

B06705048_OS_HW5

7.1

(a) 每個十字路口都被視為一種資源，每一排汽車都被視為一個過程。

(1) Mutual exclusion: 一次只有一排車可以使用該資源。

(2) Hold and wait: 每排汽車都持有一個資源，正在等待下一個資源。

(3) No preemption: 在整排車輛通過之前，不得釋放資源。

(4) Circular wait: 圖中有四排車，L1、L2、L3、L4，L1 等待 L2，L2 等待 L3，L3 等待 L4，L4 等待 L1

(b) break the second condition: a line of cars can't hold a cross and wait, it's that no car of a line can stay in the cross.

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Proof:

Suppose $N = \text{Sum of all Need}_i$, $A = \text{Sum of all Allocation}_i$, $M = \text{Sum of all Max}_i$.

Use contradiction to prove.

Assume this system is not deadlock free. If there exists a deadlock state, then $A = m$ because there's only one kind of resource and resources can be requested and released only one at a time. From condition b, $N + A = M < m + n$. So we get $N + m < m + n$. So we get $N < n$. It shows that at least one process i that $\text{Need}_i = 0$. From condition a, P_i can release at least 1 resource. So there are $n-1$ processes sharing m resources now, condition a and b still hold. Go on the argument, no process will wait permanently, so there's no deadlock.

7.13

7.13

	Allocation	Max	Available	Need
	A B C D	A B C D	A B C D	A B C D
P_0	2 0 0 1	4 2 1 2	3 3 2 1	2 2 1 1
P_1	3 1 2 1	5 2 5 2		2 1 3 1
P_2	2 1 0 3	2 3 1 6		0 2 1 3
P_3	1 3 1 2	1 4 2 4		0 1 1 2
P_4	1 4 3 2	3 6 6 5		2 2 3 3

(a) 先滿足 P_0 ($3, 3, 2, 1$) > ($2, 2, 1, 1$)，讓 P_0 release ($2, 0, 0, 1$)，available \Rightarrow ($5, 3, 2, 2$)
 再滿足 P_3 ($5, 3, 2, 2$) > ($0, 1, 1, 2$)，讓 P_3 release ($1, 3, 1, 2$)，available \Rightarrow ($6, 6, 3, 4$)
 此時 available 已夠允許其他 process run，可以依序跑完
 \Rightarrow a safety state order = $P_0 \rightarrow P_3 \rightarrow P_1 \rightarrow P_2 \rightarrow P_4$

(b) request < need 且 request < available
 $P_1 = (1, 1, 0, 0) < (2, 1, 3, 1)$ ($1, 1, 0, 0$) < ($3, 3, 3, 1$)
 available 變成 ($2, 2, 2, 1$)
 TB 存在 safe sequence $\leftarrow P_0, P_3, P_1, P_2, P_4$
 \rightarrow 請求會被立即給予

(c) request < need 且 request < available
 $P_4 = (0, 0, 2, 0) < (2, 2, 3, 3)$ ($0, 0, 2, 0$) < ($3, 3, 2, 1$)
 available 變成 ($3, 3, 0, 1$)
 不存在 safe sequence
 \rightarrow 請求不會被立即給予