SE 323 - Software Construction Testing and Maintenance

MODULE ONE
SOFTWARE CONSTRUCTION

CHAPTER THREE
IMPLEMENTING SOFTWARE CONSTRUCTION
PART ONE

SOFTWARE CONSTRUCTION PROCESS AND ACTIVITIES

Module 1
Software Construction

OUTLINE

1. ~~*Overview of Software Construction*~~
2. ~~*Planning/Preparing for Software Construction*~~
3. *Doing Software Construction*
4. ~~*Documenting Software Construction*~~
5. ~~*Measuring/Monitoring Software Construction*~~

Construction Practices -Implementation

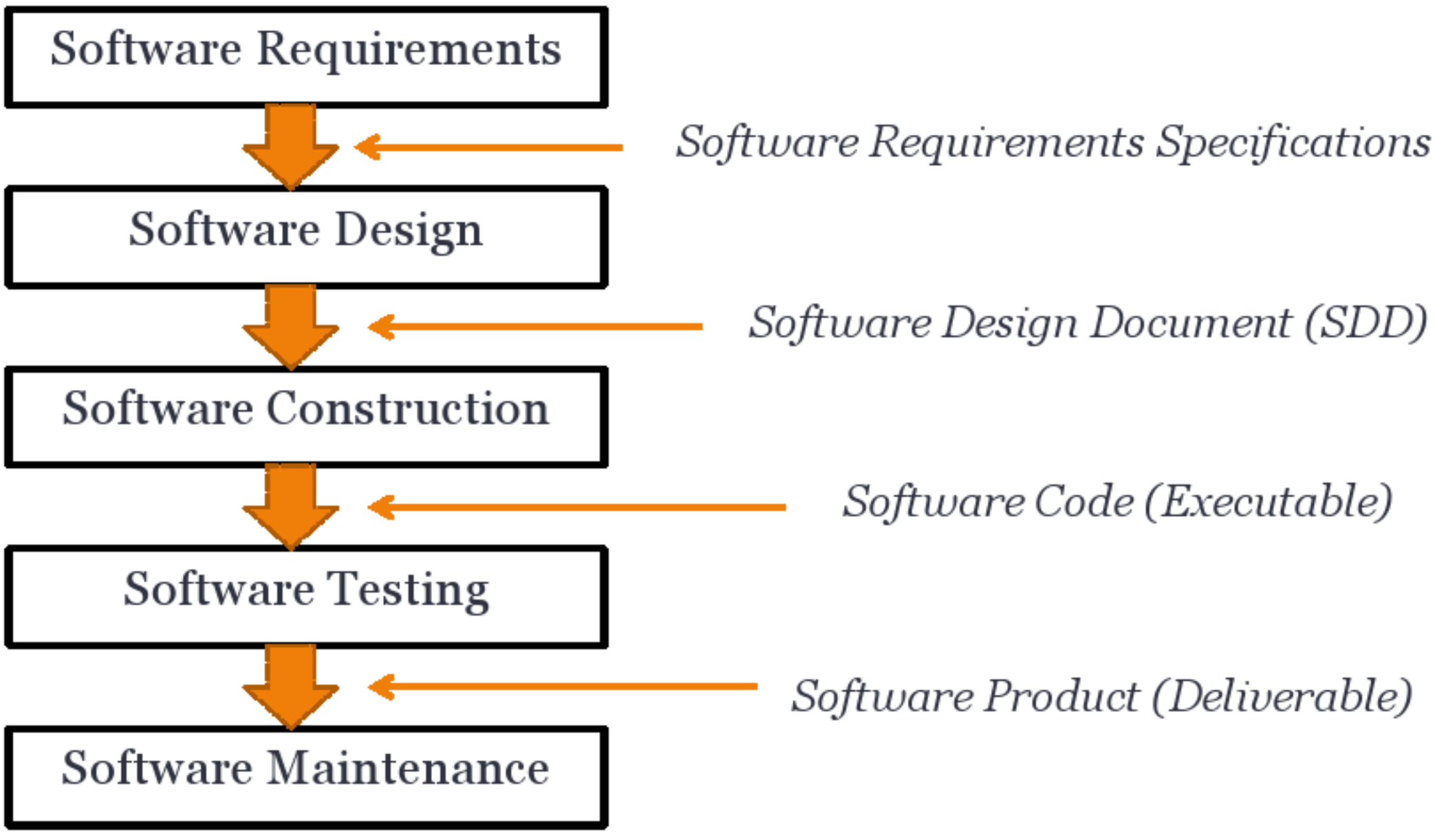
Module 1
Software Construction

OUTLINE

1. ~~*Overview of Software Construction*~~
2. ~~*Planning/Preparing for Software Construction*~~
3. *Doing Software Construction*
   - 3.1 *Software Construction Process & Activities*
   - 3.2 *Software Construction Guidelines & Practices*
4. ~~*Documenting Software Construction*~~
5. ~~*Measuring/Monitoring Software Construction*~~

Construction Practices -Implementation

3.1 Construction Practices -Process & Activities



SC Planning – SDLC – Design

Design Document - SDD (ref: IEEE 1016-1998)

1. Introduction
- 1.1 Purpose
- 1.2 Scope
- 1.3 Definitions, acronyms, and abbreviations

2. References

3. Decomposition Description
- 3.1 Module decomposition
  - 3.1.1 Module 1 description
  - 3.1.2 Module 2 description
- 3.2 Concurrent process decomposition
  - 3.2.1 Process 1 description
  - 3.2.2 Process 2 description
- 3.3 Data decomposition
  - 3.3.1 Data entry 1 description
  - 3.3.2 Data entry 2 description

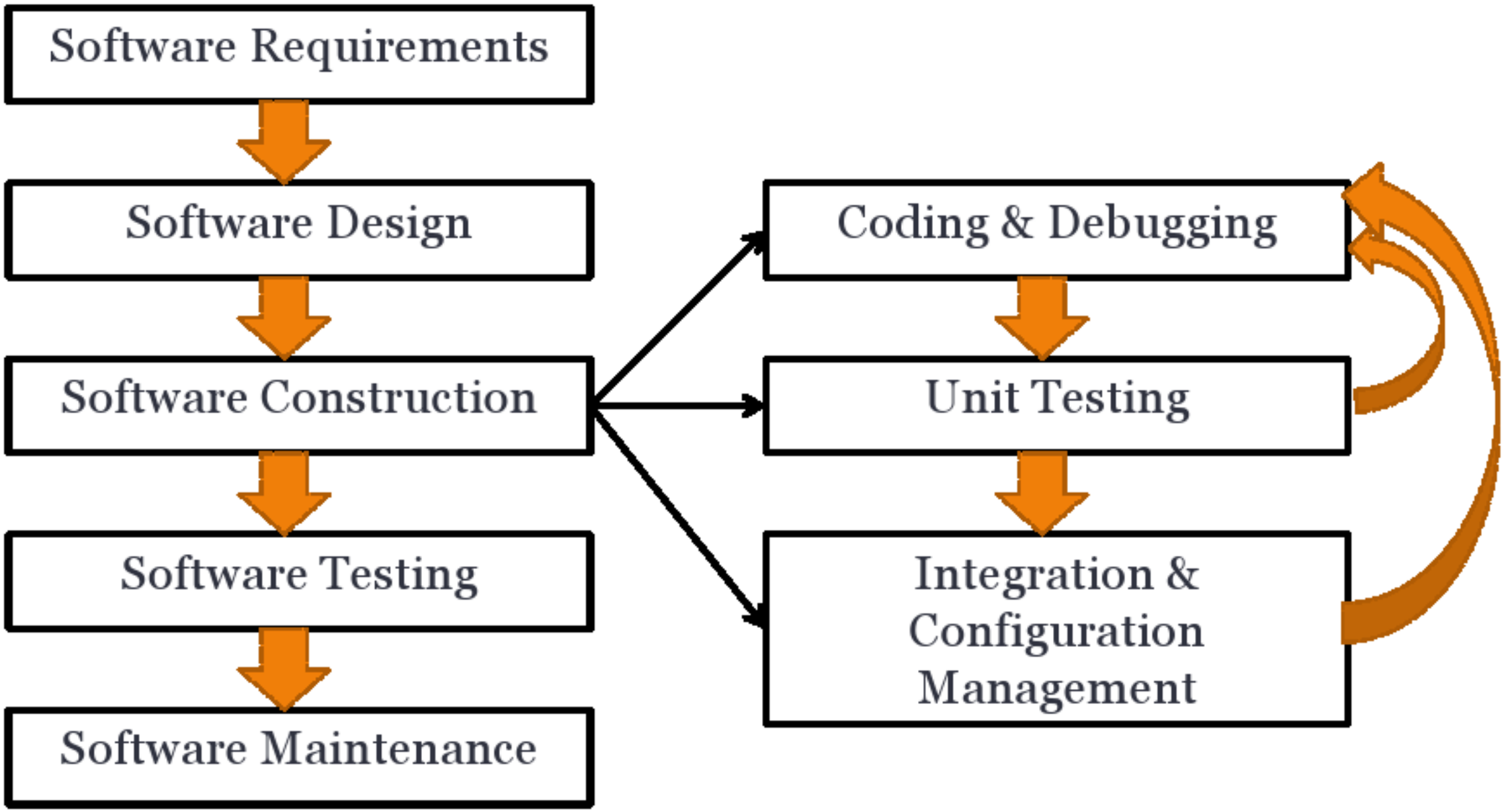
4. Dependency description
- 4.1 Intermodule dependencies
- 4.2 Interprocess dependencies
- 4.3 Data dependencies

5. Interface Description
- 5.1 Module interface
  - 5.1.1 Module 1 description
  - 5.1.2 Module 2 description
- 5.2 Process interface
  - 5.2.1 Process 1 description
  - 5.2.2 Process 2 description

6. Detailed Design
- 6.1 Module detailed design
  - 6.1.1 Module 1 detail
  - 6.1.2 Module 2 detail
- 6.2 Data detailed design
  - 6.2.1 Data entry 1 detail
  - 6.2.2 Data entry 2 detail

Construction Practices -Implementation

3.1 Construction Practices -Process & Activities



Construction Practices -Activities

3.1 Construction Practices -Process & Activities

3.1.1 Coding & Unit Testing

~~3.1.2 Integration & Integration Test~~

~~3.1.3 Configuration Management~~

3.1.1 Software Construction Activities – Integration

Software Programming

- Coding (Programming)

  Design Specs (Document) → Software Code (Program)
  Design Elements → Program/Software Modules

- Integration

  Program/Software Modules → Integrated Software/System

3.1.1 Software Construction Activities - Coding

Software Programming

- Coding Activities
  - Based on SDD*, translating the design specification into the program ***source code***
    - Based on HLD*, implementing the program ***overall structure and interfaces***
    - Based on LLD*, constructing the program ***modules*** which correspond to the specified ***design elements***
  - Compiling, debugging and ***unit testing*** the coded modules

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* *SDD: Software Design Document; HLD: High Level Design Document; LLD: Low Level Design Document*

3.1.1 Software Construction Activities – Coding

Software Programming

- Coding Example

Implementing OO design elements:

- System Structural Modelling

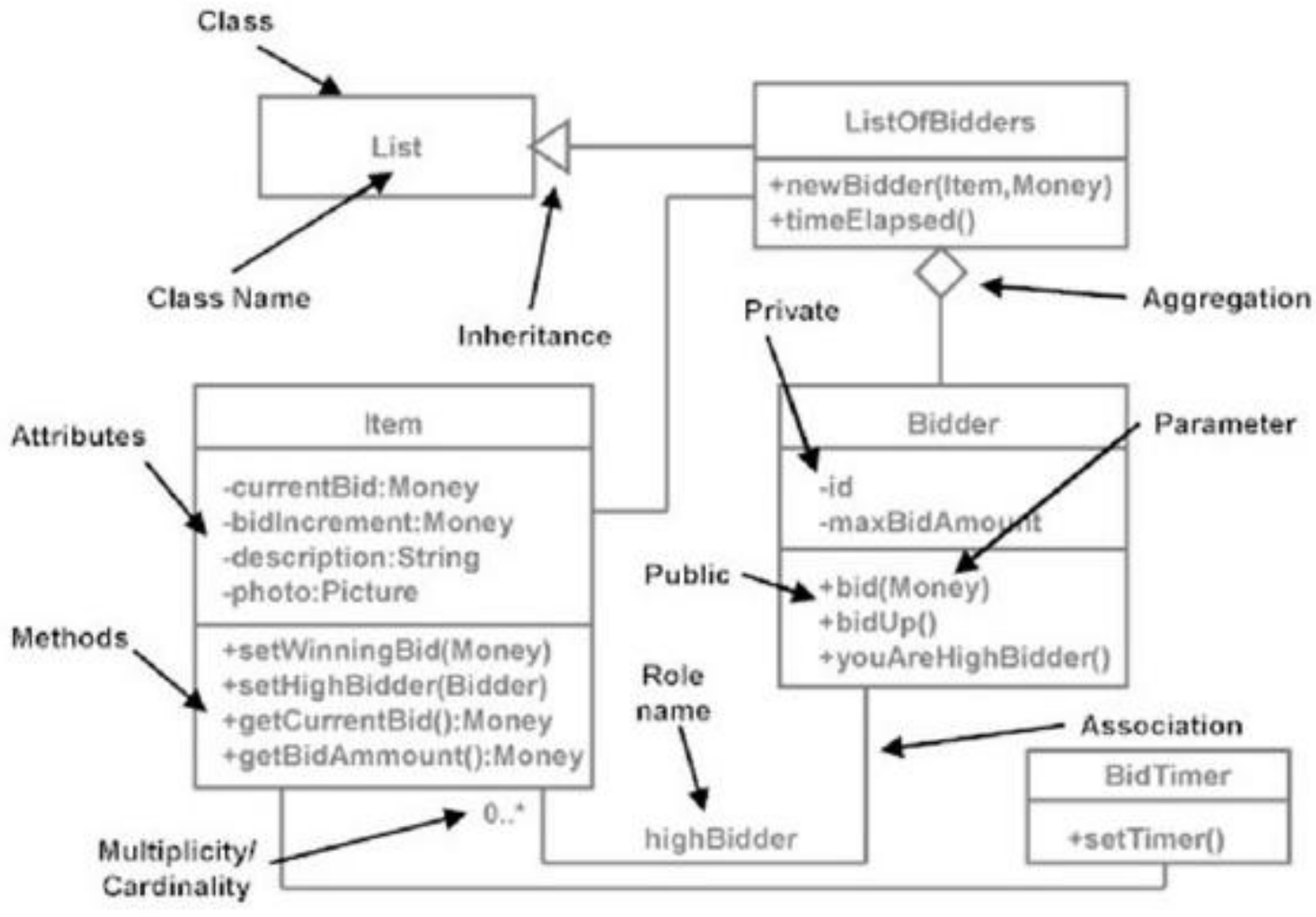
  e.g. UML Class Diagrams
- System Behavioural Modelling

  e.g. UML Sequence Diagrams

Construction Practices - Coding

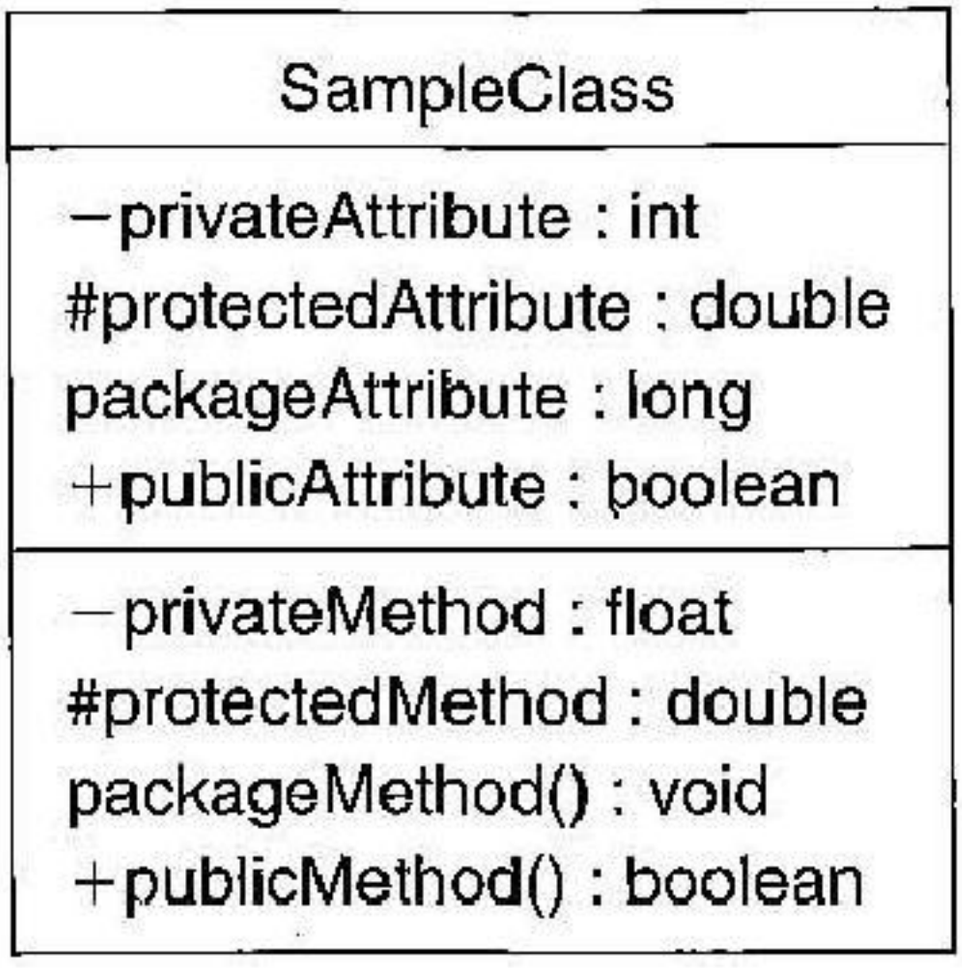
3.1.1 Software Construction Activities - Coding

- Coding Example – UML Class Diagram



Construction Practices -Coding

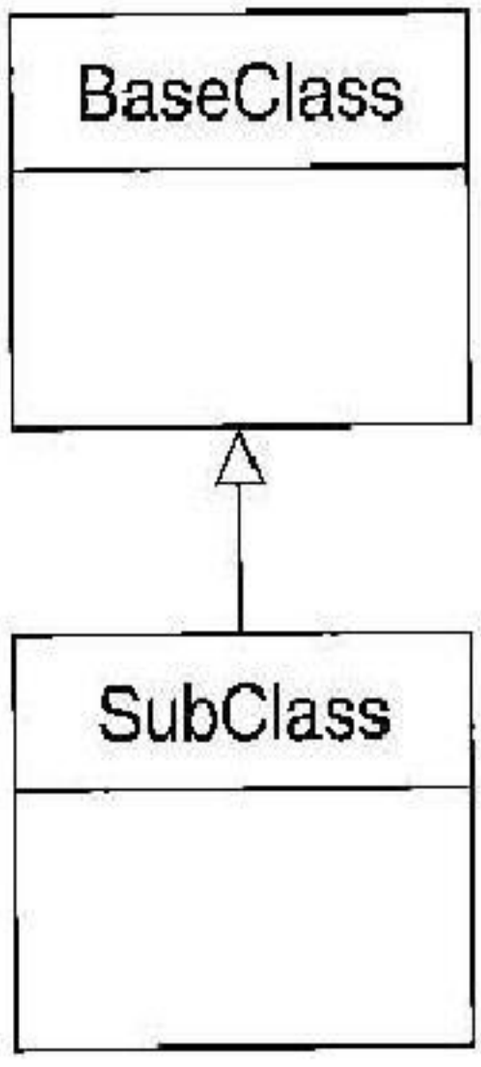
Coding Example: UML class diagram




```
class SampleClass {
    private int privateAttribute;
    protected double protectedAttribute;
    long packageAttribute;
    public boolean publicAttribute;
    public boolean publicMethod(int parameter1) {
        ...
        ...
    }
    private float  privateMethod(byte parameter1, float parameter2) {
        ...
        ...
    }
    protected double protectedMethod() {
        ...
        ...
    }
    void packageMethod(short parameter1) {
        ...
        ...
    }
}   Sample Class
```

Construction Practices -Coding

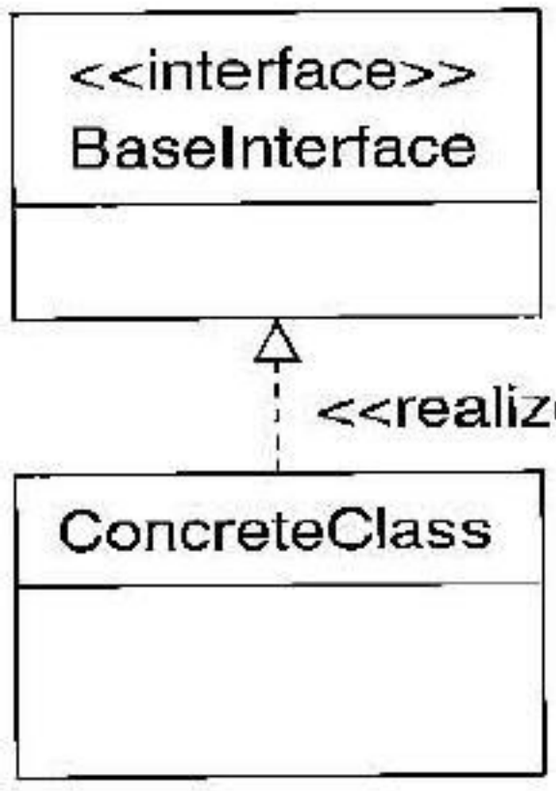
- Coding Example: Inheritance between classes




```
class SubClass extends BaseClass
{
    ...
}
```

Construction Practices -Coding

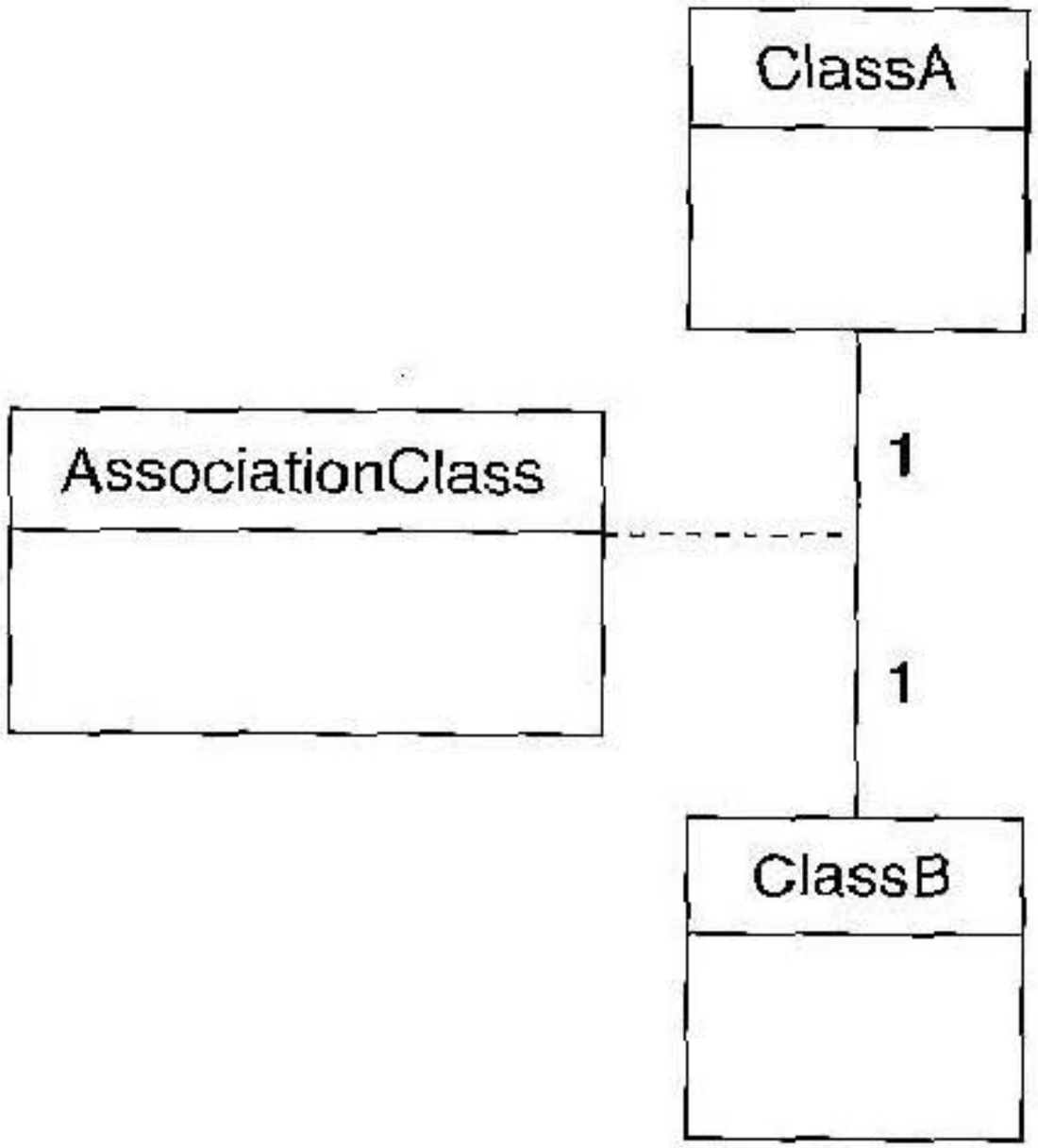
- Coding Example: Inheritance between an interface and a class




```
interface BaseInterface {
    // declaration of methods
    ...
}

class ConcreteClass implements
BaseInterface
{
    // implementation of
    // methods of the
    // interface BaseInterface
    ...
}
```

Construction Practices -Coding

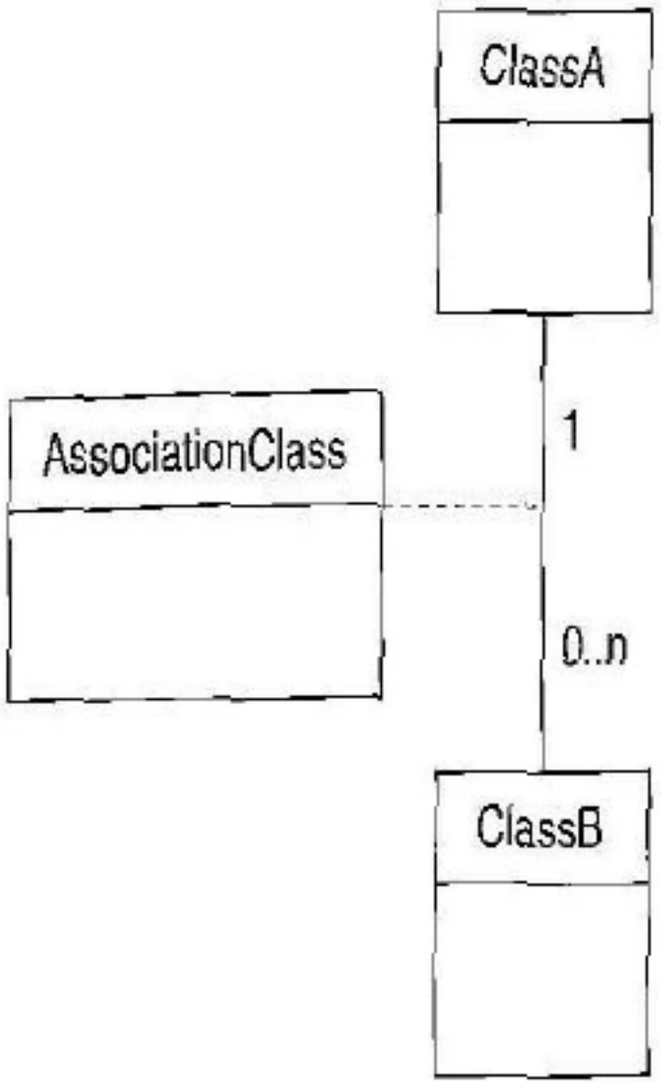
- Coding Example: One-to-one association between classes




```
class ClassA {
    ClassB _b;
    // declare attributes
    // for the
    // association class
    ...
}
class ClassB {
    ClassA _a;
    ...
}
```

Construction Practices -Coding

- Coding Example: One-to-many association between classes

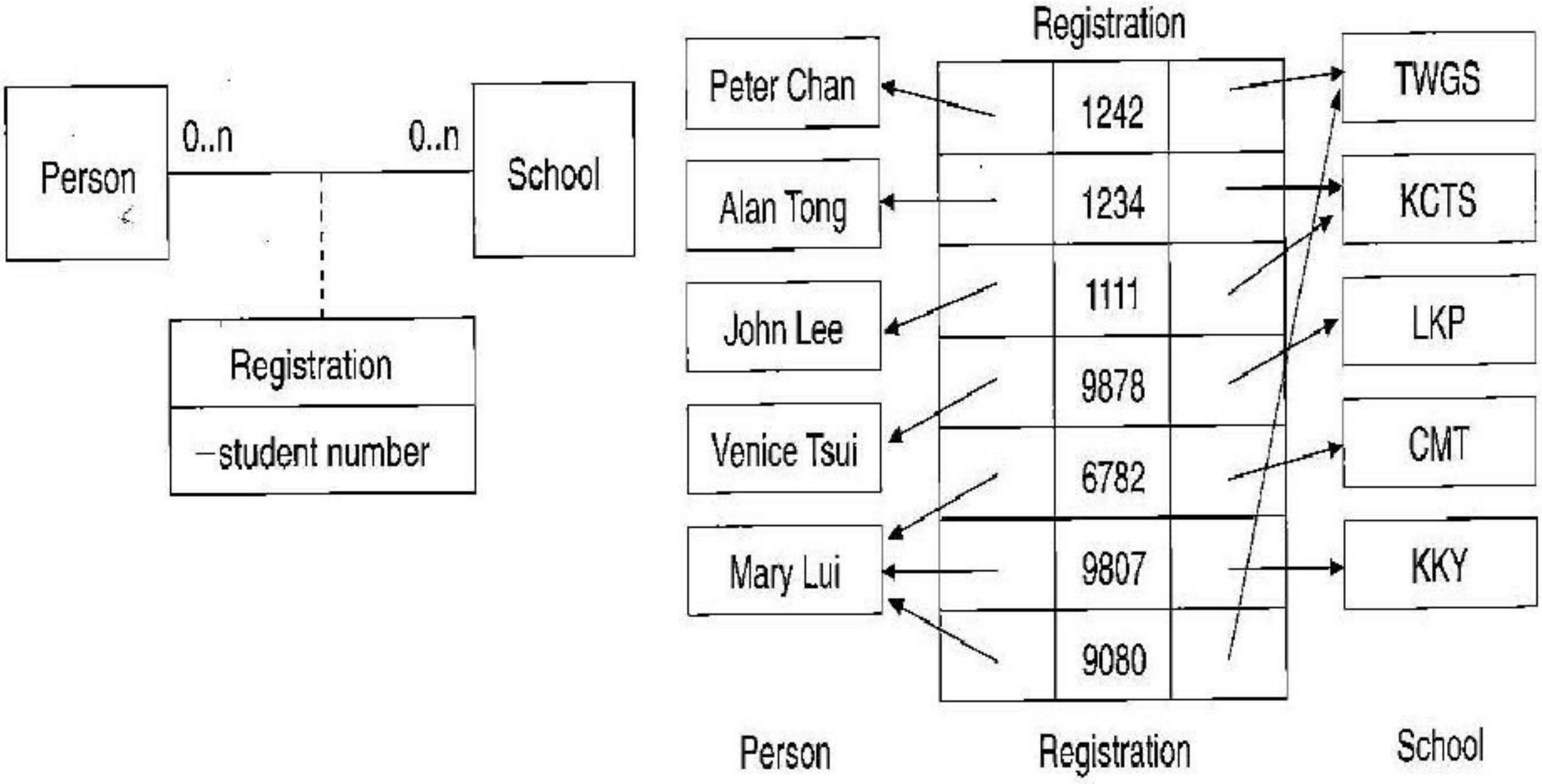



```
class ClassA {
    Vector _b;
    ...
}
class ClassB {
    ClassA _a;
    // declare attributes
    // for association
    // class
}
```

```
import java.util.Vector;
class ClassA {
    Vector _Bs;
    public ClassA() {
        _Bs = new Vector();
        ...
    }
    public Enumeration getBs() {
        return (_Bs.elements() );
    }
    // link a ClassB object to this object
    public void addB(ClassB b) {
        _Bs.add(b);
    }
    // remove the link between ClassB object to this
    // object
    public void removeB(ClassB b) {
        _Bs.remove(b);
    }
    // other functions for searching objects in the
    // vector
    ...
}   // ClassA
```

Construction Practices -Coding

- Coding Example: Many-to-many association between classes



Construction Practices -Coding

- Coding Example: Many-to-many association between classes

```
Class Registration {
    private Person _student;
    private School _school;
    private int _studentNo;

    private Registration(Person student, School school, int studentNo) {
        _school = school;
        _student = student;
        _studentNo = studentNo;
    }

    static public void register(Person student, School school, int studentNo) {
        Registration reg = new Registration(student, school, studentNo);
        school.addRegistration(reg);
        student.addRegistration(reg);
    }

    public void deregister() {
        this._school.removeRegistration(this);
        this._student.removeRegistration(this);
    }

    public School getSchool() {
        return(_school);
    }

    public Person getStudent() {
        return(_student);
    }
} // Registration
```

Construction Practices -Coding

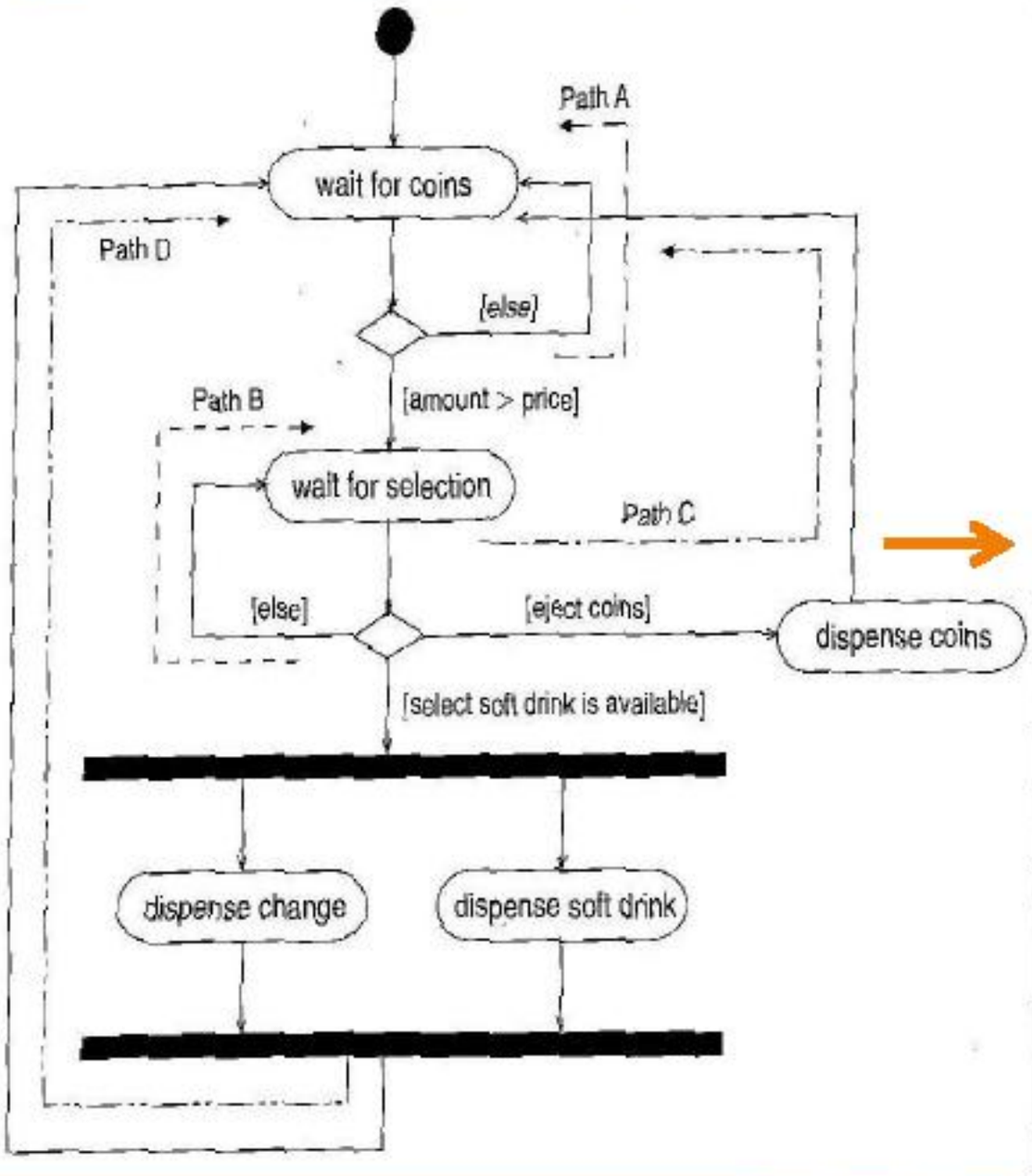
Coding Example: Many-to-many association between classes

```
class School {
    private String _name;
    private Vector _registrations;

    public School(String name) {
        _name = name;
        _registrations = new Vector();
    }

    public void setName(String name) {
        _name = name;
    }

    public String getName() {
        return (_name);
    }

    public void addRegistration(Registration reg) {
        _registrations.add(reg);
    }

    public void removeRegistration(Registration reg) {
        _registrations.remove(reg);
    }

    public Enumeration getStudents() {
        int i;
        Vector students = new Vector();

        for (i = 0; i < _registrations.size(); i++)
            students.add (((Registration)
_registrations.elementAt(i)).getStudent());
        return (students.elements());
    }
}  // School
```

```
class Person {
    private String _name;
    private Vector _registrations;

    public Person (String name) {
        _name = name;
        _registrations = new Vector();
    }

    String getName() {
        return (_name);
    }

    void setName(String name) {
        _name = name;
    }

    public void addRegistration(Registration reg) {
        _registrations.add(reg);
    }

    public void removeRegistration(Registration reg) {
        _registrations.remove(reg);
    }

    public Enumeration getSchools() {
        int i;
        Vector schools = new Vector();

        for (i = 0; i < _registrations.size(); i++)
            schools.add (((Registration)
_registrations.elementAt(i)).getSchool());
        return (schools.elements());
    }
}  // Person
```

Construction Practices -Coding

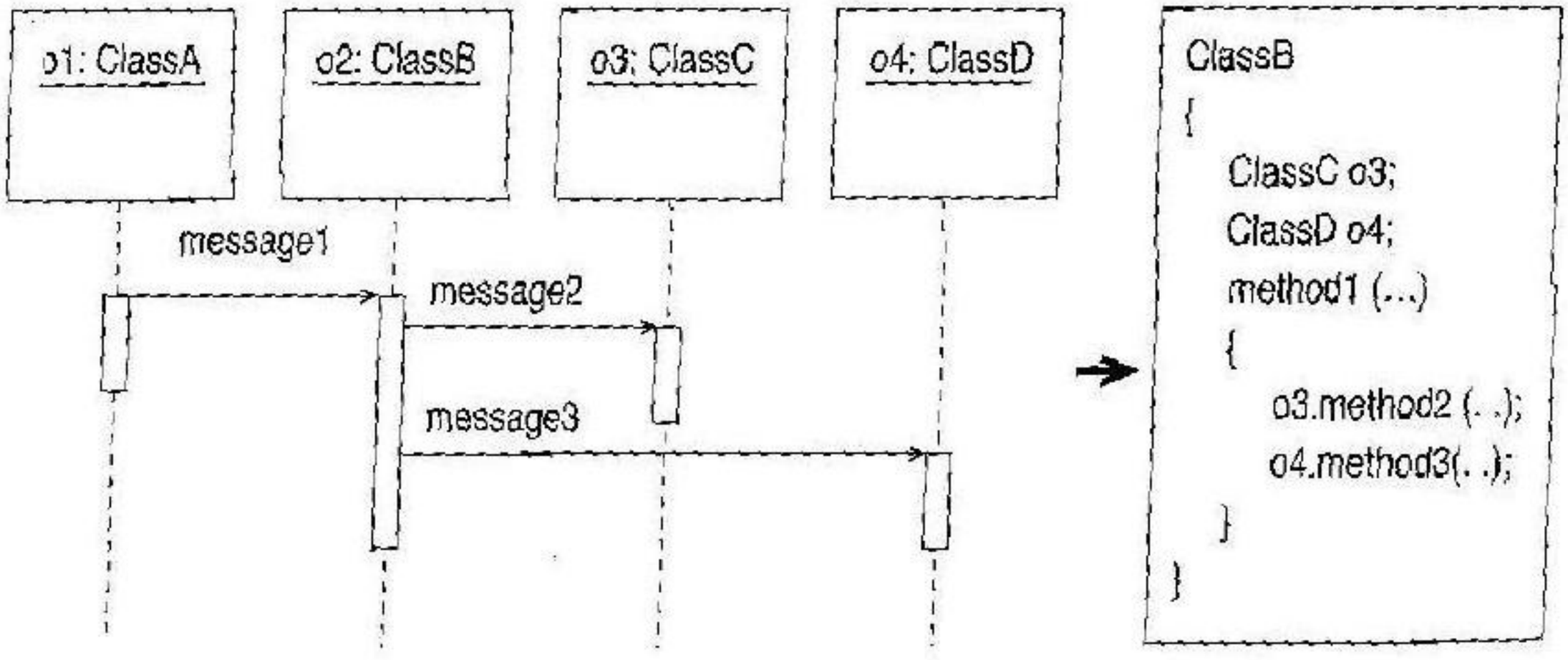
Coding Example: Activity diagram




```
while (true) {
    amount = 0.0;
    while (amount < price) {
        wait for a coin;
        add coin value to amount;
    }
    show all available soft drink;
    while (selection  is not done) {
        wait for selection from user;
        if selection is "eject coins" {
            dispense coins;
            set selection to "done";
        }
        else if selection is a valid soft drink {
            dispense change and dispense soft drink concurrently;
            set selection to "done";
        }
    }
}
```

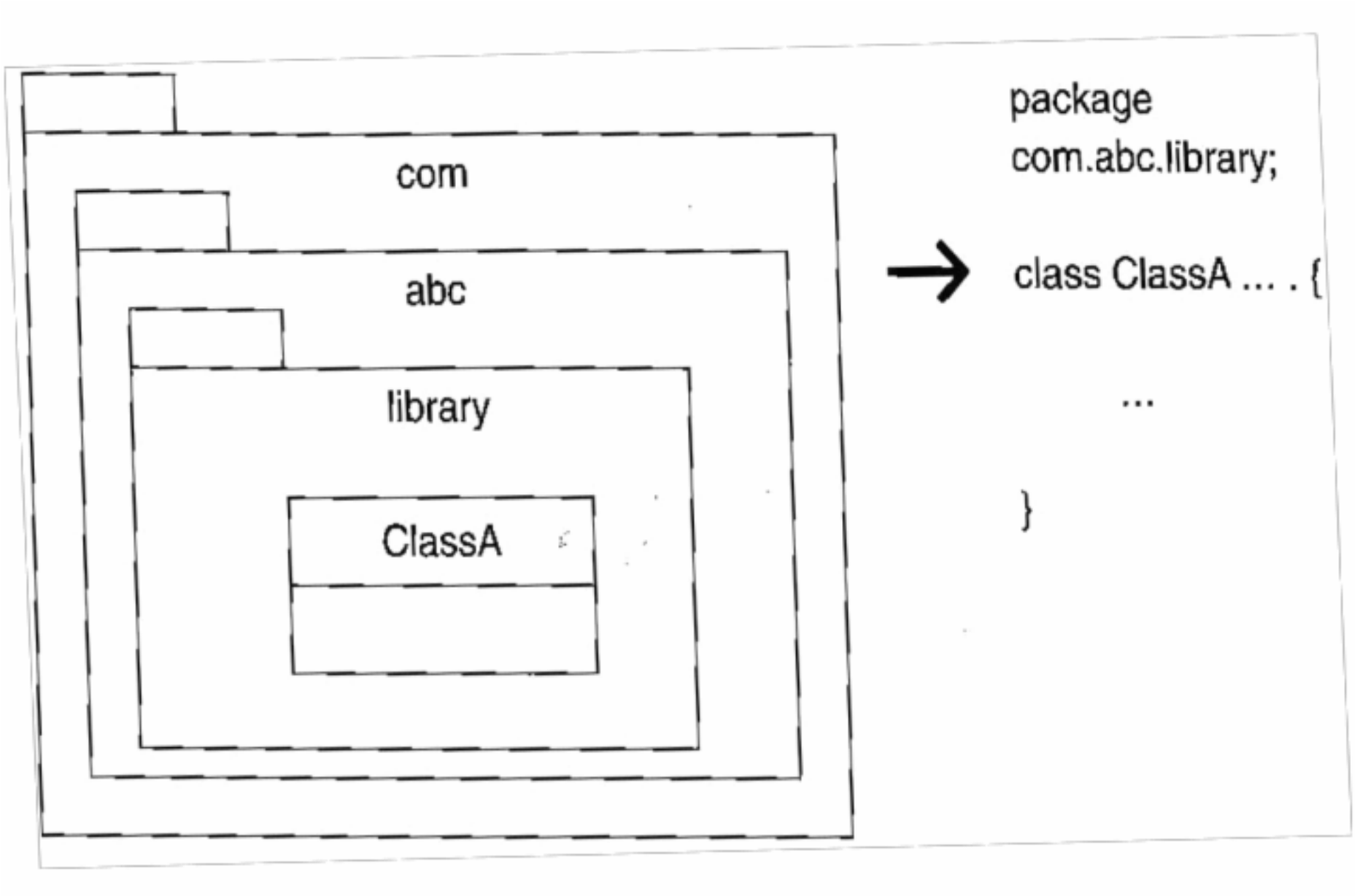
Construction Practices -Coding

- Coding Example: Sequence diagram



Construction Practices -Coding

- Coding Example: Package diagram



Construction Practices -Activities

3.1 Construction Practices -Process & Activities

3.1.1 Coding & Unit Testing

~~3.1.2 Integration & Integration Test~~

~~3.1.3 Configuration Management~~

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

- Unit
  - A program *unit is one or more contiguous program* statements, with a name that other parts of the software use to call it.
  - It is the smallest part of the program that can be tested
  - Units are called *functions* in C and C++, *procedures* in Ada and Pascal, *methods* in Java, and *routines* in Fortran.

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

- Module
  - A module may refer to a unit or a collection of related units that are assembled in a file, package, or class.
  - This corresponds to a file in C, a package in Ada, and a class in C++ and Java
  - Often the term “units” and “modules” can be used interchangeably, i.e. meaning the same thing!

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

- Unit Testing
  - Testing of an individual program unit/module, e.g. routines, methods, classes in isolation
  - Testing at the lowest level of testing
  - Testing at or closest to the program code level
  - Object oriented unit testing:
    - Testing individual method
    - Testing a group of collaborating methods within a class
    - Testing the class

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

- How to do unit testing?
  - DIY - *Test Harness Programs, Test Drivers*
    - Invoke the UUT (unit under test), e.g. method, class
    - Pass the parameters (test data) to the UUT
    - Observe the output from and behaviors of the UUT
  - Tools - *Unit Testing Frameworks*
    - JUnit: Java
    - NUnit: .NET
    - CppUnit: C++
    - PHPUnit : PHP

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

Example – Test Harness for BankAccount Class & Methods

ch03/account/BankAccountTester.java

```
1  /**
2     A class to test the BankAccount class.
3  */
4  public class BankAccountTester
5  {
6     /**
7        Tests the methods of the BankAccount class.
8        @param args not used
9     */
10    public static void main(String[] args)
11    {
12       BankAccount harrysChecking = new BankAccount();
13       harrysChecking.deposit(2000);
14       harrysChecking.withdraw(500);
15       System.out.println(harrysChecking.getBalance());
16       System.out.println("Expected: 1500");
17    }
18 }
```

Program Run

```
1500
Expected: 1500
```

Construction Practices – Unit Testing

3.3.1 **Software Construction Activities –** Unit Testing

Example – BankAccount Class and Methods for Unit Test

ch03/account/BankAccount.java

```
1  /**
2     A bank account has a balance that can be changed by
3     deposits and withdrawals.
4  */
5  public class BankAccount
6  {
7     private double balance;
8
9     /**
10       Constructs a bank account with a zero balance.
11    */
12    public BankAccount()
13    {
14       balance = 0;
15    }
16
17    /**
18       Constructs a bank account with a given balance.
19       @param initialBalance the initial balance
20    */
21    public BankAccount(double initialBalance)
22    {
23       balance = initialBalance;
24    }
25
26    /**
27       Deposits money into the bank account.
28       @param amount the amount to deposit
29    */
30    public void deposit(double amount)
31    {
32       balance = balance + amount;
33    }
34
35    /**
36       Withdraws money from the bank account.
37       @param amount the amount to withdraw
38    */
39    public void withdraw(double amount)
40    {
41       balance = balance - amount;
42    }
43
44    /**
45       Gets the current balance of the bank account.
46       @return the current balance
47    */
48    public double getBalance()
49    {
50       return balance;
51    }
52 }
```

3.1 Software Construction Activities

~~3.1.1 Coding & Unit Testing~~

3.1.2 Integration & Integration Test

~~3.1.3 Configuration Management~~

3.1.2 Software Construction Activities – Integration

Software Integration

- What is Software Integration?
- Benefits of (Good) Integration
- Integration Approaches

3.1.2 Software Construction Activities – Integration

Software Programming

- Coding (Programming)

  Design Specs (Document) → Software Code (Program)
  Design Elements → Program/Software Modules

- Integration

  Program/Software Modules → Integrated Software/System

3.1.2 Software Construction Activities - Coding

Software Programming & Integration

- Coding Activities
  - Based on SDD*, translating the design specification into the program ***source code***
    - Based on HLD*, implementing the program ***overall structure and interfaces***
    - Based on LLD*, constructing the program ***modules*** which correspond to the specified ***design elements***
  - Compiling, debugging and ***unit testing*** the coded modules
- Integration Activities
  - Linking all the ***unit-tested*** modules into a ***single*** integrated system/subsystem
  - Compiling, debugging and ***integration testing*** the integrated system/subsystem

Software Integration - Benefits

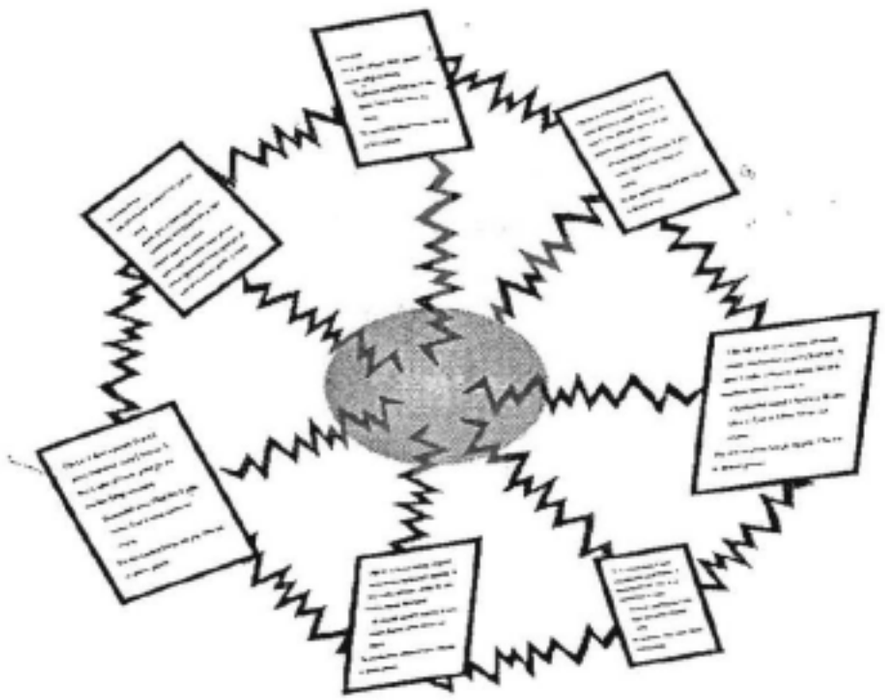
- **Benefits of (Good) Integration**

Software Integration - Benefits

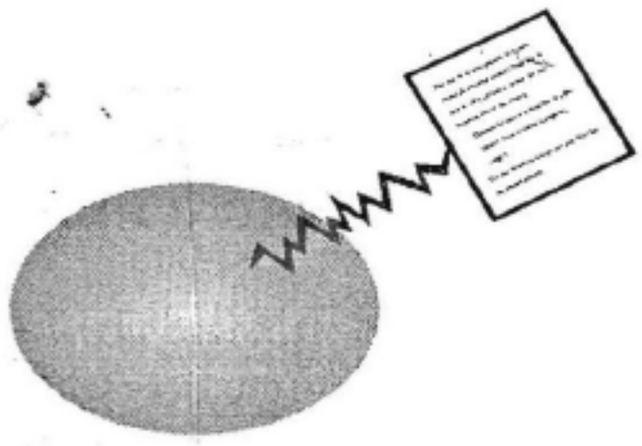
- **Benefits of (Good) Integration**
  - Easier defect diagnosis
  - Fewer defects
  - Less scaffolding
  - Shorter time to first working product
  - Better customer relations
  - Improved morale
  - Improved chance of project completion
  - More reliable schedule estimates
  - More accurate status reporting
  - Improved code quality
  - Less documentation

Software Integration - Approaches

- **Integration Approaches**
  - Phased (Big Bang) Integration
  - Incremental Integration



Phased Integration



Incremental Integration

Software Integration - Approaches

- **Phased (Big Bang) Integration - Approach**

  Step 1: Unit Development

  - Design, code, test and debug each unit/module/class

  Step 2: System Integration

  - Combine all the units into a single overall system

  Step 3: System Test

  - Test and debug the whole system

  Problems with this approach:

  - All problems surface at once
  - Hard to isolate/locate the causes of the problems

Software Integration - Approaches

Incremental Integration - Approach

Step 1: Unit Development

- Develop a small functional part of the system
- Design, code, test and debug a class

Step 2: Skeleton Integration

- Integrate the new unit with the skeleton.
- Test and debug the combination of skeleton and the new unit. Make sure the combination works before adding any new units.

Step 3: System Integration

- Repeat the above process until all units are integrated.

Software Integration - Approaches

- **Incremental Integration - Benefits**
  - Errors are easy to locate
  - The system succeeds early in the project
  - Progress monitoring is improved
  - Customer relation is improved
  - The units of the system are tested more fully
  - The system can be built with a shorter time

Software Integration - Approaches

- **Incremental Integration - Structure**
  - Top level contains:
    - Uppermost modules in the system hierarchy
    - Application/system control logic/loop
    - Top level classes, business-object classes
    - Main window, main user interface menus
    - Object containing *main()*, *WinMain()*
  - Bottom level contains:
    - System interfaces, device interfaces
    - Utility classes

Software Integration - Approaches

Incremental Integration – Strategies

Different ways/order of integrating components into a complete system:

- Top-Down Integration
- Bottom-Up Integration
- Sandwich Integration
- Risk-Oriented Integration
- Feature Oriented Integration
- T-Shaped Integration

Software Integration - Approaches

- Top-Down Integration – Using "Stubs"

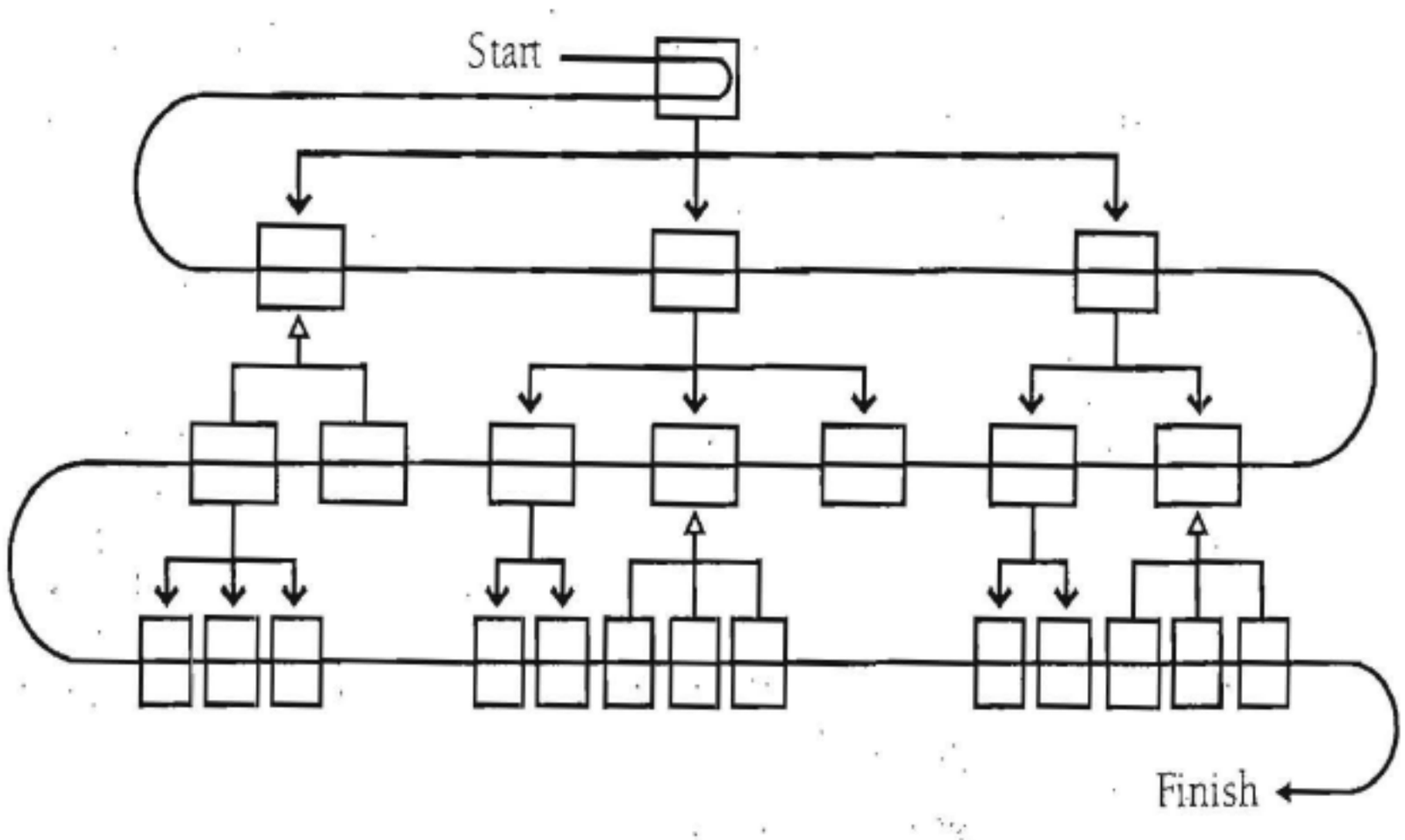


Figure 29-5 In top-down integration, you add classes at the top first, at the bottom last.

Software Integration - Approaches

- Top-Down Integration – Advantages
  - The application/system control logic, overall conceptual design issues, tested early
  - Partially working system completed early, e.g. user interface parts; hence, a morale booster
  - Coding can begin before low level design details are completed

Software Integration - Approaches

- Top-Down Integration – Disadvantages
  - Interfaces between classes must be carefully specified
  - Late discovery of system interface problems cause high-level changes
  - Large number of stubs needed introducing more errors from the new code
  - Not applicable if the collection of classes has no top

Software Integration - Approaches

- Top-Down Integration – Hybrid: Slides

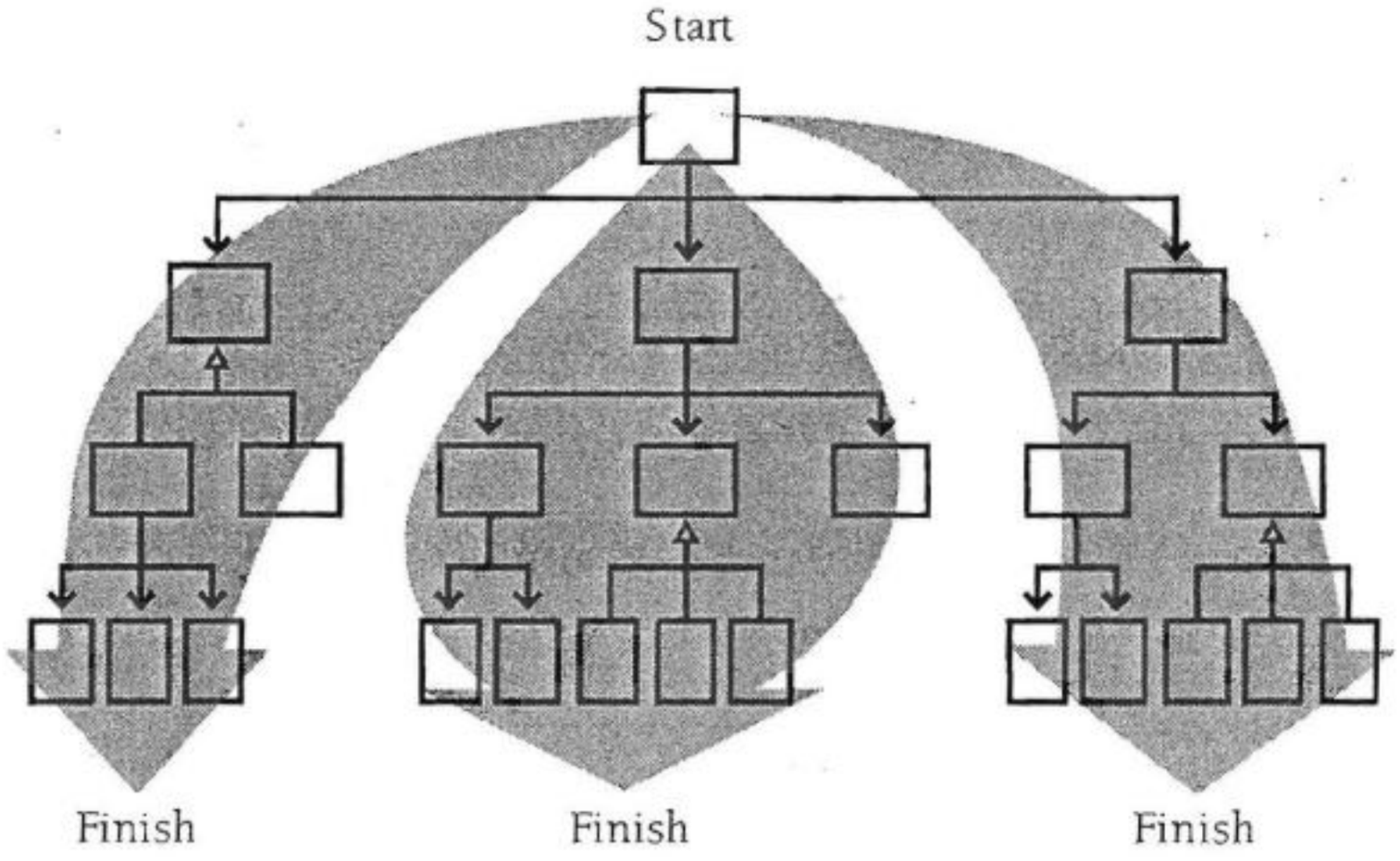


Figure 29-6 As an alternative to proceeding strictly top to bottom, you can integrate from the top down in vertical slices.

Software Integration - Approaches

- Bottom-Up Integration – Using Drivers

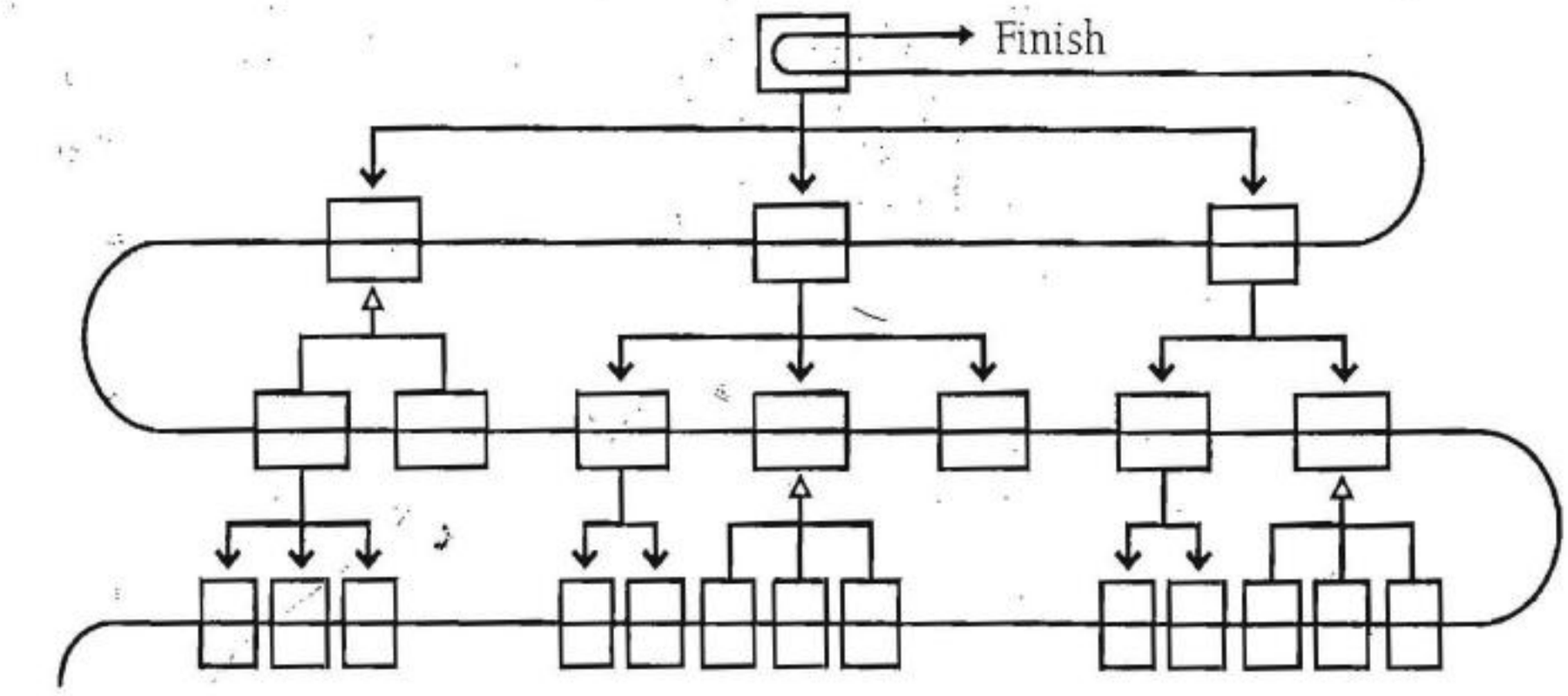


Figure 29-7 In bottom-up integration, you integrate classes at the bottom first, at the top last.

Software Integration - Approaches

- Bottom-Up Integration – Advantages
  - Possible sources of error restricted to the single class being integrated
  - Potentially troublesome system interfaces exercised early
- Bottom-Up Integration – Disadvantages
  - High-level conceptual design problems found too late that all low level works may be wasted
  - Design of the whole system must be completed before integration can begin

Software Integration - Approaches

- Bottom-Up Integration – Hybrid: Sections

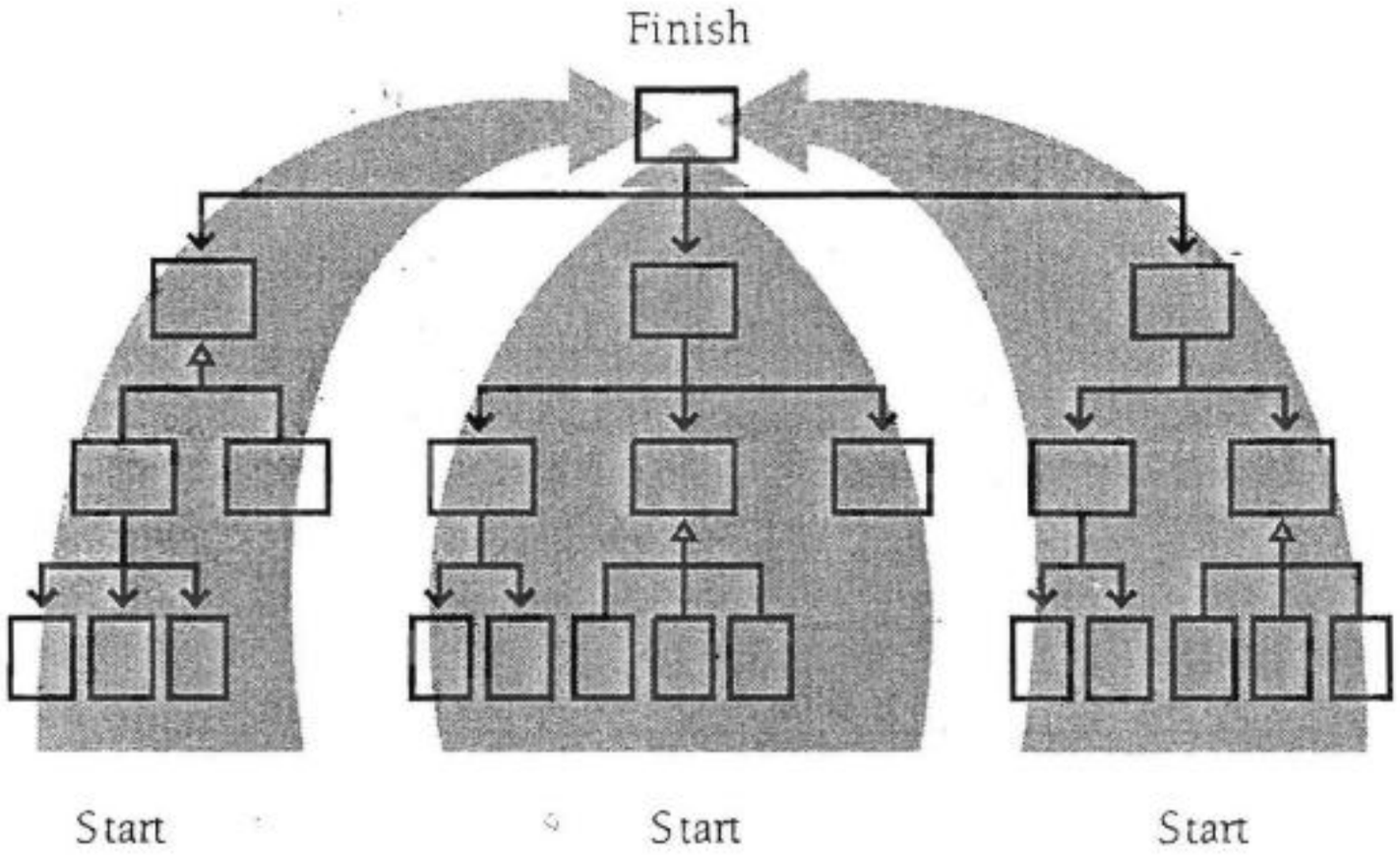


Figure 29-8 As an alternative to proceeding purely bottom to top, you can integrate from the bottom up in sections. This blurs the line between bottom-up integration and feature-oriented integration, which is described later in this chapter.

Software Integration - Approaches

- Sandwich Integration

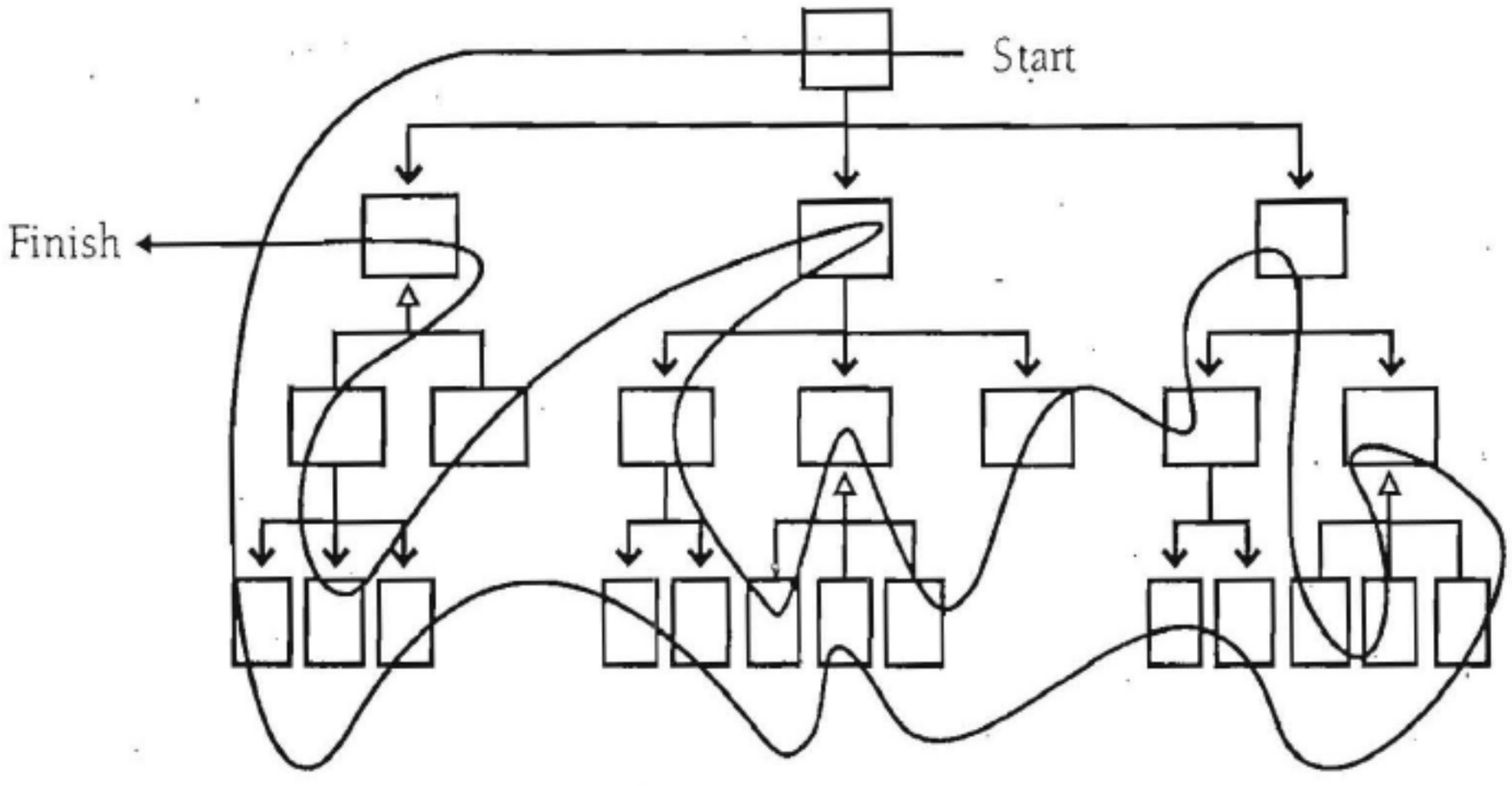


Figure 29-9 In sandwich integration, you integrate top-level and widely used bottom-level classes first and you save middle-level classes for last.

Software Integration - Approaches

- Sandwich Integration – Advantages
  - Rigidity of pure top-down and bottom-up integration is avoided
  - Amount of scaffolding is potentially minimized
  - A realistic, practical approach

Software Integration - Approaches

- Risk-Oriented Integration – *"Hard Part First"*

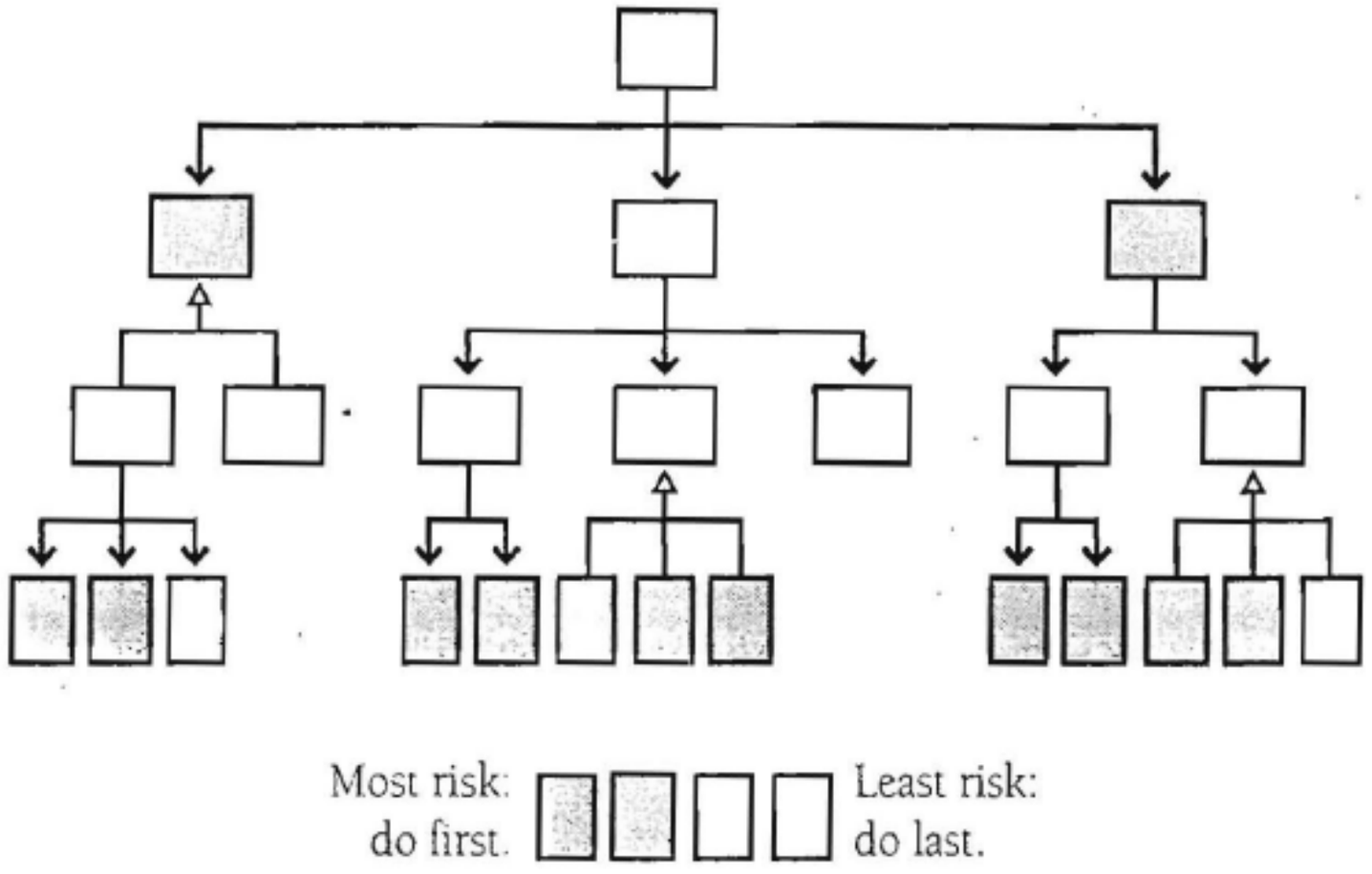


Figure 29-10 In risk-oriented integration, you integrate classes that you expect to be most troublesome first; you implement easier classes later.

Software Integration - Approaches

Feature-Oriented Integration

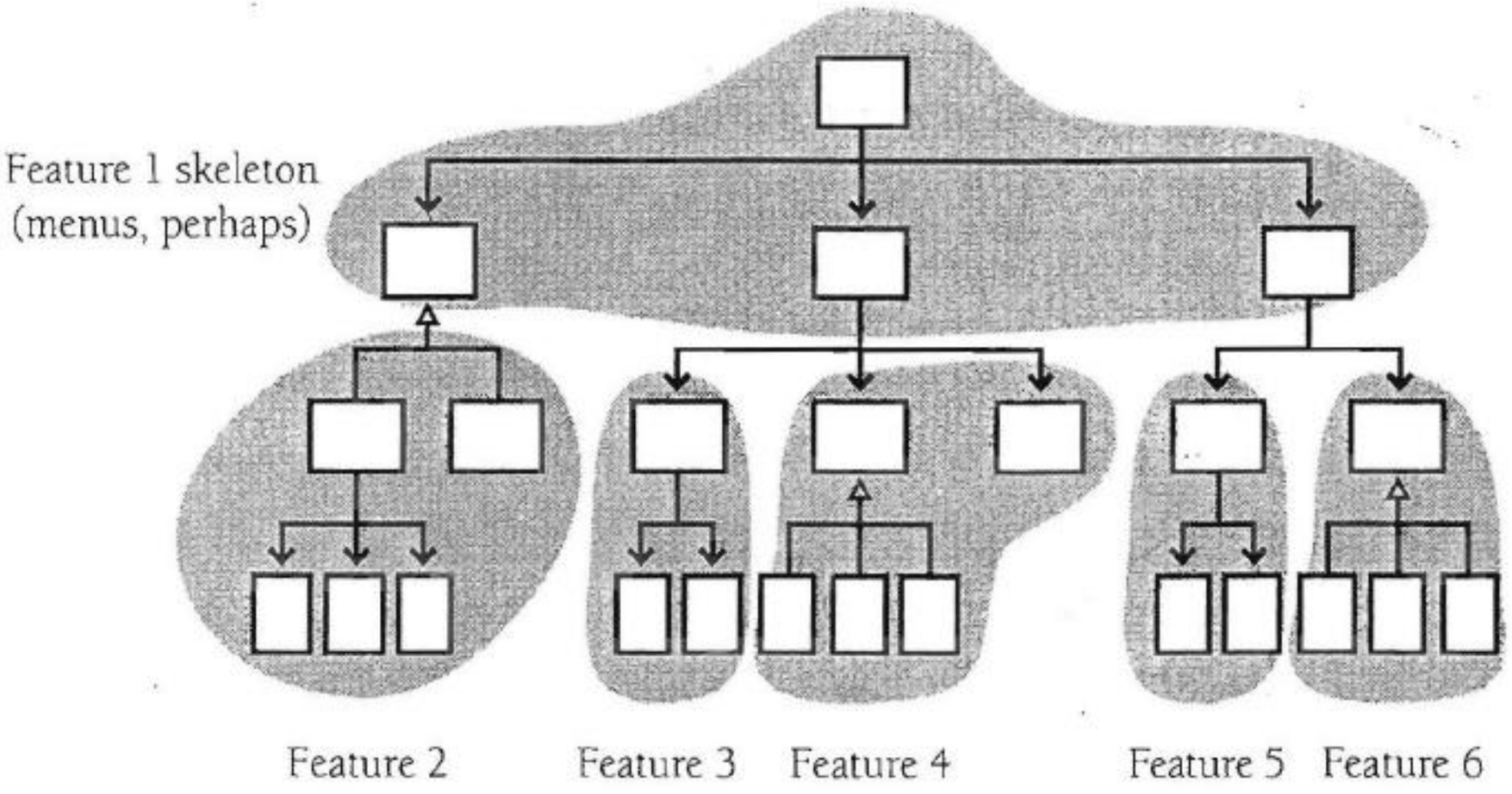


Figure 29-11 In feature-oriented integration, you integrate classes in groups that make up identifiable features—usually, but not always, multiple classes at a time.

Software Integration - Approaches

- Feature-Oriented Integration – Advantages
  - Most scaffolding eliminated
  - Functional software for early release
  - Works well with object-oriented design as objects tend to map well to features

Software Integration - Approaches

- T-Shaped Integration

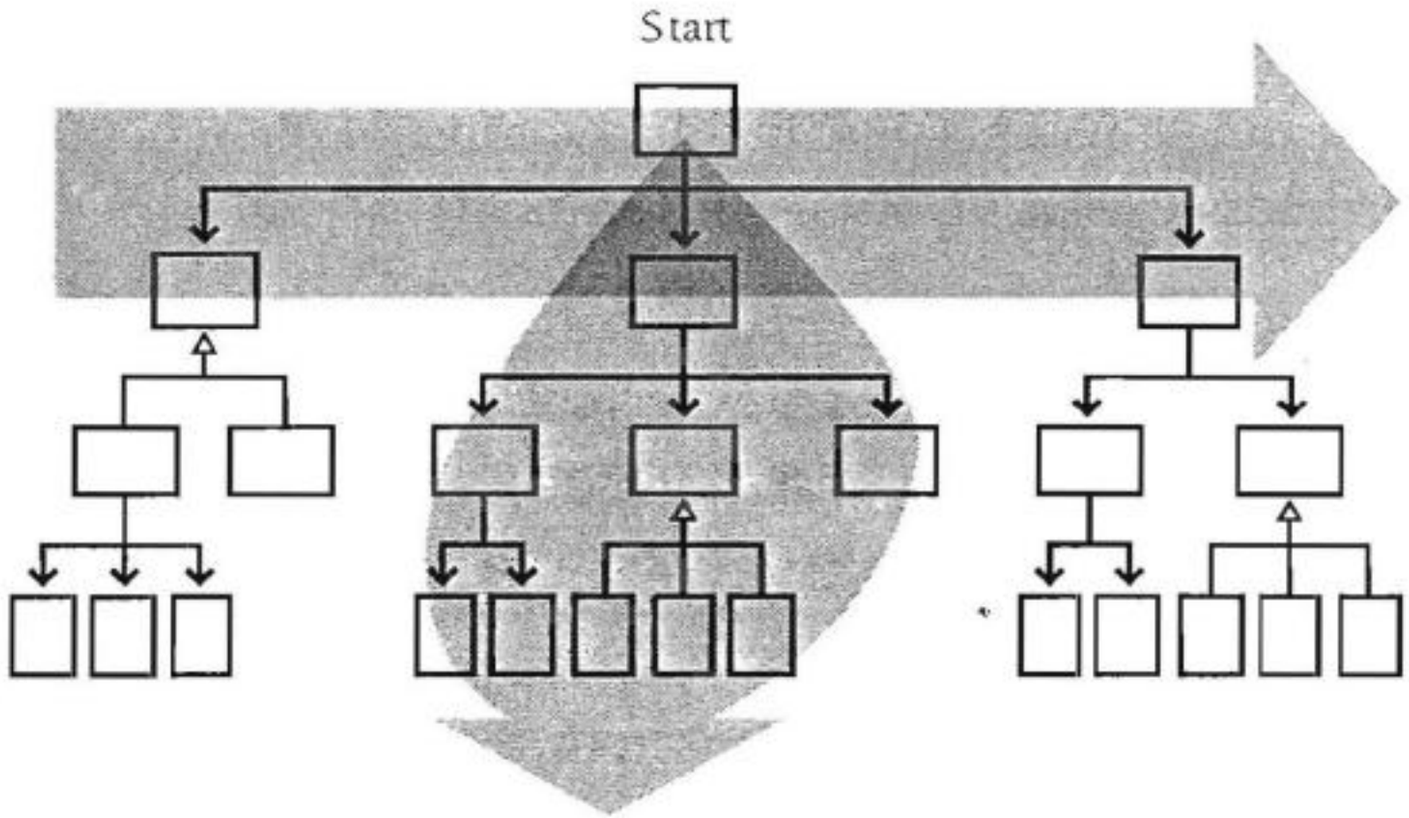


Figure 29-12 In T-shaped integration, you build and integrate a deep slice of the system to verify architectural assumptions, and then you build and integrate the breadth of the system to provide a framework for developing the remaining functionality.

Software Integration - Approaches

Object Oriented Integration

- Can be done top down or bottom up depending on the program structure
- Top-Down integration used for controlling classes
- Bottom-Up integration used for operational classes
- Typical integration sequence:
  - Objects with no messages to other objects are integrated first
  - Then objects with messages to the above objects
  - And so on until the whole system is tested

Software Integration - Approaches

Object Oriented Integration

- Intra-method testing
  - Testing of individual methods in isolation
- Inter-method testing:
  - Pairs of methods within the same class
- Intra-class testing
  - A single entire class usually by a sequence of class method calls
  - Usually as sequences of calls to methods within the class
- Inter-class testing
  - More than one class is tested at the same time

3.1 Software Construction Activities

~~3.1.1 Coding & Unit Testing~~

~~3.1.2 Integration & Integration Test~~

3.1.3 Configuration Management

3.1.3 Software Construction Activities – Configuration Management

Software Configuration Management (SCM)

- What is SCM?
- Purpose of SCM
- SCM Process & Activities
- SCM Tools and Case Study

3.1.3 Configuration Management - Definition

- What is SCM? - Definition
  - Process of identifying, tracking and storing all the artifacts on a project
  - The practice of identifying project artifacts and handling changes systematically so that a system can maintain its integrity over time
  - Each artifact referred to as a *Configuration Item (CI)*

3.1.3 Configuration Management - Terminology

- What is SCM ? - Terminology
  - Version
  - Revision
  - Variation
  - Configuration
  - Configuration Item
  - Baseline
  - Build

3.1.3 Configuration Management - Terminology

- Configuration Item (CI)
  - An artifacts produced in the course of developing a software product, e.g. code and documents, which are subject to SCM process.
- Configuration
  - A unique combination of all related CI's which makes up a specific version of a unified system/product. A software configuration maintains the information about which version of all the related CI's correspond to a particular version/release of the product.

3.1.3 Configuration Management - Terminology

- Version
  - Each unique form of a software module (artifact) existed over time during the course of software development. Usually each module has at least 2 versions: old & new.
- Revision
  - A new version of the module (artifact) intended to replace the old version of the same module
- Variation
  - Different versions of the same module (artifact) intended to co-exist for different purposes

3.1.3 Configuration Management - Terminology

- Build (Product Build)
  - To create the final (executable) form of the software system/product by integrating all the CI's as per the SCM configuration specification.
- Release
  - The final product version built from a particular CI configuration for the purpose of public distribution.

3.1.3 Configuration Management - Terminology

- Baseline
  - A set of one or more configuration items whose content and status have been reviewed technically and officially accepted at some step in the product life cycle.
- Generic types of baselines
  - Functional baseline
  - Allocated baseline
  - Developmental baseline
  - Product baseline

Software Construction – Configuration Management

Terms Clarity

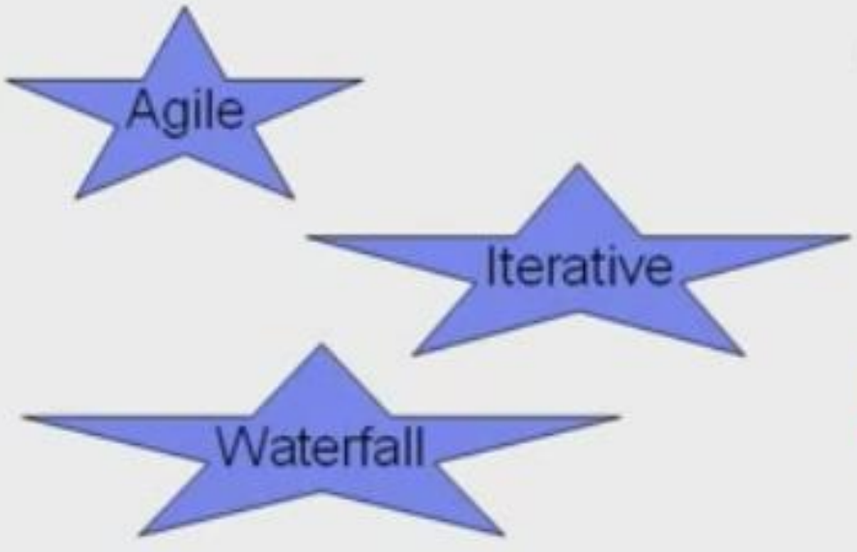
SCM – Software Configuration Management
SCCM – Software Change and Configuration Management
SCRM – Software Configuration and Release Management

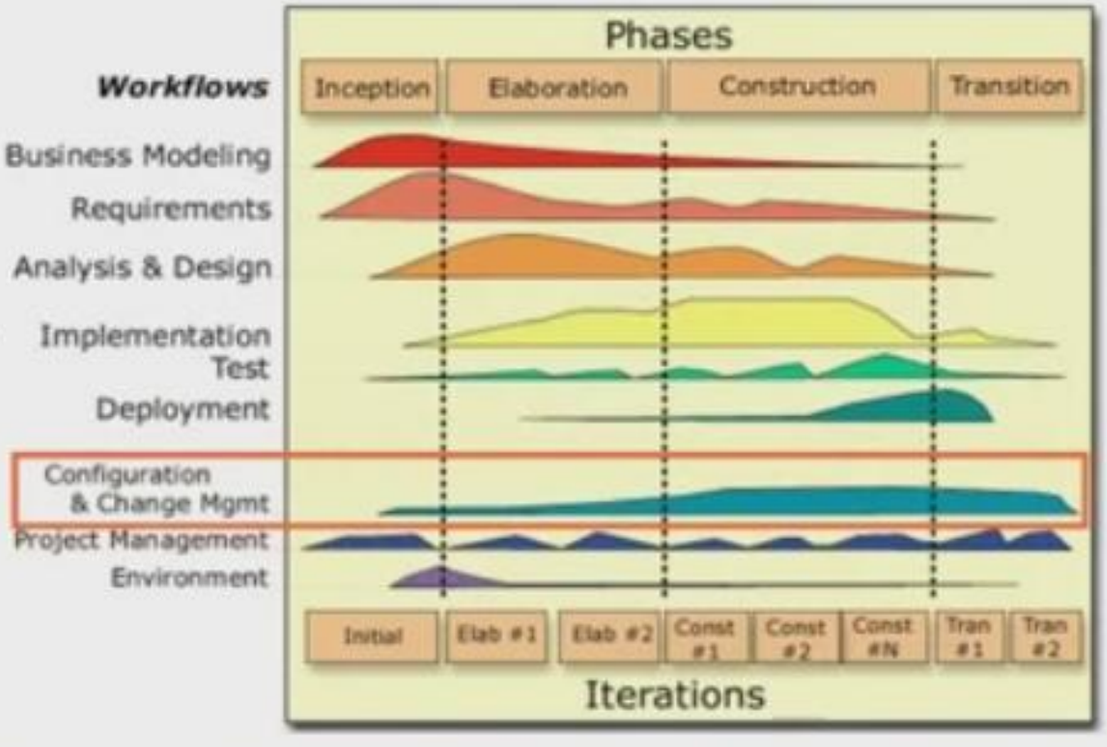
Terms are used interchangeably in the industry and is a huge topic for separate discussion

Software Construction – Configuration Management

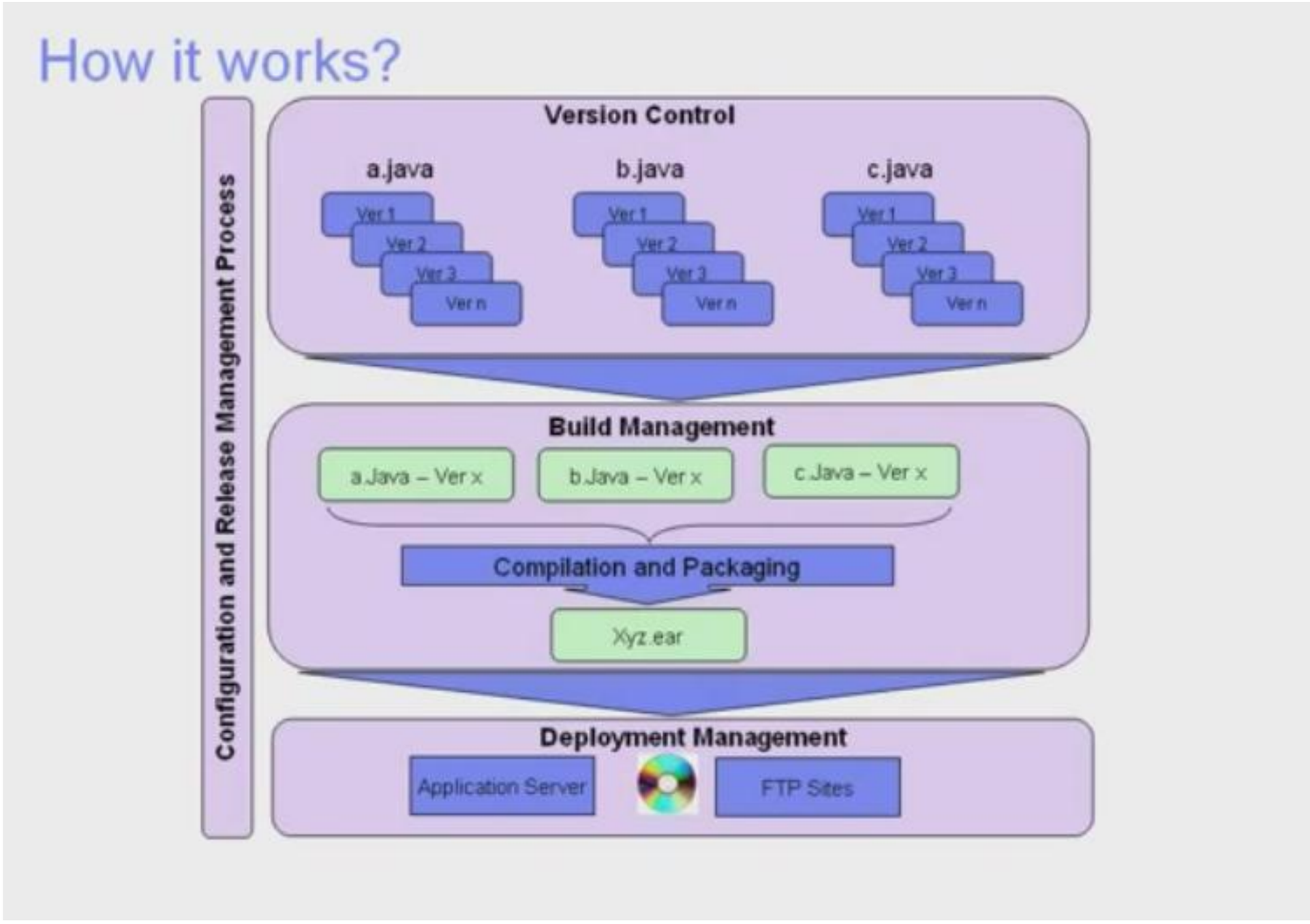
Brief on SCRM

- SCRM is the way to manage change in the development life cycle by controlling the configuration of your configurable items (items that tend to change Eg: source code, executable, documentation etc.,) with the help of some set process, tools and standards
- It is a very important aspect that cuts across all the phases of Development Lifecycle
- Its an integral part of the software development irrespective of the development models being practiced





Software Construction – Configuration Management



3.1.3 Software Construction Activities – Configuration Management

Software Configuration Management (SCM)

- ~~What is SCM?~~
- Purpose of SCM
- ~~SCM Process & Aetivities~~
- ~~SCM Tools and Case Study~~

3.1.3 Configuration Management - Purposes

- Purposes of SCM
  - Right version of code is included in the system
  - Same code can't be changed by different people at the same time
  - Different software versions can be built and distributed as and when needed
  - Changes can be traced and impacted code rolled back
  - Any changes can be group focused/coordinated
  - Different product releases can be worked in parallel

3.1.3 Configuration Management - Purposes

- SCM Goals
  - Baseline Safety
    Ensure that new or changed CI's are safely stored in a repository and can be retrieved when necessary
  - Overwrite Safety
    Ensure that engineer's changes to the same CI's are applied correctly
  - Revision
    Ensure ability to revert to earlier version
  - Disaster Recovery
    Retain backup copy in case of disaster

3.1.3 Software Construction Activities – Configuration Management

Software Configuration Management (SCM)

- ~~What is SCM?~~
- ~~Purpose of SCM~~
- SCM Process & Activities
- ~~SCM Tools and Case Study~~

Software Construction – Configuration Management

Various Activities in SCRM

- **SCRM at a broader level have below activities**
  - Version Control
    - Using a central repository with access control, managing versions of individual files to be able to control and track who, when, why and how of changes to the files
  - Change Control
    - Controlling changes (defects or new enhancements) to the software product using a work flow management system which helps track aspects like who approved what changes to what release and who has implemented the changes
  - Build Management
    - Compile and package source code into binaries that will be delivered to internal or external customers
  - Release Management
    - Plan and manage releases as per the time lines
  - Deployment Management
    - Deploy product or application to various environments
  - Process Management
    - Define, manage and implement configuration management process

3.1.3 Configuration Management - Activities

- SCM Process & Activities
  1. Configuration identification
  2. Baselines
  3. Change control
  4. Version control
  5. Configuration audits
  6. Configuration status reporting
  7. Release management and delivery

3.1.3 Configuration Management - Activities

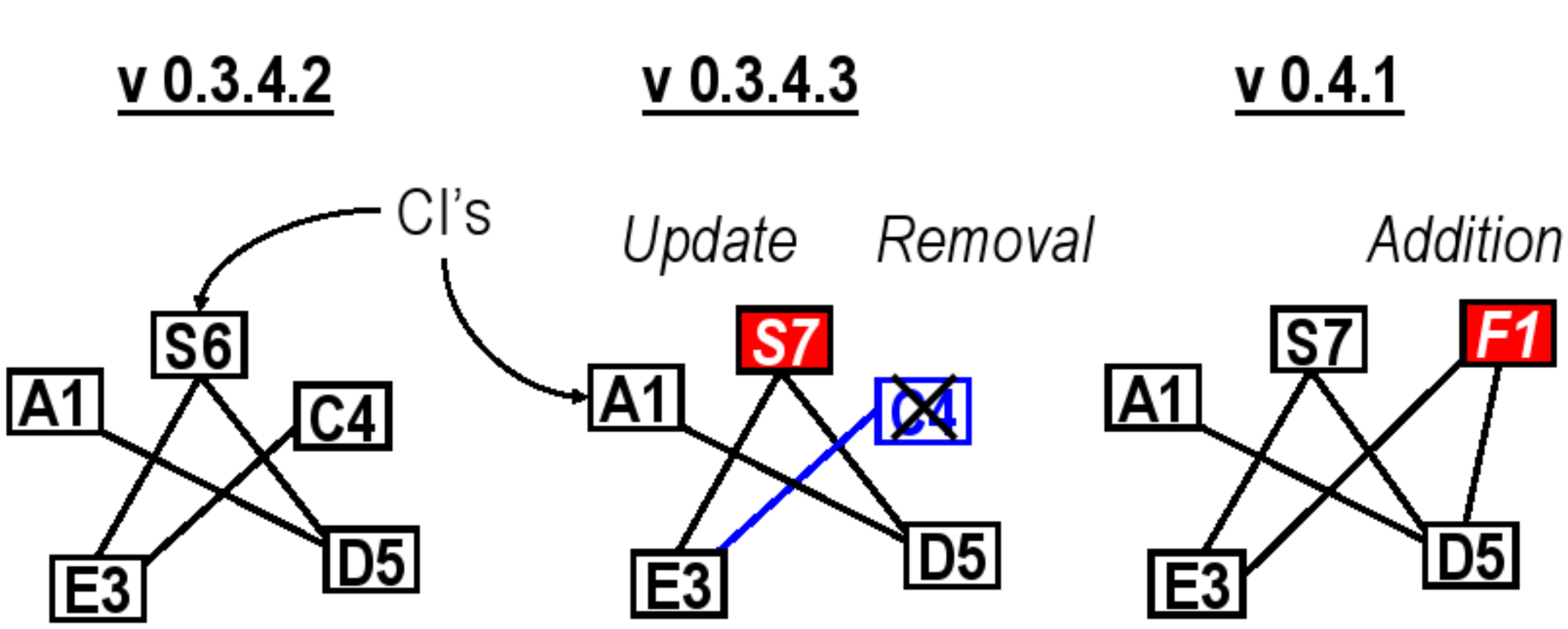
1. Configuration Identification

- First step in the SCM process
- Candidate CI's include:
  - source and object code
  - project specifications
  - user documentation
  - test plans and data
  - supporting software such as compilers, editors
  - any artifact that will undergo modification or need to be retrieved at some time after its creation

3.1.3 Configuration Management – Activities

2. Baseline

- Is an individual or group of CI's labeled at a key project milestone
- Each version below is a baseline



3.1.3 Configuration Management – Activities

3. Change Control

- Set of activities to request, evaluate, approve or disapprove, and implement changes to baselined CI's
- Steps:
  - identification and documentation
  - analysis and evaluation
  - approval or disapproval
  - verification, implementation and release
- Also called *Change Management System*

3.1.3 Configuration Management – Activities

3. Change Control – Step 1

- Identification and Documentation
  - Name of requester
  - Description and extent of the change
  - Reason for the change (e.g. defects fixed)
  - Urgency
  - Amount of time required to complete change
  - Impact on other CI's or impact on the system

3.1.3 Configuration Management – Activities

3. Change Control – Step 2

- Analysis and Evaluation
  - Reason for the change (e.g. bug fix, performance improvement, cosmetic)
  - Number of lines of code changed
  - Complexity
  - Other source files affected
  - Amount of independent testing required to validate the change

3.1.3 Configuration Management – Activities

3. Change Control – Step 3

- Approval or Disapproval

  A management decision by the *change control board* or *change management committee*

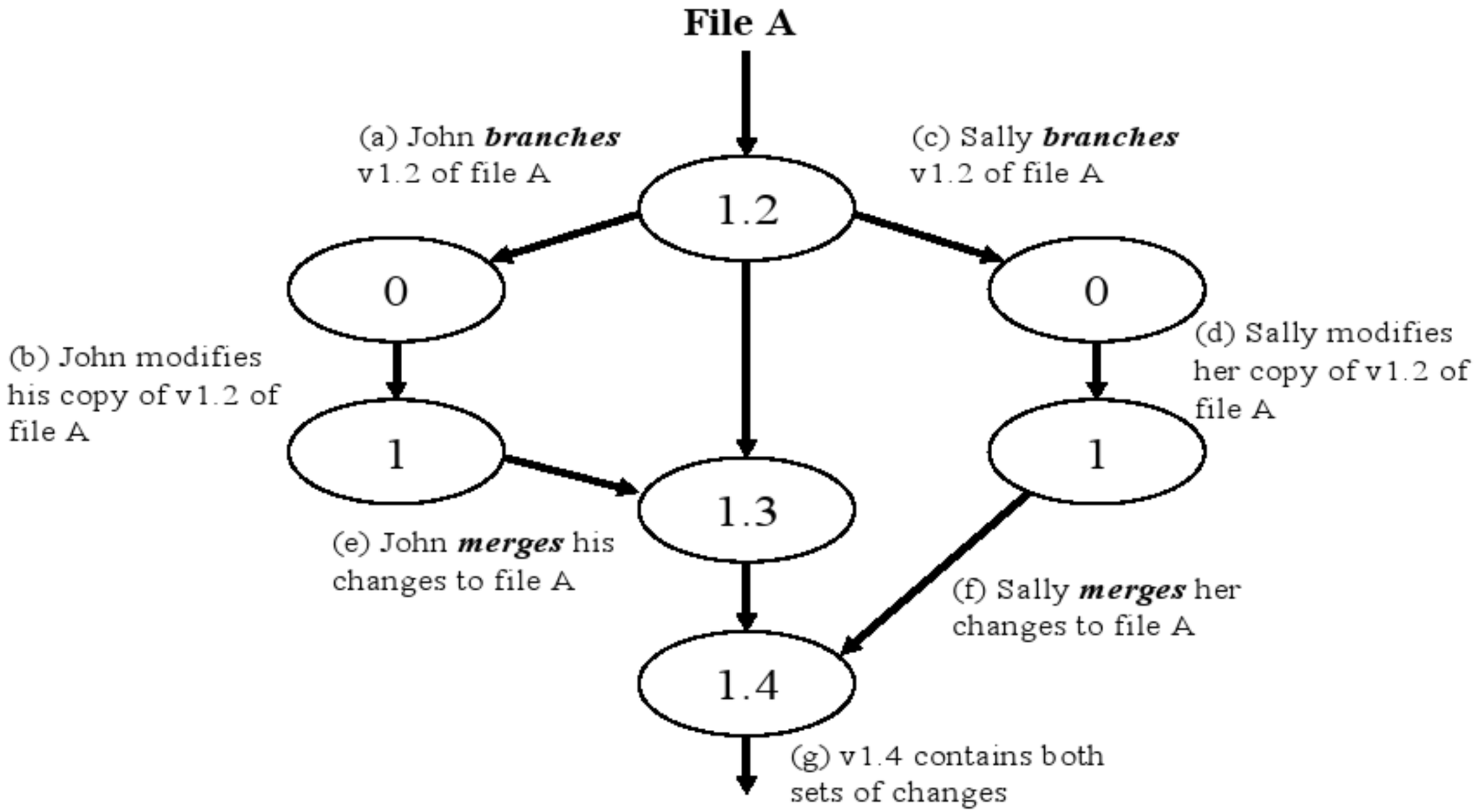
  - Establish a change control procedure
  - Establish a product baseline, versions, subversions
  - Handle change requests in groups
  - Estimate the cost of each change
  - Cost & benefit analysis based on the previous impact analysis
  - Good balance between bureaucracy and effective change control

3.1.3 Configuration Management – Activities

4. Version Control

- System that supports the management and storage of CIs as they are created and modified throughout the SDLC.
- Typical capabilities include:
  - Repository
  - Checkin/Checkout
  - Branching and merging
  - Builds
  - Version labeling

3.1.3 Configuration Management – Activities



3.1.3 Configuration Management – Activities

4. Version Control – Source Code Control

- Automatic version numbering
- Atomic operations on source files--accessed via strict check-in and check-out procedures
- File locking against concurrent access
- Version merging for multiple check-in's
- Easy updates of all files to the current versions
- Files can be backtracked to any versions
- History of all changes can be listed

3.1.3 Configuration Management – Activities

5. Configuration Audits

- Verify proper procedures are followed, such as formal technical reviews
- Verify SCM policies, such as those defined by change control, are followed
- Determine whether a software baseline is comprised of the correct configuration items
  - Are there extra items included? Are there items missing? Are the versions of individual items correct?
- Typically conducted by quality assurance group

3.1.3 Configuration Management – Activities

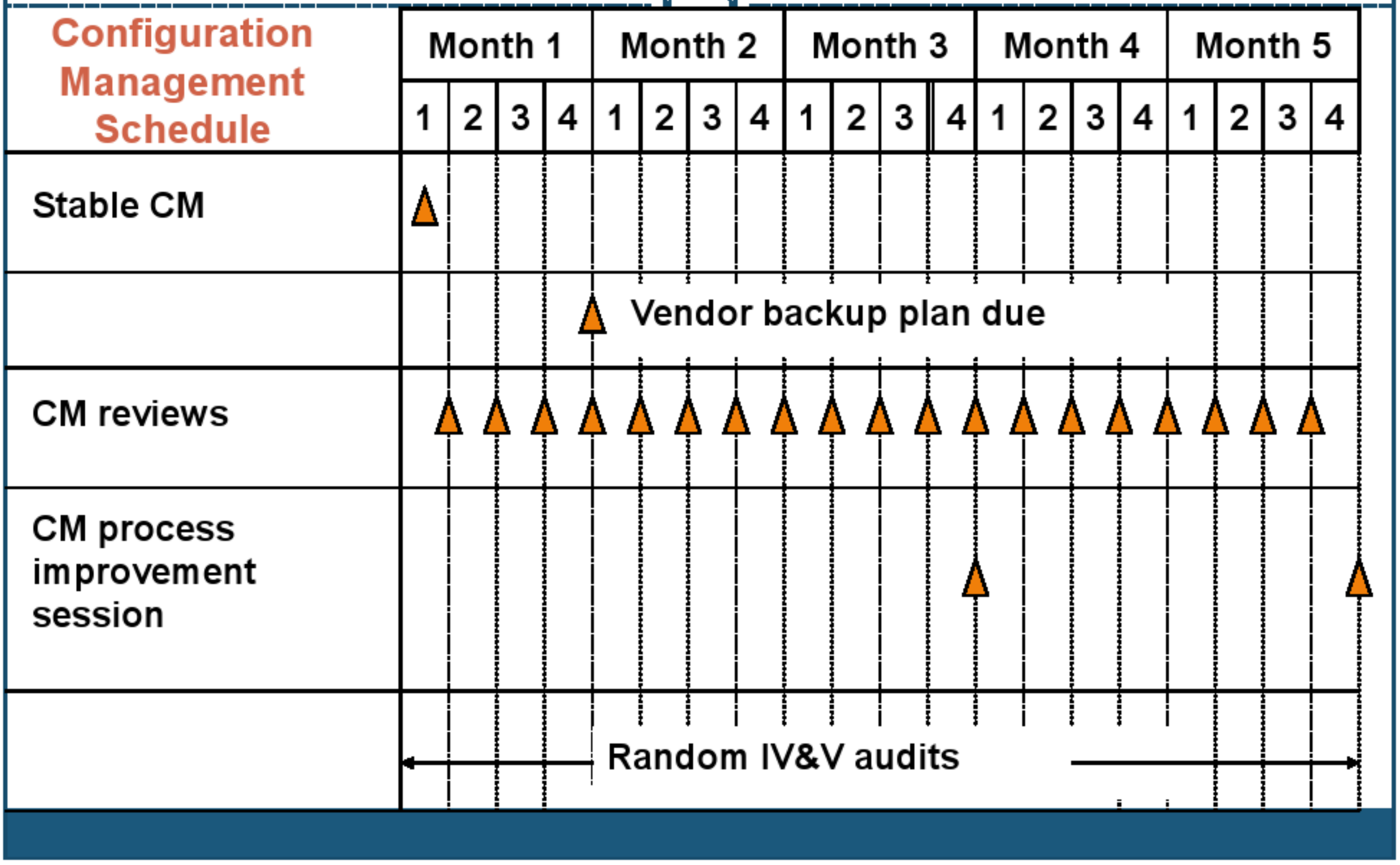
6. Configuration Status Reporting

- Extraction, arrangement and formation of configuration reports
  - Name and version of CI's
  - Approval history of changed CI's
  - Software release contents and comparison between releases
  - Number of changes per CI
  - Average time taken to change a CI

3.1.3 Configuration Management – Planning

1. Roughly sketch out your SCMP
   Determine procedures for making changes
   See the case study for an example
2. Specify what you need from a CM tool
   For class use, maybe only *locking* and *backup*
3. Evaluate affordable tools against needs and budget
   Commercial tools are in wide use
   For class use, try free document storage web sites; simple method of checking out, e.g. renaming, can be too simple
5. Finalize your SCMP

Software Construction – Configuration Management



3.1.3 Configuration Management - Documentation

IEEE 828-2005 SCMP Table of Contents

3.1 Introduction
3.2 SCM **management**
  3.2.1 Organization
  3.2.2 SCM responsibilities
  3.2.3 Applicable policies, directives & procedures
  3.2.4 Management of the SCM process
3.3 SCM **activities**
  3.3.1 Configuration identification
    3.3.1.1 Identifying configuration items
    3.3.1.2 Naming configuration items
    3.3.1.3 Acquiring configuration items
  3.3.2 Configuration control
    3.3.2.1 Requesting changes
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    3.3.2.3 Approving or disapproving changes
    3.3.2.4 Implementing changes
  3.3.3 Configuration status accounting
  3.3.4 Configuration evaluation & reviews
  3.3.5 Interface control
  3.3.6 Subcontractor / vendor control
  3.3.7 Release management and delivery
3.4. SCM **schedules**
3.5. SCM **resources**
3.6. SCM **plan maintenance**

3.1.3 Software Construction Activities – Configuration Management

Software Configuration Management (SCM)

- ~~What is SCM?~~
- ~~Purpose of SCM~~
- ~~SCM Process & Aetivities~~
- SCM Tools and Case Study

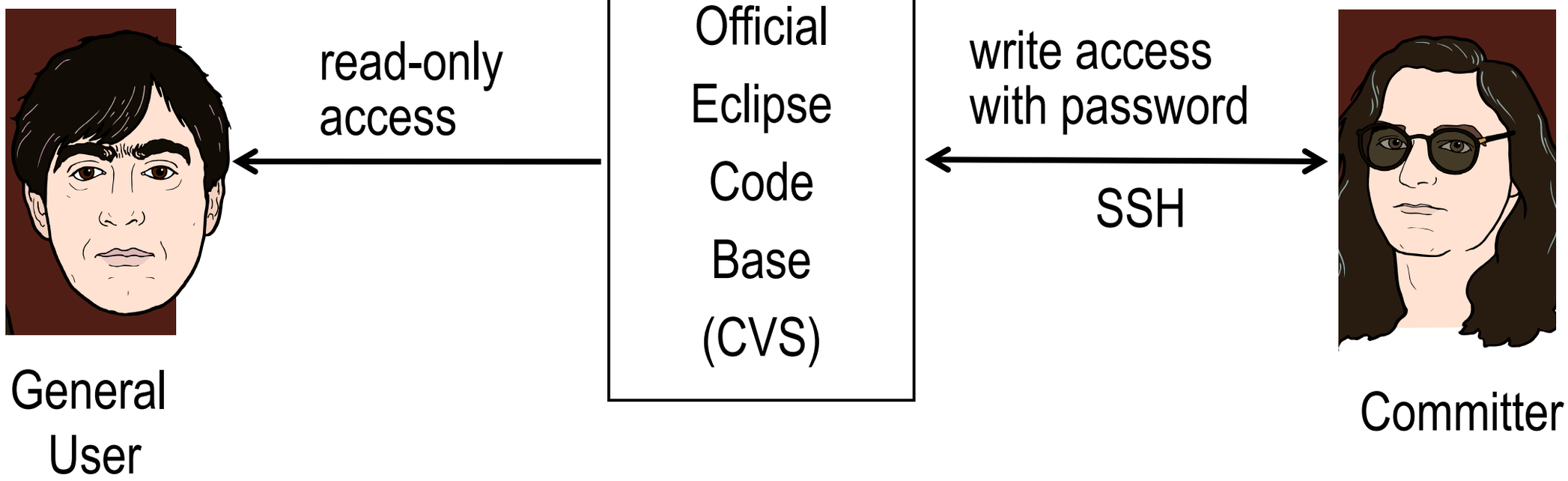
3.1.3 Configuration Management – Tools

- Examples of SCM systems:
  - Subversion
  - CVS
  - Rational Clearcase
  - Microsoft's *SourceSafeTM*
  - Perforce

3.1.3 Configuration Management – Case Study

- CVS - Possible file status:
  - ***Up-to-date***
    identical with the latest revision in the repository.
  - ***Locally Modified***
    File has been edited but has not replaced latest revision
  - ***Needing Patch***
    Someone else has committed newer revision to the repository.
  - ***Needs Merge***
    You have modified the file but someone else has committed a newer revision to the repository, and.
  - ***Unknown***
    A temporary file or never added

3.1.3 Configuration Management – Case Study



Eclipse Configuration Management

3.1.3 Configuration Management – Case Study

Eclipse - Plug-in Version Numbering Scheme

In Eclipse, the format of version numbers are composed of 4 segments:

major.minor.service.qualifier

Each segment captures a different intent:

- the major segment (integer) indicates breakage in the API
- the minor segment (integer) indicates "externally visible" changes
- the service segment (integer) indicates bug fixes and the change of development stream
- the qualifier segment (string) indicates a particular build

Example *1.0.2.x, 1.4.0, 2.1, 5.100.9999.abc*

http://wiki.eclipse.org/Version_Numbering

3.1.3 Configuration Management – Case Study

Eclipse - Plug-in Version Numbering

First development stream
- 1.0.0

Second development stream
- 1.0.100 (indicates a bug fix)
- 1.1.0 (a new API has been introduced)

The plug-in ships as 1.1.0

Third development stream
- 1.1.100 (indicates a bug fix)
- 2.0.0 (indicates a breaking change)

The plug-in ships as 2.0.0

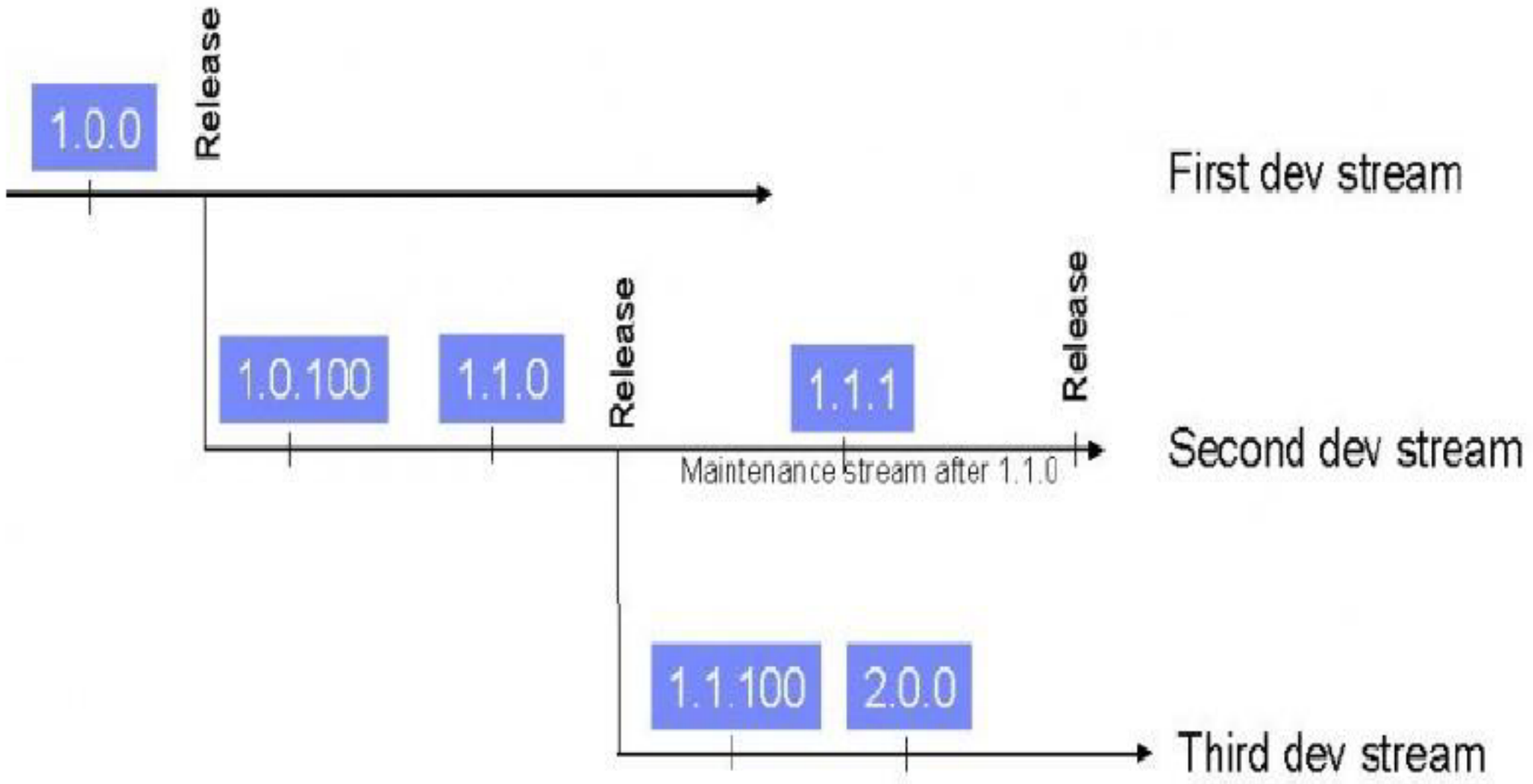
Maintenance stream after 1.1.0
- 1.1.1

The plug-in ships as 1.1.1

http://wiki.eclipse.org/Version_Numbering

3.1.3 Configuration Management – Case Study

- Eclipse - Plug-in Version Numbering



Software Construction -Reference

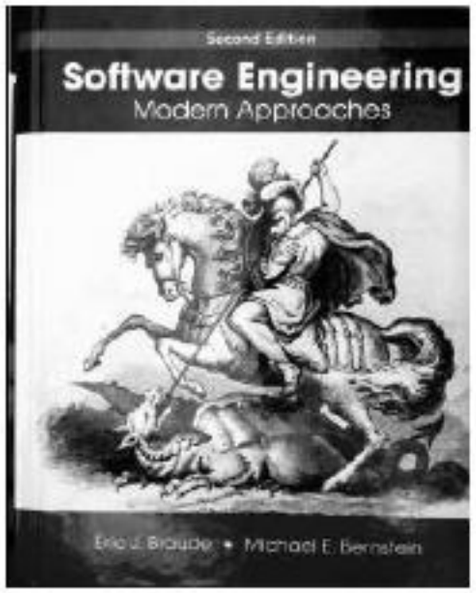
Reading Assignment

Textbook: *"Code Complete"*, 2nd edition

- Chapter 29: Integration
- Chapter 27: Managing Construction

Software Construction -Reference :

REFERENCE



Textbook: *"Software Engineering, Modern Approaches"*, 2nd edition

- Chapter 6: Software Configuration Management