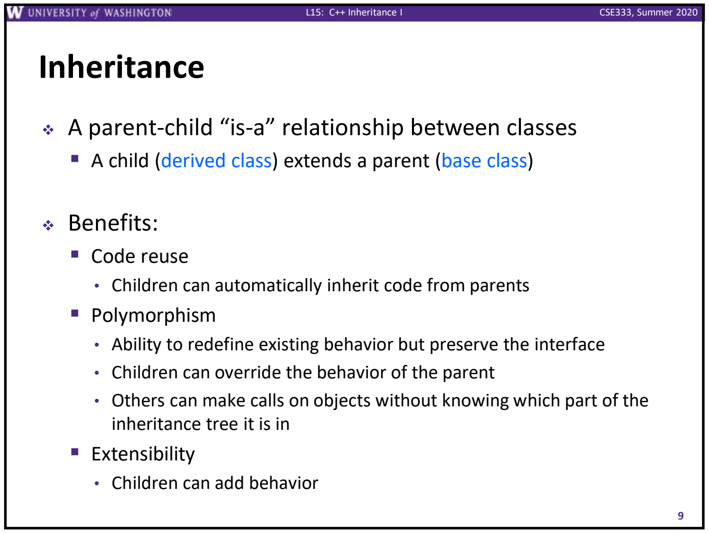
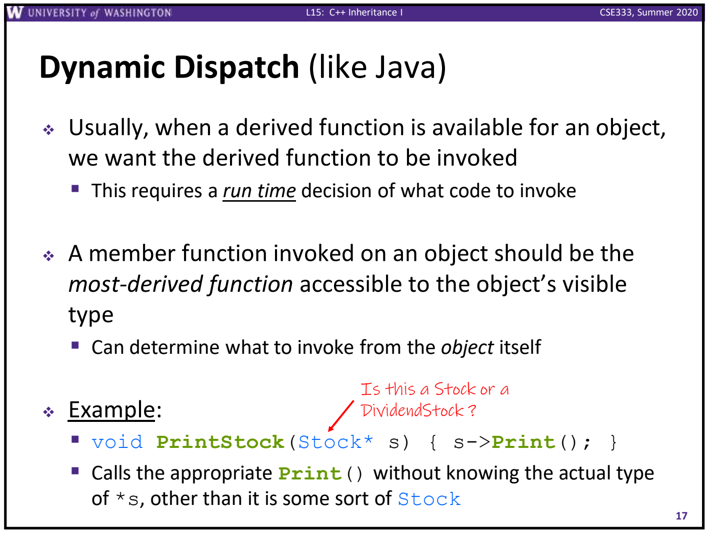


Inheritance

- A parent-child "is-a" relationship between classes
  - A child (derived class) extends a parent (base class)
- Benefits:
  - Code reuse
    - Children can automatically inherit code from parents
  - Polymorphism
    - Ability to redefine existing behavior but preserve the interface
    - Children can override the behavior of the parent
    - Others can make calls on objects without knowing which part of the inheritance tree it is in
  - Extensibility
    - Children can add behavior

9



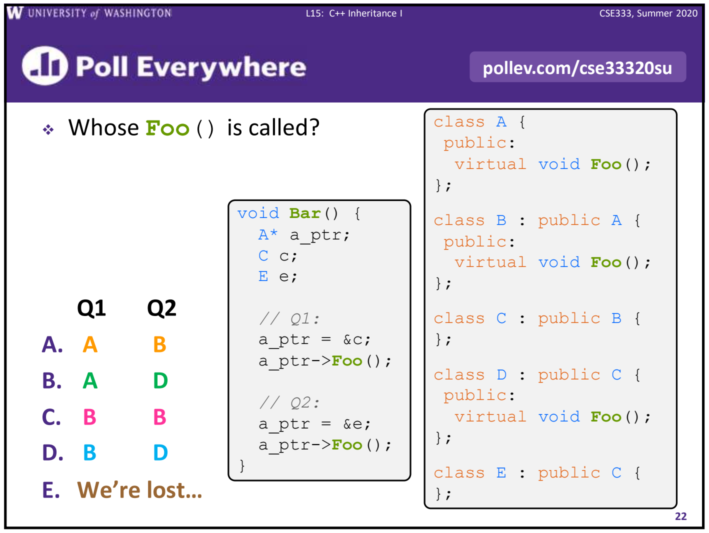
Dynamic Dispatch (like Java)

- Usually, when a derived function is available for an object, we want the derived function to be invoked
  - This requires a *run time* decision of what code to invoke
- A member function invoked on an object should be the *most-derived function* accessible to the object's visible type
  - Can determine what to invoke from the *object* itself
- Example:

Is this a Stock or a DividendStock ?

  - `void PrintStock(Stock* s) { s->Print(); }`
  - Calls the appropriate `Print()` without knowing the actual type of `*s`, other than it is some sort of `Stock`

17



Poll Everywhere

pollev.com/cse33320su

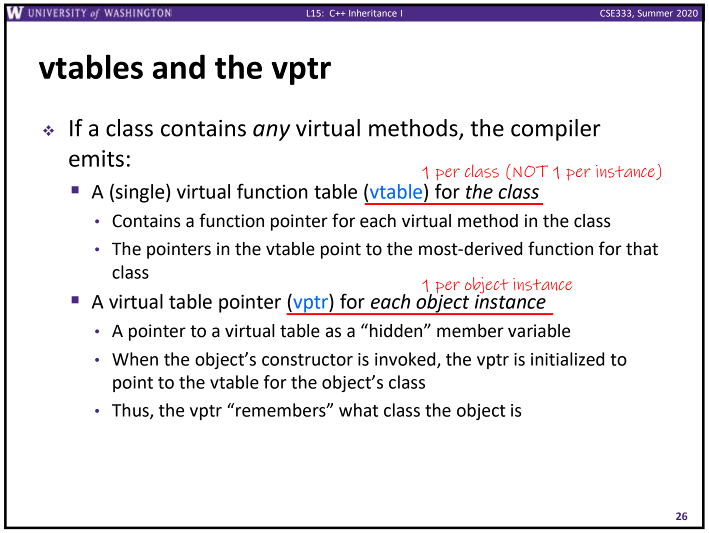
- Whose `Foo()` is called?

```
void Bar() {
  A* a_ptr;
  C c;
  E e;

  // Q1:
  a_ptr = &c;
  a_ptr->Foo();

  // Q2:
  a_ptr = &e;
  a_ptr->Foo();
}
```

```
class A {
 public:
  virtual void Foo();
};

class B : public A {
 public:
  virtual void Foo();
};

class C : public B {
};

class D : public C {
 public:
  virtual void Foo();
};

class E : public C {
};
```

	Q1	Q2
A.	A	B
B.	A	D
C.	B	B
D.	B	D
E.	We're lost...	

22



vtables and the vptr

- If a class contains *any* virtual methods, the compiler emits:

1 per class (NOT 1 per instance)

  - A (single) virtual function table (vtable) for *the class*
    - Contains a function pointer for each virtual method in the class
    - The pointers in the vtable point to the most-derived function for that class

1 per object instance

  - A virtual table pointer (vptr) for *each object instance*
    - A pointer to a virtual table as a "hidden" member variable
    - When the object's constructor is invoked, the vptr is initialized to point to the vtable for the object's class
    - Thus, the vptr "remembers" what class the object is

26