Storage Class Specifier

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Variable Types

Automatic Variable
a variable defined inside a function block.
invisible outside the function
a local variable which is allocated and deallocated automatically
when program flow enters and leaves the variable's scope.

External Variable
a variable defined outside any function block

Static Variable
a variable that has been allocated "statically",
meaning that its lifetime (or "extent") is the entire run of the program.

Global Variables

Variables declared outside any function definition
Accessible to any function defined in the same file
after the global variable is defined

Global Variables (A1, A2, A3)

Global Variables (A1)

```
include <stdio.h>

int a;

int main(void) {
  printf("a=%d\n", a);
}
```

a=0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a;
```

undeclared error

```
include <stdio.h>

extern int a;

int main(void) {
  printf("a=%d\n", a);
}
```

undefined reference

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a;
```

undeclared error

https://cprogramex.wordpress.com/

Global Variables (A2)

```
include <stdio.h>

int a;

int main(void) {
  printf("a=%d\n", a);
}

int a;
```

a=0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a;
int a;
```

undeclared error

```
include <stdio.h>

extern int a;

int main(void) {
  printf("a=%d\n", a);
}

int a;
```

a=0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a;
int a;
```

undeclared error

https://cprogramex.wordpress.com/

Global Variables (A3)

```
include <stdio.h>

int a;

int main(void) {
  printf("a=%d\n", a);
}

int a = 333;
```

a=333

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a;
int a = 333;
```

undeclared error

```
include <stdio.h>

extern int a;

int main(void) {
  printf("a=%d\n", a);
}

int a = 333;
```

a=333

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a;
int a = 333;
```

undeclared error

https://cprogramex.wordpress.com/

Global Variables (B1, B2, B3)

Global Variables (B1)

```
include <stdio.h>

int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

a= 0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a = 111;
```

undeclared error

```
include <stdio.h>

extern int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

initialized warning
a=111

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a = 111;
```

undeclared error

https://cprogramex.wordpress.com/

Global Variables (B2)

```
include <stdio.h>

int a = 111;

int main(void) {
  printf("a=%d\n", a);
}

int a;
```

a=111

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a = 111;
int a;
```

undeclared error

```
include <stdio.h>

extern int a = 111;

int main(void) {
  printf("a=%d\n", a);
}

int a;
```

initialized warning
a=111

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a = 111;
int a;
```

undeclared error
initialized warning

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Global Variables (B3)

```
include <stdio.h>

int a = 111;

int main(void) {
  printf("a=%d\n", a);
}

int a = 333;
```

redefinition error

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a = 111;
int a = 333;
```

undeclared error
redefinition error

```
include <stdio.h>

extern int a = 111;

int main(void) {
  printf("a=%d\n", a);
}

int a = 333;
```

redefinition error
initialized warning

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a = 111;
int a = 333;
```

undeclared error
redefinition error
initialized warning

https://cprogramex.wordpress.com/

Global Variables (P1, P2)

Global Variables (P1)

```
include <stdio.h>

int a;

int main(void) {
  printf("a=%d\n", a);
}
```

a=0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a;
```

undeclared error

```
include <stdio.h>

extern int a;

int main(void) {
  printf("a=%d\n", a);
}
```

a=0

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a;
```

undeclared error

```
int a;
```

```
int a;
```

```
int a;
```

```
int a;
```

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Global Variables (P2)

```
include <stdio.h>

int a;

int main(void) {
  printf("a=%d\n", a);
}
```

a=333

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a;
```

undeclared error

```
include <stdio.h>

extern int a;

int main(void) {
  printf("a=%d\n", a);
}
```

a=333

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a;
```

undeclared error

```
int a = 333;
```

```
int a = 333;
```

```
int a = 333;
```

```
int a = 333;
```

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Global Variables (Q1, Q2)

Global Variables (Q1)

```
include <stdio.h>

int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

a=111

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

int a = 111;
```

undeclared error

```
include <stdio.h>

extern int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

initialized warning
a=111

```
include <stdio.h>


int main(void) {
  printf("a=%d\n", a);
}

extern int a = 111;
```

undeclared error
initialized warning

```
int a;
```

```
int a;
```

```
int a;
```

```
int a;
```

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Global Variables (Q2)

```
include <stdio.h>

int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

multiple definition

```
include <stdio.h>

int main(void) {
  printf("a=%d\n", a);
}

int a = 111;
```

undeclared error

```
include <stdio.h>

extern int a = 111;

int main(void) {
  printf("a=%d\n", a);
}
```

initialized warning
multiple definition

```
include <stdio.h>

int main(void) {
  printf("a=%d\n", a);
}

extern int a = 111;
```

undeclared error
initialized warning

```
int a = 333;
```

```
int a = 333;
```

```
int a = 333;
```

```
int a = 333;
```

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Function Definitions (C1, C2, C3)

Function Definitions (C1)

```
include <stdio.h>

void func( );

int main(void) {
  func();
}
```

undefined reference

```
include <stdio.h>


int main(void) {
  func();
}

void func( );
```

function warning
undefined reference

```
include <stdio.h>

extern void func( );

int main(void) {
  func();
}
```

undefined reference

```
include <stdio.h>


int main(void) {
  func();
}

extern void func( );
```

function warning
undefined reference

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Function Definitions (C2)

```
include <stdio.h>

void func( );

int main(void) {
  func();
}

void func( );
```

undefined reference

```
include <stdio.h>



int main(void) {
  func();
}

void func( );
void func( );
```

function warning
undefined reference

```
include <stdio.h>

extern void func( );

int main(void) {
  func();
}

void func( );
```

undefined reference

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( );
void func( );
```

function warning
undefined reference

https://cprogramex.wordpress.com/

Function Definitions (C3)

```
include <stdio.h>

void func( );

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

func

```
include <stdio.h>


int main(void) {
  func();
}

void func( );
void func( ) {
  printf("func \n");
}
```

function warning
func

```
include <stdio.h>

extern void func( );

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

func

```
include <stdio.h>


int main(void) {
  func();
}

extern void func( );
void func( ) {
  printf("func \n");
}
```

function warning
func

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Function Definitions (D1, D2, D3)

Function Definitions (D1)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

function warning
func called

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
```

function warning
func called

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Function Definitions (D2)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( );
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
void func( );
```

function warning
func called

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( );
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
void func( );
```

function warning
func called

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Function Definitions (D3)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

redefinition error

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
void func( ) {
  printf("func \n");
}
```

function warning
redefinition error

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

redefinition error

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
void func( ) {
  printf("func \n");
}
```

function warning
redefinition error

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Function Definitions (M1, M2)

Function Definitions (M1)

```
include <stdio.h>

void func( );

int main(void) {
  func();
}
```

undefined reference

```
include <stdio.h>


int main(void) {
  func();
}

void func( );
```

function warning
undefined reference

```
include <stdio.h>

extern void func( );

int main(void) {
  func();
}
```

undefined reference

```
include <stdio.h>


int main(void) {
  func();
}

extern void func( );
```

function warning
undefined reference

```
void func( );
```

```
void func( );
```

```
void func( );
```

```
void func( );
```

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Function Definitions (M2)

```
include <stdio.h>

void func( );

int main(void) {
  func();
}
```

func

```
include <stdio.h>


int main(void) {
  func();
}

void func( );
```

function warning
func

```
include <stdio.h>

extern void func( );

int main(void) {
  func();
}
```

func

```
include <stdio.h>


int main(void) {
  func();
}

extern void func( );
```

function warning
func

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

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Function Definitions (N1, N2)

Function Definitions (N1)

```
#include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func

```
void func( );
```

```
#include <stdio.h>

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

function warning
func

```
void func( );
```

```
#include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func

```
void func( );
```

```
#include <stdio.h>

 int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
```

function warning
func

```
void func( );
```

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Function Definitions (N2)

```
#include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

multiple definition

```
#include <stdio.h>

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

function warning
multiple definition

```
#include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

multiple definition

```
#include <stdio.h>

 int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
```

function warning
multiple definition

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

```
void func( ) {
  printf("func \n");
}
```

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Function Definitions (D1, D2, D3)

Function Definitions (D1)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

function warning
func called

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
```

function warning
func called

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Function Definitions (D2)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( );
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
void func( );
```

function warning
func called

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( );
```

func called

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
void func( );
```

function warning
func called

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Function Definitions (D3)

```
include <stdio.h>

void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

redefinition error

```
include <stdio.h>



int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
void func( ) {
  printf("func \n");
}
```

function warning
redefinition error

```
include <stdio.h>

extern void func( ) {
  printf("func \n");
}

int main(void) {
  func();
}

void func( ) {
  printf("func \n");
}
```

redefinition error

```
include <stdio.h>



int main(void) {
  func();
}

extern void func( ) {
  printf("func \n");
}
void func( ) {
  printf("func \n");
}
```

function warning
redefinition error

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Storage Class Specifiers

- auto
- extern
- register
- static
- typedef
-

Storage Duration

	Functions	Global Variables	Local Variables
static	static storage	static storage	static storage
extern	static storage	static storage	static storage
no specifier	static storage	static storage	auto storage

Linkage

	Functions	Global Variables	Local Variables
static	internal linkage	internal linkage	
extern	external linkage	external linkage	
no specifier	external linkage	external linkage	

References

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[2] Efficient C Programming, Mark A. Weiss
[3] C A Reference Manual, Samuel P. Harbison & Guy L. Steele Jr.
[4] C Language Express, I. K. Chun