

Threading the application

LAB # 2 (Using Thread Checker)

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////////////////////////////////////
```

1. Compiling and running PrimeOpenMP.exe
 - a. View the changes made in PrimeOpenMP.cpp Visual studio.NET. The statement `"#pragma omp parallel for"` in FindPrime() is used to create a parallel region.
 - b. Compile the PrimeOpenMP.cpp by bld.bat in the Intel C++ compiler command line environment.

- c. Run the using command “PrimeOpenMP.exe 1 1000000”.

```
Intel(R) C++ Compiler 9.0.022 build environment for 32-bit applications

C:\ThreadingClassIDF\PrimeOpenMP>hld.bat

C:\ThreadingClassIDF\PrimeOpenMP>icl /O2 /nologo /I ../../include -D WIN32 /W3
Zi /Qopenmp /Qoption,link,/fixed:no PrimeOpenMP.cpp
PrimeOpenMP.cpp
PrimeOpenMP.cpp(106) : (col. 1) remark: OpenMP DEFINED LOOP WAS PARALLELIZED.

C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMP 1 1000000
100%

      78282 primes found between      1 and 1000000 in      2.03 secs

C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMP 1 1000000
100%

      78153 primes found between      1 and 1000000 in      2.05 secs

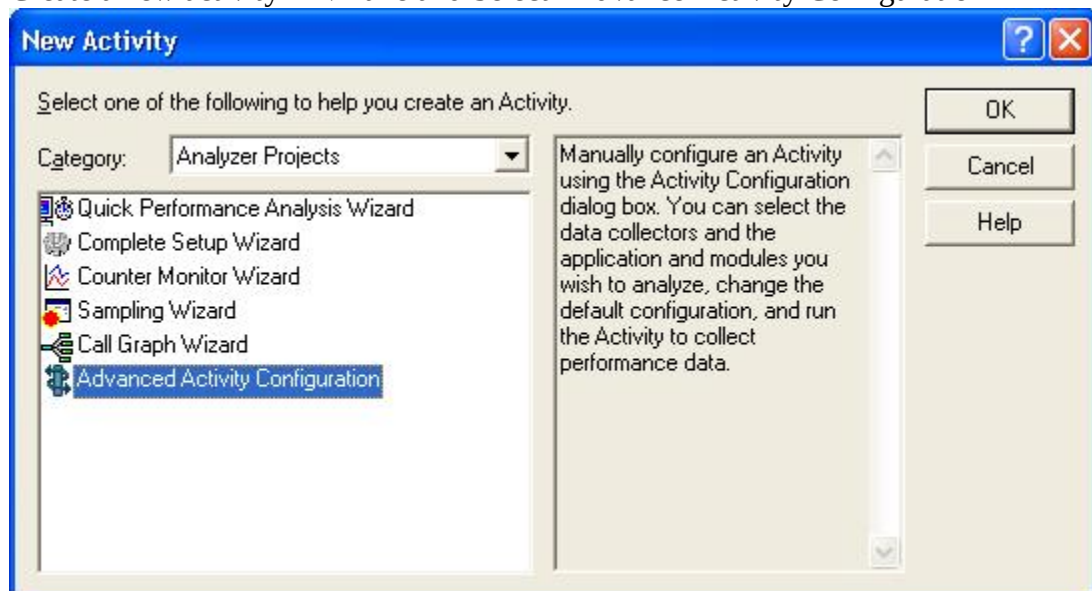
C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMP 1 1000000
100%

      77905 primes found between      1 and 1000000 in      2.03 secs

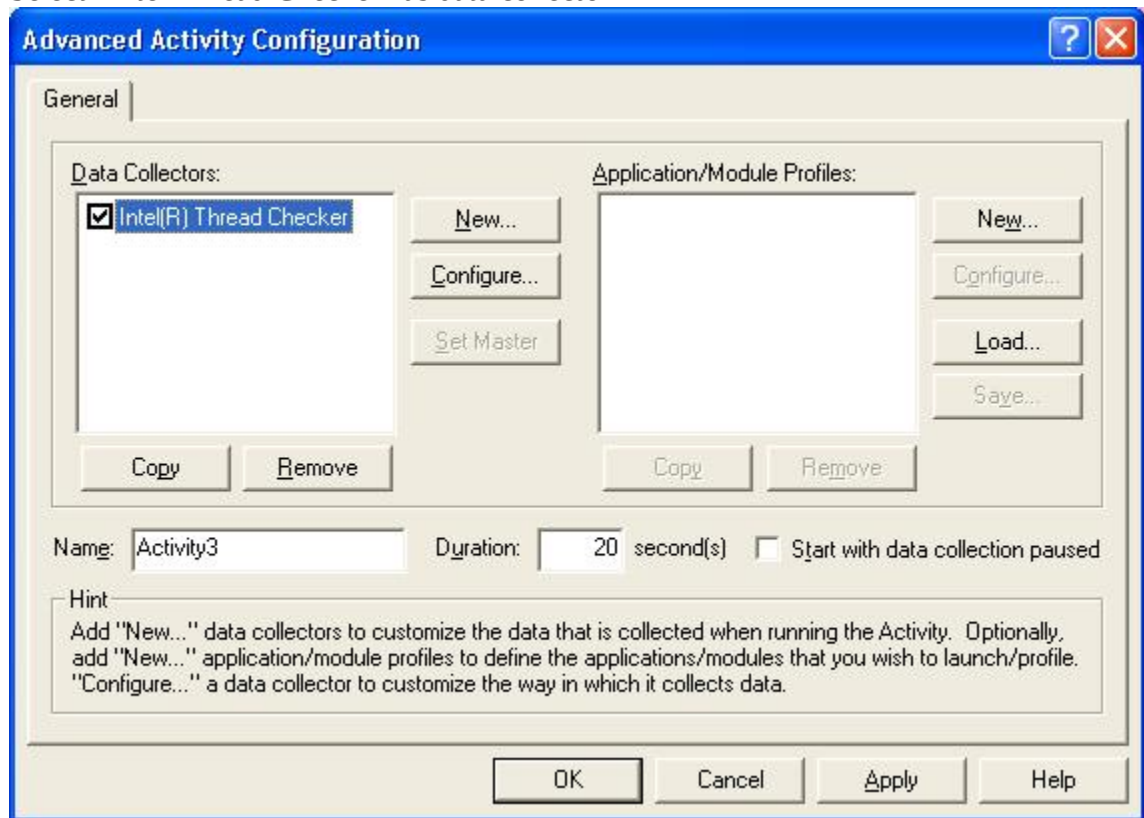
C:\ThreadingClassIDF\PrimeOpenMP>_
```

We are getting different result now.

2. Analyze the PrimeOpenMP.exe for threading errors using ThreadChecker and fixed the programming errors.
 - a. Create a new activity in VTune and Select “Advance Activity Configuration”



- b. Select “Intel Thread Checker” as data collector



- c. Click “new” button for selecting Application/module profile and select the entries as provided below

Application/Module Profile Configuration

General

Application to Launch

Filename: C:\ThreadingClass\DF\PrimeOpenMP\PrimeOpenMP.exe

☒ Add to Modules of Interest List

Working directory: C:\ThreadingClass\DF\PrimeOpenMP\

Command line arguments: 1 1000000

System on which to launch application: <localhost>

Local filename for remote application:

☒ Add to Modules of Interest List

Modules of Interest

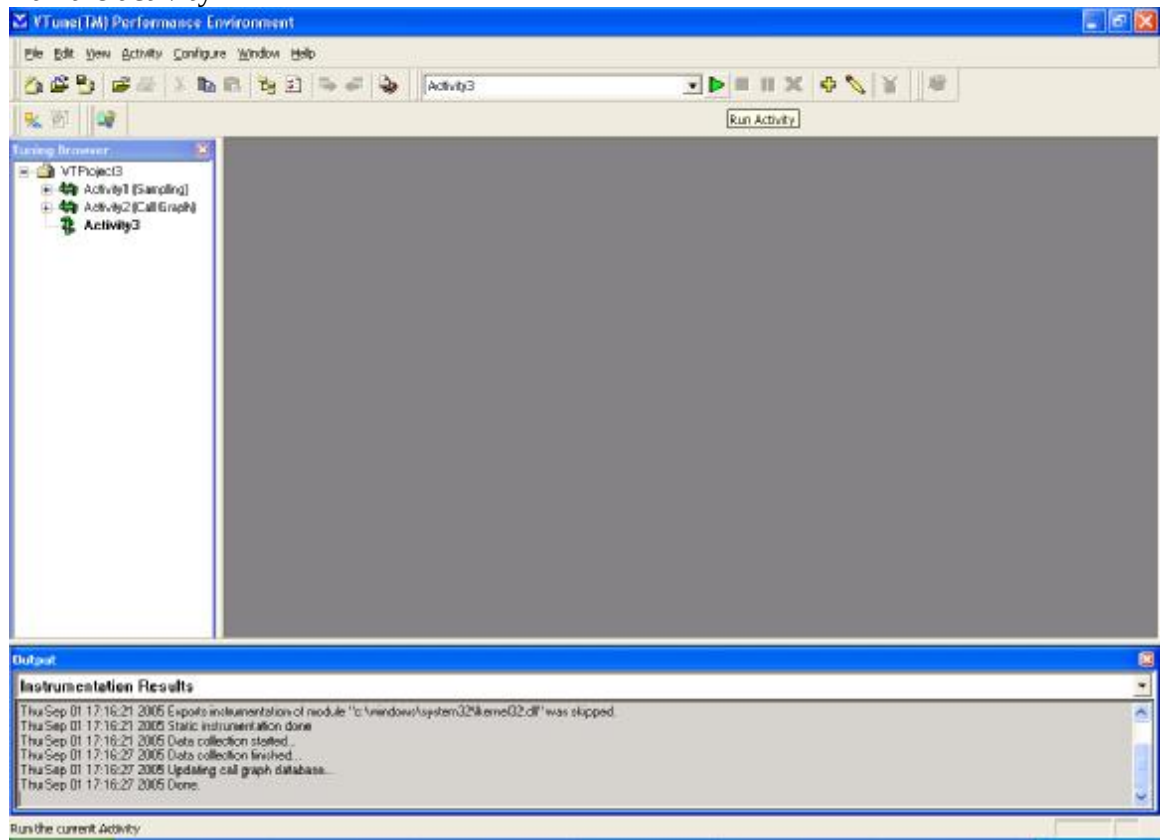
Files: C:\ThreadingClass\DF\PrimeOpenMP\PrimeOpenMP.exe

Name: PrimeOpenMP

OK Cancel Apply Help

- d. Click OK
- e. Click OK again in “Advance Activity configuration”.

f. Run the activity



g. The view shows the errors in the application:

The screenshot displays the VTune Performance Environment interface. The main window is titled "VTune(TM) Performance Environment - [Thread Checker - Activity:]". The interface includes a menu bar (File, Edit, View, Activity, Configure, Windows, Help) and a toolbar with various icons. On the left, the "Running Browser" shows a tree view with "VTProject3" expanded, containing "Activity1 [Sampling]", "Activity2 [Call Graph]", and "Activity3" (selected, timestamped 06:20 PM, 2005 34). The central pane shows a table of diagnostics with columns: Context, ID, Short Description, Severity, and Description. The table lists six memory-related errors, all with a severity of "Error" (indicated by a red 'X'). To the right of the table is a "Severity distribution" chart showing a single red bar for "Error". At the bottom, the "Output" window is set to "Source View" and displays two warning messages from Sep 01 18:20:30 and Sep 01 18:20:34, both stating: "WARNING: Line number information is not available for this module. Only Disassembly view will be available. Do you want to continue?".

Context	ID	Short Description	Severity	Description
'PrimeOpenMP.cpp' 13		Write -> Write data-race	Error	Memory write of Unknown at 'PrimeOpenMP.cpp' 110 conflicts with a prior memory write of Unknown at 'PrimeOpenMP.cpp' 110 (output dependence)
'PrimeOpenMP.cpp' 16		Write -> Write data-race	Error	Memory write of Unknown at 'PrimeOpenMP.cpp' 110 conflicts with a prior memory write of Unknown at 'PrimeOpenMP.cpp' 110 (output dependence)
'PrimeOpenMP.cpp' 15		Write -> Read data-race	Error	Memory read of Unknown at 'PrimeOpenMP.cpp' 110 conflicts with a prior memory write of Unknown at 'PrimeOpenMP.cpp' 110 (flow dependence)
'PrimeOpenMP.cpp' 9		Read -> Write data-race	Error	Memory write of Unknown at 'PrimeOpenMP.cpp' 77 conflicts with a prior memory read of Unknown at 'PrimeOpenMP.cpp' 77 (anti dependence)
'PrimeOpenMP.cpp' 10		Write -> Read data-race	Error	Memory read of Unknown at 'PrimeOpenMP.cpp' 77 conflicts with a prior memory write of Unknown at 'PrimeOpenMP.cpp' 77 (flow dependence)
'PrimeOpenMP.cpp' 11		Write -> Write data-race	Error	Memory write of Unknown at 'PrimeOpenMP.cpp' 77 conflicts with a prior memory write of Unknown at 'PrimeOpenMP.cpp' 77 (output dependence)

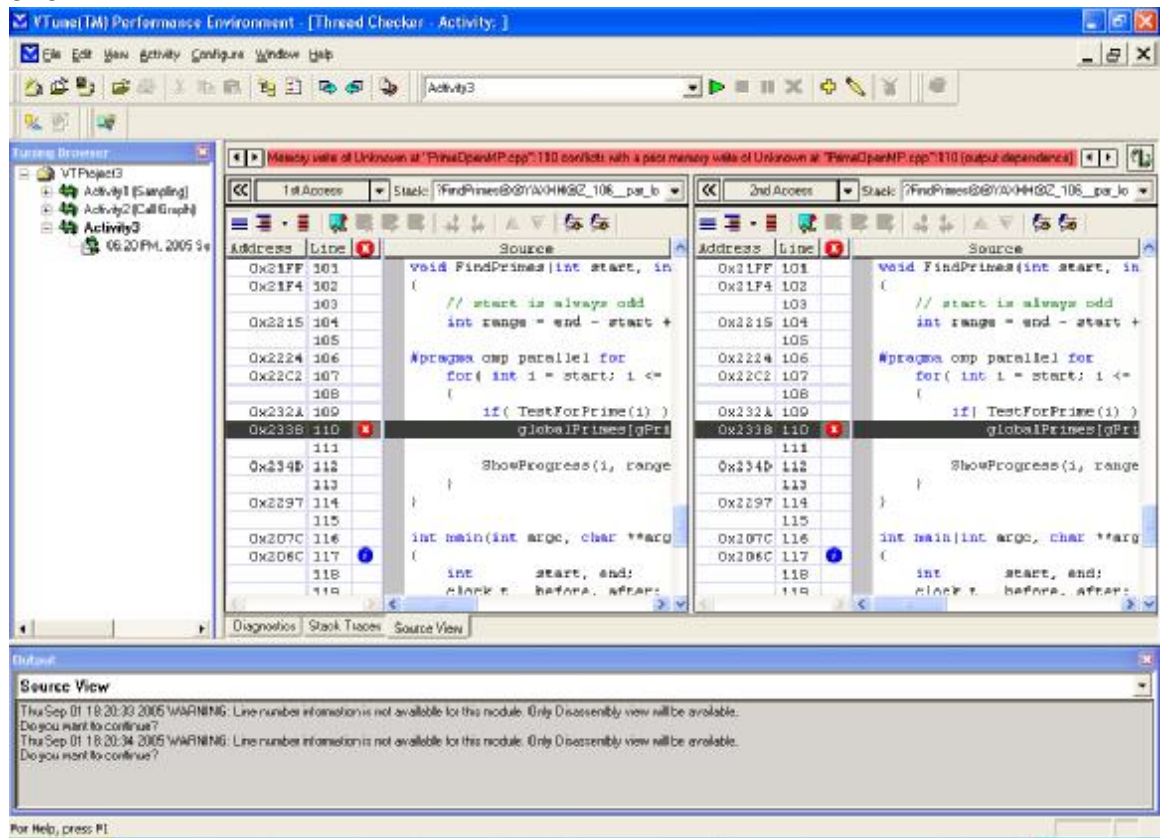
Output Window (Source View):

```

Thu Sep 01 18:20:30 2005 WARNING: Line number information is not available for this module. Only Disassembly view will be available.
Do you want to continue?
Thu Sep 01 18:20:34 2005 WARNING: Line number information is not available for this module. Only Disassembly view will be available.
Do you want to continue?
  
```

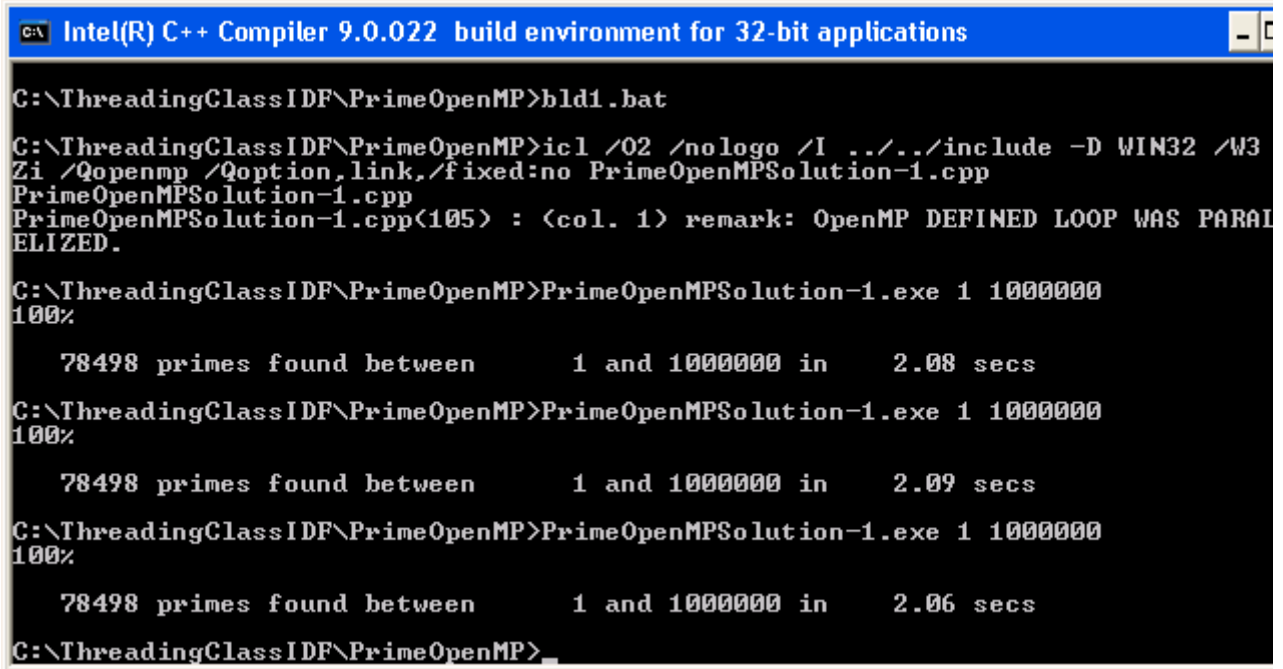
h. Select the particular error and click in source view to locate the statement in the source causing the

error



- i. Fix all the error using “#program omp Critical section (lockname)”. The changed program is available in PrimeOpenMPSolution-1.cpp.
3. Rebuild the application and run.
 - a. Compile the PrimeOpenMPSolution-1.cpp by bld1.bat in the Intel C++ compiler command line environment.

b.Run the using command “PrimeOpenMPSolution-1.exe 1 1000000”



```
C:\> Intel(R) C++ Compiler 9.0.022 build environment for 32-bit applications

C:\ThreadingClassIDF\PrimeOpenMP>hld1.bat

C:\ThreadingClassIDF\PrimeOpenMP>icl /O2 /nologo /I ../../include -D WIN32 /W3
Zi /Qopenmp /Qoption,link,/fixed:no PrimeOpenMPSolution-1.cpp
PrimeOpenMPSolution-1.cpp
PrimeOpenMPSolution-1.cpp(105) : (col. 1) remark: OpenMP DEFINED LOOP WAS PARAL
ELIZED.

C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMPSolution-1.exe 1 1000000
100%

    78498 primes found between      1 and 1000000 in    2.08 secs

C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMPSolution-1.exe 1 1000000
100%

    78498 primes found between      1 and 1000000 in    2.09 secs

C:\ThreadingClassIDF\PrimeOpenMP>PrimeOpenMPSolution-1.exe 1 1000000
100%

    78498 primes found between      1 and 1000000 in    2.06 secs

C:\ThreadingClassIDF\PrimeOpenMP>_
```

4. Again create an activity, analyze the application and check that there are no errors.
5. Record the number of primes found
6. Record the run time
7. Calculate the scaling factor achieved
8. Compare it with theoretical scaling.