A SIMPLE READER/WRITER APPLICATION

1 OBJECTIVES

The main goals of this assignment are:

- Handling communication between threads using a simple writer/reader pattern.
- Observing the behavior of non-synchronized threads.
- Learning how multiple threads can be synchronized when accessing a shared resource.

2 DESCRIPTION

Implement a Writer/Reader pattern to solve this assignment, as illustrated in the following simple class diagram.

We shall use the technique with a writer class, a reader class and a third class, the character buffer as the shared object.

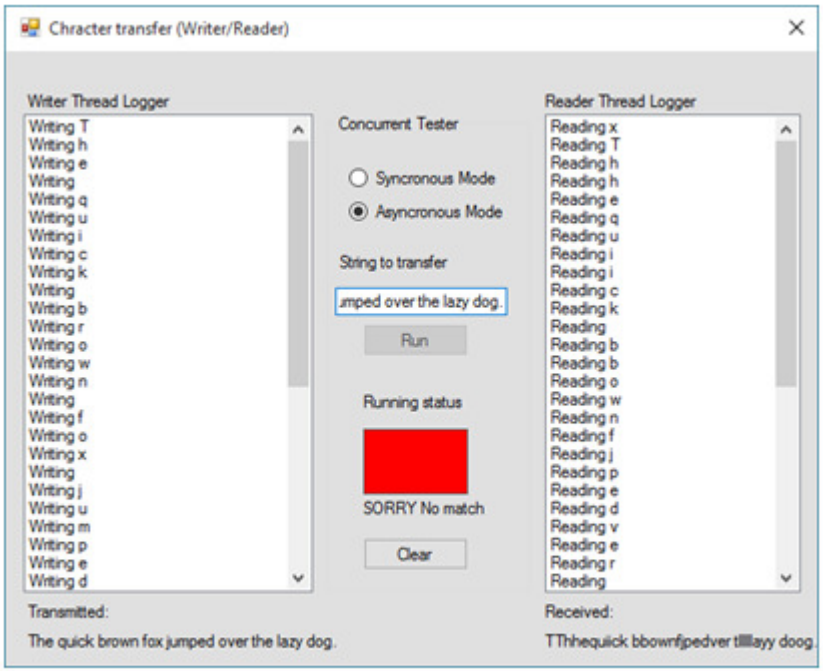
3 CHARACTER TRANSFER

The application should let the user input a string for use as the text to be transferred from the input source (a text-field on the GUI) to the target source (a ListBox on the GUI). The writer thread writes the characters of the string (one by one) to the shared buffer as long as the buffer is not full. The reader thread reads the characters (one by one) from the shared buffer to a target as long as there are characters to read and the buffer is not empty.

The following requirement are for the assignment:

- The character buffer shall hold only ONE character.
- The buffer also has a bool variable like “HasCharacter”.
- NOTE! This bool can’t be tested by a property, it can ONLY be tested

  Inside the critical section.
- In asynchronous mode, only simple get/set shall be done.
- All synchronization takes place in buffer, NOT in writer/reader.
- The reader shall put all the read characters back into a string.
- NO sleep in buffer.



Demo: 1a: Asynchronized

The transfer should be done character by character with a random waiting interval between each character writing and character reading, in order to create a timespan long enough to watch each step on the output window; otherwise things will happen too quickly. The states of the process should be displayed to the screen for the user, as demonstrated in the run sample images (Demo 1a: and 1b). The user should be given the option of choosing to run the application in both synchronized and asynchronized modes. You may use any development tools and IDEs and any of the languages, C#, Jave or C++.

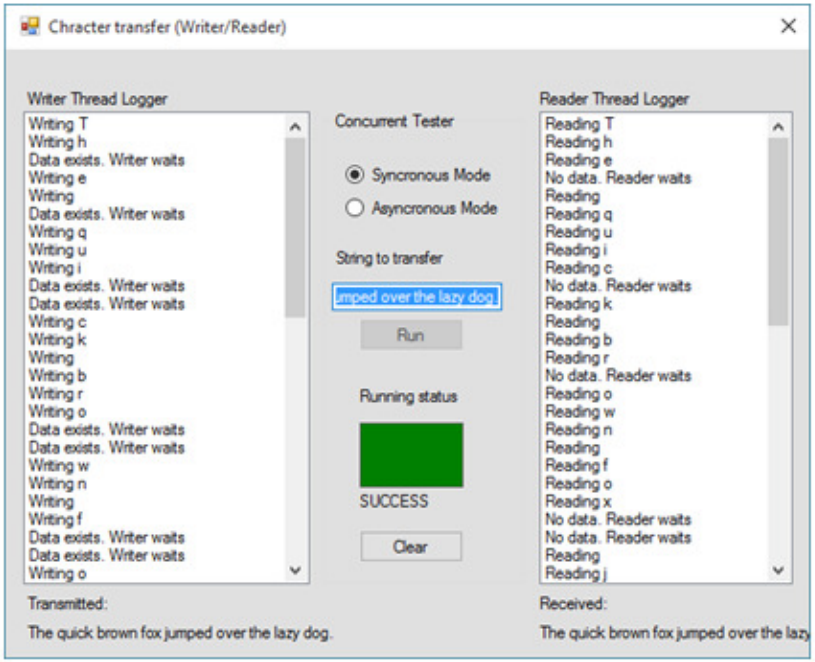
Note: By **asynchronized**, here in this assignment, it is simply meant **not-syncrhonized**. Asynchronized programming will be discussed in its technical meaning later in this course.

3.1 The GUI based application

3.1.1 Create a GUI-based application and design the user interface with necessary input/out components so the user is able to input a text string and run the application, with either synchronized or asynchronized option. The user should also see a log of the readings and writings as they happen.

3.1.2 Create and initialize an instance of the above-mentioned classes in the user-interface class (MainForm in C#) or another start class.

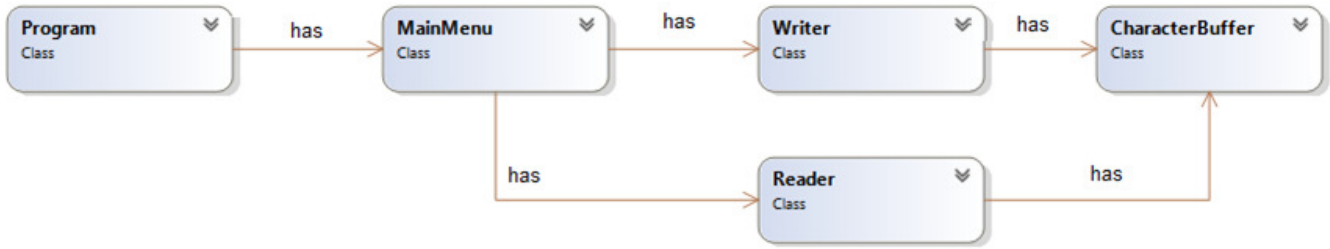
3.1.3 Do the necessary programming to accomplish the task (see the run examples images to get an idea of how the application is expected to work).



Demo 1b: Synchronized

3.2 Console based application

3.2.1 If you find GUI-based programming (in particular in C++) difficult, you may implement a console application. In this case you use a program structure as below can be applied.



You can start synchronized/asynchronized processing.

4 SPECIFICATIONS AND REQUIREMENTS FOR A PASS GRADE (G)

4.1 To qualify for a pass-grade, you should implement at least one of the above alternatives with good code quality.

4.2 Do your programming work well-structured, well organized and always have OOP in mind. Use proper variable and method names, document your code by writing comment in your code.

4.3 NO logic in GUI! And NO GUI component in logic.

4.4 Comment your files with xml headers on classes and methods (C#), comment with JavaDoc in java files.

4.5 You may certainly bring changes in the application to make it more it more fun full-featured.

4.6 Test your application carefully before submitting.

5 GRADING AND SUBMISSION

Show your assignment to your lab leader during the scheduled hours in the labs, but before doing so, you must upload your work to Its' L. Make sure that you submit the correct version of your project and that you have compiled and tested your project before handing in. Be careful not to

use any hard-coded file paths (for example path to an image file on your C-drive) in your source code. It will not work on other computers. Projects that do not compile and run correctly, or is done with poor code quality, will be returned for completion and resubmission.

Compress all the files, folders and subfolders into a Zip, Rar or 7z file, and then upload it via the Assignment page on It's L. Click the button "Submit Answer" and attach your file. Do not send your project via mail!

6 TIPS AND LINKS

C#: In general, avoid locking on a public type, e.g. `lock(this),` or instances beyond your code's control. Best practice is to define a private object to lock on, or a private static object variable to protect data common to all instances.

```
private Object lockObj = new Object(); //instance variable

//lock block
lock (lockObj)
{
      //code    }
```

As we have not yet covered some features that make the work easier for this assignment, here is some guidelines:

To notify a thread in the waiting queue of a change in the locked object's state, the **Monitor.Pulse** in C# and **threadName.notify** in Java can be used. In addition, the following is copied from the Internet:

C#: The equivalent functionality (including the normal locking) is in the Monitor class (foo is the thread object):

```
foo.notify() => Monitor.Pulse(foo)
foo.notifyAll() => Monitor.PulseAll(foo)
foo.wait() =>  Monitor.Wait(foo)
```

The lock statement in C# is equivalent to calling **Monitor.Enter** and **Monitor.Exit** with an appropriate try/finally block. The lock statement is recommended.

Besides the lock, if you don't feel good with monitors, it IS ok to use a bool variable as the result, but remember you can't test it by itself, it must be tested IN buffer.

C++

Where you would have called `java.lang.Object.wait`, call `pthread_cond_wait` or `pthread_cond_timedwait`.
Where you would have called `java.lang.Object.notify`, call `pthread_cond_signal`.
Where you would have called `java.lang.Object.notifyAll`, call `pthread_cond_broadcast`

Try to use names for your components and variables that describes their behavior.

Useful Links:

C#: http://www.yoda.arachsys.com/csharp/threads/
Reader/Writer: http://msdn.microsoft.com/en-us/library/system.threading.readerwriterlock(v=vs.110).aspx
Lock: http://msdn.microsoft.com/en-us/library/c5kehkcz.aspx

Java: http://www.journaldev.com/1037/java-thread-wait-notify-and-notifyall-example
Reader/Writer: https://docs.oracle.com/javase/7/docs/api/java/util/concurrent/locks/ReadWriteLock.html

C++: http://stackoverflow.com/questions/2085511/wait-and-notify-in-c-c-shared-memory
Reader/Writer: http://www.codeproject.com/Articles/598695/Cplusplus-threads-locks-and-condition-variables

Good Luck!

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