Producer/Consumer Problem

• One or more producers are generating data and placing these in a buffer
• A single consumer is taking items out of the buffer one at time
• Only one producer or consumer may access the buffer at any one time
Producer

```java
producer:
while (true) {
    /* produce item v */
    b[in] = v;
    in++;
}
```
Consumer

consumer:
while (true) {
    while (in <= out)
        /*do nothing */;
    w = b[out];
    out++;
    /* consume item w */
}
Producer/Consumer Problem

![Diagram of Buffer]

Note: shaded area indicates portion of buffer that is occupied

Figure 5.8  Infinite Buffer for the Producer/Consumer Problem
Producer with Circular Buffer

producer:
while (true) {
    /* produce item v */
    while (((in + 1) % n == out)
        /* do nothing */;
    b[in] = v;
    in = (in + 1) % n
}

Consumer with Circular Buffer

customer:
while (true) {
    while (in == out) {
        /* do nothing */
    }
    w = b[out];
    out = (out + 1) % n;
    /* consume item w */
}
Figure 5.12 Finite Circular Buffer for the Producer/Consumer Problem
/* program producerconsumer */
int n;
binary_semaphore s = 1;
binary_semaphore delay = 0;
void producer()
{
    while (true)
    {
        produce();
        semWaitB(s);
        append();
        n++;
        if (n==1)
            semSignalB(delay);
        semSignalB(s);
    }
}
void consumer()
{
    semWaitB(delay);
    while (true)
    {
        semWaitB(s);
        take();
        n--;
        semSignalB(s);
        consume();
        if (n==0)
            semWaitB(delay);
    }
}
void main()
{
    n = 0;
    parbegin (producer, consumer);
}

Figure 5.9 An Incorrect Solution to the Infinite-Buffer Producer/Consumer Problem Using Binary Semaphores
Table 5.4 Possible Scenario for the Program of Figure 5.9

<table>
<thead>
<tr>
<th>Producer</th>
<th>Consumer</th>
<th>s</th>
<th>n</th>
<th>Delay</th>
</tr>
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<td>1</td>
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<td>4</td>
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<tr>
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<tr>
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<td>if (n==0) (semWaitB(delay))</td>
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</tr>
<tr>
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<td>if (n==0) (semWaitB(delay))</td>
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<td>1</td>
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</tr>
</tbody>
</table>
/* program producerconsumer */
int n;
binary_semaphore s = 1;
binary_semaphore delay = 0;
void producer()
{
    while (true)
    {
        produce();
        semWaitB(s);
        append();
        n++;
        if (n==1) semSignalB(delay);
        semSignalB(s);
    }
}
void consumer()
{
    int m; /* a local variable */
    semWaitB(delay);
    while (true)
    {
        semWaitB(s);
        take();
        n--;
        m = n;
        semSignalB(s);
        consume();
        if (m==0) semWaitB(delay);
    }
}
void main()
{
    n = 0;
    parbegin (producer, consumer);
}

Figure 5.10  A Correct Solution to the Infinite-Buffer Producer/Consumer Problem Using Binary Semaphores
/* program producerconsumer */
semaphore n = 0;
semaphore s = 1;
void producer()
{
    while (true)
    {
        produce();
        semWait(s);
        append();
        semSignal(s);
        semSignal(n);
    }
}
void consumer()
{
    while (true)
    {
        semWait(n);
        semWait(s);
        take();
        semSignal(s);
        consume();
    }
}
void main()
{
    parbegin (producer, consumer);
}

Figure 5.11 A Solution to the Infinite-Buffer Producer/Consumer Problem Using Semaphores
/* program boundedbuffer */
const int sizeofbuffer = /* buffer size */;
semaphore s = 1;
semaphore n = 0;
semaphore e = sizeofbuffer;
void producer()
{
    while (true)
    {
        produce();
        semWait(e);
        semWait(s);
        append();
        semSignal(s);
        semSignal(n)
    }
}
void consumer()
{
    while (true)
    {
        semWait(n);
        semWait(s);
        take();
        semSignal(s);
        semSignal(e);
        consume();
    }
}
void main()
{
    parbegin (producer, consumer);
}