CSE 12 – Basic Data Structures and Object-Oriented Design
Lecture 3

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Basic idea of ADT

This lecture is being recorded

Announcements

- Quiz 3 due Friday @ 9am
- Survey 1 due Friday @ 11:59pm

How many pre-videos

A: 1

B: 2

C: 3

D: 0

Topics

- Questions on Lecture 3?
- Interfaces

Inheritance review: Which is legal?

is a

type = type

A

C

class Foo

```
public class Base
{
  protected int x;
}

public class Derived extends Base
{
  protected int y;
}
```

compiler

Derivde d= (Derived)(new Base());

super

sub

A:

Base b=new Base();

Derived d=b; X

isa

B:

Derived d=new Derived();

Base b=d; ✓

"is a"

C:

Base b=new Derived(); ✓

D:

Derived d=new Base(); Base X

Devride ← X

E:

More than one of these

13) Given the following definitions:

```
public interface Printable
{
  public abstract String print( boolean duplex );
}
```

```
class Thing1 implements Printable
{
  private String str;

  public Thing1()
  {
    this.str = "Thing 1";
  }

  public String print( boolean duplex )
  {
    return this.str + " duplex = " + duplex;
  }

  public String print()
  {
    // print single sided by default
    return this.print( false );
  }
}
```

```
class Thing2 implements Printable
{
  private String str;

  public Thing2()
  {
    this.str = "Thing 2";
  }

  public String print( boolean duplex )
  {
    return this.str + " duplex = " + duplex;
  }

  public String print( String user )
  {
    System.out.print( user + ": " );

    // print double sided by default
    return this.print( true );
  }
}
```

And the following variable definitions:

```
Thing1 thing1 = new Thing1();
Thing2 thing2 = new Thing2();
Printable printable;
```

Hint: What does the compiler know about any reference variable at compile time (vs. run time)?

What gets printed with the following statements (each statement is executed in the order it appears). If there is a compile time error, write "Error" and assume that line is commented out when run.

```
System.out.println( thing1.print() );                 ______________________________

System.out.println( thing1.print( "CS11SZZ" ) );      ______________________________

System.out.println( thing1.print( false ) );          ______________________________

System.out.println( thing2.print() );                 ______________________________

System.out.println( thing2.print( "CS11SZZ" ) );      ______________________________

System.out.println( thing2.print( false ) );          ______________________________

printable = thing1;

System.out.println( printable.print( true) );         ______________________________

System.out.println( printable.print() );              ______________________________

System.out.println( printable.print( "CS11SZZ" ) );   ______________________________

printable = new Thing2();

System.out.println( printable.print( true ) );        ______________________________

System.out.println( printable.print() );              ______________________________

System.out.println( printable.print( "CS11SZZ" ) );   ______________________________
```

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```
public interface Printable
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class Thing1 implements Printable
{
  private String str;

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  }

  public String print()
  {
    // print single sided by default
    return this.print( false );
  }
}
```

```
class Thing2 implements Printable
{
  private String str;

  public Thing2()
  {
    this.str = "Thing 2";
  }

  public String print( boolean duplex )
  {
    return this.str + " duplex = " + duplex;
  }

  public String print( String user )
  {
    System.out.print( user + ": " );

    // print double sided by default
    return this.print( true );
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```

And the following variable definitions:

```
Thing1 thing1 = new Thing1();
Thing2 thing2 = new Thing2();
Printable printable;
```

Hint: What does the compiler know about any reference variable at compile time (vs. run time)?

What gets printed with the following statements (each statement is executed in the order it appears). If there is a compile time error, write "Error" and assume that line is commented out when run.

`System.out.println( thing1.print() );` Thing 1 duplex false

`System.out.println( thing1.print( "CS11SZZ" ) );` compiler error

`System.out.println( thing1.print( false ) );` Thing 1 duplex false

`System.out.println( thing2.print() );` Compiler error

`System.out.println( thing2.print( "CS11SZZ" ) );` CS11SZZ : Thing 2 : duplex true

`System.out.println( thing2.print( false ) );` Thing 2 : duplex false

`printable = thing1;`

`System.out.println( printable.print( true) );` Thing 1 : duplex true

`System.out.println( printable.print() );` compiler error

`System.out.println( printable.print( "CS11SZZ" ) );` compiler error

`printable = new Thing2();`

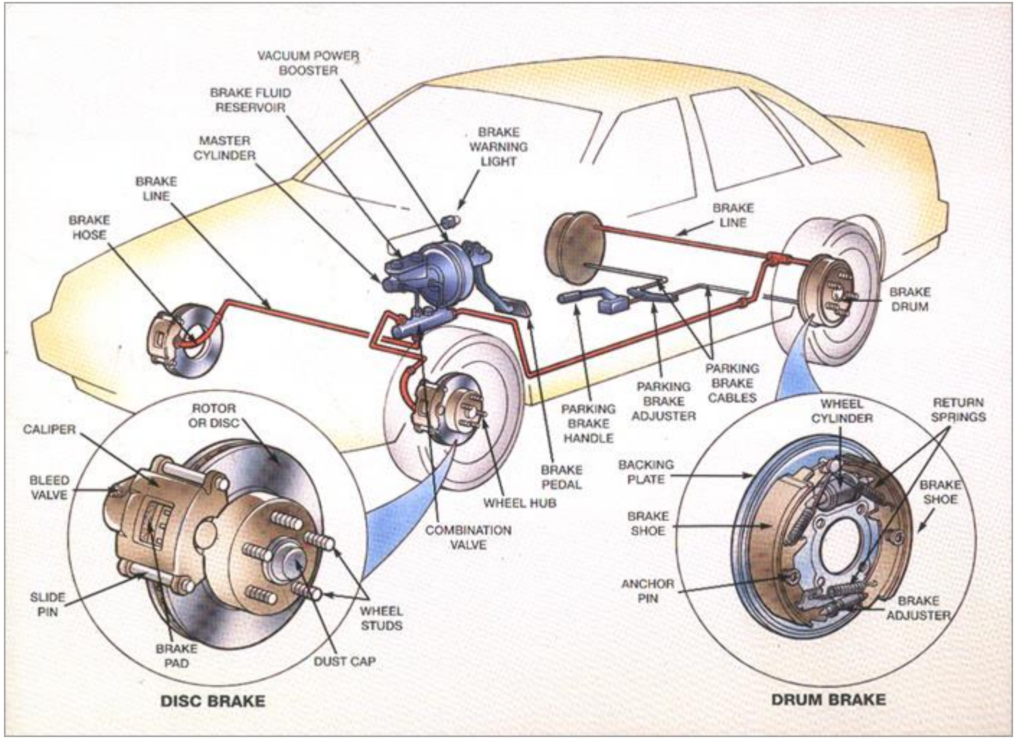
`System.out.println( printable.print( true ) );` Thing 2 : duplex true

`System.out.println( printable.print() );` compiler error

`System.out.println( printable.print( "CS11SZZ" ) );` compiler error

Key idea in designing code: Data Abstraction

Abstraction example: car brakes



ADT Implementers and Users

Implementers

"We can implement the ADT however we want!"

ADT Interface:

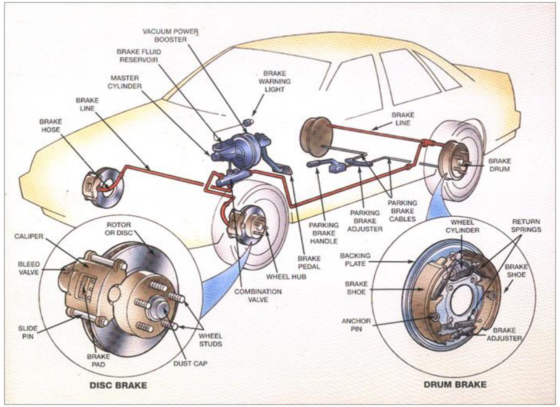
sets the rules of interaction

Users

"We can use the ADT however we want!"

ADTs vs specific implementations

- Sometimes the line between the abstract data type and the implementation is confusing. E.g. Car brakes



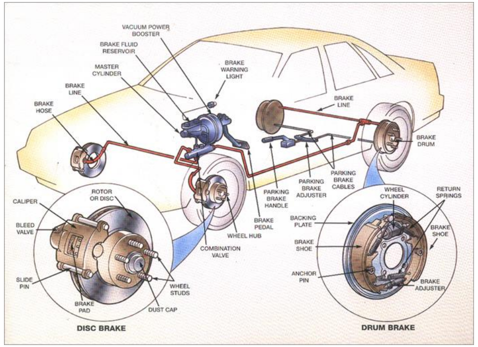
To drive my car, I rely on the abstract idea of brakes.

But for that idea to work, my car needs to have a specific implementation of brakes.

Someone needs to care about both sides!

ADTs vs specific implementations

- It usually depends on which side you’re looking from. e.g. car brakes



In this class (and as a computer scientist) you will be the driver AND the mechanic! (i.e. the designer and the user)

ADTs vs APIs

ADT = "Abstract Data Type"

Defines the behaviors of a data type, but NOT its implementation

API = "Application Programming Interface"

Specifies public methods for interacting with a library or class

Does NOT reveal implementation details

Think of it as a language/code-specific ADT

Exercise

- Please create an interface for Animals on Earth
  - Think what functionalities earth creatures share (dog, cat, dophin, human, etc)
  - Why don’t we make it an abstract class? → more freedom.