Information and communication technologies

Plan

- **Lecture 1.** ICT role in key sectors of development of society. Standards in the field of ICT;
- **Lecture 2.** Introduction to computer systems. Architecture of computer systems;
- **Lecture 3.** Software. Operating systems;
- **Lecture 4.** Human-computer interaction;
- **Lecture 5.** Database systems;
- **Lecture 6.** Data analysis. Data management;

Plan

- **Lecture 8.** Cyber safety;
- **Lecture 9.** Internet technologies;
- **Lecture 10.** Cloud and mobile technologies;
- **Lecture 11.** Multimedia technologies;
- **Lecture 12.** Smart Technology;
- **Lecture 13.** E-technologies. Electronic business. Electronic learning. Electronic government;
- **Lecture 14.** Information technologies in the professional sphere. Industrial

ICT role in key sectors of development of society. Standards in the field of ICT

Content

- Definition of ICTs;
- ICT subject and its objectives;
- ICT in key sectors of society;
- Advantages of computers and disadvantages of computers;
- Data representation;
- Standards in the field of ICT;
- Connection between ICT and achievement of the objectives of a sustainable development.

ICT (information and communications technology - or technologies) is an common term that includes any communication device or application, such us: radio, television, cellular phones, computer and network hardware and software, satellite systems and so on, as well as the various services and applications associated with them, such as videoconferencing and distance learning. ICTs are often spoken of in a particular context, such as ICTs in education, health care, or libraries.

Definition of ICT (1)

ICT is defined as an industry, i.e. as a set of enterprises and organizations engaged in economic activities related to the design, production and trade of software, computing, communications equipment, consumer electronics and its components, as well as system integration, with the provision of telecommunication and information technology services (According to the Order of the Minister of Transport and Communications of the Republic of Kazakhstan in Industry frame of qualifications).

Definition of ICT (2)

Information and communication technologies (ICT) are regarded as modern methods and means of communication of people in a normal and professional activities with the help of information technologies for the search, collection, storage, processing and dissemination of information.

Definition of Development Program of Organization of United Nations in 2003

ICT is, mainly, a tool for processing information - a wide range of products, software and services that are used for production, storage, processing, distribution and exchange of information. They also include "old" ICTs, including radio, TV and telephone, as well as "new" ICT: computers, satellite systems and wireless technologies and the Internet. These different tools are now able to work together, and together they make up our "network world", a gigantic structure of the combined telephone networks, standardized computer hardware, Internet, radio and television, while using these components can be easily accessed in anywhere in the world.

Subject of ICT and purpose

Discipline "ICT" is used for the formation of a particular
ideology in the field of information and modern

information culture, i.e. the ability to interact with

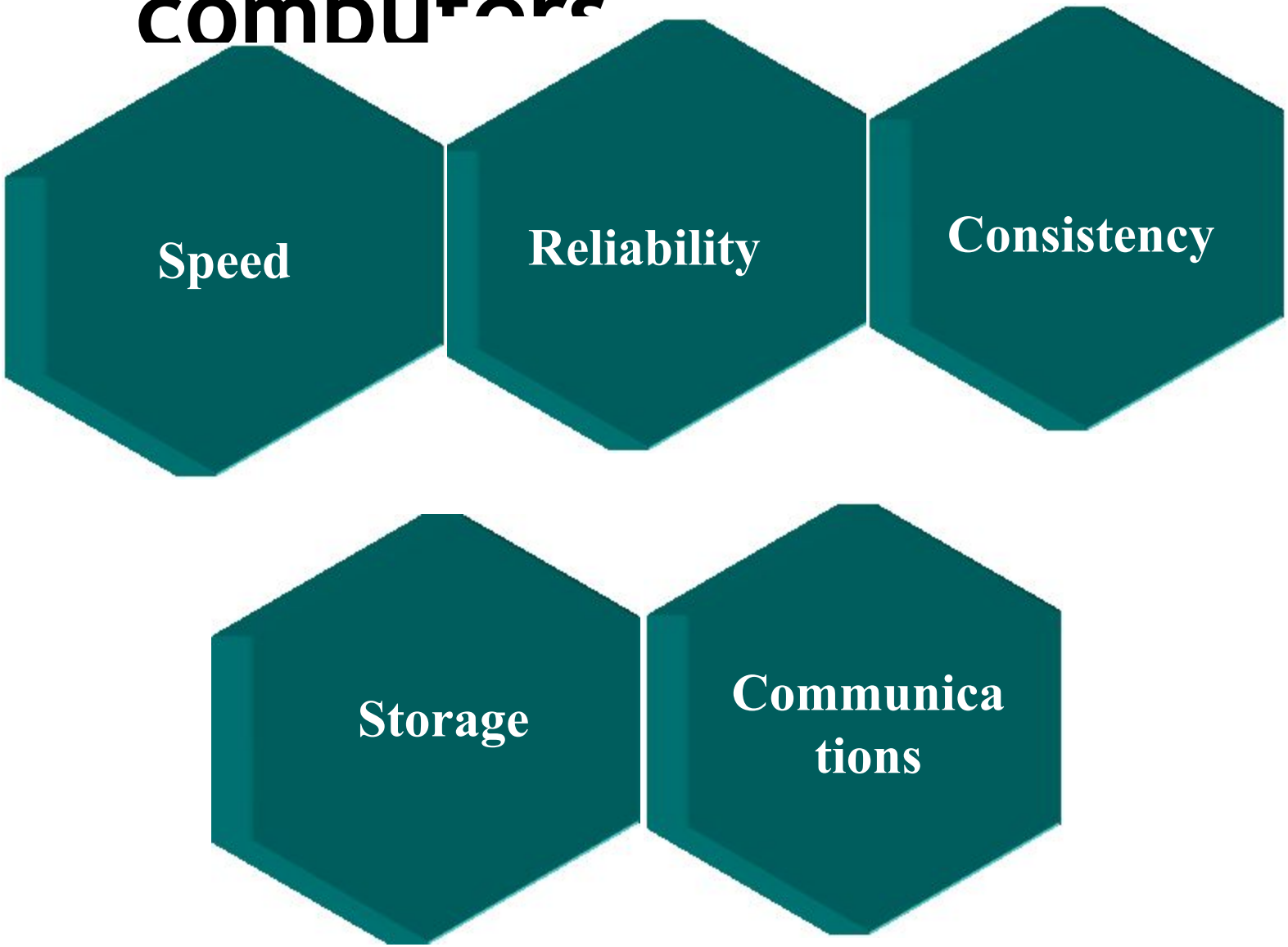
information, professional use for receiving,

processing, transmitting and storing it.

Computers in society

- Home - Games, surf the Internet, communicate with friends and family, write music
- Education - Finding information on the Internet; access to libraries, …
- Small business - Reports, calculations, …
- Industry – Robotics, enterprise management, manufacturing automation , …
- Government - Egov.kz
- Health care - Expert systems, …
- Banking - Electronic payments, electronic transfers
- Communication - Database, video Internet shops, Local networks, global …
- Police Department - surveillance, …

Advantages of computers



Speed Up Work Efficiency

This is by far the biggest advantage using computers. They have replaced the use of manpower in carrying out tedious and repetitive work. Work that can take days to complete manually can be done in a few minutes using a computer. This is made possible by the fact that **data, instructions and information move very fast in the electric circuits of computers. They process trillions of instructions within a second.**

Large and Reliable Storage Capacity

Computers can store huge volumes of data. To put this into perspective, physical files that can fill a whole room can be stored in one computer once they are digitized. Better yet, access to the stored information is super-fast. **It takes micro-seconds for data to be transferred from storage to memory in a computer.** The same cannot be said for the retrieval of physical files. With a computer, you can store videos, games, applications, documents etc. that you can access whenever required. Better yet, storage can be backed up fast and efficiently.

Connection with Internet

The Internet is probably the most outstanding invention in history. **Computers allow you to connect to the Internet and access this global repository of knowledge.** With the Internet, you can communicate faster with people across the globe. You can send email, hold voice and video calls or use IM (**Instant Messaging**) services. **The Internet also allows for instant sharing of files.** You can also connect with friends and family on social networks and even learn a new language online. The Internet is a great educational resource where you can find information on virtually anything.

One of the biggest breakthroughs on the Internet is probably E-commerce. You can actually shop in the convenience of your home and have the items delivered

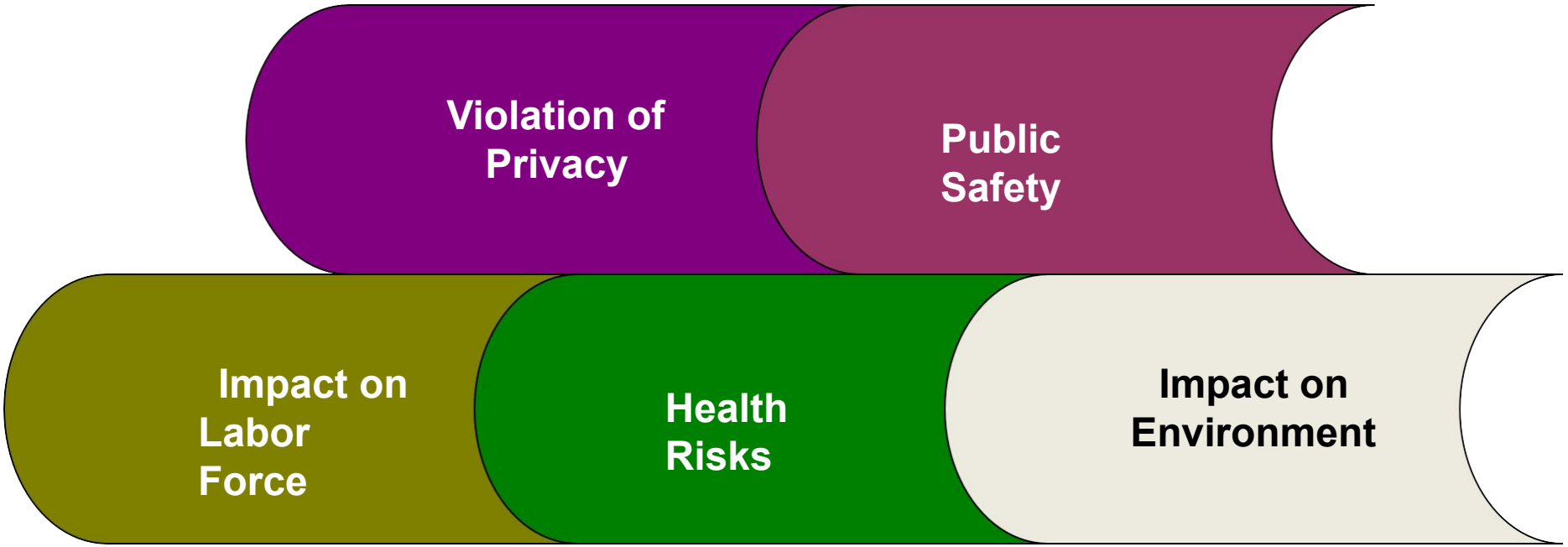
Consisten cy

You always get the same result for the same process when using a computer. For example if you created a document on one computer, you can open it on another without making any special adjustments. **This consistency makes it possible to save and edit a document from different computers in different parts of the world.** Collaboration is therefore easier.

Whatever job you need done, you can always rest assured that the computer will get it just right. There will be no variations in results achieved from the same

process. This makes computers ideal for doing

Disadvantages of computers



Health Risk

Improper and prolonged use of a computer might lead to disorders or injuries of the elbows, wrist, neck, back, and eyes. As a computer user you can avoid these injuries by working in a workplace that is well designed, using a good sitting position and taking proper work breaks. **Technology load and computer addiction are the major behavioral health risks.** Addiction comes when you are obsessed with a computer. Technology overload comes when you are over loaded with computer and mobile phones. Both technology overload and computer addiction are avoidable if the habits are noted and a follow up is done.

https://www.youtube.com/watch?v=uSBakWOsYdA

Violation of Privacy

When using the Internet on your computer, you run the risk of leaking your private information. This is especially so if you happen to download malicious software into your computer. **Trojans and Malware** can infiltrate your system and give identity thieves access to your personal information. Of particular interest to identity thieves are your bank and **credit card details**. Make sure to install reliable antivirus software to keep malware and Trojans at bay. You should also avoid clicking on suspicious looking links when using the Internet.

Impact on Environment

Manufacturing process of computers and computer waste are harmful to the environment. When computer junk is discarded in open grounds, they release **harmful chemicals** like **lead** and **mercury** to the environment. Mercury can result in cancer and lead can cause radiation diseases when exposed to the environment. **Disposed computers could also cause fire.**

https://www.youtube.com/watch?v=YqqC--LxAyY

Data Security

This is one of the most controversial aspects of computers today. The safety and integrity of data is key for any business. However, **data stored in a computer can be lost or compromised in a number of ways.** There are instances where the computer could **crash** wiping out all data that had been stored therein. **Hackers** could also gain access into your computer and compromise the integrity of your data. **This is why you should always have a backup.** Moreover, you should put measures in place to keep your data safe from hackers.

Other

- Unemployment - **Different tasks are performed automatically by using computers. It reduces the need of people and increases unemployment in society**;
- Wastage of time and energy - **use computers without positive purpose**;
- Computer Crimes - **use the computer for negative activities**.

Data Representation

Computing Systems Data

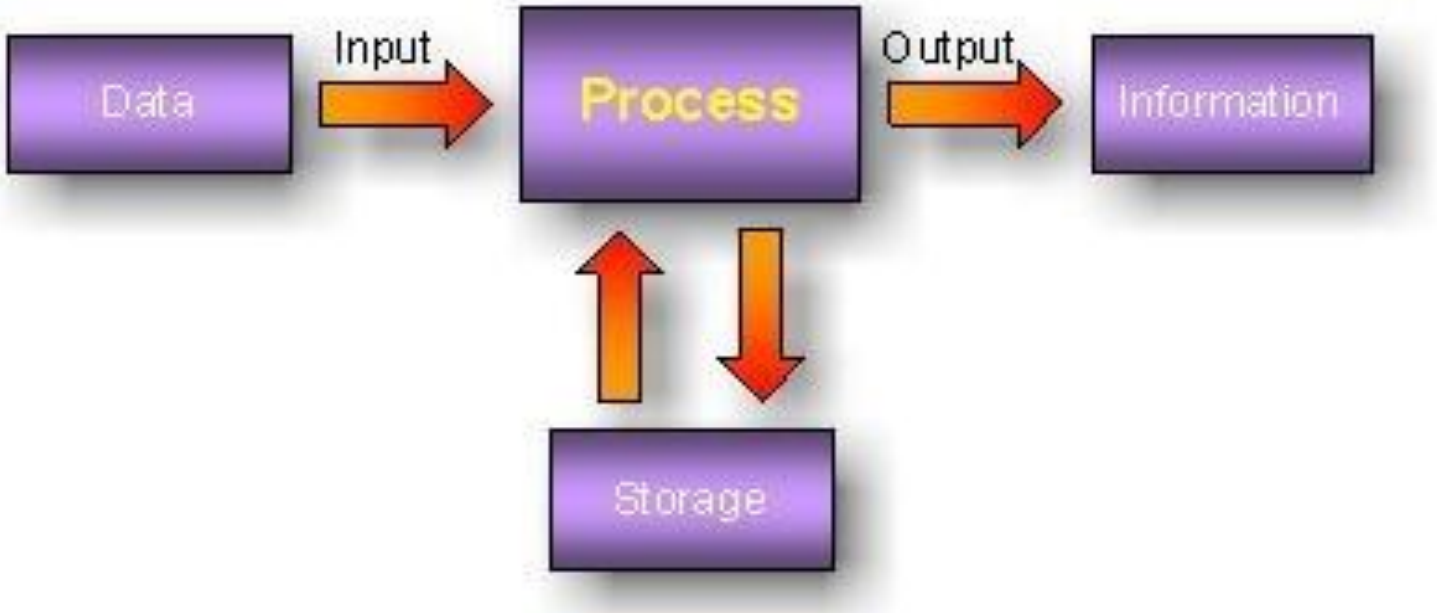
- Usually the computing systems are complex devices, dealing with a vast array of information categories
- **The computing systems store, present, and help us modify:**
  - **Text**
  - **Audio**
  - **Images and graphics**
  - **Video**

Definitions of data, information and knowledge in

Category	Definition
Data	**Computerized representations of models and attributes of real or simulated entities**
Information	**Data that represents the results of a computational process, such as statistical analysis**, for assigning meanings to the data, or the transcripts of some meanings assigned by human beings
Knowledge	**Data that represents the results of a computer-simulated cognitive process**, such as **perception**, **learning**, **association**, and **reasoning**, or the transcripts of some knowledge acquired by human beings

Information Processing Cycle

- **Data is collected and given to the computer for processing;**
- Computer process data to the required information;
- **The information is given to the user as output.**
- **Infor**
  furth



Digital versus Analog

- Computing systems are **finite machines**. They store a limited amount of information, even if the limit is very big.
  - The goal, is to represent enough of the world to satisfy our computational needs and our senses of sight and sound.
- **The information can be represented in one or two ways: analog or digital.**
  - **Analog data is a continuous representation, analogous to the actual information it represents.**
  - **Digital data is a discrete representation,**

Binary Representation

- Why **binary representation** (as suppose to **decimal** or **octal**, etc..)?
  - Because **the devices that store and manage the digital data are far less expensive and complex for binary representation.**
  - They are also far more reliable when they have to represent one out of two possible values.
  - Because the electronic signals are easier to maintain if they carry only binary data.

Binary Representation

- One bit can be either 0 or 1. Therefore, one bit can represent only two things.
- To represent more than two things, we need multiple bits. Two bits can represent four things because there are four combinations of 0 and 1 that can be made from two bits: 00, 01, 10,11.
- In general, n bits can represent 2^n (two to the n power) things because there are 2^n combinations of 0 and 1 that can be made from n bits. Note that every time we increase the number of bits by 1, we double the number of things we can represent.

Standards in the field of ICT

They exist because they:

- **Allow communication and sharing of information**
- **Allow computing systems and software to interoperate**

  (at both hardware and software levels)

Standards Organizations

- ISO – International Standards Organization;
- IEEE – Institute for Electrical and Electronics Engineers;
- ANSI – American National Standards Institute;
- ETSI – the European Telecommunications Standards Institute;
- CEN – the European Committee for Standardization;
- CENELEC – the European Committee for Electrotechnical Standardization;

Examples of Standards

Type of Data	Standards
Alphanumeric	ASCII, Unicode
Image	JPEG, GIF, PCX, TIFF, BMP, etc
Motion picture	MPEG-2, MPEG-4, etc
Sound	WAV, AU, MP3, etc..

Alphanumeric Data (example)

- **Three standards for representing letters (alpha) and numbers:**
  - **ASCII** – ***A***merican ***S***tandard ***C***ode for ***I***nformation ***I***nterchange;
  - **EBCDIC** – ***E***xtended ***B***inary-***C***oded ***D***ecimal ***I***nterchange ***C***ode (not used anymore, used to be used in IBM mainframes);
  - **Unicode.**

Codes and Characters

- The problem:
  - Representing text strings, such as
    "`Hello, world`", in a computer
- **Each character is coded as a byte (= 8 bits)**
- Most common coding system is ASCII
- ASCII = American National Standard Code for Information Interchange
- Defined in ANSI document X3.4-1977

ASCII Features

- **7-bit code**
- **8^{th} bit is unused (or used for a parity bit)**
- **2^7 = 128 codes**
- **Two general types of codes:**
  - **95 are "Graphic" codes** (displayable on a console)
  - **33 are "Control" codes** (control features of the console or communications channel)

Most significant bit

	000	001	010	011	100	101	110	111
0000	NULL	DLE	0		@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

Least significant bit

	000	001	010	011	100	101	110	111
0000	NULL	DLE	0		@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

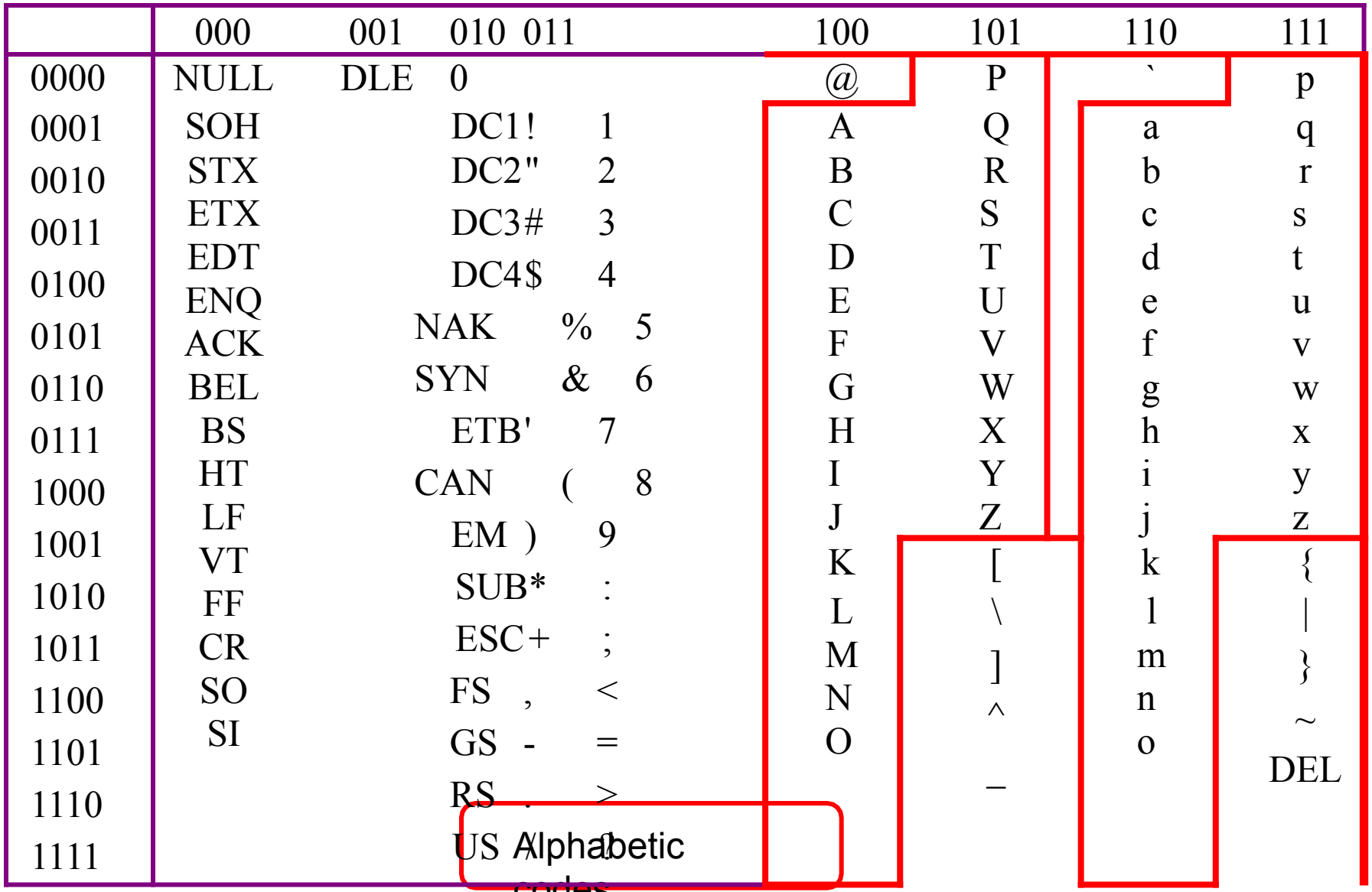
i.e. ‘a’ = $1100001_2 = 97_{10} = 61_{16}$

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

95 Graphic codes

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

33 Control codes


000 001 010 011 100 101 110 111
0000 NULL DLE 0 @ P ` p
0001 SOH DC1! 1 A Q a q
0010 STX DC2" 2 B R b r
0011 ETX DC3# 3 C S c s
0100 EDT DC4$ 4 D T d t
0101 ENQ NAK % 5 E U e u
0110 ACK SYN & 6 F V f v
0111 BEL ETB' 7 G W g w
1000 BS CAN (8 H X h x
1001 HT EM) 9 I Y i y
1010 LF SUB* : J Z j z
1011 VT ESC+ ; K [k {
1100 FF FS , < L \ l |
1101 CR GS - = M] m }
1110 SO RS . > N ^ n ~
1111 SI US / ? O _ o DEL
Alphabetic codes

“Hello, world” Example

		Binary		Hexadecimal		Decimal
H	=	01001000	=	48	=	72
e	=	01100101	=	65	=	101
l	=	01101100	=	6C	=	108
l	=	01101100	=	6C	=	108
o	=	01101111	=	6F	=	111
,	=	00101100	=	2C	=	44
	=	00100000	=	20	=	32
w	=	01110111	=	77	=	119
o	=	01101111	=	6F	=	111
r	=	01110010	=	72	=	114
l	=	01101100	=	6C	=	108
d	=	01100100	=	64	=	100

Note: 12 characters – requires 12 bytes
Each character requires 1 byte

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

Numeric codes

“4+15” Example

		Binary	Hexadecima		Decima
4	=	00110100	I 34	=	I 52
+	=	=	2B	=	43
I	=	00101011	31	=	49
5	=	=	35	=	53
		00110001			
		=			
		00110101			

“4+15” is represented as

“00110100 00101011 00110001 00110101”

or “$34_{16}2B_{16}31_{16}35_{16}$”

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

Punctuation, etc

Common Control Codes

- CR 0D carriage return
- LF 0A line feed
- HT 09 horizontal tab
- DEL 7F delete
- NULL 00 null

	000	001	010	011	100	101	110	111
0000	NULL	DLE		0	@	P	`	p
0001	SOH	DC1	!	1	A	Q	a	q
0010	STX	DC2	"	2	B	R	b	r
0011	ETX	DC3	#	3	C	S	c	s
0100	EDT	DC4	$	4	D	T	d	t
0101	ENQ	NAK	%	5	E	U	e	u
0110	ACK	SYN	&	6	F	V	f	v
0111	BEL	ETB	'	7	G	W	g	w
1000	BS	CAN	(	8	H	X	h	x
1001	HT	EM	)	9	I	Y	i	y
1010	LF	SUB	*	:	J	Z	j	z
1011	VT	ESC	+	;	K	[	k	{
1100	FF	FS	,	<	L	\	l	|
1101	CR	GS	-	=	M	]	m	}
1110	SO	RS	.	>	N	^	n	~
1111	SI	US	/	?	O	_	o	DEL

Unicode

- The extended version of the ASCII character set is not enough for international use.
- **The Unicode character set uses 16 bits per character. Therefore, the Unicode character set can represent 2^{16}, or over 65 thousand, characters.**
- Unicode was designed to be a superset of ASCII. That is, **the first 256 characters in the Unicode character set correspond exactly to the extended ASCII character set.**

TASK

1010111 1110010 1101001
1110100 1100101 1111001
1101111 1110101 1110010
1101110 1100001 1101101
1100101 1100001 1101110
1100100 1110011 1110101
1110010 1101110 1100001
1101101 1100101 1101001
1101110 1100010 1101001
1101110 1100001 1110010

Communication between IKT and achievement of the objectives of a sustainable development

Human Resource Development

1) Provide linkages, coordination and also providing accreditation between government and ICT firms.
2) Promote activities of ICT firms.
3) Research and Development activities in ICT and quality control.
4) Create a pool of highly trained professionals that drive the next generation of ICT development through research and development efforts in the private and public sectors.
5) Empowering the labour force with ICT skills
6) Encouraging massive local and global ICT skills acquisition through training and re-training in the public and private sectors.

Electronic Government

1) Provide stakeholders with enhanced access to government information.
2) Facilitate enhanced citizen interaction with public officials and organizations.
3) Enhance public sector accountability and transparency while minimizing corruption by opening up government operations to public scrutiny feedback.
4) Provide communities with developmental opportunities. For instance, electronic government of Kazakhstan has web-site address: egov.kz.

Infrastructure Development

1) Provide leadership and vision to guide ICT infrastructure development.
2) Provide equitable access to all users and stakeholders.
3) Guarantee the privacy, integrity, accuracy, confidentiality, security, availability and quality of personal information.
4) Create an ubiquitous and affordable technology with an "open standard" approach, scalable and capable of adapting to changes.
5) Stimulate the creation and sharing of national and international knowledge.

Education

1) Re-engineer teaching and learning using ICT.
2) Development of ICT education.
3) Provision of adequate instructional materials, ICT driven teaching and learning facilities.
4) Provision of adequate staff development programs for sustainable career structure and job security.
5) Mass capacity building for both teaching and non- teaching.

Health

1) Deploy and increase access to ICT within the National Health system to improve health delivery and provision.
2) Use ICT to improve network and collaboration in the health sector of the nation.
3) Promote the acquisition of ICT skills within health system.
4) Deploy ICT to address major issues of national health threats.

Awareness, Popularization and Development

1) Encourage ICT skills acquisition for all officers at all tiers of government.
2) Educate work force to use computers within their work environments such as farmers, nurses, exporters and office-workers.
3) Facilitate research and development of appropriate and affordable ICT.
4) Ensure the integration of ICT into poverty reduction strategies at all tiers of Government.

Agriculture

1) Use ICT tools such as Global positioning system (GPS), Geographic Information system (GIS) software to gather, store, view and analyses vast amount of data which can be converted to other usable information media for better farm management, weather forecasting, water level management and crop production.
2) Use ICT tools that integrate geographical, soil, weather, market and human to assist the farmer not only to better his lot, but also in getting the very best out of the soil and of course as bottom line from his/her efforts.

Private sector development

1) Develop an economy characterized by a large commercial services sector with a reasonably large and vibrant ICT services sector and industry.
2) Develop an economy characterized by a technology- based knowledge-driven industrial sector.
3) Develop an economy characterized by a wide-spread deployment and exploitation of ICT within the Society to support the delivery of health, education, government and social services.

Governance and Legislation Framework

1) Facilitate electronic communication, governance and commerce.
2) Promote and foster security in computer networks generally.
3) Maintain the security and integrity of data, records and information in digital form.
4) Enact and enforce laws to combat computer crimes.
5) Promote acceptable standard, authenticity and integrity in ICT use nationwide.

National security and Law Enforcement

1) Enhance national security and law enforcement.
2) Ensure that ICT resources are readily available to promote efficient national development.
3) Create ICT awareness and ensure universal access in order to promote ICT diffusion to all sectors of our national life.
4) Eliminate waste and ensure that governance and businesses are done in the global standard of using ICT for easier, faster and cheaper delivery of services.

Research and Development

1) Ease the difficulty in accessing relevant and up-to-date information on research in similar areas/sectors.
2) Reduce or eliminate duplication of R&D activities by different bodies.
3) Ensure coordination within the different levels of government.
4) Need for ICT capacity building.
5) Need for institutionalized relationship with local and international R&D bodies.

Conclusion

The world of ICT applications in all sectors offers great opportunities for gross national development; most especially in developing countries. The global economy era facilitates easy collection, processing documentation, analysis and presentation of information in all sectors; Health, Transport, Commerce, Industrial and education. This invariably presents a pleasing working environment for the individual and improved governing process in the country. ICT, most importantly through the adoption of mobile phones and internet access makes distance to be transparent. Also ICT has impact on educational field. For instance, there are many web-sites in educational field such as khanacademy.org, coursera.org, edx.org. Thus, ICT have direct positive relationship with economic growth with social and all round national development.

Questions

1. What is the definition of ICT?
2. What is the advantages of using computers?
3. What is the disadvantages of using computers?
4. Which field of your life ICT impacts most?
5. Define role of ICT in our society.