

MINISTRY OF HEALTH OF UKRAINE  
ODESSA NATIONAL MEDICAL UNIVERSITY  
Department of Biophysics, Informatics and Medical Devices



Vice-Rector on Educational and Pedagogic Work

Prof.

APPROVED

Shmakova I.P.

*“ 30 ” august* 2021

**SUBJECT PROGRAM FOR THE COURSE**

**"EUROPEAN STANDARD OF COMPUTER LITERACY "**

**Level of Higher Education:** Second (Master's)

**Field of knowledge:** 22 "Health Care"

**Specialty:** 222 "Medicine"

**Educational qualification:** Medicine

Composed on the basis of the educational-professional program of the second level of higher education for the preparation of Masters in the specialty 222 "Medicine" ONMedU, approved by the Academic Council of ONMedU from 04.06.2020.

The program was discussed at a meeting of the Department of Biophysics, Informatics and Medical Devices.

Protocol #1 from August 27, 2021

Head of the Department,



Professor L.S. Godlevsky

The program was approved at a meeting of the Cycle Subject Commission of Biomedical Science of ONMedU.

Protocol #1 from August 30, 2021

Head of the Cycle Subject Commission of Biomedical Science,



Professor O.L. Appelhans

The program was certified at a meeting of the Central Coordination and Methodological Council of ONMedU on August 30, 2021, Protocol #1.

## 1. Description of the course

Name of indexes	Characteristics of the course	
	full-time education	
The total number of: Credits-3,5 Hours - 105 Content blocks -5	<i>selective</i>	
	Year of studying:	2
	Semester	IV
	Lectures	10 hrs.
	Practices	30 hrs.
	ISW	65 hrs.
	Individual work	-
	Form of final control:	test

## 2. The purpose and objectives of the course

- **The purpose:** Student acquisition of knowledge and formation of elements of professional competencies in the field of computer literacy, and improvement of basic skills in PC. Acquire solid computer skills.

### **Objective:**

1. Formation of abilities and skills of use of hardware and software of the computer for the decision of medical problems: drawing up of electronic regulatory medical documents, storage, the analysis of the data of medical analyzes in an electronic format.

2. Acquaintance with the theory of information, coding and international systems of classifications of diseases, drawing up of mathematical, program models of biological, pathological processes in a human body, researches with use of the device of mathematical statistics

3. Mastering the ability to use word processors, spreadsheets and cloud technologies to work with medical data.

**The process of learning the discipline is directed to the formation of elements of the following competencies:**

***Integral competence***

IC. Ability to solve complex problems and problems in a particular field of health care in the specialty "Medicine", in professional activities or in the learning process, which involves research and / or innovation and is characterized by complexity and uncertainty of conditions and requirements.

***General competencies :***

GC1. Ability to abstract thinking, analysis and synthesis.

GC2. Ability to know and understand the area of EUROPEAN STANDARD OF COMPUTER LITERACY and professional activity.

GC3. Ability to communicate in the state language.

GC4. Ability to learn and master modern knowledge in computer literacy, use information and communication technologies; ability to search, process and analyze information from various sources.

GC5. Ability to adapt and make an informed decision in a new situation.

GC6. Ability to work in a team.

GC7. Ability to work in an international context, to communicate in a foreign language.

GC8. Ability to evaluate and ensure the quality of work performed.

GC10. Ability to be aware of equal opportunities and gender issues; appreciate and respect diversity and multiculturalism.

***Special competencies:***

SC2 Ability to maintain regulatory medical electronic documentation

SC5 Ability to effectively use information and information technology in a medicine professional activity

SC9 Ability to communicate effectively in a computer literacy context

SC10 Ability to use cloud technologies in professional activities.

**Expected learning outcomes.** As a result of studying the discipline the student must

*To Know:*

- Basic concepts of information technology
- PC hardware and software base
- Data types. Binary system
- Algorithms
- Principles of work and structural and logical scheme of PC construction
- Text editor. Document editing styles

*Be able to :*

- Introduce information technology in medicine
- Build graphs, data charts of laboratory tests or medical research.
- Creating forms and reports in the DBMS environment
- Creating tables, formatting cells, building graphs and charts in a spreadsheet environment
- Search for information in the materials of the Cochrane Collaboration
- Maintain medical records in electronic format

### **3. Contents of the subject plan**

**Content module 1. Basic concepts of information technology, application of computers and software in the medical field.**

**Topic 1 Principles of work and structural and logical scheme of PC construction. Information as a Resource. Information and coding theory**

Definition, purpose, tasks of computer literacy among medical staff Structure of informatics as a science of information storage in electronic form. Basic definitions and categories of computer science; Information, types of information, key concept of computer science

**Topic 2. Arithmetic logic Unit. ALU. Data bus. Address bus. Processor. RAM Binary codes.**

Software modules. Memory. Video card RAM management. OS kernel memory management subsystem). Process management. OS kernel process control subsystem

**Topic 3. General hardware and software architecture of modern computer systems. Operating Systems. IT Security. Viruses**

Block diagram of the PC. Components of the system unit. Operating System. Operating system kernel. Basic set of application software. Interface between application processes and computer equipment. Hardware Management, Hardware Drivers. Multi-user support for multi-user mode. Support for parallel execution of many processes in the system. Multitasking

**Topic 4. Artificial intelligence and Bio-inspired computing**

Computational learning theory. Computer vision. Neural networks. Planning and scheduling. Natural language processing. Computational game theory. Evolutionary computation. Autonomic computing. Representation and reasoning. Pattern recognition. Robotics. Swarm intelligence.

**Content module 2. Text documents. Spreadsheets.**

**Topic 5. Text editors.**

Microsoft Word, Libre Office. Functions of text formatting, introduction of graphs, formulas, tables and objects. Functionality of code editors: syntax highlighting, line sorting, templates, encoding conversion, display of character codes Text environments.

Express style. Auto format. Types of style. Symbol style. Paragraph style. Table style

### **Topic 6. Spreadsheets. Google Sheets: Online Spreadsheets**

MS Excel spreadsheet processing package. Advantages of MS Excel among other spreadsheets. Types of data used in spreadsheets

### **Topic 7. Creating tables, formatting cells, building graphs and charts in a spreadsheet environment.**

Page titles, data entry. Cell format. Cell address, cell block, row and column size. Rules for entering formulas in Excel. Special functions (mathematical, statistical) Construction of graphs. Construction of diagrams. Creating labels in charts. Types of diagrams

### **Content module 3. Data structure. Data mining.**

#### **Topic 8. Data structure. Primitive data types. Graphs and binary trees. Data mining. Data storage**

n array, a linked list, a record, a union, a tagged union, an object, graphs and binary trees. Data mining is a process of extracting and discovering patterns in large data sets involving methods at the intersection of machine learning, statistics, and database systems.

### **Content module 4. Computer graphics and visualization.**

#### **Topic 9 Image and sound processing. Medical image computing. Speech synthesis.**

APNG - Animated PNG. BMP.ECW.DRG - digital raster graphic.GIF.ICO (Windows Icon) ILBM. JPEG

#### **Topic 10. Graphic formats. Bitmap vs. vector formats.**

Vector and raster images. Bitmap. Vector operations. Primitive objects of raster images. Bezier curves. Bezigony.

#### **Topic 11 Graphic and video applications. Medical devices based on embedded systems**

Vector graphics programs. Adobe Illustrator. Corel Draw. Macromedia Freehand. Affinity Designer

#### **Topic 12. Animation of 3D objects**

3D Studio MAX programs. Modeling. Rendering

### **Content module 5. Web resources. Cloud technologies**

#### **Topic 13. Cloud technologies**

Cloud computing. Advantages and disadvantages. Software as a Service (SaaS) Platform-as-a-Service (PaaS) Infrastructure as a Service (IaaS) Deployment Models: Private Cloud Public Cloud Hybrid Cloud

#### **Topic 14. Web resources. Internet pages. HTML code**

HTML data markup language; data formatting rules; properties of styles and their meaning; with tags and selectors of cascading style sheets

#### **Topic 15. Presentation**

Create presentations in the PowerPoint web application. Add images, videos, transitions and animations.

#### 4. Structure of the course

Topics	Hours			
	Total	Including		
		Lecture	Practice	IWS
1	2	3	4	5
<b>Content module 1.</b> Basic concepts of information technology, application of computers and software in the medical field.				
Topic 1 Principles of work and structural and logical scheme of PC construction. Information as a Resource. Information and coding theory.	8	2	2	4
Topic 2. Arithmetic logic Unit. ALU. Data bus. Address bus. Processor. RAM. Binary codes.	6		2	4
Topic 3. General hardware and software architecture of modern computer systems. Operating Systems. IT Security. Viruses.	8	2	2	4
Topic 4. Artificial intelligence and Bio-inspired computing.	6		2	4
Total on the content module 1	28	4	8	16
<b>Content module 2.</b> Text documents. Spreadsheets.				
Topic 5. Text editors	8	2	2	4
Topic 6. Spreadsheets. Google Sheets: Online Spreadsheets	6		2	4
Topic 7. Creating tables, formatting cells, building graphs and charts in a spreadsheet environment.	6		2	4
Total on the content module 2	20	2	6	12
<b>Content module 3.</b> Data structure. Data mining.				
Topic 8. Data structure. Primitive data types. Graphs and binary trees. Data mining. Data storage	6		2	4



Total on the content module 3	6	-	2	4
<b>Content module 4. Computer graphics and visualization.</b>				
Topic 9. Image and sound processing. Medical image computing. Speech synthesis	8	2	2	4
Topic 10 Graphic formats. Bitmap vs. vector formats.	6		2	4
Topic 11 Graphic and video applications. Medical devices based on embedded systems	6		2	4
Topic 12. Animation of 3D objects	6		2	4
Total on the content module 4	26	2	8	16
<b>Content module 5. Web resources. Cloud technologies</b>				
Topic 13. Cloud technologies	8		2	6
Topic 14. Web resources. Internet pages. HTML code	8	2	2	4
Topic 15. Presentations	6		2	4
Total on the content module 5	22	2	6	14
Preparation for the test	3			3
<b>Individual tasks</b>	-	-	-	-
Total	105	10	30	65

## 5. LECTURE PLAN

№	Topics	Hours
1	Basic concepts of information technology. Computer and software in the doctor's activity. Information as a Resource. Information and coding theory. Data structure. Data mining.	2
2	General hardware and software architecture of modern computer systems. Operating Systems	2
3	Text editors. Spreadsheets. Google Sheets: Online Spreadsheets	2
4	Computer graphics and visualization.	2
5	Web resources. Cloud technologies.	2
	Total	10

## 6. Practice plan

№	Topics	Hours
1	Basic concepts of application of information technologies in the field of health care. Information as a Resource. Information and coding theory	2
2	Arithmetic logic unit. ALU. Data bus. Address bus. Processor. RAM. Unit of information. Binary codes.	2
3	General hardware and software architecture of modern computer systems. Operating Systems	2
4	Artificial intelligence and Bio-inspired computing.	2
5	Text editor. Document editing styles.	2
6	Spreadsheets. Google Sheets: Online Spreadsheets	2
7	Data structure. Primitive data types. Graphs and binary trees. Data mining. Data storage	2
8	Security. Viruses. Firewalls	2
9	Computer graphics and visualization. Bitmap vs. vector formats.	2

10	Image and sound processing. Medical image computing. Speech synthesis	
11	Graphic and video applications. Medical devices based on embedded systems	2
12-	Animation of 3D objects.	2
13	Cloud technologies.	2
14	Web resources. Web pages. HTML	2
15	Presentations. Test.	2
	Total	30

### 7. Independent work

№	Topics	Hours
1	Principles of work and structural and logical scheme of PC construction. Data bus Address bus. Processor. RAM.	2
2	Basic and system software.	2
3	Operating Systems.	2
4	Document editing styles.	2
5	Decision-action mapping cycle in decision support systems	2
6	Creating tables, formatting cells, building graphs and charts in a spreadsheet environment	2
7	Imperative and declarative paradigms. Knowledge base.	2
8	Data types. Binary system.	2
9	Physical grounds for storing information in RAM.	2
10	Independent software modules. Plugin.	2
11	Polymorphism and inheritance in programming.	2
12	Programming languages. Abstraction, Encapsulation and modularity.	2
13	Logical operations. Predicate.	2
14	Algorithms.	2
15	Modern expert systems. Rete algorithm.	2
16	Vector and raster graphics in the visualization of medical images.	2
17	Empirical data processing software packages. Raster graphic editors. Adobe Photoshop GIMP, Krita, Photofiltre, Paint. NET and Canva.	2
18	Cascading web page styles..	2
19	Vector graphic editor and. Corel Draw, Adobe Illustrator, Inkscape and Figma.	2
20	World Wide Web technology. CSS, HTML	2
21	Word Processing	2
22	IT Security	2

23	2D Computer Aided Design	2
24	Online Collaboration	2
25	Image Editing	2
26	Web Editing	2
27	Project Planning	2
28	2D Computer Aided Design	2
29	Health Information Systems Usage	2
30	Artificial intelligence in healthcare	2
31	Email and other communication programs.	2
32	Repetition of educational material for the test	3
	Total	65

### 8. Individual tasks

Not provided

### 9. Methods of studying

**Practical classes:** explanation, conversation, instruction, discussion, debate, discussion of problem situations, situational training, illustration (including multimedia presentations), demonstration, method of direct observation, exercises; training exercises; creative exercises; solution of calculation problems, practical works; performing experiments.

Study of material from textbooks and manuals

. Interviewing students and a teacher's conversation with them, with the identification of fragments of material that seem difficult and unclear to them.

An explanation by the teacher of these parts of the material, with an illustration of their practical significance in medicine.

Completion of the assignments set by the teacher in the classroom, with their verification and clarification of errors.

**Independent work:** independent work with a textbook, independent work with a bank of test tasks, independent work with computer programs.

## 10. Methods of control and criteria for evaluating learning outcomes

Current control: oral examination, testing, assessment of practical skills, problem solving, assessment of activity in the classroom.

Final control: oral test, testing.

The structure of the current assessment in the practical lesson:

1. Assessment of theoretical knowledge on the topic of the lesson:

- methods: survey,

- maximum score - 5, minimum score - 3, unsatisfactory score - 2.

2. Assessment of practical skills and literacy when working with computer programs on the topic of the lesson:

- methods: assessing the correctness of practical skills

- maximum grade - 5, minimum grade - 3, unsatisfactory grade - 2;

Criteria for current assessment in the practical lesson:

«5 »	The student is fluent in the material, takes an active part in discussing and solving a situational clinical problem, confidently demonstrates practical skills during the examination of a sick child and interpretation of clinical, laboratory and instrumental studies, expresses his opinion on the topic, demonstrates clinical thinking.
«4 »	The student is well versed in the material, participates in the discussion and solution of situational clinical problems, demonstrates practical skills during the examination of a sick child and interpretation of clinical,

	laboratory and instrumental studies with some errors, expresses his opinion on the topic, demonstrates clinical thinking.
«3 »	The student does not have enough material, insecurely participates in the discussion and solution of the situational clinical problem, demonstrates practical skills during the examination of a sick child and interpretation of clinical, laboratory and instrumental studies with significant errors.
«2 »	The student does not have the material, does not participate in the discussion and solution of the situational clinical problem, does not demonstrate practical skills during the examination of a sick child and the interpretation of clinical, laboratory and instrumental studies.

The student is admitted to the test subject to the requirements of the curriculum and if for the current educational activity he received at least 3.00 points

#### Credit structure

The content of the evaluated activity	Number
Testing	1
Answer to theoretical questions.	3
Practical task	1

The final control in the form of tests is evaluated on a two-point scale:

- the grade "passed" is given to a student who has completed the curriculum of the discipline, has no academic debt; level of competence - high (creative);
- the grade "not credited" is given to a student who has not fulfilled the curriculum of the discipline, has an academic debt (average score below 3.0 and / or absences); level of competence - low (receptive-productive).

### **11. Distribution of points received by applicants for higher education**

The grade for the discipline is 50.0% of the grade for current performance and 50.0% of the grade for credit.

The average score for the discipline is translated into a national grade and converted into scores on a multi-point scale.

Conversion of the traditional grade for the discipline in the 200-point is carried out by the information and computer center of the university program "Contingent".

Table for conversion of traditional assessment into multi-point:

National assessment for the discipline	The sum of points for the discipline
«5»	185 - 200
«4»	151 - 184
«3»	120 - 150

Points from the discipline are independently converted into both the ECTS scale and the four-point scale. ECTS scale scores are not converted to a four-point scale

and vice versa. Further accounts are carried out by the information and computer center of the university.

Conversion of traditional assessment in the discipline and the amount of points on the ECTS scale

Assessment on the ECTS scale	Statistical indicator
AND	The best 10% of students
IN	The next 25% of students
WITH	The next 30% of students
D	The next 25% of students
IS	The next 10% of students

The ECTS grade is given by the ONMedU educational subdivision or the dean's office after ranking the grades in the discipline among students studying in one course and in one specialty. The ranking of students - citizens of foreign countries is recommended by the decision of the Academic Council to be conducted in one array.

## 12. Questions for final control

1. PC hardware and software base.
2. PC architecture.
3. Processor. Data bus. Address bus. RAM.
4. Control device.
5. Arithmetic logic unit.
6. Arithmetic operations with binary numbers.
7. Text editors.
8. Editing text documents.
9. Principles of construction and scope of presentation preparation programs
10. Spreadsheets.
11. Operating Systems.



- 12.Principles of construction and scope of spreadsheets
- 13.Database definition.
- 14.Database types.
- 15.Examples of models and structures.
- 16.Programming paradigms.
- 17.Database.
- 18.Knowledge base.
- 19.Comparison of Database and Knowledge base.
- 20.Hierarchical database model.
- 21.Relational model.
- 22.Object-oriented database model.
- 23.Spatial database model.
- 24.Distributed database model.
- 25.Aspect-indicative, logical, structural, procedural programming.
- 26.Templates, classes, functions, blocks, programming patterns.
- 27.Debugging programs.
- 28.Pragmatic and evidence-based approaches to program verification.
- 29.Imperative and declarative programming paradigms.
- 30.How should statistics be prepared for analysis?
- 31.List 5 functional blocks of programs that process empirical data.
- 32.Graphic image formats.
- 33.Raster and vector graphics.
- 34.Compare ways to store images in vector graphics and raster.
- 35.Vector graphics programs.
- 36.Vector operations.
- 37.Comparison of the vector method of describing graphics with raster.
- 38.Definitions, advantages and disadvantages of raster graphics.
- 39.Definitions, advantages and disadvantages of vector graphics.
- 40.Give examples and describe the formats of raster graphics.
- 41.Compression with losses.
- 42.Lossless compression
- 43.Examples and characteristics of vector graphics formats.
- 44.Sorting and comparison in expert knowledge systems.
- 45.Rete sorting network. Comparison with the sample.
- 46.Dicotyledonous graphs.
- 47.Cyclic and acyclic graphs.
- 48.How are Kohonen networks trained?
- 49.Define the training radius, weight, winning cluster
- 50.Cluster analysis. Clustering mechanism. Perceptrons.

51. Logic circuit of the perceptron with three outputs: sensors, associative and responsive elements.
52. Rumelhart's multilayer perceptron
53. Problem XOR
54. How does CSS describe the look of a web page?
55. Six CSS rules?
56. Is CSS a tabular or block layout?
57. What are the benefits of CSS?
58. What format is used to create a visual design of web pages, and which - to write web pages?
59. What are the functions of HTML in creating a web page
60. What are the functions of XHTML?
61. The CSS format
62. What Is a Web Resource?
63. Website Elements: Domain, Hosting, Content
64. Types of Websites
65. Benefits of a Website
66. The Concept of Information as a Resource
67. Application Program
68. Common CPU components
69. What is Platform-as-a-Service PAAS?
70. What is Software-as-a-Service SAAS?
71. What is Infrastructure-as-a-Service IAAS?
72. Microsoft Word or Google Docs
73. Microsoft Excel or Google Sheets
74. Special and statistical functions in Excel
75. Define the concept of "cloud technology"
76. Explain the content of three types of cloud services (IaaS, SaaS, PaaS)
77. Give examples of companies that provide cloud storage services.
78. Advantages and disadvantages of cloud storage.
79. Guarantee of data confidentiality and security of cloud storage
80. Publish information on the Internet
81. Operating Systems: Security.

### **13. Methodical support**

1. Working program of the discipline
2. The syllabus of the discipline
3. Textbooks
4. Multimedia presentations
5. Methodical materials.
6. Electronic bank of test tasks.



## 14. Recommended Literature

### Basic

1. Informatics in tables and diagrams: PC and its components, Windows operating system, Internet, basic and auxiliary devices, system and application software, modeling and programming / [Bilousova LI, Olefirenko NV]. - Kharkiv: Torsing Plus, 2014. - 111 p.
2. Informatics and computer technology: textbook. way. / Bakushevich Ya. M., Kapatsila Yu. B. - Lviv: Magnolia, 2015. - 311 p.
3. Informatics: workshop on inform. technologies / Ya. M. Glinsky. - Ternopil: Nearby. and manual., 2014. - 302 p.

### Additional

1. Fundamentals of computer science. Microsoft Office 2013 (Word, PowerPoint in practice): textbook. way. / MM Drin, NV Romanenko; City of Education and Science of Ukraine, Cherniv. nat. Univ. Yu. Fedkovich. - Chernivtsi: Chernivtsi. nat. University, 2014. - 75 p.
2. Informatics and information technologies: a workshop for org. students' work on practice. and laboratory. classes / Yu. Yu. Bilak, V. O. Laver, Yu. V. Andrashko, IM Lyakh; City of Education and Science of Ukraine, SHEI "Uzhhorod. nat. University ", Faculty of Inform. Technologies, Dept. Informatics and Phys.-Math. disciplines. - Uzhhorod: Outdoor Shark, 2015.
3. Medical informatics in modules: workshop / IE Bulakh, LP Voitenko, MR Mruga and others; for order. I.Ye. Bulakh. –К .: Медицина, 2012. - 208 с.
4. Medical informatics: a textbook / I.E. Bulakh, Yu.E. Лях, В.П. Марценюк, И.И. Haimzon. - К .: ВСИ «Медицина», 2012. - 424 с.
5. Medical Informatics, Medical Informatics: a textbook / I.Ye. Bulakh, Yu.Ye. Лях, В.П. Martsenyuk, I.Y. Haimzon. - К .: ВСИ «Медицина», 2012. - 368 с.
6. Information technologies in psychology and medicine: textbook / I.Ye. Bulakh, II Haimzon. - К .: ВСВ «Медицина», 2011. - 216 с.
7. Dario Ilija Rendulić ITdesk.info – project of computer e-education with open access Subtitle: Basic Concepts of Information and Communication Technology, notes. - Open Society for Idea Exchange (ODRAZI), Zagreb, 2011.

8. Dragoni, Nicole (n.d.). *"Introduction to peer to peer computing"* (PDF). DTU Compute – Department of Applied Mathematics and Computer Science. Lyngby, Denmark.
9. Schmalz, M.S. "Organization of Computer Systems". UF CISE. Retrieved 11 May 2017.
10. "Operating Systems: Security". www.cs.uic.edu. Retrieved 27 November 2020.
11. "Reading: Operating System". Lumen. Retrieved 5 January 2019.
12. "What is Computer Science? - Computer Science. The University of York". www.cs.york.ac.uk. Retrieved June 11, 2020.

## 16. Electronic information resources

1. <https://support.office.com/en-us/> (Microsoft Office Help and Training)
2. [www.uacm.kharkov.ua](http://www.uacm.kharkov.ua) (Ukrainian Association of Computer Medicine)
3. [www.mednavigator.net](http://www.mednavigator.net) (Medical search engine)
4. <http://www.itdesk.info/Basic%20Concepts%20of%20Information%20Technology%20notes.pdf> (Basic Concepts of Information and Communication Technology, notes)
5. <http://www.itdesk.info/en/> (project of computer e-education with open access)
6. <https://www.cise.ufl.edu/~mssz/CompOrg/CDAintro.html> (Organization of Computer Systems)
7. [https://en.wikipedia.org/wiki/Information\\_technology](https://en.wikipedia.org/wiki/Information_technology) (Information technology)
8. [https://en.wikipedia.org/wiki/Operating\\_system](https://en.wikipedia.org/wiki/Operating_system) (Operating system)
9. <https://courses.lumenlearning.com/sanjacinto-computerapps-v2/chapter/reading-operating-system/> (An operating system (OS))
10. [https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/15\\_Security.html](https://www.cs.uic.edu/~jbell/CourseNotes/OperatingSystems/15_Security.html) (Operating Systems. Security)
11. <https://guides.lib.berkeley.edu/evaluating-resources> (Publication & format)
12. <https://www.wix.com/> (Create a website)
13. <https://elgrandesconocido.es/what-is-a-web-resource/> (Web Resource)
14. <https://ecomputernotes.com/servlet/intro/introductiontowebservice> (Introduction To Web Resource)
15. <https://ecomputernotes.com/fundamental/terms/application-program> (Application Program and application software)
16. <https://ecomputernotes.com/fundamental/disk-operating-system/application-software> (Types of Application Software.)
17. [https://en.wikipedia.org/wiki/Computer\\_architecture](https://en.wikipedia.org/wiki/Computer_architecture) (Computer architecture)



18. [https://www.youtube.com/watch?v=\\_I8CLQazom0](https://www.youtube.com/watch?v=_I8CLQazom0) (Personal Computer Architecture 2020.)
19. <https://www.youtube.com/watch?v=So9SR3qpWsM> (Computer System Architecture. 2018.)
20. <https://www.sciencedirect.com/topics/computer-science/computer-architecture> (Computer architectures)
21. <https://www.oreilly.com/library/view/designing-embedded-hardware/0596007558/ch01.html> (An Introduction to Computer Architecture)
22. <https://www.educba.com/types-of-computer-architecture/> (types-of-computer-architecture)
23. <https://www.coursera.org/learn/comparch> (Digital Systems: From Logic Gates to Processors)
24. <https://azure.microsoft.com/en-us/overview/what-is-cloud-computing/#benefits> (Top benefits of cloud computing)
25. <https://www.salesforce.com/ca/cloud-computing/> (Types of Cloud Computing)
26. <https://dynamixsolutions.com/what-is-cloud-technology-and-how-does-it-work/> (What is Cloud Technology and How Does It Work?)
27. <https://www.investopedia.com/terms/c/cloud-computing.asp> (Cloud Computing)
28. <https://www.zdnet.com/article/what-is-cloud-computing-everything-you-need-to-know-about-the-cloud/> (What is Software-as-a-Service? IAAS, PAAS)
29. <http://www2.imm.dtu.dk/courses/02220/2017/L6/P2P.pdf> (Introduction to Peer-to-Peer Computing. Nicola Dragoni)
30. [https://en.wikipedia.org/wiki/Computer\\_literacy](https://en.wikipedia.org/wiki/Computer_literacy) (Computer literacy)
31. <https://www.indeed.com/career-advice/career-development/how-to-become-computer-literate> (Improving Your Computer Literacy)
32. <https://www.definitions.net/definition/computer+literacy> (definition/computer literacy)
33. [http://dept.harpercollege.edu/gedstudy/handouts/computer\\_literacy\\_skills.pdf](http://dept.harpercollege.edu/gedstudy/handouts/computer_literacy_skills.pdf) (An Overview of Basic Computer Literacy Skills)
34. <http://www.gcflearnfree.org/devices> (Free Devices Tutorials at GCF Learn Free: the functions and features of mobile devices)
35. [http://edutechwiki.unige.ch/en/Computer\\_literacy](http://edutechwiki.unige.ch/en/Computer_literacy) (Computer literacy)
36. [https://en.wikipedia.org/wiki/European\\_Computer\\_Driving\\_Licence](https://en.wikipedia.org/wiki/European_Computer_Driving_Licence) (European Computer Driving Licence)
37. <https://www.cs.york.ac.uk/undergraduate/what-is-cs/> (Computer Science)