CRICOS PROVIDER 00123M

School of Computer Science

COMP SCI 1103/2103 Algorithm Design & Data Structure

More about Inheritance

adelaide.edu.au

seek LIGHT

Previously on ADDS

- Class Hierarchies
  - Behavior Separation
  - How to build a good class hierarchy? Focus on the requirements
- Inheritance
  - Build classes from other classes
  - Why do we need inheritance?
  - Benefits
  - The derived class and the base class have an IS-A relationship
  - We don't actually inherit the constructors but we can (and should) use them in our own.

Access Specifiers

- **Private members** can only be accessed from the inside of the class. (default for objects)
- **Public members** can be accessed from any other classes.
- A **protected member** (data field or function) in a base class can be accessed in its derived classes.

- While, technically, we inherit almost everything from a parent, we can't USE everything from the parent, unless it's set up correctly.

Access Specifier on Inheritance

- Things that we inherit and use from a parent, are not necessarily visible from outside our class.

class Child : [access specifier] Parent { … };

```
class Bird : public Animal { ... };
class Bird : private Animal { ... };
class Bird : protected Animal { ... };
```

Types of Inheritance (continue)

- With public inheritance
  - Public members of parent become public members of child
  - Protected members of base become protected members of child
- With protected inheritance
  - Public and protected members of parent become protected members of child
- With private inheritance
  - Public and protected members of parent become private members of child

- **Quick Quiz**

True or false?

Grand children always have access to protected members of grand parents.

False.

Types of Inheritance

Public inheritance			
Base access specifier	Derived access specifier	Derived class access?	Public access?
Public			
Private			
Protected			

Protected inheritance			
Base access specifier	Derived access specifier	Derived class access?	Public access?
Public			
Private			
Protected			

What else can you guess?

Hint: protected inheritance vs private inheritance

Private inheritance			
Base access specifier	Derived access specifier	Derived class access?	Public access?
Public			
Private			
Protected			

Inheritance: some points

- Regardless of access specifier:
  - The derived class inherits access to all public and protected members from the base class
  - The derived class has no access to the private members of the base class
  - The **constructors and destructors** of the base class are **not** members and therefore are not inherited
  - The **assignment operator**, while inherited, is hidden and can **not** be accessed.
  - The **friend** functions and classes of the base class are **not** inherited

Motivation for friends

- Suppose you want to compare two objects to see if they're equal:
- You could use the accessor methods to carry out comparison - what's the problem with that?
- You could access all of the member variables directly - what's the potential problem with that?
- Let's say we want to define an external function that could still get access to the private members of a class.

```
bool equal(Circle c1, Circle c2)
{
  return (c1.getRadius() == c2.getRadius());
}
```

```
bool equal(Circle c1, Circle c2)
{
  return (c1.radius == c2.radius);
}
```

Friend

- A friend function of a class has access to the private members of that class.
- A friend function can directly read and change the value of a member variable.

```
class Circle{

public:
  friend bool equal (Circle c1, Circle c2);


};


bool equal(Circle c1, Circle c2)
{
  return (c1.radius == c2.radius);
}
```

Friend Class

```
class A{
  friend class B;

private:
  string secret;
};
```

- You can also have a friend class.
- B has access to secret.

Friend

- Friendship isn't reciprocal.
- Friendship isn't transitive.
- Friendship isn't inherited.

- You should use members when you can and friends when you have to.
  - The choice is based on design, syntactic suitability, and when it's much harder to do it the other way.

Overloading

- Overloading lets us reuse the same name but for different situations.

- Functions have the same name but different parameter.
  - Overloading functions can make programs clearer and more readable.
  - Based on different return types?
    - No. Overloaded functions must have different parameter lists

Overloading Operators

- This isn't just limited to functions.
- We can overload operators (+,-,<<,>>) as well.

Operators That Can Be Overloaded							
+	-	*	/	%	^	&	|
~	!	=	<	>	+=	-=	*=
/=	%=	^=	&=	|=	<<	>>	>>=
<<=	==	!=	<=	>=	&&	||	++
--	->*	,	->	[]	()	new	delete

Operators That Can Not Be Overloaded			
?:	.	.*	::

Friends and operators

- If we overload an operator, we want to mimic the existing operator behavior, but using one of our classes.

```
class Circle{
public:
  friend Circle operator +(Circle, Circle);
private:
  int area;
};

Circle operator +(Circle c1, Circle c2){
  Circle tmp;
  tmp.area = c1.area + c2.area;
  return tmp;
}
```

Multiple Inheritance

- When something inherits behavior from two (or more) different objects!

- Deriving directly from more than one class is called multiple inheritance.

```
class Child : public Parent1, public Parent2{

  /* more code goes here*/
}
```

- How does this look like?
- What are the possible problems?

Multiple Inheritance

- The child gets all of the parents' behaviors.
- The order of derivation matters only for the order of default initialization and cleanup by constructors and destructors.

- What happens if you derive from one class more than once? I mean indirectly!

Example

```
class Animal { ... };
class Bird : public Animal { ... };
class SeaC : public Animal { ... };

class Penguin :
  public Bird, public SeaC { ... } ;
```

  - This will compile.

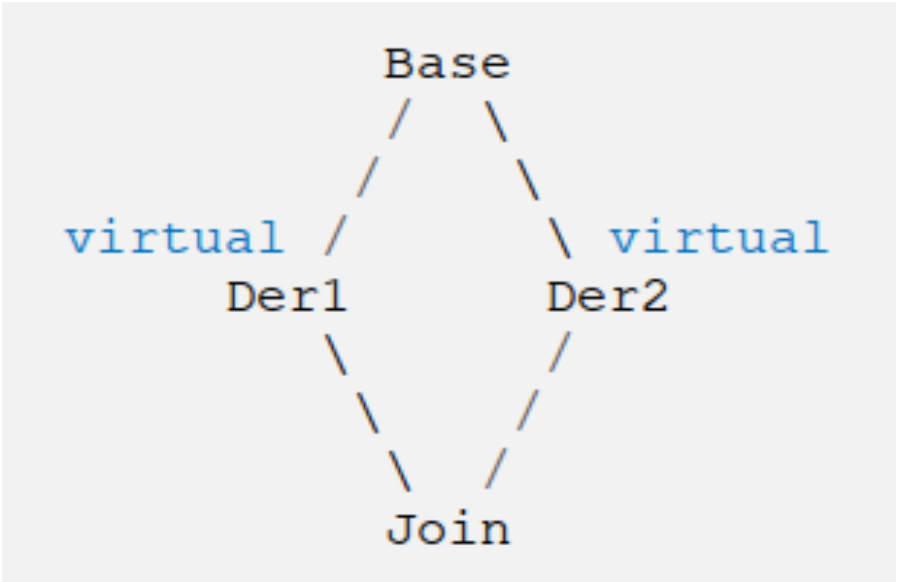
- But we have ambiguity. Why?

  - We have to refer to `Bird::Animal` or `SeaC::Animal`.

  - This is called a qualified class name.

Using `virtual`

- Referring to the same base class through different inheritance pathways is ambiguous if we are referring to **two *different* versions of the base class**.
- Using `virtual` in the declaration of inheritance means that the grand child inherit only one subobject of the base class.



- Problem solved by using virtual

Example

```
class Animal { ... };
class Bird : virtual public Animal { ... };
class SeaC : virtual public Animal { ... };

class Penguin :
  public Bird, public SeaC { ... } ;
```

  - This will compile.

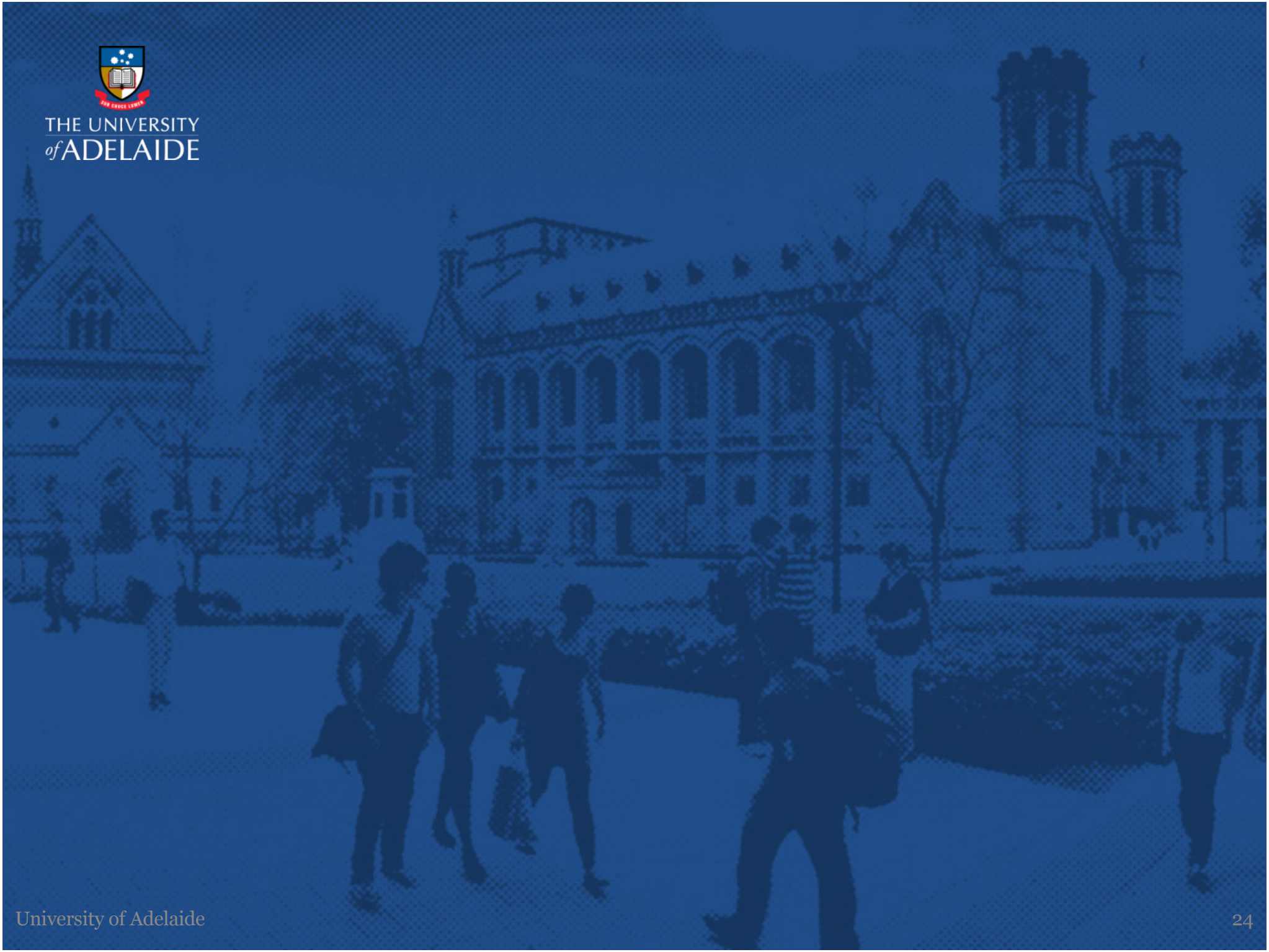
- We no longer have ambiguity because all references to `Animal` in `Penguin` go to the same class.
- Look carefully at where we use virtual to control this.

Multiple Inheritance

- It's possible to mix up the use of `virtual` and have some derived classes sharing a base class and some not.
- Always make sure you understand why you are using a keyword!

Summary

- Inheritance is a very useful technique but you need to know how to use it effectively.
  - Behaviors are inherited.
  - Access modifiers.
  - When should I overload?
  - Multiple inheritance
- We'll talk about this more in Polymorphism.
  - When should I redefine/override?


THE UNIVERSITY
of ADELAIDE