Embedded Operating Systems

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An Real-Time OS: µC/OS-II Quick Overview

Introduction of µC/OS–II (1/2)

- The name is from micro-controller operating system, version 2
- µC/OS-II is certified in an avionics product by FAA in July 2000 and is also used in the Mars Curiosity Rover
- It is a very small real-time kernel
  - Memory footprint is about 20KB for a fully functional kernel
  - Source code is about 5,500 lines, mostly in ANSI C
  - It's source is open but not free for commercial usages
- Preemptible priority-driven real-time scheduling
  - 64 priority levels (max 64 tasks)
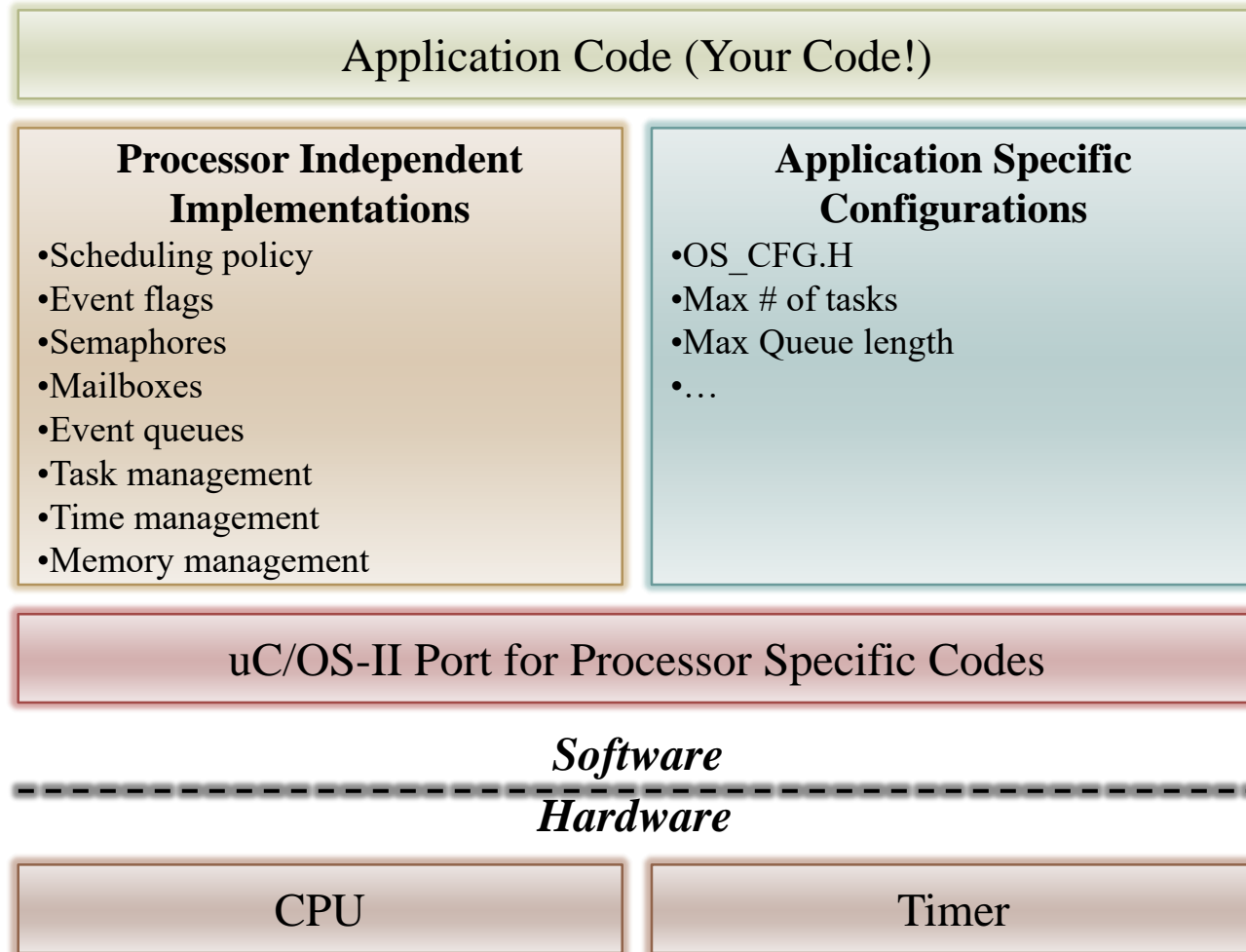 - 8 reserved for µC/OS-II
  - Each task is an infinite loop

Micriµm

µC/OS-II
The Real-Time Kernel

Introduction of µC/OS-II (2/2)

▸ Deterministic execution times for most µC/OS-II functions and services

▸ Nested interrupts could go up to 256 levels

▸ Supports of various 8-bit to 64-bit platforms: x86, ARM, MIPS, 8051, etc.

▸ Easy for development: Borland C++ compiler and DOS (optional)

▸ However, uC/OS-II still lacks of the following features:
  ◦ Resource synchronization protocol
  ◦ Soft-real-time support

The µC/OS-II File Structure

Application Code (Your Code!)

Processor Independent Implementations
- Scheduling policy
- Event flags
- Semaphores
- Mailboxes
- Event queues
- Task management
- Time management
- Memory management

Application Specific Configurations
- OS_CFG.H
- Max # of tasks
- Max Queue length
- …

uC/OS-II Port for Processor Specific Codes

Software
- -
*Hardware*

CPU

Timer

Requirements of μC/OS-II Emulator

- Operating System
  - Windows XP 32bits
  - Use virtual machine to install the OS
  - Install "Guest Additions" for Virtualbox
- Tools
  - Borland C++ compiler (V4.5)
    - BC45 is the compiler
  - Turbo Assembler
    - The assembler is in tasm
  - The source code and the emulation environment of μC/OS-II
    - SOFTWARE is the package
- Full Package
  - Download it from the course website with password: csie2018

Borland C++ Compiler

- Download Borland C++ and install it on your windows XP environment
  - Double click the "INSTALL.EXE"
- Add ";C:\BC45\BIN" to your system Path
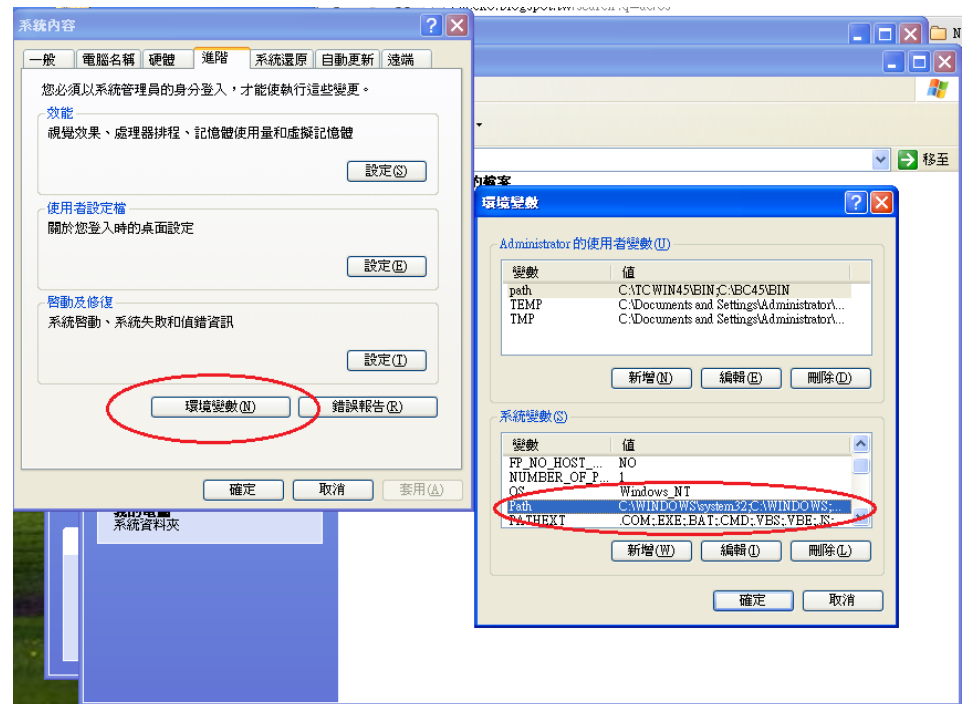
Turbo Assembler

- Download Turbo assembler and unzip the file
- Copy "\tasm\BIN\TASM.EXE" to your "C:\BC45\BIN"
  - Include the missing assembler which is going to be used during we compile the source code of μC/OS-II

Compile µC/OS–II Example Code

▸ Download the source code and emulator µC/OS-II
  ◦ It is recommended to put the source code package "SOFTWARE" directly in C:\

▸ Test the first example
  ◦ Execute C:\SOFTWARE\uCOS-II\EX1_x86L\BC45\TEST\TEST.EXE
  ◦ Press ECS to leave

▸ Rename or remove the executable file
  ◦ Rename TEST.EXE

▸ Compile the µC/OS-II and the source code of the first example
  ◦ Run C:\SOFTWARE\uCOS-II\EX1_x86L\BC45\TEST\MAKETEST.BAT
  ◦ A new "TEST.EXE" will be created if we compile it successfully

Common Mistakes

▸ Did you directly put the package "SOFTWARE" in C:\ ?

▸ Have you copied the correct file "TASM.EXE" to your "C:\BC45\BIN" directory?

▸ Did you set the Path correctly?
  ◦ See the picture in Page 7
  ◦ There is no space

Homework 1

▸ Textbook and source code reading:
  ◦ Chapters 1 and 2
▸ Study report: 2 pages
▸ Deadline: 2022/11/29
▸ The grading baseline: 80

Homework 2

▸ Textbook and source code reading:
  ◦ Chapters 3, 4 and 5
▸ Study report: 2 pages
▸ Deadline: 2022/12/06
▸ The grading baseline: 80
▸ Extra exercise
  ◦ Chapters 6, 7 and 13

Report Format

▶ Each student should write a report

▶ Only two A4 pages

▶ Use 12 pt font

▶ File name: EOS-Homework(1 or 2)-StudentID

▶ File type: PDF or Word

▶ Send it to my email: chewei@mail.cgu.edu.tw

▶ Email title: EOS Homework (1 or 2) StudentID