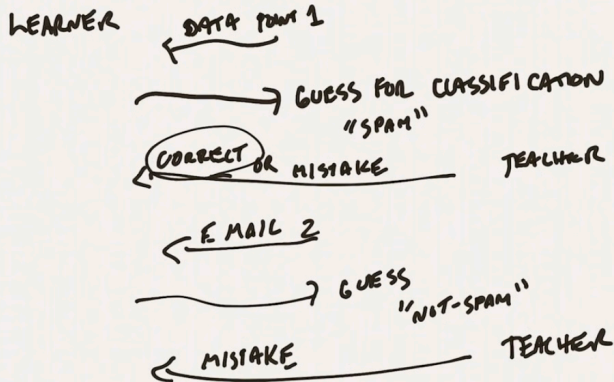


# MISTAKE-BOUNDED MODEL



#MISTAKES INCREASES BY 1  
LEARNER WILL UPDATE ITS INTERNAL STATE

WE SAY A LEARNER HAS MISTAKE-BOUND  $\underline{t}$   
IF FOR EVERY SEQUENCE OF CHALLENGES, LEARNER  
MAKES AT MOST  $\underline{t}$  MISTAKES.

---

$\mathcal{C} = \{ \text{MONOTONE DISJUNCTIONS ON } n \text{ VARIABLES} \}$   
DOMAIN  $= \{0,1\}^n$

e.g.  $x_1 \vee x_2$        $f(x) = x_1 \vee x_7 \vee x_9$

$f \in \mathcal{C}$

$f$  IS A MONOTONE DIST

LEARNER

$x \in \{0,1\}^n$

0 or 1

"TRYING TO LEARN  $f$ "

TEACHER SAYS

"CORRECT" IF GUESS =  $f(x)$

"MISTAKE" OTHERWISE

$x' \in \{0,1\}^n$

QUESTION: CAN YOU COME UP WITH A LEARNER/  
ALGORITHM  
WITH MISTAKE BOUND AT MOST  $n$ ?

LEARNER WILL START WITH THE  
MONOTONE DIST  $X_1 \vee X_2 \vee \dots \vee X_n$

INITIAL STATE =  $X_1 \vee \cancel{X_2} \vee \cancel{X_3} \vee \dots \vee \cancel{X_6} \vee \dots \vee X_n$

LEARNER RECEIVES 0 1 1 0 0 1 0  
← 1 . . .

TEACHER  
← MISTAKE

⇒  $X_2$  CANNOT BE IN THE UNKNOWN SET  
⇒  $X_3$  " " " " " "  
⇒  $X_6$  " " " " " "

EVERY TIME WE MAKE A MISTAKE  
AT LEAST ONE LITERAL IS ELIMINATED.

AT MOST  $n$  LITERALS

$\Rightarrow \# \text{ MISTAKES} \leq n.$

---

$C = \{ \text{DISJUNCTIONS} \}$

$$f = x_1 \vee \bar{x}_2 \vee x_7 \vee \bar{x}_9$$

QUESTION: HOW CAN WE USE THE ALGORITHM  
FOR MONOTONE DISJUNCTIONS TO  
LEARN DISJUNCTIONS?

$$x_1, \dots, x_n \in \{0,1\}^n$$

"FEATURE EXPANSION"

APPLY MONOTONE  
DIST ALG ON THESE  
CHALLENGES

$$\underbrace{x_1, \dots, x_n}_n$$

$$\underbrace{x_1, \dots, x_n, y_1, \dots, y_n}_{2n}$$

EACH  $y_i = \bar{x}_i$

$$\underbrace{0110}_{n=4} \rightsquigarrow \underline{01101001}$$

$$f(x_1, \dots, x_n) = x_2 \vee \bar{x}_4 \vee x_7 \equiv$$

$$\underline{f(x_1, \dots, x_n, y_1, \dots, y_n)} = \underline{x_2 \vee y_4 \vee x_7}$$

USE ALGO  
FOR MONOTONE  
DIST WE HAVE  
A NEW ALGO  
WITH MISTAKE BOUND

$$\leq 2n$$