Makefiles

David Newman

(from slides by Thomas Logan)

Makefiles

- Large scientific codes often have hundreds to thousands of files
- Each file needs to be compiled to objects using many compiler flags
- All of the object files need to be linked together to create binary
- Long Painful Process unless we use Makefiles

Simple Makefile

```
# Makefile for          : mean
F90 = pgf90
mean: mean.f90
	$(F90) -o mean mean.f90
```

- **# denotes a comment**
- **F90 is a variable**
- **mean is the rule to create the executable file ‘mean’**
- **mean.f90 is a requirement/dependency**

Standard Format

- **Invoke make using**

  make <rulename>   i.e. make mean

- **Can have many different rules**
- **Default is to use the first rule**
  - Typing make gives same result as ‘make mean’, because mean is the first rule in the file

Another Example

```
CF90 = pgf90
F90FLAGS = -O3 -OPT:Ofast
LDFLAGS = -O3 -OPT:Ofast
FOBJS = planets.o initialize.o solarSys.o

solarSysOmp: $(FOBJS)
	$(CF90) $(LDFLAGS) $(F90FLAGS) -o solarSysOmp $(FOBJS)
clean:
	rm -f *.o
	rm -f core
	rm -f solarSys
```

Multiple Source Types

```
SHELL = /bin/csh
CF = pathf77
CF1 = pathf90

# For use Pathscale compiler
FFLAGS = -byteswapio –apo –O3
FFLAGS_1 = -byteswapio –apo –O3
LDFLAGS = -byteswapio –apo –O3

OBJS =  strings.o boundaries.o grid_params.o sine_wave.o timers.o setup.o \
        ReadConfigFile.o tsunami.o work_routines.o masks.o output.o
```

Multiple Source Types (cont.)

```
.SUFFIXES:     .f .f90
.f90.o:
        $(CF) $(FFLAGS_1) -c $(<F)
.f.o:
        $(CF1) $(FFLAGS) -c $(<F)

tsunami: $(OBJS)
        $(CF) $(LDFLAGS) -o tsunami $(OBJS)
clean:
        rm -f *.o
        rm -f core
        rm -f tsunami
```

And another

- all: standard standard-O2 standard-O3 clp-opt-O2-dual clp-opt-O2-primal sparse-opt sparse-opt-O2 sparse-opt-O3 clp-opt-nosparse-O2

```
standard:
   g++ -o bin/standard \
      src/main.cpp \
      src/bhat.cpp \
      src/simplex.cpp \
      src/ivector.cpp \
      src/flows.cpp \

standard-O2:
   g++ -O2 -o bin/standard-O2 \
      src/main.cpp \
      src/bhat.cpp \
      src/simplex.cpp \
      src/ivector.cpp \
      src/flows.cpp \
```