

TRAINING DATA

	STATE	CONTRACT	SEX	CALLS	CHURN
1)	IT	C	F	> 10	Y
2)	GE	T	M	≤ 10	N
3)	IT	T	M	> 10	Y
4)	GE	Y	F	≤ 10	N
5)	GE	T	F	> 10	N
6)	GE	C	M	> 10	Y
7)	GE	C	M	≤ 10	Y
8)	GE	Y	F	≤ 10	Y
9)	GE	Y	M	> 10	N
10)	GE	T	F	≤ 10	N
11)	GE	Y	F	> 10	Y
12)	IT	C	F	> 10	N

ROOT

Y = 6      ME =  $\frac{6}{12}$   
 N = 6

STATE

	IT	GE	
Y	2	4	ME(IT) = $\frac{1}{3}$
N	1	5	ME(GE) = $\frac{4}{9}$

$E = \frac{1}{3} \cdot \frac{3}{12} + \frac{4}{9} \cdot \frac{9}{12} = \frac{5}{12}$

CONTRACT

	C	T	Y	
Y	3	1	2	ME(C) = $\frac{1}{4}$
N	1	3	2	ME(T) = $\frac{1}{4}$
				ME(Y) = $\frac{2}{4}$

$E = \frac{1}{4} \cdot \frac{9}{12} + \frac{1}{4} \cdot \frac{4}{12} + \frac{2}{4} \cdot \frac{4}{12} = \frac{4}{12}$

CONTRACT

	C	T	Y	
Y	4		2	ME(C) = $\frac{4}{8}$
N	4		2	ME(Y) = $\frac{2}{4}$

$E = \frac{4}{8} \cdot \frac{8}{12} + \frac{2}{4} \cdot \frac{4}{12} = \frac{6}{12}$

(2)

CONTRACT

	C	TY		
Y	3	3	$ME(C) = 1/4$	$E = \frac{1}{4} \cdot \frac{4}{12} + \frac{3}{8} \cdot \frac{8}{12} = \frac{4}{12}$
N	1	5	$ME(TY) = 3/8$	

CONTRACT

	CY	T		
Y	5	1	$ME(CY) = 3/8$	$E = \frac{3}{8} \cdot \frac{8}{12} + \frac{1}{4} \cdot \frac{4}{12} = \frac{4}{12}$
N	3	3	$ME(T) = 1/4$	

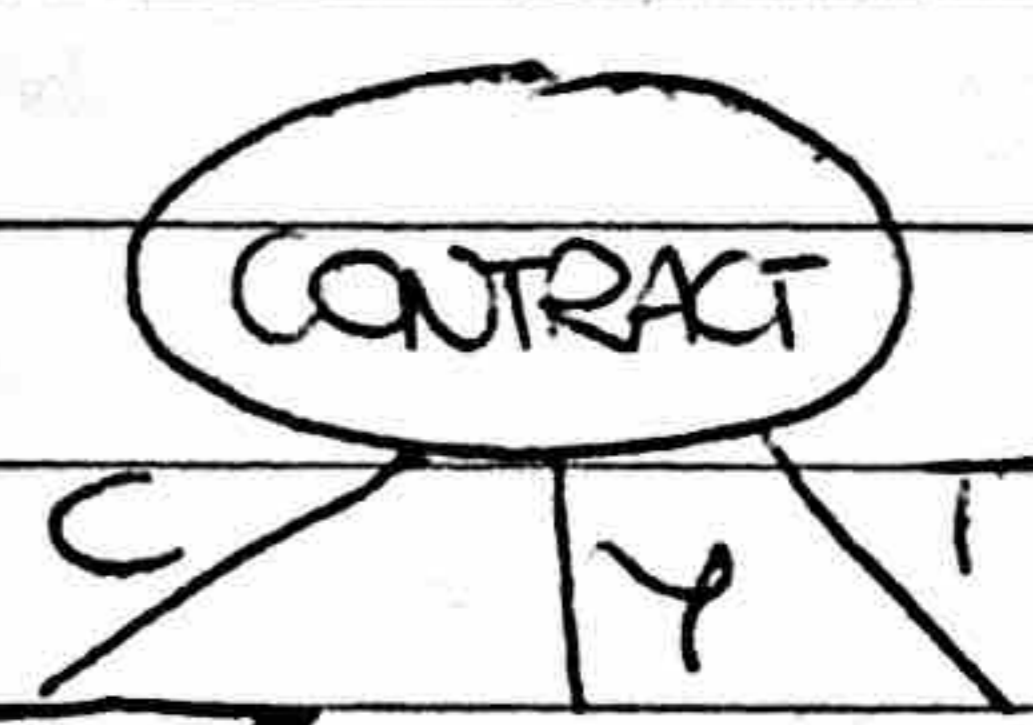
SEX

	F	M		
Y	3	3	$ME(F) = 3/7$	$E = \frac{3}{7} \cdot \frac{7}{12} + \frac{2}{5} \cdot \frac{5}{12} = \frac{5}{12}$
N	4	2	$ME(M) = 2/5$	

CALLS

	$\leq 10$	$> 10$		
Y	2	6	$ME(\leq 10) = 2/5$	$E = \frac{2}{5} \cdot \frac{5}{12} + \frac{3}{7} \cdot \frac{7}{12} = \frac{5}{12}$
N	3	3	$ME(> 10) = 3/7$	

SPLIT → CONTRACT : C, Y, T



CONTRACT = C    Y = 3    E = 1/4  
N = 1

Y = 3	Y
N = 1	ES

STATE

	IT	GE		
Y	1	2	$ME(IT) = 1/2$	$E = \frac{1}{2} \cdot \frac{2}{4} = \frac{1}{4}$
N	1	0	$ME(GE) = 0$	

SEX

	F	M		
Y	1	2	$ME(F) = 1/2$	$E = \frac{1}{4}$
N	1	0	$ME(M) = 0$	

CALLS

	$\leq 10$	$> 10$		
Y	1	2	$ME(\leq 10) = 0$	$E = \frac{1}{3} \cdot \frac{3}{4} = \frac{1}{4}$
N	0	1	$ME(> 10) = 1/3$	

CONTRACT = T     $Y = 3$      $N = 1$      $E = \frac{1}{4}$

STATE		
IT	GE	
Y	0	$ME(IT) = 0$
N	0	$ME(GE) = 0$

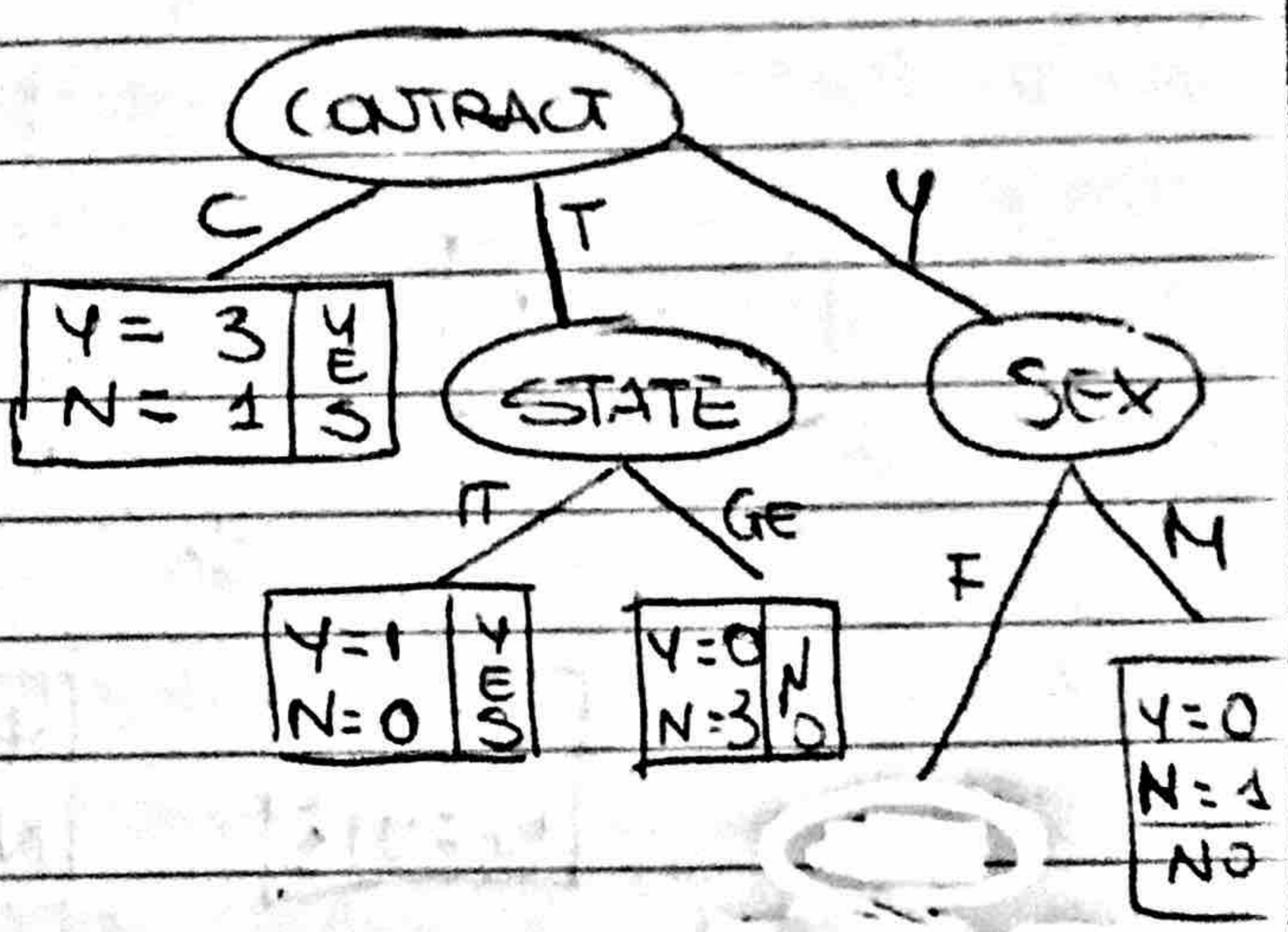
SEX		
F	M	
Y	0	$ME(F) = 0$
N	1	$ME(M) = \frac{1}{2}$

$E = \frac{1}{2} \cdot \frac{2}{4} = \frac{1}{4}$

CALLS		
$\leq 10$	$> 10$	
Y	0	$ME(\leq 10) = 0$
N	1	$ME(> 10) = \frac{1}{2}$

$E = \frac{1}{4}$

SPLIT → STATE  $\begin{matrix} IT \\ GE \end{matrix}$



CONTRACT = Y     $Y = 2$      $N = 2$      $E = \frac{2}{4}$

STATE		
IT	GE	
Y	0	$ME(IT) = 0$
N	2	$ME(GE) = \frac{2}{4}$

$E = \frac{2}{4} \cdot \frac{4}{4} = \frac{2}{4}$

SEX		
F	M	
Y	2	$ME(F) = \frac{1}{3}$
N	1	$ME(M) = 0$

$E = \frac{1}{3} \cdot \frac{3}{4} = \frac{1}{4}$

CALLS		
$\leq 10$	$> 10$	
Y	1	$ME(\leq 10) = \frac{1}{2}$
N	1	$ME(> 10) = \frac{1}{2}$

$E = \frac{1}{2} \cdot \frac{2}{4} + \frac{1}{2} \cdot \frac{2}{4} = \frac{2}{4}$

SPLIT → SEX

SEX = M IS LEAF  $\begin{matrix} 0 = Y \\ 1 = N \end{matrix}$

(4)

SEX = F Y = 2  
N = 1 E = 1/3

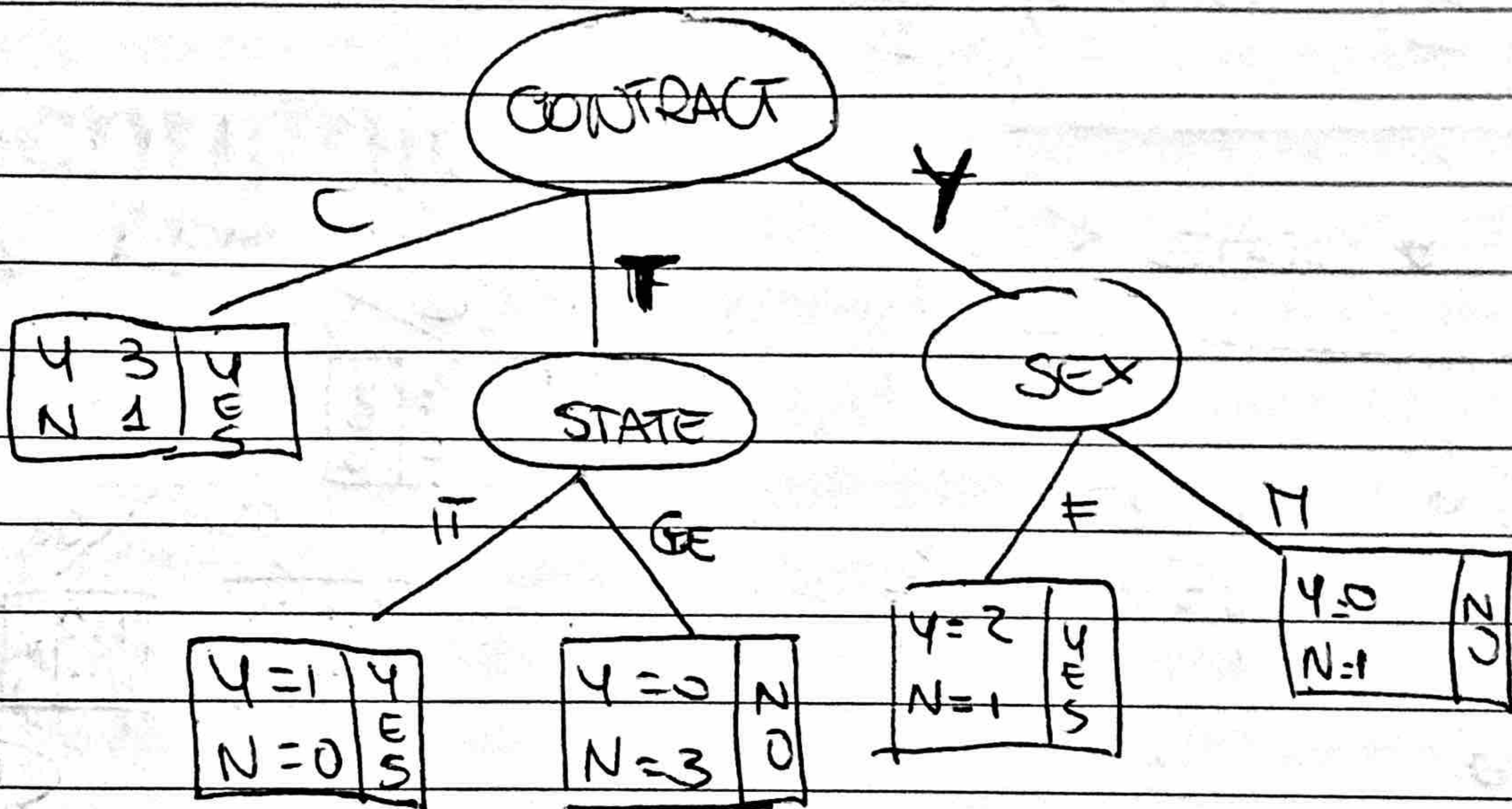
CALLS

Y	1	1	ME( $\leq 10$ ) = 1/2
N	1	0	ME( $> 10$ ) = 0

E = 1/3

NO GAIN

### FINAL TREE



### TEST

STATE	CONTRACT	SEX	CALLS	CHURN	PRED.	
GE	C	M	<10	YES	YES	TP
IT	T	F	<10	NO	YES	FP
GE	C	F	≤10	YES	YES	TP
IT	Y	M	>10	YES	NO	FN

### CONFUSION MATRIX

		PREDICTED			
		Y	N		
ACTUAL	Y	2	1	ACC = 2/4	PRECISION = 2 / (2+1) = 2/3
	N	1	0		
				RECALL = 2 / (2+1) = 2/3	