MINISTRY OF EDUCATION AND SCIENSE OF UKRAINE
Ternopil Ivan Puluj National Technical University

Computer Systems and Networks Department

GUIDELINES
on performing a course project
on Computer Systems
for students of
Bachelor's Degree Program 123 Computer Engineering

Ternopil 2018

Методичні вказівки до виконання курсового проекту з дисципліни "Комп'ютерні системи" длястудентів спеціальності 123 "Комп'ютерна інженерія" / уклад. Н.Я. Шингера. – Тернопіль: ТНТУ, 2018. – 17.

Методичні вказівки розроблені у відповідності з навчальним планом спеціальності 123 "Комп'ютерна інженерія"

Укладач: к.т.н., доц. Шингера Н.Я.

Рецензент: к.т.н., доц. каф. КН Загородна Н.В.

Відповідальний за випуск: зав. каф. КС, к.т.н., доц. Осухівська Г.М.

Затверджено на засіданні кафедри комп’ютерних систем та мереж, протокол №\_\_\_\_ від «\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_2018 р.

Схвалено та рекомендовано до друку методичною комісією факультету комп’ютерно-інформаційних систем і програмної інженерії Тернопільського національного технічного університету імені Івана Пулюя, протокол №\_\_\_\_ від «\_\_\_» \_\_\_\_\_\_\_\_\_\_\_\_2018 р.

TABLE OF CONTENTS

|  |  |
| --- | --- |
| 1 General instructions ………………………………………….………………… | 5 |
| 2 COURSE PROJECT PREPARATION ………………………………………... | 7 |
| 2.1 Requirements for the text documents ……………………………………. | 7 |
| 2.2 Documents designation ………………………………………………….. | 8 |
| 3 CONTENTS OF A COURSE PROJECT ………………………………….....  | 9 |
| 3.1 Task for the course project……………………………………………….. | 9 |
| 3.2 Introduction ……………………………………………………………… | 9 |
| 3.3 Requirements list analysis ……………………………………………….. | 9 |
| 3.4 Theoretical aspects of computer system operation ……………………… | 10 |
| 3.5 The hardware and software ………………………………….................... | 11 |
| 3.5.1 General rules ……………………………………………………. | 11 |
| 3.5.2 The hardware principles of operation ………………………........ | 11 |
| 3.5.3 The software principles of operation ……………………………. | 11 |
| 3.5.4 The hardware and software interaction …………………………. | 12 |
| 3.5.5 The program interface description ……………………………… | 12 |
| 3.6 Displaying the computer system functioning ……………………………. | 12 |
| 3.7 Conclusions ……………………………………………………………… | 12 |
| 3.8 Table of references ………………………………………………………. | 12 |
| 3.9 Appendixes ………………………………………………………………. | 13 |
| **Appendix A** Course project sample title page …………………………………... | 14 |
| **Appendix B** Course project recommended structure ……………………………. | 15 |
|  |  |
|  |  |

INTRODUCTION

Course project is one of the first individual works of a future engineer.

When performing the course project a student deepens his/her knowledge of basic disciplines, masters techniques of experimental research and skills of research results and theoretical data comparison, masters skills of analysis, synthesis and technical displaying of the research results, acquires the ability to conduct scientific research that develops young engineer creative approach.

The course project should demonstrate the ability to use the acquired theoretical knowledge in solving specific application problems. The main purpose of the course project on computer systems is to practically strengthen the theory, methods and tools of computer systems development and operation, principles of organization and operation of modern operating systems and tools. Working on course project allows the student to master the skills of installation, configuration and maintenance of operating systems and their components better.

1 General INSTRUCTION

Course project is a part of a learning process. Completing of it is a must element of bachelor degree program of 6.050102 Computer Engineering. The aim of the course project on computer systems discipline is the analysis and in some cases the design of computer systems.

The course projects topics are assigned by teacher on consideration the students' personal written statements taking into account their desires, aptitudes and experience. Typically, the task of the course project is to study and analyze some existing computer systems or develop/improve the new ones. In particular, it is useful for the formation of future specialists in 6.050102 "Computer Engineering" to choose a theme that is of student's self-interest and corresponds to the department occupation direction.

To formulate the theme and problems of the project correctly it is crucial for the student to understand the structure of a computer system and its components.

When talking about computer system we mean a set of hardware and software and their interconnection. The structure of a typical computer system is shown on Fig. 1.1.



Figure 1.1 Network-oriented computer system

So the course project should consider the characteristics of hardware and software (the system and specialized one, but not application one) of a computer system that is used for solving a specific technical problem. In a particular case focusing only on hardware and software is acceptable. However, it is necessary to emphasize their close interconnection!

When performing the course project a student should apply knowledge gained during the learning process. In particular, knowledge of profiling subjects.

A student also has to understand that the course project is a qualifying work that reflects his/hers theoretical knowledge and practical skills in the specialty 7.05010201 "Computer systems and networks".

As an example of computer system the ADSL2 wireless router D-Link DSL-2640U can be used. The analysis of above mentioned computer system components is to be carried out according to the block diagram. Let us go into particulars with the system's hardware and represent them in the table 1.1. The router's software is based on an OS Linux core with some modifications of D-Link company.

In his/her project a student should analyze all the computer system components and interconnections between them.

If a student, in coordination with a supervisor, decides to focus his/her main attention on a particular component of the computer system, such as for example BCM6348 chipset, he/she still has to describe other hardware and software components in the extent that is sufficient for understanding the operational principals of the studied computer system in general. When describing the BCM 6348 chipset the main attention should be paid to the RISC-architecture high-performance MIPS32-processor and its interconnections with other components. That is to cover the structural and/or functional scheme of the processor, its operating peculiarities, commands set, expansions, its programming characteristics, schematic features etc. The functional and/or structural schemes can be used as supporting broad sheets for the project.

Table 1.1 – Components of DSL-2640U computer system

|  |  |  |  |
| --- | --- | --- | --- |
| **Characteristics of the system element** | **Implementation details** | **Brand** | **The model of the device (controller)** |
| ADSL technology (supported by the chipset) | ADSL2+ | Broadcom | BCM6348SKFBG |
| Processor | MIPS32 |  | BCM6348SKFBG |
| ROM | FLASH 4МВ | Macronix International | MX29LV320CBTC-90G - 32М-ВТТ [4М х 8/ 2Мx 16] SINGLE VOLTAGE 3V |
| RAM | SDRAM 16МВ | ESMT | M12L64164A-7T х2 |
| Switch | 10/100MBit | Broadcom | BCM5325EKQMG |
| Wireless network | WLAN 802.11b/g | Broadcom | BCM4318KFBG |
| ADSL-line driver |  | Broadcom | BCM6301KSG |
| WLAN |  | Skyworks | SKY65206-13 |

In case when it is decided to focus on DSL-2640U system software, it is necessary to highlight the operational principles of the operating system, its components, features of functioning on the MIPS32 architecture, its functionality, technologies of its modification and programming etc.

Here you can find some example topics for the course project:

www.electronicshub.org/embedded-systems-projects-ideas/

OR you can chose something else to write about. It depends on your area of interest.

Each year the course projects themes change and cannot be repeated.

When performing the course project is necessary to map up a plan, estimate the amount of work and apprehend the expected results.

It is desirable to provide the course project with qualitative and semantic illustrations (original charts, diagrams, etc.).

When performing course projects it is not enough to use only textbooks and teaching materials, as they mostly reveal only the basis of technology, rather than describing the application problems and issues. It is better to study literary sources going from simple to complex ones. When studying scientific literature a student must learn to clearly distinguish between the important and secondary material, which has no direct connection to the subject of the research, and reject non-technical promotional material.

2 COURSE PROJECT PREPARATION

2.1 Requirements for the text documents

Explanatory note (EN) must report in depth the course project topic, include the reasons for choosing particular methods, algorithms and software to solve the problem, analysis of the obtained results and other materials.

The explanatory note material should be given correctly, clearly and concisely. The text of the note should contain the references to the used literature and other sources.

It is not recommended to use in the explanatory note the first-person pronouns expressions, such as: “I think...”, “we think...” etc. Instead you can use, for example: “It is believed ...”, “It is considered ...” etc.

The course project EN is to be made on one side of white A4-format paper (210 x 297 mm).

The volume of EN is 25-30 typewritten pages (not including appendices). 1,5 interval (up to 30 lines on a sheet of A4), margins: top and bottom – 2 cm, right – 1.5 cm, left – 3 cm.

EN must begin with the title page. (See Appendix A) Next goes: the task for course project, a list of abbreviations (if necessary), table of contents, main text, list of references and appendices.

Page numbering of EN begins with the title page, on which the number by itself is not affixed. A sheet that is next after the course project task is numbered with a digit 4.

EN is divided into sections and subsections, paragraphs and subparagraphs.

Sections within the entire explanatory note should have numbers marked in Arabic numerals without a period.

Subsections should be numbered within the section: the subsection number consists of a section number and subsection number, separated by a period, eg., 2.3 mean the third subsection of the second section. At the end of the section/subsection number a period is not needed.

A paragraph number contains a section, subsection and paragraph numbers separated by periods, as 3.2.1 – the first paragraph of the second subsection of the third section.

Section titles should be short and written in capital letters in the middle of a row. The subsections names should be written with smaller letters (the first one is capital). The period at the end of the title is not needed. Between the sections/subsections names and the main text a blank row should be left.

Graphic material in the EN (diagrams, sketches, graphs, drawings) should be made in graphics editors or with a pencil.

Illustrations are placed right after mentioning them in EM.

All illustrations in the EN are numbered in Arabic numerals within one section, for example, Figure 2.3 – section 2, figure 3.

The list of references should include only the literature that were used and referred to in the text.

2.2 Documents designation

Each document of the course project has its own designation. This designation should have the following structure:

CPCS 1.118.009.00 EN

The first group – a code composed of the type of work (CP – course project) and the abbreviated name of the department where the project was implemented (CS – computer systems).

The second group – course project orientation: 1 – hardware, 2 – software.

The third group – the first three digits of the student’s record book number. (If the number is less than three characters long, complement it with zeros at the beginning).

The fourth group – the last three digits of the student’s record book number. (If the number is less than three characters long, complement it with zeros at the beginning).

The fifth group – the number of a component part, fabrication, sub-script, etc. or just zeroes.

The sixth group – document code (for explanatory notes – EN).

Let's take, for example, a course project explanatory note of the student with his/her record book number 118-09, and his/her project related to hardware: CPCS 1.118.009.00 EN.

3 CONTENTS OF A COURSE PROJECT

The recommended course project structure is presented in Appendix B.

3.1 Task for the course project

A student draw up the task for his/her course project. The task species: the name of the university; code and name of the specialty; name of the department; course project theme; deadline date; initial data; contents (a list of issues to study). The course project task should be signed by the supervisor and student.

The task should be made on the two sides of A4 white paper (Appendix B).

As the course project initial data a student should specify: hardware and/or software, computer system, processed materials and test data.

3.2 Introduction

In the course project introduction the student justifies the choice of the theme, briefly outlines its relevance and points out the specific practical problems the system can solve. The goals and objectives of the project should be formulated here along with identifying the main approaches and ideas, choosing a way to solve the problem.

The main emphasis in the introduction is applied to the task or problem that is solved in the course project, not the means to solve it. It is inappropriate to cite in the introduction the definition of computer systems well-known terms and detailed specifications and descriptions of software and other information that does not apply to the theme of the course project.

The volume of introduction is 1..1,5 pages.

3.3 Requirements list analysis

The main purpose of this EN section is to analyze the course project task requirements and formulation of the additional technical requirements that are directly derived from the subject and purpose of the study.

Here the basic software parameters, its features and functions, means of implementation, user interface, working environment should be specified.

And if in the previous section we formulated only a general method for solving the problem, here we outline a concrete plan of the study. The simple rewriting of course project tasks requirements is not allowed here. You need to creatively reflect on it and formulate specific technical requirements and ways to achieve them.

The volume of this section is 1..2 pages.

3.4 Theoretical aspects of computer system operation

Based on the objectives and technical requirements it is necessary to submit basic theoretical material that is the basis of the studied computer system. In particular, these are the main operational algorithms, key data transfer protocols, typical basic functions, and functional, structural and schematic diagrams of the hardware. The algorithms can be displayed as flowcharts, designed according to the standard requirements or verbal description that includes the sequence of generalized operations and transitions between them. Such description can have a hierarchical structure, where you first record more general operations and then describe them more deeply at a lower hierarchical level. When describing the protocol it is advisable to show the package format and structure.

For certain types of software it is easier to carry out the algorithm description in terms of objects interaction via messages and events. In this case, the algorithm is divided into several independent sequences of operations that respond to events and manage messages processing.

For real time systems the chronological sequence of message and events processing are important. That is why apart from the algorithm description the time diagrams are also used here. The time diagrams characterize the sequence of various processes and their interaction with the hardware.

In general, a way of describing the algorithm is selected based on the particular task, but it must be complete, consistent and sufficient for understanding the operation principle of designed program.

Analyzing the algorithm the basic structural parts should be specified (modules, programs, libraries).

For some tasks there is a need to create also some auxiliary programs (utilities) that perform specific service functions (such as files converting, test data forming, graphs displaying, etc.). In this case the problem should be implemented in the form of packages that contain the main program, modules and assistive programs.

It is necessary to consider the aspects of the hardware and software interaction with the operating system via system calls, Win32API functions, and investigate the usage of computer system resources: memory, CPU time, ports, input/output devices, and draw attention to data packets processing and their structure.

According to the above mentioned scheme it is needed to conduct the decomposition of theoretical material and display it in this section.

The volume of the section is 5..10 pages.

3.5 The hardware and software

3.5.1 General rules

This section is the main one in the course project. Its volume is 15-20 pages.

There can be various approaches to its representation, depending on the selected computer systems. In the simplest cases the ready-assembled system based on some test data or operation scenarios should be investigated; in more complex cases – the implementation of personal software or hardware, or modifying of an existing ones.

It is advisable to consider the operation algorithms of the software, its main modes, exceptional situation. Particular attention is to be paid to the operating system as a key element of hardware/software interaction.

3.5.2 The hardware operation principles

In this subsection you have to analyze the hardware architecture, key aspects of its components operation, their functional area and architectural features.

It is reasonable to illustrate these aspects by means of functional and structural schemes.

3.5.3 The software operation principles

This section should be devoted to the description of the operation principle of the main software and problems it solves. It is good to analyze a wide number of programs that are consistently used to solve the problem.

Certainly the computer system operating system, its architecture and functions should be analyzed.

3.5.4 The hardware and software interaction

This section should be sufficient for understanding the operation of all the details of computer system in general: hardware and software.

3.5.5 The program interface description

If the program has a command line interface, it is to be described the key command line arguments and their functionality.

In case of interactive software with well-developed system of menus and dialog boxes in this section it should be described the purpose of menu item and working with them, as well as dialog boxes options.

It should be described in details the procedure of software using. All available to the user (system administrator) functionality should be put in alphabetical order.

3.6 Displaying the computer system functioning

In this section you should describe the software testing methods, test data and results of software operation. If the software operates in graphic mode, the copy of graphic window should be printed. If the result of software operation is a text file, it is necessary to show the content of this file. For the software with wide system of dialog windows and menus you should represent only the most essential results that demonstrate software operation (not the entire screen for each opened menu item). In this case a list of all menu items and the dialog windows content can be presented in text form.

If the representation of the software operation is going to be long, you can present it in appendices.

The volume of the section is 1..5 pages.

3.7 Conclusions

Write down the conclusions based on your research findings. You may represent the results in the form of briefly formulated and numbered theses. The number of conclusions depends on the amount of the results, the complexity of the program and the problem it solves.

The volume of the conclusions is 1..2 pages.

3.9 Appendices

The material that complements the text of the explanatory note may be placed in the Appendices. Program codes, graphics and tables can be represented in Appendices.

Each appendix should start with a new page.

As an appendix no. 1 you can represent a text of a developed program or a hardware structure of the computer system. When it is a significant volume of program code it is allowed to represent only the text of main modules of the program.

APPENDIX A СOURSE PROJECT SAMPLE TITLE PAGE

MINISTRY OF EDUCATION AND SCIENSE OF UKRAINE

Ternopil Ivan Puluj National Technical University

Computer Systems and Networks Department

COURSE PROJECT
ON COMPUTER SYSTEMS

on the theme of:

“COURSE PROJECT THEME”

Prepared by

the student of ICI-22 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Name, Surname

credit book number (signature)

Project supervisor \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Natalya Shynhera

 (mark, signature, date)

Ternopil 2018

APPENDIX B СOURSE PROJECT RECOMMENDED STRUCTURE

TABLE OF CONTENTS

Task for the course project 2

INTRODUCTION 4

1 REQUIREMENTS list analysis 5

2Theoretical aspects of using

D-Link G804V computer system 7

3 Computer system hardware 9

3.1 Architecture 11

3.2 Main controls tools 14

3.3 Communication 17

4 Computer system software 20

4.1 Operation system 22

4.2 Additional software 24

4.3 Control tools of computer system hardware 27

5 Monitoring of computer system operation 30

Conclusions 33

Table of references 35

Appendix A Program code 36

Appendix B Graphic material

|  |  |
| --- | --- |
|  | **MINISTRY OF EDUCATION AND SCIENSE OF UKRAINE**Ternopil Ivan Puluj National Technical UniversityFaculty of Computer Information Systems  and Software EngineeringComputer Systems and Networks Department |

 CALENDAR PLAN
**of a course project**

Degree Program 6.050102 Computer Engineering

***Student of group*** **ICI-22 Name of the student**

The course project theme: **D-Link G804V Computer System**

|  |  |  |  |
| --- | --- | --- | --- |
| **No** | **The projection phase** | **Deadline**  | **Note on performing** |
| 1 | Analyzing thу course project task | 3.03.2018 |  |
| 2 | Studying the documentation on D-Link G804V | 12.03.2018 |  |
| 3 |  D-Link G804V setting | 22.03.2018 |  |
| 4 | D-Link G804V hardware analyzing | 3.04.2018 |  |
| 5 | D-Link G804V software analyzing | 7.04.2018 |  |
| 6 | Equipment Design Memorandum (EDM) completion | 12.04.2018 |  |
| 7 | Course project graphical part completion | 22.04.2018 |  |
| 8 | Course project try-out defense | 12.05.2018 |  |
| 9 | Course project main defense | 13.05.2018 |  |

|  |  |  |  |
| --- | --- | --- | --- |
|  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(student’s signature) |  | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_(supervisor’s signature) |
| Course project defense date: **\_\_\_\_\_\_\_\_\_\_\_\_\_** | «\_\_\_»\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  **2018** |
|  |  |