Using Intel® VTune™ Amplifier XE

This lab introduces basic usage of Intel® VTune™ Amplifier XE profiling tool, for which these exercises will cover only the basic use. After you have completed the exercises, feel encouraged to familiarize yourself more with the tool and its features.

Setup

Building the Application

Begin by loading the Intel Compiler and VTune modules:

```
module load intel/15.0.2
module load intel/vtune/15.0.2
```

Decide whether you would like to work with C\C++ or Fortran. The techniques covered in this lab are applicable to both, so you should choose whichever language is most familiar. Begin by copying the **Makefile_<c|ftn>** of the language of choice to **Makefile**.

For C\C++

```
cp Makefile_c Makefile
```

For Fortran

```
cp Makefile_ftn Makefile
```

Then, for both C\C++ and Fortran, you can then build the analysis target applications by

```
make
```

The command creates two binaries both for the Xeon host (**nbody-orig** and **nbody-opt**) and coprocessor (**nbody-orig.mic** and **nbody-opt.mic**). The host binaries can be explicitly created by typing

```
make nbody-orig
make nbody-opt
```

In order to build for an Intel® Xeon Phi™ coprocessor, type:

```
make nbody-orig.mic
make nbody-opt.mic
```

Configuring and Running the Application

Configuration will be done as previously.

Host

Before running the application, be sure to set the OpenMP thread affinity as below. The optional **verbose** flag will show the binding of threads to logical processors:

```
export KMP_AFFINITY=compact,granularity=fine[,verbose]
```

or, alternatively, by using the OpenMP 4.0 thread affinity syntax

```
export OMP_PLACES=threads
export OMP_PROC_BIND=close
[export KMP_AFFINITY=verbose]
```

Then, to execute the original application without optimizations, run:

```
./nbody-orig 262144
```

To execute the optimized application:

```
./nbody-opt 262144
```

Coprocessor

The easiest way to execute the application built for Xeon Phi™ on the coprocessor is to use the scripts provided:

```
./nbody-orig_mic.sh
./nbody-opt_mic.sh
```

Background (optional):

> Have a look into the scripts. The application is started from the host on the coprocessor by using the tool **micnativeloadex** which will also resolve all required libraries (**micnativeloadex –h** will show the options). The tool **micnativeloadex** will not use the last core on the coprocessor by default.

> If the NFS export is enabled for your current working directory and the compiler paths you can issue an alternative command using **ssh** to start the application from the host on the coprocessor. It will exploit all cores on Xeon Phi™ including the last one which often works well for running native codes as in the present lab. You will find the **ssh** command commented out in the script **nbody_mic.sh** as well.

> The third alternative is to login with **ssh** directly onto the coprocessor and execute the application as in the Xeon case. Without NFS you have to copy the application and required libraries over before; with NFS you have to setup the environment, in particular the paths to the libraries.

Hotspots Analysis

For analysis of the application, you can use either the command line or the graphical user interface. Basic hotspot analysis is described for both usage models in the following. Note that for more advanced analysis, we will resort only to the graphical user interface.

Command line analysis with Intel® VTune™ Amplifier

Perform a hotspots analysis for the original application **nbody-orig** from the command-line:

Host

```
amplxe-cl -collect hotspots -r nbody_hs -- ./nbody-orig 262144
```

Coprocessor

```
amplxe-cl -collect knc-hotspots -r nbody_hs -- ./nbody-orig_mic.sh
```

And examine the output:

```
amplxe-cl -report hotspots -r nbody_hs
```

If you feel that generating a full report generates too many columns, you can limit the amount of columns by using **–column**:

```
amplxe-cl -report hotspots -r nbody_hs \
   -column="CPU Time:Self","Source File"
```

For a list of available columns, use **–column=?**. There are multiple other ways of filtering and grouping data from the command line. See the Intel® VTune™ Amplifier manual or **amplxe-cl –help** for more information.

Which function takes the most time? Record it below:

Hotspot:	

Repeat the process for the optimized application **nbody-opt**.

Graphical user interface analysis with Intel® VTune™ Amplifier

Perform a hotspots analysis for the original application **nbody-orig** from the graphical user interface:

Launch Intel® VTune™ Amplifier:

```
amplxe-gui &
```

1. Create or select project. Click *"New Project"*, select a suitable name ("nbody" will do fine) and click *"Create project"*.
2. Choose the application and its parameters.

a. **Host** analysis. Select *Analysis Target* as *"local"* (the default). Then input "Application" as **./nbody-orig**, set "Application parameters" as **262144** and click *"Choose Analysis"*

b. **Coprocessor** analysis. Select *Analysis Target* as *"Intel Xeon Phi coprocessor (native)"*. Then input "Application" as **./nbody-orig_mic.sh** and click *"Choose Analysis"*

3. Choose the analysis type. Intel® VTune™ Amplifier offers several different kinds of analysis types, but initially we are only interested the basic hotspots. Select *Analysis Type* as *"Basis Hotspots"*.

4. Run the analysis. Click *"Start"* to start the analysis.

5. Once the analysis finishes, the summary page will display the hotspots under *Top Hotspots*.

Which function takes the most time? Record it below:

Hotspot:	

Repeat the process for the optimized application `nbody-opt`.

Further features

Intel® VTune™ Amplifier XE offers several other analysis types in addition to the basic hotspots analysis. Top level groups for available types of analysis are *Algorithm analysis*, *Microarchitecture analysis* and *Platform analysis*. In addition, there is a possibility to create a *Custom analysis* target.

Refer to the Intel® VTune™ Amplifier XE User Guide and online tutorials for more details.

Product documentation:
https://software.intel.com/en-us/intel-vtune-amplifier-xe-support/documentation

Online tutorials:
https://software.intel.com/en-us/articles/intel-vtune-amplifier-tutorials

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