CSE 333 AA
Section 02
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Structures in C

Defining a struct:

```c
struct orchard_st { char name[20]; };
```

Using a struct:

```c
struct orchard_st my_orchard;
```

Does this work?

```c
orchard_st my_orchard;
```
Structures in C

Defining a struct:

```c
struct orchard_st {
    char name[20];
};
```

Using typedef to create type name aliases:

```c
typedef struct orchard_st Orchard, *OrchardPtr;
```

Now:

```c
Orchard x;  // is equivalent to:  struct orchard_st x;
OrchardPtr y;  // is equivalent to:  struct orchard_st *y;
```
Structures in C

Combining structure definition with typedef:

```c
typedef struct orchard_st {
    char name[20];
} Orchard, *OrchardPtr;
```
void func(Orchard x) {
    x.name[0] = 'B';
}

int main(int argc, char *argv[]) {
    Orchard my_orchard;
    strcpy(my_orchard.name, "A");
    func(my_orchard);
    return 0;
}
Structures are passed by value

```c
void func(Orchard x) {
    x.name[0] = 'B';
}

int main(int argc, char *argv[]) {
    Orchard my_orchard;
    strcpy(my_orchard.name, "A");
    func(my_orchard);
    return 0;
}
```

Stack frame of main:

```
<table>
<thead>
<tr>
<th>name</th>
<th>0x00</th>
<th>0x??</th>
<th>0x??</th>
</tr>
</thead>
<tbody>
<tr>
<td>'A'</td>
<td>0x00</td>
<td>0x??</td>
<td>0x??</td>
</tr>
<tr>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
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<td>0x??</td>
</tr>
<tr>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
</tr>
</tbody>
</table>
```

This diagram illustrates the stack frame for the `main` function, showing the allocation of memory for the `my_orchard` structure.
Structures are passed by value

```c
void func(Orchard x) {
    x.name[0] = 'B';
}

int main(int argc, char *argv[]) {
    Orchard my_orchard;
    strcpy(my_orchard.name, "A");
    func(my_orchard);
    return 0;
}
```
Structures are passed by value

```c
void func(Orchard x) {
    x.name[0] = 'B';
}

int main(int argc, char *argv[]) {
    Orchard my_orchard;
    strcpy(my_orchard.name, "A");
    func(my_orchard);
    return 0;
}
```

Stack frame of main:

<table>
<thead>
<tr>
<th>name</th>
<th>0x00</th>
<th>0x??</th>
<th>0x??</th>
</tr>
</thead>
<tbody>
<tr>
<td>'A'</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Stack frame of func:

<table>
<thead>
<tr>
<th>name</th>
<th>0x00</th>
<th>0x??</th>
<th>0x??</th>
<th>0x??</th>
</tr>
</thead>
<tbody>
<tr>
<td>'B'</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
</tr>
<tr>
<td></td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
</tr>
<tr>
<td></td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
</tr>
<tr>
<td></td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
<td>0x??</td>
</tr>
</tbody>
</table>
Structures are passed by value

void func(Orchard x) {
    x.name[0] = 'B';
}

int main(int argc, char *argv[]) {
    Orchard my_orchard;
    strcpy(my_orchard.name, "A");
    func(my_orchard);
    return 0;
}
Worksheet Problem 1

typedef struct orchard_st {
    char name[20];
} Orchard, *OrchardPtr;

typedef struct fruit_st {
    OrchardPtr origin;
    double weight;
    int volume;
} Fruit, *FruitPtr;

Example usage:
a Fruit object:

| origin: | weight: 2.0 | volume: 5 |

an Orchard object:

| name: | Angry Orchards |
Worksheet Problem 1

main:

bt: name: ?????????

apple: origin: ???
weight: ???
volume: ???

applePtr: ???
Worksheet Problem 1

main:
bt: name: Apple Orchard
apple:
  origin: ???
  weight: ???
  volume: ???
applePtr: ???
Worksheet Problem 1

bt:

apple:

applePtr:

main:

name: Apple Orchard

origin:

weight: ???

volume: ???
Worksheet Problem 1

bt:
  name: **Apple Orchard**

apple:
  origin: 
  weight: **10.5**
  volume: **???**

applePtr:
Worksheet Problem 1

main:
bt:

apple:
origin:
weight: 10.5
volume: 33

applePtr:
Worksheet Problem 1

main:

bt:

apple:

applePtr:
Worksheet Problem 1

1. 20.5, 33, Apple Orchard

bt: name: Apple Orchard

apple: origin: weight: 20.5 volume: 33

applePtr:
Worksheet Problem 1

bt:
name: Apple Orchard

apple:
origin: 
weight: 20.5
volume: 33

applePtr: 

eatFruit:
fruit:
origin: 
weight: 20.5
volume: 33

1. 20.5, 33, Apple Orchard
Worksheet Problem 1

bt:

apple:

applePtr:

main:

eatFruit:

fruit:

1. 20.5, 33, Apple Orchard

<table>
<thead>
<tr>
<th>apple</th>
<th>origin:</th>
<th>weight:</th>
<th>volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20.5</td>
<td>33</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>fruit</th>
<th>origin:</th>
<th>weight:</th>
<th>volume:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>20.0</td>
<td>33</td>
</tr>
</tbody>
</table>
Worksheet Problem 1

1. 20.5, 33, Apple Orchard

```
bt: name: Apple Orchard

apple:
    origin: 
    weight: 20.5
    volume: 33

applePtr: 

eatFruit:

fruit:
    origin: 
    weight: 20.0
    volume: 23
```
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
Worksheet Problem 1

bt:
  name: Eaten Fruit Orchard

apple:
  origin: 
  weight: 20.5
  volume: 23

applePtr:
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard

bt:

apple:

applePtr:

main:

name: Eaten Fruit Orchard

origin:

weight: 20.5

volume: 23

fruitPtr:

growFruit:
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard

```
bt: {
    name: "Eaten Fruit Orchard"
}

apple: {
    origin: 
    weight: 333.0
    volume: 23
}

applePtr: 

fruitPtr: 

growFruit: 
```
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard

bt:
- name: Eaten Fruit Orchard

apple:
- origin:
- weight: 333.0
- volume: 30

applePtr:

fruitPtr:

growFruit:
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard

main:

bt:
  name: Eaten Fruit Orchard

apple:
  origin: 
  weight: 333.0
  volume: 30

applePtr:
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
Worksheet Problem 1

bt:
- name: Eaten Fruit Orchard

apple:
- origin: 
- weight: 333.0
- volume: 30

applePtr:

exchangeFruit:

fruitPtrPtr:

banana: ???

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
### Worksheet Problem 1

<table>
<thead>
<tr>
<th>Number</th>
<th>Origin</th>
<th>Orchard</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20.5, 33</td>
<td>Apple Orchard</td>
</tr>
<tr>
<td>2</td>
<td>20.5, 23</td>
<td>Eaten Fruit Orchard</td>
</tr>
<tr>
<td>3</td>
<td>333.0, 30</td>
<td>Eaten Fruit Orchard</td>
</tr>
</tbody>
</table>

#### Diagram:

- **bt**: `name: Eaten Fruit Orchard`
- **apple**: `origin:`, `weight: 333.0`, `volume: 30`
- **applePtr**:
- **exchangeFruit**: `fruitPtrPtr:`, `banana: ???`
- **heap**: `origin: ???`, `weight: ???`, `volume: ???`
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard

main:

bt:

name: Eaten Fruit Orchard

apple:

origin: 
weight: 333.0
volume: 30

applePtr:

exchangeFruit:

fruitPtrPtr:

banana:

heap:

origin: ???
weight: 50.0
volume: ???
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard

main:

bt: name: Eaten Fruit Orchard

apple:
origin:
weight: 333.0
volume: 30

applePtr:

exchangeFruit:

fruitPtrPtr:

banana:

heap:
origin:
weight: 50.0
volume: 12

name: ????????????
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard

```
bt:
  name: Eaten Fruit Orchard

apple:
  origin: 
  weight: 333.0
  volume: 30
  applePtr: 

applePtr:

exchangeFruit:
  fruitPtrPtr: 

heap:
  origin: 
  weight: 50.0
  volume: 12

name: Banana Orchard
```

banana:
Worksheet Problem 1

bt:
  name: Eaten Fruit Orchard

apple:
  origin: 
  weight: 333.0
  volume: 30

applePtr: 

main:

exchangeFruit:
  fruitPtrPtr:
  banana: 

heap:
  origin: 
  weight: 50.0
  volume: 12

name: Banana Orchard

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard

main:

bt:
- name: Eaten Fruit Orchard

apple:
- origin:
- weight: 333.0
- volume: 30

applePtr:

heap:

- origin:
- weight: 50.0
- volume: 12
- name: Banana Orchard
Worksheet Problem 1

main:

bt: name: Eaten Fruit Orchard

apple:
- origin: 
- weight: 333.0
- volume: 30

applePtr: 

heap:

origin: 
weight: 50.0
volume: 12

name: Banana Orchard

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
4. 50.0, 12, Banana Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
4. 50.0, 12, Banana Orchard
Worksheet Problem 1

1. 20.5, 33, Apple Orchard
2. 20.5, 23, Eaten Fruit Orchard
3. 333.0, 30, Eaten Fruit Orchard
4. 50.0, 12, Banana Orchard

main:

bt:

name: Eaten Fruit Orchard

apple:

origin: 
weight: 333.0
volume: 30

applePtr: 

(Dangling!)