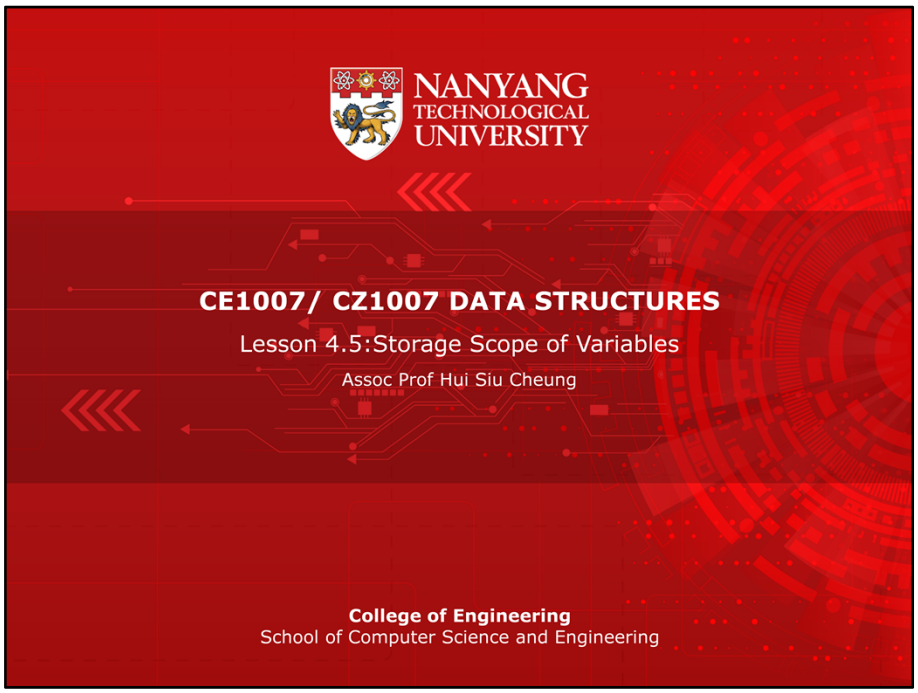
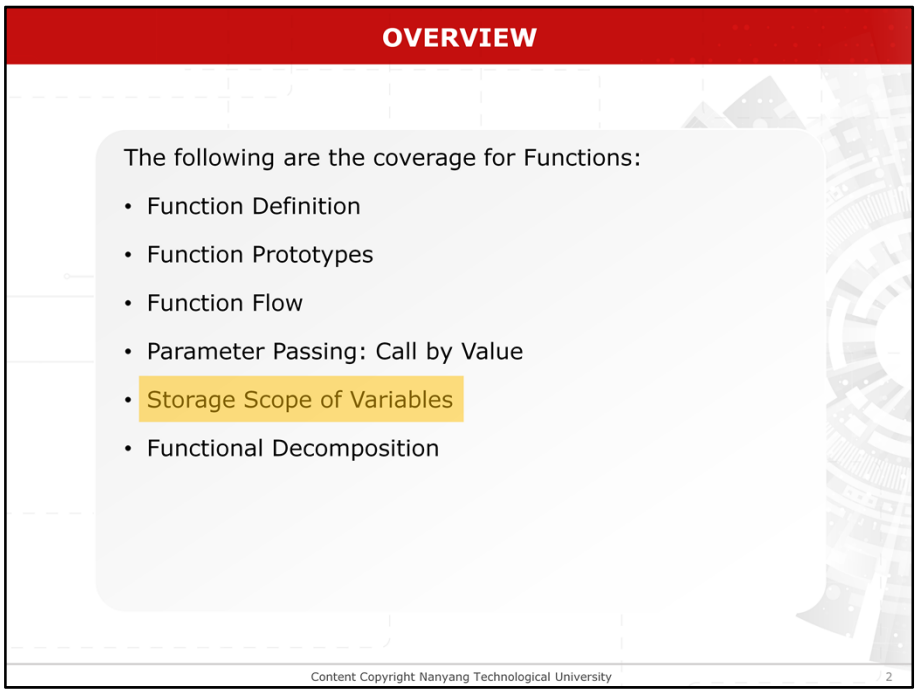
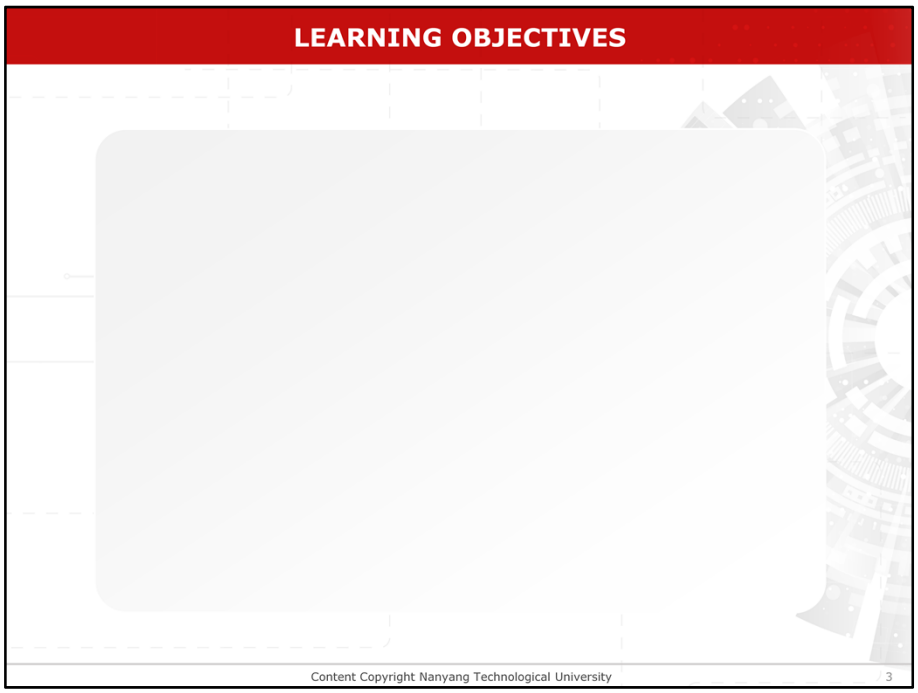


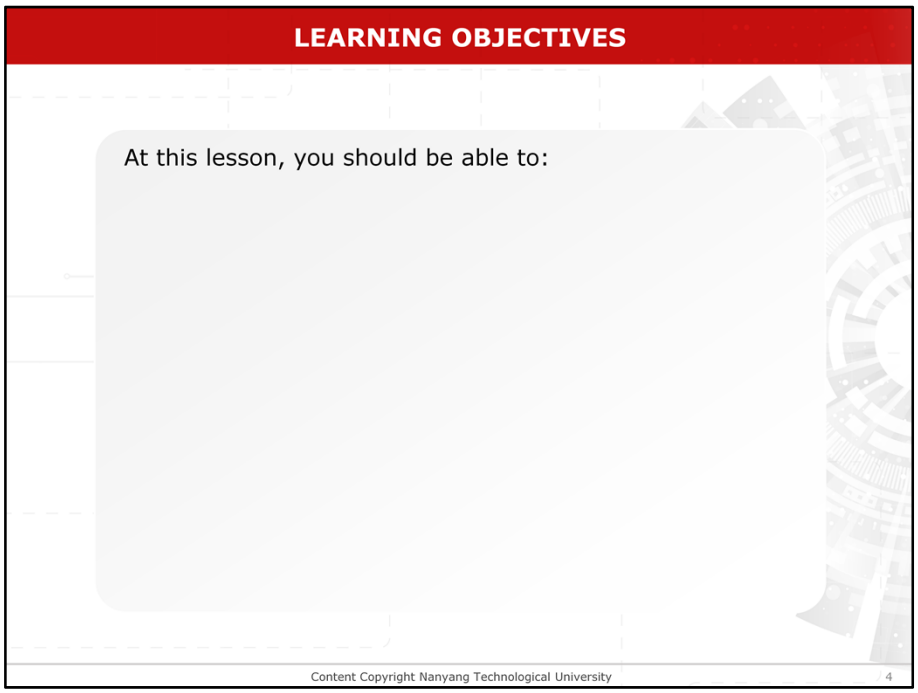
This lesson is on Functions



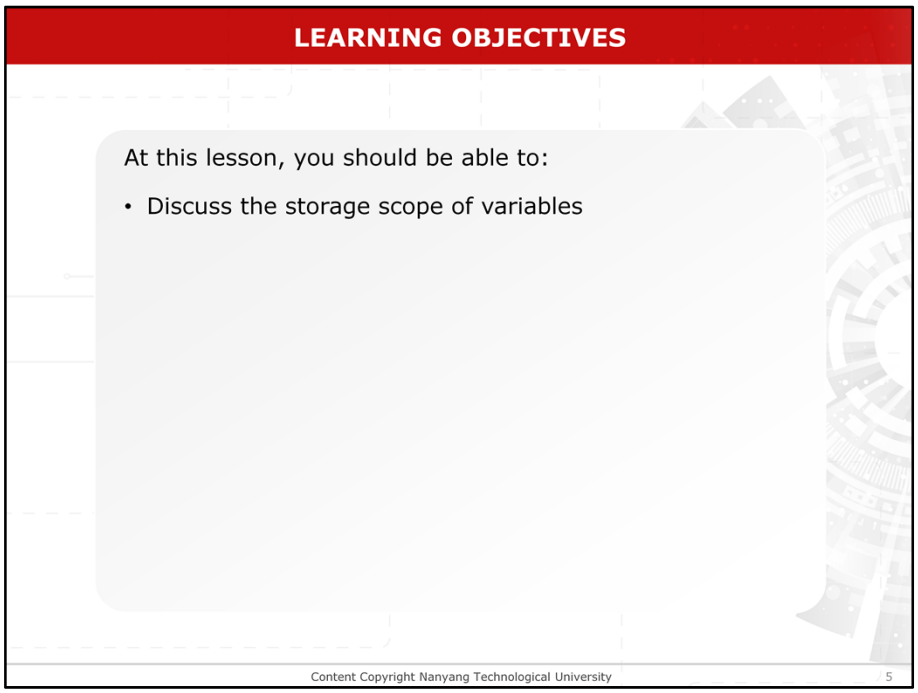
There are 6 main sections to cover for Functions. This video focused on the 5th topic: storage scope of variables



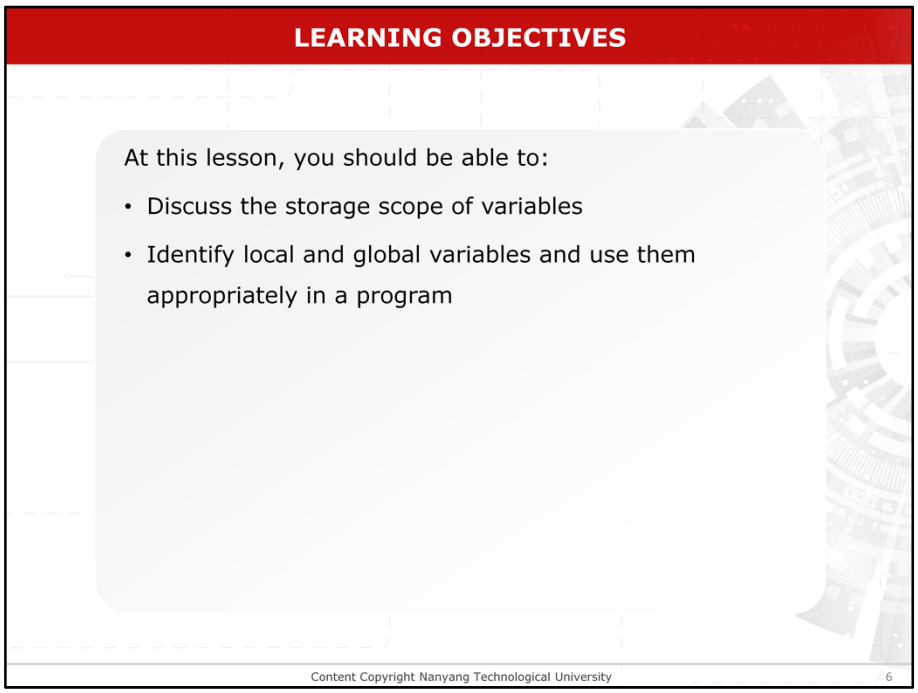
LEARNING OBJECTIVES



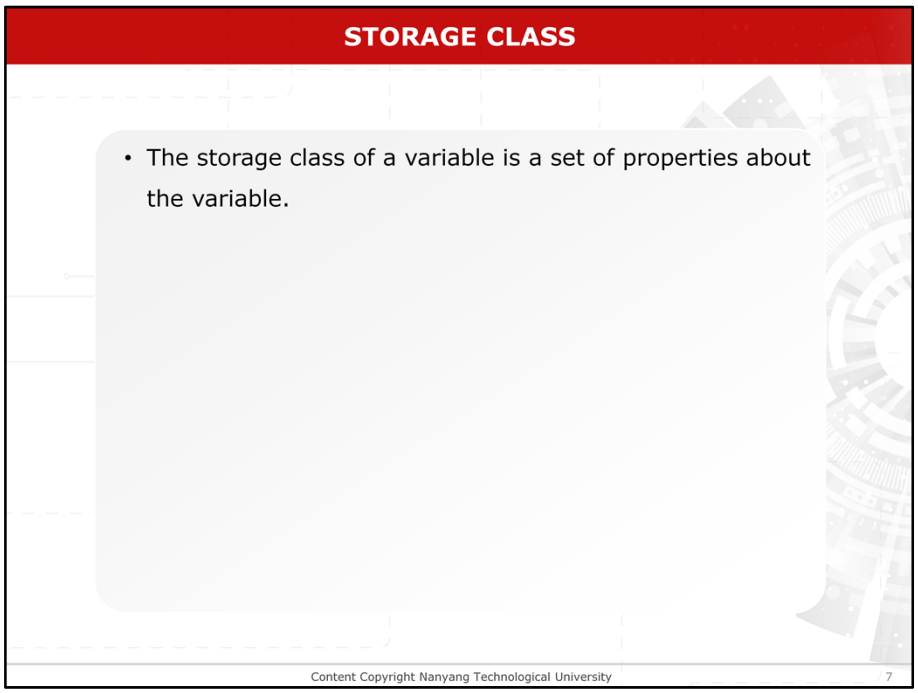
At this lesson, you should be able to



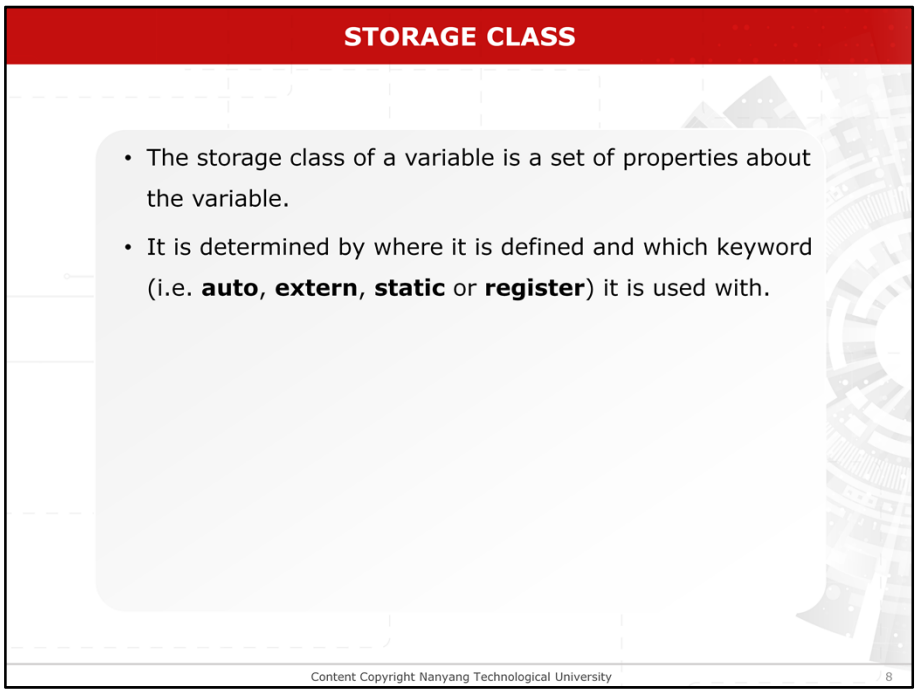
Discuss the storage scope of variables



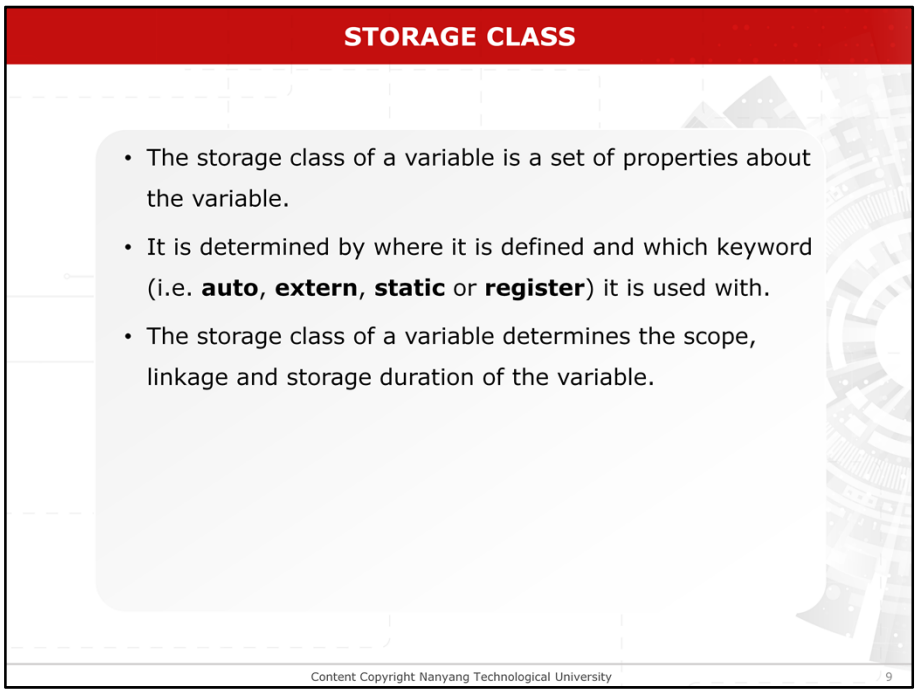
Identify local and global variables and use appropriately in a program



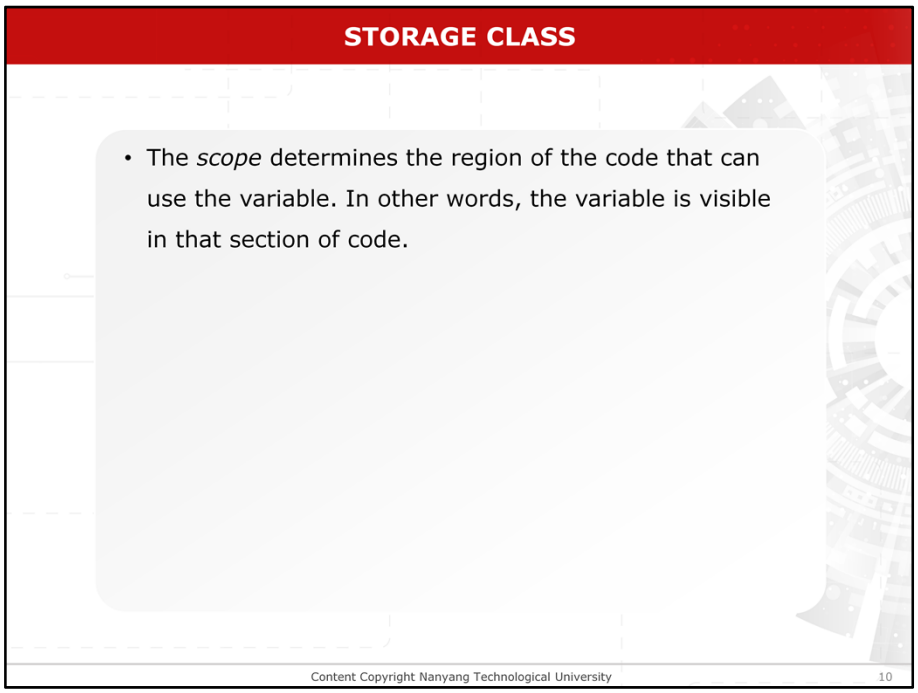
The storage class of a variable is a set of properties about the variable



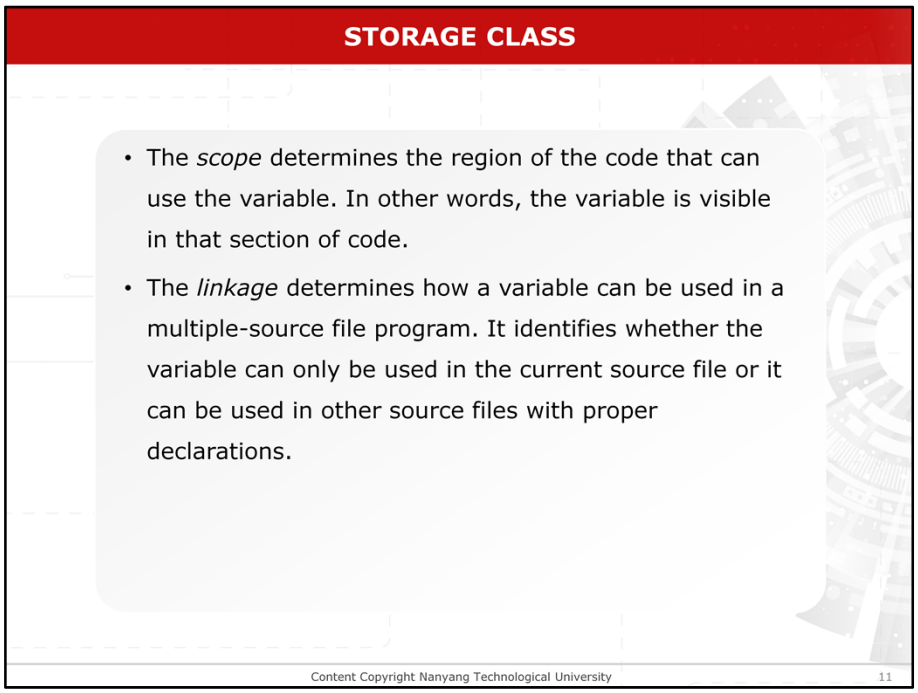
It is determined by where it is defined and which keyword (i.e. **auto**, **extern**, **static** or **register**) it is used with.



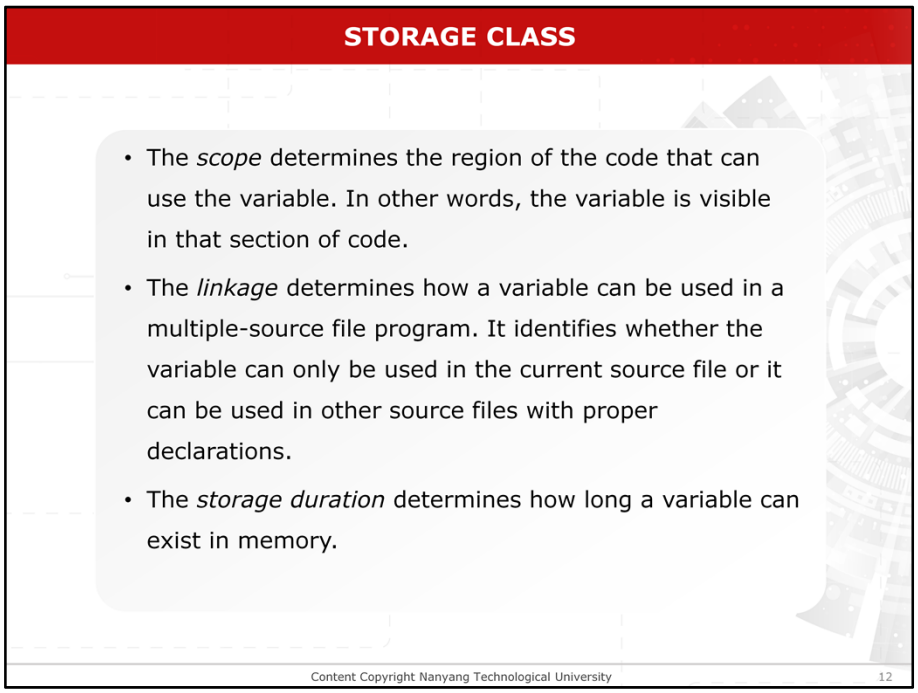
The storage class of a variable determines the scope, linkage and storage duration of the variable.



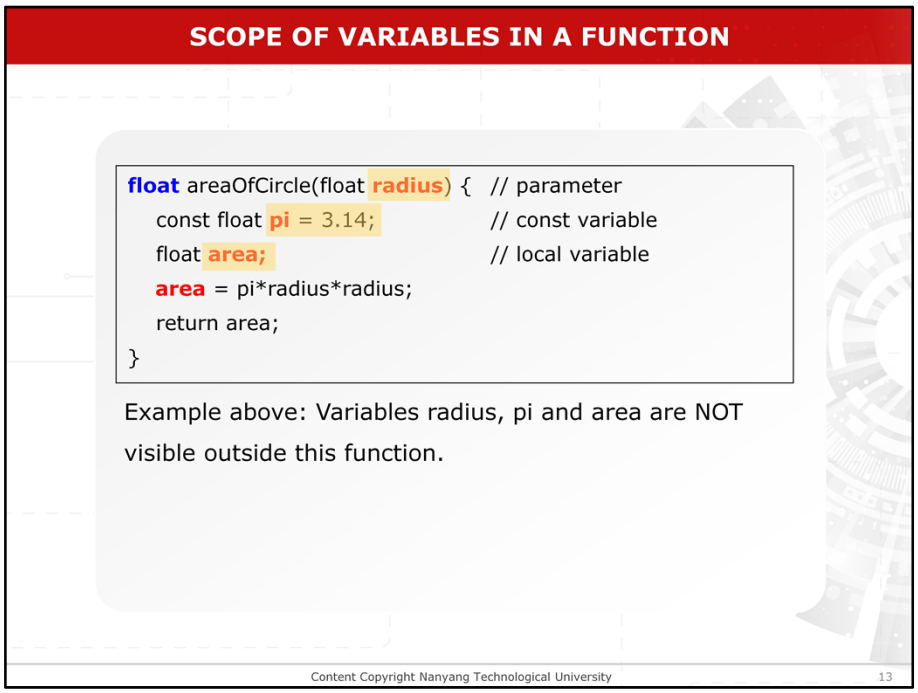
The *scope* determines the region of the code that can use the variable. In other words, the variable is visible in that section of code.



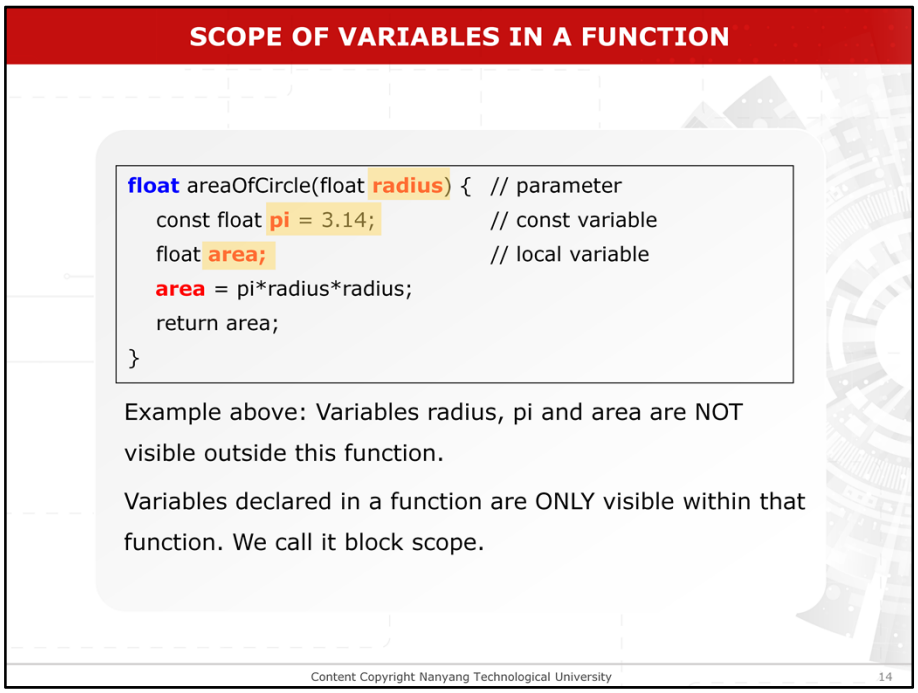
The *linkage* determines how a variable can be used in a multiple-source file program. It identifies whether the variable can only be used in the current source file or it can be used in other source files with proper declarations.



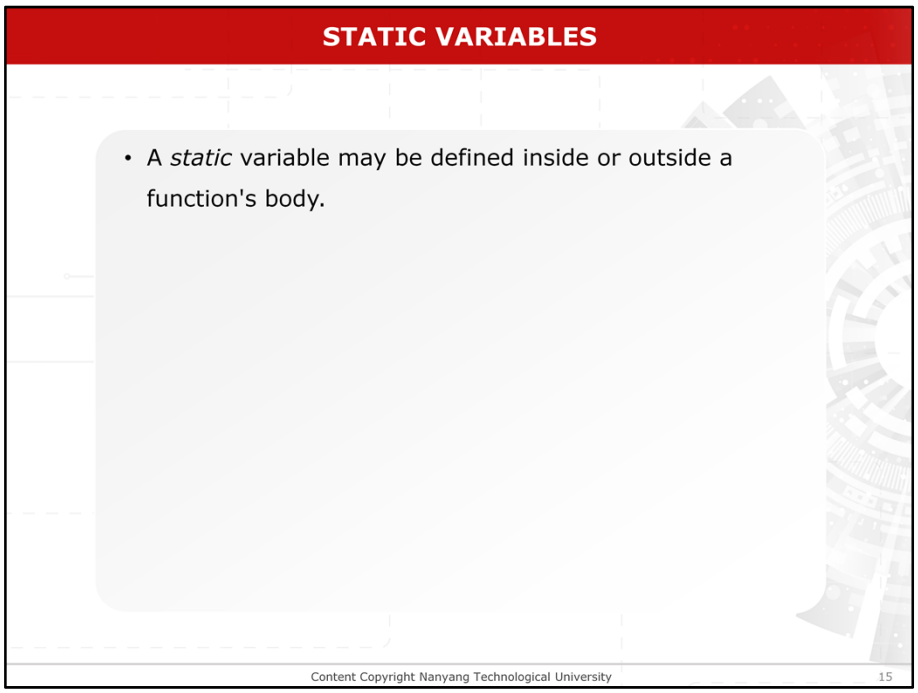
The storage duration of a C variable can be static or automatic. The *storage duration* determines how long a variable can exist in memory.



The variables radius, pi and area in the program shown are NOT visible outside this function.

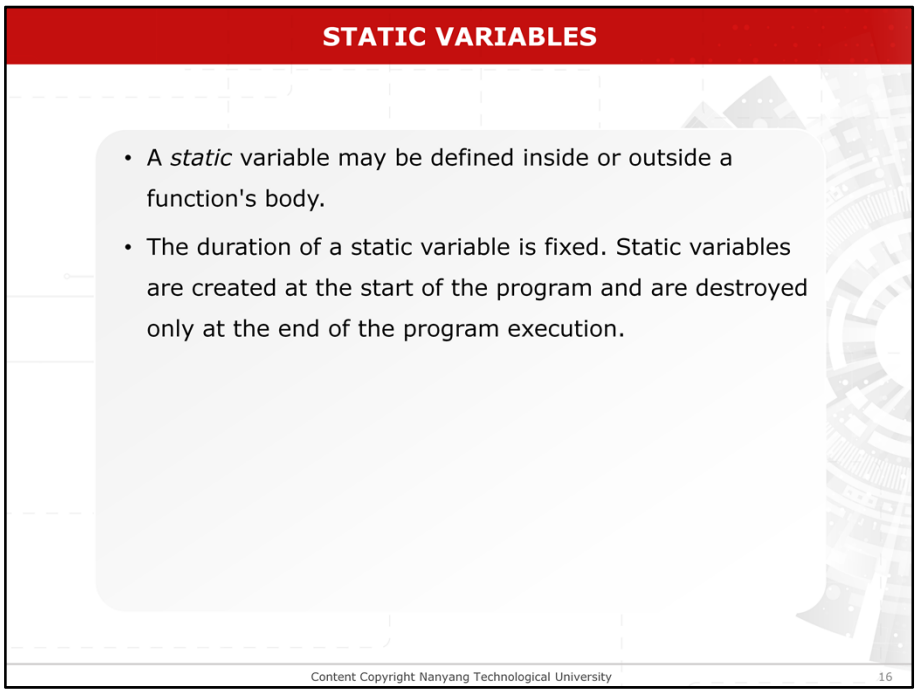


Variables declared in a function is ONLY visible within that function. We call it block scope.

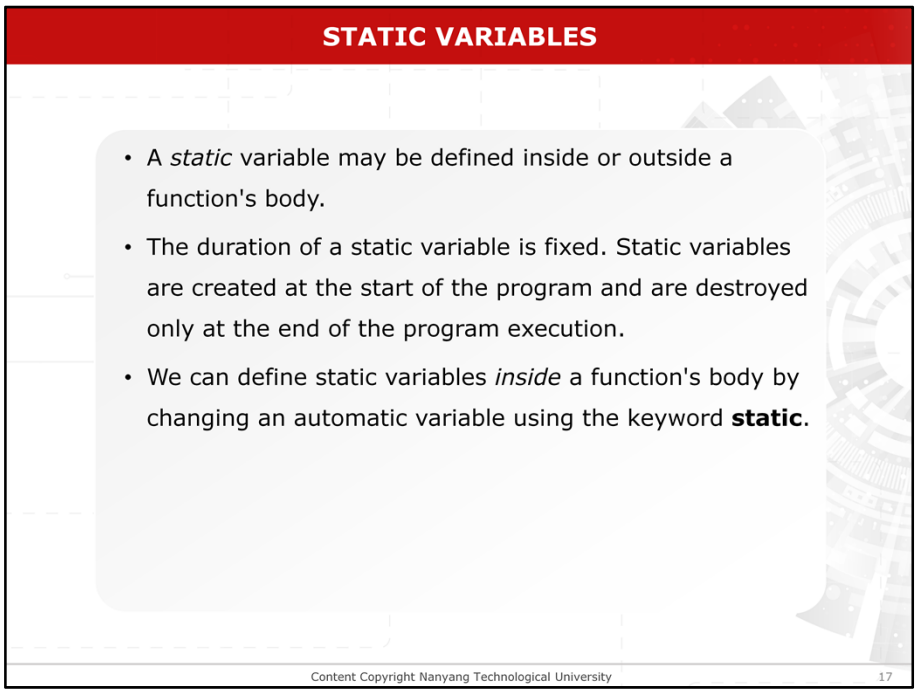


Static Variables

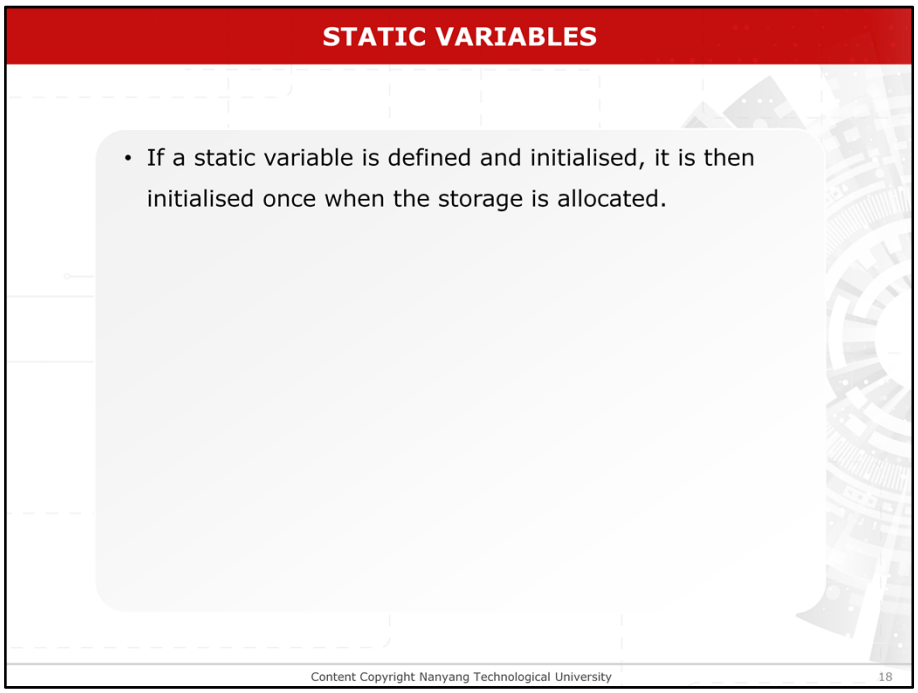
A *static* variable may be defined inside or outside a function's body.



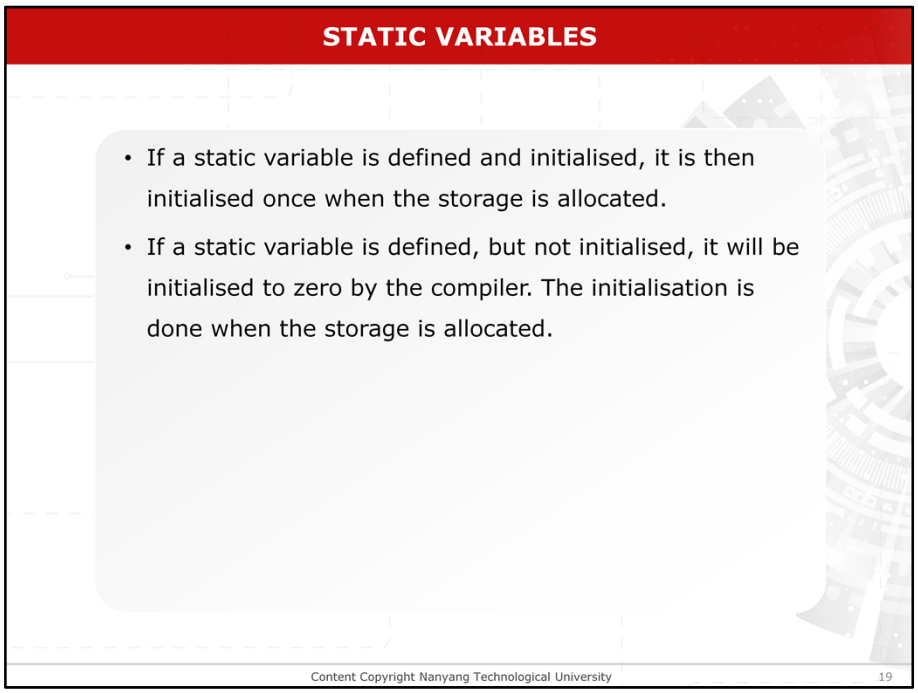
The duration of a static variable is fixed. Static variables are created at the start of the program and are destroyed only at the end of the program execution.



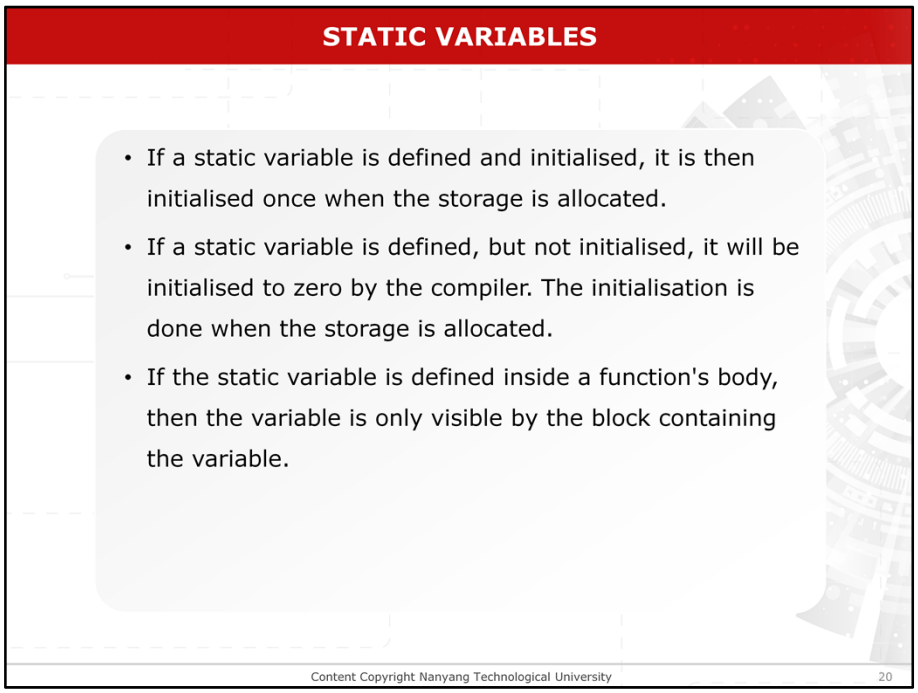
We can define static variables *inside* a function's body by changing an automatic variable using the keyword **static**.



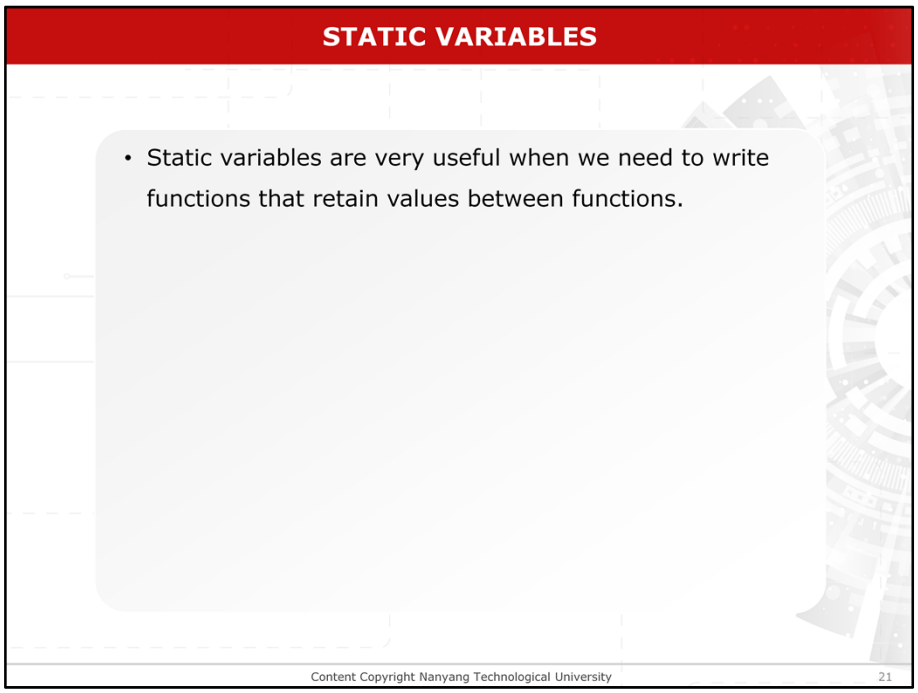
If a static variable is defined and initialised, it is then initialised once when the storage is allocated.



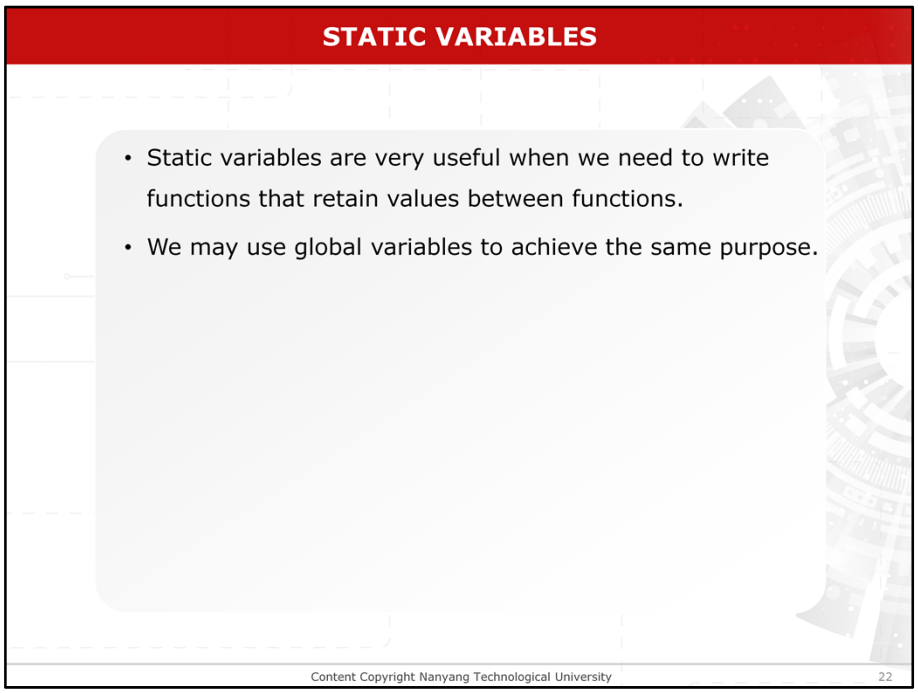
If a static variable is defined, but not initialised, it will be initialised to zero by the compiler. The initialisation is done when the storage is allocated.



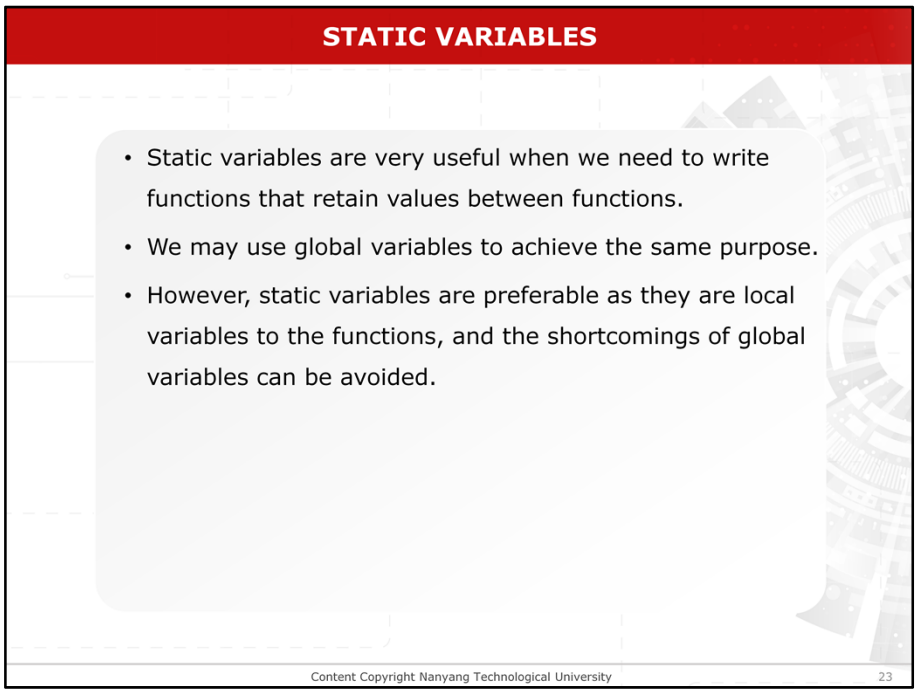
If the static variable is defined inside a function's body, then the variable is only visible by the block containing the variable.



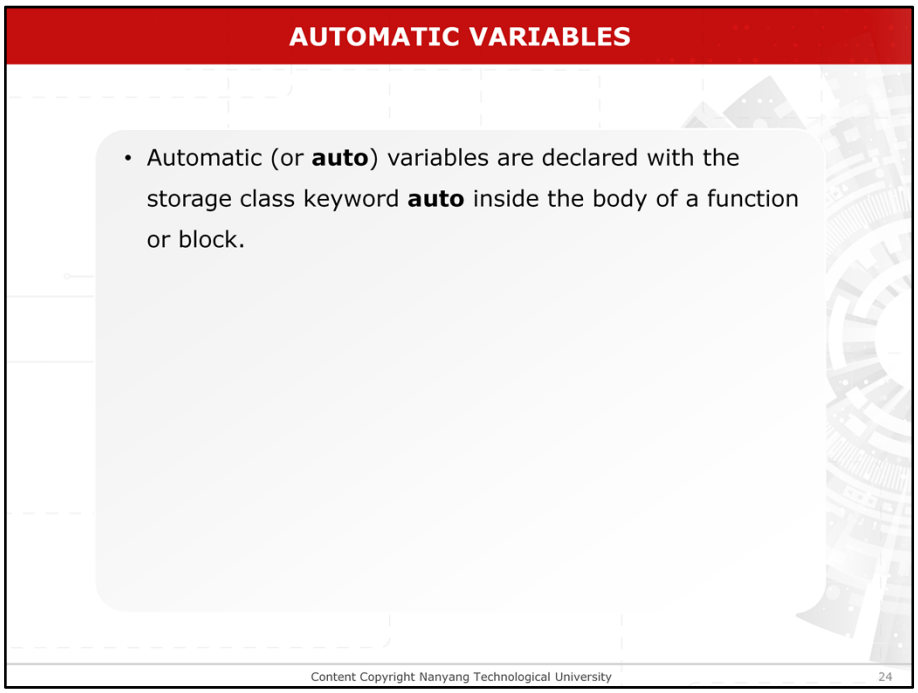
Static variables are very useful when we need to write functions that retain values between functions.



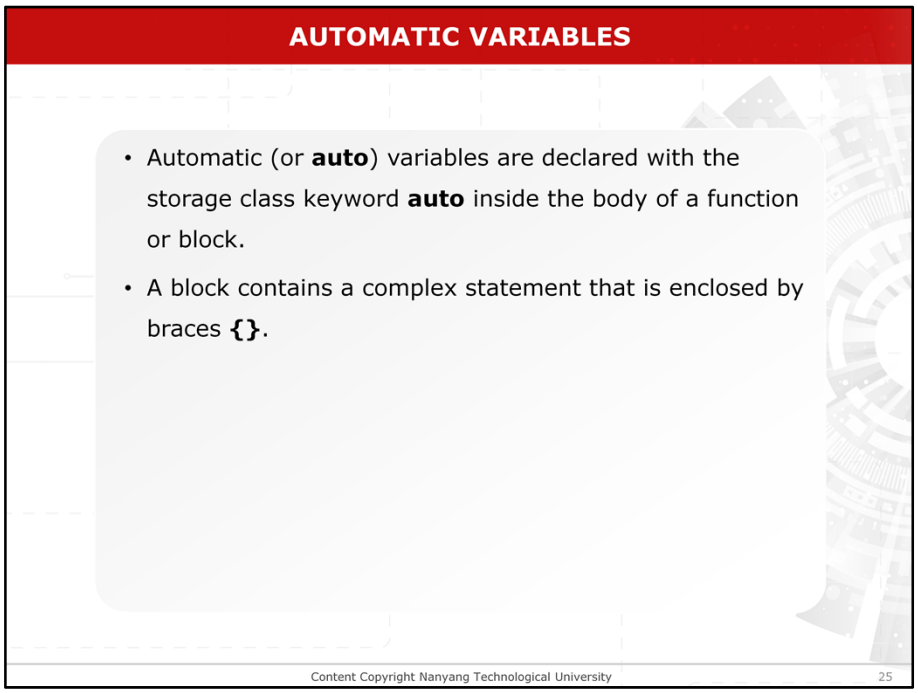
We may use global variables to achieve the same purpose



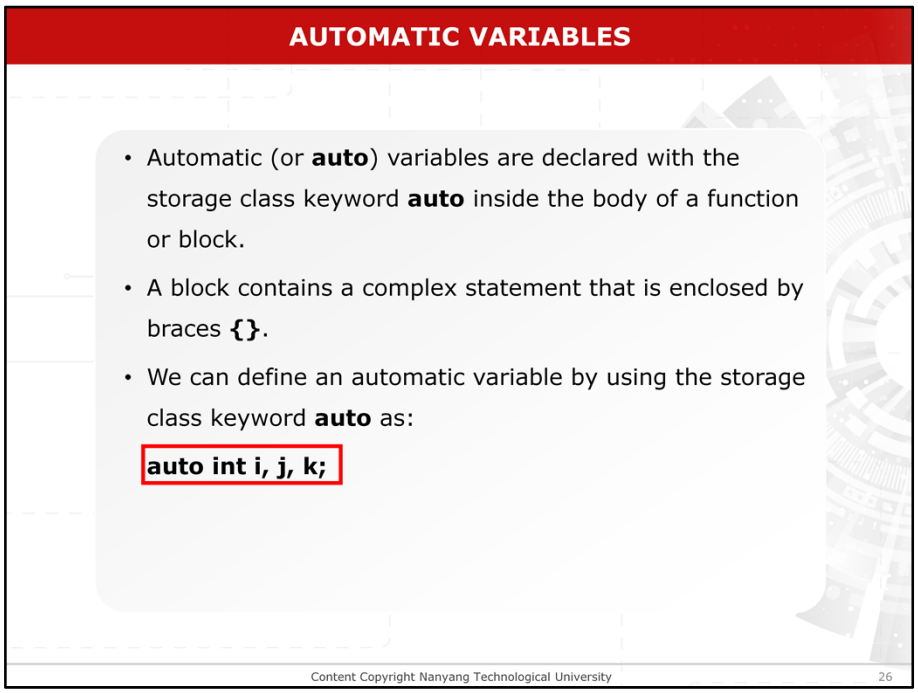
However, static variables are preferable as they are local variables to the functions, and the shortcomings of global variables can be avoided.



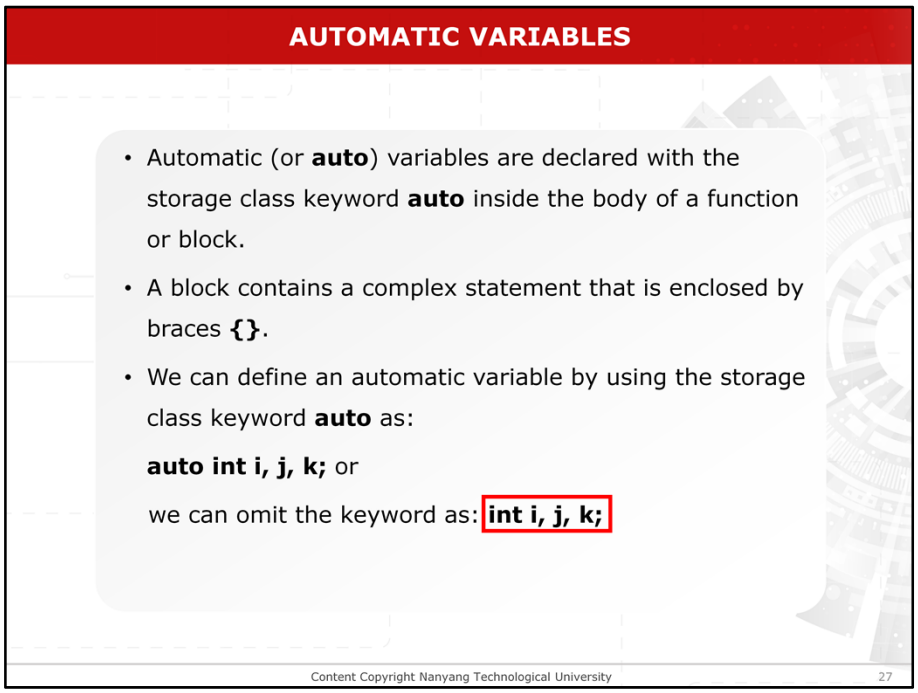
Automatic (or **auto**) variables are declared with the storage class keyword **auto** inside the body of a function or block.



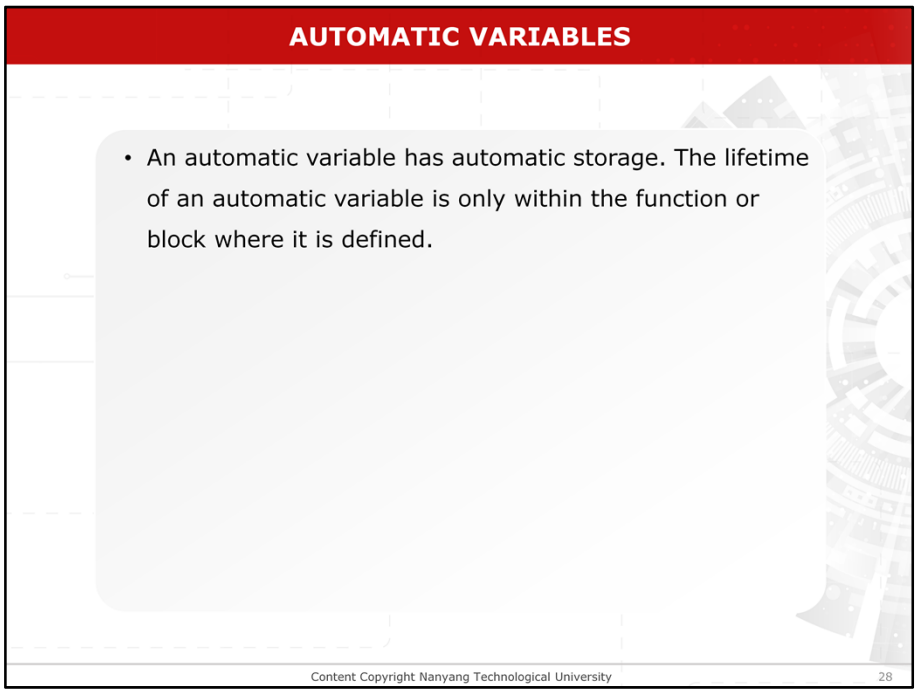
A block contains a complex statement that is enclosed by braces



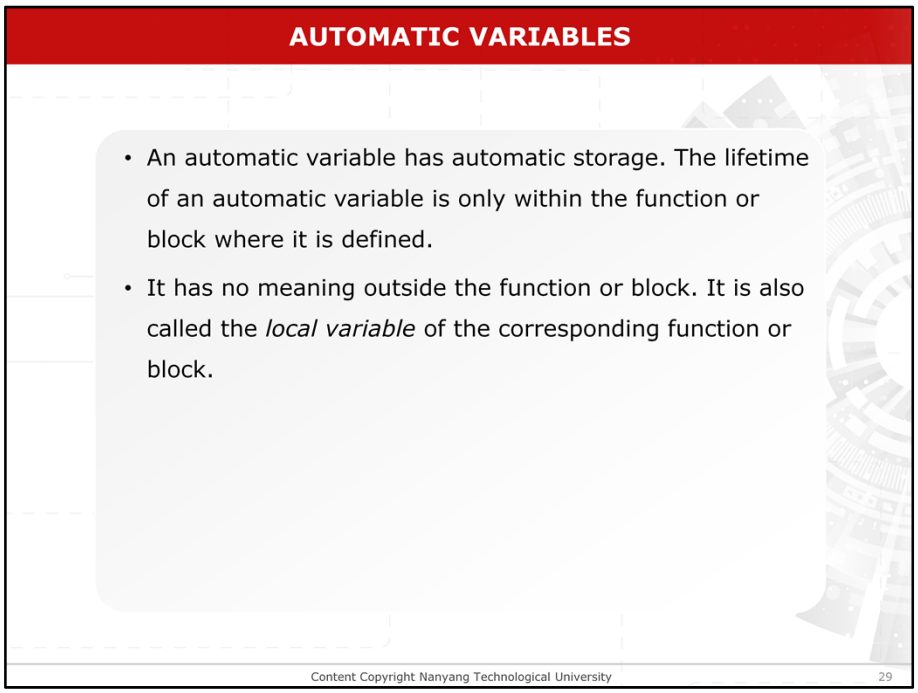
We can define an automatic variable by using the storage class keyword **auto** as a**uto int i, j, k**



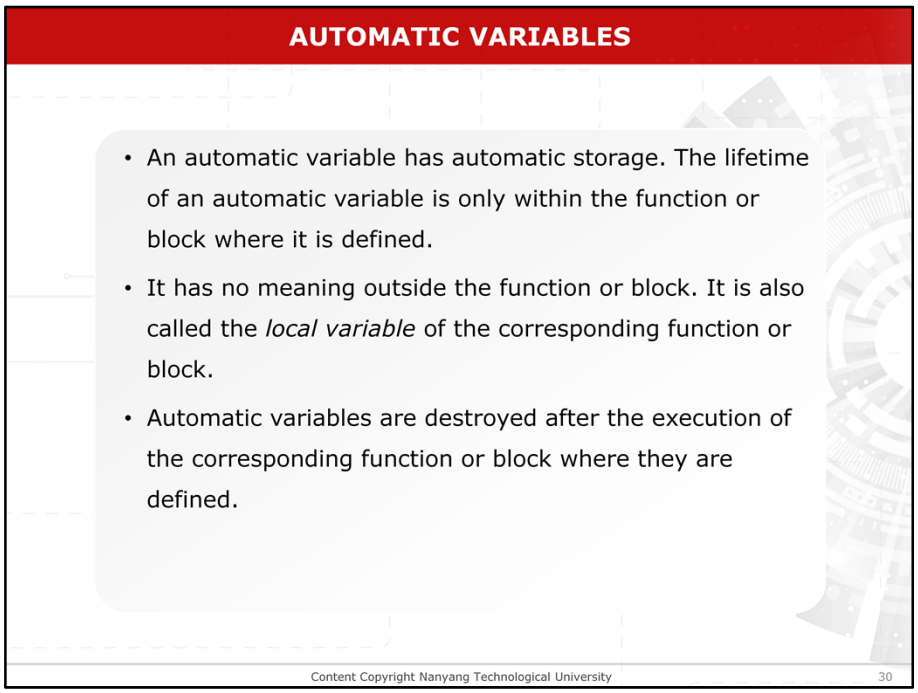
or we can omit the keyword auto.



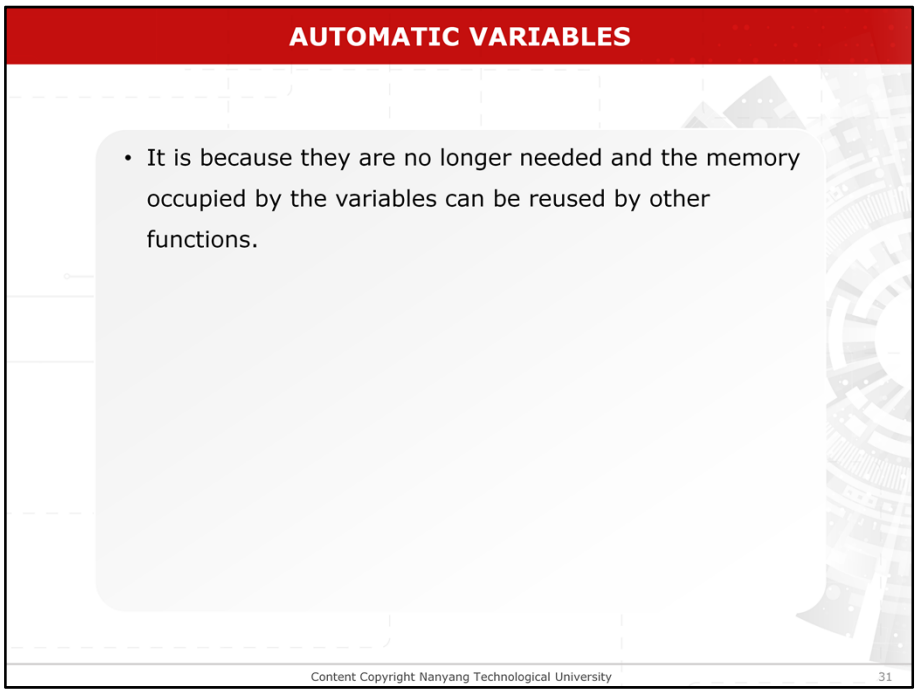
An automatic variable has automatic storage. The lifetime of an automatic variable is only within the function or block where it is defined.



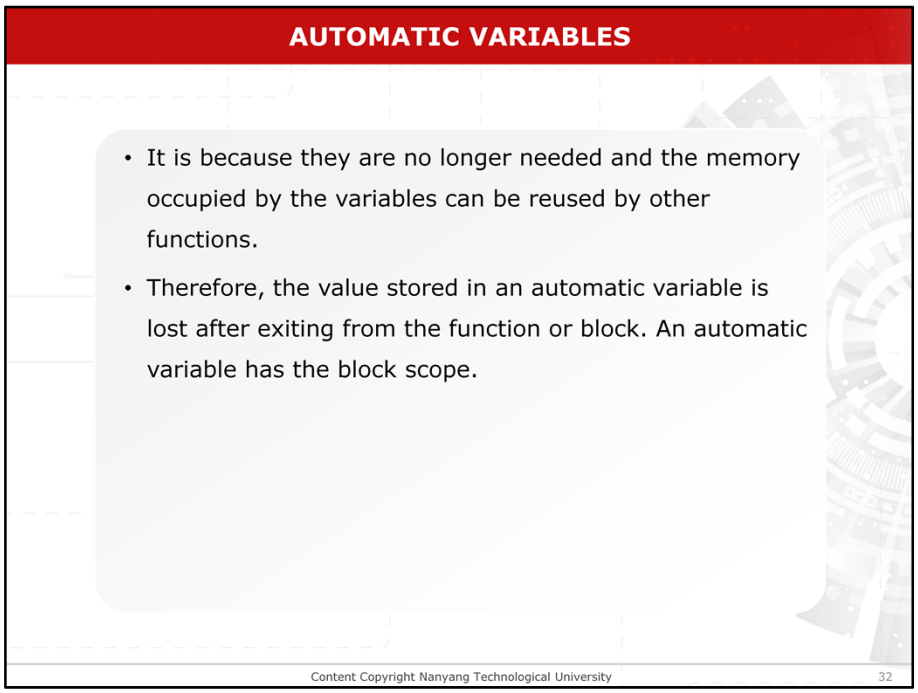
It has no meaning outside the function or block. It is also called the *local variable* of the corresponding function or block.



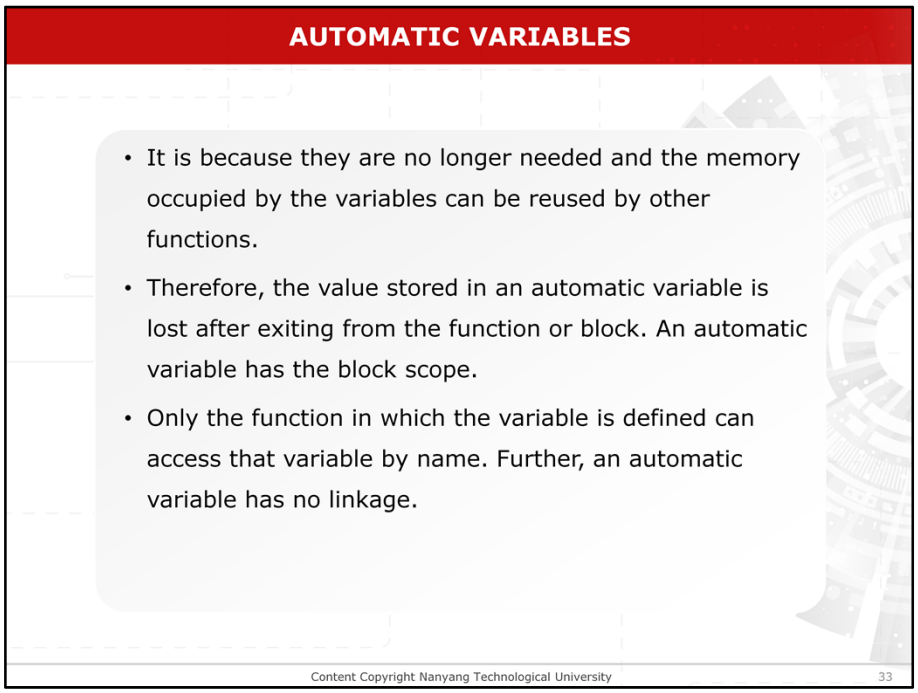
Automatic variables are destroyed after the execution of the corresponding function or block where they are defined. It



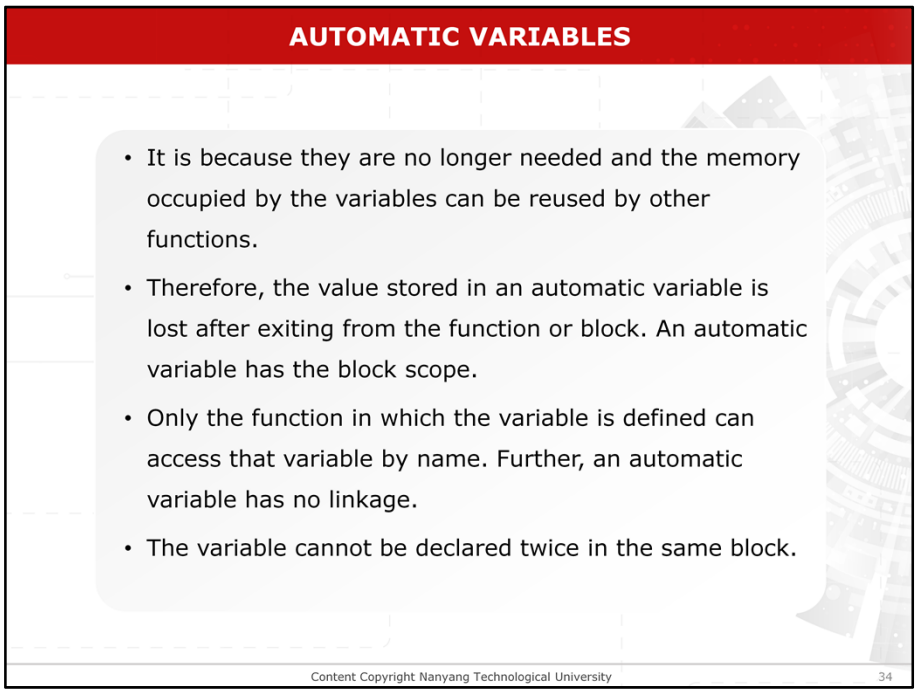
It is because they are no longer needed and the memory occupied by the variables can be reused by other functions.



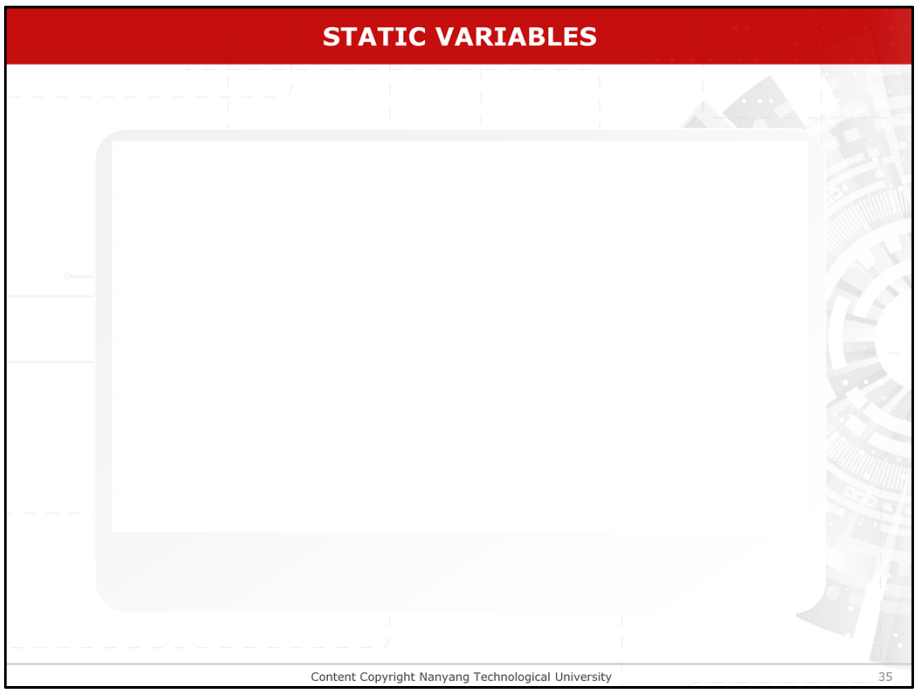
Therefore, the value stored in an automatic variable is lost after exiting from the function or block. An automatic variable has the block scope.



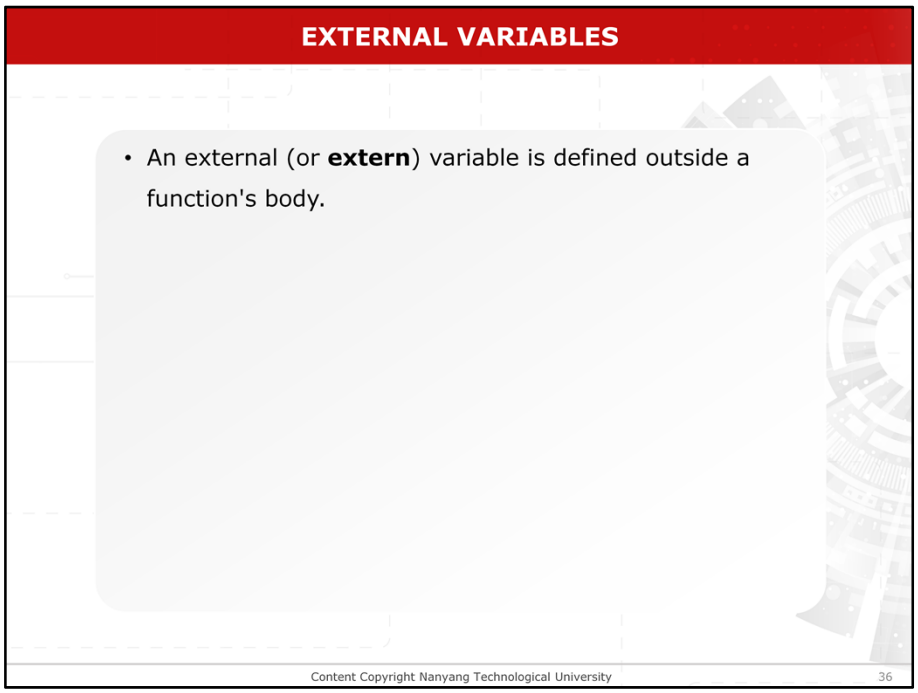
Only the function in which the variable is defined can access that variable by name. Further, an automatic variable has no linkage.



The variable cannot be declared twice in the same block.

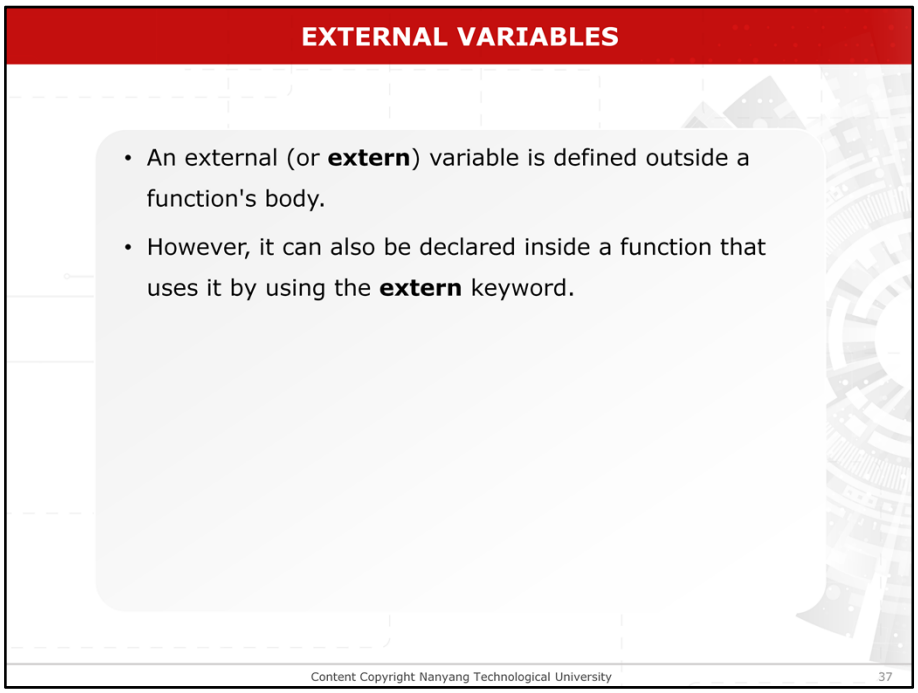


The number of static and automatic variables are computed as shown. Automatic variable or local variables disappear after each function execution. Static variable like global variables stay until end of program execution.

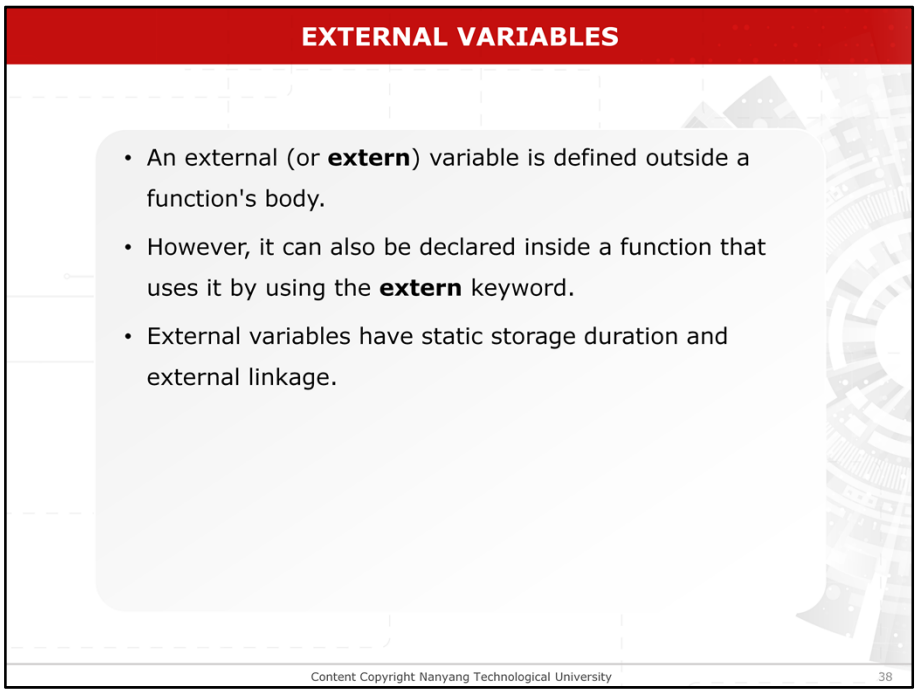


External Variables

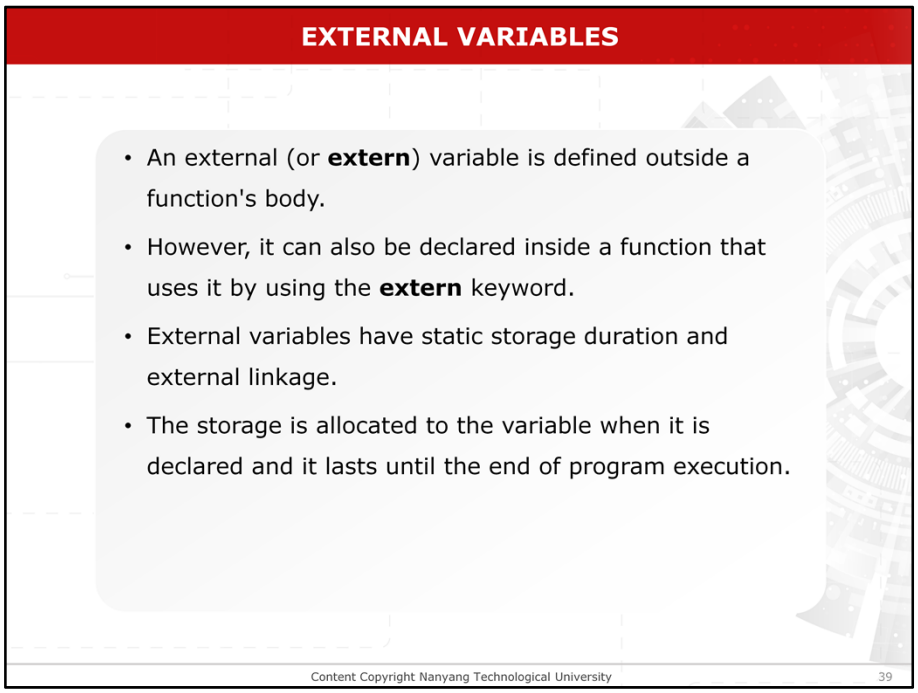
An external (or **extern**) variable is defined outside a function's body.



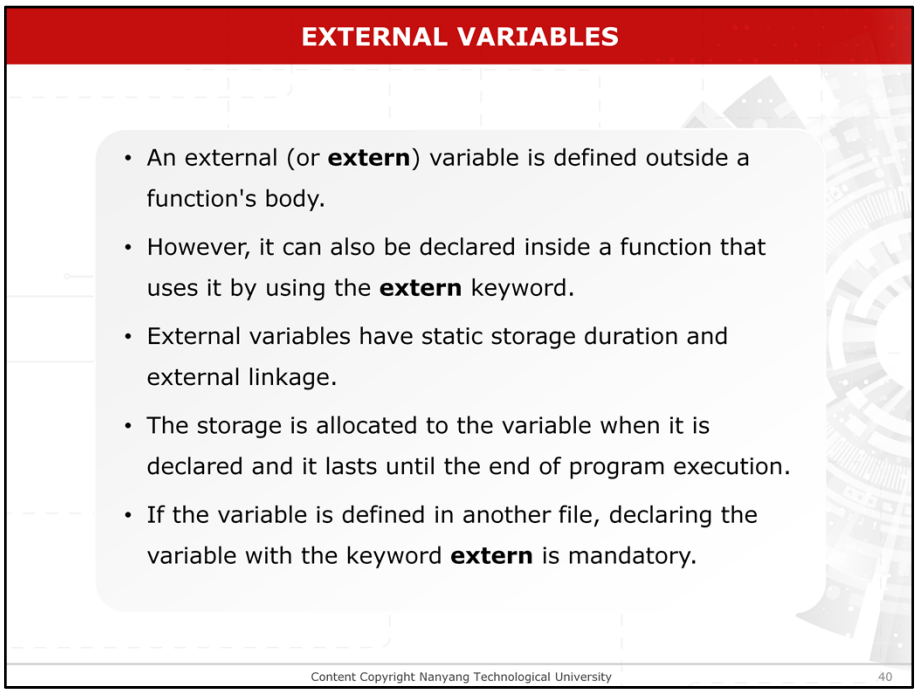
However, it can also be declared inside a function that uses it by using the **extern** keyword.



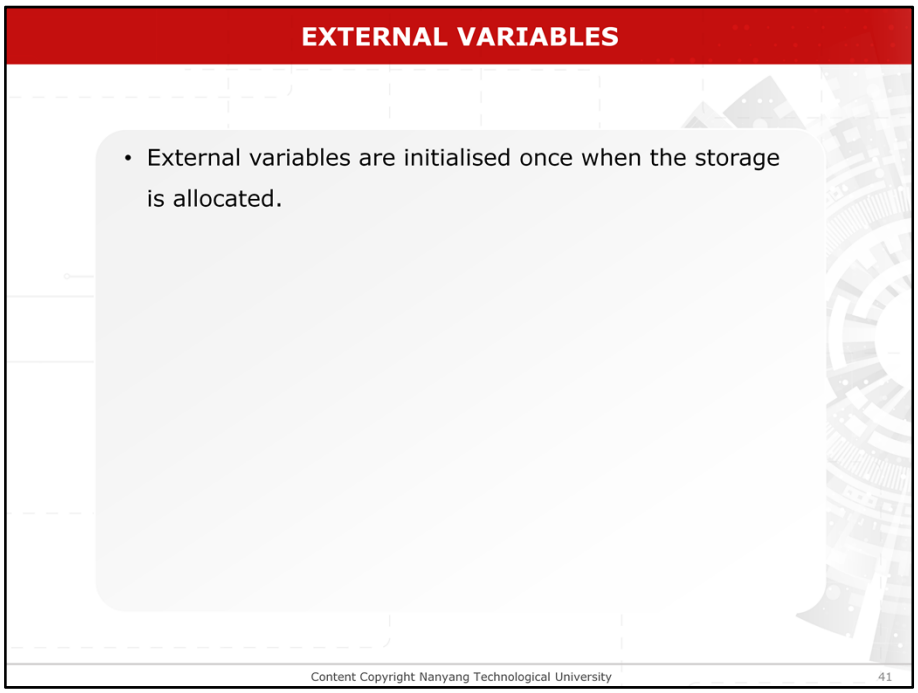
External variables have static storage duration and external linkage.



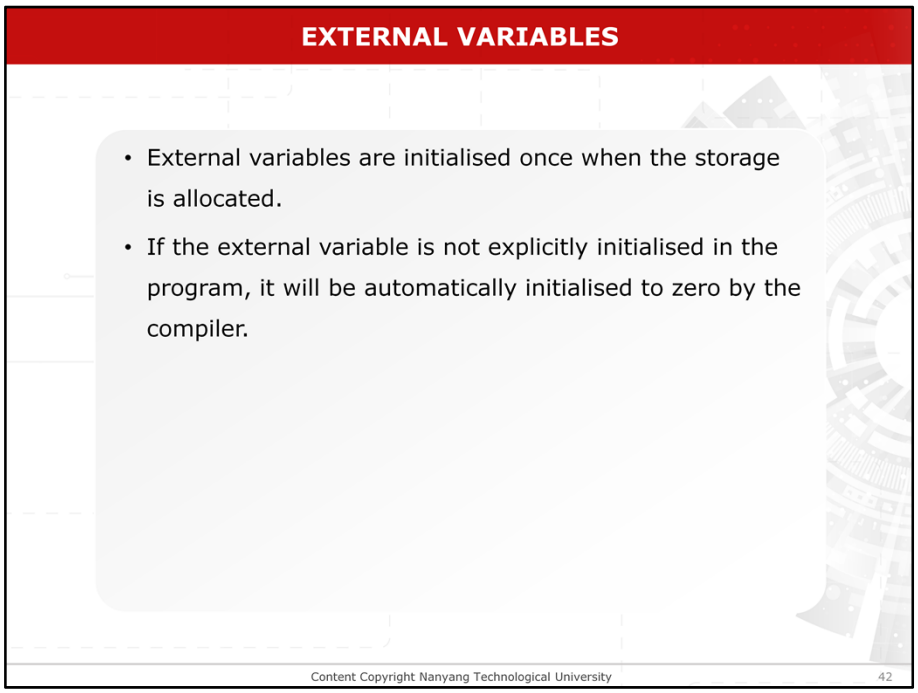
The storage is allocated to the variable when it is declared and it lasts until the end of program execution.



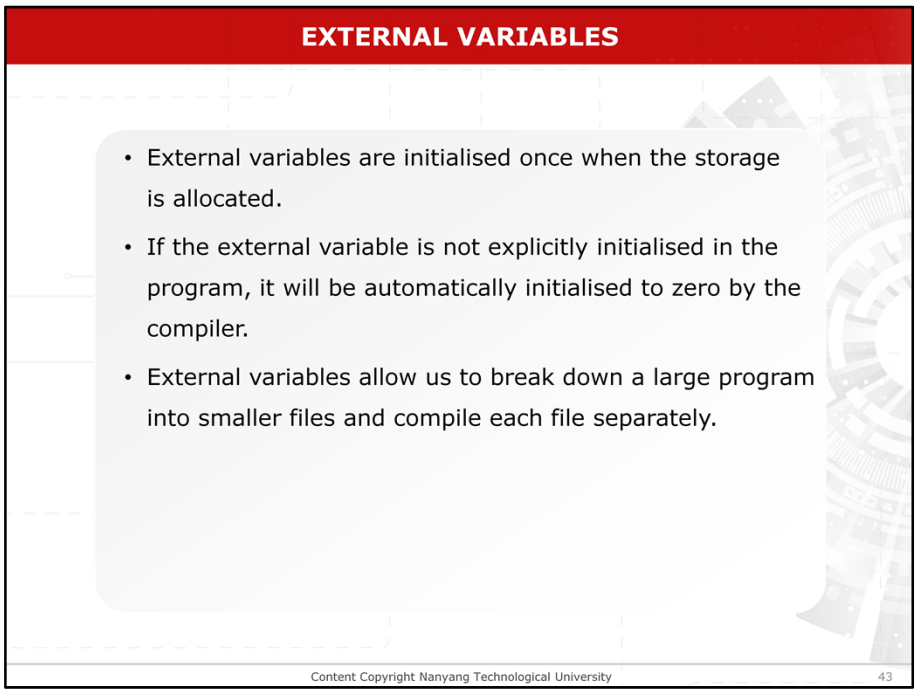
If the variable is defined in another file, declaring the variable with the keyword **extern** is mandatory.



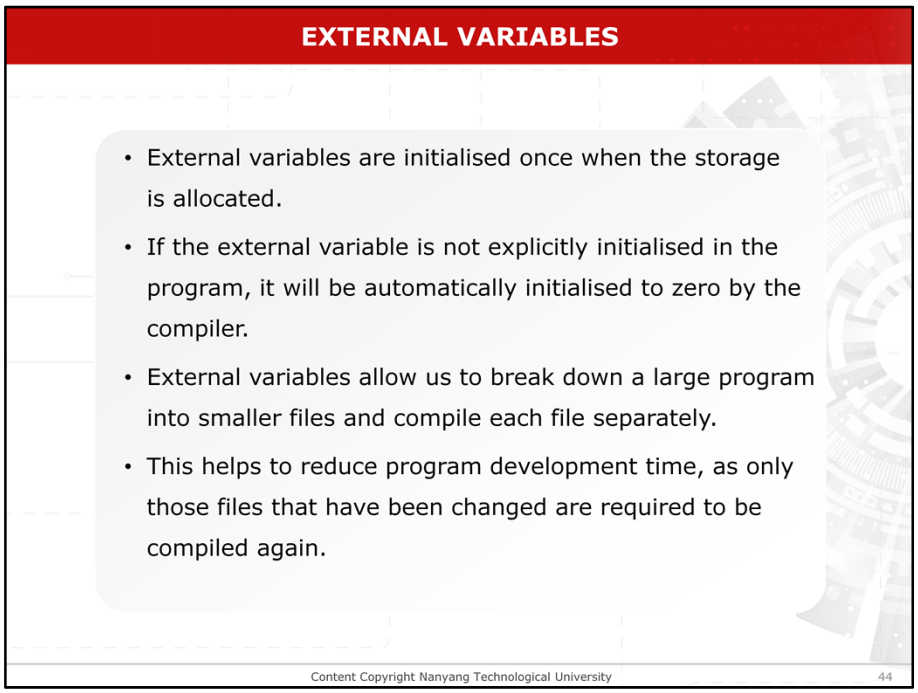
External variables are initialised once when the storage is allocated.



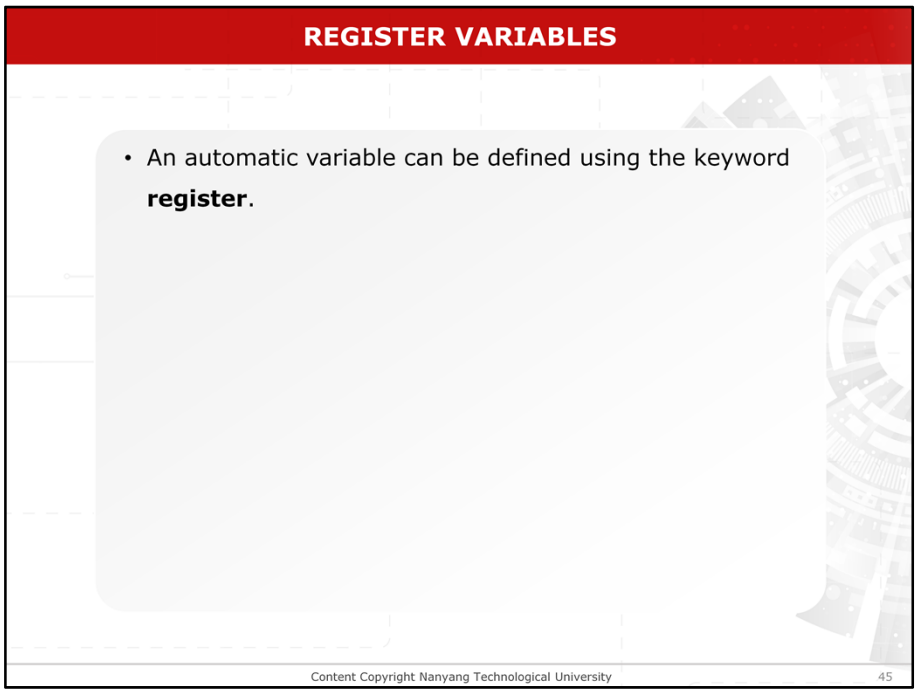
If the external variable is not explicitly initialised in the program, it will be automatically initialised to zero by the compiler.



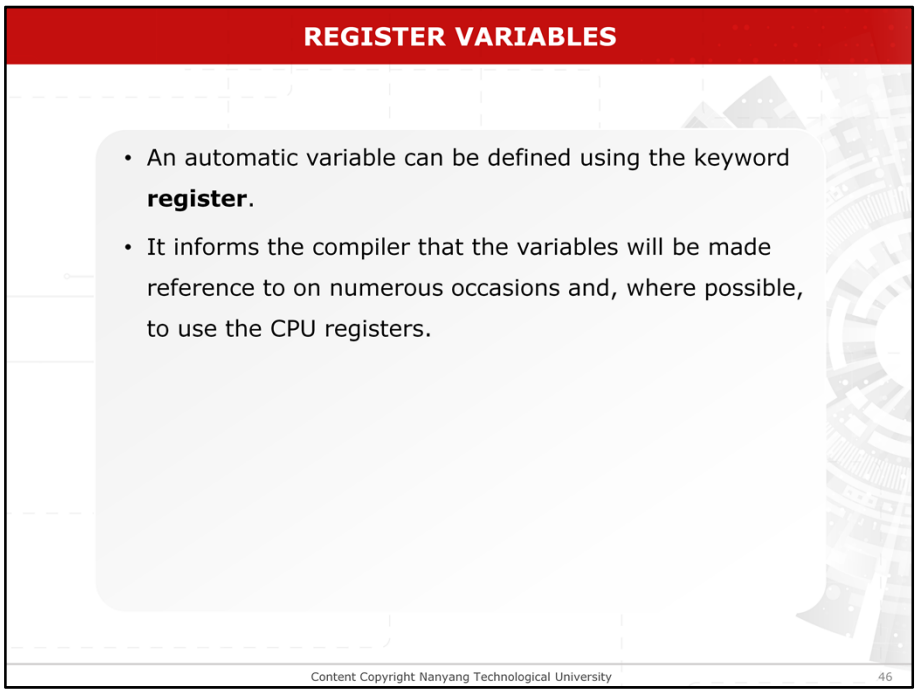
External variables allow us to break down a large program into smaller files and compile each file separately.



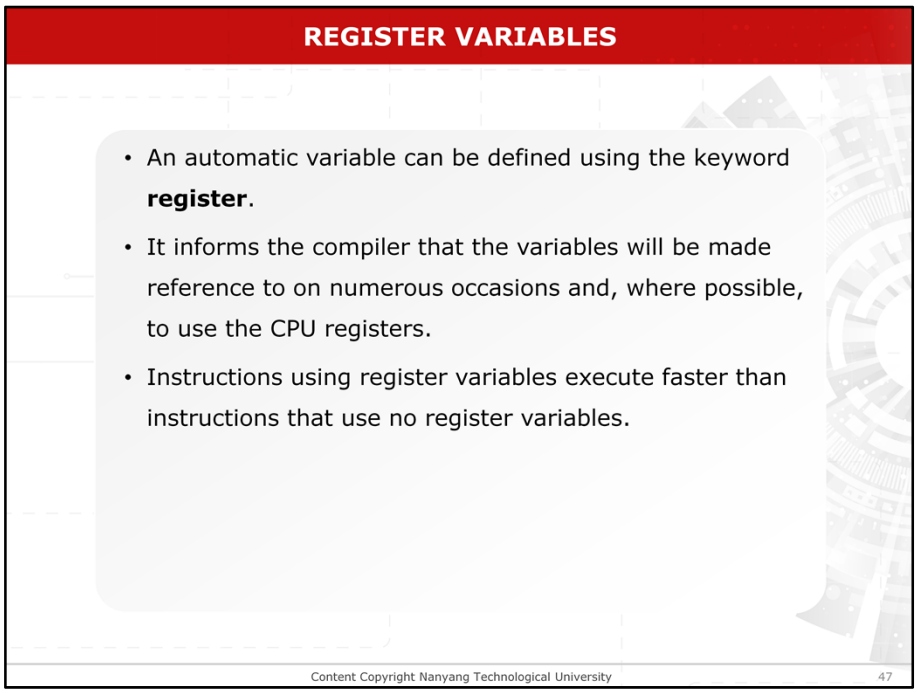
This helps to reduce program development time, as only those files that have been changed are required to be compiled again.



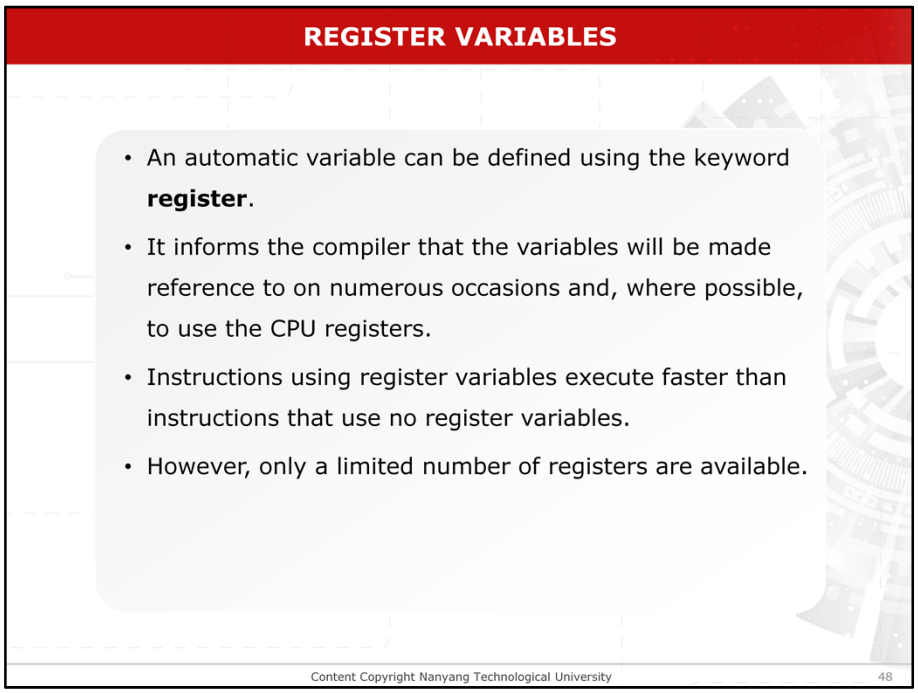
An automatic variable can be defined using the keyword **register**.



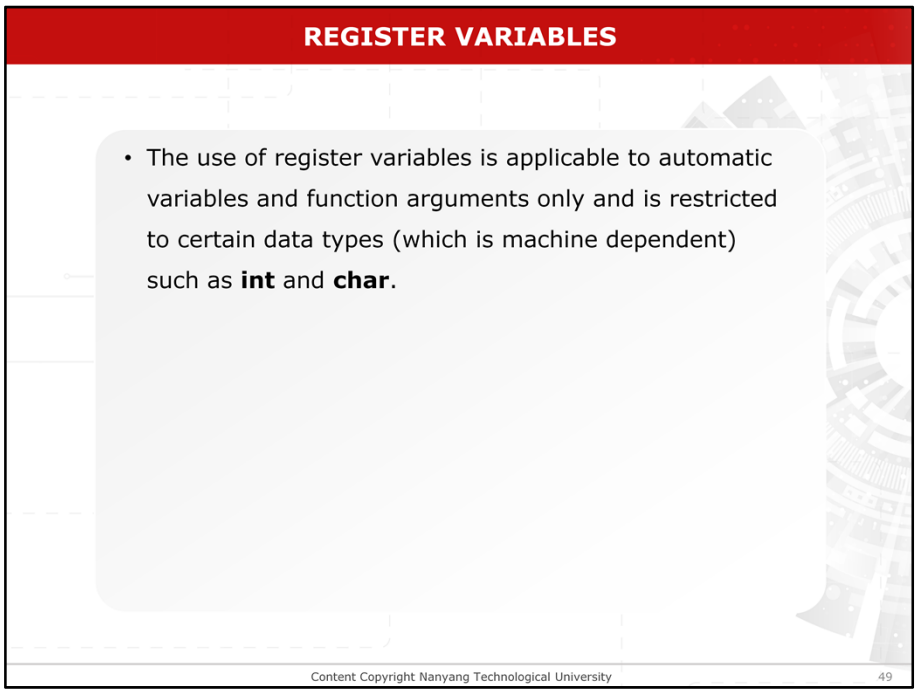
It informs the compiler that the variables will be made reference to on numerous occasions and, where possible, to use the CPU registers.



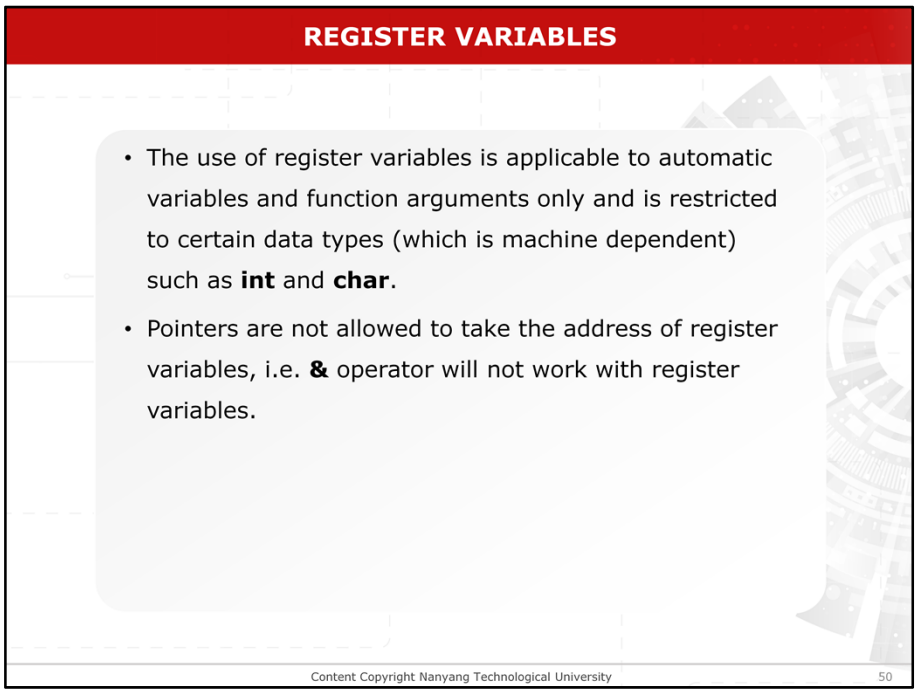
Instructions using register variables execute faster than instructions that use no register variables.



However, only a limited number of registers are available.



The use of register variables is applicable to automatic variables and function arguments only and is restricted to certain data types (which is machine dependent) such as **int** and **car**.



Pointers are not allowed to take the address of register variables, i.e. **&** operator will not work with register variables.

STATIC VARIABLES

- It is defined using the **static** keyword.

Remove the

STATIC VARIABLES

- It is defined using the **static** keyword.
- The duration of a static variable is fixed.

Remove the

STATIC VARIABLES

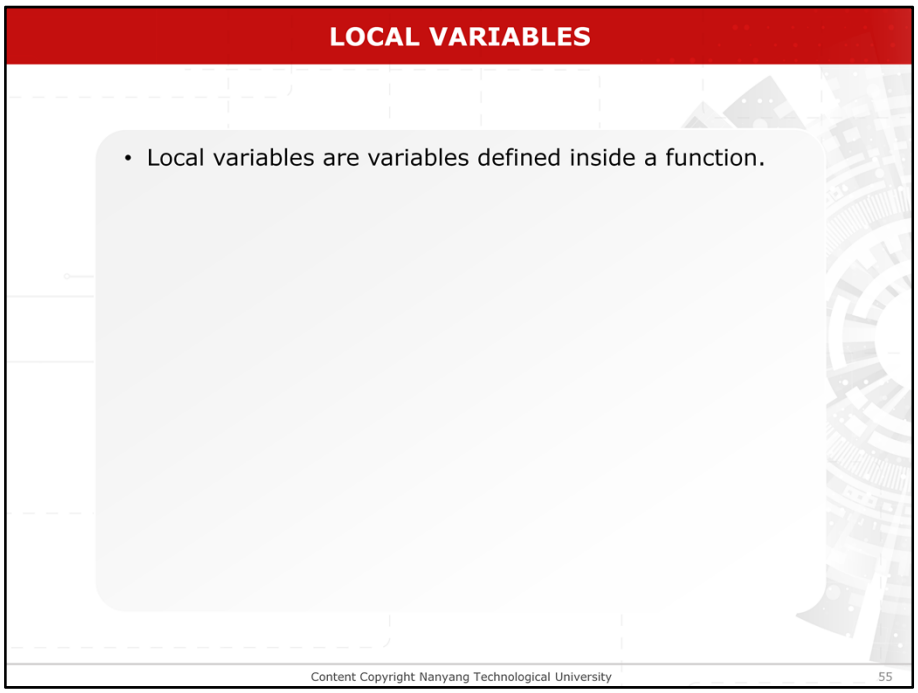
- It is defined using the **static** keyword.
- The duration of a static variable is fixed.
- Static variables are created at the **start** of the program and are destroyed only at the **end** of program execution.

Remove the

STATIC VARIABLES

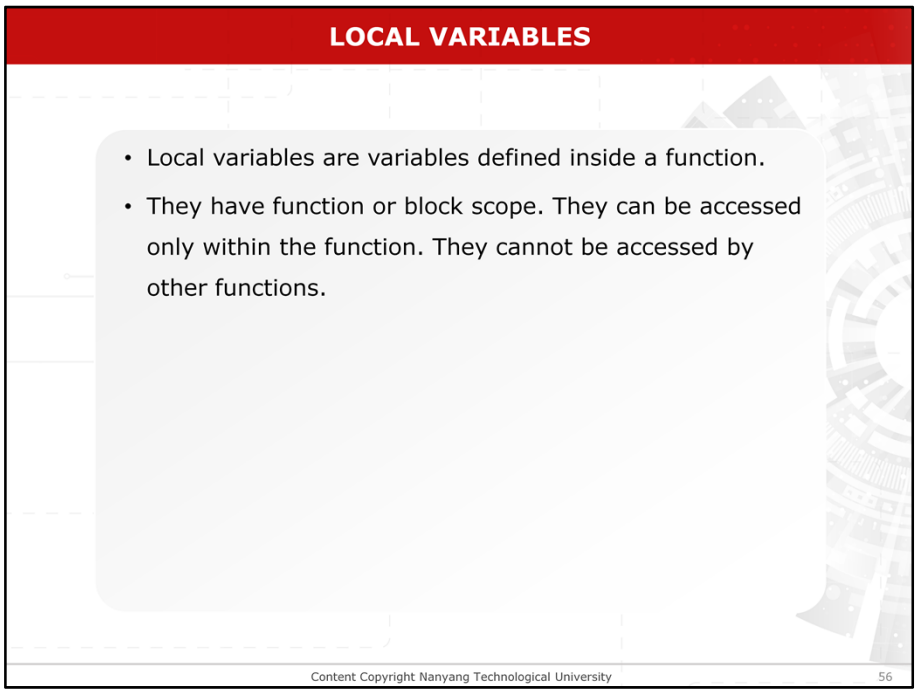
- It is defined using the **static** keyword.
- The duration of a static variable is fixed.
- Static variables are created at the **start** of the program and are destroyed only at the **end** of program execution.
- That is, they exist throughout the program execution once they are creates.

Remove the



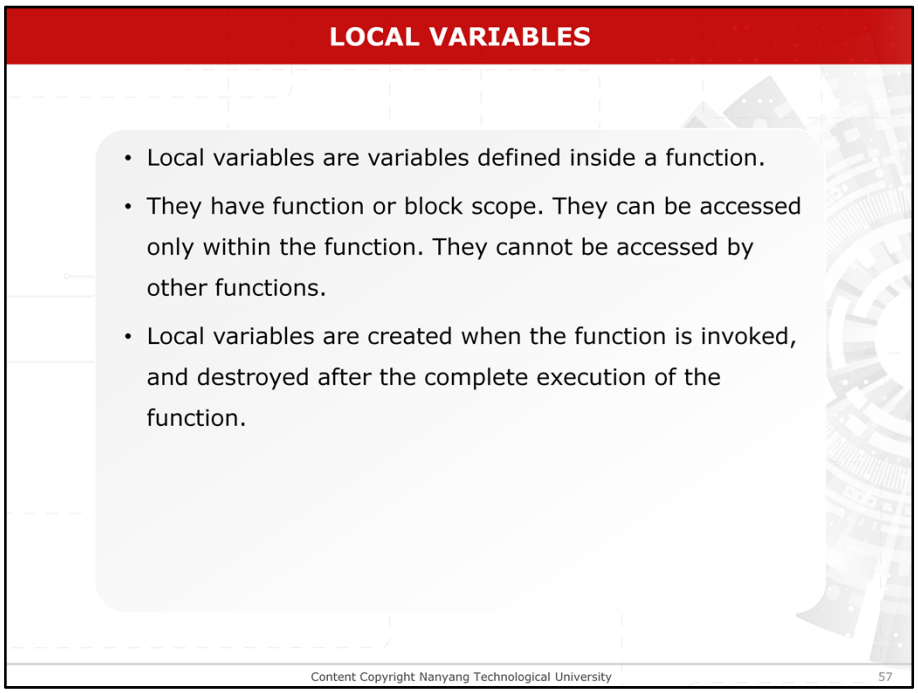
Local and Global Variables

Local variables are variables defined inside a function. They have function or block scope. They can be accessed only within the function. They cannot be accessed by other functions. Local variables are created when the function is invoked, and destroyed after the complete execution of the function.



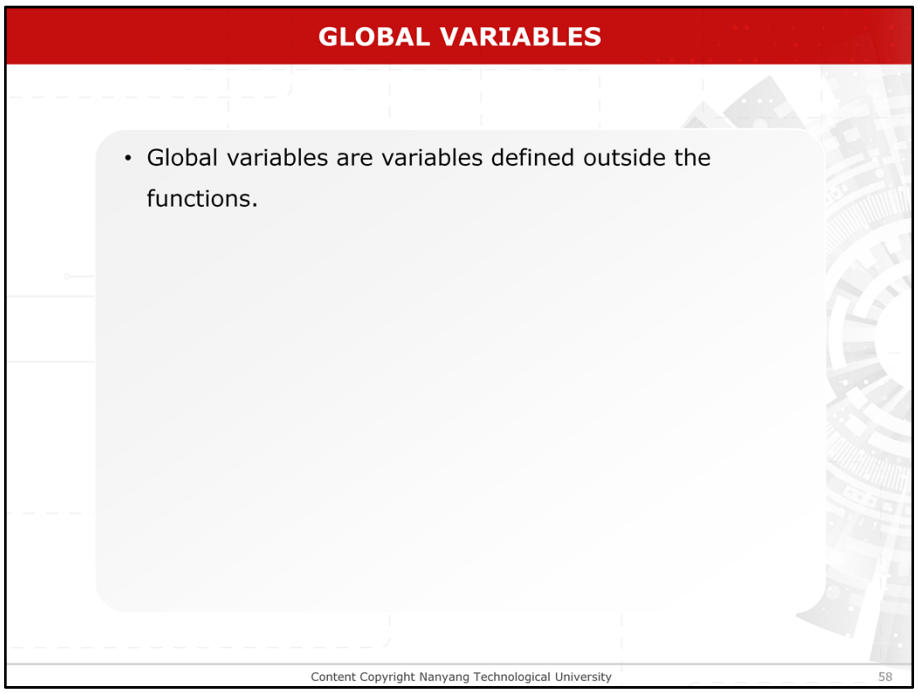
Local and Global Variables

Local variables are variables defined inside a function. They have function or block scope. They can be accessed only within the function. They cannot be accessed by other functions. Local variables are created when the function is invoked, and destroyed after the complete execution of the function.

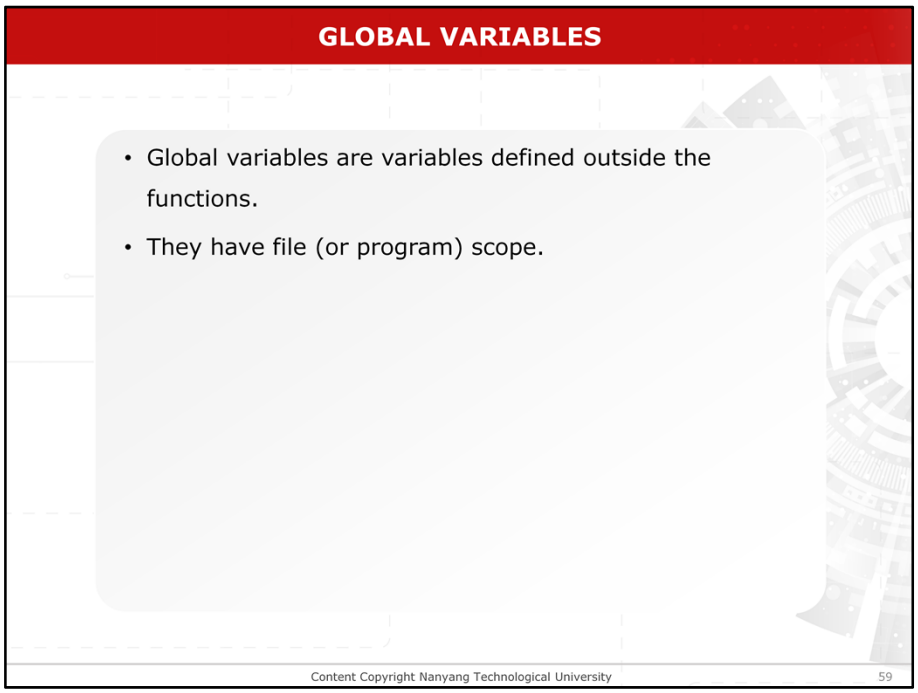


Local and Global Variables

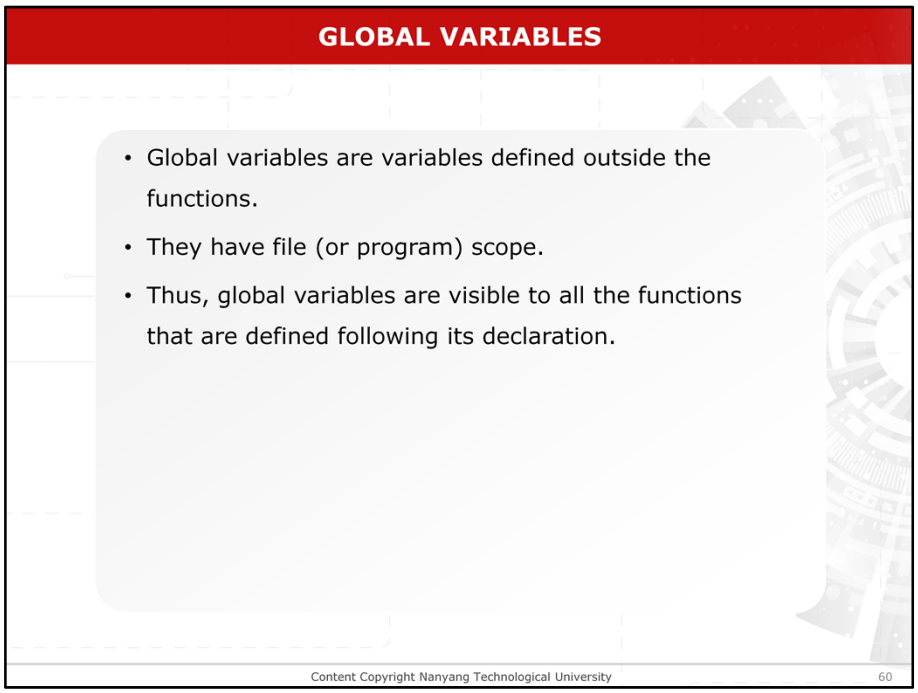
Local variables are variables defined inside a function. They have function or block scope. They can be accessed only within the function. They cannot be accessed by other functions. Local variables are created when the function is invoked, and destroyed after the complete execution of the function.



Global variables are variables defined outside the functions

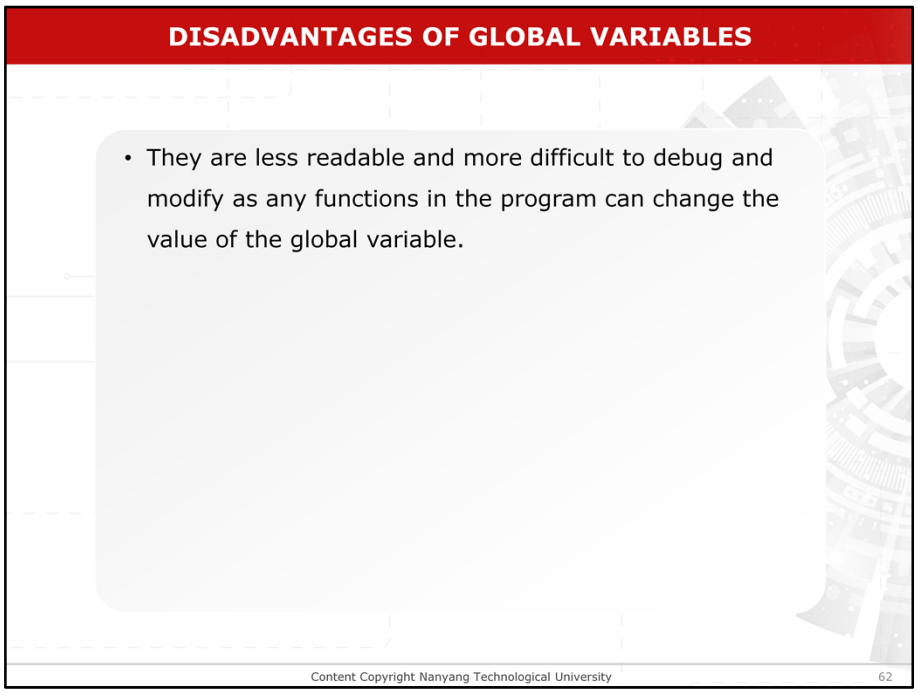


They have file or program scope.

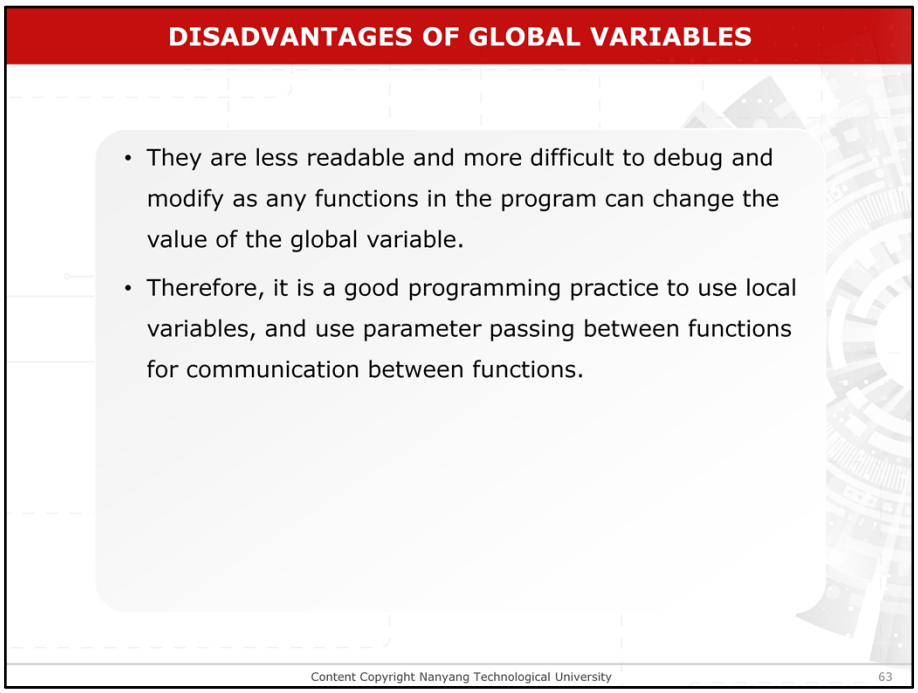


Thus, global variables are visible to all the functions that are defined following its declaration.

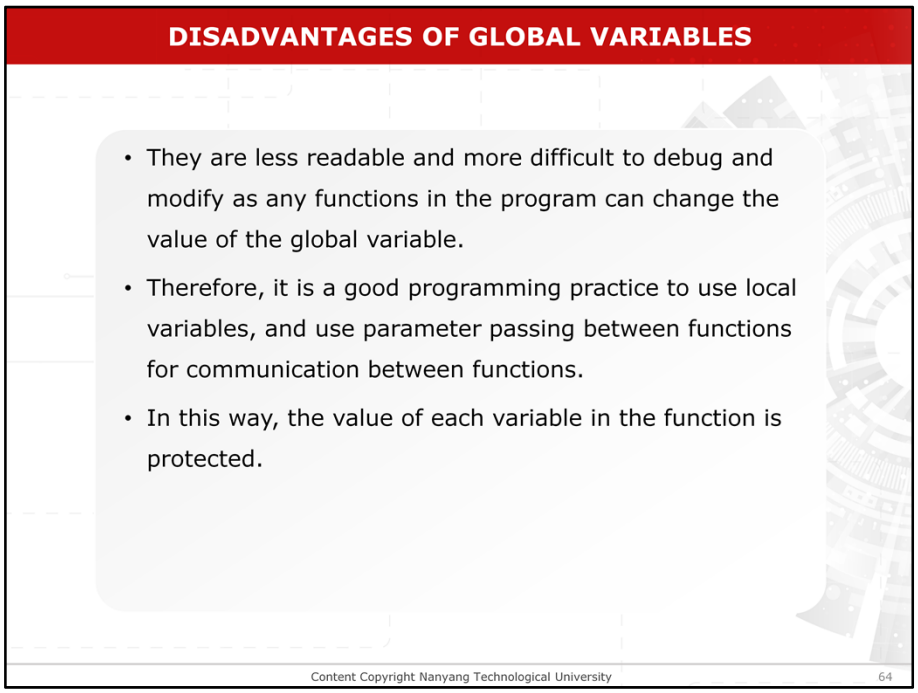
The advantages of global variables in programs are that global variables are the simplest way of communication between functions and they are efficient.



The disadvantages of programs using global variables are that they are less readable and more difficult to debug and modify as any functions in the program can change the value of the global variable. Therefore, it is a good programming practice to use local variables, and use parameter passing between functions for communication between functions. In this way, the value of each variable in the function is protected.



The disadvantages of programs using global variables are that they are less readable and more difficult to debug and modify as any functions in the program can change the value of the global variable. Therefore, it is a good programming practice to use local variables, and use parameter passing between functions for communication between functions. In this way, the value of each variable in the function is protected.



The disadvantages of programs using global variables are that they are less readable and more difficult to debug and modify as any functions in the program can change the value of the global variable. Therefore, it is a good programming practice to use local variables, and use parameter passing between functions for communication between functions. In this way, the value of each variable in the function is protected.

LOCAL AND GLOBAL VARIABLES: EXAMPLE

```
#include  <stdio.h>
int g_var = 5;
int fn1(int, int);
float expn(float);
int main( ) {
     char reply;
     int num;
     …
}
 int fn1(int x, int y) {

     float fnum;
     int temp;
     g_var += 10;
     …
}
float expn(float n)  {
     float temp;
     …
}
```


This program illustrates the use of local and global variables

LOCAL AND GLOBAL VARIABLES: EXAMPLE

```
#include  <stdio.h>
int g_var = 5;                  // global variable –  has file scope
int fn1(int, int);
float expn(float);
int  main( ) {
     char reply;
     int num;
     …
}
 int fn1(int x, int y) {

     float fnum;
     int temp;
     g_var += 10;
     …
}
float expn(float n)  {
     float temp;
     …
}
```


The global variable **g_var** is declared outside the main() function. Global variables will have the file scope.

LOCAL AND GLOBAL VARIABLES: EXAMPLE

```
#include  <stdio.h>
int g_var = 5;
int fn1(int, int);
float expn(float);
int main( ) {
     char reply;                  // local - These two variables are only
     int num;                     // known inside main() function - block scope
     ...
}
 int fn1(int x, int y) {

     float fnum;
     int temp;
     g_var += 10;
     ...
}
float expn(float n)  {
     float temp;
     ...
}
```


- these two variables are only known inside main() function, they are said to be block scope

LOCAL AND GLOBAL VARIABLES: EXAMPLE

```
#include  <stdio.h>
int g_var = 5;
int fn1(int, int);
float expn(float);
int main( ) {
     char reply;
     int num;
     …
}
 int fn1(int x, int y) {          // local x,y - formal parameters  are only
                                  // known inside this function – Block scope
     float fnum;
     int temp;
     g_var += 10;
     …
}
float expn(float n)  {
     float temp;
     …
}
```


- these two variables are only known inside this function, hence they are said to be block scope

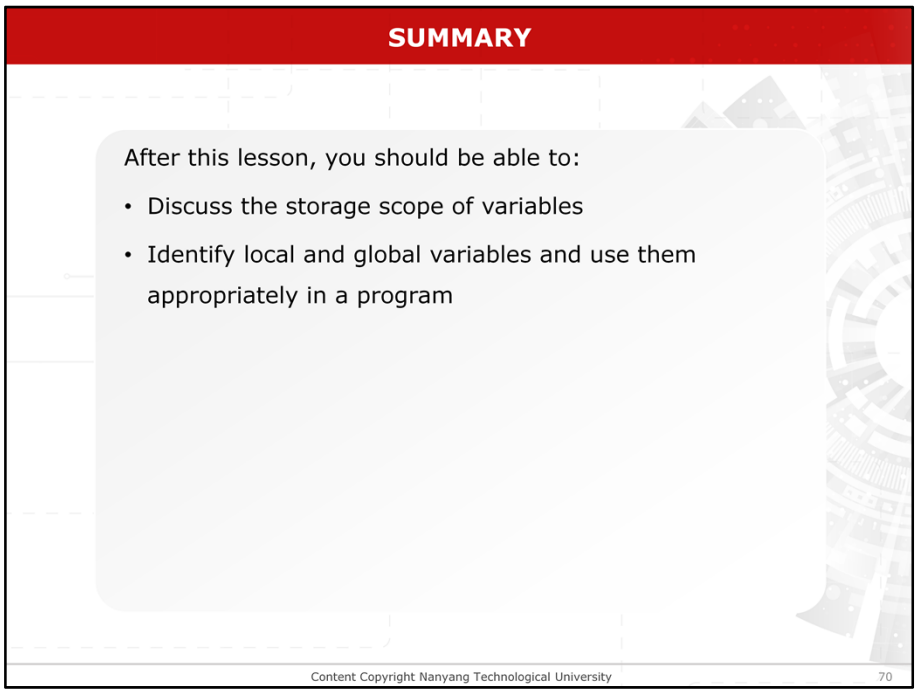
LOCAL AND GLOBAL VARIABLES: EXAMPLE

```
#include  <stdio.h>
int g_var = 5;
int fn1(int, int);
float expn(float);
int main( ) {
     char reply;
     int num;
     …
}
 int fn1(int x, int y) {

     float fnum;                  // local - These two variables are known
     int temp;                    // in this function only. – Block scope
     g_var += 10;
     …
}
float expn(float n)  {
     float temp                   // local - this variable is known in expn()
     …                            // block scope

}
```


The variables **fnum** and **temp** are local variables which will have block scope.



In summary, after viewing this video lesson, your should be able to do the listed