Basis and Practice in Programming

Lab 9

Structure

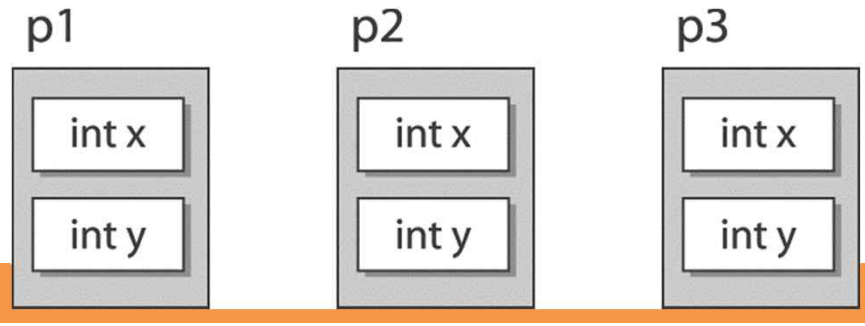
- User defined data structure
  - Consists of one or more basic data type

```
struct point            // declaring a structure named as 'point'
{
    int x;              // a member of the structure int x
    int y;              // a member of the structure int y
};
```

Structure

- Declaration of structure
  - Case 1

```
struct point {
   int x;
   int y;
} p1, p2, p3;

int main(void)
{
   . . . . .
}
```



Structure

- Declaration of structure
  - Case 2

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

int main(void)
{
   struct point p1, p2, p3;
   ...
   return 0;
}
```

Structure

- Accessing structure variable

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

int main(void)
{
   struct point p1;
   p1.x=10;                    // assign 10 to x, a member of p1
   p1.y=20;                    // assign 20 to y, a member of p1
   ...
   return 0;
}
```

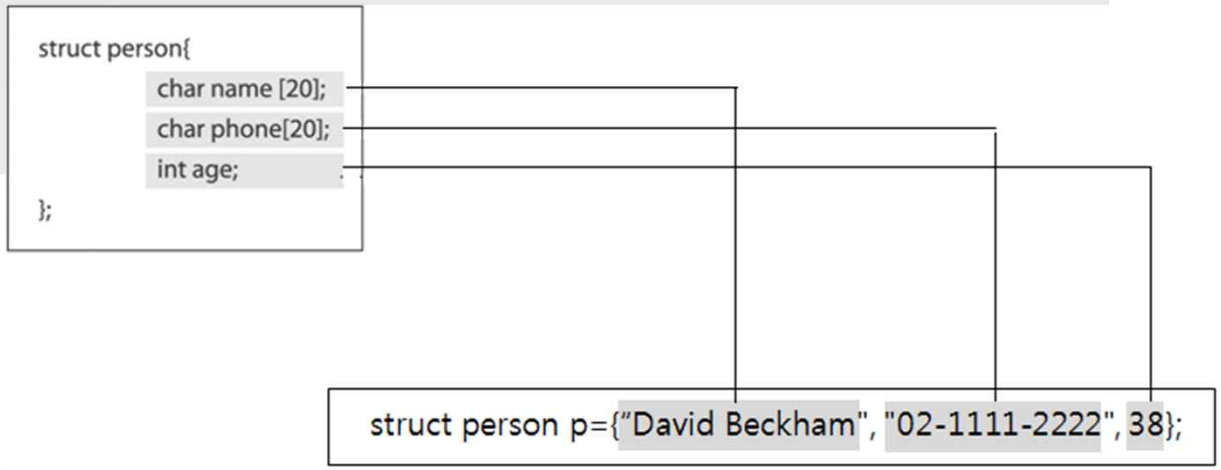
Structure

```
/* Lab 9 example 1 */

#include <stdio.h>
#include <math.h>

struct point{
    int x;
    int y;
};

int main(void)
{
    struct point p1, p2;
    double distance;

    printf("Input x, y position of 1st point : ");
    scanf("%d %d", &p1.x, &p1.y);

    printf(" Input x, y position of 1st point : ");
    scanf("%d %d", &p2.x, &p2.y);

    /* getting distance between the two points */
    distance = sqrt((p1.x-p2.x)*(p1.x-p2.x)
                +(p1.y-p2.y)*(p1.y-p2.y));

    printf("Distance of two points : %f₩n", distance);

    return 0;
}
```

Structure

- Initialization of structure variable

```
struct person {
    char name[20];
    char phone[20];
    int age;
};
int main (void)
{
    struct person p={“David Beckham", "02-1111-2222", 38};
    …
    return 0;
}
```



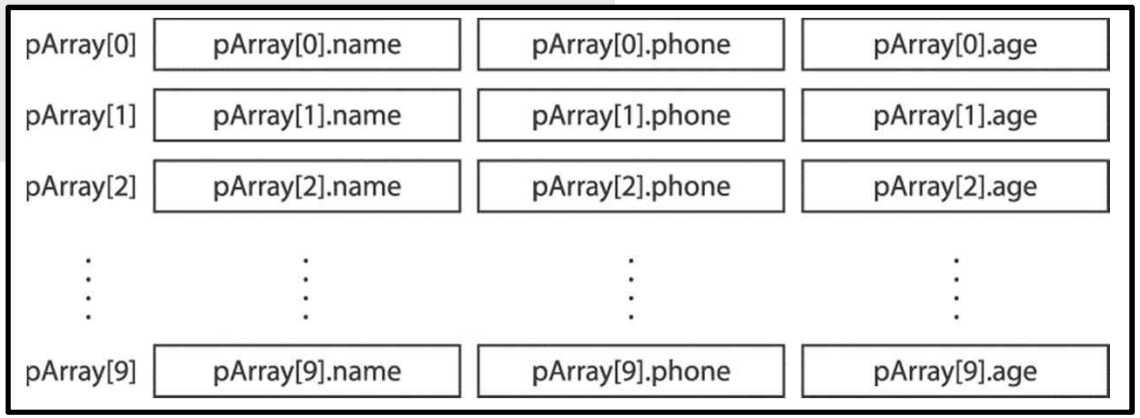
Structure

```
/* Lab 9 example 2 */

#include <stdio.h>
#include <string.h>

struct person
{
        char name[20];
        char phone[20];
};

int main(void)
{
        struct person p;

        strcpy(p.name, "Daniel Henny");
        strcpy(p.phone, "02-1212-2323");

        printf("name : %s, phone : %s ₩n", p.name, p.phone);

        return 0;
}
```

Structure

- Declaration of array of structure

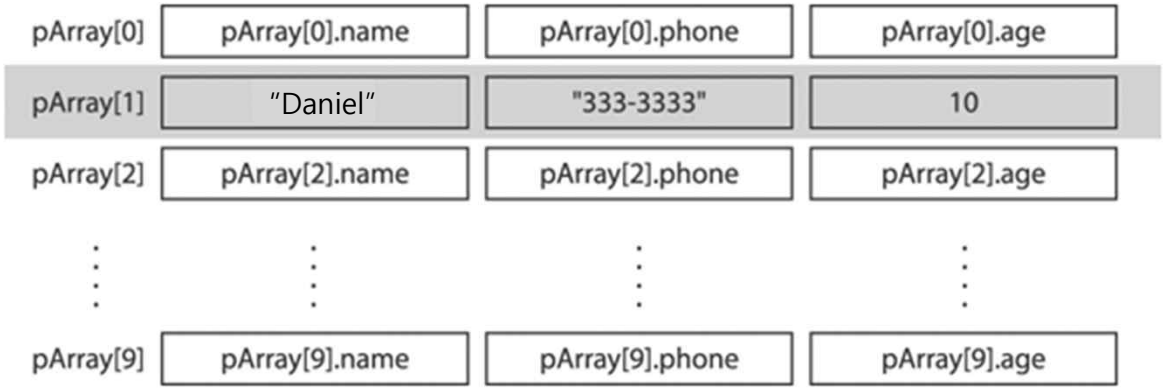
```
struct person {
    char name[20];
    char phone[20];
    int age;
};

int main (void)
{
    struct person pArray[10];
    ...
    return 0;
}
```



Structure

- Accessing an element of structure array

```
pArray[1].age=10;                                          //
accessing age of 2nd element
strcpy(pArray[1].name, “Daniel”);                          //
accessing name of 2nd element
strcpy(pArray[1].phone, “333-3333”);                       //
accessing phone of 2nd element
```



Structure

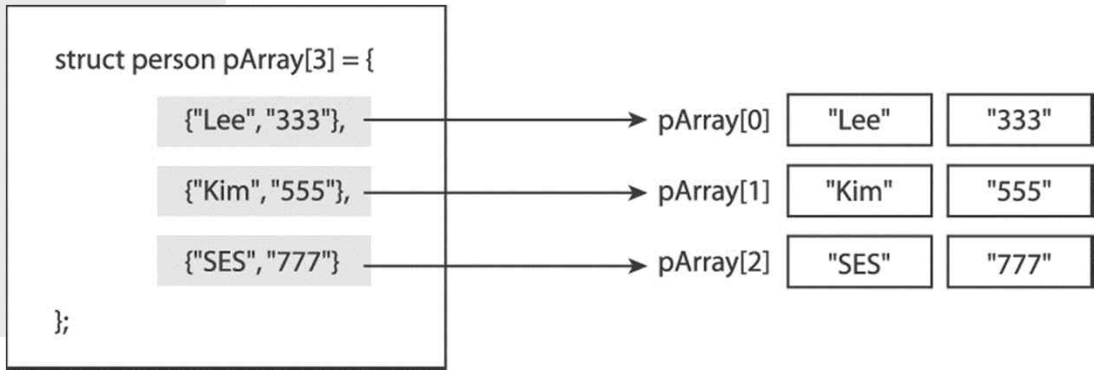
```
/* Lab 9 example 3 */

#include <stdio.h>

struct person {
    char name[20];
    char phone[20];
};

int main (void)
{
    struct person pArray[3];
    int i;

    for(i=0; i<3; i++)    // Input data
    {
        printf("Input name and phone number : ");
        scanf("%s %s", pArray[i].name, pArray[i].phone);
    }
```

```
printf("₩nResult of input information₩n");

    for(i=0; i<3; i++) //Output data
    {
        printf("Name : %s, ", pArray[i].name);
        printf("Phone : %s₩n", pArray[i].phone);
    }

    return 0;
}
```

Structure

- Initialization of structure array

```
struct person {
     char name[20];
     char phone[20];
};

int main (void)
{
    struct person pArray[3]={
          {"Lee", "333"},
          {"Kim", "555"},
          {"SES", "777"}
    };
    .....
    return 0;
}
```



Structure

- Structure and pointer
  - Case 1
    - Declares structure pointer and references structure variable
  - Case 2
    - Pointer variable is declared as a member of structure

Structure

```
/* Lab 9 example 4 */

#include <stdio.h>

struct person {
    char name[20];
    char phone[20];
};

int main()
{
    struct person man={"Thomas", "354-00xx"};
    struct person * pMan;
    pMan=&man;

    // using structure variable
    printf("name : %s₩n", man.name);
    printf("phone : %s₩n", man.phone);

    // using structure pointer 1
    printf("name : %s₩n", (*pMan).name);
    printf("phone : %s₩n", (*pMan).phone);

    // using structure pointer 2
    printf("name : %s₩n", pMan->name);
    printf("phone : %s₩n", pMan->phone);

    return 0;
}
```

Structure

```
/* Lab 9 example 5 */

#include <stdio.h>

struct perInfo {
    char addr[30];
    char tel[20];
};

struct person {
    char name[20];
    char pID[20];
    struct perInfo* info;
};
```

```
int main()
{
    struct perInfo info={"Korea Seoul", "333-4444"};
    struct person man={"Mr. Lee", "820204-xxxx512"};

    man.info=&info;

    printf("name : %s₩n", man.name);
    printf("pID  : %s₩n", man.pID);
    printf("addr : %s₩n", man.info->addr);
    printf("tel  : %s₩n", man.info->tel);

    return 0;

}
```

Structure

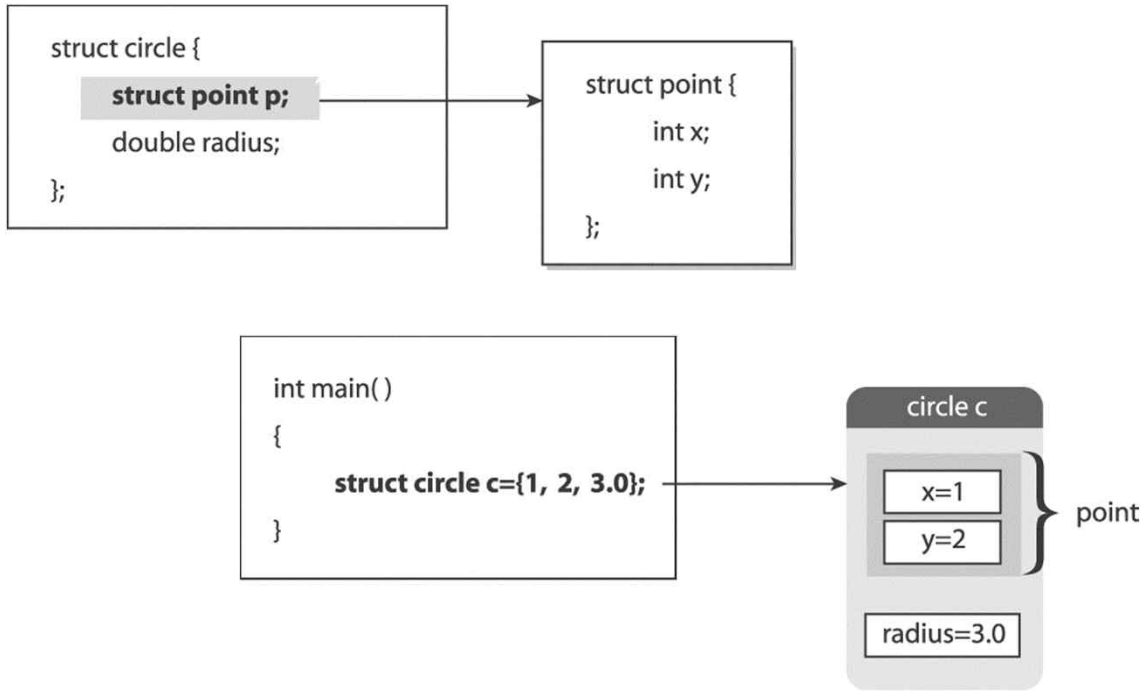
- Structure variables as a function argument
  - The same as passing basic data type variables as function arguments
- Operations of structure variable
  - The only permitted operation is ‘assign’ (=)
  - The four fundamental arithmetic operations are not granted

Structure

```
/* Lab 9 example 6 */
  #include <stdio.h>

struct simple {
    int data1;
    int data2;
};

void show(struct simple ts);

int main()
{
    struct simple s1={1, 2};
    struct simple s2;

    s2=s1;
    show(s2);
    return 0;
}

void show(struct simple ts)
{
    printf("data1:%d, data2:%d₩n", ts.data1, ts.data2);
}
```

Structure

- Overlapped structure
  - A structure has a structure as its own member
    - A structure in a structure



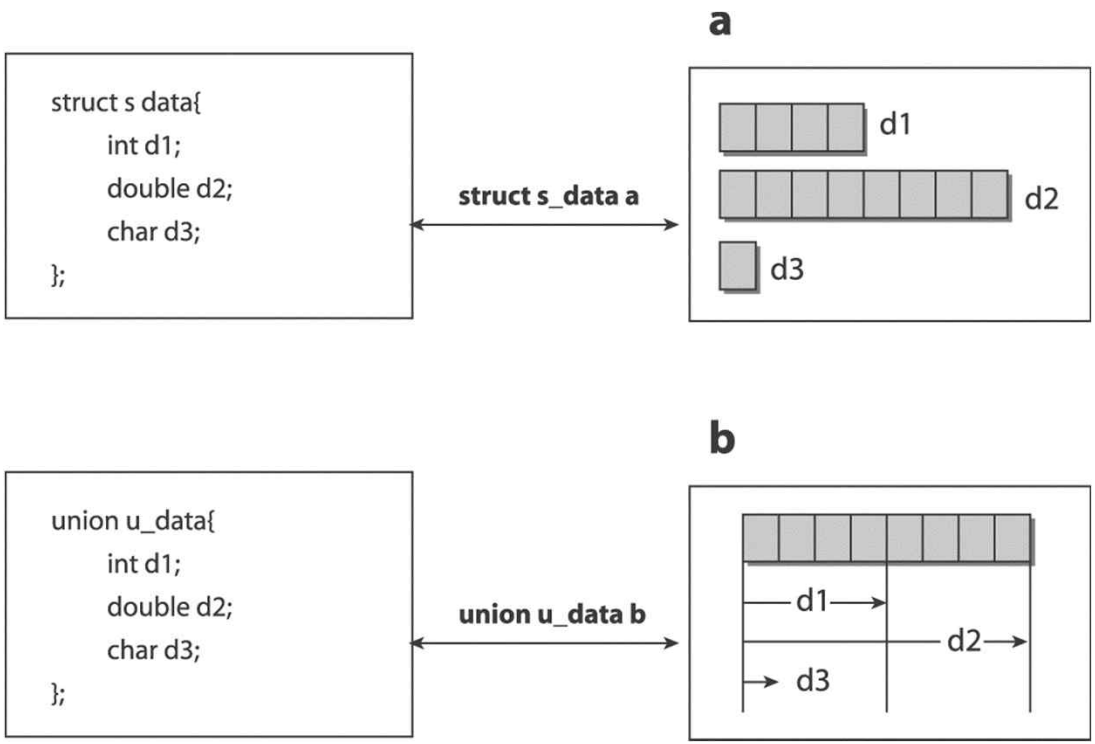
Structure

```
/* Lab 9 example 7 */

#include <stdio.h>

struct point{
    int x;
    int y;
};

struct circle {
    struct point p;
    double radius;
};
```

```
int main()
{
    struct circle c1={10, 10, 1.5};
    struct circle c2={{30, 30}, 2.4};

    printf("[circle1] ₩n");
    printf("x:%d, y:%d ₩n", c1.p.x, c1.p.y);
    printf("radius:%f ₩n",c1.radius);

    printf("[circle2] ₩n");
    printf("x:%d, y:%d ₩n", c2.p.x, c2.p.y);
    printf("radius:%f ₩n",c2.radius);

    return 0;
}
```

Structure

- Union
  - Several variables share the same memory space

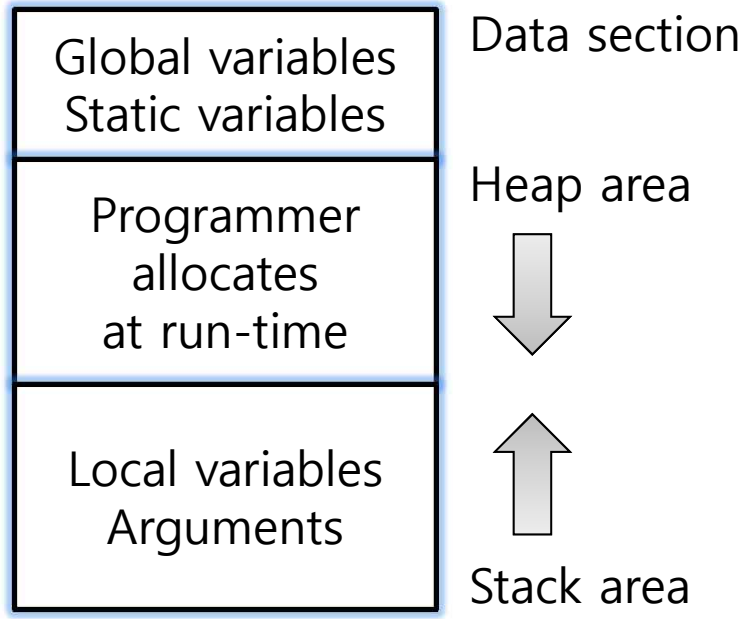


Structure

```
/* Lab 9 example 8 */
#include <stdio.h>

union u_data{
    int d1;
    double d2;
    char d3;
};

int main (void)
{
    union u_data data;

    data.d2=3.3;
    printf("%d, %f, %c ₩n", data.d1, data.d2, data.d3);

    data.d1=2;
    printf("%d, %f, %c ₩n", data.d1, data.d2, data.d3);

    data.d3='a';
    printf("%d, %f, %c ₩n", data.d1, data.d2, data.d3);

    return 0;
}
```

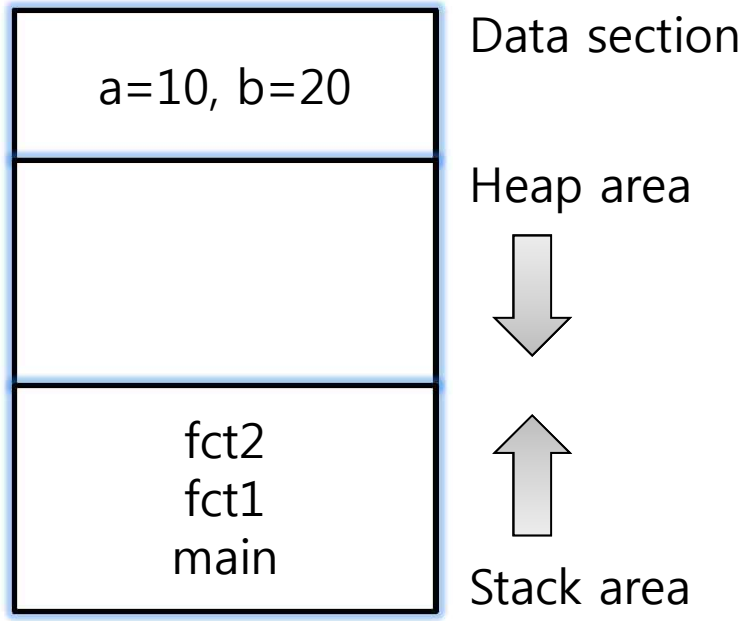
Structure

- Stack, heap and data section
  - Memory space allocated to run program
  - The stack size how much functions request must be determined at compile time



Structure

```
void fct1(int);
void fct2(int);

int a=10;
int b=20;

int main (void)
{
    int m=123;

    fct1(m);
    fct2(m);
    return 0;
}
void fct1(int c){
    int d=30;
}
void fct2(int e){
    int f=40;
}
```



Structure

- Dynamic memory allocation
  - Allocating memory space with determined size at run-time (on heap area)

```
#include <stdlib.h>

void* malloc(size_t size)
```

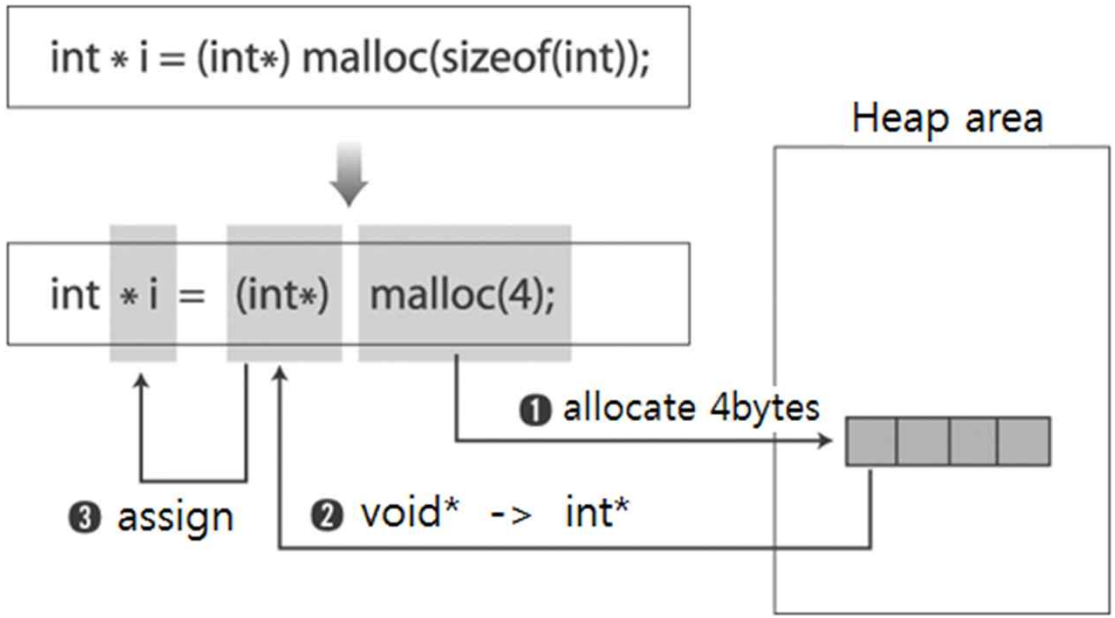
if successful, it returns the address of allocated memory space
Otherwise, returns NULL pointer

- Freeing memory space dynamically allocated

```
#include <stdlib.h>

void free(void* ptr)
```

Structure

- Malloc function



Structure

```
/* Week9 example 9 */

#include <stdio.h>
#include <stdlib.h>

int main (void)
{
    int* pi;

    pi = (int*)malloc(sizeof(int));
    *pi = 3;

    printf("%d₩n", *pi);

    free(pi);

    return 0;
}
```

Structure

- Exercise
  - Write an address book program
    - Define a structure named ‘Contact’ including three members of name(char[20]), age(int), phone number(char[15])
    - Make 10 elements pointer array referencing the Contact structure
    - Allocate memory space dynamically by size of the Contact structure using malloc function
    - Input the information of n persons(n <= 10) from user and save it to the newly allocated memory space through structure pointer
    - Then print out all information of persons