Arrays

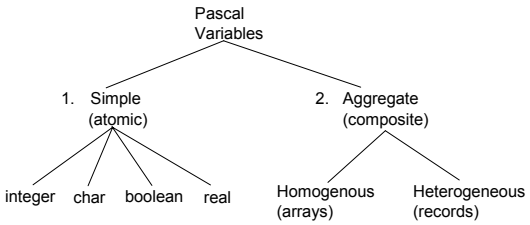
In this section of notes you will be introduced to a homogeneous composite type, one-dimensional arrays

Why Bother With Composite Types?

For a compilable example look in Unix under: /home/231/examples/arrays/classList1.p

```
const
  CLASS_SIZE =  5;
begin
  var stu1     : real;
  var stu2     : real;
  var stu3     : real;
  var stu4     : real;
  var stu5     : real;
  var total    : real;
  var average : real;
  write('Enter grade for student number 1: ');
  readln(stu1);
```

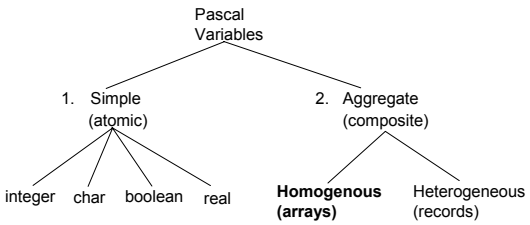

Types Of Variables



Why Bother With Composite Types? (2)

```
  write('Enter grade for student number 2: ');
  readln(stu2);
  write('Enter grade for student number 3: ');
  readln(stu3);
  write('Enter grade for student number 4: ');
  readln(stu4);
  write('Enter grade for student number 5: ');
  readln(stu5);
  total := stu1 + stu2 + stu3 + stu4 + stu5;
  average := total / CLASS_SIZE;
  writeln('The average grade is ', average:6:2, '%');
```


Types Of Variables



With Bother With Composite Types? (3)

```
(* Printing the grades for the class. *)
  writeln('Student1: ', stu1:6:2);
  writeln('Student2: ', stu2:6:2);
  writeln('Student3: ', stu3:6:2);
  writeln('Student4: ', stu4:6:2);
  writeln('Student5: ', stu5:6:2);
end.
```

With Bother With Composite Types? (3)

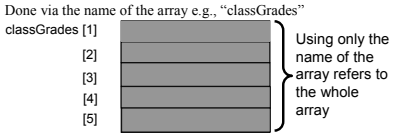
```
(* Printing the grades for the class. *)
  writeln('Student1: ', stu1:6:2);
  writeln('Student2: ', stu2:6:2);
  writeln('Student3: ', stu3:6:2);
  writeln('Student4: ', stu4:6:2);
  writeln('Student5: ', stu5:6:2);
end.
```

NO!

Accessing Data In The Array

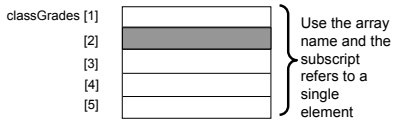
First you need to indicate which array is being accessed

- Done via the name of the array e.g., "classGrades"



If you are accessing a single element, you need to indicate which element that you wish to access.

- Done via the array index e.g., "classGrades[2]"



What's Needed

- A composite variable that is a collection of another type.
- The composite variable can be manipulated and passed throughout the program as a single entity.
- At the same time each element can be accessed individually.
- What's needed…an array!

Assigning Data To The Array

Format:

(Whole array)	(One element)
name of array	name of array [index]

Examples (assignment via the assignment operator):

(Whole array)	(One element)
firstArray := secondArray;	classGrades [1] := 100;

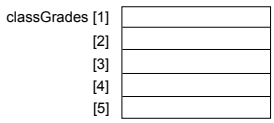
Declaring Arrays

Format:

name: array [*low index*..*high index*] of *element type*;

Example:

classGrades : array [1..CLASS_SIZE] of real;



Assigning Data To The Array (2)

Examples (assigning values via read or readln):

```
(Single element)
readln(classGrades[1]);


(Whole array – all elements)
for i: = 1 to CLASS_SIZE do
begin
   write('Input grade for student No. ', i, ': ');
   readln(classGrades[i]);
end;
```

Assigning Data To The Array (3)

(Whole array – all elements: Character arrays only)

```
var charArray : array [1..5] of char;
readln(charArray);
```


Revised Version Using An Array

For a compilable example look in Unix under:
/home/231/examples/arrays/classList2.p

```
const
  CLASS_SIZE =  5;
begin
  var classGrades : array [1..CLASS_SIZE] of real;
  var i           :  integer;
  var total       : real;
  var average     : real;
  total := 0;
```


Accessing Data In The Array

Examples (displaying information):

(Single element)

```
writeln(classGrades[1]);
```

(Whole array – all elements)

```
for i := 1 to CLASS_SIZE do
    writeln('Grade for student No. ', i:2, ' ', classGrades[i]:6:2);
```


Class Example Using An Array (2)

```
for i := 1 to CLASS_SIZE do
begin
    write('Enter grade for student no. ', i, ': ');
    readln (classGrades[i]);
    total := total + classGrades[i];
end;
average := total / CLASS_SIZE;
writeln;
writeln('The average grade is ', average:6:2, '%');

for i := 1 to CLASS_SIZE do
   writeln('Grade for student no. ', i, ' is ', classGrades[i]:6:2, '%');
```


Accessing Data In The Array (2)

(Whole array – all elements: Character arrays only)

```
var charArray : array [1..5] of char;
write(charArray);
```


Passing Arrays As Parameters

1. Declare a type for the array.

   e.g.

   ```
   type
      Grades = array [1..CLASS_SIZE] of real;
   ```

   - Declaring A type does not create an instance
     - A type only describes the attributes of a new kind of variable that can be created and used.
     - No memory is allocated.

Passing Arrays As Parameters (2)

2. Declare an instance of this type.
   e.g., var lecture01 : Grades;
   - Memory is allocated!

3. Pass the instance to functions/procedures as you would any other parameter.

```
(Function/procedure call)
 displayGrades (L01, average);

(Function/procedure definition)
procedure displayGrades (L01      : Grades;
                         average : real);
```


Passing Arrays As Parameters: An Example

The full example can be found in Unix under
/home/231/examples/classList3.p)

```
program classList (input, output);

const
  CLASS_SIZE =  5;

type
  Grades = array [1..CLASS_SIZE] of real;


procedure tabulateGrades (var lecture01      : Grades;
                          var average        : real);

var
  i      : integer;
  total : real;
```


Passing Arrays As Parameters: An Example (2)

```
begin      (* tabulateGrades *)
  total := 0;
  for i := 1 to CLASS_SIZE do
  begin
    write('Enter grade for student no. ', i, ': ');
    readln(lecture01[i]);
    total := total + lecture01[i];
  end;
  average := total / CLASS_SIZE;
  writeln;
end;       (* tabulateGrades *)
```


Passing Arrays As Parameters: An Example (3)

```
procedure displayGrades (lecture01      : Grades;
                                  average        : real);
var
  i : integer;
begin
  writeln('Grades for the class...');
  for i := 1 to CLASS_SIZE do
    writeln('Grade for student no. ', i, ' is ', lecture01[i]:6:2, '%');
  writeln('The average grade is ', average:6:2, '%');
  writeln;
end;
```


Passing Arrays As Parameters: An Example (4)

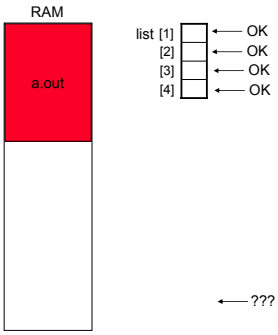
```
begin
  var lecture01 : Grades;
  var average   : real;
  tabulateGrades (lecture01, average);
  displayGrades (lecture01, average);
end.
```


Returning Arrays From Functions

1. Declare a type for the array.
   e.g.
   ```
   type
       Grades = array [1..CLASS_SIZE] of real;
   ```
2. Declare an instance of this type.
   e.g.,
   ```
   var lecture01 : Grades;
   ```
3. Return the instance of the array as you would any other return value.

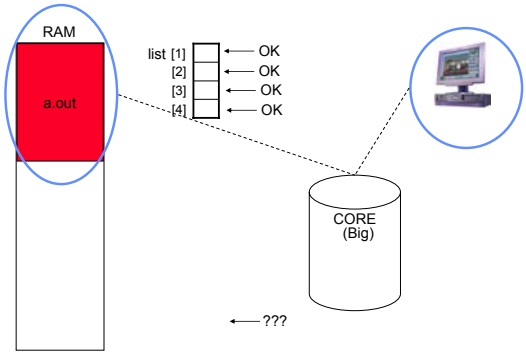
```
(Function/procedure call)
 lecture01 := fun (L01);

(Function/procedure definition)
function fun (lecture01 : Grades ): Grades;
```

Segmentation Faults And Arrays



James Tam

Segmentation Faults And Arrays



Wav file from "The SImpsons"

James Tam

You Should Now Know

- What is the difference between simple types (atomic) and composite types (aggregate)
- What is the benefit of using homogeneous composite types (arrays)
- How to declare arrays
- How to access or assign values to array elements
- How to work with an entire array
- How to pass instances of arrays into methods and how to return an array from a function.
- What is a segmentation fault and core dump file.

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