

# Assignment Project Exam Help

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Bjørn Sand Jensen  
bjorn.jensen@glasgow.ac.uk

## Lecture 1

# Today's Plan

- 10:05-10:55:
  - What is software engineering?
  - Housekeep
- Break
- 11:05-11:55:
  - Software development process
  - Requirements (mostly review)
- Long break
- 14:05-14:55: Object Orientation – important concepts (mostly review) [Sir Alexander Stone 208, no lab!]

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What is Software Engineering ?

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# Software Development is Hard

■ Software is Intangible **Assignment Project Exam Help**

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# Software Development is Hard

■ Software is Complex **Assignment Project Exam Help**

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# Software Development is Hard

■ Software Fails **Assignment Project Exam Help**

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■ <http://spectrum.ieee.org/computing/software/why-software-fails>



# Software Development is Hard

■ Software is Malleable **Assignment Project Exam Help**

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# Characteristics of Good Software

- Easy of use
- Modularity
- Modifiability
- Efficient
- Correct
- Maintainability
- Understandability
- Reusable
- Portable
- Security
- ... etc

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# What is Software Engineering?

- “Software engineering is an engineering discipline that is concerned with all aspects of software production” (Sommerville)
- “A discipline of software systems which are so large that they require the management and co-ordination of teams of engineers.” (Ghezzi, Jazayeri, Mandrioli)
- “The application of a systematic, quantifiable approach to the development, operation, maintenance of software; that is, the application of engineering to software....” IEEE
- **“The process of solving customers’ problems by the systematic development and evolution of large, high-quality software systems within cost, time and other constraints**

# Why is Software Engineering Important?

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# Software Engineering is Design!

- Very much related to the **design** of the internal structure of software to **implement**ments.

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- This is the fun aspect of software development !

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# Course Aims

- To introduce the basic concepts of software engineering in the small
- To present methods for the implementation, testing and documentation of programs;
- To develop program comprehension and design skills by studying and extending existing programs.

# Intended Learning Outcomes and Course Objectives

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# Intended Learning Objectives

- 1: Develop clear, concise, and sufficiently formal documentation of extensions to an existing system, based on the true needs of users and other stakeholders;
- 2: Apply design principles while designing and implementing reusable technology;
- 3: Produce documentation for programs developed in practical exercises;
- 4: Create UML class diagrams which model aspects of the domain and the software architecture;
- 5: Carry out testing of programs and apply simple measurement techniques to software;
- 6: Discuss the breadth of software engineering practices.

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Topic		Who	Assigned Reading (OOSE, unless otherwise indicated)	Morning Session 10:00-12:00 MB420	Afternoon Session 14:00-15:00 BO1028, if not otherwise indicated	Assessed coursework
W17	8/1	Introduction and review	BSJ	Ch 1+2 (review Ch 4)	Lec 1.1 Lec 1.2 (in SAS208) Lab 1: Review Eclipse (review outside of class)	(PI1/Q1, not assessed; demo only)
W18	15/1	Modelling and UML	BSJ	Ch 5	Lec 2 Lab 2: Design using UML	PI2/Q2
	19/1					AE1 Handout
W19	22/1	Design Patterns	B	Ch 6	Lec 3 Lab 2: Patterns	PI3/Q3
W20	29/1	Design Patterns	B		ns	PI4/Q4
W21	5/2	Design Principles and Architecture	B			PI5/Q5
W22	12/2	Design Principles and Architecture (incl. documentation)	BSJ	Ch 9	Lec 6	PI6/Q6
	16/2					AE1 Deadline & AE2 Handout
W23	19/2	Testing	KY	Ch 10	Lec 7 Lab 6: Test	PI7/Q7
W24	26/2	Testing	KY	Ch 10 +TBD	Lec 8 Lab 7: Test	PI8/Q8
W25	5/3	Continuous Integration	KY		Lec 9 Lab 8: Continuous integration	PI9/Q9
W26	12/3	Revision	KY (BSJ)	Revision	Lec 10 Lab revision	PI10/Q10
	16/3					AE2 Deadline

# Course Details

- Assignment Project Exam Help
- The syllabus is available on Moodle
- <https://eduassistpro.github.io/>
- <http://moodle.nyu.edu/course/view.php?id=2780>

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# Primary Textbook & Videos

- Object Oriented Software Engineering – Lethbridge and Laganier  
**Assignment Project Exam Help**  
**<https://eduassistpro.github.io/research/lloseng/>**
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**<http://www.site.uottawa.ca/school/research/lloseng/supportMaterial/videos/>**
- Classical one-way lectures om.
- Note: Our aim is not to repeat the recorded lectures but to get you involved and help you to reflect on the material during lectures.

# Venues

- Lectures (w/ quizzes and exercises):
  - Week 1-10: Monday 10:00-12:00 Main Building 420
  - Week 11-12: Monday 10:00-12:00 Alexander Stone 208
- Labs
  - Week 2 onwards:
    - Monday 13:00-14:00 Boyd Orr Building 1028
    - OR
    - Monday 14:00-15:00 Boyd Orr Building 1028

# Lab Scheduling

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Monday 13:00-14:00 Boyd Orr Building 1028

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ding 1028  
?

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Please indicate your preference vi

<http://moodle2.gla.ac.uk/mod/choice/view.php?id=819064>

# Who are we?

- Lecturer: Bjørn Sand Jensen (aka Bjørn / Bjorn)

- Office: SAWB 306

- Email: [Bjoern.SandJensen@glasgow.ac.uk](mailto:Bjoern.SandJensen@glasgow.ac.uk)

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- Lecturer: Ke Yuan

- Office: SAWB 205

- Email: [Ke.Yuan@glasgow.ac.uk](mailto:Ke.Yuan@glasgow.ac.uk)

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# Who are we?

- What we (also) spend our time on...
  - Research, rarely on SE aspects per say.
  - We are both Machine Learning researchers. We do Machine Learning, AI and Signal/Image Processing in biology, cancer, audio, images, text, human behaviour....
  - We regularly develop and apply scientific software
- My personal experience with engineering...

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# Who are you?

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# Course assessment

- Exam, 70% **Assignment Project Exam Help**
- Course-work **<https://eduassistpro.github.io/>**  
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# Coursework

- 30% of your total mark **Assignment Project Exam Help**
- We expect **<https://eduassistpro.github.io/>**
- Coursework must have one **Add WeChat edu\_assist\_pro**
- Hand in times are at 4:30 on the due date
- No questions will be accepted two days before assignments are due

# Peer Instruction and Quizzes

- 10% of your total grade will be based on your participation in peer instruction activities. This will include:
  - Quizzes during lectures. You will receive 1 point for each correct answer. <https://eduassistpro.github.io/>
  - Problem Solving during lectures. You will receive 1 point for each correct answer. Add WeChat edu\_assist\_pro
- In order to receive full marks for this assessment, you need only to complete 90% of the total possible points.
- <http://learn.gla.ac.uk/yacrs/index.php>

# How does this class work?

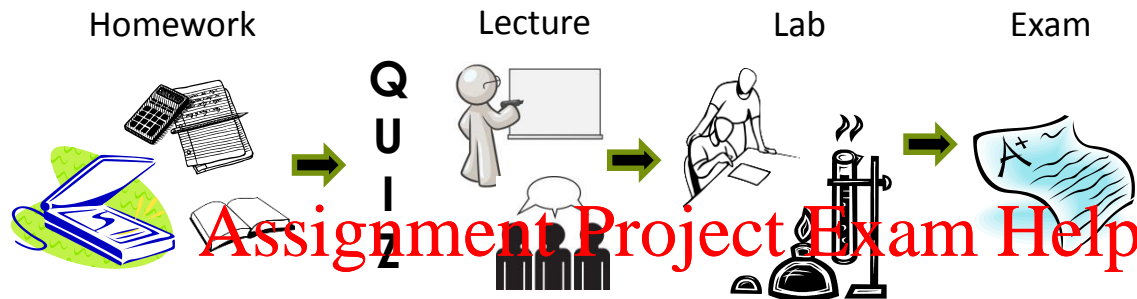
- This class is designed a bit differently from what you might normally be used to
  - “Lecture”
  - What YO
- A “clicker” is required for in
  - It’s not optional, using it will be 10% of your grade
  - In this class, your “clicker” will be the YACRS system
- So, lecture will be different
  - Ever thought about why we have “lecture”?

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# Peer Instruction-Based Design



First Exposure:  
With resources and  
Feedback

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Knowledge  
Mastery

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- Greater opportunity for feedback
- Research on how people learn:
  - Everyone constructs their own understanding
    - We can't dump understanding into your brain
  - To learn YOU must actively work with a problem and construct your own understanding of it

# Peer Instruction

- Are you prepared? (quick quiz at beginning of class, using YACRS)
- Pose carefully designed question
  - Solo vote: Think independently
  - Discuss: Analyze and debate (mentally)
    - Practice analyzing, talking about concepts
    - Reach consensus
    - If you have questions, raise your hand
- Group vote: Everyone in group votes
- Class wide discussion:
  - Led by YOU (students) – tell us what you talked about in discussion that everyone should know!

# Q1.1: Animal preference

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# Q1.1: Animal preference

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I am a:

- A: Cat P <https://eduassistpro.github.io/>
- B: Dog Person [Add WeChat edu\\_assist\\_pro](#)
- C: I don't like cats or dogs



# Q1.1: Animal preference (solution)

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I am a:

- A: Cat Person <https://eduassistpro.github.io/>
- B: Dog Person **Add WeChat** [edu\\_assist\\_pro](#) *fer dogs!*
- C: I don't like cats nor dogs

# PI 1.1 Software aspects [group vote]

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- <https://cl>

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## PI 1.1: Software aspects [solo vote]

Consider on your own, which aspect of quality is most important in developing a software system for handling medical records

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- ☐ A. Easy of use
- ☐ B. Modularity
- ☐ C. Modifiability
- ☐ D. Efficient
- ☐ E. Correct
- ☐ F. Maintainability
- ☐ G. Understandability
- ☐ H. Reusable
- ☐ I. Portable

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## PI 1.2: Software aspects [group vote]

Consider in groups of 3-4 next to you, which aspect of quality is most important in developing a software system for handling me

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- ☐ A. Easy of use
- ☐ B. Modularity
- ☐ C. Modifiability
- ☐ D. Efficient
- ☐ E. Correct
- ☐ F. Maintainability
- ☐ G. Understandability
- ☐ H. Reusable
- ☐ I. Portable

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# PI 1.1-2: Team Challenge (solution)

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What did you discuss? Anything missing?

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# Assignment 1

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- Modelling and Design using UML (10% of your total grade)

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- Full details available on M018

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- Due 16/2 2018 at 4:30 on M

# Assignment 2

## Assignment Project Exam Help

- Software testing (incl design for testing) (10% of your total grade)

<https://eduassistpro.github.io/>

- Full details available on M 18

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- Due 16/3 2018 at 4:30 PM o

# Academic Honesty

- The School has clear policies for academic honesty, if you've for <https://eduassistpro.github.io/>
- This course depends on discussion and creativity, so collaboration and encouragement must be completed individually
- It is your responsibility to be familiar with the policy, but if you are unsure email me



# Marking

- All marking schemes will be provided when assignments are announced.
- No remarking is allowed except in cases of administrative error.

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# How to Pass this Class

- Do the readings before coming to the lectures (and perhaps watch lectures on videos)
- Attend the <https://eduassistpro.github.io/> (active)
- Attend the labs Add WeChat edu\_assist\_pro
- Work Hard
- Ask questions

**You are very unlikely to pass this course by reading the slides alone !**

Questions?

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Concer

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Break (~10 min)

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Software Engineering cont.

# A Generic Software Project

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- ▣ Requirements Gathering & Specification
- ▣ Design <https://eduassistpro.github.io/>
- ▣ Construction/implementation (programming)
- ▣ Quality Assurance (i.e. Add WeChat edu\_assist\_pro)
- ▣ Deployment
- ▣ Maintenance & Support

- ▣ Project Management (planning, resource allocation, development process, risk estimation/mitigation, cost estimation etc)

# Common Activities During Software Projects

- Requirements Specification
    - Domain
    - Defining
    - Requirements Gathering
    - Requirements Analysis
    - Requirements Specification
  - Covered in Software Project Management course (?)
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# Common Activities During Software Projects

- Design
  - How should the system be decomposed into subsystems?
  - How should the subsystems be integrated?
  - How should users interact with the system?
  - How should the underlying data be organised and stored?

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# Common Activities During Software Projects

- Modeling
    - Use case
    - Structural
    - Dynamic and behavioural
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# Common Activities During Software Projects

- Programming
  - What are high level designs?  
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  - Project management: How should projects be organized and managed to successfully complete software?  
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# Common Activities During Software Projects

- Quality Assurance
  - Design (
  - Reviews
  - Testing
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# Common Activities During Software Projects

- Deployment, Maintenance & Support
  - Release
  - User doc
  - Customer support
  - Updates

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# Common Activities During Software Projects

- Management
  - Resource
  - Cost esti
  - Development models
  - Risk estimation
  - Customer relations
  - ... etc

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Requirements

# PI 1.3-4: Review requirements

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- Go to YA

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## PI 1.3: Stakeholders [solo vote]

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All software engineering projects will have stakeholders. The different stakeholders in a software engineering project will:

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- A – all participate in the development of the software
- B – have different priorities and needs for the software
- C – be interested in the development of the software
- D – carry stakes to destroy the software



# PI 1.3: Stakeholders (solution)

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Stakeholders often have different and sometimes competing interests and priorities. Consider how the following stakeholders affect the development of a software system:

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- Users
- Customers
- Developers
- Managers

## PI 1.4 – Requirements [group vote]

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The requirements stage is used to understand the customers needs. The requirements must primarily describe:

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- A: The cost of the system
- B: What the system will do
- C: How the system will be implemented
- D: Who will develop the system

# PI 1.4 Requirements (solution)

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- The requirements specification must describe what the system will do and only be included if it is unavailable elsewhere.

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- i.e. **B: What the system will do**

# Requirement Specification

- It is a statement describing either
  - 1) an aspect of the system that the system must do,
  - or 2) a constraint on the system development.
  - In either case it must contribute in some way towards adequately solving the problem;
  - the set of requirements as a whole represents a negotiated agreement among the stakeholders.
- A collection of requirements is a *requirements document*.

# Types of requirements

- Functional requirements
  - Describe
- Quality req
  - Constraints on the design of levels of quality
- Platform requirements
  - Constraints on the environment and technology of the system
- Process requirements
  - Constraints on the project plan and development methods

# Use cases (& scenarios)

- A use case is a typical sequence of actions that a user performs in task
- The object of the use case is to model the system from the point of view of the user.
  - ... how users interact with the system
  - ... when trying to achieve their goals.It is one of the key activities in requirements analysis
- A use case model consists of
  - a set of use cases
  - an optional description or diagram indicating how they are related

# Use case description

- A. **Name/id:** Give a short, descriptive name to the use case.
- B. **Actors:** List all actors involved in this use case.
- C. **Goals:** Explain what the actors are trying to achieve.
- D. **Preconditions:** State of the system before the use case.
- E. **Summary:** Give a short informal description.
- F. **Related** use cases.
- G. **Steps:** Describe each step using a 2-column format.
- H. **Postconditions:** State of the system in following completion.

# Use case diagrams (modelling)

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# Use case diagrams (modelling)

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# Requirement document

1. Problem
2. Background
3. Environment
4. Functional Requirement
5. Non-functional requirements

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# Issues with requirements

- Lack of understanding of the domain or the real problem
  - Do do
- Requirements are often changing
  - Perform regular reviews, build flexibility into the design, do regular review
- Attempting to do too much
  - Document the problem carefully, estimate the time an early stage,
- It may be hard to reconcile conflicting sets of requirements
  - Brainstorming, group sessions, competing prototypes
- It is hard to state requirements precisely
  - Break requirements down into simple sentences and review them carefully, look for potential ambiguity, make early prototypes

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# SE (M) 2017-2018

- The focus of this course is to outline principles for how to take a requirement and come up with a “good” design that can be verified to fulfil the requirements (functional, non-functional)

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<LONG BREAK>

See you at 14:00 in SAS 208

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Bjørn Sand Jensen  
bjorn.jensen@glasgow.ac.uk

## Lecture 1.2 – OO development



- Procedural programming:
  - Software i of procedures
  - Procedur
  - Works
  - Adding data abstractions
    - Groups together the pieces that describe some entity
    - Helps reduce the system's complexity.
      - Such as Records and structures
- Object oriented paradigm:
  - Organizing procedural abstractions in the context of data abstractions

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- An approach to the solution of problems in which all computations are done in terms of objects.

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- The objects are instances
  - are data abstractions
  - contain procedural abstractions that operate on the objects
- A running program can be seen as a collection of objects collaborating to perform a given task

# Core OO concepts

- Core OO principles.
  - Encapsulation
  - Inheritance
  - Polymorphism
- All allows abstraction...but how ?

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# SE is not entirely about programming but...

- We assume you are familiar with the following programming/OO concepts (in Java):
  - Variables and assignments (incl. `static` and `final`, and `static final`)
  - Class (incl. `static`, `final` and `static final`)
  - ... and objects (incl. `final` and `static final`)
  - Method (incl. `priv` and `static final`)
  - Attributes
  - Inheritance (extends) (simple associ)
  - Basic datatypes (Boolean, Integer, St
- We will need a few more concepts to do “good” design:
  - Nested classes
  - Abstract classes
  - Interfaces
- We will not rely on Java Generics (albeit useful) and we will not worry (to much) about concurrency

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# Classes and objects

- Object
  - A chunk of software system
  - Has *properties*
    - Represent its state
  - Has *behaviour*
    - How it acts and reacts
    - May simulate the behaviour of an object in the real world

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# Classes and objects

- A class.
  - A unit of nted (OO) program
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  - Represents similar objects
    - Its *instances*
- A kind of software module
  - Describes its instances' structure (properties)
  - Contains *methods* to implement their behaviour

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# PI 1.5: Objects and Java

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# PI 1.5 - Objects and Java

In this code, bob is a:

- A: Class
- B: Object
- C: Variable
- D: Abstraction

```
public class Bunny {
```

```
    private String name;  
    private int weight;
```

```
        name, int weight) {
```

```
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```

```
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    }
```

```
Bunny bob = new Bunny("bob", 12);
```

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# PI 1.5 - Objects and Java (sol.)

In this code, bob is a:

- A: Class
- B: Object
- C: Variable
- D: Abstraction

```

                                Class
public class Bunny {
    private String name;
    private int weight;
                                Instance Variables
                                name, int weight) {
}

Bunny bob = new Bunny("bob", 12);
    Variable           Object

```

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# Methods

- Method
  - A process of a class that implements the behaviour
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  - Several different classes can have methods with the same name
    - They implement the same abstract operation in ways suitable to each class
    - E.g. calculating area in a rectangle is done differently from in a circle

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# Polymorphism

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- A property of object oriented software by which an abstract operation is performed in different ways in different classes
  - Requires that there be multiple methods of the same name
  - The choice of which one is performed depends on the object that is in a variable
  - Reduces the need for programmers to code many if-else or switch statements

# Inheritance Hierarchies

- Superclasses
  - Contain features and subclasses
- Inheritance Hierarchies
  - Show the relationships among classes and subclasses
  - A triangle shows a *generalization*
- Inheritance
  - The *implicit* possession by all subclasses of features defined in its superclasses

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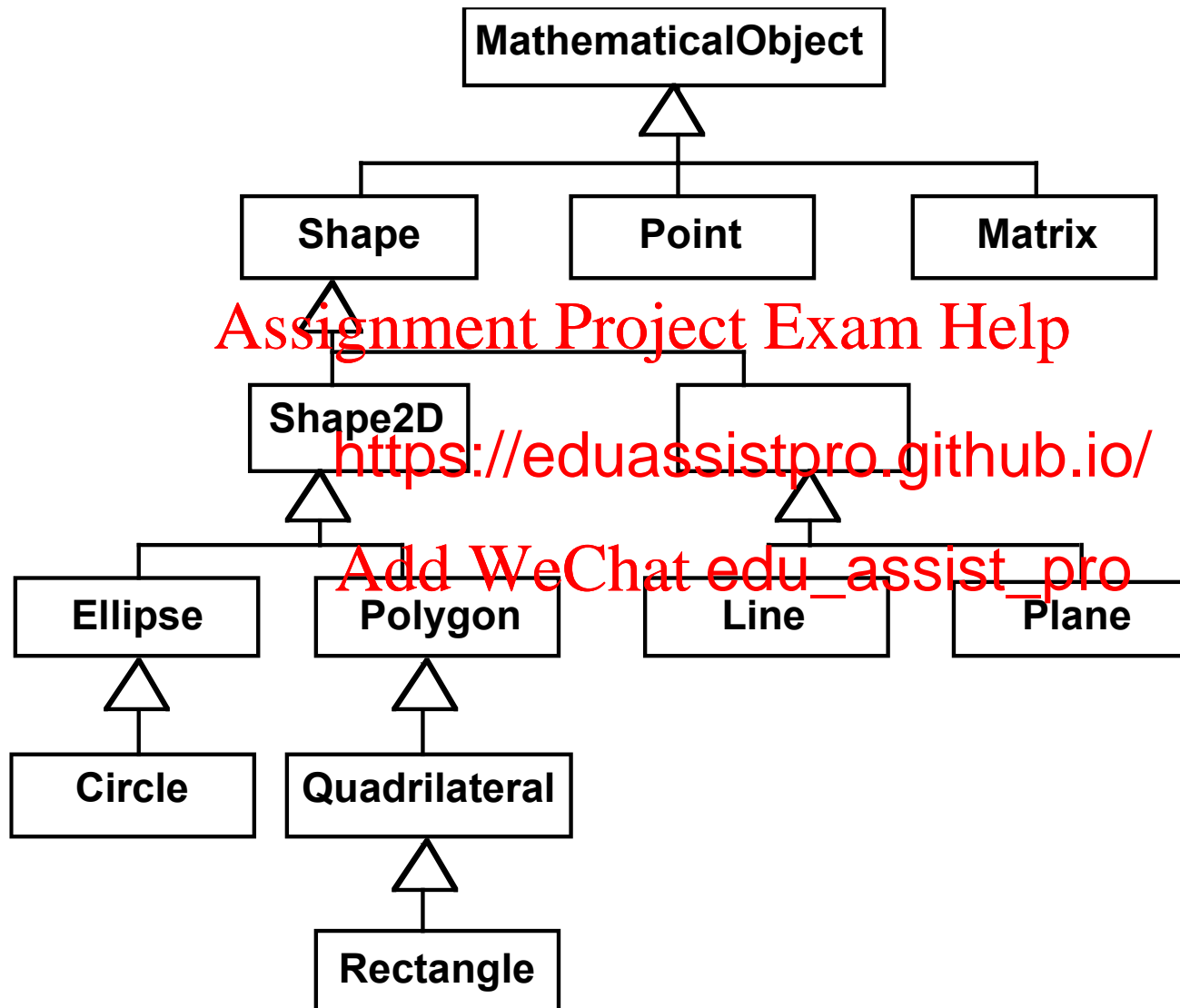
## ▣ Inheritance

- ▣ The *implicit* possession by all subclasses of features defined in its superclasses

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# Abstract Classes (and methods)

- Use when you don't want the class type to be able to be instantiated
- Declare method as abstract in the abstract class. Any class inheriting type must override the method.
- Abstract classes can give inherited functionality with non-abstract methods

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# Example: Fruit

```
public abstract class Fruit {  
  
    public abstract boolean isEdible();  
    public void takeABite() {  
  
        if (this  
            System.out.print          it.");  
        }  
  
        else {  
  
            System.out.println("You are about to be sick.");  
  
        }  
  
    }  
  
}
```

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# Interface

- Like abstract classes, but cannot have executable statements
  - Define a <https://eduassistpro.github.io/> in general possibly unrelated
- A class can implement any number of interfaces
  - It must have concrete methods for the operations
- You can declare the type of a variable to be an interface
  - This is just like declaring the type to be an abstract class
- Important interfaces in Java's library include
  - Runnable, Collection, Iterator, Comparable, Cloneable

# Overriding

- A method would be inherited, but a subclass contains a new version i
- For restriction
  - E.g. `scale(x,y)` would `circle`
- For extension
  - E.g. `SavingsAccount` might charge an extra fee following every debit
- For optimization
  - E.g. The `getPerimeterLength` method in `Circle` is much simpler than the one in `Ellipse`

# PI 1.7: OO

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- <https://eduassistpro.github.io/>

- Join Session 1127

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# PI 1.7: OO

*This code could be refactored to better utilise object orientation. How would you change this code to make it more efficient?*

A: Create an Abstract UIElement with an abstract method draw

B: Create a Class UIElement with a method draw

C: Create an Interface drawable with a method Draw

D: Create an Interface with methods for draw, getX, and getY

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```
public class Button {
    int x;
    int y;
    String text;
    public int getX() {
        return this.x;
    }
    public int getY() {
        return this.y;
    }
    public void draw() {
        // Do some swing
    }
}

Radio {
    String text;
    public int getX() {
        return this.x;
    }
    public int getY() {
        return this.y;
    }
    public void draw() {
        // Do some swing
    }
}
```

# PI 1.7: OO (solution)

*This code could be refactored to better utilise object orientation. How would you change this code to make it more efficient?*

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A: **Create an Abstract UIElement with an abstract method draw**

<https://eduassistpro.github.io/> how the “is-a” rule, a radio element

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B: Create a Class UIElement with a method draw

← I don't want a generic UIElement to be able to be instantiated

C: **Create an Interface drawable with a method Draw**

← These elements could all be clustered as “drawable” things

D: Create an Interface with methods for draw, getX, and getY

← It is context dependent if this is useful. It implies that all drawable has x and y coordinates which is not a very useful abstraction. Could be interpreted as implementing the actual methods which is not allowed on interfaces (clearly wrong in that case).



# Access

- Applies to methods and variables

- `public`

- Any class

- `protected`

- Only code in the package

- (blank)

- Only code in the package can access

- `private`

- Only code written in the class can access

- Inheritance still occurs!

- See e.g.

- <https://docs.oracle.com/javase/tutorial/java/land/subclasses.html>

# Basic documentation

- Comment extensively
  - Comment
  - Do not c
  - Comments should be 25-5
- Organize class elements consistently
  - Variables, constructors, public methods then private methods
- Be consistent regarding layout of code

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# Main idea: Coupling and Cohesion

- Cohesion
  - How related the elements are (within a class)
- Coupling
  - How dependent classes are on each other (between classes)
- Design principle: **increase cohesion** and **decrease coupling**

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# Wrap up (Week 1)

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- Reading: Chapters 1 and 2 (should be familiar, but material will be new)
- Requirements is needed before we can start designing our system (they may change) Chapter 4.
- OO approach allows abstraction
- Encapsulation, Inheritance/composition and polymorphism are core concepts of OO-based design and development.

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# Preparation for Next Week

## Assignment Project Exam Help

- We'll be c <https://eduassistpro.github.io/>
- Read OOSE Chapter 5 **Add WeChat edu\_assist\_pro**
- Assessed Quiz (starting **precisely** at 10:05) will be on **UML syntax**

Questions?

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