HW 1

CPSC424

Jake Brawer

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0.1 Software and Dev. Environments

All the programming for this assignment was done in vim. This document, including the figures, were made using emacs (and gnuplot). The only module loaded used in this assignment is Langs/Intel/15.

0.2 Running Code

The code for this assignment is separated amongst two directories Pr1 and Pr2. To compile all the code at once, simply run setup.sh located in the toplevel directory. To run the code on Omega for problem 1, navigate into Pr1 and run pr1.sh. Running this file (`qsub pr1.sh`) will output the text file out.txt. This file contains measurements regarding the timing of the integration function, estimates of divide operation, and the estimated value of pi.

Similarly, running pr2.sh located in Pr2 outputs a file output.txt. This file contains data relating the size of N to MFLOPS.

1 Pr 1

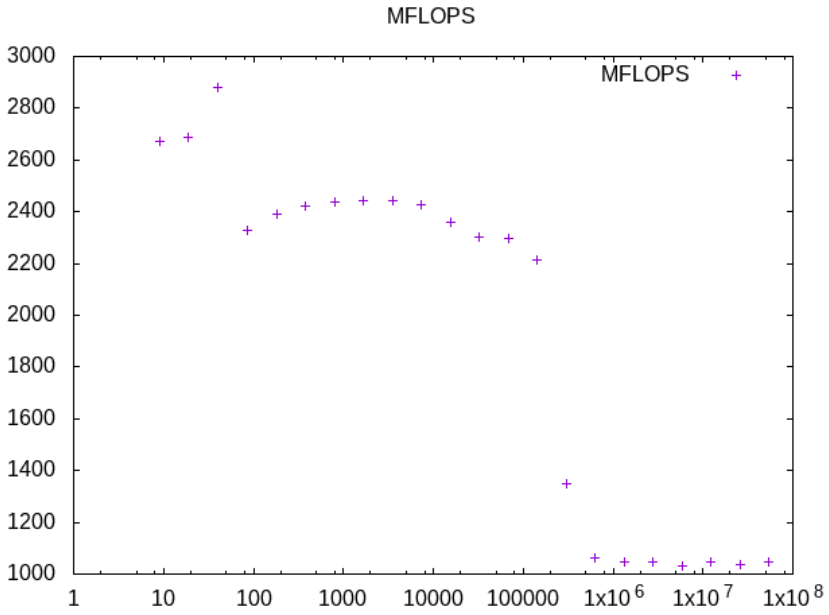
The compiler flags in group d ended up resulting more 5x performance increase (~20 secs to ~3 secs). This is most likely due, in part, to the compiler unrolling the loop where the arithmetic for the integration was taking place. In fact, I had originally written this using a while loop that was not easily unrolled and got *no* performance increase across the compiler flags (although my worse case then was much better than my worse case now), which I think lends support to this.

In order to calculate the latency for divides, I created a timed two toy functions. In theory these functions only differed by the presence/absence of

a single floating point divide. Taking the difference between the two functions should have in theory been useful for calculating the latency. However this difference differed wildly between compiler flag options, and in general, I got an answer < 1 cycle–an impossibility. In fact, for some compiler flag groups, the function with addition was actually faster than the function without. It's clear that in this case that the compiler was actually circumventing the divisions. One possible method of doing this is to replace the division with multiplication of the reciprocal of the divisor, as multiplying is much quicker. However, this means

The value of π calculate was correct to the 7th decimal place. This allowed my to estimate $\cos(\pi)$ correctly to 1o decimal places (-1) and $\sin(\pi)$ to 8 (0).

2 Pr 2



Above is a graph comparing array length to MFLOPS. Clearly there is a precipitous drop off in performance as N gets large. This is likely caused by the fact that large arrays wont fit in the cache. As a result, cache misses increase, resulting in more data transfer from main memory, which results in a lot of computational downtime.

3 Env Output

MKLROOT=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/mkl
MANPATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/man/en$_{\text{US}}$:/home/apps/fas
GDB$_{\text{HOST}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/debugger/gdb/intel64$_{\text{mic}}$/bi
ia-mic HOSTNAME=login-0-0.local IPPROOT=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe}}$
INTEL$_{\text{LICENSEFILE}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/licenses:/opt/intel/
TERM=xterm SHELL=/bin/bash HISTSIZE=1000 GDBSERVER$_{\text{MIC}}$=/home/apps/fas/Langs/Intel/2
SSH$_{\text{CLIENT}}$=172.27.41.66 41162 22 LIBRARY$_{\text{PATH}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/compose
PERL5LIB=/opt/moab/lib/perl5 FPATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.}}$
QTDIR=/usr/lib64/qt-3.3 QTINC=/usr/lib64/qt-3.3/include MIC$_{\text{LDLIBRARYPATH}}$=/home/apps/fas/I
linux-release/lib:/opt/intel/mic/myo/lib:/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$
SSH$_{\text{TTY}}$=/dev/pts/63 ANT$_{\text{HOME}}$=/opt/rocks USER=jnb37 LD$_{\text{LIBRARYPATH}}$=/home/apps/fas/Langs/
linux-release/lib:/opt/intel/mic/myo/lib:/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$
MIC$_{\text{LIBRARYPATH}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/compiler/lib/mic:/h
ROCKS$_{\text{ROOT}}$=/opt/rocks CPATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/ipp/
YHPC$_{\text{COMPILER}}$=Intel NLSPATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/com
MAIL=/var/spool/mail/jnb37 PATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/b
3.3/bin:/opt/moab/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/usr/java/latest/b
YHPC$_{\text{COMPILERMINOR}}$=164 mposer$_{\text{xe2015.2.164}}$/debugger/gdb/intel64$_{\text{mic}}$/share/locale/%l_%t/%N:/hor
MAIL=/var/spool/mail/jnb37 PATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/b
3.3/bin:/opt/moab/bin:/usr/local/bin:/bin:/usr/bin:/usr/local/sbin:/usr/sbin:/sbin:/usr/java/latest/b
YHPC$_{\text{COMPILERMINOR}}$=164 TBBROOT=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.16}}$
F90=ifort PWD=/home/fas/cpsc424/jnb37/scratch/HW1/Pr1 _LMFILES_=/home/apps/fas/Modul
YHPC$_{\text{COMPILERMAJOR}}$=2 JAVA$_{\text{HOME}}$=/usr/java/latest GDB$_{\text{CROSS}}$=/home/apps/fas/Langs/Intel/201
mic DOMAIN=omega LANG=en$_{\text{US.iso885915}}$ MODULEPATH=/home/apps/fas/Modules
MOABHOMEDIR=/opt/moab YHPC$_{\text{COMPILERRELEASE}}$=2015 LOADEDMODULES=Base/yale$_{\text{hpc}}$:La
F77=ifort MPM$_{\text{LAUNCHER}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/debugger/m
CXX=icpc SSH$_{\text{ASKPASS}}$=/usr/libexec/openssh/gnome-ssh-askpass HISTCON-
TROL=ignoredups INTEL$_{\text{PYTHONHOME}}$=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.16}}$
SHLVL=1 HOME=/home/fas/cpsc424/jnb37 FC=ifort LOGNAME=jnb37
QTLIB=/usr/lib64/qt-3.3/lib CVS$_{\text{RSH}}$=ssh SSH$_{\text{CONNECTION}}$=172.27.41.66
41162 172.18.89.8 22 MODULESHOME=/usr/share/Modules LESSOPEN=||/usr/bin/lesspipe.sh
%s arch=intel64 INFOPATH=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/debugger/
CC=icc INCLUDE=/home/apps/fas/Langs/Intel/2015$_{\text{update2}}$/composer$_{\text{xe2015.2.164}}$/mkl/include
G$_{\text{BROKENFILENAMES}}$=1 BASH$_{\text{FUNCmodule}}$()=() { eval ‘/usr/bin/modulecmd
bash $*‘ } _=/bin/env OLDPWD=/home/fas/cpsc424/jnb37/scratch/HW1k