國立交通大學
National Chiao Tung University

Microcomputer system lab.

Outline

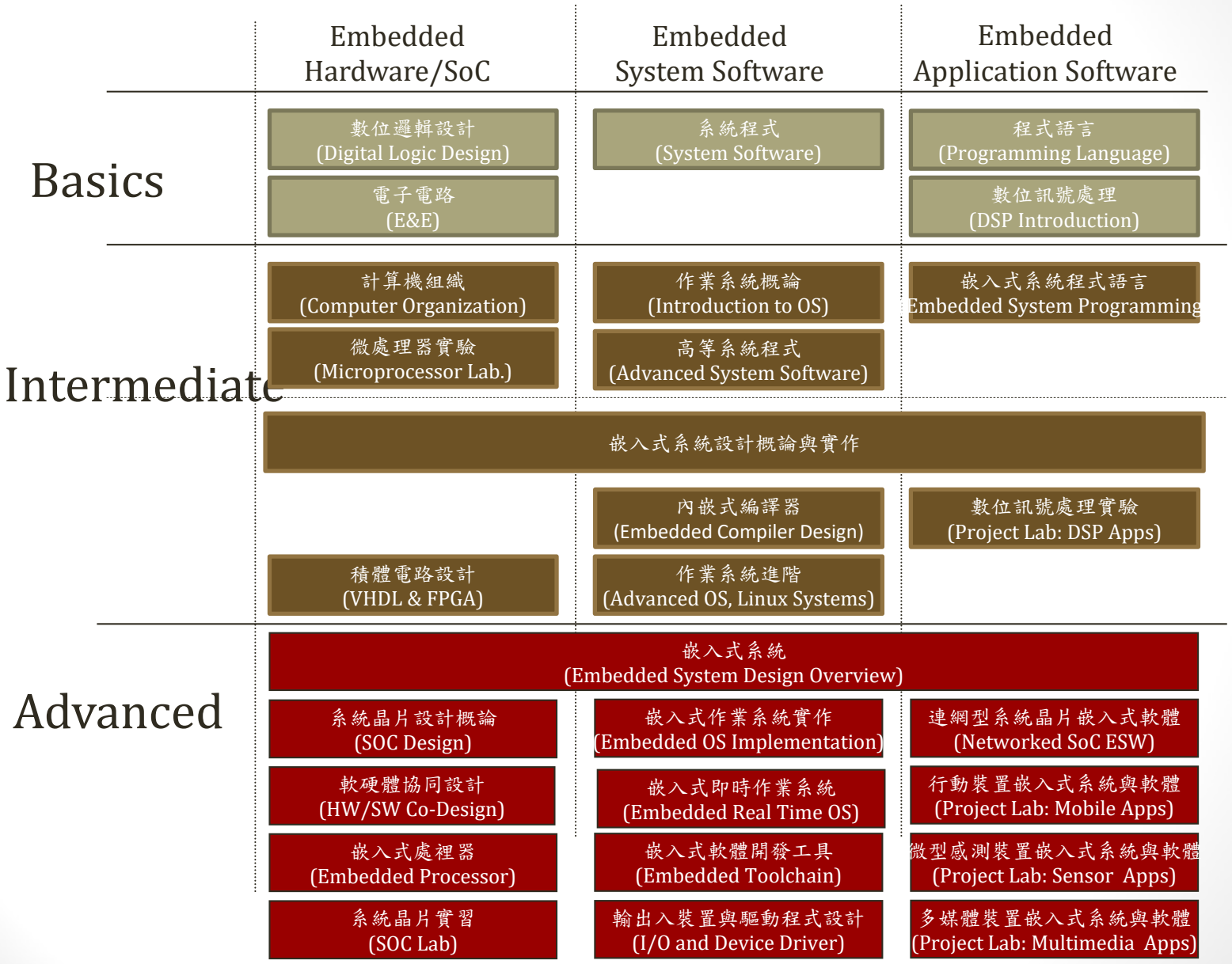
- General information
- Background
- Student evaluation
- Schedule

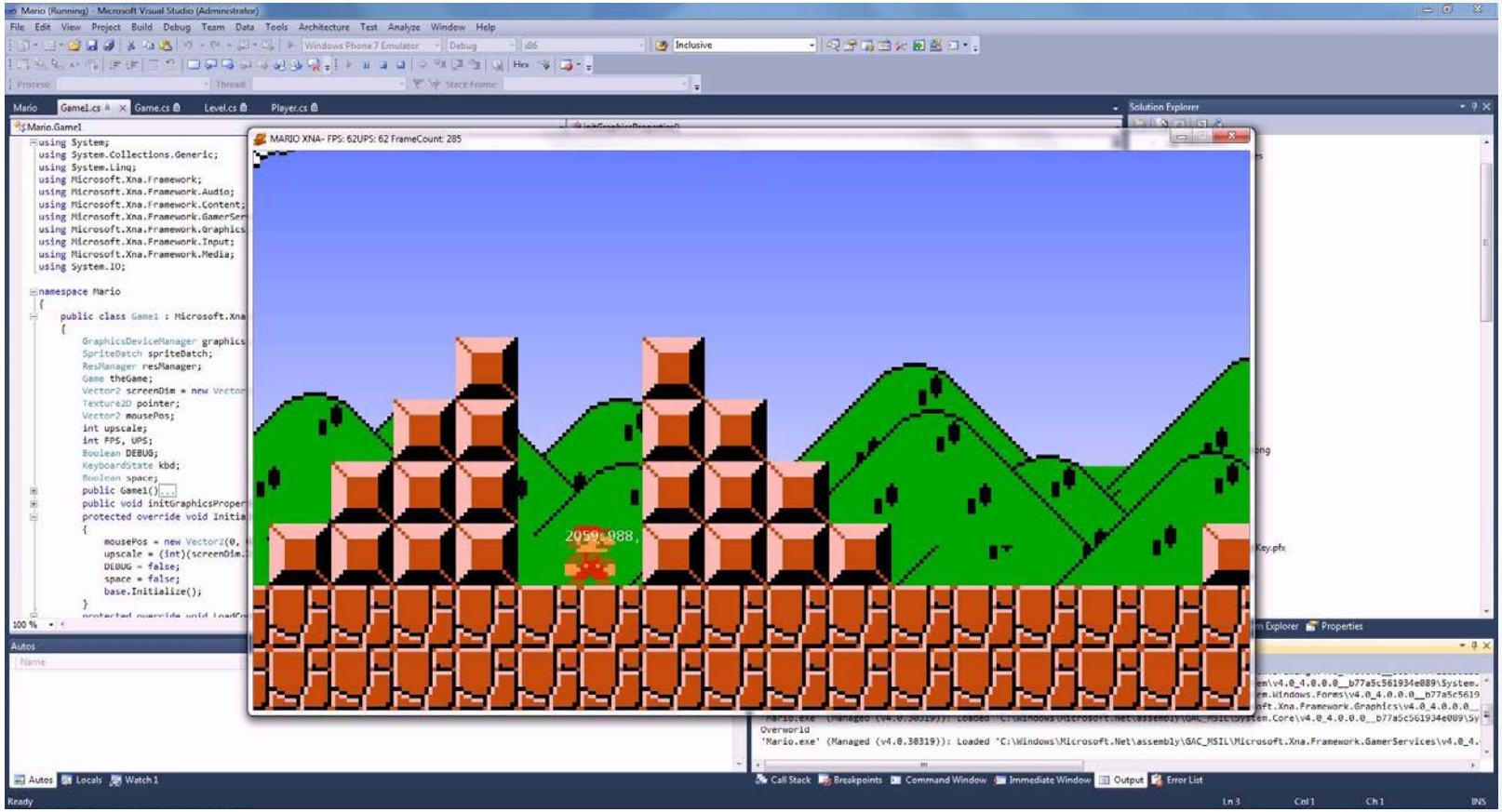
General information

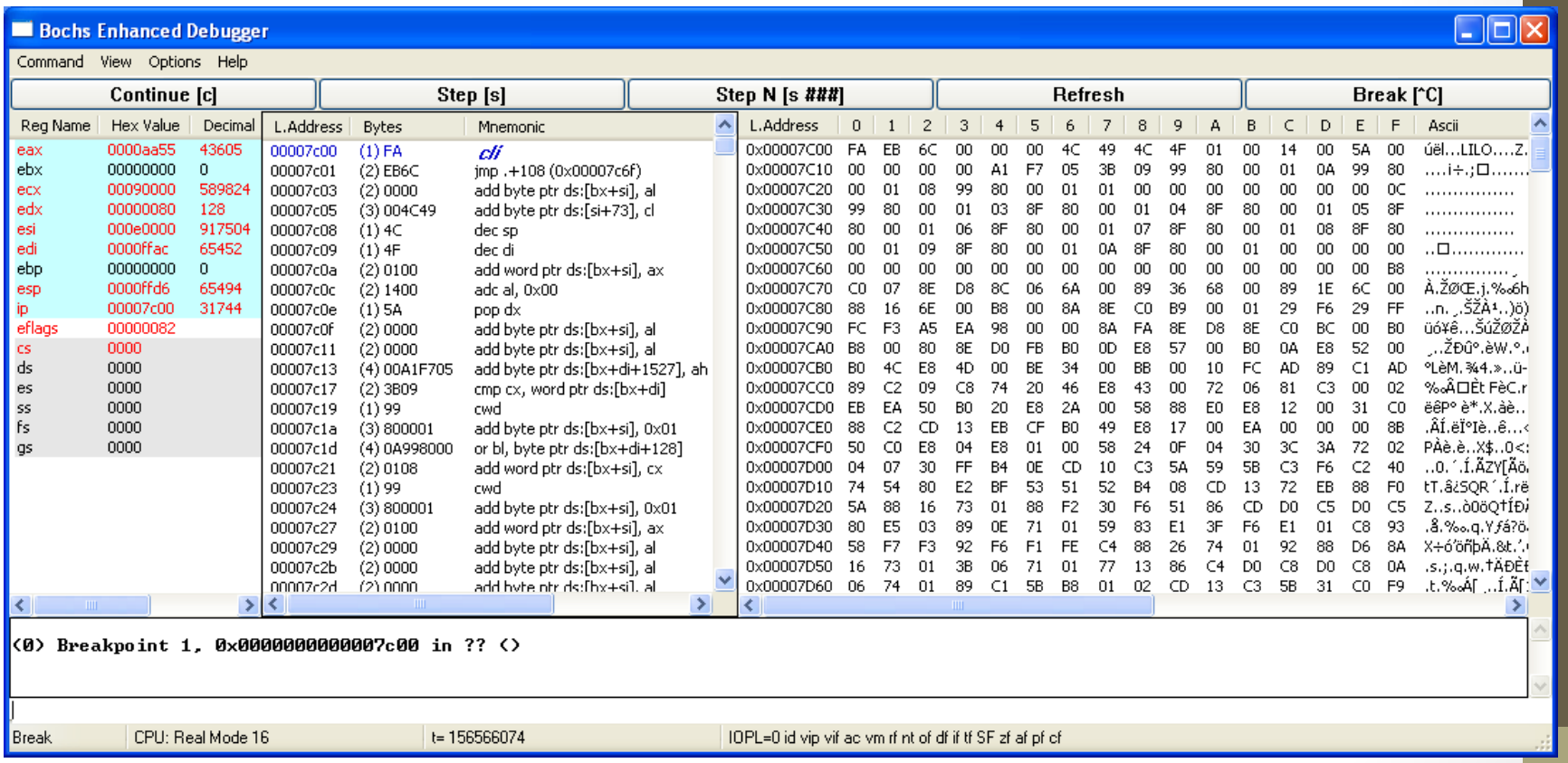
- Instructor: 曹孝櫟, EC426
- TA Team:
  - 謝成林 goodthing61@gmail.com (TA lead)
  - 林怡亨 teresacream@gmail.com
  - 吳宥柏 yupog2003@gmail.com
  - 傅意茹 zz28234830@gmail.com
  - 柴俊瑜 stanleychai1995@gmail.com
- Course: 5EF-EDB27
- Lab: Take home/Demo 3IJK-EC222/EC221/EC220
- Office hour: 5ABCD/EC426
- Course web site
  - http://dcpc.nctu.edu.tw

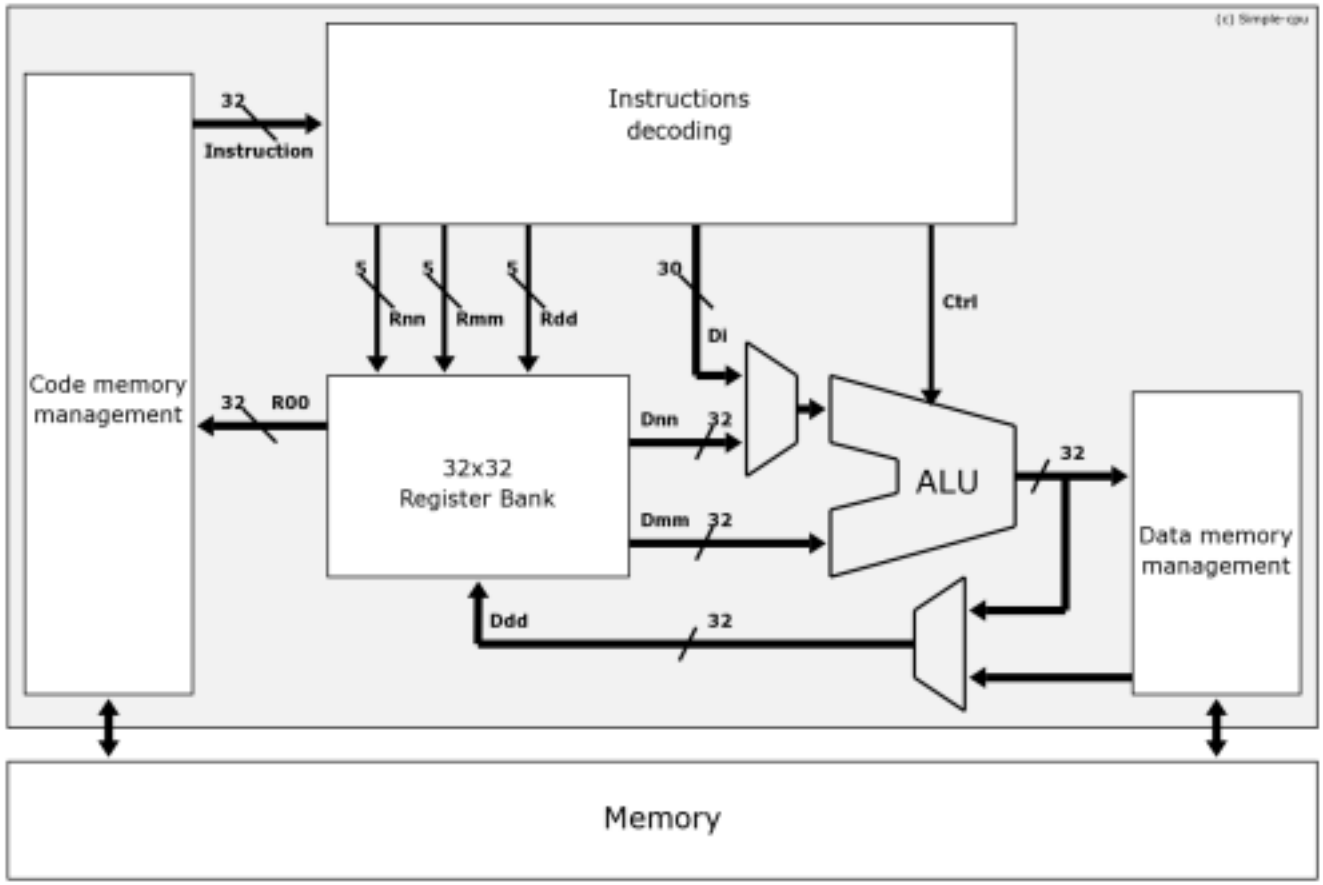
Background

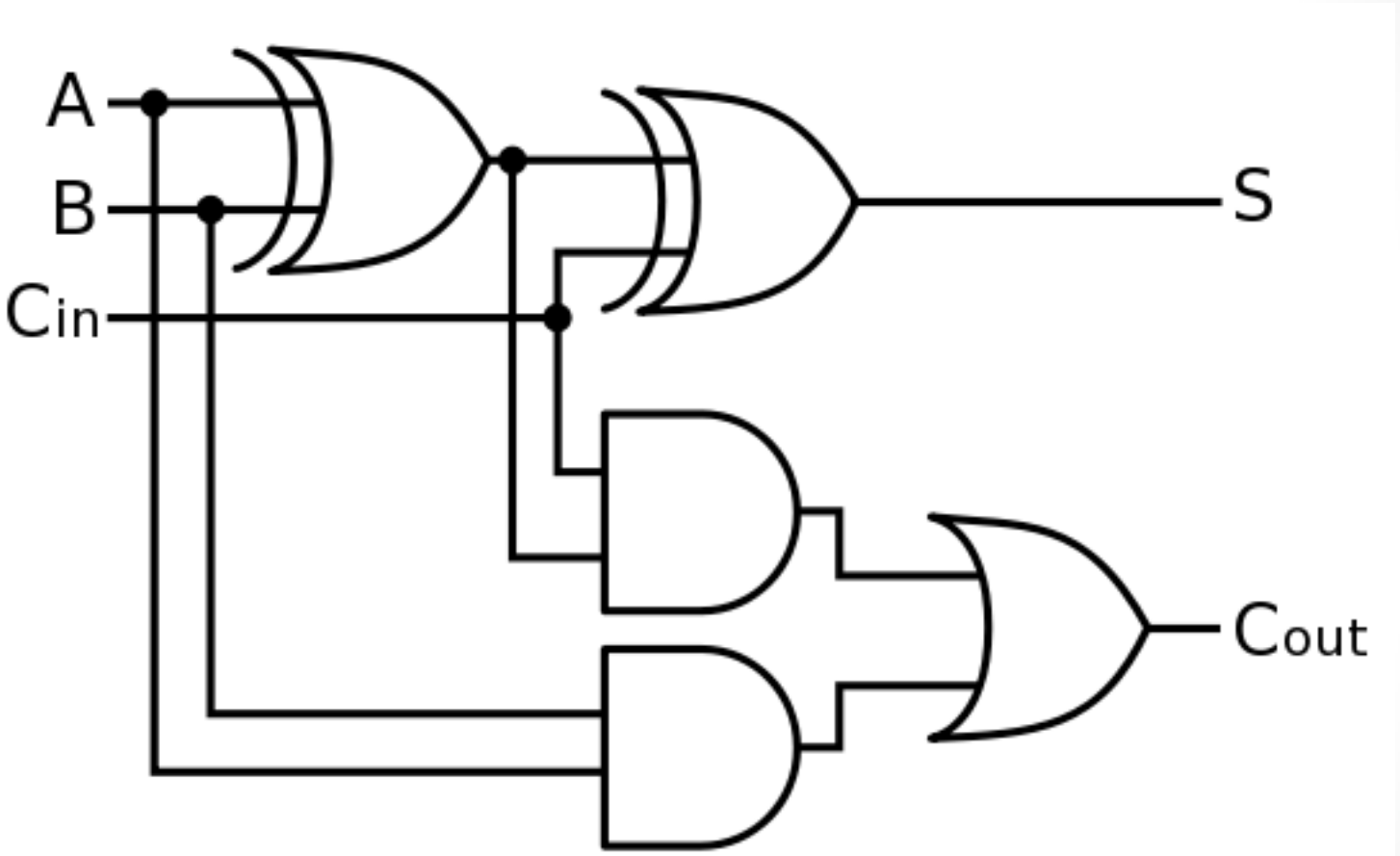
- Course
  - Micro. Computer System Lab.
- Prerequisite
  - Please advise CS rules
  - Knowledge of *computer architecture/organization*, *assembly language*, *electronics*, *electronics lab.*, *digital circuits*, *intro. to digital systems* will be very helpful
- Objective
  - To understand and **hands-on** micro. computer system about architecture, peripheral, timer, counter, interrupt, I/O control and etc.
  - ARM Cortex M4 microcontroller is used as an example

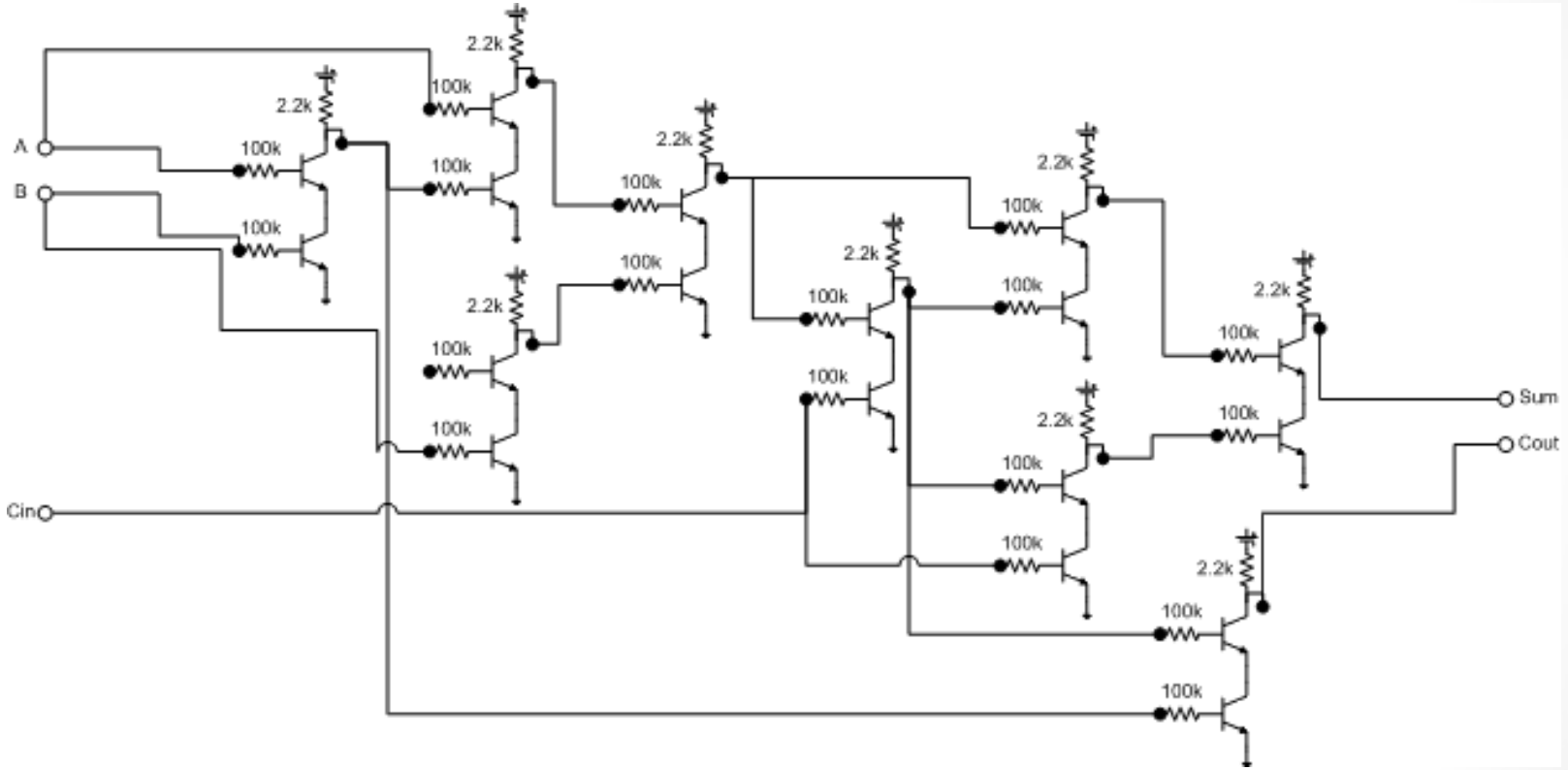

Embedded Hardware/SoC
Embedded System Software
Embedded Application Software
Basics
數位邏輯設計 (Digital Logic Design)
系統程式 (System Software)
程式語言 (Programming Language)
電子電路 (E&E)
數位訊號處理 (DSP Introduction)
Intermediate
計算機組織 (Computer Organization)
作業系統概論 (Introduction to OS)
嵌入式系統程式語言 Embedded System Programming
微處理器實驗 (Microprocessor Lab.)
高等系統程式 (Advanced System Software)
嵌入式系統設計概論與實作
內嵌式編譯器 (Embedded Compiler Design)
數位訊號處理實驗 (Project Lab: DSP Apps)
積體電路設計 (VHDL & FPGA)
作業系統進階 (Advanced OS, Linux Systems)
Advanced
嵌入式系統 (Embedded System Design Overview)
系統晶片設計概論 (SOC Design)
嵌入式作業系統實作 (Embedded OS Implementation)
連網型系統晶片嵌入式軟體 (Networked SoC ESW)
軟硬體協同設計 (HW/SW Co-Design)
嵌入式即時作業系統 (Embedded Real Time OS)
行動裝置嵌入式系統與軟體 (Project Lab: Mobile Apps)
嵌入式處裡器 (Embedded Processor)
嵌入式軟體開發工具 (Embedded Toolchain)
微型感測裝置嵌入式系統與軟體 (Project Lab: Sensor Apps)
系統晶片實習 (SOC Lab)
輸出入裝置與驅動程式設計 (I/O and Device Driver)
多媒體裝置嵌入式系統與軟體 (Project Lab: Multimedia Apps)

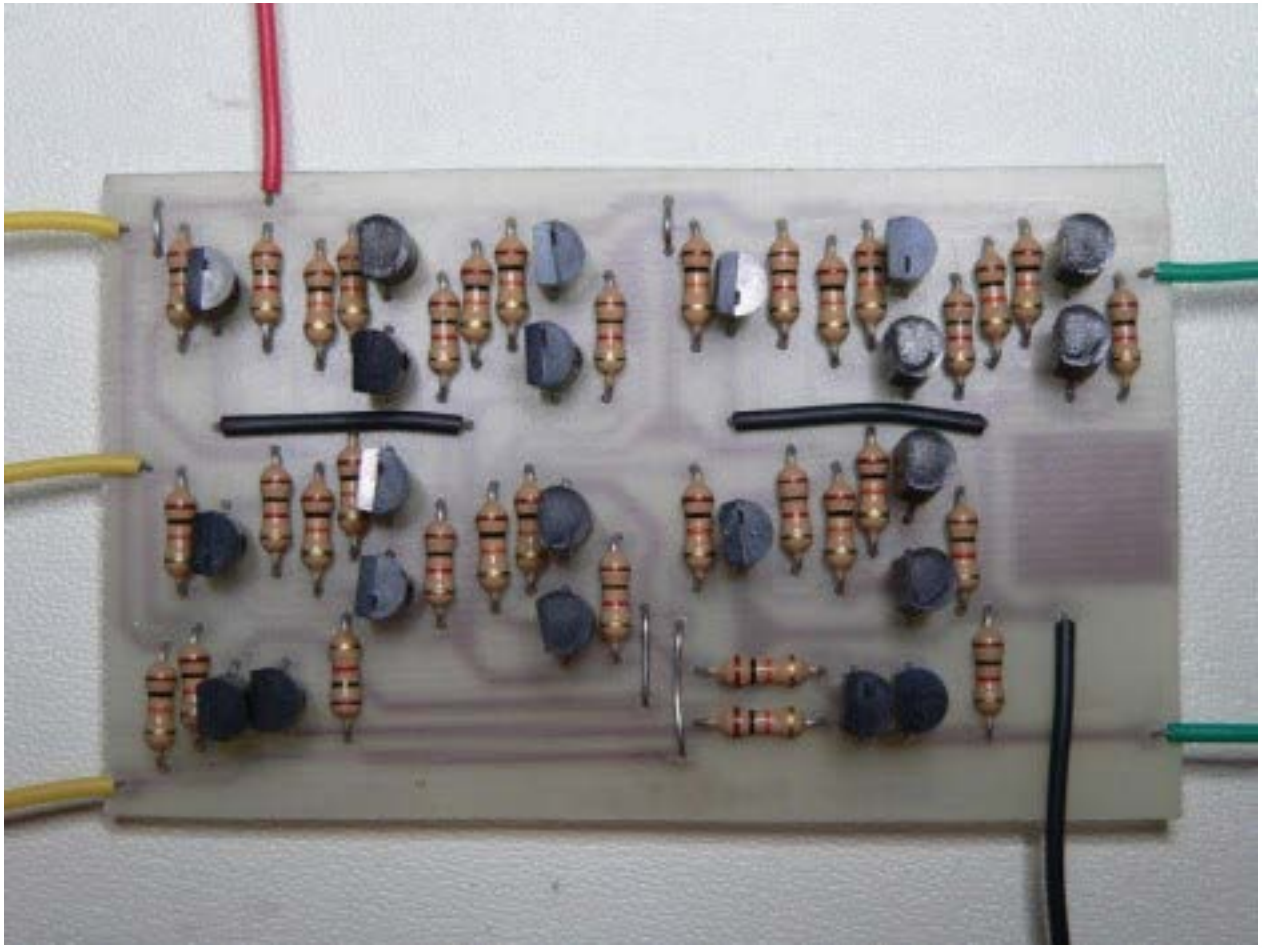

Mario (Running) - Microsoft Visual Studio (Administrator)
MARIO XNA- FPS: 62UPS: 62 FrameCount: 285
Solution Explorer
Overworld
'Mario.exe' (Managed (v4.0.30319)): Loaded 'C:\Windows\Microsoft.Net\assembly\GAC_MSIL\Microsoft.Xna.Framework.GamerServices\v4.0_4.
Ready


Bochs Enhanced Debugger
Command View Options Help
Continue [c]
Step [s]
Step N [s ###]
Refresh
Break [^C]
Reg Name Hex Value Decimal
eax 0000aa55 43605
ebx 00000000 0
ecx 00090000 589824
edx 00000080 128
esi 000e0000 917504
edi 0000ffac 65452
ebp 00000000 0
esp 0000ffd6 65494
ip 00007c00 31744
eflags 00000082
cs 0000
ds 0000
es 0000
ss 0000
fs 0000
gs 0000
L.Address Bytes Mnemonic
00007c00 (1) FA cli
00007c01 (2) EB6C jmp .+108 (0x00007c6f)
00007c03 (2) 0000 add byte ptr ds:[bx+si], al
00007c05 (3) 004C49 add byte ptr ds:[si+73], cl
00007c08 (1) 4C dec sp
00007c09 (1) 4F dec di
00007c0a (2) 0100 add word ptr ds:[bx+si], ax
00007c0c (2) 1400 adc al, 0x00
00007c0e (1) 5A pop dx
00007c0f (2) 0000 add byte ptr ds:[bx+si], al
00007c11 (2) 0000 add byte ptr ds:[bx+si], al
00007c13 (4) 00A1F705 add byte ptr ds:[bx+di+1527], ah
00007c17 (2) 3B09 cmp cx, word ptr ds:[bx+di]
00007c19 (1) 99 cwd
00007c1a (3) 800001 add byte ptr ds:[bx+si], 0x01
00007c1d (4) 0A998000 or bl, byte ptr ds:[bx+di+128]
00007c21 (2) 0108 add word ptr ds:[bx+si], cx
00007c23 (1) 99 cwd
00007c24 (3) 800001 add byte ptr ds:[bx+si], 0x01
00007c27 (2) 0100 add word ptr ds:[bx+si], ax
00007c29 (2) 0000 add byte ptr ds:[bx+si], al
00007c2b (2) 0000 add byte ptr ds:[bx+si], al
L.Address 0 1 2 3 4 5 6 7 8 9 A B C D E F Ascii
0x00007C00 FA EB 6C 00 00 00 4C 49 4C 4F 01 00 14 00 5A 00
0x00007C10 00 00 00 00 A1 F7 05 3B 09 99 80 00 01 0A 99 80
0x00007C20 00 01 08 99 80 00 01 01 00 00 00 00 00 00 00 0C
0x00007C30 99 80 00 01 03 8F 80 00 01 04 8F 80 00 01 05 8F
0x00007C40 80 00 01 06 8F 80 00 01 07 8F 80 00 01 08 8F 80
0x00007C50 00 01 09 8F 80 00 01 0A 8F 80 00 01 00 00 00 00
0x00007C60 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 B8
0x00007C70 C0 07 8E D8 8C 06 6A 00 89 36 68 00 89 1E 6C 00
0x00007C80 88 16 6E 00 B8 00 8A 8E C0 B9 00 01 29 F6 29 FF
0x00007C90 FC F3 A5 EA 98 00 00 8A FA 8E D8 8E C0 BC 00 B0
0x00007CA0 B8 00 80 8E D0 FB B0 0D E8 57 00 B0 0A E8 52 00
0x00007CB0 B0 4C E8 4D 00 BE 34 00 BB 00 10 FC AD 89 C1 AD
0x00007CC0 89 C2 09 C8 74 20 46 E8 43 00 72 06 81 C3 00 02
0x00007CD0 EB EA 50 B0 20 E8 2A 00 58 88 E0 E8 12 00 31 C0
0x00007CE0 88 C2 CD 13 EB CF B0 49 E8 17 00 EA 00 00 00 8B
0x00007CF0 50 C0 E8 04 E8 01 00 58 24 0F 04 30 3C 3A 72 02
0x00007D00 04 07 30 FF B4 0E CD 10 C3 5A 59 5B C3 F6 C2 40
0x00007D10 74 54 80 E2 BF 53 51 52 B4 08 CD 13 72 EB 88 F0
0x00007D20 5A 88 16 73 01 88 F2 30 F6 51 86 CD D0 C5 D0 C5
0x00007D30 80 E5 03 89 0E 71 01 59 83 E1 3F F6 E1 01 C8 93
0x00007D40 58 F7 F3 92 F6 F1 FE C4 88 26 74 01 92 88 D6 8A
0x00007D50 16 73 01 3B 06 71 01 77 13 86 C4 D0 C8 D0 C8 0A
0x00007D60 06 74 01 89 C1 5B B8 01 02 CD 13 C3 5B 31 C0 F9
(0) Breakpoint 1, 0x0000000000007c00 in ?? ()
Break
CPU: Real Mode 16
t= 156566074
IOPL=0 id vip vif ac vm rf nt of df if tf SF zf af pf cf

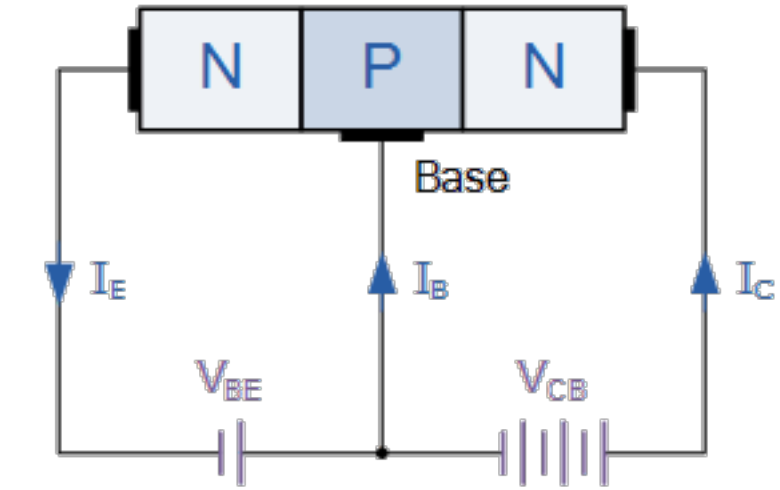

(c) Simple-cpu
Instructions decoding
32
Instruction
Code memory management
5
Rnn
5
Rmm
5
Rdd
30
DI
Ctrl
32
ROD
32x32 Register Bank
Dnn
32
Dmm
32
ALU
32
Data memory management
Ddd
32
Memory


A
B
Cin
S
Cout

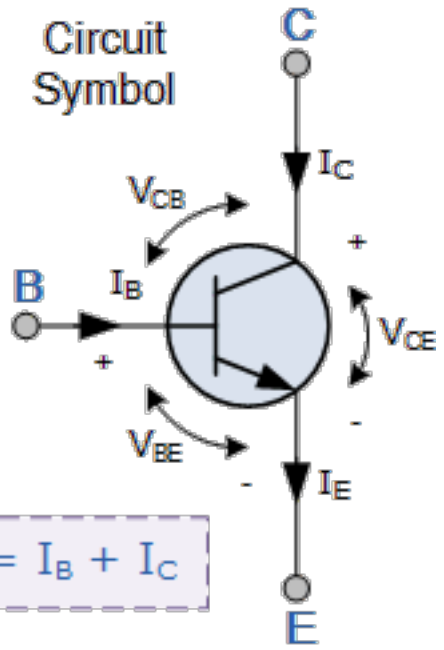

A
B
Cin
Sum
Cout
2.2k
100k



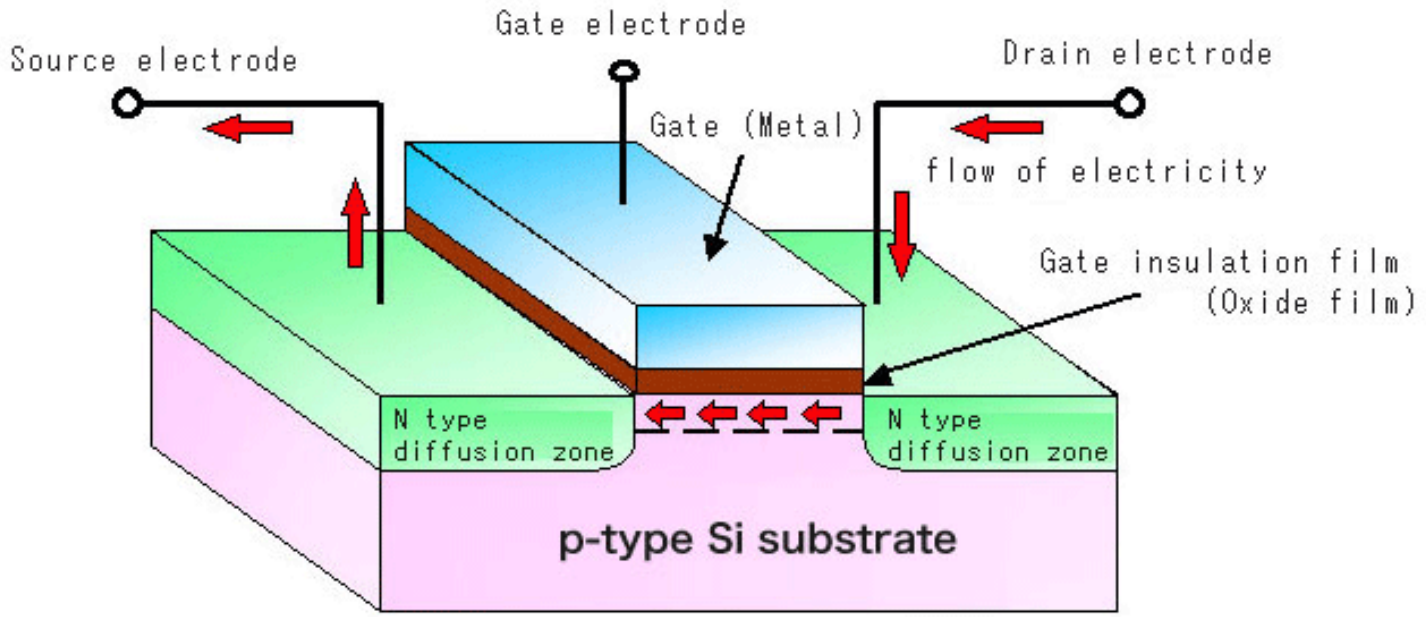
Emitter Collector



Circuit Symbol



$I_E = I_B + I_C$

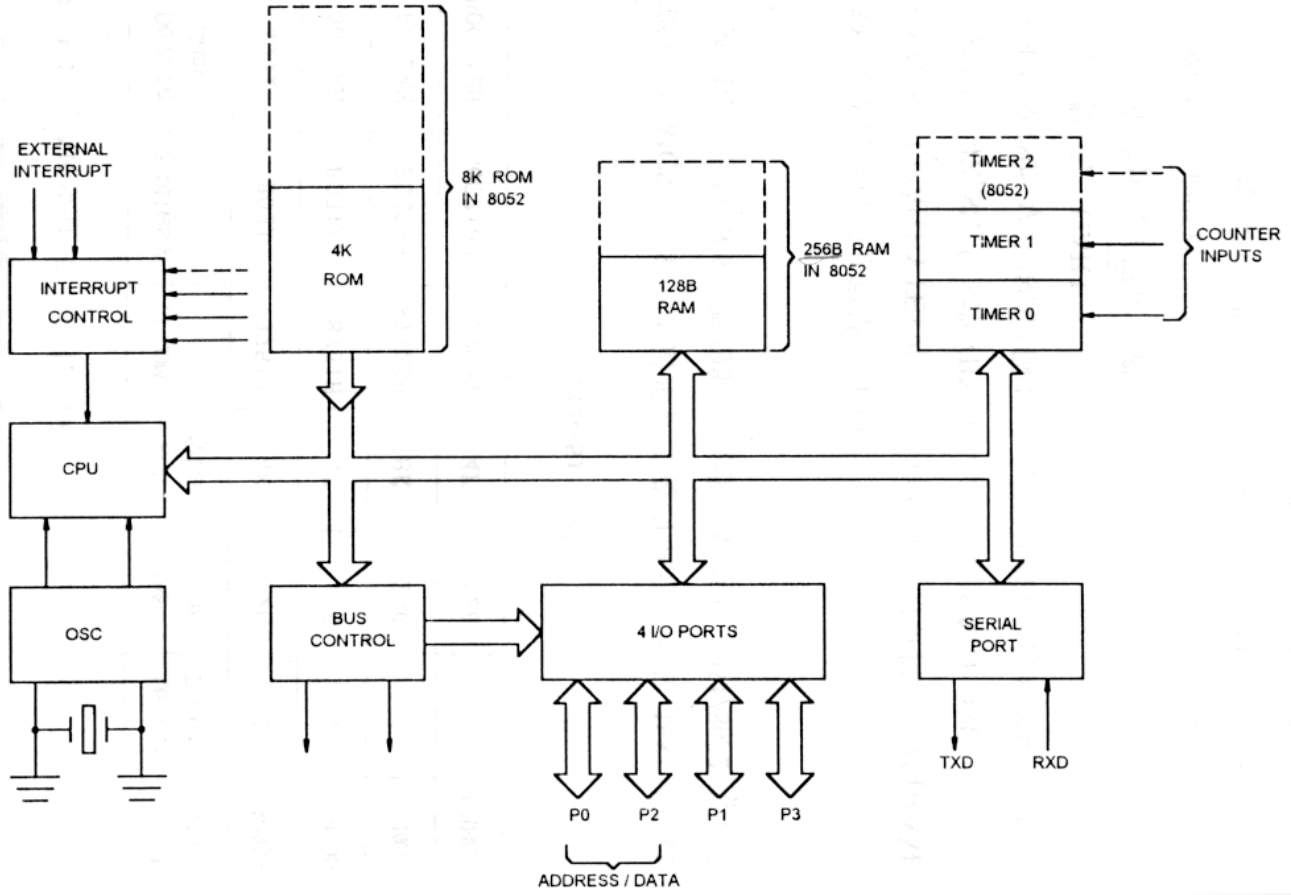


Construction of MOSFET

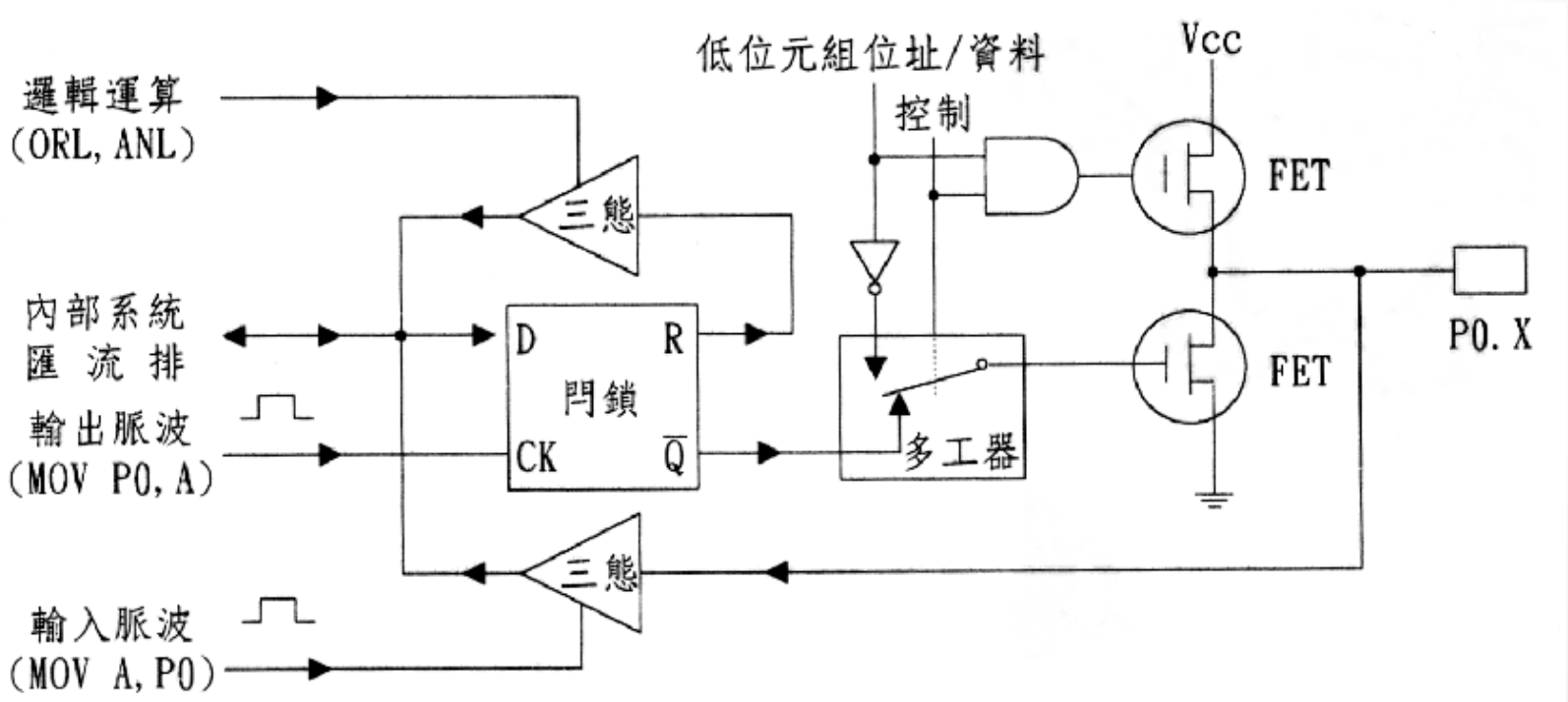
Prerequisite

- Computer architecture/organization
- Assembly language
- Electric Circuits
- Electronics
- Electronics lab.
- Digital circuits
- Digital circuits lab
- Intro. to digital systems

Architecture



Electric Circuits & Electronics



New Attempts this Semester

- ARM Cortex M4 (32 bits RISC)

- Make sure students can finish each lab within 2-6 hours
- Learn by examples (explain lab exercises)
- Problem-based learning (term project)

- 2 micro-credit courses after Oct.
  - 嵌入式微控制器應用與實務
  - 嵌入式微控制器週邊設計與進階實驗

Student Evaluation

- Lab Report
  - 10% x 6 = 60%
  - (you will receive the score for the reports you write)
- Exams
  - 20% x 1 = 20%
    - Mid-term programming exam (open book)
- Initial/term projects (two people in a group)
  - 20%
    - Report
    - Demo

Student Evaluation

- Announce lab exercises at least 2 weeks before demo
- 本學期預計有10次實驗，每兩人分為一組，實驗報告每組每人共交5次 ，每兩週交一次。每次實驗課收前一週實驗報告。
- 實驗報告撰寫格式如下：
  - 實驗名稱
  - 實驗目的
  - 實驗步驟
  - 實驗結果與分析
  - 心得討論與應用聯想

Student Evaluation

- Demo and QA
  - 6:30 p.m.~9:30 p.m. (book slots)
- 實驗報告批改和繳交
  - 實驗報告 should be submitted to E3 before demo day (11:59PM on Tue)
- 實驗室使用規則
  - 學生不可攜帶食物進入
  - 學生離開前先收拾好桌子,再請助教來確認後才可離去,否則一律扣分

Student Evaluation

- Term project (20%)
  - 期末專題計劃初稿(System Spec.)
    - 裝置原理、作用
    - 零件表
    - 功能 (Requirement Spec.)
  - 線路圖及設計(Design Spec.)
  - Demo
  - 期末專題結案報告
    - 動機/裝置原理/功能/實際線路圖/DEMO

Week	Lecture	Lab	Notes

Working Items

- Turn on group list next Wed (9/20)
- Issue the kit next Wed (9/20)
- Lab notes/Slides
  - Download from E3 system

Other rules

- You have to let me know first for any absence of this class
- Encourage to ask questions and discussion

- 加簽原則
  - I already received extra 10 students
  - Through the NCTU enrollment system
  - Let me know if two profs/classes cannot accommodate students who are interested or required to take the course

- Buy back if you did not maintain your kit well
- You are encouraged to have your own kit