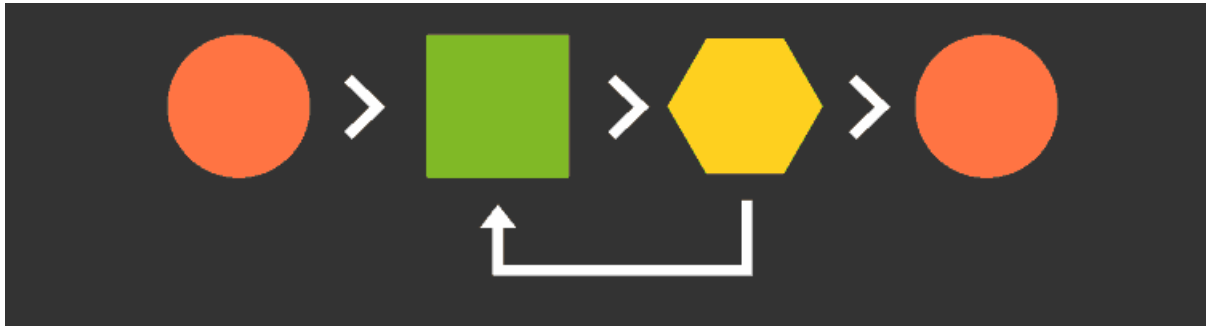
Fundamental of Computer and Algorithms



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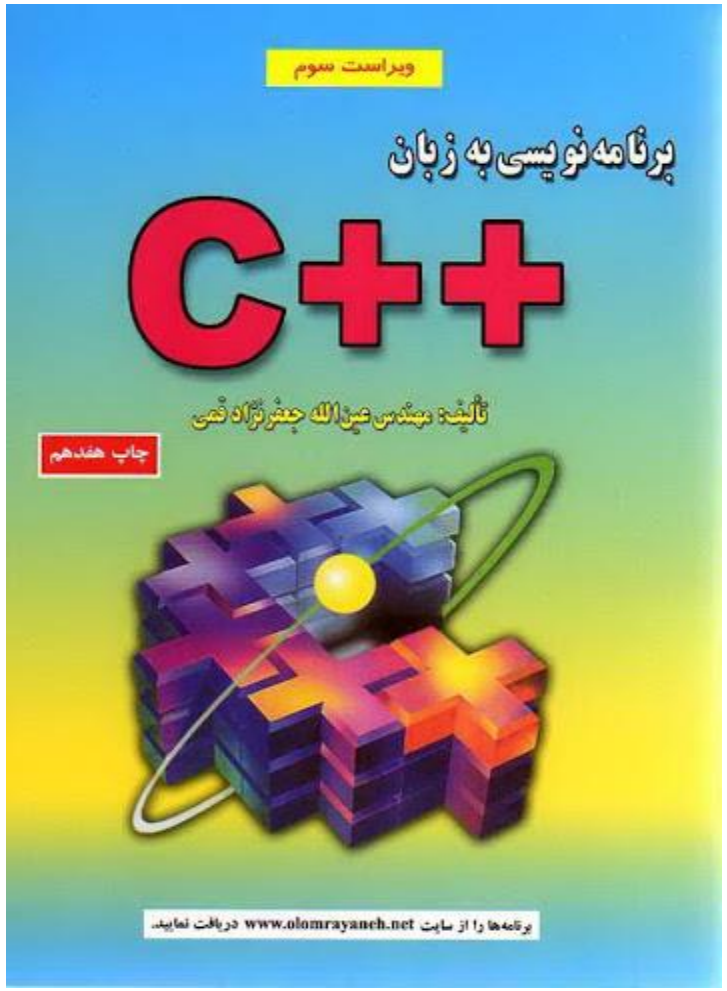
Course Overview

- Algorithms
- C++ basics
  - IDE
  - Identifiers, data types,…
- I/O commands
- if/then/else
- Loops
- Functions
- Strings
- Structures
- Link lists
- Class

Materials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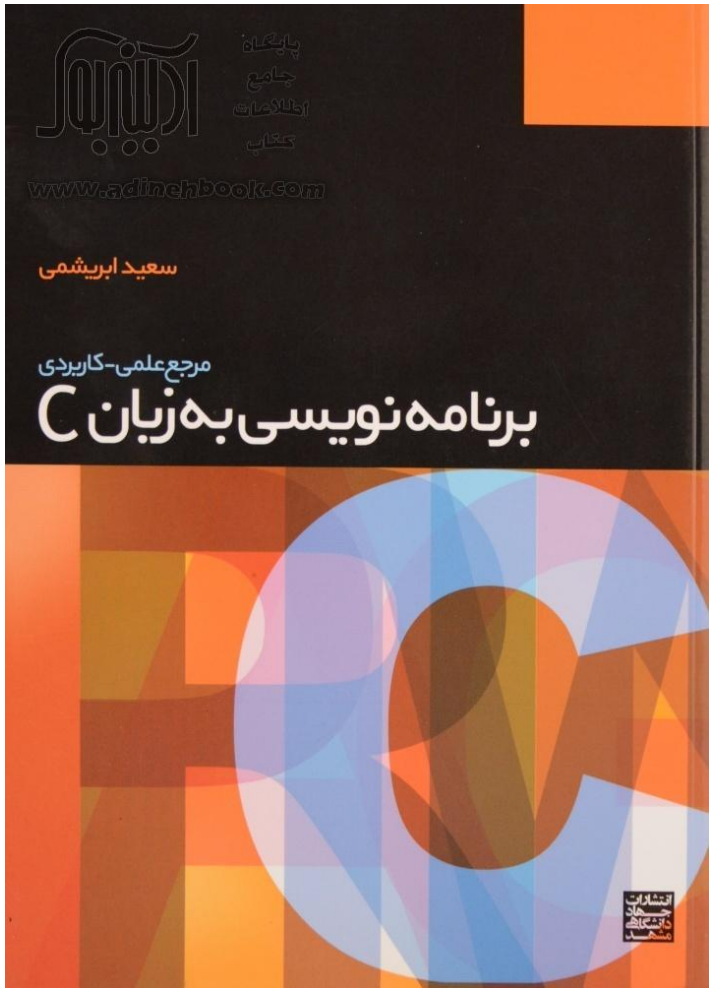
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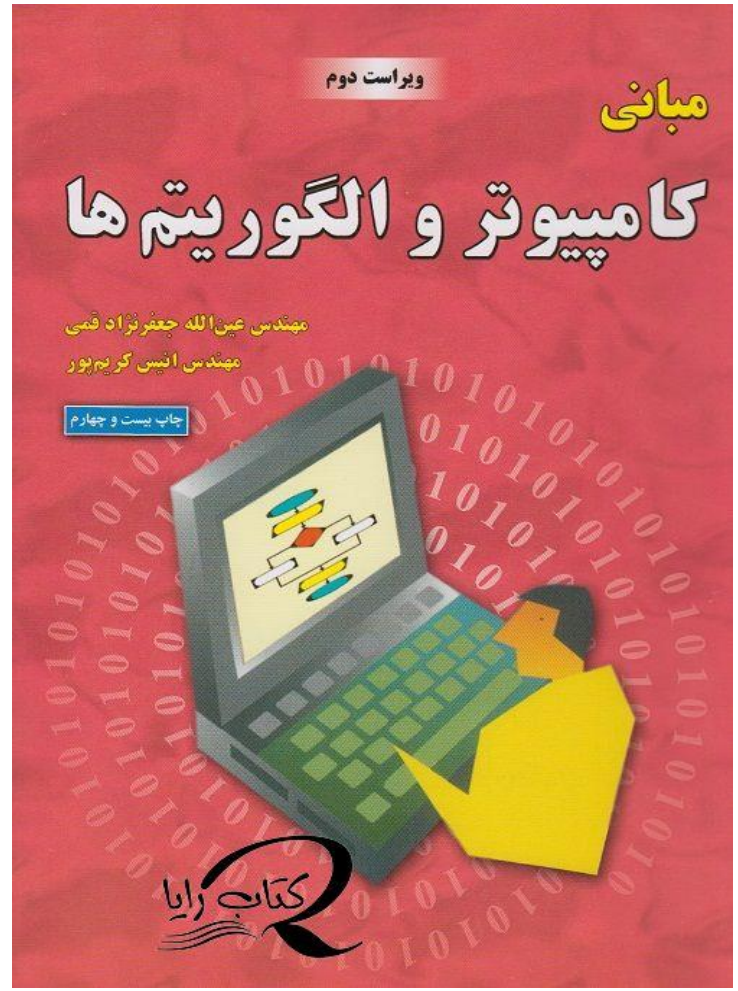
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Evaluation

- Home Works 4
- Quiz 4
- Project 3
  - It will be acceptable if your grade>=9
- Attendance 1
- Class Activity $[-\infty, +\infty]$
- Final exam 6

What is an Algorithm? – Some Definitions

Definition (found on numerous websites)

An algorithm is a set of rules that specify the order and kind of arithmetic operations that are used on a specified set of data.

Definition (Wikipedia)

An algorithm is an effective method for solving a problem using a finite sequence of instructions.

Definition (Donald Knuth)

An algorithm is a finite, definite, effective procedure, with some output.

Definition (Britannica.com)

Systematic procedure that produces – in a finite number of steps – the answer to a question or the solution of a problem.

Example Algorithm: Chocolate Chip Cookies

Ingredients

- 1 cup butter, softened
- 1 cup white sugar
- 1 cup packed brown sugar
- 2 eggs
- 2 teaspoons vanilla extract
- 3 cups all-purpose flour
- 1 teaspoon baking soda
- 2 teaspoons hot water
- 1/2 teaspoon salt
- 2 cups semisweet chocolate chips
- 1 cup chopped walnuts

Directions

1. Preheat oven to 350 degrees F (175 degrees C).
2. Cream together the butter, white sugar, and brown sugar until smooth. Beat in the eggs one at a time, then stir in the vanilla. Dissolve baking soda in hot water. Add to batter along with salt. Stir in flour, chocolate chips, and nuts. Drop by large spoonfuls onto ungreased pans.
3. Bake for about 10 minutes in the preheated oven, or until edges are nicely browned.

Essential properties of an algorithm

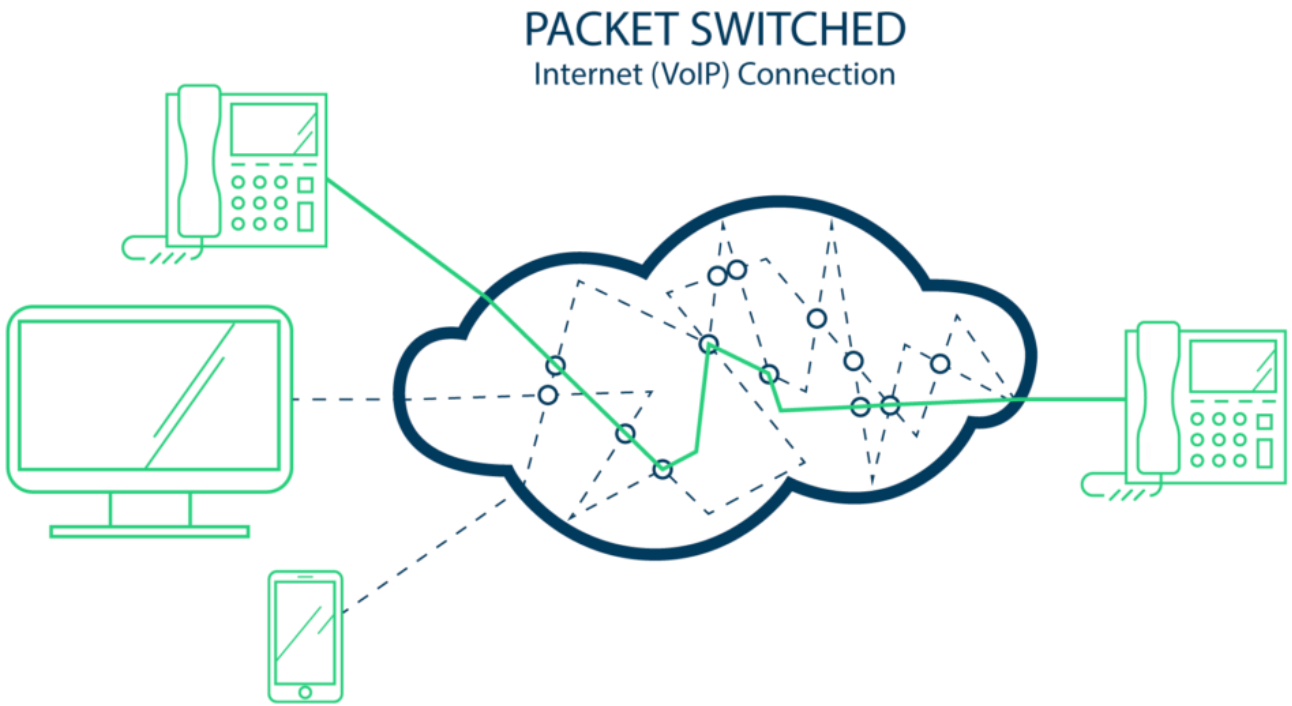
- an algorithm is **finite**
  (w.r.t.: set of instructions, use of resources, time of computation)
- instructions are **precise** and **computable**
- instructions have a specified logical order, however, we can discriminate between
  - **deterministic** algorithms
    (every step has a well-defined successor)
  - **non-deterministic** algorithms
    (randomized algorithms, but also parallel algorithms!)
- produce a **result**

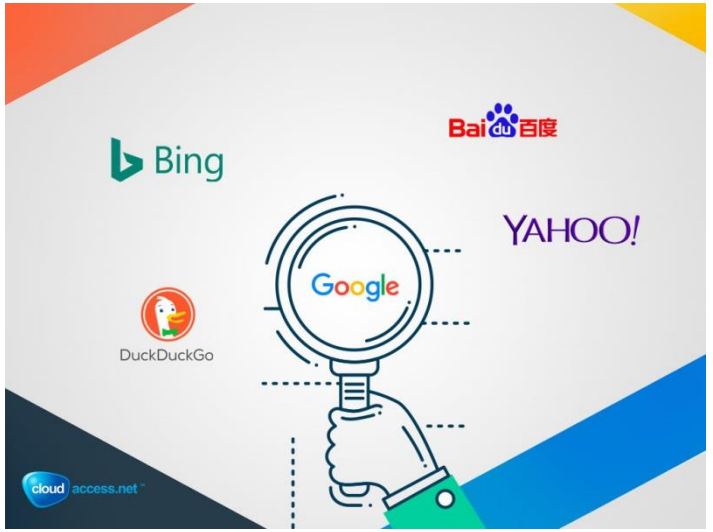
Basic Questions About Algorithms

For each algorithm, we should answer the following basic questions:

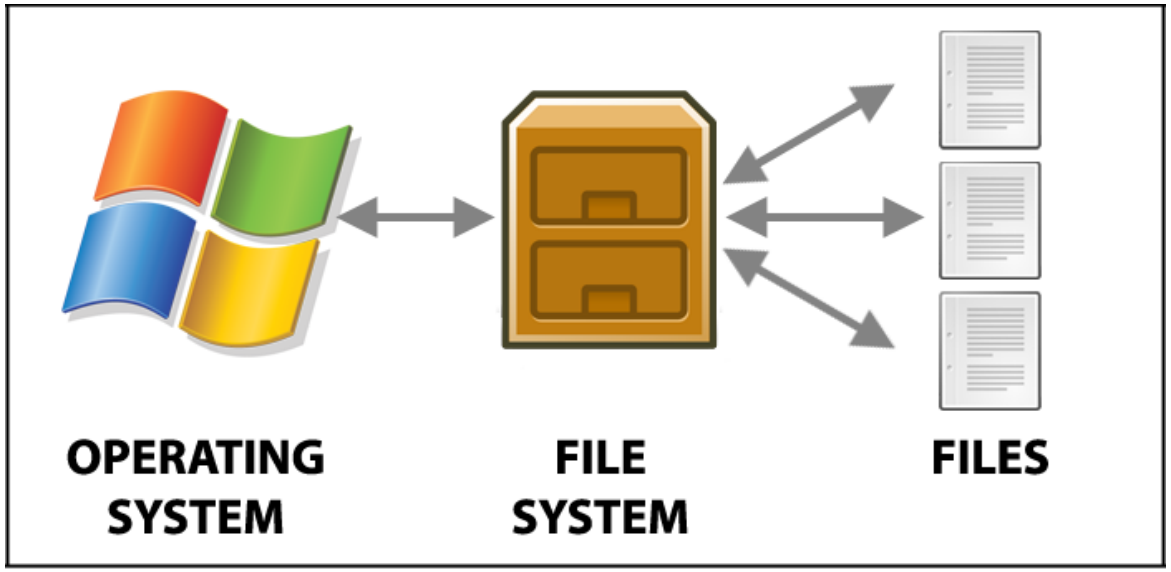
- does it terminate?
- is it correct?
- is the result of the algorithm determined?
- how much resources will it use in terms of
  - memory? (and memory bandwidth?)
  - operations?
  - run-time?
  - . . . ?

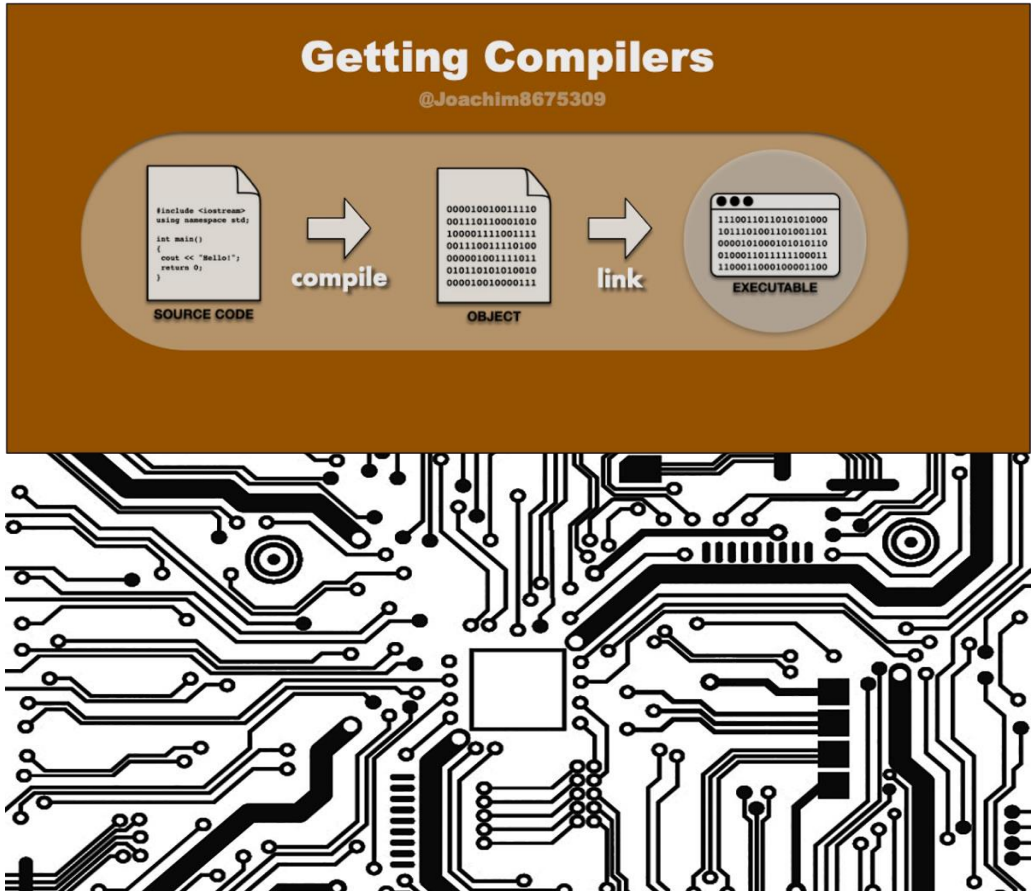
- Internet. Web search, packet routing, distributed file sharing, ...





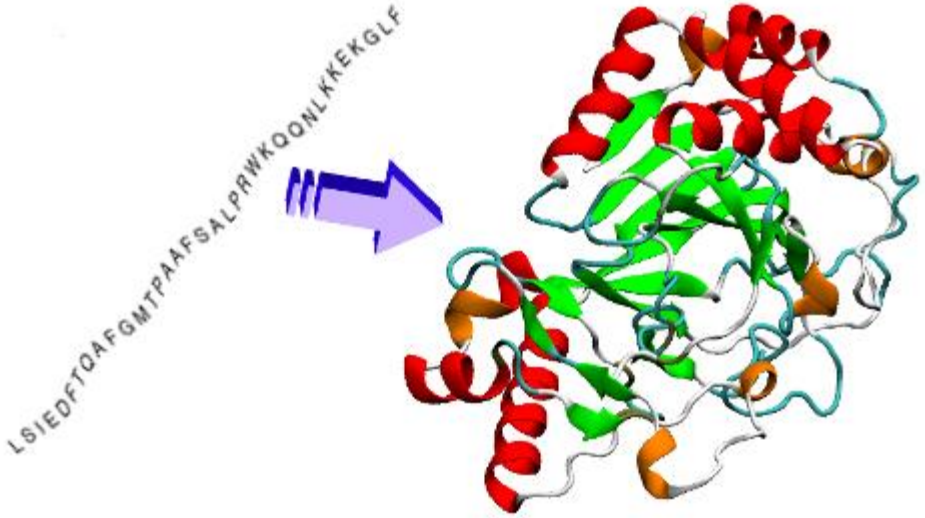
- Computers. Circuit layout, file system, compilers, …



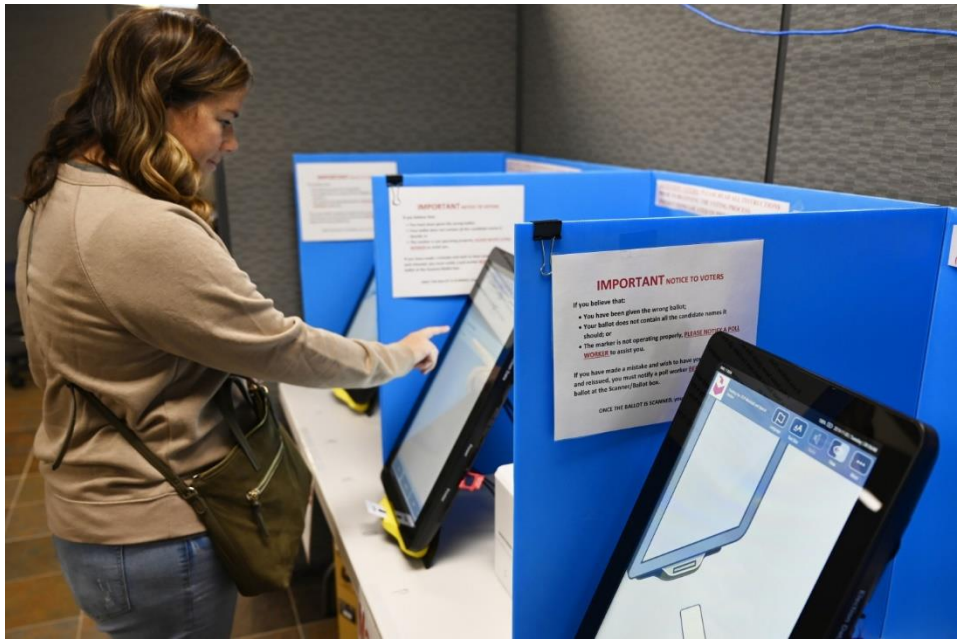


- Computer graphics. video games, virtual reality, …

- Biology. Human genome project, protein folding, …

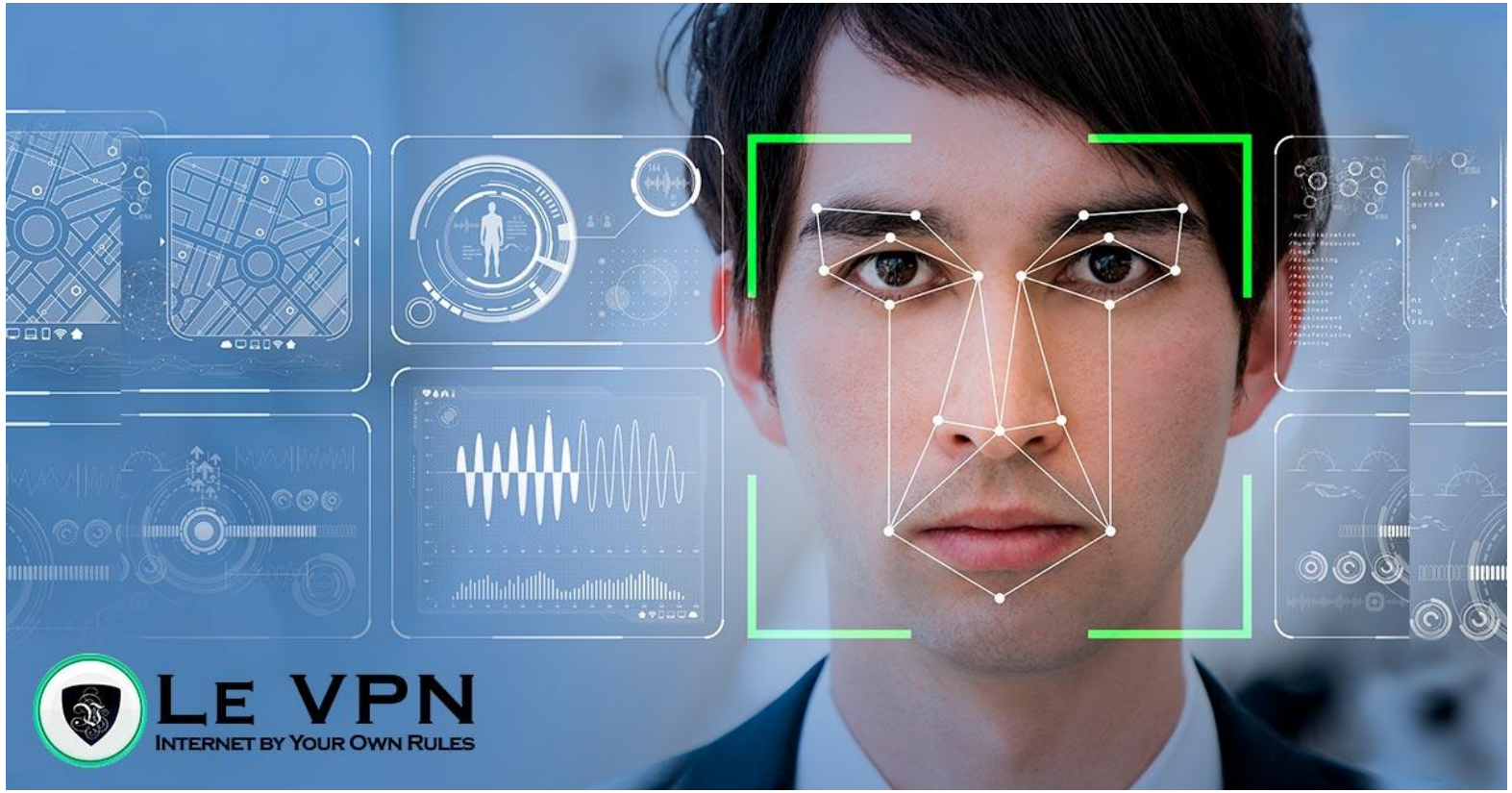


- Security. e-commerce, voting machines, …



amazon

- Multimedia. MP3, JPG, DivX, HDTV, face recognition, …



- Social networks. Recommendations, news feeds, advertisements, …