What is programming?

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Abstract

This essay is intended to answer (very briefly) to a question: *What is programming?* Although computer programs nowadays are pretty ubiquitous in nature, they remain being *black boxes of magic* for most people, even tech-savvy ones.

However, being a *black box of magic* to some extent is a requirement for some commercial software (especially when there are trade secrets involved) natural. But this essay is not intended to answer how every software works in details, but *how every software works, in general*.

Contents

1 Introduction

Basically, *everything* you do on a computer is running some program. Everything, no matter what you do is a result of executing and working with some program. Your OS[1] *is a program.* Your internet browser is a program. Your media player, file explorer, video game, media editing software, office software *are programs. Everything that allows you to interact*[2] *with computer (and not just bare metal) is a program.*

So, essentially, *what is a program?*. According to Marriam-Webster[3] definition[4] (applicable for us), we can use following as a definition:

> program is a sequence of coded instructions that can be inserted into a mechanism (such as a computer)

The gist of it being – *sequense of instructions.* So every interaction we can possibly have with a computer is somehow just a set of instructions. But *how computers do understand out instructions*? If I just shout into the microphone some command, computer will not just do as I say[5]. The same effect will have some instruction that I carefully write them in some text document, using Microsoft Word, for example.
How do I make computer to understand what I want from it? To understand this, *we must first understand what is a computer.*

[1] Operation System - Windows, Linux-based, MacOS, Android, iOS etc.

[2] Interaction with a computer here and on will not take physical interaction with a bare metal in account

[3] Here and on Marriam-Webster dictionary is referred to as a 'general-scope' dictionary to avoid technical details redundant for this essay

[4] https://www.merriam-webster.com/dictionary/program

[5] Provided, there is no running program, responsible for such behavior

2 What is Computer?

2.1 It's all about information

Let's once again refer to Marriam-Webster dictionary for a *computer* definition[6]:

> computer is a programmable usually electronic device that can store, retrieve, and process data.

So, a computer directly tied to all sorts of *data maniplation*. But what is data, and how can it be manipulated? Data is pretty much any factual information. Weather outside a window? Data. T-Shirt you're wearing? Data. Dusty books in my shelves? Data. But there are a certain layers present. The fact that I'm wearing a T-Shirt is data (even if I'm not – also data). What color it is is also, most certainly data. Is there any text or image present? Both the existence and *information* in it – also data. Let's also not forget about colors, sizes, fonts. We are living and have always lived in an enormous ocean of data. Nowadays, with our technology even more so.

But do we have use for this data? Well, the answer is – it depends. To assess data without well-defined goal will almost always result in you drowning in said data without much progress, since world offers us practically indefinite source of it. We must put our data into some perspective, some context. Once we put our data in some context and it becomes *useful* for us, *it becomes information*.

> To somehow navigate in this world, we must put our data in context. Data with given context becomes somewhat useful. Such data called *information*.

Information is much more well defined than data. *We can measure information, actually*. We even have a science discipline, called *Information theory*, that researches all about information, from mathematical and engineering standpoint. Not only that, but we have an entire industry, called *Information Technologies* built entirely on a foundation provided by Information theory and adjacent disciplines.

But until we dwell into technical stuff, we must also remember, that *we used to operate with information*. Our brain is a natural computer, disecting data into information that we use in our everyday life. How come I am so sure to call that information and not just raw data? Well, that greatly depends on a scale, but *our brain have very defined goals*. One of the main said goals being to *keep us alive*. Therefore there is a context, and brain will always tend to categorize things (organize data) based on this goal[7], making it somewhat useful, therefore making it an *information*. Even the simple fact, that we don't notice our noses, although our eyes do see it constantly, tells us how natural brain is in working with information.

[6] https://www.merriam-webster.com/dictionary/computer

[7] If your goal at the moment being something more specific, than just stay alive, many of the information brain gives you still raw data

So, being a natural organic computer, we must first understand what we do with information, to have insight on what computers do with information. All processing of information, our minds in work is mostly an internal process. *Sooner or later there is a point, when we must exchange said information.* So, how do we exhange it? We have an enormous number of ways, actually. We can say something to another person, write it down, pass via somebody a note, we can just hint at something. We can send message in a messenger, send an email, send a radio-signal, we can knock a Morse code. *We are practically limitless with one major nuance – the other side must be able to understand us.* There is no point in sending email to a person, who can't use it[8].

We now can conclude one fundamental distinction: information itself is mostly independent from it's carrier. To demonstrate it more clearly, let us consider following example: I want to send information to my friend at the table, with the main message being *'pass me salt'*. There is definetely a context: we are at the table, eating food, there are at least two parties involved (me and my friend), and I expect salt to exist somewhere at the table. I can pass this information with a various number of ways, provided my friend understands me. Just to mention a few:

- Say to him 'pass me salt'
- Ask him to pass me salt in other language, he is familiar with
- Write a note to him 'pass me salt'
- Write a note in foreign language, he is familiar with
- Get his attention and non-verbally point at salt
- Write him a message in messenger, expecting phone to be near them
- Get his attention and use ASL or alternative, provided he is familiar with it
- Exclaim obviously 'Oh! This food will be so much better with salt! I wish somebody passed it to me now', provided he understood our hint
- Rhytmically knock with Morse code, provided he understands it

In all aforementioned examples we can clearly see, that the gist of our 'message' stayed the same. *We did pass a more or less the same information* in each and every case. Despite the medium being completely different, if our friend can undestand us, nothing really changed for him or us. In such cases the 'main message' containing an actual useful information we are willing to exchange usually colloquially called a *'payload'*. However, despite our 'payload' being virtually the same, we did pass some additional information (or data – depending on context) along the way, didn't we?

[8]In general. Sometimes we are interested only in sending information, not concerned by an actual delivery. Some legal procedures can be of an example

Let's use an above list one more time, but will provide additional few details, just for example:

- Say to him 'pass me salt'
  - In what voice tone?
  - How loud did we ask?
  - What face expressions followed along our request?
  - Was there any gesticulation involved? How intense?
  - In what speed we asked?
- Ask him to pass me salt in other language, he is familiar with
  - What language?
  - Was there any context in using this language?
  - In what voice tone?
  - How loud did we ask?
  - What face expressions followed along our request?
  - Was there any gesticulation involved? How intense?
  - In what speed we asked?
- Write a note to him 'pass me salt'
  - What font did we use?
  - Is it hand-written?
  - Font color?
  - Font size?
  - Paper type?
  - Paper size?
  - Was paper plain white, or was it with pictures?
- Write a note in foreign language, he is familiar with
  - What language?
  - Was there any context in using this language?
  - What font did we use?
  - Is it hand-written?
  - Font color?
  - Font size?
  - Paper type?
  - Paper size?

  - Was paper plain white, or was it with pictures?

- Get his attention and non-verbally point at salt
  - Were we mumbling at the same time?
  - How we got his attention? Tapped his shoulder? How strongly?
  - How did we point? With a finger, palm, node?
  - What face expressions have we used?
  - How fast did we do it?

- Write him a message in messenger, expecting phone to be near them
  - Have he seen us typing a message?
  - How fast he reacted?
  - Was there any notification
  - Did we send an emoji?
  - Did we send some attachment?
  - We sent one message or several?
  - Did he read it?

- Get his attention and use ASL or alternative, provided he is familiar with it
  - How exactly did we phrase our request? By letters or by gests?
  - How fast did we transmit?
  - We followed along with our lips?

- Exclaim obviously 'Oh! This food will be so much better with salt! I wish somebody passed it to me now', provided he understood our hint
  - What intonation did we use?
  - How loud did we say it?
  - Where to did we look?
  - Do we have any specific accents?
  - Was there an emphasis on some words?

- Rhytmically knock with Morse code, provided he understands it
  - What period of time we used as an interval?
  - Did we repeat our message? How many times?
  - On what surface did we transmit?
  - Did we use our knuckle? Spoon? Knife?

So, we can conclude, that despite our *payload* being practically the same, we did pass additional information along with it. To put it into perspective, It's somewhat similar, as if we were asked to describe an envelope, it's size, stamps on it and additional notes, ignoring the payload, being a letter inside said envelope. Such auxiliary information, which is more often than not isn't of our interest, however *can be useful in certain scenarios*. Such data usually describe optional information aboout the *payload* itself, or details of how it was delivered. Such data usually called *metadata*

> The information itself, that we wish to store or exchange colloquially called a *payload*. Some additional details, that might be useful, regarding that information, but not tied to it directly usually called *metadata*

Let's say, I am writing a document in Microsoft Word. The *payload* here being anything, I typed directly in this document. However, once I saved it, not only the document itself was saved, but also a bunch of additional *metadata*. It can include date of the document creation, author[9] of the document, last save date, last print date, etc. *The same logic is applicable for virtually any file you've ever created*. [10]

[9] Usually currently active user on OS level

[10] Sometimes, ability to control metadata becomes crucial to save sensitive and personal information. Some professions can put you in physical danger, if you're not cautious enough

2.2 You can't manage what you can't measure

2.3 Countess, calculators and weaving patterns

2.4 But can it speak?