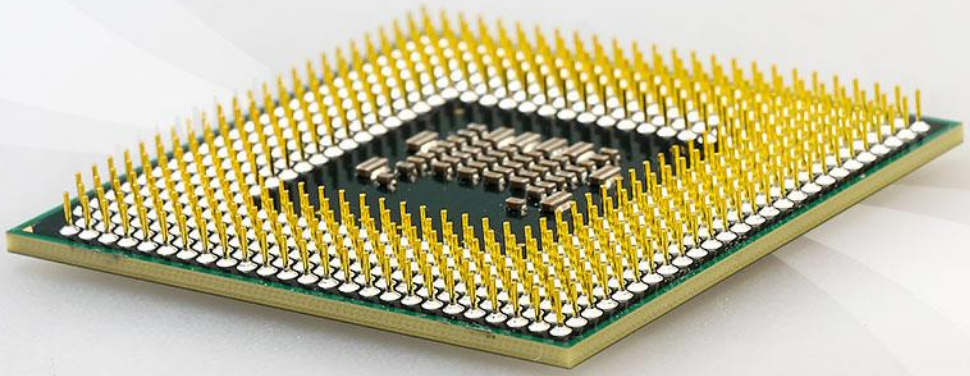


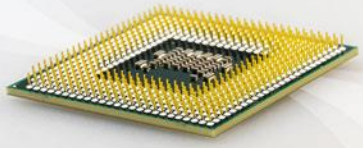
微算機應用實習

Interrupt

課程編號 ： EE4801702

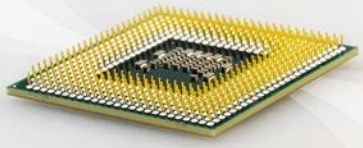
實習課助教 ： 曾子倫

Outline



- Interrupt 介紹
- 紅外線接收器介紹
- 記憶體暫存器介紹
- 函式介紹
- LAB9

Interrupt 介紹

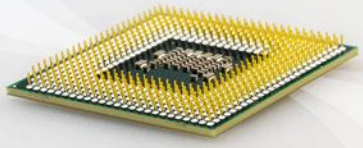


- Interrupt(中斷)

Interrupt是指CPU接收到來自硬體或軟體的信號，提示發生了某個事件，應該被處理，這種情況就稱為中斷。

通常CPU在接收到硬體或軟體的Interrupt信號之後，CPU會進行相應的硬體或軟體處理程序。

Interrupt 介紹



- Interrupt類型

不可遮罩式中斷 NMI(Non-maskable Interrupt)

無法在中斷遮蔽暫存器中設定遮罩來關閉

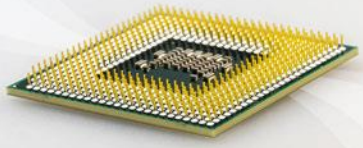
e.g.　按下Reset鍵、振盪器發生錯誤、快閃記憶體違反存取

可遮罩式中斷 GIE(Global Interrupt Enable)

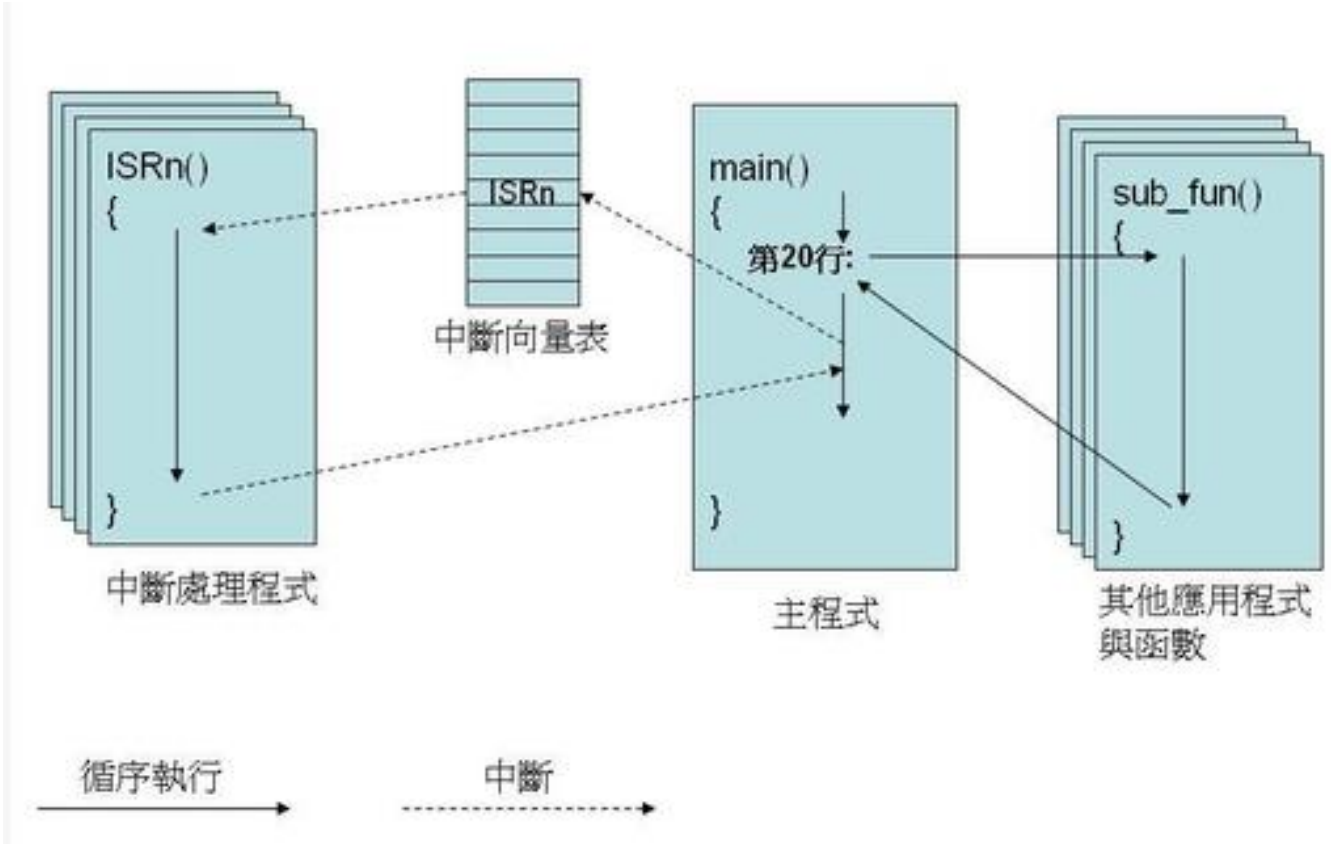
可在中斷遮蔽暫存器中設定遮罩來關閉

e.g.　UART、RTC、TIMMER ……

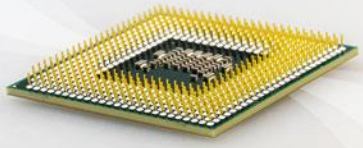
Interrupt 介紹



- Interrupt處理程序



紅外線接收器介紹

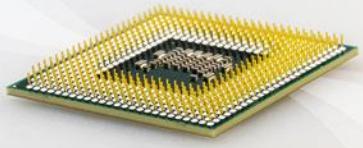


- 紅外線接收器(Infrared Receiver)

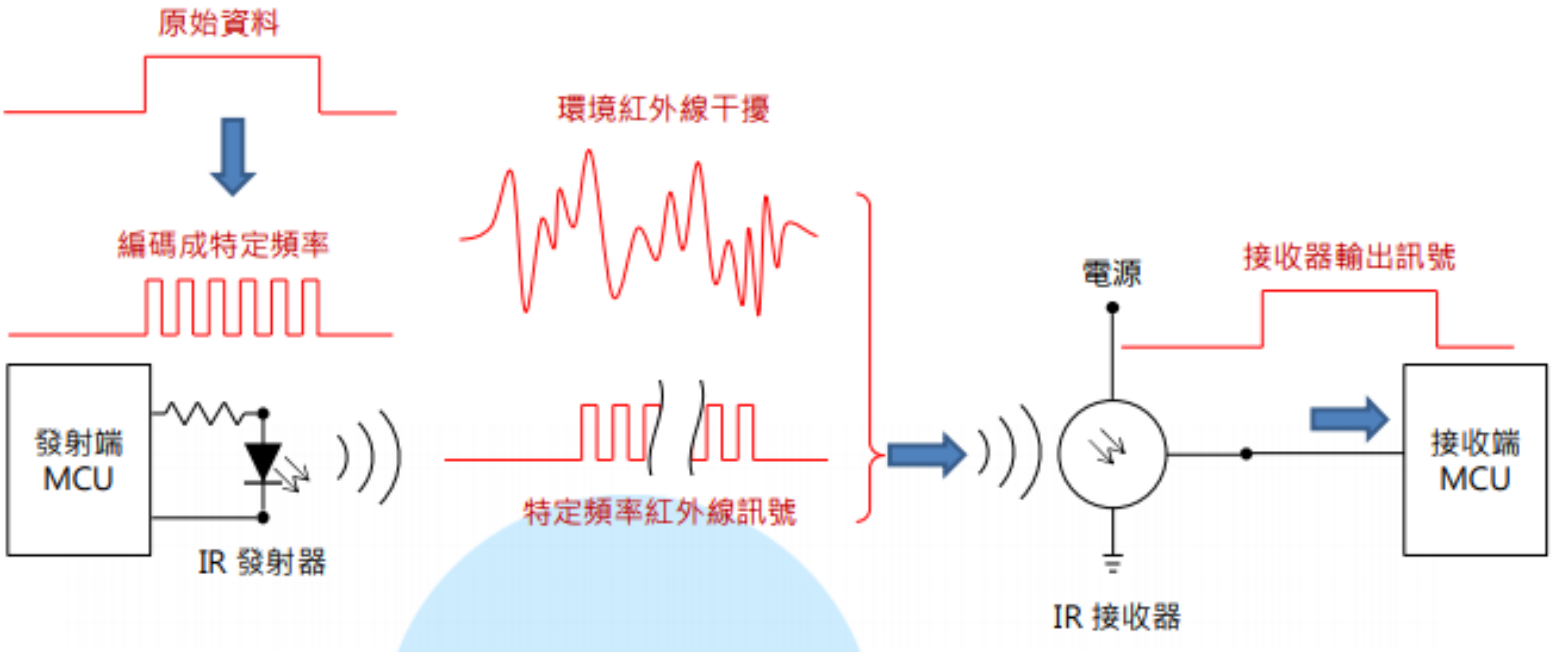
紅外線接收器是一個三腳位的封裝，其中兩腳是電源和接地，另一腳位是訊號輸出用途。

訊號腳位只會輸出高電位和低電位，需要通訊協定(protocol)來解碼，才可以得知目前的遙控指令，例如電視機開關電源、調整音量、選取頻道等等。

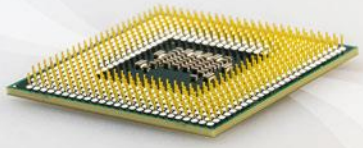
紅外線接收器介紹



- 紅外線傳送與接收示意圖



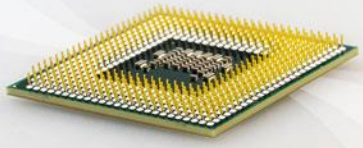
紅外線接收器介紹



- 紅外線編碼示意圖

圖 5. 紅外線傳送通訊協定範例

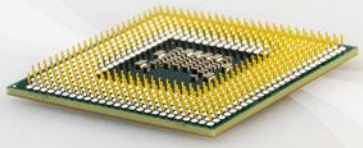
記憶體暫存器介紹



- IR記憶體暫存器介紹

```
#define IR_MEM_ADDR_BASE              (0x00205000)
#define rIR_CTL                      (IR_MEM_ADDR_BASE+0x00)
```

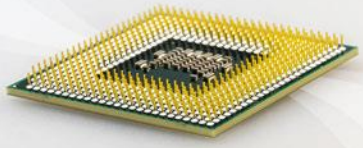
記憶體暫存器介紹



- IR_CTL

00			31:8		Reserved
	0	R/W	7	EN_IR	1: Enable IR 0: Disable IR
	0	R/W	6	IR_SEDG	1: single edge trigger 0: both edge trigger
	0	R/W	5	IR_RF	1: rising edge trigger 0: falling edge trigger
	0	R/W	4	EN_OV_INT	1: Enable over flow interrupt 0: Disable over flow interrupt
	0	R/W	3:2	PRE_SCAL	IR Pre scaler time 00: 64us 01: 32us 10: 128us 11: 1024us
		W	1	CLR_IR_INT	1: Clear interrupt “IR_INT 0: No clear interrupt “IR_INT
	0	W	0	IR_PTSEL	Input Port Sel: 0: PortB[13] 1: PortF[4]

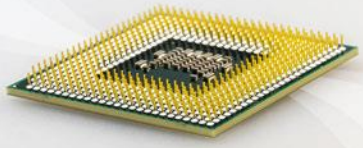
記憶體暫存器介紹



- Interrupt記憶體暫存器介紹

```
#define INT_MEM_ADDR_BASE                (0x00200D00)
#define rINT0_IE1_ENABLE                 (INT_MEM_ADDR_BASE+0x04)
```

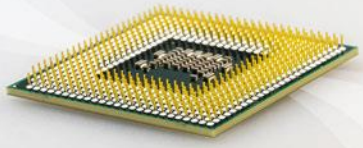
記憶體暫存器介紹



- INT0_IE1_ENABLE

104			31:20		Reserved
	0	R/W	15	IE0_I2C7	0: Disable I2C7 interrupt 1: Enable I2C7 interrupt
	0	R/W	14	IE0_I2C6	0: Disable I2C6 interrupt 1: Enable I2C6 interrupt
	0	R/W	13	IE0_I2C5	0: Disable I2C5 interrupt 1: Enable I2C5 interrupt
	0	R/W	12	IE0_I2C4	0: Disable I2C4 interrupt 1: Enable I2C4 interrupt
	0	R/W	11	IE0_I2C3	0: Disable I2C3 interrupt 1: Enable I2C3 interrupt
	0	R/W	10	IE0_I2C2	0: Disable I2C2 interrupt 1: Enable I2C2 interrupt
	0	R/W	9	IE0_IR	0: Disable IR interrupt 1: Enable IR interrupt
	0	R/W	8	IE0_I2C0	0: Disable I2C0 interrupt 1: Enable I2C0 interrupt
	0	R/W	7	IE0_SPI3	0: Disable SPI3 interrupt 1: Enable SPI3 interrupt
	0	R/W	6	IE0_SPI2	0: Disable SPI2 interrupt 1: Enable SPI2 interrupt
	0	R/W	5	IE0_SPI1	0: Disable SPI1 interrupt 1: Enable SPI1 interrupt
	0	R/W	4	IE0_SPI0	0: Disable SPI0 interrupt 1: Enable SPI0 interrupt
	0	R/W	3	IE0_UART3	0: Disable UART3 interrupt 1: Enable UART3 interrupt
	0	R/W	2	IE0_UART2	0: Disable UART2 interrupt 1: Enable UART2 interrupt
	0	R/W	1	IE0_UART1	0: Disable UART1 interrupt

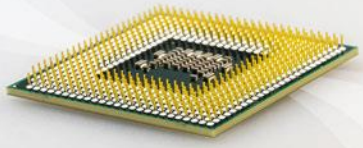
函式介紹



- 函式介紹

函式名稱	函式功能
Init_IR_Int	初始化 IR interrupt

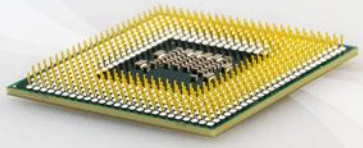
函式介紹



- Init_IR_Int

```
void Init_IR_Int(void)
{
    OUTW(rINT0_IE1_ENABLE, INW(rINT0_IE1_ENABLE) | 0x0200);
    //Set IR Interrupt enable
    OUTW(rIR_CTL, 0xD3); //Set IR control
}
```

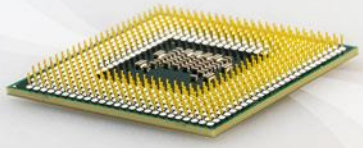
函式介紹



- Interrupt 副程式

```
void NDS32ATTR_ISR("not_nested;id=0") HW0_ISR(int vid, NDS32_CONTEXT * ptr)
{
    unsigned short int u16IntFlag1;

    DRV_Printf("===== HW0_ISR === %d ===\r\n", count);

    u16IntFlag1 = (INW(rINT0_IE1_FLAG) & INW(rINT0_IE1_ENABLE));

    if(u16IntFlag1 & 0x0200)
    {
        //-----Clear H/W IR interrupt
        OUTW(rIR_CTL, INW(rIR_CTL) | 0x02);
        count++;
    }

}
```

Example

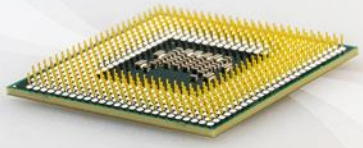


- 利用紅外線接收器來中斷，並用UART傳輸到螢幕顯示

```
int main()
{

    OS_PowerOnDriverInitial();
    Init_IR_Int();

    while(1)
    {
        DRV_Printf("=========================================\r\n", 0);
        delay1(300000);
    }

    return 0;
}
```

```
void NDS32ATTR_ISR("not_nested;id=0") HW0_ISR(int vid, NDS32_CONTEXT * ptr)
{
    unsigned short int u16IntFlag1;

    DRV_Printf("===== HW0_ISR === %d ===\r\n", count);

    u16IntFlag1 = (INW(rINT0_IE1_FLAG) & INW(rINT0_IE1_ENABLE));

    if(u16IntFlag1 & 0x0200)
    {
        //-----Clear H/W IR interrupt
        OUTW(rIR_CTL, INW(rIR_CTL) | 0x02);
        count++;
    }

}
```

LAB8



- 請先將RTC初始化到"當前時間"，並利用UART傳送至終端機每秒顯示一次
- 每當紅外線interrupt，則亮一次LED

```
09:59:59
10:00:00
10:00:01
10:00:02
10:00:03
10:00:04
10:00:05
10:00:06
10:00:07
10:00:08
10:00:09
10:00:10
10:00:11
10:00:12
10:00:13
```