Table 5.1 Process Interaction

Degree of Awareness	Relationship	Influence that one Process has on the Other	Potential Control Problems
Processes unaware of each other	Competition	•Results of one process independent of the action of others •Timing of process may be affected	•Mutual exclusion •Deadlock (renewable resource) •Starvation
Processes indirectly aware of each other (e.g., shared object)	Cooperation by sharing	•Results of one process may depend on information obtained from others •Timing of process may be affected	•Mutual exclusion •Deadlock (renewable resource) •Starvation •Data coherence
Processes directly aware of each other (have communication primitives available to them)	Cooperation by communication	•Results of one process may depend on information obtained from others •Timing of process may be affected	•Deadlock (consumable resource) •Starvation

Table 5.2 Possible Scenario for the Program of Figure 5.12

	Producer	Consumer	s	n	Delay
1			1	0	0
2	waitB(s)		0	0	0
3	n++		0	1	0
4	**if** (n==1) (signalB(delay))		0	1	1
5	signalB(s)		1	1	1
6		waitB(delay)	1	1	0
7		waitB(s)	0	1	0
8		n--	0	0	0
9		SignalB(s)	1	0	0
10	waitB(s)		0	0	0
11	n++		0	1	0
12	**if** (n==1) (signalB(delay))		0	1	1
13	signalB(s)		1	1	1
14		**if** (n==0) (waitB(delay))	1	1	1
15		waitB(s)	0	1	1
16		n--	0	0	1
17		signalB(s)	1	0	1
18		**if** (n==0) (waitB(delay))	1	0	0
19		waitB(s)	0	0	0
20		n--	0	–1	0
21		signalB(s)	1	–1	0

Shaded areas represent the critical section controlled by semaphore s.

Table 5.3 Purpose of Semaphores in Figure 5.19

Semaphore	Wait Operation	Signal Operation
max_capacity	Customer waits for space to enter shop.	Exiting customer signals customer waiting to enter.
sofa	Customer waits for seat on sofa.	Customer leaving sofa signals customer waiting for sofa.
barber_chair	Customer waits for empty barber chair.	Barber signals when that barber's chair is empty.
cust_ready	Barber waits until a customer is in the chair.	Customer signals barber that customer is in the chair.
finished	Customer waits until his haircut is complete.	Barber signals when done cutting hair of this customer.
leave_b_chair	Barber waits until customer gets up from the chair.	Customer signals barber when customer gets up from chair.
payment	Cashier waits for a customer to pay.	Customer signals cashier that he has paid.
receipt	Customer waits for a receipt for payment.	Cashier signals that payment has been accepted.
coord	Wait for a barber resource to be free to perform either the hair cutting or cashiering function.	Signal that a barber resource is free.

Table 5.4 Design Characteristics of Message Systems for Interprocessor Communication and Synchronization

- **Synchronization**
  - Send
    - blocking
    - nonblocking
  - Receive
    - blocking
    - nonblocking
    - test for arrival
- **Addressing**
  - Direct
    - send
    - receive
      - explicit
      - implicit
  - Indirect
    - static
    - dynamic
    - ownership
- **Format**
  - Content
  - Length
    - fixed
    - variable
- **Queuing Discipline**
  - FIFO
  - Priority

Table 5.5 State of the Process Queues for Program of Figure 5.29

Readers only in the system	•*wsem* set •no queues
Writers only in the system	•*wsem* and *rsem* set •writers queue on wsem
Both readers and writers with read first	•*wsem* set by reader •*rsem* set by writer •all writers queue on *wsem* •one reader queues on *rsem* •other readers queue on *z*
Both readers and writers with write first	•*wsem* set by writer •*rsem* set by writer •writers queue on *wsem* •one reader queues on *rsem* •other readers queue on *z*