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ZKLux#1

Luxembourg's First Zero Knowledge Days

Conference on Thursday 27th June 2019

ZKP (zero-knowledge proofs) is a method to prove the knowledge of some fact, without revealing that fact. It is already used in several blockchains and is expected to have a major impact on applications that involve transactions, identity systems, and proprietary information in general. ZKLux#1 is the perfect occasion to find out about this exciting and important new technology.

Venue: House of Startups / LHoFT, "Big Bang" space, 9 Rue du Laboratoire, 1911 Luxembourg

the LHoFT FANTOM Grant Thornton

An Introduction to Zero-knowledge proofs

Alex Kampa, Sikoba Research

Example of zero-knowledge proof:

Sudoku

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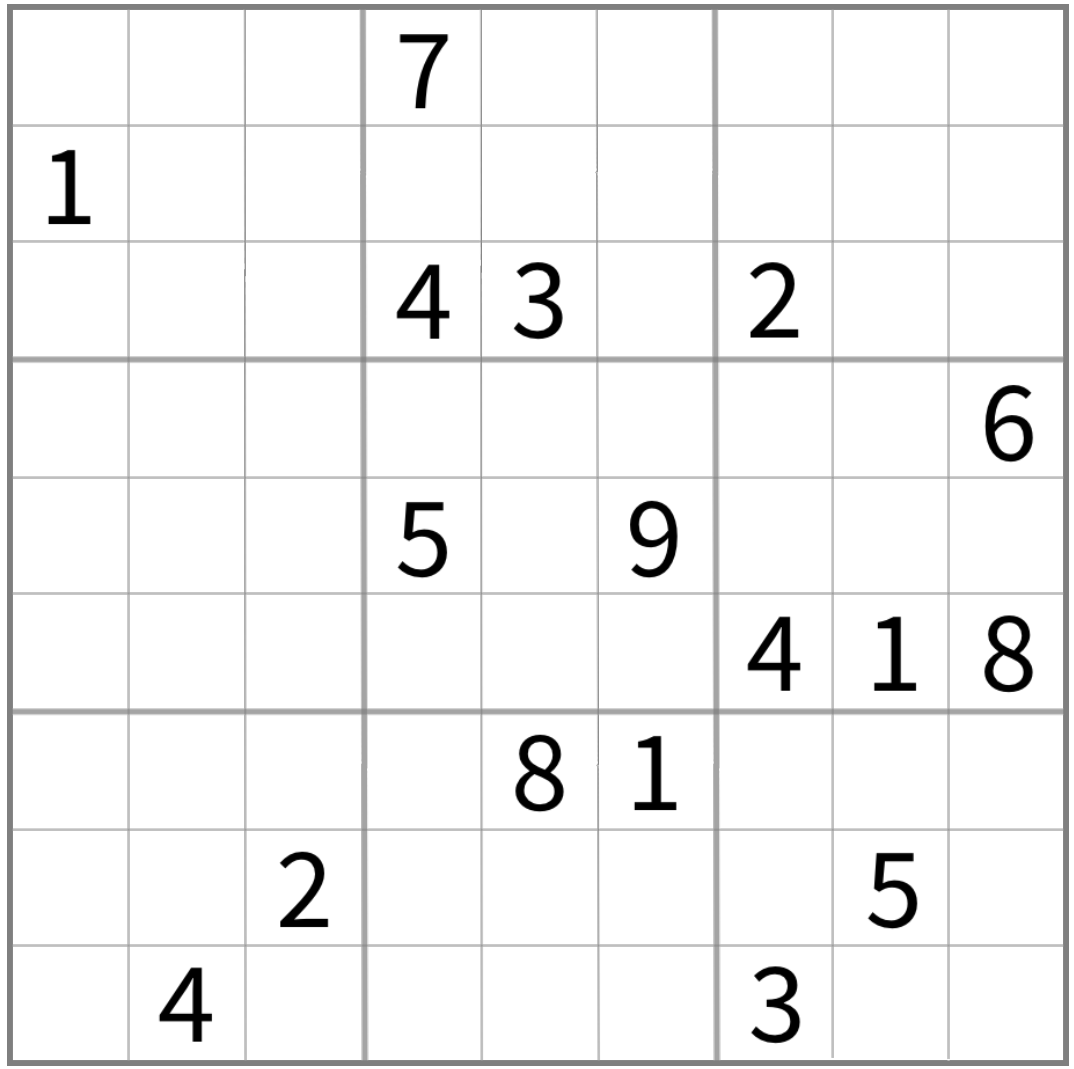

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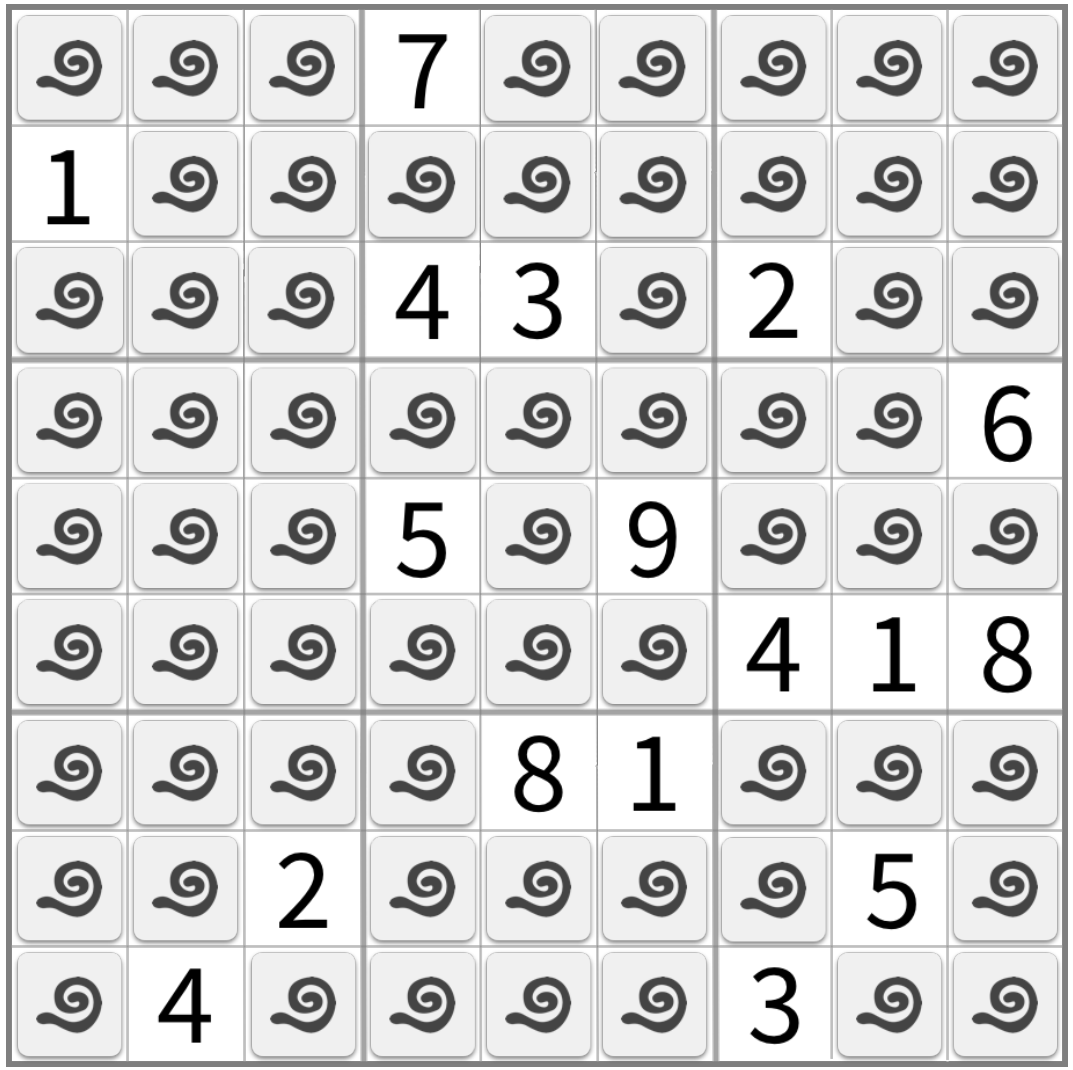

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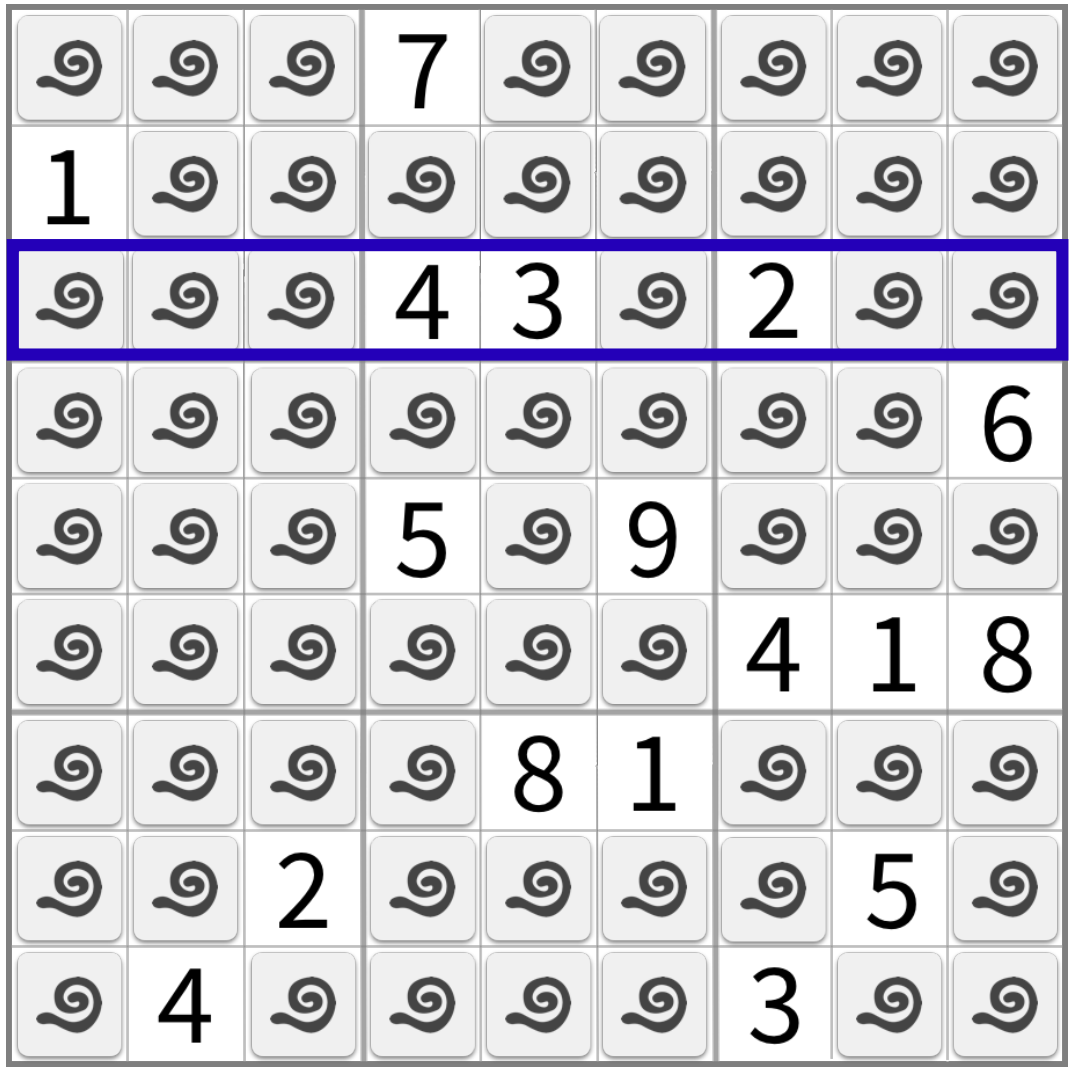

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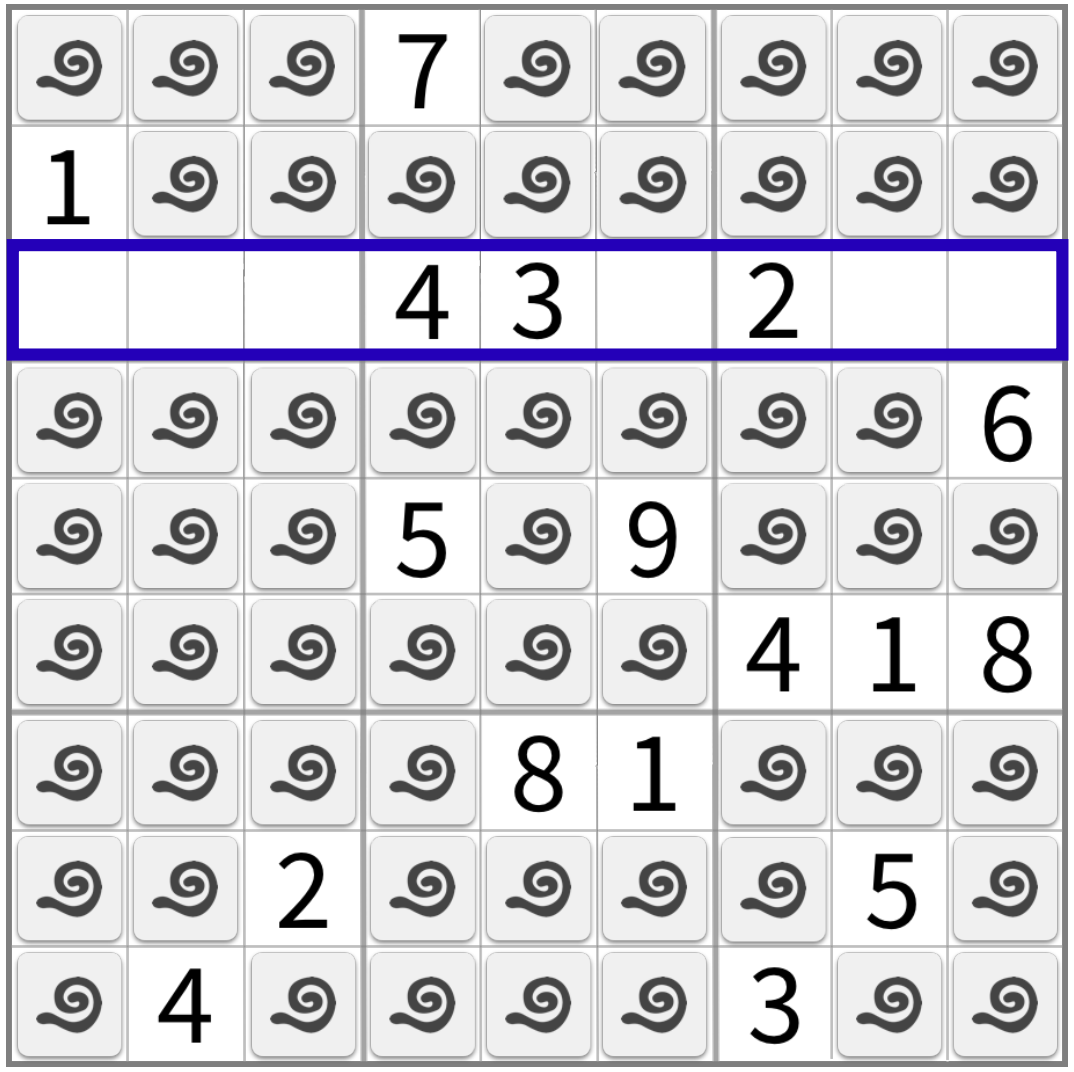

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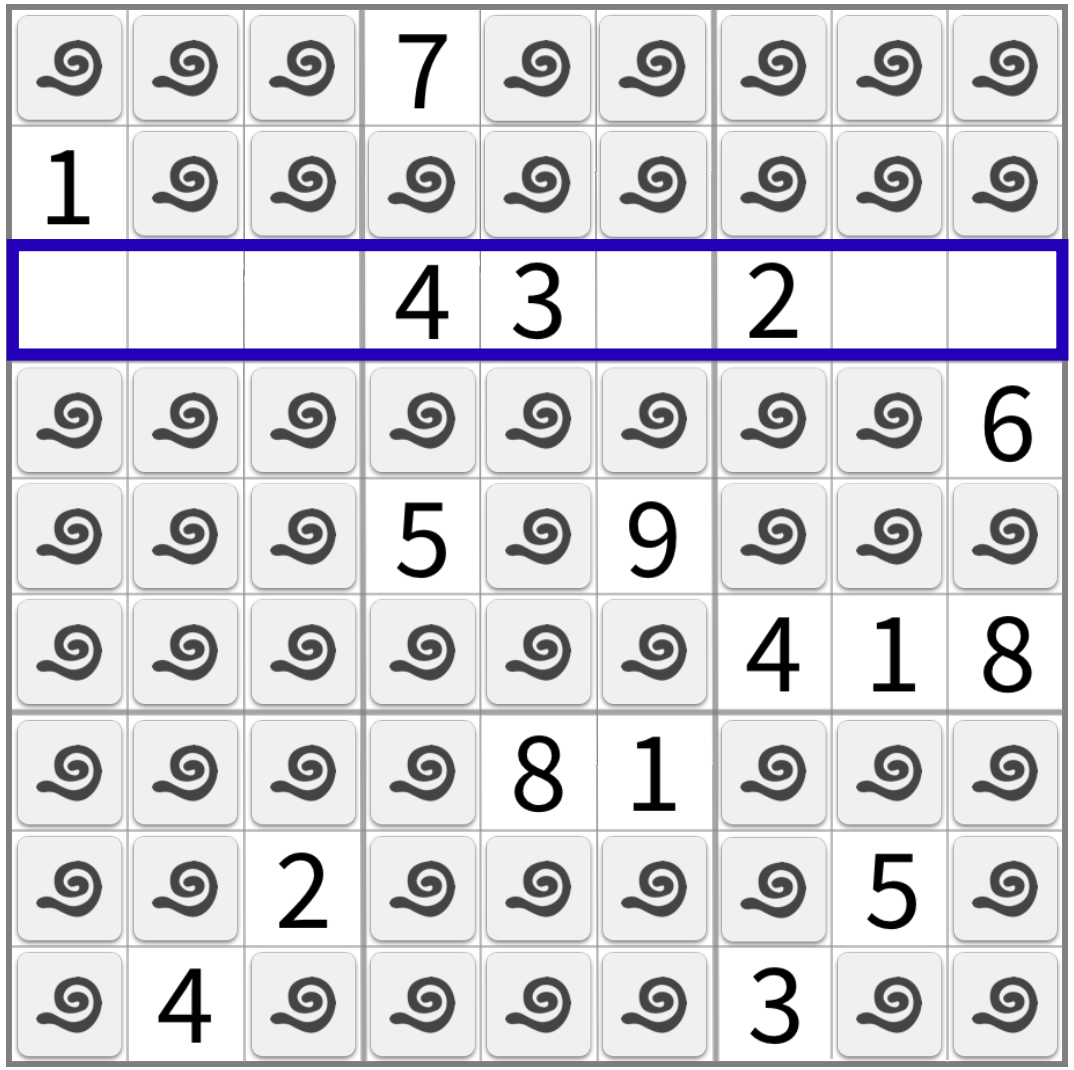

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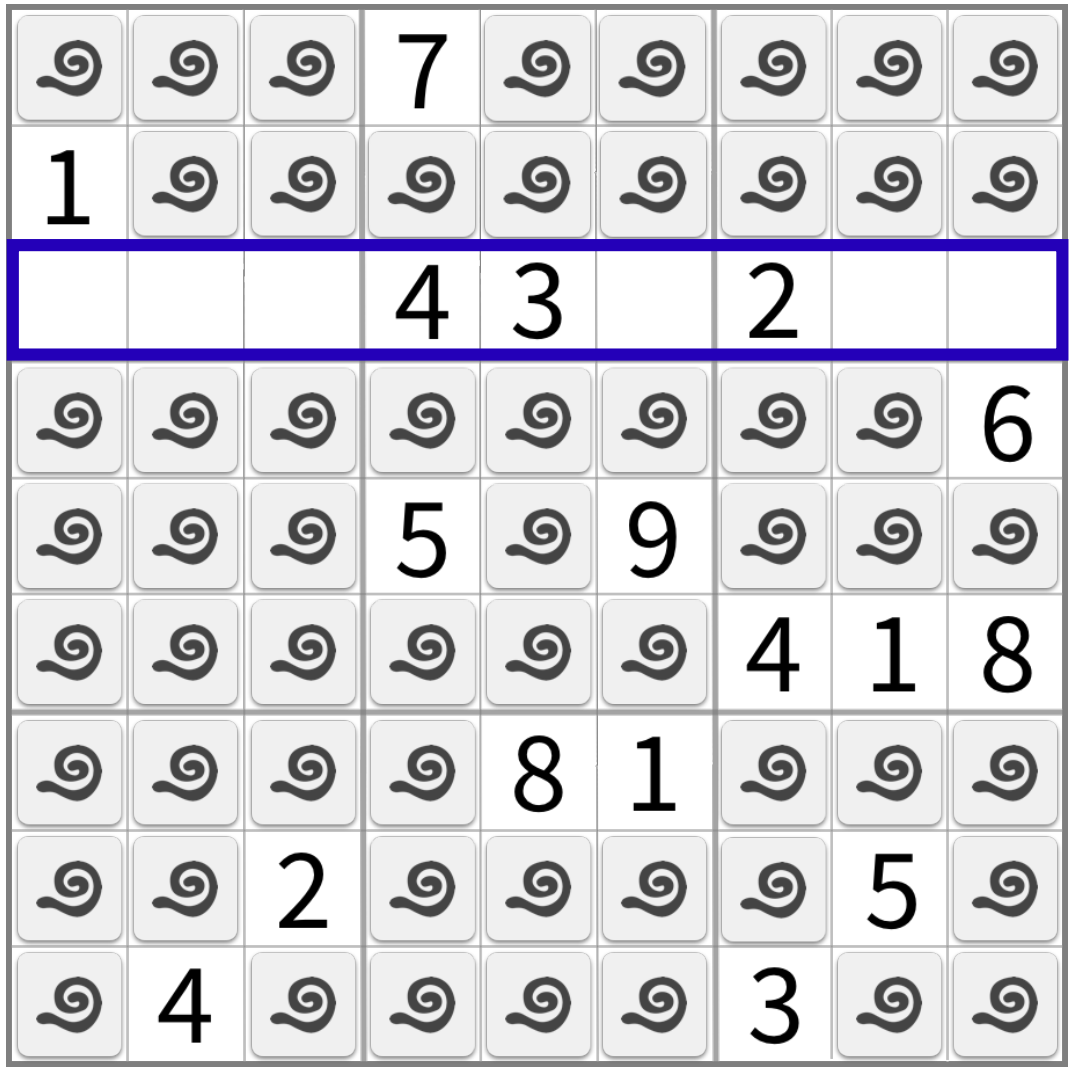

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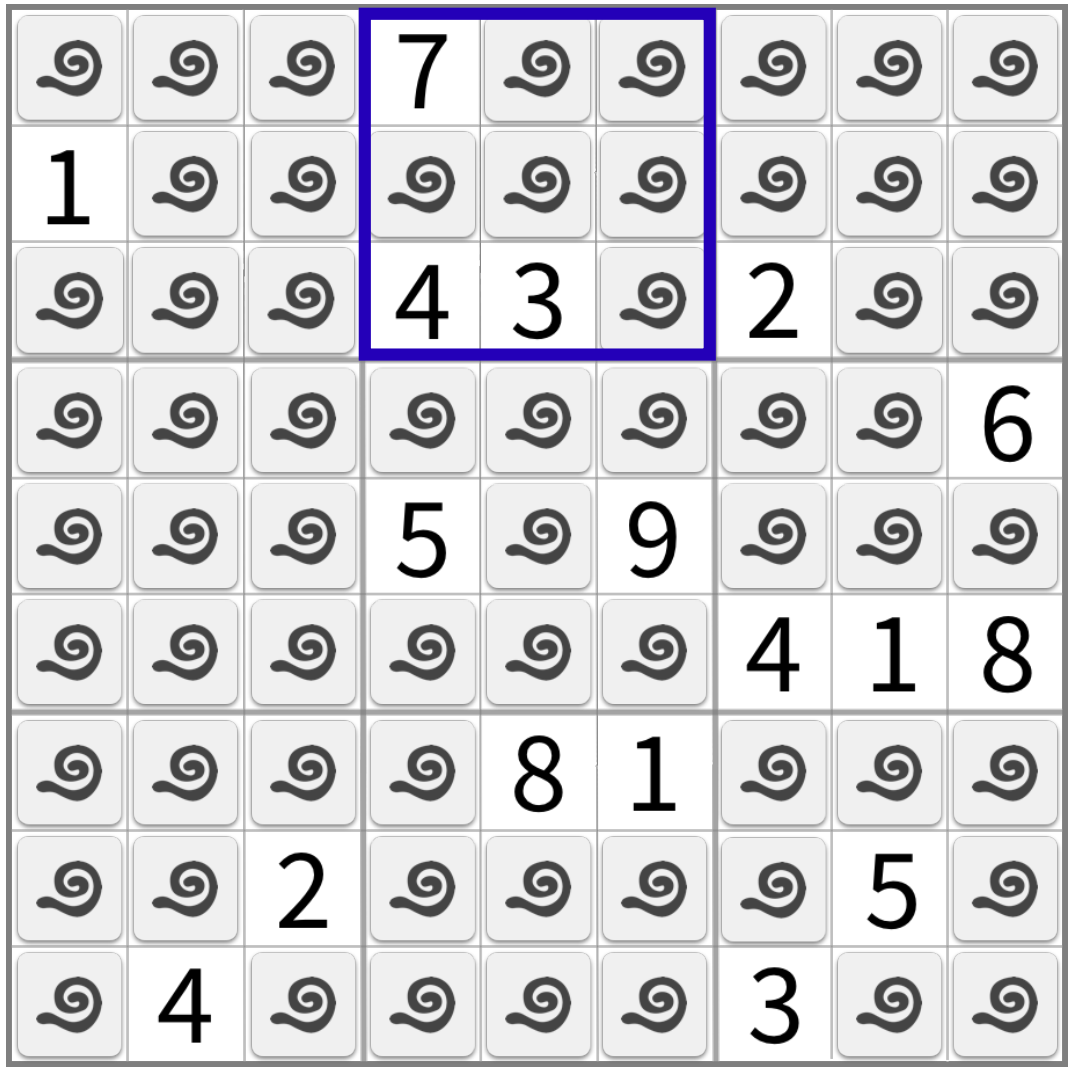

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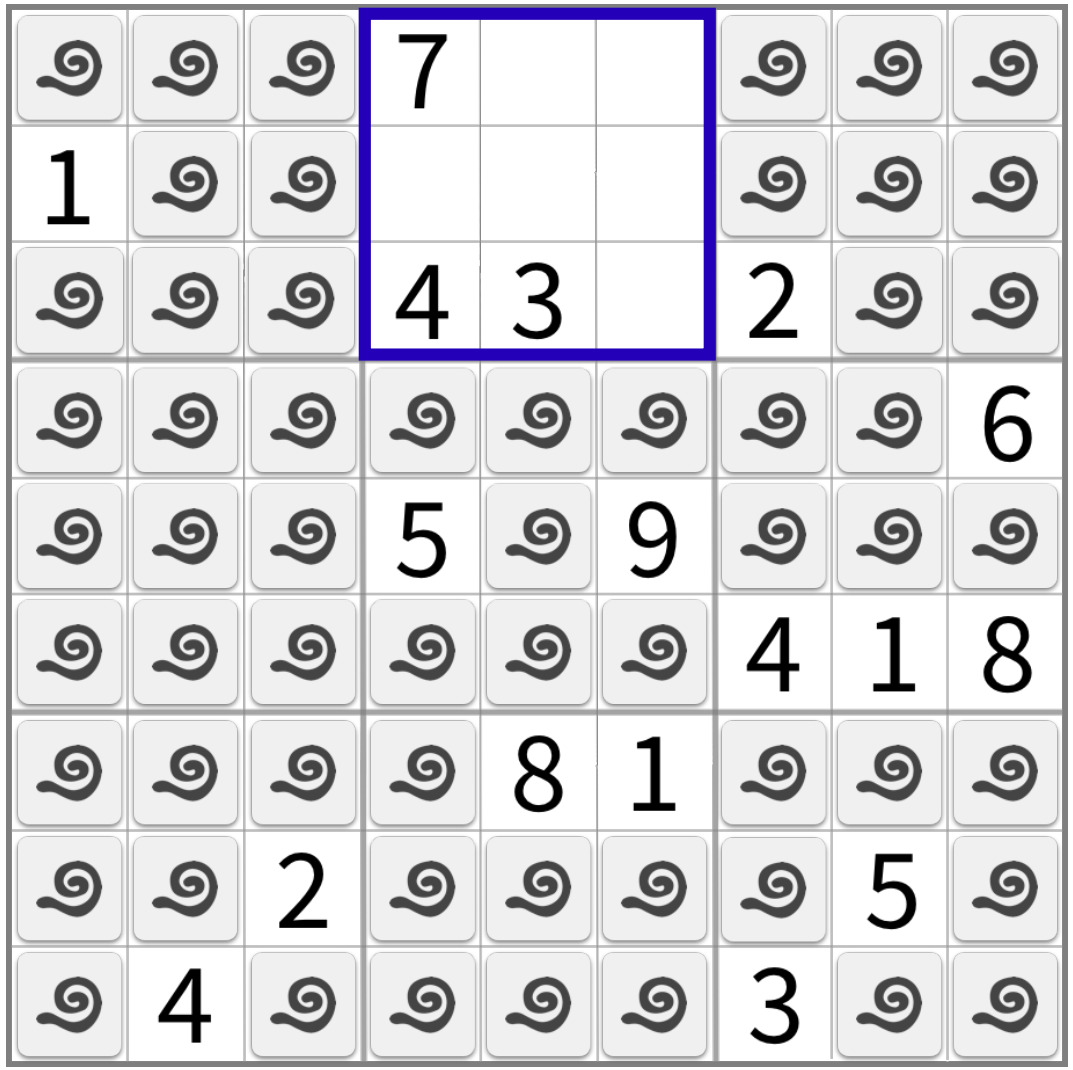

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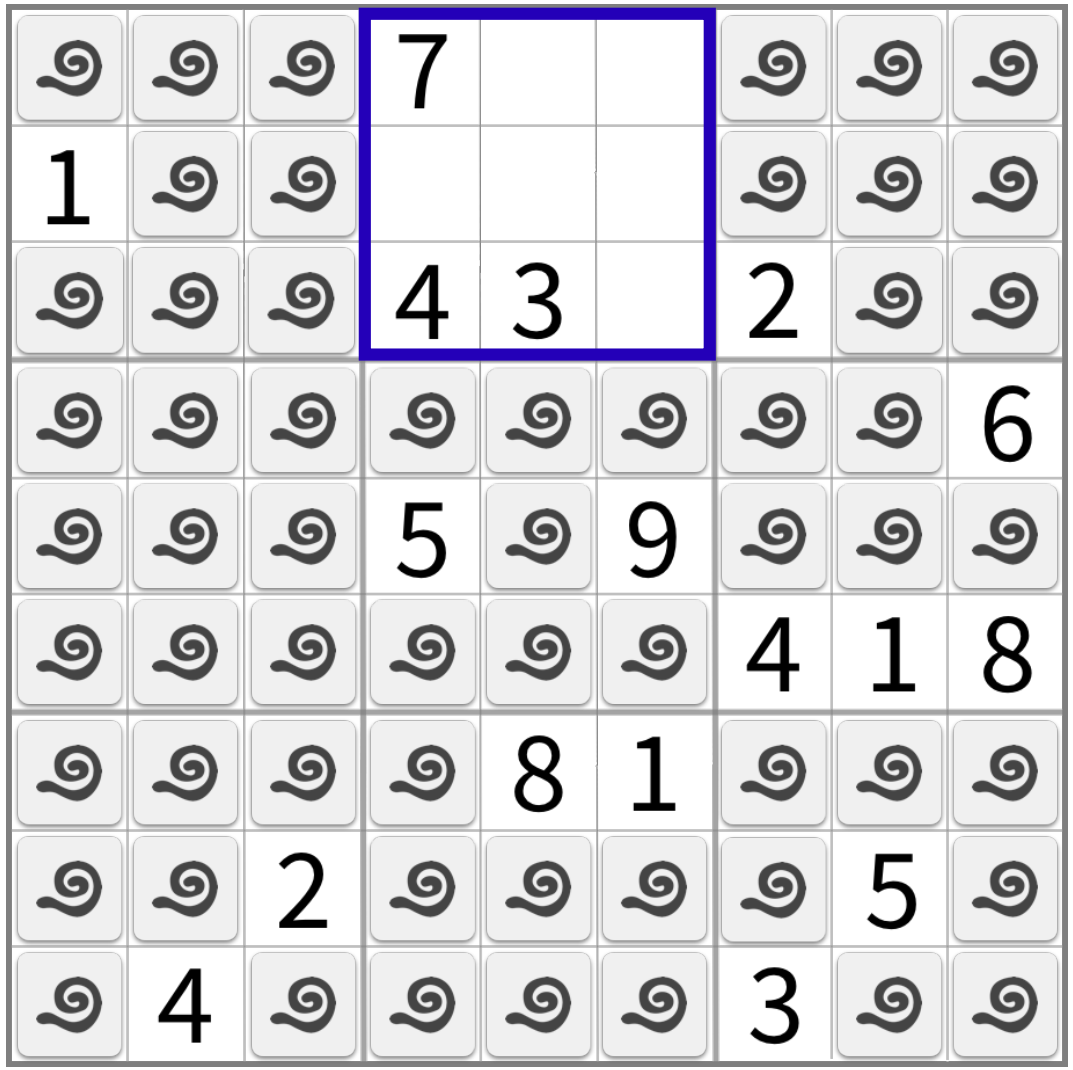

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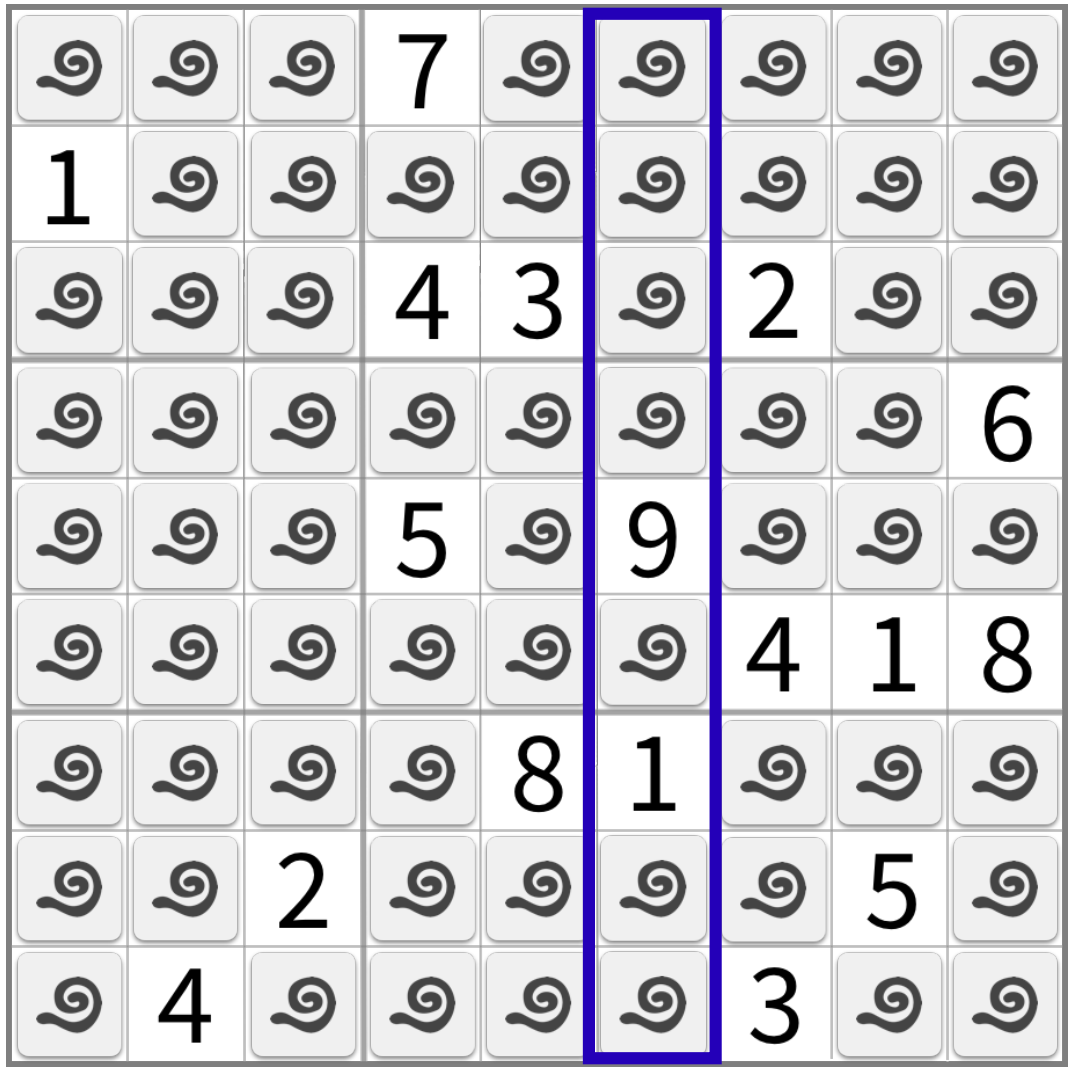

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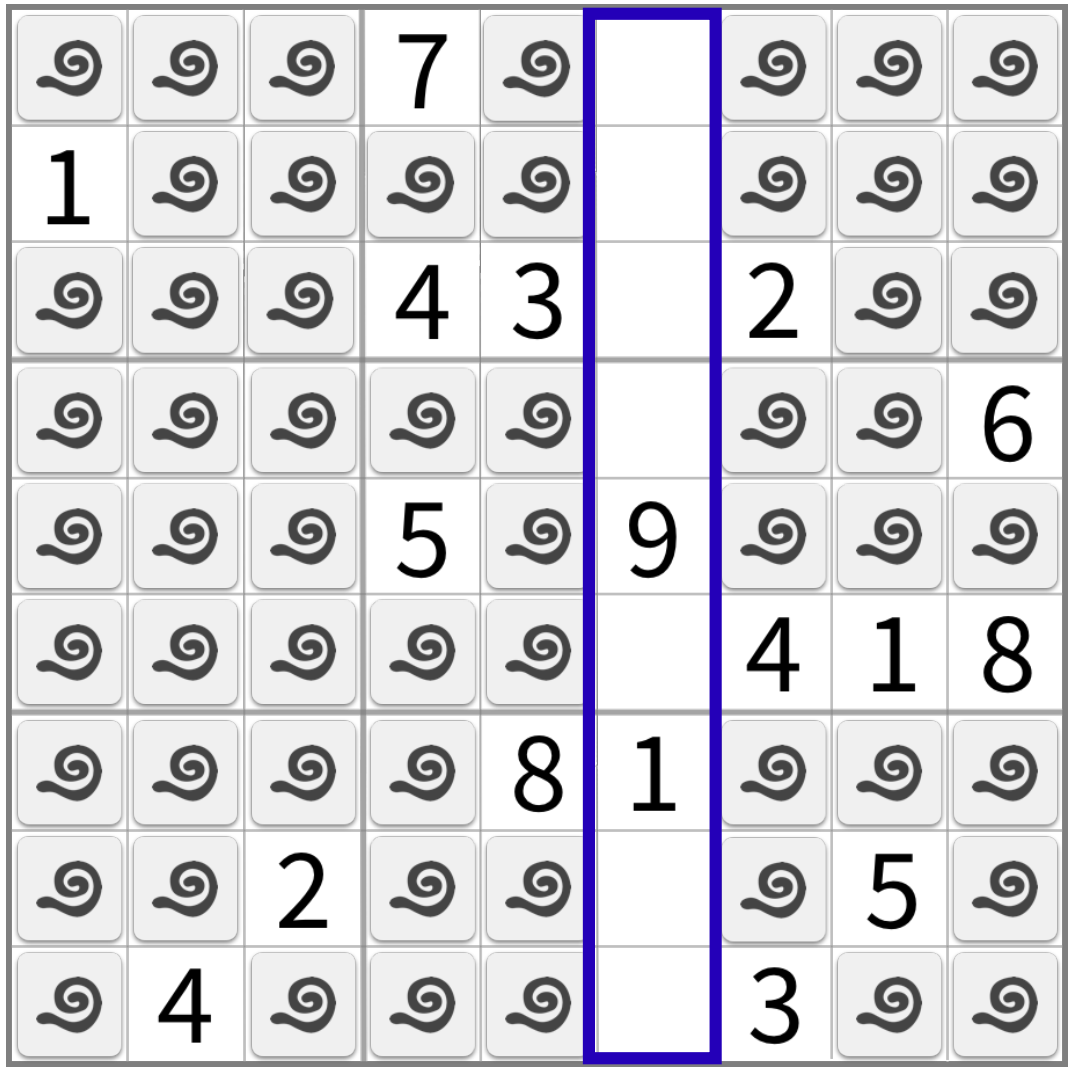

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Example of zero-knowledge proof:

The psychic

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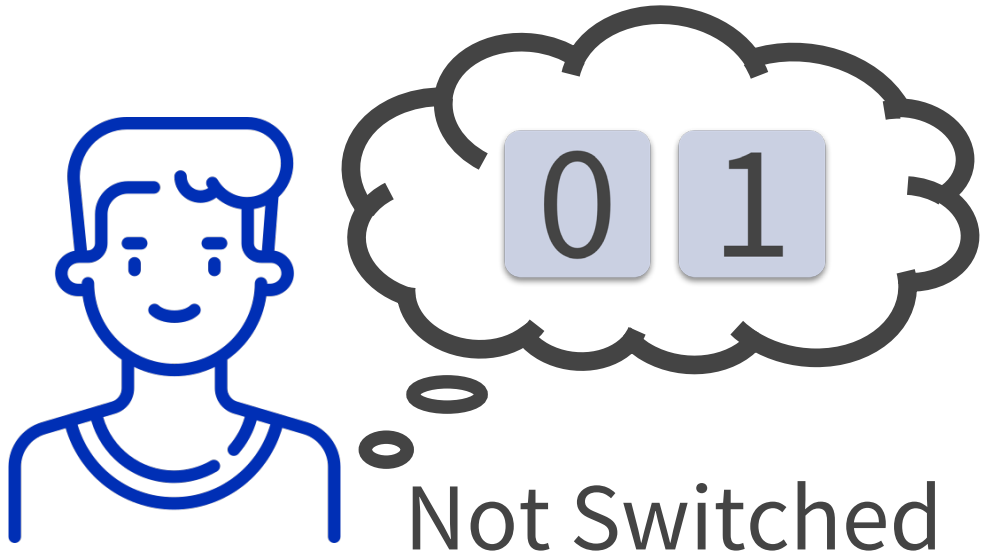

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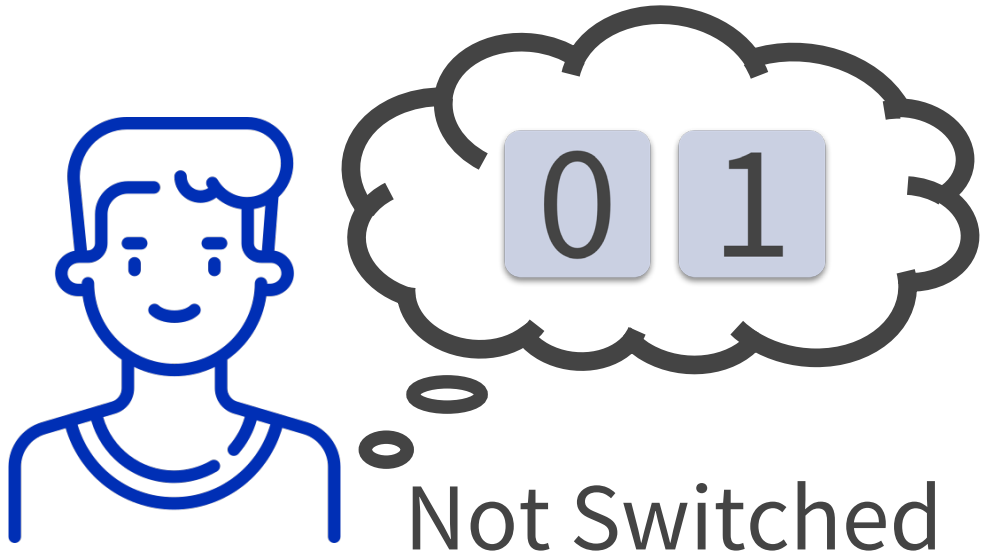

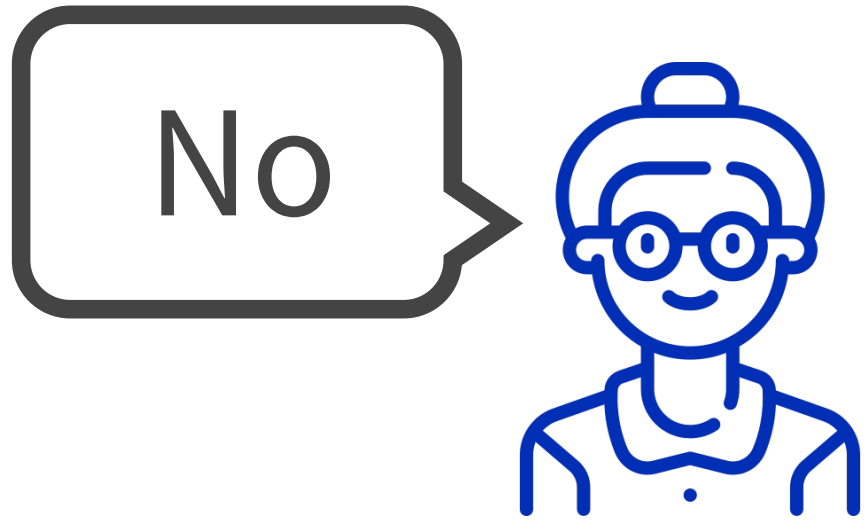

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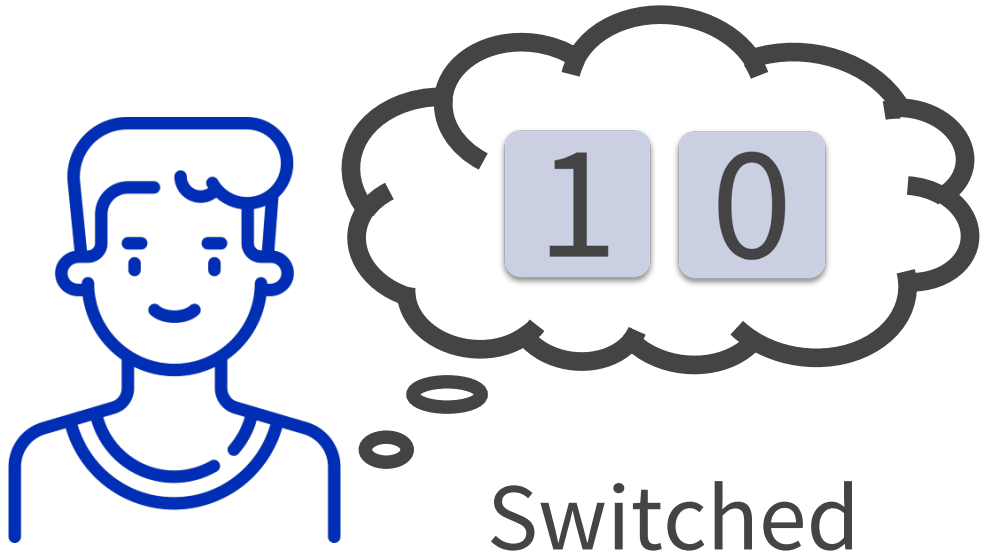

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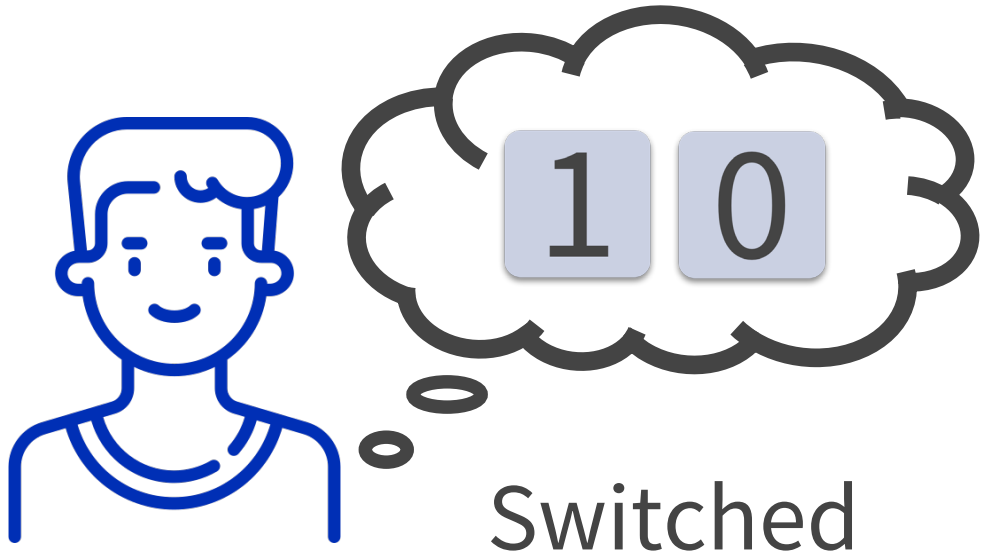

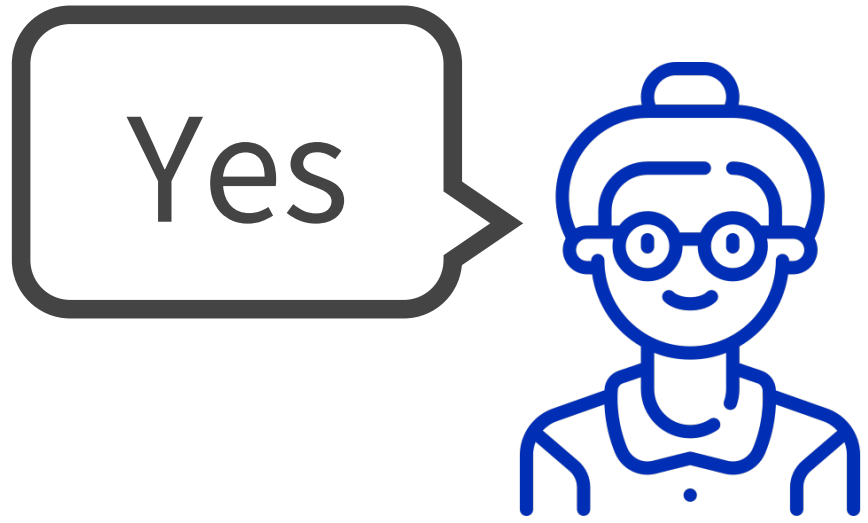

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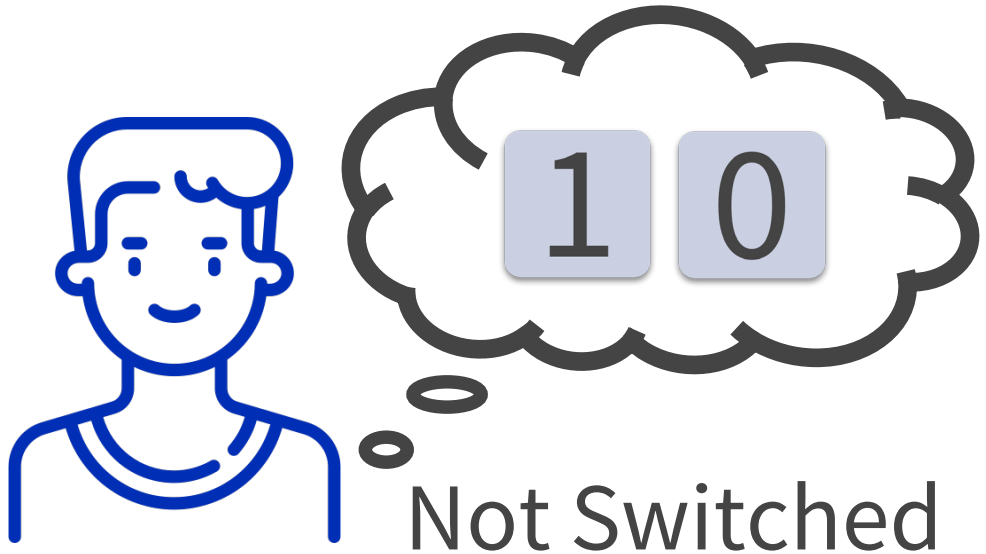

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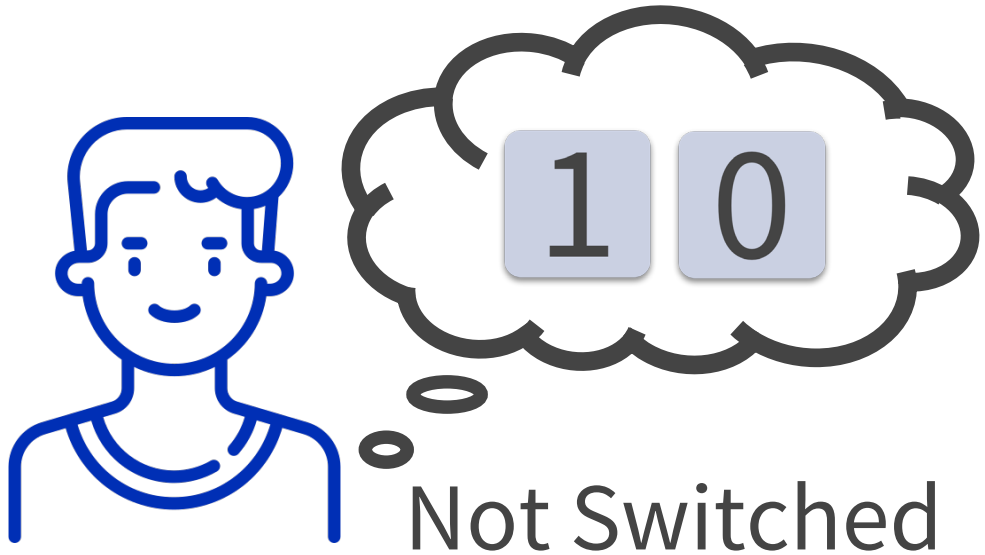

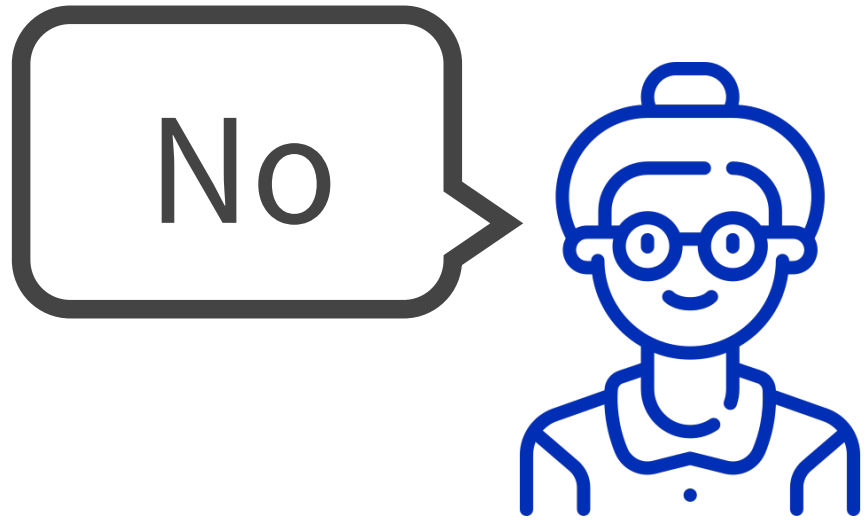

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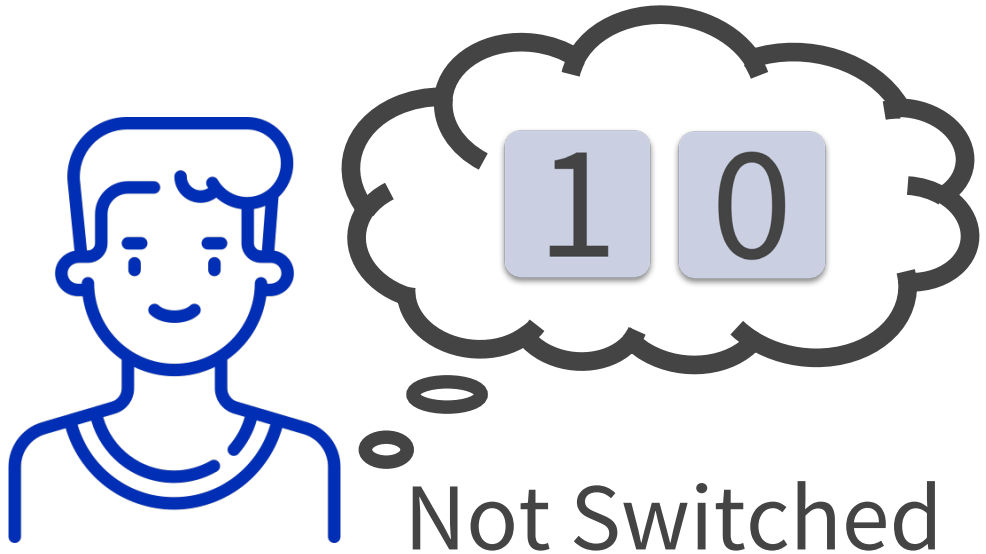

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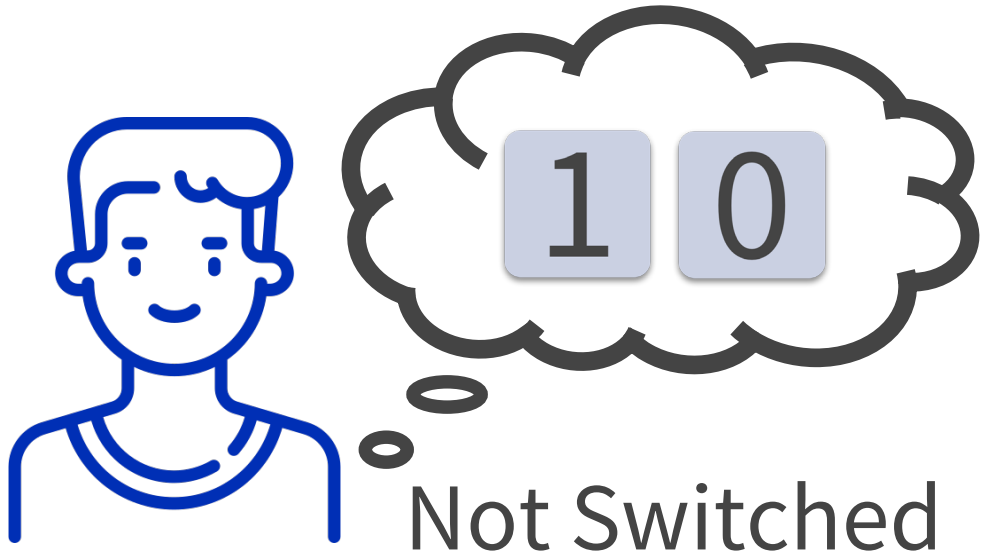

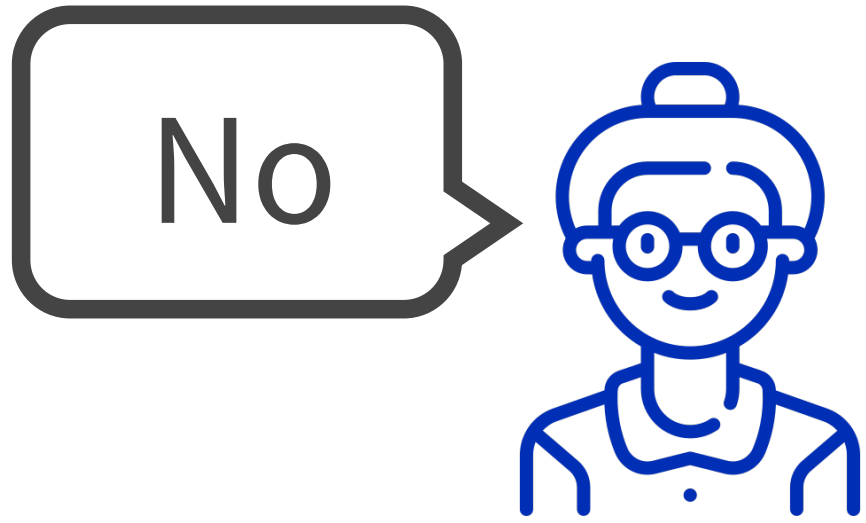

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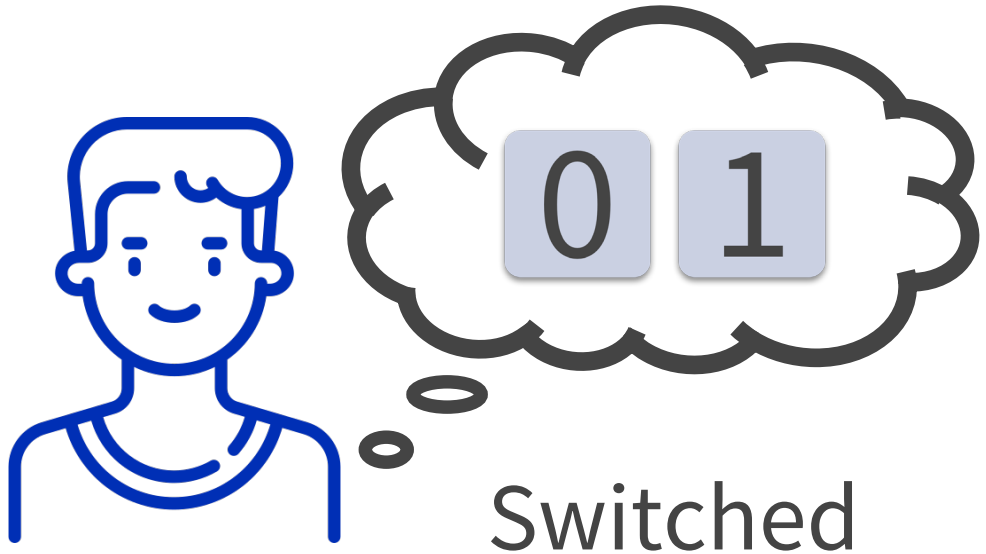

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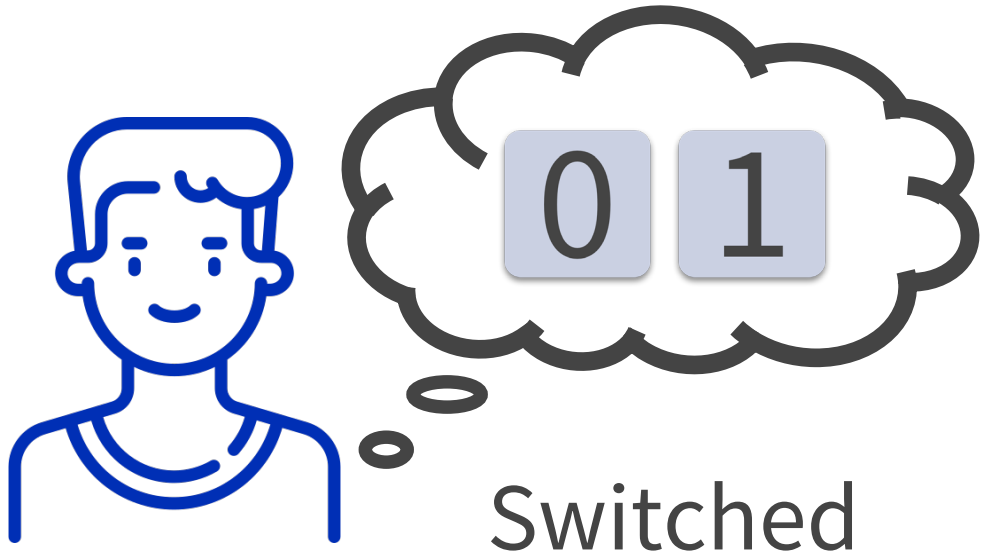

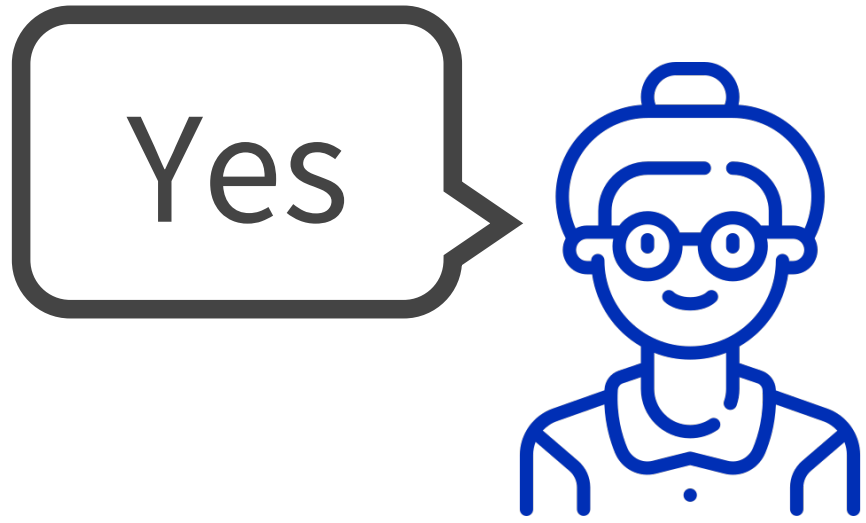

Differences

Type of proof:

- Sudoku: the proof can be made certain
- The Psychic: probabilistic proof

Information leakage to oberver:

- Sudoku: the observer is sure that the prover knows
- The Psychic: the observer cannot be certain

Avoiding information leakage

- Requires a probabilistic approach

- Typical approach:

    Commitment, then Challenge / Response

One-way functions (cryptographic hash functions)

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- Maps data of arbitrary size to pseudo-random data of fixed size, called hash value, or simply **hash**
- Given some data, it is easy to verify that this data maps to a hash.
- Given a hash value, it is practically impossible to find data that maps to that hash ("non-invertible").
- Even a small change to the data will produce a completely different hash value

Example of one-way function(SHA3-256)

"in the beginning there was light"

```
0xf6f9f09756e41faeee4b6d2baf82d59ac9be3d7f6455f5c1c5
ff0e6dc9b8e750
```

"In the beginning there was light"

```
0xdc2b73c346a88e3bf8de68cc66fe444f6f4663cd8c6b5cab38
d378b71af20df2
```

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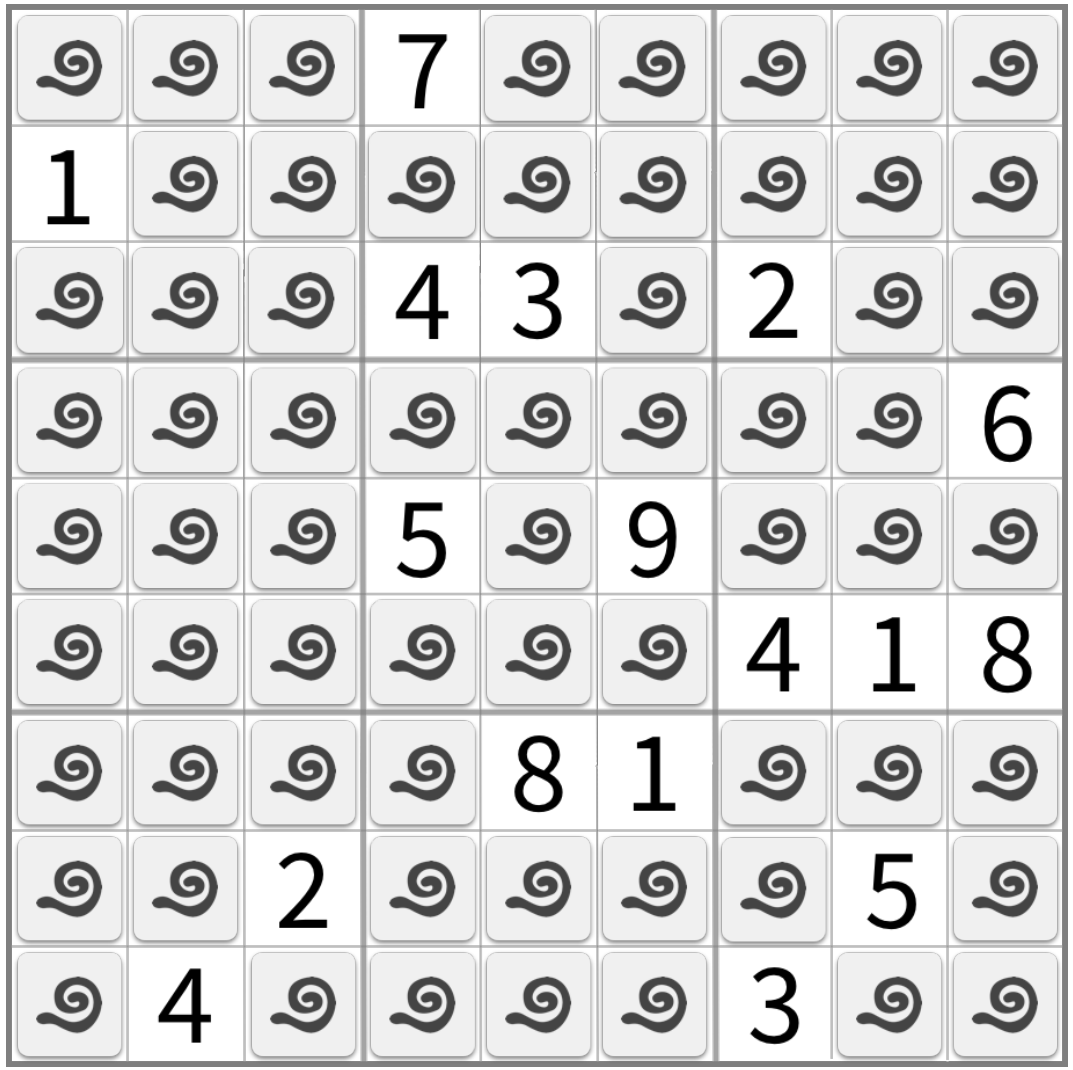

Prover generates a “Commitment” linked to the entire solution.

Repeat :

- Verifier sends a “Challenge” (typically a random number)
- Prover returns “Response” proof
- Verifier checks if proof is consistent with the commitment

… until likelihood of cheating is as small as desired

An observer obtains no information!

Vocabulary

- **Completeness**: the method works with probability 1
- **Soundness**: prover dishonest, verifier honest (prover cannot cheat)
- **Zero Knowledge**: prover honest, verifier dishonest (verifier cannot extract any information)

Thank you!