CMSC 104 - Lecture 16
Park , adapted by C Grasso

Functions: Part 4 of 4

Functions - Part 4

Topics

- In-Class Coding Practice
  - Project 1: The Box
  - Project 2: Drawing a Rectangle
  - Project 3: Multiplication Table

Coding Practice

- Starting with some simple problems, we will:
  1. Design appropriate algorithms
  2. Modularize them
  3. Create pseudocode
  4. Write actual C code

The Box

Write an interactive program to compute and display the volume and surface area of a box. The program must also display the box dimensions. Error checking should be done to be sure that all box dimensions are greater than zero.

What 3 things will the program need to do?

The Box

Write an **interactive** program to **compute** and **display** the volume and surface area of a box. The program must also display the box dimensions. Error checking should be done to be sure that all box dimensions are greater than zero.

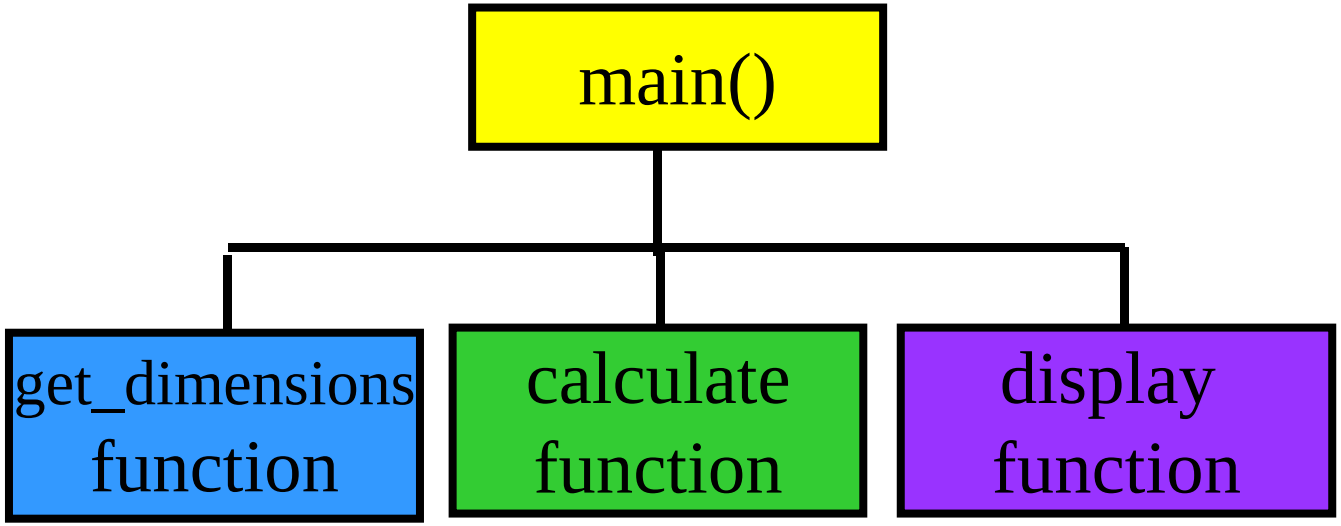
What input will it need?
What should it output?

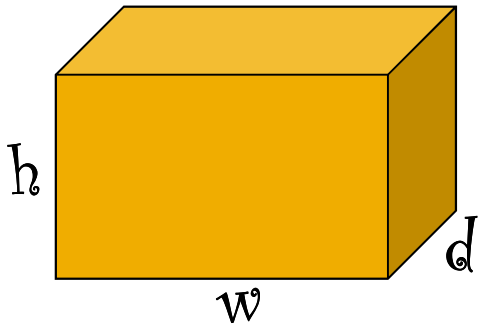
The Box

Write an **interactive** program to **compute** and **display** the volume and surface area of a box. The program must also display the box dimensions. Error checking should be done to be sure that all box dimensions are greater than zero.

What is volume and surface area?
What does it mean by box dimensions?

Hierarchy Chart

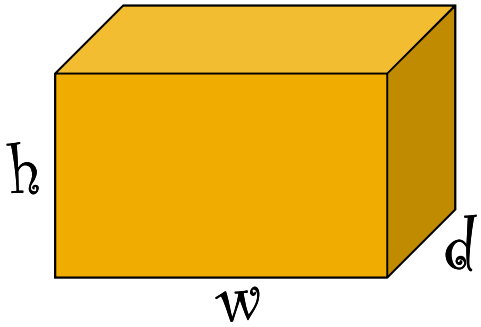


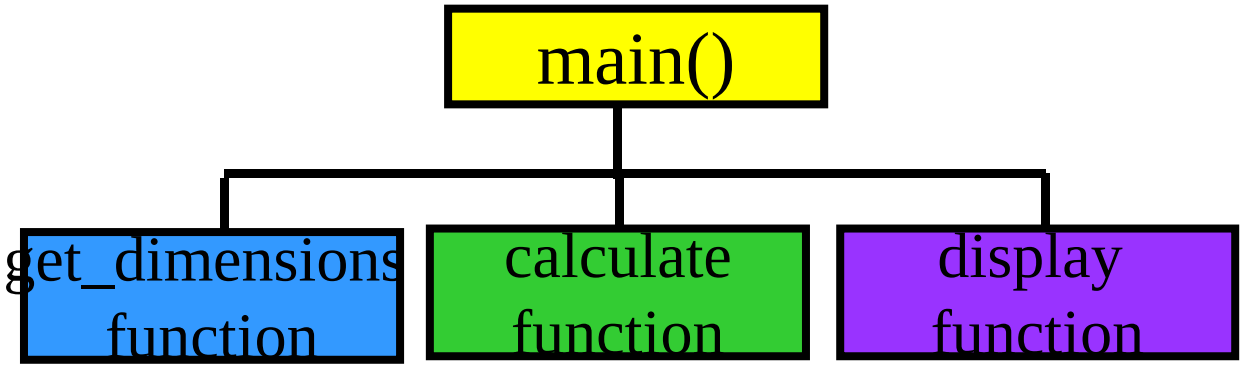


height is:
weight is:
depth is:
volume is:
surface area is:

Pseudocode to get dimensions - height

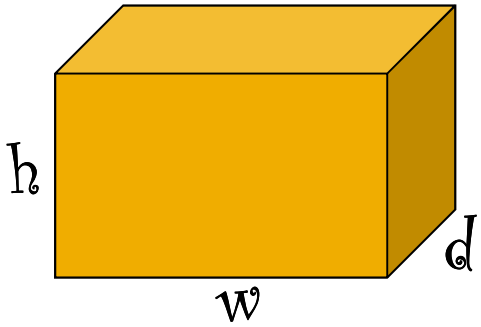
```
do
    Display "The height must be > 0"
    Display "Enter the height:  "
    Read <height>
while (<height> <= 0 )
```

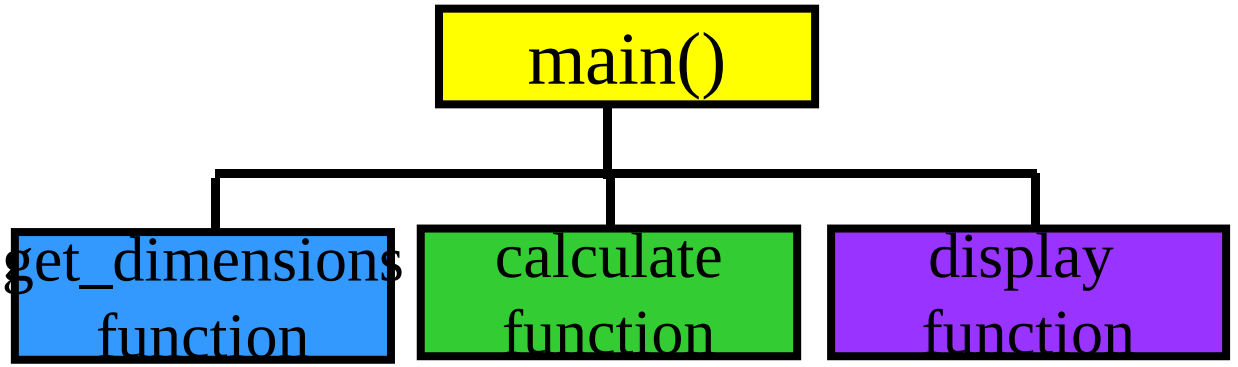




Pseudocode to get dimensions - width

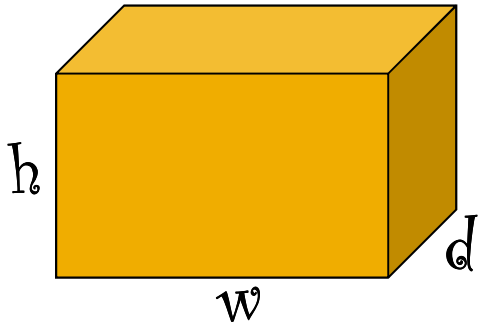
do
    Display "The **width** must be > 0"
    Display "Enter the **width**: "
    Read <**width**>
While (<**width**> <= 0)

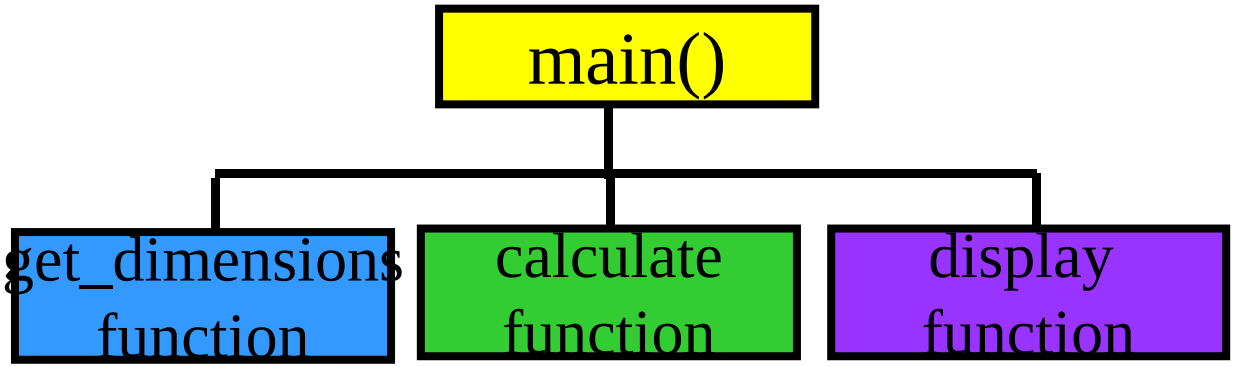




Pseudocode to get dimensions - depth

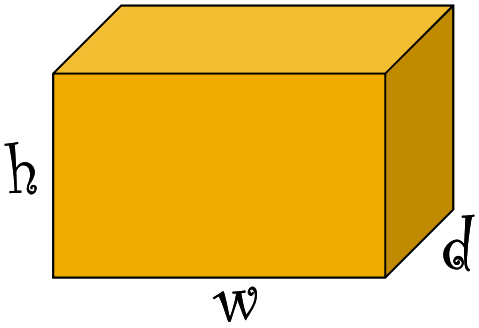
```
do
    Display "The depth must be > 0 "
    Display "Enter the depth: "
    Read <depth>
while (<depth> <= 0 )
```

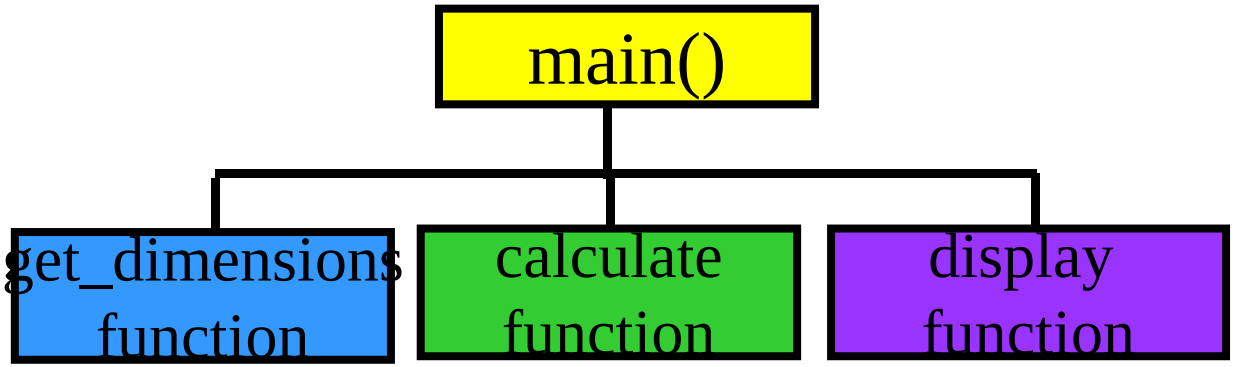




Pseudocode to calculate - volume

<volume> = <height> * <width> * <depth>

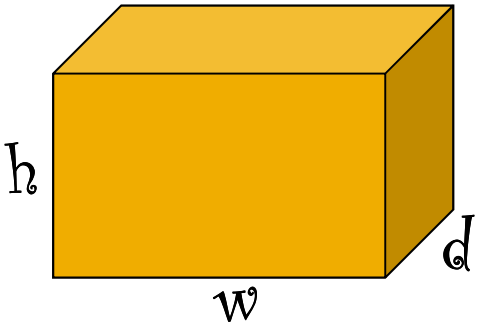


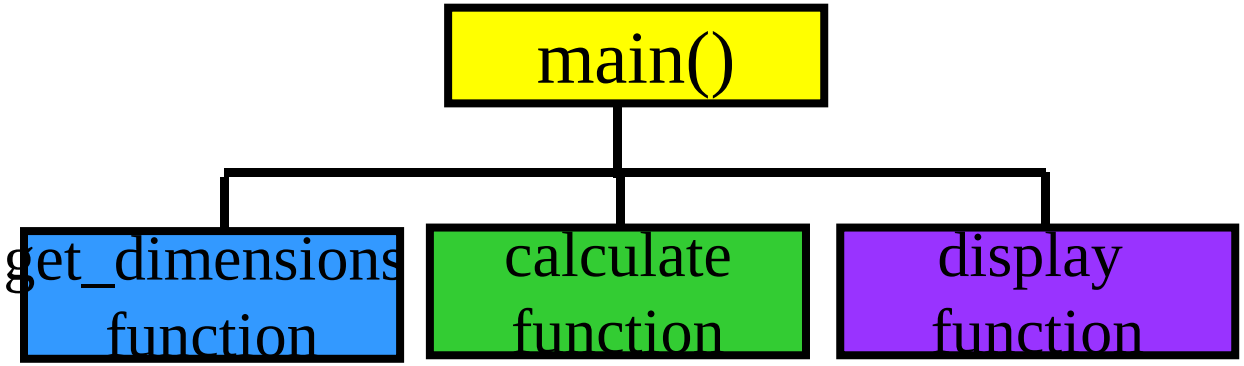


Pseudocode to calculate - surface

<surface1> = <height> * <width>
<surface2> = <width> * <depth>
<surface3> = <height> * <depth>

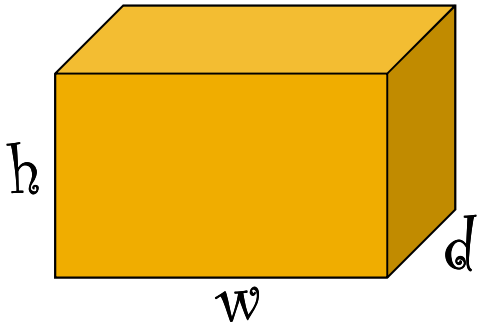
<surface area> = 2 *
(<surface1> + < surface2> + <surface3>)

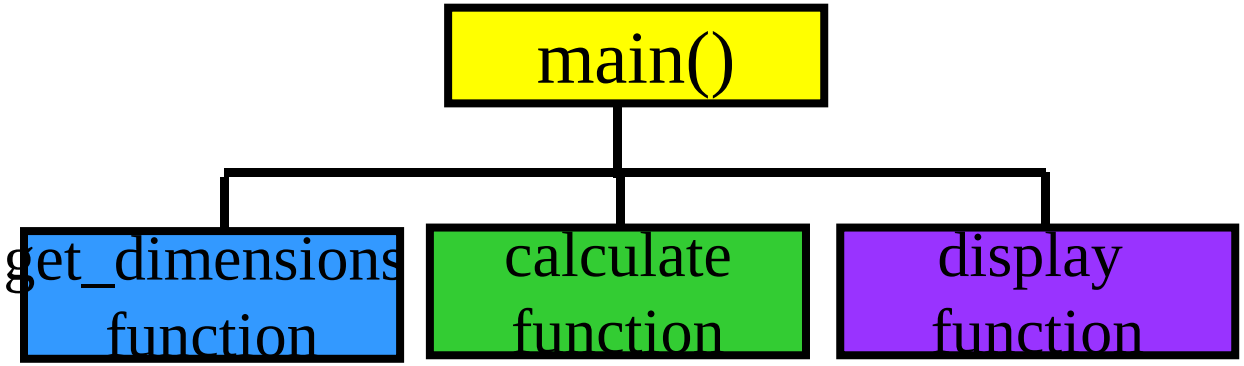




Pseudocode to display

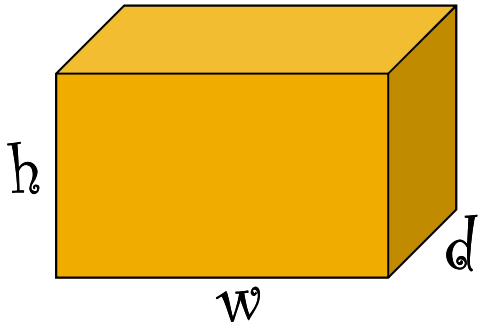
Display "Volume is: "
Display "Height is ", <height>
Display "Width is ", <width>
Display "Depth is ", <depth>
Display "Volume is ", <volume>
Display "Surface Area is ", <surface area>

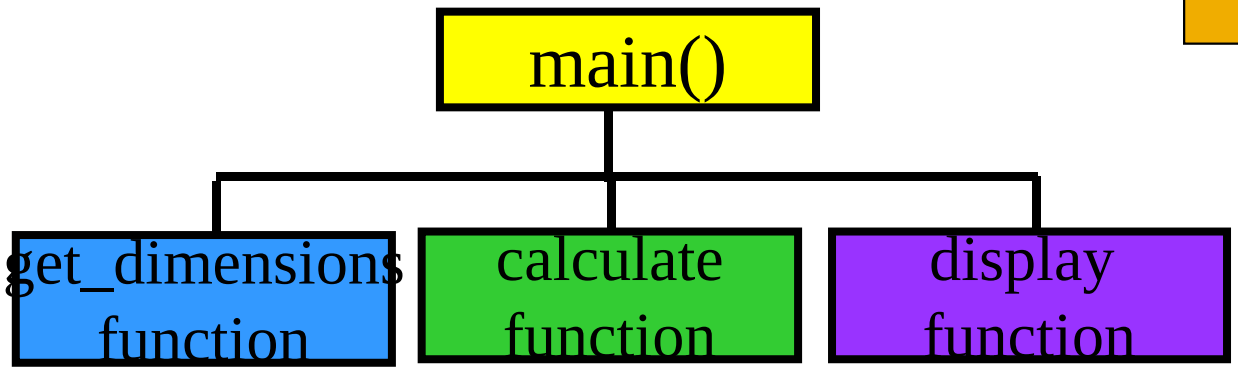




The Box - Pseudocode (cont.)

Call get_dimensions saving input in <height>, <width>, <depth>
Call calculate_volume saving answer in <volume>
Call calculate_surface saving answer in <surface>
Call display

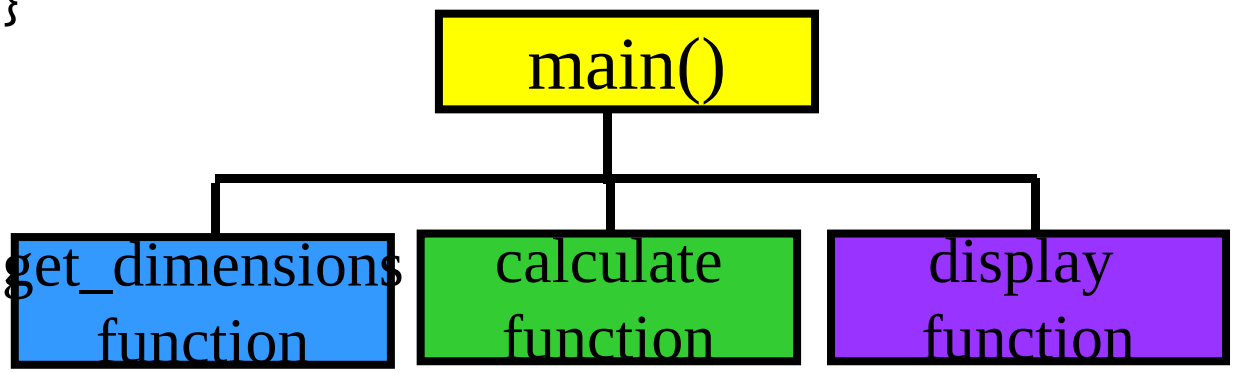


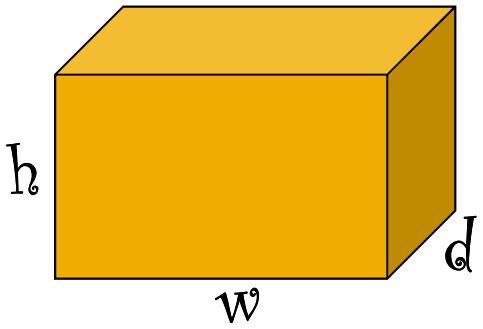


Code the Design

```
#include <stdio.h>

void   get_dimensions( int *height, int *width, int *depth);

int    calculate_volume(int height, int width, int depth);
int    calculate_surface(int height, int width, int depth);

void   display( int height, int width, int depth,
                int volume, int surface);
```

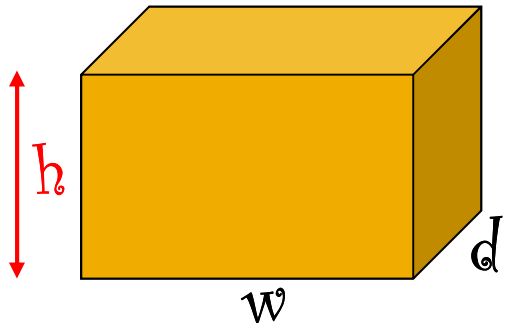
```
int main( void )
{
    int   height, width, depth,
    int   volume, surface;

     get_dimensions( &height, &width, &depth);

    volume  = calculate_volume( height , width, depth);
    surface  = calculate_surface( height , width, depth);

    display(height, width, depth, volume, surface);


    return 0;
}
```





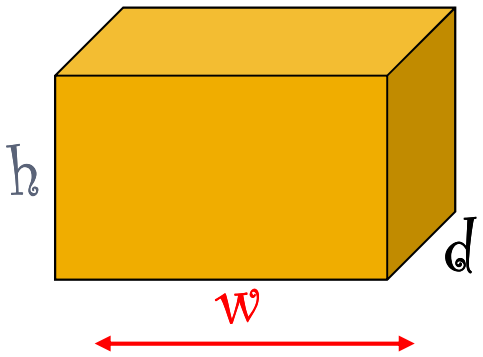
get_dimensions( )

```
void    get_dimensions(int *height, int *width, int *depth)
{

    // Get the height
    do
    {
        printf( "Please enter a height > 0   :  " );
        scanf( "%d", height);

    }  while(  *height <= 0 )

    // continued ...
```



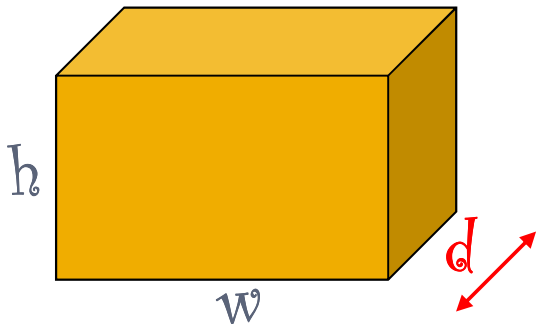
get_dimensions( )

```
// Get the width
do
{
      printf( “Please enter a width > 0  :  " );
      scanf( "%d", width );

} while(  *width <= 0 )

// continued ...
```



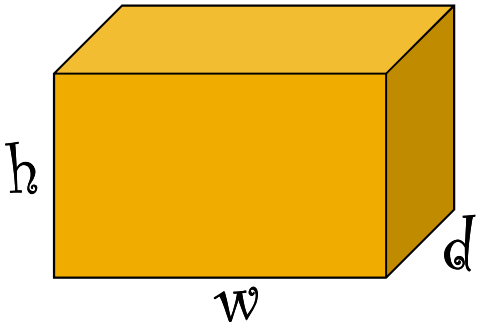
get_dimensions( )

```
    // Get the depth
    do
    {
        printf( "Please enter a depth > 0  :  " );
        scanf( "%d", depth);

    } while ( *depth <= 0 )

    return;

}   // end get_input()
```



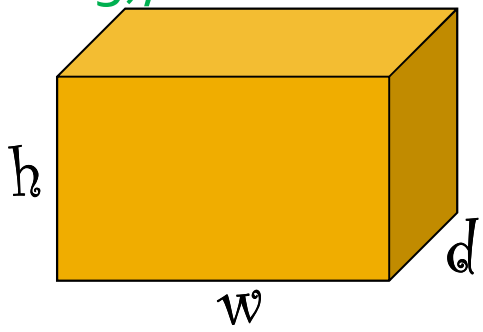
calculate_volume()

```
int calculate_volume( int height , int width, int depth)
{
    return  height * width * depth;
}
```



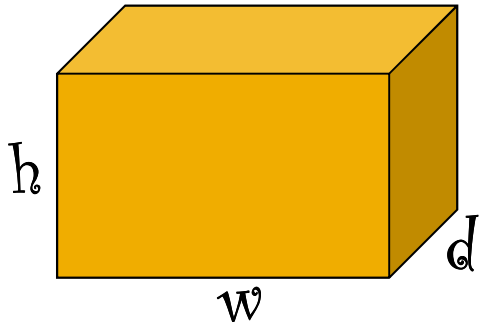
calculate_surface( )

```
int calculate_surface( int height , int width, int depth)
{
    int surface1, surface2, surface3;

    surface1 = height * width;
    surface2 = width * depth;
    surface3 = height * depth;

    return  2 * (surface1 + surface2 + surface3);

}
```



display( )

```
void    display( int height, int width, int depth,
                 int volume, int surface)
{
    printf( "Height          = %d \n", height );
    printf( "Width           = %d \n", width );
    printf( "Depth           = %d \n", depth );
    printf( "Volume          = %d \n", volume );
    printf( "Surface Area = %d \n", surface );

    return;
}
```

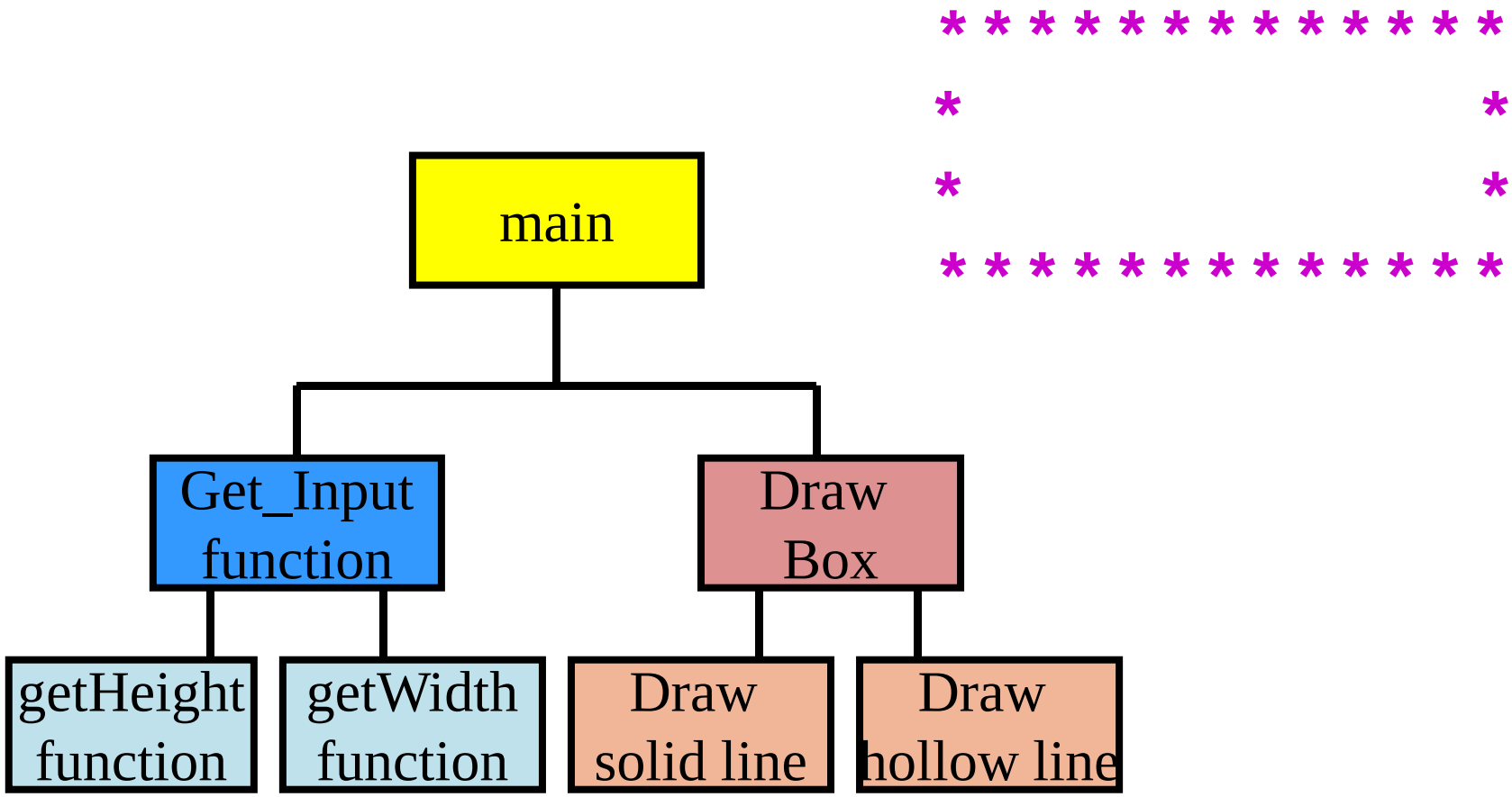


Drawing a Rectangle

Problem: Write an interactive program that will draw a solid rectangle of asterisks (*). The program must also display the dimensions of the rectangle. Error checking must be done to be sure that the dimensions are greater than zero.

```
* * * * * * * * * * * * * *
*                         *
*                         *
* * * * * * * * * * * * * *
```

Hierarchy Chart



The Rectangle – Pseudocode for get_input_function

Call **get_height_function** saving answer in <height>
Call **get_width_function** saving answer in <width>

The Rectangle – Pseudocode for get_height_function & get_width_functions

```
do
    Display "Please enter a height > 0: "
    Read <height>
While (<height>  <= 0 )
Return <height>
```

```
do
    Display "Please enter a width > 0: "
    Read <width>
while (<width>  <=  0 )
return <width>
```

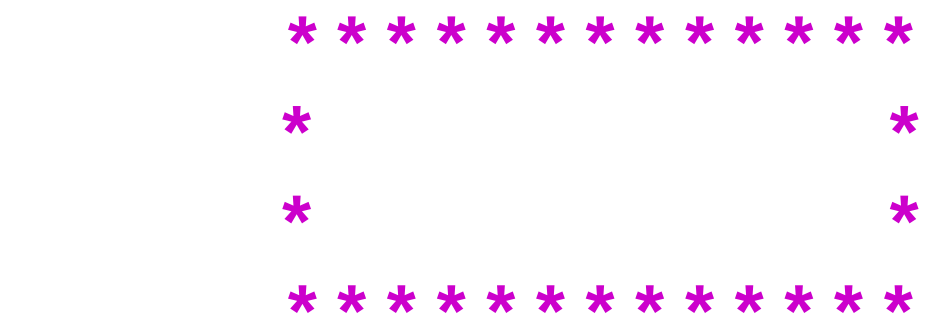
get_input_function & get_positive_integer_function

// get_input_function
Call **get_positive_integer_function** saving answer in <height>
Call **get_positive_integer_function** saving answer in <width>

// get_positive_integer_function
do
    Display "Please enter a " + input_string + "> 0: "
    Read <input>
While (< input > <= 0)
Return < input >

The Rectangle – Pseudocode draw_box_function

// draw_box_function
Call **draw_solid_line**
Call **draw_hollow_lines** for <height>-2 times
Call **draw_solid_line**



The Rectangle – Pseudocode draw_solid_line_function

```
Receive width_size
Set i to 0
While ( i < width_size )
        Display "*"
        add 1 to i
Display "\n"
```

****

The Rectangle – Pseudocode draw_hollow_line_function

```
Receive <width_size>
Display "*"
Set i to 0
While ( i < <width_size> - 2 )
        Display " "
        add 1 to i
Display "* "
```

* *

* *

The Rectangle - Pseudocode main function

Call **get_input** saving answer in <height> and <width>
Call **draw_box**

The Rectangle Code

```
#include <stdio.h>

void  get_input(int *height, int *width);
int   get_positive_integer( char *s);

void  draw_box(int width, int  height);
void  draw_solid_line( int  width);
void  draw_hollow_line( int  width);
```

main()

```
int main( void )
{
    int height ;
    int width  ;

    get_input(&height, &width);

    draw_box( height, width);

    return 0;
}
```

get_input()

```
void  get_input(int *height, int *width)
{
   *height = get_positive_integer("height") ;
   *width   = get_positive_integer("width") ;

   return 0;
}
```

get_positive_integer()

```
int    get_positive_integer( char *input_string)
{
    int input;

    do
    {
        printf( “Please enter a %s > 0 :  “, input_string );
        scanf( "%d", &input);

    } while ( input <= 0 ) ;

    return input;
}
```

draw_box( )

```
void draw_box( int  height, int width)
{
    draw_solid_line( width );

    int  i ;
    for (i = 1; i <= ( height - 2 ) ; i++ )
    {
         draw_hollow_line( width );
    }

    draw_solid_line( width );

}
```

draw_solid_line( )

```
void draw_solid_line(int width)
{
    int i;

    for  ( i= 1;  i <= width; i++ )
    {
         printf( "*" );
    }
    printf( "\n" );

}
```

draw_hollow_line( )

```
void draw_hollow_line( int width )
{

    printf( "*" );

    int i;
    for  (  i=0;  i <= ( width - 2 ) ; i++ )
    {
         printf( " " );
    }
    printf( "* \n" );

}
```