ctype.h Header File in C

The ctype.h header file in C provides functions for character classification and conversion. These functions are useful for validating and manipulating characters in various contexts, such as input validation and formatting.

♠ Character Classification Functions

1. **isalnum(int c)**

   Description: Checks if the character is alphanumeric (a letter or a digit).

   Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'a';
    if (isalnum(c))
        printf("'%c' is alphanumeric.\n", c);
    else
        printf("'%c' is not alphanumeric.\n", c);
    return 0;
}
```

2. **isalpha(int c)**

   Description: Checks if the character is an alphabetic letter (a-z or A-Z).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'Z';
    if (isalpha(c))
        printf("'%c' is an alphabetic letter.\n", c);
    else
        printf("'%c' is not an alphabetic letter.\n", c);
    return 0;
}
```

3. **isdigit(int c)**

   Description: Checks if the character is a decimal digit (0-9).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = '4';
    if (isdigit(c))
        printf("'%c' is a digit.\n", c);
    else
        printf("'%c' is not a digit.\n", c);
    return 0;
}
```

4. **isxdigit(int c)**

   Description: Checks if the character is a hexadecimal digit (0-9, a-f, A-F).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'F';
    if (isxdigit(c))
        printf("'%c' is a hexadecimal digit.\n", c);
    else
        printf("'%c' is not a hexadecimal digit.\n", c);
    return 0;
}
```

5. **islower(int c)**

   Description: Checks if the character is a lowercase letter (a-z).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'b';
    if (islower(c))
        printf("'%c' is a lowercase letter.\n", c);
    else
        printf("'%c' is not a lowercase letter.\n", c);
    return 0;
}
```

6. **isupper(int c)**

   Description: Checks if the character is an uppercase letter (A-Z).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'H';
    if (isupper(c))
        printf("'%c' is an uppercase letter.\n", c);
    else
        printf("'%c' is not an uppercase letter.\n", c);
    return 0;
}
```

7. **isspace(int c)**

   Description: Checks if the character is a whitespace character (' ', '\t', '\n', '\v', '\f', '\r').

Example:

```c
#include <stdio.h>
#include <ctype.h>
```

```c
int main() {
    char c = '\n';
    if (isspace(c))
        printf("Whitespace detected.\n");
    else
        printf("Not a whitespace character.\n");
    return 0;
}
```

8. **ispunct(int c)**

   Description: Checks if the character is a punctuation mark (e.g., '.', ',', ';').

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = ',';
    if (ispunct(c))
        printf("'%c' is a punctuation mark.\n", c);
    else
        printf("'%c' is not a punctuation mark.\n", c);
    return 0;
}
```

9. **isprint(int c)**

   Description: Checks if the character is printable (visible characters and space).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = '!';
    if (isprint(c))
        printf("'%c' is a printable character.\n", c);
    else
        printf("'%c' is not a printable character.\n", c);
    return 0;
}
```

10. **isgraph(int c)**

    Description: Checks if the character has a graphical representation (like isprint but excludes space).

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = '#';
    if (isgraph(c))
        printf("'%c' has a graphical representation.\n", c);
    else
        printf("'%c' does not have a graphical representation.\n", c);
    return 0;
```

```
}
```

11. **iscntrl(int c)**

    Description: Checks if the character is a control character (e.g., '\n', '\t').

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = '\t';
    if (iscntrl(c))
        printf("Control character detected.\n");
    else
        printf("Not a control character.\n");
    return 0;
}
```

♠ Character Conversion Functions

1. **tolower(int c)**

   Description: Converts an uppercase letter to a lowercase letter.

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'A';
    printf("Lowercase of '%c' is '%c'.\n", c, tolower(c));
    return 0;
}
```

2. **toupper(int c)**

   Description: Converts a lowercase letter to an uppercase letter.

Example:

```c
#include <stdio.h>
#include <ctype.h>

int main() {
    char c = 'b';
    printf("Uppercase of '%c' is '%c'.\n", c, toupper(c));
    return 0;
}
```


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