NATURAL ENVIRONMENT RESEARCH COUNCIL

EPSRC

Overloading, abstract classes, and inheritance

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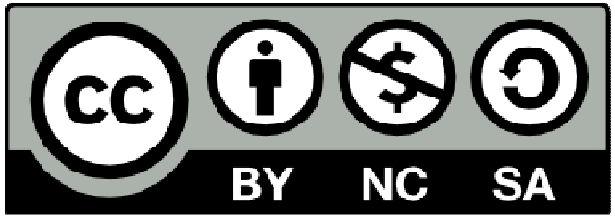
Reusing this material



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Overloading

- Recall that generic interfaces can enable procedure overloading:

```
module maths_functions
 interface my_sum
    module procedure real_sum
    module procedure int_sum
 end interface
 contains
 function real_sum (a, b)
   implicit none
   real, intent(in) :: a,b
   real_sum = a + b
 end function real_sum

 function int_sum (a, b)
   implicit none
   integer, intent(in) :: a,b
   int_sum = a + b
 end function int_sum
end module
```

Overloading in F2003

- `generic` keyword specifies polymorphism for type-bound procedure
  - polymorphism without interface block
  - Without this, type-bound procedures only resolve to a single method

```
GENERIC [, access-spec ] :: generic-spec =>
binding-name1 [, binding-name2]...
```

```
type maths_functions
contains
  procedure real_sum
  procedure int_sum
  generic :: my_sum => real_sum, int_sum
end type
```

Overloading

generic-spec

- Interface statement:
  - generic-name, must not be same as other type-binding
  - `operator (op)`
  - `assignment (=)`
- Allows for overloading of operators

```
type maths_functions
contains
  procedure real_sum
  generic :: operator(+) => real_sum
end type
```

Overloading

```
type maths_functions
contains
  procedure real_assign
  generic :: assignment(=) => real_assign
end type
```

Inheritance

- Can extend types in F2003

```
type, extends(parent_type_name) :: child_type_name
```

  - Inheritance specified via type extension
  - Parent type is extended by child type
  - Parent type may be a base type
  - Child type has access to all component in base type (and ancestors)
- Child type can add new components
  - New variables or procedures
- Includes implicit variable from parent class(es)

Inheritance example

```
type person
   private
     character(MAXLEN) :: name
     integer :: officeNumber
 contains
   private
     procedure, public :: getName
     procedure, public :: setName
     procedure, public :: getOfficeNumber
     procedure, public :: setOfficeNumber
 end type person
 type, extends(person) :: manager
 contains
   private
     procedure, public :: addPerson
     procedure, public :: removePerson
     procedure, public :: movePerson
     procedure, public :: getName => managerGetName
 end type
```

Inheritance example

```
type(manager) :: bob
type(person) :: fred

write(*,*) bob%getName()
write(*,*) bob%person%getName()

write(*,*) fred%getName()
call bob%movePerson(fred,35)
call fred%movePerson(bob,46)
```

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Abstract classes

- Can define `abstract` classes and `deferred` procedures
  - Define data
  - Define procedures and interfaces
  - Define implement procedures
  - Define procedures to be implement by further classes
- Abstract class cannot be instantiated or allocated
  - Can be used for class declaration in methods
    - Important for type hierarchies

Abstract class example

```
type, abstract :: individual
   private
     character(MAXLEN) :: name
     integer :: officeNumber
 contains
   private
     procedure, non_overridable, public :: getName
     procedure, non_overridable, public :: setName
     procedure, non_overridable, public :: getOfficeNumber
     procedure, non_overridable, public :: setOfficeNumber
     procedure(printStuff), deferred :: print
 end type individual
 abstract interface
    subroutine printStuff(self)
      import :: individual
      class(individual), intent(in) :: self
    end subroutine printStuff
 end interface
```

Abstract class example

```
type, extends(individual):: person
contains
   private
   procedure :: print => printPerson
end type person

type, extends(person) :: manager
contains
  private
  procedure :: movePerson()
  …
end type manager
```

Summary

- F2003 allows derived types to extend other derived types
  - Enables OO inheritance
- Abstract classes can be defined
  - Enables interface/specification of code without requiring implementation
- Operators and procedures can be overloaded
  - Same name used to call different procedures/operations based on the arguments passed

Exercise

- Extend your previous examples with operator overloading and class hierarchies (see the exercise sheet).
- Do the same for the percolate example.