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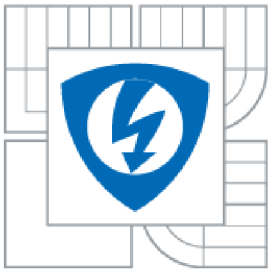

FAKULTA ELEKTROTECHNIKY A KOMUNIKAČNÍCH TECHNOLOGIÍ
ÚSTAV JAZYKŮ

FACULTY OF ELECTRICAL ENGINEERING AND COMMUNICATION
DEPARTMENT OF LANGUAGES

TECHNICKÁ TERMINOLOGIE V KAŽDODENNÍM ŽIVOTĚ

TECHNICAL TERMINOLOGY IN EVERYDAY LIFE

BAKALÁŘSKÁ PRÁCE
BACHELOR´S THESIS

AUTOR PRÁCE
AUTHOR
PAVEL DOLNÍČEK

VEDOUCÍ PRÁCE
SUPERVISOR
PHDR. MILAN SMUTNÝ, PH.D.

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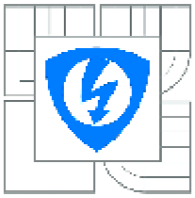

VYSOKÉ UČENÍ TECHNICKÉ V BRNĚ

Fakulta elektrotechniky a komunikačních technologií

Ústav jazyků

Bakalářská práce

bakalářský studijní obor
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Student: Pavel Dolníček ***ID:*** 145988
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Vedoucí práce: PhDr. Milan Smutný, Ph.D.
Konzultanti bakalářské práce:

doc. PhDr. Milena Krhutová, Ph.D.
Předseda oborové rady

UPOZORNĚNÍ:

Abstract

This work focuses on the history of technical terminology, its impact on everyday life and the different ways in which the history of terminology and its impact on everyday life can be researched. This work also discusses some of the limitations of such research and the probable explanations of the obtained data

Keywords

Common knowledge, history, technical terminology

Anotace

Tato práce se zaměřuje na historii technické terminologie, její dopad na každodenní život a metody, kterými lze zkoumat historii technické terminologie a její dopad na každodenní život. Tato práce se rovněž zaobírá některými omezeními takového výzkumu a pravděpodobnými vysvětleními pro získaná data.

Klíčová slova

Běžné znalosti, historie, technická terminologie

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Prohlášení

Prohlašuji, že svou bakalářskou práci na téma Technical terminology in everyday life jsem vypracoval samostatně pod vedením vedoucího bakalářské práce a s použitím odborné literatury a dalších informačních zdrojů, které jsou všechny citovány v práci a uvedeny v seznamu literatury na konci práce.

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V Brně dne ....

(podpis autora)

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Introduction

What is terminology

Terminology is an important part of linguistics as modern technology influences our daily lives more than ever before and will continue to influence them even more in the future. Terminology seeps into everyday conversations because modern day products of convenience as well as products of necessity can no longer be described properly without technical terms. The human need to label and distinguish things in combination with the desire to communicate meaning unambiguously naturally develops terminology as a practice, but the theoretical framework for terminology as a linguistic discipline has been largely overlooked and only developed relatively recently.

Many experts still regard terminology only as a practice or a means to an end and not as a separate scientific discipline. Those who do consider it a scientific discipline have managed to fulfill the basic requirements to claim such a title. Some do believe that although terminology does have a valid and separate theoretical framework, it relies too much on other scientific disciplines to create the technical terms to be called a completely separate discipline. The views on this are therefore not in a complete dichotomy, but it still leaves many people to pay terminology very little or no attention.

Cabré, one of the few experts in this field, identifies terminological units as units having special meaning and therefore any lexical unit can become a terminological unit. (Cabré, 2003) The context may also be a factor to determine whether a lexical unit carries this special meaning to be considered a terminological unit. According to Krhutová a term is a special lexical unit, creating superior inner coherence within the text, because it describes a conceptual system (Krhutová, 2009). Krhutová then describes different groups of terms based on their specificity, with the more specific terms used in texts intended for communication between professionals, because they include very specific information.

Terminology was originally developed to provide a common, multilingual and most importantly unambiguous way to communicate between professionals. The early leaders in terminology were scientists. As such the early terminology is focused more practically and fails to meet the modern requirements for claiming the title of theory. Despite that, terminology played an important role in standardizing and in communication required for the increasingly global and cooperative nature of science.

To this day, the theory of terminology carries some controversy and attracts little attention, the goal of this work is not to improve on the theoretical concepts in terminology or discuss the disputes of experts in this field of study. This work focuses on the practical aspects of terminology and instead of investigating the importance of a linguistic development, it focuses on relations between the development of the particular field of science to which a given term belongs and the use of that term outside of the professional realm.

Methods

There are two sources provided by Google which can be accessed by anyone and at any time. The first one is called Google Ngram. Google Ngram is a tool which accesses the enormous database of digitally scanned books amassed by Google and outputs the average percentage representation of a requested word in those books. For example for the word computer in the year 2000, Google Ngram outputs the value of just over 0.01% which means that the word computer makes up for more than 0.01% of all words from the books of that year that are in Google's database.

The other tool publicly accessible is Google Trends. Ever since the year 2004, Google stores the amount of times every search term was queried in each month. The way this data is public, however, is only in the terms of normalized relative value. What this means is that there are no absolute values. The graph is always normalized so that the highest value is 100 and the rest of the graph or other graphs are scaled accordingly. Therefore there is no way to find out what percentage of total search queries takes up the search query under investigation. It is still possible, for example, to input two search terms and see that one of them has double the amount of search queries in a specific month. If a search term takes up for example 0.0001% of all search terms during its peak, that 0.0001% will be shown as a 100 in the graph, but at a different time, this term would take up 0.00008% and that

would show as 80 in the same graph. In the same way if a different term is in the same graph and its peak reaches the value of 0.00005% the graph would show its value during that peak as 50, because it is 50% of the highest value in that graph. That way it is possible to find out the relative representations of different term and the relative representation of one term over time, but not its total percentage representation of all search queries.

The third reference point for this work is a small questionnaire asking elementary school children in one school in Czech Republic. The questionnaire was in Czech but the terms in question were specifically chosen so that they are the same in English or have an exact English equivalent. This way the questionnaire can be compared with data from Google Ngram, which does not have a Czech database, and the data from Google Trends, which use a larger sample and as such are more reliable. The questions and their choice of answers used in this work are a translation of the original questions therefore there may be some discrepancies.

Expectations

The frequency of the terms in books is expected to follow the development of technology in the discipline with which a given term is associated. If a given term associates with more than one discipline it is expected that such a term will rise in popularity with both these disciplines, according to their respective impact on the technological development during that era.

It is expected that school children will have a good vocabulary of technical terms associated with computer sciences. It is widely known that younger generations spend more time on the internet, using computers and watching television, although the habit of watching television is now receding in favor of online entertainment. This should inevitably result in them learning some of the basic terminology whether this is learned by using a computer, browsing the internet or from seeing a commercial for a product, which uses a new technology and is using a technical term as a so-called buzzword to persuade viewers that their product is technologically advanced. Marketing with the use of technical terminology is expected to have the greatest impact on common knowledge and use of that term.

Results

LED

Let us break down the results term by term first and then put the results in context with each other. The first technical term in question was LED (Light Emitting Diode). In fact the first and the second question in the questionnaire both inquire about this technical term. It is expected that the term LED is known very widely even amongst younger children because it is heavily advertised in many different products ranging from flashlights to television screens. That is why this term was chosen as a reference point with which other terms can be compared.

The phenomenon of electroluminescence which lies at the basis of LED technology was first discovered in 1907 but it was initially forgotten and the discovery of electroluminescence is credited to a scientist in the year 1935. After the invention of transistors in 1951 and the leap in understanding semiconductors it is possible to create a visible light LED in 1962. In 1993 the first blue light LED was created completing the spectrum. Some time after that, white LEDs were made and in 2006 these were already one of the most energy efficient light sources. In the present day LEDs are used as flashlights, mobile phone camera flashes and even headlights in cars as well as high resolution displays in televisions and mobile phones.

The history of the term in books in the database of Google can be seen in Figure 1:

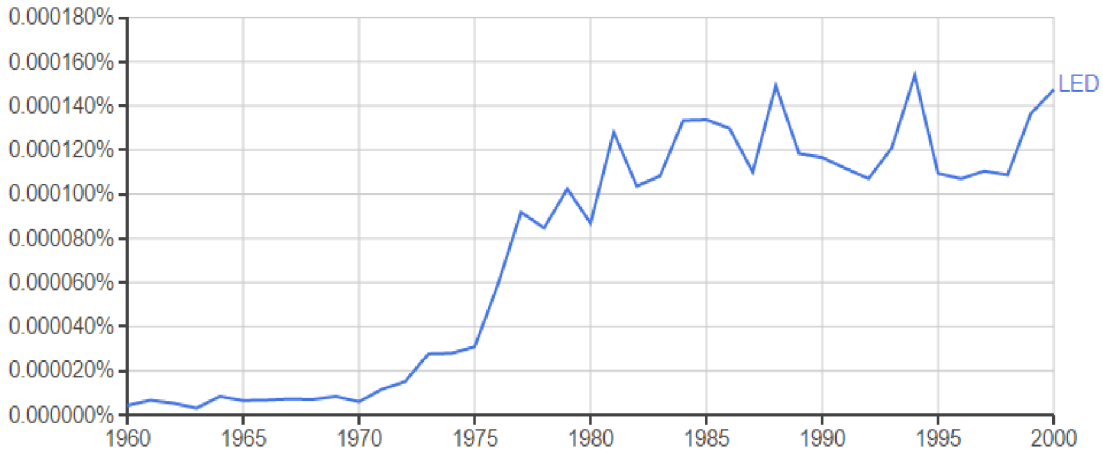

Fig. 1 History of the term LED in Google Ngram

As seen in Fig.1, there is a certain percentage falsely identified as LED in the books. The term LED did not exist and could not exist before the term diode was introduced and it did not exist before the invention of transistors. The LED that does not refer to the device only takes up a small percentage. The first visible light LED was introduced in 1962, but the term started appearing in books in the year 1971 and in the next decade experienced the most significant increase in use. In 1993 the spectrum of LED light was completed and in the same year the first white LED was invented. This shows up as a significant spike on the graph. The graph unfortunately does not extend to the era where the use of this device extended from indication lights, lights used in clocks and other special uses into the present day widespread use. For recent history of this term the only source currently available is the database of Google Trends. Here we can, however, only see relative values:

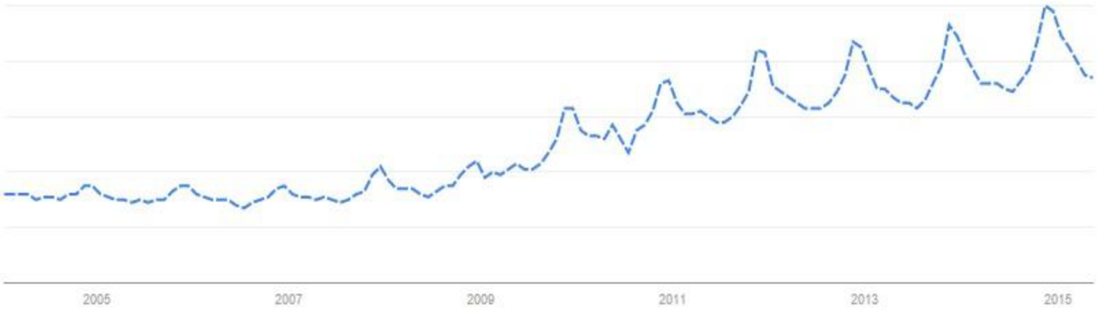

Fig. 2 Recent history of the term LED in Google Trends

Here we can see a steady increase over time with periodical highs in winter and lows in summer. This can be caused by increased need for light during times when days are shorter and nights longer. Another factor contributing to this periodicity can be people searching for Christmas presents that include LEDs or are based on them using Google. The knowledge of this term by elementary school children in Czech Republic as of May 2015 is represented in this work in the form of a simple questionnaire.

The first question in the questionnaire: “What is, in electronics, LED?”

The given choice of answers: a light source, a cooling device, source of sound

In sixth grade 1 out of 21 pupils answered incorrectly or not at all (5%)

In seventh grade 1 out of 6 pupils answered incorrectly or not at all (17%)

In eight grade 1 out of 14 pupils answered incorrectly or not at all (7%)

In ninth grade 0 out of 18 pupils answered incorrectly or not at all (0%)

One or zero wrong answers indicates that this term is well known and probably used among the pupils on a fairly regular basis. The percentages in this particular case are not a very good indicator since it is expected that there will be one wrong answer for nearly any question pupils are asked. This result fulfills the expectations and confirms that the term LED can be used as a reference term that identifies sufficient knowledge among all levels of education.

Diode

A diode is a widely used electrical component. One of its special types is a Light Emitting Diode or LED. Investigating the term diode can therefore improve on the selected reference term of LED. It is expected, however, that more people do not know the function of a generic diode as opposed to the LED. A generic diode is not something necessary to understand in everyday life. The device itself, however, is used much more widely than its special light emitting variant. Therefore it is expected that the occurrence of this term in books will be more frequent than that of LED and the occurrence of this term in search queries will be at least as high as that of LED.

Both semiconductor and vacuum tube diodes were invented in the early 1900s as radio receiver detectors, but vacuum tube diodes were more favorable because of their stability as well as the ability to integrate them into the vacuum tube amplifier used in most of the receivers. Both these types, however, were at the time called rectifiers, which is a term now used

for devices converting alternating current into direct current, in other words diodes designed for higher voltages and currents. The term diode was created in 1919 as the device had more uses other than rectifier and needed distinction.

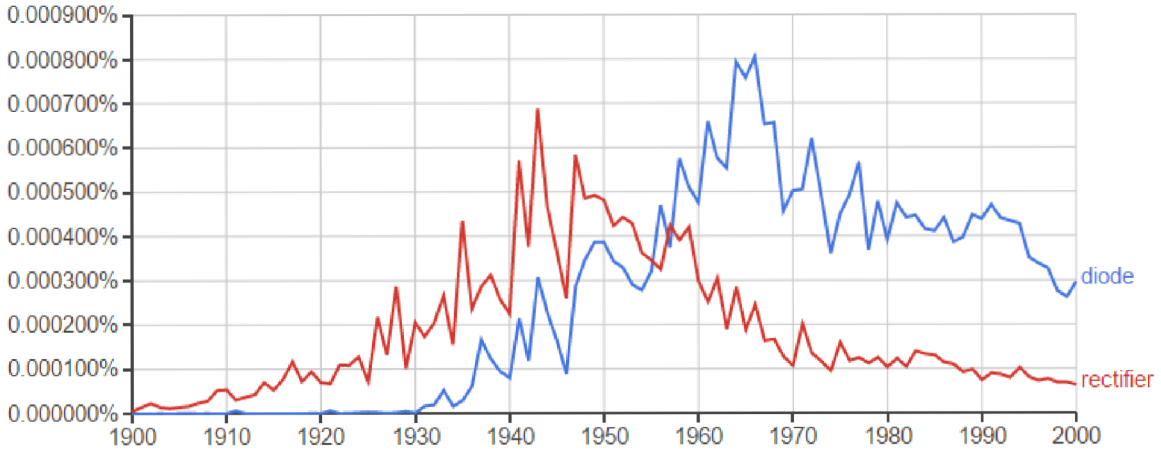

Fig. 3 Comparison of the terms diode and rectifier in Google Ngram

Here we can see that the use of the term diode surpassed that of a rectifier around the year 1956. And here are the two terms combined on Google Ngram:

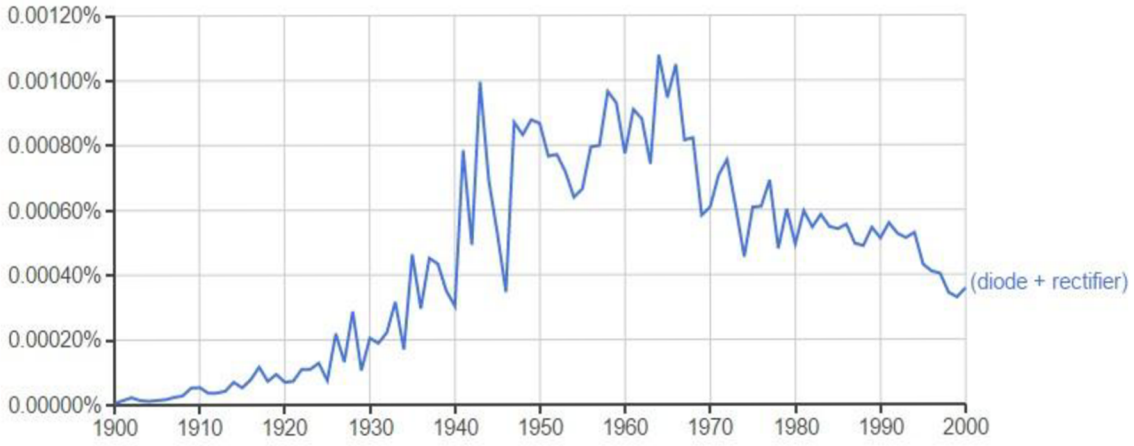

Fig. 4 Sum of values for diode and rectifier in Google Ngram

The use of these terms in books was the highest in the year 1954, which is a spike consisting mainly of the term diode. The use of both terms has been steadily declining since that year. The recent history of the term diode

as gathered in the form of search queries from Google can be seen in Figure 5:

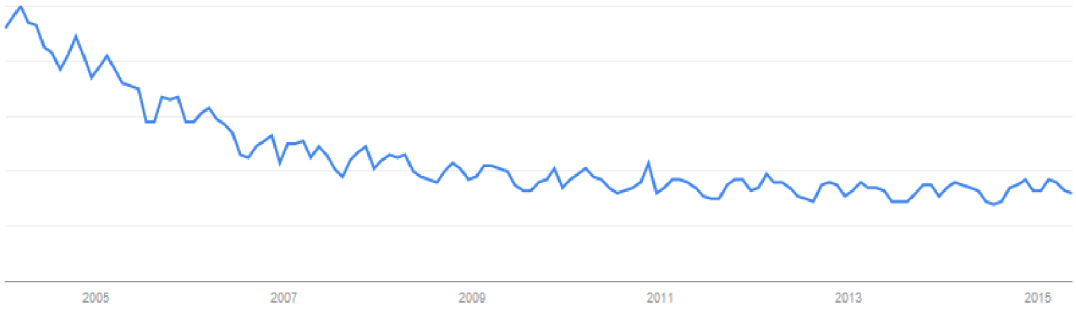

Fig. 5 Recent history of the term diode in Google Trends

The decrease seems to continue in the recent history. In fact, compared to the graph of the search query for LED, the graph for diode looks like a flat line. The search query for LED is 3.6 times more frequent in the year 2004 when Google trends began collecting their statistics and as the amount of search queries increased over time (as seen in Fig. 1-2) the final ratio in the year 2015 is more than 25 in favor of LED. In books scanned by Google, however, the timeline extends up to the year 2000 where the word diode was still twice as frequent as LED. From that it can be assumed that either the term LED surpassed the term diode between the years 2000 and 2004 or the statistics for word frequency within books and search queries on the internet do not match for these two terms.

The current knowledge of the term among the can hopefully be gleamed from the answers to the second question in the questionnaire: “What, in this LED, does the letter D stand for?”

The choice of answers: diamond, diode, difference

In sixth grade 8 out of 21 pupils answered incorrectly or not at all (38%)

In seventh grade 2 out of 6 pupils answered incorrectly or not at all (33%)

In eight grade 2 out of 14 pupils answered incorrectly or not at all (14%)

In ninth grade 0 out of 18 pupils answered incorrectly or not at all (0%)

This shows a relatively steady decrease of wrong answers with the pupils in ninth grade all knowing the answer. Of course this can not be claimed with absolute certainty as the sample for the statistic was relatively small and there are only three options for each question, which means that some of the correct answers may have been guessed. Guessing the correct answer more than third of the time when there are three options also signifies some base knowledge, therefore even guessed answers are an indication when they are correct.

Router

The third term under investigation is a router. A router is an essential part of the internet. Since the main part of the internet is in its basis a packet switched network, it requires a device to route packets to their intended destinations. A router provides this function as well as other essential functions required for such a large network to function properly. An important thing to note is that a router is also a word describing a tool used in woodworking introduced in the year 1905. This will play a role in the statistics measuring the frequency of occurrence of this word in books. It should not, however, influence the results of search queries for router, because Google Trends can distinguish a specific query for router of the computer peripheral class. Unfortunately a word gateway is not specific to the area of computing and networking and has a relatively high occurrence in books especially further in the past. The first devices with a similar function to current routers were called Interface Message Processors or IMPs or sometimes gateways, which were invented around the year 1970. The first true IP routers were implemented in a network in 1976. Up until the 1980s, general purpose computers were used as routers. Present day routers are highly specialized both in hardware as well as software. The occurrence of this term in books looks like this:

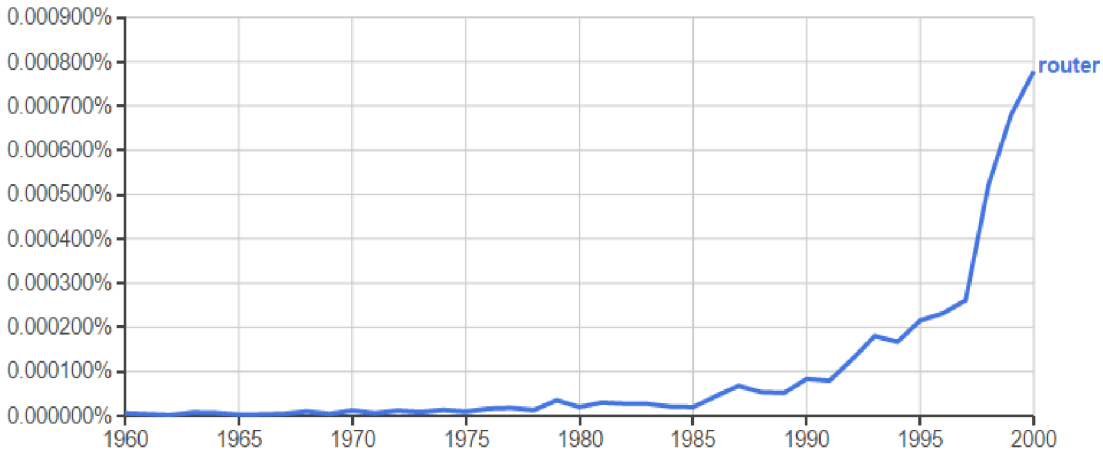

Fig. 6 History of the term router in Google Ngram

As is apparent from this graph, the woodworking tool called router has only little influence on the frequency of occurrence of this word in books. The frequency of this word in books seems to rise exponentially and possibly leveling off some time between the years 2000 and 2004 because the frequency of search queries for this tem shows a steady decrease:

Fig. 7 Recent history of the term router in Google Trends

This graph also shows a slight periodicity with minor peaks in August and larger peaks either in December or January. This term has interesting development in the past as it surpasses both the term LED and Diode in frequency of occurrence in books before 1998, but it is surpassed by the term LED in search queries in 2009. More on this in the chapter Relations.

The current knowledge as represented in Czech elementary school pupils when answering the question “What purpose does a router serve?”

The choice of answers: electricity transmission, internet functionality, navigation

In sixth grade 19 out of 21 pupils answered incorrectly or not at all (90%)

In seventh grade 5 out of 6 pupils answered incorrectly or not at all (83%)

In eight grade 9 out of 14 pupils answered incorrectly or not at all (64%)

In ninth grade 9 out of 18 pupils answered incorrectly or not at all (50%)

This statistic also shows a decrease with older pupils answering more correctly than younger ones, however only 50% of pupils in the ninth grade gave the correct answer. Admittedly the wording of this question with respect to the options was more difficult. The word router may mislead pupils into thinking that this term has something to do with navigation, because the question included both the English word router as well as its Czech equivalent, which retains the suggestion. The Czech equivalent is derived from a word meaning direction rather than route, but both words imply the same connotation with navigation.

Algorithm

An algorithm is a specific set of instructions. In mathematics and computer science it is a step by step set of operations listed in a well defined formal language (programming language). The word itself originally referred to rules of performing arithmetics but it is now almost exclusively used in programming.

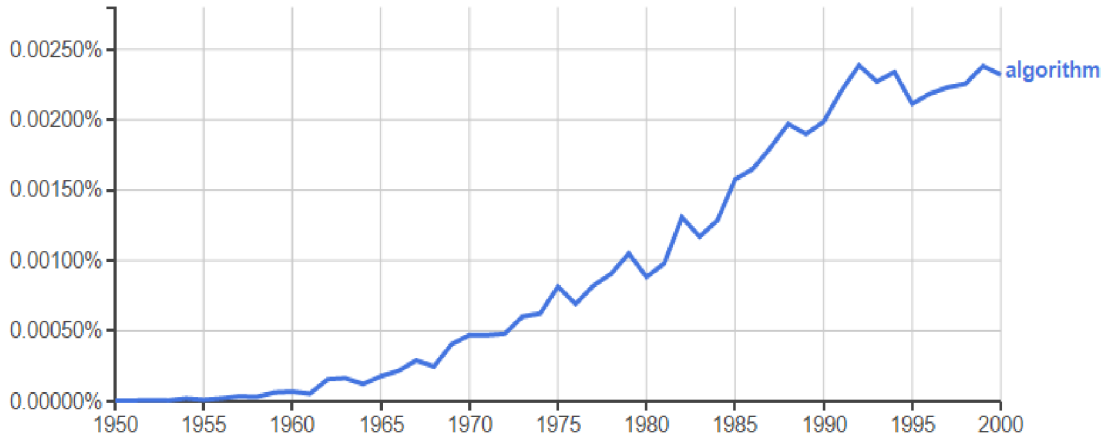

Fig. 8 History of the term algorithm in Google Ngram

This graph shows a relatively steady and linear increase over time, despite computer technology advancing exponentially. Despite that, this linearity is not abnormal. Other computer related terms tend to show a similar linearity. For example the term computer even levels off after a spike in 1985. Such behavior can be explained by the large values of total percentage representation of these terms in books. For the term computer the percentage representation leveled off at 0.01% which is a very high value and the term algorithm rose above 0.002% before the year 2000.

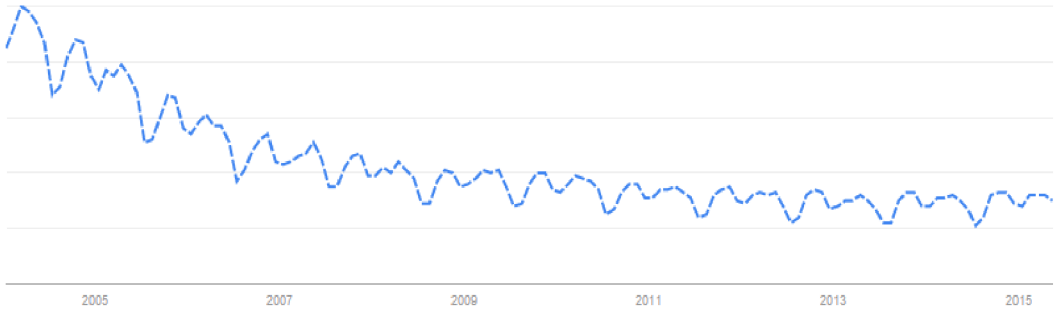

Fig. 9 Recent history of the term algorithm in Google Trends

The graph for search query frequency shows a leveled off decrease with periodicity very similar to that of a router with the most significant minimums in July to August and less significant minimums in January. The maximums can be found somewhere between October and November and around April. The relative values in search queries stay at a third of the values for a router throughout time. More on this in the chapter Relations.

The knowledge of this term as represented by Czech elementary school pupils was tested with a question: “Where is an algorithm used?”

The given choice of answers: display functionality, music reproduction, programming

In sixth grade 11 out of 21 pupils answered incorrectly or not at all (52%)

In seventh grade 5 out of 6 pupils answered incorrectly or not at all (83%)

In eight grade 4 out of 14 pupils answered incorrectly or not at all (29%)

In ninth grade 5 out of 18 pupils answered incorrectly or not at all (28%)

These results might unfortunately indicate, that the pupils have learned about this term in one of their classes. Another hints why this might be the case is the answer these pupils gave when asked where they learned these or similar terms at the end of the questionnaire with a significant portion of them answering with “computer science classes”.

Transistor

A transistor is probably the most important invention in all of electronics. It is responsible for two revolutions in science. The first one with its introduction during the year 1947 as it offered an alternative to vacuum tubes, which are larger, more fragile and consume more power during their operation than the transistor. The second revolution in 1958 is the invention of a working integrated circuit which jump started the development of modern day computers.

Fig. 10 History of the term transistor in Google Ngram

The importance of this invention is represented in the frequency with which it appears in books although it experiences a relatively early decline during which it gets surpassed by steadily rising computer science based terms such as algorithm. The term transistor itself more or less follows the term diode while remaining slightly more frequent. This decline could be caused by the necessity of this component in almost any modern device, effectively rendering its use redundant. For example after a certain year, it is no longer necessary to use the term “transistor radio” as almost all radios are based on transistors by that time and therefore only “radio” is used. Similarly in integrated circuits, the word transistor is redundant, because to this day there are no alternative technologies and all integrated circuits are based on transistors.

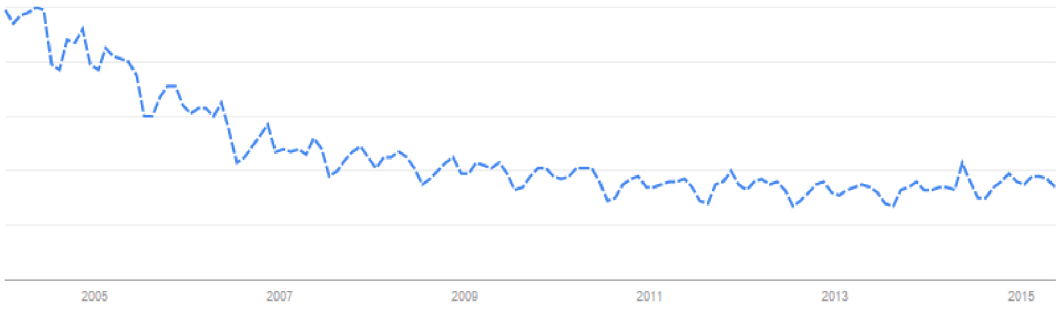

Fig. 11 Recent history of the term transistor in Google Trends

As with other long established terms, transistor experiences a decline in search queries in the recent years. And although Google does not provide

any numbers in search query statistics, only relations to other terms, but from that it can be determined that the number of search queries for transistor are relatively low compared to other terms investigated in this study. Again the explanation is probably the redundancy of this term as the device is included in nearly every modern day device. The only people in need of individual transistors in the present are the ones wishing to build a simple electronic device by themselves. To understand the basic functionality of transistors is no longer necessary in the present, because the simple devices an amateur could build from electrical components are now very cheap.

As for the knowledge for this term among pupils, the following question was presented to them: “A transistor is closest to which field of study?”

The given choice of answers: electronics, mechanics, computer sciences

In sixth grade 8 out of 21 pupils answered incorrectly or not at all (38%)

In seventh grade 4 out of 6 pupils answered incorrectly or not at all (67%)

In eight grade 3 out of 14 pupils answered incorrectly or not at all (21%)

In ninth grade 12 out of 18 pupils answered incorrectly or not at all (67%)

Here the results seem to confirm the previous explanations, although it would have been nearly inconceivable for a young person to not know what a transistor is about 40 years ago. In the present this term is no longer necessary in everyday conversations.

Local Area Network

LAN or Local Area Network is a small network of computers such as a household or a company. A local network is separated from the internet in the sense that the IP addresses of the computers within this network are not

globally exclusive and computers usually do not need any form of routing for communication within a Local Area Network. This allows for more security, conservation of IP addresses and increased security. Initially Local Area Network was implemented to provide faster communication within a local network and for this reason the technology of Ethernet was proposed in the year 1976, developed in 1976 and commercially implemented in 1977.

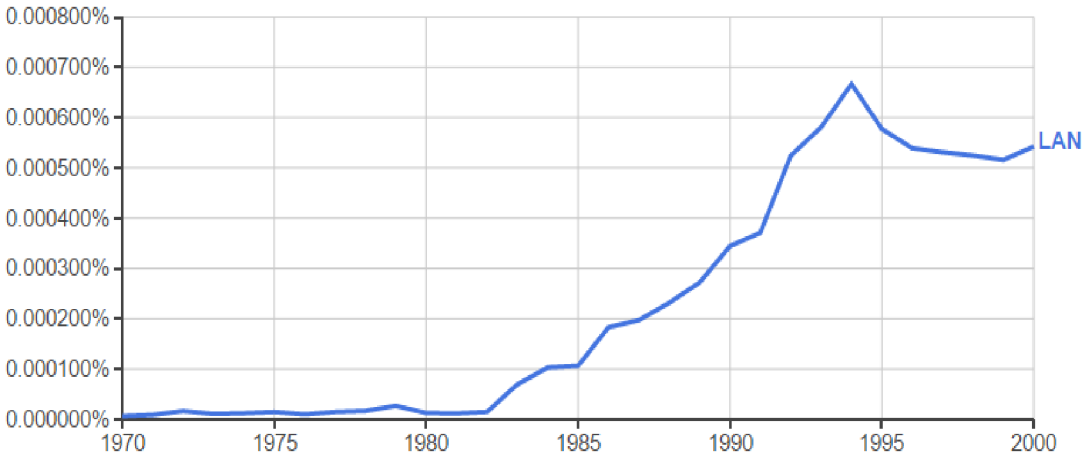

Fig. 12 History of the term LAN in Google Ngram

This graph shows a similar development as the graph corresponding with the word computer, only LAN has smaller values and takes place later in time. The increase in frequency rises in a vaguely linear fashion from the year 1982 until the year 1994, where it experiences a decrease to a value of approximately 0.0005%, where it seems to have leveled off. The values for the term LAN mirror the values for the term networking, which is an expertise overarching and using terms such as LAN and router. The term LAN has a steeper upwards slope in the graph and a slightly later start, but the term networking lacks the spike and consequent decrease so that it keeps its linear slope until the year 2000 where the statistics from Google Ngram end.

Fig. 13 Recent history of the term LAN in Google Trends

The graphical representation of the number of search queries over time follows suit with other technical terms in the sense that it experiences a gradual decrease. Another explanation for this trend which could apply for all of them is that the popularity of this particular term did not actually decrease, but with the introduction of new terms and related terms, the total volume of searched terms increases and therefore the relative value of each individual already existing term decreases even when the values for search queries for technical terms remains at a constant relative value.

As for knowledge of this term among pupils of an elementary school, this question was presented: “What does the abbreviation LAN signify?”

The given choice of answers: computer communication over the internet, small electrical circuit, local network

In sixth grade 15 out of 21 pupils answered incorrectly or not at all (71%)

In seventh grade 5 out of 6 pupils answered incorrectly or not at all (83%)

In eight grade 8 out of 14 pupils answered incorrectly or not at all (57%)

In ninth grade 11 out of 18 pupils answered incorrectly or not at all (61%)

Such values are a quite clear indication that this term is not commonly known among the pupils. Any age dependence on the knowledge is unclear from the collected data. However it can be safely said that when more than 50% of the participants do not know the subject, it can not be used in everyday conversations other than special occasions and it most likely will need explanation at such occasions. On the other hand it does not mean that the pupils never came across this particular term. They may have even used it, but they did not know its exact meaning. They would most likely encounter this term when playing games on a computer as many games have the option to connect to other players either via LAN or via the internet. For this reason the pupils might have associated the term LAN with the internet instead of understanding the term LAN as a means to separate the local network and the global one.

Random Access Memory

Random Access Memory or RAM is a special type of computer memory in which the data can be written or from which data can be read in the same time, regardless of physical placement of this data over the medium. This allows for often needed data to be ready for fast access which increases the speed of operation of a CPU by decreasing the downtime during which a CPU awaits arrival of requested data for processing. The first fast memory type took form of latches made out of vacuum tubes and later transistors. This method was, however, not very practical as it was too expensive and could only store small amounts of data. The first practical application was a device using the technology of Cathode Ray Tubes. This technology was fast enough and stored enough data that a program could be stored on this memory rather than being constructed physically, which was demonstrated in the year 1948. In the early 1970s transistor memory in integrated circuits started to be used while in 1968 a dynamic version of random access memory was invented, which allowed for the possibility increased the capacity for these memories at the cost of its volatility.

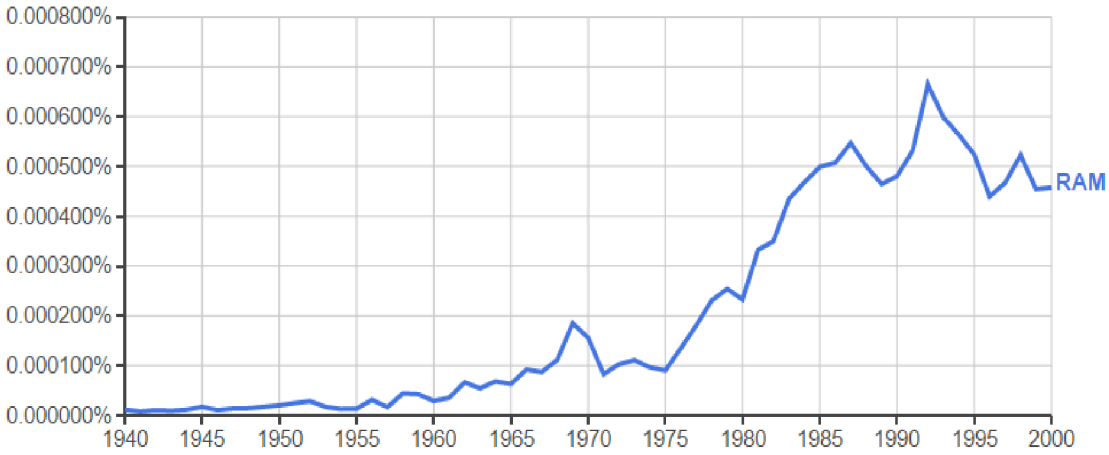

Fig. 14 History of the term RAM in Google Ngram

This term has an unusual behavior among other technical terms in the values of frequency within books. A certain familiar pattern can, however, be recognized. The behavior until the year 1975 follows the pattern of steady increase, with a drop off after the highest value and leveling off around the value 0.0001%. After the year 1975, however, there is another increase in frequency of occurrence followed by a seemingly random pattern of highs and lows from the year 1987 onwards. Still the possibility that the pattern of steady increase followed by a spike and a level off could be accidental can not be excluded. A possible explanation for this behavior is that the technology used for RAM has not evolved significantly for a long time in contrast with every other technology used in computer. The technology used in RAM only experienced miniaturization in accordance with the Moore's law.

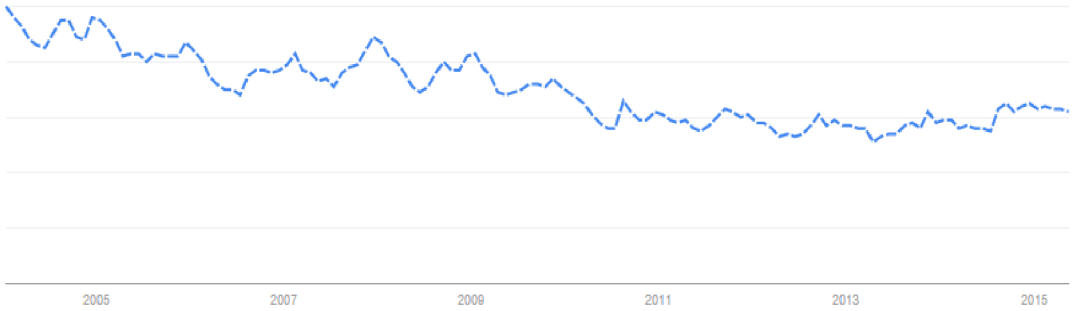

Fig. 15 Recent history of the term RAM in Google Trends

The search query statistics for RAM, despite having similar values to other computer related technical terms such as LAN, do not experience as significant decrease over time as other selected terms, possibly because RAM is still an integral part of every computer as well as mobile phone and therefore has to be bought for a computer or when someone chooses which computer or mobile phone to buy, the amount of RAM is an important, often deciding factor.

The question for the questionnaire was formulated as such: “What does the abbreviation RAM signify?”

The given choice of answers: a type of memory, program error, a method of producing electrical components

In sixth grade 8 out of 21 pupils answered incorrectly or not at all (38%)

In seventh grade 2 out of 6 pupils answered incorrectly or not at all (33%)

In eight grade 2 out of 14 pupils answered incorrectly or not at all (14%)

In ninth grade 1 out of 18 pupils answered incorrectly or not at all (6%)

This seems to suggest a rather significant increase in knowledge with higher age in eight and ninth grade. The most likely reason is that these pupils have already picked and bought their own mobile phones and probably had to consider RAM capacity when choosing it. Another possible reason is that the younger generations spend higher amounts of time using a computer for entertainment. Using a computer to play games is often demanding on its RAM capacity and speed and so the function of a RAM was learned inadvertently.

Upload

When thinking about data transfer as transmission from one computer to another, upload and download are relative terms where upload is the transfer

of data from the point of perspective to the remote computer and download is the transfer of data from the remote computer to the one which is the point of perspective. In the context of the internet, upload is the process of transferring data into the internet from the local computer and download is the process of transferring data from the internet into the local computer. The word upload can, in very rare occasions, be used as a noun in which case it would refer to a data file created by one or more end users and uploaded to the internet. When referring to the internet in this context it is almost always referring to an unspecified server connected to the internet, which means that the original relative definition of upload and download remains, only the remote computer is a server and the local computer refers to any user operated device connected to the internet.

Fig. 16 History of the term upload in Google Ngram

The term upload starts to appear later than other technical terms under investigation in this work and the frequency of occurrence in books is much lower than that of other technical terms, which explains the seemingly higher irregularities in the graph. The values, however, do rise over time much like other technical terms. The term upload even though being a technical term is probably more common in everyday conversations than it is among professionals, because it is only relevant when discussing asymmetric connections where download and upload speeds are different, which are common among end users, but not in the core infrastructure of the internet.

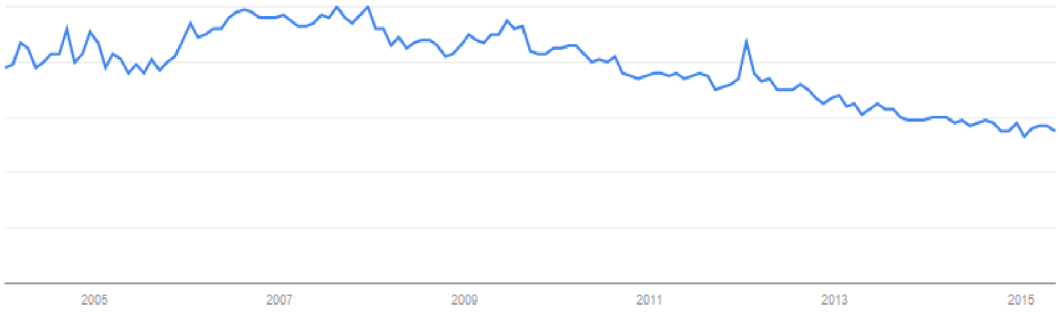

Fig. 17 Recent history of the term upload in Google Trends

For much the same reasons the term upload has relatively stable values for the amount of search queries in the recent years. The values after the year 2008 are actually nearly identical to the values for the term LAN and they both experience the same gradual decline over time, more on that in the chapter Relations. This term also seems to lack any visible periodicity in the numbers of search queries.

In the questionnaire, this term was represented by the question: “What is upload?”

The given choice of answers: a file on the internet, a file on a computer, the process of transferring data into the internet

In sixth grade 8 out of 21 pupils answered incorrectly or not at all (38%)

In seventh grade 0 out of 6 pupils answered incorrectly or not at all (0%)

In eight grade 5 out of 14 pupils answered incorrectly or not at all (36%)

In ninth grade 4 out of 18 pupils answered incorrectly or not at all (22%)

There are more wrong answers for this question than was expected, however the number of wrong answers is not too high, which indicates that

the pupils probably use this term occasionally but not all of them know what it means precisely. One thing to note is, that the term upload is used in the Czech language unchanged, whereas the words “load” and “loading” do have Czech equivalents. Therefore a Czech speaker not versed in the English language can not easily derive the meaning of the word upload from its components, the words “up” and “load”.

Server

A server is active software capable of accepting requests from clients and fulfilling them. A server in the everyday conversation will usually refer to a specialized computer connected to the internet with the sole purpose of running a server application. Self contained hardware dedicated to running server applications started appearing in increased numbers between the 1990s and 2000s. Devices like routers and modems can also be considered servers and modern operating systems in various operate in a way similar to a server. An important thing to note is that server does not always refer to the software, which may somewhat inflate the statistics gathered by Google Ngram. Google Trends will not suffer from the same inflation of results, because their results are disambiguated.

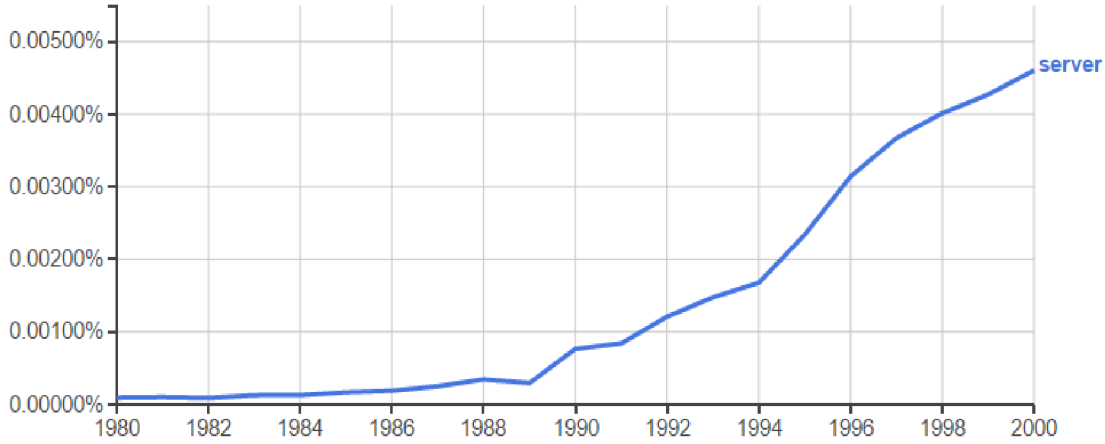

Fig. 18 History of the term server in Google Ngram

As most computer related terms, the term server experienced a rapid increase in frequency of occurrence within books. The percentage numbers for the term server are, however, much larger than for most other computer related terms, this term surpasses 0.004% in the year 1998, which is an order of magnitude larger than the values for the terms such as LAN for example. More on this in the chapter Relations.

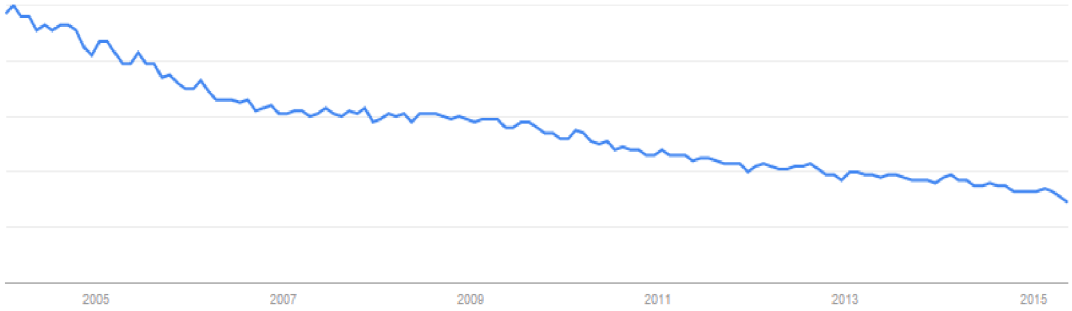

Fig. 19 Recent history of the term server in Google Trends

This term like most other technical terms experiences a decrease in popularity over time in the amount of search queries on Google. The term server, however, keeps its high values compared to other networking terms such as LAN or router. The popularity of the term server in search queries seems to match the popularity of the term computer including the rate of decline over time. Both these terms are probably already common knowledge for the majority of internet users and their search queries get distributed to more specific and less known terms.

To find out about the knowledge of this term among elementary school pupils, this question was included in the questionnaire: “What is the function of a server?”

The given choice of answers: power distribution, providing services on the internet, programming

In sixth grade 7 out of 21 pupils answered incorrectly or not at all (33%)

In seventh grade 2 out of 6 pupils answered incorrectly or not at all (33%)

In eight grade 2 out of 14 pupils answered incorrectly or not at all (14%)

In ninth grade 2 out of 18 pupils answered incorrectly or not at all (11%)

These results indicate that this term is fairly well known amongst pupils of elementary school especially those of older age. The most likely case is that these children spend a fair amount of time on the internet. Using computers for entertainment is now becoming more common than ever before and when this entertainment takes the form of playing games online, the user will get into contact with the word server very often and will very soon guess at least an approximate meaning of this term. It is also possible that this question was made too easy by the given choice of answers.

Transformer

A transformer is a device which uses electromagnetic induction to transform alternating current from the input into alternating current with different properties on the output. The transformer can produce either increased voltage on the output compared to the input by decreasing its current or decreased voltage by increasing the current. The frequency of the alternating current remains the same. The device works by inducing magnetic flux in its magnetic core using the primary (input) winding and then having this magnetic flux induce current in the secondary (output) winding. The number of windings determines the operation of the transformer. For ideal transformer if the secondary coil has double the amount of windings compared to the primary coil, the output voltage will be double the voltage of the input and the current will be halved. Because of the design of the transformer, if the connection of input and output is reversed, the transformer will have opposite transformation effect and the previously mentioned transformer would halve the voltage and double the current of the input. The process of electromagnetic induction was discovered independently by two scientists in the years 1831 and 1832. At first induction coils, and early form of transformers, were used in conjunction with an interrupter to increase the voltage from batteries, but when AC generators became available, the transformers began to take shape and finally an efficient and practical design was invented in the 1880s. The term transformer has been in use since 1882.

Fig. 20 History of the term transformer in Google Ngram

The values of frequency of occurrence in books for the term transformer seem irregular, but the graph seems similar to that of a rectifier. Both terms come from the same field of study, so they probably appear in the same books, although the term transformer appears more frequently and starts appearing sooner. The frequency of occurrence for the term transformer seems to start decreasing around the year 1950. This can not be blamed on stopped development of this device, because the principles of this device have not changed drastically since the year 1886. The decrease in frequency can be possibly explained by electricity becoming common and therefore the need to publish new books about transformers decreased.

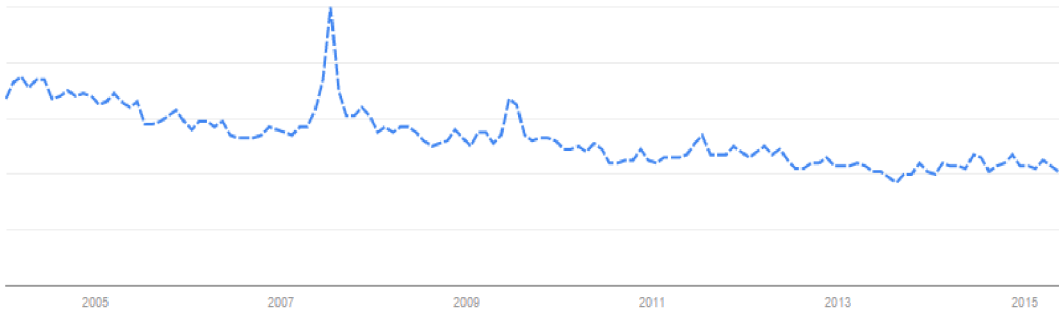

Fig. 21 Recent history of the term transformer in Google Trends

The frequency of search queries over time for transformers seems relatively stable, slowly decreasing. The spike in the number of search queries in July 2007 is caused by an article about a certain company's new transformer. Again there are no significant new developments in the

construction or operation of transformers in the recent years, which means there is no reason for the popularity of this term to change drastically.

The question representing this term in the questionnaire was formulated like this: “What is the function of a transformer?”

The given choice of answers: changing voltage and current of electricity, creating electricity, measuring electrical current

In sixth grade 14 out of 21 pupils answered incorrectly or not at all (67%)

In seventh grade 2 out of 6 pupils answered incorrectly or not at all (33%)

In eight grade 5 out of 14 pupils answered incorrectly or not at all (36%)

In ninth grade 8 out of 18 pupils answered incorrectly or not at all (44%)

These results indicate that the pupils have probably learned this term in one of their classes in seventh grade, but even after that the knowledge of this term does not correspond with its importance. Of course even though transformers are absolutely essential for the lifestyle of people in the civilized world and for the infrastructure of modern civilization, the necessity for any one individual not working in the profession within the field of electronics to know the principles of electricity transformation is nonexistent.

Firewall

Firewall is a system of security for a computer or any other device connected to a potentially unsecure network. Firewall controls incoming and outgoing traffic based on a predefined set of rules. Firewall can be either software based or hardware based. Most operating systems contain within themselves a firewall and most routers include both software and hardware firewall components. The original meaning of the word firewall is an actual wall separating parts of a building or vehicle to prevent the spreading of fire.

Historically there are three generations of network firewall. The first generation is called packet filters, the second stateful filters and the third generation is called application level firewall. The first paper about firewall technology was published in 1988.

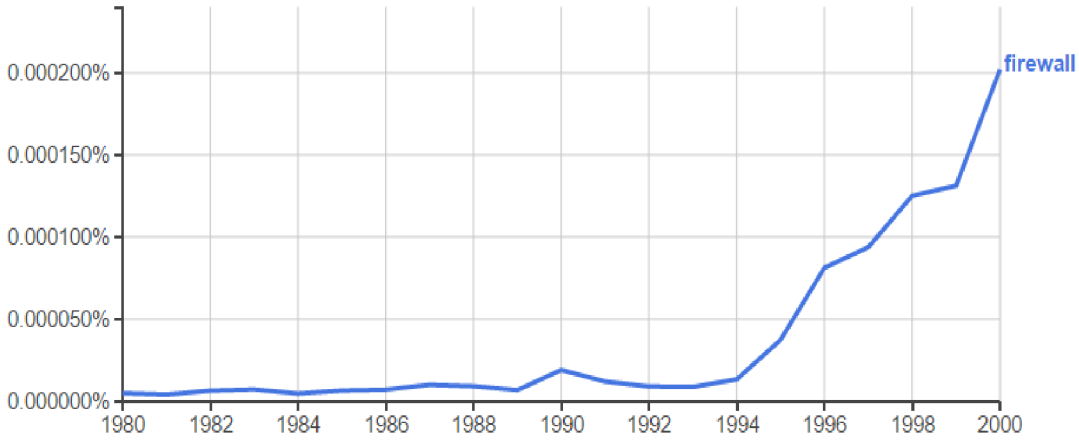

Fig. 22 History of the term firewall in Google Ngram

Firewall is yet another commonly used technical term from computer technology and its frequency of occurrence within books follows a pattern similar to the other network related terms. The rise of its occurrence takes place later in time, however, as it is a security related system and security only became an issue after more computers and more unknown computers were added to the network. The frequency of occurrence for this term is lower than other network related terms, because it is not a system essential to the function of a network and is only needed when unknown or less trustworthy clients are connected to the same network.

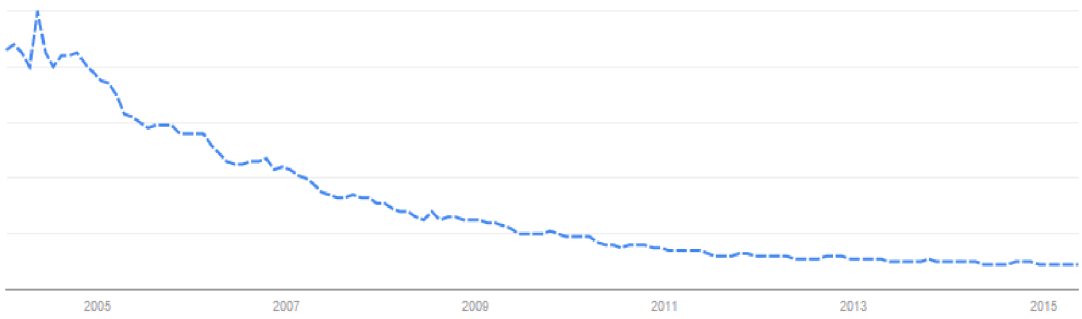

Fig. 23 Recent history of the term firewall in Google Trends

The popularity of this term in the recent year is much more interesting. The amount of search queries shows a faster decrease than other terms investigated within this work. A possible reason for this is the fact that modern day firewalls are becoming more and more integrated in the operating systems of the computers. They operate more reliably and more silently and do not cause false alarms as often as in previous years.

The Czech elementary school pupils were asked this question: “What does a firewall do?”

The given choice of answers: computer cooling, computer security, speed up the computer

In sixth grade 10 out of 21 pupils answered incorrectly or not at all (48%)

In seventh grade 3 out of 6 pupils answered incorrectly or not at all (50%)

In eight grade 7 out of 14 pupils answered incorrectly or not at all (50%)

In ninth grade 4 out of 18 pupils answered incorrectly or not at all (22%)

These results indicate that the pupils are not generally accustomed to the term firewall. The lower percentage of wrong answers in ninth grade probably means that they have learned about firewalls in school quite recently. Other than that the percentage of wrong answers stays very close to 50%, which can not be identified as sufficient when the question only had three options from which the pupils could choose.

Relations

This chapter will focus on how the technical terms relate to each other in terms of their use in history and in the present. This chapter will also try to find any correlation between the usage of terms in books and the number of search queries on the internet for these terms as well as any correlation of both of these with the results from the questionnaire given to Czech elementary school pupils.

The most popular terms

Firstly, a look at the dominating terms in the realm of Google Ngram:

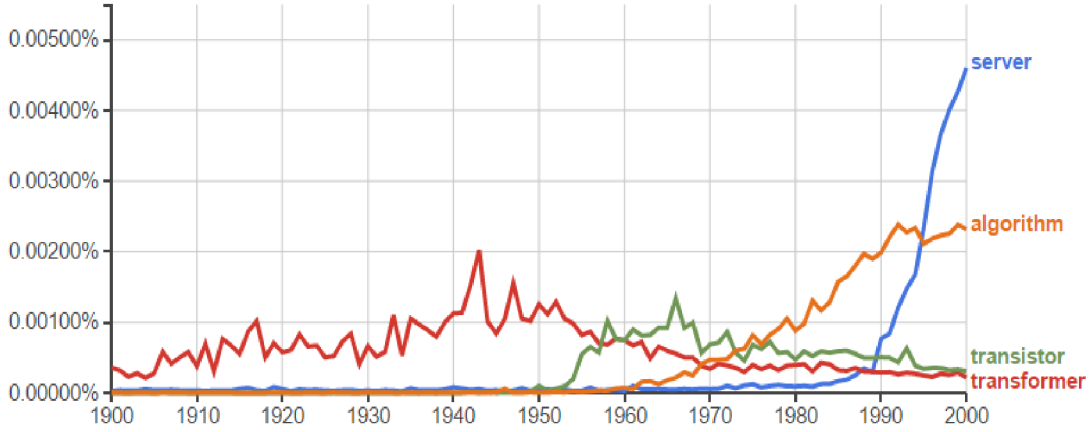

Fig. 24 The popular technical terms in Google Ngram

As can be seen in the previous chapters, all these terms were occurring with a relatively high frequency in books considering they are technical terms. Each of these terms had a period during which it dominated the others. This comparison very clearly demonstrates the development of technology over time. First there is a rather long period, during which the term transformer is the only one appearing in books, because it is the time during which infrastructure for electricity transmission was built. Then there is a period during which semiconductors began to dominate the world of electronics and the term transistor has higher occurrence than any other. After transistors were improved and integrated circuits were introduced, programming started to transition from strictly circuit based into more

abstract and theoretical realm of mathematics and the term algorithm dominates the others. At this time, programming takes place almost exclusively in the software and the hardware is abstracted. After a while the infrastructure to interconnect computers begins to develop which gives rise to the internet and with it the use of the term server. The closer to the present a term is introduced, the faster it rises in terms of frequency of use, which is a common principal in science. The rate at which new technology is developed is increasing with each decade and here it can be seen that the frequency of occurrence of the new terms also follow this rule. Globalization is a likely factor contributing to this phenomenon. Especially among the intellectual elites, communities of scientists are formed according to their specialization rather than their nationality. The secularization of society is another likely contributor towards the increased rate of technological development. The most influential factor, however, is probably the fact that many scientific discoveries are able to uncover completely new disciplines of science and therefore naturally more new discoveries are not only possible but made.

The gap in Google statistics

The popularity, if it can be called popularity, naturally changes over the long time period represented by Google Ngram. The more recent years show even faster changes in this popularity whether this is caused by the different method of comparing these terms or not. Even if the change in the order of representation is caused by the different source for their ordering, the terms change their order over time even within the single method of ordering (Google Trends) faster more recently than in the more distant past. However as was mentioned in the introduction, there is a gap of four years between the statistics of relative frequency of word occurrence in books and relative amount of search queries, both provided by Google. That means that these two sources can not be compared at the moment to determine which is more suitable and accurate at providing the correct order of popularity or common knowledge for these different terms. This gap will hopefully be covered by extending the digital archive of books further towards the present, but for now, these two datasets can only be compared indirectly. It can still be guessed, however, what kind of correlation there may be between those two methods. The review the change of order between the two methods and between the year 2000 and 2004 could provide some evidence to this correlation if the change is in any way anomalous:

All the investigated terms ordered by the frequency of occurrence in books as gathered by Google Ngram in the last year of its statistics, the year 2000:

Server, algorithm, router, LAN, RAM, transistor, transformer, diode, firewall, LED, upload

The same terms ordered by the amount of search queries for them according to Google Trends in the year 2004:

Server, firewall, router + LAN, RAM, LED, upload, algorithm, transformer, transistor, diode

For the most part the resulting change in order is to be expected. Networking and computer technology related terms were still for the most part on the rise in the year 2000 so it is no surprise that they surpassed the terms relating to electronics. The important thing to note, however, is that all the terms relating to electronics apart from LED ended up behind all the other terms. Of course there have been no significant improvements or developments on these devices with the exception of LED, while the computers as well as network speeds still improved at the rate comparable to the one predicted using the Moore's law. The fact that all of the terms for electrical components ended up behind all the other terms might suggest that the more computer related terms end up in search queries on the internet more often than less related terms. The order of the terms within individual disciplines, however, remained the same or following the expected trend.

Recent development

More interesting development occurs between the years 2004 and 2015. Here are the terms ordered by the relative amount of search queries according to Google Trends in years 2004 and 2015 from highest to lowest:

2004:

Server, firewall, router + LAN, RAM, LED, upload, algorithm, transformer, transistor, diode

2015:

Server, LED, RAM, LAN, router, upload, transformer, firewall + algorithm, transistor, diode

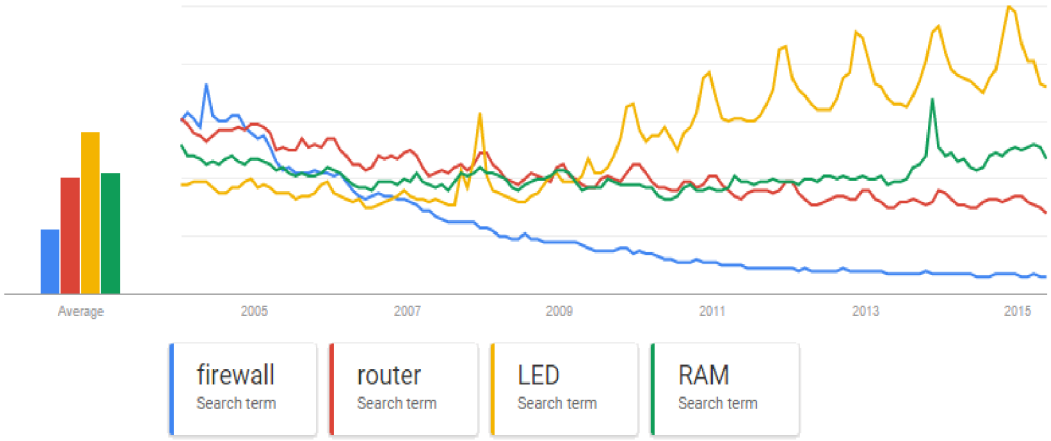

Fig. 25 The trending of technical terms in Google Trends

These are the most interesting recent developments in the popularity of these technical terms. These terms are in the reverse order in the present compared to the year 2004. They are also more dispersed in the sense that there are larger gaps between the values of search queries in the present compared to the year 2004. Unfortunately Google Trends does not show the actual values in percentage of search queries. Even so, the relative values testify to an interesting development.

The term LED has now reached second place, quickly catching up to the term server, because almost every flashlight is now based on LED technology, LEDs are implemented in almost every mobile phone, there are high luminosity LEDs which can substitute almost any other type of lighting while decreasing power consumption and increasing longevity. The introduction of organic LEDs miniaturized this technology to such a point that displays are now often based on it. Nearly every modern electronic device uses LEDs for one reason or another. Illumination, display of information or at the very least indication for example to indicate that the batteries inside the device are nearly depleted.

The term firewall as mentioned previously is now implemented in nearly every operating system and rarely needs any sort of intervention from the user. It is much more reliable and discrete now than it was in the year 2004. Moreover firewalls are now implemented in nearly every router available on the market therefore the need to search for a router with a firewall disappears. Both these factors are a likely cause for the rate of deterioration this term experiences in its amount of search queries. The percentage decline for this term between the years 2004 and 2015 is even faster than that of the term server.

The decline in popularity for the term router is not as significant as other terms. This device is still quite necessary and it usually has to be purchased separately. In the cases where it does not need to be purchased separately it is usually advertised as such. For example a free router with the contract to provide internet may be a selling point. Any type of marketing which uses a technical term is also likely to increase the popularity of the term in question. In fact, the influence of marketing can be one of the strongest if not the strongest cause of a term invading everyday life.

The term RAM is the most stable out of these four terms. Although there have been many developments in the technology, making the hardware faster and giving it greater capacity, these developments followed the developments of all the other computer components at the same rate. The term RAM, however, seems to avoid the decrease in relative popularity, which seems to be the standards for all the other technical terms, even those still relevant today. This gradual decrease in other terms is probably caused by the appearance of new terms. For example with the term router, the likely situation is, that as the term wifi, which is a technology with strong connection to the router, gained popularity, instead of the term router, searches were queried with the compound term wifi router. This will cause a decrease in the relative representation of the term router, because this term is now being diffused with another term in many queries. This is however very likely counteracted by the increase in demand for routers, especially wifi routers. Coincidentally, the term wifi has very similar development and values on Google Trends to the term LED in the later years (after the year 2007). The likely reason for the stable representation of the term RAM is that the steady increase in number of computer-like electronic devices will cause small percentage of their users to take the capacity of the RAM into consideration when buying such a device and this will counteract the natural decrease in the representation of the term RAM in search queries. The term LAN has nearly identical values and development in the recent history to the

term RAM. No evidence was, however, revealed during this investigation to explain this behavior.

The reason that the term transformer has moved up in this order between the years 2004 and 2015 is not any new development neither the need for this term in everyday life. The only reason that this term is now more popular than the terms algorithm and firewall is that the terms algorithm and firewall have been decreasing in numbers of search queries much faster.

Questionnaire results

The results of the questionnaire should be the most indicative of the influence of technical terms on everyday life. The demographic chosen to answer the questions is specifically chosen to be elementary school pupils as their education has the least amount of influence possible on their knowledge of these terms and therefore any knowledge they do have of them should come from everyday life. Even so, the influence of their education on this knowledge is not negligible. As a part of the questionnaire, the pupils were asked where they learned the terms in question or terms similar to them and some of the pupils responded with the answer "school" or identifying a particular class in school. Another disadvantage of this questionnaire is the size of the sample it works with. Only four classes of a single elementary school were issued this questionnaire, which makes the statistical data less accurate than would be perhaps desirable. Despite that, the answers from the questionnaire do provide some interesting and even conclusive data.

Here are the terms ordered from lowest to highest by the percentage of wrong answers inquiring Czech elementary school pupils about these terms:

LED (5%), diode (20%), RAM + server (22%), upload (29%), firewall (41%), algorithm (42%), transistor (46%), transformer (49%), LAN (66%), router (71%)

The exact formulation of the questions in Czech can be found in the appendix and their translation is included in the chapter corresponding with the term in question. The term LED was chosen as a reference point as it was almost certain that this term, as well as terms such as computer or wifi,

is commonly used in everyday life even among elementary school pupils. The results indeed confirm this assumption quite conclusively. These results, however, correlate with the results of the amount of search queries in a rather unexpected way. There is a very significant difference in the percentage of wrong answers for the term LED compared to the amount of search queries. This could be either because this term surpasses some threshold which correlates with the actual number of search queries and causes the term to appear in everyday conversations much more frequently or the influence of this term on everyday life does not directly correlate with the total amount of search queries for it but rather correlates with the rate of increase of the amount of search queries instead. Which of these correlations is true is currently impossible to decide from the gathered data and would require a separate investigation inquiring about terms with the same volume of search queries on Google but different rates of increase of this value.

The term diode has been inquired, because it does not have a particularly large representation in the amount of search queries, but it very closely relates to the commonly known term LED. This gives some insight into the amount of understanding people may have of a term which they commonly use. Unfortunately LED is a term which is often used incorrectly in everyday life. The way it is used incorrectly is by adding the word diode after the abbreviation LED, in other words doubling the word diode in much the same way that makes people say ATM machine even though the “M” in the abbreviation ATM stands for “machine”. This phenomenon causes the term diode, or at least its connection to the term LED, to “leak” into public knowledge just by misusing the term LED. Thus the result of only 20% of wrong answers for this particular question might be skewed.

The terms RAM, server and upload have a similar percentage of wrong answers. The result of fewer than 30% of wrong answers could indicate that these terms are perhaps in the public knowledge but probably not used very often if at all in everyday life. The amount of wrong answers for the question inquiring about the term upload is somewhat surprising. It was expected for this term to be commonly known even amongst elementary school children. Although the result of 29% of answers being incorrect does not indicate ignorance about this term, it certainly indicates that this term is not used very often in everyday life.

The other terms reached relatively high percentages of wrong answers and these results can be accredited to so-called “educated guess”. In other words the pupils likely eliminated one of the possible answers based on the

very basic notion they would have about the term in question and then guessed the answer between the remaining two possibilities, which gives the result of approximately 50% of the answers being wrong. The result for the term router also indicates that there was a significant amount of guessing involved in answering the questions, because the term itself is derived from the word “route” which misleads the pupils into connecting this term with navigation.

The questionnaire also asked pupils to circle the number of a question if they knew or used the technical term in that question. This was unfortunately largely ignored and the amount of pupils who did identify those questions was too small to draw any conclusions from.

As a final part of the questionnaire, the pupils were asked to state where they learned these or similar terms. The most common answers were: the internet, computer, family members, everyday life and their peers.

Conclusions

In conclusion technical terminology does have an importance in everyday life and the greatest impact can probably be felt when shopping for modern devices. Of course electronic devices can only be distinguished from each other using technical terms, which often forces marketing companies to push a technical term onto the consumers to promote their product as being superior in one way or another.

It can also be concluded that the historical development of a technical term is very closely linked to the development of the technology behind it. Not only has that, but the frequency of use of a given term in books seemed to follow patterns shared with other technical terms in the same field of study. For example the terms specifying concepts in general electronics and electricity transmission and production follow the pattern of gradual increase in frequency which gradually slows down and transitions into just as gradual decrease in frequency, while the intermediate values between each year show relatively high deviations. Meanwhile computer related as well as networking related terms follow a pattern of sudden increase in frequency as the field of study developed very quickly after its conception. The terms after their very sharp increase in frequency of use then experience a return to a value slightly below their peak value, where they level off and stabilize. If the values of frequency of occurrence in books and the values of relative amount of search queries correlate as they are expected, the networking and computer related terms start to experience a decrease in popularity at some time during the gap between the database of books used to calculate the frequency of occurrence and the database of search queries used to compare terms in their relative number of search queries.

The results of the questionnaire also seem to suggest that the current trends on the internet correlate with the use of the trending terms in everyday life. The correlation possibly holds a certain threshold in the number of relative search queries on Google Trends which, if exceeded, radically increases the common knowledge and everyday use of that particular term. The other explanation is that the disproportionately more common knowledge and use of a term correlates instead with the amount of increase of the value of relative search queries on Google or in other words with recent developments in that particular technology.

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