COMPUTER SLANG

Ю.А. Зайцева
Научный руководитель – кандидат филологических наук, доцент Т.К. Чарская

Работа посвящена проблеме распространения огромного количества неологизмов в глобальной сети в связи с бурным развитием компьютерных и информационных технологий в последние два десятилетия. Особое внимание уделяется анализу структурных типов сложных слов, образованных при помощи аббревиации.

The rapid development of computer industry and information technology during the last two decades gave rise to a large amount of neologisms. Most of them were exceptionally professional words but then they became almost widespread among computer users. Professional terms were simplified and abbreviated turning into the so called computer slang that was originally the way of communication for "devoted" people (e.g. programmers). As a result of growing amount of people related to computers, slang passes into common usage.

Internet slang consists of terms which users of the Internet have developed and utilized. Many of its terms originated with the purpose of saving keystrokes.

Internet slang came from many different sources – typical environments that placed value on brevity of communication. Some terms, such as FUBAR have roots as far back as World War II. Other terms came from more recent forms of communication, such as TTY and IRC.

Chat acronyms originally developed on pre-Internet bulletin board systems. The three-letter acronym remains one of the most popular types of abbreviation in computing and telecom terminology and slang. Similar systems came into use with users of text-messaging wireless telephones.

With the rise of instant messaging services (ICQ, AOL, and MSN among others) the vocabulary has expanded dramatically.

Aside from instant messaging programs another realm full of online languages exists: the Internet gaming world. One of the most popular forms of video game slang has become known as H4X0R or as 13375P34K (in leetspeak). Leetspeak, or leet for short, is a specific type of computer slang where a user replaces regular letters with other keyboard characters to form words phonetically – creating the digital equivalent of Pig Latin with a twist of hieroglyphics.

Note that the many "true" computer gurus, hackers and coders regard leetspeak as a pathetic trademark of a newbie or of a show-off. Gurus, hackers and coders almost always use leetspeak sarcastically. They label the use of leetspeak, excessive use of abbreviations, and incorrect spelling and grammar as rude, and they usually regard it as indicative of a script kiddie or of a computer newbie.

Users sometimes make up Internet abbreviations on the spot, therefore many of them can seem confusing, obscure, whimsical, or even nonsensical. This type of on-the-spot abbreviating leads to such things as: OTP (on the phone) or the less common, OPTD (outside petting the dog). Another feature common to Internet communication involves the truncation and morphing of words to forms that users can type more readily. Examples of this include:
- addy – "Address" (plural: "addys")
- convo – "Conversation"
- pic – "Picture" ("pics", "pix" or "piccies" for plural)
- proggy – "Computer program"

- prolly – "Probably" (The Oxford English Dictionary traces this usage back as far as 1962)
- sig – "Signature" (also "siggy")

The form "teh" offers a special case of this transformation. This originated as a corruption of "the", and often pops up spontaneously when typing fast. So common has it become, in fact, that it has made the jump to purposeful usage. Typically it occurs in situations where the writer presents as self-consciously enthusiastic, mimicking the less-grammatical Internet newbie: "That movie was teh suck!!", "The fight scene with all the Agent Smiths was TEH AWESOME", etc. It occurs most commonly in "teh suck", "teh lame" and cool or "teh cool".

Similarly, netizens may use the word "liek" or "leik" as sarcastic mis-spellings of the word "like", as in "I LIEK PIE". It often implies an insult to one's intelligence and/or typing ability.

Internet abbreviations evolve and change continually. Online games provide a good place to observe language variation in use. .

Common disclaimer phrases (sometimes called "parentheticals") also often contract into acronyms – they tend to occur at certain points in a sentence, which can facilitate decoding. This is a fraction of the full list, but some of these disclaimers include:

- TRDMF: tear rolling down my face
- IMHO: in my humble/honest opinion
- AFAIK: as far as I know
- IIRC: if I recall correctly
- OTOH: on the other hand
- IANAL: I am not a lawyer
- YMMV: your mileage may vary

The word newbie occurs almost exclusively to refer to all sorts of new users of an Internet forum or starters in a particular field of activity. It does not function as a pejorative term per se, but can do so when combined with RTFM, etc.
"n00b" has much more derogatory implications than "newbie".

Certain online personalities have begun to decry the usage of Internet slang, going so far as to refer to it as the crude truncations of the lower classes.

Although Internet slang has a close relationship with leetspeak, only online gamers traditionally use leet, while much larger groups of Internet users commonly use Internet slang.

The symbols < and > or * * often enclose a user's facial expression, action, or other feeling that is difficult to express via other online methods. For instance: <smile>, *smile*, <jumping up and down>, *jumping up and down*, <very very sad right now> or *very very sad right now* are all acceptable usages. Double colons are occasionally seen on each side of such expressions (::excited::).

The symbols [ ] and [/] or simply / are often used with a word inside [] or after / to denote the author's feelings at the time of writing an enclosed sentence or paragraph. For instance: [sarcasm]I just love how wonderfully the new nerf to our characters has gone.[/sarcasm], the developers have gone mad! /anger. This can be said to be derived from code commonly used on bulletin board systems.

Some of the most commonly occurring elements of this slang include:

- lol – laughing out loud
- bbl – be back later
- brb – be right back
- rofl – rolling on the floor laughing
- ttyl – talk to you later
- gg – good game, good going
- omg – oh my god!

- btw – by the way
- afk – away from keyboard
- kthx – OK, thanks

However, this list is a small fraction of the total Internet slang lexicon.

Leet words can be expressed in hundreds of ways using different substitutions and combinations, but once one understands that nearly all characters are formed as phonemes and symbols, leetspeak isn't difficult to translate. Also, because leet is not a formal or regional dialect, any given word can be interpreted differently, so it's important to use discretion when evaluating terms. The following serves as a brief (and by no means definitive) introduction to leet through examples.

- Numbers are often used as letters. The term "leet" could be written as "1337," with "1" replacing the letter L, "3" posing as a backwards letter E, and "7" resembling the letter T. Others include "8" replacing the letter B, "9" used as a G, "0" (zero) in lieu of O, and so on.
- Non-alphabet characters can be used to replace the letters they resemble. For example, "5" or even "$" can replace the letter S. Applying this style, the word "leetspeak" can be written as "133t5p33k" or even "!337$p34k," with "4" replacing the letter A.
- Letters can be substituted for other letters that may sound alike. Using "Z" for a final letter S, and "X" for words ending in the letters C or K is common. For example, loudspeakers might refer to their computer "5x1llz" (skills).
- Rules of grammar are rarely obeyed. Some loudspeakers will capitalize every letter except for vowels (LiKe THiS) and otherwise reject conventional English style and grammar, or drop vowels from words (such as converting very to "vry").
- Mistakes are often left uncorrected. Common typing misspellings (typos) such as "teh" instead of the are left uncorrected or sometimes adopted to replace the correct spelling.
- Non-alphanumeric characters may be combined to form letters. For example, using slashes to create "/\/\" can substitute for the letter M, and two pipes combined with a hyphen to form "|-|" is often used in place of the letter H. Thus, the word ham could be written as "|-|4/\/\."
- The suffix "0rz" is often appended to words for emphasis or to make them plural. For example, "h4xx0rz," "sk1llz0rz," and "pwnz0rz," are plural or emphasized versions (or both) of hacks, skills, and owns.

It's important to remember that the leetspeak community encourages new forms and awards individual creativity, resulting in a dynamic written language that eludes conformity or consistency. However, there are a few standard terms. The following is a sample of key words that haven't changed fundamentally (although variations occur) since the invention of leetspeak. .

- "warez" or "w4r3z": Illegally copied software available for download.
- "h4x": Read as "hacks," or what a malicious computer hacker does.
- "pr0n": An anagram of "porn," possibly indicating the use of pornography.
- "sploitz" (short for exploits): Vulnerabilities in computer software used by hackers.
- "pwn": A typo-deliberate version of own, a slang term often used to express superiority over others that can be used maliciously, depending on the situation. This could also be spelled "0\/\/n3d" or "pwn3d," among other variations. Online video game bullies or "griefers" often use this term.
- **"m4d sk1llz"** or "mad skills": Refers to one's own talent. "m4d" itself is often used for emphasis.
- **"n00b," "noob," "newbie," or "newb":** Combinations synonymous with new user. Some leetspeakers view "n00b" as an insult and "newbie" as an affectionate term for new users.

- **"w00t"** or the smiley character \o/: An acronym that usually means "We Own the Other Team," used to celebrate victory in a video game.
- **"roxx0rs"** Used in place of "rocks," typically to describe something impressive.
- **"d00d":** Replaces the greeting or addressing someone as a "dude."
- **"joo"** and **"u"**: Used instead of "you." This is also commonly written as "j00" or "_|00."
- **"ph":** often replaces "f," as in "phear" for "fear" (as in "ph34r my l33t skillz") and vice versa, such as spelling "phonetic" as "f0|\|371.("Game slang is an essential part of the Internet gaming world. People speak such a strange dialect in MMORPG (Massively Multiplayer Online Role-Playing Games) worlds and at LAN-parties (where groups of people get together in one room to play an online game) that it's common for new players to flounder in confusion for a few days trying to sort out what everyone is saying.

Game slang is actually quite necessary because game life is so larded with unique experiences, inside jokes, and tech jargon that it requires a new language to describe it all. It's a concise language that emphasizes shorthand, abbreviation, and linguistic economy. And, over time, most players adopt the speech patterns of the game they're in, becoming genuine citizens of the virtual world.

The spelling of many phrases, for example, is done in chat room rebus fashion to save on keystrokes. "Anyone" becomes "**ne1**." And "**g2g**" is "got to go." Most single words are similarly contracted.

The same concision occurs in all of the real languages that people use in the game world (the most common being French, Swedish, Danish, Korean, German, Japanese, and Dutch). Francophones, for example, often use "pkoi" instead of "pourquoi" to save a few keystrokes. "Quebecois" becomes "kebekoi." "Qu'est-ce que c'est" becomes "kes k c."

The one borrowed foreign word used by all players is "uber"— from the German word for "over" or "above" (as in the national anthem: *Deutschland über alles*). Uber in the game context refers to very highlevel items that can be attained only by powerful characters or large groups working together.

Many words refer to ideas unique to MMORPG life. Some words refer to the mechanics of the world itself.

Technology has undoubtedly brought about a revolution in communication. Most people would agree that this has been a positive development. Recently, however, there has been concern over the negative effect that modern methods of communication are having on the English language.The increasing use of e-mails and test messages is changing the way people use grammar. Education experts warn of the potentially damaging effect on literacy of text messaging.

Texting has become second nature to a generation of young people. To people who are not used to abbreviations, this might be seen as a threat to the language. To my mind, the language is changing in much the same way as it has done for centuries.

List of commonly used slang, smileys and acronyms.

Commonly used slang
- LOL = Laugh Out Loud
- U = You
- G2G = Got To Go
- KK = Okay
- LYL = Love You Lots
- NVM = Never Mind
- LYLAS/LYLAB = Love You Like a Sister/Love You Like A Brother
- BRB = Be Right Back

- C = See
- 2 = to, too, or two
- S^ = What's Up
- R = Are
- L8er = Later
- 2morrow = Tomorrow
- Kewl = Cool
- @ = At
- Skool = School
- w/ = With
- ROTFLOL = Rolling On The Floor Laughing Out Loud
- BF/GF = Boy Friend and Girl Friend
- What's ^ = What's Up
- Wazzup = What's Up
- Dawg = Dog
- Wuz^ = What's Up
- O = oh

Acronyms

- ABT = About
- ADN = Any Day Now
- AFAIK = As Far As I Know
- AWHFY? = Are We Having Fun Yet?
- AYOR = At Your Own Risk
- B4 = Before
- B4N = Bye For Now
- B/C = Because
- BTDT = Been There Done That
- CID = Crying In Disgrace
- CTS = Changing The Subject
- CWOT = Complete Waste Of Time
- DLTBBB = Don't Let The Bad Bugs Bite
- DTC = Darn This Computer
- EOS = End Of Story
- FAWC = For Anyone Who Cares
- FOTFLOL = Falling Onto The Floor Laughing Out Loud
- FYE = For Your Entertainment
- FYEO = For Your Eyes Only
- GA = Go Ahead
- GMTA = Great Minds Think Alike

Smileys/Emoticons

- :-) = Happy
- :-D = Laugh
- ;-) = Wink
- :-P = Sticking tongue out
- :-* = Kiss
- 8-) = Geek w/ glasses (My favorite!)
- :'-(= Sad
- >:-D = Evil grin
- [:-(= Frankenstein
- [{--Crayon--}]> = Crayola Crayon
- @}-,-'-,-- = Rose

- ✓ ol-<]: = Skater Dude
- ✓ ~(_8^(l) = Homer Simpson
- ✓ @@@@:^) = Marge Simpson
- ✓ (:V) = PacMan

Summary

This paper deals with the phenomenon of computer slang. Slang words are characterized by the fact that they are not coined as words belonging to the standard vocabulary of the language.

They originate as terms of a special group and are considered to be both creative and stereotypical. Stereotypes presuppose using and reproducing different actual and potential word-building patterns, whereas creativity reveals itself in new form and meaning. There are different structural types of computer neologisms: abbreviations, acronyms, initials, signs and symbols.

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STONEHENGE – FOREVER A MYSTERY

Е.А. Федоренко
Научный руководитель – кандидат филологических наук,
профессор Л.П. Маркушевская

Стоунхендж является древнейшим памятником прошлых веков, самым большим в Европе и самым известным дольменом мира. До сих пор ученые так и не пришли к единому мнению, кто и для чего воздвиг это сооружение. Как возводили эти тонны камня? Почему люди до сих пор к ним едут только для того, чтобы прикоснуться, в надежде излечиться и набраться жизненной энергии?

Introduction

There is nothing quite like Stonehenge (fig. 1, fig. 2) anywhere in the world and for 5000 years it has drawn visitors to it. We shall never know what drew people here over the centuries or why hundreds of people struggled over thousands of years to build this monument, but visitors from all over the world come to marvel at this amazing feat of engineering.

Before Stonehenge was built thousands of years ago, the whole of Salisbury Plain was a forest of towering pines and hazel woodland. Over centuries the landscape changed to open chalk down land. What you see today is about half of the original monument, some of the stones have fallen down, others have been carried away to be used for building or to repair farm tracks and over centuries visitors have added their damage too. It was quite normal to hire a hammer from the blacksmith in Amesbury and come to Stonehenge to chip bits off.

The stones we see today represent Stonehenge in ruin. Many of the original stones have fallen or been removed by previous generations for home construction or road repair. There has been serious damage to some of the smaller bluestones resulting from close visitor contact and the prehistoric carvings on the larger sarsen stones show signs of significant wear.

Fig. 1. Stonehenge

Fig. 2. Stonehenge

It's thought that the name Stonehenge originates from the Anglo-Saxon period - the old English word "henge" meaning hanging. So what we have is literally "the hanging stones". Today the word "henge" has a specific archaeological meaning: a circular enclosure surrounding settings of stones and timber uprights, or pits.

Stonehenge was built in three phases. The first stage was a circle of timbers surrounded by a ditch and bank. The ditch would have been dug by hand using animal bones. Excavations of the ditch have shown that the first henge was built over 50 centuries ago. That's where the mystery begins. We haven't just found old bones, around the edge of the bank we also found 56 holes now known as Aubrey Holes, named after the 17th century antiquarian, John Aubrey, who found them in about 1666. We know that these holes were dug to hold wooden posts, just as holes were dug later to hold the stone pillars that you see today. So this was the first stage built about 5,050 years ago, wooden post circle surrounded by a deep ditch and bank.

Then about 4,500 years ago – about 2,400 years before the Romans set foot in Britain, it was rebuilt. This time in stone, bluestones were used which are the smaller stones. These came from the Priscilla Mountains in Pembroke, South Wales (380kms), dragged down to the sea, floated on huge rafts, brought up the River Avon, finally overland to where they are today. It was an amazing feat when you consider that each stone weighs about five tons. It required unbelievable dedication from ancient man to bring these stones all the way from South Wales.

Before the second phase of Stonehenge was complete work stopped and there was a period of abandonment. Then began a new bigger, even better Stonehenge, the one that we know today- this was approximately 4,300 years ago, the third and final stage of what we see now.

The bluestones were dug up and rearranged and this time even bigger stones were brought in from the Marlborough Downs, 20 miles. These Sarsen stones, as they are now called were hammered to size using balls of stone known as "mauls". Even today you can see the drag marks. Each pair of stones was heaved upright and linked on the top by the lintels. To get the lintels to stay in place, the first wood working techniques were used. This was all cleverly designed on the alignment of the rising of the mid summer sun.

How did they get these stones to stand upright? The truth is really known by nobody. It required sheer muscle power and hundreds of men to move one of these megaliths, the heaviest of them weighing probably about 45 tons.

There are some wonderful myths and legends and you can hear them on the audio tour at Stonehenge in nine different languages, English, French, German, Dutch, Spanish, Italian, Swedish, Russian and Japanese. The legend of King Arthur provides a story of the construction of Stonehenge. It is told by the twelfth century writer, Geoffrey of Monmouth,

in his History of the Kings of Britain that Merlin brought the stones to the Salisbury Plain from Ireland. Sometime in the fifth century, there had been a murder of 300 British noblemen by the treacherous Saxon leader, Hengest. Geoffrey tells us that the king, Aurelius Ambrosius, wanted to create a fitting memorial to the slain men. Merlin suggested an expedition to Ireland for the purpose of transplanting the Giant's Ring stone circle to Britain.

According to Geoffrey of Monmouth, the stones of the Giant's Ring were originally brought from Africa to Ireland by giants (who else but giants could handle the job?). The stones were located on "Mount Killaraus" and were used as a site for performing rituals and for healing. Led by King Uther and Merlin, the expedition arrived on the spot on Ireland. The Britons, none of whom were giants, apparently, were unsuccessful in their attempts to move the great stones. At this point, Merlin realized that only his magic arts would turn the trick. So, they were dismantled and shipped back to Britain where they were set up as they had been before, in a great circle, around the mass grave of the murdered noblemen. The story goes on to tell that Aurelius, Uther and Constantine were also buried there in their time.

Stonehenge was formerly owned by a local man, Sir Cecil Chubb, and he gave it to the nation in 1918 and it is now managed by English Heritage on behalf of the Government. In 1986, it was inscribed as a World Heritage Site and you can learn more about this on the World Heritage Site section. It is without doubt one of the finest prehistoric monuments in existence and an even more remarkable mystery.

The area is not special just because of the stones or the archaeologically rich landscape it sits in, but because of the plants that grow there. There is rare sedge grass and even the yellow and grey patches on the stones are tiny, slow growing plants called lichens.

Three kilometres to the north-east of Stonehenge, Woodhenge is another henge monument. Dated to around 2,300BC, originally it comprised six concentric rings of wooden post. It was probably covered with a roof, or perhaps the wooden posts were joined in the Stonehenge fashion. Now, although there is no evidence for animal or human sacrifice at Stonehenge, some believe that the presence of the grave of a young child, found at Woodhenge, would seem to indicate a ritual sacrifice, possibly a dedicatory burial.

Another feature which is worth mentioning, which was built before the stone settings, is the Cursus − which lies to the north. It consists of two straight banks and ditches 90−130 metres apart running 2.8 kilometres in length, from east to west. When it was called the Cursus in the eighteenth century, it was thought to be some sort of racetrack. Some people also think that it has a processional ritual use. However, its true function remains a mystery.

English Heritage is charged with caring for Stonehenge and is committed to its conservation and good management and preservation for future generations. In the landscape around it, the National Trust − who owns nearly 1500 acres − is equally concerned for the well-being of this area. This is a vast prehistoric scene, with Stonehenge as the ultimate expression of the power which held society together at that time.

Stonehenge itself remains a steadfast observer of the world, watching the seasons change thousands of times over. But it also bears witness to movements in the heavens, observing the rhythm of the Moon and, more noticeably, the Sun.

For most parts of the year, the sunrise can't even be seen from the centre of the monument. But on the longest day of the year, the June 21st summer solstice, the rising sun appears behind one of the main stones, creating the illusion that it is balancing on the stone.

This stone, called the "Heel Stone", sits along a wide laneway, known as the Avenue that extends from the northeast corner of the main monument. The rising Sun creeps up the length of the rock, creating a shadow that extends deep into the heart of five pairs of stone trilithons in the shape of a horseshoe that opens up towards the rising sun.

Just as the Sun clears the horizon, it appears to hover momentarily on the tip of the Heel Stone. A few days later, on midsummer's day, the sun will appear once again, but this time, it will begin to move to the right of the heel stone. The same phenomenon happens again during the winter solstice, only it's in the opposite direction and a sunset. Both indicate a change of seasons.

But who would have needed to make this connection between Earth and Sun? The first builders, who may have just started farming the land, might have needed to know when the seasons were about to change. At a later phase in its development, Stonehenge may have been used as some sort of temple, or it could have been an astronomer's tool, used to judge the movements in the heavens.

"Nobody really knows at all what [Stonehenge] was intended for," says Christopher Witcombe, a professor of art history an authority on Stonehenge.

"The fact that it was built over a long period of time makes it difficult to know if it maintained the same function over the time period or not."

But this doesn't mean there aren't a number of theories that set out to explain Stonehenge's purpose. Eighteenth century British antiquarian, William Stukeley, was one of the first people to report seeing the event of the sunrise on that special day in June. This led him to believe that Stonehenge was a temple, possibly an ancient cult centre for the Druids. This theory isn't as popular now.

"When people started paying attention to Stonehenge, back in the 18th century, people like William Stukeley were calling it a temple," says Witcombe. "That sort of association has been more or less attached to Stonehenge for the last two or three hundred years."

Others, like 20th century British astronomer, Sir Norman Lockyer, also saw Stonehenge as a temple, but a temple to the Sun. For him, its significance lay in celebration of ancient Celtic festivals.

But to see Stonehenge as a temple, or retaining a religious quality may just be an assumption. It is a structure that clearly does not resemble a house or hall or anything else secular, which could indicate that it is sacred, according to Witcombe.

"We're also influenced by the fact that a lot of the more complex buildings that survive from the ancient past, like in Greece and Egypt, are buildings that are religious," says Witcombe. "We are presuming that's also the case with Stonehenge."

There are also more than 400 burial mounds surrounding the ancient monument. Many of these graves have been found to contain gold breast plates and other precious metal items. These people may have wanted to be buried close to Stonehenge, which could reinforce a spiritual aspect, or as modern day astronomer Gerald Hawkins says in his book, "Beyond Stonehenge", a concern for life after death.

In the middle of the 20th century, a new theory was born – one that suggests that Stonehenge could have been used as an astronomical calendar, marking lunar and solar alignments. If this is true, it would have held great power for the people who controlled the megalithic monument.

Aside from the sarsen horseshoe trilithons, there are four stones, called "Station Stones" that may have played an astronomical role. These were placed in a rectangle around the main monument, within the ditch and bank that surrounds the circle of stones. These are believed to point out the moonrise, moonset, sunrise and sunset. Only two stand today.

One of the first people to propose the idea that Stonehenge could have been a tool used in understanding the heavens was 20th century astronomer Gerald Hawkins. He proposed that Stonehenge, which he called a primitive astronomical computer, could predict events of the Moon and Sun as well as eclipses. Hawkins discovered astronomical patterns in the station stones, possibly erected in the first phase of building. This connection

was made by computer calculation, based on maps and charts. It led him to believe that because astronomical properties could be found in two aspects of the monument, there is definite evidence of a heavenly purpose.

Modern day astronomer, Fred Hoyle, tested Hawkins hypothesis. "I set myself the clearcut target of finding out if the stones that exist at Stonehenge could, in fact, be used to predict eclipses − and it seemed to me that they could."

Hoyle took a slightly different approach to Hawkins. His calculations are based on the 56 pits or "Aubrey Holes" first discovered in the 17th century by British antiquary John Aubrey. These holes can be found on the inside circle created by the ditch and bank, or henge. Hoyle believed it was possible to determine eclipses by moving three markers, or stones, around the Aubrey holes in such a way that when all three arrived at the same hole, an eclipse of the Sun or Moon was about to occur.

But Stonehenge may not have always been used in this way, according to Hoyle. He believes that the first phase of building, where it was simply a ditch and bank with 56 pits (the Aubrey holes) carved out on the inner side of the henge, is the only section of Stonehenge that holds astronomical value.

"I was convinced that the inner part, which was built around 1500 BC, was really mostly a matter of simply religious construction," Hoyle says. "I thought the people who built the first structures there, were the cleverest and that the later people didn't know what they were doing."

And there may be many theories that haven't even been explored or discovered yet. One just proposed suggests that Stonehenge is a sexually symbolic site, with both male and female represented in stone.

"In some cases, some of these ideas may initially sound a bit wacky, but you never know - there may be one or two aspects of them which may indeed have some bearing," says Witcombe.

Although the purpose of the stone monument is still unsure, most people think its worth preserving, for one reason or another.

Summary

Stonehenge and its purpose remains an enigma even now, more than 4,000 years after it was first begun. It could have been a temple, an astronomical calendar, or guide to the heavens. Despite the fact that we don't know its purpose for certain, Stonehenge acts as a prehistoric timepiece, allowing us to theorize what it would have been like during the Neolithic Period, and who could have built this megalithic wonder.

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COMPARISON OF HI-END POCKET PC PDAS

В.П. Михайленко
Научный руководитель – Т.В. Примакина

Карманные персональные компьютеры (КПК, наладонник, палмтоп) – это компьютеры, помещающиеся на ладони или в кармане. Они были изобретены первоначально как персональные органайзеры, но со временем стали более универсальными. КПК можно использовать как блокнот, органайзер, игровая приставка. На нем можно читать книги, выходить в Интернет и слушать музыку. Одним словом, КПК – это то, что нужно пользователю, когда доступ к настольному компьютеру невозможен.

Introduction

Personal digital assistants (also called PDAs) are handheld devices that were originally designed as personal organizers, but became much more versatile over the years. A basic PDA usually includes date book, address book, task list, memo pad, clock, and calculator software. Newer PDAs also have both color screens and audio capabilities, enabling them to be used as mobile phones, web browsers or media players. Many PDAs can access the Internet, intranets or extranets via Wi-Fi, or Wireless Wide-Area Networks (WWANs).

What is a Pocket PC?

According to Microsoft, the Pocket PC is "a handheld device that enables users to store and retrieve e-mail, contacts, appointments, play multimedia files, games, exchange text messages with MSN Messenger, browse the Web, and more."
From a technical standpoint, "Pocket PC" is a standard from Microsoft that sets various hardware and software requirements for mobile devices bearing the "Pocket PC" label. For instance, any device which is to be classified as a Pocket PC must:
- Run Microsoft's Windows CE, PocketPC edition
- Come bundled with a specific suite of applications in ROM
note: the name Windows Mobile refers to both the Windows CE operating system and a suite of basic applications
- Include a touchscreen
- Include a directional pad or touchpad
- Include a set of hardware application buttons
- Be based on an ARM version 4 compatible CPU, Intel XScale CPU, MIPS CPU or SH3 CPU. (Pocket PC 2002, previously codenamed Merlin, works only with ARM-based CPUs.)
A Pocket PC runs Windows Mobile operating system(based on Windows CE and .NET), which is pared-down version of Windows. It has the same look, but not all of the features of Windows. You'll see familiar Start Menu, taskbar, Control Panels (called Settings). Navigation is pen-based, or you can use your finger if you aren't afraid of scratches and smudges on the screen. Windows Mobile 2003 Second Edition offers both landscape and portrait orientations and support for VGA resolution. All have one or two expansion slots (Compact Flash and SD) which allow you to add more memory, modem, network cards, etc. Most Pocket PCs have a USB sync connector, to synchronize with Microsoft Outlook.
Pocket PCs are generally a bit larger than Palm OS devices (the main difference is in the OS running on the PDA), though some models are now as small as some Palm OS PDAs. You'll get the following applications with Pocket PCs: Pocket Outlook for mail, calendaring, contact and task management, a Notes Application, Pocket Internet Explorer, Pocket Word and Excel. Input is done using the stylus and the on-screen keyboard or built-in joystick, or via handwriting recognition programs included with the units.

Pocket PC models with Windows Mobile Phone Edition include cellular phone, and are available on CDMA networks as well as GSM networks. Non-Phone Edition models do not have built-in mobile phones.

They all include a stereo headphone jack and Windows MediaPlayer, which can play MP3 files and Windows Media format movies (ASF and WMV). There are several free and commercial video players that can play MPEG1, AVI and DivX files. You get Pocket Word, Pocket Excel, and Pocket Internet Explorer as well as a calculator, MSN Messenger and Pictures for viewing photos. Many come with Terminal Services and MS Reader. Handwriting recognition is a part of the operating system and works well.

All PPCs come with MS ActiveSync, the desktop synchronizing application for Windows desktops. It syncs your Outlook data to the PDA (you can select what will be synced, for example: you can choose to sync contacts but not email if you desire). ActiveSync supports "partnerships" with 2 different computers (i.e. home and work) on the Pocket PC, and file/application install capabilities (in "guest" mode) from as many PCs as you like. You'll also use ActiveSync to install applications and transfer files to the PDA and to backup the PDA. Unlike Palm OS PDAs, backup isn't automatic, so do remember to choose the backup menu item in ActiveSync on the PC regularly to backup the PDA, or turn on automatic backup.

Battery life averages three days on a charge with average use. All Pocket PCs (and Palm OS devices except the Tungsten T5) will lose all data stored in memory if the battery drains completely. So do remember to charge your Pocket PC and back it up too!

Most PPCs have 32, 64 or 128 Megs of RAM (memory), and 32 megs or more of ROM (where the OS and built-in applications are permanently stored). They run on XScale ARM family processors at speeds of 200 to 624 MHz, depending on the model. The specs vary depending on the price of the unit, just as with notebook and desktop computers. But all of these devices pack quite a lot of power in a small package! Most PPCs also have one SD card slot (generally used for memory cards and SD WiFi cards) and some have a CompactFlash Card slot, generally used for adding more memory (these are the same memory cards many digital cameras use). The CF expansion slot can also accommodate CF modems, wired Ethernet cards, Bluetooth cards and WiFi (802.11b wireless Ethernet networking) cards. Current Pocket PCs with CF slots can accept both type I and II cards. The older high end iPAQs (3600/3800/3900 and 5000 series) could slide into an accessory sleeve that allowed them to use PCMCIA cards such as the Toshiba PC Card 2 and 5 gigabytes hard drives and full size PCMCIA network/wireless cards such as the Verizon AirCard. In the end of 2004, HP announced that they would no longer manufacture sleeve compatible iPAQs.

All Pocket PCs come with IrDA infrared ports, a 3.5 mm stereo headphone jack, a stylus, built-in speaker and microphone, syncing cradle or cable, rechargeable Lithium-Ion battery, color display and hardware-based navigation buttons. Several models feature integrated WiFi and/or Bluetooth wireless networking.

So the PPC has Palm functionality, often with greater processing, memory and graphics capability than many (but not all) Palm OS PDAs. The Pocket PC operating system is more demanding however, so it needs more processing power and memory compared to Palm OS PDAs.

A Little History of Windows Mobile

Windows Mobile 5.0 was released in the early summer of 2005. Windows Mobile 5 devices began hitting the market in September 2005. They offer all of the features of Windows Mobile 2003 SE, and add improved mobile versions of Internet Explorer, Word, Excel and Outlook. WM 5 adds PowerPoint Mobile, which can read and display PowerPoint presentations, basic GPS driver support (drivers are no longer required for GPS devices) and

more. The user interface was improved to make one-handed operating possible (still a ways to go here), and to make the device more intuitive.

Windows Mobile 2003 Second Edition was announced in the summer of 2004. It varies little from Windows Mobile 2003. The most significant feature of Second Edition is the ability to support larger displays such as VGA (Pocket PCs have always had QVGA 240 x 320 displays) and both portrait and landscape display orientations.

Windows Mobile 2003 (sometimes called Pocket PC 2003) was introduced in June 2003. It has many similarities with the original Pocket PC 2002 operating system, but it has numerous bug fixes, a better version of Pocket Internet Explorer that supports many current browser standards, improved networking capabilities and support has been added for XScale optimized applications. It's built in the Windows CE 4.2 core, while older versions are built on Windows CE 3.0.

Pocket PC 2002 was introduced in the end of 2001. It's similar to the original Pocket PC operating system, but the user interface and networking capabilities were significantly improved. Generally, Pocket PC 2002 units physically differ from their Pocket PC forbears in 2 ways: they have more built-in memory for storage, and faster processors. Pocket PC 2002 models were replaced by Pocket PC 2003 models in the summer of 2003. The original Pocket PC OS and models were introduced by Microsoft on April 19, 2000. Models with WinCE are discontinued and were replaced by Pocket PC 2002 in the end of 2001.

History of the Personal Data Assistant (PDA)

Genesis. Back in the late 1970s and early '80s, if you wanted to make a note of someone's phone number, you either used a notepad, a diary organiser or a Rolodex^{TM}, which was hardly portable(You've probably seen a Rolodex. It's that rotating card index device that sits on a desk. You can remove and add cards as you wish. The cards are slightly bigger than a business card.). Of these, only the latter was searchable as it could be continually re-organised into alphabetical order. What was needed was something that could be organised to an order that suited the user, could be configured to their needs, was portable and above all, was easy to use.

The Ringbound Organiser. The ringbound organiser, commonly called the Filofax (Although there was another popular one later called Time Manager and others that were more a general organiser, such was the success of the Filofax that the brand name has evolved into a generic term for similar organisers.), entered the popular scene in the late 1970s and early 1980s, and the yuppies saw that it was good. It became their symbol. It was small, about the size of an A5 page, and came in a variety of colours and textiles, including genuine leather. It contained a basic set of sheets for diary, notes, addresses and phone numbers, tasks and other office-related activities, plus dividers to keep each section separate. They used up to six rings, rather than the conventional two so that the pages could not move around and therefore the holes would not tear thus keeping the pages secure from falling out.

However, what made it unique was that the user could purchase new sheets for it, like the next year's diary, and other sections for almost any task you care to mention. There were sections for projects, meetings, minutes, maps, travel information, etc. There were even some computer applications that could print pages that would fit in the Filofax.

Believe it or not, the Filofax was first created on 6 June, 1921, by Norman & Hill, Ltd. in London. It was based on an American design from World War One (There is an obligatory, but reportedly true story of a soldier in 1943 whose life was saved by a Filofax which deflected a bullet.) and its name means 'file of facts'.

Electronic Organisers. Electronic organisers eventually supplanted the Filofax, but not without a fight. When the first models hit the market, they were expensive and had only a few functions. It took some time before they became a viable alternative to the Filofax.

Conversely to the norm in technology developments, later models increased in size. They also increased in functionality. At first they could do little more than store names and telephone numbers. Later versions could store notes, memos and run a basic daily planner.

All electronic organisers suffered from the same problem: compatibility. Many would not communicate with other devices, and even the ones that would connect to a PC would do so using different formats, so that if you upgraded to a newer model, it was often not possible to copy all your data across to the new machine.

A few manufacturers even created an organiser in a watch. They held telephone numbers and could hold basic schedules.

Evolution

The Personal Information Manager, or PIM, is the direct ancestor of the modern PDA. It set out all the ground rules that modern PDAs still follow. These included:
- PC link
- Standard functions, including calendar, address book, etc
- User-friendliness
- Stylus input (on some models)
- Upgradable with new software by PC link

These features made the PIM a formidable tool of its day. Most had the ability to link to a PC to back-up files, synchronise with email and set up alarms from the calendar. Some could communicate with each other, usually using cables or infrared (IR). Again these suffered from compatibility issues with other manufacturers.

The PC link also allowed the user to install new software and download files. They could read large numbers of emails on the move and write responses to them, play games and the PIM introduced the idea of the portable e-book to the general public. The user could install software and download entire books to the PIM and read them on the go. This was an entirely novel concept.

The leading PIM manufacturers tended to be the same companies that were famous for their electronic organisers, companies like Sharp and Casio. One of the more famous PIM manufactures was Psion. Their first organiser looked like a mutant scientific calculator and was the same size and weight as a standard brick (it is classed as a PIM by most because it had a PC link ability, but lacked the usability of a PDA). It has an ABC keyboard, rather than a QWERTY and only a two-line display. Still, despite its apparent cumbersome appearance and limited abilities in comparison to modern machines, it was very powerful and very useful. At one time Marks and Spencer in the UK used them for stock control in their stores and it was a common sight to see an assistant punching away at one. They were the yuppies' first machine of choice to replace their ageing Filofaxes.

The Modern Outlook

The leader until 2005 was the PDA. Most people will be familiar with their overall design. Most are closely based on the highly successful Palm Pilot and HP iPAQ models, using a stylus input on a touch sensitive screen and scratch pad (an area off the screen to write numbers in – ie, to prevent scratching the screen.). Arguably the very first PDA like this was a device called the Apple Newton (the Apple iPod bears a remarkable resemblance to the Newton). It featured a touch-sensitive screen and a stylus to enable the user to write on it. It also came equipped with innovative handwriting recognition software that, once trained to the user's handwriting, could accept an entire word at a time and convert it into text on the screen. This is something that even modern PDAs cannot do. Unfortunately, as with many PDA designs, it was ahead of its time.

The recognition software was about 85% accurate. This sounds good, but in effect means that it misinterprets 15% of the letters entered into it. This is most famously satirised in an episode of The Simpsons, where the text 'Beat Up Martin' becomes 'Eat Up Martha'.

Other designs have gone after the Psion style, a fold-out design that resembles a small laptop computer – however, this design has fallen out of fashion due to the overall size of the device and the keyboard input makes it hard to use on the move without a surface to work on. Successful models (all called 'Series') include the Psion 3C, Sienna, 5, 5MX7, Revo (a cut down, smaller series 5MX) and the Psion 7, the only one of its brothers to bear a full colour screen. Psion stopped making PDAs in the late 1990s. Most could install new software and some had expansion slots for extra memory or devices, like modems.

The third common design is a clam-shell – this is currently rare, but used by some of Sony's Clie PDAs, where the device folds out with a screen and camera on the upper section and a full QWERTY keyboard and scratch pad on the lower.

Smartphones

Smartphones are devices that are very similar to network-enabled PDAs, but are designed to function as a phone first, with added subordinate PDA functionality. Examples include the Sony Ericsson P800 and P900, the Nokia 6600, Motorola MPx200, Siemens SX1 and many of the new 3G phones, such as the Motorola A835 or the NEC e808.

Operating Systems

The main operating systems used by PDAs are:
- Palm OS
- Symbian
- Windows Mobile

Palm OS was developed for the Palm Pilots and is very user friendly. It comes with conversion software to enable the user to read Word, Excel and Powerpoint files.

Symbian was originally part owned by Psion and wrote the successful EPOC software that will be familiar to any Psion owner. It acts in a similar way to Windows, allowing the user to create directories, move and copy files and view properties. It is fully compatible with Microsoft Windows, and can convert most Office documents. Sony Ericsson devices still use it.

It is worth pointing out that many PIMs had their own operating system also. The Sharp series used a system called 'Synergy' and Casio used 'PVOS' for their highly successful Pocket Viewer series.

Compatibility

With these new devices has come a new wave of compatibility between them. Most now share a common communication method, Bluetooth; a wireless communication system using radio signals. Data can be sent from one PDA to another via Bluetooth even if they are from different manufacturers. This has led to a new phenomenon called blue-jacking, where a person sends an empty phonebook entry with a message in the title, so that anyone nearby with their Bluetooth on gets a message.

Hi-End Pocket PC

Hi-End Pocket PC profile has distinctive features, we can define some general ones: two slots for extension, two wireless adapters, VGA-screen, relatively big dimensions, price of $500–600. Very often expensive PDAs are positioned as corporate devices and thus have no cameras.

Asus A730W is the modification of Asus A730, it differs from Asus A730 in an integrated Wi-Fi module, larger RAM, extended standard kit and the shell color. At first I

didn't want to include the A730 in the list, but different productivity performance and different standard kits made me enter both models in the list.

Here we have Fujitsu Siemens Pocket LOOX 720 and 718 modification, which I'll treat the same, Fujitsu Siemens Pocket LOOX 718 has no camera and is cheaper.

Well, my list involves 5 handhelds:

Asus MyPal A730
Asus MyPal A730W
Dell Axim X50v
Fujitsu Siemens Pocket LOOX 720
HP iPaq hx4700

Design

All of the current handhelds has a successful design. Each model has its individuality. No doubt, professionals worked out the design. I won't judge, which model has a more interesting design or looks more attractive. Within their own product lines, these models carry the best design.

Assembly quality, dimensions, weight

As for the quality of the shell, the model by HP stands out from the line – most of it is made of magnesium alloy. Other handhelds feature high assembly quality, but still they are made of plastic. There is a certain backlash in FS LOOX 720 (depending on the sample) and Asus A730. In all, HP iPaq hx4700 has better assembly quality, and other models stay at the same level.

HP iPaq hx4700 is the biggest and the heaviest model (due to its large screen and capacious battery), and Asus A730W – the smallest.

	Asus A730	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
Height, mm	117.5	131	122	119
Width, mm	72.8	77	72	73
Depth, mm	16.9	14.9	15.2	16.9
Weight	170 g	186.7 g	170 g	175 g
Material	Plastic	Magnesium alloy	Plastic	Plastic
Manufacturer	Asus	HTC	HTC	HTC

All models are equipped with two slots, i.e. they are definitely bigger than single slot PDAs and weighty compared with HP iPaq 1940, for example. Many still postpone the purchase of a VGA Pocket PC waiting for smaller size solutions, however there is none at the moment. Talking about dual slot models, we can say that Dell, Fujitsu Siemens and Asus have almost optimal dimensions. You won't feel its weight or size, when the handheld rests in the pocket of the jacket or in the belt case, but not in the pocket of the shirt or jeans.

Ergonomics

This time again HP handheld stands out for its ergonomics – there is a touchpad instead of an ordinary joystick, like in notebooks, but of smaller size. There are two main shortcomings about it – you have to get used to it, even if you had an experience with notebooks, this touchpad isn't adjusted for arcade games. However some of my friends find the touchpad of the iPaq hx4700 very comfortable.

The ergonomics of FS Pocket LOOX 720 is close to the classical ideal. The device has convenient grooves at sides and big buttons and the joystick, it lies comfortably in hand, and it's the only model with the scrolling wheel. With the default settings the buttons have a backlash, which prevent from playing arcade games and emulators. It's possible to improve the situation by switching off the button hold function, for example with ButtonHold Switcher.
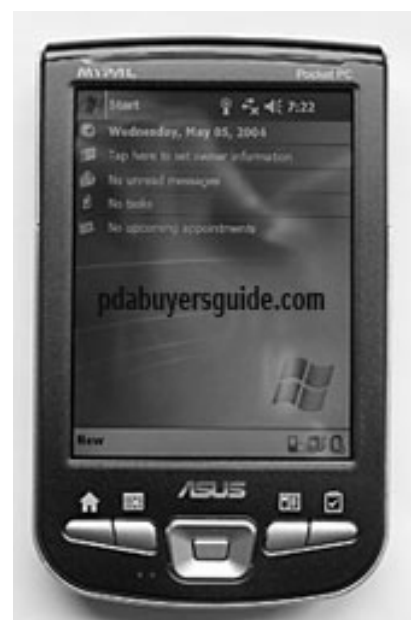

HP iPaq hx4700

FS LOOX 720

Dell Axim X50v

Asus A730

Dell X50v lacks the scrolling wheel. The joystick and buttons have no backlash, however they are too small and located very close to each other, providing little comfort in gaming.

Asus model fits games better with its comfortable buttons. If you plan to use your Pocket PC as a game console, I advise to pay attention to Asus A730 or FS LOOX 720, Dell

X50v is less appropriate here, and HP iPaq hx4700 isn't designed for it at all. The winner in ergonomics is FS LOOX 720 (the scrolling wheel, comfortable big buttons and grooves at sides).

Standard kit

Let's pass over to the standard kit of the VGA Pocket PCs. Almost all handhelds come with cradles. Asus and Fujitsu Siemens add to the package extra styluses. Asus A730W has the fullest kit, which includes a USB-host cable to plug peripherals and an extra battery of extended capacity. Dell and HP models have comparatively poor packages.

	Asus A730	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
PDA	+	+	+	+	+
Extra stylus	+	+	–	+	–
Cradle	+	+	+	+	+
Cable for charging without the cradle	+	+	+	+	+
USB-host cable	–	+	–	+	–
Carrying case	+	+	–	+	+
Screen protective cover	–	–	+	–	–
Extra battery	–	+	–	–	–
Manual	+	+	+	+	+
CD with the software	+	+	+	+	+

All these PDAs can be charged without the cradle and via USB. HP iPaq hx4700 lacks the carrying case, but there is a translucent screen cover instead. I think, there is no need in the case, if you handle the PDA carefully, the screen cover will be enough. Dell and Fujitsu Siemens supplied simple and cheap-looking cases in the kit. They will do at first, till you buy a good case. The vertical case for Asus model deserves some good words – it can be attached to the belt, has a wrist strap, soft inside, closed by hidden magnet lock. It makes pleasant impression.

Comparison of displays

One of the most important criteria in the PDA choice is the screen, you should pay due attention to it. All PDAs can be divided into two groups. The first group includes screen made by Sony – HP and Fujitsu Siemens models. The rest models with matrixes by Sharp belong to the second group. Sony matrixes prove to be fairly better with viewing angles, brightness, the image doesn't get inverted, even if you look at a zero angle. Subjectively they render colors better.

	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
Diagonal claimed	3.7"	4"	3.6"	3.7"
Real diagonal	3.68"	3.96"	3.56"	3.68"
Backlight levels	7	52	10	7
Auto backlight	–	+	–	–
Manufacturer	Sharp	Sony	Sony	Sharp/Samsung

HP iPaq hx4700 is equipped with the best screen, which is the major plus of the device. It's bigger and has a wide backlight settings range, a perfect minimum backlight level, it's good under the sun, there are auto backlight settings depending on the illumination. In a word, it is the best. Then goes the screen of the LOOX 720, the device features less backlight levels, a shorter diagonal, the image quality is that by Sony (viewing angles, color rendering). The third place is shared by Dell and Asus, both models have comparable features. If we have a closer look at the models, we'll notice that white colors on the Asus screen get somewhat blue, but you'll see it with the naked eye, only if you lay HP and FS handhelds with it.

The HP screen is larger by 0.3–0.4" compared with others. There is an opinion that only screens with a 4" diagonal (not less) can ensure a normal work with the VGA screen. I think it's not true, other diagonals do provide a comfort work. Yes, there is a certain difference, like between 15" and 17" monitors, but that's not crucial.

Battery life

All the models are equipped with removable Li-Ion batteries of different capacity.

	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
Removable	+	+	+	+
Battery type	Li-Ion	Li-Ion	Li-Ion	Li-Ion
Standard battery capacity	1100 mAh	1800 mAh	1640 mAh	1100 mAh
Extended battery capacity	1100 mAh + 1800 mAh (jacket)	3600 mAh	–	2200 mAh
Weight of PDA with extended battery	118 g	~86 g	–	51 g
Weight of extended battery	288 g	~230 g	–	197.6 g

HP iPaq hx4700 is an absolute leader in battery life test, it lasted longer in all modes, another plus for this model. FS Pocket LOOX 720 performed also well. Asus and Dell PDAs stay behind due to weaker batteries.

Interface

The standard Bluetooth + Wi-Fi pair is available in all these models, except for Asus A730, which has only Bluetooth.

	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
Bluetooth version	Bluetooth 1.1	Bluetooth 1.2	Bluetooth 1.2	Bluetooth 1.2
Broadcom drivers	1.4.1 b54a	1.5.0 b2000	1.5.0 b1800	1.5.0 b2600
hands-free/headset profile	–/+	+/+	+/+	+/+
Simultaneous work of Wi-Fi + Bluetooth	+	+	+	+
Dynamic for VoIP	–	–	+	–
Wire headset	+	+	+	+
Wi-Fi version	802.11 b	802.11 b	802.11 b	802.11 b
WEP/WPA security	+/+	+/+	+/+	+/+
IrDA	SIR	SIR/FIR/CIR	SIR/FIR/CIR	SIR/CIR

Bluetooth. These models come with Broadcom drivers, which have long become a kind of industry standard. We faced no problems with Bluetooth functionality, all profiles worked smoothly. The built-in Bluetooth radio technology enables Internet access via the phone, data synchronization with PC, data exchange, creation of local networks, gaming and so on within 10 meters distance.

Wireless-Fidelity. Wi-Fi standard wins more and more popularity in the world, mainly due to Intel Wi-Fi has become almost an integral part of new handheld computers and notebooks. It can be used to enter the Internet within wireless access zone and from the home access point, as well as to make calls via Internet (VoIP). In all, wireless modules in all given models work at the same level. Built-in utilities for Wi-Fi are weak (for example, you can't set WPA in the LOOX 720, however as a matter of fact this PDA supports this wireless connection security standard), you'd better install some exterior manager such as PocketWinC.

IrDA. An infrared port can differ in speed: Slow Infrared (SIR, 115 kbps), Fast Infrared (FIR, 4 mbps). There is also Consumer Infrared (CIR) that features long distance effect, it can control remotely home appliances. We won't go into details, just tell you that there is no PDA with full CIR support, only SIR or FIR with different signal power. That's why you can use them as a remote control, the maximum active distance varies from 20–30 cm to 10 m depending on the chip.

External and internal memory

All top Pocket PCs carry from 64 to 128 MB onboard. A part of this size is busy with the operating system at the start, in the specifications you come across this size usually. As a matter of fact less memory is available – some of it is busy with preinstalled applications and some of it is additionally reserved by the OS. 40-50 MB of RAM is usually enough for the normal functioning, and 30 MB is already tight (you have to think of other places than RAM to install applications). However large RAM is not always good: the copy of the reserve memory is larger, and the battery life in the standby mode gets shorter (only memory is fed).

	Asus A730	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
RAM	64 MB	128 MB	64 MB	128 MB	64 MB
Available RAM	45.45 MB	107.43 MB	62.28 MB	123.23 MB	61.78 MB
Actual available RAM	33.05 MB	94.2 MB	48.67 MB	113.52 MB	48.18 MB
Available integrated Flash	19.22 MB	19.22 MB	85.06 MB	28.68 MB	91.43 MB

Taking into account prices for flash cards and the size of internal flash memory, the latter is of little use. Besides its speed is too low. It can be used to backup data and store small files (it's of help in the iPaqs, as when the battery is drained to 10%, external cards get switched off).

All the models have both SD/MMC and Compact Flash slots. Thus there is no problem in extending total memory size to 5–6 GB (the package with 1 GB SD + 4 GB CF costs some $430). Each slot can be used to plug peripherals (for example, GPS receiver).

Dell X50v is leading with its storage card speed, and Flash memory is very slow in all PDAs. The maximum read speed makes up 2.1 Mbps (Dell X50v). However, in the USB 2.0 card reader the same SD card can be read at 9.6 Mbps. That is, the read speed in the PDA isn't limited by the card speed, but by the slot speed. The read speed from the Flash memory is low.

As for the write speed the results are similar – the speed is up to 1.3 Mbps, and much less for the integrated Flash memory. In the USB 2.0 card reader the write speed makes up 2 Mbps, compared with the slot speed the lag is less.

PDAs do not deal with stream video and do not convert DVD files. In all, there is no need in high speeds. In usual usage you won't notice the difference in slot speeds, the extreme speeds prove to be unclaimed.

Sound

All PDAs have the standard 3.5 mm audio jack, so you can use your favorite headphones.
The sound quality in Fujitsu Siemens, HP and Asus is high, it's possible to use these handhelds as an MP3 player. The model by Dell has subjectively worse quality because the sound post processing is off. HP iPaq stands out for its very high maximum sound volume. Well, there is nothing more to add here.

Productivity

All these Hi-End Pocket PC are equipped with Intel XScale processors. You can manually adjust the clock rate on all models except for HP iPaq hx4700. See the table below:

	Asus A730W	HP iPaq hx4700	FS LOOX 720	Dell Axim X50v
Processor maker	Intel	Intel	Intel	Intel
Type	XScale PXA272	Xscale PXA270	Xscale PXA272	Xscale PXA270
The highest clock rate	520 MHz	624 MHz	520 MHz	624 MHz
Manual clock rate adjustment	+	–	+	+
Graphics subsystem	–	ATI Imageon 3220	–	Intel 2700G
Acceleration type	–	2D	–	2D/3D
Video memory	–	2 MB	–	16 MB

I've used the SPB Benchmark package to test the productivity.

HP iPaq hx4700 is on the top. See also that Asus A730W gained much higher speed compared with Asus A730. Dell X50v comes last, however with a slight gap from others, because the test didn't involve graphics subsystem, and standard interfaces, for example GAPI, aren't adjusted to the 2700G accelerator. Thus we have the following picture, under the graphics test (with Game API) the device with the graphical accelerator is behind the others. Note, there is an exterior GAPI driver optimized to Intel 2700G.

The maker of the graphical chip Intel had to provide some explanations to the public. It says, currently programs (including graphic test packages) and games do not involve high level API (Application programming interface), such as GDI, OpenGL ES and Direct3D Mobile, each application should be optimized to certain hardware (ATI Imageon, Intel 2700G). That means, in near future before the switch to high level API, programs and games are divided into two camps: the one supports graphical accelerators and the other – don't. This process is familiar to the computer industry, remember first graphical accelerators for PC, when games were specially adapted to 3Dfx. The same way will follow handheld computers, probably the process will take less time, but not an instant. And now we have to put up with the fact, the majority of applications do not use opportunities of application programming interface.

Software

All given handhelds are powered by Windows Mobile 2003 for Pocket PC SE.
Let's compare the set of additional applications, whether preloaded or stored on the CD.

	Asus A730	HP iPaq hx4700	FS LOOX 720	Dell X50v
Preloaded extra applications	Asus Backup; Asus Camera; Asus Launcher	Pocket Informant 5; ClearVue PDF; ClearVue Presentation; DockWare; HP Image Zone; HP Protect Tool; iTask	Album; E2C; FSC Backup; FSC SpeedMenu; Camera	Switcher Bar; Data Backup; Home
Full versions on CD	Only trail versions, non-adapted to VGA. Calculator, some simple games and the software to work with the Chinese language.	ClearVue Office Suite	None	Enigmo; Stuntcar Extreme
Voucher to buy the software	www.mmcode.com activate applications from the bonus-CD	4 points at www.iPaqchoice.com	5 points at www.PocketLOOX-Choice.com	None

Almost all models have the voucher for certain number of points (see the table above), which can be exchanged for applications at special sites. So you have a chance to get very good application by this way. HP iPaq has the richest package, Pocket Informant is of great value. Dell model has a poor set of preinstalled applications, an extra CD with 2 games compensate for it in part. Asus A730 features the poorest set of preinstalled programs, and the extra CD has an unclear set of trial applications. Besides they are adapter to VGA-resolution, among them you can come across the map of Hong Kong or the program to work with the Chinese language.

To complete this chapter, I'll note, all basic applications for Pocket PC are already adapted to VGA-resolution by developers, the situation was improved since the release of Toshiba e800. The only weak point here, there is a shortage in really good games, fully adapted to VGA-resolution, you can count them by fingers of your hand.

Built-in cameras

As I said in the very beginning, the presence of the built-in camera greatly restricts the corporate use of PDA, the devices equipped with built-in cameras are often the subject to ban. For example, influenced by corporate customers Fujitsu Siemens had to release the modification Pocket LOOX 718, which wasn't initially planned. Only Asus has no version without the camera. I won't go into details with cameras of Asus A730 and FS Pocket LOOX 720, just in brief. The picture quality is comparable in both models, the flash is useless, the model by Asus has richer camera settings, however the camera itself is slower.

The Future

Future products currently in development include a speech-to-text interface. You say it, it types it. This is already available on desktop computers, but at present requires time to train

the program. It also needs a boom microphone attached to headphones, so that the microphone stays a constant distance from the user's mouth, and it is very susceptible to background noise. As the PDA would be used outside and in noisy offices, it would need to overcome this problem. One suggested solution even included a camera so that the device could lip-read.

However you feel about PDAs, you are likely to see a lot more of them in the future. With their wireless connectivity, they will start to integrate themselves more and more into everyday lives. People have already started using them for dating; the PDA transmits what kind of person it is owned by and what type of person they are looking for. When it finds a match in the room, it alerts its user.

Summary

The price for these models varies about $600, only Asus A730 stands out with $500. Let's give marks from 1 to 10 to all PDAs in the assessment by main features to complete my review.

Indicator	Asus A730	Asus A 730 W	HP iPaq hx4700	FS LOOX 720	Dell X50v
Ergonomics	8	8	6	9,5	7,5
Screen	7,5	7,5	10	8,5	7,7
Battery life	7	7,5	10	9	7
Price, Europe	$510	$570	$620	$600	$600

I think, the price, the ergonomics, the battery life and the screen are the key features. In my opinion the handhelds are ranked in the following way:
1. Fujitsu Siemens Pocket LOOX 720
2. HP iPaq hx4700
3. Dell Axim X50v
4. Asus A730W
5. Asus A730

I tried to make the most objective comparison I could, in different views, considering different features. All the PDAs I tested do differ from each other, I can't say for sure one of them is worse than others: every model has its peculiarity.

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MATHEMATICS, ITS THEOREMS, AXIOMS AND PARADOXES

Л.А. Хамитова
Научный руководитель – С.А. Ермолаева

Тема доклада «Математика, ее разделы и нерешенные проблемы». Статья носит обзорный характер. В статье описываются основные разделы математики, упоминается о парадоксах математики.

Introduction

The students of math may wonder where the word "mathematics" comes from. 'Mathematics' is a Greek word, and, by origin or etymologically, it means "something that must be learnt or understood", perhaps "acquired knowledge" or "knowledge acquirable by learning" or "general knowledge". The word "math" is a contraction of all these phrases. The celebrated Pythagorean School in ancient Greece had both regular and incidental members. The incidental members were called "auditors"; the regular members were named "mathematicians" as a general class and not because they specialized in math; for them math was a mental discipline of science learning. What is math in the modern sense of the term, its implications and connotations? There is no neat, simple, general and unique answer to this question.

Math is a science, viewed as a whole, is a collection of branches. The largest branch is that which builds on the ordinary whole numbers, fractions, and irrational numbers, or what collectively, is called the real number system. Arithmetic, algebra, the study of functions, the calculus, differential equations, and various other subjects, which follow the calculus in logical order, are all developments of the real number system. This part of maths is termed the math of number. A second branch is geometry consisting of several geometries. Math contains many more divisions. Each branch has the same logical structure: it begins with certain concepts, such as the whole numbers or integers in the math of number, and such as point, line and triangle in geometry. These concepts must verify explicitly stated axioms. Some of the axioms of the math of number are the associative, commutative, and distributive properties and the axioms about equalities. Some of the axioms of geometry are that two points determine a line; all right angles are equal, etc. From the concepts and axioms theorems are deduced. Hence, from the standpoint of structure, the concepts, axioms and theorems are the essential components of any compartment of math. We must break down maths into separately taught subjects, but this compartmentalization taken as a necessity, must be compensated for as much as possible. Students must see the interrelationships of the various areas and the importance of maths for other domains. Knowledge is not additive but an organic whole, and math is an inseparable part of that whole. The full significance of math can be seen and taught only in terms of its intimate relationships to other fields of knowledge. If math is isolated from other provinces, it loses importance [3].

Concepts, Axioms, Theorems

The basic concepts of the main branches of maths are abstractions from experience, implied by their obvious physical counterparts. But it is noteworthy, that many more concepts are introduced which are, in essence, creations of the human mind with or without any help of experience. Irrational numbers, negative numbers and so forth are not wholly abstracted from the physical practice, for the man's mind must create the notion of entirely new types of which operations such as addition, multiplication, and the like can be applied. The notion of a variable that represents the quantitative values of some changing physical phenomena, such as temperature and time, is also at least one mental step beyond the mere observation of change. The concept of a function, or a relationship between variables, is almost totally a mental

creation. The more we study math, the more we see that the ideas and conceptions involved become more divorced and remote from experience, and the role played by the mind of the mathematician becomes larger and larger. The gradual introduction of new concepts, which more and more depart from forms of experience, finds its parallel in geometry and many of the specific geometrical terms are mental creations.

As mathematicians nowadays working in any given branch discover new concepts which are less and less drawn from experience and more and more from human mind, the development of concepts is progressive and later concepts are built on earlier notions. These facts have unpleasant consequences. Because the more advanced ideas are purely mental creations rather than abstractions from physical experience and because they are defined in terms of prior concepts, it is more difficult to understand them and illustrate their meanings even for a specialist in some other province of math. Nevertheless, the current introduction of new concepts in any field enables math to grow rapidly. Indeed, the growth of modern math is, in part, due to the introduction of new concepts and new systems of axioms.

Axioms constitute the second major component of any branch of math. Up to the 19th century axioms were considered as basic self-evident truths about the concepts involved. We know now that this view ought to be given up. The objective of math activity consists of the theorems deduced from a set of axioms. The amount of information that can be deduced from some sets of axioms is almost incredible. The axioms of number give rise to the results of algebra, properties of functions, the theorems of the calculus, the solution of various types of differential equations. Math theorems must be deductively established and proved. Much of the scientific knowledge is produced by deductive reasoning; new theorems are proved constantly, even in such old subjects as algebra and geometry and the current developments are as important as the older results.

Growth of math is possible in still another way. Mathematicians are sure now that sets of axioms, which have no bearing on the physical world, should be explored. Accordingly, mathematicians nowadays investigate algebras and geometries with no immediate applications. There is, however, some disagreement among mathematicians as to the way they answer the question: Do the concepts, axioms, and theorems exist in some objective world and are they merely detected by man or are they entirely human creations? In ancient times the axioms and theorems were regarded as necessary truths about the universe already incorporated in the design of the world. Hence each new theorem was a discovery, a disclosure of what already existed. The contrary view holds that math, its concepts and theorems are created by man. Man distinguishes objects in the physical world and invents numbers and numbers names to represent one aspect of experience. Axioms are man's generalizations of certain fundamental facts and theorems may very logically follow from the axioms. Math, according to this viewpoint, is a human creation in every respect. Some mathematicians claim that pure math is the most original creation of the human mind [2].

Geometry

No doubt the Greeks deserve the highest praise in all these fields. Euclid deducted all the most important results of the Greek masters of the classical period and therefore the Elements constituted the math history of the age as well as the logical presentation of geometry. The effect of this single book on the future development of geometry was enormous and is difficult to overstate.

The creation of Euclidean geometry is more than the contribution of numerous useful theorems. It reveals the power of reason. No other human creation demonstrates how much knowledge can be derived by reasoning alone as have the hundreds of proofs in Euclid's Elements. The necessity for accurate and exact definitions, for clearly stated assumptions and for rigorous proof became evident in Euclid's Elements.

We know much of the material of Euclid's Elements through our high school studies. By studying Euclid, hundreds of generations from Greek times learned how to reason, how perfect logical reasoning must proceed, how to master the procedure, how to distinguish exact reasoning from vague pretence of proof. Even nowadays this masterpiece of Euclid serves as a logical exercise and as a model of reasoning and the art of the mind [1].

Algebra

Algebra is not only a part of math; it also plays within math the role which math itself had been playing for a long time with respect to physics. What does the algebraist have to offer to other mathematicians? Occasionally, the solution of a specific problem; but mostly a language in which to express math facts and a variety of patterns of reasoning, put in a standard form. Algebra is not an end in itself; it has to listen to outside demands issued from various parts of math. This situation is of great benefit to algebra; for, a science, or a part of science, which exists to solve its own problems only, is always in danger of falling into peaceful slumber and from there into a quiet death.

But in order to take full advantage of this state of affairs, the algebraist must have the ability to derive profit from what he perceives is going on outside his own domain. Algebra, like every other modern branch of math and science, continues to proliferate with the vitality and expansiveness of a tropical forest and every particular part of algebra has much new math knowledge that is being discovered, so that the algebraist should keep his eyes open for the small piece that may be of great value to him [2].

Cybernetics

The word "cybernetics" originated from the Greek "Kibernetike", the Latin "gubernator" and the English "governor" all meaning, in one sense or another, "control", "management" and "supervision". More recently Norbert Wiener has used the word to name his book, which deals with the activity of a group of scientists engaged in the solution of a wartime problem and some of the math concepts involved. Nowadays the word has become associated with the solution of problems dealing with activities for computers. As such, the discipline must rely on the exact sciences as well as sciences such as biology, psychology, biochemistry and biophysics, neurophysiology and anatomy.

Before studying computer systems it is necessary to distinguish between computers and calculators. These terms have, by connotation, two distinctly different meanings. The term "calculator" will refer to a machine which can perform arithmetic operations, which is mechanical, which has a keyboard input, which has manually – operated controls. The term "computer" will refer to automatic digital computers which can solve complete problems, are generally electronic, have various rapid input – output devices, have internally – stored control programs. Speed and general usefulness make a computer equivalent to thousands of calculators and their operators. The ability of electronic computers to solve math and logical problems, thereby augmenting the efficiency and productivity of the human brain, has made the sphere of their application practically boundless.

Informatics

We may ask a question what "information" is. In the discussions of computers, the word "information" has a rather special definition. Information is a set of marks that have meaning. In a large automatic electronic computer, information may be recorded and manipulated as sequence of minute electrical pulses which are about a millionth of a second apart; and the presence or absence of a position where either may occur is the basic code which represents

information. "Informatics" is a collection of computer theories and novel information technologies.

In terms of computer development informatics is concerned with the design and construction of electrical or electronic analogs capable of performing processes carried out within a living entity, including the selection and evaluation, as well as the storage of information. In terms of understanding the operation of the human nervous system, informatics contributes new insight into a wide range of processes such as learning, regulation of and the emotional behavior of individual human beings as well as societies. Specifically, the problems of decision – making, thinking and synthesis, imagination and creative endeavor of people, come under the scrutiny of informatics [5].

Mathematics – the language of science

One of the foremost reasons given for the study of maths is to use a common phrase, that math is useful only to those who specialize in science. No, it implies that even a layman must know something about the foundations, the scope and the basic role played by maths in our scientific age.

The language of maths consists mostly of signs and symbols, and, in a sense, is an unspoken language. There can be no more universal or more simple language; it is the same throughout the civilized world, though the people of each country translate it into their own particular spoken language. For instance, the symbol 5 means the same to a person in England, Spain, Italy or any other country; but in each country it may be called by a different spoken word. Some of the best known symbols of maths are the numerals 1, 2, 3, 4, 5, 6, 7, 8, 9, 0 and the signs of addition (+), subtraction (–), multiplication (*), division (:), equality (=) and the letters of the alphabets: Greek, Latin, Gothic and Hebrew (rather rarely).

Symbolic language is one of the basic characteristics of modern maths for it determines its true aspect. With the aid of symbolism mathematicians can make translation in reasoning almost mechanically by the eye and leave their mind free to grasp the fundamental ideas of the subject matter. Just as music uses symbolism for the representation and communication of sounds, so maths expresses quantitatively relations and spatial forms symbolically. Unlike the common language, which is the product of custom, as well as social and political movements, the language of maths is carefully, purposefully and often ingeniously designed. By virtue of its compactness, it permits a mathematician to work with ideas which when expressed in terms of common language are unmanageable. This compactness makes for efficiency of thought.

Math language is precise and concise, so that it is often confusing to people unaccustomed to its forms. The symbolism used in math language is essential to distinguish meanings often confused in common speech. Math style aims at brevity and formal perfection. Let us suppose we wish to express in general terms the Pythagorean Theorem, well-familiar to every student through his high-school studies. We may say: 'We have a right triangle. If we construct two squares each having an arm of the triangle as a side and if we construct a square having the hypotenuse of the triangle for its side, then the area of the third square is equal to the sum of the areas of the first two'. But no mathematician expresses himself that way. He prefers: 'The sum of the squares on the sides of a right triangle equals the square on the hypotenuse'. In symbols this may be stated as follows: $c^2=a^2+b^2$. This economy of words makes for conciseness of presentation, and math writing is remarkable because it encompasses much in few words. In the study of maths much time must be devoted 1) to the expressing of verbally stated facts in math language, that is, in the signs and symbols of math; 2) to the translating of math expressions into common language. We use signs and symbols for convenience. In some cases the symbols are abbreviations of words, but often they have no such relations to the thing they stand for. We cannot say why they stand for what

they do; they mean what they do by common agreement or by definition.

The students must always remember that the understanding of any subject in math presupposes clear and definite knowledge of what precedes. This is the reason why " there is no royal road" to maths and why the study of maths is discouraging to weak minds, those who are not able to master the subject.

Myth in mathematics

There are many myths about math, e.g., that "mathematics is the queen of the sciences"; that the Internet is the cyberspace world- a new universe- and that informatics will reign and dominate throughout the 21st century. Some people believe that only gifted, talented people can learn maths that it is only for math-minded boys, that only scientists can understand math language, that learning maths is a waste of time and efforts, etc.

Another myth in math is that "women cannot be genuine mathematicians". Female applicants must satisfy the same requirements at the entrance competitive examinations as boys should, there are no special tracks for girls. Most female applications assert to have chosen to study maths because they like it rather than as a career planning. The change of high - school maths into university maths is for many of them a real shock, especially in the amount of information covered and the skills that are being developed. Despite this shock the study of higher maths should be available to a large set of students, both male and female, and not to the selected few.

There is no reason that women cannot be outstanding mathematicians and the Russian women mathematicians have proved it. There should be affirmative action to bring women teachers onto math faculties at colleges and universities. One cannot expect the ratio to be 50/50, but the tendency should continue until male mathematicians no longer consider the presence of female mathematicians to be unusual at math department faculty or at the conferences and congresses.

Some ambitions experts claim that they think of mathematicians as forming a world nation of their own without distinctions of geographical origins, race, creed, sex, age or even time because the mathematicians of the past and "would – be" are all dedicated to the most beautiful of the arts and sciences. As far as math language is concerned, it is in fact too abstract and incomprehensible for average citizens. It is symbolic, too concise and often confusing to non – specialists. The myth that there is a great deal of confusion about math symbolism, that mathematicians try by means of their peculiar language to conceal the subject matter of maths from people at large is unreasonable and meaningless. The maths language is not only the foremost means of scientist's intercourse, finance, trade and business accounts, it is designed and devised to become universal for all the sciences and engineering, e.g., multilingual computer processing and translation [4].

Paradoxes inn mathematics

In 1926 F.P. Ramsey proposed a distinction of the paradoxes known at that time into two types: logical or mathematical paradoxes, and semantical paradoxes. Ramsey argued that paradoxes of the latter sort by virtue of making reference to language (meaning, truth, definability) cannot be stated within math, in which there is no reference to such matters, and thus there is no need to consider them at all in attempting to devise ways of avoiding paradoxes within maths. This reasoning is not as conclusive as Ramsey apparently thought, but his classification is helpful and has been widely used.

The most famous of the logical, or math paradoxes is Russell's paradox. This paradox proceeds as follows. First we define a class K, say, as the class of all those classes that are not elements of themselves. The class of dogs, for example, is not itself a dog and this is not an

element of itself. By the definition of K, then, the class of dogs is an element of K. And so are most, if not all, of the classes that first come to mind. Now we ask whether K itself is an element of K. We see immediately that K is an element of K if, and only if, it is not an element of K. It follows by the propositional logic that the class K both is and is not an element of itself. But this is a contradiction, or a paradox. As a well-known example of the semantical paradoxes, we have the paradox of the liar. This paradox, in one form or another, goes back to ancient times. In one of its forms it proceeds as follows. Consider a man who says, "I am lying" and then says nothing further. If this man is telling the truth, then (as he says) he is lying; if, however, he is lying, then he is telling the truth in saying so. It follows by the propositional calculus of logic that he is both lying and telling the truth, which is a contradiction. This paradox is a semantical paradox because it makes reference to certain uttered words, which express a lie. True, this paradox does indeed at first seem frivolous and unworthy of serious consideration. Yet, it is as genuine a paradox as any other, and must be taken seriously if any paradoxes are taken seriously at all. These paradoxes cannot appear within maths, in particular within set theory [2].

Summary

There are two ways in which maths has become so effective in our age. The first is through its relationships with science, the second is through its connection with human reasoning. Math method is reasoning of the highest level known to man, and every field of investigation – be it law, politics, psychology, medicine or anthropology – has felt its influence and had modelled itself on maths to some extent ever since its creation. In order to gain a more comprehensive view of the relation of maths to the sciences, let us analyze the various ways in which maths has been serving scientific investigations.

Maths has been supplying a language for the treatment of the quantitative problems of the physical and social sciences. Much of this language has taken the form of math symbols. Symbols also permit concise, clear representation of ideas which are sometimes very complex. Scientists have learned to use math symbols whenever possible.

Maths has been supplying science with numerous methods and conclusions. Among the important conclusions are its formulas, which scientists have accepted and used in solving problems. The use of such formulas is so common that the contribution of maths in this direction has not been fully appreciated.

Maths has been enabling the sciences to make predictions. This is perhaps the most valuable contribution of maths to the sciences. The ability to make predictions by math means was exemplified in the most remarkable way in 1846 by the two astronomers Leverrier and Adams. As a result of calculations, they predicted, working independently, that there must exist another planet beyond those known at the time. A search for it in the sky at the predicted place and time revealed the planet Neptune. Prediction has played a part in every math solution of a quantitative problem arising in the physical and social sciences.

Maths has been furnishing science with ideas to describe phenomena. Among such ideas may be mentioned the idea for functional relation; the graphical representation of functional relations by means of coordinate geometry; the notion of a limit; the notion of infinite classes which helps us to understand motion. Of special importance are the statistical methods and theories which have led to the idea of a statistical law. The description is not complete without mentioning the fact that for many physical phenomena no exact concepts exist other than math ones.

Maths has been of use to science in preparing men's mind for new ways of thinking. The concepts of importance in science had been coming to men with great difficulty. The concepts of gravity, of energy and of limitless space took years to develop and men of genius were required to express them precisely. Great as is the genius of Einstein, it is almost certain that

he was able to achieve some of his results only because the maths of preceding decades had suggested new ways of thinking about space and time.

To summarize: Maths has been supplying a language, methods and conclusions for science; enabling scientists to predict results; furnishing science with ideas to describe phenomena and preparing the minds of scientists for new ways of thinking.

It would be quite wrong to think that maths had been giving so much to the sciences and receiving nothing in return. Physical objects and observed facts had often served as a source of the elements and postulates of maths. Actually, the fundamental concepts of many branches of maths are the ones that had been suggested by physical experiences. Scientific theories have frequently suggested directions for pursuing math investigations, thus furnishing a starting point for math discoveries. For example, Copernican astronomy had suggested many new problems involving the effects of gravitational attraction between heavenly bodies in motion. These problems had stimulated the further activities of many scientists in the field of differential equations [4].

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PHP: THE BEST WEB-PROGRAMMING LANGUAGE
Д.Б. Сорин
Научный руководитель – Т.В. Примакина

PHP является лучшим языком для веб-программирования в мире. С его помощью можно создавать как большие корпоративные сайты, так и, например, маленькие скрипты для администрирования вашей операционной системы. Нижеизложенный доклад раскрывает преимущества и недостатки этого языка.

Introduction

Internet appeared in the second half of the 20th century. Firstly it was a network connecting different American universities. Afterwards it grew into the biggest network connecting millions of people all over the world. Today's internet is a large variety of different sites. You can find practically everything on the internet. The most famous sites have millions of visitors every day. They have to possess the freshest information. News appears on these sites in a moment. And meanwhile these sites consist of many cascade style sheets, HTML-code (the language of web-pages on the internet), server and client scripts – and these integral parts of the web-page and the whole site occupy the disc and server space. And the daily changing of the content is really hard as it requires the changing of the whole code, changing of the scripts and changing of the whole content. Often these tiresome and hard operations can be divided in some groups of monotonous operations. And the operations in these groups can be carried out in the similar way.

The simple and mostly used goal of the server web-programming languages is to create and give out dynamically generated web-pages. This is the way of fast generating of the content without the straight changing of the code of the site. For example, you have a web-page which consists of many tables, layers and scripts. If you want to add a column or another element to the code of the page, you have to make the changes in the whole code of the page. And if you can use the server web-programming language tools you can for example just insert the text in the text field and the whole content of the site will change. This is very convenient way. You can achieve great changes without great efforts.

The legend of PHP

Nowadays there are a lot of server web-programming languages. Some of them are closely connected with web-servers, operational systems or with the browsers and cannot process without them. These languages are often created by the famous oligarchic corporations which are engaged in almost everything.

ASP.NET was created by the Microsoft Corporation. This corporation has to create all the needed software including the software for web-pages development so that the users wouldn't have a need to choose another platform (UNIX or its twins). The .NET technology was made specially for these needs. Advantage of this technology is deep integration in Windows that allows doing really advanced things. And a disadvantage of this technology is that a server and clients should work under control of Windows and a browser must be Internet Explorer. ASP.NET is the main web software product of Microsoft. ASP.NET is really strong competitor of PHP language that allows to bring all the power of Windows interface in Web-applications. However it is widespread more in the West than in Russia. It is simply the economic factor. In our country hosting-providers prefer to study all and to adjust PHP-hosting on FreeBSD, and in the West hosting-providers cannot allow "free-of-charge" hosting. It is easier to pay for Windows licenses, MS SQL server, but then it is clear from whom to demand the penalty, against whom to bring an action and where to demand updates. The disadvantages of ASP.NET is dependence on Windows platform (and from Internet

Explorer), complexity of development of technology and difficulty of development of Web-applications in comparison with the PHP.

Java was created by the Sun Corporation – a giant who makes money with the sale of servers on the basis of UNIX. As a company selling brand servers it couldn't sell to buyers the empty servers, therefore it developed commercial UNIX and has created Java-technology that is an analogue of ASP.NET in the world of UNIX. The difference between them is that ASP.NET is multilanguage one-platform, and Java is one-language crossplatform technology. The advantages of the Java-technology are: Java is a legend, 90th years have passed under the symbol of Java, technologies that appeared for the first time in it became the standard de facto. Disadvantages: the slow, confused system of libraries, the unreasonable use of memory which the famous collector of dust returns to virtual Java-machine, but not to operational system. At universities Java is preferred because it is a legend. It should be studied at first because the object-oriented approach appeared here in its final variant. The most advanced object-oriented model considerably surpassing object-oriented model C++ in flexibility is realized in it (by the way, developers in PHP try to realize Java-model nowadays, but current realization is still enough raw). At the moment Java is at the decrease. The reason of it: instead of making Java a receiver of C++ (more powerful universal language, as it was supposed all over again), it has transformed into the web-technology including both server and client parts. This technology demands not universal server like Apache but specific that are very whimsical. The technology became enough artificial and complex in development and using, though the ideas that lie in its beginnings are very beautiful and advanced.

Besides there are small firms and communities which create their own languages. Thanks to these groups we have ColdFusion, PHP, Perl, Python and some others.

ColdFusion. In the modern Internet there are sites consisting of CFM-files. CFM – is deciphered as ColdFusion. It is an environment, with own server, own language and own functions. ColdFusion is not widespread nowadays in Russia. As there are few supporting materials for CFML (Cold Fusion Markable Language – like HTML) in Russian. The language itself is simple, functions are enough logical. The interface of ColdFusion Studio program created by Macromedia repeats HomeSite as it is made on the basis of HomeSite. It seems to much, that ColdFusion practically beats off the ability to think. All is done by the automatic device. And in PHP you won't be able to write a simple line if you don't know the syntax. Many people after some years of work on ColdFusion turn to PHP. The reasons – ColdFusion is expensive (though "free-of-charge" hostings on it already have begun to appear), unpopular in Russia and few free scripts are present on it that strongly complicates its studying.

Perl has appeared firstly and unlike ASP and PHP it is not only server language. Simply CGI-programs can be easier created on it than with the help of C. Its strong part is creating of short scripts for administrating of the machines. PHP and Perl are very Unix-oriented languages and the methods of decisions of the problems in these languages are simple and elegant unlike Java and ASP.NET. Perl is the main ancestor of PHP. So PHP is considered to be a descendant of Perl and it's possible to tell that PHP is civilized Perl made specially for web. Perl is specially created for manipulation with the text, for example regular expressions in it are not caused by functions as in PHP – they are the constructions of language (it is the most powerful dialect of regular expressions today). And in general style of a writing the programs on Perl is more "hacker". Perl is not a simple language – it is a culture. People write verses on Perl, compete in making the most intricate program. Giving people an opportunity to read the code stands on the last place in Perl programming, on the first place is put the beauty of the program and elegance of the decision. Although PHP has inherited the majority of the features of Perl, it is more civilized – giving people an opportunity to read the code stands on the first place as PHP is used not as a hobby but for making money. The ideas and the methods in PHP and Perl are often the same but the syntax differs considerably. For

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example Perl functions have no classical parameters, record in a file or a target stream is carried out by the operator <> and regular expressions are written directly in the body of the program.

PHP has appeared later because of the rapid Internet development. It has taken much from Perl, but contains less "hacker" methods and in general is more readable. It is considered to be the most convenient language of web-programming in the world. Any university is very conservative and therefore PHP studying there still isn't widespread. The matter is that the strong evolution of PHP is still going on and the language has still not completely developed. If you develop the applications now you must be ready that in a few years after they should be re-written from the beginning. Standards are absent, adjustments are so flexible, that the code developed for one server can not work for another. Thus, earlier the name of the constructor in a class, as well as in C++ was the same as a name of a class. Since PHP 5 special keywords __construct and __destruct are allocated for the constructor and destructor. Whether the old scheme would be supported is not known. Earlier it was possible to use external variables under their name. Now superglobal arrays are recommended for this purpose (and in following versions it can become the obligatory requirement). Speed of applications' creating on PHP is above than at competitors approximately twice. Its unique disadvantage is that it still has not absolutely developed and its evolution continues. Still JavaScript is to be used in PHP-applications, because PHP is only server language and during the development of large web-applications you cannot avoid the work made on client's part. PHP is a very perfidious language. At the first acquaintance there is an impression, that it as is simple as Visual Basic, but actually it is a little bit intricate and here is the reason of it. The person who knows Delphi, knows that Delphi is logic continuation of Pascal. It is other language, but it logically follows Pascal. Some kind of symbiosis of Pascal and WinAPI. It is very simple: if you know Pascal you will know Delphi, and besides if you also know WinAPI, you will simply be the guru in the field of Delphi. PHP itself is a logic continuation of Perl. As Perl possesses the confused syntax and did not intend for using in web-environment, PHP has very well got accustomed in Web – its syntax is easier, and decisions are terribly simple (beat ASP.NET and Java in the field of simplicity and, hence, in the speed of development). And the goal of PHP is opposition to Java (SUN) and ASP.NET (Microsoft) – therefore here half of functions does not work under Windows, therefore it is so complex for studying: the person studying PHP must firstly study Unix file system, Berkley sockets and the Internet itself (HTTP, mail protocols, RFC etc). And one of the main things of PHP-libraries. In PHP there are original libraries – GDLib (dynamic generation of images), PDFLib (dynamic generation PDF), work with databases etc. As in Delphi it is possible to write the self-made libraries (not in PHP but in C++). It is not necessary to consider PHP to be a simple script language. It is more likely the answer of *NIX communities on Java-technology and ASP.NET. This technology is often named "PHP+Apache+MySQL (all under UNIX)"-community. PHP is the young non-standardized language, frequently inconsistent. It leaves the impression of being non-completed and non-harmonious. If Perl is non-perpendicular and C is perpendicular, PHP is neither Perl, nor C – it is in the middle. It is conveniently, but it is not graceful. The beautiful code can be created everywhere and its beauty will be determined with its harmony and culture. It is possible to create a beautiful code on PHP, simplicity and reading ability are the real attributes of beauty. The beauty of a code is defined not by a code, but by the community of programmers – if it seems to people who read a code it beautiful, it is beautiful. "The black square" itself by Malevich is beautiful but the value of a picture is that a picture is one in a series and it is written in a context of other pictures. The code acts in the same way. It is possible to create a beautiful code on PHP, it is intended for Web and it is the best in the area of web-programming.

PHP history. PHP has come a long way in the last few years. Growing to be one of the most prominent languages powering the Web was not an easy task. PHP succeeds an older

product, named PHP/FI. PHP/FI was created by Rasmus Lerdorf in 1995, initially as a simple set of Perl scripts for tracking accesses to his online resume. He named this set of scripts 'Personal Home Page Tools'. As more functionality was required, Rasmus wrote a much larger C implementation, which was able to communicate with databases, and enabled users to develop simple dynamic Web applications. Rasmus chose to release the source code for PHP/FI for everybody to see, so that anybody can use it, as well as fix bugs in it and improve the code. PHP/FI, which stood for Personal Home Page / Forms Interpreter, included some of the basic functionality of PHP as we know it today. It had Perl-like variables, automatic interpretation of form variables and HTML embedded syntax. The syntax itself was similar to Perl. By 1997, PHP/FI 2.0, the second write-up of the C implementation, had a cult of several thousand users around the world, with approximately 50,000 domains reporting as having it installed, accounting for about 1% of the domains on the Internet. While there were several people contributing bits of code to this project, it was still at large a one-man project. PHP/FI 2.0 was officially released only in November 1997, after spending most of its life in beta releases. It was shortly afterwards succeeded by the first alphas of PHP 3.0. PHP 3.0 was the first version that closely resembles PHP as we know it today. It was created by Andi Gutmans and Zeev Suraski in 1997 as a complete rewrite, after they found PHP/FI 2.0 severely underpowered for developing an eCommerce application they were working on for a University project. In an effort to cooperate and start building upon PHP/FI's existing user-base, Andi, Rasmus and Zeev decided to cooperate and announce PHP 3.0 as the official successor of PHP/FI 2.0, and development of PHP/FI 2.0 was paused. One of the biggest advantages of PHP 3.0 was its strong extensibility features. In addition to providing users with a solid infrastructure for lots of different databases, protocols and APIs, PHP 3.0's extensibility features attracted dozens of developers to join in and submit new extension modules. This was the key to PHP 3.0's tremendous success. Other key features introduced in PHP 3.0 were the object oriented syntax support and the much more powerful and consistent language syntax. The whole new language was released under a new name, that removed the implication of limited personal use that the PHP/FI 2.0 name held. It was named plain 'PHP', with the meaning being a recursive acronym – PHP: Hypertext Preprocessor. By the end of 1998, PHP grew to an install base of tens of thousands of users and hundreds of thousands of Web sites reporting it installed. At its peak, PHP 3.0 was installed on approximately 10% of the Web servers on the Internet. PHP 3.0 was officially released in June 1998, after having spent about 9 months in public testing. By the winter of 1998, shortly after PHP 3.0 was officially released, Andi Gutmans and Zeev Suraski had begun working on a rewrite of PHP's core. The design goals were to improve performance of complex applications, and improve the modularity of PHP's code base. Such applications were made possible by PHP 3.0's new features and support for a wide variety of third part databases and APIs, but PHP 3.0 was not designed to handle such complex applications efficiently. The new engine, dubbed "Zend Engine" (comprised of their first names, Zeev and Andi), met these design goals successfully, and was first introduced in mid 1999. PHP 4.0, based on this engine, and coupled with a wide range of additional new features, was officially released in May 2000, almost two years after its predecessor, PHP 3.0. In addition to the highly improved performance of this version, PHP 4.0 included other key features such as support for many more Web servers, HTTP sessions, output buffering, more secure ways of handling user input and several new language constructs. Today, PHP is being used by hundreds of thousands of developers, and several million sites report as having it installed, which accounts for over 20% of the domains on the Internet. PHP's development team includes dozens of developers, as well as dozens others working on PHP-related projects such as PEAR and the documentation project. PHP 5 was released in July 2004 after long development and several pre-releases. It is mainly driven by its core, the Zend Engine 2.0 with a new object model and dozens of other new features. Nowadays it is still not widely spread because the PHP 4 language is also very convenient and

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the hosting providers do not want to change anything. The history of PHP cannot be full without a few words about PEAR. PEAR, the PHP Extension and Application Repository is PHP's version of foundation classes, and may grow in the future to be one of the key ways to distribute PHP extensions among developers. PEAR was born in discussions held in the PHP Developers' Meeting (PDM) held in January 2000 in Tel Aviv. It was created by Stig Bakken. Since early 2000, PEAR has grown to be a big, significant project with a large number of developers working on implementing common, reusable functionality for the benefit of the entire PHP community. PEAR today includes a wide variety of infrastructure foundation classes for database access, content caching, mathematical calculations, eCommerce and much more.

PHP opportunities. PHP can do everything. Mainly scope of PHP is focused on a writing the scripts working on the part of a server; thus PHP is capable to carry out all that any other CGI-program carries out, for example, to process the given forms, to generate dynamic pages or to send and accept cookies. But PHP is capable to carry out many other problems. There are three basic areas where PHP is used. The first is creating scripts for performance on the part of a server. PHP is most widely used for this. The only thing that is required for this purpose is PHP parser (in the form of CGI-program or the server module), web-server and a browser. You need a working web-server and installed PHP to see the results of our PHP-scripts' work in a browser. The second area is creating scripts for performance in a command line. You can create a PHP-script that can be started without dependence from web-server and a browser. The only thing that is required is PHP parser. Such way of using PHP is ideally for scripts which should be carried out on a regular basis, for example, by Cron (on platforms *nix or Linux) or by Task Scheduler on Windows platforms. These scripts can also be used to process texts like Perl scripts. And finally the third area of using PHP is creating the scripts that work on client's part. It is called PHP-GTK. Using PHP-GTK you can create cross-platform applications. PHP is accessible to the majority of operational systems, including OS/2, Linux, many Unix twins such, as HP-UX, Solaris and OpenBSD, Microsoft Windows, Mac OS X, RISC OS, and many others. Also the support of the majority modern web-servers such as Apache, Microsoft Internet Information Server, Personal Web Server, Netscape and iPlanet servers and others is included in PHP. For the majority of servers PHP is delivered as the module and for others, supporting CGI-standard, PHP can process as CGI-module. Thus, choosing PHP, you receive the freedom of choice of operational system and web-server. Besides you have a choice between using of procedural or object-oriented programming or their combination. Though current version PHP supports not all the features of OOP, many libraries of a code and large applications, including PEAR library, are written only with OOP-using. PHP is not only capable to give out HTML. Opportunities of PHP include formation of images, PDF-files and even Flash created "in real-time". PHP is also capable to give out any text, such as XHTML and other XML-files. PHP is capable to carry out automatic generation of such files and to keep them in file system of your server instead of giving to the client, thus, making the cache of dynamic content, located on the part of a server. One of significant advantages of PHP is the support of the broad audience of databases. Creating of the script using databases is very simple. Also in PHP DBX-support for work at an abstract level is included, so you can work with any database using DBX. Besides PHP supports ODBC (Open Database Connection standard), thus, you can work with any database supporting this world-wide recognized standard.

The core of PHP 5. Zend Engine 2

The name Zend refers to the language engine, PHP's core. The term PHP refers to the complete system as it appears from the outside. This might sound a bit confusing at first, but it's not that complicated. To implement a Web script interpreter, you need three parts: 1) the interpreter part which analyzes the input code, translates it and executes it, 2) the functionality

part which implements the functionality of the language (its functions, etc.), 3) the interface part talks to the Web server, etc. Zend takes part 1 completely and a bit of part 2; PHP takes parts 2 and 3. Together they form the complete PHP package. Zend itself really forms only the language core, implementing PHP at its very basics with some predefined functions. PHP contains all the modules that actually create the language's outstanding capabilities. PHP can be extended primarily at three points: external modules, built-in modules, and the Zend engine. The following sections discuss these options.

External modules can be loaded at script runtime using the function dl(). This function loads a shared object from disk and makes its functionality available to the script to which it's being bound. After the script is terminated, the external module is discarded from memory. This method has both advantages and disadvantages. The advantages are: 1) external modules don't require recompiling of PHP, 2) the size of PHP remains small by "outsourcing" certain functionality. And the disadvantages are: 1) the shared objects need to be loaded every time a script is being executed (every hit), which is very slow, 2) external additional files clutter up the disk, 3) Every script that wants to use an external module's functionality has to specifically include a call to dl(), or the extension tag in php.ini needs to be modified (which is not always a suitable solution). To sum up, external modules are great for third-party products, small additions to PHP that are rarely used, or just for testing purposes. To develop additional functionality quickly, external modules provide the best results. For frequent usage, larger implementations, and complex code, the disadvantages outweigh the advantages. Third parties might consider using the extension tag in php.ini to create additional external modules to PHP. These external modules are completely detached from the main package, which is a very handy feature in commercial environments. Commercial distributors can simply ship disks or archives containing only their additional modules, without the need to create fixed and solid PHP binaries that don't allow other modules to be bound to them.

Built-in modules are compiled directly into PHP and carried around with every PHP process; their functionality is instantly available to every script that's being run. Like external modules, built-in modules have advantages and disadvantages. Advantages: 1) no need to load the module specifically; the functionality is instantly available, 2) no external files clutter up the disk; everything resides in the PHP binary. And the disadvantages are: 1) changes to built-in modules require recompiling of PHP, 2) the PHP binary grows and consumes more memory. Built-in modules are best when you have a solid library of functions that remains relatively unchanged, requires better than poor-to-average performance, or is used frequently by many scripts on your site. The need to recompile PHP is quickly compensated by the benefit in speed and ease of use. However, built-in modules are not ideal when rapid development of small additions is required.
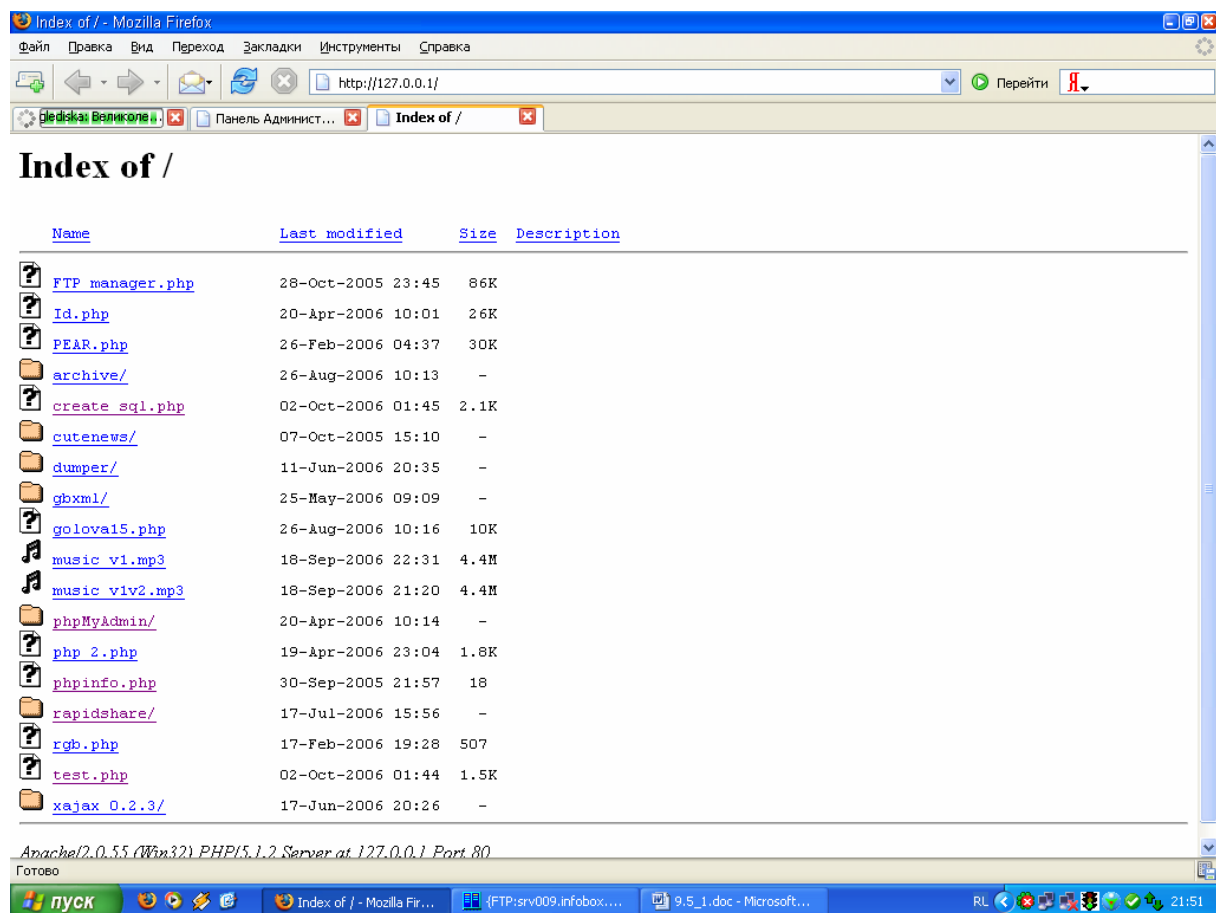
The Zend Engine. Of course, extensions can also be implemented directly in the Zend engine. This strategy is good if you need a change in the language behavior or if you require special functions to be built directly into the language core. In general, however, modifications to the Zend engine should be avoided. Changes here result in incompatibilities with the rest of the world, and hardly anyone will ever adapt to specially patched Zend engines. Modifications can't be detached from the main PHP sources and are overridden with the next update using the "official" source repositories. Therefore, this method is generally considered bad practice.

Memory management. Resource management is a crucial issue, especially in server software. One of the most valuable resources is memory, and memory management should be handled with extreme care. Memory management has been partially abstracted in Zend, and you should stick to this abstraction for obvious reasons: Due to the abstraction, Zend gets full control over all memory allocations. Zend is able to determine whether a block is in use, automatically freeing unused blocks and blocks with lost references, and thus prevent memory leaks. The functions to be used are described here: 1) emalloc() – serves as

replacement for malloc(), 2) efree() – serves as replacement for free() … and 4 others. emalloc(), estrdup(), estrndup(), ecalloc(), and erealloc() allocate internal memory; efree() frees these previously allocated blocks. Memory handled by the e*() functions is considered local to the current process and is discarded as soon as the script executed by this process is terminated. To allocate resident memory that survives termination of the current script, you can use malloc() and free(). This should only be done with extreme care, however, and only in conjunction with demands of the Zend API; otherwise, you risk memory leaks. Zend also features a thread-safe resource manager to provide better native support for multithreaded Web servers. This requires you to allocate local structures for all of your global variables to allow concurrent threads to be run. Because the thread-safe mode of Zend was not finished back when this was written, it is not yet extensively covered here.

Header files inclusions. The only header file you really have to include for your modules is "php.h", located in the PHP directory. This file makes all macros and API definitions required to build new modules available to your code. It's good practice to create a separate header file for your module that contains module-specific definitions. This header file should contain all the forward definitions for exported functions and include "php.h".

Examples

Pic. 1. The Apache window

Pic. 2. Simple PHP code

Pic. 3. Results of PHP work in Mozilla FireFox browser

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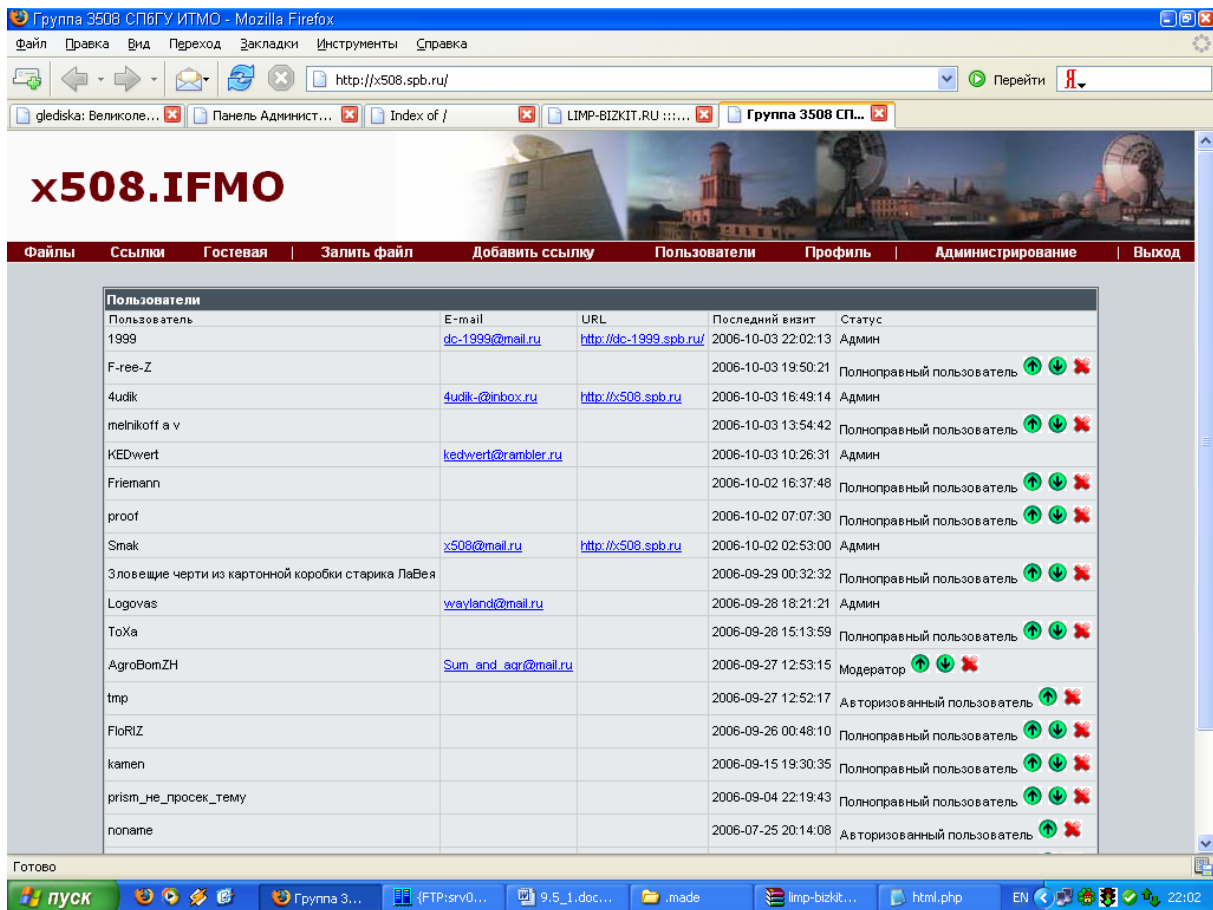
Pic. 4. Another site written on PHP

Summary

Nowadays PHP is the most convenient language for creating web-applications. Its evolution is still going on, its object-oriented model is still enough raw, its has many competitors – but it has so many advantages in comparison with its competitors and it is so convenient for studying that every person who wants to create own web-applications or who just wants to get acquainted with the world of web-programming should just learn its basics. And my experience tells that if you have learnt its basics you won't be able to give up its further studying. The world of PHP programming is very strange and interesting. Just don't forget 'bout your real life =).

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PRACTICAL USAGE OF ARTIFICIAL NEURAL NETWORKS FOR THE TASKS OF CLASSIFICATION AND IMAGE COMPRESSION

В.Д. Стремоухов
Научный руководитель – Т.В. Примакина

Тема статьи – практическое применение нейронных сетей для решения задач классификации и программного сжатия изображений. В статье рассмотрены базовые аспекты функционирования нейросетей, различные виды сетевых топологий и методов обучения нейросетей, особенности построения нейронных сетей для рассмотренных практических задач.

1. Introduction

In this work I'm going to introduce you some examples of practical usage of neural networks. The term "Neural Network", which can nowadays be heard just everywhere, however, can not be distinctly explained by ordinary man. M. Negnevitsky in his book "Artificial Intelligence. A guide to Intelligent Systems" defines the neural network as "a model of reasoning based on the human's brain". However, this work doesn't take as a goal to define the basic principals of our neural system working, so I'll only try to explain in a few sentences.

1.1. How does neural network model the brain

The neural network consists of a number of nodes, which are called neurons. Neurons are connected with weighted links, corresponding to biological dendrites and axons.
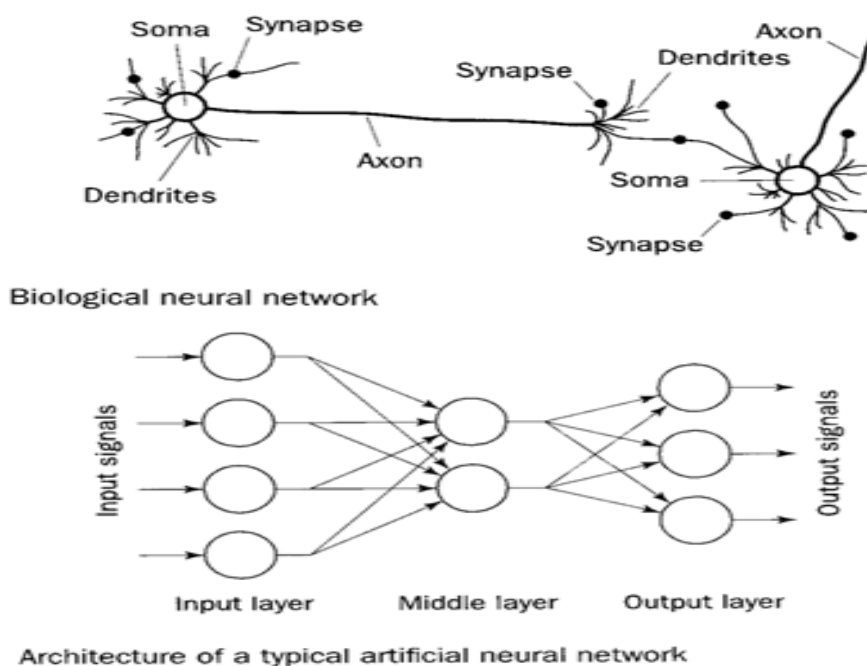

Fig. 1. Biological & artificial NNs

Each link is characterized by its weight, weights of all neurons form the memory of neural network. Each neuron receives a number of input signals through input connections (b. dendrites) and the output signal is transmitted through the outgoing connection (b. axon).

But before our neural network starts working, we should **learn** it. The goal of the learning process is choosing the right connection's weights.

1.2. Goals of this work

In this work I'll explain the methods of application of neural networks for solving problems of economical analysis (task of clustering) and image compression. Problems of choosing the right topology of neural network, learning algorithm and data coding method in each case will be discussed.

2. The NN building

2.1. Practical tasks

As it was told earlier, I'm going to get you known with methods of neural networks usage according to 2 tasks – economical analysis (task of clustering) and image compression. Solving problems of classification requires ranging the available static patterns (parameters of the market situation, medical examination data or information about a client) in certain classes, while the task of image compression, I think, needn't be explained.

Why have I chosen them? Because before the ANN appearance the task of classification could not be solved by a machine, so in this case the ANN just "filled the cavity", replacing the real human brain.

The situation with image compression is another. This task was, of course, always solved by computers, but the image files' sizes continue to grow up, traditional algorithms everything they could (nowadays image file formats even take account of how our eye "decode" the image, being observed, to know, where the decline of the quality will not be noticeable), so we need brand new algorithms. And one of possible trends here is the usage of ANNs for image coding.

2.2. Representation and coding of the input data

Solving a problem of data space representation corresponding to the image compression we have rather small amount of problems. The input image is split up into blocks or vectors of 8×8, 4×4 or 16×16 pixels Sometimes, these blocks are gathered in the groups of blocks, usually it is tightly connected with the chosen topology. Each pixel's value is being normalized inside the segment [0, 1]. The reason of using normalised pixel values is due to the fact that neural networks can operate more efficiently when both their inputs and outputs are limited to a range of [0, 1]. The right choice of the normalization function is a long conversation, connected with biological optics (the attention is usually paid to the characteristics of a human's eye).

When constructing the ANN-based classifier (for using in economics or medicine), the task of input data representation is, maybe, one of the most complicated. First of all it is necessary to determine the complexity level of the system. In real tasks the situation is very common when the number of patterns is limited and this complicates evaluation of the task complexity. It is possible to specificate three main levels of complexity. The first (the simplest one) is when classes can be separated by straight lines (or hyperplanes if the input space has more than two dimensions). This is so called linear separability. In the second case classes cannot be separated by lines (planes), but they can be separated with more complex divisions – nonlinear separability. In the third case classes intersect and we can only speak of probabilistic separability.

In ideal model after preliminary processing we must obtain a linearly separable problem, because after that construction of the classifier is significantly simpler. Unfortunately with real problems we have a limited number of patterns to construct the classifier with. We cannot perform such a preliminary data processing that would result in the linear separability of the patterns.

Using neural networks as a classifier Feed-forward networks are universal tool of functions approximation, therefore they can be used for solving classification tasks.

For the purpose of constructing a classifier it is necessary to determine what parameters influence a decision of ranging a pattern to this or that class. Two problems can arise. First, if the number of parameters is small the situation can develop when the same set of initial data corresponds to examples in different classes. It will be impossible to train the neural network then and the system will not work correctly (it is impossible to find the minimum corresponding to such an initial data set). Initial data must not be contradictive. To solve this problem it is necessary to increase dimensionality of the attributes space (number of components of the input vector corresponding to the pattern). But after increasing the dimensionality of the attributes space we can face a situation when a number of attributes would not be enough for training the system and instead of generalization it will simply remember the training samples and will not function correctly. Thus when determining the attributes we have to find a compromise with their number.

We've already touched the problem of input values normalization. Various functions can be used, from simple linear transformation to the required range to multivariate analysis of parameters and non-linear normalization, depending on cross-impact of the parameters.

2.3. Choosing the size and topology

Correct selection of the network size is very important. It is often impossible to construct a small and fine-working model. The main problem when making a classifier is that our training set in usually very limited, so sometimes a larger model will simply remember patterns from the training samples and will not perform the approximation. It will certainly result in incorrect functioning of the classifier. There are two main approaches to the network construction: constructive and destructive. With the first approach a network of minimal size is created first, then it is gradually increased to achieve the required accuracy. On every step it is trained again. There is also a so-called method of cascade correlation in which after the end of epoch the network architecture is corrected to minimize the error.

With the destructive approach, first an oversized network is taken, then nodes and connections that have little influence on the decision are removed. It is useful to remember the following rule – the number of patterns in the set used for training must be higher than the number of weight being adjusted. Otherwise instead of generalization the network will simply remember the data and lose its ability to classify. The result will be indefinite for the patterns that were not included in the training set.

In the case of image compression, the size and topology is being chosen according to the size of initial image and its input blocks, and to the level of compression we want to achieve.

2.3.1. Back-Propagation Neural Network

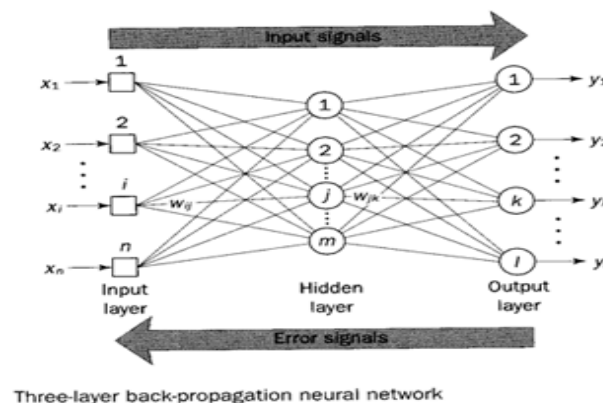Three-layer back-propagation neural network

Fig. 2. Back-Propagation NN

It's the simplest type of neural network given a name because of a learning algorithm, usually used in it. Typically, it is a simple three-layer network, but sometimes more compli-

cated architecture is used. For example, in image compression the Hierarchical Back-Propagation Neural Network can be used, which is like the network of sub-networks.

2.3.2. Hebbian-Based Neural Network

Hebbian-based neural network is a network, in which the learning in being processed according to Hebb's Law. Actually, Hebbian learning can be applied to different types of network topologies, but most often it is used in rather big networks with more then one hidden layer.
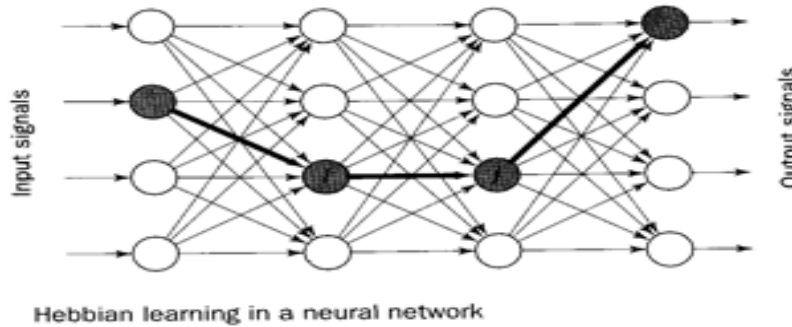

Hebbian learning in a neural network

Fig. 3. Hebbian learning

There are other types of the ANN topology, but the main idea you should learn is that usually **the network topology is created according to the chosen learning algorithm**, so let's talk about

2.4. Methods of the ANN training

2.4.1. Back-Propagation

To derive the back-propagation learning law, let us consider the three-layer network. The indices i,j,k refer to neurons in the input, hidden, output layers respectively.

Input signals $x_1, x_2, \ldots, x_n$ are propagated through the network from left to right, and error signals, $e_1, e_2, \ldots e_l$ from right to left. The symbol w_{ij} denotes the weight for the connection between neuron i in the input layer and neuron j in the hidden layer, and symbol w_{jk} the weight between neuron j in the hidden layer and neuron k in the output layer.

To propagate error signals, we start at the output layer and work backward to the hidden layer. The error signal at the output of neuron k at iteration p is defined by

$e_k(p) = y_{d,k}(p) - y_k(p)$,

where $y_{d,k}(p)$ is the desired output of neuron k at iteration p.

Neuron k, which is located in the output layer, is supplied with a desired output of its own. Hence, we may use a straightforward procedure to update weight w_{jk}. The rule for updating weights at the output layer is

$w_{jk}(p+1) = w_{jk}(p) + \Delta w_{jk}(p)$,

where $\Delta w_{jk}(p)$ is the weight correction.

This method is, maybe, the simplest in the realization, but for complicated tasks is not the best choice often. But the improvement of this method, called adaptive back-propagation is used in the image compression.

2.4.2. Adaptive back-propagation

Adaptive back-propagation neural network is designed to make the neural network compression adaptive to the content of input image. The basic idea is to classify the input image blocks into a few sub-sets with different features according to their complexity measurement. A fine tuned neural network then compresses each sub-set.

Training of such a neural network can be designed as: (a) parallel training; (b) serial training; and (c) activity based training;

The parallel training scheme applies the complete training set simultaneously to all neural networks and use S/N (signal-to-noise) ratio to roughly classify the image blocks into the same number of sub-sets as that of neural networks. After this initial coarse classification is completed, each neural network is then further trained by its corresponding refined sub-set of training blocks.

Serial training involves an adaptive searching process to build up the necessary number of neural networks to accommodate the different patterns embedded inside the training images. Starting with a neural network with pre-defined minimum number of hidden neurones, h_{min}, the neural network is roughly trained by all the image blocks. The S/N ratio is used again to classify all the blocks into two classes depending on whether their S/N is greater than a preset threshold or not. For those blocks with higher S/N ratios, further training is started to the next neural network with the number of hidden neurones increased and the corresponding threshold readjusted for further classification. This process is repeated until the whole training set is classified into a maximum number of sub-sets corresponding to the same number of neural networks established.

In the next two training schemes, extra two parameters, activity $A(P_l)$ and four directions, are defined to classify the training set rather than using the neural networks. Hence the back propagation training of each neural network can be completed in one phase by its appropriate sub-set.

The so called activity of the lth block is defined as:

$$A(P_l) = \sum_{i,j} A_p(P_l(i,j)) \quad \text{and} \quad A_p(P_l(i,j)) = \sum_{r=-1}^{1} \sum_{s=-1}^{1} (P_l(i,j) - P_l(i+r, j+s))^2 \, ,$$

where $A_p(P_l(i,j))$ is the activity of each pixel which concerns its neighbouring 8 pixels as r and s vary from -1 to $+1$ in equation (11).

Prior to training, all image blocks are classified into four classes according to their activity values which are identified as very low, low, high and very high activities. Hence four neural networks are designed with increasing number of hidden neurones to compress the four different sub-sets of input images after the training phase is completed.

On top of the high activity parameter, further feature extraction technique is applied by considering four main directions presented in image details, i.e., horizontal, vertical and the two diagonal directions. These preferential direction features can be evaluated by calculating the values of mean squared differences among neighbouring pixels along the four directions.

For those image patterns classified as high activity, further four neural networks corresponding to the above directions are added to refine their structures and tune their learning processes to the preferential orientations of the input. Hence, the overall neural network system is designed to have six neural networks among which two correspond to low activity and medium activity sub-sets and other four networks correspond to the high activity and four direction classifications.

2.4.3. Hebbian learning

While the back-propagation based narrow-channel neural network aim at achieving compression upper bounded by K–L transform, a number of Hebbian learning rules have been developed to address the issue how the principal components can be directly extracted from input image blocks to achieve image data compression. The general neural network structure consists of one input layer and one output layer. Hebbian learning rule comes from Hebb's postulations:

1. If two neurons of either side of connection are activated synchronously, then the weight of the connection is increased

2. If two neurons of either side of connection are activated asynchronously, then the weight of the connection is decreased

Hence, for the output values expressed as $[h] = [w]^T[x]$, the learning rule can be described as:

$$W_i(t+1) = \frac{W(t) + \alpha h_i(t) X(t)}{\| W(t) + \alpha h_i(t) X(t) \|},$$

where, $W_i(t+1) = \{w_{i1}, w_{i2}, \dots w_{iN}\}$ – the ith new coupling weight vector in the next cycle $(t+1)$; $1 <= i <= M$ and M is the number of output neurons; α – learning rate; $h_i(t)$ – ith output value; $X(t)$ – input vector, corresponding to each individual image block.
$\| . \|$ – Euclidean norm used to normalise the updated weights and make the learning stable.

From the basic learning rule, a number of variations have been developed in the existing research.

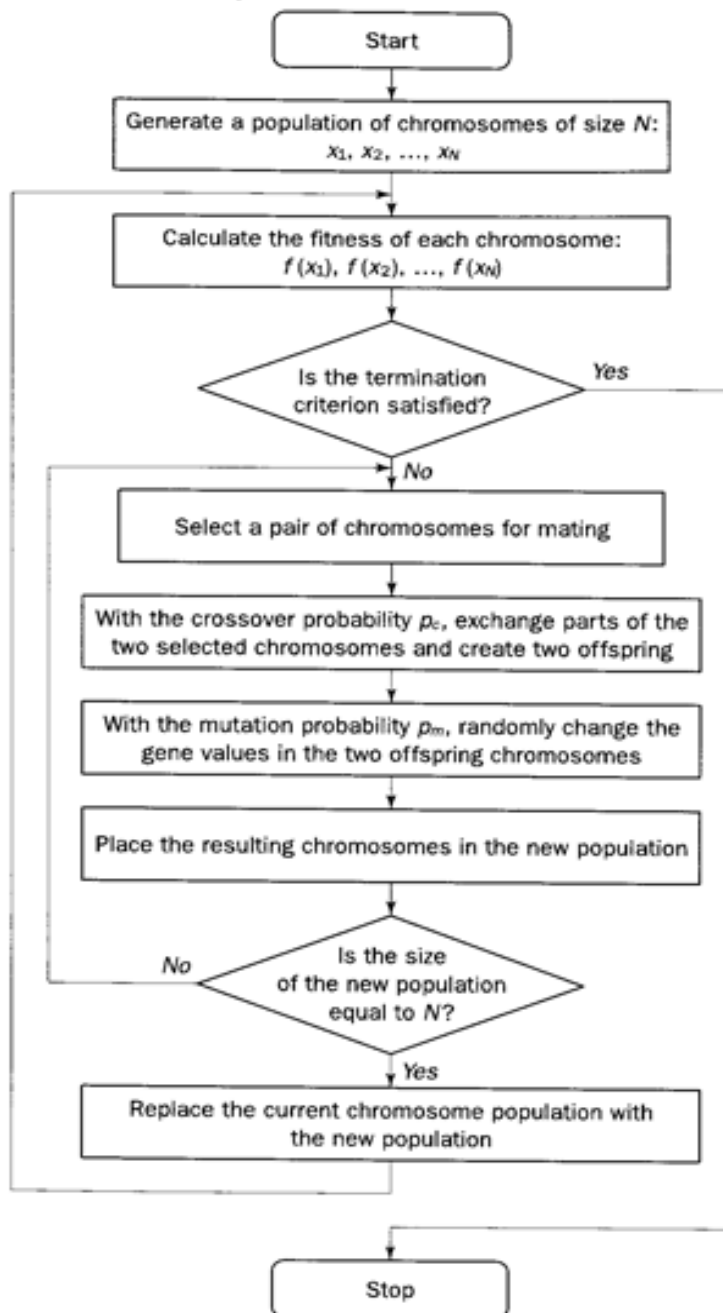## 2.4.4. Genetic algorithms

Fig. 4. The GA

This type of learning algorithms is based on the by C. Darwin's laws. When the topology of the network is established, each link weight is coded into bitstring with fixed length, called gene. The set of genes in the fixed order is called chromosome. When the size of the chromosome is determined, the initial population of chromosomes is created randomly. And then, these chromosomes take part in the GA cycle. Here is the principal scheme of the GA cycle, offered by M. Negnevitsky:

The GA are often used in cases, when the initial data set is very limited (typical situation in the economical analysis).

3. Conclusion

With the appearance of neural networks, new types of tasks can be solved by computers. But to make the ANN work properly, we should use a proper structure and learning algorithm.

First, we should work with data. In the task of image compression, it means we should choose the block size and in the case of making classifier it means, that we should decompose the whole set of data into two sets: training and testing sets (decomposition in three sets is also possible: training, testing and confirmation sets). The complexity level should be established.

Then, according to the initial data analysis, we should choose the right topology and training method. There are a lot of training methods, but each typical task has a number of methods, most widely used. For example, only 2 methods, in fact, are used when solving the task of classification: the back-propagation learning and genetic algorithms. The activation function choice also has to be paid attention to.

Literature

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