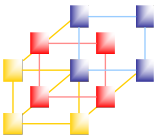
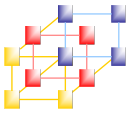
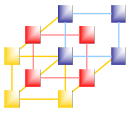


Unit 5
Concurrent Processes



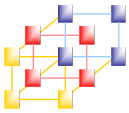
執行緒(thread)的觀念

- 電腦系統常利用多工(multitasking)的方式來提昇效率
- 執行緒(thread)是一種輕量級(lightweight)的執行程式，占用較少的系統資源
  - 執行緒之間共享位址空間(address space)
  - 執行緒執行時的切換(context switching)成本較低
  - 執行緒之間的溝通方便



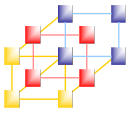
執行緒可分成兩大類

- 使用者執行緒(user threads)
  - 系統在執行應用程式時產生的執行緒 – main()
  - 稱為主執行緒(main thread)
- 常駐執行緒(daemon threads)
  - 系統產生的執行緒
  - 常駐於系統中，直到所有的使用者執行緒都結束才停止



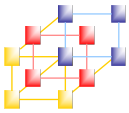
多執行緒程式設計的優點

- 資源的共用
- 提升系統回應的效率 – concurrent processing
- 整體效能的提升 – context switch 的負擔低



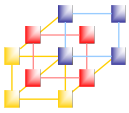
Python Thread

- Python提供了兩個模組
  - _thread – 低階模組
  - threading – 為高階模組，對_thread進行了封裝
- 啟動一個執行緒就是把一個函式傳入並建立Thread例項，然後呼叫start()開始執行
- threading.Thread(target, name, args)
  - t1 = threading.Thread(target=func, args=(10,), name='Loop1')
- start() – start the thread
  - t1.start()



Thread class

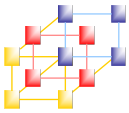
```
class LoopThread(threading.Thread):
        def __init__(self, t_name, num):
                super().__init__(name=t_name)
                self.num = num

        def run(self):
                name = threading.current_thread().name
                print('Thread %s is runnung...' % name)
                for i in range(self.num):
                        print(name, i)
                        time.sleep(1)

if __name__ == '__main__':
        t1 = LoopThread('Loop1', 10)
        t1.start()
```



Thread methods

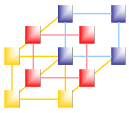
- `threading.active_count()`
  - Return the number of Thread objects currently alive
- `threading.current_thread()`
  - Return the current Thread object.
- `name`
  - A string used for identification purposes only
- `threading.main_thread()`
  - Return the main Thread object
- `join()`
  - Wait until the thread terminates
  - This blocks the calling thread until the thread whose join() method is called terminates

`3-lock.py`



同時性控制 (Synchronization Control)

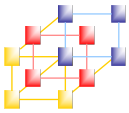
- 當多個 Thread 會存取同一資源，而這一資源一次僅允許一個 Thread 存取時即需要同時性控制 (Critical Section Problem)
- `threading.Lock()`
  - `acquire()`
    - changes the state to locked and returns immediately
    - When the state is locked, acquire() blocks until a call to release() in another thread changes it to unlocked, then the acquire() call resets it to locked and returns
  - `release()`
    - should only be called in the locked state
    - it changes the state to unlocked and returns immediately
  - `locked()`
    - Return true if the lock is acquired



執行緒的溝通

- `threading.Condition()`
  - `wait(`*`timeout=None`*`)`
    - Wait until notified or until a timeout occurs.
  - `notify()`
    - By default, wake up one thread waiting on this condition, if any.
  - If the calling thread has not acquired the lock when this method is called, a RuntimeError is raised
    - Use `with` statement

```
condition = threading.Condition()
with condition:
        condition.wait()
```

Multithread socket server