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Computer Programming

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Session: More on Structures

Quick Recap of Relevant Topics

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- Brief introduction to object-oriented programming
- Structures as collections of variables of possibly different data types
- Accessing members of structures
- Programming using simple structures

Overview of This Lecture

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- Common conventions when speaking of structures
- More features of structures
  - Structures as members of other structures
  - Initializing members of structures in structures
- Disallowed structure definitions
- Visibility of structure definitions in C++ programs

Acknowledgment

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- Some examples in this lecture are from

  An Introduction to Programming Through C++

  by Abhiram G. Ranade

  McGraw Hill Education 2014

- All such examples indicated in slides with the citation **AGRBook**

Common Conventions

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```
struct  MyStructType {
   int x;
   char y;
};

MyStructType  myVariable;
```

Common Conventions

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```
struct  MyStructType {
   int x;
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};

MyStructType  myVariable;
```

"structure" refers to a specific structure type

The definition of structure MyStructType is given here.

Common Conventions

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```
struct  MyStructType {
   int x;
   char y;
};

MyStructType  myVariable;
```

"structure" refers to a specific object of a structure type

The structure myVariable is used in the program.

Common Conventions

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```
struct  MyStructType {
   int x;
   char y;
};

MyStructType  myVariable;
```

"structure" refers to a an arbitrary object of type MyStructType

A structure of type MyStructType needs 5 bytes of storage

Common Conventions

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```
struct  MyStructType {
   int x;
   char y;
};

MyStructType  myVariable;
```

Member “x” of structure “myVariable” is like an object/variable of type int

myVariable.x = 12;

Points and Disks in 2D space [Ref. AGRBook]

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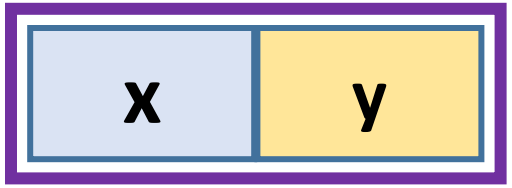
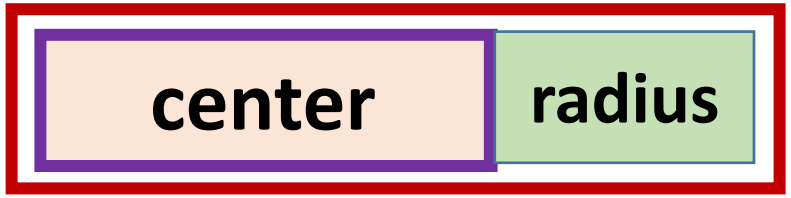
- We want to represent points and disks in 2-dimensional space
- Every point has an x-coordinate and a y-coordinate
- Every disk has a center (point) and a radius

```
struct Point {
   double x, y;
};
```




```
struct Disk {
   Point center;
   double radius;
};
```



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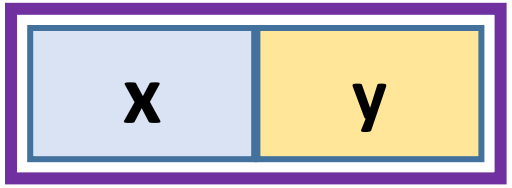


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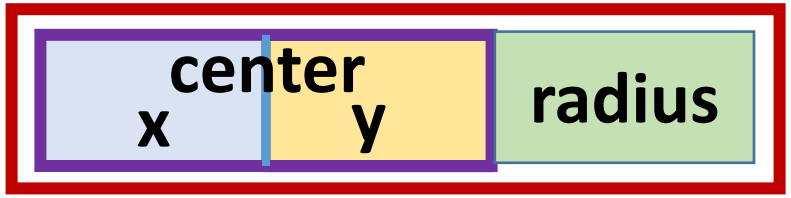
struct Disk {
   Point center;
   double radius;
};
```



Accessing Members of Structures in Structures

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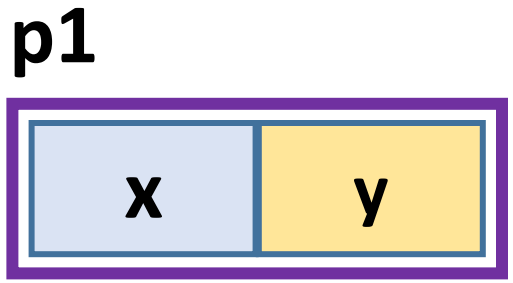
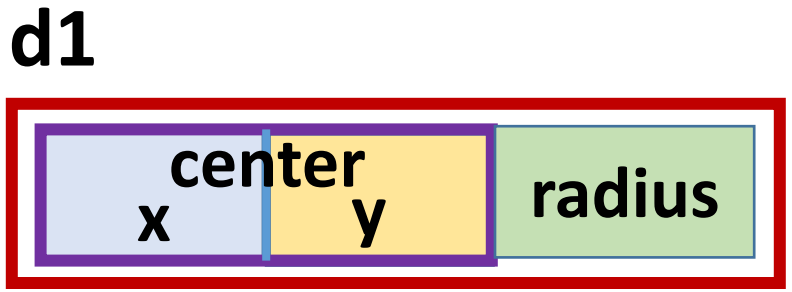
Point p1;

Disk d1;




```
struct Point {
   double x, y;
};
```




```
struct Disk {
   Point center;
   double radius;
};
```

Accessing Members of Structures in Structures

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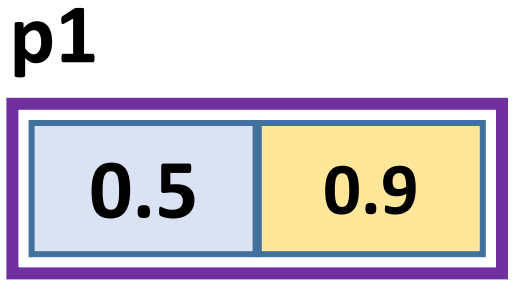
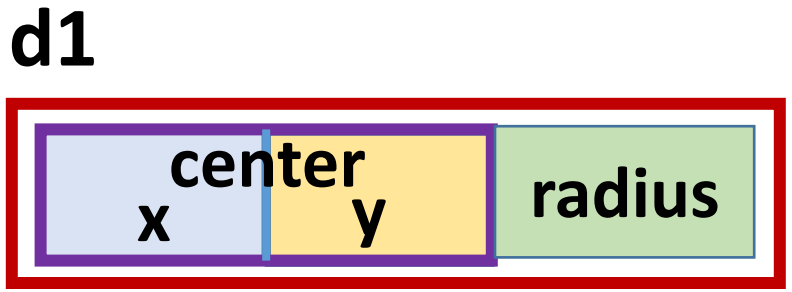
```
Point p1;
Disk d1;
p1.x = 0.5; p1.y = 0.9;
```




```
struct Point {
   double x, y;
};
```




```
struct Disk {
   Point center;
   double radius;
};
```

Accessing Members of Structures in Structures

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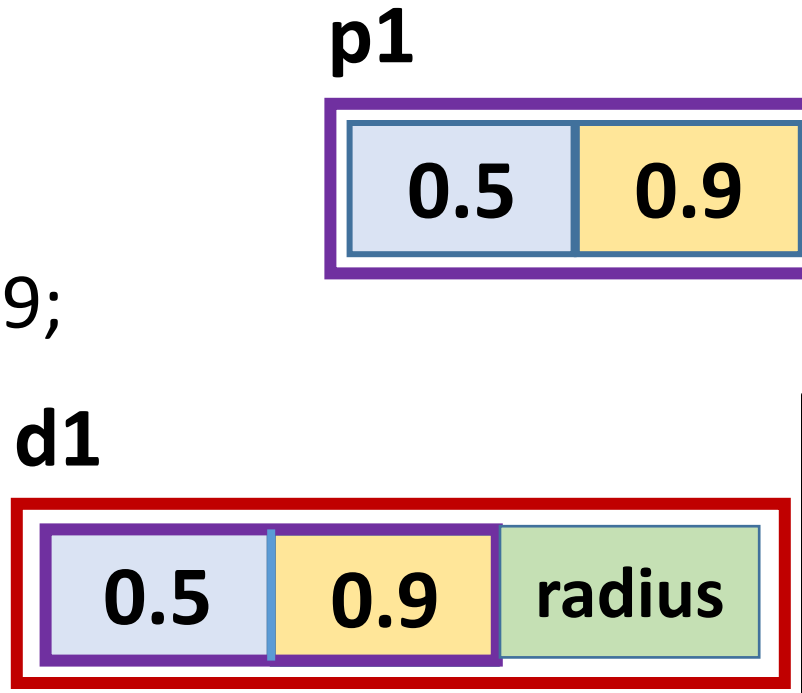
```
Point p1;
Disk d1;
p1.x = 0.5; p1.y = 0.9;
d1.center = p1;
```




```
struct Point {
  double x, y;
};
```

```
struct Disk {
  Point center;
  double radius;
};
```

Accessing Members of Structures in Structures

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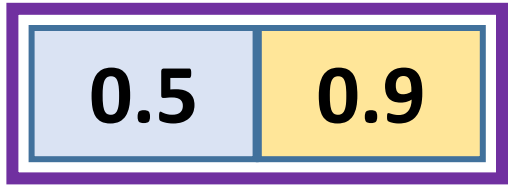
```
Point p1;
Disk d1;
p1.x = 0.5; p1.y = 0.9;
d1.center = p1;
d1.radius = 3.2;
```

p1




```
struct Point {
   double x, y;
};
```

d1


```
struct Disk {
   Point center;
   double radius;
};
```

Accessing Members of Structures in Structures

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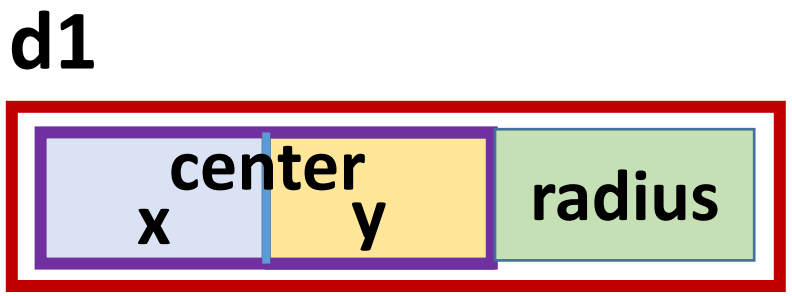
Disk d1;

```
struct Point {
   double x, y;
};
```




```
struct Disk {
   Point center;
   double radius;
};
```

Accessing Members of Structures in Structures

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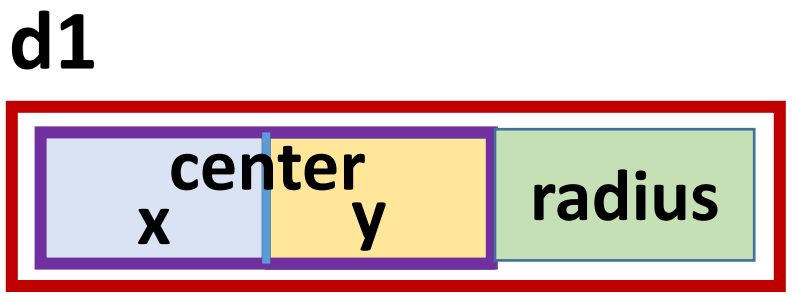
```
Disk d1;
d1.center.x = 0.5;
```

```
struct Point {
   double x, y;
};
```

```
struct Disk {
   Point center;
   double radius;
};
```



d1: Object of type Disk

Accessing Members of Structures in Structures

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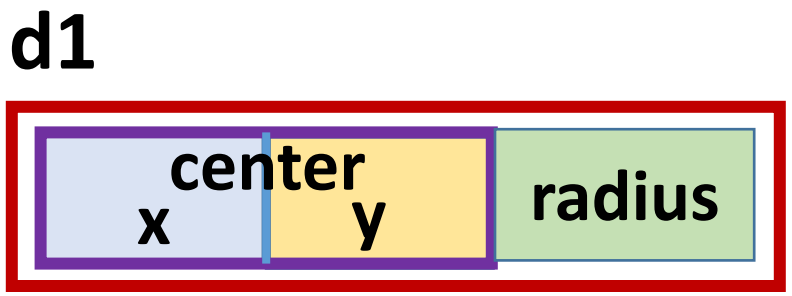
```
Disk d1;
d1.center.x = 0.5;
```

```
struct Point {
   double x, y;
};
```

```
struct Disk {
   Point center;
   double radius;
};
```



d1.center: Member "center" of d1 can be used as an object of type Point

Accessing Members of Structures in Structures

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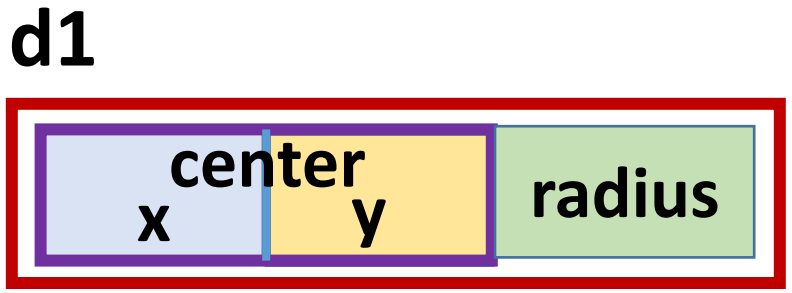
```
Disk d1;
d1.center.x = 0.5;
```

```
struct Point {
   double x, y;
};
```

```
struct Disk {
   Point center;
   double radius;
};
```



d1.center.x: Member "x" of d1.center can be used as an object of type double

Accessing Members of Structures in Structures

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```
Disk d1;
d1.center.x = 0.5;
d1.center.y = 0.9;
d1.radius = 3.2;
```

d1


```
struct Point {
   double x, y;
};
```

```
struct Disk {
   Point center;
   double radius;
};
```

Initializing Members of Structures in Structures

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```
Disk d1 = {{0.5, 0.9}, 3.2};
const Disk d2 = {{1.0, 2.0}, 3.0};
```

```
struct Point {
   double x, y;
};
```

d1

d2


```
struct Disk {
   Point center;
   double radius;
};
```

Disallowed Structure Construction

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- Structure type “StructType1” cannot have a member of the same structure type “StructType1”

```
struct StructType1 {
    int x;
    StructType1 y;
};
```

Storage required for an object of type StructType1 would be infinite!

Visibility of Structure Types

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- Where should we define structure types?
- If a structure type is used only in one function, it can be defined in the body of the function

```
void doSomethingWithDisks()
{ struct Point { double x, y; };
  struct Disk {Point center; double radius};
  // Code that does something with points and disks
  return;
}
```

Visibility of Structure Types

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- If a structure data type is used in multiple functions, it must be defined **outside and before** the functions in program file.

```
struct Point {double x, y;};
struct Disk {Point center; double radius;};

void doOneThingWithPointsAndDisks() { … return; }
void doAnotherThingWithPointsAndDisks() { … return; }
void updatePointsAndDisks(Point &p, Disk &d) { … return; }
```

Summary

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- Common conventions when speaking of structures
- Additional features of structures
  - Structures as members in other structures
  - Accessing and initializing members of structures in structures
- Illegal to have a structure with a member of the same structure type
- Visibility of structure types in a C++ program