

*Visit Devian:

```
struct NecVis {  
  
    template <typename T, typename U>  
    void operator()(const T& t, const U& u)  
    {  
        std::cout << typeid(T).name() << ", " << typeid(U).name() << '\n';  
        cout << "(" << t << ", " << u << ")\n";  
    }  
  
};  
  
int main()  
{  
    using namespace std;  
  
    variant<int, double, string> vx(3.4);  
    variant<long, int, Date> vy(56);  
  
    visit(NecVis{}, vx, vy);  
}
```

```
using namespace std;  
  
auto fn = [](const auto& t, const auto& u)  
{  
    std::cout << typeid(t).name() << ", " << typeid(u).name() << '\n';  
    std::cout << "(" << t << ", " << u << ")\n";  
};  
  
variant<int, double, string> vx(4.5);  
variant<long, int, Date> vy(in_place_index<2>, 23, 7, 2023);  
  
visit(fn, vx, vy);
```

→ *Activated Template Syntax*

C++ 20

🤔 *unstanden kalitim yapilamaz X*

Variantlar kalitim yapilabilir. C++ Class derler!!

```
class Derived : public std::variant<int, std::string> {};  
  
int main()  
{  
    using namespace std;  
  
    Derived d = { "hello" };  
    cout << d.index() << '\n';  
    cout << get<1>(d) << '\n';  
    d.emplace<0>(77);  
    cout << get<0>(d) << '\n';  
}
```

```
template <typename ...Args>
struct Der : Args ... {
};
```

↓
pack expansion

↓
variable template
pack

```
struct A { };
struct B { };
struct C { };
```

I

```
int main()
{
    Der<A> x;
    Der<A, B> y;
    Der<A, B, C> y;
}
```

* Aggregate Initialization: Hakkında

```
struct A {
    A(int);
};

struct B {
    B(double);
};

struct C {
    C(int);
};

struct D : A, B, C {
};

int main()
{
    D dx = {35, 2.3, 34};
}
```

I

* Lambda Expressions: Hakkında

```
int main()
{
    auto fn = [](int x) {return x * 5; };
    decltype(fn) fx;
}
```

I

Bu bildirim
C++ 20'den sonra
geçerli ✓

→ C++ 20'e kadar, closure type'in
default ctor'u deleted!

* Overload Initiation:

```
template <typename ...Args>
struct Overload : Args... {
};

int main()
{
    Overload x{
        [](int a) {return a * a; },
        [](int a) {return a * 3; },
        [](int a) {return a * 4; },
        [](int a) {return a * 3; },
    };
}
```

burada for'a atılmamızı
sağlayan: CTAD

→ C++ 17'de çalışmaz, çünkü deduction guide geçersiz!

C++ 17'de
eklenmiştir!

* Variant ve Overloader Idiom'u:

```
template<typename... Ts>
struct overload : Ts...
{
    using Ts::operator()...;
};

int main()
{
    using namespace std;
    variant<int, string> vx(99);

    visit(overload{
        [](int ival) {cout << "int: " << ival << '\n'; },
        [](const std::string& s) {
            std::cout << "string: " << s << '\n'; },
        },
        vx);

    auto twice = overload{
        [](std::string& s) { s += s; },
        [](auto& i) { i *= 2; },
    };

    visit(twice, vx);
    std::cout << get<0>(vx) << "\n";
}
```

```
template<typename... Ts>
struct overload : Ts...
{
    using Ts::operator()...;
};

int main()
{
    using namespace std;
    variant<int, double, string> vx("ahmet");
    variant<int, long, string> vy("aksoy");

    visit(
        overload{
            [](int, int) { cout << "int, int\n"; },
            [](int, string) { cout << "int, string\n"; },
            [](double, long) { cout << "double, long\n"; },
            [](auto, auto) { cout << "other types\n"; },
        }, vx, vy);
}
```



* Valueless By Exception:

```
struct S {
    operator int()const {
        throw std::runtime_error{ "hata" };
        return 1;
    } // any conversion to int throws
};

int main()
{
    using namespace std;
    variant<double, int> var{ 12.2 };
    try {
        var.emplace<1>(S{});
    }
    catch (const std::exception& ex) {
        cout << "hata yakalandi ... " << ex.what() << "\n";
        cout << boolalpha << var.valueless_by_exception() << "\n";
        cout << "var.index() = " << var.index() << "\n";
        std::cout << (var.index() == variant_npos) << "\n";
    }
}
```

return değeri bool

• Exception throw edildiğin, variant'ın boş olduğu

• Eğer üye destroy olup, yeni üyenin oluşması sırasında exception throw etmeli!

→emplace variant'ın altındaki destroy eder!

* std::variant kullanım. Atenler: • N tane alternatif den her yerde variant kullanılabilir.

→ Error type için kullanılabilir!

```
1 struct Data {  
2     //...  
3 };  
4  
5  
6  
7  
8  
9 enum ErrorType {system, archive, log};  
10  
11  
12 std::variant<Data, ErrorType> foo();  
13  
14
```

→ Run time polymorphism'e alternatif • Virtual Dispatch mekanizmasında, Compiler bütün ifadeslerde fonksiyonlara v pointer gönder. Sadece fonksiyon tablosunda o fonksiyon adreslere atılır. → bellek ve zaman açısından maliyet!

- Polimorfik nesneler dinamik oluşturulur. Her biri için new/delete operasyonu gerçekleştirilir.
- Sınıflar birbirine bağımlı!

```
1 class Xls {  
2  
3 };  
4  
5  
6  
7  
8  
9 class Pdf {  
10  
11 };  
12  
13  
14  
15  
16  
17  
18 class Word {  
19  
20 };  
21  
22 using Document = std::variant<Xls, Pdf, Txt, Word>;  
23  
24  
25  
26  
27  
28
```

Artık artık bir interface'e sahip olmak zorunda değiller!

başta bir documentimiz belli concrete

```
1  
2  
3  
4  
5 class Document {  
6 public:  
7     virtual void print()const = 0;  
8     //  
9 };  
10  
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```

→ otomatik oluşturulmuş nesneler okur!

* std::Any: - Bu bir class template değil!
- Type erase var!

* Optional → default constrikt edilmeye değere sahip değil!

* variant → default constrikt edilmeye değere sahip değil! → boş alternatif yok! Monostate kullanılır!

* Any → default constrikt edilmeye değere sahip değil!

• has value ile değeri var mı yok mu sorgulanabilir

• Kendisi atama yapılabilir!

```
any a(45);  
  
a = 1.5;  
a = "mustafa";  
a = string{"yilmaz denizhan"};
```

* Type Function:

```
int main()
{
    using namespace std;

    any a(45);

    a = "ali"s;

    if (a.type() == typeid(int)) {
        std::cout << "int\n";
    }
    else if (a.type() == typeid(double)) {
        std::cout << "double\n";
    }
    else if (a.type() == typeid(string)) {
        std::cout << "string\n";
    }
}
```

- Eger bir tür varsa, type = void

* any_cast:

```
any a{3.4};
cout << any_cast<int>(a) << "\n";
```

→ Kullandığınız any nesnesine erişmek!

* make_any / reset / emplace:

```
auto a = make_any<string>(20, 'T');
cout << boolalpha << a.has_value() << "\n";
a.reset();
cout << a.has_value() << "\n";
a.emplace<Date>(4, 5, 1987);
cout << a.has_value() << "\n";
cout << any_cast<Date>(a) << "\n";
```


* Std::Any in Containers:

```
int main()
{
    using namespace std;

    vector<any> avec{ 12, 1.43, "alican", 34L, "murathan"s };

    for (const auto& a : avec) {
        if (auto pi = any_cast<int>(&a)) {
            std::cout << *pi << "\n";
        }
        else if (auto pd = any_cast<double>(&a)) {
            std::cout << *pd << "\n";
        }
        else if (auto pc = any_cast<const char*>(&a)) {
            std::cout << *pc << "\n";
        }
        else if (auto pl = any_cast<long>(&a)) {
            std::cout << *pl << "\n";
        }
    }
}
```

```
using tv_pair = std::pair<std::string, std::any>;
```

```
int main()
{
    using namespace std;

    vector<tv_pair> vec;

    vec.emplace_back("name", "ahmet aksoy"s);
    vec.emplace_back("year", 1998);
    vec.emplace_back("month", 11);
    vec.emplace_back("month day", 22);
    vec.emplace_back("wage", 87.67);
    vec.emplace_back("town", "eskisehir"s);
    vec.emplace_back("gender", "male"s);
    vec.emplace_back("country", "Turkey"s);
    //

    cout << left;

    for (const auto& [property, value] : vec) {
        if (value.type() == typeid(int))
            cout << setw(16) << property << any_cast<int>(value) << '\n';
        else if (value.type() == typeid(double))
            cout << setw(16) << property << any_cast<double>(value) << '\n';
        else if (value.type() == typeid(string))
            cout << setw(16) << property << any_cast<string>(value) << '\n';
    }
}
```