

Derived Types and Modules in Fortran

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Structures

Structures: type

The Fortran name for structures is `type` or *derived type*.

Type definition

Type name / End Type block.

Variable declarations inside the block

```
type mytype
  integer :: number
  character :: name
  real(4) :: value
end type mytype
```

Creating a type structure

Declare a type object in the main program:

```
Type(mytype) :: object1,object2
```

Initialize with type name:

```
object1 = mytype( 1, 'my_name', 3.7 )
```

Copying:

```
object2 = object1
```

Member access

Access structure members with %

```
Type(mytype) :: typed_object  
type_object%member = ....
```

Example

```
type point  
  real :: x,y  
end type point
```

```
type(point) :: p1,p2  
p1 = point(2.5, 3.7)  
  
p2 = p1  
print *,p2%x,p2%y
```

Type definitions can go in the main program

Types as subprogram argument

```
real(4) function length(p)          print *, "Length:", length(p2)
  implicit none
  type(point), intent(in) :: p
  length = sqrt( p%x**2 + p%y )
end function length
```


Exercise 1

Define a type `Point` that contains real numbers `x,y`.

Define a type `Rectangle` that contains two `Points`.

Write a function `area` that has one argument, a `Rectangle`.

Modules

Module definition

Modules look like a program, but without executable code:

```
Module definitions
  type point
    real :: x,y
  end type point
contains
  real(4) function length(p)
    implicit none
    type(point),intent(in) :: p
    length = sqrt( p%x**2 + p%y )
  end function length
end Module definitions
```

Module use

Module imported through use statement;
comes before implicit none

Program size

```
use definitions  
implicit none
```

```
type(point) :: p1,p2  
p1 = point(2.5, 3.7)
```

```
p2 = p1  
print *,p2%x,p2%y
```

end Program size

Exercise 2

Take exercise 1 and put all type definitions and all functions in a module.

Separate compilation of modules

Suppose program is split over `theprogram.F90` and `themodule.F90`.

- `icpc -c themodule.F90`; this gives
- an *object file* that will be linked later, and
- a `.mod` file (with the name of the module, not of the file);
- `icpc -c theprogram.F90` will read the `.mod` file; and finally
- `icpc -o myprogram theprogram.o themodule.o` uses the compiler as *linker* to form the executable.

The module needs to be compiled before the program.