

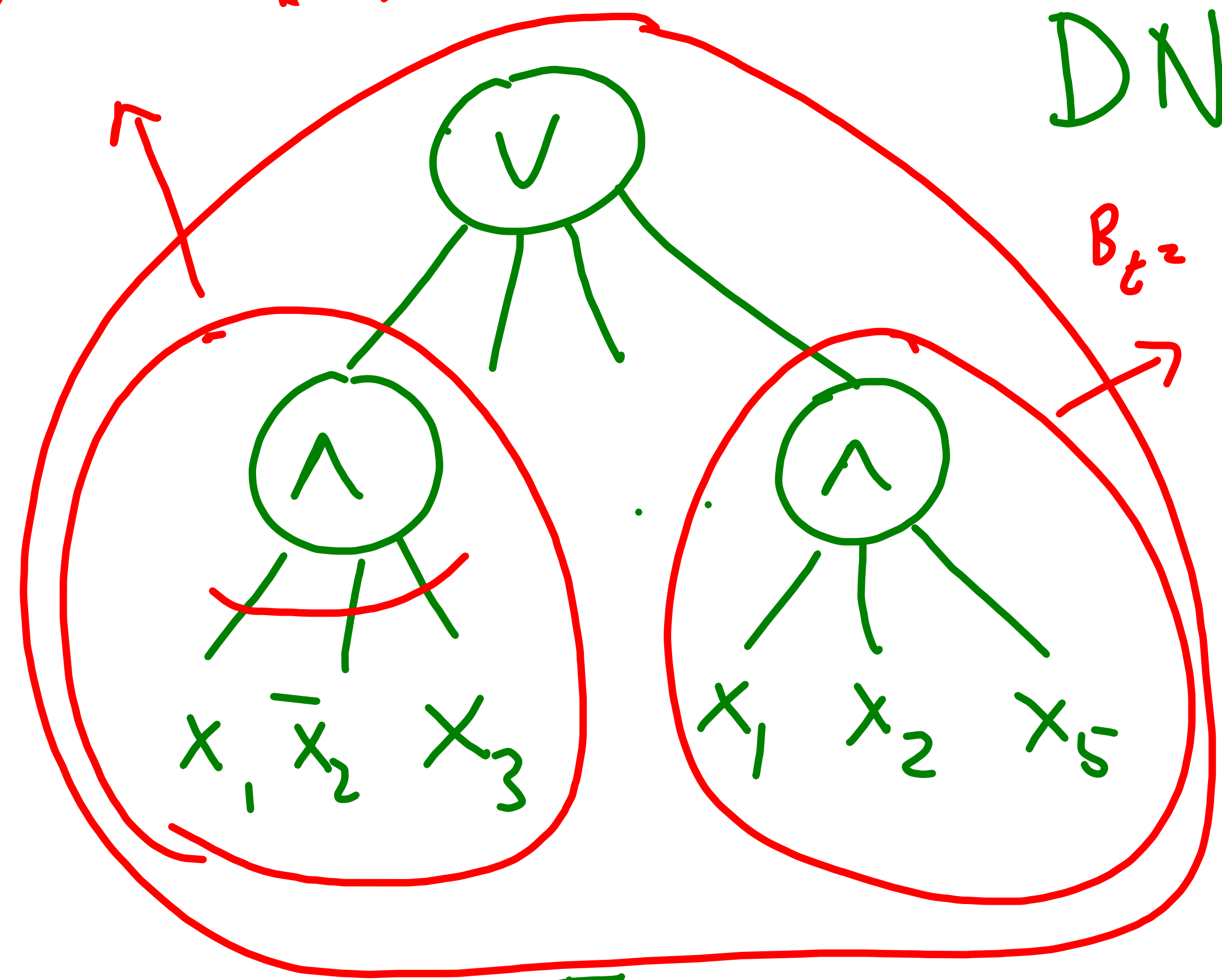
$$B_1 = T \times F \times T \times \{T, F\}^{n-3}$$

DNF

DNF Count

Output a number k s.t.

$$(1-\epsilon)T \leq k \leq (1+\epsilon)T$$



$$B_2 = T \times T \times \{T, F\}^2 \times T \times \{T, F\}^{n-5}$$

of variables = n

Count the number of satisfying assignments. = T

#P-hard.

$$\parallel \\ |\cup B_i|$$

$$f_1 \quad \dots \quad f_n \quad f_i \in \{0,1\}$$

$$\text{A setting} \in \{0,1\}^n$$

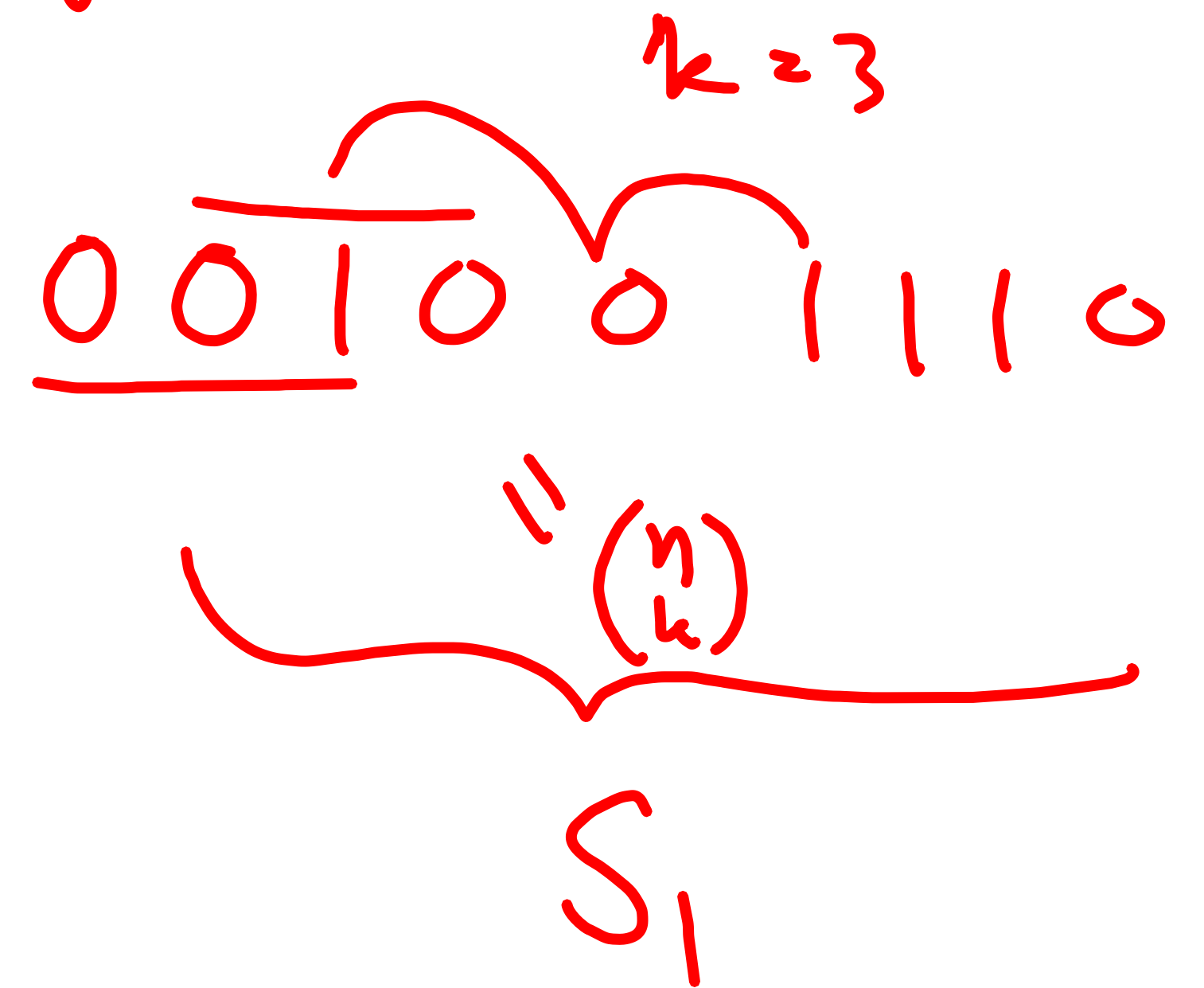
$$\# \text{ total \# of settings} = 2^n$$

$$\text{K-covrage testing} \quad \forall S \subseteq \{f_1, \dots, f_n\} \quad |S| = k$$

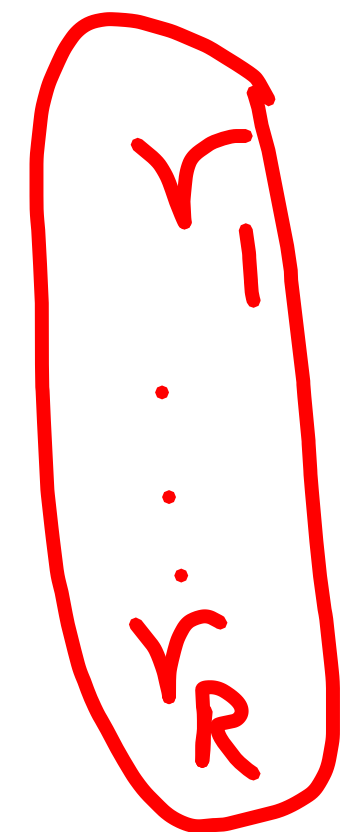
& for all setting $S \rightarrow \{0,1\}^k$
test properly

$$\# \text{ k-covrages} =$$

$$\binom{n}{k} \cdot 2^k$$



R_{runs}



$$\in \{0,1\}^n \quad S_i$$

$$|\cup S_i|$$

S_R

$$\cancel{S_1} \quad \cancel{S_2} \quad \dots \quad S_m \quad \dots \quad S_M \subseteq \Omega \quad |\Omega| = n$$

Goal: Estimate $|U S_i|$, output k s.t.

$$(1-\epsilon)|U S_i| \leq k \leq (1+\epsilon)|U S_i|$$

① The sets are in streaming fashion

② Local storage

Klee-measure Problem



F_0 - estimation / Distinct elts problem / Set size 1

Karger '80

Alon-Matias-Szegedy '96

$$O\left(\frac{\log n}{\epsilon^2}\right)$$

Hash-function.

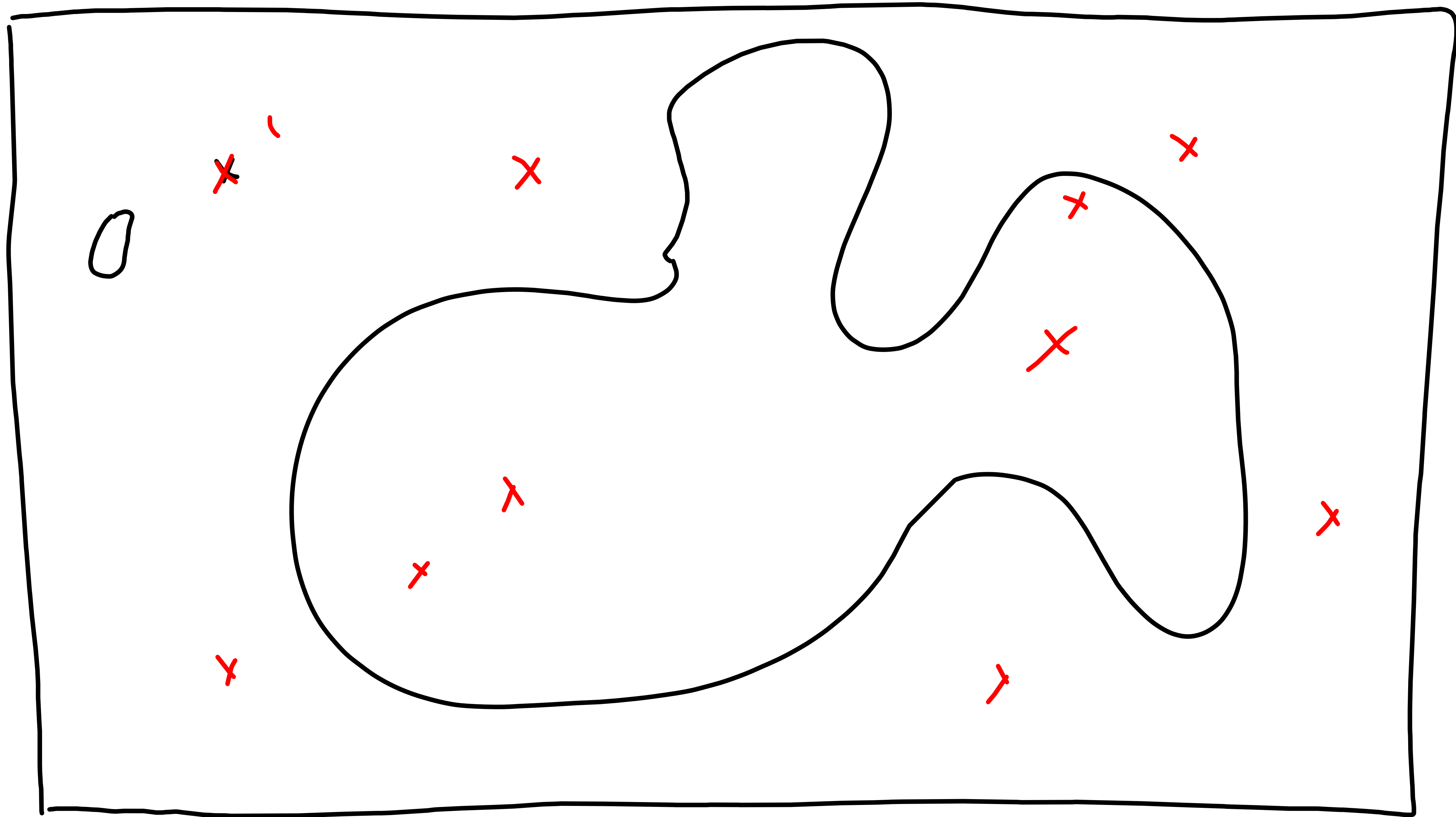
Nelson, Woodruff ... - $\Theta\left(\log n + \frac{1}{\epsilon^2}\right)$

Delphic Sets

- ① Draw a sample from S_i uniformly at random
- ② $e \in \Omega$ Is $e \in S_i$?
- ③ $|S_i|$ is known

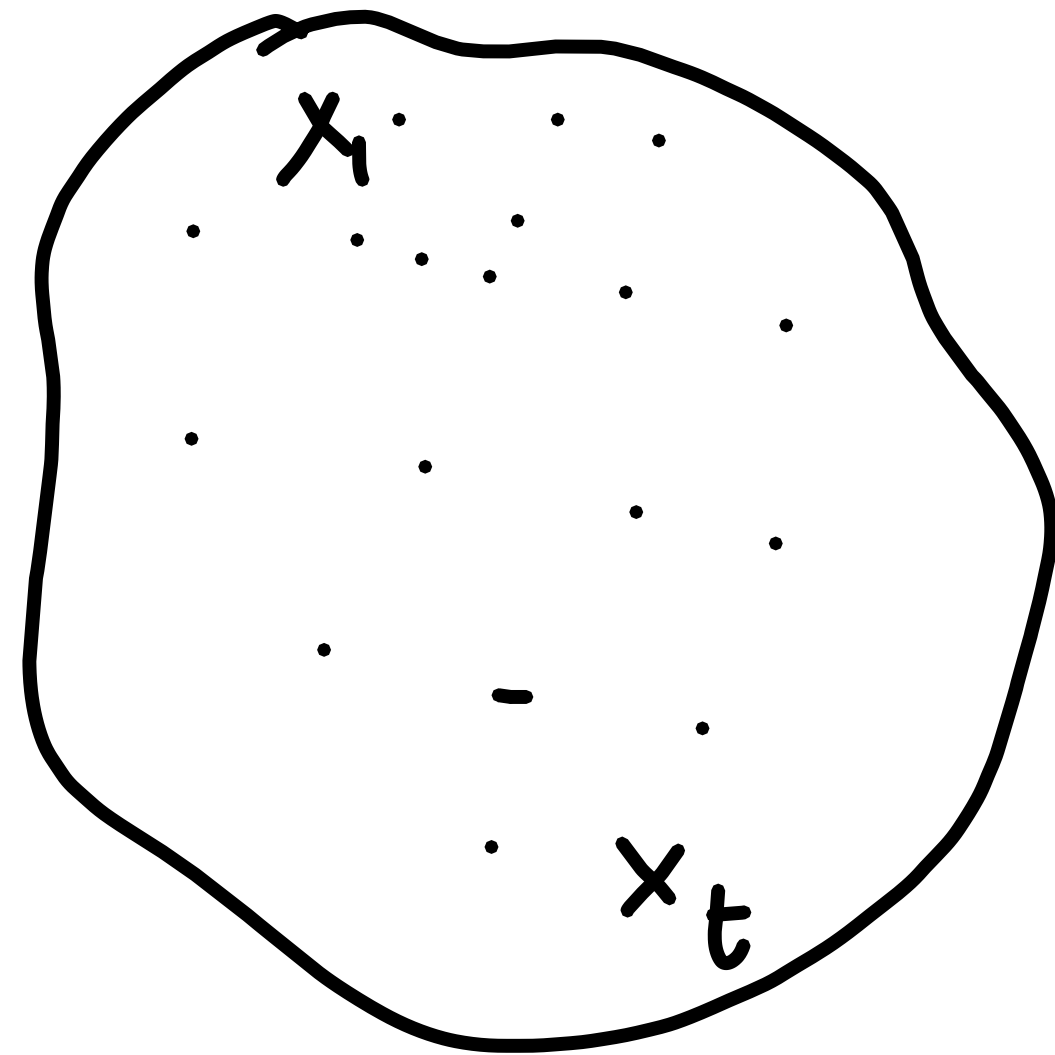
Delphic Sets

- ① Draw a sample from S_i uniformly at random
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Let us for each $i \in 1, \dots, t$

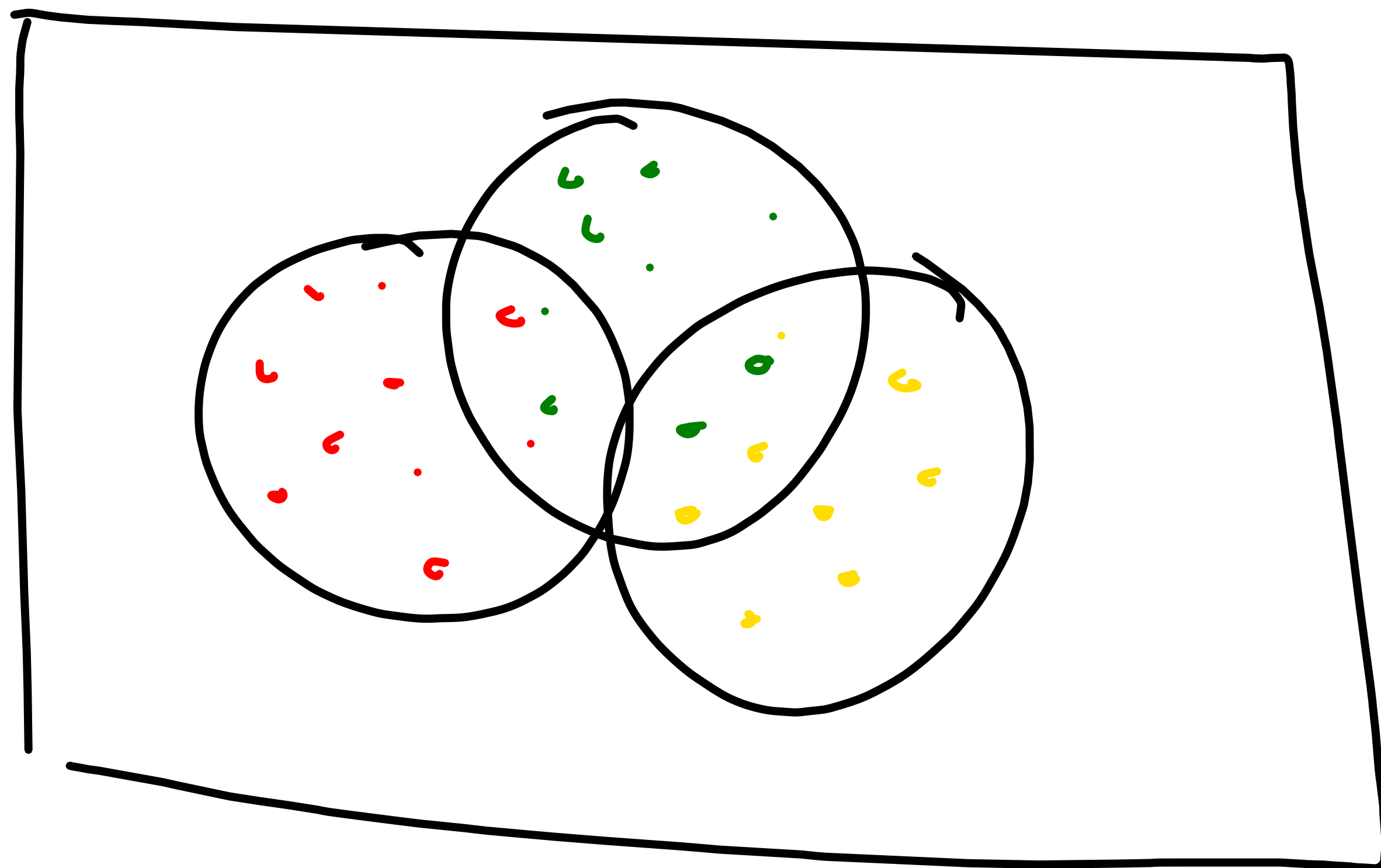
pick x_i w.p. p .



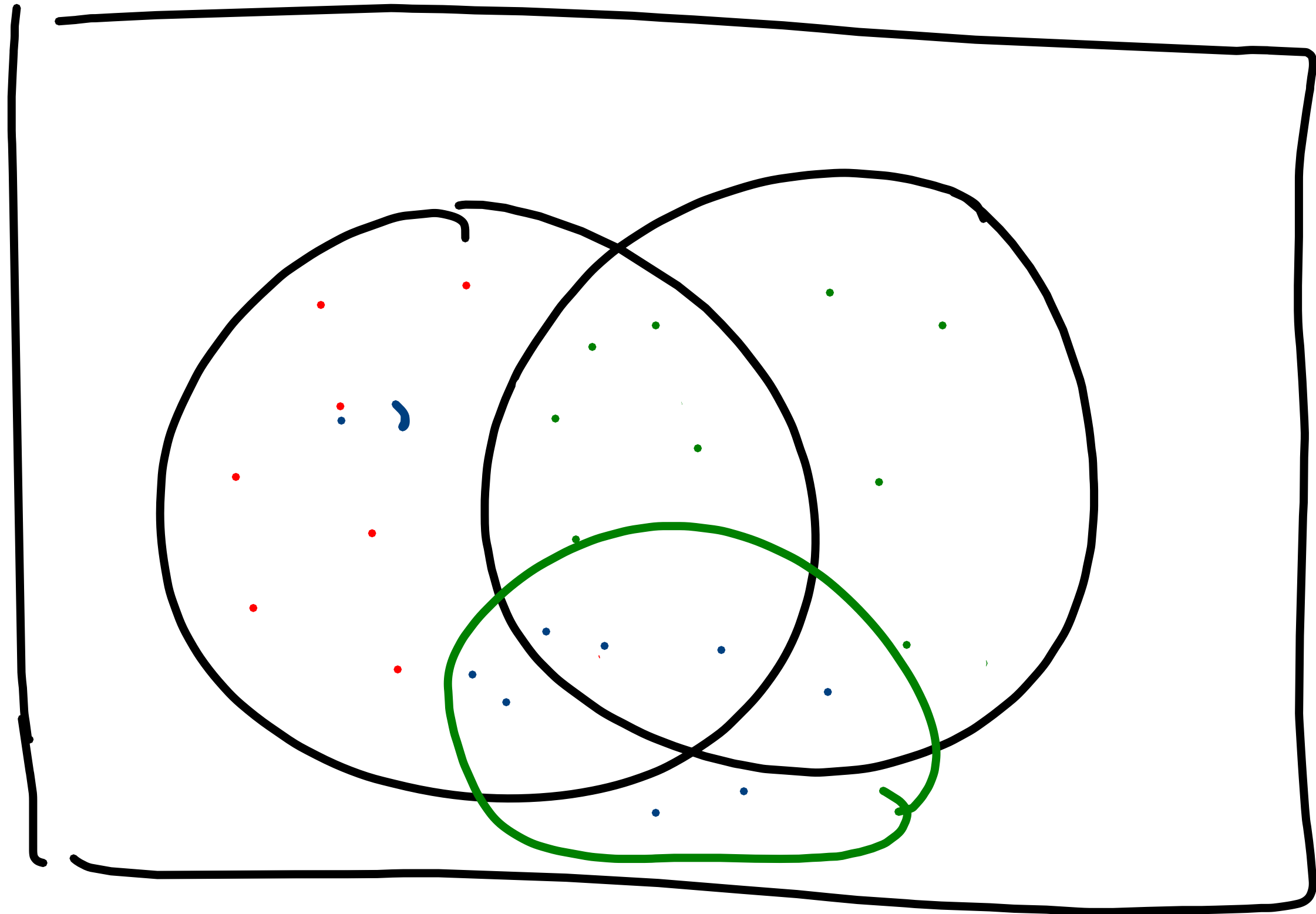
Let the # of elts picked = q

$$\frac{q}{p}$$

p



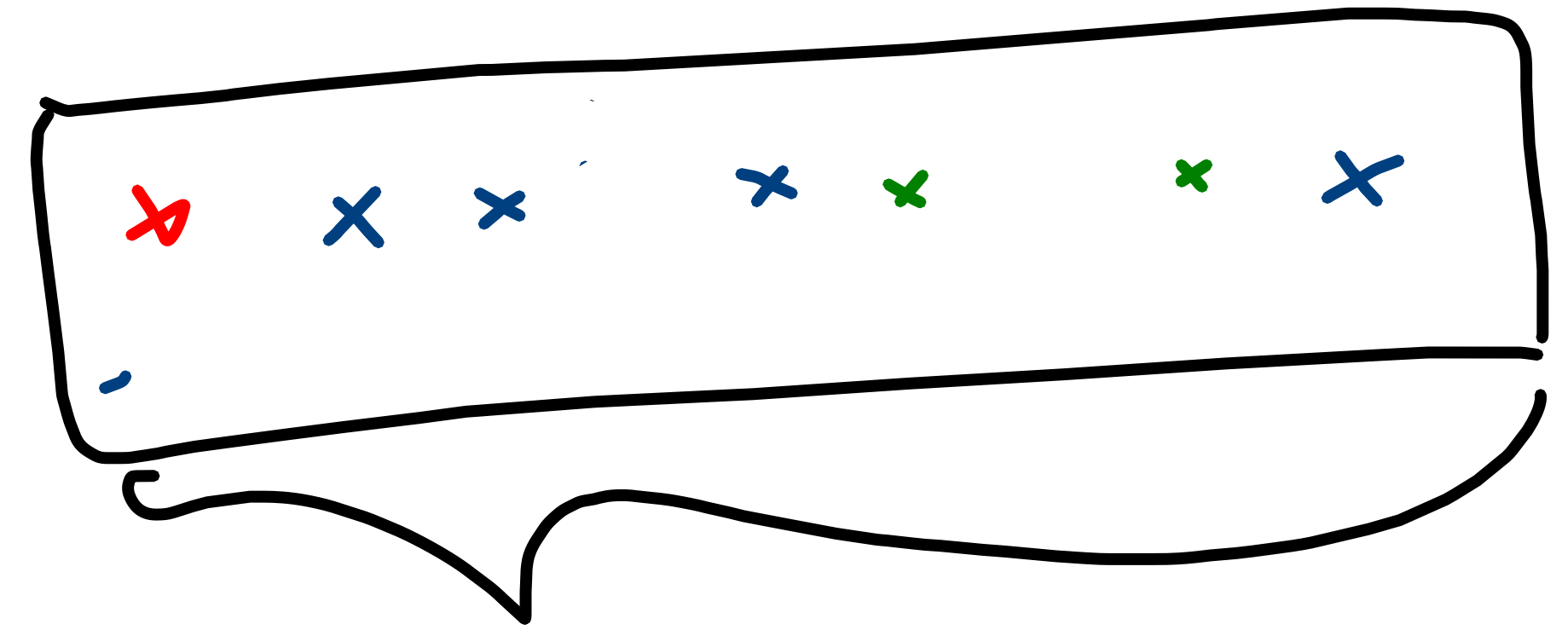
P



$$\frac{1}{100}$$

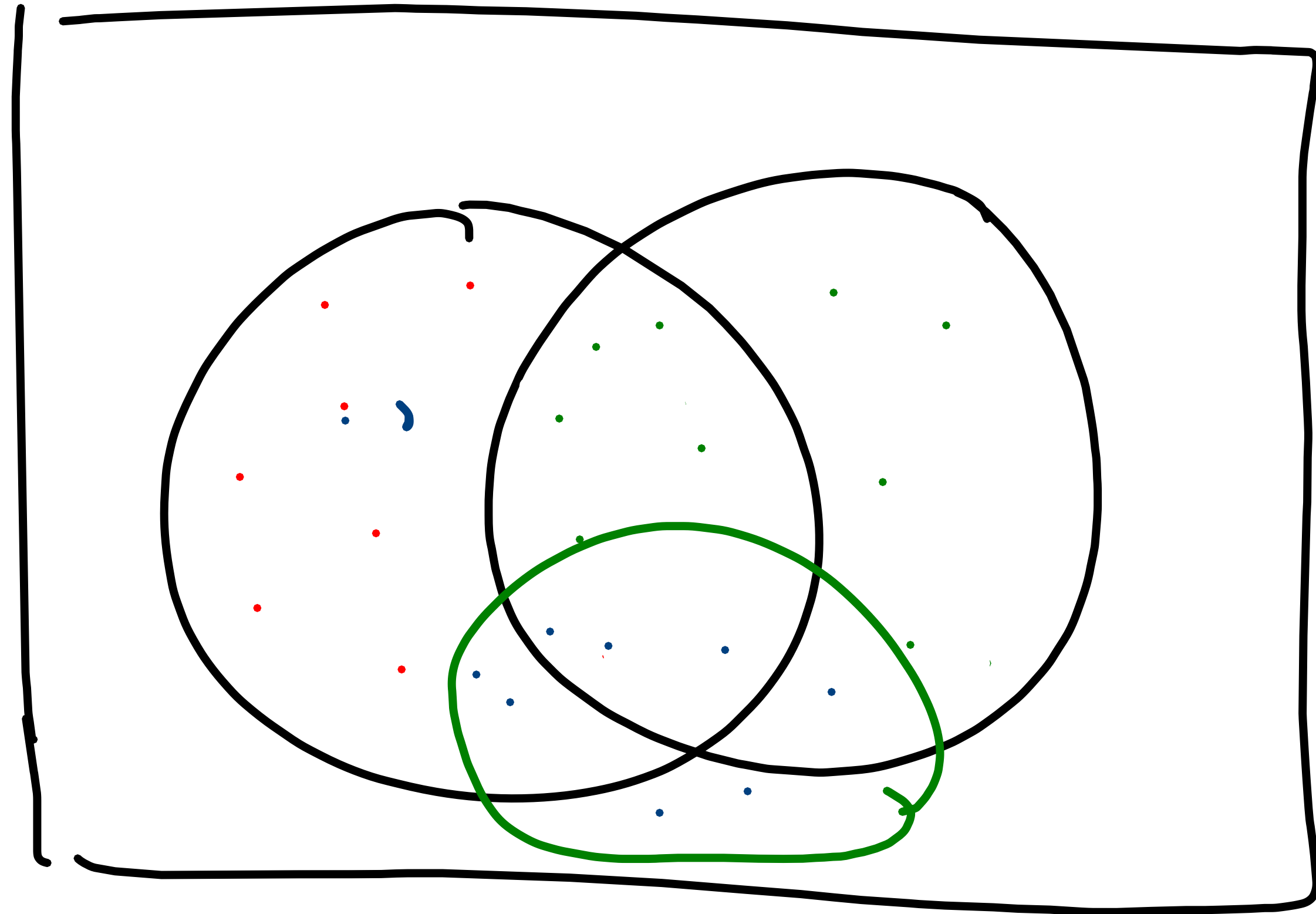
$$S_1 \quad S_2 \quad S_3 \quad \dots \quad S_k \quad \dots$$

$$\frac{1}{100} \quad \frac{1}{200}$$



$$\log n \log m$$

P



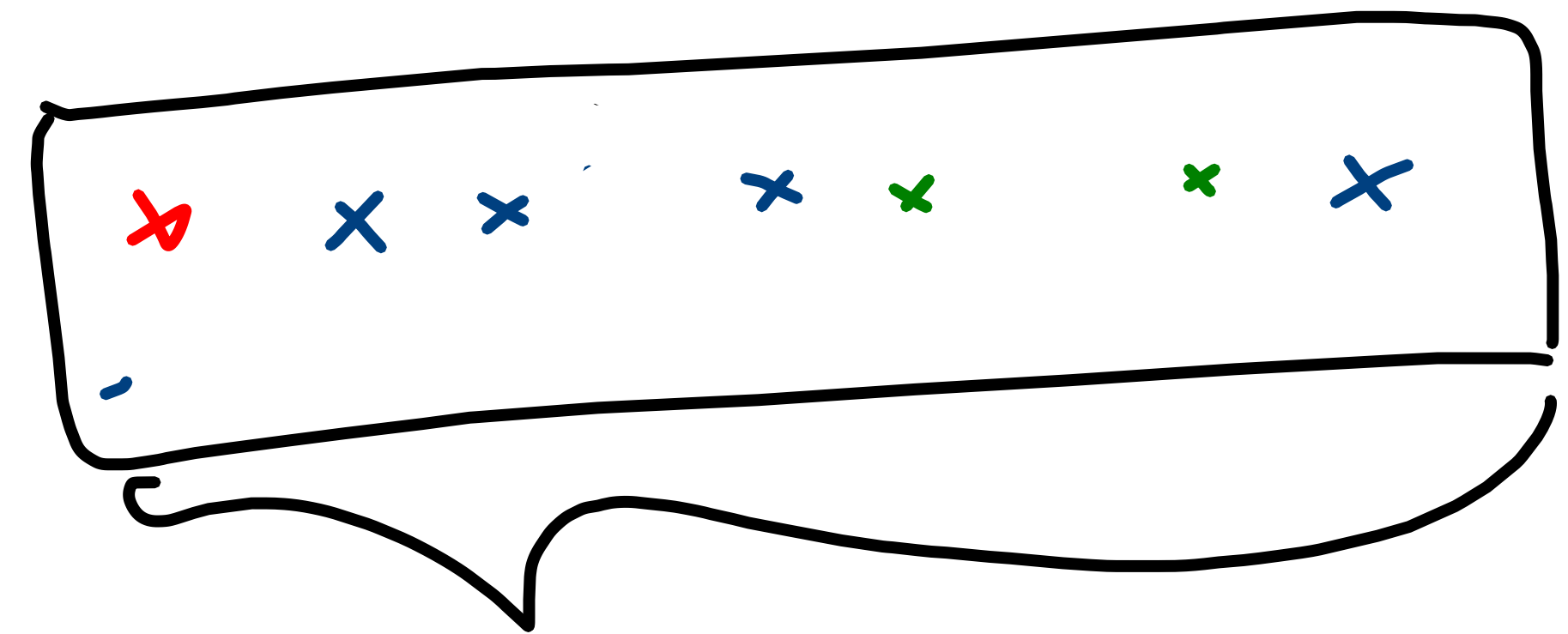
PODS 21
PODS 22
IJCAI 23

ESA 22
ICSE 22

$$\frac{1}{100}$$

$$S_1 \quad S_2 \quad S_3 \quad \dots \quad S_t \quad \dots$$

$$\frac{1}{100} \quad \frac{1}{200}$$



$$\log n \log m$$

Assumed: Every elt from S can be picked.
independently w/p p .

Given: - Random samples from S

Pick $k \leftarrow \text{Bin}(n, p)$

Draw k distinct samples from S .