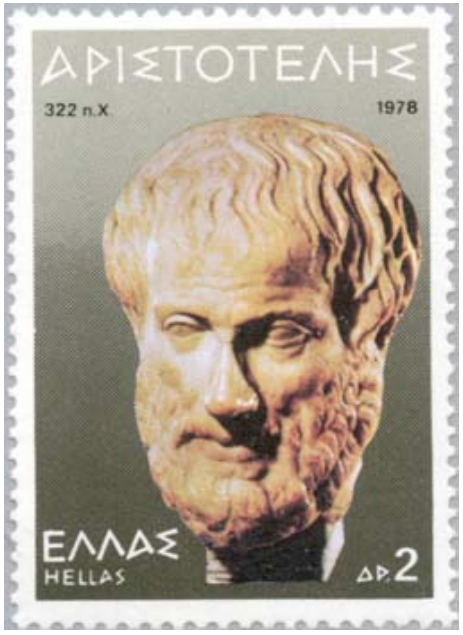
Logics for Social Behaviour

Alessandra Palmigiano

12 November 2014
Museum Boerhaave

Classical Logic

Aristotle



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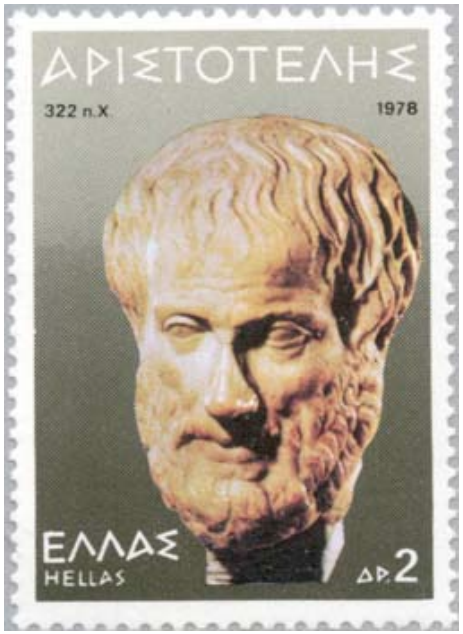

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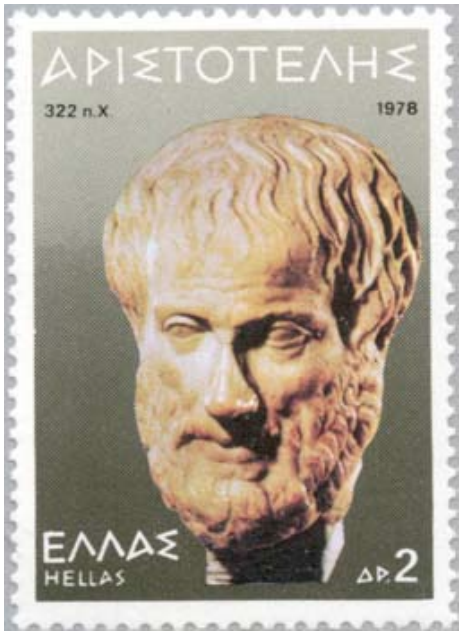

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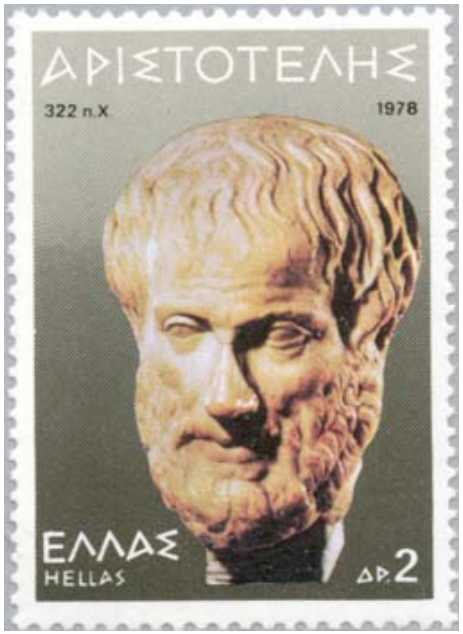

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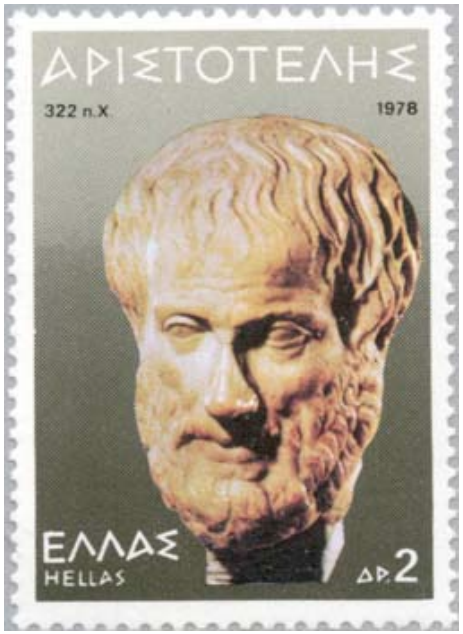

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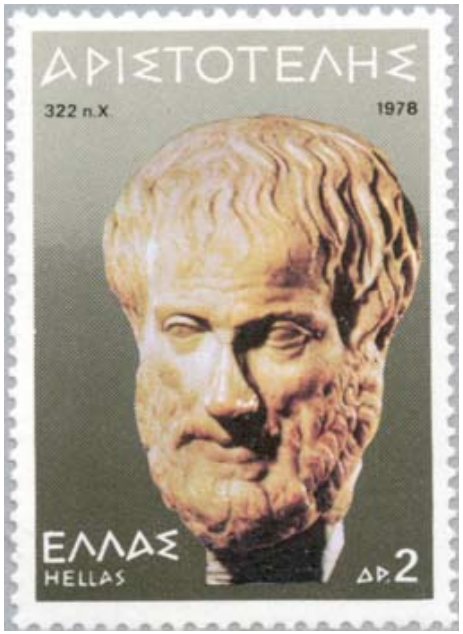

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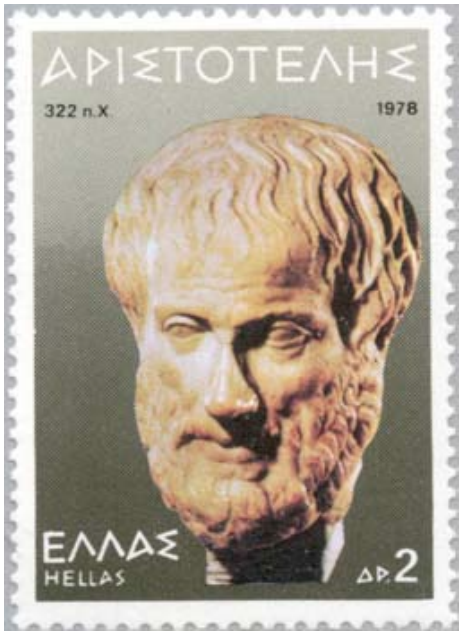

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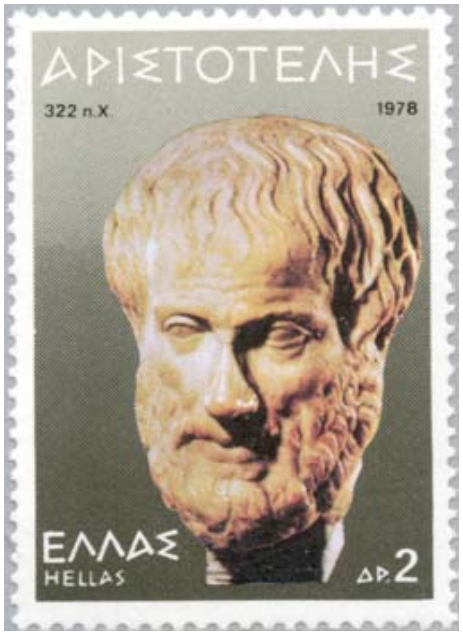

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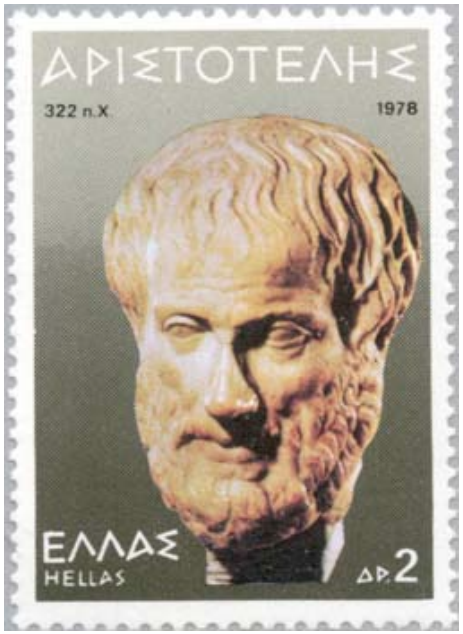

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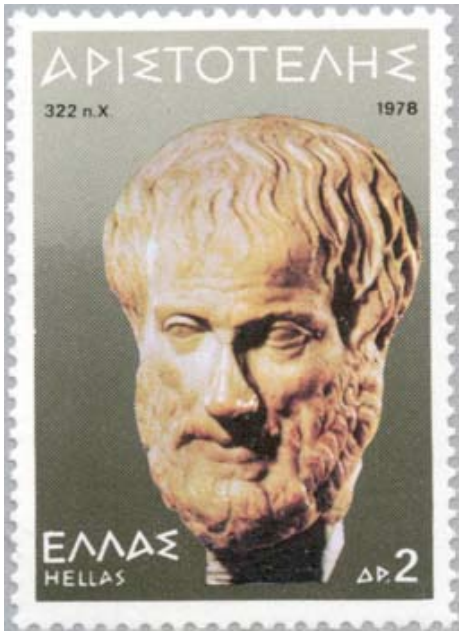

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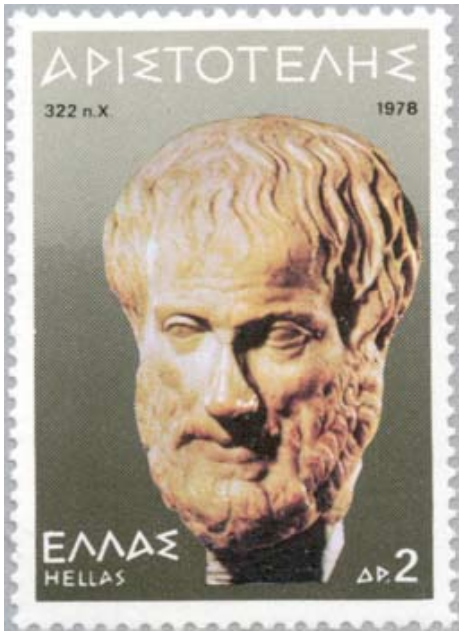

1. $P \to Q$.
2. not Q.
3. not P.

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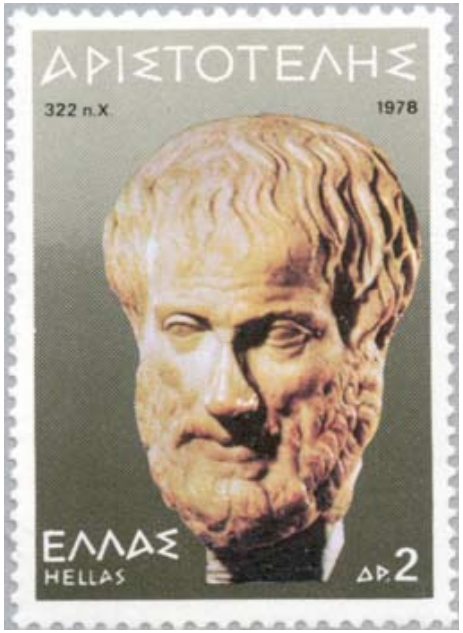
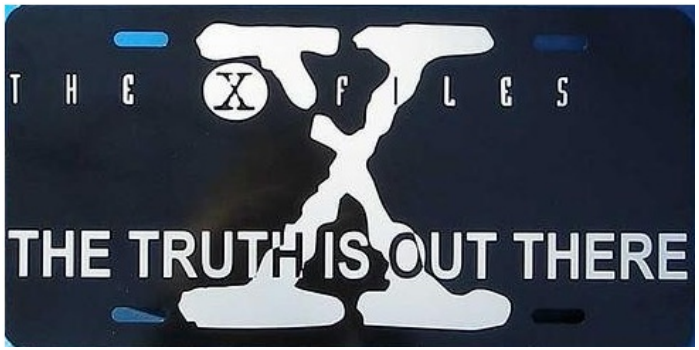


1. $P \rightarrow Q$.
2. not Q.
3. not P.

The **truth-value** of P and Q is the focus.

Classical notion of truth



Two possibilities exist: Either we are alone in the Universe or we are not. Both are equally terrifying.

(Arthur C. Clarke)

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2. Our thoughts and claims are about that world.
3. Every statement is either true or false.

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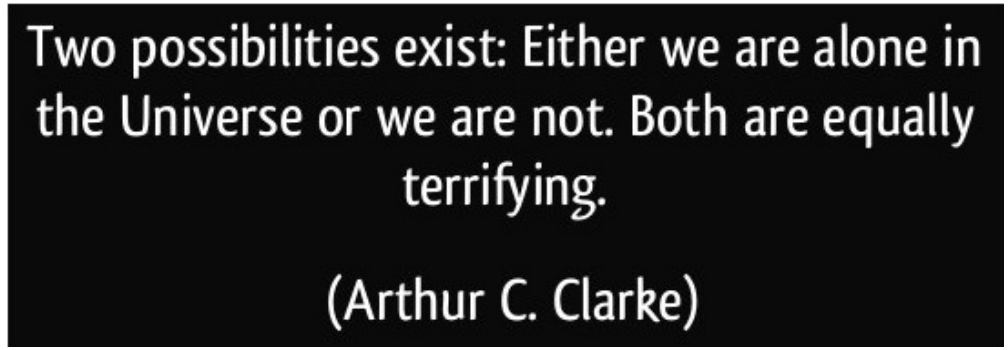

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Law of excluded middle "P or **not** P" is true in classical logic.

O Tell Me The Truth About Truth

Is it sharp or quite smooth at the edges? [...]
Does it only like Classical stuff?

W.H. Auden

What if, rather than out there, **we look for truth here among us?**

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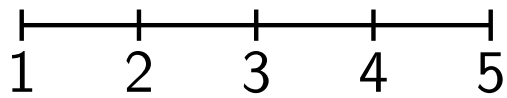
Example 1: "Nice weather, isn't it?"

5 degrees of agreement in evaluation forms:



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Example 1: "Nice weather, isn't it?"
Example 2: Jurisprudential truth

6 verdicts in Italian criminal trials:
5 mutually incomparable types of acquittal

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Example 2: Jurisprudential truth
Example 3: Scientific truth

3 outcomes in medical diagnostics:
hypothesis confirmed, refuted, inconclusive evidence

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Truth as social construction

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In all these contexts, classical principles fail

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Example 2: Jurisprudential truth

Example 3: Scientific truth

In all these contexts, classical principles fail

1. No statement about the ontological status of the world
2. Focus shifted to the **procedures** to attain truth
3. Different procedures call for **different logics**

Nonclassical logics

- Intuitionistic and intermediate logics
- Many-valued logics
- Nonmonotonic logics
- Modal and dynamic logics
- ...

Nonclassical logics

- Intuitionistic and intermediate logics

  Truth is proof
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L.E.J. Brouwer

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- Many-valued logics

Truth comes in degrees

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- Modal and dynamic logics
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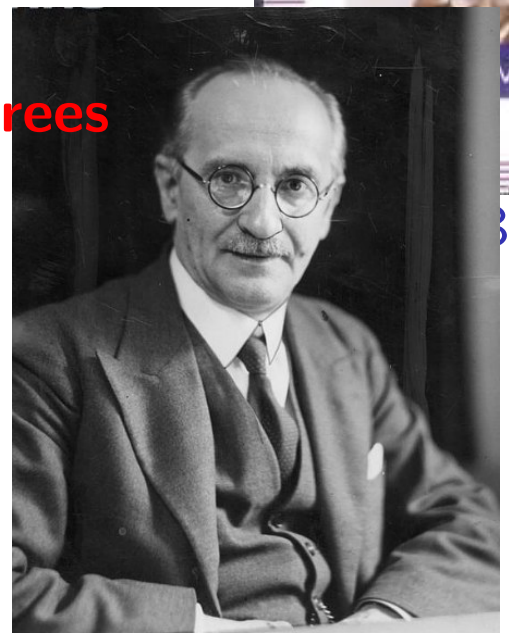

J. Łukasiewicz

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  Truth and stereotypes

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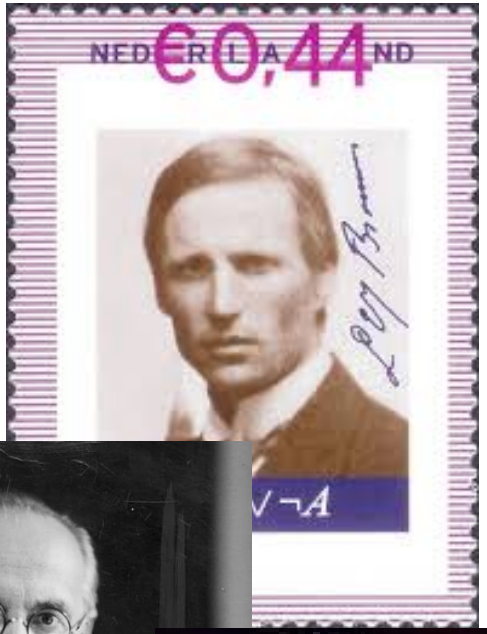

J. Łukasiewic

J. McCarthy

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  Truth and stereotypes

- Modal and dynamic logics

  Truth changes

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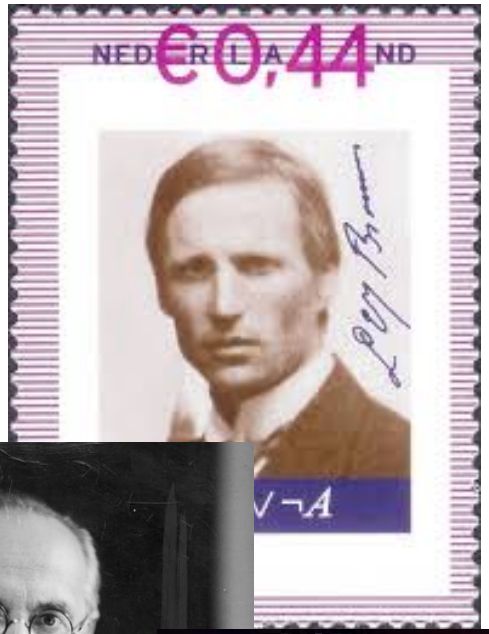

Łukasiewic

J. McCarthy

J. van Benthem

CIA's Analysis of Competing Hypotheses

"AND YE SHALL KNOW THE TRUTH AND THE TRUTH SHALL MAKE YOU FREE."
(carved in stone at the CIA headquarters)

Intelligence analysis
a problem in information aggregation:

- different degrees of reliability of sources
- different ways of interpreting evidence (even if coming from trusted sources!)
- high risk of errors

CIA's Analysis of Competing Hypotheses

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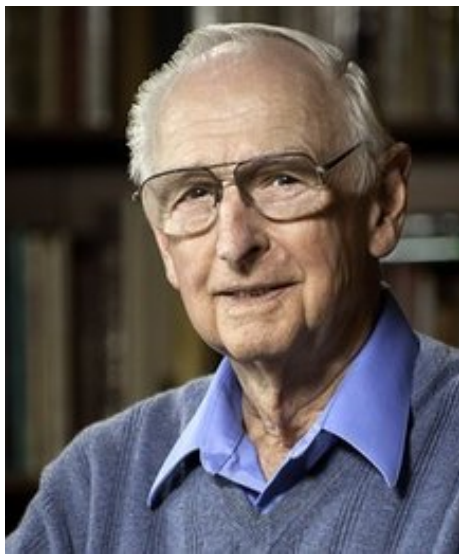
ACH: protocol to test hypotheses against evidence
Goal: refuting hypotheses rather than proving them!

- identify complete set of exclusive hypotheses,
- evaluate consistency of **evidence** with hypothesis
- assess diagnostic value of evidence.
  'Smoking gun' may be consistent with more than one hypothesis!



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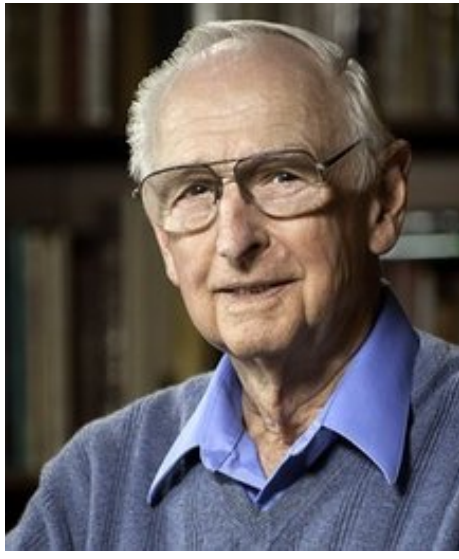

R. Heuer

ACH has been formalized using **nonclassical logics**

Software created on the basis of this formalization used by corporations, forensic analysts, journalists...

Real Option Analysis

Investing decisions of firms:

How much to invest? When to invest?

Main strategic question: How to hedge?

Design coherent investment portfolios

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Many-valued logics for quantitative decision-making!

Truth values as decisions, coherence axiomatized

References

- A.K. Dixit, R.S. Pindyck, Investment under Uncertainty. Princeton University Press, Princeton, New Jersey, 1994.
- S. Pope and A. Jøsang, Analysis of Competing Hypotheses using Subjective Logic, Proc. 10th International Command and Control Research Technology Symposium (ICCRTS'05), McLean Virginia, USA, 2005.
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