

What is an Algorithm?

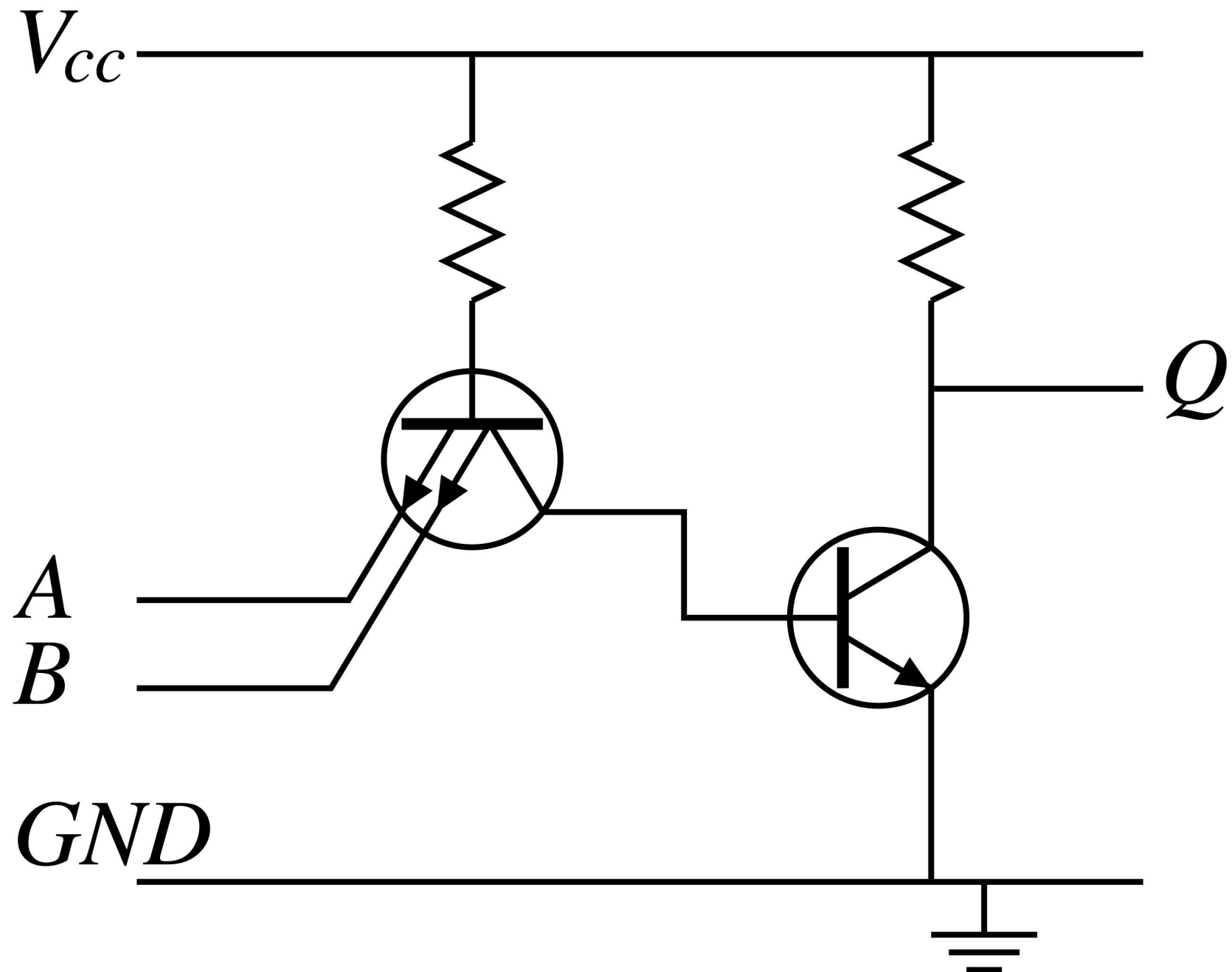
Information Analytics

Week 7

Is this an Algorithm?

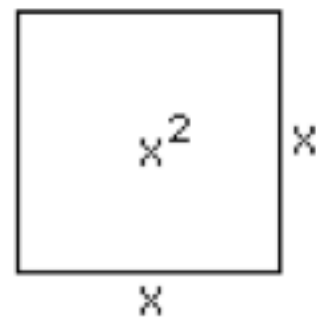
```
int main()
{
    int n = 0;
    while(n < 100)
    {
        n = n + 5;
        print("n = %d\n", n);
        pause(200);
        if(n == 50) break;           // <- add
    }
    print("All done!");
}
```

Or this?

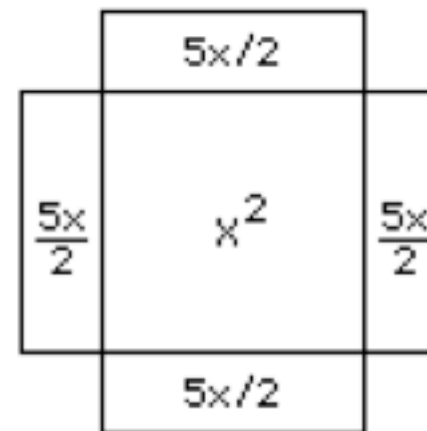


Or this?

al-Khwarizmi completes the square



①



②



③

Algorithms are very old

Have something to do with this
guy

Muḥammad ibn Mūsā al-
Khwārizmī

c. 780 – c. 850



al-Khwārizmī wrote this
book

Al-Kitāb al-muḥtaṣar fī ḥisāb
al-ğabr wa-l-muqābala

*On the Calculation with Hindu
Numerals*

Better known by its Latin name,
Algoritmi de numero Indorum





**Algorithms are as
old as Algebra**

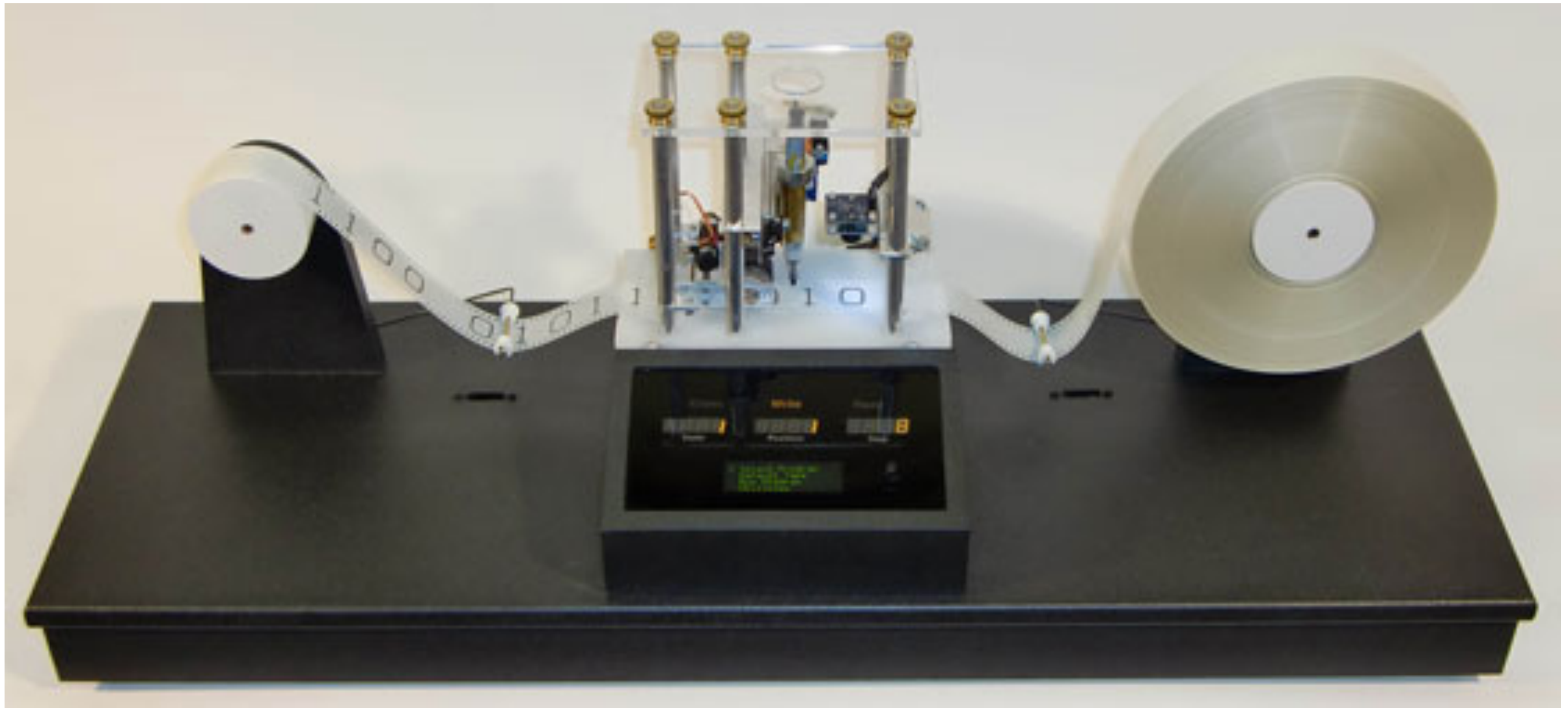
Also as old as
computing

Algorithms are as old as Algebra

Also as old as electronic computing



The Universal Turing Machine



What is an Algorithm?

An algorithm is an effective method that can be expressed within a finite amount of space and time and in a welldefined formal language for calculating a function. Starting from an initial state and initial input (perhaps empty), the instructions describe a logical process that, when executed, proceeds through a finite number of welldefined successive states, eventually producing "output" and terminating at a final ending state.

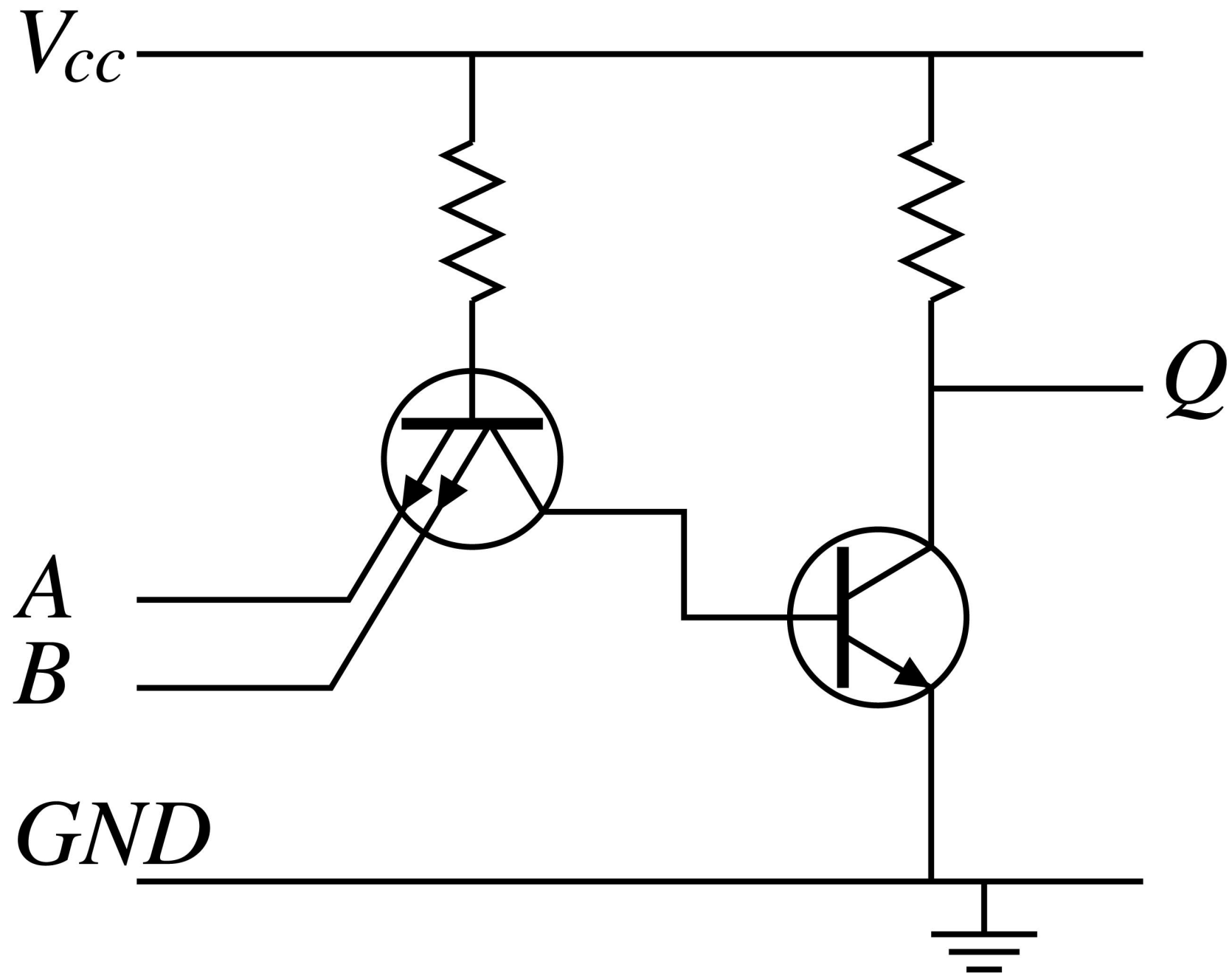
What is an Algorithm?

A self contained step by step set of instructions to be performed, that must end (at some point).

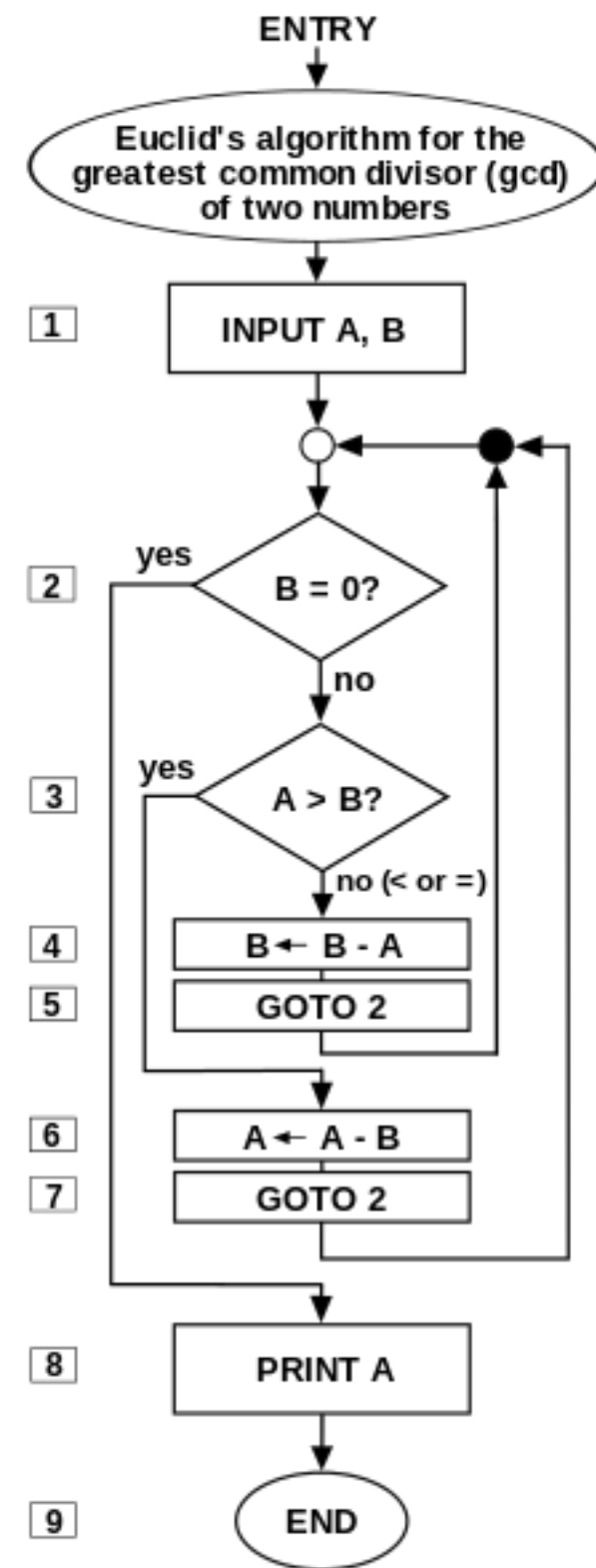
This is an Algorithm

```
main()  
  
let n = 0;  
while (n < 100)  
  
    n = n + 5;  
    print("n = %d\n", n);  
    pause(200);  
    if (n == 50) break;           // <- add  
  
print("All done!");
```

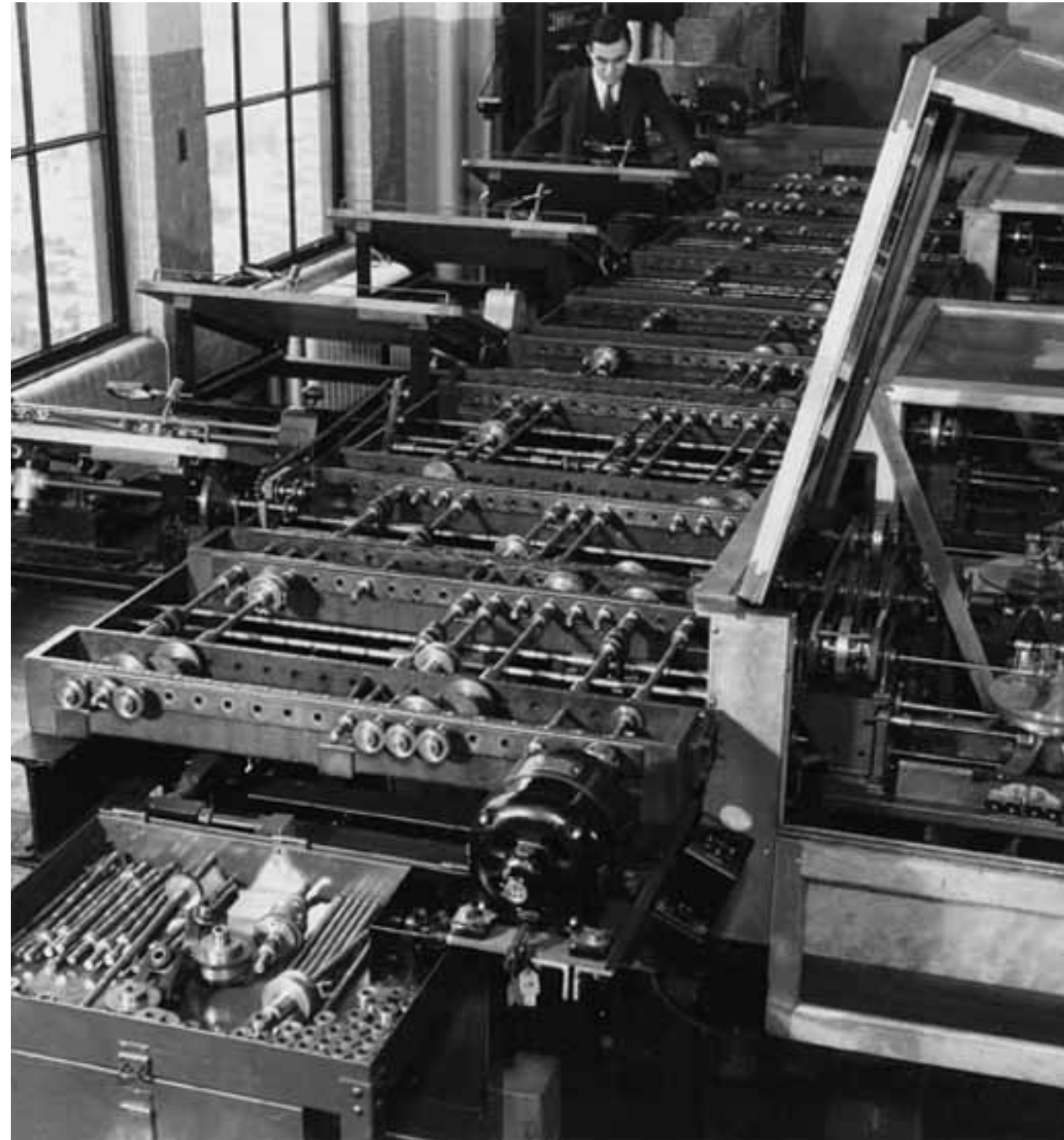
And this



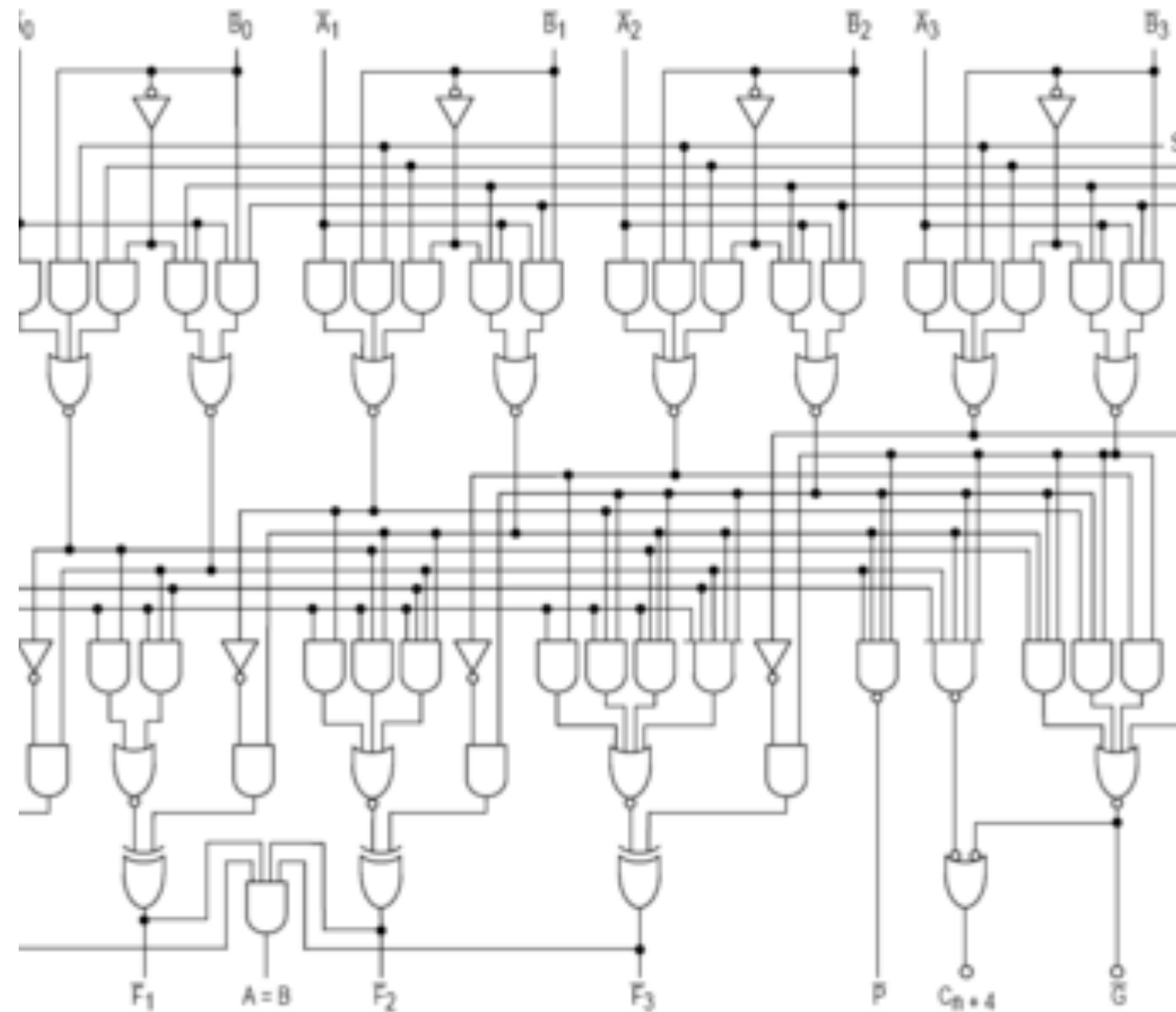
An ancient one from Euclid



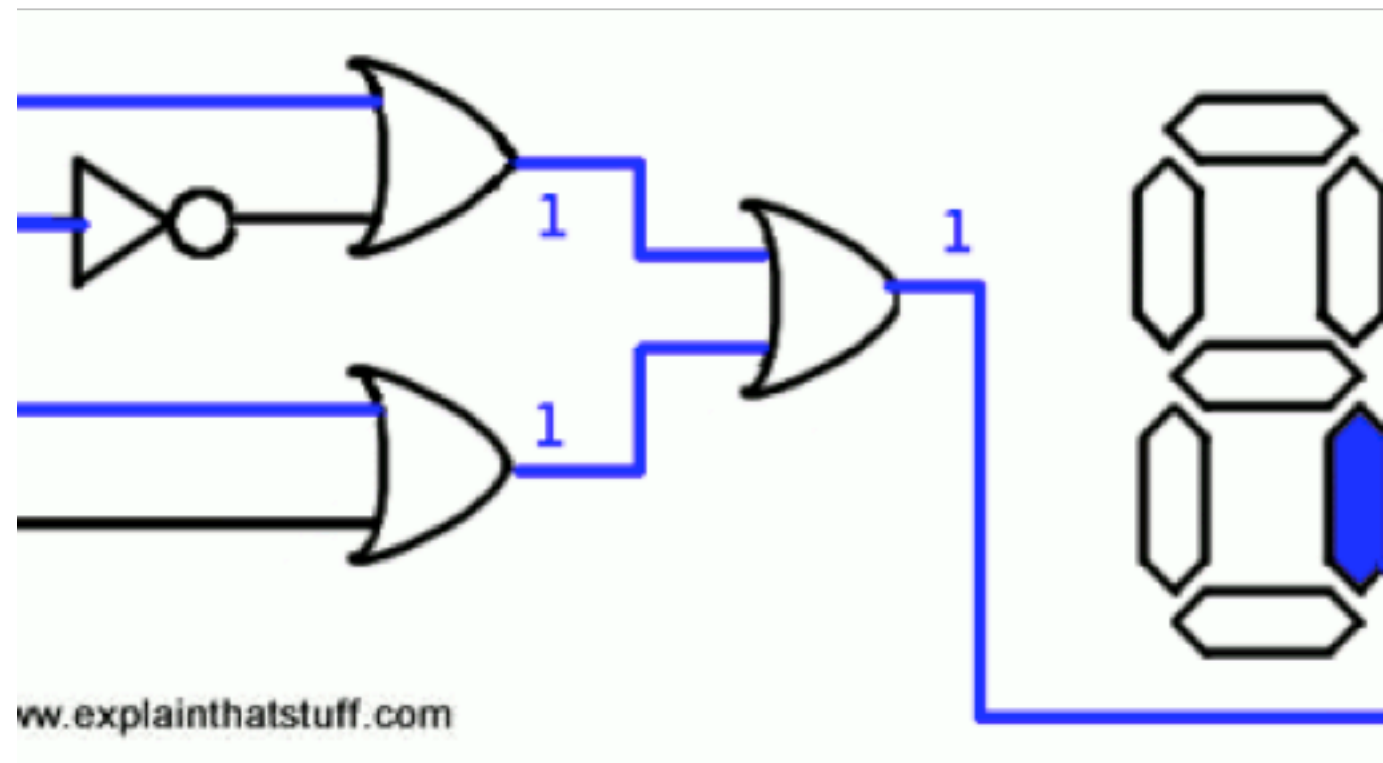
An algorithm solving computer - Analogue



Also, how all
digital
computers
work

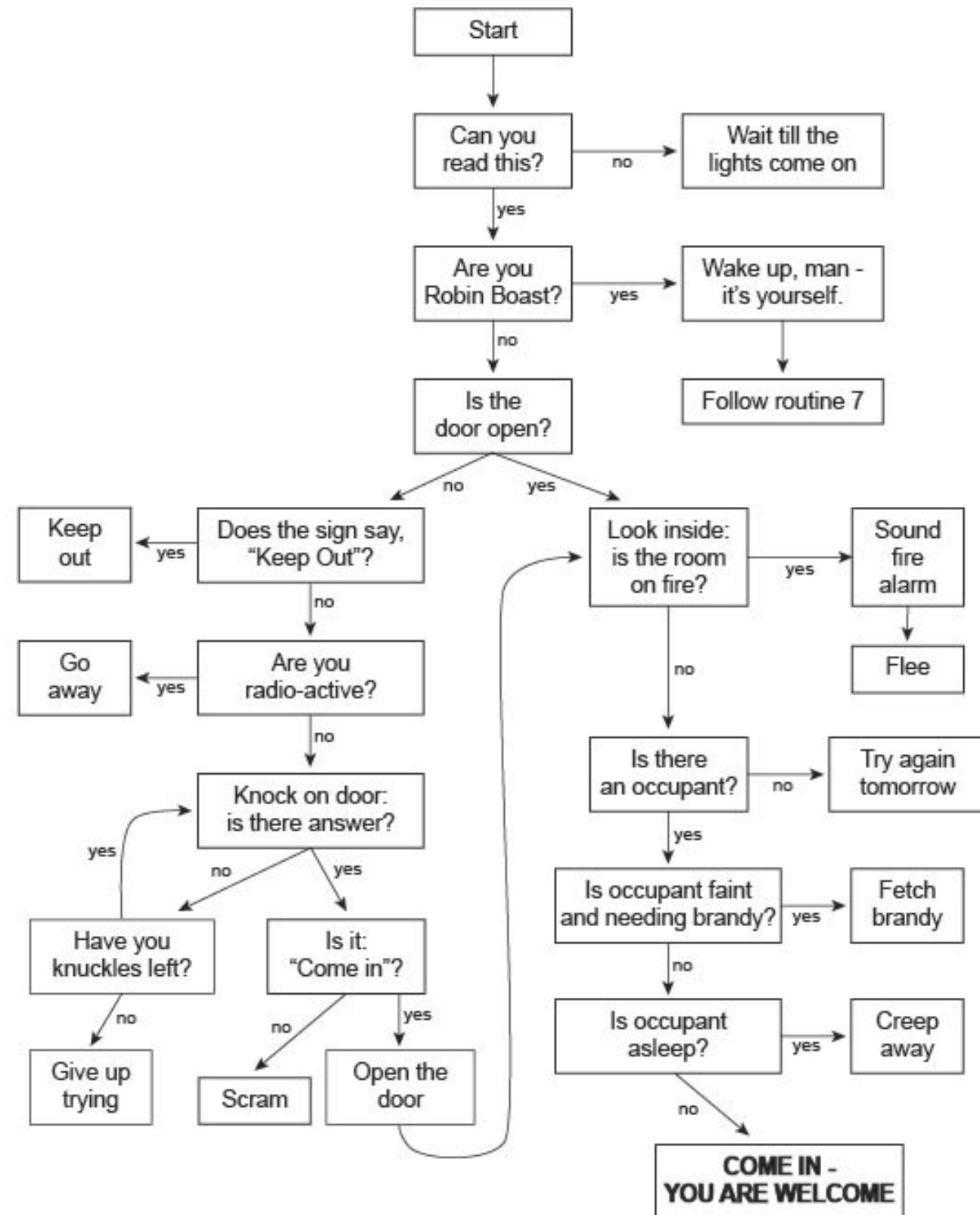


This is a bit clearer



I particularly like this one

VISITOR ALGORITHM



BREAK

What is Computational Logic?

What is Computational Logic?

Invention of AI

First Computational Logic Lab at Edinburgh University
from 1972

Metamathematics Unit at the University of Edinburgh
was renamed “The Department of Computational
Logic” in the School of Artificial Intelligence.

But Just What Is It?

Computational Logic is a wide interdisciplinary field having its theoretical and practical roots in mathematics, computer science, logic, and artificial intelligence. Its subfields include:

- Mathematical logic
- Logic programming
- Deduction systems
- Knowledge representation
- Artificial intelligence
- Methods of formal specification and verification
- Inference techniques
- Syntax-directed semantics
- The relationship between theoretical computer science and logic.

Computational Logic is, basically:

Deduction

Computational Logic is, basically:

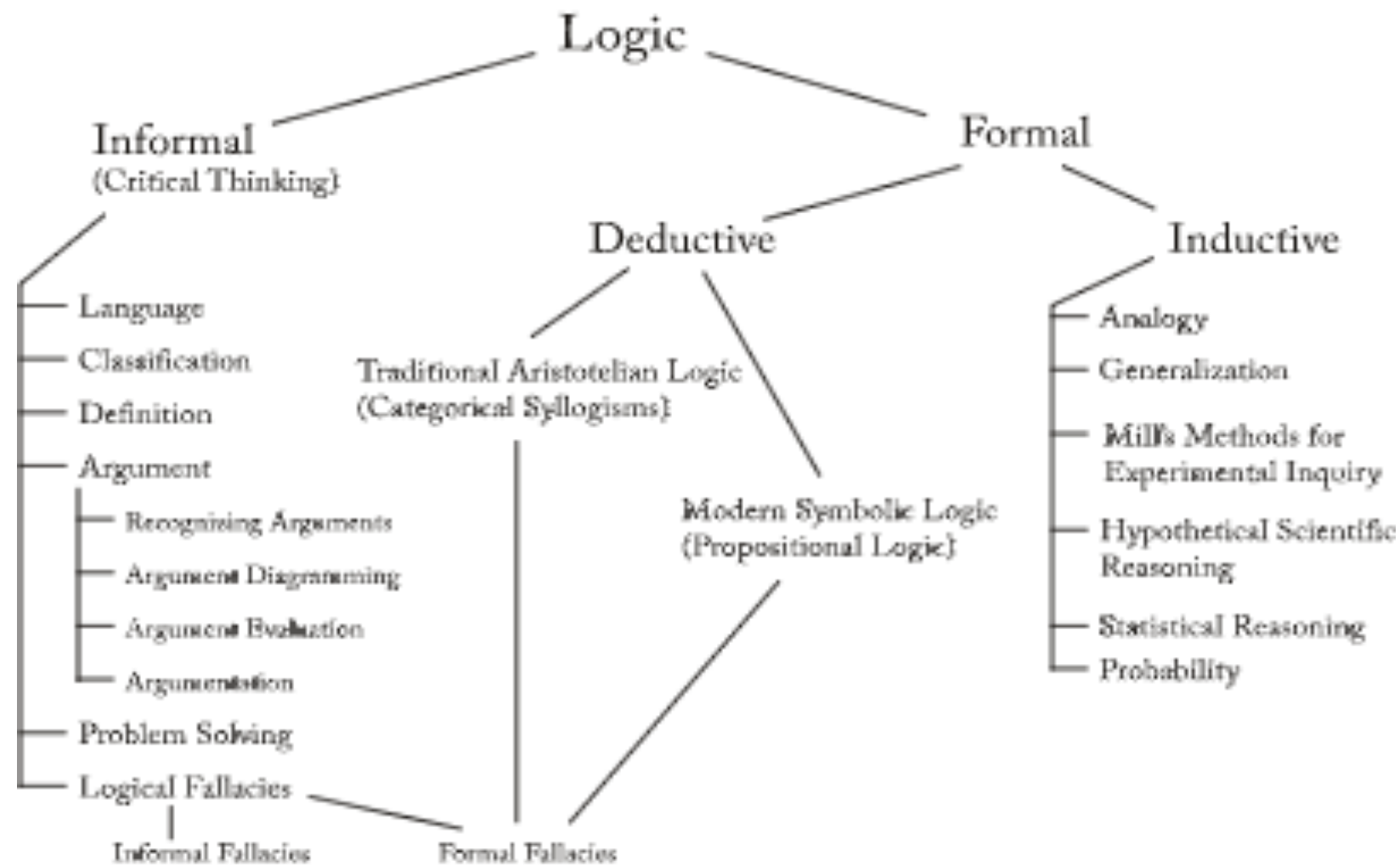
Deduction

**IF A is True and B is True, then (A,B)
is True**

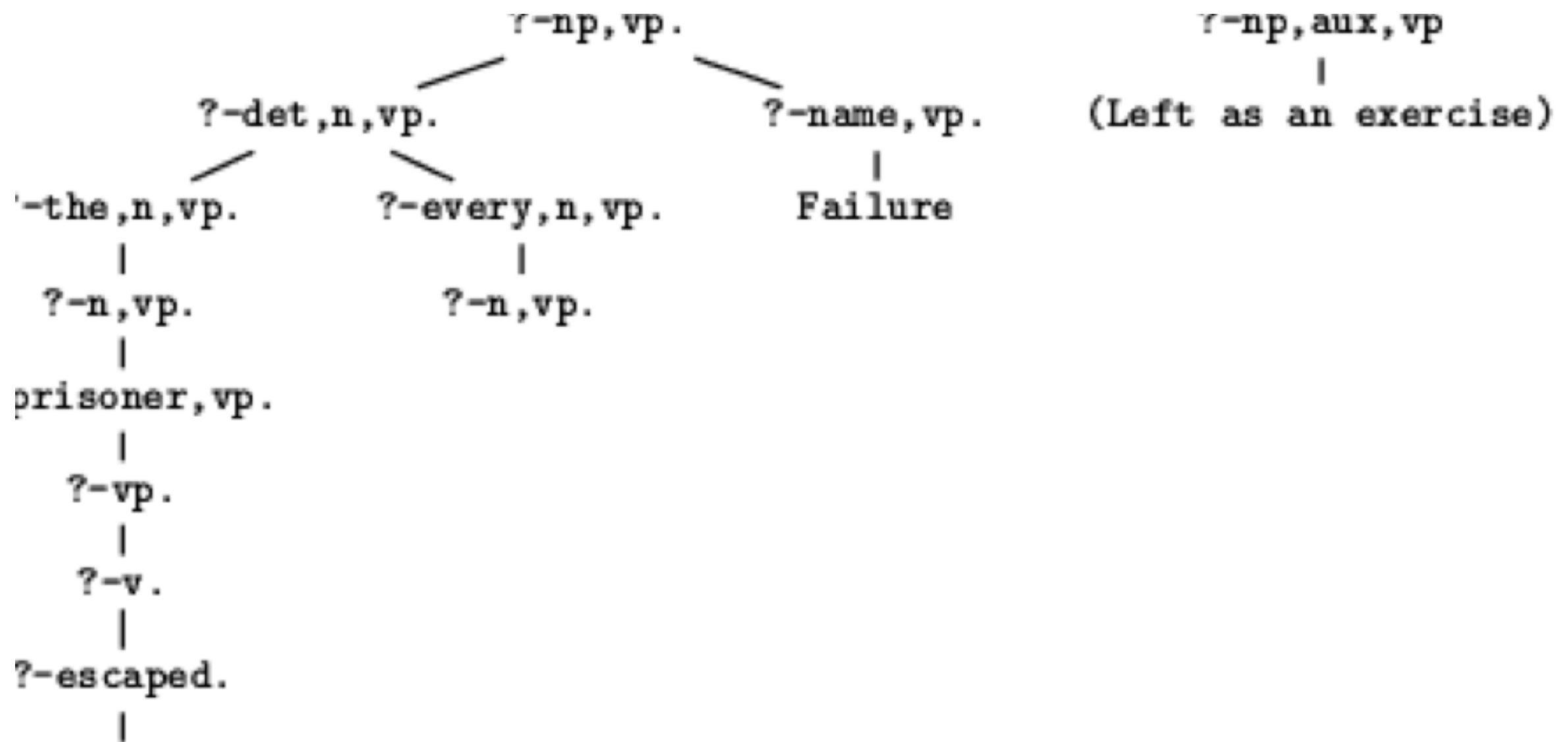
Formal Logic

This is what Formal Logic looks like

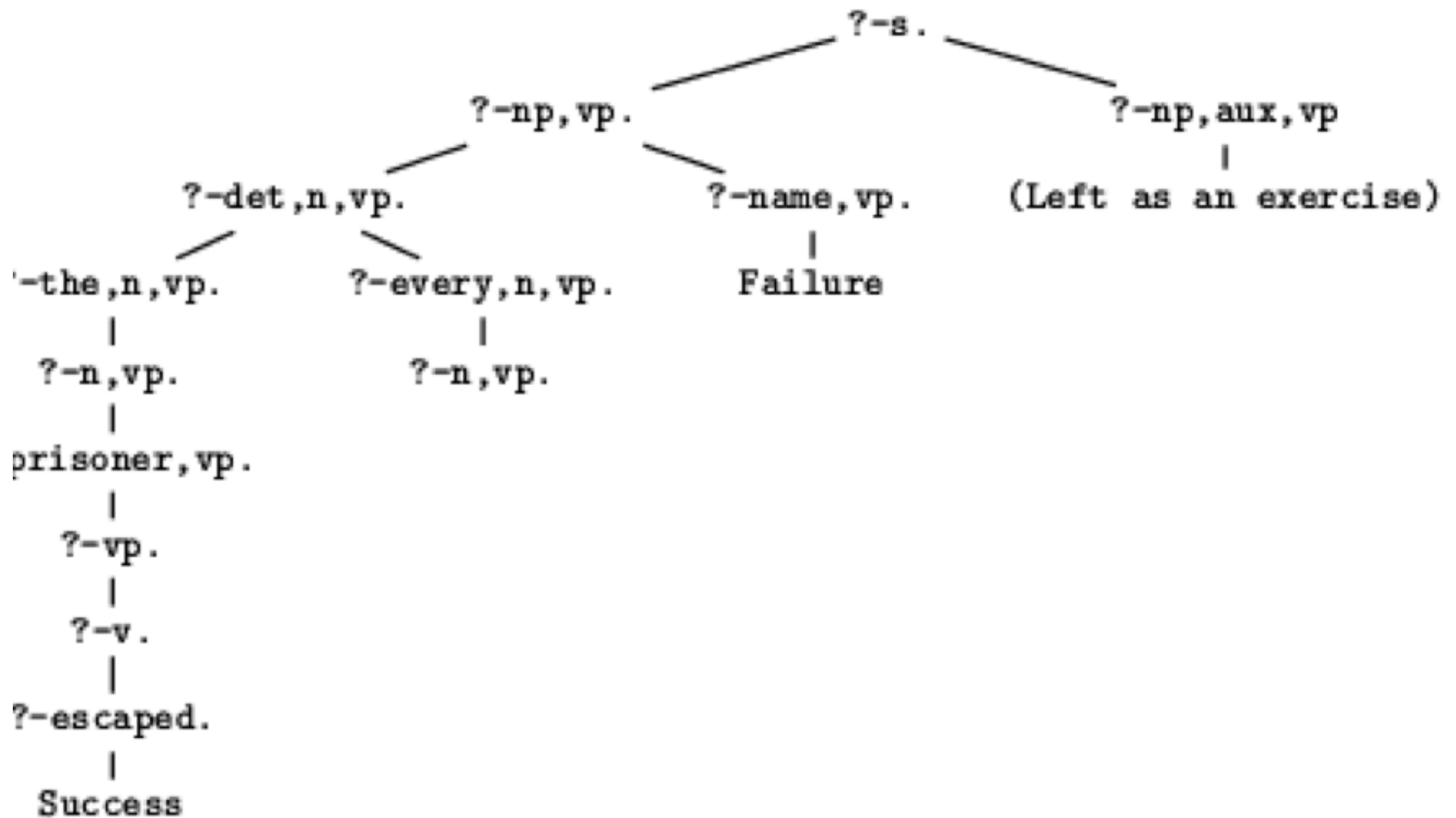
$$\begin{array}{c} \overline{\Delta, B \longrightarrow B} \text{ initial}^\dagger \\ \frac{\Delta \longrightarrow B \quad \Delta \longrightarrow C}{\Delta \longrightarrow B \wedge C} \wedge R^\dagger \quad \frac{B, C, \Delta \longrightarrow G}{B \wedge C, \Delta \longrightarrow G} \wedge L^\dagger \\ \frac{\Delta \longrightarrow B}{\Delta \longrightarrow B \vee C} \vee R \quad \frac{\Delta \longrightarrow C}{\Delta \longrightarrow B \vee C} \vee R \\ \frac{B, \Delta \longrightarrow C}{\Delta \longrightarrow B \supset C} \supset R^\dagger \quad \frac{C, B, \Delta \longrightarrow G}{B \supset C, B, \Delta \longrightarrow G} \supset L_1 \\ \frac{A \supset (B \supset C), \Delta \longrightarrow G}{(A \wedge B) \supset C, \Delta \longrightarrow G} \supset L_2^\dagger \quad \frac{A \supset C, B \supset C, \Delta \longrightarrow G}{(A \vee B) \supset C, \Delta \longrightarrow G} \supset L_3^\dagger \\ \frac{B \supset C, \Delta \longrightarrow A \supset B \quad C, \Delta \longrightarrow G}{(A \supset B) \supset C, \Delta \longrightarrow G} \supset L_4 \end{array}$$



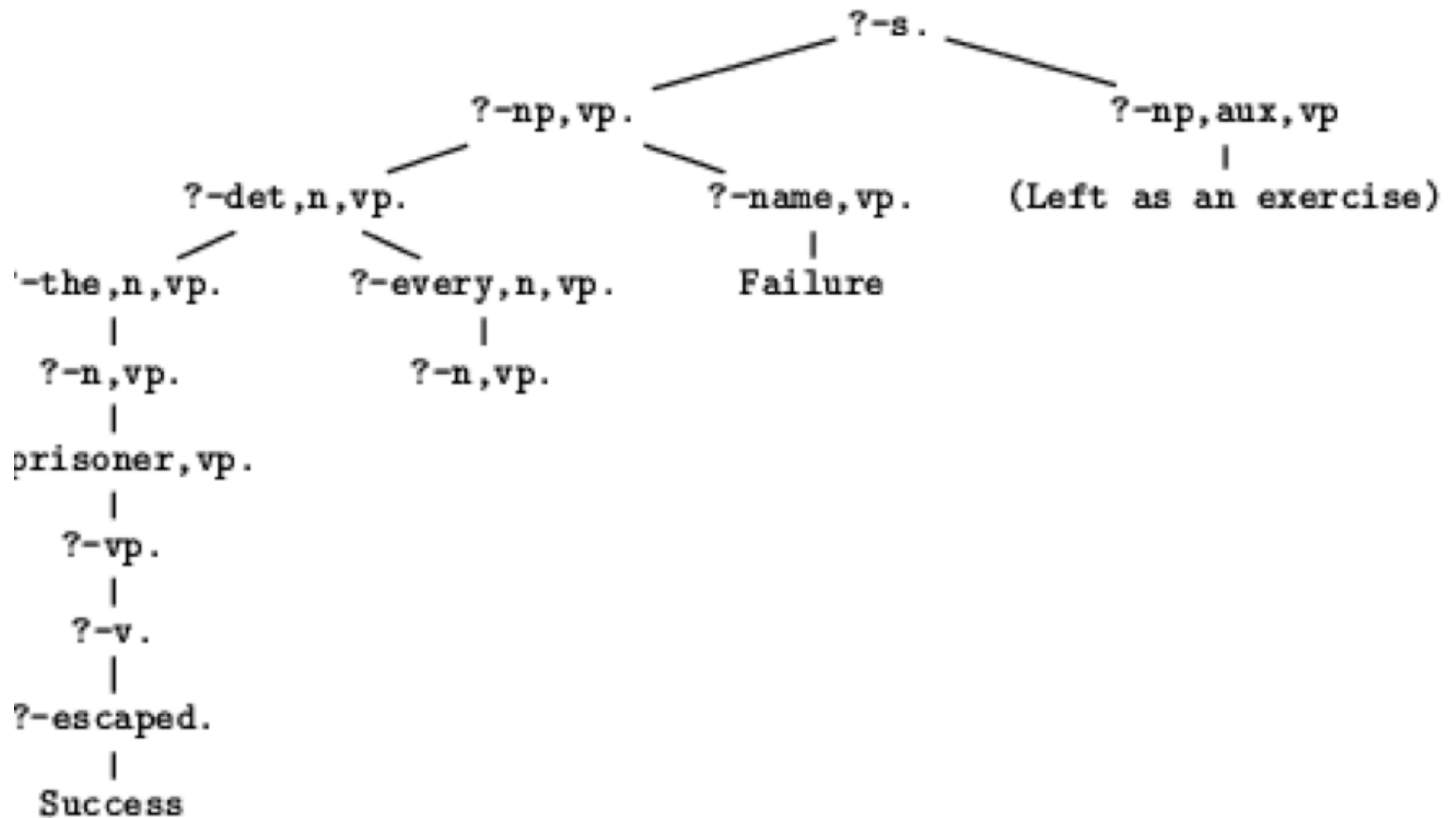
**It is geneologically organised like
this**



**You can also do proofs with it like
this**



But, what does this look like?



ALGORITHMS

Make your own algorithm

1. Break up into 4 groups
2. In your group, devise an algorithm for the following problem:
 - **How to make a cup of tea?**
 - Make sure to make it detailed, you are telling a machine how to do this
3. Write down your algorithm and present it to the class for 5 minutes