Developing OpenACC Applications

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AMD
together we advance_

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OpenACC compilers

- OpenMP® is the primary directive-based language for AMD
- But compilers based on GCC can be set up with OpenACC support

- Siemen's® sourcery compiler is one option

- Cray Fortran compilers have support for OpenACC version 2.6 + a little???

- LLVM™ based compilers are focusing on OpenMP but have said they will support an OpenACC to OpenMP® translation

Examples -- Fortran vecadd with OpenACC

```
program main
    integer :: i, n = 100000
    real(8),dimension(:),allocatable :: a, b, c
    real(8) :: sum
    allocate(a(n), b(n), c(n))
    do i=1,n
        a(i) = sin(dble(i)*1.0d0)*sin(dble(i)*1.0d0)
        b(i) = cos(dble(i)*1.0d0)*cos(dble(i)*1.0d0)
    enddo
    !$acc parallel loop copyin(a(1:n),b(1:n)), copyout(c(1:n))
    do i=1,n
        c(i) = a(i) + b(i)
    enddo
    sum = 0.0d0
    do i=1,n
        sum = sum +  c(i)
    enddo
    sum = sum/dble(n)
    write(*,'("Final result: ",f10.6)') sum
    deallocate(a, b, c)
end program
```

Only change from OpenMP version

Examples -- Fortran vecadd with OpenACC -- environment

```
module load rocm sourceryg++
export FC=<path-to-siemens>/bin/x86_64-none-linux-gnu-gfortran
```

The makefile uses the ${FC} environment variable so that different Fortran compilers can be used

The ROCm™ module may need to be loaded for the calculation to be able to run on the GPU.

If there is no module, this is what is necessary to set.

```
export PATH=<path-to-siemens>/bin:${PATH}
export INCLUDE=<path-to-siemens>/include:${INCLUDE}
export LD_LIBRARY_PATH=<path-to-siemens>/lib64:/opt/rocm<-version>/lib:${LD_LIBRARY_PATH}
export MANPATH=<path-to-siemens>/bin:${MANPATH}
export FC=<path-to-siemens>/bin/x86_64-none-linux-gnu-gfortran
```

Yes, that is really the compiler name. We've soft linked it to srcy-gfortran for ease of use.

For more verbose debugging output during run

```
export GCN_SUPPRESS_HOST_FALLBACK=true
export GCN_DEBUG=1
```

Examples -- Fortran vecadd with OpenACC -- Makefile

```
default: vecadd
all: vecadd

ROCM_GPU ?= $(strip $(shell rocminfo |grep -m 1 -E gfx[^0]{1} | sed -e 's/ *Name: *//'))
UNAMEP = $(shell uname -p)
ROCM_CPUTARGET = $(UNAMEP)-pc-linux-gnu
ROCM_GPUTARGET ?= amdgcn-amd-amdhsa

ifeq ($(notdir $(FC)), ftn)
  OPENMP_FLAGS = -hacc #the craype-accel-amd-gfx* module sets the architecture
  FREE_FORM_FLAG = -ffree
else
  OPENACC_FLAGS = -fopenacc -foffload=-march=${ROCM_GPU} -fopt-info-optimized-omp
  FREE_FORM_FLAG = -Mfreeform
endif

FFLAGS = -g -O3 ${FREE_FORM_FLAG}  ${OPENACC_FLAGS}
LDFLAGS = ${OPENACC_FLAGS}

vecadd: vecadd.o
    $(FC) $(LDFLAGS) $^ -o $@

clean:
    rm -f *.o vecadd *.mod
```

Summary of OpenACC across AMD compilers

- For Siemens® GCC compiler:
  - Compile succeeded, ran on the GPU
- For HPE compiler:
  - Compile succeeded, ran on the GPU

Only the Siemens® GCC and HPE compilers work for the OpenACC code for AMD GPUs

Using CRAY_ACC_DEBUG=[1,2,3] can help expose what is happening with the application while running

- –hlist=aimd and –hmsgs will give more detail during the compilation

Exercises:

- Try modifying the program to put the initialization of the arrays on the GPU
- Test your own OpenACC Fortran application and report any issues with any of these compilers

Conversion Utilities

Clacc converts OpenACC to OpenMP

- Availability– Hosted publicly by the LLVM DOE Fork– https ://github.com/llvm-doe-org/llvm-project/tree/clacc/master
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Intel OpenACC to OpenMP migration tool

- https://github.com/intel/intel-application-migration-tool-for-openacc-to-openmp

Summary

OpenMP® offloading and OpenACC

- Many features are still being added to Fortran compilers
- Use the latest compiler version
- Expect features to be added with every release
- HPE Fortran compilers are more mature and may be the best choice if they are available, especially in the short term
- OpenMP is getting stronger development support
- May want to transition from OpenACC to OpenMP in the longer term
- Please report any compiler issues so that they can continue to be improved

Some common error reports

HSA_STATUS_ERROR_MEMORY_FAULT: Agent attempted to access an inaccessible address. code: 0x2b

Data is not present on GPU!

Host region (7ffc4df0dd20 to 7ffc4df1dd20) overlaps present region (7ffc4df19e80 to 7ffc4df22e80 index 42) but is not contained for A in source.f90

Data is mapped to device but is not deleted/released!

Thank you!

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