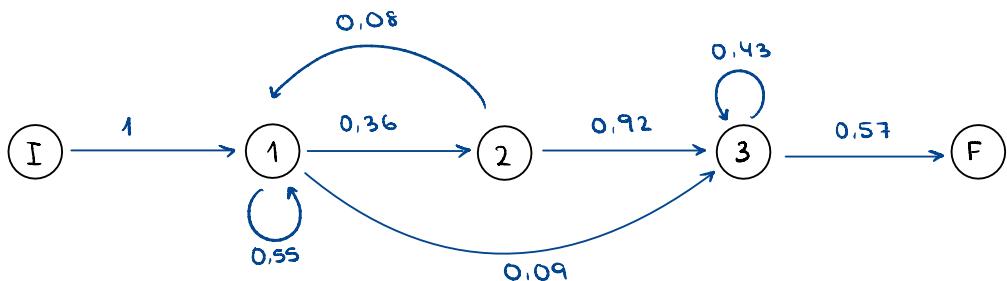
$$\begin{array}{c}
 \text{ccc}aa \\
 \left\{ \begin{array}{l}
 \begin{array}{c} a \\ \uparrow \\ 3 \end{array} \\
 \begin{array}{l} 1 \cdot 1,11132 \cdot 10^{-3} \\ 2 \cdot 9,8784 \cdot 10^{-4} \\ 2 \cdot 1,0584 \cdot 10^{-3} \\ 1 \cdot 1,9845 \cdot 10^{-4} \\ 2 \cdot 1,764 \cdot 10^{-4} \end{array} \\
 \hline
 5,75505 \cdot 10^{-3}
 \end{array} \right. \\
 \mid \qquad \qquad \qquad \mid \qquad \qquad \qquad \mid
 \end{array}$$

$$\begin{array}{c}
 bcbaa \\
 \left\{ \begin{array}{l}
 \begin{array}{c} a \\ \uparrow \\ 3 \end{array} \\
 \begin{array}{l} 1 \cdot 2,0412 \cdot 10^{-4} \\ 2 \cdot 1,8144 \cdot 10^{-4} \\ 2 \cdot 2,7216 \cdot 10^{-3} \\ 1 \cdot 3,643 \cdot 10^{-5} \\ 2 \cdot 3,24 \cdot 10^{-5} \end{array} \\
 \hline
 6,11145 \cdot 10^{-3}
 \end{array} \right. \\
 \mid \qquad \qquad \qquad \mid \qquad \qquad \qquad \mid
 \end{array}$$

$$\bar{e}(a,3) = \frac{5,75505 \cdot 10^{-3} + 6,11145 \cdot 10^{-3}}{(5,75505 \cdot 10^{-3} + 0 + 0) + (6,11145 \cdot 10^{-3} + 0 + 0)} = 1$$

$$\bar{e}(a,3) = \frac{0}{(5,75505 \cdot 10^{-3} + 0 + 0) + (6,11145 \cdot 10^{-3} + 0 + 0)} = 0$$

$$\bar{e}(a,3) = \frac{0}{(5,75505 \cdot 10^{-3} + 0 + 0) + (6,11145 \cdot 10^{-3} + 0 + 0)} = 0$$

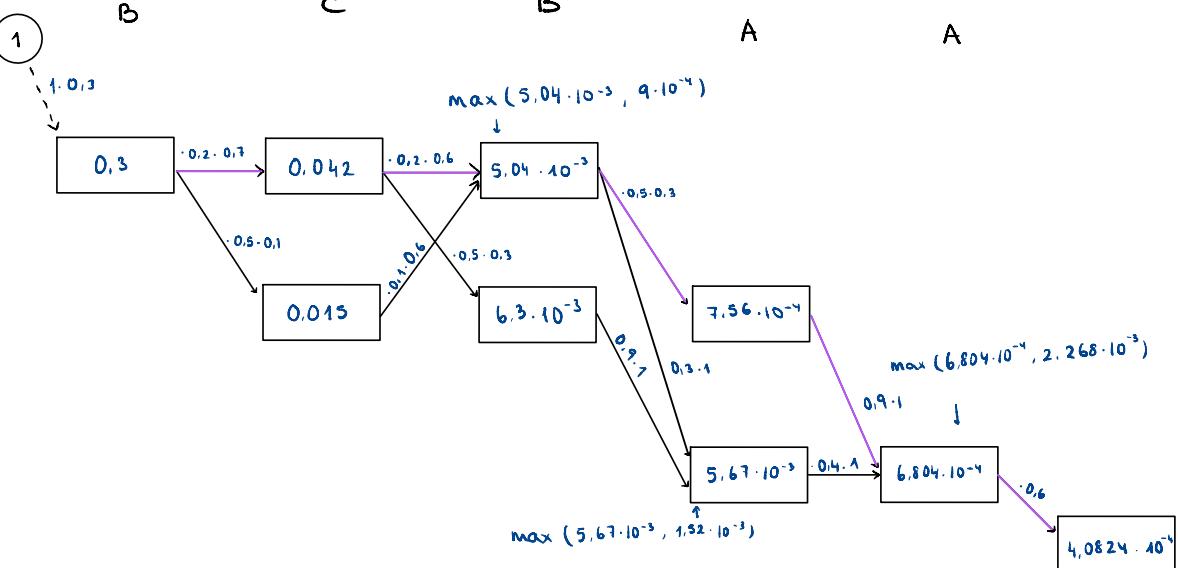
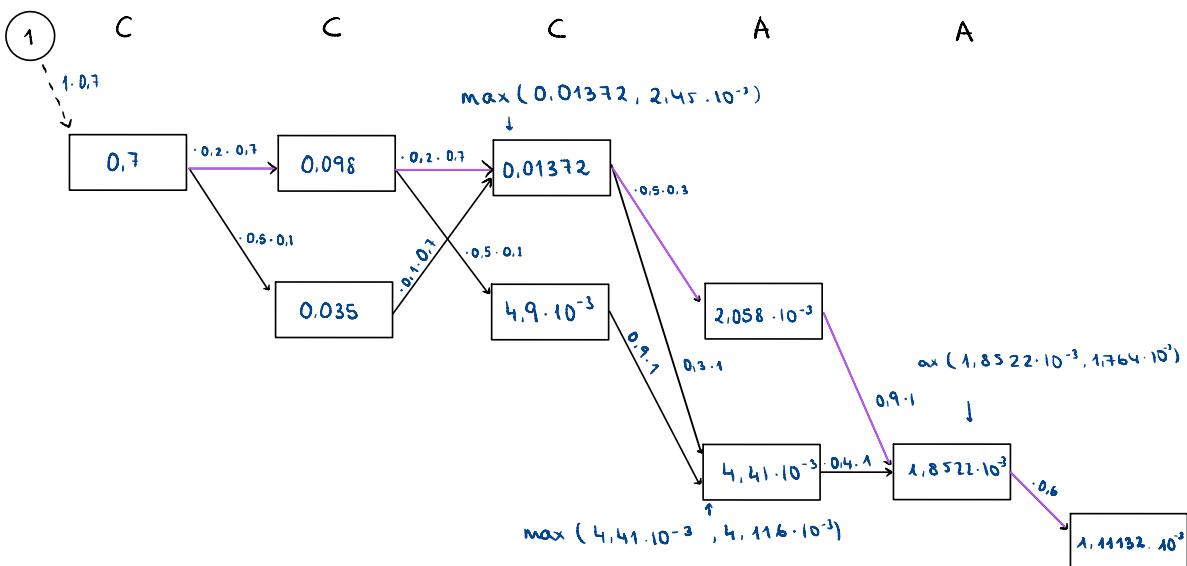


$$a \begin{bmatrix} 0 \\ 0,23 \\ 0,77 \end{bmatrix}$$

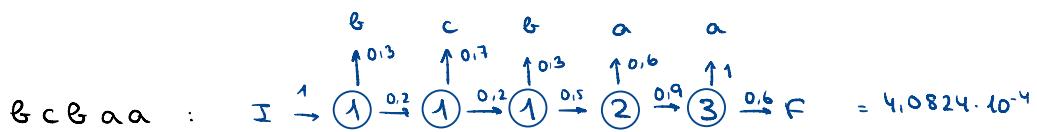
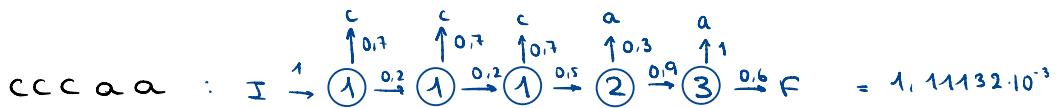
$$b \begin{bmatrix} 0,27 \\ 0,47 \\ 0,26 \end{bmatrix}$$

$$c \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix}$$

2

VITERBI

Ahora solo tenemos un camino:



$$\begin{array}{l} \left. \begin{array}{c} 1 \rightarrow 1 \\ 2 \cdot 1,11132 \cdot 10^{-3} \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow 2 \\ 1 \cdot 1,11132 \cdot 10^{-3} \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow 3 \\ 0 \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow F \\ 0 \end{array} \right| \\ \left. \begin{array}{c} 1 \rightarrow 1 \\ 2 \cdot 4,0824 \cdot 10^{-4} \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow 2 \\ 1 \cdot 4,0824 \cdot 10^{-4} \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow 3 \\ 0 \end{array} \right| \quad \left. \begin{array}{c} 1 \rightarrow F \\ 0 \end{array} \right| \end{array} \end{array}$$

$$\bar{q}(111) = \frac{2 \cdot 1,11132 \cdot 10^{-3} + 2 \cdot 4,0824 \cdot 10^{-4}}{(2 \cdot 1,11132 \cdot 10^{-3} + 1,11132 \cdot 10^{-3}) + (240824 \cdot 10^{-4} + 4,0824 \cdot 10^{-4})} = \\ = \frac{3,03912 \cdot 10^{-3}}{4,55868 \cdot 10^{-3}} = 0,66$$

$$\bar{q}(112) = \frac{1,11132 \cdot 10^{-3} + 4,0824 \cdot 10^{-4}}{(2 \cdot 1,11132 \cdot 10^{-3} + 1,11132 \cdot 10^{-3}) + (240824 \cdot 10^{-4} + 4,0824 \cdot 10^{-4})} = \\ = \frac{1,81956 \cdot 10^{-3}}{4,55868 \cdot 10^{-3}} = 0,33$$

$$\bar{q}(113) = 0$$

$$\bar{q}(11F) = 0$$

cccaa	$\left\{ \begin{array}{c} 2 \rightarrow 1 \\ 0 \end{array} \right.$	$ $	$\begin{array}{c} 2 \rightarrow 2 \\ 0 \end{array}$	$ $	$\begin{array}{c} 2 \rightarrow 3 \\ 1,11132 \cdot 10^{-3} \end{array}$	$ $	$\begin{array}{c} 2 \rightarrow F \\ 0 \end{array}$
bcbaa	$\left\{ \begin{array}{c} 2 \rightarrow 1 \\ 0 \end{array} \right.$	$ $	$\begin{array}{c} 2 \rightarrow 2 \\ 0 \end{array}$	$ $	$\begin{array}{c} 2 \rightarrow 3 \\ 4,028 \cdot 10^{-4} \end{array}$	$ $	$\begin{array}{c} 2 \rightarrow F \\ 0 \end{array}$

$$\bar{q}(2|1) = 0$$

$$\bar{q}(2|2) = 0$$

$$\bar{q}(2|3) = \frac{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}}{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}} = 1$$

$$\bar{q}(2|F) = 0$$

cccaa	$\left\{ \begin{array}{c} 3 \rightarrow 1 \\ 0 \end{array} \right.$	$ $	$\begin{array}{c} 3 \rightarrow 2 \\ 0 \end{array}$	$ $	$\begin{array}{c} 3 \rightarrow 3 \\ 0 \end{array}$	$ $	$\begin{array}{c} 3 \rightarrow F \\ 1,11132 \cdot 10^{-3} \end{array}$
bcbaa	$\left\{ \begin{array}{c} 3 \rightarrow 1 \\ 0 \end{array} \right.$	$ $	$\begin{array}{c} 3 \rightarrow 2 \\ 0 \end{array}$	$ $	$\begin{array}{c} 3 \rightarrow 3 \\ 0 \end{array}$	$ $	$\begin{array}{c} 3 \rightarrow F \\ 4,028 \cdot 10^{-4} \end{array}$

$$\bar{q}(3|1) = 0$$

$$\bar{q}(3|2) = 0$$

$$\bar{q}(3|3) = 0$$

$$\bar{q}(3|F) = \frac{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}}{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}} = 1$$

$\{$	a ↑ 1 0	b ↑ 1 0	c ↑ 1 0
$\{$	a ↑ 1 0	b ↑ 1 0	c ↑ 1 0

$$\bar{q}(a|1) = 0$$

$$\bar{q}(b|1) = \frac{2 \cdot 1,11132 \cdot 10^{-3} + 2 \cdot 4,028 \cdot 10^{-4}}{(1,11132 \cdot 10^{-3} + 2 \cdot 1,11132 \cdot 10^{-3}) + (4,028 \cdot 10^{-4} + 2 \cdot 4,028 \cdot 10^{-4})} = 0,66$$

$$\bar{q}(c|1) = \frac{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}}{(1,11132 \cdot 10^{-3} + 2 \cdot 1,11132 \cdot 10^{-3}) + (4,028 \cdot 10^{-4} + 2 \cdot 4,028 \cdot 10^{-4})} = 0,33$$

$\{$	a ↑ 2 $1,11132 \cdot 10^{-3}$	b ↑ 2 0	c ↑ 2 0
$\{$	a ↑ 2 $4,028 \cdot 10^{-4}$	b ↑ 2 0	c ↑ 2 0

$$\bar{q}(a|2) = \frac{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}}{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}} = 1$$

$$\bar{q}(b|2) = 0$$

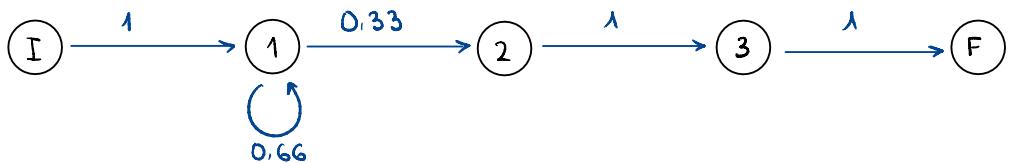
$$\bar{q}(c|2) = 0$$

	a ↑ 3	b ↑ 3	c ↑ 3
$cccaa \left\{ \begin{array}{l} \\ \end{array} \right.$	$1,11132 \cdot 10^{-3}$	0	0
$bcbaa \left\{ \begin{array}{l} \\ \end{array} \right.$	$4,028 \cdot 10^{-4}$	0	0

$$\bar{q}(a|3) = \frac{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}}{1,11132 \cdot 10^{-3} + 4,028 \cdot 10^{-4}} = 1$$

$$\bar{q}(b|3) = 0$$

$$\bar{q}(c|3) = 0$$



$$\begin{matrix}
 a & \begin{bmatrix} 0 \\ 0,66 \\ 0,33 \end{bmatrix} \\
 b & \begin{bmatrix} 1 \\ 0 \\ 0 \end{bmatrix} \\
 c & \begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}
 \end{matrix}$$

Para este ejercicio se ha aplicado el modelo Gt-0 para evaluar su rendimiento. A la vista de los resultados obtenidos en la matriz de confusión, se observa que las tres clases tienen un alto error de clasificación, especialmente la clase Isósceles obteniendo un error de 96%, por lo que el modelo prácticamente confunde la gran mayoría de las muestras pertenecientes a esta clase. Por otro lado, la clase Equilátero alcanza un error de 54,4% ya que clasifica erróneamente prácticamente la mitad de las muestras, confundiéndola con la clase Rectangular. De manera similar, el modelo confunde clase Rectangular gran parte de sus muestras con la clase Equilátero, obteniendo un error de 55,3%

A la vista de los resultados obtenidos, el modelo muestra una elevada tasa de clasificación errónea, especialmente confundiendo las clases Equilátero y Rectangular. Estas confusiones dan la impresión de una clasificación casi aleatoria entre estas dos clases, destacando un desempeño deficiente. Además, el modelo demuestra que no logra clasificar prácticamente ninguna muestra de la clase Isósceles.

```
allilli@alumno.upv.es@ldsic-vdi11:~/Escritorio/2PCFG-AL$ cat results | scfg-toolkit/confus
    equi  isos  righ  Err  Err%
equi    456     0   544   544  54,4
isos    461    40   499   960  96,0
righ    525    28   447   553  55,3
```

Error: 2057/3000 = 68,57%