Lab1 ~ Lab5 共用規定

- 上課時間: 14:10~17:00；地點 @新館一樓 65105
- 每一個 lab 最晚都會在上課當天中午12:00前上傳投影片到 moodle，

  為避免教室網路訊號不好，請同學在14:00上課前先下載投影片至電腦中。
- 每一個 lab 佔總分 8%, 獨立計分. (Final Project 佔總分 60%)
- Lab 完成後, 要在 7 天內寫好 lab report 上傳moodle。
- 要來上 lab 課簽到，我們才會為你的 lab 成果評分。
- 若 lab 下課前有做完，我們會現場幫你評分。
- 若 lab 下課前沒做完，會有補交機制 (各 lab 規定方式可能不同)，

  期限內有完成就不會扣分 (期限為 7 天內，超過不計分)。

Lab2 規定

- Lab2 補交機制 (各 lab 規定方式可能不同)

  本次lab不開放補交

- 寫 lab report (上傳moodle)

Lab 2: TaskMonitor

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TA: 鄭宇辰

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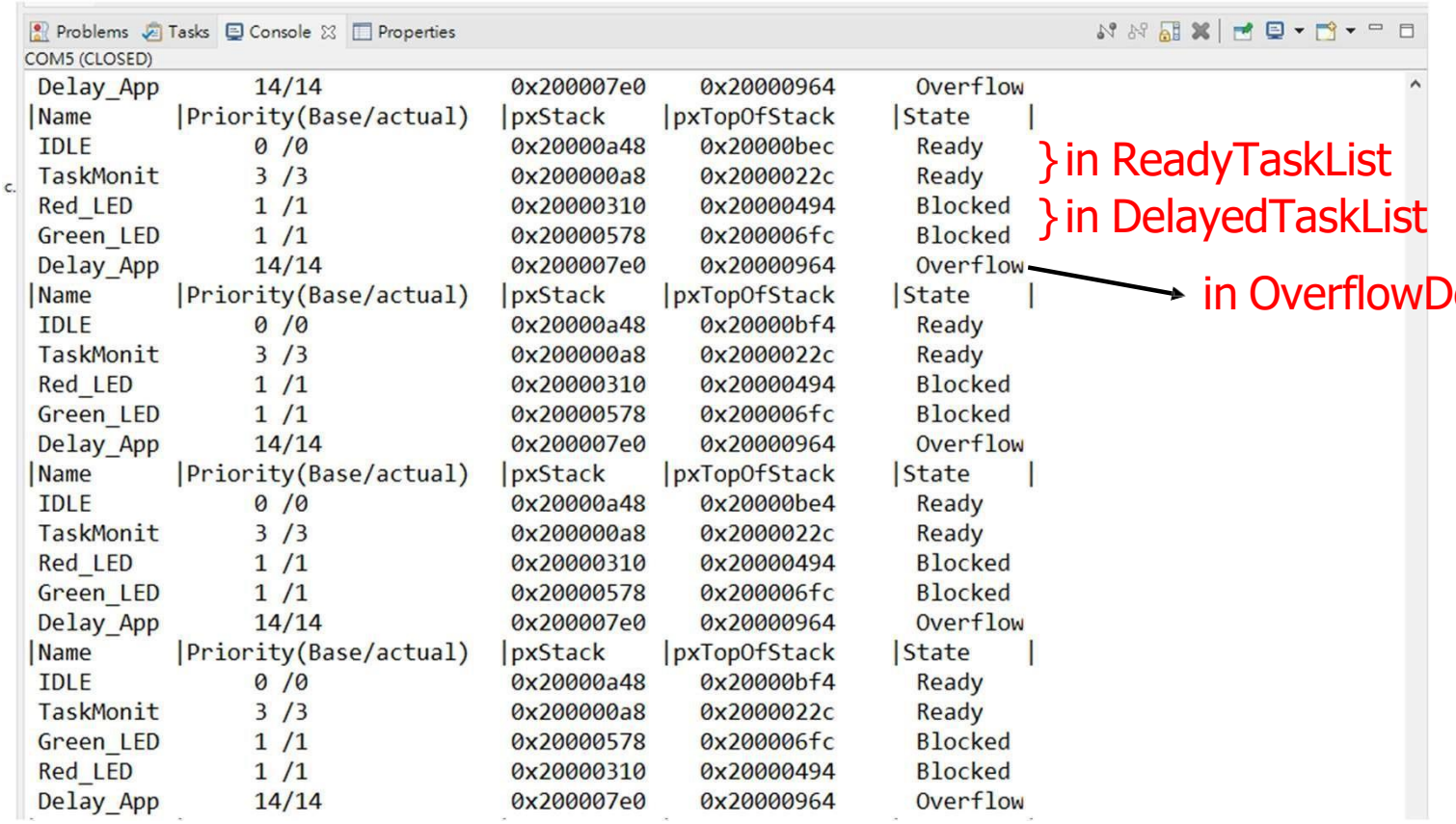
Lab requirement

- Create four task // 不用自己寫
  - Red_LED_App、Green_LED_App、Delay_App、TaskMonitor_App
- TaskMonitor_App will call **Taskmonitor()** periodicity
- **TaskMonitor()**
  - Traverse ReadyTaskList, DelayedTaskList, OverflowDelayedTaskList
  - Print TCB information by **UART**
    - Task Name、Priority(Base/actual)、Stack Pointer、Topofstack Pointer、Task State

Demo


Problems
Tasks
Console
Properties
COM5 (CLOSED)
Delay_App 14/14 0x200007e0 0x20000964 Overflow
|Name |Priority(Base/actual) |pxStack |pxTopOfStack |State |
IDLE 0 /0 0x20000a48 0x20000bec Ready
TaskMonit 3 /3 0x200000a8 0x2000022c Ready
Red_LED 1 /1 0x20000310 0x20000494 Blocked
Green_LED 1 /1 0x20000578 0x200006fc Blocked
Delay_App 14/14 0x200007e0 0x20000964 Overflow
|Name |Priority(Base/actual) |pxStack |pxTopOfStack |State |
IDLE 0 /0 0x20000a48 0x20000bf4 Ready
TaskMonit 3 /3 0x200000a8 0x2000022c Ready
Red_LED 1 /1 0x20000310 0x20000494 Blocked
Green_LED 1 /1 0x20000578 0x200006fc Blocked
Delay_App 14/14 0x200007e0 0x20000964 Overflow
|Name |Priority(Base/actual) |pxStack |pxTopOfStack |State |
IDLE 0 /0 0x20000a48 0x20000be4 Ready
TaskMonit 3 /3 0x200000a8 0x2000022c Ready
Red_LED 1 /1 0x20000310 0x20000494 Blocked
Green_LED 1 /1 0x20000578 0x200006fc Blocked
Delay_App 14/14 0x200007e0 0x20000964 Overflow
|Name |Priority(Base/actual) |pxStack |pxTopOfStack |State |
IDLE 0 /0 0x20000a48 0x20000bf4 Ready
TaskMonit 3 /3 0x200000a8 0x2000022c Ready
Green_LED 1 /1 0x20000578 0x200006fc Blocked
Red_LED 1 /1 0x20000310 0x20000494 Blocked
Delay_App 14/14 0x200007e0 0x20000964 Overflow
} in ReadyTaskList
} in DelayedTaskList
in OverflowDelayedTaskList

Lab2 grading

- (2%) 有印出**五個**TASK
- (2%) TCB 資料正確
- (1%) 不會多印出其他資料
- (3%) Lab report (一定要交)

Add New code

- Create four task
  - Red_LED_App priority = 1
  - Green_LED_App priority = 1
  - Delay_App priority = 14
  - TaskMonitor_App priority = 3 (把Stack調大一點，至少256)

Add New code

- **task.h**
  - #include "stm32f4xx_hal.h"
  - UART_HandleTypeDef huart2; //for USART2
  - void Taskmonitor(void);
- **Task.c**
  - void Taskmonitor(void){...}
- **List.h**
  - #define listGET_ITEM_OF_HEAD_ENTRY(pxList) ((&((pxList)->xListEnd))->pxNext)
- **FreeRTOSConfig.h**
  - configMAX_PRIORITIES **15**

Add New code

```
void Taskmonitor(void)
{
        /* Initialize string */
        char Monitor_data[130];
        memset(Monitor_data,'\0',sizeof(Monitor_data));

        /* Stop scheduler */
        /* Taskmonitor() will block when UART is transmitting data */
        /* Scheduler will change list data when Taskmonitor() is blocked */
        vTaskSuspendAll();

        /* Print title */
        sprintf(Monitor_data,"|Name      |Priority(Base/actual) |pxStack    |pxTopOfStack    |State    |\n\r");
        HAL_UART_Transmit(&huart2,(uint8_t *)Monitor_data,strlen(Monitor_data),0xffff);

        /* pxReadyTasksLists  */
        /* pxDelayedTaskList*/
        /* pxOverflowDelayedTaskList  */

        /* Resume scheduler */
        xTaskResumeAll();
}
```

Add New code

- **Main.c**

```
void TaskMonitor_App(void *pvParameters){
        for(;;){
        Taskmonitor();
        vTaskDelay(1000);
        }
 }

void Red_LED_App(void *pvParameters){
        uint32_t Redtimer = 800;
        for(;;){
                HAL_GPIO_TogglePin(GPIOD,Red_LED_Pin);
                vTaskDelay(Redtimer);
                Redtimer+=1;
        }
  }
```

Add New code

- **Main.c**

```
void Green_LED_App(void *pvParameters){
        uint32_t Greentimer = 1000;
        for(;;){
                HAL_GPIO_TogglePin(GPIOD,Green_LED_Pin);
                vTaskDelay(Greentimer);
                Greentimer+=2;
        }
}
void Delay_App(void *pvParameters){
        int delayflag=0;
        uint32_t delaytime;
        while(1){
                if(delayflag==0){
                        delaytime = 1000;
                        delayflag=1;
                }else{
                        delaytime=0xFFFFFFFF;
                }
                vTaskDelay(delaytime);
        }
}
```

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USB to TTL

GND

TXD

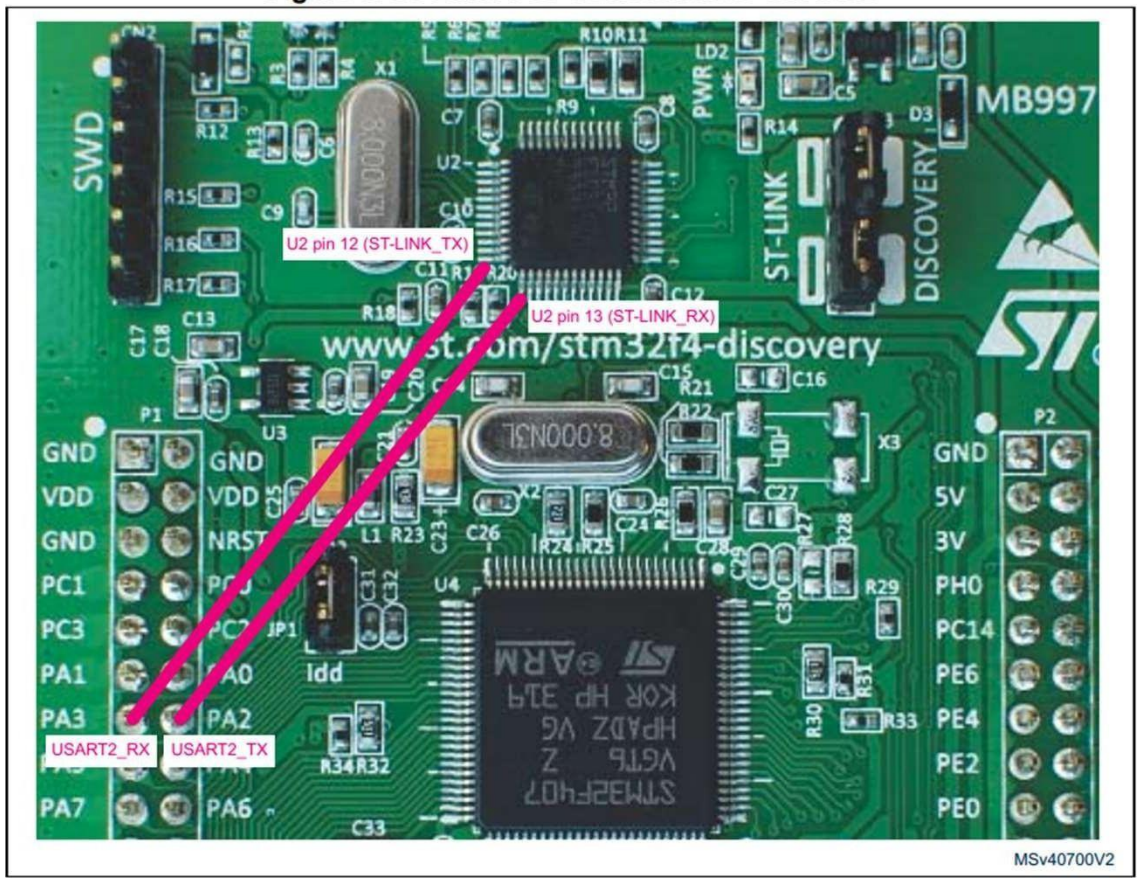
RXD

+5V

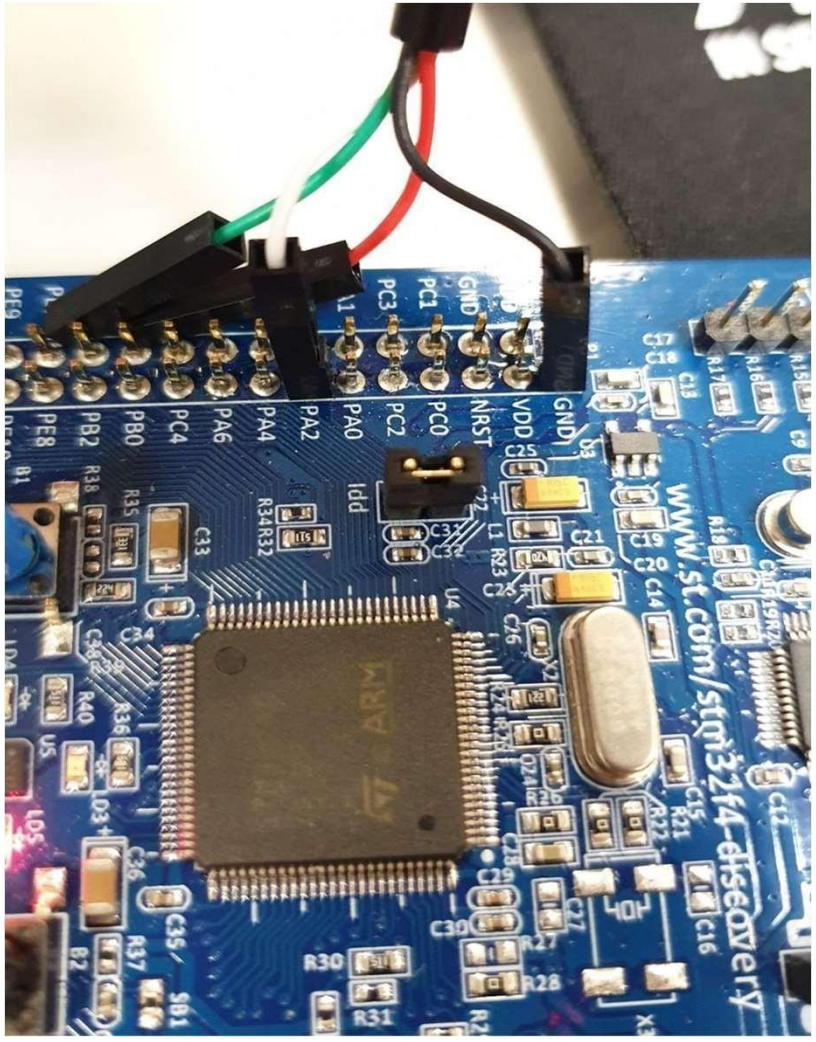
USART pin

Using an USART to USB dongle from the market connected for instance to STM32F407 USART2 available on connector P1 pin 14 (PA2: **USART2**_TX) and P1 pin 13 (PA3: **USART2**_RX).

Figure 6. ST-LINK VCP connection to USART2



USB to TTL



F407G-DISC transmit data(TXD) to PC. therefore, we need use PA2.

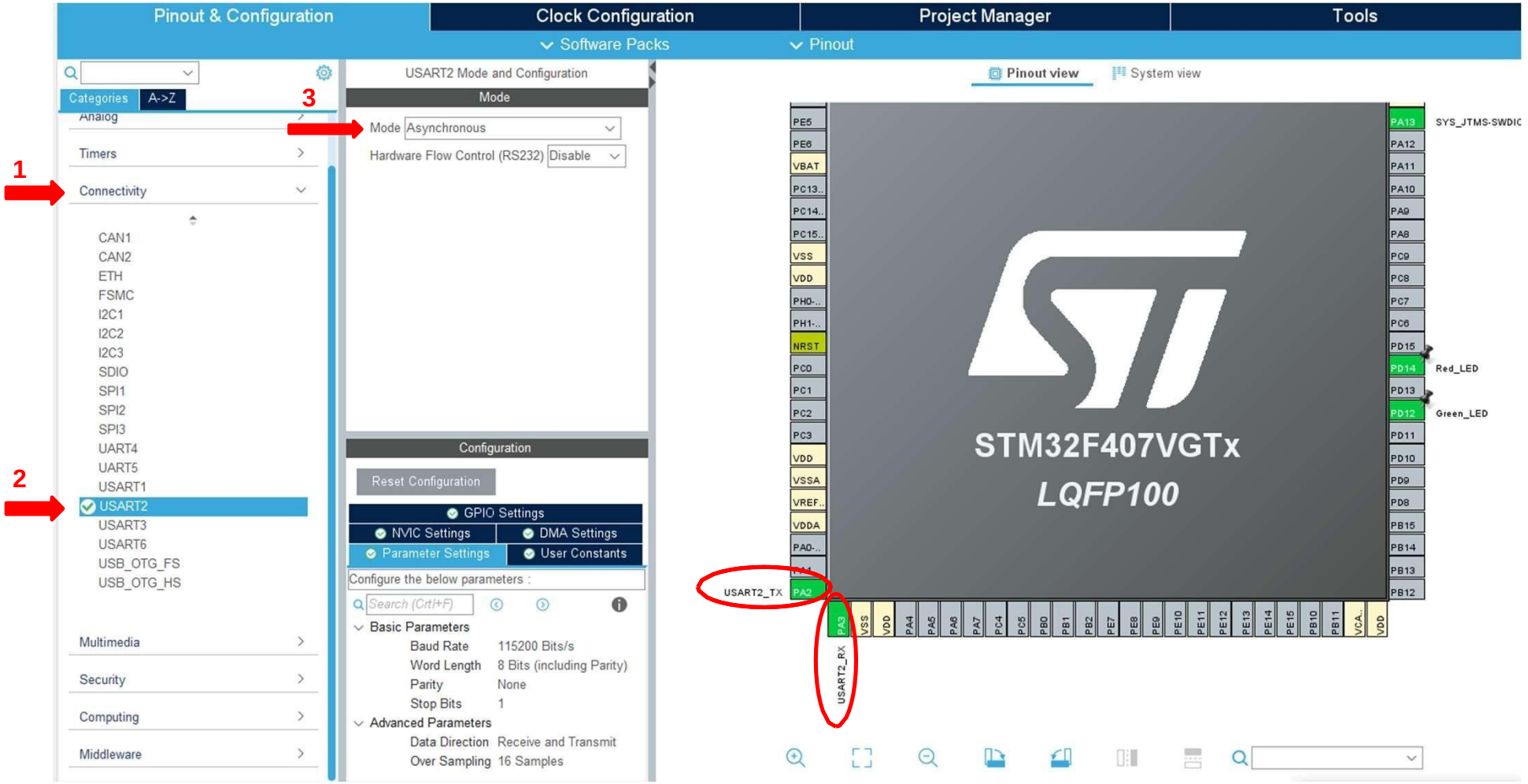
PC will receive external data(RXD), so we need use **white line** connect to PA2.

PA2(TXD) ⟷ **RXD**

F407G-DISC GND ⟷ **GND**

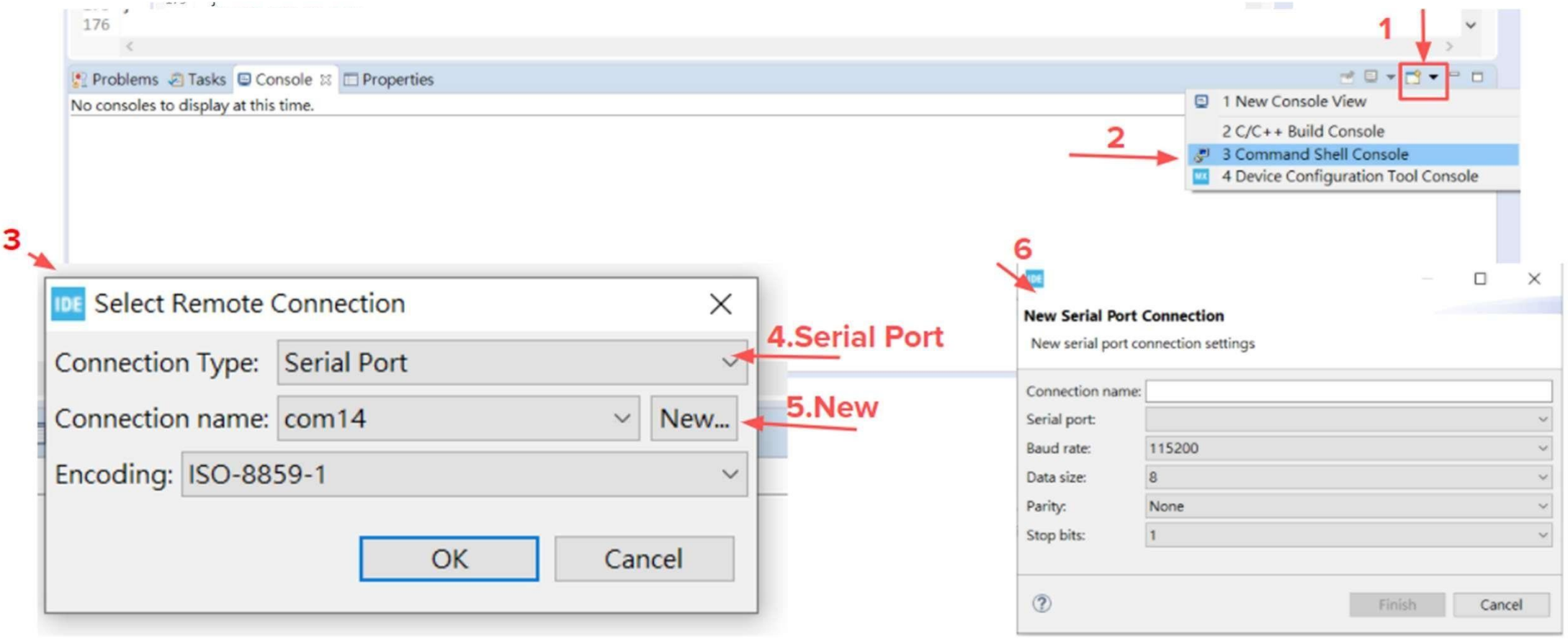
[USART]

USART set up


Pinout & Configuration
Clock Configuration
Project Manager
Tools
Software Packs
Pinout
Categories
A->Z
Analog
Timers
Connectivity
Multimedia
Security
Computing
Middleware
CAN1
CAN2
ETH
FSMC
I2C1
I2C2
I2C3
SDIO
SPI1
SPI2
SPI3
UART4
UART5
USART1
USART2
USART3
USART6
USB_OTG_FS
USB_OTG_HS
1
2
3
USART2 Mode and Configuration
Mode
Mode Asynchronous
Hardware Flow Control (RS232) Disable
Configuration
Reset Configuration
GPIO Settings
NVIC Settings
DMA Settings
Parameter Settings
User Constants
Configure the below parameters :
Search (Crtl+F)
Basic Parameters
Baud Rate 115200 Bits/s
Word Length 8 Bits (including Parity)
Parity None
Stop Bits 1
Advanced Parameters
Data Direction Receive and Transmit
Over Sampling 16 Samples
Pinout view
System view
STM32F407VGTx
LQFP100
USART2_TX
USART2_RX
SYS_JTMS-SWDIO
Red_LED
Green_LED

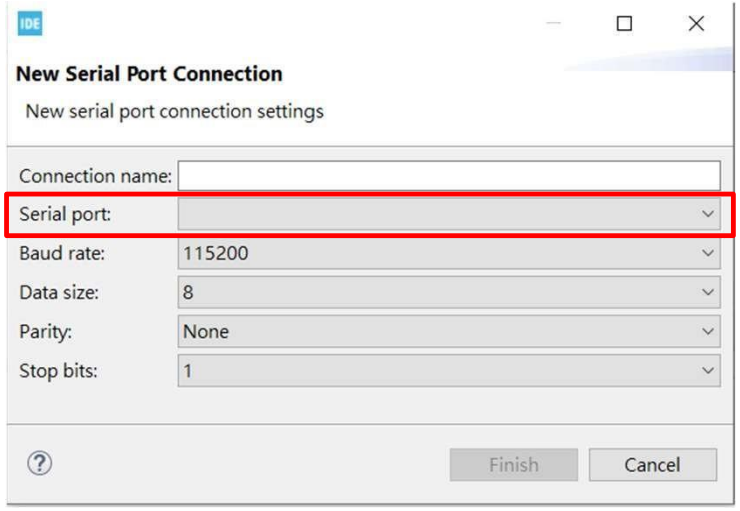
Command shell set up

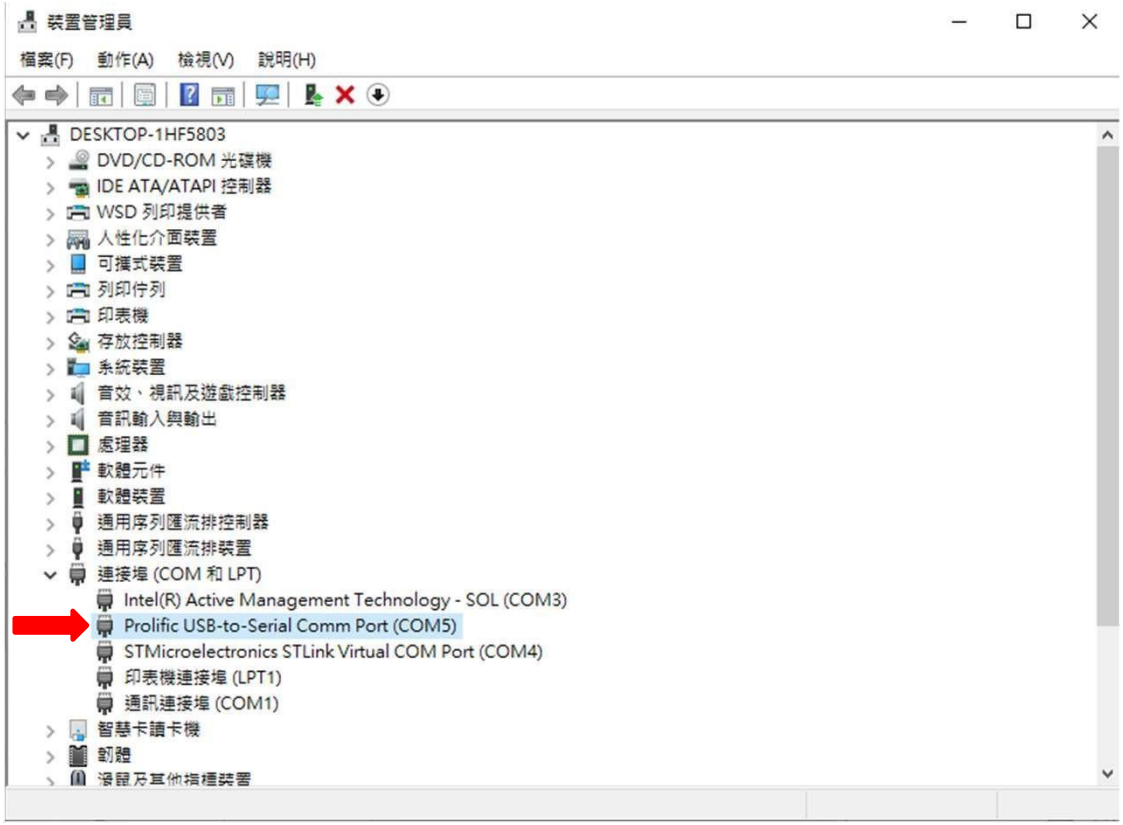
Serial port指的是電腦的USB port編號



How to find serial port

先開啟裝置管理員
USB to TTL插上電腦時，裝置管理員的連接埠會跳出一個Prolific USB-to-Serial Comm port
Serial port就會是括弧裡的編號





HAL_UART_Transmit

```
HAL_UART_Transmit(
                    USART_HandleTypeDef * huart,
                    uint8_t * pTxData,
                    uint16_t Size,
                    uint32_t Timeout
                  );
```

huart: Pointer to a UART_HandleTypeDef structure that contains the configuration information for the specified UART module

PTxData: Pointer to data buffer

Size: Amount of data elements to be sent

Timeout: Timeout duration

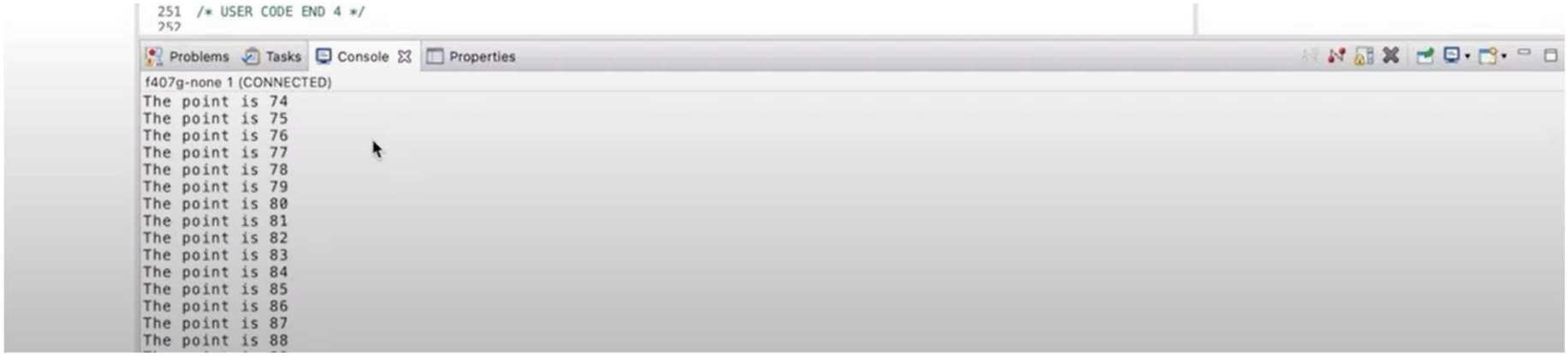
USART Tx Test

創建一個 Task 以測試USART 。

```
UART_HandleTypeDef huart2;
void USART_Test(void *pvParameters){
        uint32_t Monitortimer = 400;
        char MonitorTset[30];
        char num[15];
        int i = 0;
        while(1){
                memset(MonitorTset,'\0',sizeof(MonitorTset));
                memset(num,'\0',sizeof(num));
                itoa(i,num,10);
                strcat(num," ");
                sprintf(MonitorTset,"The point is %s\n\r",num);
                HAL_UART_Transmit(&huart2,(uint8_t *)MonitorTset,strlen(MonitorTset),0xffff);
                vTaskDelay(Monitortimer);
                Monitortimer += 1;
                i += 1;
        }
}
```

USART Tx Test

- 理論上如果設定沒有問題，運行後會看到console 顯示你transmit 的 string
- 如下圖所示
- 連接你TTL的port的Console 只要創建一個就好，或是只connect 一個。



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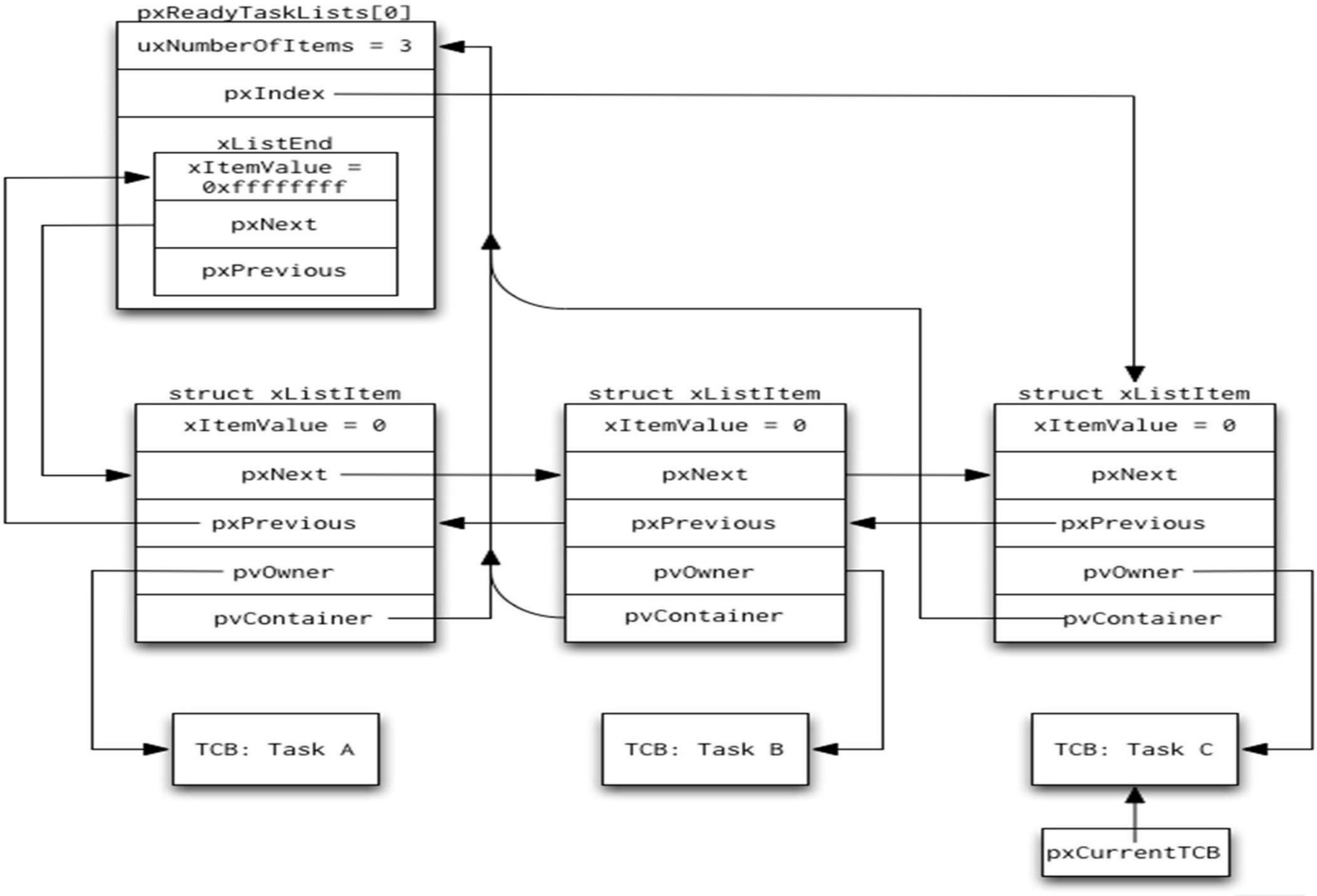
List

tasks.c

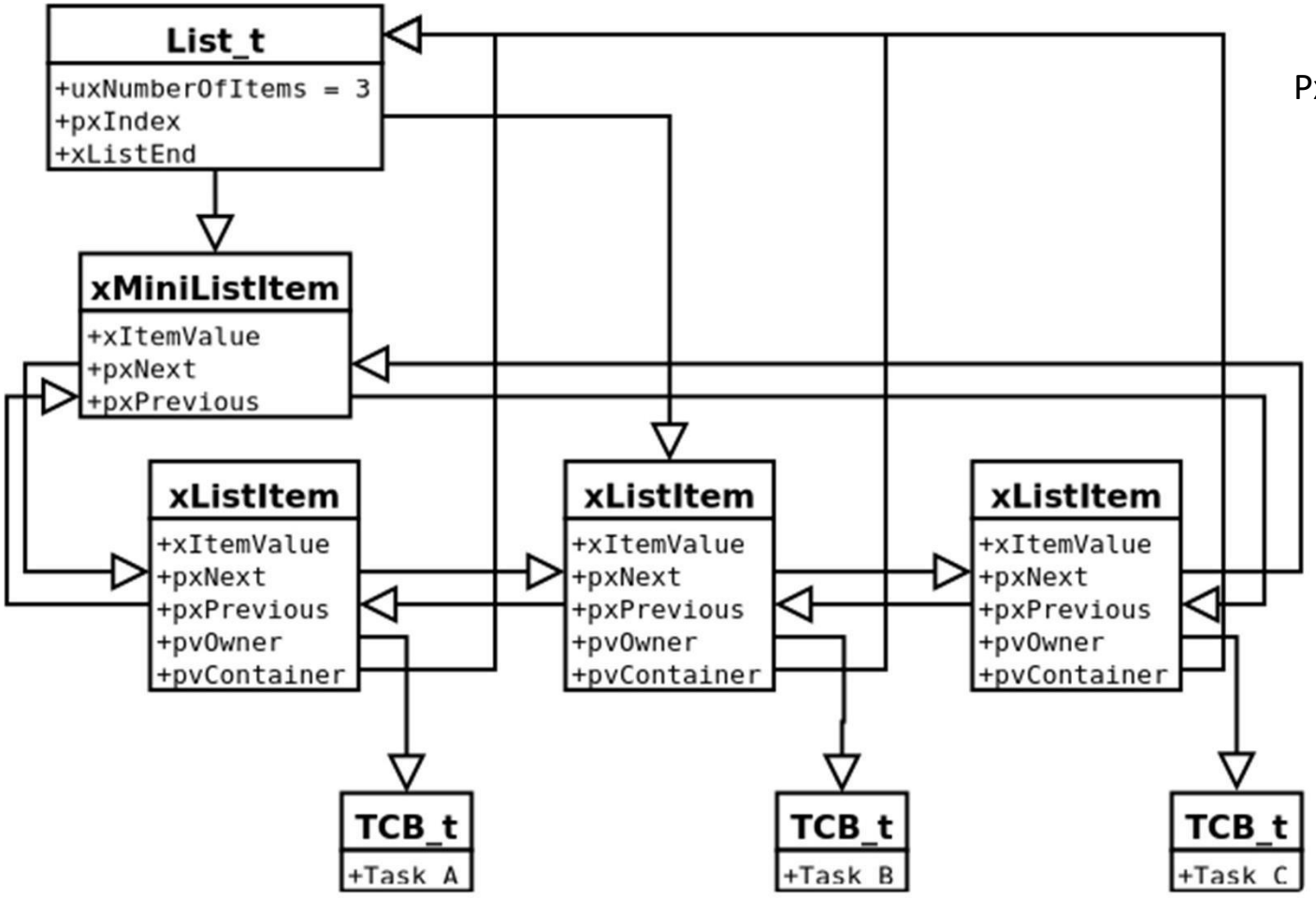
```
PRIVILEGED_DATA static List_t pxReadyTasksLists[ configMAX_PRIORITIES ];/*< Prioritised ready tasks. */
PRIVILEGED_DATA static List_t xDelayedTaskList1; /*< Delayed tasks. */
PRIVILEGED_DATA static List_t xDelayedTaskList2; /*< Delayed tasks (two lists are used - one for delays that have overflowed the current tick count. */
PRIVILEGED_DATA static List_t * volatile pxDelayedTaskList; /*< Points to the delayed task list currently being used. */
PRIVILEGED_DATA static List_t * volatile pxOverflowDelayedTaskList; /*< Points to the delayed task list currently being used to hold tasks that have overflowed the current tick count. */
```

- Only need access
  a. pxReadyTasksLists
  b. pxDelayedTaskList
  c. pxOverflowDelayedTaskList

List


pxReadyTaskLists[0]
uxNumberOfItems = 3
pxIndex
xListEnd
xItemValue = 0xffffffff
pxNext
pxPrevious
struct xListItem
xItemValue = 0
pxNext
pxPrevious
pvOwner
pvContainer
struct xListItem
xItemValue = 0
pxNext
pxPrevious
pvOwner
pvContainer
struct xListItem
xItemValue = 0
pxNext
pxPrevious
pvOwner
pvContainer
TCB: Task A
TCB: Task B
TCB: Task C
pxCurrentTCB

List



Pxindex: 會指到其中一個list item

xLIST_ITEM

```
struct xLIST_ITEM
{
        configLIST_VOLATILE   TickType_t  xItemValue;
        struct xLIST_ITEM  * configLIST_VOLATILE  pxNext;
        struct  xLIST_ITEM  * configLIST_VOLATILE  pxPrevious;
        void * pvOwner;
        struct xLIST  * configLIST_VOLATILE  pxContainer;
};
typedef struct xLIST_ITEM ListItem_t;
```

Task Control Block

```
typedef struct tskTaskControlBlock  /* The old naming convention is used to prevent breaking kernel aware debuggers. */
{
        volatile StackType_t *pxTopOfStack; /*< Points to the location of the last item placed on the tasks stack. THIS MUST BE THE FIRST MEMBER OF THE TCB STRUCT. */

        ListItem_t xStateListItem; /*< The list that the state list item of a task is reference from denotes the state of that task (Ready, Blocked, Suspended ). */
        ListItem_t xEventListItem; /*< Used to reference a task from an event list. */
        UBaseType_t uxPriority; /*< The priority of the task. 0 is the lowest priority. */
        StackType_t *pxStack; /*< Points to the start of the stack. */
        Char pcTaskName[ configMAX_TASK_NAME_LEN ]; /*< Descriptive name given to the task when created.  Facilitates debugging only. */ /*lint !e971 Unqualified char types are allowed for strings and single characters only. */

        #if ( ( portSTACK_GROWTH > 0 ) || ( configRECORD_STACK_HIGH_ADDRESS == 1 ) )
                StackType_t             *pxEndOfStack; /*< Points to the highest valid address for the stack. */
        #endif

        #if ( configUSE_MUTEXES == 1 )
                UBaseType_t             uxBasePriority; /*< The priority last assigned to the task - used by the priority inheritance mechanism. */
                UBaseType_t uxMutexesHeld;
        #endif
} tskTCB;
```

tasks.c

```
static void prvAddCurrentTaskToDelayedList( TickType_t xTicksToWait, const BaseType_t xCanBlockIndefinitely ){

                /* Calculate the time at which the task should be woken if the event
                does not occur. This may overflow but this doesn't matter, the
                kernel will manage it correctly. */
                xTimeToWake = xConstTickCount + xTicksToWait;

                /* The list item will be inserted in wake time order. */
                listSET_LIST_ITEM_VALUE( &( pxCurrentTCB->xStateListItem ), xTimeToWake );
( ( &( pxCurrentTCB->xStateListItem ) )->xItemValue = ( xTimeToWake
)
                if( xTimeToWake < xConstTickCount )
                {
                        /* Wake time has overflowed. Place this item in the overflow
                        list. */
                        vListInsert( pxOverflowDelayedTaskList, &( pxCurrentTCB->xStateListItem ) );
                }
                else
                {
                        /* The wake time has not overflowed, so the current block list
                        is used. */
                        vListInsert( pxDelayedTaskList, &( pxCurrentTCB->xStateListItem ) )


}
```

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Macro

- list.h
  - **#define** listLIST_IS_EMPTY(pxList) (((pxList)->uxNumberOfItems == (UBaseType_t) 0) ? pdTRUE : pdFALSE)
    - listLIST_IS_EMPTY(&(pxReadyTasksLists[xPriority]);
  - **#define** listCURRENT_LIST_LENGTH(pxList) ((pxList)->uxNumberOfItems)
    - listCURRENT_LIST_LENGTH(&(pxReadyTasksLists[xPriority]));