

EECS 10: Computational Methods in Electrical and Computer Engineering

Lecture 20

Rainer Dömer

doemer@uci.edu

The Henry Samueli School of Engineering
Electrical Engineering and Computer Science
University of California, Irvine

Lecture 20: Overview

- Data Structures
 - Structures
 - Declaration and definition
 - Instantiation and initialization
 - Member access
 - Unions
 - Declaration and definition
 - Member access
 - Enumerators
 - Declaration and definition
 - Type definitions

Data Structures

- Structures (aka. records): **struct**
 - User-defined, composite data type
 - Type is a composition of (different) sub-types
 - Fixed set of members
 - Names and types of members are fixed at structure definition
 - Member access by name
 - Member-access operator: *structure_name.member_name*
- Example:

```
struct S { int i; float f;} s1, s2;

s1.i = 42;      /* access to members */
s1.f = 3.1415;
s2 = s1;       /* assignment */
s1.i = s1.i + 2*s2.i;
```

Data Structures

- Structure Declaration
 - Declaration of a user-defined data type
- Structure Definition
 - Definition of structure members and their type
- Structure Instantiation and Initialization
 - Definition of a variable of structure type
 - Initializer list defines initial values of members
- Example:

```
struct Student;      /* declaration */

struct Student      /* definition */
{ int ID;           /* members */
  char Name[40];
  char Grade;
};

struct Student Jane = /* instantiation */
{1001, "Jane Doe", 'A'}; /* initialization */
```

Data Structures

- Structure Access
 - Members are accessed by their name
 - Member-access operator .
- Example:

```

struct Student
{
    int ID;
    char Name[40];
    char Grade;
};

struct Student Jane =
{1001, "Jane Doe", 'A'};

void PrintStudent(struct Student s)
{
    printf("ID:    %d\n", s.ID);
    printf("Name:  %s\n", s.Name);
    printf("Grade: %c\n", s.Grade);
}

```

Jane	
ID	1001
Name	"Jane Doe"
Grade	'A'

```

ID:    1001
Name:  Jane Doe
Grade: A

```

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5

Data Structures

- Unions: **union**
 - User-defined, composite data type
 - Type is a composition of (different) sub-types
 - Fixed set of *mutually exclusive* members
 - Names and types of members are fixed at union definition
 - Member access by name
 - Member-access operator: *union_name.member_name*
 - *Only one member may be used at a time!*
 - *All members share the same location in memory!*
- Example:

```

union U { int i; float f;} u1, u2;

u1.i = 42;      /* access to members */
u2.f = 3.1415;
u1.f = u2.f;   /* destroys u1.i! */

```

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6

Data Structures

- Union Declaration
 - Declaration of a user-defined data type
- Union Definition
 - Definition of union members and their type
- Union Instantiation and Initialization
 - Definition of a variable of union type
 - *Single* initializer defines value of *first* member
- Example:

```
union HeightOfTriangle; /* declaration */
union HeightOfTriangle /* definition */
{ int Height; /* members */
  int LengthOfSideA;
  float AngleBeta;
};
union HeightOfTriangle H /* instantiation */
= { 42 }; /* initialization */
```

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7

Data Structures

- Union Access
 - Members are accessed by their name
 - Member-access operator .
- Example:

```
union HeightOfTriangle
{ int Height;
  int SideA;
  float Beta;
};
union HeightOfTriangle t1, t2, t3
= { 42 };
```

	t1
Height/	
SideA/	0
Beta	
	t2
Height/	
SideA/	0
Beta	
	t3
Height/	
SideA/	42
Beta	

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8

Data Structures

- Union Access
 - Members are accessed by their name
 - Member-access operator .
- Example:

```
union HeightOfTriangle
{
  int   Height;
  int   SideA;
  float Beta;
};

union HeightOfTriangle t1, t2, t3
= { 42 };

void SetHeight(void)
{
  t1.Height = 10;
  t2.SideA = t1.Height / 2;
  t3.Beta = 90.0;
}
```

	t1
Height/	
SideA/	10
Beta	
	t2
Height/	
SideA/	5
Beta	
	t3
Height/	
SideA/	90.0
Beta	

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9

Data Structures

- Enumerators: **enum**
 - User-defined data type
 - Members are an enumeration of integral constants
 - Fixed set of members
 - Names and values of members are fixed at enumerator definition
 - Members are constants
 - Member values cannot be changed after definition
- Example:

```
enum E { red, yellow, green };
enum E LightNS, LightEW;

LightEW = green;          /* assignment */
if (LightNS == green)    /* comparison */
  { LightEW = red; }
```

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10

Data Structures

- Enumerator Declaration
 - Declaration of a user-defined data type
- Enumerator Definition
 - Definition of enumerator members and their value
- Enumerator Instantiation and Initialization
 - Definition of a variable of enumerator type
 - Initializer should be one member of the enumerator
- Example:

```
enum Weekday;           /* declaration */
enum Weekday           /* definition */
{ Monday, Tuesday,    /* members */
  Wednesday, Thursday,
  Friday, Saturday, Sunday
};
enum Weekday Today     /* instantiation */
= Wednesday;          /* initialization */
```

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11

Data Structures

- Enumerator Values
 - Enumerator values are integer constants
 - By default, enumerator values start at 0 and are incremented by 1 for each following member

- Example:

Today

Wednesday

Day: 2

```
enum Weekday
{ Monday,
  Tuesday,
  Wednesday,
  Thursday,
  Friday,
  Saturday,
  Sunday
};
enum Weekday Today
= Wednesday;
void PrintWeekday(
    enum Weekday d)
{
    printf("Day: %d\n", d);
}
```

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12

Data Structures

- Enumerator Values
 - Enumerator values are integer constants
 - By default, enumerator values start at 0 and are incremented by 1 for each following member
 - Specific enumerator values may be defined by the user
- Example:

Today

Wednesday

Day: 3

```
enum Weekday
{ Monday = 1,
  Tuesday,
  Wednesday,
  Thursday,
  Friday,
  Saturday,
  Sunday
};

enum Weekday Today
= Wednesday;

void PrintWeekday(
    enum Weekday d)
{
    printf("Day: %d\n", d);
}
```

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13

Data Structures

- Enumerator Values
 - Enumerator values are integer constants
 - By default, enumerator values start at 0 and are incremented by 1 for each following member
 - Specific enumerator values may be defined by the user
- Example:

Today

Wednesday

Day: 4

```
enum Weekday
{ Monday = 2,
  Tuesday,
  Wednesday,
  Thursday,
  Friday,
  Saturday,
  Sunday = 1
};

enum Weekday Today
= Wednesday;

void PrintWeekday(
    enum Weekday d)
{
    printf("Day: %d\n", d);
}
```

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14

Data Structures

- Type definitions: `typedef`
 - A *typedef* can be defined as an alias type for another type
 - A *typedef* definition follows the same rules as a variable definition
 - Type definitions are usually used to abbreviate access to user-defined types
- Examples:

```
typedef long MyInteger;  
  
typedef enum Weekday Day;  
Day Today;  
  
typedef struct Student Scholar;  
Scholar Jane, John;
```