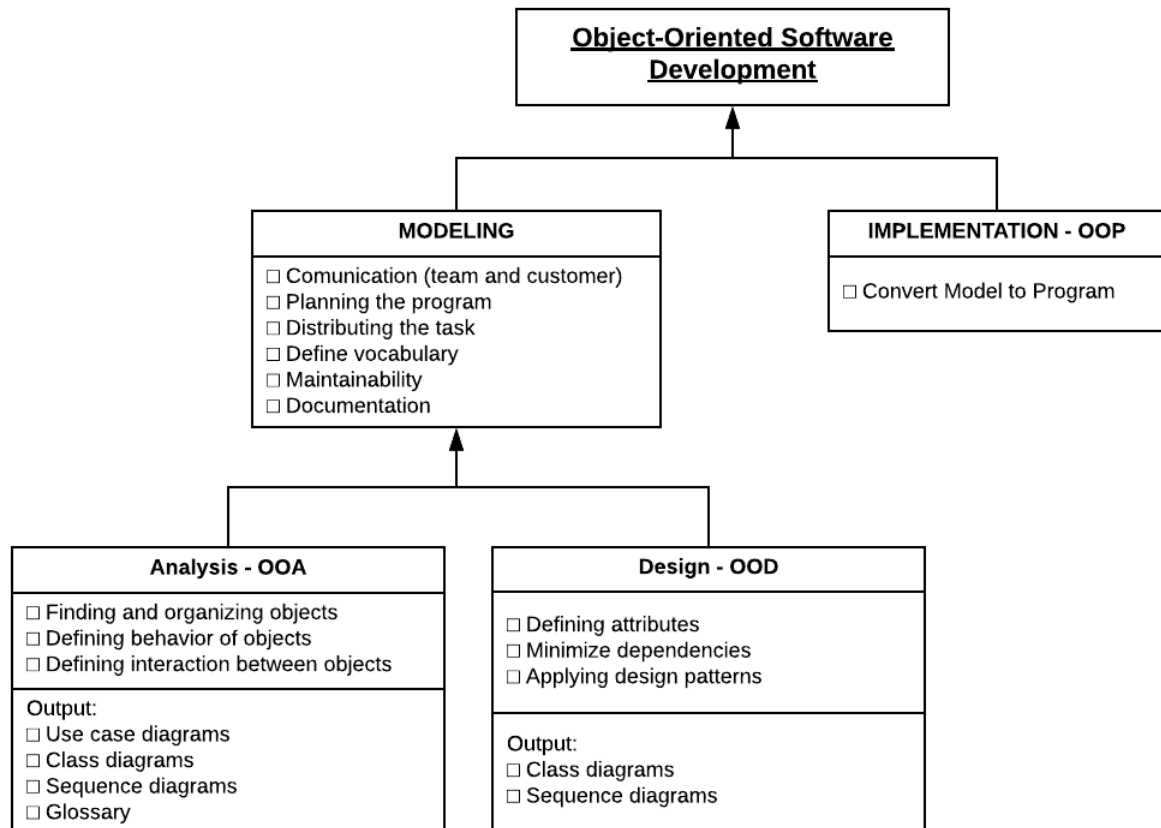
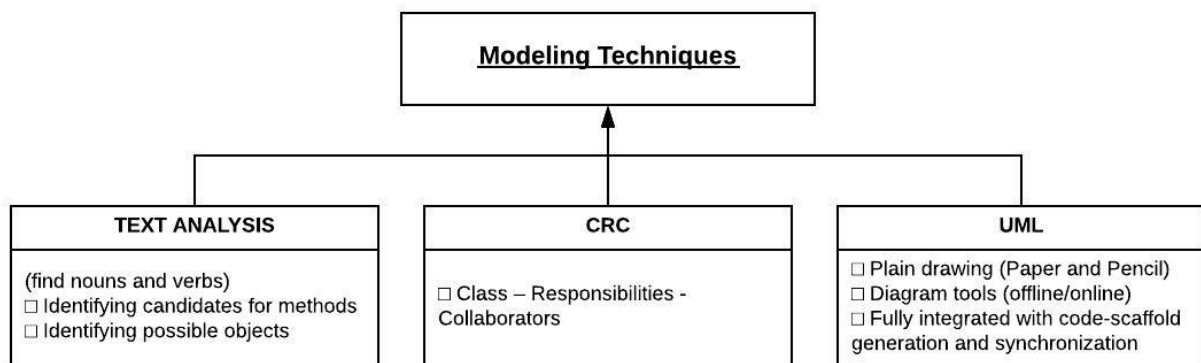


Summary Week 4

Object-Oriented Software Development



Modeling Techniques



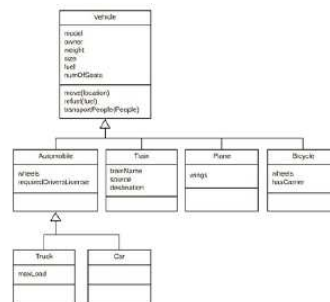
CRC Cards

| CLASS | |
|----------------|---------------|
| Responsibility | Collaborators |
| | |

UML Diagrams (Unified Modeling Language)

■ Structure

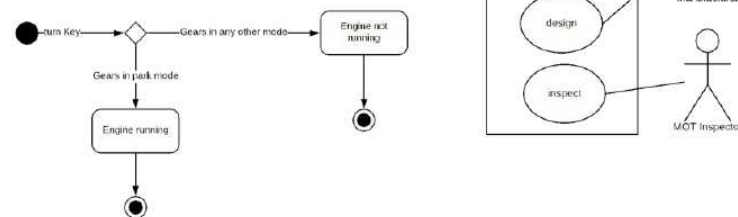
□ Class diagram



■ Behavior

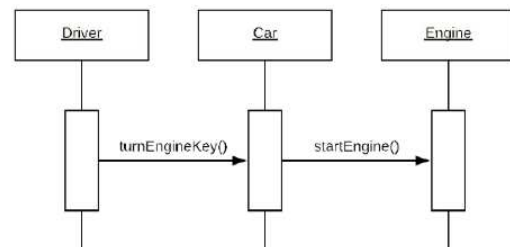
□ Use case diagram

□ State diagram



■ Interaction

□ Sequence diagram



UML Tools

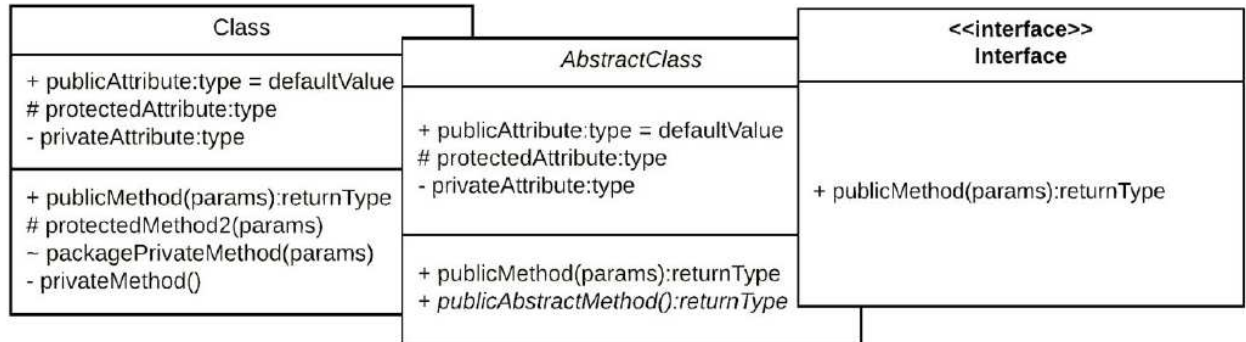
■ Offline

- Dia, yED (open source)
- ArgoUML (open source)
- Umbrello (open source)
- Many more (commercial and open source)

■ Online

- draw.io
- lucidchart.com
- gliffy.com
- creately.com
- Many more

(Abstract) Classes, Interfaces



Relationships – Types, Multiplicity

Class level

Inheritance

Implementation



Instance level

Association

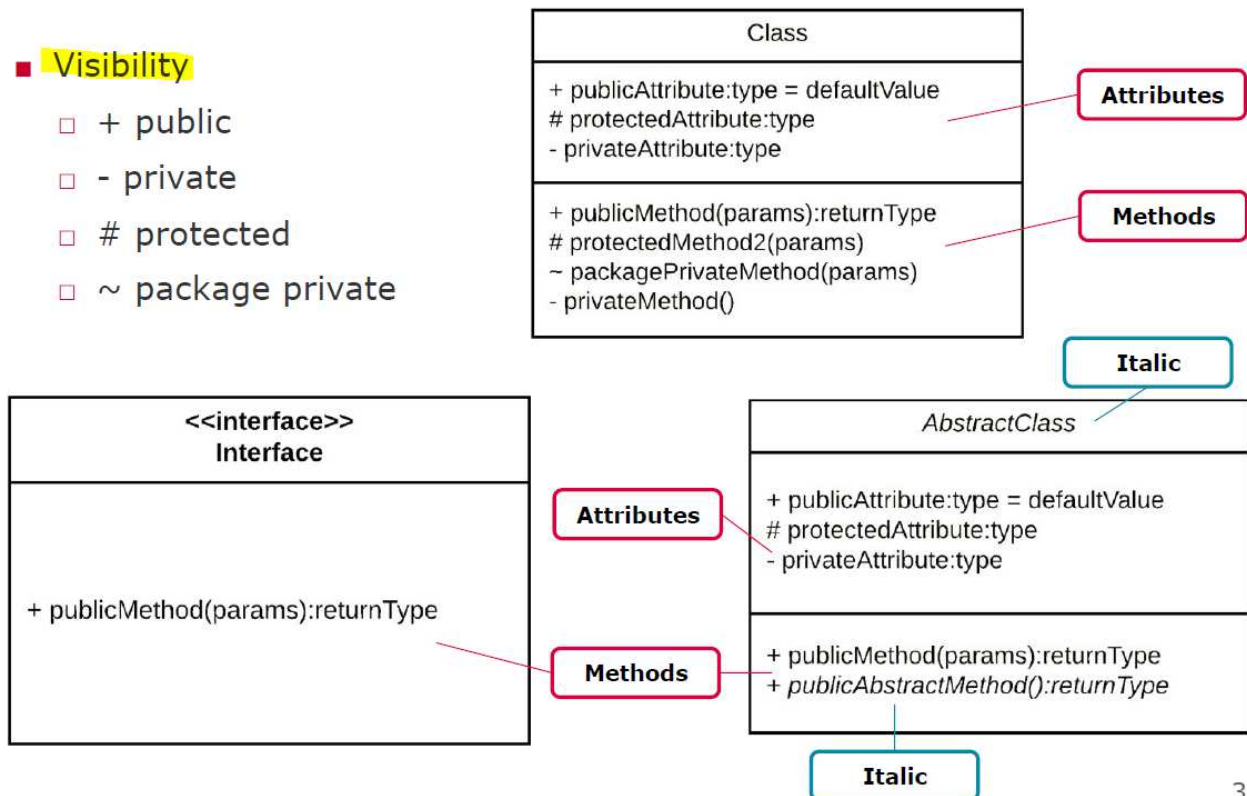
Aggregation

Composition

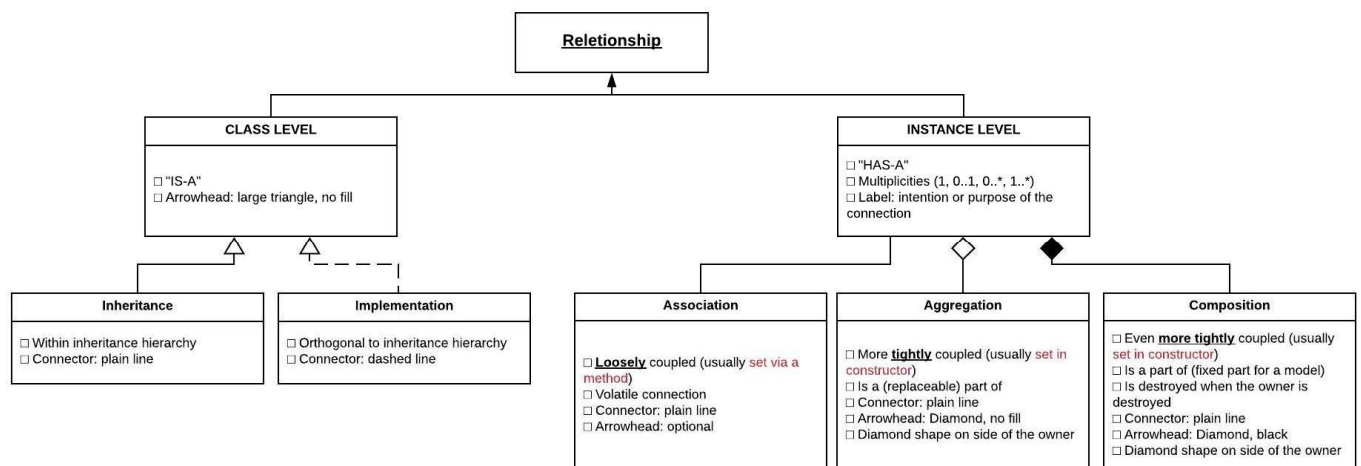


Visibility

- + public
- - private
- # protected
- ~ package private

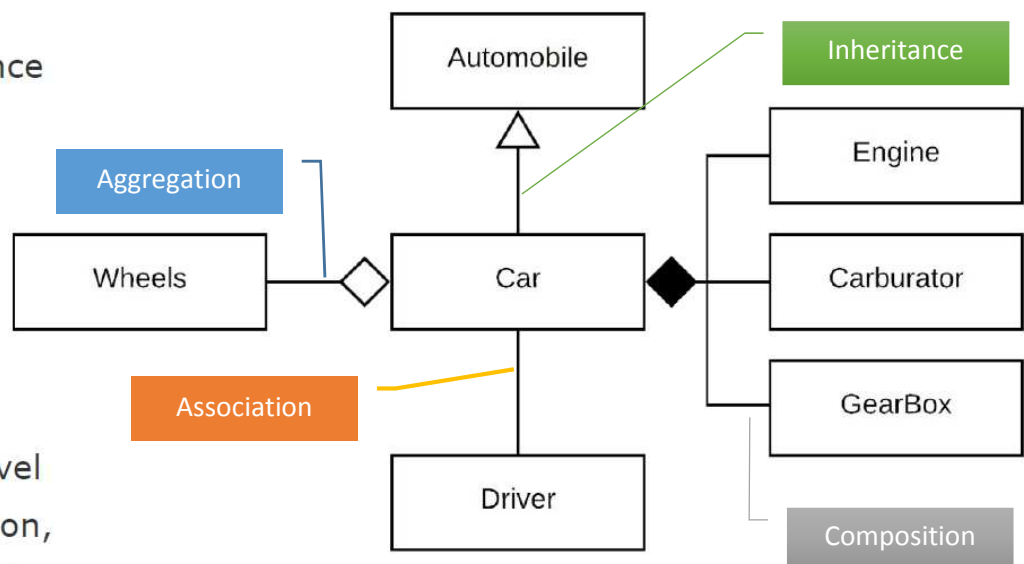


Relationships



■ Class level

□ Inheritance



■ Instance level

□ Association,

□ Aggregation,

□ Composition

Class Level

Class Level:

- Inheritance
- Implementation

□ "IS-A"

- Arrowhead: large triangle, no fill

Inheritance

- Within inheritance hierarchy
- Connector: plain line

Implementation

- Orthogonal to inheritance hierarchy
- Connector: dashed line

Instance Level

Instance Level:

- Association
- Aggregation
- Composition

- "HAS-A"
- Multiplicities (1, 0..1, 0..*, 1..*)
- Label: intention or purpose of the connection

Multiplicities define → the number of instances of each class in a relation in a generalized format (e.g. 1 car has many(*) wheels).

Association

- **Loosely** coupled (usually **set via a method**)
- Volatile connection
- Connector: plain line
- Arrowhead: optional

Aggregation

- More **tightly** coupled (usually **set in constructor**)
- Is a (replaceable) part of
- Connector: plain line
- Arrowhead: Diamond, no fill

- Diamond shape on side of the owner

Composition

- Even **more tightly** coupled (usually **set in constructor**)
- Is a part of (fixed part for a model)
- Is destroyed when the owner is destroyed
- Connector: plain line
- Arrowhead: Diamond, black
- Diamond shape on side of the owner