Fortran pointers

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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
Biggest element is   9.0000000
 1.00 2.00 3.00 4.00 5.00 0.00 8
```

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
```