

Course Schedule and Homework

Prof. Dr. Dirk Riehle

Friedrich-Alexander University Erlangen-Nürnberg

ADAP A02

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Course Schedule

#	Class Content	Homework Due
01	Introduction	-
02	Component testing with JUnit	Wahlzeit instance
03	Acceptance and integration testing	Simple tests
04	Method types and properties	Test set-up, mocks
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)
 - 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
 - Prepare next week's class

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 homework 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

- This week's **required content**
 - Set-up accounts, fork Wahlzeit
- Build and start application
 - Add at least three photos for illustration
- Commit and tag with **adap-hw01** on GitHub
- Build commit tagged with **adap-hw01** using TravisCI
- Submit this week's summary

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**

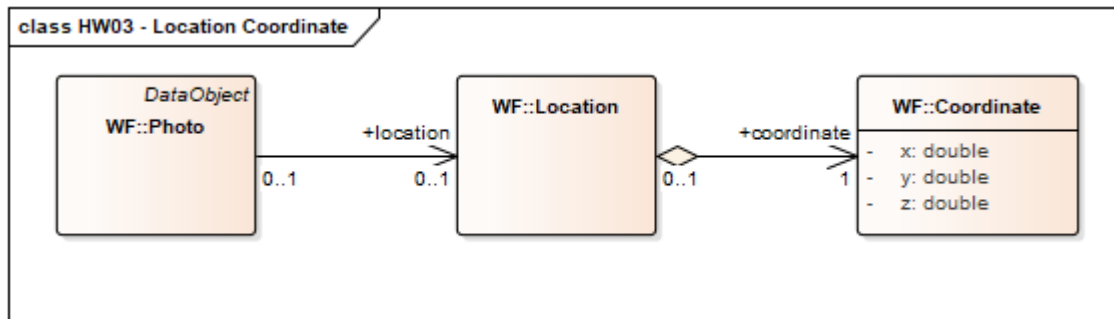
- [BG98] Beck, K., Gamma, E. (1998). Test infected: Programmers love writing tests. Self-published.
- [B02] Kent, B. (2002). Test driven development: By example. Addison-Wesley Professional.
- [V15] Van Deursen, A. (2015). Testing web applications with state objects. Communications of the ACM, 58(8), 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
 - Implement component tests for new classes
- Build, commit, and tag with adap-hw02
- 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, and tag with adap-hw03
- Submit this week's summary

CW #04 Class Preparation Due

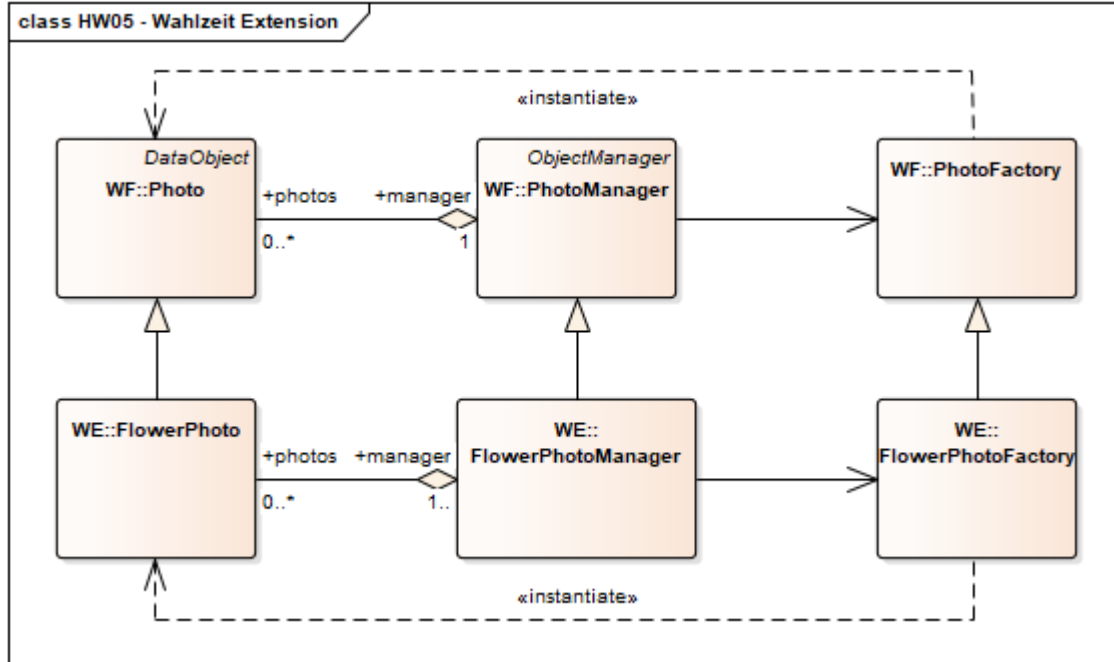
- **Class preparation (in recommended order)**
 - **Required reading**
 - [R00a] Riehle, D. (2000). “Method Types.” Java Report 5, 2.
 - [R00b] Riehle, D. (2000). “Method Properties.” Java Report 5, 5.
 - **Suggested reading**
 - [B97a] Beck, K. (1997). Behavior. Chapter 3 in [B97].

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, and tag
- Submit this week's summary

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

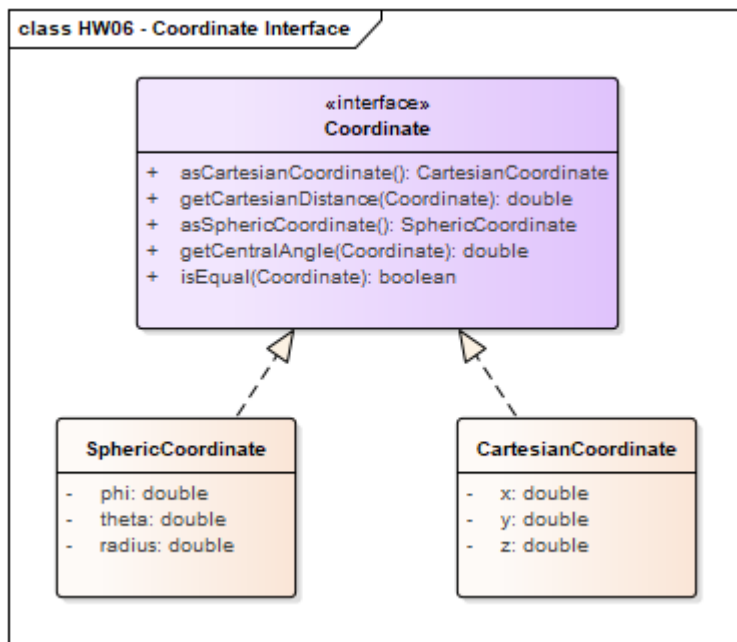
- **Class preparation (in recommended order)**
 - **Required reading**
 - [RD99a] Riehle, D., & Dubach, E. (1999). Working with Java interfaces and classes. Java Report 4(7).
 - [RD99b] Riehle, D., & Dubach, E. (1999). Working with Java interfaces and classes, part 2. Java Report 4(10).
 - **Suggested 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].

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, and tag
- Submit this week's summary

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



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.
- [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].

- **Suggested reading**

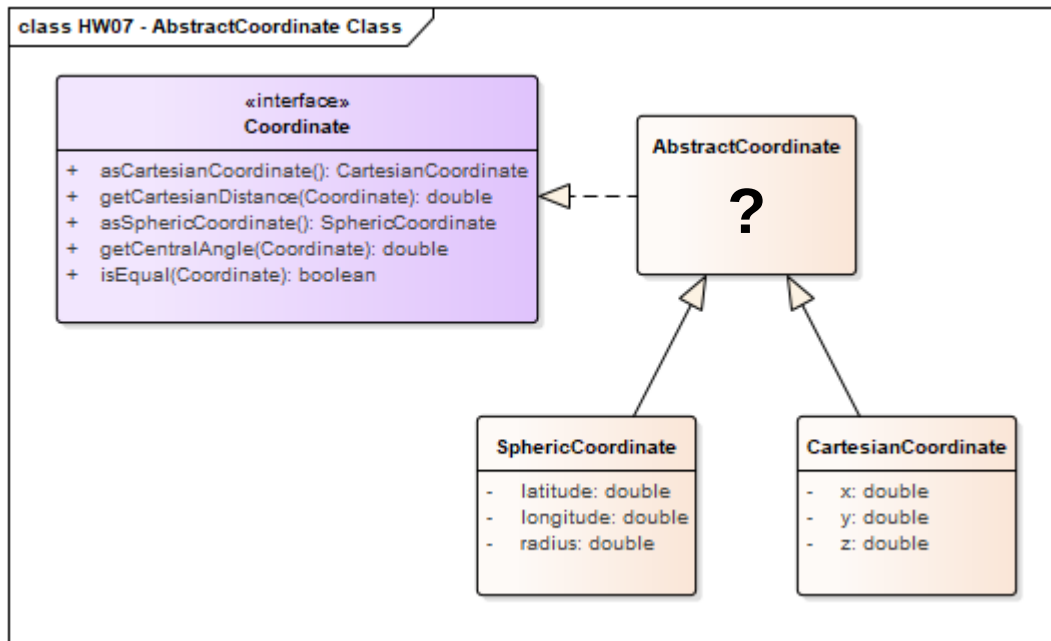
- None

CW #07 Homework Due 1 / 2

- This week's **required content**
 - Introduce an abstract superclass for the **Coordinate** class hierarchy
- Build, commit, and tag
- Submit this week's summary

CW #07 Homework Due 2 / 2

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



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

CW #08 Class Preparation Due

- **Class preparation (in recommended order)**
 - **Required 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.
 - **Suggested reading**
 - [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, and tag
- Submit this week's summary

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.
 - [R06] Riehle, D. (2006). Value object. In Proceedings of the 2006 conference on pattern languages of programs (p. 30). ACM.
 - **Suggested reading**
 - [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

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].
- [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].

- **Suggested reading**

- [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, and tag
- Submit this week's summary

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

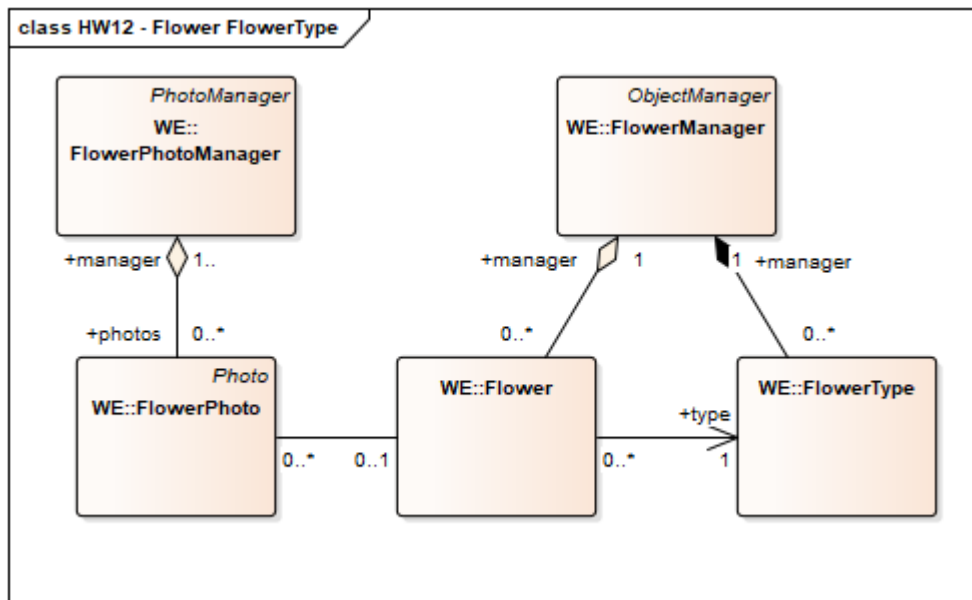
- **Class preparation (in recommended order)**
 - **Required reading**
 - [JW98] Johnson, R. E., Woolf, B. (1998). Type Object. Chapter 4 in [M+98].
 - [H95a] Hay, D. C. (1995). Things of the enterprise: Products and product types. Chapter 4 in [H95].
 - **Suggested reading**
 - None

CW #12 Homework Due 1 / 2

- This week's **required content**
 - Apply the Type Object pattern to your class model
- Build, commit, and tag
- Submit this week's summary

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**

- [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].

- **Suggested reading**

- [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, 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**
 - [R96a] Reenskaug, T. (1996). The Main Ideas. Chapter 1 in [R96].
 - **Suggested reading**
 - [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, and tag
- Submit this week's summary

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**

- [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.

- **Suggested reading**

- [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

Thanks! Questions?

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

dirk@riehle.org – <http://dirkriehle.com> – [@dirkriehle](#)

Credits and License

- Original version
 - © 2012-2018 [Dirk Riehle](#), some rights reserved
 - Licensed under [Creative Commons Attribution 4.0 International License](#)
- Contributions
 - Andreas Bauer (2018)

Course Schedule and Homework

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It is Friedrich-Alexander University Erlangen-Nürnberg – FAU, in short.
Corporate identity wants us to say “Friedrich-Alexander University”.

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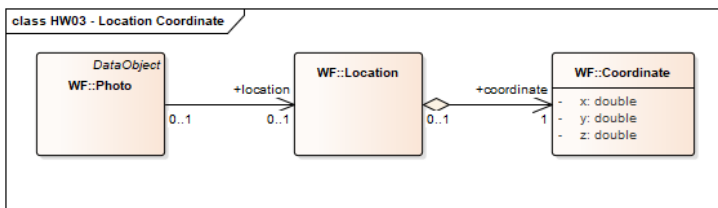
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 - [BG98] Beck, K., Gamma, E. (1998). Test infected: Programmers love writing tests. Self-published.
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 - `boolean Coordinate#isEqual(Coordinate)`
- Forward `equals()` to `isEqual()`



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 - Adjust Gradle test task in build.gradle file, so that "AllTests.java" will be used instead of the wildcard filter
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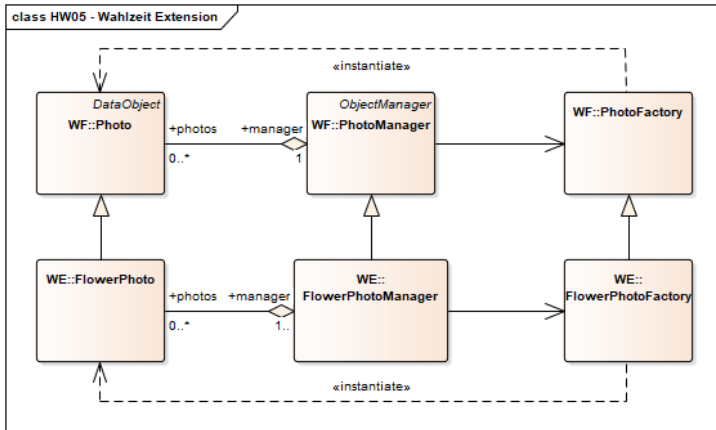
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- Extend Wahlzeit with your Photo class (e.g. FlowerPhoto)
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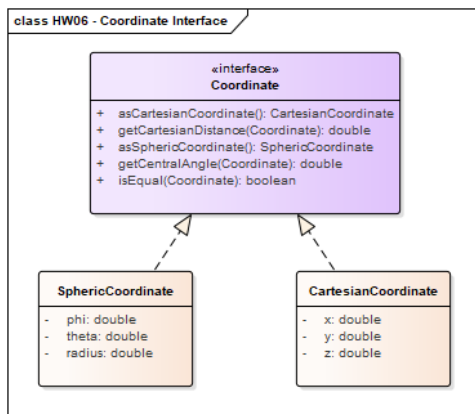
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 - [RD99b] Riehle, D., & Dubach, E. (1999). Working with Java interfaces and classes, part 2. Java Report 4(10).
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 - Introduce an interface for the **Coordinate** class
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CW #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
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 - See https://en.wikipedia.org/wiki/Great-circle_distance for definition of central angle
 - Refactor classes accordingly



CW #06 Class Preparation Due

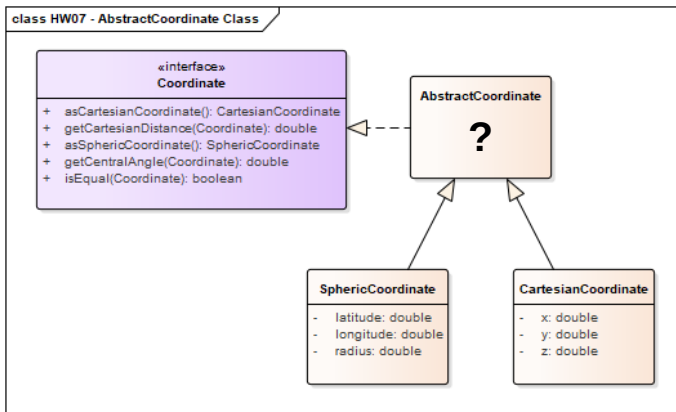
- **Class preparation (in recommended order)**
 - **Required reading**
 - [H94] Hürsch, W. L. (1994). Should superclasses be abstract?. In Object-Oriented Programming (pp. 12-31). Springer Berlin Heidelberg.
 - [LW94] Liskov, B. H., & Wing, J. M. (1994). A behavioral notion of subtyping. ACM Transactions 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].
 - **Suggested reading**
 - None

CW #07 Homework Due 1 / 2

- This week's **required content**
 - Introduce an abstract superclass for the Coordinate class hierarchy
- Build, commit, and tag
- Submit this week's summary

CW #07 Homework Due 2 / 2

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



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

CW #08 Class Preparation Due

- **Class preparation (in recommended order)**
 - **Required 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.
 - **Suggested reading**
 - [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, and tag
- Submit this week's summary

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.
 - [R06] Riehle, D. (2006). Value object. In Proceedings of the 2006 conference on pattern languages of programs (p. 30). ACM.
 - **Suggested reading**
 - [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

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].
 - [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].
 - **Suggested reading**
 - [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, and tag
- Submit this week's summary

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

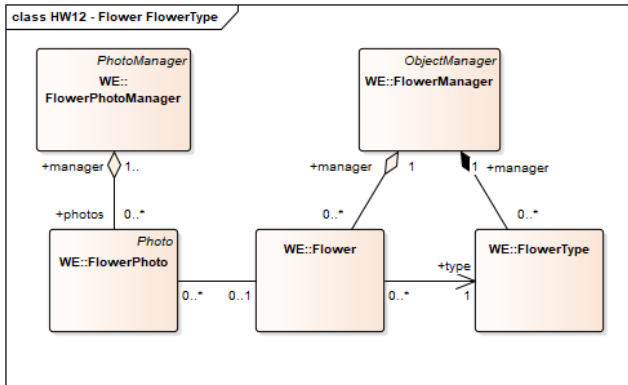
- **Class preparation (in recommended order)**
 - **Required reading**
 - [JW98] Johnson, R. E., Woolf, B. (1998). Type Object. Chapter 4 in [M+98].
 - [H95a] Hay, D. C. (1995). Things of the enterprise: Products and product types. Chapter 4 in [H95].
 - **Suggested reading**
 - None

CW #12 Homework Due 1 / 2

- This week's **required content**
 - Apply the Type Object pattern to your class model
- Build, commit, and tag
- Submit this week's summary

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**
 - [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].
 - **Suggested reading**
 - [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, 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**
 - [R96a] Reenskaug, T. (1996). The Main Ideas. Chapter 1 in [R96].
 - **Suggested reading**
 - [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, and tag
- Submit this week's summary

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**
 - [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.
 - **Suggested reading**
 - [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

Thanks! Questions?

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DR

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- Contributions
 - Andreas Bauer (2018)