📘 C++ Full Notes

🧱 1. Introduction to C++

- **C++** is a **general-purpose, object-oriented programming language** developed by Bjarne Stroustrup.
- It supports both **procedural** and **object-oriented programming (OOP)**.

Example:

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```cpp
#include <iostream>
using namespace std;

int main() {
    cout << "Hello, C++!";
    return 0;
}
```

🔤 2. Basic Syntax

- **Header Files**: `#include <iostream>`
- **Namespace**: `using namespace std;`
- **Main Function**: Entry point of C++ program.

🔢 3. Data Types

- **int** – Integer values

- **float, double** – Decimal numbers
- **char** – Single character
- **bool** – Boolean value
- **string** – Text (from `#include <string>`)

📚 4. Variables & Constants

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```
int age = 20;
const float PI = 3.14;
```

🧮 5. Operators

- **Arithmetic**: +, -, *, /, %
- **Relational**: ==, !=, >, <
- **Logical**: &&, ||, !
- **Assignment**: =, +=, -=

🔁 6. Control Statements

✔️ if, else if, else

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```
if (a > b) { cout << "A is big"; }
```

🔁 Loops: for, while, do-while

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```
for (int i = 1; i <= 5; i++) {
    cout << i;
}
```

🧰 7. Functions

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```
int add(int a, int b) {
    return a + b;
}
```

🏗️ 8. Object-Oriented Programming

🧱 Class and Object

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```
class Car {
  public:
    string brand;
    void drive() {
        cout << "Driving...";
    }
};

Car c;
c.drive();
```

Key OOP Concepts:

- **Encapsulation**
- **Inheritance**

- **Polymorphism**
- **Abstraction**

🎒 9. Arrays and Strings

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```
int nums[3] = {10, 20, 30};
string name = "Dhanush";
```

📦 10. Pointers

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```
int a = 5;
int *p = &a;
```

🧵 11. File Handling

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```
ofstream file("data.txt");
file << "Hello File!";
file.close();
```

➕ 12. Advanced Topics

- **Templates**
- **Exception Handling**
- **STL (Standard Template Library)**

- **Linked List, Stack, Queue**

🧾 13. User Input and Output

📥 Input with `cin`, 📤 Output with `cout`

cpp
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```
#include <iostream>
using namespace std;

int main() {
    int age;
    cout << "Enter your age: ";
    cin >> age;
    cout << "You are " << age << " years old.";
    return 0;
}
```

🎭 14. Conditional Statements

🌐 Nested if-else

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```
int x = 10;
if (x > 0) {
    if (x % 2 == 0)
        cout << "Positive even";
    else
        cout << "Positive odd";
}
```

🧮 Switch Case

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```
int day = 2;
```

```
switch(day) {
  case 1: cout << "Sunday"; break;
  case 2: cout << "Monday"; break;
  default: cout << "Invalid";
}
```

🔁 15. Loops - More Examples

📈 While Loop

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```
int i = 1;
while(i <= 5) {
    cout << i << " ";
    i++;
}
```

🔄 Do-While Loop

cpp
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```
int i = 1;
do {
    cout << i << " ";
    i++;
} while (i <= 5);
```

🧠 16. Functions – Types

⚙️ Function with No Arguments

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```
void greet() {
    cout << "Hello!";
}
```

📥 Function with Arguments

cpp

CopyEdit

```
void add(int a, int b) {
    cout << a + b;
}
```

🔁 Function with Return Type

cpp

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```
int multiply(int x, int y) {
    return x * y;
}
```

🏗️ 17. Classes and Objects – Explained

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```
class Student {
public:
    string name;
    int age;

    void display() {
        cout << "Name: " << name << ", Age: " << age;
    }
};

int main() {
    Student s1;
    s1.name = "Dhanush";
    s1.age = 21;
    s1.display();
}
```

🔐 18. Access Specifiers

- **public**: Accessible from anywhere.
- **private**: Accessible only within the class.
- **protected**: Accessible in base and derived class.

🧬 19. Inheritance

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```cpp
class Animal {
public:
    void sound() {
        cout << "Animal Sound";
    }
};

class Dog : public Animal {
public:
    void bark() {
        cout << "Woof!";
    }
};
```

🌀 20. Polymorphism

🔁 Compile-time Polymorphism (Function Overloading)

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```cpp
void display(int a) {
    cout << a;
}
void display(string b) {
    cout << b;
}
```

🔄 Runtime Polymorphism (Virtual Functions)

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```
class Base {
public:
    virtual void show() {
        cout << "Base";
    }
};

class Derived : public Base {
public:
    void show() override {
        cout << "Derived";
    }
};
```

🚨 21. Exception Handling

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```
try {
    int a = 5, b = 0;
    if (b == 0)
        throw "Division by zero!";
    cout << a / b;
} catch (const char* msg) {
    cout << msg;
}
```

📦 22. Templates

🔣 Function Template

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```
template <typename T>
T add(T a, T b) {
    return a + b;
}
```

📂 Class Template

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```
template <class T>
class Box {
public:
    T value;
};
```

📚 23. STL - Standard Template Library

- **vector**
- **map**
- **set**
- **stack**
- **queue**

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```
#include <vector>
vector<int> v = {1, 2, 3};
v.push_back(4);
```

🧮 24. Recursion

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```
int factorial(int n) {
    if (n <= 1) return 1;
    return n * factorial(n - 1);
}
```

📂 25. File Handling (More Examples)

Write to File

cpp

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```
ofstream file("output.txt");
file << "Hello, C++!";
file.close();
```

Read from File

cpp

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```
ifstream file("output.txt");
string line;
while (getline(file, line)) {
    cout << line;
}
file.close();
```