Course Schedule and Homework

Prof. Dr. Dirk Riehle

Friedrich-Alexander University Erlangen-Nürnberg

ADAP A02

Course Schedule

#	Class Content	Homework Due
01	Introduction	-
02	Containerization	Wahlzeit instance
03	Application testing	Containerized instance
04	Method types and properties	Example tests
05	Class and interface design	Domain classes
06	Subtyping and inheritance	Implementation classes
07	Design by contract	Abstract superclasses
08	Error and exception handling	Classes with contracts
09	Value objects	Classes with error handling
10	Design patterns	Value object applied
11	Type objects	Design patterns applied
12	Object creation	Type object applied
13	Collaboration-based design	Object creation applied
14	Object-oriented frameworks	Collaboration-based design applied
15	Guest talk and conclusions	Frameworks applied

Types of Deliverables

- Summary (of homework)
  - Explains your programming homework
  - Should have the following header (at max. ½ page):
    - **Project name**
      - **E.g. Flowers**
    - **Project repository**
      - **E.g. http://github.com/dirkriehle/wahlzeit**
    - **Project's continuous integration information**
      - **E.g. https://travis-ci.org/andreas-bauer/wahlzeit**
    - **This week's tag**
      - **E.g. adap-cw03 on master**
    - **This week's diff:**
      - **E.g. https://github.com/dirkriehle/repository/compare/adap-cw02...dirkriehle:adap-cw03**
  - Followed by the explanation of what you did and why (at max. 1.5 page)
    - Each week has some additional questions that should be answered here!
  - Name PDF using **lastname-firstname.pdf** convention
  - Includes tagged version of program code

Time of Day for Weekly Deliverables

- Right before class
    - Submit this week's deliverables

Plagiarism

- Plagiarism
    - is providing as your work the work of others
    - with or without those other people’s consent
- Other people
    - Other people may be other students in the course
    - May be any web source, including Wikipedia
- Citing sources
    - You can cite or use others if you clearly list the source
    - In most cases, you should limit any verbatim use

Handling Plagiarism

- Detecting plagiarism
  - We review your work and will detect plagiarism
  - Students are required to report any plagiarism they see
- Handling plagiarism
  - Any plagiarizing student will receive 0 points for their work
  - We will review any involved student's full submission history
- Review components
  - For reviews, it is acceptable to reuse your own text components
  - This is called self-plagiarism (and usually not acceptable)

Open Source License Compliance

- You can copy other people’s code to solve some homework if
  - You copy the code only after the homework deadline (to catch-up) and
  - Comply with the license requirements of that code
- Wahlzeit is licensed under the AGPLv3 license
  - All contributed code is thereby also licensed under AGPLv3
  - Combining such code is possible if you comply with the license
- The AGPLv3 license requirements are to
  - Publish your own changes to the source code (done automatically) and to
  - Attribute the original author of the code you use and some more
- Please see https://www.gnu.org/licenses/agpl-3.0.en.html

CW #01 Homework Due

- None

CW #01 Class Preparation Due

- None

CW #02 Homework Due 1 / 4

- **This week's required content**
  - **Set-up accounts**
    - GitHub
    - DockerHub
    - Travis CI
  - **Fork Wahlzeit**
- **Set-up environment**
  - Install necessary applications
- **Build and start application**
  - Add at least three photos for illustration
- **Commit and tag with adap-hw01 on GitHub**
- **Submit this week's summary**
  - Answer the questions in the next few pages!

CW #02 Homework Due 2 / 4

- **Simple Docker Build**
  - Create Dockerfile in root directory of the repository
  - Use the image *adoptopenjdk/openjdk8-openj9:alpine-slim* as basis
  - Copy the required artifacts from the host to the image
    - Sources
    - Gradle file
    - Other Gradle resources (gradlew file + gradle directory)
  - Expose the port of the Wahlzeit application to the host (8080)
  - Define an command to start the Wahlzeit Application on a development server (see README)
  - Test your Dockerfile
    - Build the docker image: *docker build -t wahlzeit .*
    - Run a docker container: *docker run --network=host -p 8080:8080 wahlzeit*
    - The Wahlzeit application should be available under localhost:8080

CW #02 Homework Due 3 / 4

- **Multi-Stage Docker Build 1 / 2**
  - Read up what a Docker Multi-Stage Build means. **Summarize** what it is and why we want to use it in the context of Wahlzeit.
    - Suggested source: https://docs.docker.com/develop/develop-images/multistage-build/
  - Rename the Dockerfile from (1) to Dockerfile.old. Create a new Dockerfile in the root directory with the name Dockerfile.
  - Stage 1: Building the artifacts
    - Use the image *adoptopenjdk/openjdk8-openj9:alpine-slim* as basis
    - Copy the required artifacts from the host to the image
      - Sources
      - Gradle file
      - Other Gradle resources (gradlew file + gradle directory)
    - Build the artifacts of the Wahlzeit application (exploded WAR) by using the gradle command *./gradlew appengineExplodeApp*

CW #02 Homework Due 4 / 4

- **Multi-Stage Docker Build 2 / 2**
  - Stage 2: Defining the final image
    - Use the image *adoptopenjdk/openjdk8-openj9:alpine-slim* as basis
    - Copy the required artifacts from the builder image to this image into a directory called */app*
      - The whole build directory
      - Set the working directory to */app*
    - Copy the required Appengine SDK from the builder image to this image
      - This step is special for Appengine Projects, most other frameworks don't require such a step!
      - It is located here in the builder image: /root/.gradle/appengine-sdk/appengine-java-sdk-1.9.76/
      - Place it in a directory with the same path in this image
    - Expose the port of the Wahlzeit application to the host (8080)
    - Define a command to start the Wahlzeit Application in development mode
      - Use the following code snippet:
        - CMD ["/opt/java/openjdk/bin/java", "-Xdebug", "-Xrunjdwp:transport=dt_socket,server=y,suspend=n,address=8000", "-Dfile.encoding=UTF-8", "-classpath", "/root/.gradle/wrapper/dists/gradle-4.10-bin/bg6py687nqv2mbe6e1hdtk57h/gradle-4.10/lib/gradle-launcher-4.10.jar:/root/.gradle/appengine-sdk/appengine-java-sdk-1.9.76/lib/appengine-tools-api.jar", "com.google.appengine.tools.development.DevAppServerMain", "--property=kickstart.user.dir=/app", "--no_java_agent", "--port=8080", "--address=localhost", "--allow_remote_shutdown", "/app/build/exploded-app"]
    - Test your Dockerfile
      - Build the docker image: *docker build -t wahlzeit .*
      - Run a docker container: *docker run --network=host -p 8080:8080 wahlzeit*
      - The Wahlzeit application should be available under localhost:8080
- **What differences do you experience between the simple docker build and the two-stage build?**

CW #02 Class Preparation Due

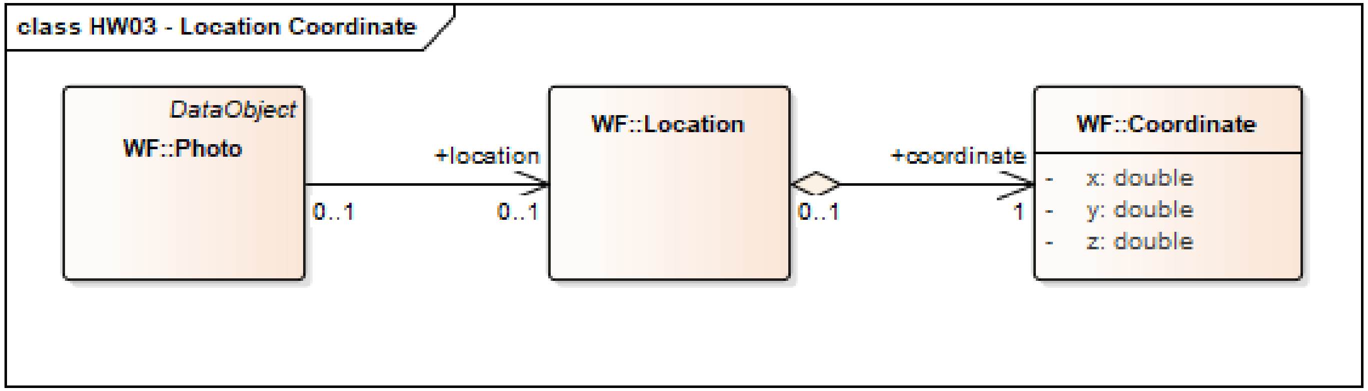
- **Class preparation (in recommended order)**
  - **Required reading**
    - [B02a] Beck, K. (2002). The Money Example. Part 1 in [B02].
    - [W98] Woolf, B. (1998). Null object. Chapter 1 in [M+98].
  - Suggested reading
    - [BG98] Beck, K., Gamma, E. (1998). Test infected: Programmers love writing tests. Self-published.
    - [B02] Kent, B. (2002). Test driven development: By example. Addison-Wesley Professional.
    - [V15] Van Deursen, A. (2015). Testing web applications with state objects. Communications of the ACM, 58(8), 36-43.

CW #03 Homework Due 1 / 2

- **This week's required content**
  - **Make project decision (type of photo)**
  - **Add a Location and Coordinate class to Wahlzeit**
  - **Containerized application (dockerfile)**
- Build, commit, push, and tag with adap-hw02 to GitHub and DockerHub
- Submit this week's summary
  - Use https://github.com/user/repository/compare/adap-hw01...user:adap-hw02

CW #03 Homework Due 2 / 2

- Add a Location and a Coordinate class to Wahlzeit
  - Associate classes as shown in class model
  - Use Cartesian coordinates for Coordinate class
- Implement at least the following methods
  - double Coordinate#getDistance(Coordinate) // direct Cartesian distance
  - boolean Coordinate#isEqual(Coordinate)
- Forward equals() to isEqual()



CW #03 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - [M07a] Meszaros, G. (2007). Test smells. Chapter 2 in [M07].
    - [M07b] Meszaros, G. (2007). Persistent fixture management. Chapter 9 in [M07].
    - [M07c] Meszaros, G. (2007). Testing with databases. Chapter 13 in [M07].
  - Suggested reading
    - [M07] Meszaros, G. (2007). xUnit test patterns: Refactoring test code. Pearson Education.
    - [F04] Feathers, M. (2004). Working effectively with legacy code. Prentice Hall Professional.

CW #04 Homework Due

- **This week's required content**
  - **Add a new test case to EmailAddressTest**
  - **Add a new test case to EmailServiceTest**
  - **Create an EmailService test suite for testing the email service**
  - **Integrate all test cases into an overall Wahlzeit test suite "AllTests.java"**
    - **Adjust Gradle test task in build.gradle file, so that "AllTests.java" will be used instead of the wildcard filter**
- Build, commit, push, and tag with adap-hw03 to GitHub and DockerHub
- Submit this week's summary
  - Which external systems could you generally mock in Wahlzeit to isolate the application?
  - How did you decide that you don't need to write more tests?
  - Which benefits could distinguishing multiple test suites have?

CW #04 Class Preparation Due

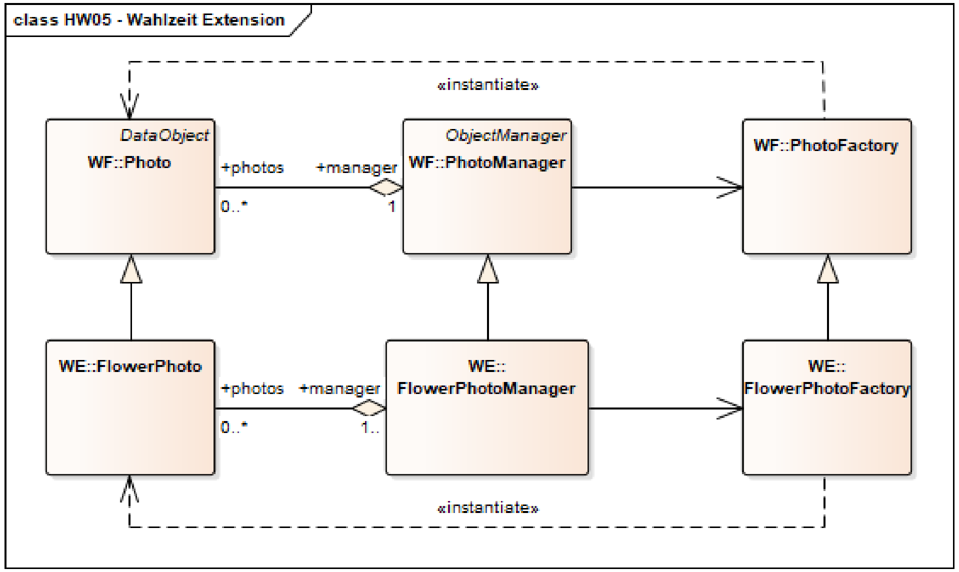
- **Class preparation (in recommended order)**
  - **Required reading**
    - None
  - Suggested reading
    - [R00a] Riehle, D. (2000). “Method Types.” Java Report 5, 2.
    - [R00b] Riehle, D. (2000). “Method Properties.” Java Report 5, 5.
    - [B97a] Beck, K. (1997). Behavior. Chapter 3 in [B97].

CW #05 Homework Due 1 / 2

- **This week's required content**
  - **Extend Wahlzeit with your Photo class; add others if necessary**
  - **Keep adding and adjusting test cases**
- Build, commit, push, and tag
- Submit this week's summary
  - Why do you extend the Photo class and not just replace it?
  - Which tests did you add and why?

CW #05 Homework Due 2 / 2

- Extend Wahlzeit with your Photo class (e.g. FlowerPhoto)
  - Add other classes, where necessary
  - Ensure that your classes plays well with Wahlzeit
    - Specifically, make sure that your photo class is instantiated
    - Make sure that your photos can be saved and loaded using your photo class
  - Ignore the user interface (if your class adds new attributes)



CW #05 Class Preparation Due

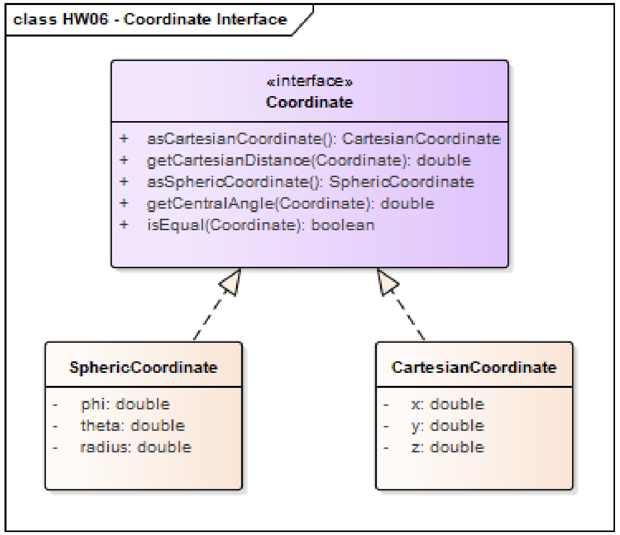
- **Class preparation (in recommended order)**
  - **Required reading**
    - [F97a] Fowler, M. (1997). Class diagrams: The essentials. Chapter 4 in [F97].
    - [F97b] Fowler, M. (1997). Class diagrams: Advanced concepts. Chapter 5 in [F97].
  - Suggested reading
    - [RD99a] Riehle, D., & Dubach, E. (1999). Working with Java interfaces and classes. Java Report 4(7).
    - [RD99b] Riehle, D., & Dubach, E. (1999). Working with Java interfaces and classes, part 2. Java Report 4(10).

CW #06 Homework Due 1 / 2

- **This week's required content**
  - **Introduce an interface for the Coordinate class**
  - **Add an alternative implementation for the Coordinate class**
- Build, commit, push, and tag
- Submit this week's summary
  - How did you implement the equality check and why?

CW #06 Homework Due 2 / 2

- Add a Coordinate interface to Wahlzeit
  - Add an alternative implementation of your current Coordinate class
    - Provide spheric and Cartesian coordinate implementations of Coordinate
    - Ensure that spheric and Cartesian coordinates can be used interchangeably
    - Try to solve it with short methods and no typecasts (but interpretation methods)
    - See https://en.wikipedia.org/wiki/Great-circle_distance for definition of central angle
  - Refactor classes accordingly


class HW06 - Coordinate Interface
«interface»
Coordinate
+ asCartesianCoordinate(): CartesianCoordinate
+ getCartesianDistance(Coordinate): double
+ asSphericCoordinate(): SphericCoordinate
+ getCentralAngle(Coordinate): double
+ isEqual(Coordinate): boolean
SphericCoordinate
- phi: double
- theta: double
- radius: double
CartesianCoordinate
- x: double
- y: double
- z: double

CW #06 Class Preparation Due

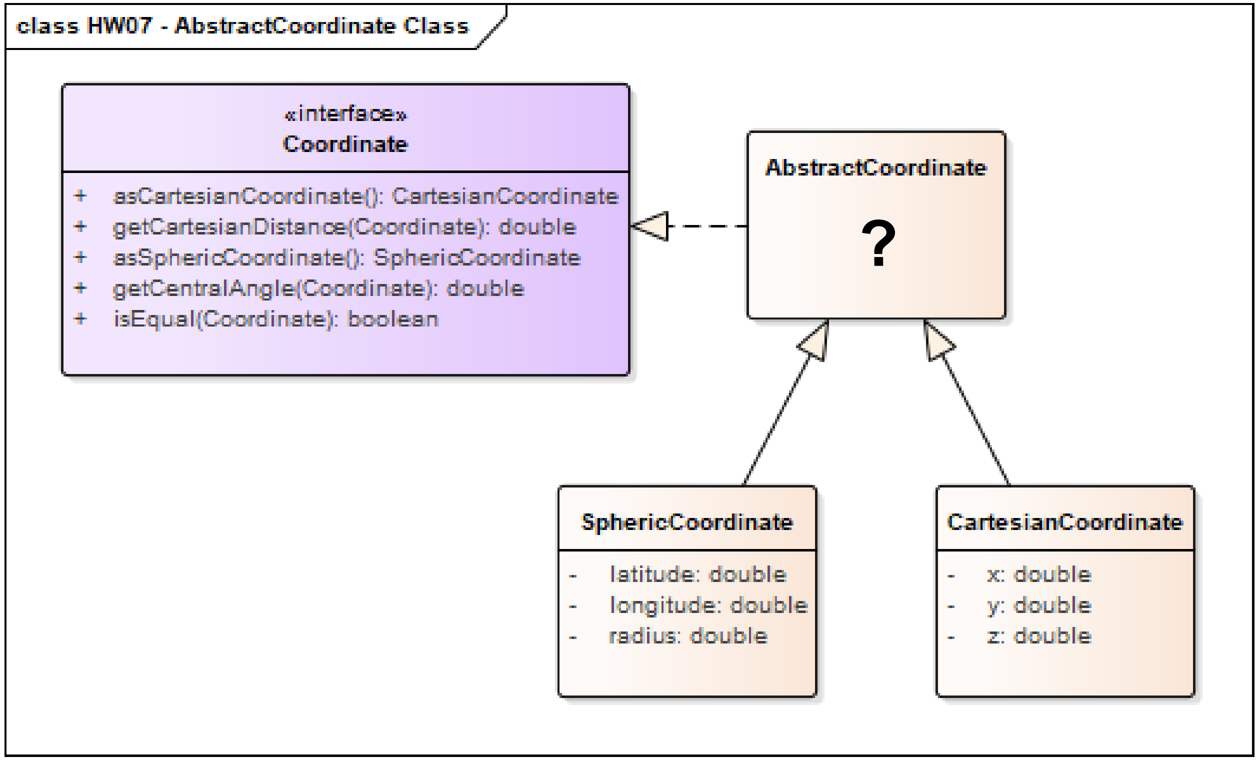
- **Class preparation (in recommended order)**
  - **Required reading**
    - [H94] Hürsch, W. L. (1994). Should superclasses be abstract?. In Object-Oriented Programming (pp. 12-31). Springer Berlin Heidelberg.
  - Suggested reading
    - [LW94] Liskov, B. H., & Wing, J. M. (1994). A behavioral notion of subtyping. ACM Transactions on Programming Languages and Systems, 16(6), 1811-1841.
    - [G+95f] Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). Template Method. Pattern in [G+95].

CW #07 Homework Due 1 / 2

- **This week's required content**
  - **Introduce an abstract superclass for the Coordinate class hierarchy**
- Build, commit, push, and tag
- Submit this week's summary
  - How did you decide which methods go into the abstract superclass or in the implementations?

CW #07 Homework Due 2 / 2

- Introduce an abstract superclass AbstractCoordinate
  - Refactor for minimal redundancy using an inheritance interface


class HW07 - AbstractCoordinate Class
«interface»
Coordinate
+ asCartesianCoordinate(): CartesianCoordinate
+ getCartesianDistance(Coordinate): double
+ asSphericCoordinate(): SphericCoordinate
+ getCentralAngle(Coordinate): double
+ isEqual(Coordinate): boolean
AbstractCoordinate
?
SphericCoordinate
- latitude: double
- longitude: double
- radius: double
CartesianCoordinate
- x: double
- y: double
- z: double

CW #07 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - [M91] Meyer, B. (1991). Design by contract. Chapter 1 in [MM91].
  - Suggested reading
    - [DS10] Dietrich, J., & Stewart, L. (2010). Component contracts in eclipse-a case study. In Component-Based Software Engineering (pp. 150-165). Springer Berlin Heidelberg.
    - [N+09] Nienaltowski, P., Meyer, B., & Ostroff, J. S. (2009). Contracts for concurrency. Formal Aspects of Computing, 21(4), 305-318.

CW #08 Homework Due

- **This week's required content**
  - **Add design-by-contract to Coordinate interface and class hierarchy**
    - **Use assert statements and assertion methods for both**
      - **Preconditions**
      - **Postconditions**
    - **Implement assertClassInvariants methods for class invariants**
- Build, commit, and tag
- Submit this week's summary
  - For checking postcondictions, would you rather use Java's *assert* statement or throw an Exception in a custom assertion method?

CW #08 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - None
  - Suggested reading
    - [A+04] Avižienis, A., Laprie, J. C., Randell, B., & Landwehr, C. (2004). Basic concepts and taxonomy of dependable and secure computing. Dependable and Secure Computing, IEEE Transactions on, 1(1), 11-33.
    - [GT07] Grottke, M., & Trivedi, K. S. (2007). Fighting bugs: Remove, retry, replicate, and rejuvenate. Computer, 40(2), 107-109.

CW #09 Homework Due 1 / 2

- **This week's required content**
  - **Add error and exception handling to your classes**
- Build, commit, push, and tag
- Submit this week's summary
  - Did you choose to use runtime exceptions or checked exceptions and why?

CW #09 Homework Due 2 / 2

- Your classes are, at a minimum
  - The Coordinate and related classes
  - Your Photo and related classes
- Review the contracts
  - Associated with your classes
  - And extend them, if necessary
- Determine components boundaries
  - Persistence, domain model, user interface
  - And implement appropriate error handling

CW #09 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - [M82] MacLennan, B. J. (1982). Values and objects in programming languages. ACM SIGPLAN Notices, 17(12), 70-79.
  - Suggested reading
    - [R06] Riehle, D. (2006). Value object. In Proceedings of the 2006 conference on pattern languages of programs (p. 30). ACM.
    - [E04a] Evans, E. (2004). Entities vs. values. Chapter 5 in [E04].

CW #10 Homework Due

- **This week's required content**
  - **Turn the Coordinate classes into value object classes**
    - **All Coordinate classes should be immutable and shared**
    - **Make sure that Coordinate objects are still interchangeable**
- Build, commit, and tag
- Submit this week's summary
  - What benefits or drawbacks does the Value Object pattern have in this context?
  - How did you handle interchangeability of subclasses and why?

CW #10B Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - [G+95a] Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). Introduction. Chapter 1 in [G+95].
  - Suggested reading
    - [RZ96] Riehle, D., & Züllighoven, H. (1996). Understanding and using patterns in software development. TAPOS, 2(1), 3-13.
    - [V98a] Vlissides, J. (1998). Top ten misconceptions. Chapter 1 in [V98].
    - [R03] Riehle, D. (2003). The perfection of informality: Tools, templates, and patterns. Cutter IT Journal, 16(9), 22-26.

CW #11 Homework Due 1 / 2

- **This week's required content**
  - **Document five design pattern instances in Wahlzeit using annotations**
  - **Explain the purpose of the design patterns in the context of Wahlzeit**
- Build, commit, push, and tag
- Submit this week's summary
  - Does the use of each documented design pattern make sense in the context and why?
  - What are drawbacks of using design patterns?

CW #11 Homework Due 2 / 2

- Emulate the following example

```
@PatternInstance(
  patternName = “Abstract Factory”
  participants = {
    “AbstractFactory”, “ConcreteFactory”
  }
)
public class PhotoFactory { ... }
```

```
@PatternInstance(
  patternName = “Abstract Factory”
  participants = {
    “AbstractProduct”,
    “ConcreteProduct”
  }
)
public class Photo { ... }
```

CW #11 Class Preparation Due

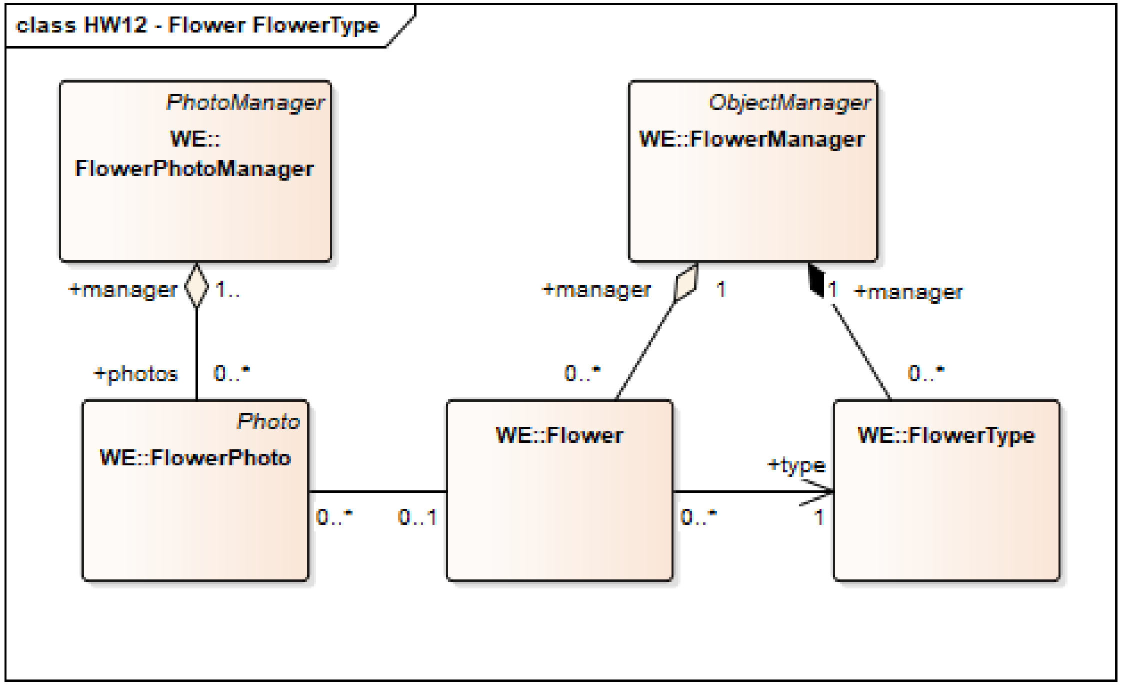
- **Class preparation (in recommended order)**
  - **Required reading**
    - [H95a] Hay, D. C. (1995). Things of the enterprise: Products and product types. Chapter 4 in [H95].
  - Suggested reading
    - [JW98] Johnson, R. E., Woolf, B. (1998). Type Object. Chapter 4 in [M+98].

CW #12 Homework Due 1 / 2

- **This week's required content**
  - **Apply the Type Object pattern to your class model**
- Build, commit, push, and tag
- Submit this week's summary
  - How do you deal with type hierarchies by using the Type Object pattern?

CW #12 Homework Due 2 / 2

- Apply the Type Object pattern to your class model
  - Add your domain class and the corresponding type (object) class
  - Implement an isSubtype() method for your type object class



CW #12 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - None
  - Suggested reading
    - [G+95b] Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). Factory Method. Pattern in [G+95].
    - [G+95i] Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). Abstract Factory. Pattern in [G+95].
    - [BR98] Bäumer, D., Riehle, D. (1998). Product Trader. Chapter 3 in [M+98].
    - [G+95c] Gamma, E., Helm, R., Johnson, R., & Vlissides, J. (1995). Prototype. Pattern in [G+95].

CW #13 Homework Due 1 / 2

- **This week's required content**
  - **Trace and document the instantiation of both**
    - **your photo class and**
    - **your domain class**
- Build, commit, push, and tag
- Submit this week's summary

CW #13 Homework Due 2 / 2

- Trace and document the instantiation process of both
  - your photo class and
  - your domain class
- For each class, document
  - the sequence of method calls that lead to the new object
  - Start with the call to your object manager or, if none, your factory
- For each class, document
  - the object creation solution as a point in the solution space
  - Use the object creation table (i.e. you should provide a six tuple)

CW #13 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - None
  - Suggested reading
    - [R96a] Reenskaug, T. (1996). The Main Ideas. Chapter 1 in [R96].
    - [VN96] VanHilst, M., & Notkin, D. (1996). Using role components in implement collaboration-based designs. ACM SIGPLAN Notices, 31(10), 359-369.

CW #14 Homework Due 1 / 2

- **This week's required content**
  - **Describe the following three collaborations**
    - **YourObjectPhoto with YourObject**
    - **YourObject with YourObjectType**
    - **A collaboration of your choice**
- Build, commit, push, and tag
- Submit this week's summary
  - What is the connection between collaborations and design patterns?

CW #14 Homework Due 2 / 2

- Describe the following three collaborations
  - YourObjectPhoto with YourObject
  - YourObject with YourObjectType
  - A collaboration of your choice
- Use the syntax from class, i.e. these keywords
  - `collaboration`, `role`, `binds`, ...

CW #14 Class Preparation Due

- **Class preparation (in recommended order)**
  - **Required reading**
    - None
  - Suggested reading
    - [JF88] Johnson, R. E., & Foote, B. (1988). Designing reusable classes. Journal of object-oriented programming, 1(2), 22-35.
    - [WG94] Weinand, A., & Gamma, E. (1994). ET++-a portable, homogenous class library and application framework. Computer Science Research at UBILAB, 66-92.
    - [B+97] Bäumer, D., Gryczan, G., Knoll, R., Lilienthal, C., Riehle, D., & Züllighoven, H. (1997). Framework development for large systems. Communications of the ACM, 40(10), 52-59.

CW #15 Homework Due

- None

CW #15 Class Preparation Due

- None

Thank you! Questions?

dirk.riehle@fau.de – http://osr.cs.fau.de

dirk@riehle.org – http://dirkriehle.com – @dirkriehle

Credits and License