# Single Responsibility Principle (SRP)

Produced by:

Eamonn de Leastar (edeleastar@wit.ie)

Dr. Siobhán Drohan (sdrohan@wit.ie)

Waterford Institute *of* Technology
INSTITIÚID TEICNEOLAÍOCHTA PHORT LÁIRGE

Department of Computing and Mathematics
http://www.wit.ie/

# “S” in SOLID - Single Responsibility Principle

Every object should have a single responsibility and all of its services should be aligned with that responsibility.

“Responsibility” is defined as “a reason to change”

# SRP: The Single Responsibility Principle

**THERE SHOULD NEVER BE MORE THAN ONE REASON FOR A CLASS TO CHANGE.**

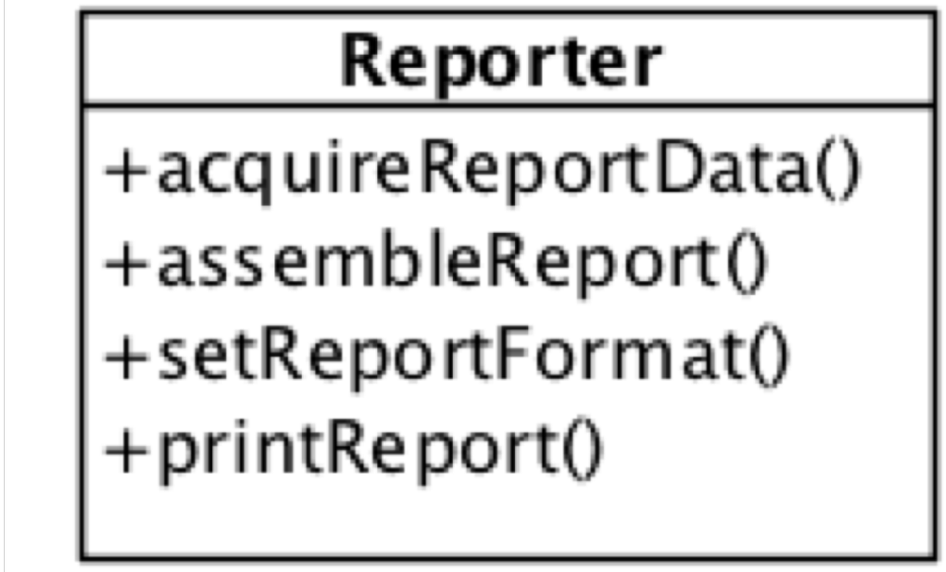
- Each responsibility is an axis of change.

- When requirements change
  → a change in responsibility amongst the classes.

- If a class assumes more than one responsibility
  → more than one reason for it to change.
  → changes to one responsibility may impair or inhibit the class' ability to meet the others.

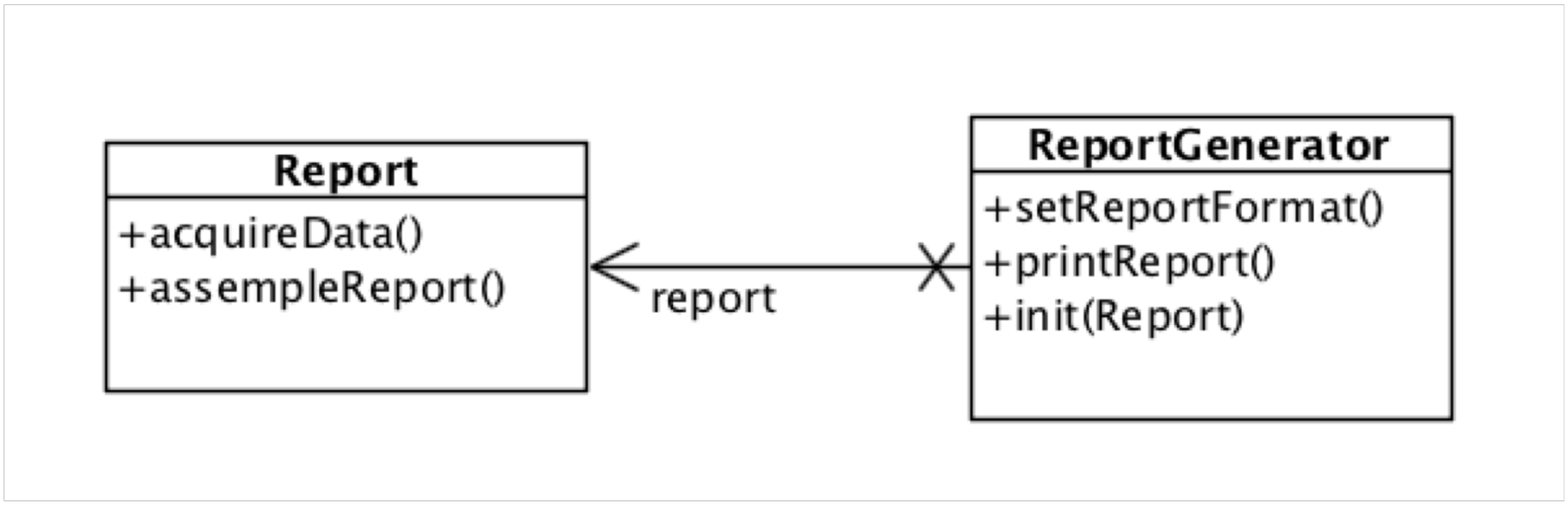
# Single Responsibility Principle – Example 1

- Consider a Class that assembles and prints a report.
- The class can be changed for two reasons.
  - the content of the report can change.
  - the format of the report can change.
- These two things change for very different causes; one perhaps substantive, and one cosmetic.



# Single Responsibility Principle – Example 1

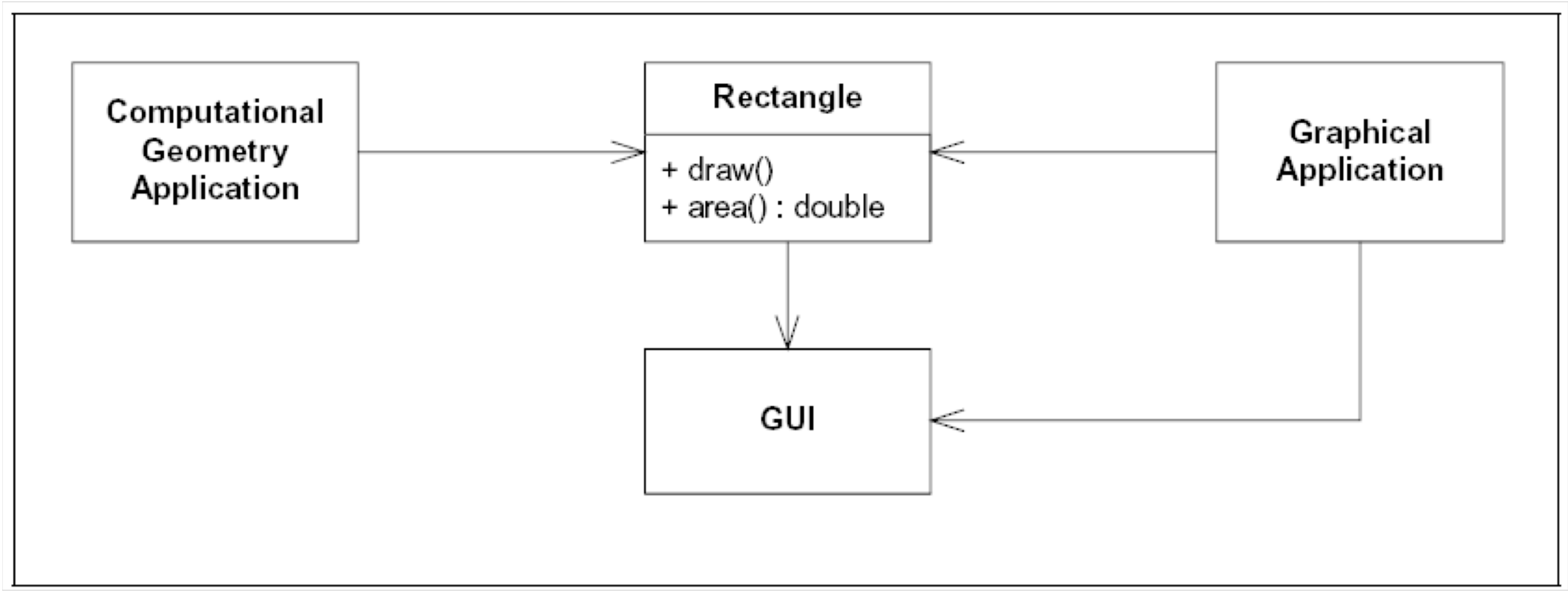
- SRP: these two aspects of the problem are really two separate responsibilities, and should therefore be in separate classes:



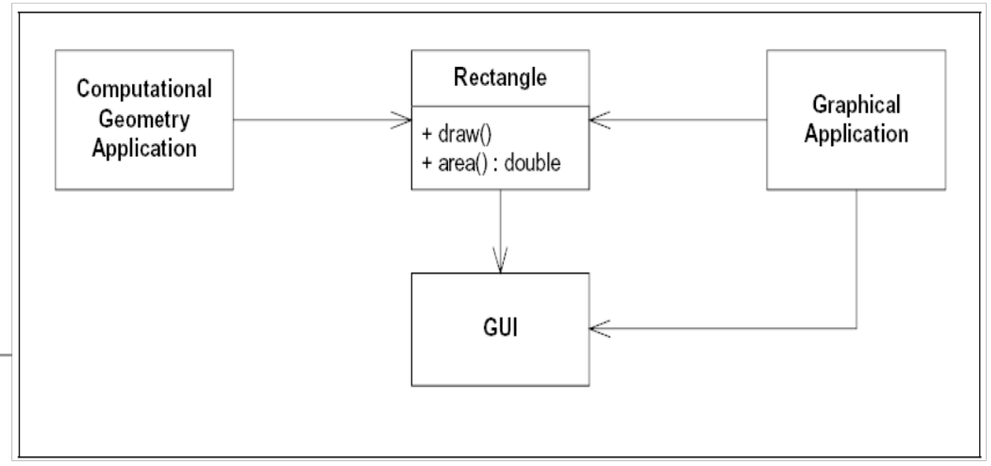

- SRP: Avoid coupling two things that change for different reasons at different times.

# Single Responsibility Principle – Example 2

- The Rectangle class has two methods:
  - one draws the rectangle on the screen
  - the other computes the area of the rectangle.
- Two applications use this class:
  - one application uses Rectangle to help it with the mathematics of geometric shapes.
  - the other uses the class to render a Rectangle on a window.



# SRP Violation

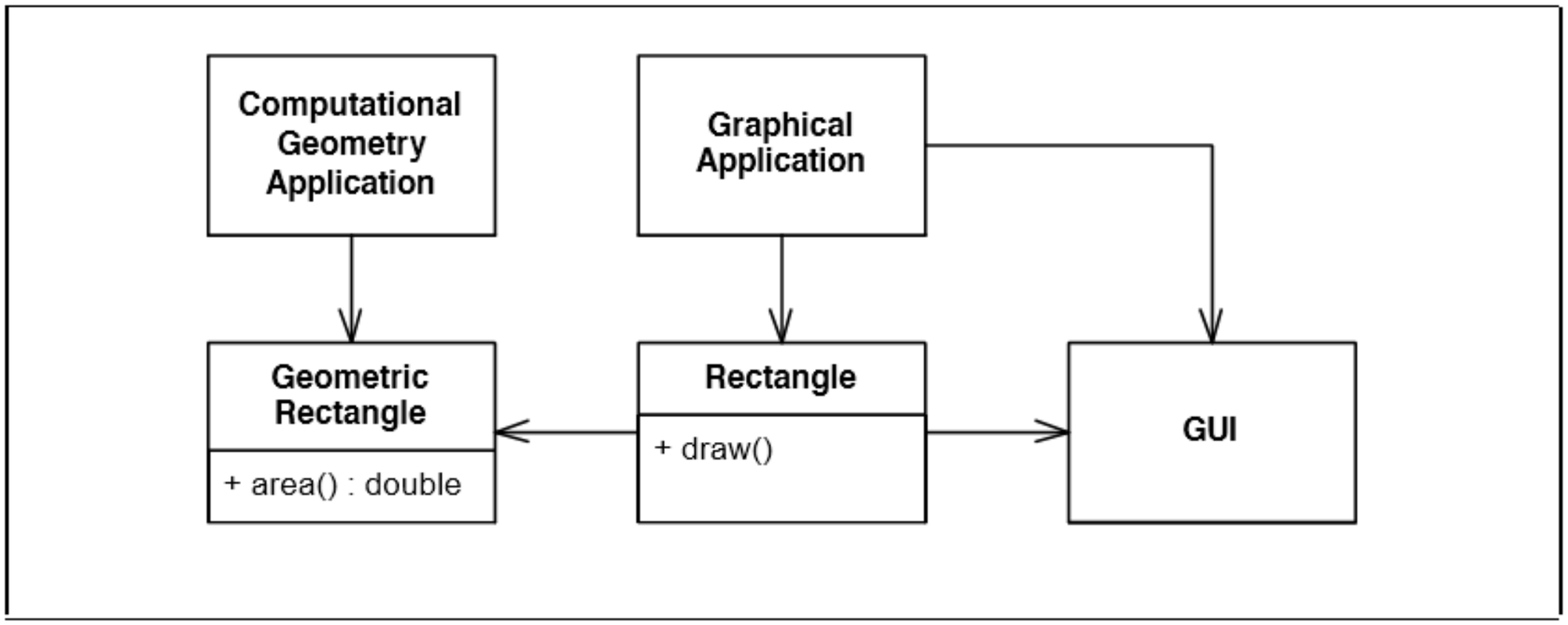



- Rectangle has two responsibilities:
  - provide a mathematical model of the geometry of a rectangle.
  - render the rectangle on a graphical user interface.

- Violation of SRP:
  - the GUI must be included in the in the computational geometry application.
    - the class files for the GUI have to be deployed to the target platform.
  - if a change to the Graphical Application causes the Rectangle to change for some reason, that change may force us to rebuild, retest, and redeploy the Computational Geometry Application.

# Single Responsibility Principle – Example 2

- Separate the two responsibilities into two separate classes
  - Moves the computational portions of Rectangle into the GeometricRectangle class.
- Now changes made to the way rectangles are rendered cannot affect the ComputationalGeometry Application.



# What is a Responsibility?

- “A reason for change.”
- If you can think of more than one motive for changing a class, then that class has more than one responsibility.

```
interface Modem
{
  void dial(String pno);
  void hangup();
  void send(char c);
  char recv();
}
```

# Modem Responsibilities

```
interface Modem
{
  void dial(String pno);
  void hangup();
  void send(char c);
  char recv();
}
```

- Two responsibilities:
  - connection management (dial and hangup functions)
  - data communication (send and recv functions)
- They have little in common
  - may change for different reason
  - will be called from different parts of the applications
- They will change for different reasons.

# Should the responsibilities be separated?

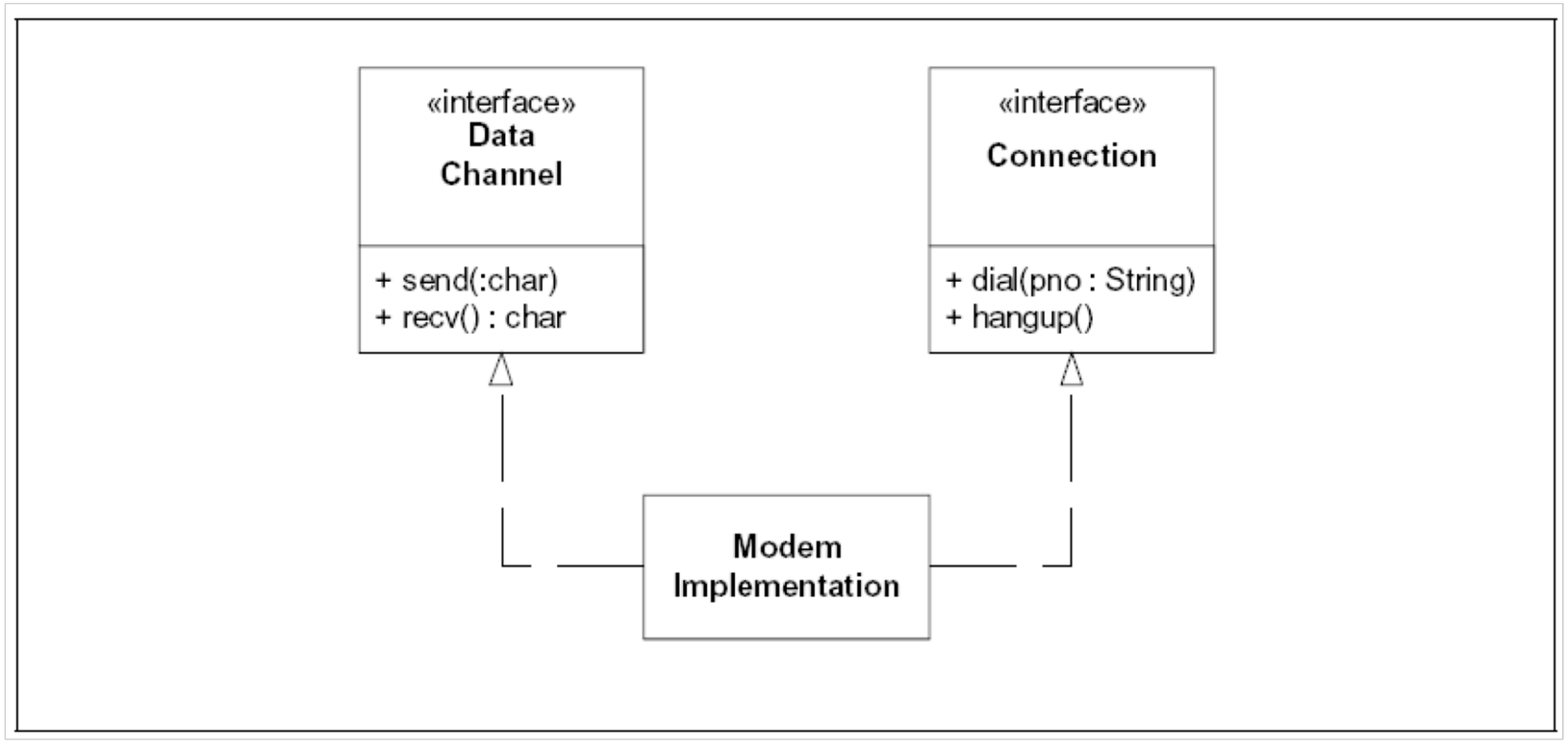
- It depends!

- How do you foresee the application changing?
  - e.g. could the signature of the connection methods potentially change, without any change to the send/receive mechanism?

```
interface Modem
{
  void dial(String pno);
  void hangup();
  void send(char c);
  char recv();
}
```

# Should the responsibilities be separated?

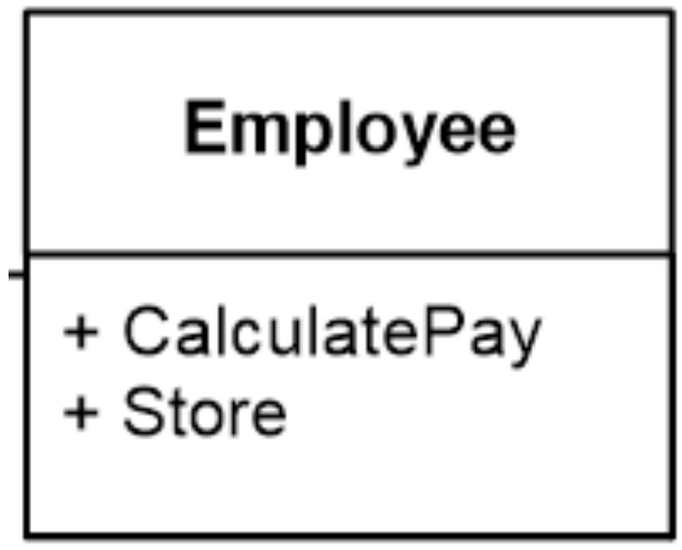
- If the application can change in ways that cause the two responsibilities to change at different times → separate the responsibilities.
- Separation here is at interface level and not class level.




- *CAUTION: Needless complexity* can occur when there is no *foreseeable* need to separate the responsibilities.

# Single Responsibility Principle – Example 4

- Coupling persistence services (store) with business rules (calculatePay) could violate SRP.



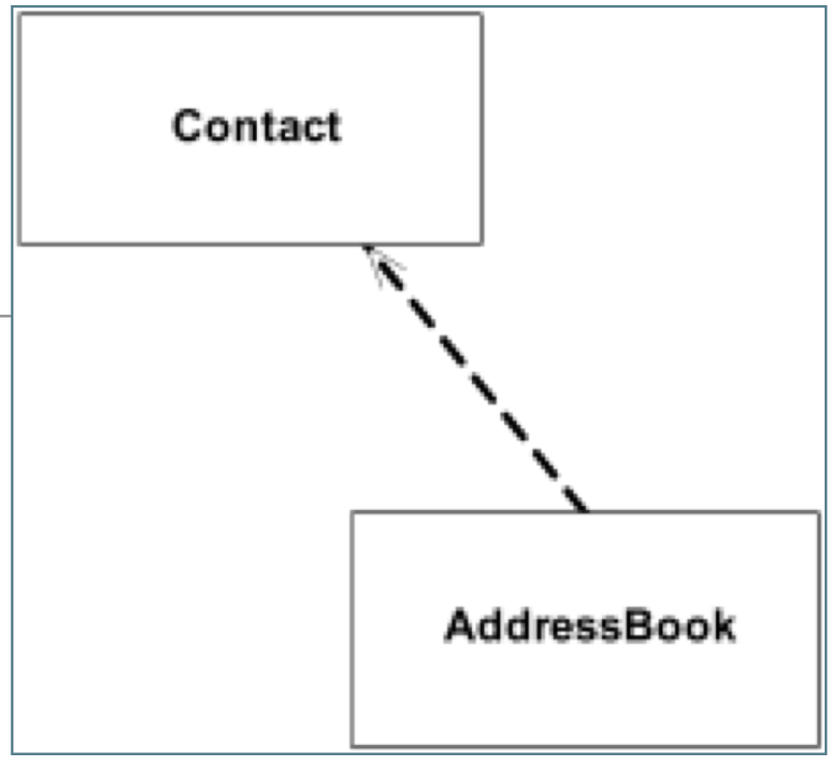
# Separate the Responsibilities

# Single Responsibility Principle – Example 5

- Design an Application to manage a contact list.

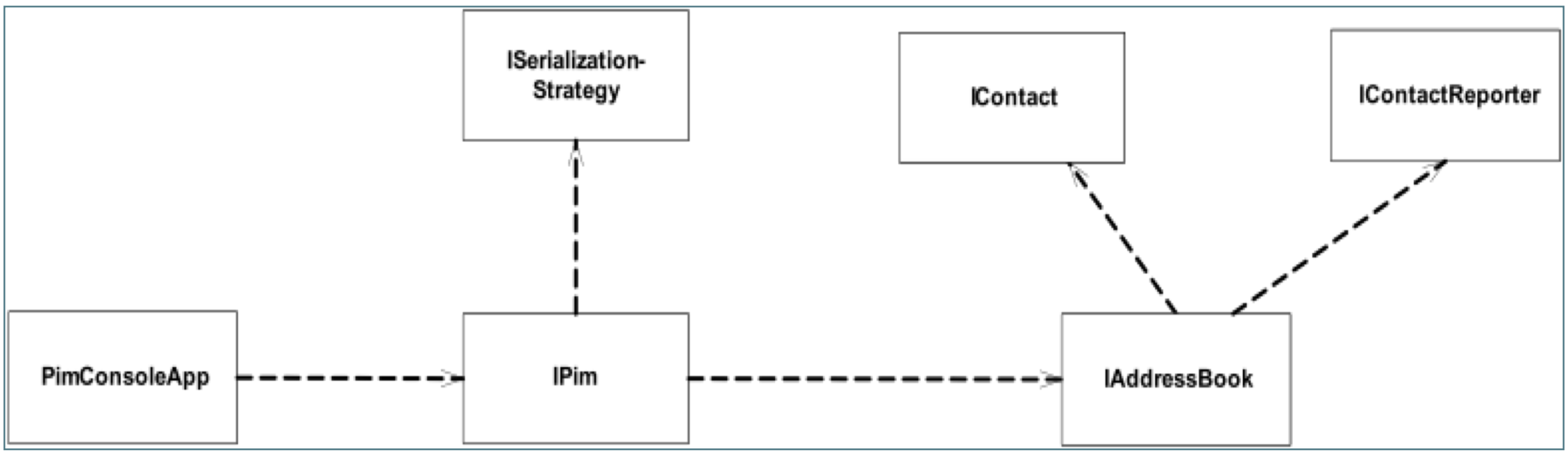
- It should support:
  - Console based UI
  - Load/save to/from a file on disk
  - Simple reports and search functions

# AddressBook



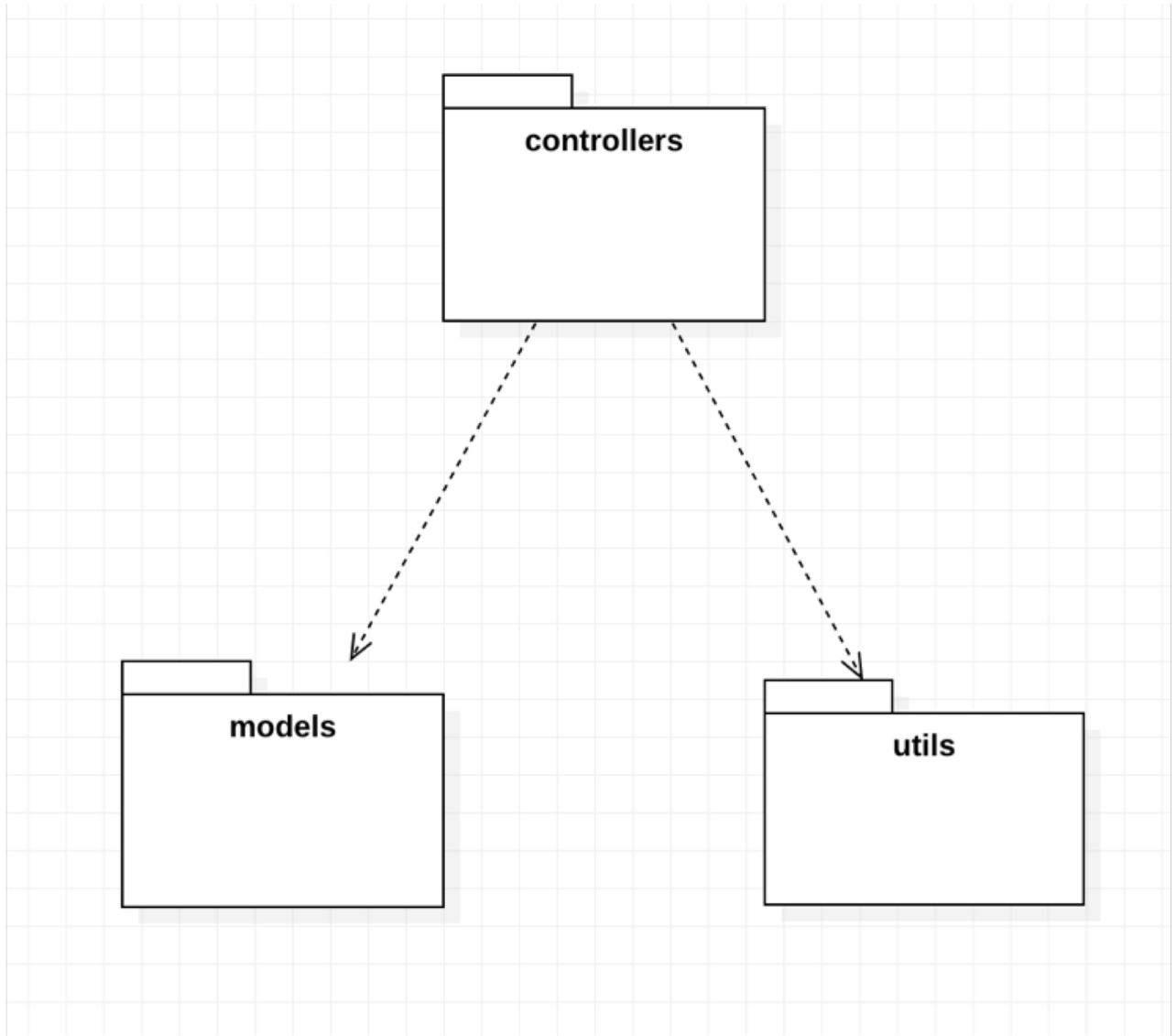

- Propose two classes:
  - Contact - to represent each contact
  - AddressBook - to incorporate
    - serialization
    - reporting
    - UI
    - etc…
- Violates SRP as AddressBook has multiple reasons to change
  - Data structure change (e.g. HashMap to TreeMap)
  - Serialization mechanism (e.g. binary to XML)
  - Alternative reports (e.g. different formats and content)
  - Command line syntax changes

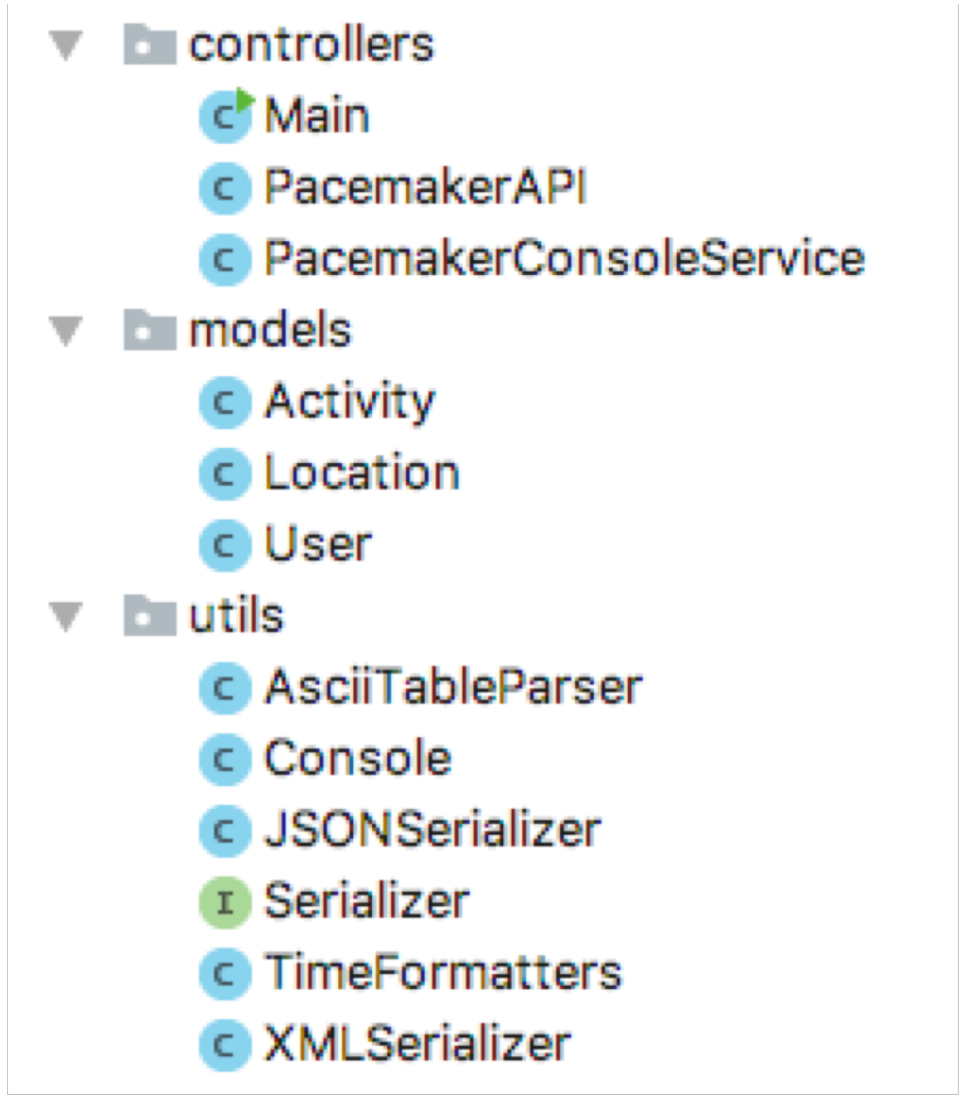
# Refactor Addressbook



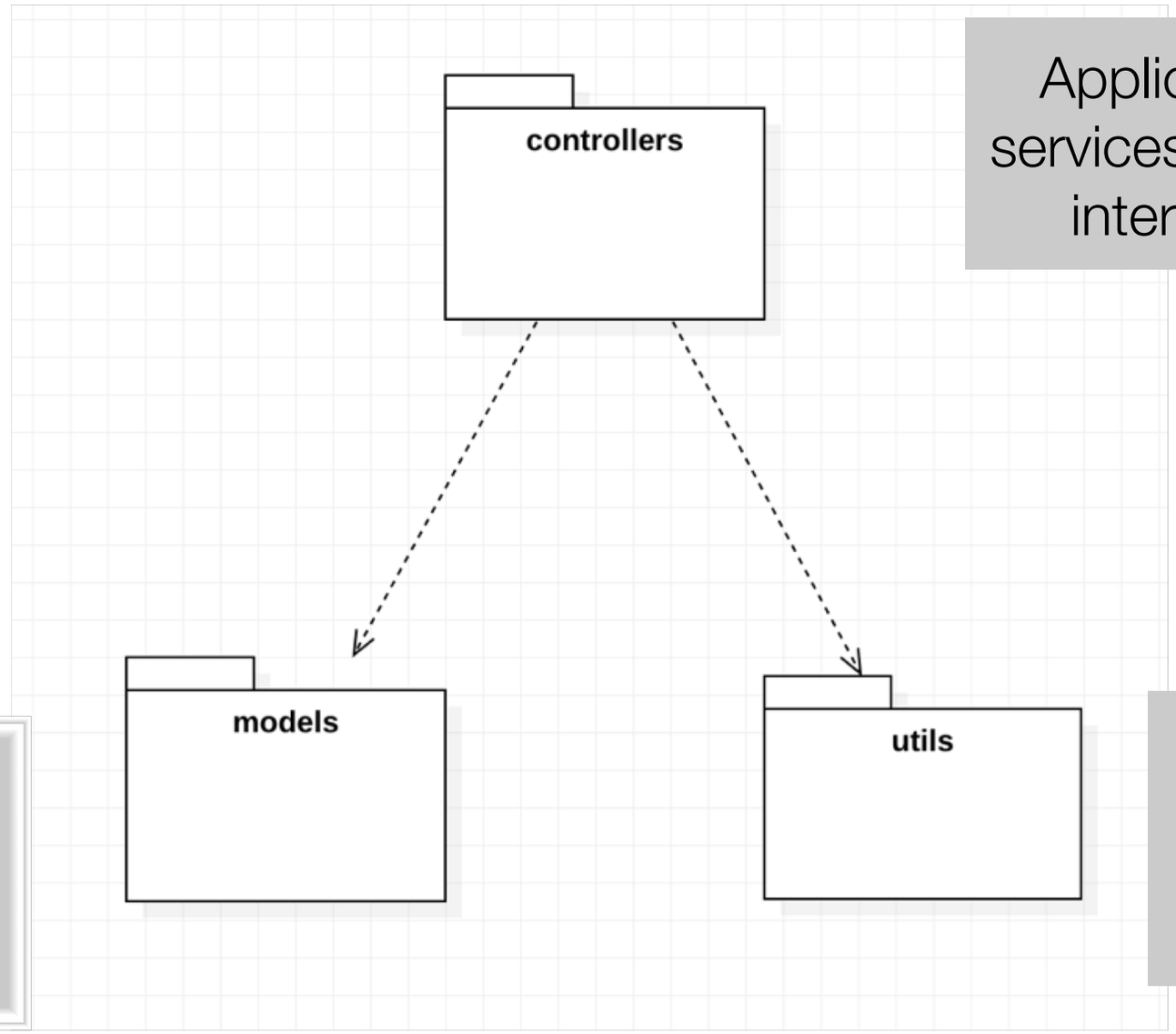

| | |
|---|---|
| IAddressBook | responsible for contact data structure |
| IContactReporter | responsible for format and content of reports |
| ISerializationStrategy | responsible for persistence |
| IPim | responsible for binding address book to serialization mechanism – and for exposing coherent top level functionality |
| PimConsoleApp | responsible binding an running application to an IPim. |

# Pacemaker-console-solution



# Pacemaker - package responsibilities

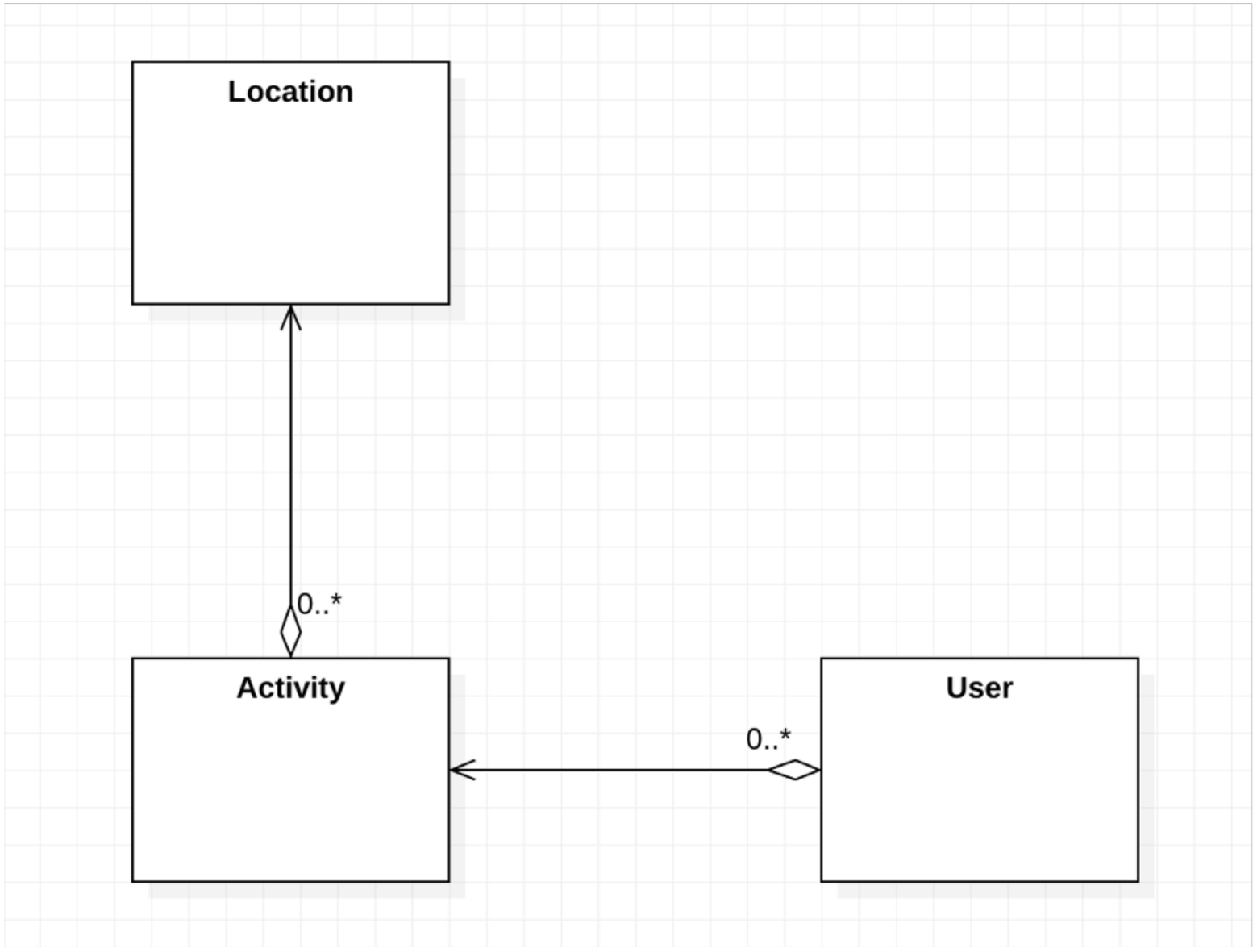



Application services + user interface

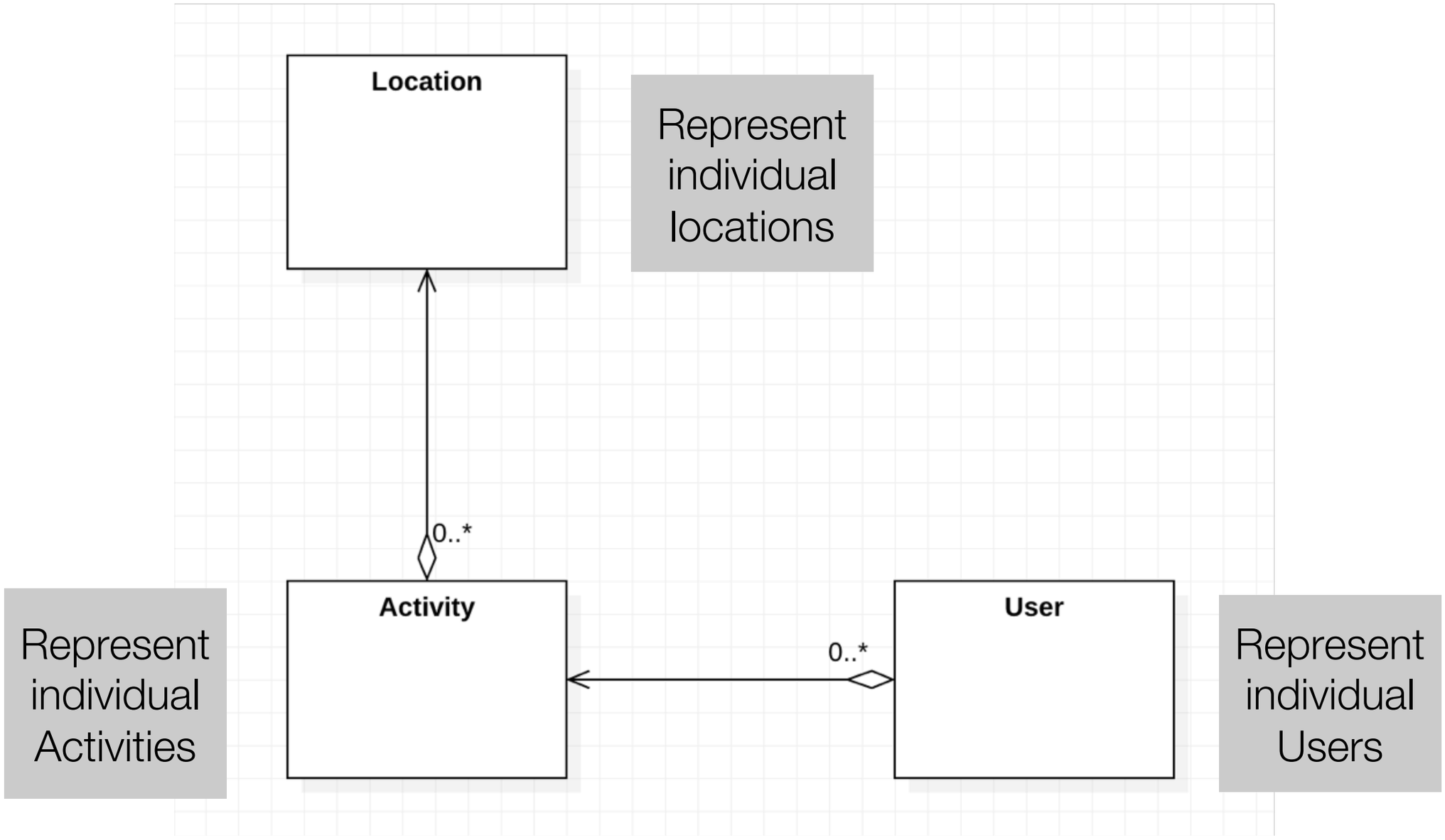
information model for the app

general purpose utilities

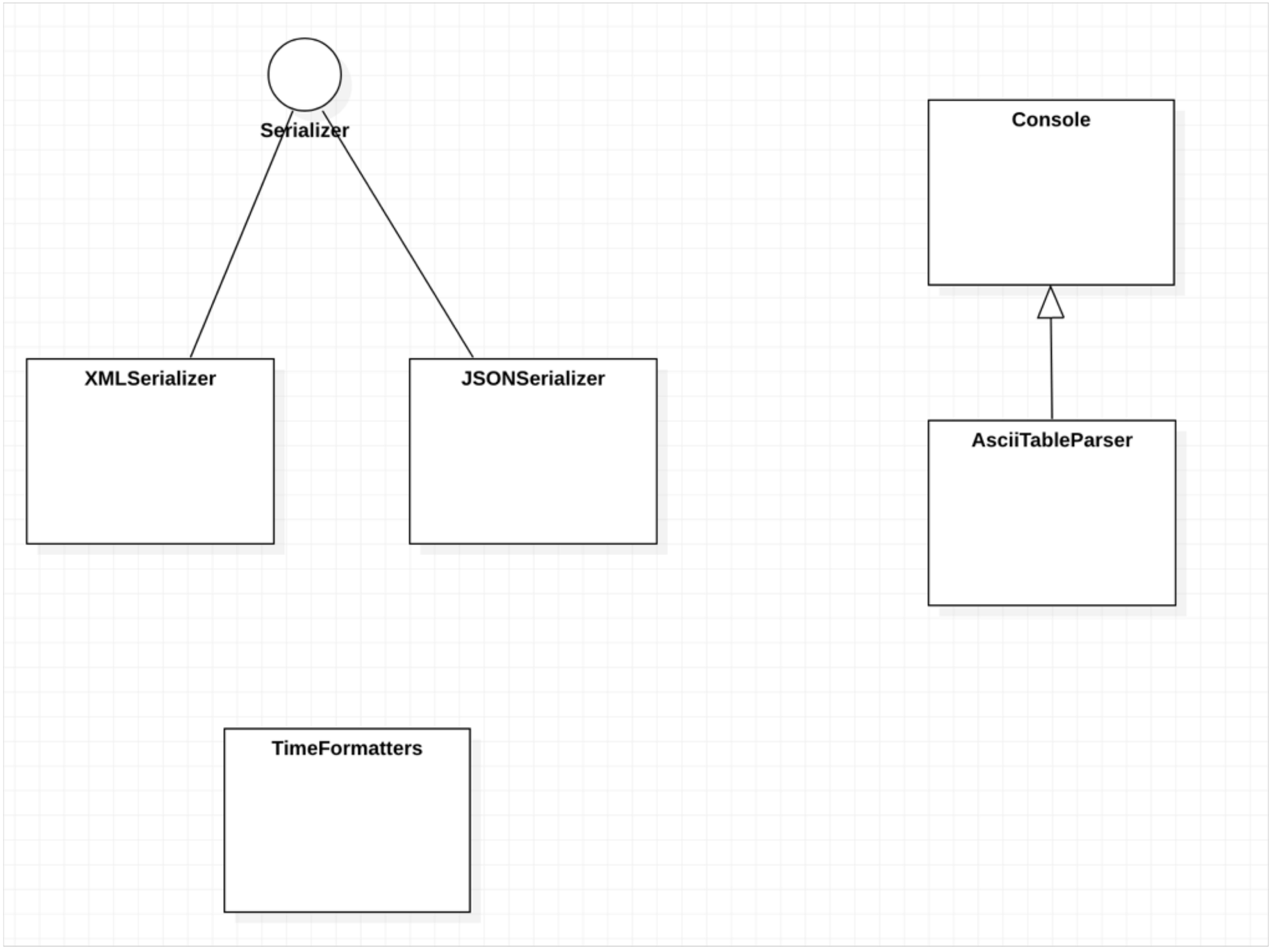
# Pacemaker – Model



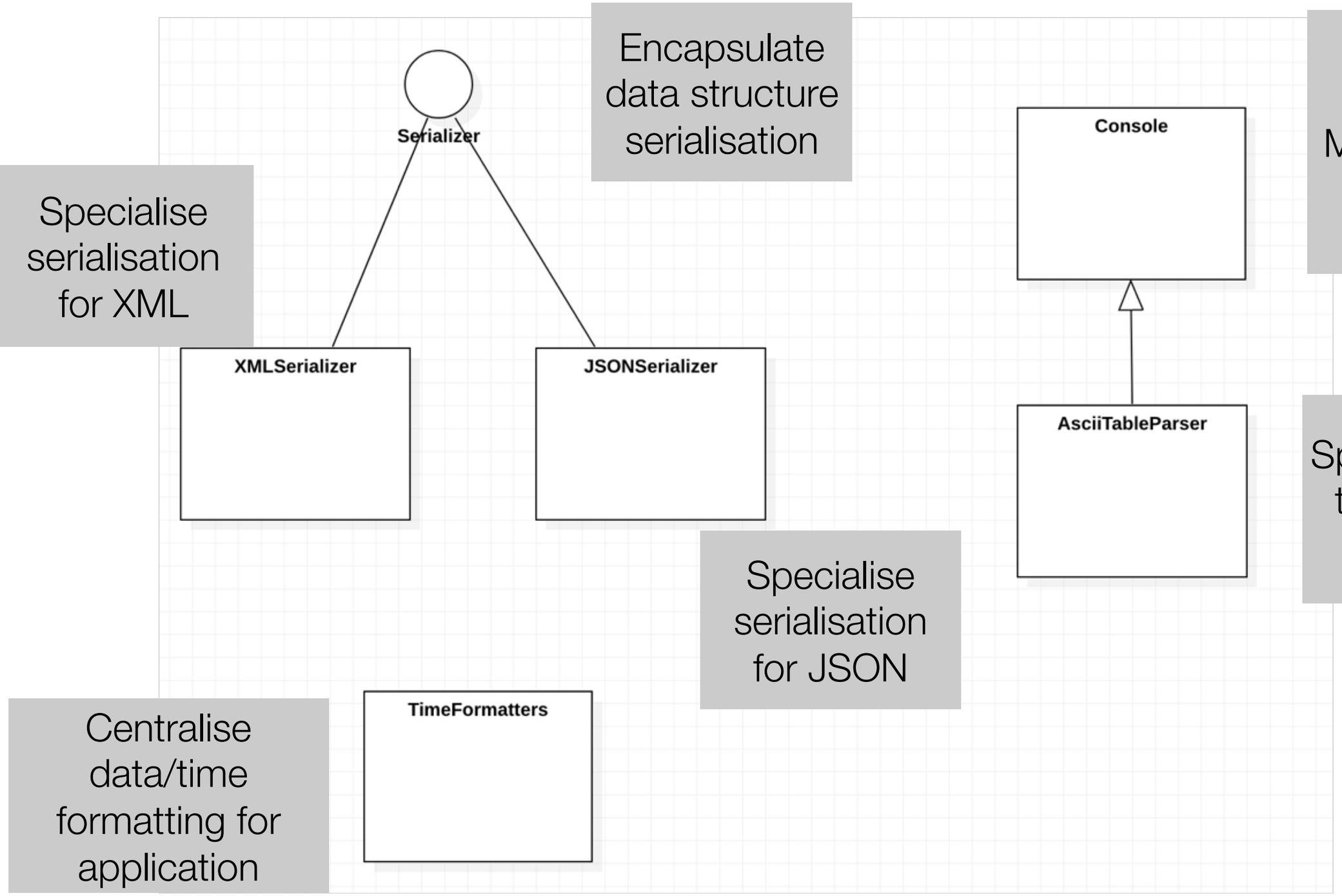
# Pacemaker – Model Responsibilities



# Pacemaker – Utils



# Pacemaker – utils responsibilities




Encapsulate data structure serialisation

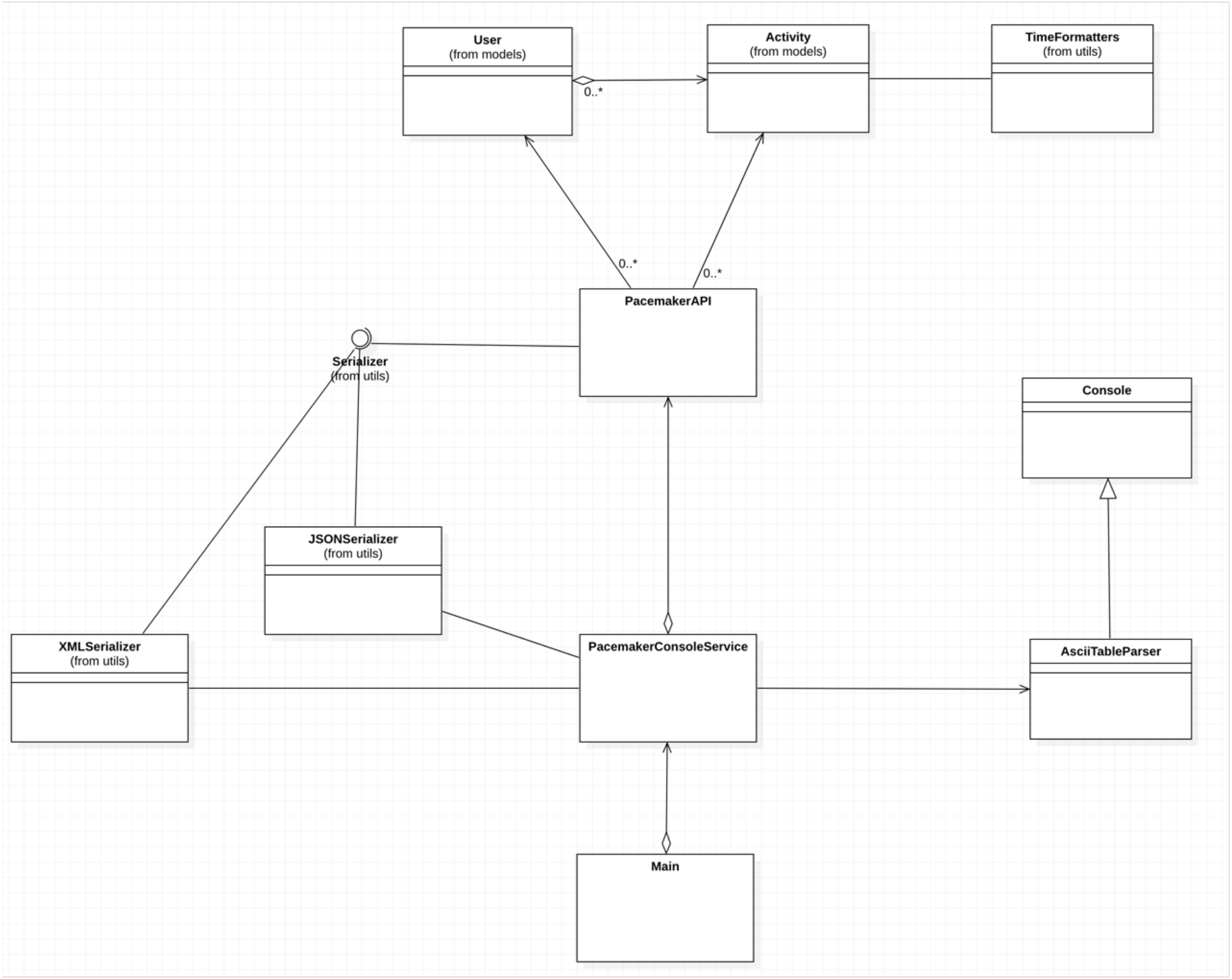
Encapsulate rendering of Model elements to a standard console

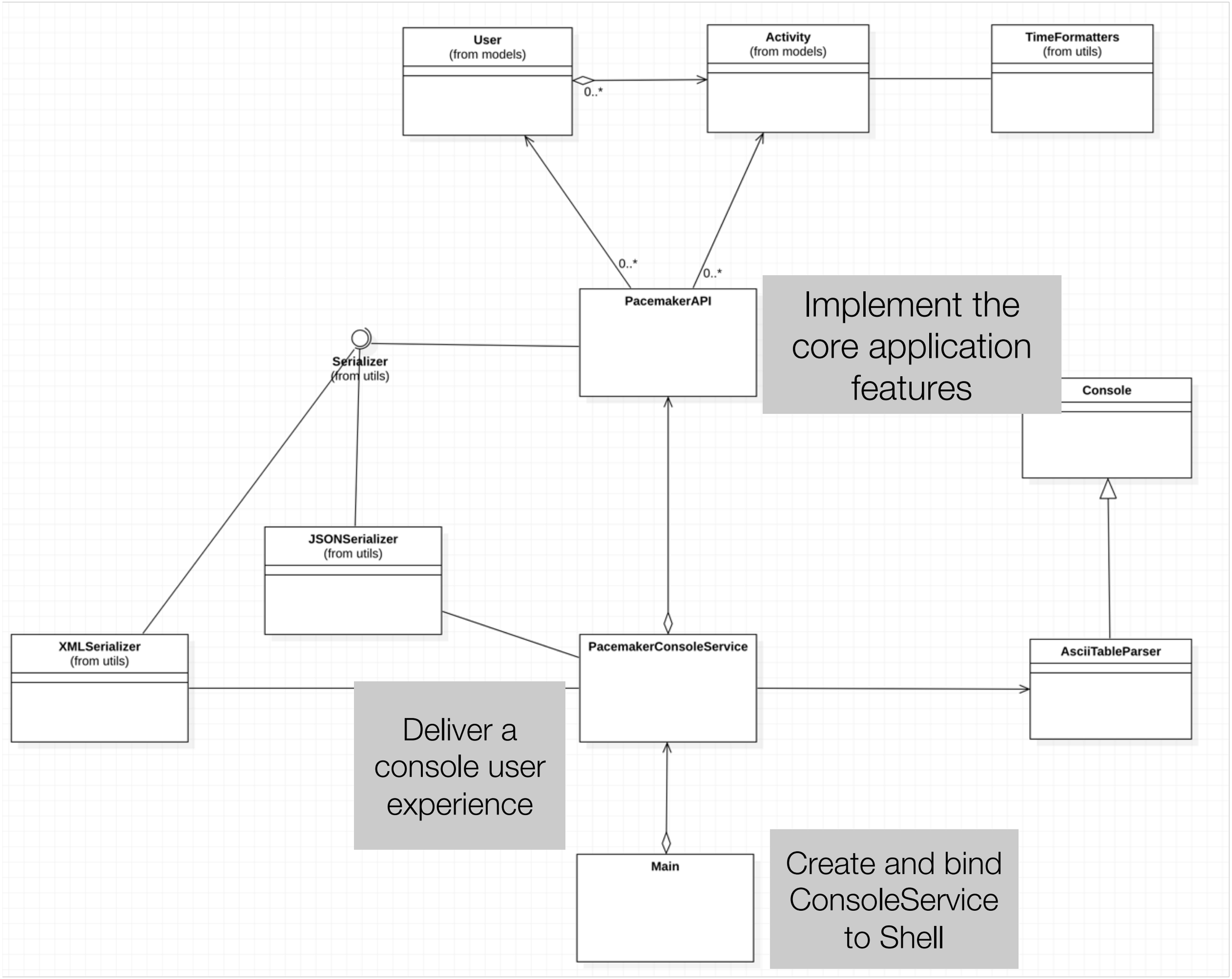
Specialise serialisation for XML

Specialise serialisation for JSON

Specialise to use table btc-ascii component

Centralise data/time formatting for application


User
(from models)
Activity
(from models)
TimeFormatters
(from utils)
0..*
0..*
0..*
PacemakerAPI
Serializer
(from utils)
Console
JSONSerializer
(from utils)
XMLSerializer
(from utils)
PacemakerConsoleService
AsciiTableParser
Main


User
(from models)
Activity
(from models)
TimeFormatters
(from utils)
0..*
0..*
0..*
PacemakerAPI
Implement the core application features
Serializer
(from utils)
Console
JSONSerializer
(from utils)
XMLSerializer
(from utils)
PacemakerConsoleService
AsciiTableParser
Deliver a console user experience
Main
Create and bind ConsoleService to Shell

Represent individual Users

User
(from models)

0..*

Represent individual Activities

Activity
(from models)

TimeFormatters
(from

Centralise data/time formatting for application

Encapsulate data structure serialisation

0..*

0..*

PacemakerAPI

Implement the core application features

Encapsulate rendering of Model elements to a standard console

Serializer
(from utils)

Console

JSONSerializer
(from utils)

Specialise serialisation for JSON

XMLSerializer
(from utils)

PacemakerConsoleServ

Deliver a console user experience

AsciiTableParser

Specialise serialisation for XML

Specialise to use table btc-ascii component

Main

Create and bind ConsoleService to Shell

# SRP Summary

- Changes in requirements are manifested as changes in class responsibilities.
- Therefore a ‘cohesive’ responsibility is a single axis of change – requirement changes often are restricted to a few cohesive responsibilities (in a reasonably designed system).
- Thus, to avoid coupling responsibilities that change for different reasons, a class should have only one responsibility, one reason to change.
- Violation of SRP causes spurious dependencies between modules that are hard to anticipate, in other words fragility.

# Single Responsibility Principle

Just because you *can* doesn't mean you *should*.