

# Synchronization

Example & Exercise

# 1. Discussion

- ให้ศึกษาโปรแกรม Ex00, Ex01, Ex02 และ Ex03
- ก่อนจะทดลอง **run** โปรแกรมให้ นศ อภิปรายกันในกลุ่มเกี่ยวกับ
  - ผลลัพธ์จากแต่ละโปรแกรม ในแง่ความถูกต้อง
  - ความเร็วในการทำงานคาดว่าโปรแกรมใดจะเร็วที่สุด เพราะเหตุใด
- ทำการ **run** แต่ละโปรแกรมเพื่อทดสอบสมมุติฐานที่ได้อภิปรายกันไว้
- เปรียบเทียบผลที่คาดการณ์กับผลที่ **run** ได้
  - หาเหตุผลสนับสนุน
- สรุป

# Ex-00

```
1  using System;
2  using System.Diagnostics;
3  using System.Threading;
4
5  namespace OS_Sync_Ex_01
6  {
7      class Program
8      {
9          private static int sum = 0;
10
11         static void plus()
12         {
13             int i;
14             for (i = 1; i < 1000001; i++)
15                 sum += i;
16         }
17
18         static void minus()
19         {
20             int i;
21             for (i = 0; i < 1000000; i++)
22                 sum -= i;
23         }
24
25         static void Main(string[] args)
26         {
27             Stopwatch sw = new Stopwatch();
28             Console.WriteLine("Start...");
29             sw.Start();
30             plus();
31             minus();
32             sw.Stop();
33             Console.WriteLine("sum = {0}", sum);
34             Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
35         }
36     }
37 }
```

# Ex-01

```
1  using System;
2  using System.Diagnostics;
3  using System.Threading;
4
5  namespace OS_Sync_Ex_01
6  {
7      class Program
8      {
9          private static int sum = 0;
10
11         static void plus()
12         {
13             int i;
14             for (i = 1; i < 1000001; i++)
15                 sum += i;
16         }
17
18         static void minus()
19         {
20             int i;
21             for (i = 0; i < 1000000; i++)
22                 sum -= i;
23         }
24
25         static void Main(string[] args)
26         {
27             Thread P = new Thread(new ThreadStart(plus));
28             Thread M = new Thread(new ThreadStart(minus));
29
30             Stopwatch sw = new Stopwatch();
31             Console.WriteLine("Start...");
32             sw.Start();
33
34             P.Start();
35             M.Start();
36
37             P.Join();
38             M.Join();
39
40             sw.Stop();
41             Console.WriteLine("sum = {0}", sum);
42             Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
43         }
44     }
45 }
```

# Ex-02

```
1  using System;
2  using System.Diagnostics;
3  using System.Threading;
4
5  namespace OS_Sync_Ex_01
6  {
7      class Program
8      {
9          private static int sum = 0;
10         private static object _Lock = new object();
11
12         static void plus()
13         {
14             int i;
15             for (i = 1; i < 1000001; i++)
16                 lock (_Lock)
17                 {
18                     sum += i;
19                 }
20         }
21
22         static void minus()
23         {
24             int i;
25             for (i = 0; i < 1000000; i++)
26                 lock (_Lock)
27                 {
28                     sum -= i;
29                 }
30         }
31
32         static void Main(string[] args)
33         {
34             Thread P = new Thread(new ThreadStart(plus));
35             Thread M = new Thread(new ThreadStart(minus));
36
37             Stopwatch sw = new Stopwatch();
38             Console.WriteLine("Start...");
39             sw.Start();
40
41             P.Start();
42             M.Start();
43
44             P.Join();
45             M.Join();
46
47             sw.Stop();
48             Console.WriteLine("sum = {0}", sum);
49             Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
50         }
51     }
52 }
```

# Ex-03

```
1  using System;
2  using System.Diagnostics;
3  using System.Threading;
4
5  namespace OS_Sync_Ex_01
6  {
7      class Program
8      {
9          private static int sum = 0;
10         private static object _Lock = new object();
11
12         1 reference
13         static void plus()
14         {
15             int i;
16             lock (_Lock)
17             {
18                 for (i = 1; i < 1000001; i++)
19                     sum += i;
20             }
21         }
22
23         1 reference
24         static void minus()
25         {
26             int i;
27             lock (_Lock)
28             {
29                 for (i = 0; i < 1000000; i++)
30                     sum -= i;
31             }
32         }
33
34         2
35         0 references
36         static void Main(string[] args)
37         {
38             Thread P = new Thread(new ThreadStart(plus));
39             Thread M = new Thread(new ThreadStart(minus));
40
41             Stopwatch sw = new Stopwatch();
42             Console.WriteLine("Start...");
43             sw.Start();
44
45             P.Start();
46             M.Start();
47
48             P.Join();
49             M.Join();
50
51             sw.Stop();
52             Console.WriteLine("sum = {0}", sum);
53             Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
54         }
55     }
56 }
```

## 2. Modification

- ให้ดัดแปลงแก้ไขโปรแกรม **Ex-04** ให้ทำงานแล้วได้ผลลัพธ์ดังรูป **R-01** ในหน้าถัดไป

# Ex-04

```
using System.Threading;

namespace OS_Sync_01
{
    class Program
    {
        private static string x = "";
        private static int exitflag = 0;

        static void ThReadX()
        {
            while(exitflag==0)
                Console.WriteLine("X = {0}", x);
        }

        static void ThWriteX()
        {
            string xx;
            while (exitflag == 0)
            {
                Console.Write("Input: ");
                xx = Console.ReadLine();
                if (xx == "exit")
                    exitflag = 1;
                else
                    x = xx;
            }
        }

        static void Main(string[] args)
        {
            Thread A = new Thread(ThReadX);
            Thread B = new Thread(ThWriteX);

            A.Start();
            B.Start();
        }
    }
}
```



R-01

```
Input: 1
X = 1
Input: 2
X = 2
Input: 3
X = 3
Input: 4
X = 4
Input: 5
X = 5
Input: 6
X = 6
Input: 7
X = 7
Input: 8
X = 8
Input: 9
X = 9
Input: 99
X = 99
Input: 999
X = 999
Input: exit
Thread 1 exit
```

# 3. Modification

- ให้ดัดแปลงแก้ไขโปรแกรม **Ex-05** ให้ทำงานแล้วได้ผลลัพธ์ดังรูป **R-02** ในหน้าถัดไป

# Ex-05

```
1  using System;
2  using System.Threading;
3
4  namespace cv_lab
5  {
6      class Program
7      {
8          private static string x = "";
9          private static int exitflag = 0;
10         private static int updateFlag = 0;
11
12         static void ThReadX(object i)
13         {
14             while(exitflag == 0)
15             {
16                 if (x != "exit")
17                 {
18                     Console.WriteLine("****Thread {0} : x = {1}****",i,x);
19                 }
20             }
21             Console.WriteLine("---Thread {0} exit---", i);
22         }
23         static void ThWriteX()
24         {
25             string xx;
26             while(exitflag == 0)
27             {
28                 Console.Write("Input: ");
29                 xx = Console.ReadLine();
30                 if (xx == "exit")
31                     exitflag = 1;
32                 x = xx;
33             }
34         }
35         static void Main(string[] args)
36         {
37             Thread A = new Thread(ThWriteX);
38             Thread B = new Thread(ThReadX);
39             Thread C = new Thread(ThReadX);
40             Thread D = new Thread(ThReadX);
41
42             A.Start();
43             B.Start(1);
44             C.Start(2);
45             D.Start(3);
46         }
47     }
48 }
```

R-02

```
Input: 1
***Thread 1 : x = 1***
Input: 2
***Thread 3 : x = 2***
Input: 3
***Thread 3 : x = 3***
Input: 4
***Thread 3 : x = 4***
Input: 5
***Thread 3 : x = 5***
Input: 6
***Thread 1 : x = 6***
Input: 7
***Thread 1 : x = 7***
Input: 1111
***Thread 1 : x = 1111***
Input: 99
***Thread 3 : x = 99***
Input: exit
---Thread 2 exit---
---Thread 3 exit---
---Thread 1 exit---
```