NATURAL
ENVIRONMENT
RESEARCH COUNCIL

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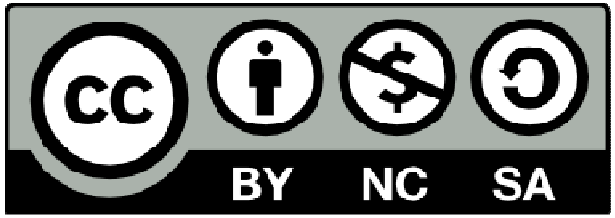
Derived Types

Reusing this material



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Derived data types

- Fortran allows the use of derived data types
  - Groups of data structures
  - Enables building of more sophisticated types than the intrinsic ones, i.e. linked data structures, lists, trees etc…
- Imagine we wish to specify objects representing persons
  - Each person is uniquely distinguished by a name and room number
  - We can define a corresponding “person” data type as follows:

```
type person
  character (len=10):: name
  integer            :: officeNumber
end type person
```

Derived data types

- To create a derived type variable you use the syntax:

```
type(person) :: fred, me
```

- Initialisation (construction) possible as well:

```
fred = person("Fred Jones", 21)
```

- **`fred`** is a variable containing 2 elements: **`name`**, **`officeNumber`**
- Elements (individual components) of derived type can be accessed by component selector: `%`

```
fred%name                ! contains the name of you
fred%officeNumber        ! contains the age of you
```

Derived data types

- Can perform computations using derived type variables as follows:
  - Difference in officeNumber between variables **`fred`** and **`me`**

```
integer :: officeNumberDiff
officeNumberDiff = fred%officeNumber - me%officeNumber
```

- I/O access components in defined order, i.e.:

```
fred%name
fred%officeNumber
```

Supertypes

- Derived type can be used in other derived types:

```
type corridor
  type(person),dimension(:),allocatable   :: rooms(:)
   integer                                :: numberOfRooms
end type corridor

type(corridor) :: a1
…
a1%rooms(1)%name
a1%numberOfRooms = 10
```

Further example

```
TYPE COORDS_3D
  REAL :: x, y, z
END TYPE COORDS_3D
TYPE SPHERE
  TYPE(COORDS_3D) :: centre
  REAL :: radius
END TYPE SPHERE
TYPE(SPHERE) :: ball
type(coords_3d) :: pt1
pt1 = COORDS_3D(3.0, 4.0, 5.0)
ball = SPHERE(centre=pt1, radius=5.0)
```

Summary

- Derived types can provide class like features for data
  - Package up similar/related data together
  - Use composition to build on other types
  - Don't bring functions together with the data
- Derived types can be included in modules
  - Together with module procedures can provide class like functionality
  - Module private can restrict data to module procedures only
  - Module private can restrict procedures to module procedures only
- Derived types and modules together can provide basic OO-like functionality
  - Does not necessarily provide proper data/procedure control
  - Does not provide inheritance
  - Can provide composition and basic polymorphism

Exercise

- Derived type basic exercises
- A separate CFD exercise
- Create appropriate derived types for the percolate exercise
  - What data structures could be grouped together? Which module should it be created in?