Computer Programming 143 – Lecture 2
Introduction to module

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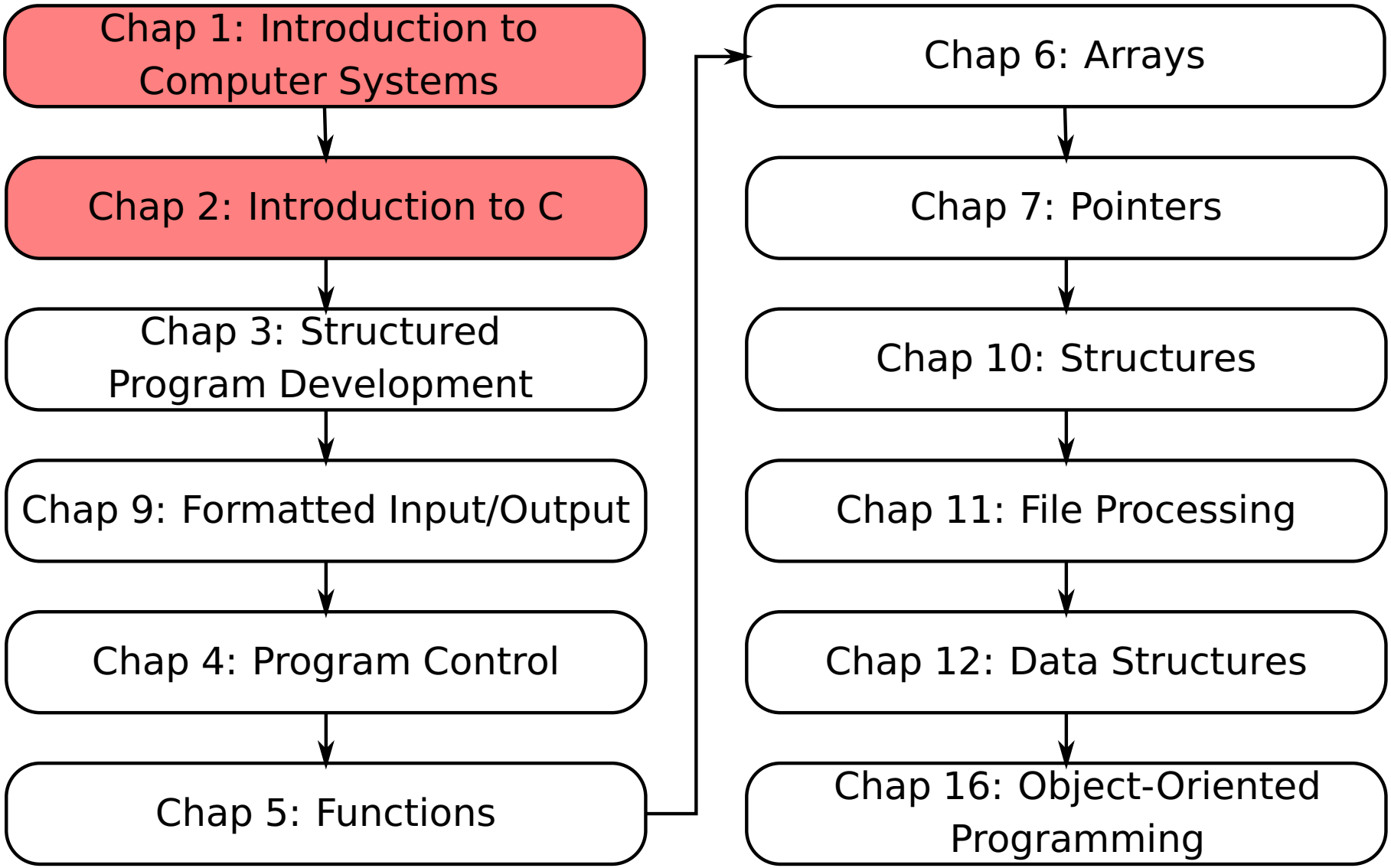
Module Overview



Lecture Overview

1. Introduction (1.1)
2. Computer Systems (1.2)
3. Programming Languages (1.4-1.9)
4. Simple C Program 1: Printing Text (2.2)

1.1 Introduction

We will learn

- How to think in a structured way in order to solve problems using computers
- The C programming language
- Proper programming techniques

The textbook also covers

- C++: Chapters 15 to 24 introduce the C++ programming language

This course is appropriate for

- Technically oriented people with little or no programming experience
- Experienced programmers who want a deep and rigorous treatment of the C language

1.2 Computers: Hardware and Software

Computer

- Device capable of performing computations and making logical decisions
- Computers process data under the control of sets of instructions called computer programs

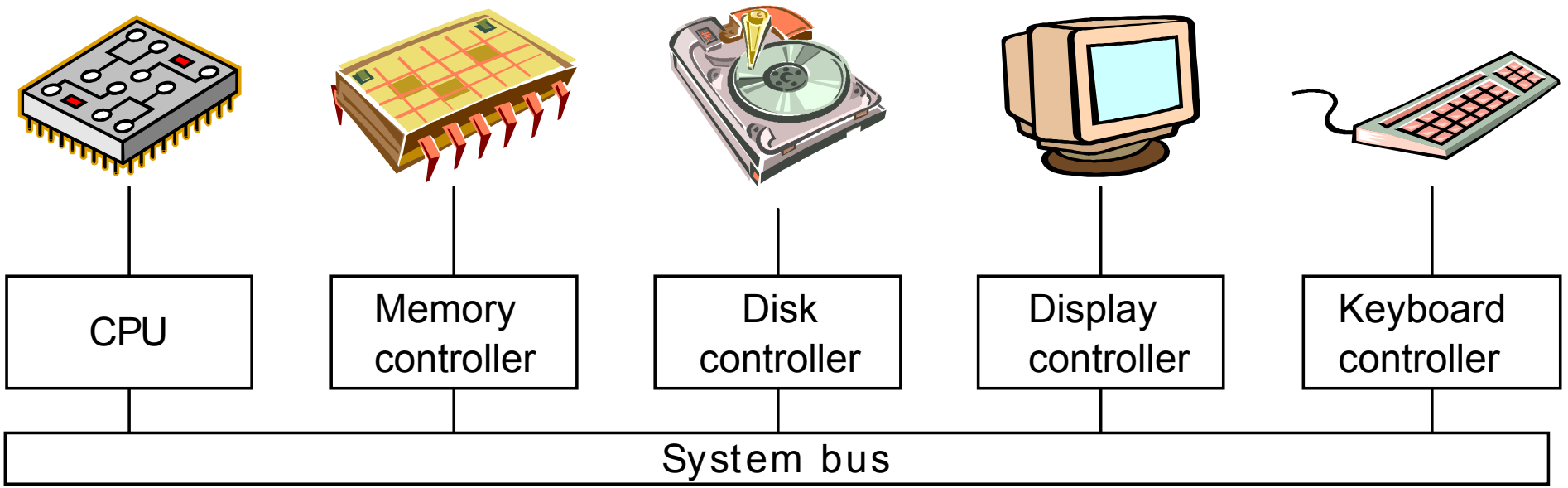
Hardware

- A computer consists of various devices
- Keyboard, screen, mouse, disks, memory, CD-ROM, and processing units

Software

- Programs that run on a computer

1.2.2 Computer Organization (Hardware) I



1.2.2 Computer Organization (Hardware) II

Six logical units in every computer:

1. Input unit (Keyboard, mouse)
   - Obtains user input information from input devices
2. Output unit (Screen, printer)
   - Outputs user or processed information and results
3. Arithmetic Logic Unit (ALU)
   - Performs arithmetic calculations and logic decisions
   - Implemented as part of CPU (below)
4. Central processing unit (CPU)
   - Supervises and coordinates the other sections of the computer
5. Memory unit (RAM)
   - Volatile, rapid access, low capacity, and expensive
   - Stores program and input information temporarily
6. Secondary storage unit (Disks)
   - Cheap, long-term, high-capacity storage
   - Stores inactive programs and data

1.4 Machine Languages, Assembly Languages, and High-level Languages I

Three types of programming languages:

1. Machine languages
   - Strings of numbers giving machine specific instructions
   - Example:

```
+1300042774
+1400593419
+1200274027
```

2. Assembly languages
   - English-like abbreviations representing elementary computer operations (translated via assemblers)
   - Example:

```
LOAD    BASEPAY
ADD     OVERPAY
STORE   GROSSPAY
```

1.4 Machine Languages, Assembly Languages, and High-level Languages II

3. High-level languages
   - Codes similar to everyday English
   - Use mathematical notations
   - Translated via compilers
   - Example:

```
grossPay = basePay + overTimePay
```

This course: C

Why do we use C in this module?

- Programming principles are easy to learn in C
- Provides a good base from which to learn higher level languages (C++/Java)
- Essential for embedded applications
- Many libraries for mathematical and scientific applications available

1.5 History of C

C

- Evolved by Ritchie from two previous programming languages, BCPL and B
- Used to develop UNIX
- Used to write modern operating systems
- Hardware independent (portable)
- By late 1970's C had evolved to "Traditional C"

Standardization

- Many slight variations of C existed, and were incompatible
- Committee formed to create a "unambiguous, machine-independent" definition
- Standard created in 1989, updated in 1999 (C99) and 2011 (C11)

1.6 The C Standard Library

C programs consist of pieces/modules called functions

- A programmer can create his own functions
  - Advantage: the programmer knows exactly how it works
  - Disadvantage: time consuming
- Programmers will often use the C library functions
  - Use these as building blocks
  - Advantages: saves time
  - Disadvantages: must know exactly how the library work
- Avoid re-inventing the wheel
  - If a pre-made function exists, generally best to use it rather than write your own
  - Library functions carefully written, efficient, and portable

1.9 Typical C program development environment I

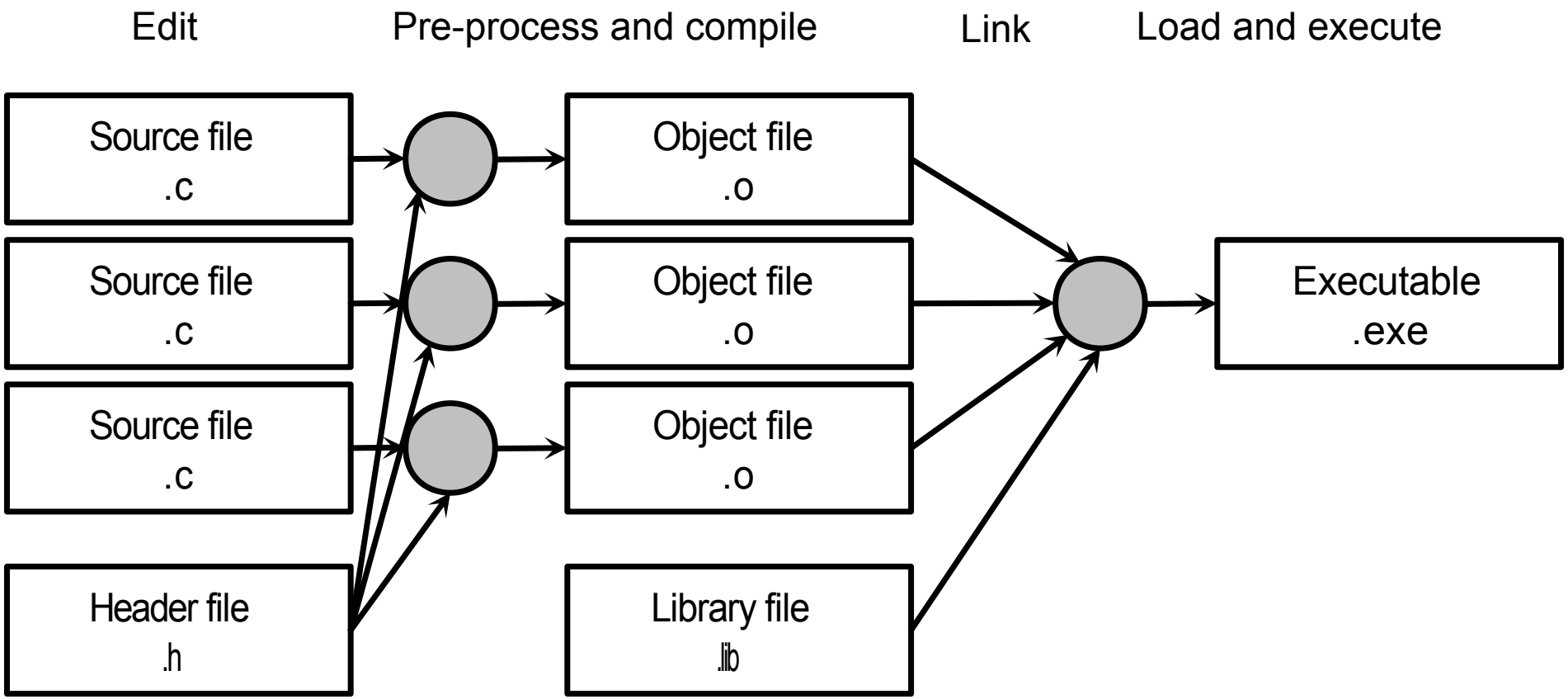
Typical C systems consists of many parts, they include:

- a program development environment
- the language
- the C Standard Library

C programs typically go through six phases to be executed:

- edit
- pre-process
- compile
- link
- load
- execute

1.9 Typical C program development environment II



2.2 Simple C Program: Printing Text I

Fig 2.1 Text printing program

```c
/* filename: helloworld.c
 * description: My first program in C
 * version: 3
 * date: 10/02/2004
 * author: RG and DE
 */
#include <stdio.h>

/* function main() begins program execution */
int main()
{
   printf( "Hello World!\n" );

   return 0; // program ended successfully
}
```

2.2 Simple C Program: Printing Text II

Output

```
Hello World!
```

2.2 Simple C Program: Printing Text III

Comments

- Used to describe program
- Text surrounded by /* and */ is ignored by compiler

```
/* filename: helloworld.c
 * description: My first program in C
 * version: 3
 * date: 10/02/2004
 * author: RG and DE
 */

/* function main() begins ... */
```

- Remainder of line after // is ignored by compiler

```
   return 0; // program ended successfully
```

2.2 Simple C Program: Printing Text IV

`#include <stdio.h>`

- Pre-processor directive
  - Tells the computer to include the contents of the specified file with the source code
- `<stdio.h>` allows standard input/output operations

`int main()`

- C programs always contain one or more functions, exactly one of which must be main
- Parenthesis used to indicate a function
- **`int`** means that main “returns” an integer value to calling function or batch process

2.2 Simple C Program: Printing Text V

Braces { and }

- Braces ({ and }) indicate a block
- The bodies of all functions must be contained in braces

```
{
   //Block contents
}
```

printf("Hello World!\n");

- Instructs computer to perform an action
  - Specifically, prints the string of characters within quotes (" ")
- Escape character (\)
  - Indicates that `printf` should do something out of the ordinary
  - \n is the newline character
- Entire line called a statement
  - All statements must end with a semicolon (;)

2.2 Simple C Program: Printing Text VI

return 0;

- A way to exit a function
- `return 0`, in this case, means that the program terminated normally

Perspective

Today

Introduction to Computer Systems and Programming

- Introduction (1.1)
- Computer Systems (1.2)
- Programming Languages (1.4-1.9)

Introduction to C

- First program (2.2)

Next lecture

Introduction to C continued

- Arithmetic, user input

Homework

1. Read Chapter 1
2. Do Self-Review Exercises 1.1, 1.2
3. Do Exercises 1.4, 1.5
4. Go through first program 2.2