3. Variables and Data Types

3.1 Variable Declaration

Python vs C:

Python	C
`x = 5`	`int x = 5;`
`name = "John"`	`char name[] = "John";`
`pi = 3.14`	`float pi = 3.14f;`

3.2 Basic Data Types

3.2.1 Integer Types

Type	Size (bytes)	Range	Usage
`char`	1	-128 to 127	Small integers, characters
`short`	2	-32,768 to 32,767	Small integers
`int`	4	-2,147,483,648 to 2,147,483,647	Standard integers
`long`	4/8	System dependent	Large integers
`long long`	8	Very large range	Very large integers

Unsigned Variants:

```
unsigned char uc;    // 0 to 255
unsigned int ui;     // 0 to 4,294,967,295
unsigned short us;   // 0 to 65,535
```

3.2.2 Floating-Point Types

Type	Size	Precision	Range
`float`	4 bytes	~7 digits	±3.4 × 10^±38
`double`	8 bytes	~15 digits	±1.7 × 10^±308
`long double`	12/16 bytes	Extended precision	System dependent

3.2.3 Character and String Types

Single Characters:

```
char letter = 'A';        // Single character
char digit = '5';         // Character representation of digit
char newline = '\n';      // Escape sequence
```

Strings (Character Arrays):

```
char name[20] = "John";           // Fixed-size array
char message[] = "Hello World";   // Size determined by initializer
char buffer[100];                 // Uninitialized array
```

Python vs C String Comparison:

Python	C
`name = "John"`	`char name[] = "John";`
`len(name)`	`strlen(name)`
`name[0]`	`name[0]`
`name + " Doe"`	`strcat(name, " Doe");`

3.3 Variable Declaration Rules

1. **Must declare before use** (unlike Python)
2. **Case-sensitive** (`age` ≠ `Age`)
3. **Cannot start with digits** (`2x` is invalid)
4. **Cannot use keywords** (`int`, `if`, `while`, etc.)
5. **Should use meaningful names** (`student_count` not `sc`)

3.4 Constants

```
// Method 1: #define preprocessor directive
#define PI 3.14159
#define MAX_SIZE 100

// Method 2: const keyword
const int ARRAY_SIZE = 50;
const float GRAVITY = 9.81f;
```

Python vs C Constants:

Python	C
`PI = 3.14159`	`#define PI 3.14159`
`PI = 3.14159`	`const float PI = 3.14159f;`

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