The price of gold

source: nowiknow.com

The price of gold

Write an app that pops up a dialog box with the title "The Price of Gold" and the message "Enter the amount of gold in kilos" and, after the user has entered the amount k and clicks the OK button, pops up another dialog box with the title "The Price of k kilos of Gold" and the current price of k kilos of Gold in Canadian dollars. If the users enters a negative amount, the app crashes with the message "The amount of gold cannot be negative."

Determine the price of k kilos of gold in Canadian dollars

Forget about writing an app for now. How would *you* solve this problem for $k = 0.5$?

- Using a search engine, find a website that contains the current gold price.

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- But the price is given in US dollars, not in Canadian dollars. How do we address this?
- Using a search engine, find a website that contains the current exchange rate.

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- Using a search engine, find a website that contains the current exchange rate.
- `www.gocurrency.com`

Delegation

In our solution we use delegation. Instead of solving each part of the puzzle ourselves, we ask "someone else" to do it for us.

For example, we delegate to `www.goldpriceoz.com` for the current price of gold.

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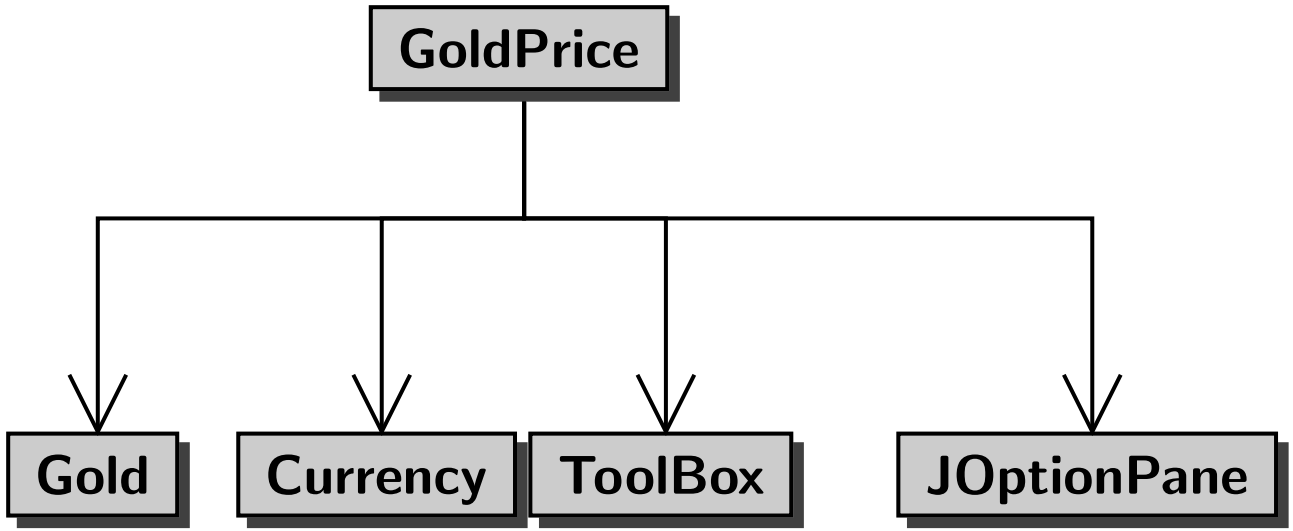
Could we do it ourselves?

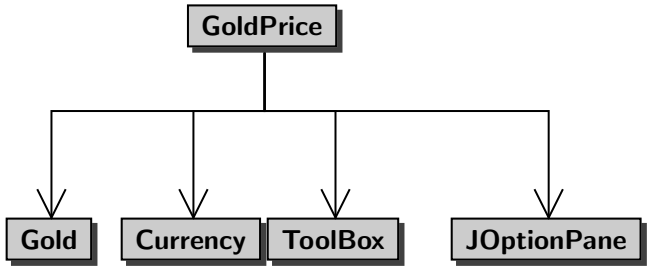
Yes, we could travel to London where to price of gold is determined daily at 10.30 am and 3.00 pm, but delegation seems a little easier.

Delegation

Also when writing an app, we try to delegate.



Some terminology

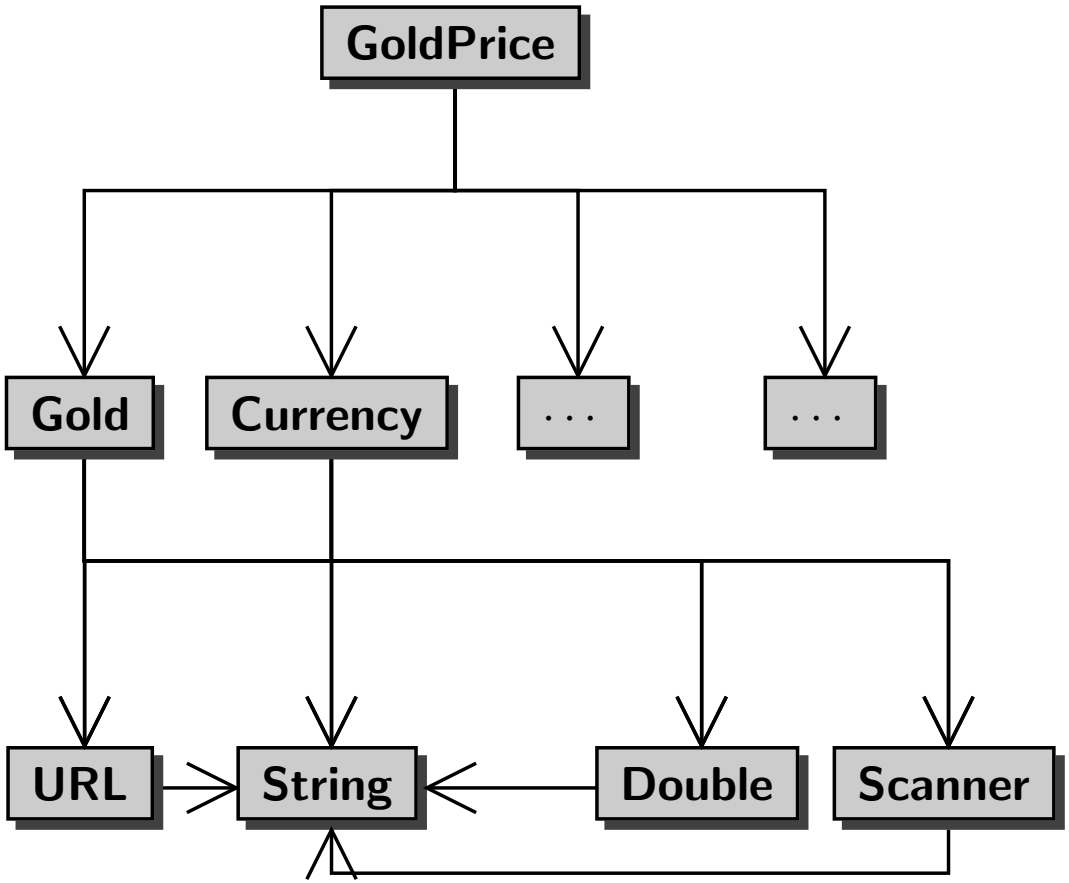


- main class or app
  GoldPrice
- helper classes or components
  Gold, Currency, ToolBox, and JOptionPane

The main class only contains a main method.

- client: developer of main class
- implementer: developer of components

Implementers delegate too

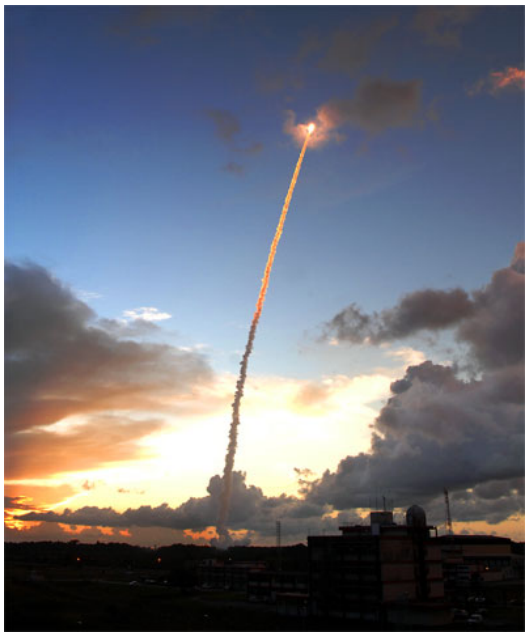


Client approach

1. To solve a problem, decide what type of components are needed.
2. Find the appropriate components.
3. Delegate to the components.

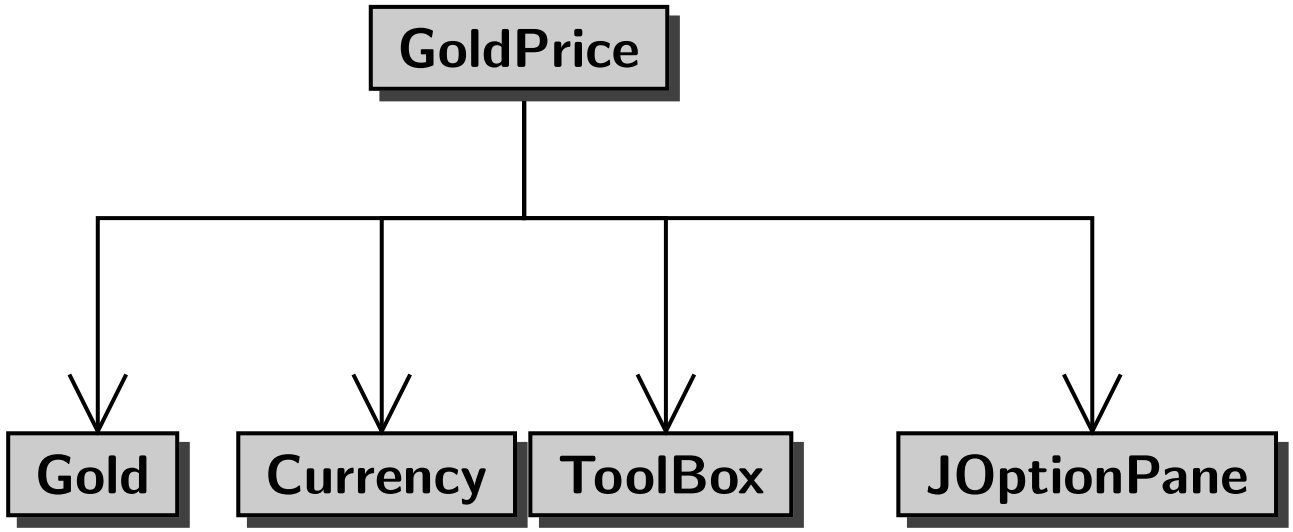
Bugs can be expensive

Flight 501, which took place on June 4, 1996, was the first, and unsuccessful, test flight of the European Ariane 5 expendable launch system. Due to an integer overflow, the rocket veered off its flight path 37 seconds after launch and was destroyed by its automated self-destruct system. It is one of the most infamous computer bugs in history costing roughly $ 370,000,000.



source: spaceflightnow.com

Who is to blame for the bug?



- The user of the app (user)?
- The developer of the app (client)?
- The developer of one of the components (implementer)?

Interface of a component

An interface is a contract between the client of the component and the implementer of the component.

For each operation, it specifies

- **parameters**: "the type of data to be provided by the client to the component"
- **precondition**: "a property to be satisfied by the data provided by the client to the component"
- **postcondition**: "a property to be satisfied by the data returned by the component to the client"

The precondition is the client's responsibility and the postcondition is the implementer's responsibility.

Interface of www.bankofcanada.ca/rates/exchange/daily-converter/

parameters

amount : integer

precondition

amount $< 10^{21}$

postcondition

returns the amount converted from Canadian to US dollars

Question

Assume that the client provides -1 to the component and the component crashes. Who is to blame?

Interface of www.bankofcanada.ca/rates/exchange/daily-converter/

parameters

amount : integer

precondition

amount $< 10^{21}$

postcondition

returns the amount converted from Canadian to US dollars

Question

Assume that the client provides -1 to the component and the component crashes. Who is to blame?

Answer

The implementer, since the client has done its job by providing an integer that satisfies the precondition, whereas the implementer did not satisfy the postcondition.

Interface of www.bankofcanada.ca/rates/exchange/daily-converter/

parameters

amount : integer

precondition

amount $< 10^{21}$

postcondition

returns the amount converted from Canadian to US dollars

Question

Assume that the client provides 10^{21} to the component and the component crashes. Who is to blame?

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parameters

amount : integer

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amount $< 10^{21}$

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returns the amount converted from Canadian to US dollars

Question

Assume that the client provides 10^{21} to the component and the component crashes. Who is to blame?

Answer

The client, since the client did not provide an integer that satisfies the precondition.

Advantages of interfaces

- Accountability: if something goes wrong, then the interface can be used to determine who is to blame.
- Abstraction: the interface abstracts from many implementations details (an interface of a component is usually much simpler than the code of the component).

  The interface specifies what the component does, not how it does it.
- Substitutibility: the implementer can change the code of the component as long as it still conforms to the interface, without affecting the client in any way.

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The Price of Gold

Let us start with a simplified version.

Problem

Write an app that prints the price of one Troy ounce of gold in US dollars.

Let's go component shopping!

The interface of a Java class is described by its Application Programming Interface (API). Many of these APIs can be found on the Internet.

- Java Standard Library (JSL)
  `docs.oracle.com/javase/8/docs/api`
- TYPE package
  `www.eecs.yorku.ca/teaching/docs/type/api`
- franck.cse5910
  `www.eecs.yorku.ca/course_archive/2014-15/F/5910/api/`
- and many many more.

Pre- and postconditions in JSL

Convention

If the precondition is "true" (that is, it holds vacuously) then it is left out.

All classes in the JSL contain no preconditions.

Convention

If the postcondition is "returns what is specified by **Returns:**" and "crashes as specified by **Throws:**" then it is left out.

All classes in the JSL contain no postconditions.

Static methods

`public static type methodName(type`$_1$ `parameterName`$_1$`, ..., type`$_n$ `parameterName`$_n$`)`

- All methods we will use in our apps are `public`.
- All methods we will use today are `static`. In the near future, we will discuss methods that are not `static`.
- `type` is the type of the value that is returned by the method.
- `methodName` is the name of the method.
- `type`$_i$ is the type of the parameter named `parameterName`$_i$.

Terminology

`public static type methodName(type`$_1$ `parameterName`$_1$`, ..., type`$_n$ `parameterName`$_n$`)`

- `methodName(type`$_1$`, ..., type`$_n$`)` is the signature of the method.
- `type` is the return type of the method.

Static methods

```
public static double price()
```

Question

What is the return type of the method `price`?

Static methods

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Question

What is the return type of the method `price`?

Answer

`double`.

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Question

How many parameters does the method `price` have?

Static methods

```
public static double price()
```

Question

What is the return type of the method `price`?

Answer

`double`.

Question

How many parameters does the method `price` have?

Answer

Zero.

Static methods

```
public static double price()
```

Question

What is the signature the method `price`?

Static methods

```
public static double price()
```

Question

What is the signature the method `price`?

Answer

`price()`.

Static methods

`public static void methodName(type1 parameterName1, ..., typen parameterNamen)`

- All methods we will use in our apps are `public`.
- All methods we will use today are `static`. In the near future, we will discuss methods that are not `static`.
- The method does not return anything.
- `methodName` is the name of the method.
- `typei` is the type of the parameter named `parameterNamei`.

Invoking a static method

Consider the method `public static type methodName(type`$_1$ `parameterName`$_1$`, ..., type`$_n$ `parameterName`$_n$`)` in the class `ClassName`.

This method is invoked as
`ClassName.methodName(argument`$_1$`, ..., argument`$_n$`)`
where the type of `argument`$_i$ is (compatible with) `type`$_i$.

Invoking a static method

Question

How do you invoke the method `price` of the class `Gold`?

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`Gold.price()`.

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Should we store the result in a variable?

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`Gold.price()`.

Question

Does the method `price` return anything?

Answer

Yes.

Question

Should we store the result in a variable?

Answer

Yes.

The price of gold

Problem

Write an app that prints the price of one kilo of gold in US dollars.

Static attributes

```
public static type attributeName
```

- All attributes we will use in our apps are `public`.
- All attributes we will use in our apps are `static`.
- `type` is the type of the attribute.

Static attributes

```
public static final type attributeName
```

- All attributes we will use in our apps are `public`.
- All attributes we will use in our apps are `static`.
- The attribute is a constant.
- `type` is the type of the attribute.

Static attributes

```
public static final double GRAMS_PER_TROY_OUNCE
```

Question

What is the type of the attribute `GRAMS_PER_TROY_OUNCE`?

Static attributes

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public static final double GRAMS_PER_TROY_OUNCE
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Question

What is the type of the attribute `GRAMS_PER_TROY_OUNCE`?

Answer

double.

Static attributes

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public static final double GRAMS_PER_TROY_OUNCE
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Question

What is the type of the attribute `GRAMS_PER_TROY_OUNCE`?

Answer

double.

Question

Is the attribute `GRAMS_PER_TROY_OUNCE` a constant?

Static attributes

```
public static final double GRAMS_PER_TROY_OUNCE
```

Question

What is the type of the attribute `GRAMS_PER_TROY_OUNCE`?

Answer

double.

Question

Is the attribute `GRAMS_PER_TROY_OUNCE` a constant?

Answer

Yes.

Using a static attribute

Consider the attribute `public static type attributeName` in the class `className`.
The attribute is used as `className.attributeName`.

Using a static attribute

Question

How do you use the attribute `GRAMS_PER_TROY_OUNCE` of the class `Gold`?

Using a static attribute

Question

How do you use the attribute `GRAMS_PER_TROY_OUNCE` of the class `Gold`?

Answer

```
Gold.GRAMS_PER_TROY_OUNCE
```

Code convention for names of constants

- Use uppercase characters.
- If the name is made up of more than one word, separate the words by an underscore.

Memory model