Software Engineering (CS401)

Lab Assignment 4

U19CS012

Q1.) Write a **Program** to create a process that prints **"Hello World"**. Use run in init process to instantiate it and _pid to print the ids of all create processes.

Code

```
/* A "Hello World" Promela model for SPIN. */

proctype Hello()
{
    printf("[Inside] Hello() Process \n");
    printf("Hello() pid : %d \n", _pid);
}

init
{
    printf("[Inside] init() Process \n");
    printf("init() pid : %d \n", _pid);

    int lastpid=-1;
    lastpid = run Hello();
    printf("Last Process ID : %d \n", lastpid);
}
```

Output

```
Admin/Desktop/SEL4
ϟ  spin -n2 q1.pml
      [Inside] init() Process
      init() pid : 0
      Last Process ID : 1
          [Inside] Hello() Process
          Hello() pid : 1
2 processes created
```

Q2.) Model **Euclid's algorithm** for **Greatest Common Divisor**.

Code

```
/* Euclid GCD algorithm Implementation. */

proctype gcd(int x;int y)
{
    if
    :: (y == 0) -> printf("%d\n",x);
    :: (y != 0) -> run gcd(y, x % y)
    fi
}

init
{
    int number1=12319; // 12319 = 97*127
    int number2=21631; // 21631 = 97*223
    printf("gcd(%d, %d) = ",number1,number2);
    run gcd(number1, number2);
}
```

Approach 2

```
/* Approach 2 : TC is Higher*/

init
{
    int x = 12319;
    int y = 21631;

    do
    :: x > y -> x = x - y;
    :: y > x -> y = x - y;
    :: x == y -> break;
    od

    printf("gcd(%d, %d) : %d\n",x,y, x);
}
```

Output

```
Admin/Desktop/SEL4
 spin -n2 q2.pml
      gcd(12319, 21631) =                                    97
8 processes created

Admin/Desktop/SEL4
 spin -n2 q2.pml
```

Lot of Processes are Created

Q3.) Create a process **factorial(n, c)** that recursively computes the factorial of a given non-negative integer "n".

Code

```
int res = 1;

proctype fac(int n) {
    if
    :: (n == 0 || n == 1) -> printf("%d\n", res)
    :: (n >=2 ) -> res = res * n; run fac(n-1)
    fi
}

init
{
    // Replace with Number whose Factorial Needs to be Found
    int number = 10;
    printf("%d! = ",number);
    run fac(number);
}
```

Output

```
Admin/Desktop/SEL4
 spin -n2 q3.pml
      5! =                    120
6 processes created

Admin/Desktop/SEL4
 spin -n2 q3.pml
      10! =                   3628800
11 processes created
```

Q4.) Create a **Promela** model for Producer-Consumer problem with **buffer size 5**.

- ✓ In the **producer-consumer** problem, there is **one Producer** that is producing something and there is **one Consumer** that is consuming the products produced by the Producer.
- ✓ The producers and consumers share the same memory buffer that is of fixed-size.
- ✓ The **job of the Producer** is to generate the data, put it into the buffer, and **again start generating data**. While the **job of the Consumer** is to consume the data from the buffer.

Problems that might occur in the Producer-Consumer

- ✓ The producer should produce data only when the buffer is not full. If the buffer is full, then the producer shouldn't be allowed to put any data into the buffer.
- ✓ The consumer should consume data only when the buffer is not empty. If the buffer is empty, then the consumer shouldn't be allowed to take any data from the buffer.
- ✓ The producer and consumer should not access the buffer at the same time.

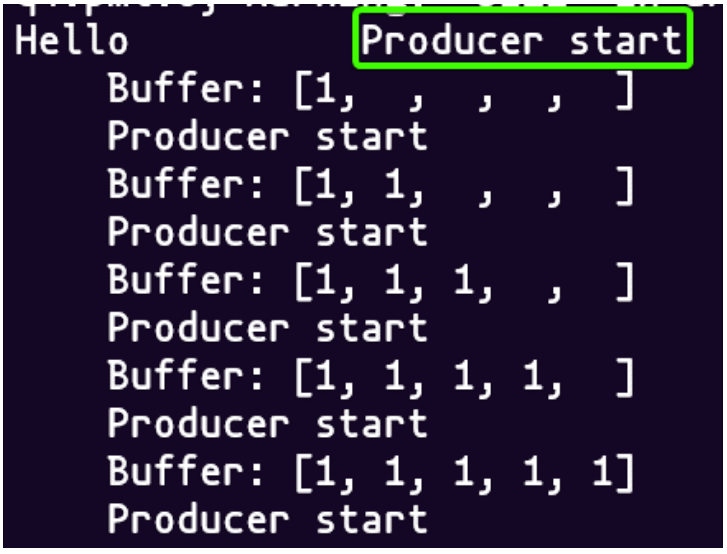
Code

```
int SIZE = 5;
int FULL = 0;
int S = 1;
int IN = 0;
int OUT = 0;
byte BUFFER[SIZE];

init {
  printf("Hello");
  BUFFER[0] = ' ';
  BUFFER[1] = ' ';
  BUFFER[2] = ' ';
  BUFFER[3] = ' ';
  BUFFER[4] = ' ';
  run producer();
  run consumer();
```

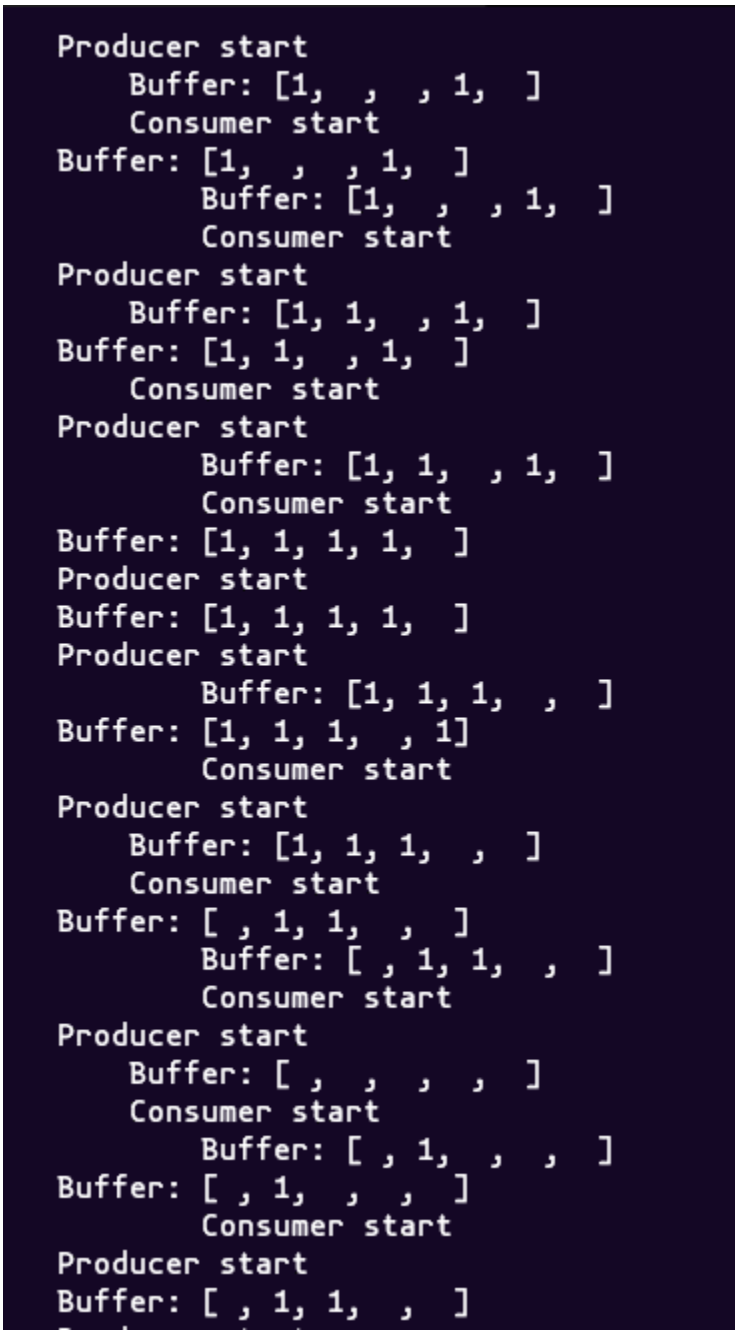
```
  run consumer();
}

proctype consumer() {
  do
  :: printf("Consumer start\n");
  (FULL > 0) -> FULL = FULL - 1;
  (S == 1) -> S = 0;
  BUFFER[OUT] = ' ';
  OUT = OUT + 1;
  OUT = OUT % SIZE;
  S = 1;
  printf("Buffer: [%c, %c, %c, %c, %c]\n", BUFFER[0], BUFFER[1], BUFFER[2], BUFFER[3],
BUFFER[4])
  od
}


proctype producer() {
  do
  :: printf("Producer start\n");
  (FULL < SIZE) -> FULL = FULL + 1;
  (S == 1) -> S = 0;
  BUFFER[IN] = '1';
  IN = IN + 1;
  IN = IN % SIZE;
  S = 1;
  printf("Buffer: [%c, %c, %c, %c, %c]\n", BUFFER[0], BUFFER[1], BUFFER[2], BUFFER[3],
BUFFER[4])
  od
}
```

Output

(Only Producer)



(Both Producer & Consumer)



SUBMITTED BY: U19CS012

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