|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 资源  情况  进程 | Max | | | Allocation | | | Need | | | Available | | |
| A | B | C | A | B | C | A | B | C | A | B | C |
| P0 | 7 | 5 | 3 | 0 | 1 | 0 | 7 | 4 | 3 | 3 | 3 | 2 |
| P1 | 3 | 2 | 2 | 2 | 0 | 0 | 1 | 2 | 2 |  | | |
| P2 | 9 | 0 | 2 | 3 | 0 | 2 | 6 | 0 | 0 |
| P3 | 2 | 2 | 2 | 2 | 1 | 1 | 0 | 1 | 1 |
| P4 | 4 | 3 | 3 | 0 | 0 | 2 | 4 | 3 | 1 |

1.T0时刻的安全性：

T时刻：系统可利用资源Available(3,3,2)

**P0:** Need(7,4,3)>Available(3,3,2) ---->等待wait

**P1:** Need(1,2,2)<Available(3,3,2) ---->**①执行** ---->分配矩阵Allocation(2,0,0)

---->Work + Allocation(5,3,2)

**P2:** Need(6,0,0)>Work + Allocation(5,3,2) ---->等待wait

**P3:** Need(0,1,1)<Work + Allocation(5,3,2) ---->**②执行** ---->分配矩阵Allocation(2,1,1)

---->Work + Allocation(7,4,3)

**P4:** Need(4,3,1)<Work + Allocation(7,4,3) ---->**③执行** ---->分配矩阵Allocation(0,0,2)

---->Work + Allocation(7,4,5)

**P2:** Need(6,0,0)<Work + Allocation(7,4,5) ---->**④执行** ---->分配矩阵Allocation(3,0,2)

---->Work + Allocation(10,4,7)

**P0:** Need(7,4,3)<Work + Allocation(10,4,7) ---->**⑤执行** ---->分配矩阵Allocation(0,1,0)

---->Work + Allocation(10,5,7)

**---------------------->结束**

具体表格如下：

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 资源  情况  进程 | Work | | | Need | | | Allocation | | | Work+ Allocation | | | Finish |
| A | B | C | A | B | C | A | B | C | A | B | C |
| P1 | 3 | 3 | 2 | 1 | 2 | 2 | 2 | 0 | 0 | 5 | 3 | 2 | true |
| P3 | 5 | 3 | 2 | 0 | 1 | 1 | 2 | 1 | 1 | 7 | 4 | 3 | true |
| P4 | 7 | 4 | 3 | 4 | 3 | 1 | 0 | 0 | 2 | 7 | 4 | 5 | true |
| P2 | 7 | 4 | 5 | 6 | 0 | 0 | 3 | 0 | 2 | 10 | 4 | 7 | true |
| P0 | 10 | 4 | 7 | 7 | 4 | 3 | 0 | 1 | 0 | 10 | 5 | 7 | true |

结论：T0时刻存在着一个安全序列{P1,P3,P4,P2,P0}，系统是安全的。

同上可以推测出{ P1,P3,P4, P0 ,P2}也同样是一个安全序列

2.P1请求资源：P1发出请求向量Request1(1,0,2)：

（1）Request1(1,0,2)<=Need1(1,2,2);

（2）Request1(1,0,2)<=Available1(3,3,2);

（3）系统先假定可为P1分配资源，并修改P1的Allocation1为(3,0,2)，和Need1为(0,2,0)向量，此时系统可利用资源Available(2,3,0)

（4）安全性算法检查系统此时安全性：

**P1:** Need(0,2,0)<Available(2,3,0) ---->**①执行** ---->分配矩阵Allocation(3,0,2)

---->Work + Allocation(5,3,2)

**P2:** Need(6,0,0)>Work + Allocation(5,3,2) ---->等待wait

**P3:** Need(0,1,1)<Work + Allocation(5,3,2) ---->**②执行** ---->分配矩阵Allocation(2,1,1)

---->Work + Allocation(7,4,3)

**P4:** Need(4,3,1)<Work + Allocation(7,4,3) ---->**③执行** ---->分配矩阵Allocation(0,0,2)

---->Work + Allocation(7,4,5)

**P0:** Need(7,4,3)<Work + Allocation(7,4,5) ---->**④执行** ---->分配矩阵Allocation(0,1,0)

---->Work + Allocation(7,5,5)

**P2:** Need(6,0,0)<Work + Allocation(7,5,5) ---->**⑤执行** ---->分配矩阵Allocation(3,0,2)

---->Work + Allocation(10,5,7)

**---------------------->结束**

具体表格如下：

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 资源  情况  进程 | Work | | | Need | | | Allocation | | | Work+ Allocation | | | Finish |
| A | B | C | A | B | C | A | B | C | A | B | C |
| P1 | 2 | 3 | 0 | 0 | 2 | 0 | 3 | 0 | 2 | 5 | 3 | 2 | true |
| P3 | 5 | 3 | 2 | 0 | 1 | 1 | 2 | 1 | 1 | 7 | 4 | 3 | true |
| P4 | 7 | 4 | 3 | 4 | 3 | 1 | 0 | 0 | 2 | 7 | 4 | 5 | true |
| P0 | 7 | 4 | 5 | 7 | 4 | 3 | 0 | 1 | 0 | 7 | 5 | 5 | true |
| P2 | 7 | 5 | 5 | 6 | 0 | 0 | 3 | 0 | 2 | 10 | 5 | 7 | true |

结论：**存在着一个安全序列{P1,P3,P4,P0,P2}，系统是安全的，所以可以立即将P1,所申请的资源分配给他。**

3.P4请求资源：P4发出请求向量Request4(3,3,0)：

（1）Request4(3,3,0)<=Need4(4,3,1);

（2）Request4(3,3,0)>Available(2,3,0)

**---------------------->让P4等待wait**

4.P0请求资源：P0发出请求向量Request0(0,2,0)：

（1）Request0(0,2,0)<=Need0(7,4,3);

（2）Request0(0,2,0)<=Available(2,3,0)

（3）系统先假定可为P0分配资源，并修改P0的Allocation0为(0,3,0)，和Need0为(7,2,3)向量，此时系统可利用资源Available(2,1,0)

（4）安全性算法检查系统此时安全性：

**P0:** Need(7,2,3)<Available(2,1,0) ---->等待wait

**P1:** Need(0,2,0)<Available(2,1,0) ---->等待wait

**P2:** Need(6,0,0)<Available(2,1,0) ---->等待wait

**P3:** Need(0,1,1)<Available(2,1,0) ---->等待wait

**P4:** Need(4,3,1)<Available(2,1,0) ---->等待wait

**--->此时，可用资源<Available(2,1,0)已不能满足任何进程的需要，系统进入不安全状态---------------------->系统不分配资源**