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1 Throwing eggs from a building

Question: Throwing eggs from a building. Suppose that you have an N-story building and plenty of eggs. Suppose also that an egg is broken if it is thrown off floor F or higher, and unhurt otherwise. First, devise a strategy to determine the value of F such that the number of broken eggs is $\sim\lg N$ when using $\sim\lg N$ throws, then find a way to reduce the cost to $\sim 2\lg F$.

Answer: $\sim\lg N$: start at the top, always cut search space in half $\rightarrow$ binary search; $\sim 2\lg F$: start at 1, next 2, 4, 8 (i.e., 2^i), once the egg breaks after ($\sim\lg F$ steps) do binary search in the smaller search space (range $\leqslant F$ and hence number of searches $< \sim\lg F$) $\rightarrow$ exponential search.

$$2^{\lfloor \lg F \rfloor} \leqslant F \leqslant 2^{\lceil \lg F \rceil}$$

$$range = 2^{\lceil \lg F \rceil} - 2^{\lfloor \lg F \rfloor} = \{0, 2^{\lfloor \lg F \rfloor}\} \leqslant 2^{\lg F} = F$$

$$range \leqslant F$$