Hypothesis Spaces

- Suppose we have one Boolean feature (X1) with Boolean target class or hypothesis H(X)

X1	h1	h2	h3	h4
0	0	0	1	1
1	0	1	0	1

- Suppose we have two Boolean features (X1 and X2) with Boolean target class or hypothesis H(X)

X1	X2	h1	h2	h3	h4	…	h16
0	0	0	0	0	0	…	1
0	1	0	0	0	0	…	1
1	0	0	0	1	1	…	1
1	1	0	1	0	1	…	1

- Suppose we have three Boolean feature (X1, X2 and X3) with Boolean target class or hypothesis H(X)

X1	X2	X3	h1	H2	h3	h4	…	h256
0	0	0	0	0	0	0	…	1
0	0	1	0	0	0	0	…	1
0	1	0	0	0	0	0	…	1
0	1	1	0	0	0	0	…	1
1	0	0	0	0	0	0	…	1
1	0	1	0	0	0	0	…	1
1	1	0	0	0	1	1	…	1
1	1	1	0	1	0	1	…	1

- For d binary features
  - Truth table has **2^d rows** (d is the length of feature vector)
  - For Boolean target variable, there are **2 to the power of 2^d** different Boolean functions (possible hyposthesis) we can define.
  - This is the size of our hypothesis space
- In general, the hypothesis space size is given by:

$$Size = \#\ of\ classes^{(\#\ of\ feature\ values)^{\#\ of\ features}}$$

- As an example, with binary classes, binary features, with three features:

$$Size = 2^{2^3} = 256$$