

Data  
Assimilation  
Research  
Testbed



## DART Tutorial Section 11: Creating DART Executables



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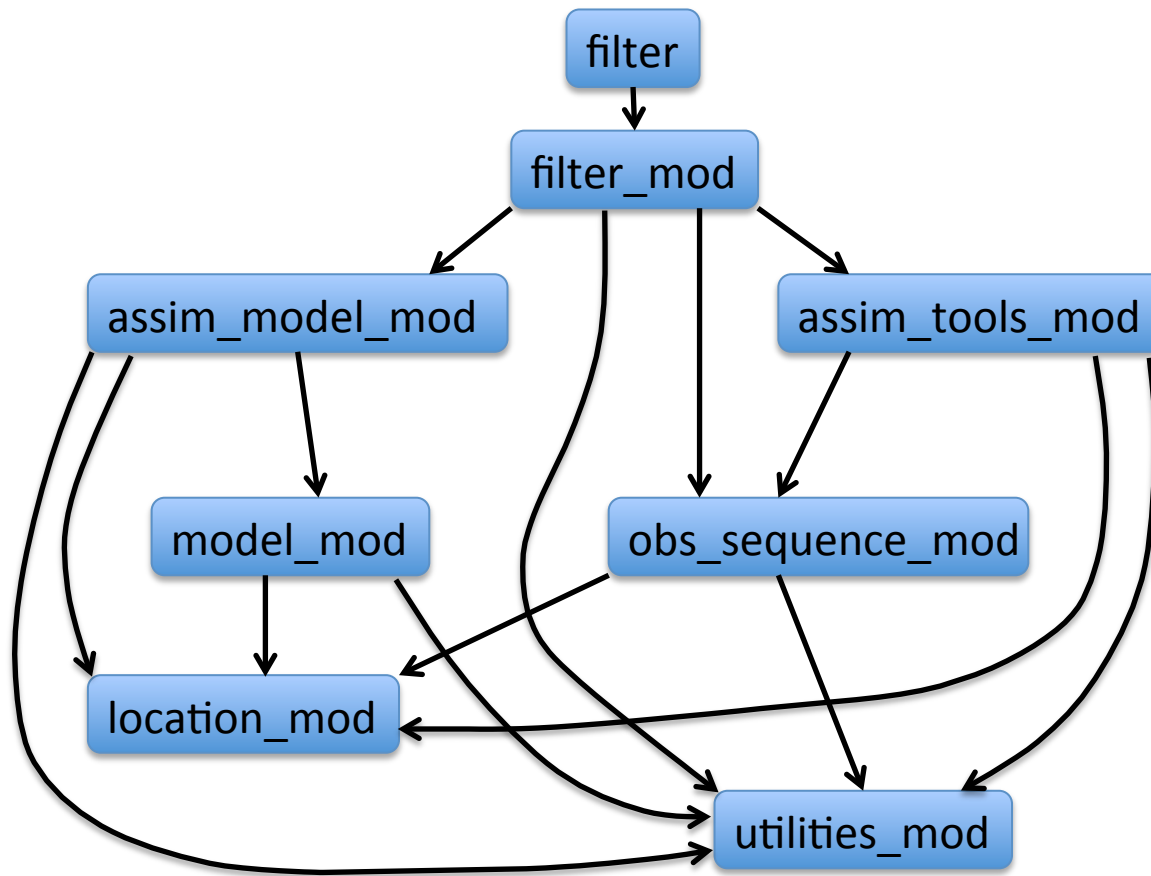
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# Fortran 90 'Use' Trees

DART requires use of F90 *use module\_mod, only:*

No other mechanism for use of 'external' routine.



Program viewed as  
Directed Acyclic Graph  
(tree with shared leaves)

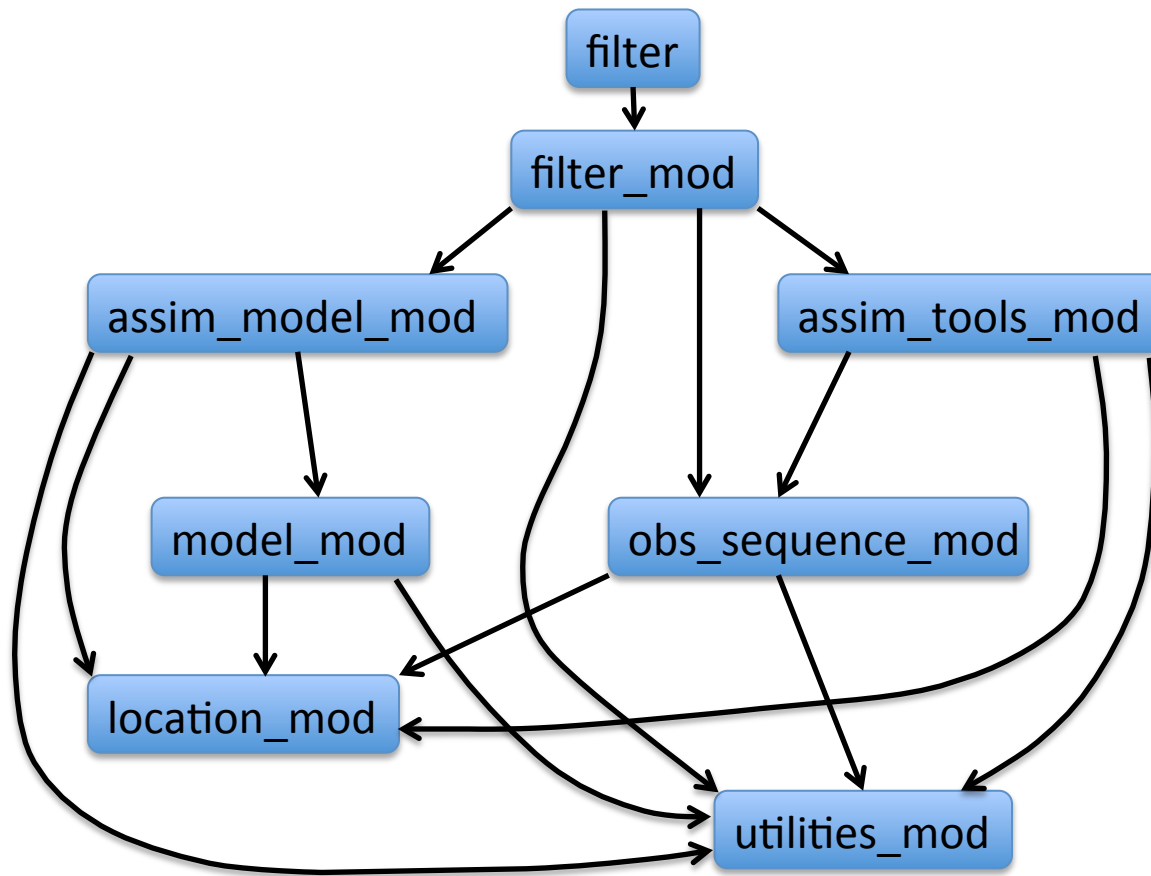
No cycles!

Partial tree for program  
filter is shown.

Vector represents use of  
target module.

# Generating a Makefile with mkmf

DART requires use of F90 *use module\_mod, only:*



Use **mkmf** perl script to *make a makefile*

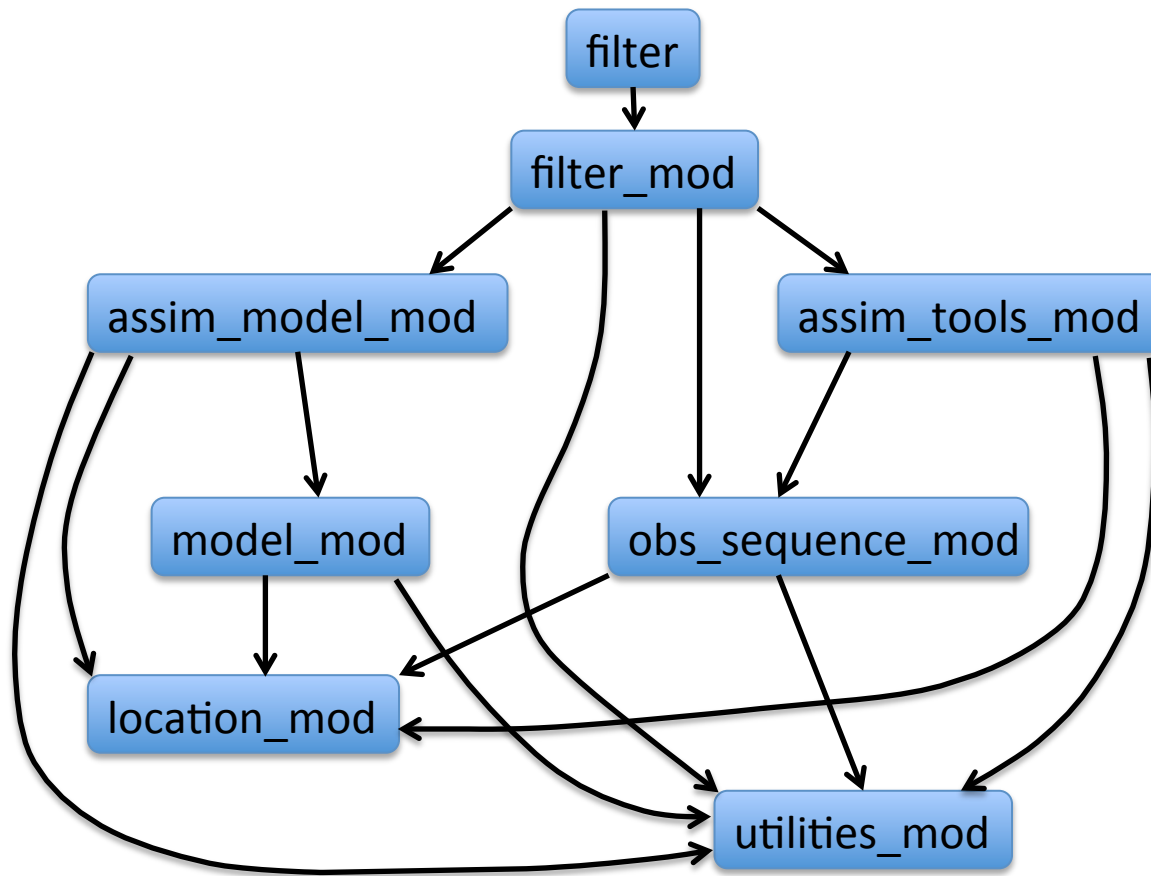
mkmf requires a list of files to search for the main program and modules that are used.

This is called a *path\_names* file.

See *path\_names\_filter* in *models/lorenz\_63/work*.

# Generating a Makefile with mkmf

DART requires use of F90 *use module\_mod, only:*



mkmf searches files in path\_names for one that contains *program filter*.

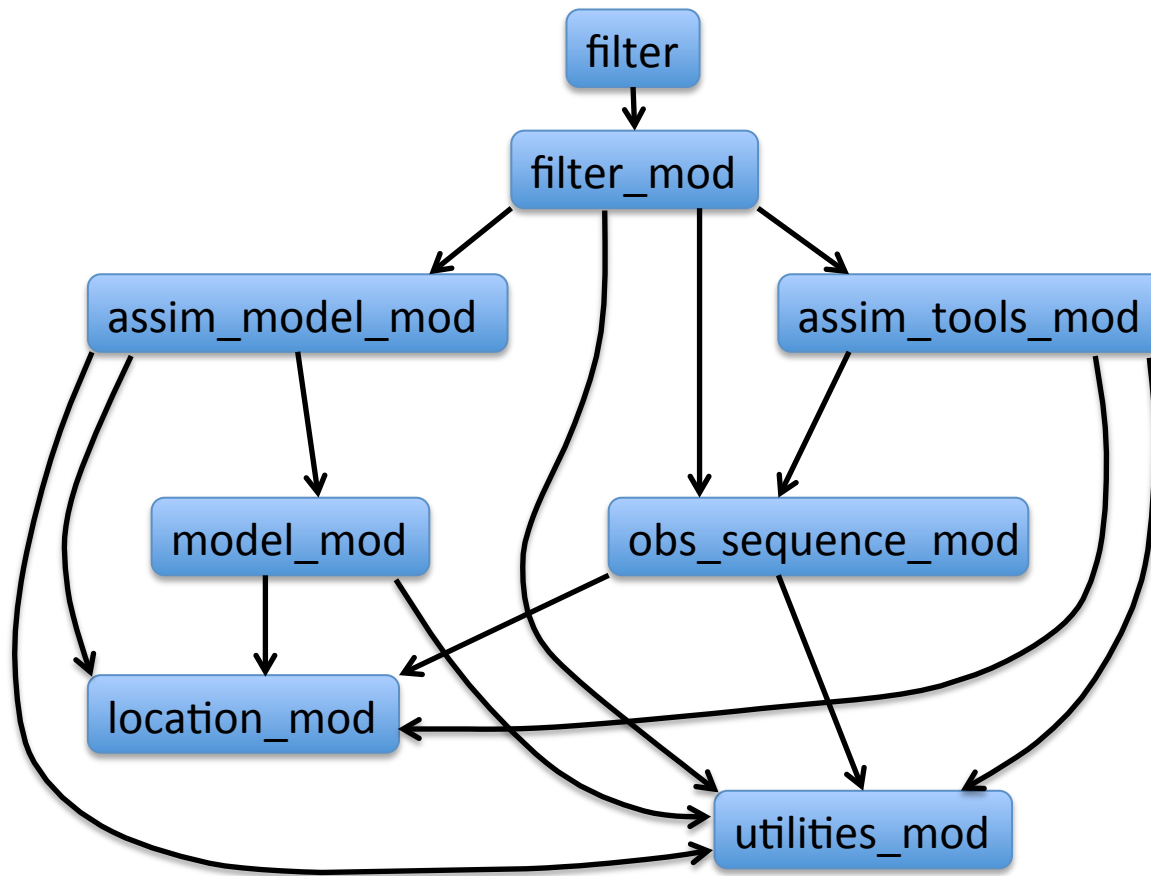
Finds first *use only* in filter.

Searches path\_names files for this module recursively.

Builds a dependency graph like one at left.

# Generating a Makefile with mkmf

DART requires use of F90 *use module\_mod, only:*



From dependency graph, mkmf generates a standard *Makefile*.

Also creates a default namelist file, *input.nml.filter\_default*.

Examine to see namelists required, default values.

Enter *make* to create filter executable.

# mkmf Details

Each DART program has *mkmf\_* and *path\_names\_* files. Can see a selection of these in *models/lorenz\_63/work*.

Let's look at *mkmf\_perfect\_model\_obs* first.

File *mkmf\_perfect\_model\_obs* contains (default values in parentheses):

1. Relative location of mkmf program (../../../build\_templates/mkmf)
2. Name of executable program to create (-p perfect\_model\_obs)
3. Compiler options file (-t ../../../build\_templates/mkmf.template)
4. Relative base location for file search (-a "../../.."),
5. Name of the path\_names file (path\_names\_perfect\_model\_obs).

# mkmf Details

A variety of mkmf templates for different machines and compilers are available in the directory *build\_templates* (You can also see the perl script *mkmf* there).

mkmf templates specify:

- What compiler to use,
- Where to find the netCDF libraries,
- Compile and link command line options.

Templates usually include comments about useful compiler and linker options for both debugging and production.

To change your template:

- Copy the appropriate *mkmf.template.xxx* file to *mkmf.template* and make any needed changes

# mkmf Details

File *mkmf\_filter* contains the same lines as other *mkmfs* but has additional scripting to build filter with or without MPI.

Two versions of the MPI module are available; one which really calls MPI and one with dummy routines.

The small models default to building a serial program.  
The large models default to building an MPI parallel version.

To run mkmf for filter, execute shell script *mkmf\_filter*:  
*./mkmf\_filter*    OR    *csh mkmf\_filter*



# DART Modular Philosophy

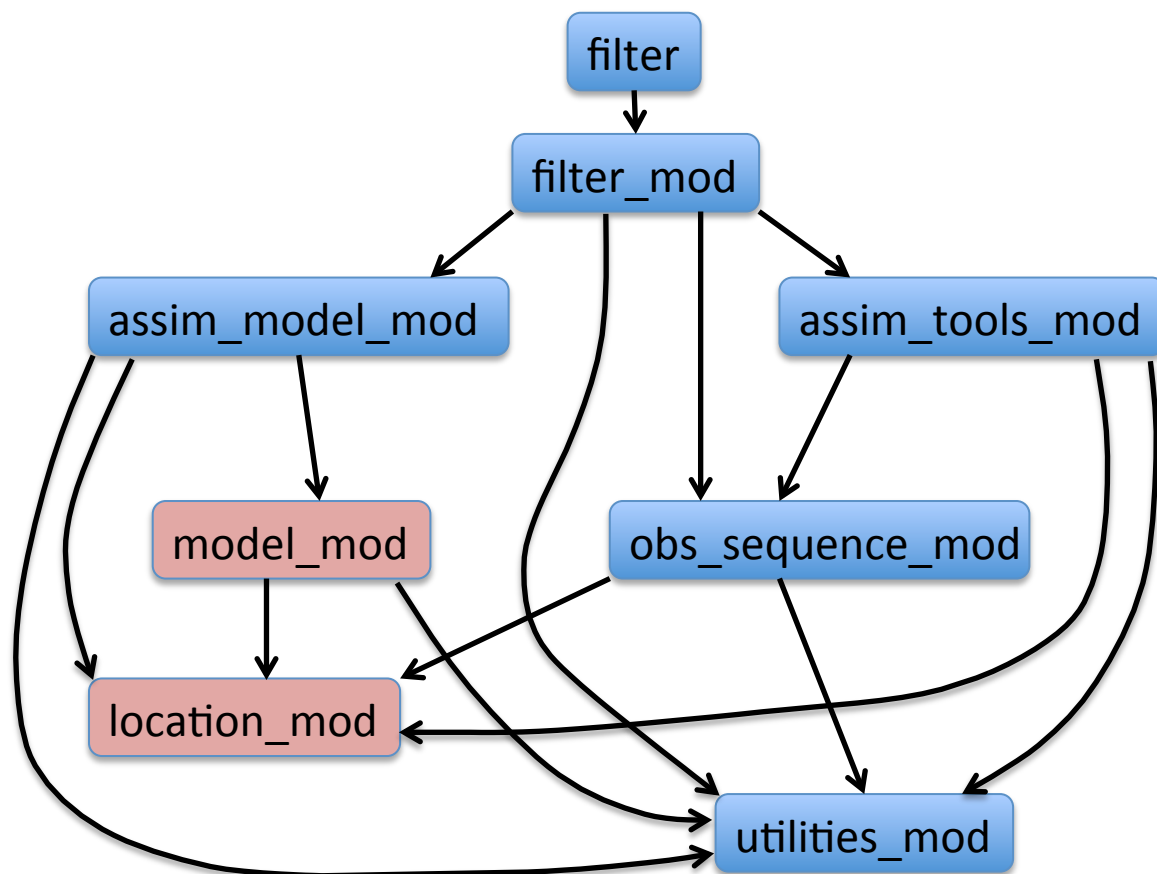
Can swap modules with same names and public interfaces.

Changing the following paths in `path_names_filter`:

`models/lorenz_63/model_mod.f90` -> `models/cam-fv/model_mod.f90`

`assimilation_code/location/oned/location_mod.f90` ->

`assimilation_code/location/threed_sphere/location_mod.f90`



switches from lorenz-63 to  
CAM-FV GCM!

Modules with multiple  
implementations have  
second directory level (see  
paths above).

Compare `path_names` files  
in `models/lorenz_63` with  
`models/cam-fv`

# Exercise: Compiling lorenz\_63 filter program

1. Go to *models/lorenz\_63/work*
2. Remove all files with .o and .mod extensions.
3. Generate a *Makefile* and *input.nml.filter\_default* by:  
*csh mkmf\_filter*
4. Generate program filter:  
Enter *make*

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