**Regression Testing in Product Lines
- Theory and Practice**

Professor Per Runeson

Product Line Principles

- Reuse of common assets, primarily through configuration
- Product line development saves development effort
- Product line testing expensive – if brute force is used

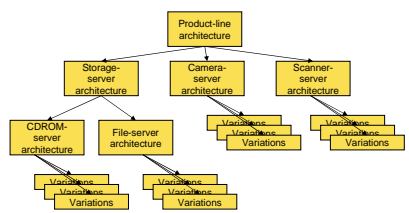**Key term: Variability**

In theory:
- Well defined
- Well controlled

In practice:
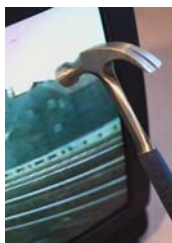- Indentified in hindsight
- Defined at various levels

[Bosch00]

Testing Purposes

- Reveal faults
- Build trust

" The Testing Paradox"

Regression testing

"Retesting...to ensure that the new version of the software has retained the capability of the old version"

[Burnstein02]

Within project/product regression
Across project/product regression

Regression test selection

	Manual	Automated
Small programs	Analysis based	Retest all, e.g. TDD
Large systems	Risk based Change based	Utopia

Product Line Processes [Pohl et al 05]
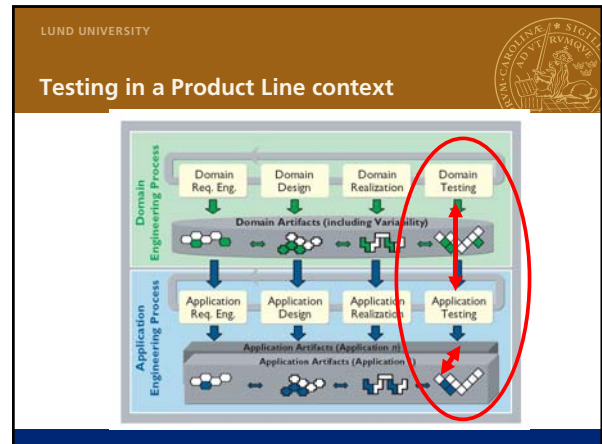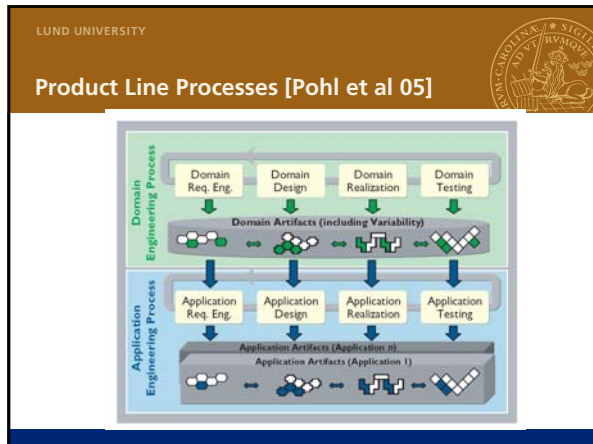
Testing in a Product Line context
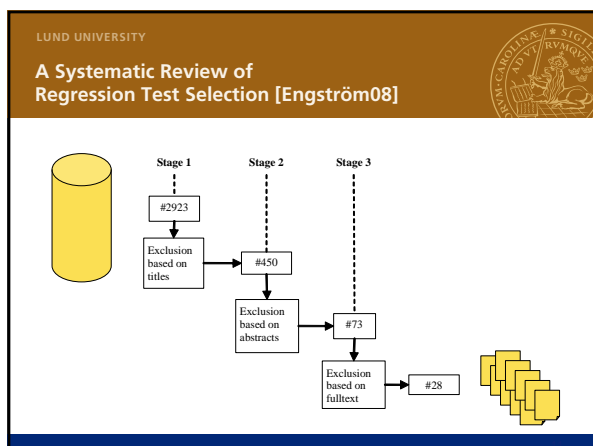
Test strategies

- Brute Force Strategy – test everything at domain level
- Pure Application Strategy – test everything at application level
- Sample Application Strategy – test a sample at domain level, and the full application testing
- Commonality and Reuse Strategy – test common parts at domain level, and variability at application level

Evaluation [Pohl05]

	Time to create	Absent variants	Early validation	Learning effort	Overhead
(BFS)	-	-	+	0	-
(PAS)	0	+	-	+	-
SAS	0	+	+	+	-
CRS	+	+	0	-	+
SAS+ CRS	+	+	+	0	0

A Systematic Review of Regression Test Selection [Engström08]

Studies overview

Table 6 Studies of different type and size

Type of studies	Size of subjects under study	Number of studies	%
Experiment	Large	1	3
Experiment	Medium	7	18
Experiment	Small	15	39
Case study	Large	4	11
Case study	Medium	5	13
Case study	Small	4	11
Case study	Not reported	2	5
	Total	38	100

Good control

Good relevance

Regression Test Selection – Principles


```
Change
information
           ↓
Test          Test trace        Test          Test cases
execution  →  information  →   selection  →
```

What do we know about regression testing techniques?

- 38 studies of 32 techniques

- T2 (minimization) - efficient but not safe
- T6 (slicing) - safe but costly analysis
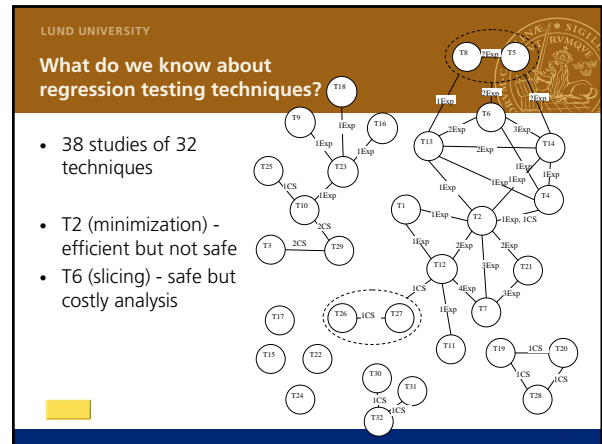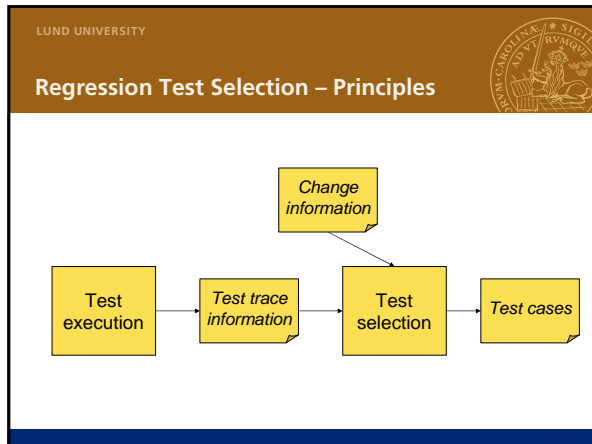
Future research

- Scale up: 100 LOC –> 10 KLOC –> 0,7 MLOC –> ?? MLOC
- Case study: risk based regression testing – Effectiveness?
- Survey: regression testing practices – Volunteers?

Summary

- Potential for saving on product-line regression testing
- Trade-off between domain and application testing
- Investigations on technical level exist
- Strategic level research needed

References

Bosch (2000) *Design and Use of Software Architectures*, Addison-Wesley

Burnstein (2002) *Practical Software Testing*, Springer

Engström, Skoglund, Runeson (2008) Empirical Evaluations of Regression Test Selection Techniques: A Systematic Review, *Proceedings of Empirical Software Engineering and Measurements (ESEM)*

Pohl , Böckle, van der Linden (2005) *Software Product Line Engineering*, Springer

Skoglund, Runeson (2007) Improving Class Firewall Regression Test Selection by Removing the Class Firewall *International Journal of Software Engineering and Knowledge Engineering* 17(3):359-378