A REPORT ON DEVELOPMENT OF ECLIPSE PLUGIN FOR PREDICTING EXECUTION TIME AND ENERGY CONSUMPTION OF HETEROGENEOUS PARALLEL PROGRAMS

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ABSTRACT

The project aims at the development of a plugin for the Nvidia Nsight Eclipse Edition IDE, using which the user can predict the execution time and energy consumption of his/her CUDA programs, without actually running them on actual hardware. One of the many steps to accomplish this is doing a static analysis of the intermediate PTX code. The current version of the plugin takes three inputs from the user: the number of blocks, the number of threads per block, and the number of loop iterations. Calculation of every other parameter is done without user intervention. The plugin is able to automatically query any Nvidia GPU available on the user's machine. If more than one cards are present, then the first one is selected.

Currently, the plugin works only if the user's machine has a CUDA capable Nvida GPU. If not, then the plugin is rendered useless. For best experience, the user is recommended to use the Nvidia Nsight Eclipse Edition version 8 IDE.

DIFFICULTY AND CHALLENGES

One of the many challenges in the development process was successful installation of CUDA on a Ubuntu machine. Thanks to Nvidia's pathetic support, the installation process was a big pain. Automatic parameter calculation was also a major challenge. We wanted to take the least number of inputs from the user. Since much of architectural specification of Nvidia's GPUs is not made available to public, we had to develop a micro-benchmark suite to obtain many of these parameters. Currently, we are taking three parameters as input from the user (the number of blocks, the number of threads per block, and the number of loop iterations). Future versions of the plugin may see further reduction.

Last but not the least, testing the plugin was a major challenge. Not many machines today come with Nvidia GPUs, and even if they do, not everyone has CUDA installed on their computer. If we borrowed any machine, we had to install Ubuntu, CUDA, Nvidia Nsight Eclipse and other software. Much time was wasted in this process.

WORKING AND USAGE

As soon the the Nvidia Nsight Eclipse IDE is started, the plugin calls a method to check if NVCC is installed on the user's machine or not. If not, it freezes the plugin and prompts the user to install NVCC. Note that in this scenario, the user cannot use the plugin.

If NVCC is installed, then certain executable files are extracted to a temporary location by the plugin. These executables are needed for querying and bench-marking the user's hardware. The method for extracting these files is called on Eclipse start-up.

The user can now enter the "Preparation" phase. It is in this phase that the executables are run for querying and bench-marking the user's GPU. If it is being done for the first time, then this phase might take some time. The output of these executables are stored as text files on the user's machine, and after the first time, the preparation phase consists of just reading from those text files, which is extremely fast. Note that the plugin generates some models during this phase, that are not stored as text files. So, every time the user wants to use the plugin, he has to "Prepare" at least once.

After the "Preparation" phase is done, the user may proceed to fill the three required inputs. This step is absolutely necessary, failing which the user won't be able to use the plugin any further. To fill-in these parameters, right click on the project in the project explorer, select properties, and go to Energy Estimation. Here, the user may also override any parameter if he wants.

After the required parameters have been filled, the user can perform energy estimation by going to "Energy Estimation>Perform Energy Estimation" on the menu bar. The results will be displayed on the custom console. It is advised that the user expands this custom console, for ease in viewing the results.

FUTURE WORK

The plugin needs some improvements. Firstly, a better micro-bench-marking suite has to be developed. This will result in better prediction results. Currently, the plugin works only if a Nvidia GPU is available on the user's machine. Future versions have to do away with this, and should have an option for the user to manually supply the required files for parameter calculation. Thus, the user will be able to predict the execution time and energy consumption of his/her programs without having any Nvidia hardware. The custom console needs to be worked upon, and more functionality has to be added to it, such as an option to clear it. Last but not the least, the plugin needs thorough testing using formal procedures on different hardware to test its robustness.