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

```
using System;
using System.Diagnostics;
using System.Threading;

namespace OS_Sync_Ex_01
{
    class Program
    {
        private static int sum = 0;

        static void plus()
        {
            int i;
            for (i = 1; i < 1000001; i++)
                sum += i;
        }

        static void minus()
        {
            int i;
            for (i = 0; i < 1000000; i++)
                sum -= i;
        }

        static void Main(string[] args)
        {
            Stopwatch sw = new Stopwatch();
            Console.WriteLine("Start...");
            sw.Start();
            plus();
            minus();
            sw.Stop();
            Console.WriteLine("sum = {0}", sum);
            Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
        }
    }
}
```

Ex-01

```
using System;
using System.Diagnostics;
using System.Threading;

namespace OS_Sync_Ex_01
{
    class Program
    {
        private static int sum = 0;

        static void plus()
        {
            int i;
            for (i = 1; i < 1000001; i++)
                sum += i;
        }

        static void minus()
        {
            int i;
            for (i = 0; i < 1000000; i++)
                sum -= i;
        }

        static void Main(string[] args)
        {
            Thread P = new Thread(new ThreadStart(plus));
            Thread M = new Thread(new ThreadStart(minus));

            Stopwatch sw = new Stopwatch();
            Console.WriteLine("Start...");
            sw.Start();

            P.Start();
            M.Start();

            P.Join();
            M.Join();

            sw.Stop();
            Console.WriteLine("sum = {0}", sum);
            Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
        }
    }
}
```

Ex-02

```
using System;
using System.Diagnostics;
using System.Threading;

namespace OS_Sync_Ex_01
{
    class Program
    {
        private static int sum = 0;
        private static object _Lock = new object();

        static void plus()
        {
            int i;
            for (i = 1; i < 1000001; i++)
                lock (_Lock)
                {
                    sum += i;
                }
        }

        static void minus()
        {
            int i;
            for (i = 0; i < 1000000; i++)
                lock (_Lock)
                {
                    sum -= i;
                }
        }

        static void Main(string[] args)
        {
            Thread P = new Thread(new ThreadStart(plus));
            Thread M = new Thread(new ThreadStart(minus));

            Stopwatch sw = new Stopwatch();
            Console.WriteLine("Start...");
            sw.Start();

            P.Start();
            M.Start();

            P.Join();
            M.Join();

            sw.Stop();
            Console.WriteLine("sum = {0}", sum);
            Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
        }
    }
}
```

Ex-03

```
using System;
using System.Diagnostics;
using System.Threading;

namespace OS_Sync_Ex_01
{
    0 references
    class Program
    {
        private static int sum = 0;
        private static object _Lock = new object();

        1 reference
        static void plus()
        {
            int i;
            lock (_Lock)
            {
                for (i = 1; i < 1000001; i++)
                    sum += i;
            }
        }

        1 reference
        static void minus()
        {
            int i;
            lock (_Lock)
            {
                for (i = 0; i < 1000000; i++)
                    sum -= i;
            }
        }
        2
        0 references
        static void Main(string[] args)
        {
            Thread P = new Thread(new ThreadStart(plus));
            Thread M = new Thread(new ThreadStart(minus));

            Stopwatch sw = new Stopwatch();
            Console.WriteLine("Start...");
            sw.Start();

            P.Start();
            M.Start();

            P.Join();
            M.Join();

            sw.Stop();
            Console.WriteLine("sum = {0}", sum);
            Console.WriteLine("Time used: " + sw.ElapsedMilliseconds.ToString() + "ms");
        }
    }
}
```

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

```
using System;
using System.Threading;

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

        static void ThReadX(object i)
        {
            while(exitflag == 0)
            {
                    if (x != "exit")
                    {
                        Console.WriteLine("***Thread {0} : x = {1}***",i,x);
                    }
            }
            Console.WriteLine("---Thread {0} exit---", i);
        }
        static void ThWriteX()
        {
            string xx;
            while(exitflag == 0)
            {
                    Console.Write("Input: ");
                    xx = Console.ReadLine();
                    if (xx == "exit")
                        exitflag = 1;
                    x = xx;
            }
        }
        static void Main(string[] args)
        {
            Thread A = new Thread(ThWriteX);
            Thread B = new Thread(ThReadX);
            Thread C = new Thread(ThReadX);
            Thread D = new Thread(ThReadX);

            A.Start();
            B.Start(1);
            C.Start(2);
            D.Start(3);
        }
    }
}
```

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---
```