Software Reuse

Software Engineering 2
(3103313-1)

Amirkabir University of Technology
Fall 1399-1400

Software Reuse

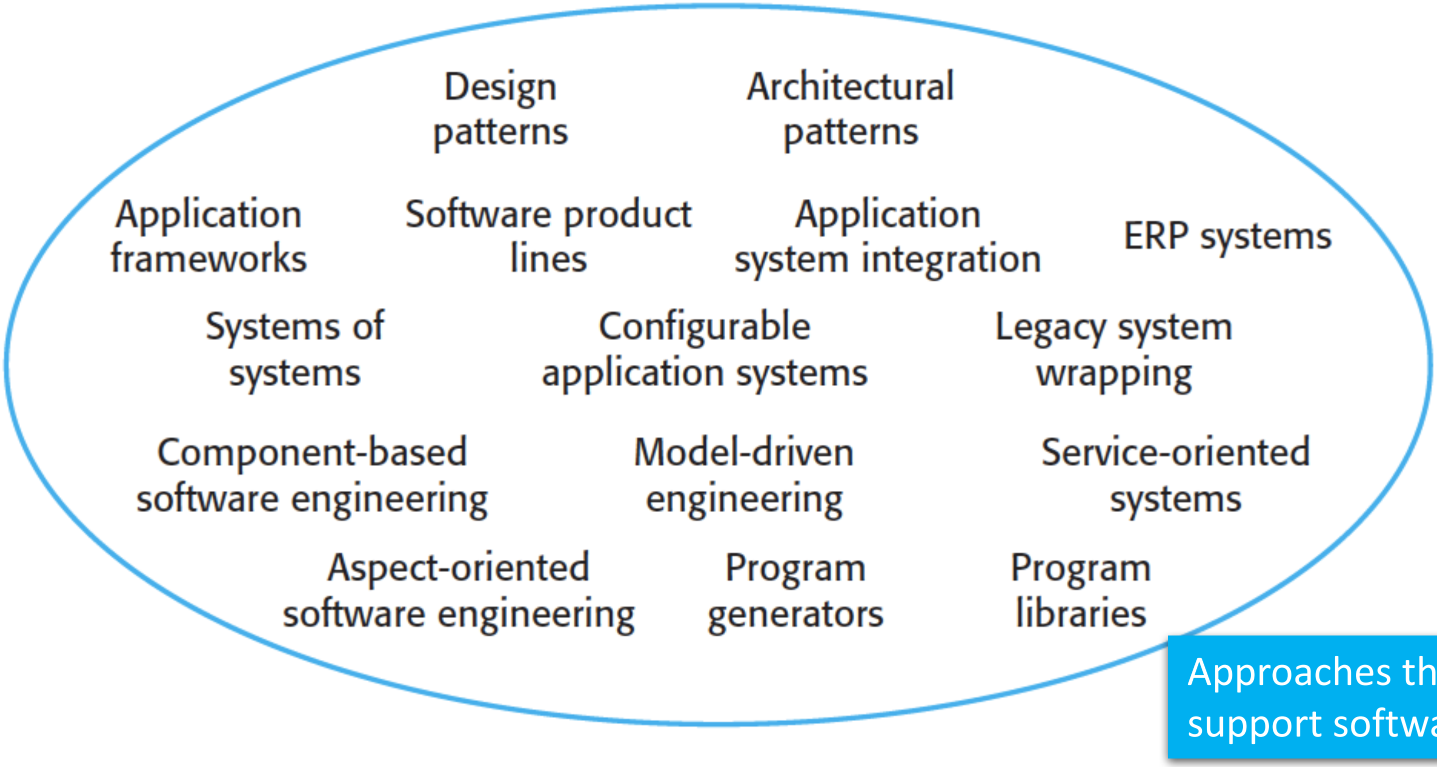
What, Why, How

The Reuse Landscape

Reuse is possible at a range of levels from simple functions to complete application systems

- Reusable Artefact
- Software Asset

- Reusable data
- Reusable architecture/designs
- Reusable programs/systems
  - COTS (Commercial Off-the Shelf)
- Reusable modules/components
- Reusable application framework
- Reusable X



Design patterns

Architectural patterns

Application frameworks

Software product lines

Application system integration

ERP systems

Systems of systems

Configurable application systems

Legacy system wrapping

Component-based software engineering

Model-driven engineering

Service-oriented systems

Aspect-oriented software engineering

Program generators

Program libraries

Approaches that support software reuse

Software Reuse

Benefits

✓ Accelerated development

✓ Effective use of specialists

✓ Increased dependability

✓ Lower development costs

✓ Reduced process risk

✓ …

Disadvantages

✘ Finding, understanding, and adapting reusable components

✘ Increased maintenance costs

✘ Lack of tool support

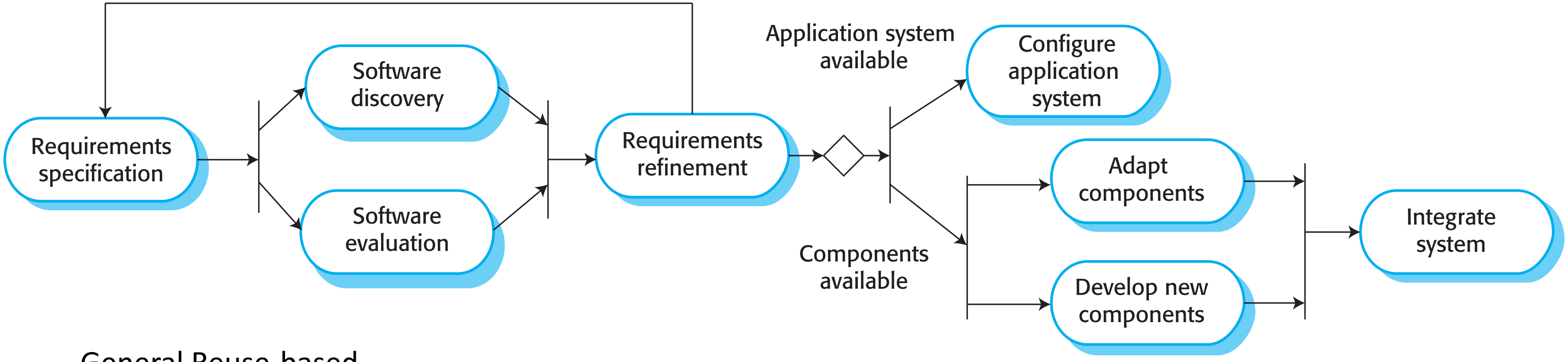
✘ “Not-invented-here” syndrome

✘…

Reuse in Practice

- Systematic vs. Ad hoc

- A disciplined process of software development
  1. (for reuse) Design and development of reusable components
  2. (with reuse) Utilization of reusable components



General Reuse-based
Software Development

Legal and Contractual Issues

- Liability in case of failure of a reused component
- Ownership of reused components
- Maintenance costing
- Security of potentially reusable components

Software Reuse
&
OO Design and Programming

Reuse Approaches & Techniques

Application Frameworks

Application System Reuse

Component-Based System Engineering

Software Product Lines

…

Approaches

Application Frameworks

- A framework is a generic structure that is extended to create a more specific subsystem or application.

Application System Reuse

- An application system is adapted to the needs of different customers without changing the source code of the system.

1. Configurable systems
   - Configurable modules, Configuration process
2. Integrated systems
   - API, service interfaces, …
   - Adapter, Wrapper, …

Underlying Principles

- Independent components
- well-defined interfaces
- Reusable infrastructure
- CBSE-tailored Dev. Process
- …

Approaches

Component-Based System Engineering

- Domain Engineering
  - Identify, construct, catalog, and disseminate a set of software components

    => library of reusable components

- Component Qualification
  - Does a component “fit” …?

- Component Adaptation & Composition
  - Wrapper
  - Adapter, APIs, ….

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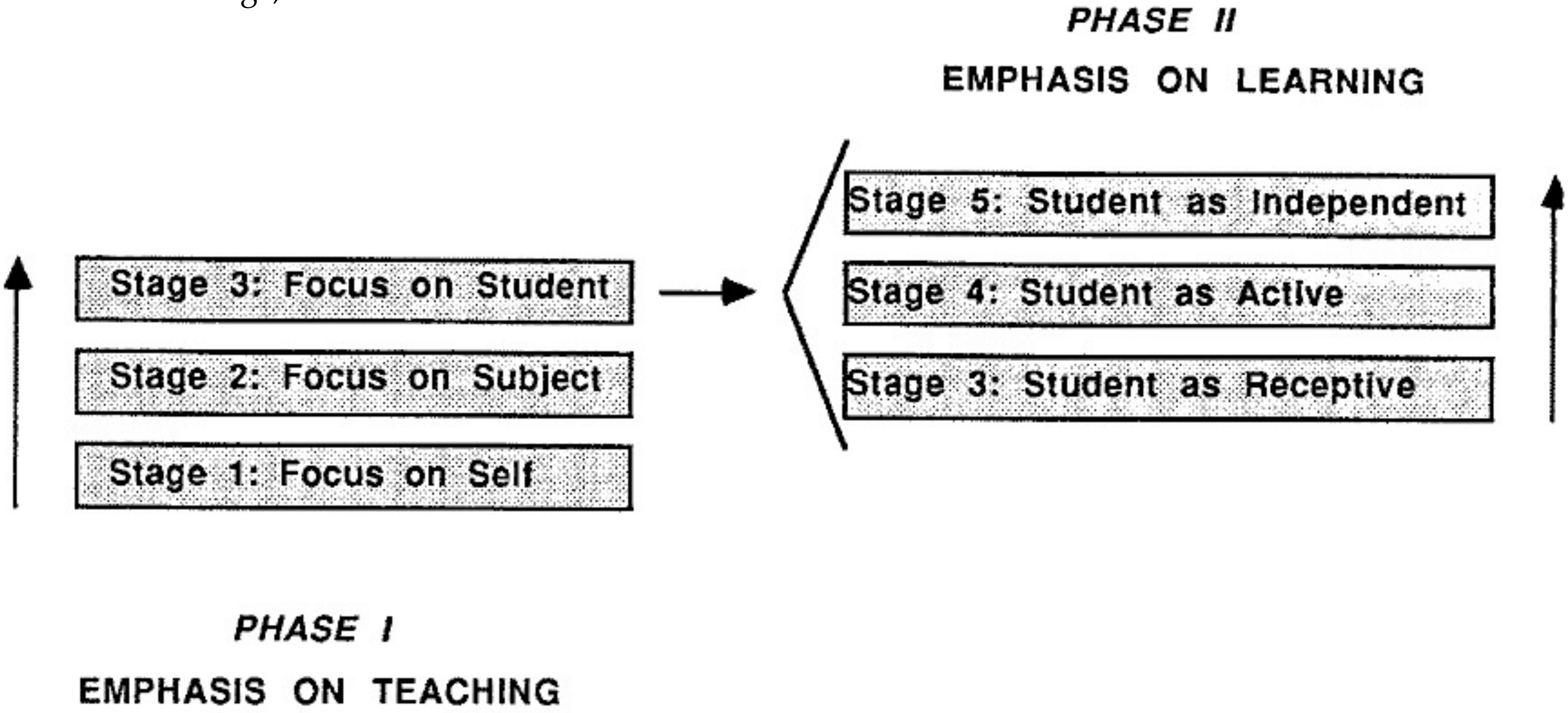
How Professors Develop as Teachers

PETER KUGEL
Boston College, USA



PHASE II

EMPHASIS ON LEARNING

Stage 5: Student as Independent

Stage 4: Student as Active

Stage 3: Student as Receptive

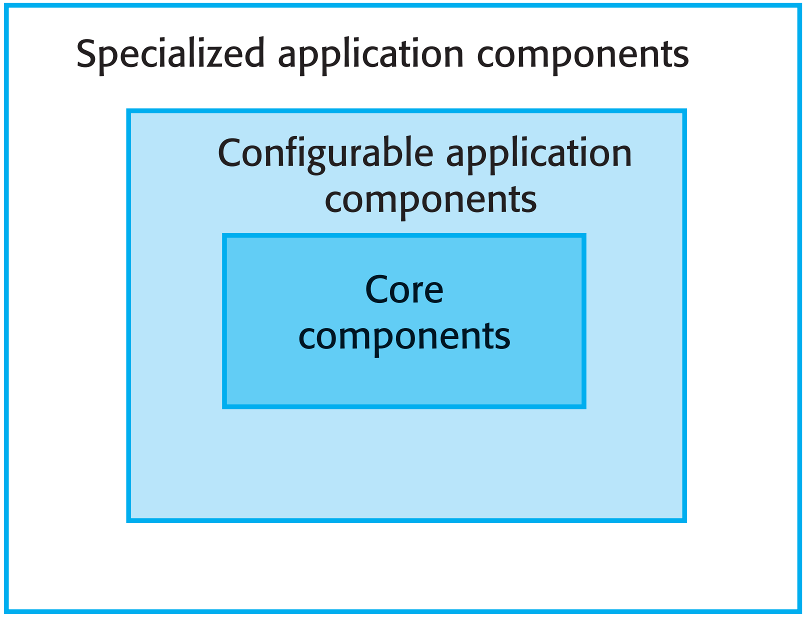
Stage 3: Focus on Student

Stage 2: Focus on Subject

Stage 1: Focus on Self

PHASE I

EMPHASIS ON TEACHING

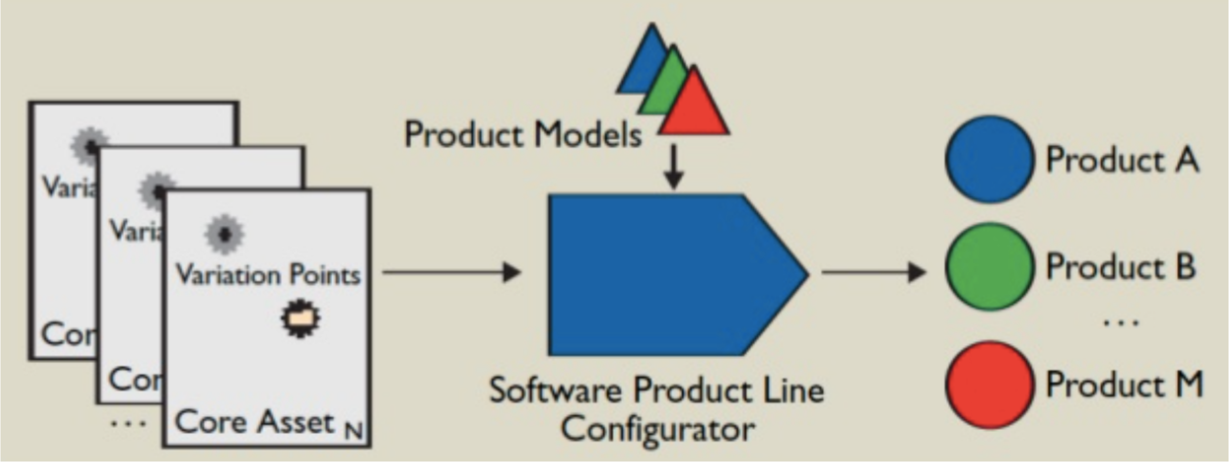

Specialized application components
Configurable application components
Core components

Software Product Lines

A software product line is a **set** of applications with a **common architecture** and shared components, with each application **specialized** to reflect specific customer requirements.

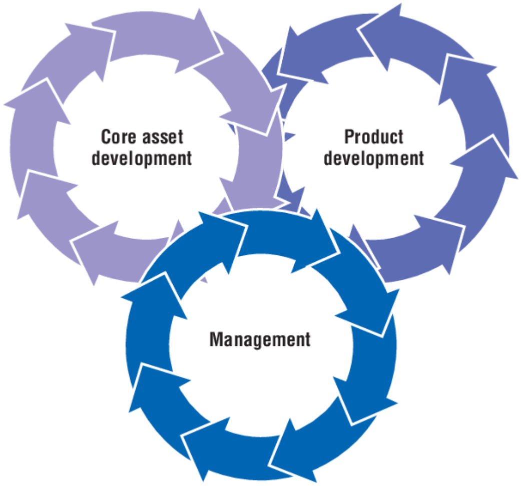
Families of Software Products

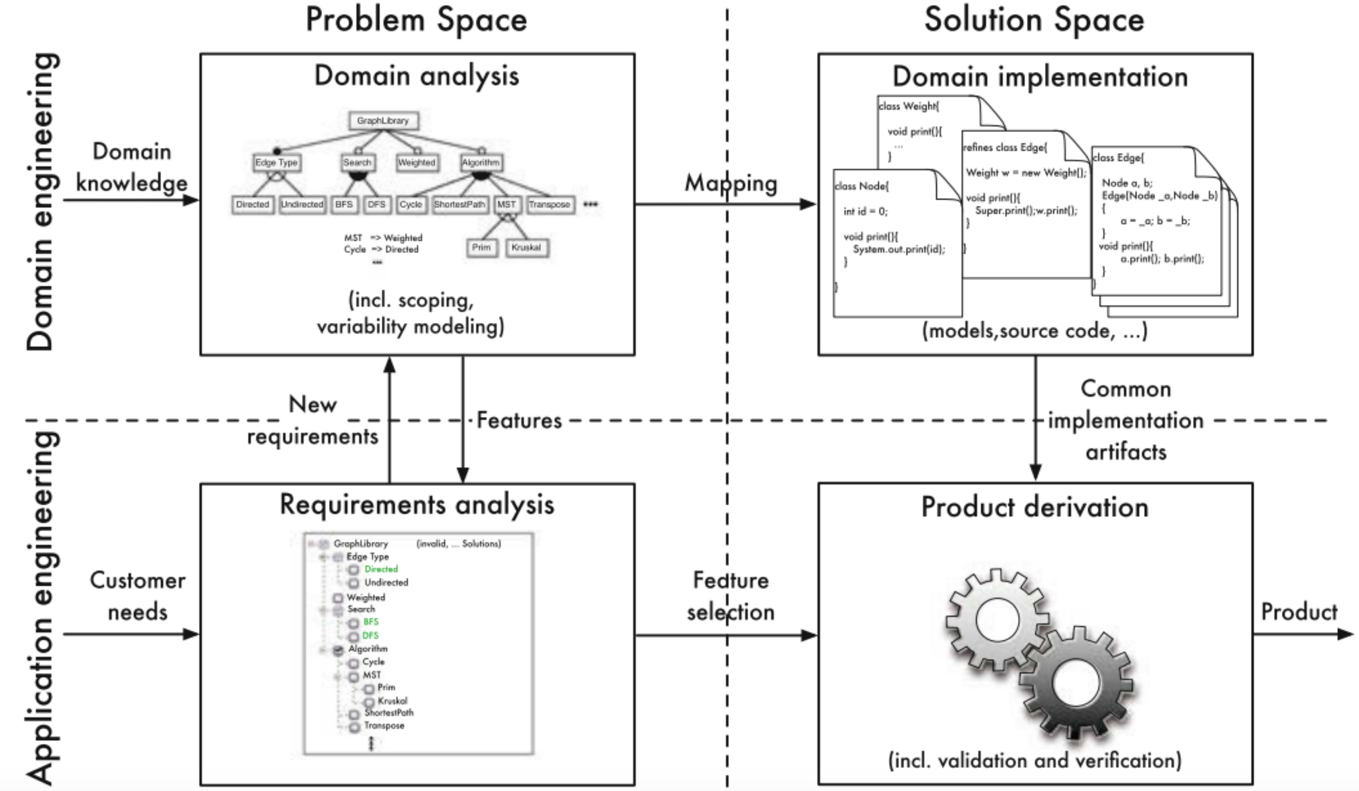
Software Product Line



- Core Asset for the basis of an SPL.
  - The **architecture**, reusable software components, domain models, requirements statements, documentation and specifications, performance models, schedules, budgets, test plans, test cases, work plans, and process descriptions
- Production Plan, SPL Configurator, …
  - How products are produced from the core assets.

Product Line Engineering





```
class Weight{

  void print(){
   ...
  }
```

```
class Node{

  int id = 0;

  void print(){
    System.out.print(id);
  }

}
```

```
refines class Edge{

 Weight w = new Weight();

 void print(){
   Super.print();w.print();
 }

}
```

```
class Edge{

  Node a, b;
  Edge(Node _a,Node _b)
  {
       a = _a; b = _b;
  }
 void print(){
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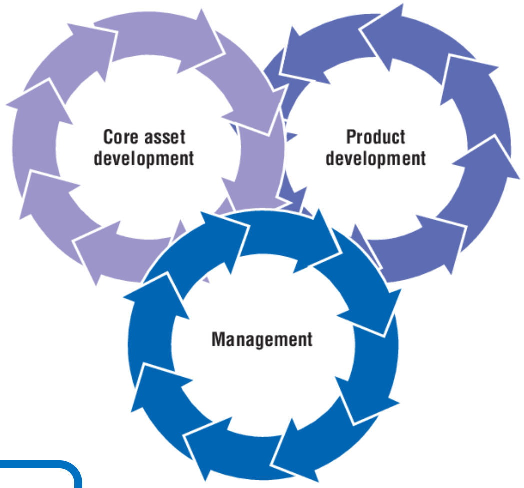
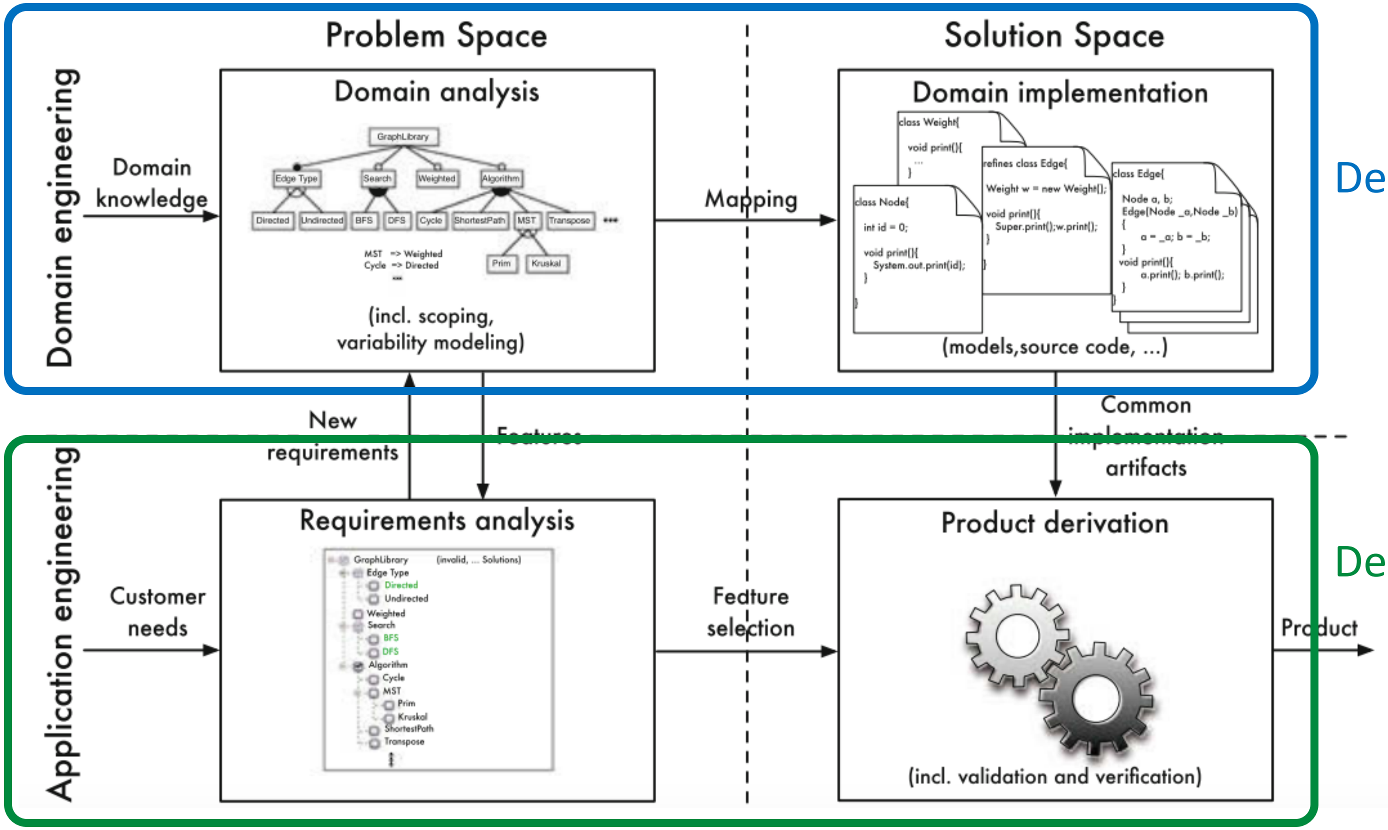
  }
}
```

Product Line Engineering





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}
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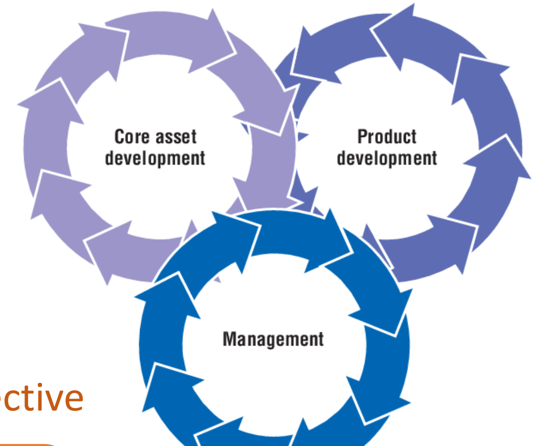
Dev. for reuse

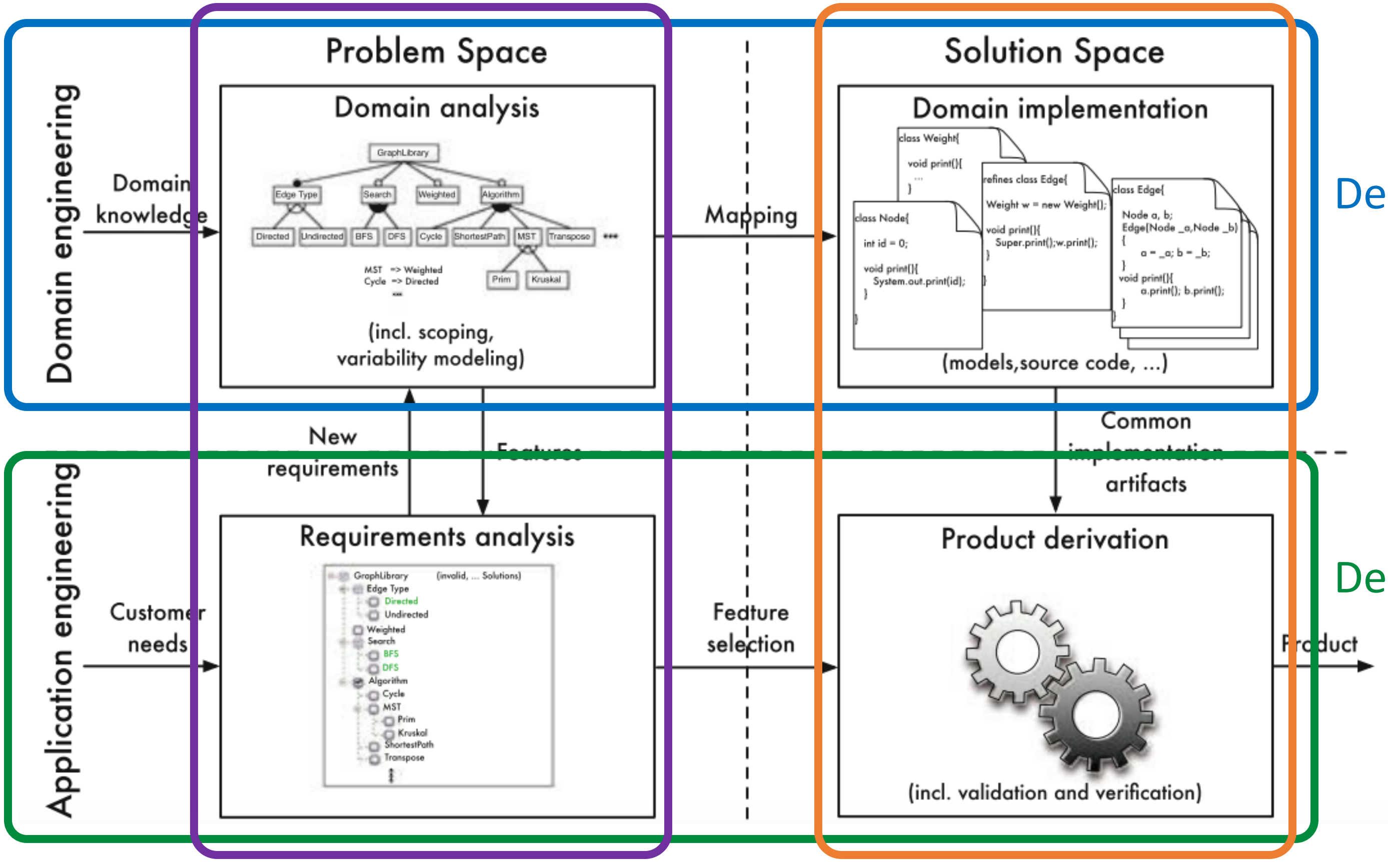
Dev. with reuse

Product Line Engineering



Problem Domain perspective

Implementation perspective



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  }
 void print(){
       a.print(); b.print();
  }
}
```

```
GraphLibrary        (invalid, ... Solutions)
  Edge Type
    Directed
    Undirected
  Weighted
  Search
    BFS
    DFS
  Algorithm
    Cycle
    MST
      Prim
      Kruskal
    ShortestPath
    Transpose
```

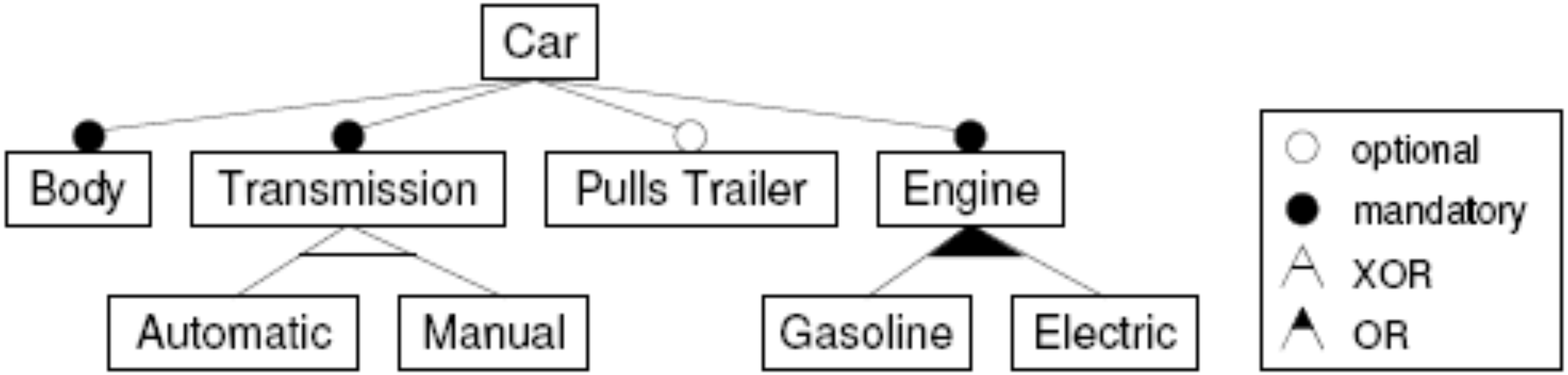
Dev. for reuse

Dev. with reuse

Domain Analysis

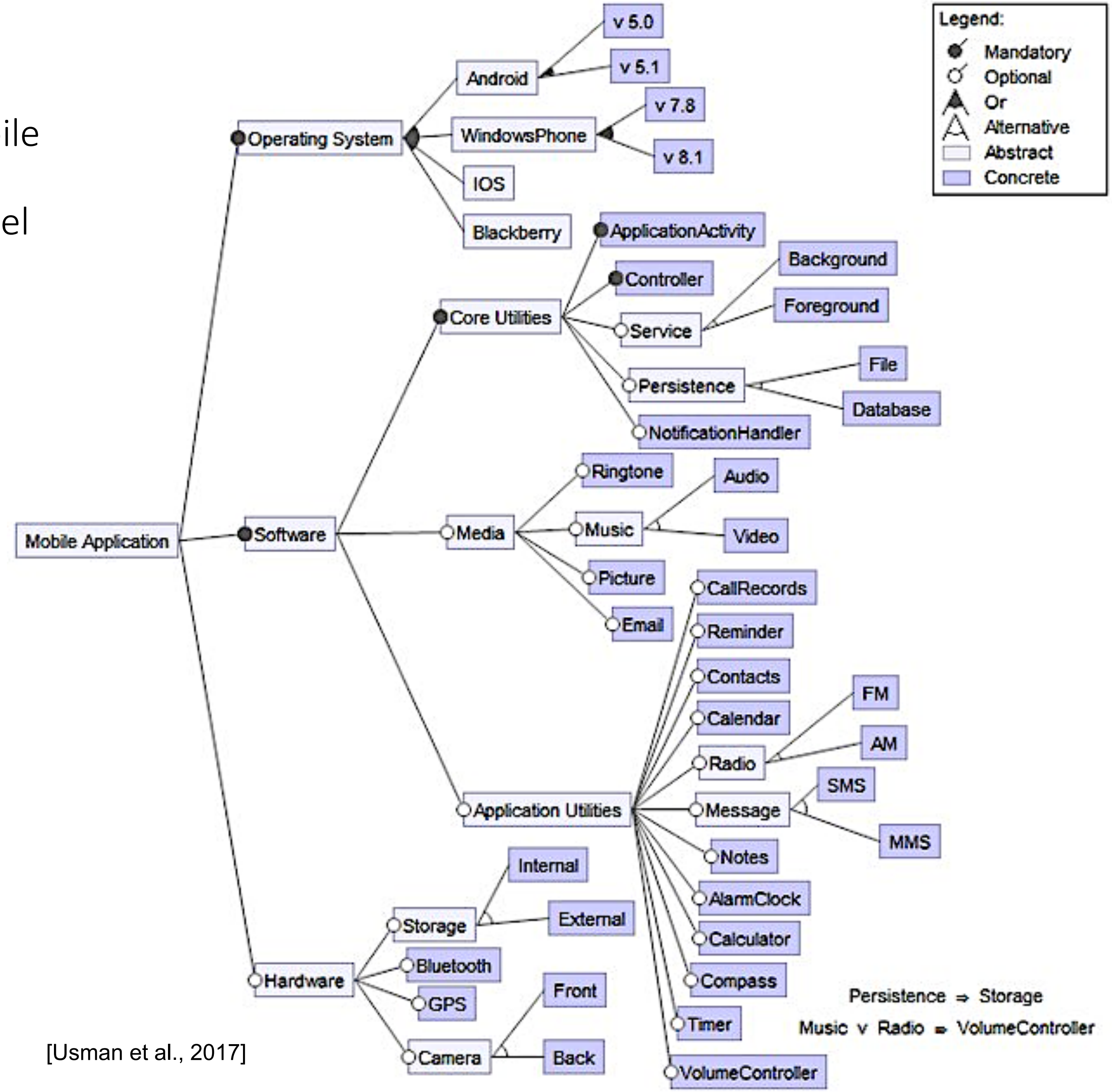
- Domain Scoping
  - Deciding on product line's extent or range

- Domain Modelling
  - Captures & documents the commonalities & variabilities
  - E.g., Feature Model
  - Feature-Oriented SPL



Feature Model - Document the features of a product line & their relationships

Generic Mobile Application Feature Model

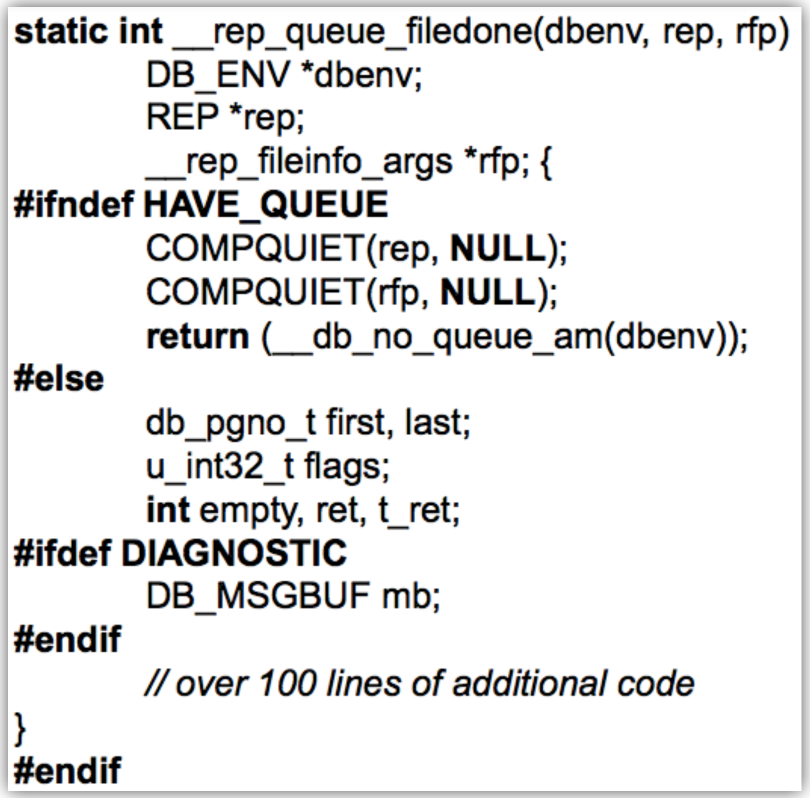


[Usman et al., 2017]

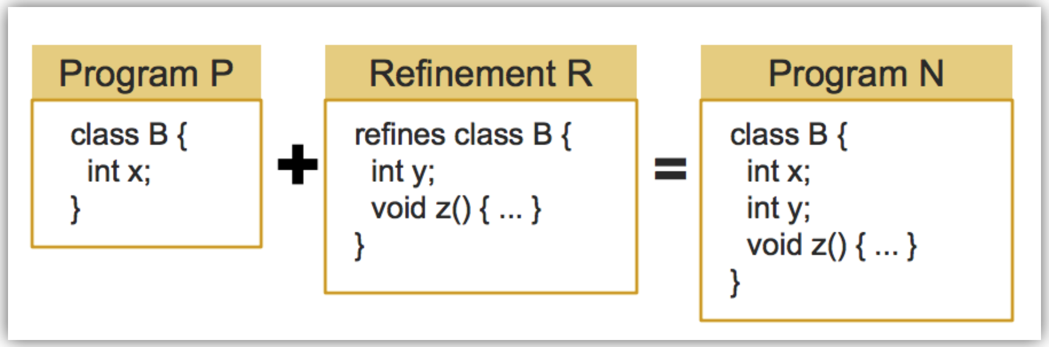
Domain Implementation

- Binding times
  - Compile-time, load-time, and run-time
- Representation
  - Annotation vs composition

- Variability Implementation
  - Parameters, Design patterns, Build systems, Preprocessors, FOP, AOP, DOP, …



```
static int __rep_queue_filedone(dbenv, rep, rfp)
        DB_ENV *dbenv;
        REP *rep;
        __rep_fileinfo_args *rfp; {
#ifndef HAVE_QUEUE
        COMPQUIET(rep, NULL);
        COMPQUIET(rfp, NULL);
        return (__db_no_queue_am(dbenv));
#else
        db_pgno_t first, last;
        u_int32_t flags;
        int empty, ret, t_ret;
#ifdef DIAGNOSTIC
        DB_MSGBUF mb;
#endif
        // over 100 lines of additional code
}
#endif
```



Program P

```
class B {
  int x;
}
```

➕

Refinement R

```
refines class B {
  int y;
  void z() { ... }
}
```

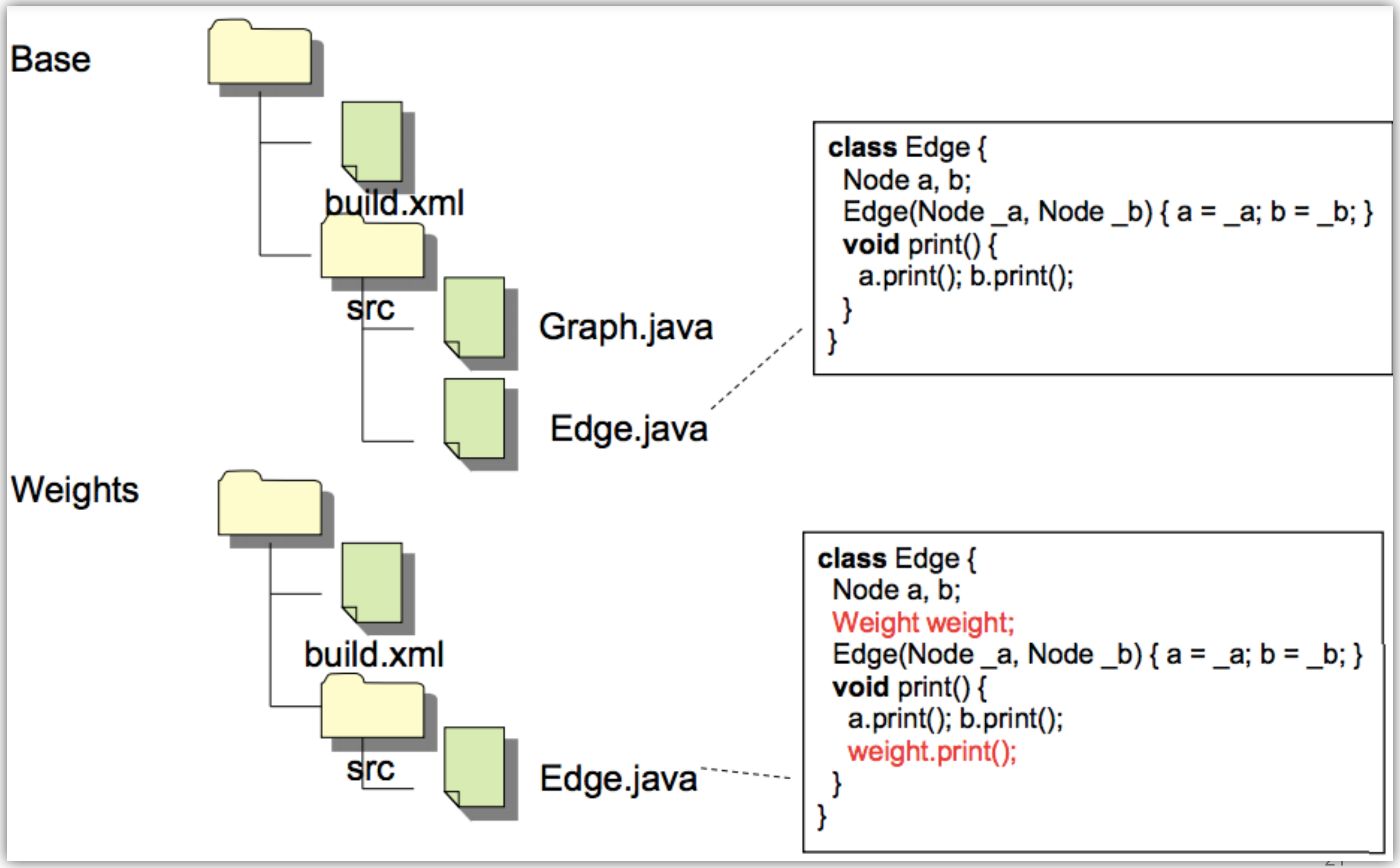
=

Program N

```
class B {
  int x;
  int y;
  void z() { ... }
}
```

DeltaJava

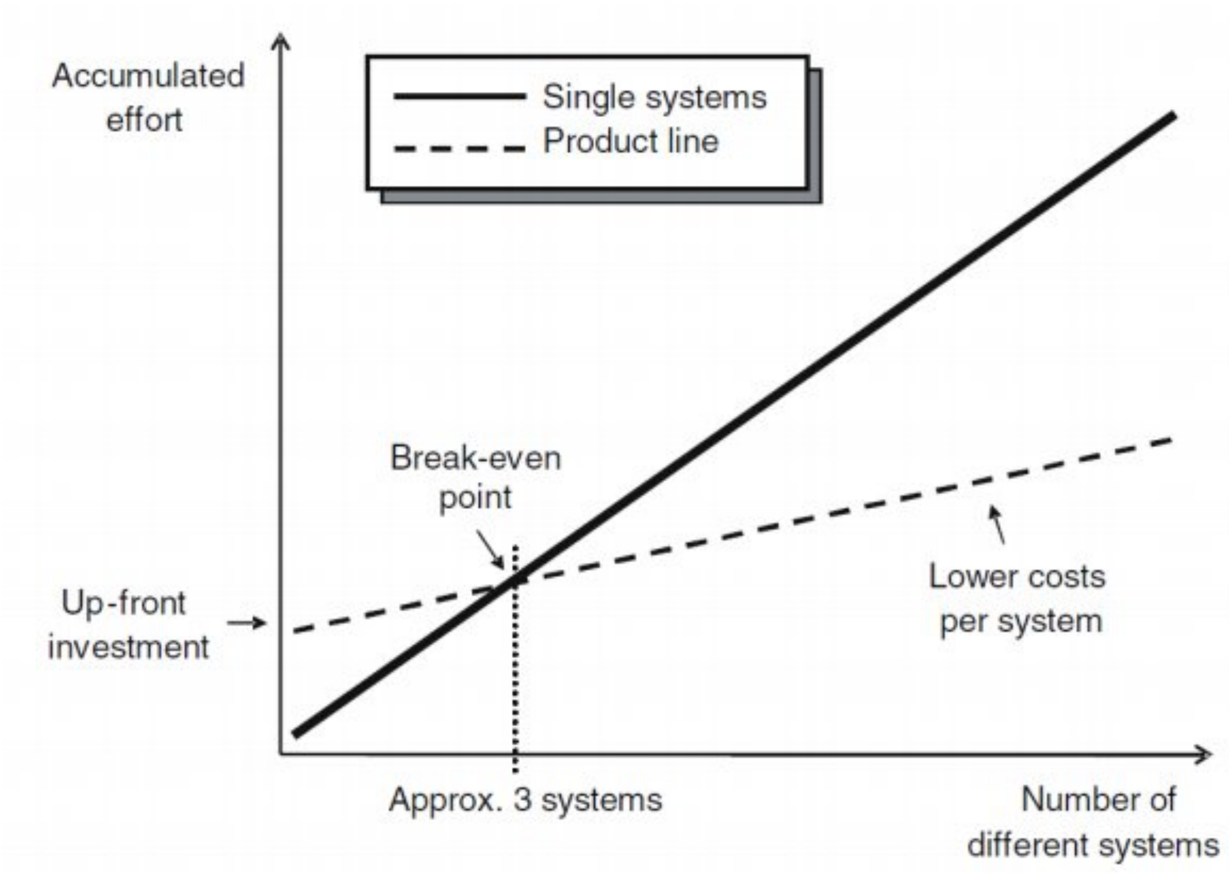
Build Systems



```
class Edge {
  Node a, b;
  Edge(Node _a, Node _b) { a = _a; b = _b; }
  void print() {
    a.print(); b.print();
  }
}
```

```
class Edge {
  Node a, b;
  Weight weight;
  Edge(Node _a, Node _b) { a = _a; b = _b; }
  void print() {
    a.print(); b.print();
    weight.print();
  }
}
```

Economics of SPL



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lowcomote

Low-code development platforms (LCDP) are software development platforms on the Cloud, provided through a Platform-as a-Service model, which allow users to build completely operational applications by interacting through dynamic graphical user interfaces, visual diagrams and declarative languages. They address the need of non-programmers to develop personalised software, and focus on their domain expertise instead of implementation requirements.

https://www.lowcomote.eu/

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BT

intecs Solutions the Brainware company

UGROUND

CLMS

IncQueryLabs

SPARX SYSTEMS

METADEV

THE Open GROUP

aws

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