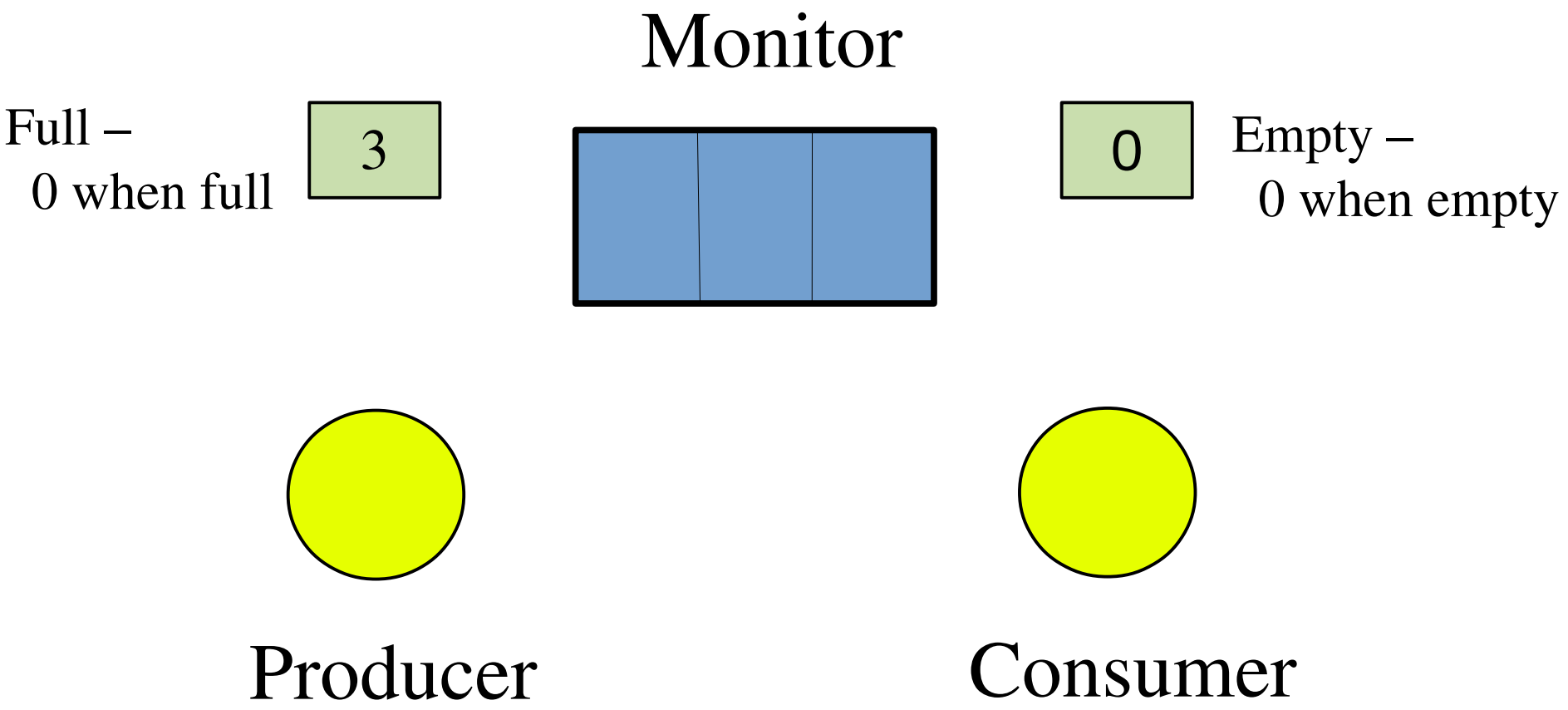
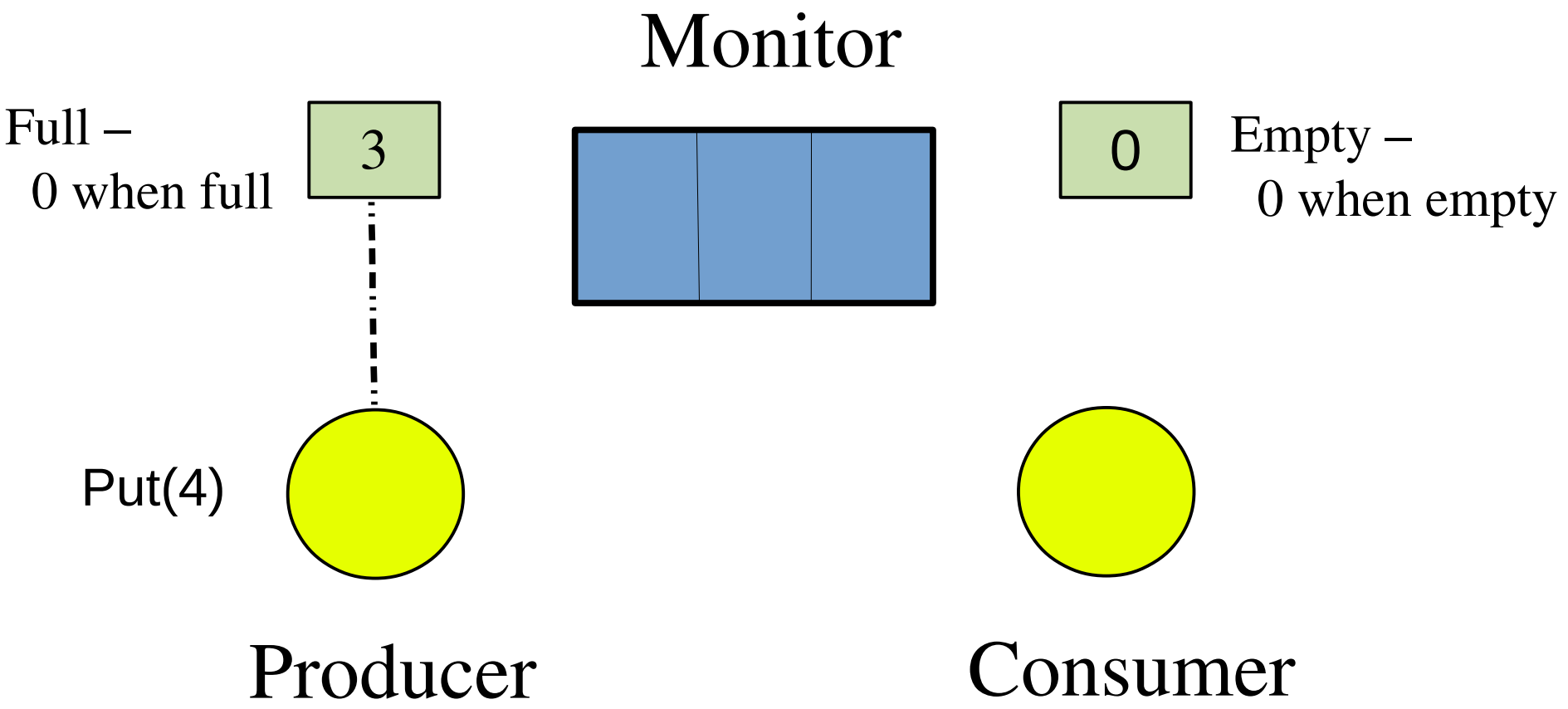
Monitor with a Queue and Semaphores

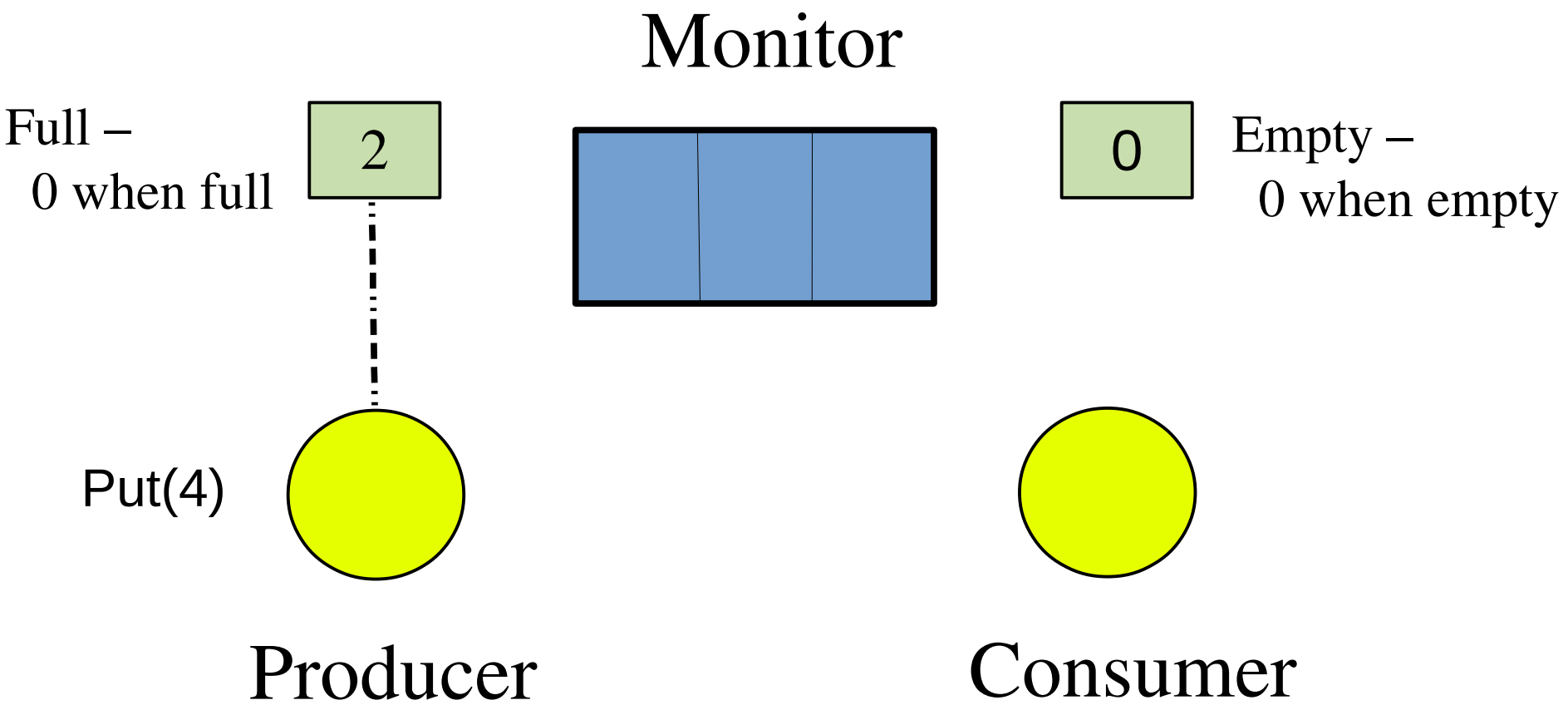


Monitor uses a buffer capable of holding three tokens
Count of Full semaphore goes to 0 when the buffer is full
Count of Empty semaphore goes to 0 when the buffer is empty

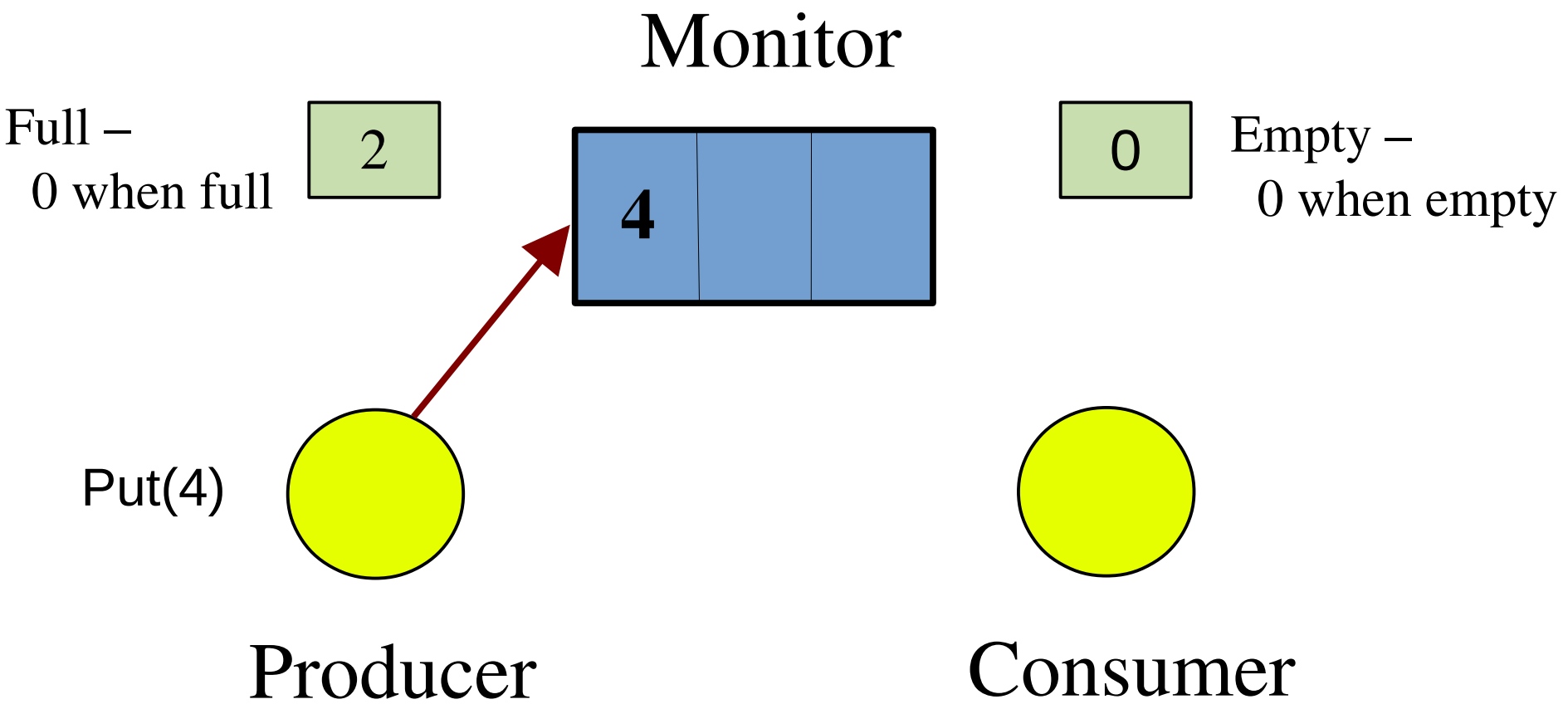


Monitor buffer is empty

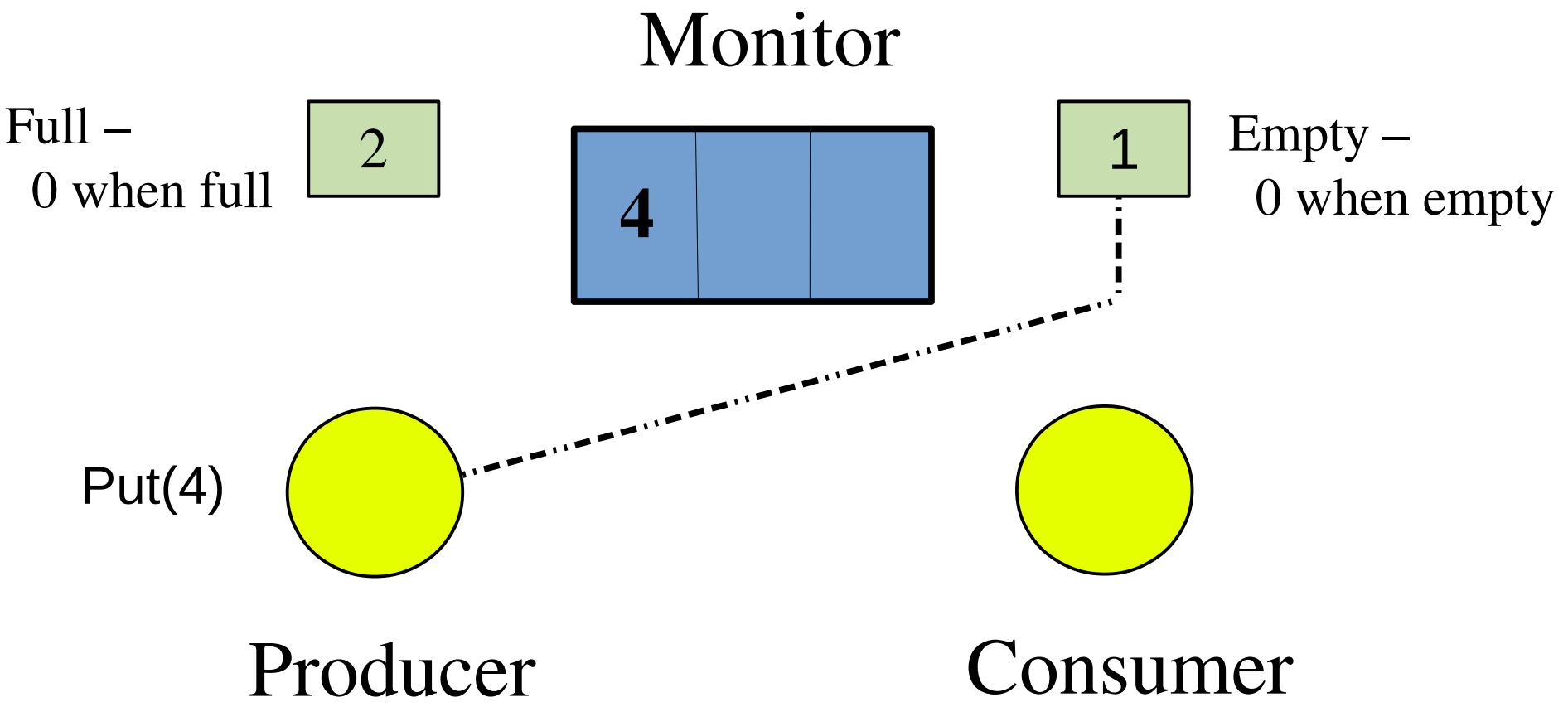
The Full semaphore's count is checked to be > 0



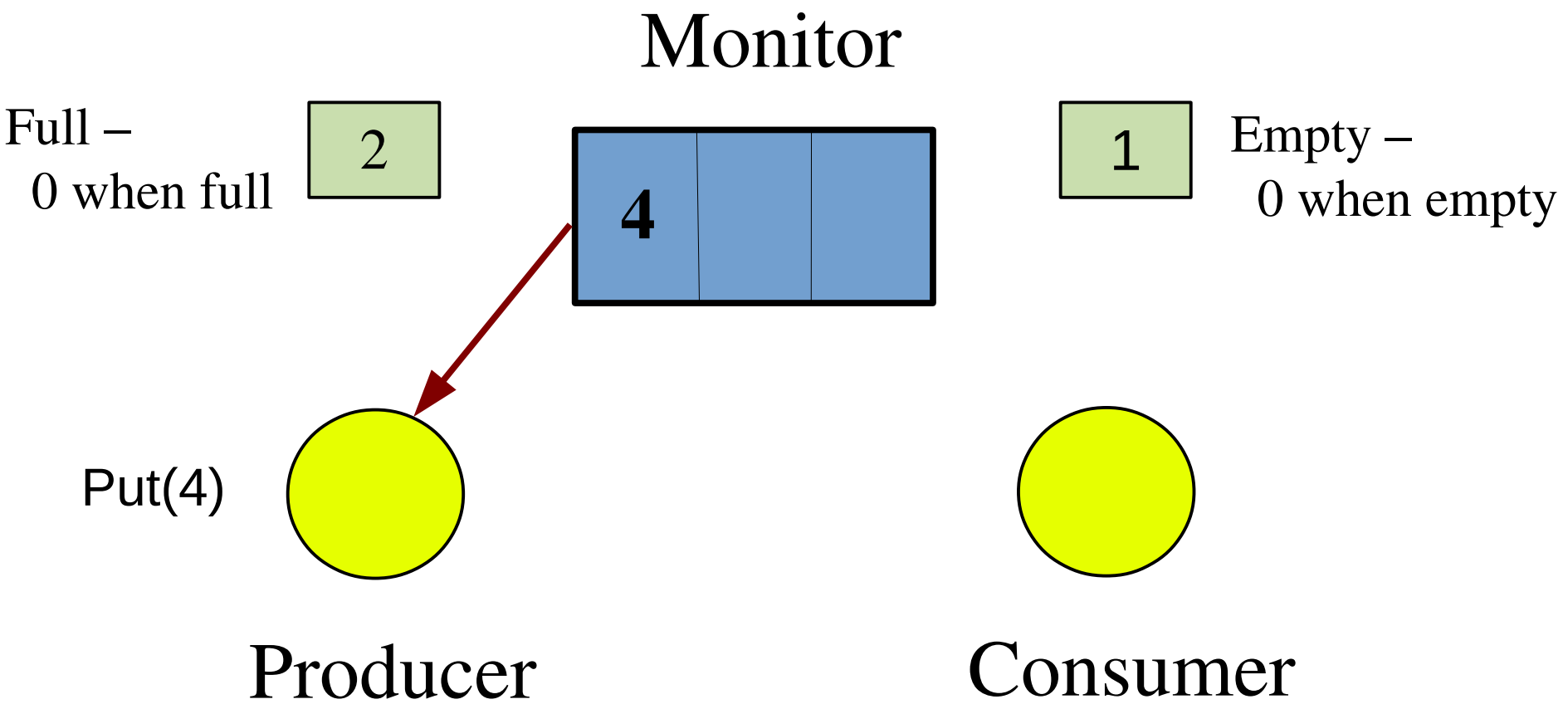
Monitor buffer is empty
The Full semaphore's count is checked to be > 0
It is! So producer passes through and decrements Full's count



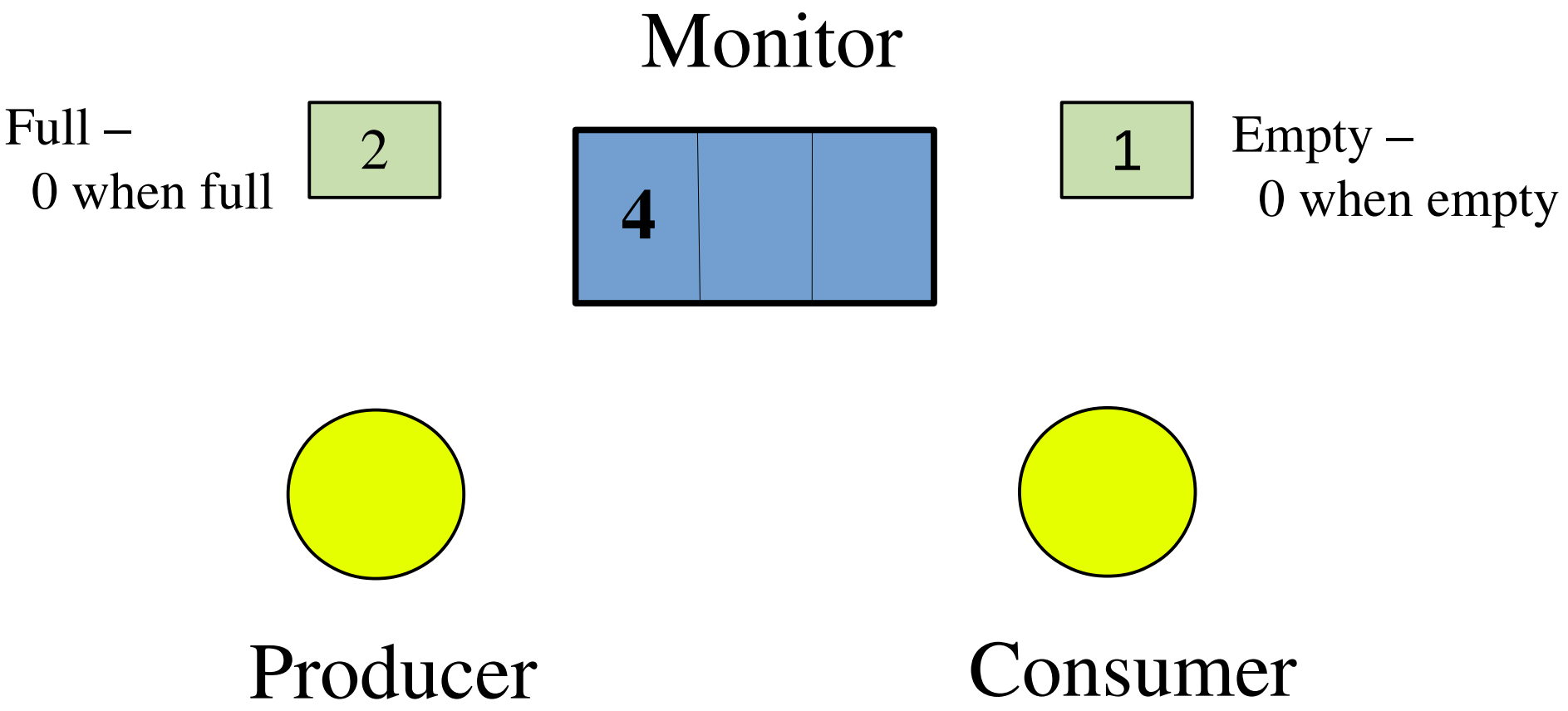
Monitor now has two vacant slots, one slot contains 4
Producer sends a 4 into the Monitor's buffer



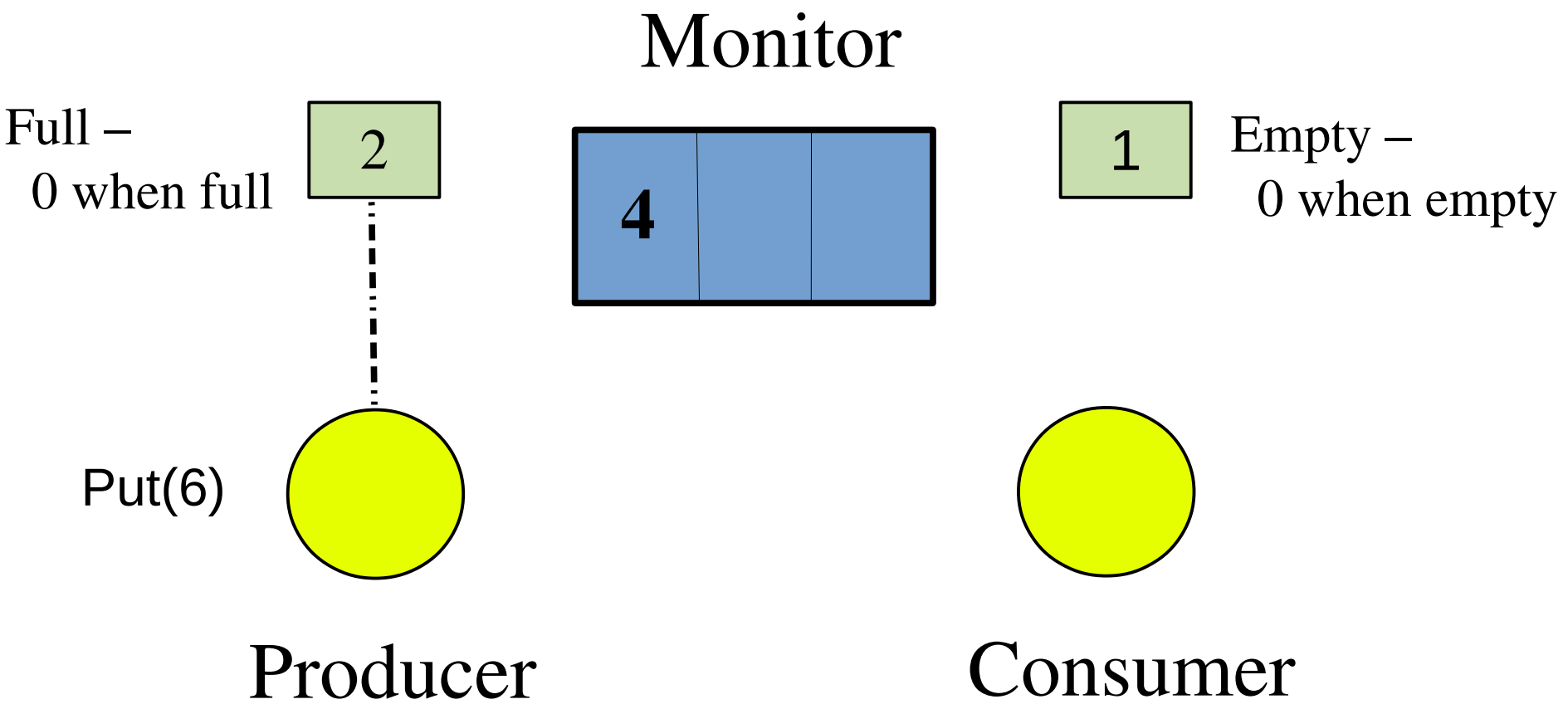
Monitor now has two vacant slots, one slot contains 4
Producer increments the Empty semaphore's count



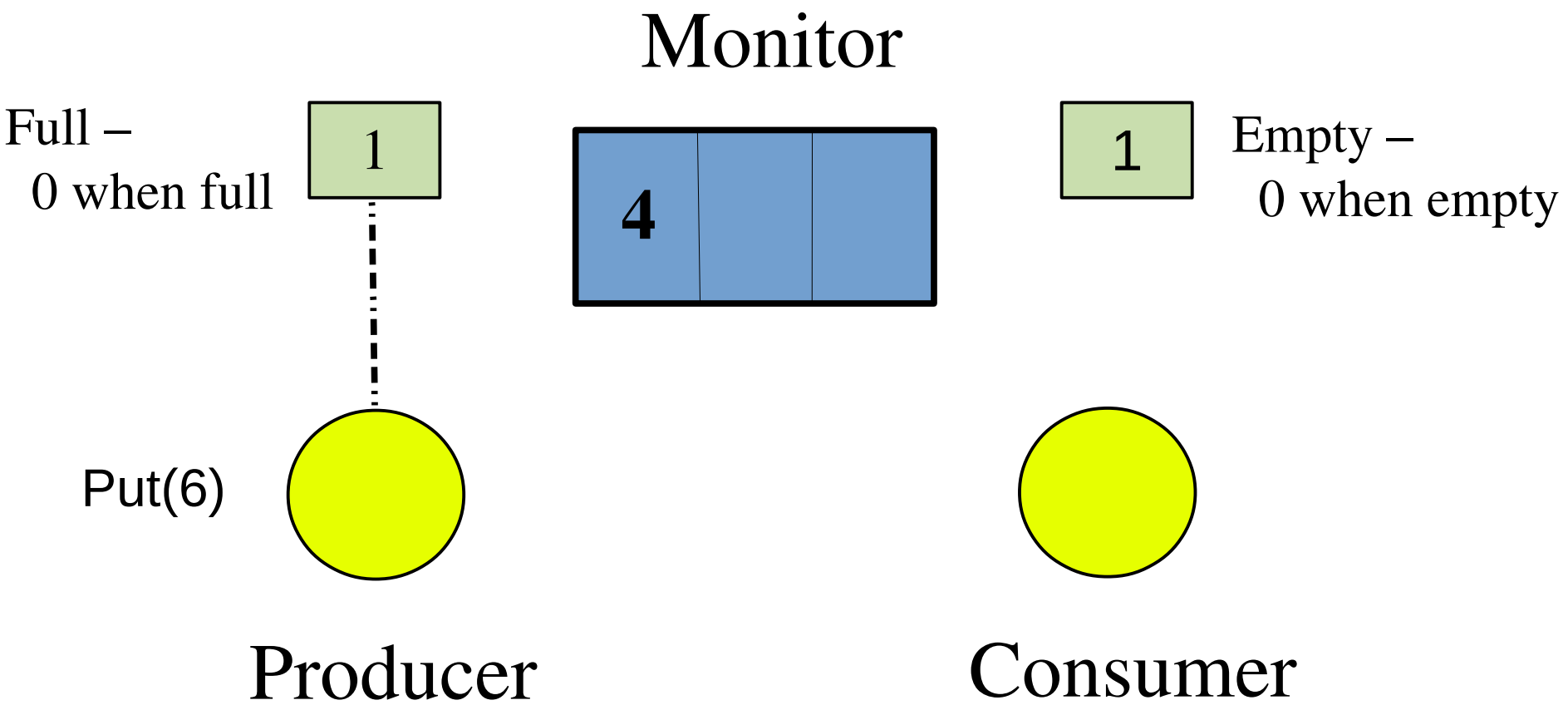
Monitor now has two vacant slots, one slot contains 4
Producer returns and continues processing



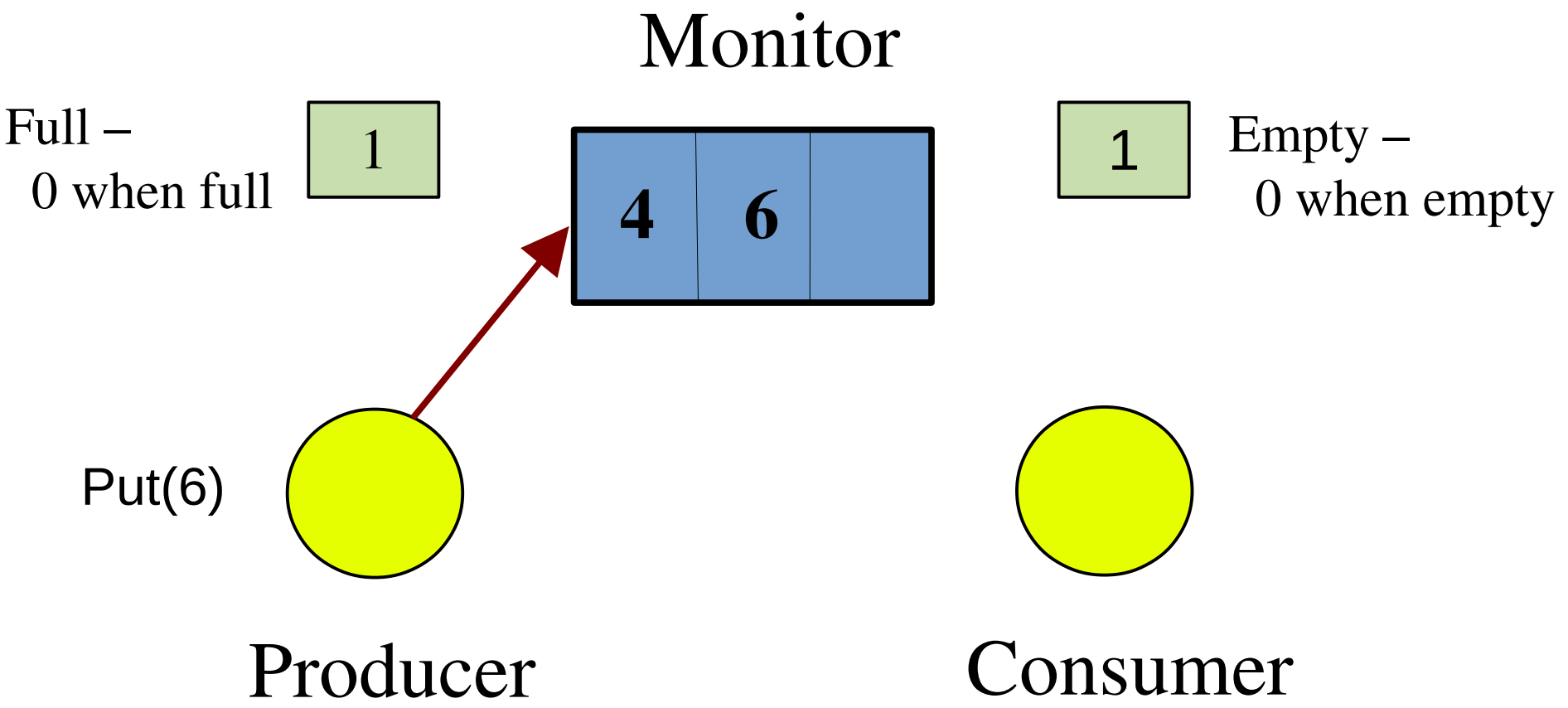
Monitor now has two vacant slots, one slot contains 4
The Full semaphore's count is 2
The Empty semaphore's count is 1



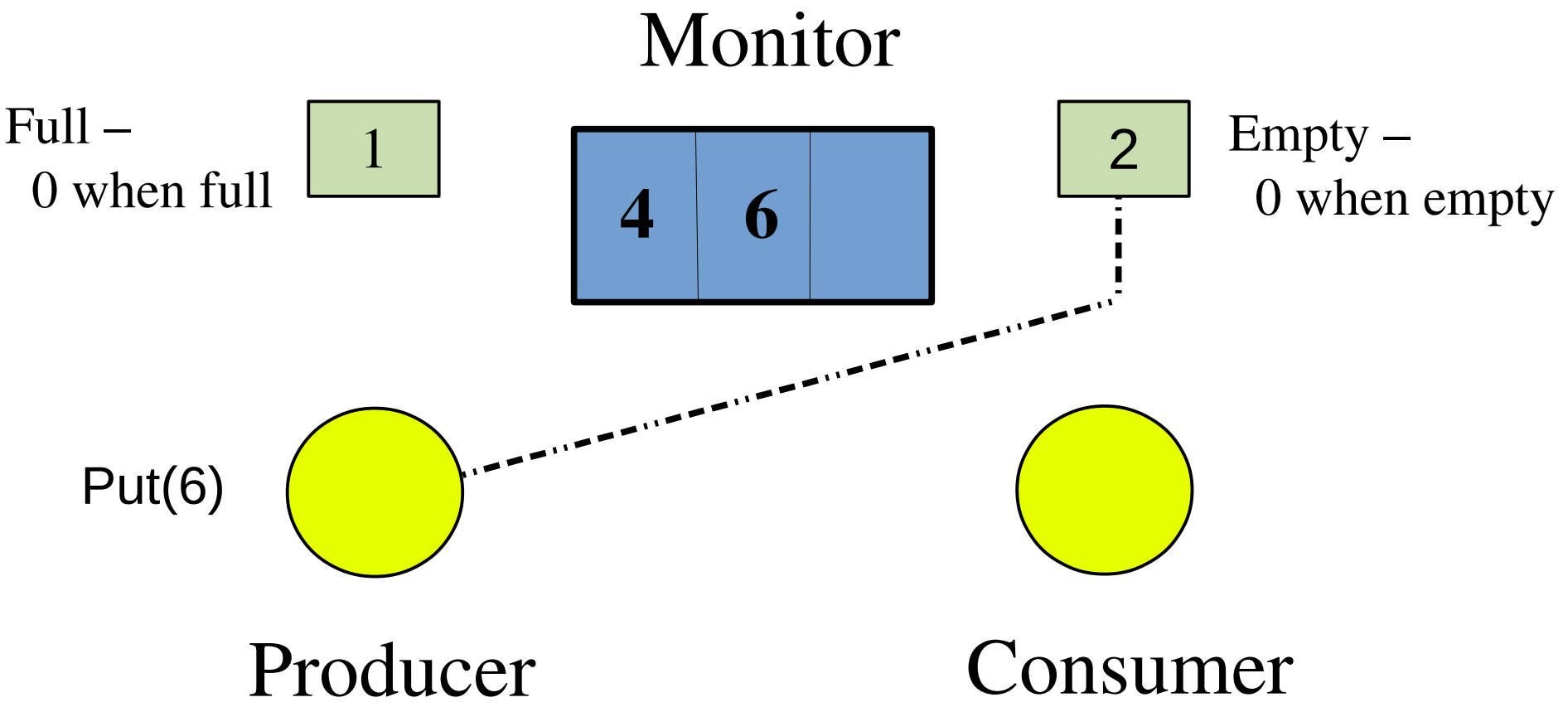
Monitor now has two vacant slots, one slot contains 4
The Full semaphore's count is checked to be > 0



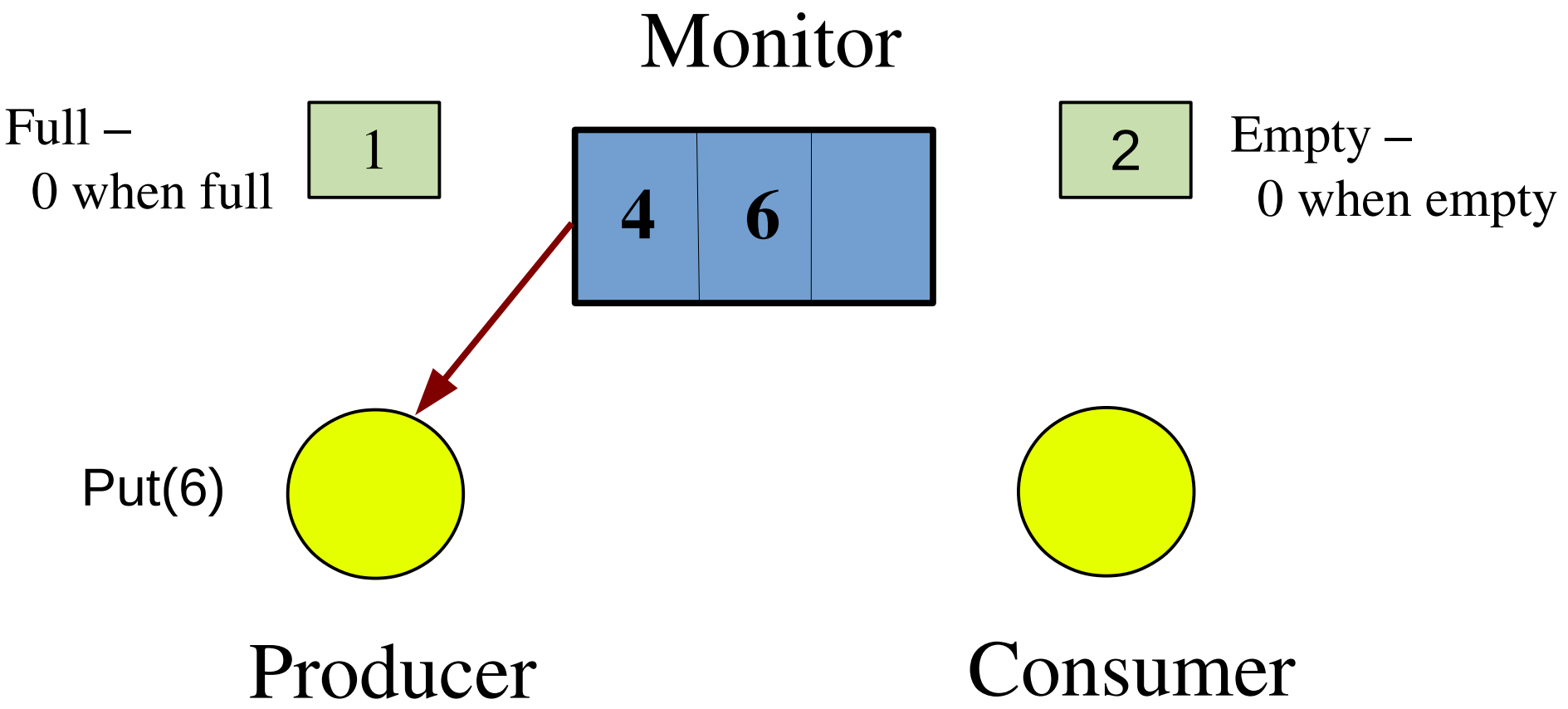
Monitor now has two vacant slots, one slot contains 4
The Full semaphore's count is checked to be > 0
It is! So producer passes through and decrements Full's count



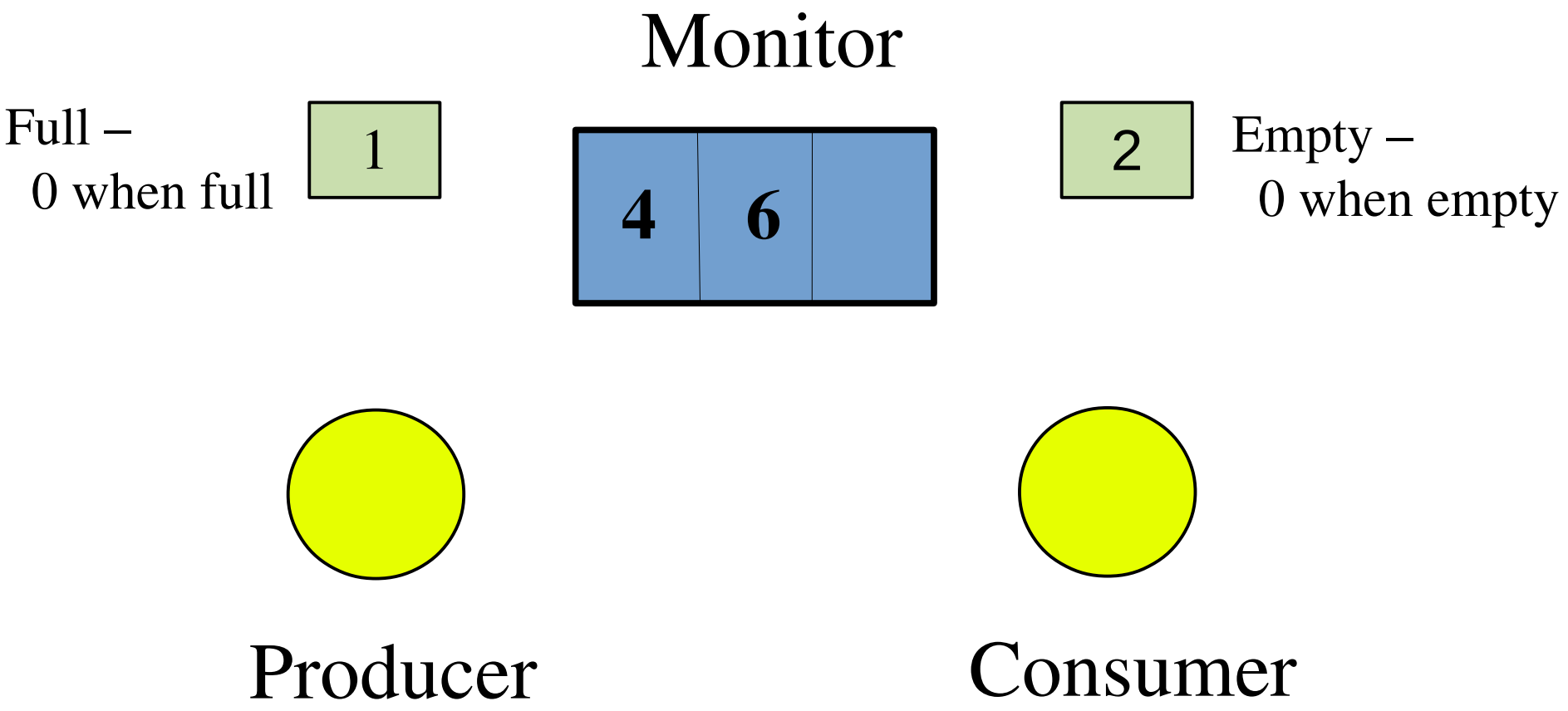
Monitor now has one vacant slot, one slot contains 4, one contains 6
Producer sends a 6 into the Monitor's buffer



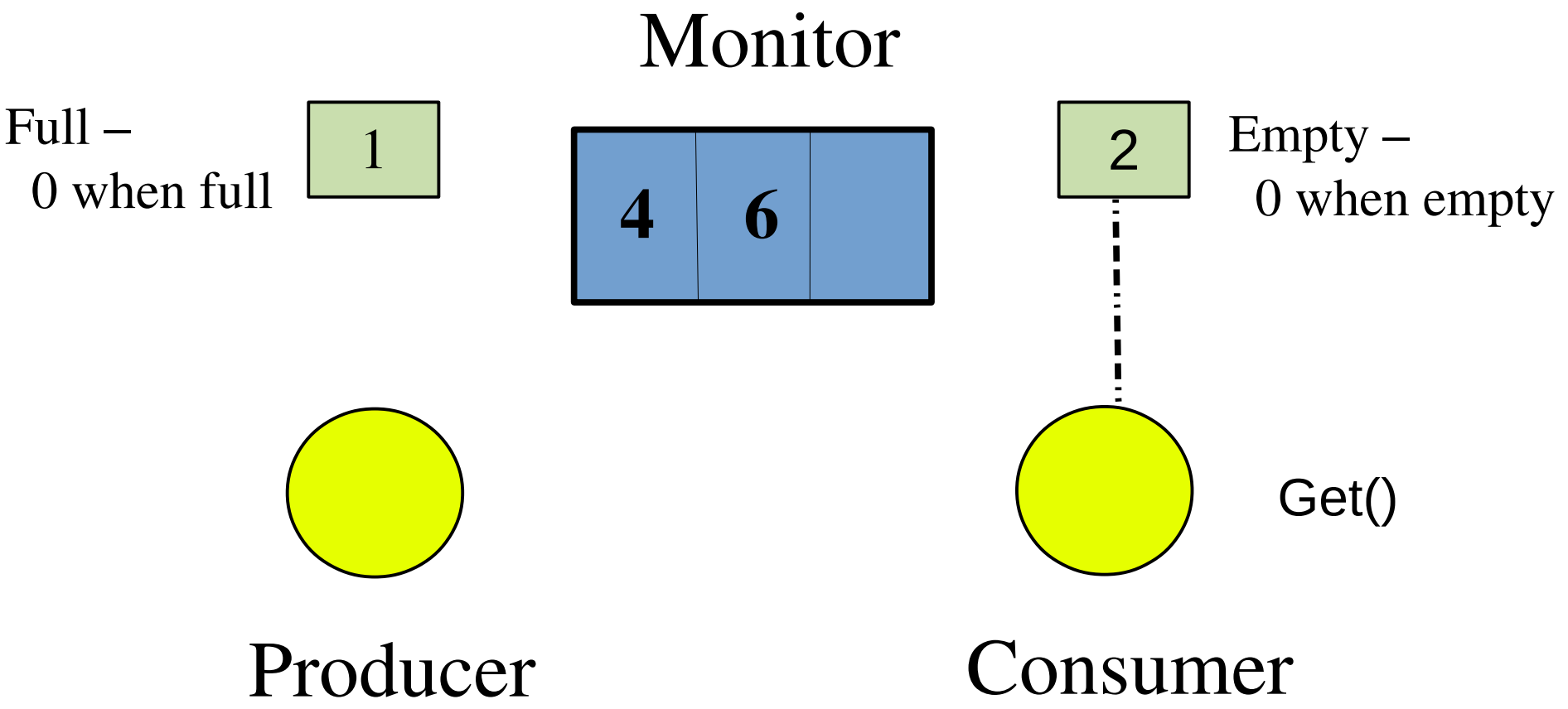
Monitor now has one vacant slot, one slot contains 4, one contains 6
Producer increments the Empty semaphore's count



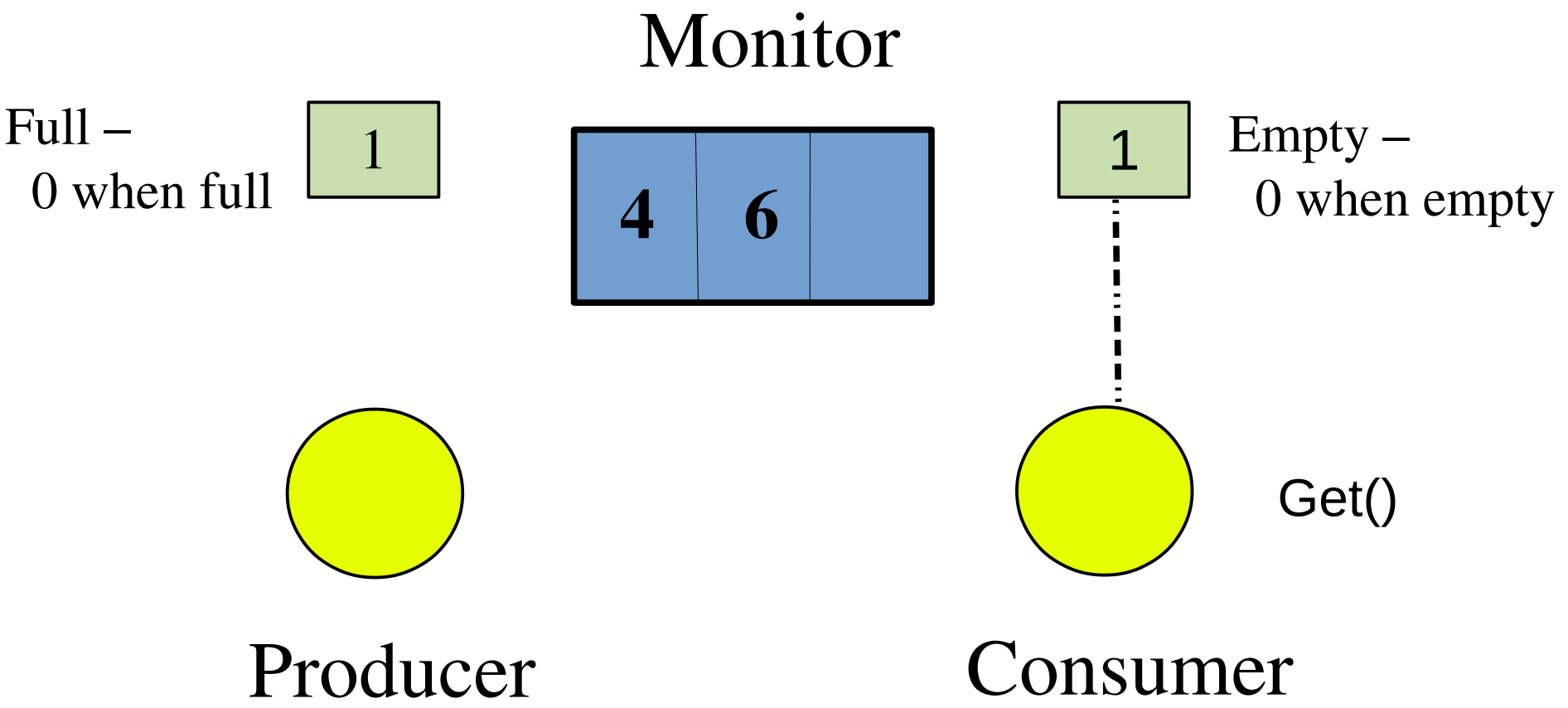
Monitor now has one vacant slot, one slot contains 4, one contains 6
Producer returns and continues processing



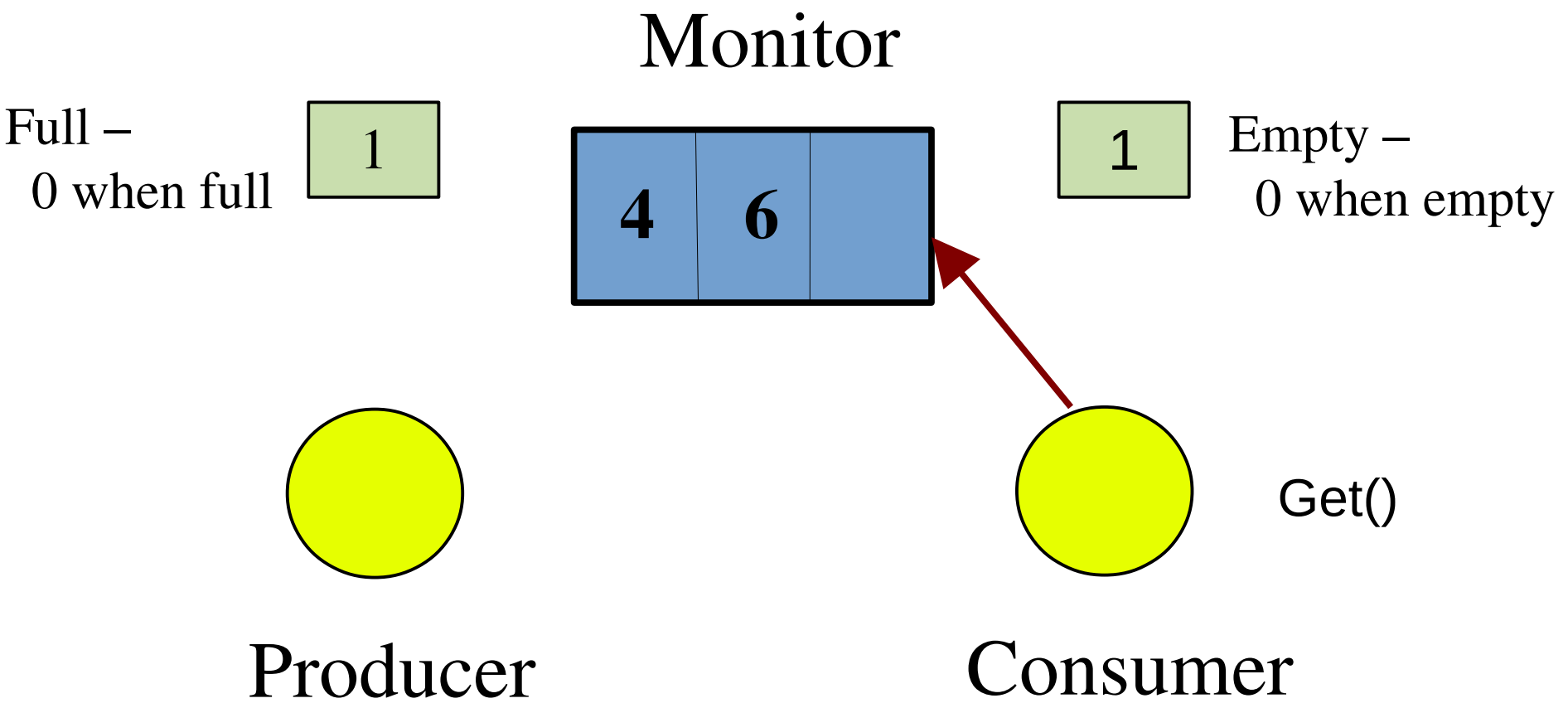
Monitor now has one vacant slot, one slot contains 4, one contains 6
The Full semaphore's count is 1
The Empty semaphore's count is 2



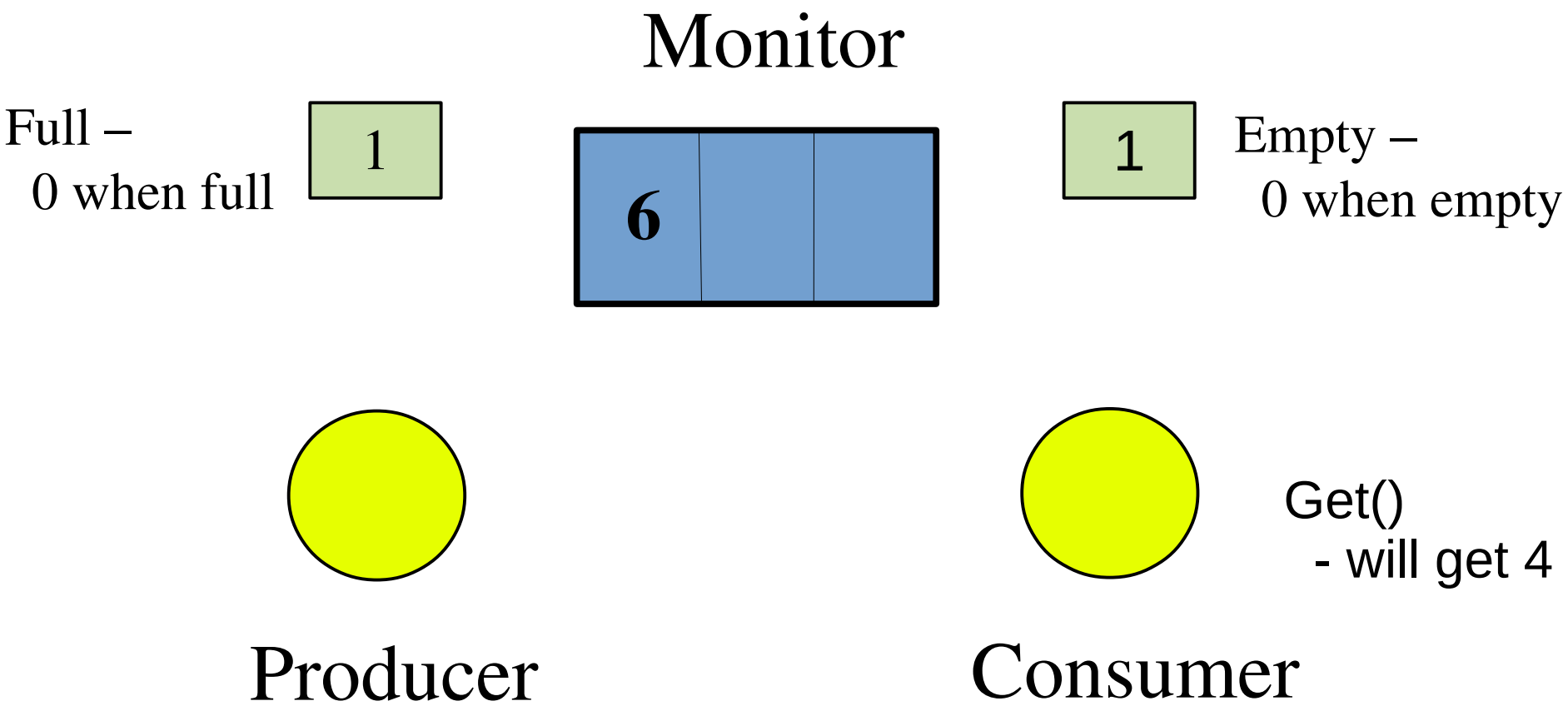
Monitor now has one vacant slot, one slot contains 4, one contains 6
The Empty semaphore's count is checked to be > 0



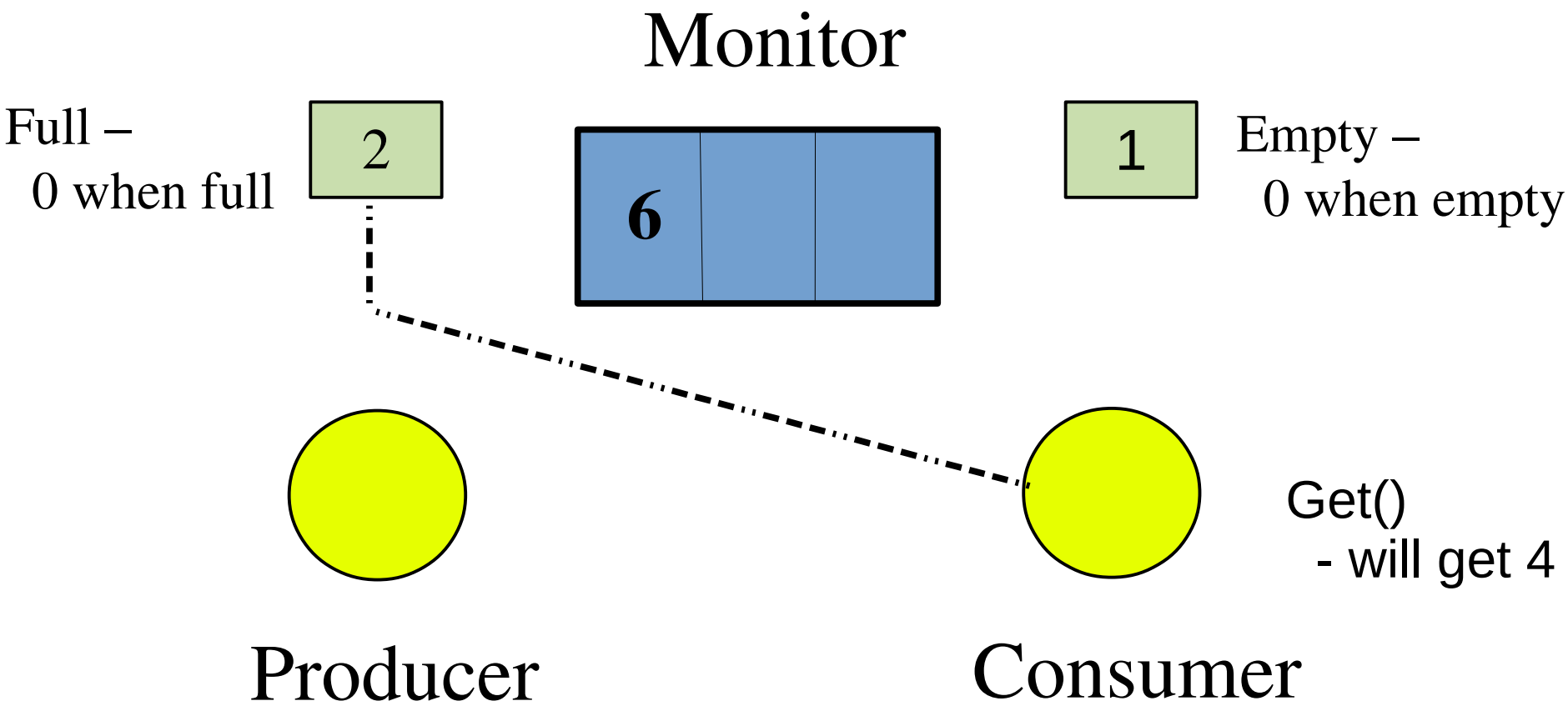
Monitor now has one vacant slot, one slot contains 4, one contains 6
The Empty semaphore's count is checked to be > 0
It is! So consumer passes through and decrements Empty's count



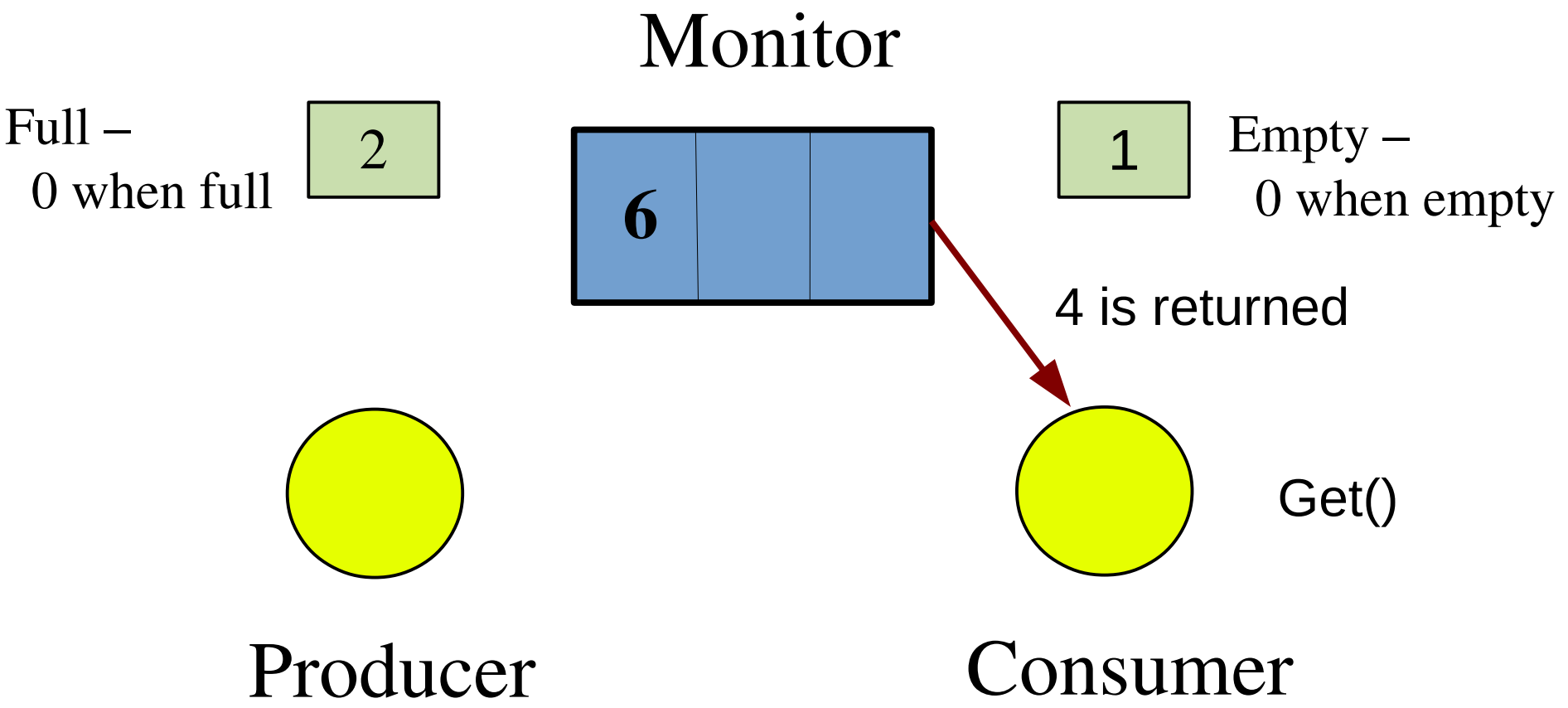
Monitor now has one vacant slot, one slot contains 4, one contains 6
Consumer continues with get()



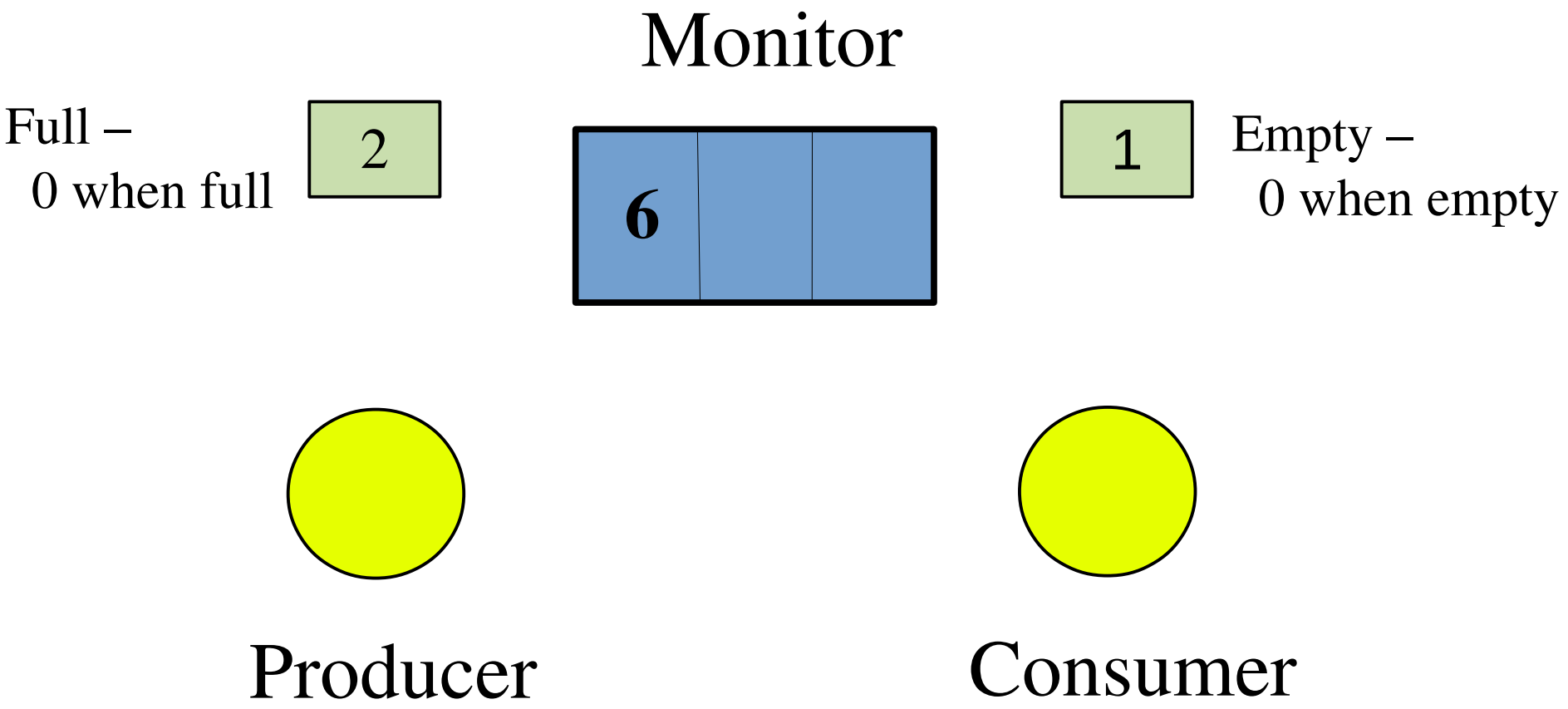
Monitor now has two vacant slots, one slot contains 6
Monitor removes 4 from buffer, holds onto it



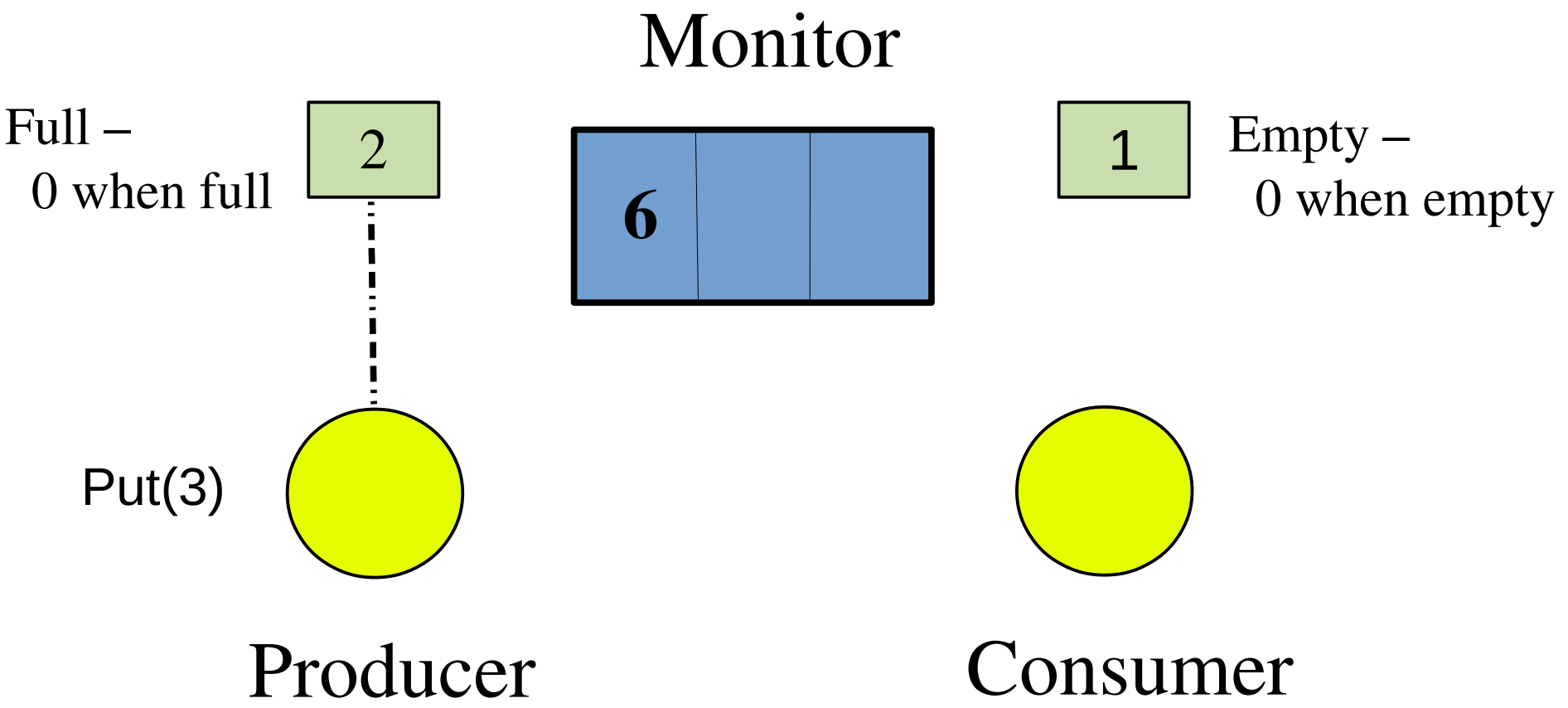
Monitor now has two vacant slots, one slot contains 6
Monitor removes 4 from buffer, holds onto it
Consumer increments the Full semaphore's count



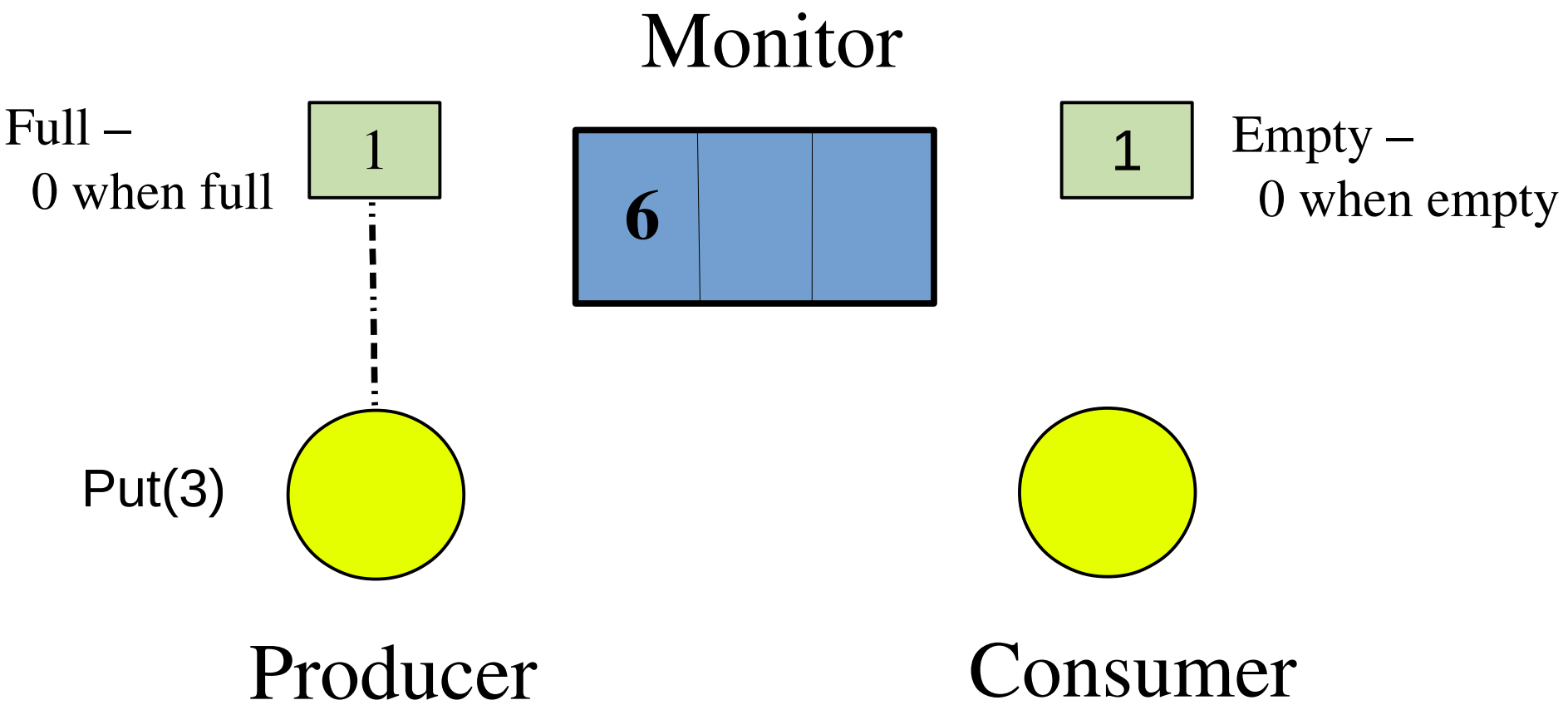
Monitor now has two vacant slots, one slot contains 6
Monitor sends 4 to the consumer



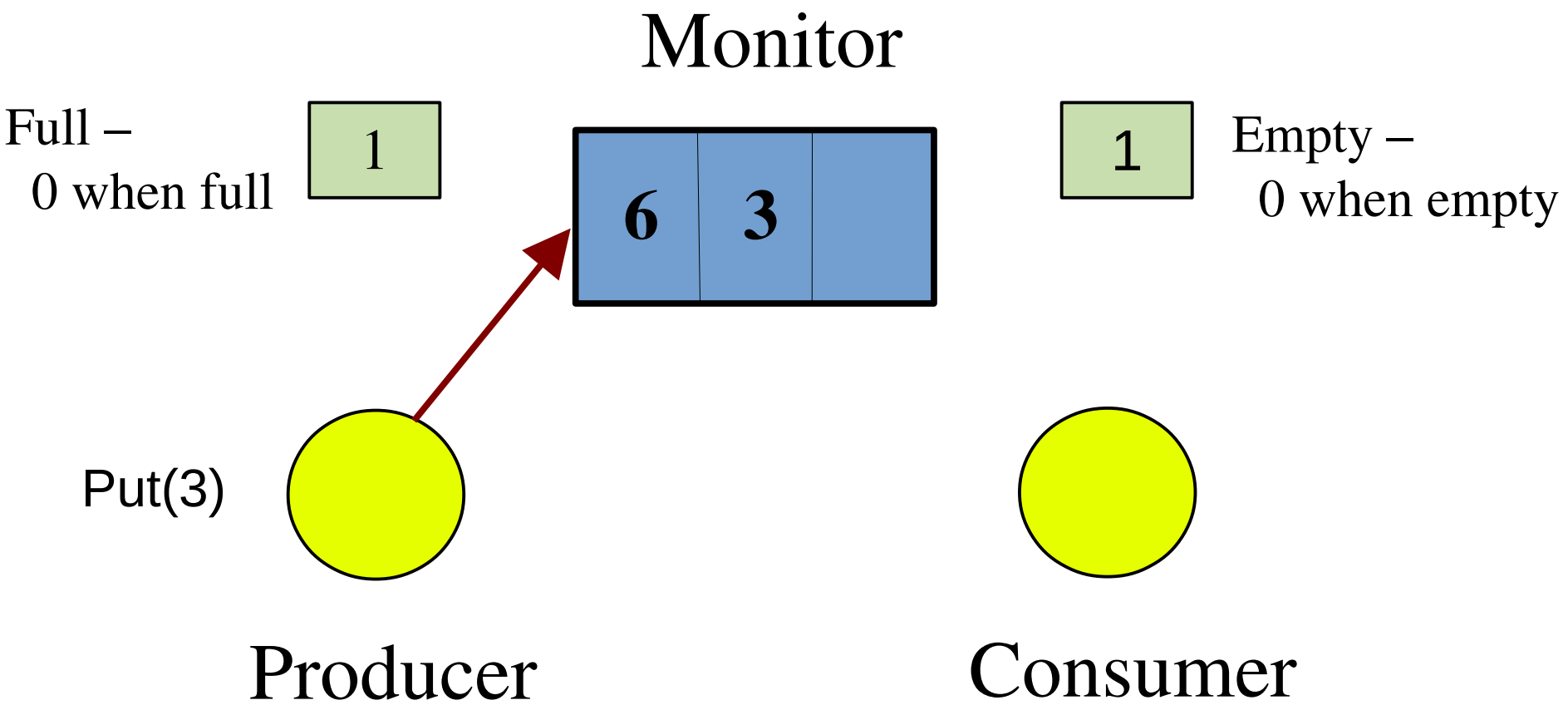
Monitor now has two vacant slots, one slot contains 6
The Full semaphore count is 2
The Empty semaphore count is 1



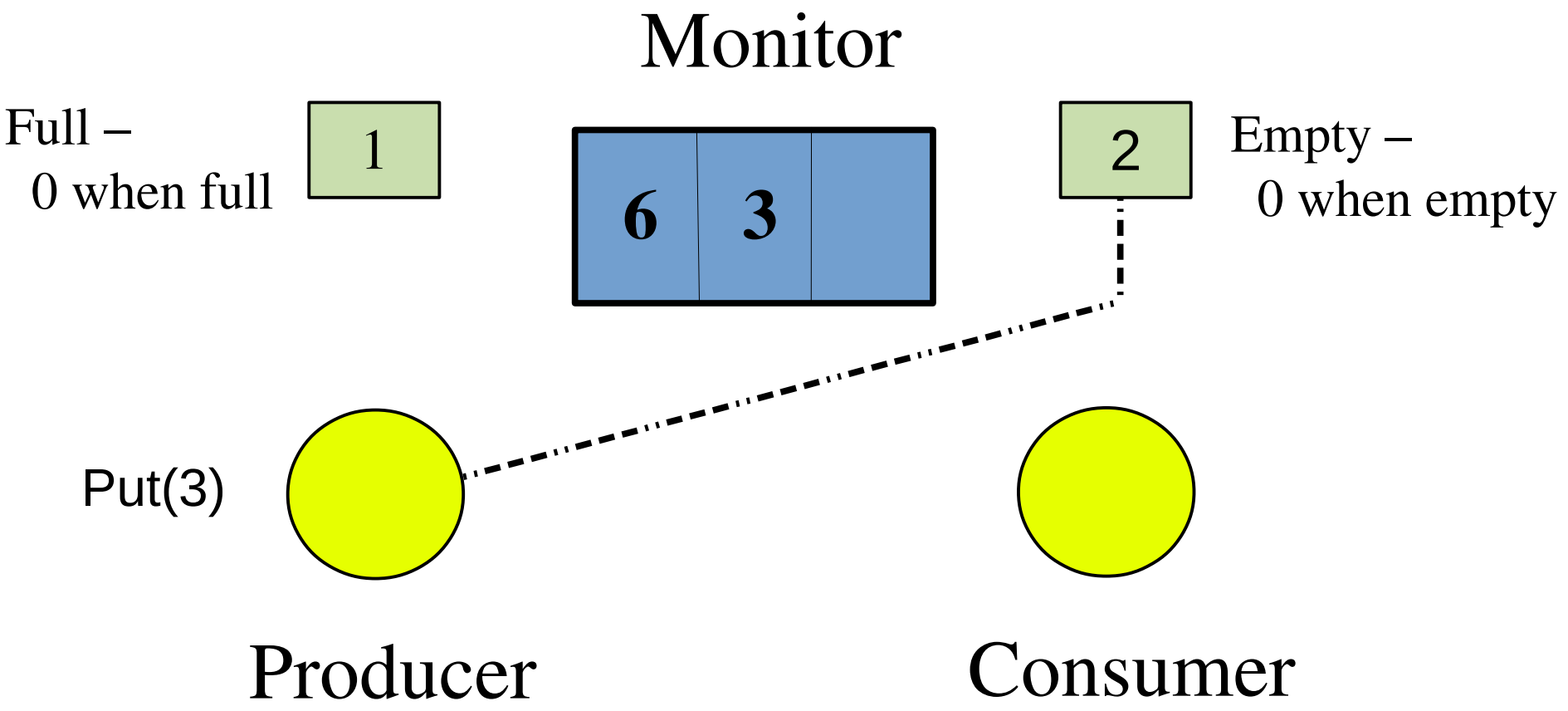
Monitor now has two vacant slots, one slot contains 6
The Full semaphore's count is checked to be > 0



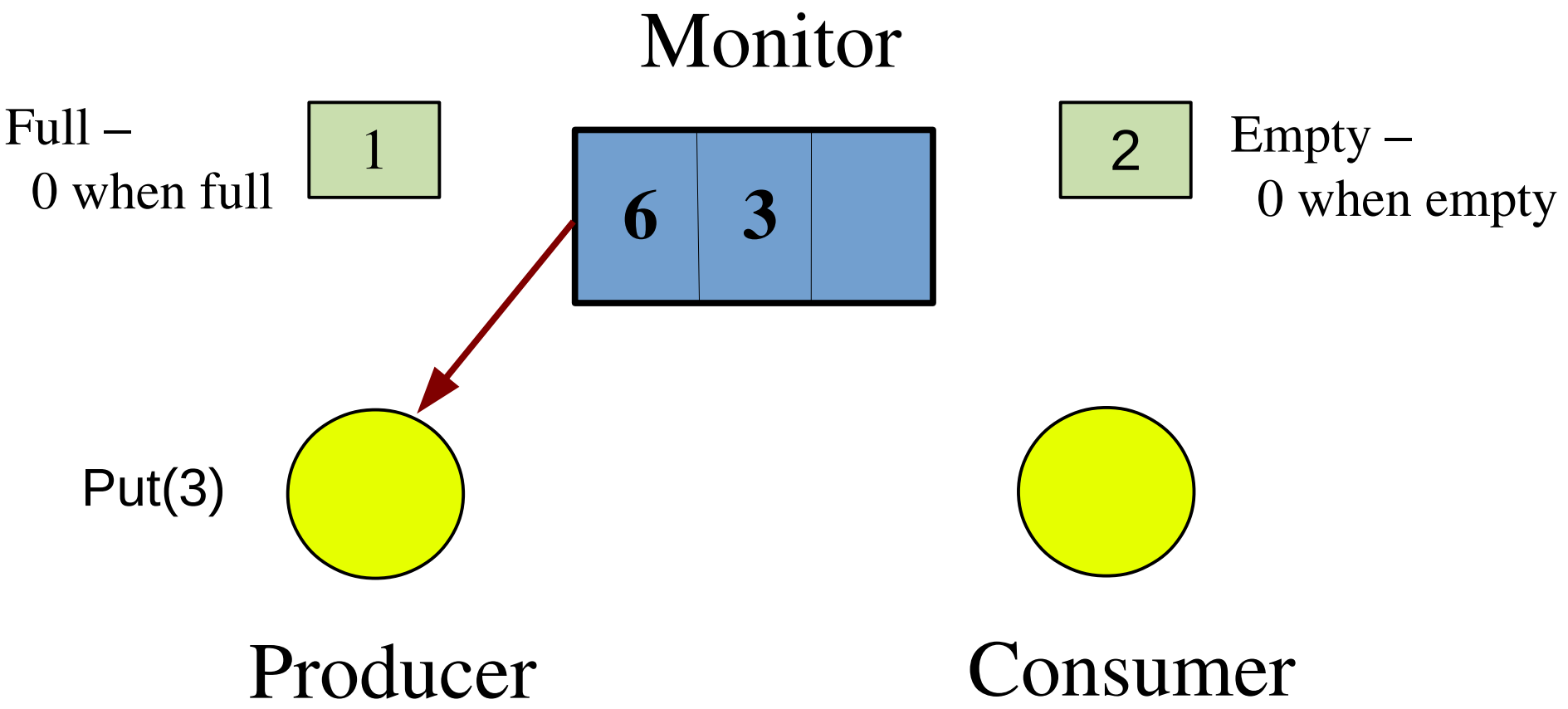
Monitor now has two vacant slots, one slot contains 6
The Full semaphore's count is checked to be > 0
It is! So producer passes through and decrements Full's count



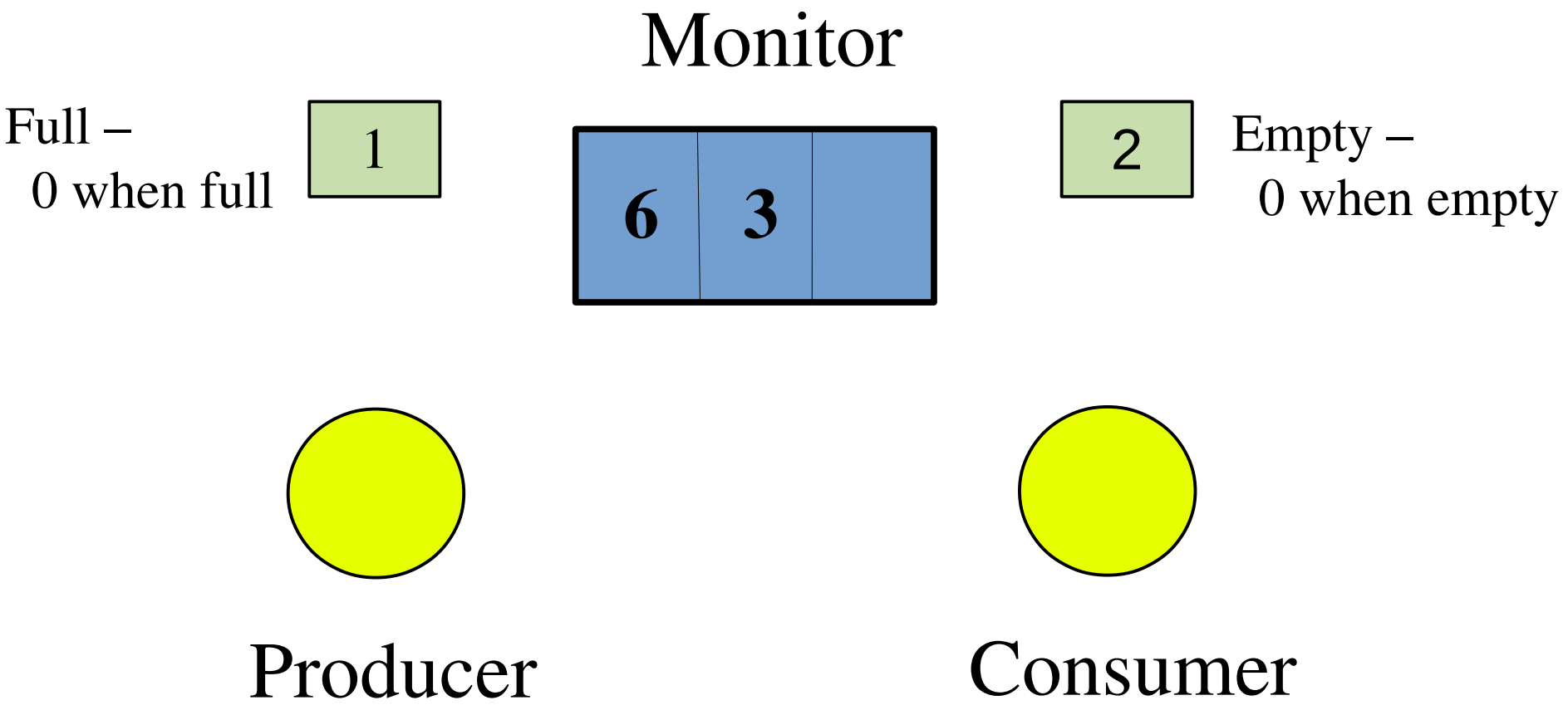
Monitor now has one vacant slot, one slot contains 6, one contains 3
Producer sends 3 to the Monitor's buffer



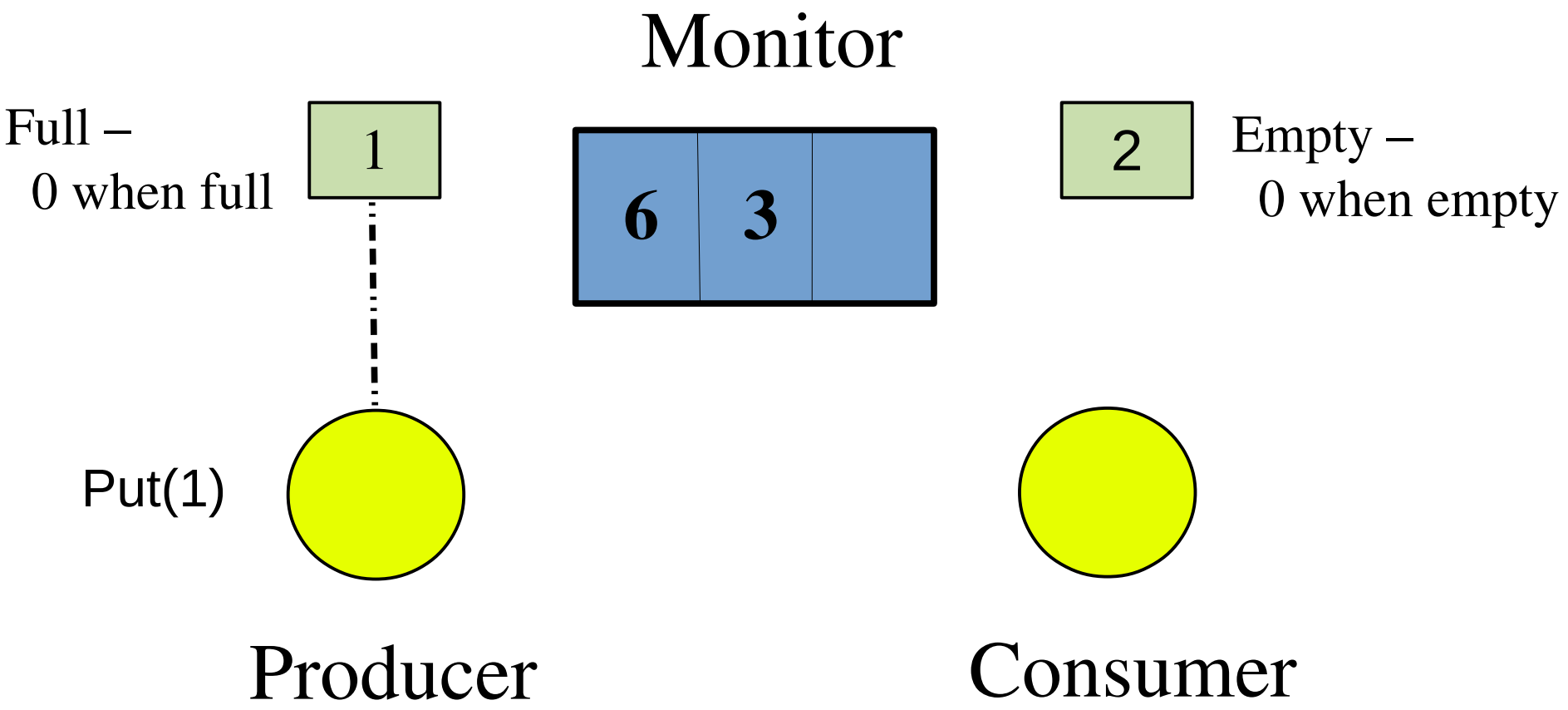
Monitor now has one vacant slot, one slot contains 6, one contains 3
The Empty semaphore's count is incremented by 1



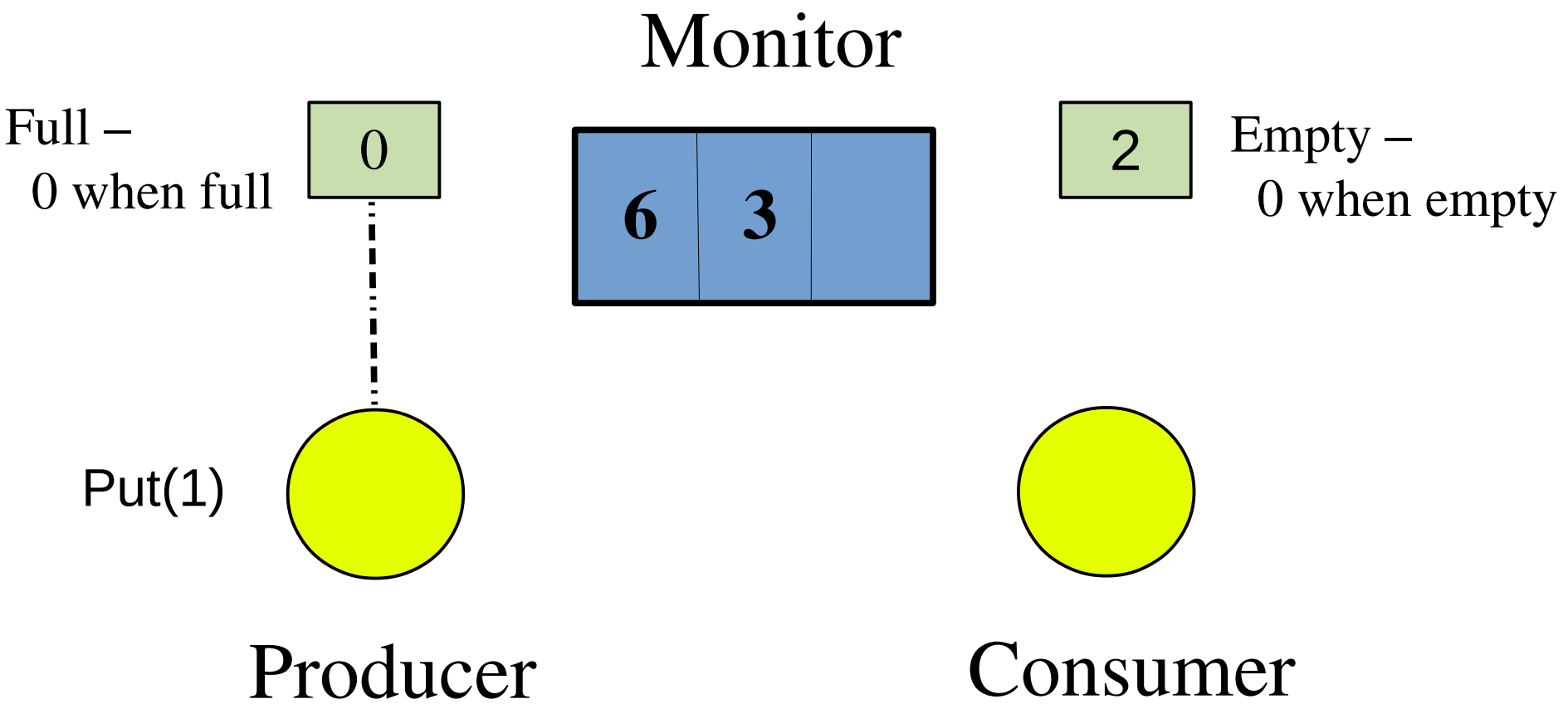
Monitor now has one vacant slot, one slot contains 6, one contains 3
Producer continues processing



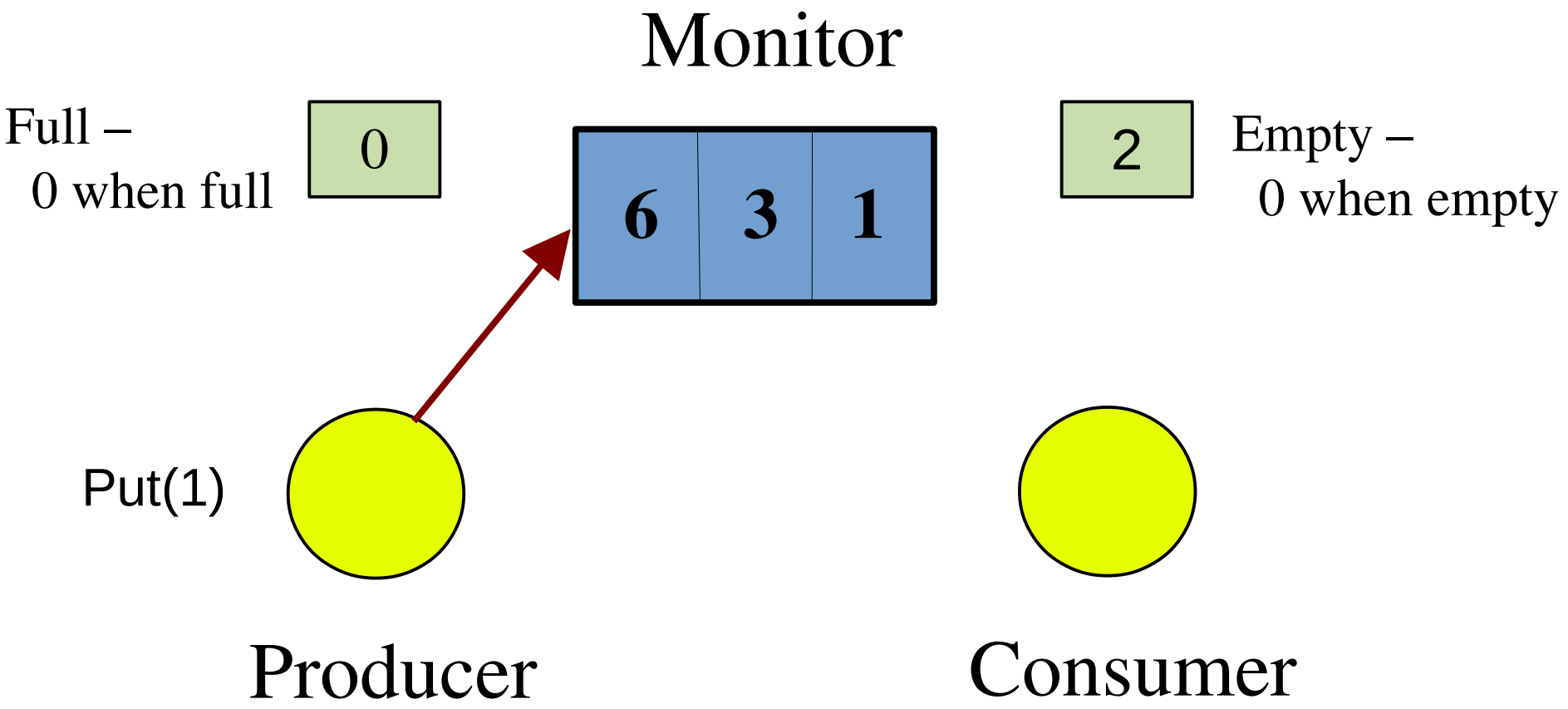
Monitor now has one vacant slot, one slot contains 6, one contains 3
The Full semaphore's count is 1
The Empty semaphore's count is 2



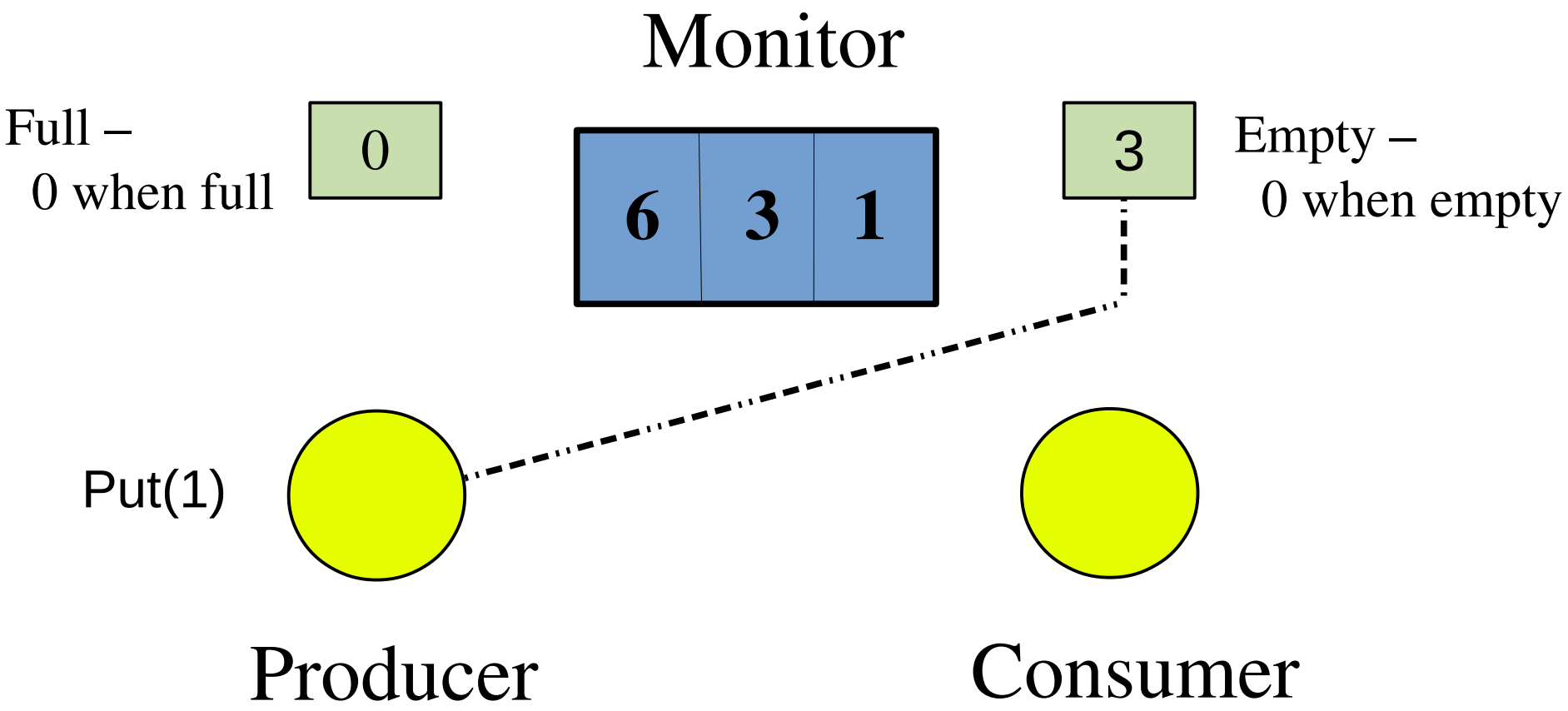
Monitor now has one vacant slot, one slot contains 6, one contains 3
The Full semaphore count is checked to be > 0



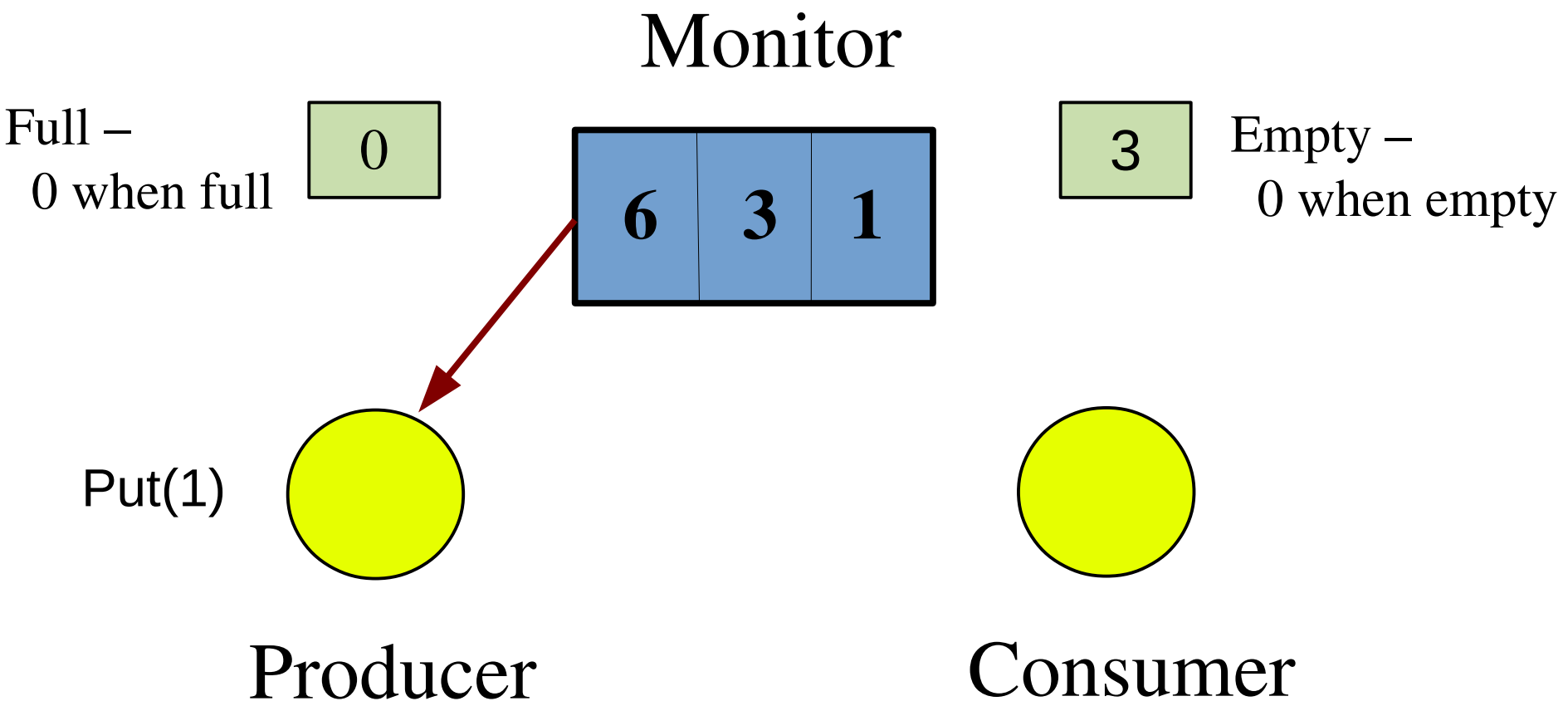
Monitor now has one vacant slot, one slot contains 6, one contains 3
The Full semaphore count is checked to be > 0
It is! So the producer passes through and decrements Full's count



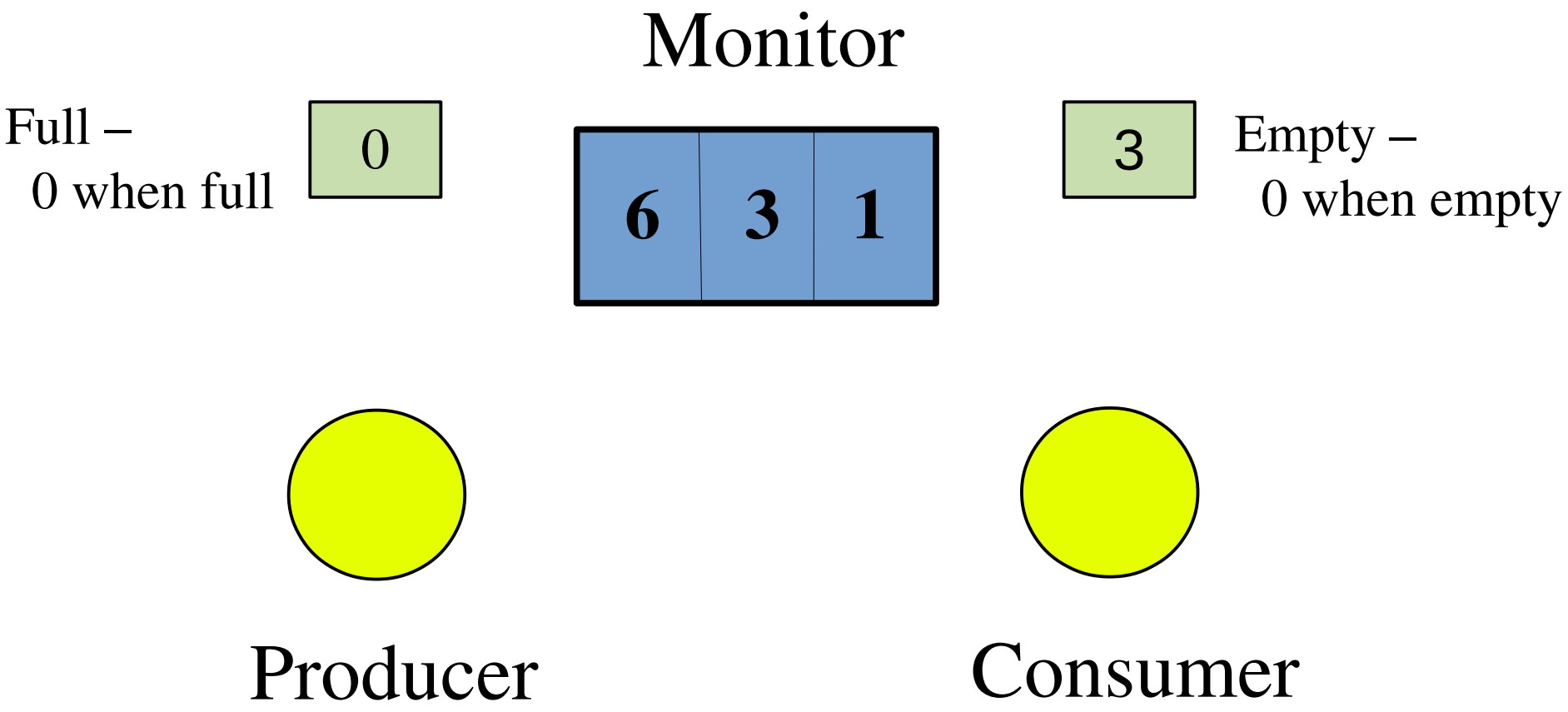
Monitor now has one slot with 6, one slot with 3, one slot with 1
Producer sends 1 to the Monitor's buffer



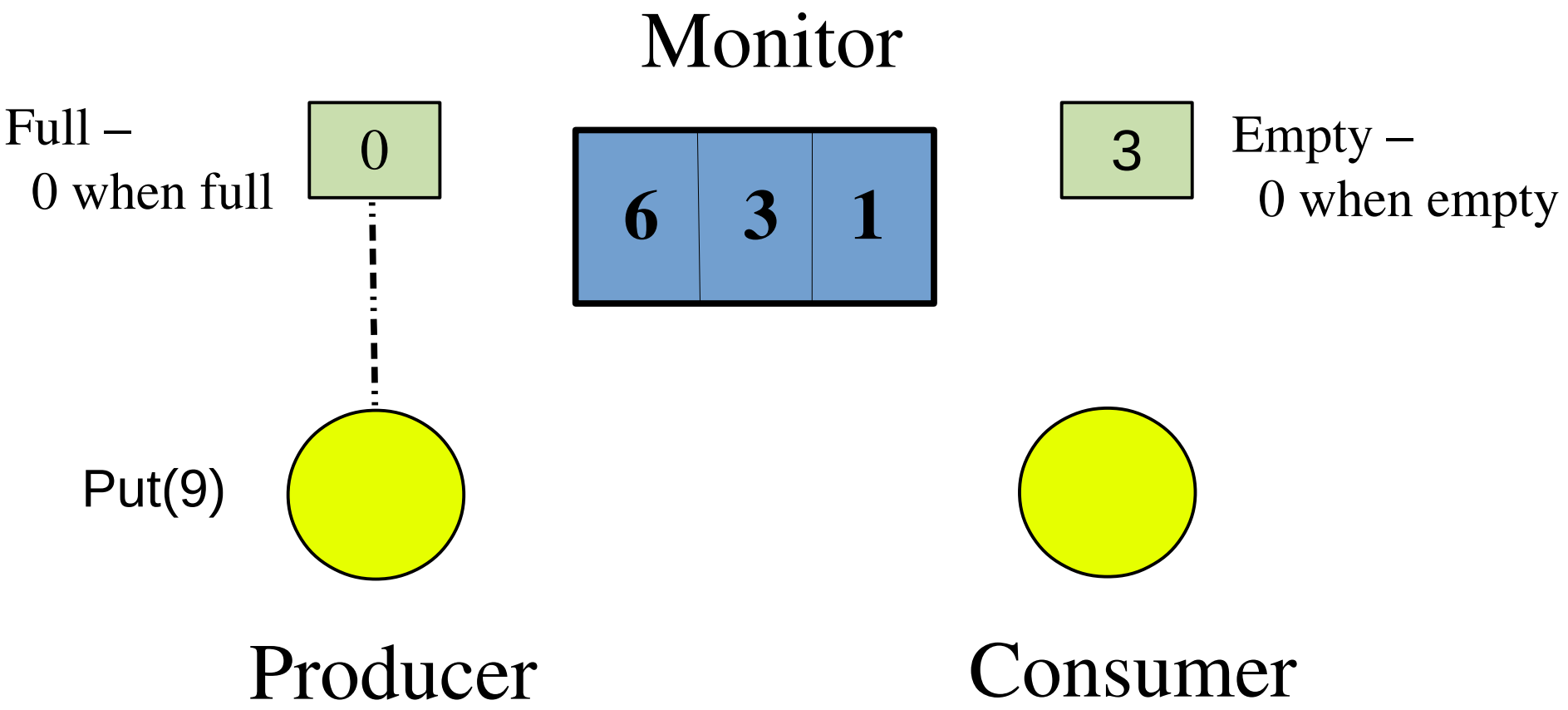
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Empty semaphore's count is incremented



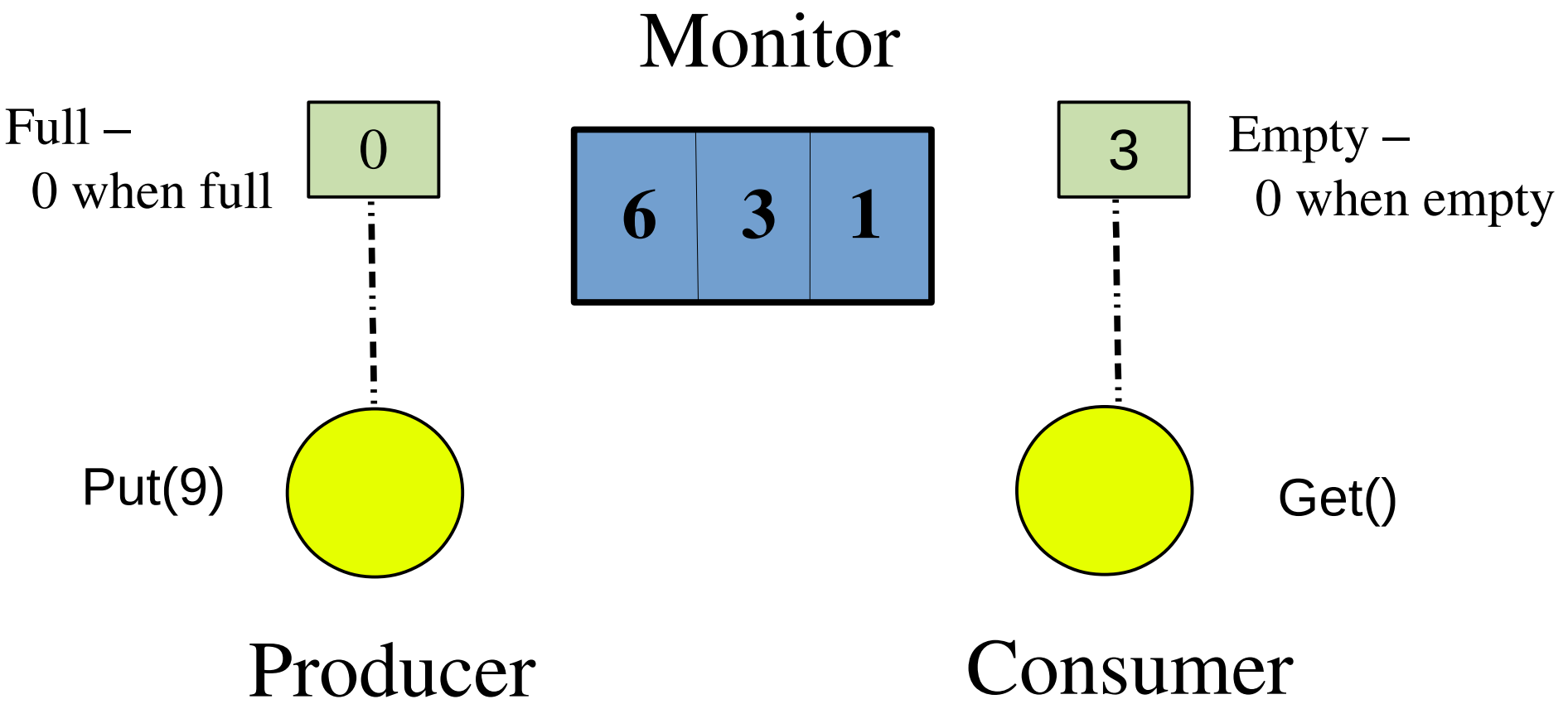
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Empty semaphore's count is incremented
Producer returns from put and continues processing



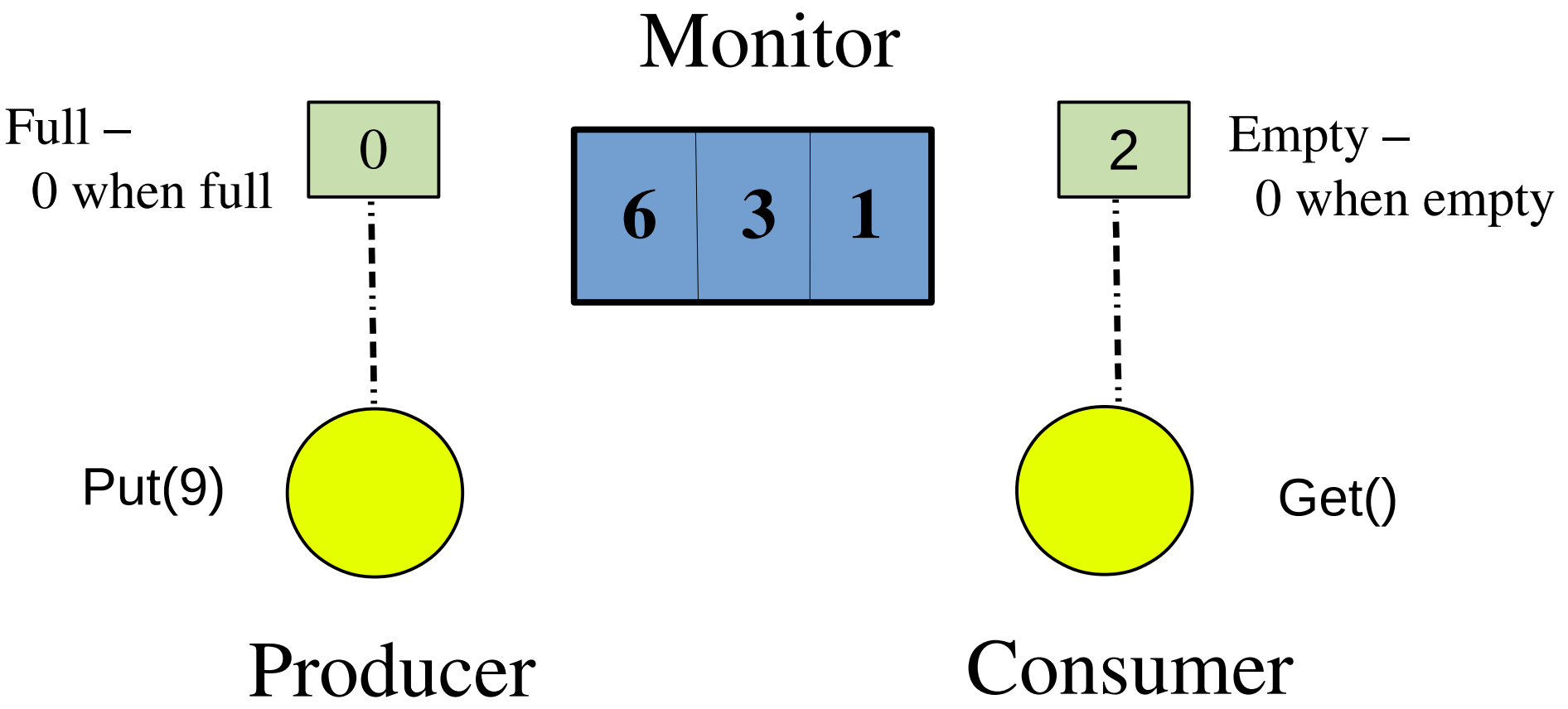
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Full semaphore's count is 0
The Empty semaphore's count is 3



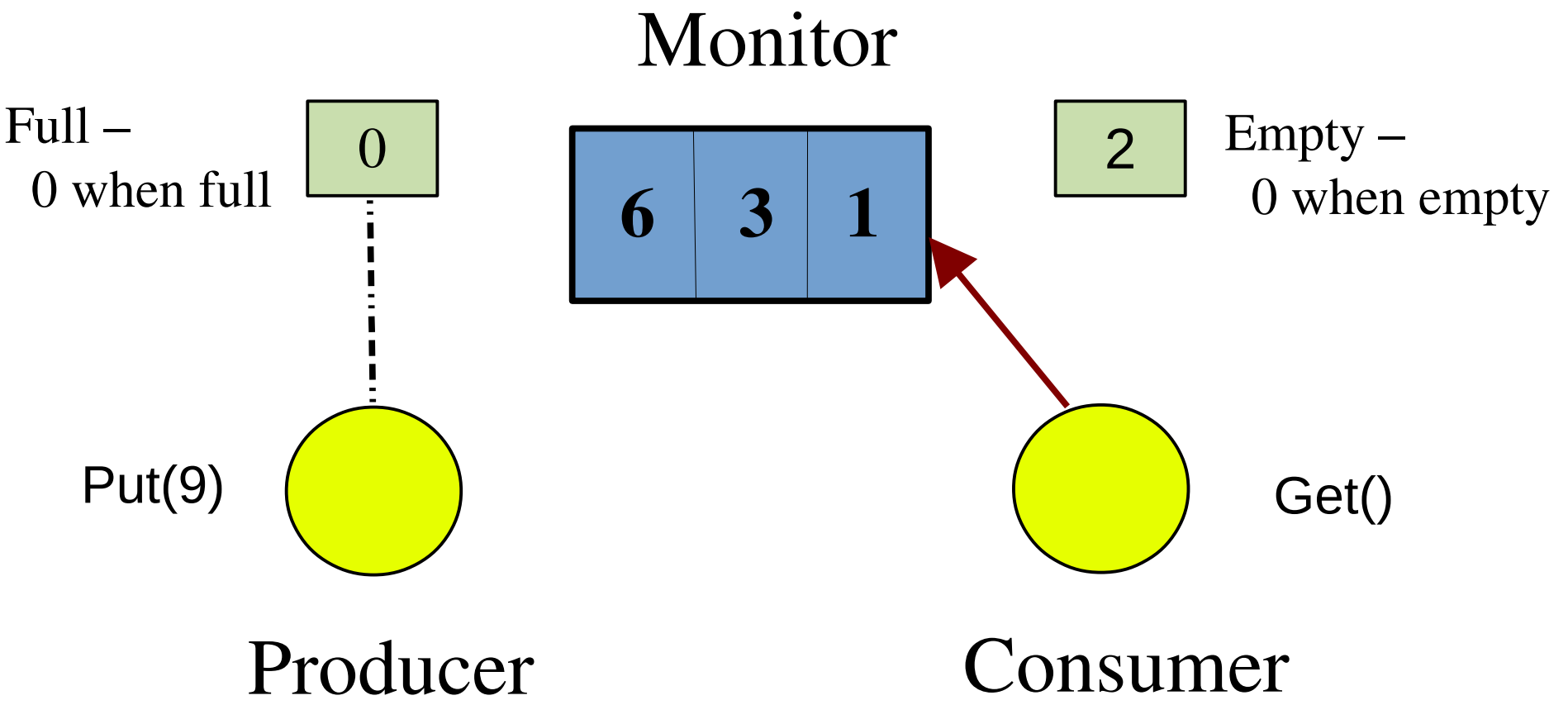
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Full semaphore's count is checked but is 0, producer is blocked!



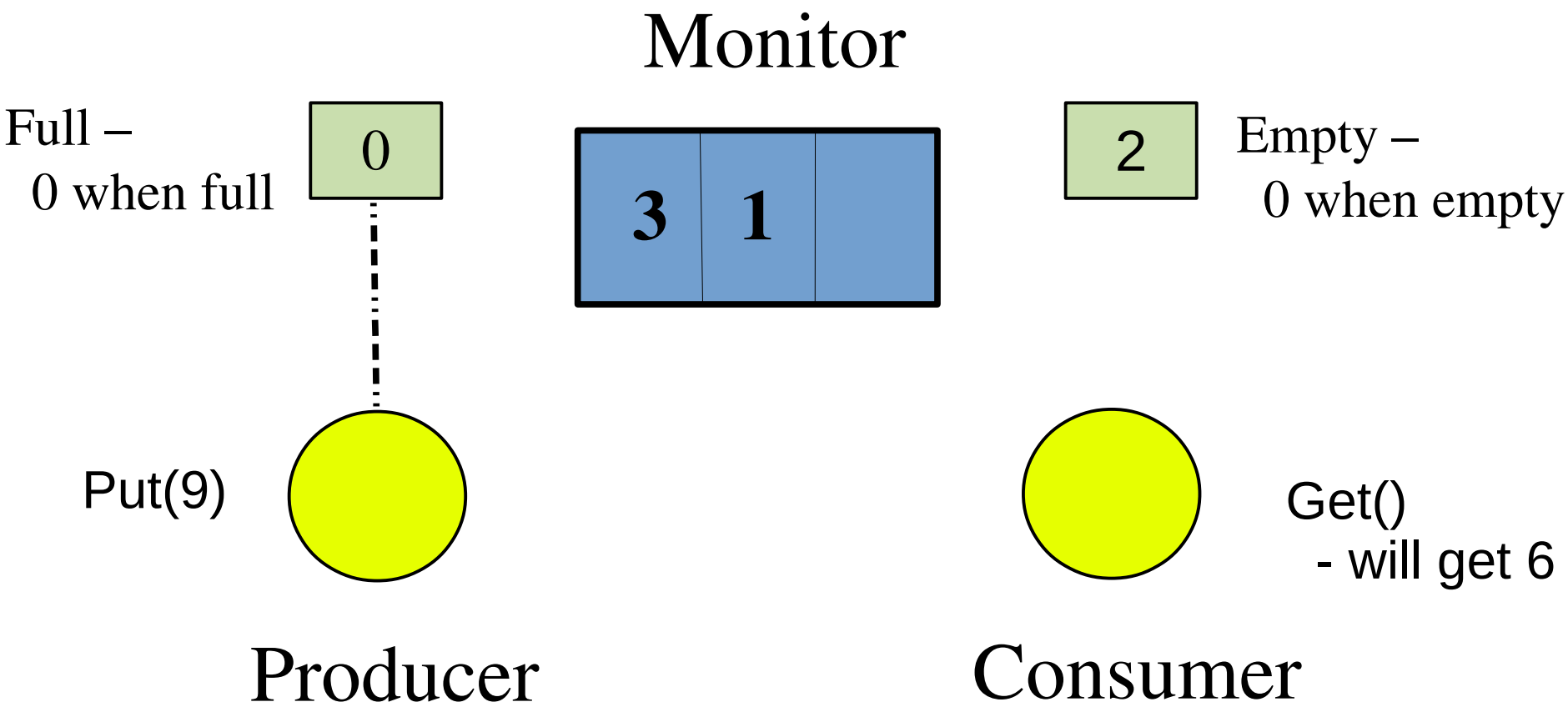
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Full semaphore's count is checked but is 0, producer is blocked!
The Empty semaphore's count is checked to be > 0



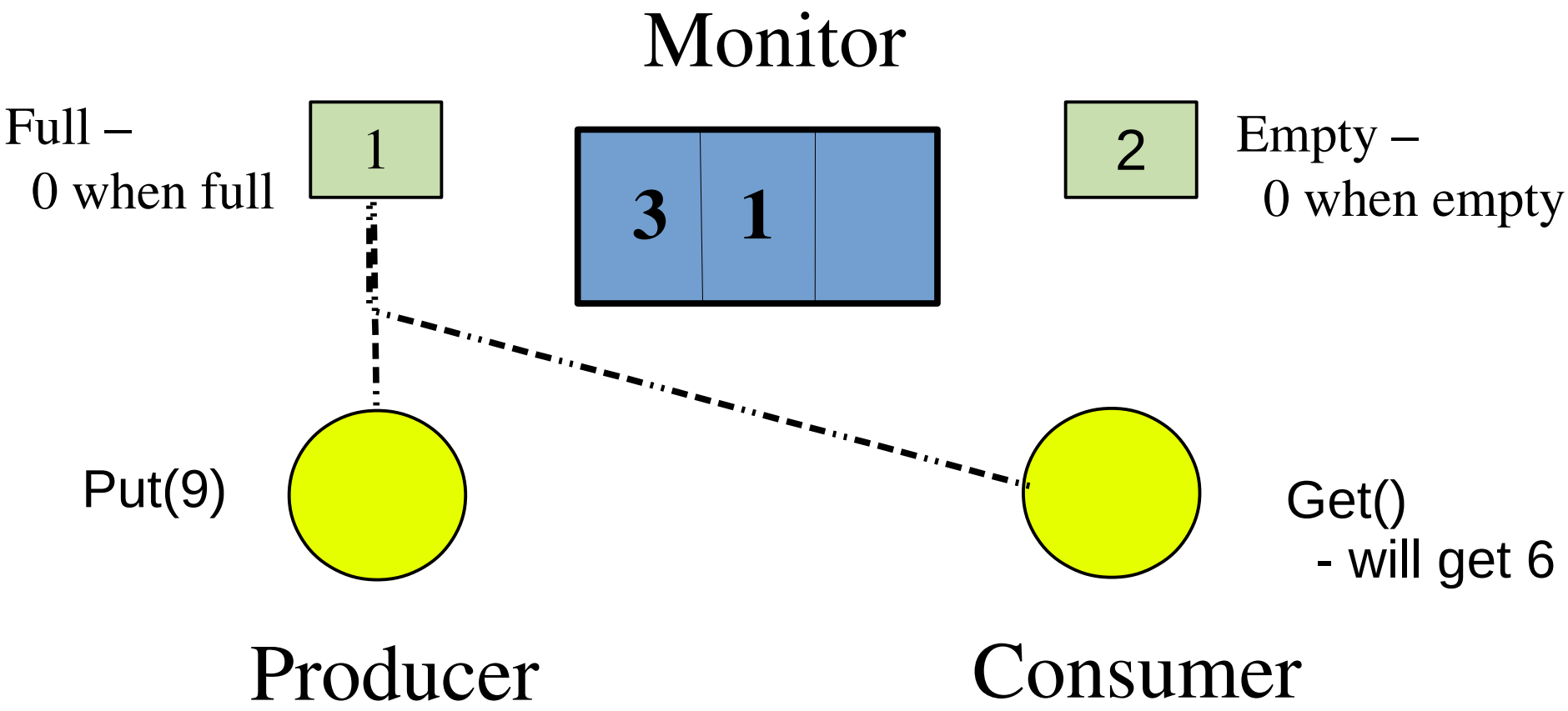
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Full semaphore's count is checked but is 0, producer is blocked!
The Empty semaphore's count is checked to be > 0
It is! So consumer passes through and decrements Empty's count



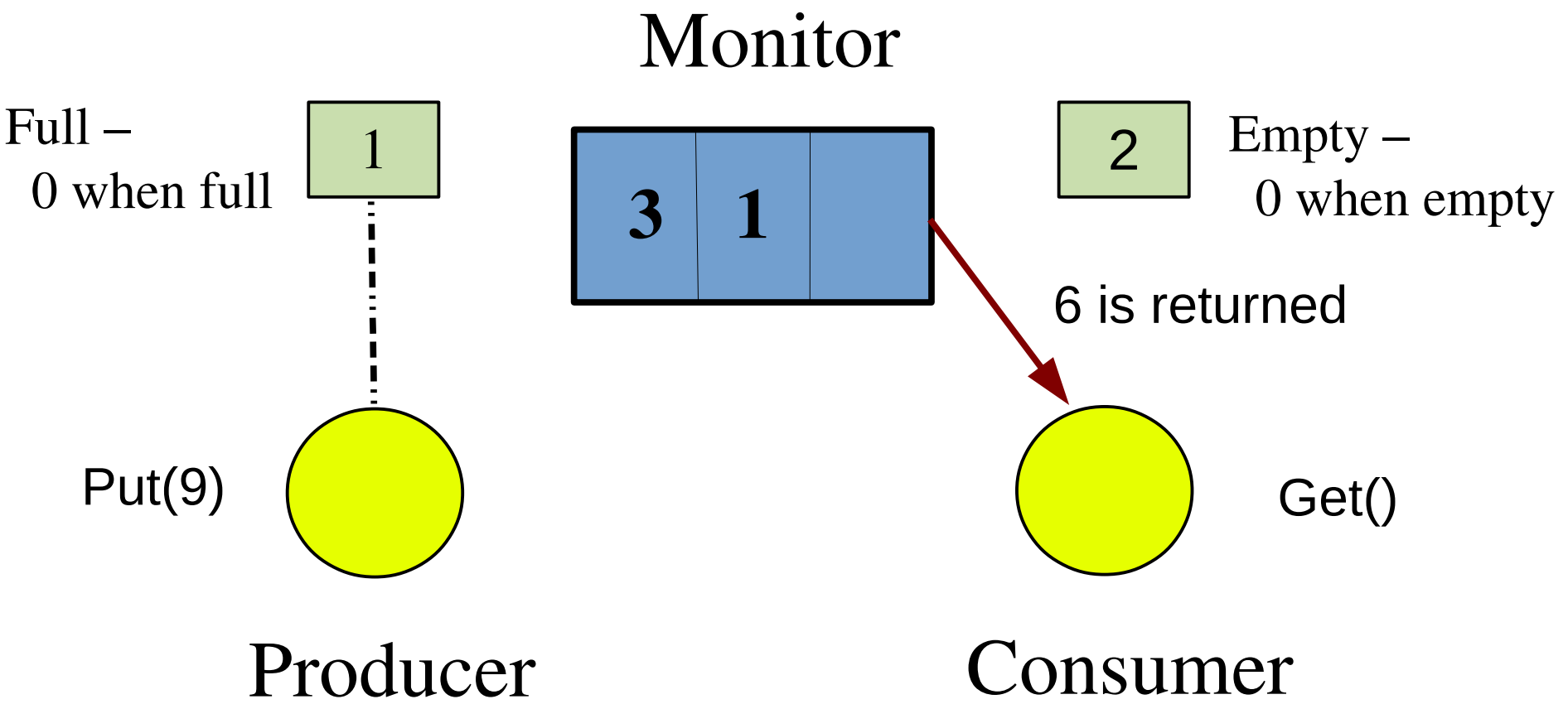
Monitor now has one slot with 6, one slot with 3, one slot with 1
The Full semaphore's count is checked but is 0, producer is blocked!
Consumer requests a token from the Monitor



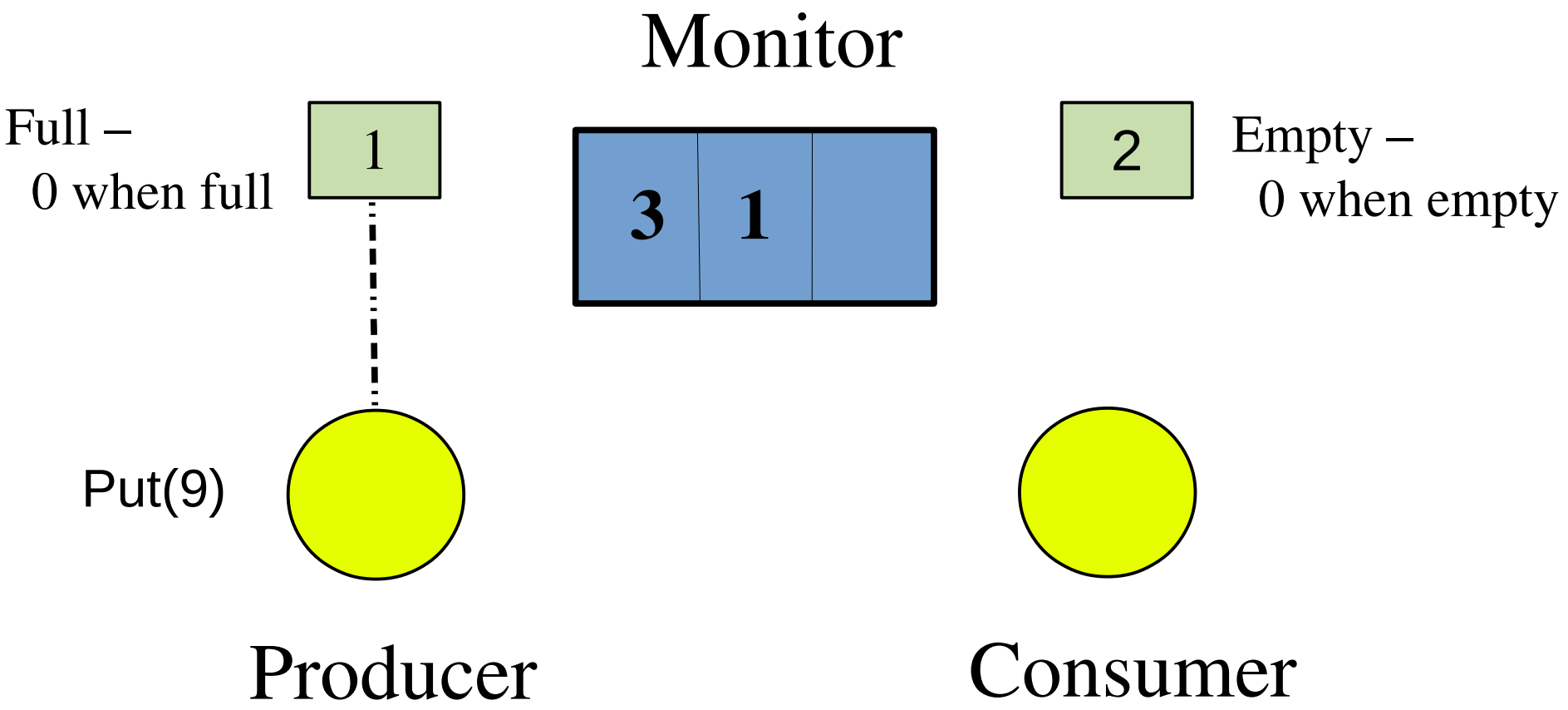
Monitor now has one vacant slot, one slot with 3, one slot with 1
Monitor removes 6 from buffer, holds onto it



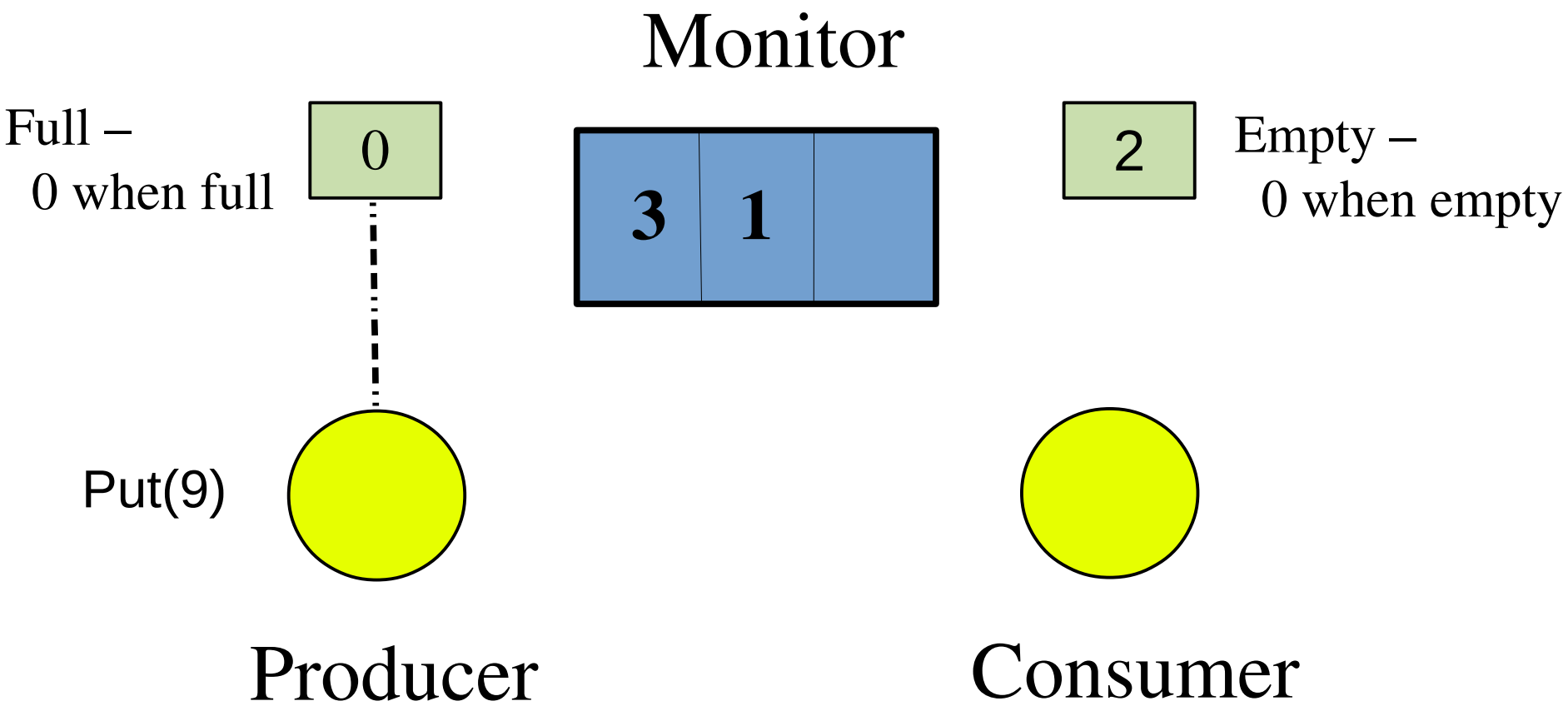
Monitor now has one vacant slot, one slot with 3, one slot with 1
Monitor removes 6 from buffer, holds onto it
The Full semaphore's count is incremented



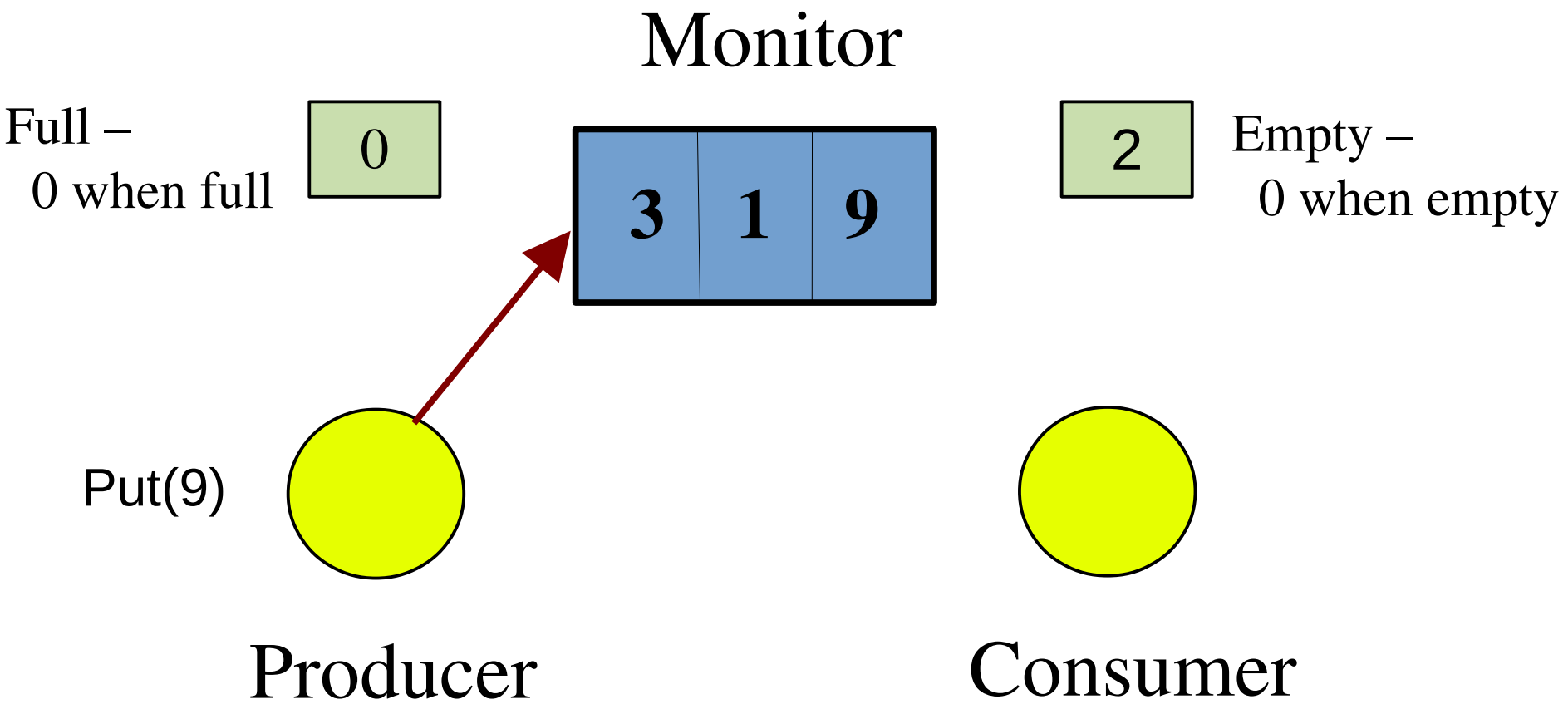
Monitor now has one vacant slot, one slot with 3, one slot with 1
Monitor sends 6 to the consumer, consumer continues processing



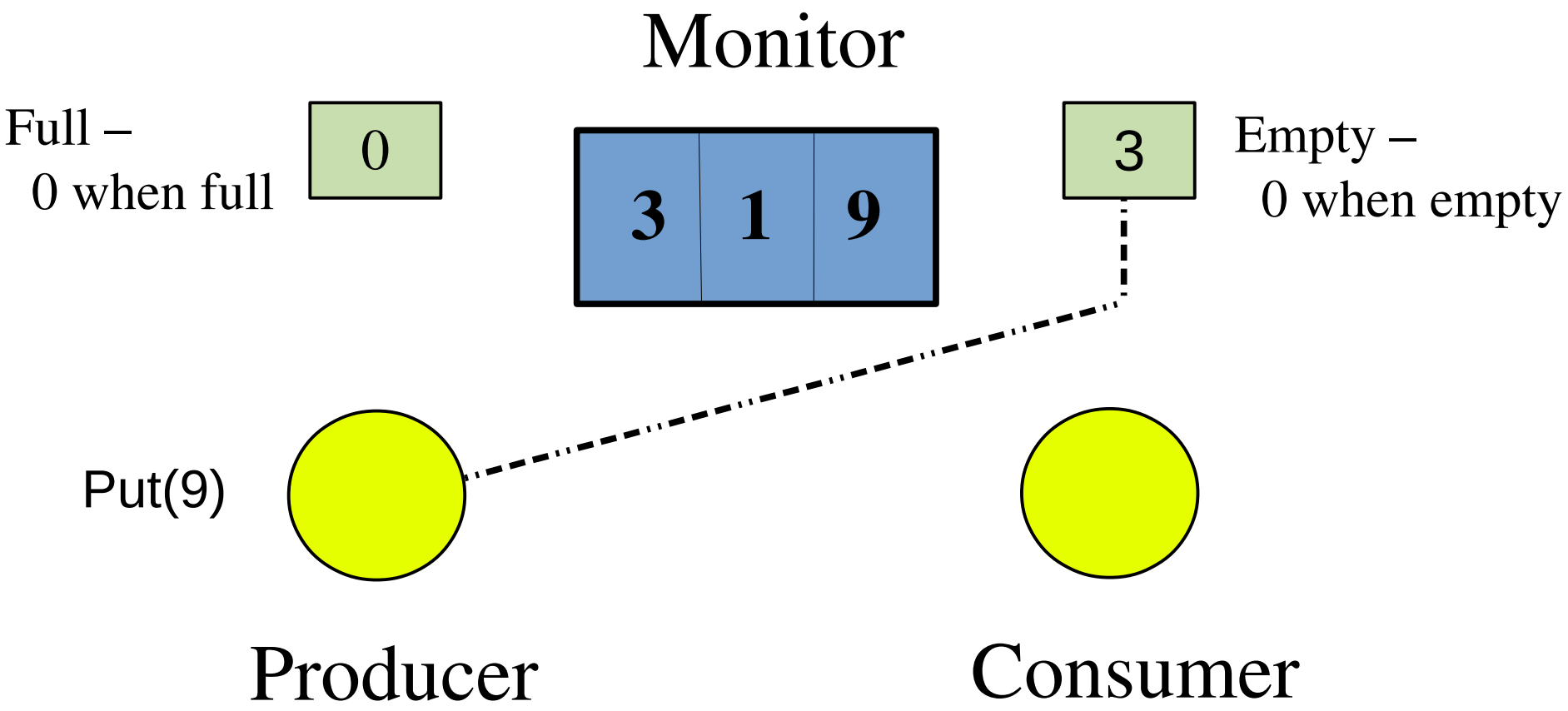
Monitor now has one vacant slot, one slot with 3, one slot with 1
Producer is no longer blocked, continues



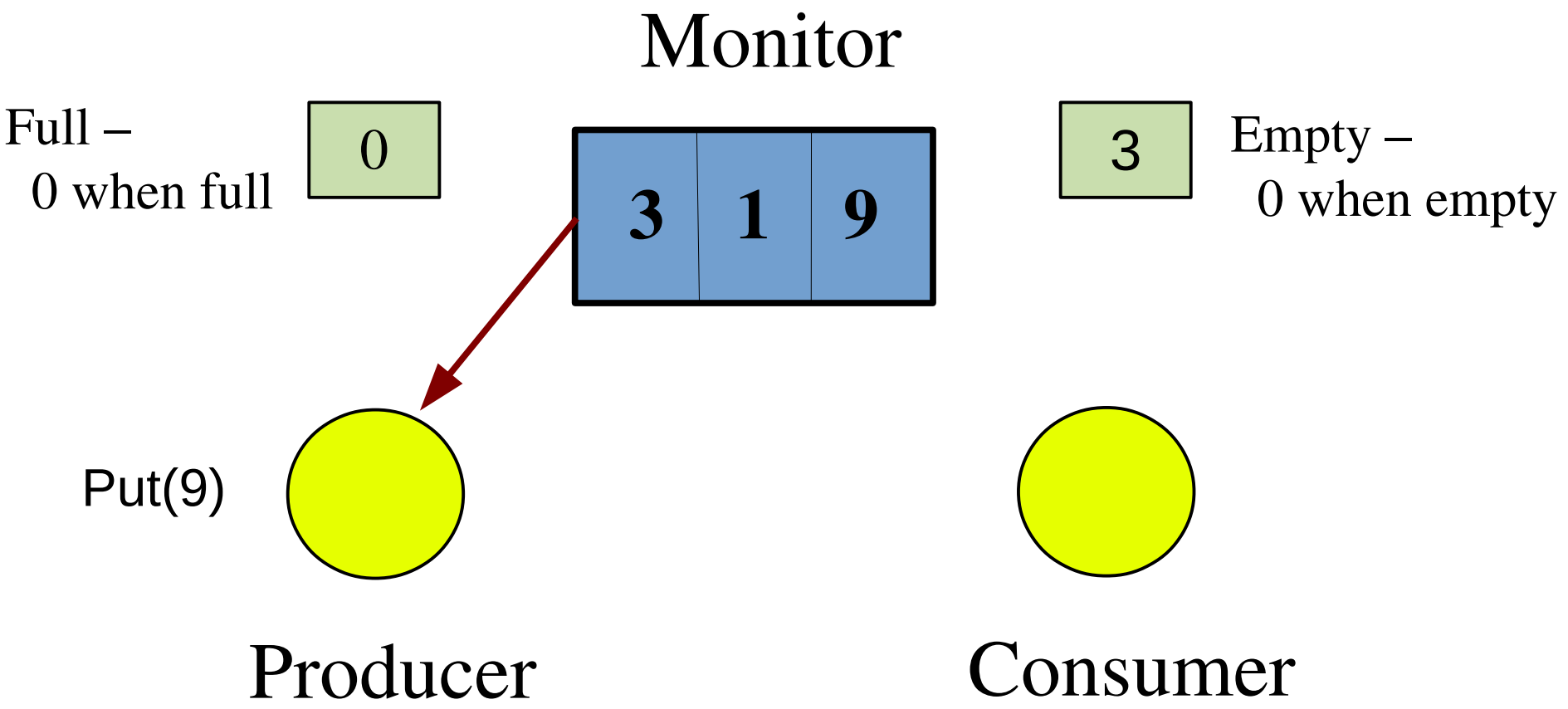
Monitor now has one vacant slot, one slot with 3, one slot with 1
Producer is no longer blocked, continues
The Full semaphore's count is decremented



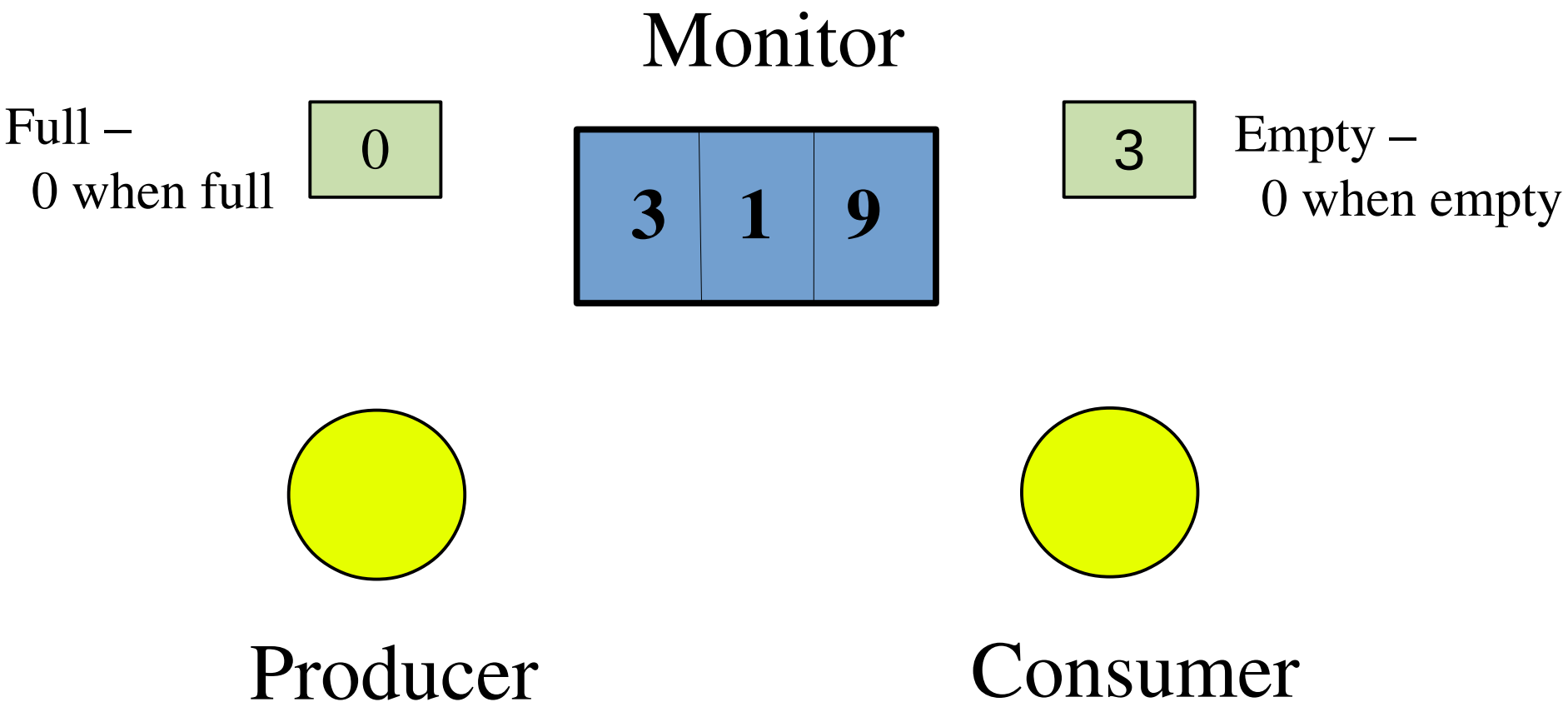
Monitor now has one slot with 3, one slot with 1, one slot with 9
Producer sends 9 to the Monitor's buffer



Monitor now has one slot with 3, one slot with 1, one slot with 9
The Empty semaphore's count is incremented



Monitor now has one slot with 3, one slot with 1, one slot with 9
Producer continues processing



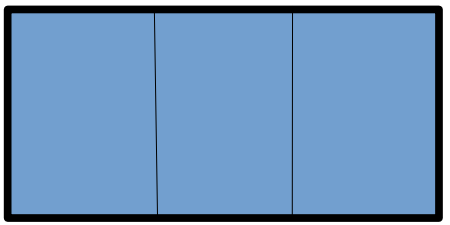
Monitor now has one slot with 3, one slot with 1, one slot with 9
The Full semaphore's count is 0
The Empty semaphore's count is 3

Consumer gets three tokens from Monitor

Monitor

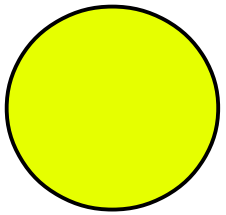
Full –
0 when full

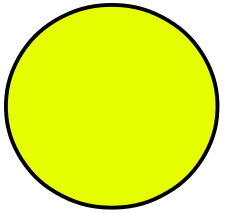
3



0

Empty –
0 when empty

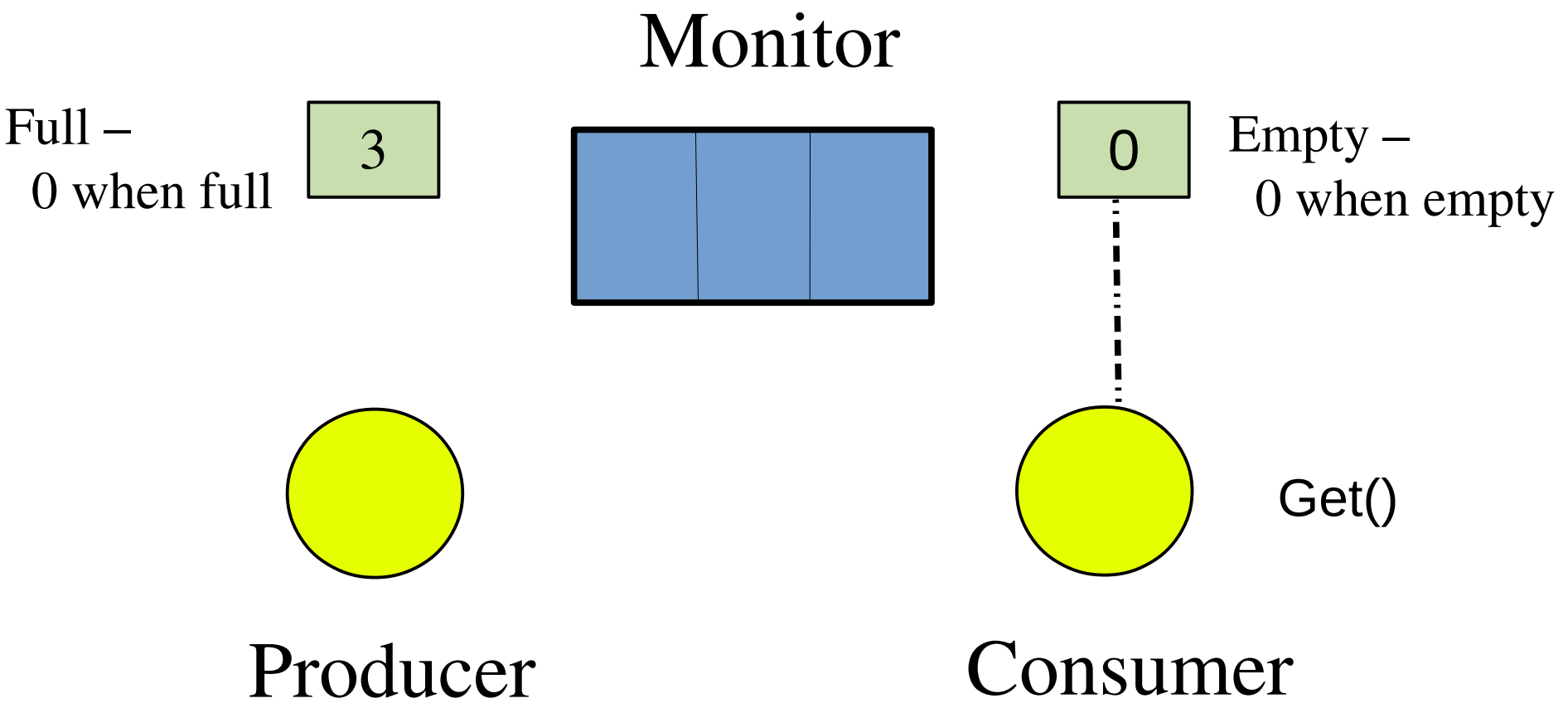




Producer

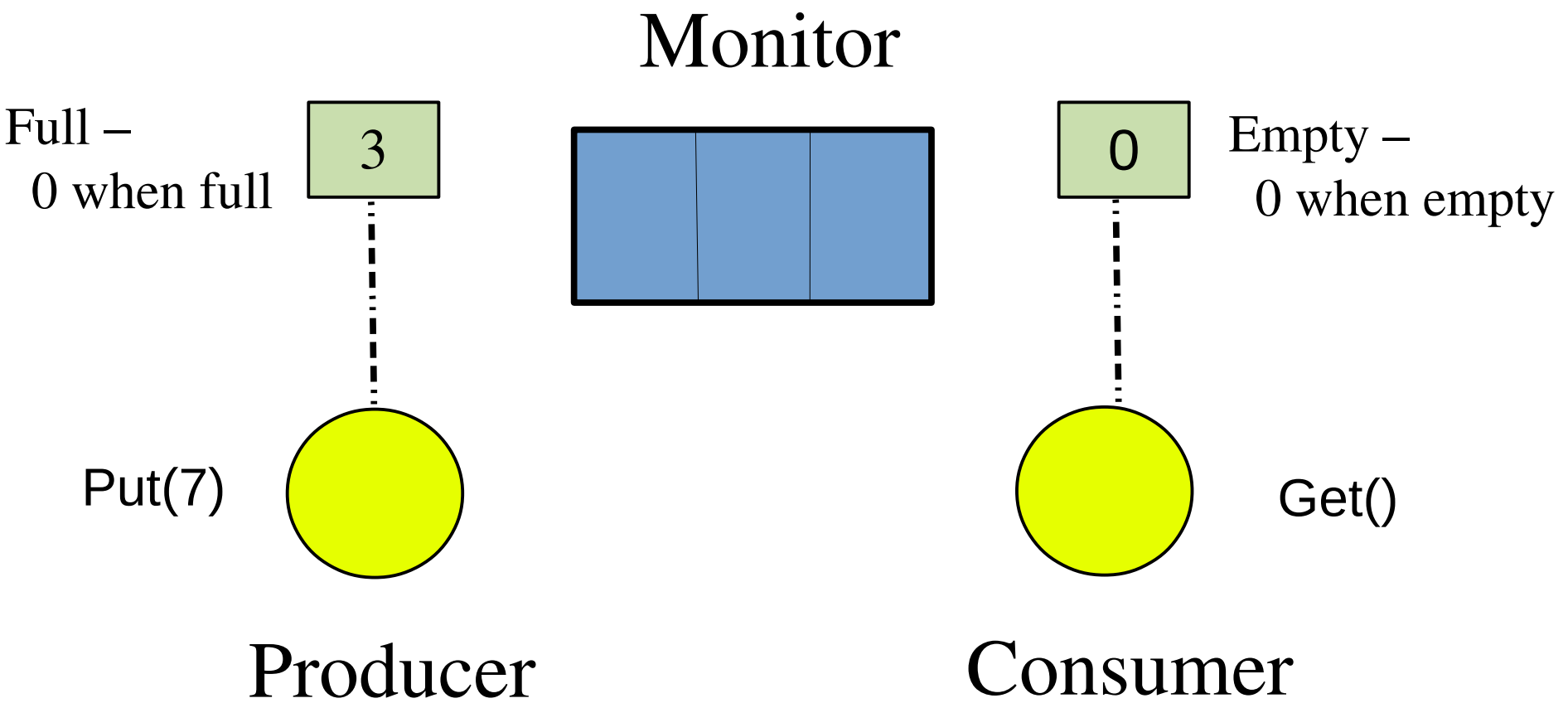
Consumer

Monitor buffer is empty



Monitor buffer is empty

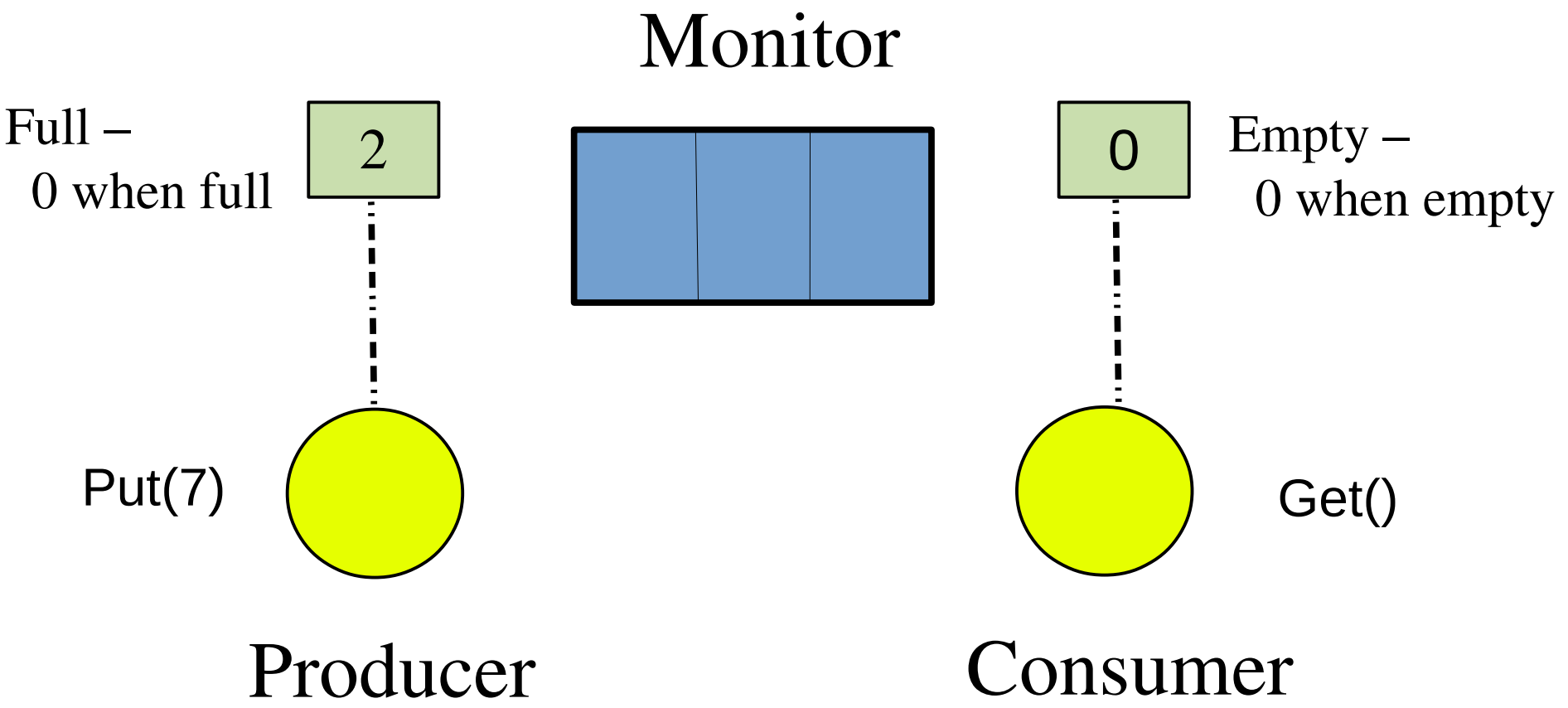
The Empty semaphore's count is checked but is 0, consumer blocked!



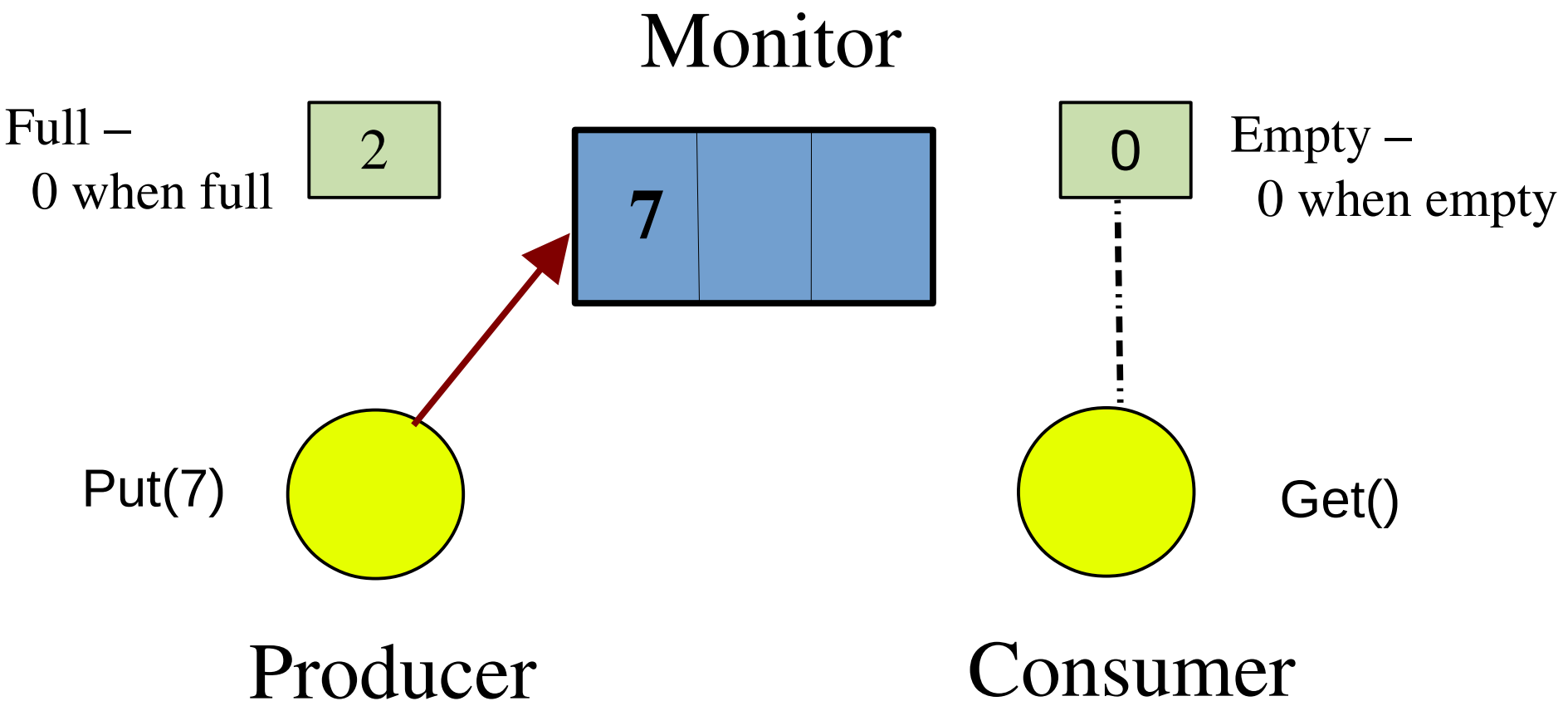
Monitor buffer is empty

The Empty semaphore's count is checked but is 0, consumer blocked!

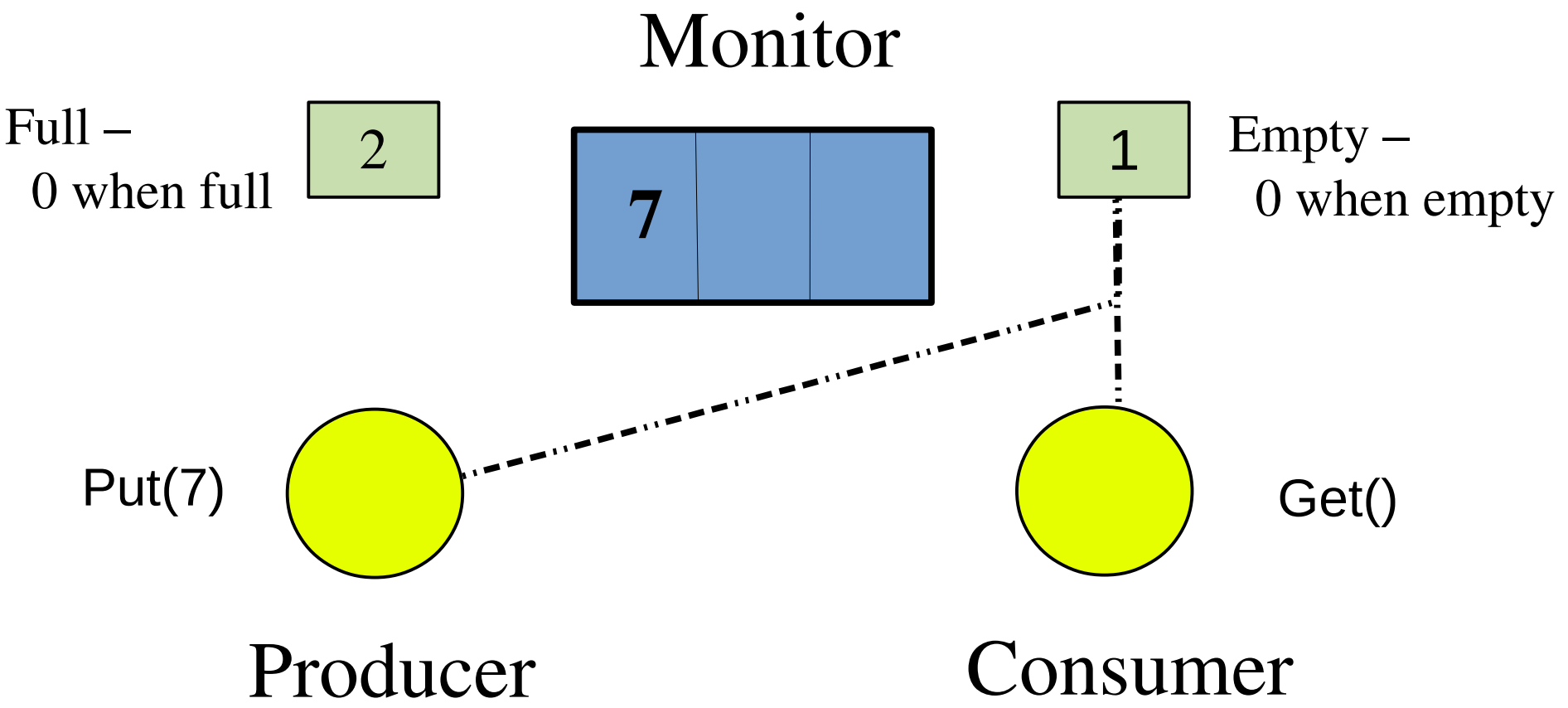
The Full semaphore's count is checked to be > 0



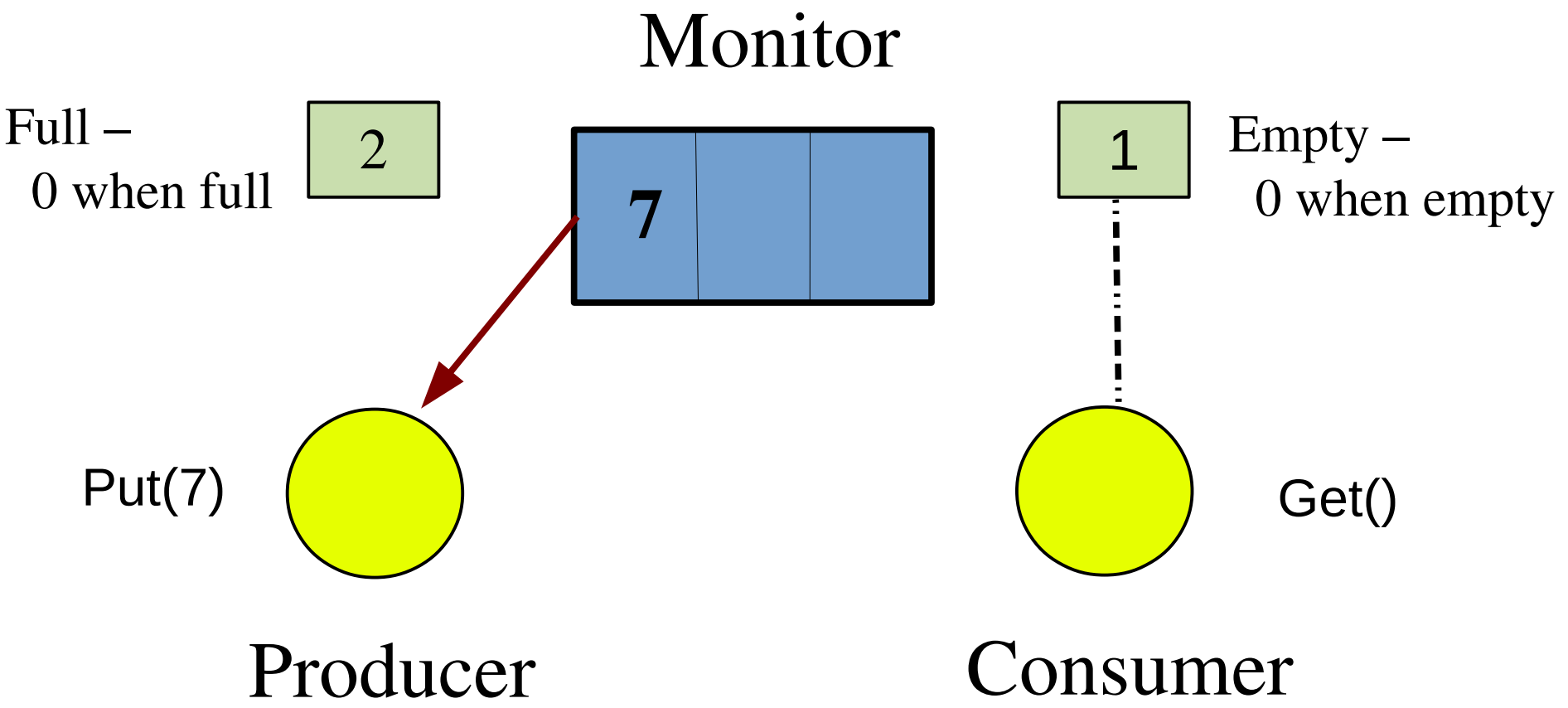
Monitor buffer is empty
The Empty semaphore's count is checked but is 0, consumer blocked!
The Full semaphore's count is checked to be > 0
It is! So producer passes through and decrements Full's count



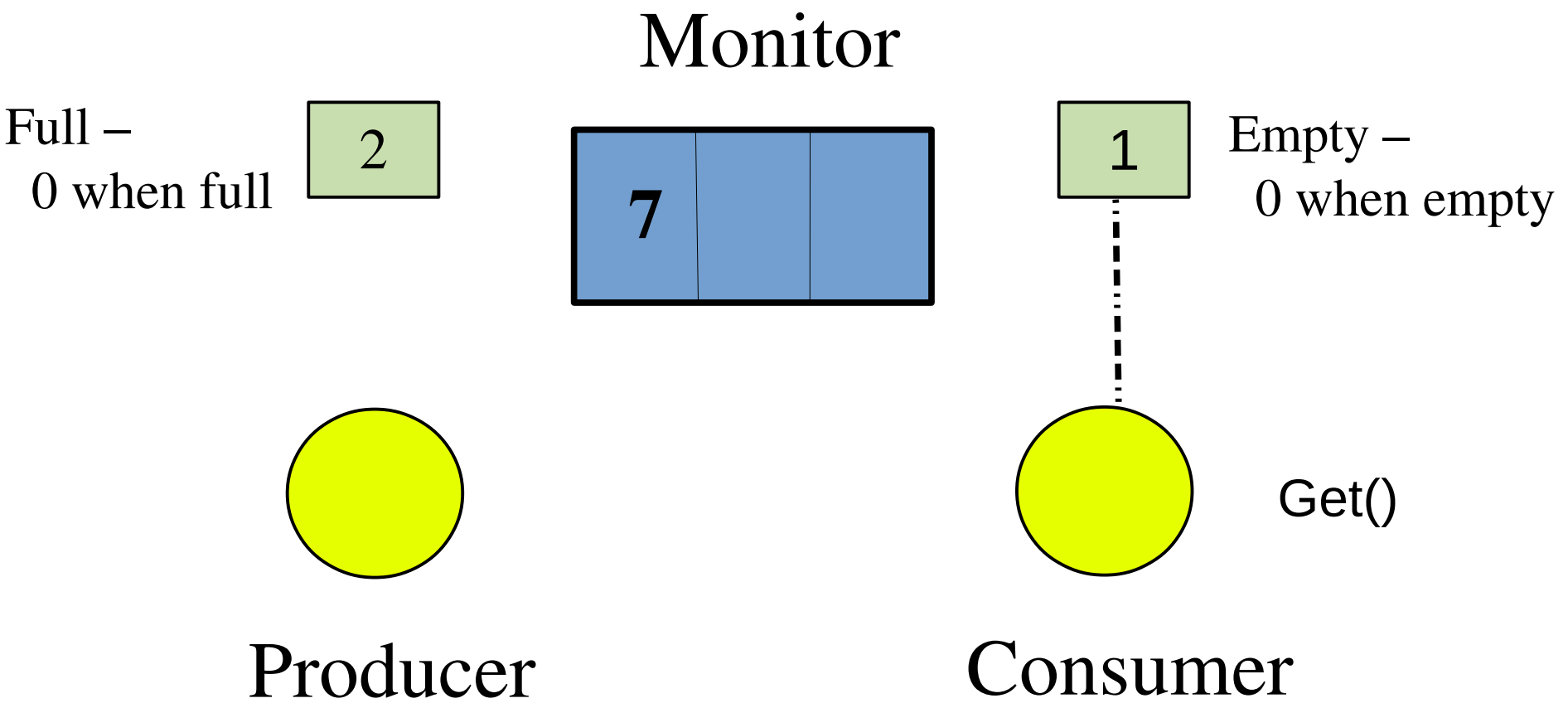
Monitor now has two vacant slots and one slot with 7
Empty semaphore's count is checked but is 0, consumer is blocked
Producer sends 7 to the Monitor's buffer



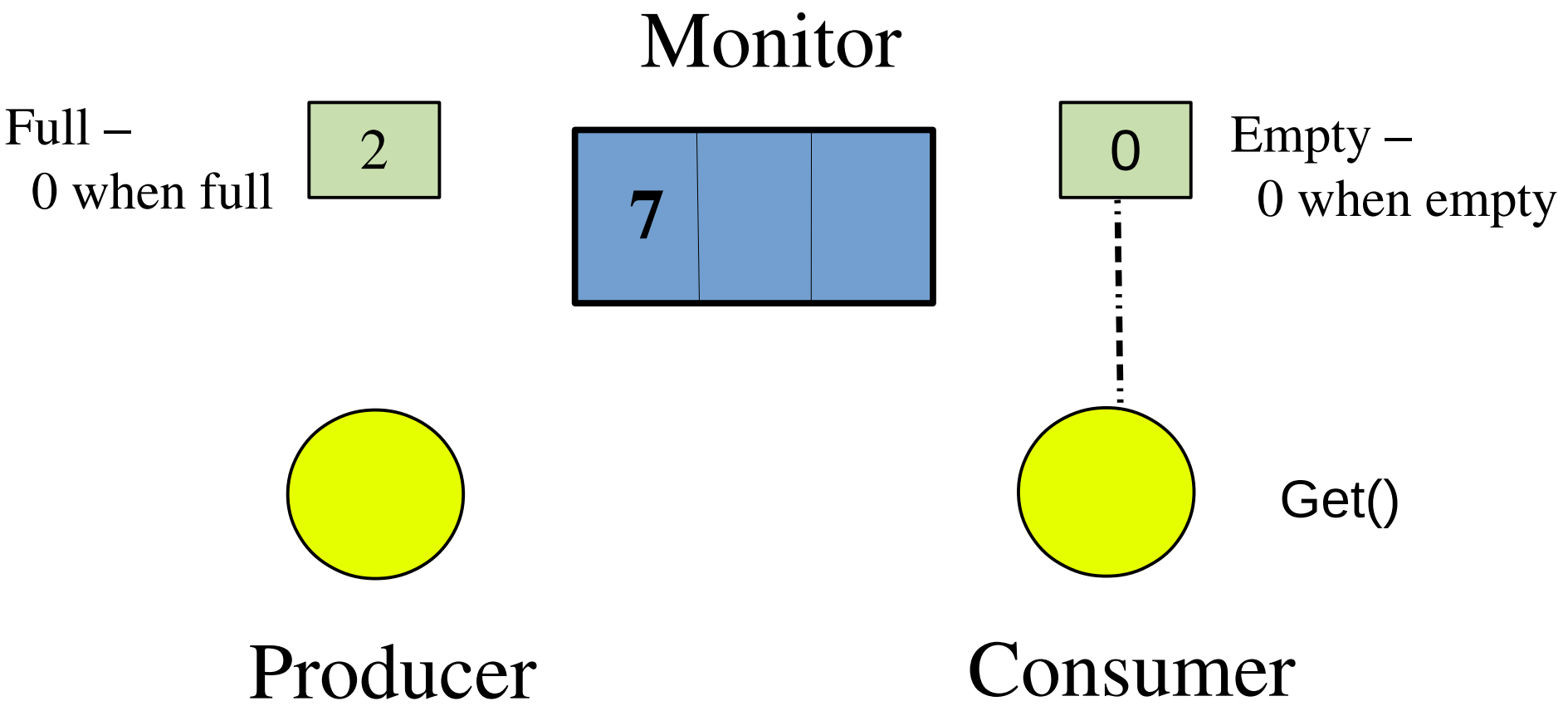
Monitor now has two vacant slots, one slot with 7
The Empty semaphore's count is incremented



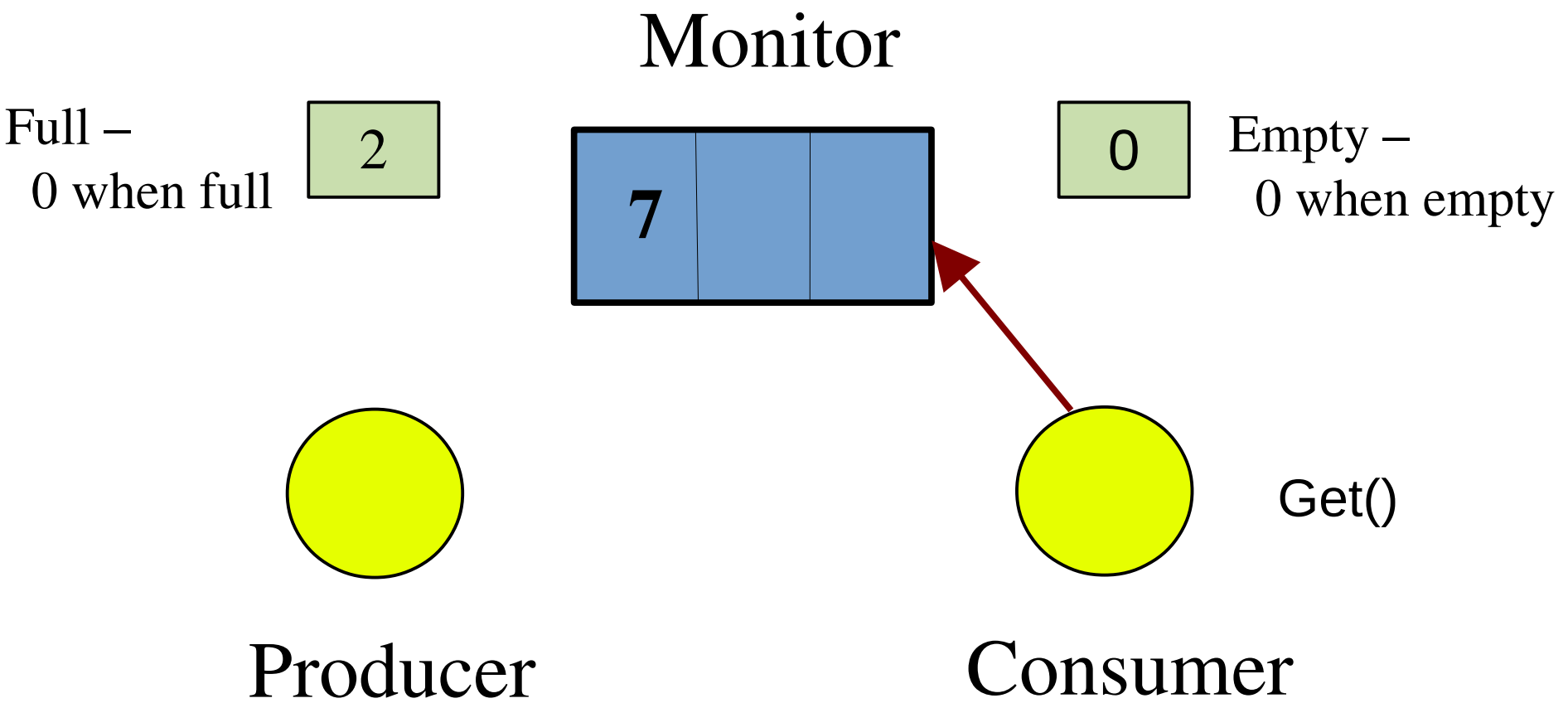
Monitor now has two vacant slots, one slot with 7
Producer returns from put



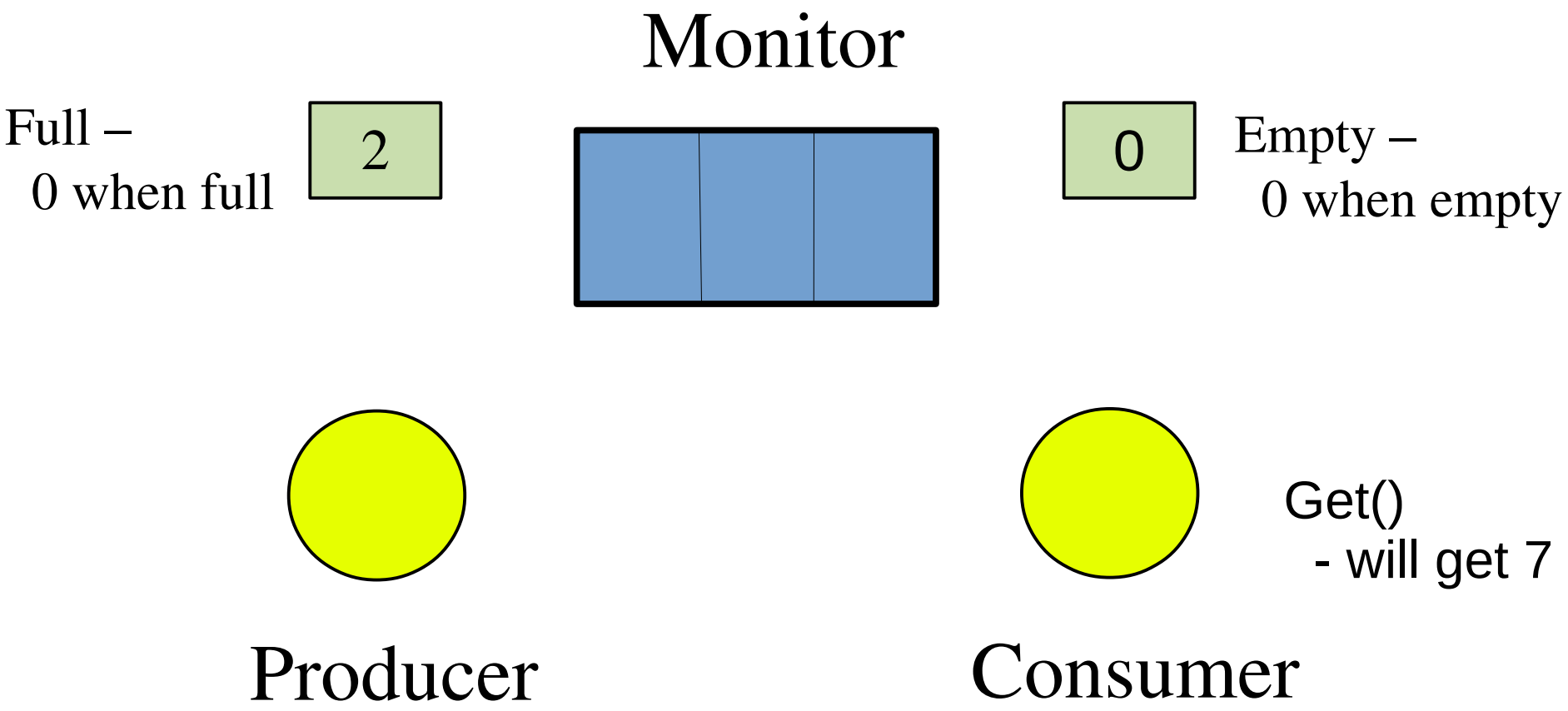
Monitor now has two vacant slots, one slot with 7



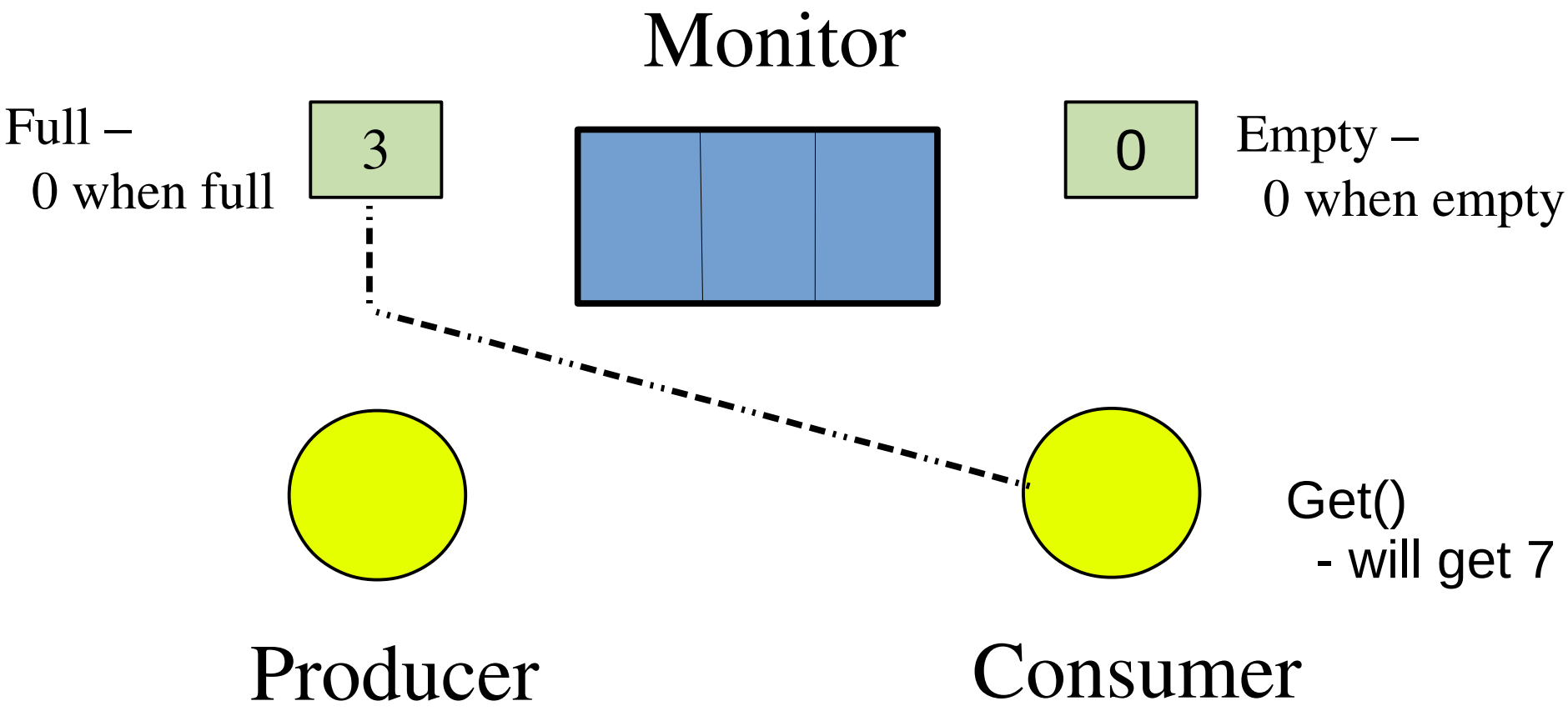
Monitor now has two vacant slots, one slot with 7
Consumer awakens, decrements the Empty semaphore's count



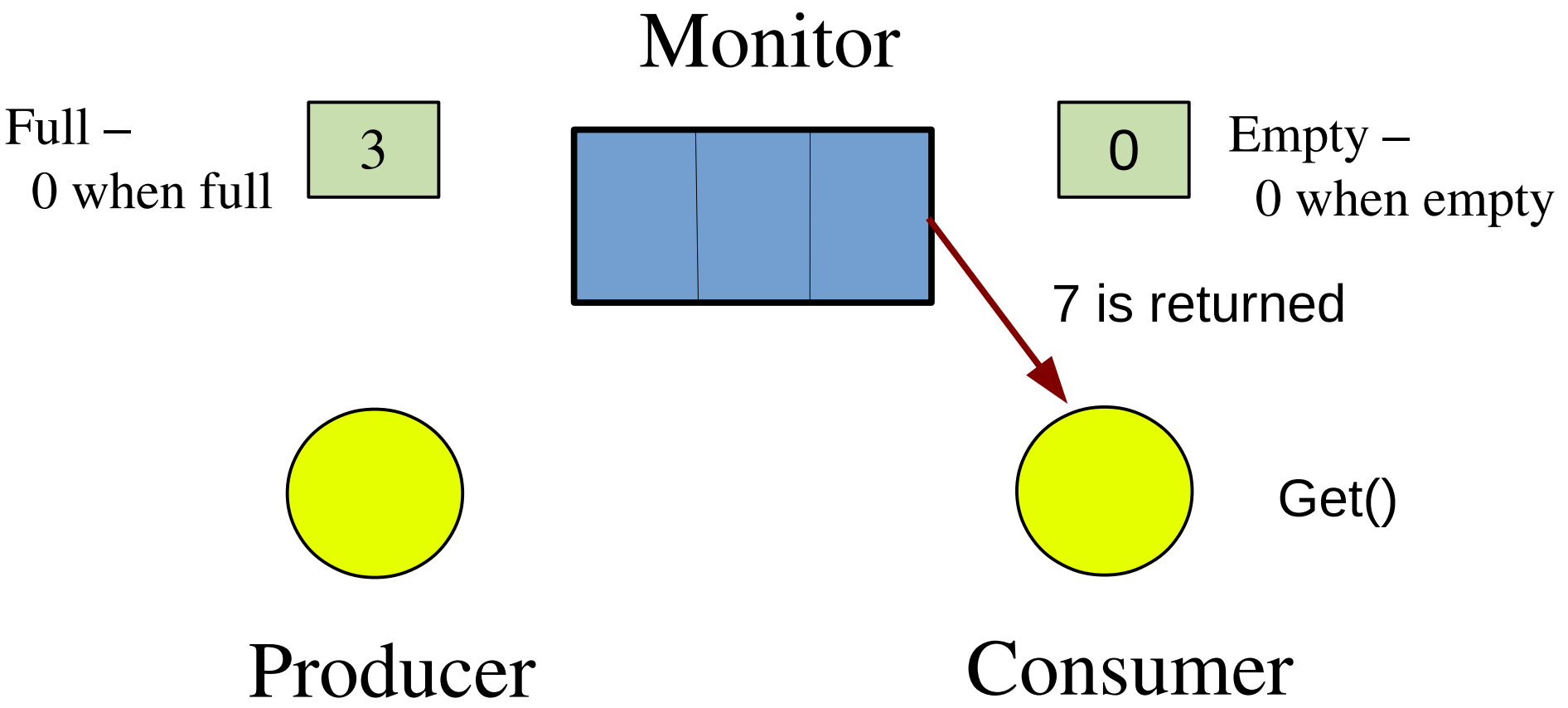
Monitor now has one position with 7
Consumer requests a token from the Monitor



Monitor is empty
Monitor removes 7 from buffer, holds onto it



Monitor is empty
Monitor removes 7 from buffer, holds onto it
The Full semaphore's count is incremented



Monitor is empty
Monitor sends 7 to the consumer