

Fortran pointers

Kevin Schmidt, Susan Lindsey, Charlie Dey

Spring 2019

Pointers are aliases

- Pointer points at an object
- Access object through pointer
- You can change what object the pointer points at.

`real, pointer :: point_at_real`

C++ vs Fortran pointers

Fortran pointers are automatically *dereferenced*: if you print a pointer you print the object it references, not some representation of the pointer.

Setting the pointer

- You have to declare that a variable is pointable:

```
real,target :: x
```

- Set the pointer with => notation:

```
point_at_real => x
```

- Now using point_at_real is the same as using x.

```
print *,point_at_real ! will print the value of x
```

Pointer example

Code:

```
real,target :: x,y
real,pointer :: that_real

x = 1.2
y = 2.4
that_real => x
print *,that_real
that_real => y
print *,that_real
y = x
print *,that_real
```

Output

[pointerf] realp:

```
1.20000005
2.40000010
1.20000005
```

1. The pointer points at x, so the value of x is printed.
2. The pointer is set to point at y, so its value is printed.
3. The value of y is changed, and since the pointer still points at y, this changed value is printed.

Assign pointer from other pointer

```
real,pointer :: point_at_real,also_point  
point_at_real => x  
also_point => point_at_real
```

Now you have two pointers that point at x.

Very important to use the =>, otherwise strange memory errors

Pointer status

- Nullify: zero a pointer
- Associated: test whether assigned

Dynamic allocation

Associate unnamed memory:

```
Integer,Pointer,Dimension(:) :: array_point  
Allocate( array_point(100) )
```

This is automatically deallocated when control leaves the scope.

Exercise 1

Write a routine that accepts an array and a pointer, and on return has that pointer pointing at the largest array element:

Code:

```
real,dimension(10),target :: array &  
    = [1, 2, 3, 4, 5, 9, 8, 7, 6, 0]  
real,pointer :: biggest_element  
integer :: index  
logical :: correct  
  
print '(10f5.2,1x)',array  
call SetPointer(array,biggest_element)  
print *, "Biggest element is",  
    biggest_element  
biggest_element = 0  
print '(10f5.2,1x)',array
```

Output

[pointerf] arpointf:

```
1.00 2.00 3.00 4.00 5.00 9.00 8.00 7.00 6.00 0.00  
Biggest element is 9.00000000  
1.00 2.00 3.00 4.00 5.00 0.00 0.00 0.00 0.00 0.00
```

Linked list

- Linear data structure
- more flexible for insertion / deletion
- ... but slower in access

Linked list datatypes

- Node: value field, and pointer to next node.
- List: pointer to head node.

```
type node
  integer :: value
  type(node), pointer :: next
end type node
```

```
type list
  type(node), pointer :: head
end type list
```

```
type(list) :: the_list
nullify(the_list%head)
```

List initialization

First element becomes the list head:

```
allocate(new_node)
new_node%value = value
nullify(new_node%next)
the_list%head => new_node
```

Attaching a node

Keep the list sorted: new largest element attached at the end.

```
allocate(new_node)
new_node%value = value
nullify(new_node%next)
current%next => new_node
```

Inserting 1

Find the insertion point:

```
current => the_list%head ; nullify(previous)
do while ( current%value < value &
    .and. associated(current%next) )
    previous => current
    current => current%next
end do
```

Inserting 2

The actual insertion requires rerouting some pointers:

```
allocate(new_node)
new_node%value = value
new_node%next => current
previous%next => new_node
```