17-708 SOFTWARE PRODUCT LINES: CONCEPTS AND IMPLEMENTATION

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INSTITUTE OF SOFTWARE RESEARCH

MOTHERS®
Polishes•Waxes•Cleaners

BUILD & PRICE YOUR 2016 IMPALA

Chat Now With An Impala Specialist

1 Trim — 2 Colors & Wheels — 3 Options — 4 Accessories — 5 Summary

2016 Impala LS

Price

$27,920* OR

Please see your dealer for payment information

View Standard Equipment

View: Package Mechanical Exterior Interior Safety

Package

☐	Protection Package	$570
☐	All-Weather Mat Protection Package	$200

Mechanical

☑	ECOTEC 2.5L DOHC 4-cylinder engine with direct injection (DI), Variable Valve Timing (VVT) and auto start/stop	Standard
☐	Engine block heater	$75

Exterior

◉	No Selection	$0
○	18" chrome finish aluminum wheels	$2,500
○	18" aluminum wheels	$1,500
○	19" aluminum wheels	$3,530
☐	Rear spoiler	$425
☐	Body-color surround grille	$595

Exterior: Front Back Side Interior: Front Side

Some selected configurations, options, accessories, and/or colors may not be shown on image.

MASS CUSTOMIZATION IN CAR PRODUCTION

30 years ago

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15 years ago

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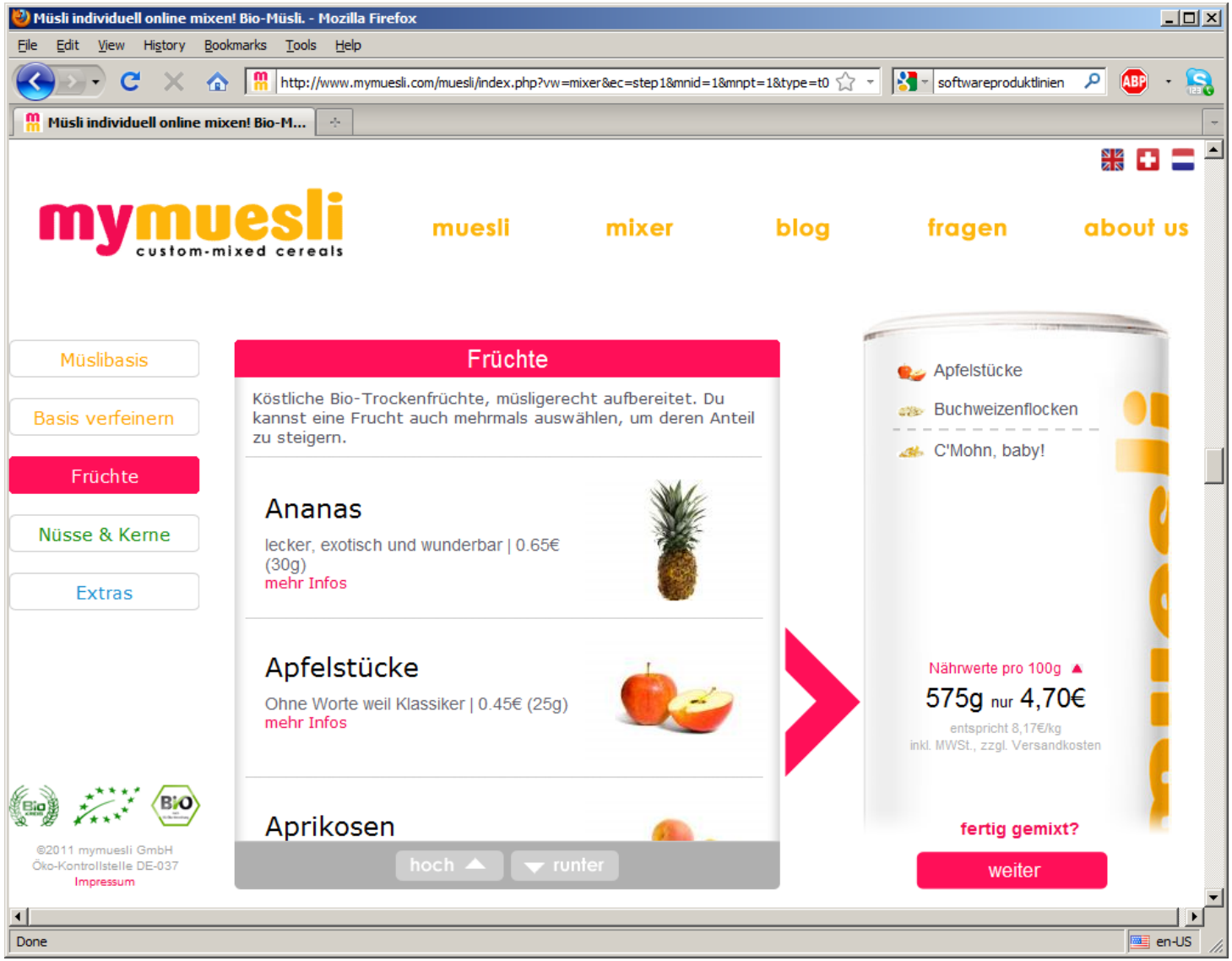
Müsli individuell online mixen! Bio-Müsli. - Mozilla Firefox
File Edit View History Bookmarks Tools Help
http://www.mymuesli.com/muesli/index.php?vw=mixer&ec=step1&mnid=1&mnpt=1&type=t0
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mymuesli
custom-mixed cereals
muesli
mixer
blog
fragen
about us
Müslibasis
Basis verfeinern
Früchte
Nüsse & Kerne
Extras
Früchte
Köstliche Bio-Trockenfrüchte, müsligerecht aufbereitet. Du kannst eine Frucht auch mehrmals auswählen, um deren Anteil zu steigern.
Ananas
lecker, exotisch und wunderbar | 0.65€ (30g)
mehr Infos
Apfelstücke
Ohne Worte weil Klassiker | 0.45€ (25g)
mehr Infos
Aprikosen
hoch
runter
Apfelstücke
Buchweizenflocken
C'Mohn, baby!
Nährwerte pro 100g
575g nur 4,70€
entspricht 8,17€/kg
inkl. MWSt., zzgl. Versandkosten
fertig gemixt?
weiter
©2011 mymuesli GmbH
Öko-Kontrollstelle DE-037
Impressum
Done
en-US

VEGETARIAN

WHICH WICH WOULD YOU LIKE?

- ○ TRIPLE CHEESE MELT
- ○ ELVIS WICH (PB, Honey & Banana)
- ○ TOMATO & AVOCADO
- ○ BLACK BEAN PATTY
- ● HUMMUS & BELL PEPPERS

CHOOSE YOUR BREAD

○ WHITE ● WHEAT

CHOOSE YOUR CHEESE (Optional)

○ AMERICAN ○ SWISS ○ PROVOLONE
○ CHEDDAR ● PEPPER JACK ○ MOZZARELLA

How Would You Like Your WICH Worked?

MUSTARDS
○ Yellow ○ Dijon ○ Honey ● Deli

MAYOS
○ Regular ○ Lite ○ Horseradish ● Spicy

SPREADS & SAUCES
○ BBQ ○ Buffalo ○ Marinara
○ 1000 Island ○ Ranch

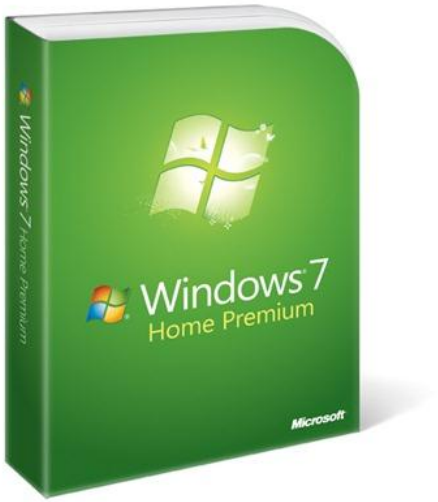
ONIONS
● Red ○ Grilled ○ Crispy Strings

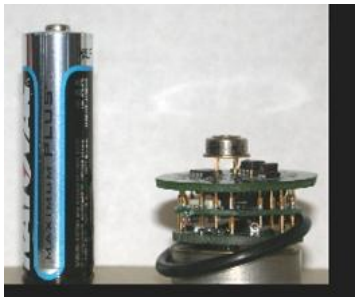
VEGGIES
● Lettuce ● Tomato ○ Pickles ● Jalapenos
● Olive Salad ○ Mushrooms ○ Sauerkraut
○ Coleslaw ○ Bell Peppers

OILS & SPICES
○ Oil ○ Vinegar
● Salt ● Pepper ○ Oregano ○ Parmesan

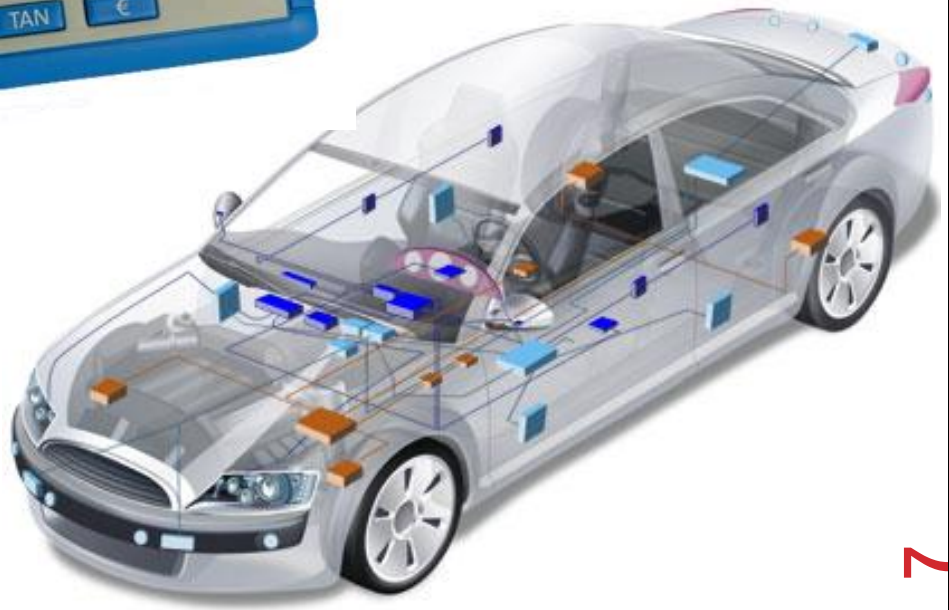
EXTRAS (.75¢ Each)
○ Bacon ○ Avocado ○ Pickle (Whole)
○ Mare Meat ○ More Cheese

SOFTWARE BETWEEN STANDARDIZATION AND SPECIALIZATION





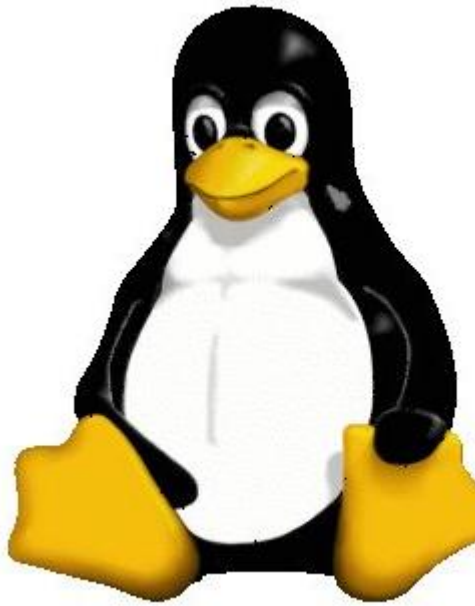
ORACLE®

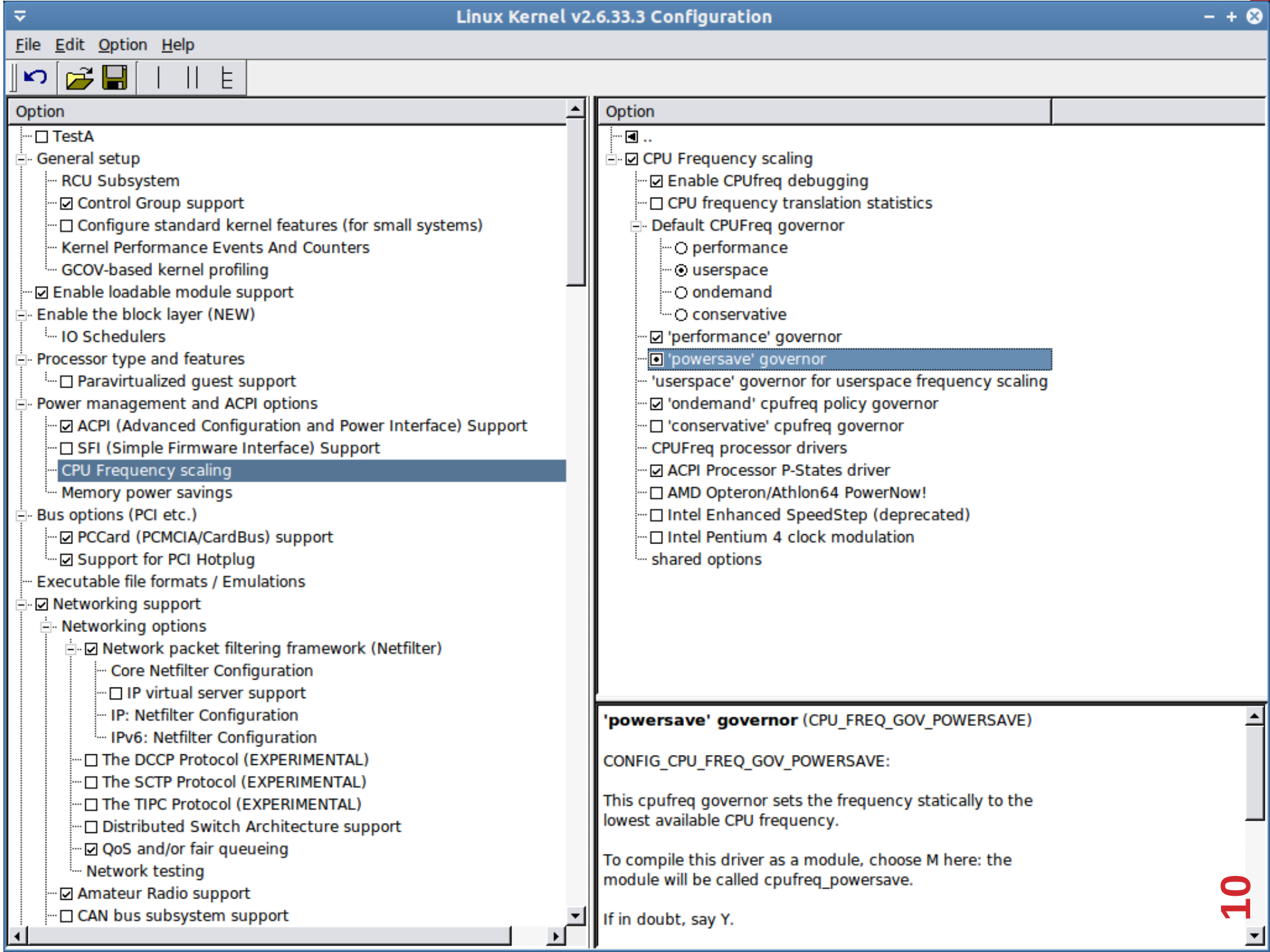


Printer Firmware

LINUX KERNEL

- ~6 000 000 Lines of C code
- Highly configurable
- > 10.000 configuration options! (x86, 64bit, …)
- Most source code is “optional”




Linux Kernel v2.6.33.3 Configuration
File Edit Option Help
Option
TestA
General setup
RCU Subsystem
Control Group support
Configure standard kernel features (for small systems)
Kernel Performance Events And Counters
GCOV-based kernel profiling
Enable loadable module support
Enable the block layer (NEW)
IO Schedulers
Processor type and features
Paravirtualized guest support
Power management and ACPI options
ACPI (Advanced Configuration and Power Interface) Support
SFI (Simple Firmware Interface) Support
CPU Frequency scaling
Memory power savings
Bus options (PCI etc.)
PCCard (PCMCIA/CardBus) support
Support for PCI Hotplug
Executable file formats / Emulations
Networking support
Networking options
Network packet filtering framework (Netfilter)
Core Netfilter Configuration
IP virtual server support
IP: Netfilter Configuration
IPv6: Netfilter Configuration
The DCCP Protocol (EXPERIMENTAL)
The SCTP Protocol (EXPERIMENTAL)
The TIPC Protocol (EXPERIMENTAL)
Distributed Switch Architecture support
QoS and/or fair queueing
Network testing
Amateur Radio support
CAN bus subsystem support
Option
..
CPU Frequency scaling
Enable CPUfreq debugging
CPU frequency translation statistics
Default CPUFreq governor
performance
userspace
ondemand
conservative
'performance' governor
'powersave' governor
'userspace' governor for userspace frequency scaling
'ondemand' cpufreq policy governor
'conservative' cpufreq governor
CPUFreq processor drivers
ACPI Processor P-States driver
AMD Opteron/Athlon64 PowerNow!
Intel Enhanced SpeedStep (deprecated)
Intel Pentium 4 clock modulation
shared options
'powersave' governor (CPU_FREQ_GOV_POWERSAVE)
CONFIG_CPU_FREQ_GOV_POWERSAVE:
This cpufreq governor sets the frequency statically to the lowest available CPU frequency.
To compile this driver as a module, choose M here: the module will be called cpufreq_powersave.
If in doubt, say Y.
10

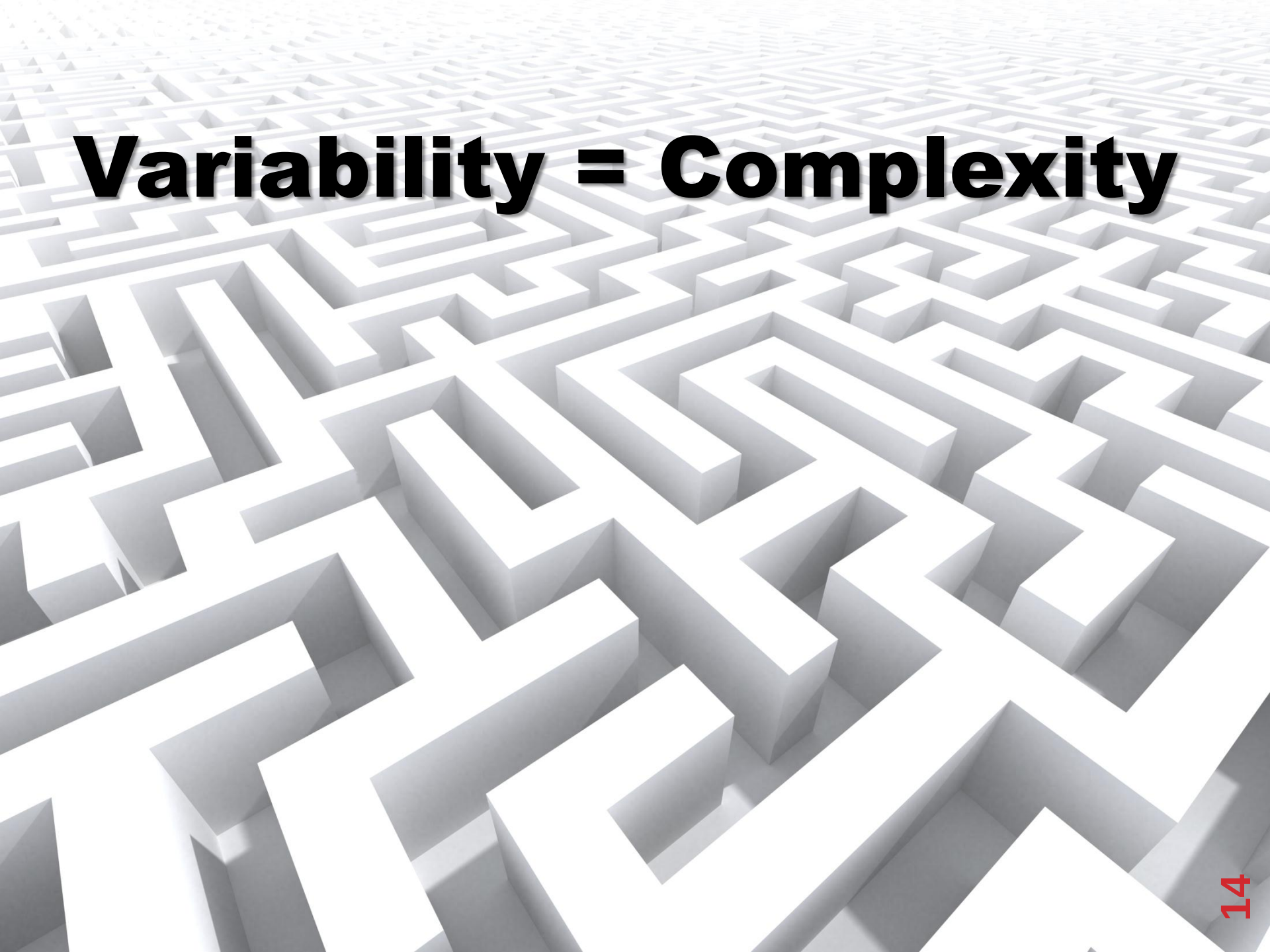
SOFTWARE PRODUCT LINES IN INDUSTRY

Boeing
Bosch Group
Cummins, Inc.
Ericsson
General Dynamics
General Motors
Hewlett Packard
Lockheed Martin
Lucent
NASA
Nokia
Philips
Siemens
…

Android Ecosystem

BUT

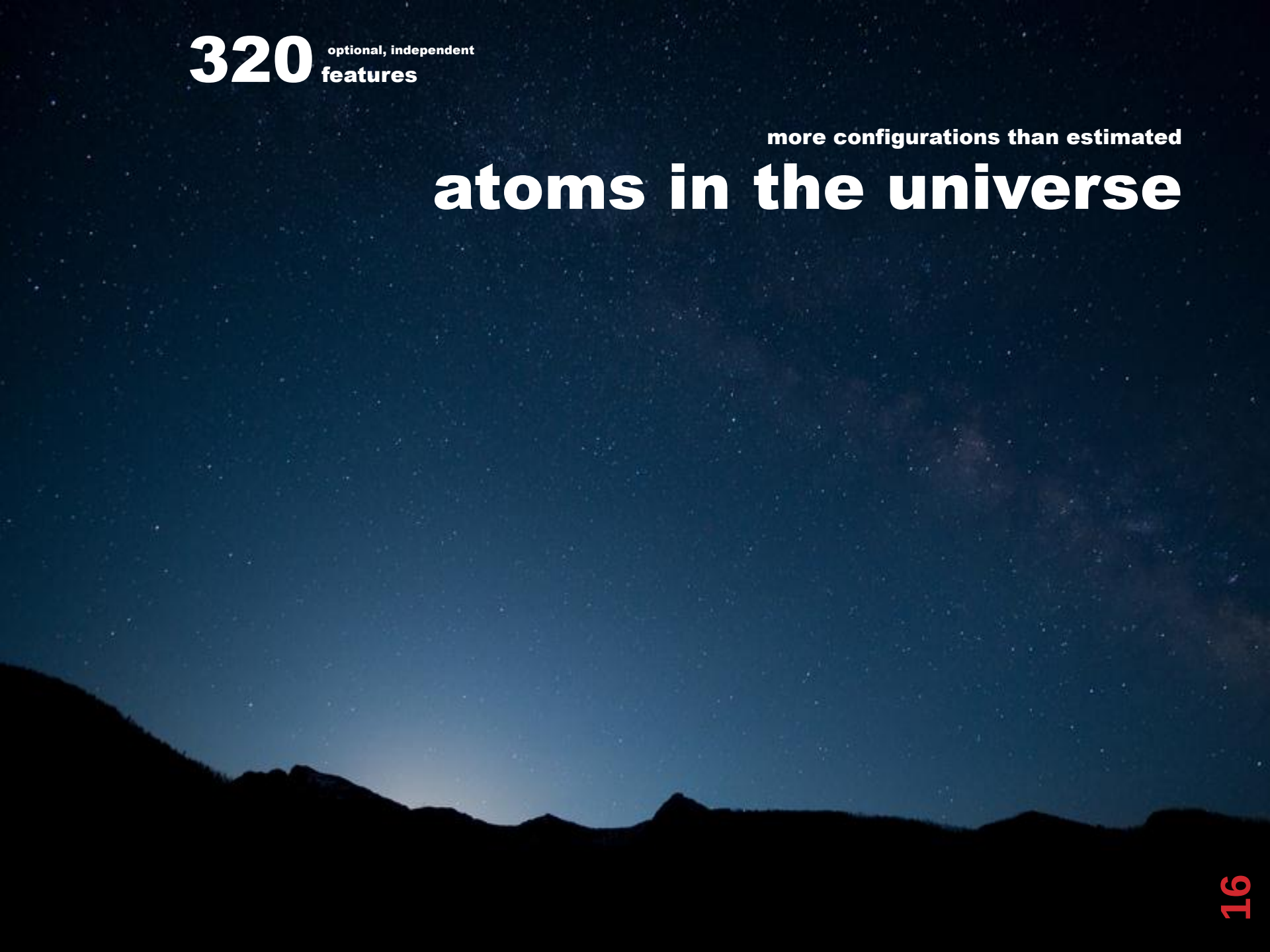
Variability = Complexity



33 optional, independent features

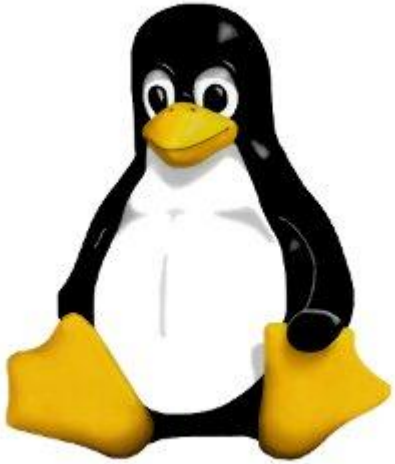
a unique configuration for every

person on this planet

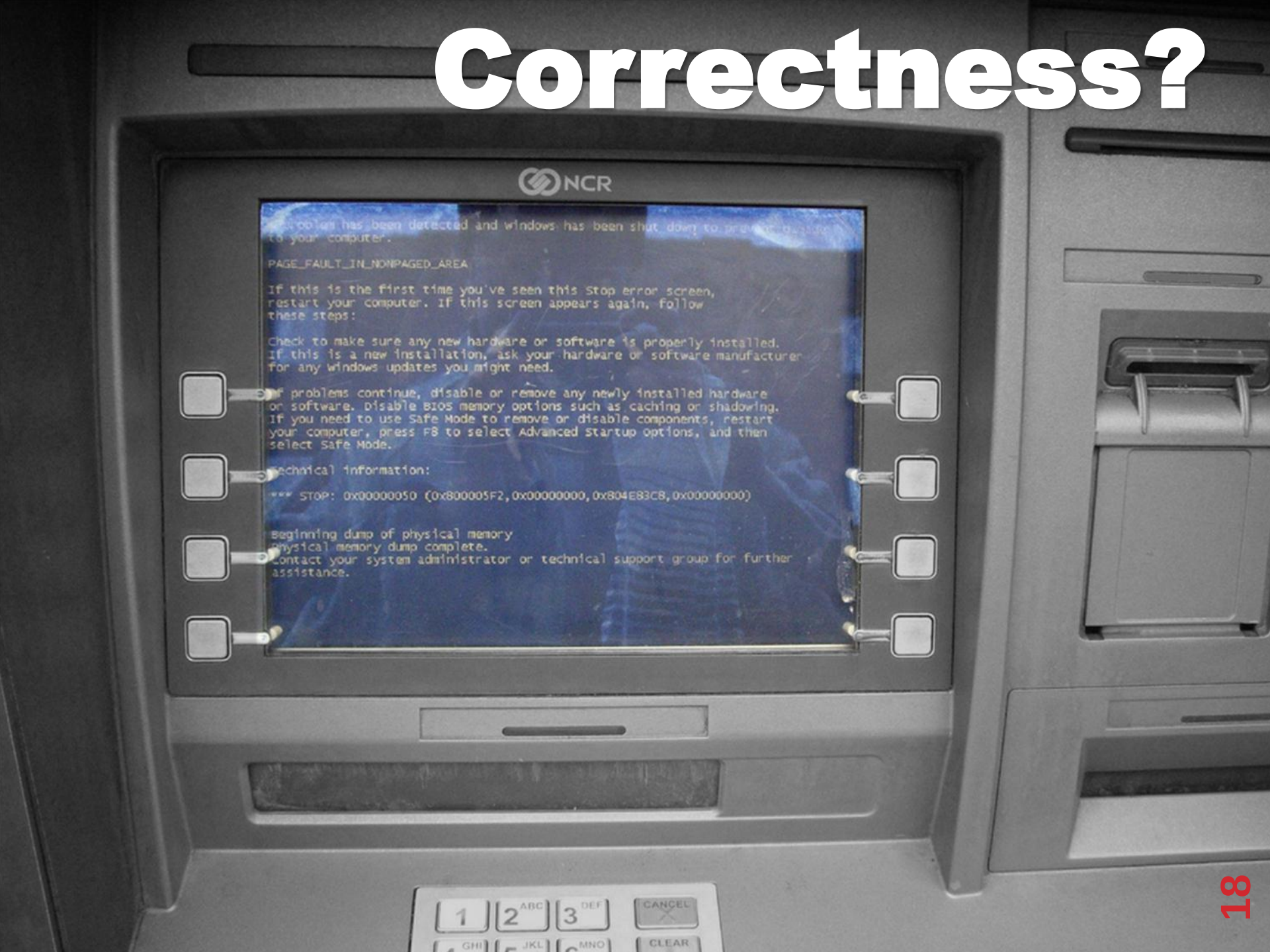

320
optional, independent
features
more configurations than estimated
atoms in the universe

2000 features

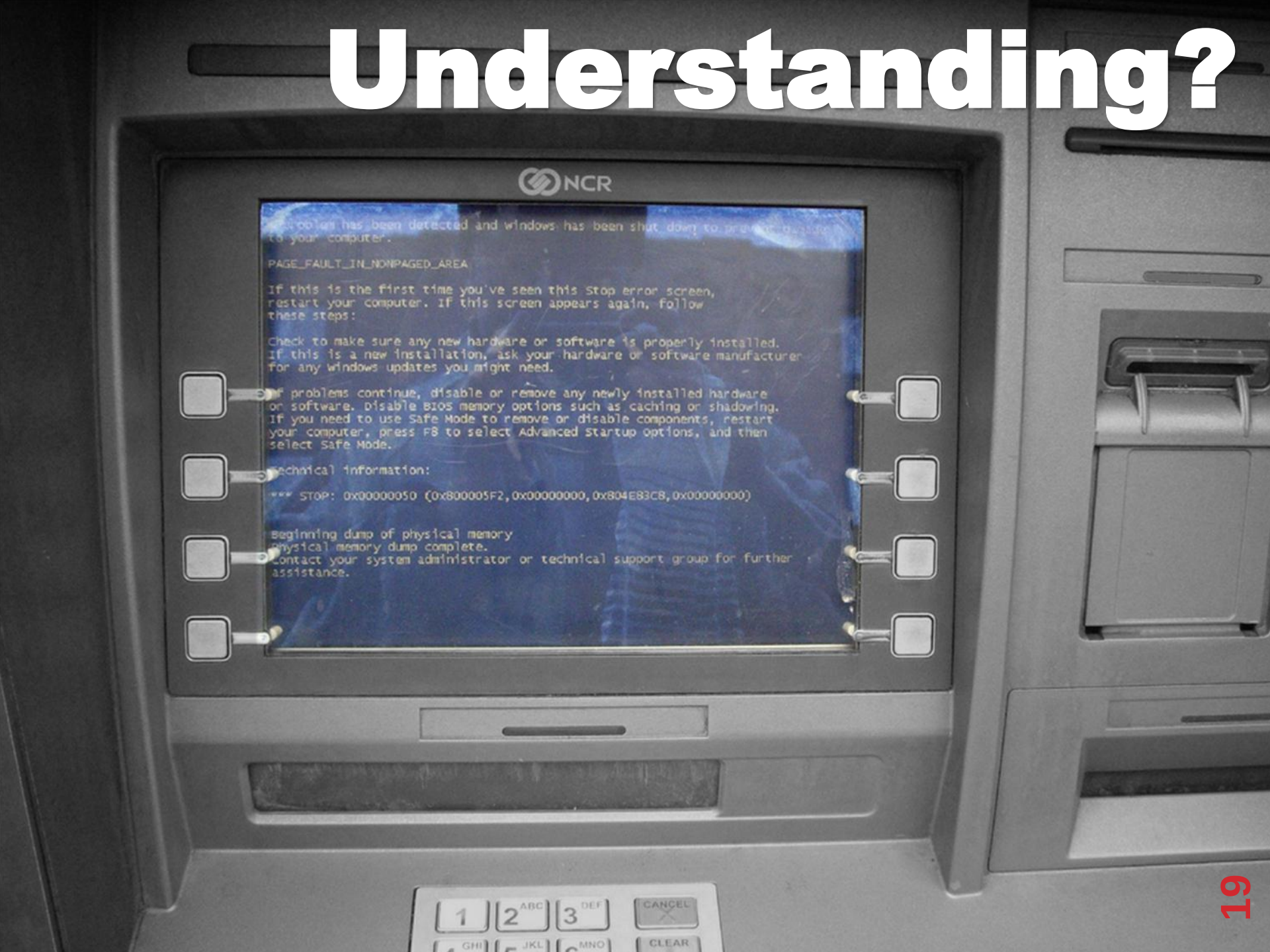
10000 features



Correctness?



Understanding?



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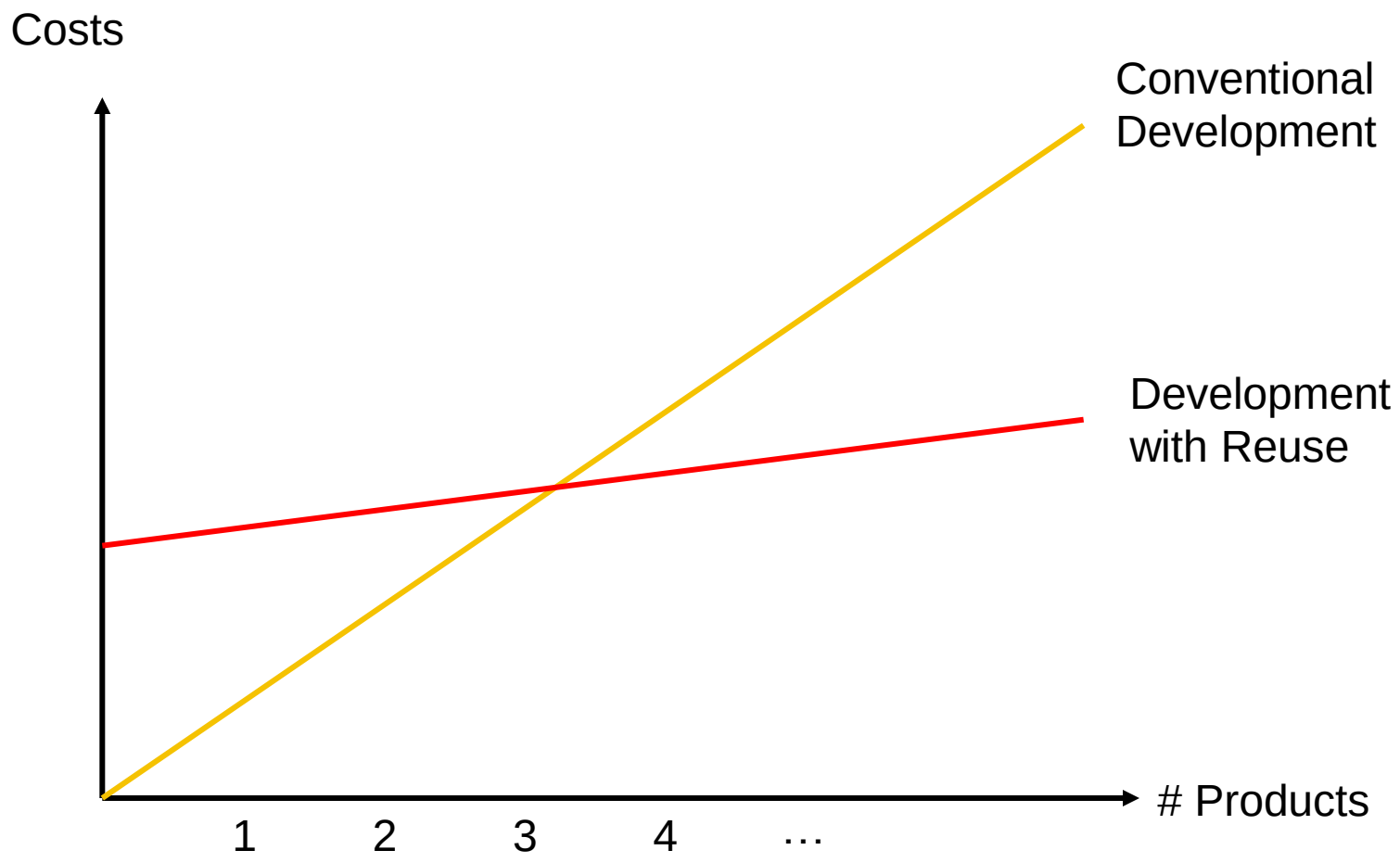
THE PROMISE


Costs
Conventional Development
Development with Reuse
Products
1
2
3
4
…

TOPICS

Process and Domain Engineering

Feature and decision models

Analysis of feature models

Product management, scoping

Variability in requirements

Version control systems, Parameters

Design patterns, architecture, components, frameworks, platforms

Build systems, preprocessors

Tradeoff and maintenance discussion (separation of concerns, modularity, traceability, ...)

Advanced Concepts: Feature-Oriented Programming, Aspect-Oriented Programming, Generators

Quality assurance: Testing and Analysis

Variability management

Team organization

Transition process, refactoring

ORGANIZATION

PREREQUISITES

Basic programming skills (any language, Java preferred)

Basic software engineering knowledge (e.g., process, requirements)

PROJECT

In the second half of the course

Connect course to your research / interests

Explore a topic in depth

Case study, experiment, …

Suggest a topic by Oct 14

Summarize results in a report (paper draft)

ASSIGNMENTS & READINGS

Weekly assignments

- **Small analysis, modeling, or implementation tasks**
- **Investigating open source implementations**
- **Due 11:59pm before class, expect in-class discussion**

Reading assignments for most classes

- **Book chapters and papers**
- **Background, context, case studies, …**
- **Expect in-class discussions**
- **see website for links**

GRADING

30% assignments, graded on 3-point likert scale:

- **exceeds expectations**
- **matches expectations**
- **below expectations**

30% project

30% exams

- **midterm Oct 14, final tbd.**

10% participation

HOMEWORK 1 (DUE NEXT WEEK)

Select an experience report Chapter 8—17 of *Software Product Lines in Action* (first come first serve)

- *http://link.springer.com/book/10.1007%2F978-3-540-71437-8*

Prepare a 10 minute presentation

- Context
- Why a software product line?
- Development using domain/application engineering
- Goals, benefits, surprises, and challenges

READING ASSIGNMENT (WEDN.)

Apel, S., Batory, D., Kaestner, C., & Saake, G. (2013). Feature-Oriented Software Product Lines. Berlin: Springer.

pages 3-31 (chapters 1 & 2 until 2.3.2)

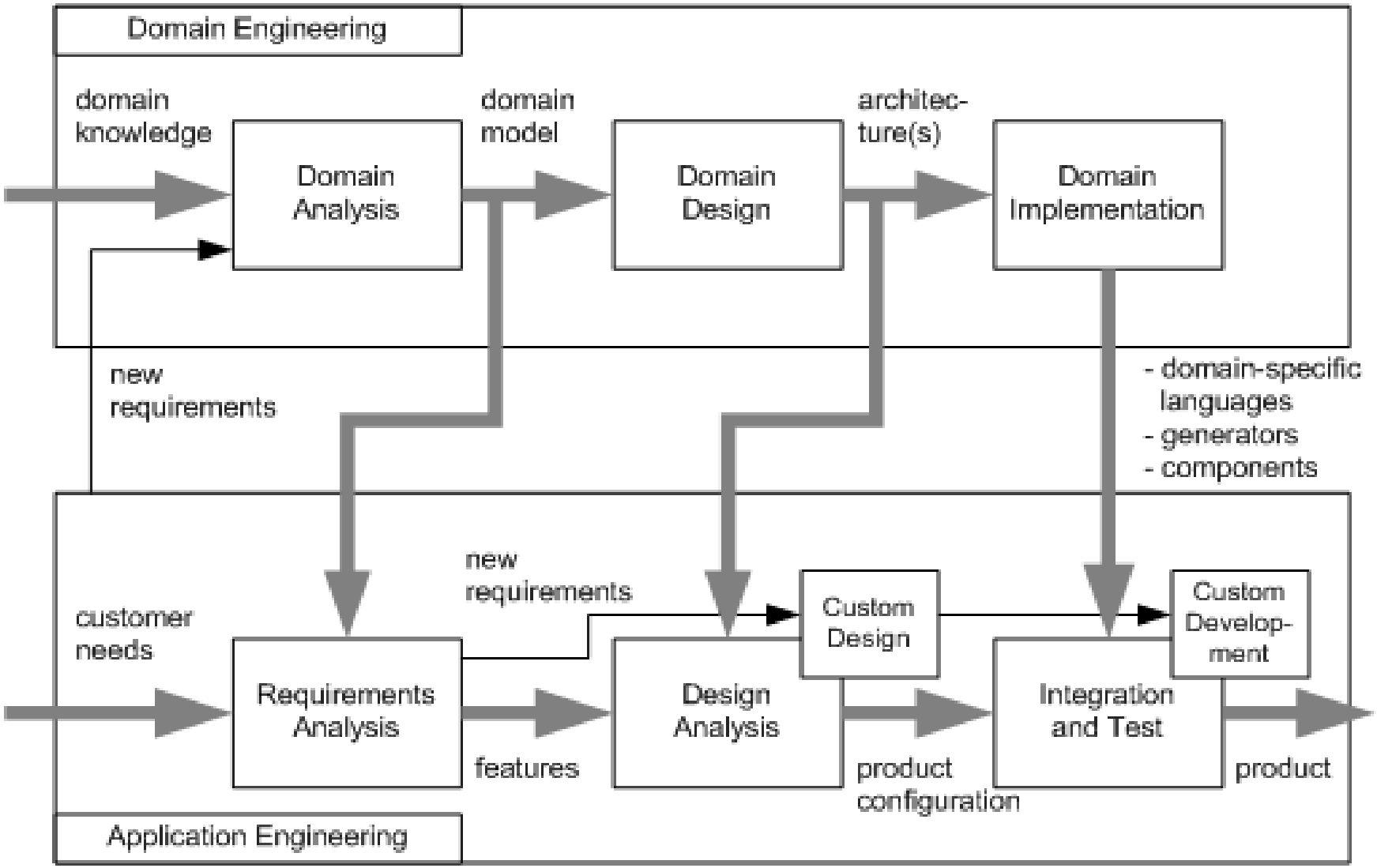
DOMAIN ENGINEERING

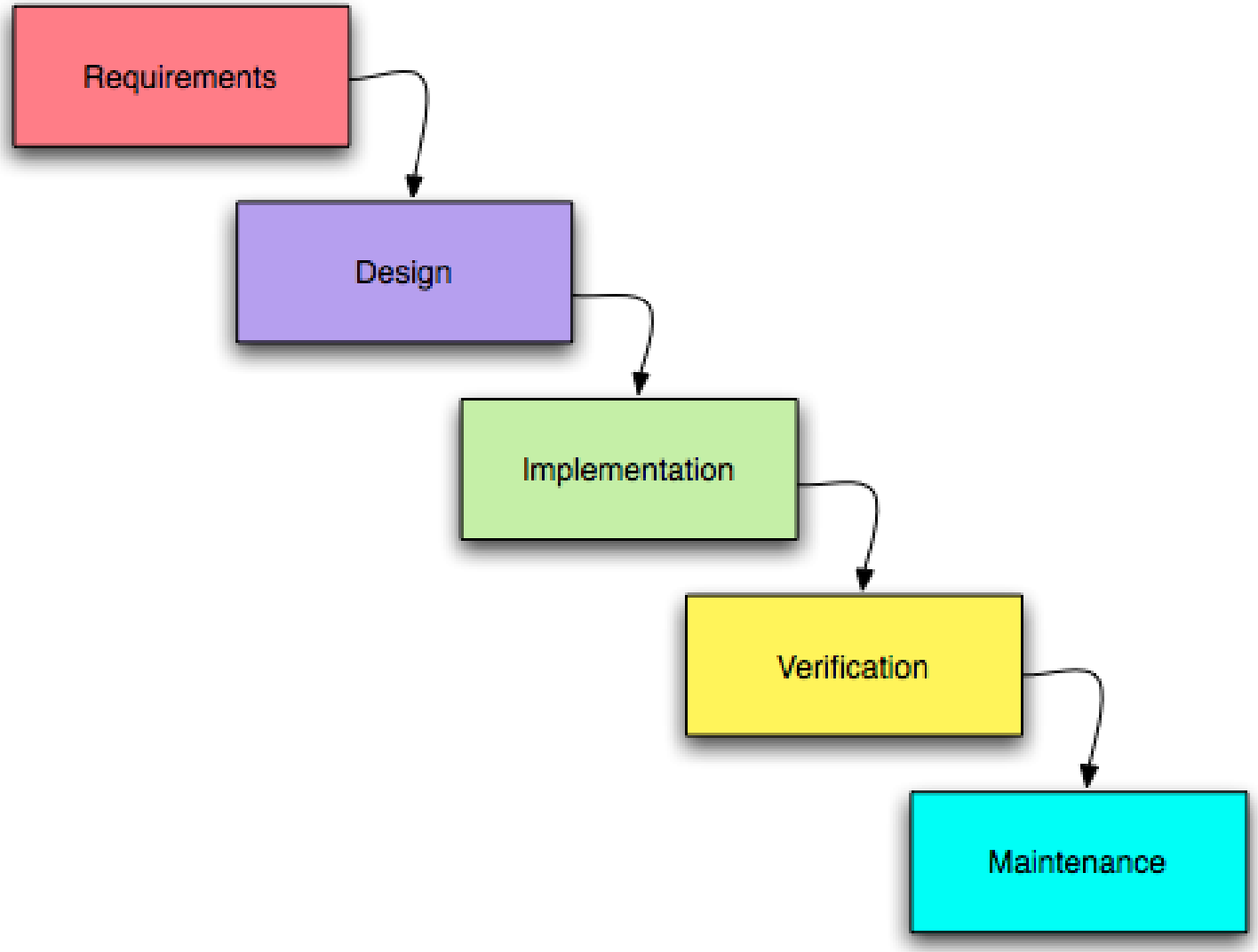
LEARNING GOALS

explain the product-line development process consisting of domain engineering and application engineering (including how the different phases interact),

distinguish problem space and solution space,

explain the economic lever of product lines and understand the benefit of automation,


Domain Engineering
domain knowledge
Domain Analysis
domain model
Domain Design
architec-ture(s)
Domain Implementation
new requirements
- domain-specific languages
- generators
- components
customer needs
Requirements Analysis
new requirements
Custom Design
Design Analysis
Custom Develop-ment
Integration and Test
features
product configuration
product
Application Engineering


Requirements
Design
Implementation
Verification
Maintenance

DOMAIN ENGINEERING

[...] is the activity of collecting, organizing, and storing past experience in building systems [...] in a particular domain in the form of reusable assets [...], as well as providing an adequate means for reusing these assets (i.e., retrieval, qualification, dissemination, adaptation, assembly, and so on) when building new systems.

K. Czarnecki and U. Eisenecker

SOFTWARE PRODUCT LINES

A software product line (SPL) is a set of software-intensive systems that share a common, managed set of features satisfying the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way.

Software Engineering Institute
Carnegie Mellon University

FURTHER READINGS

K. Kang, S. Cohen, J. Hess, W. Novak, and A. Peterson. Feature-Oriented Domain Analysis (FODA) Feasibility Study. Technical Report CMU/SEI-90-TR-21, SEI,1990.

K. Czarnecki and U. Eisenecker. Generative Programming: Methods, Tools, and Applications. Addison-Wesley, 2000.

Apel, S., Batory, D., Kaestner, C., & Saake, G. (2013). Feature-Oriented Software Product Lines. Berlin: Springer. Chapter 1 & 2