# Magic number game

A magic application of Zeckndorf theorem

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october 2025

**Theorem: Zeckndorf theorem**

Each positive integer is uniquely written as a sum of distinct non -adjacent terms of fibonnaci sequence .

**Remainder:** The fibonacci sequence defined as follow $F_{n+2} = F_{n+1} + F_n$ , $\forall n \geq 0$ and $F_0 = 0$ and $F_1 = 1$ .

First, there are 10 terms of the Fibonacci sequence that are strictly less than 100: (1, 2, 3, 5, 8, 13, 21, 34, 55, 89). By Zeckendorf's theorem, any positive integer smaller than 100 can be constructed from these numbers.

**The Main Idea:** How can we be sure to identify which Fibonacci numbers construct each positive integer between 1 and 100?

**Card Design:** We design cards containing numbers between 1 and 100 with the following conditions:

- The numbers appear in order.
- The first number of card $i$ is the $i^{\text{th}}$ Fibonacci term (among those less than 100).
- The other numbers on card $i$ are all numbers less than 100 that contain the $i^{\text{th}}$ Fibonacci term in their Zeckendorf representation.

**How It Works:** If the user chooses whether their number appears on each card (Yes/No), we can determine which Fibonacci terms appear in the unique Zeckendorf representation of their number. After 10 steps, we have identified all the Fibonacci terms that build this number.

**Key Insight:** The algorithm does not find your number—you construct your number through your choices.

For example when the user think in the number 60 , 60 appear just in the two following card:

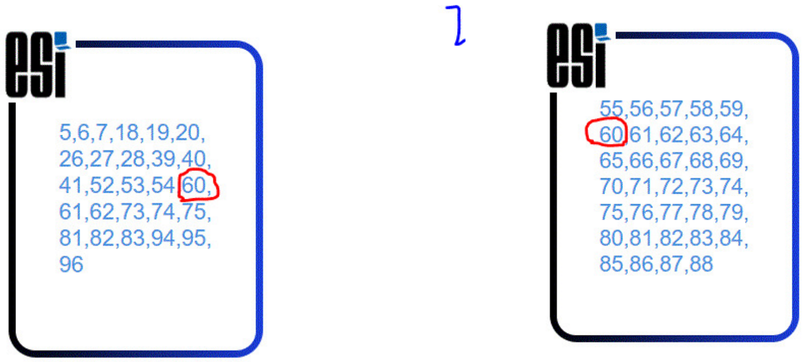


Figure 1: The game cards that have 60.

Because Figure 1 present all the cards that have 60 , so we Notice that 60=55+5 .( adding the first number of each card that is fibonnaci term also ).