



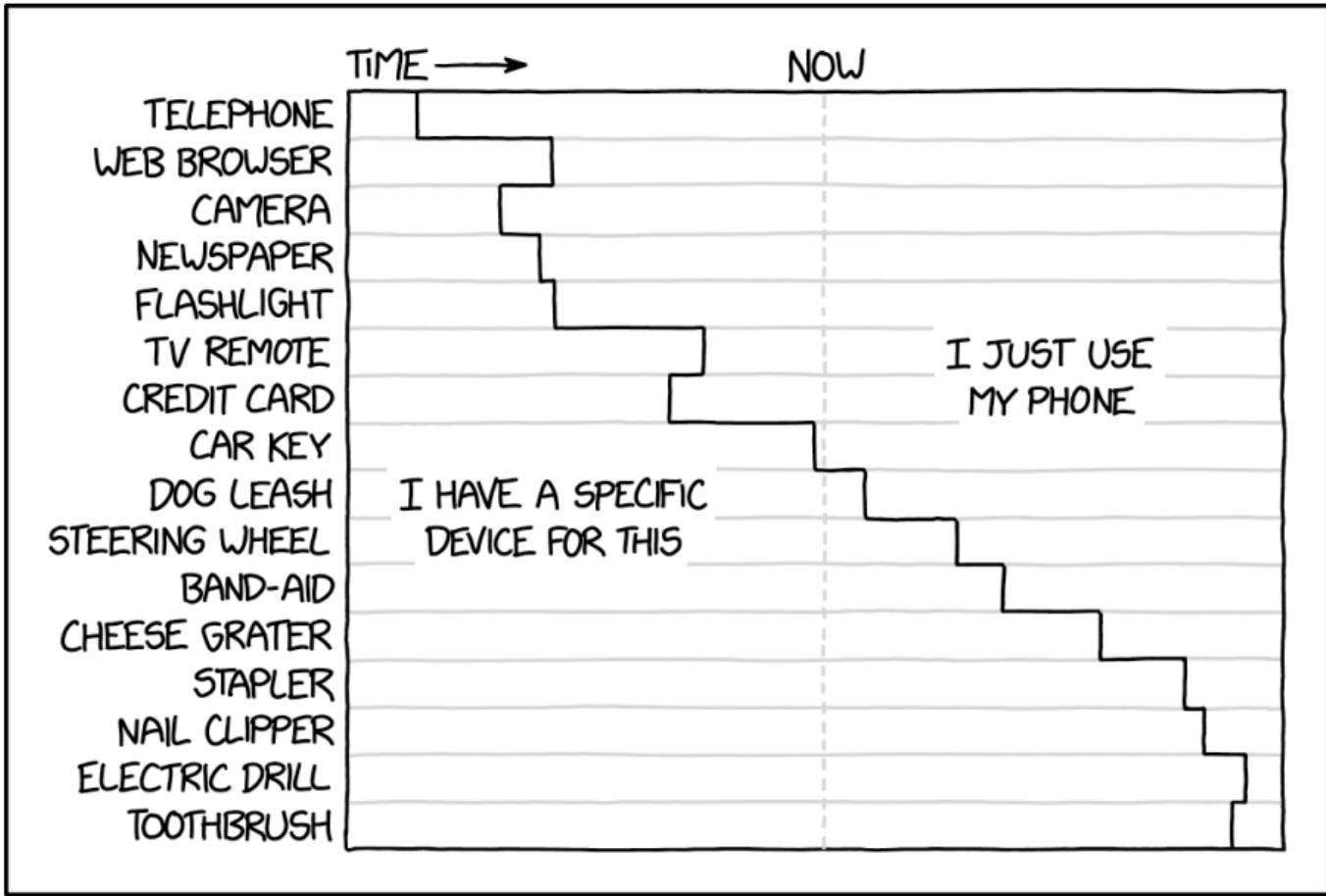
# Software Engineering

1. Introduction | Thomas Thüm | November 5, 2020

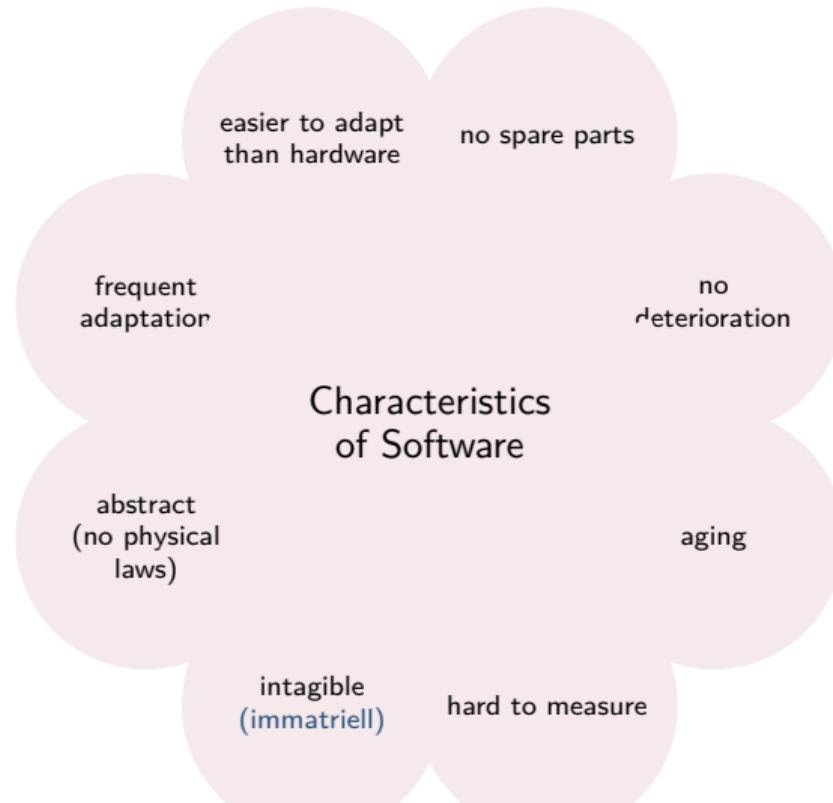
# Lecture Overview

1. What is Software?
2. How Relevant is Software?
3. What is Software Engineering Good For?

## What is Software?



# Characteristics of Software



# Software

## Software

Software stands for one or several computer programs and all associated documentation, libraries, support websites, and configuration data that are needed to make these programs useful.

[adapted from Sommerville]

## Explanation

The term program is used in a broader sense here. Software may also include source code, software models, or binaries.

# Software Products

## Software Product and Professional Software

A software product is a software that can be sold to a customer.

Professional software is software intended for use by someone apart from its developer and it is usually developed by teams rather than individuals.  
[adapted from Sommerville]



# Application and System Software

## Application Software or Application

Software that is designed for end users and applied for certain purposes.

(Anwendungssoftware oder Anwendung)



### Examples

web browsers, media players, email or chat clients, text or photo editors, games

## System Software

Software that is not application software and typically being designed to provide a platform for other software.



### Examples

operating systems, game engines, GUI frameworks

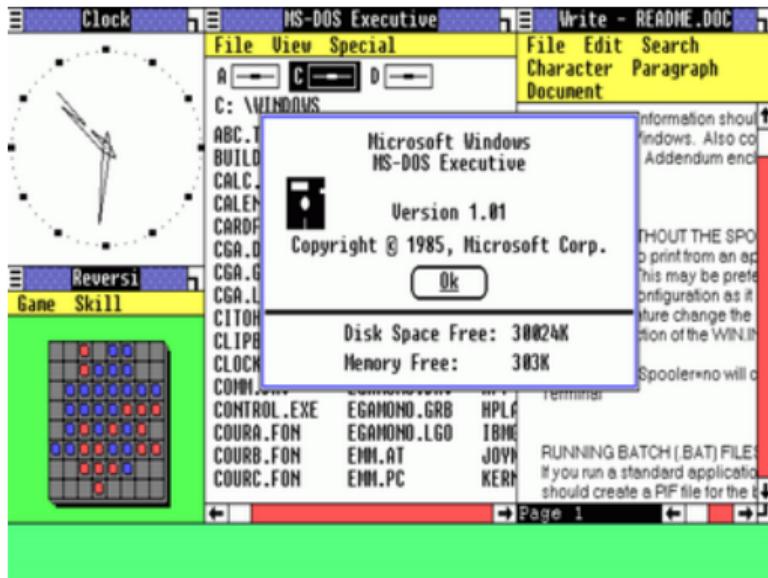
## Classification Not Always Unique

e.g., web browsers and chat clients take over more and more features of operating systems

# Application Software

## Desktop Application or Desktop App

Windows 1.0 released in 1985



## Web Application or Web App

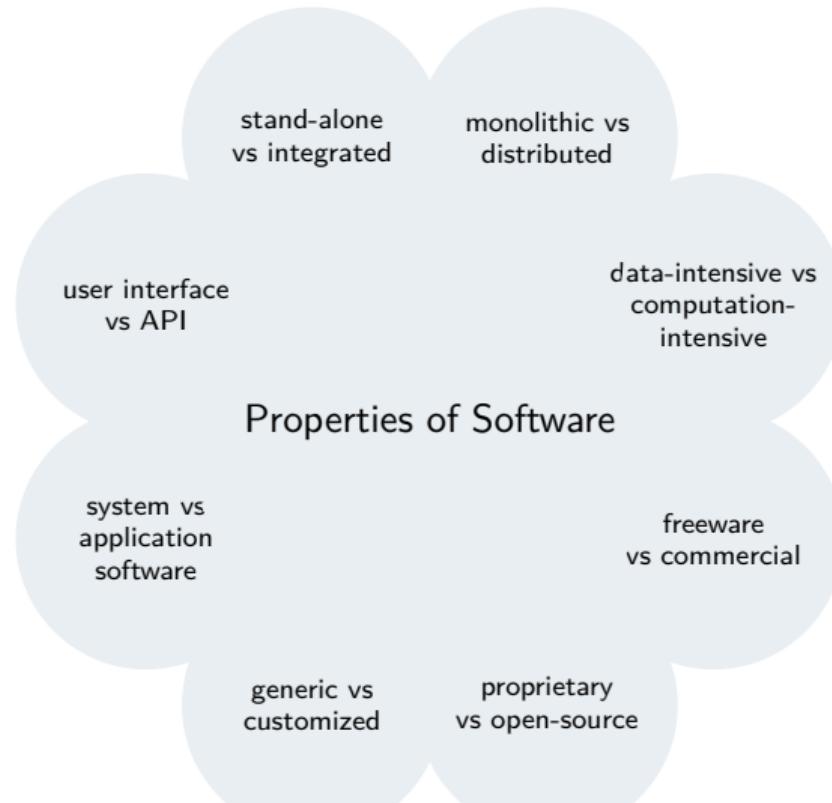
Ebay was born in 1995



## Mobile Application or Mobile App or App

First iPhone released in 2007

# Properties of Software



# What is Software?

## Lessons Learned

- What is software?
- What is the difference between program, software product, professional software, desktop/web/mobile app?
- Next: How does software influence our life?

## Practice

- What is your experience with software?  
Answer the following questionnaire:  
<https://moodle.uni-ulm.de/mod/questionnaire/view.php?id=274413>
- Read about *Korean Air Flight 801* and *Ariane 5 Flight 501* in Wong et al.'s article on “Recent Catastrophic Accidents: Investigating How Software Was Responsible”

# Lecture Contents

## 1. What is Software?

Characteristics of Software

Software

Software Products

Application and System Software

Application Software

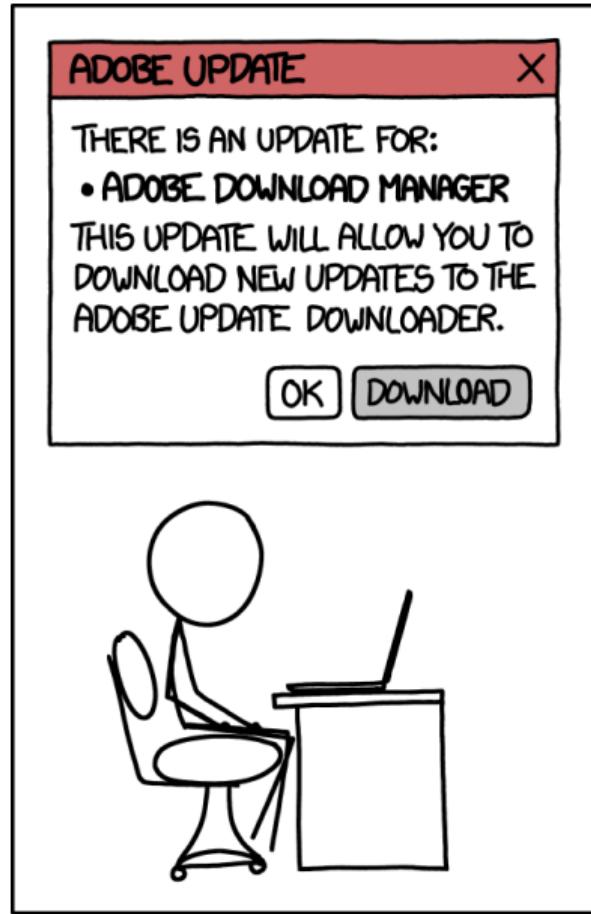
Properties of Software

Lessons Learned

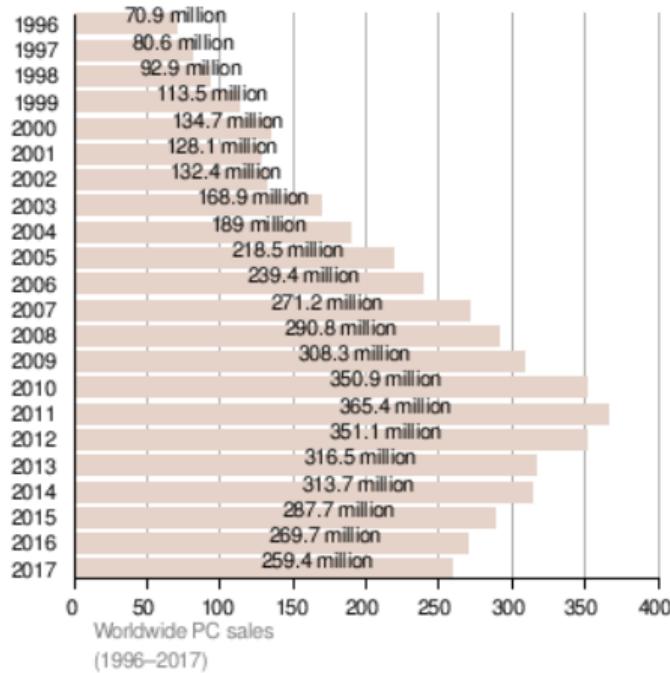
## 2. How Relevant is Software?

## 3. What is Software Engineering Good For?

## How Relevant is Software?

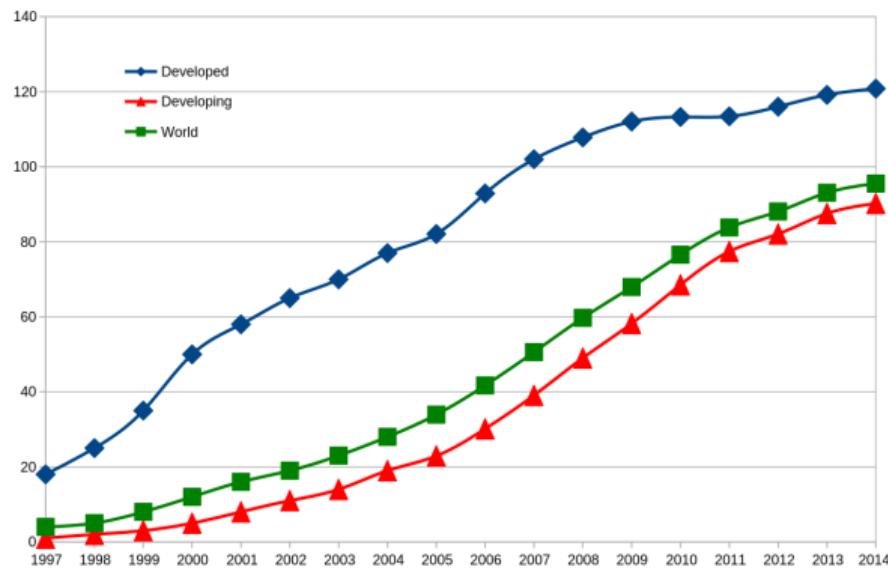


# World-Wide PC Sales

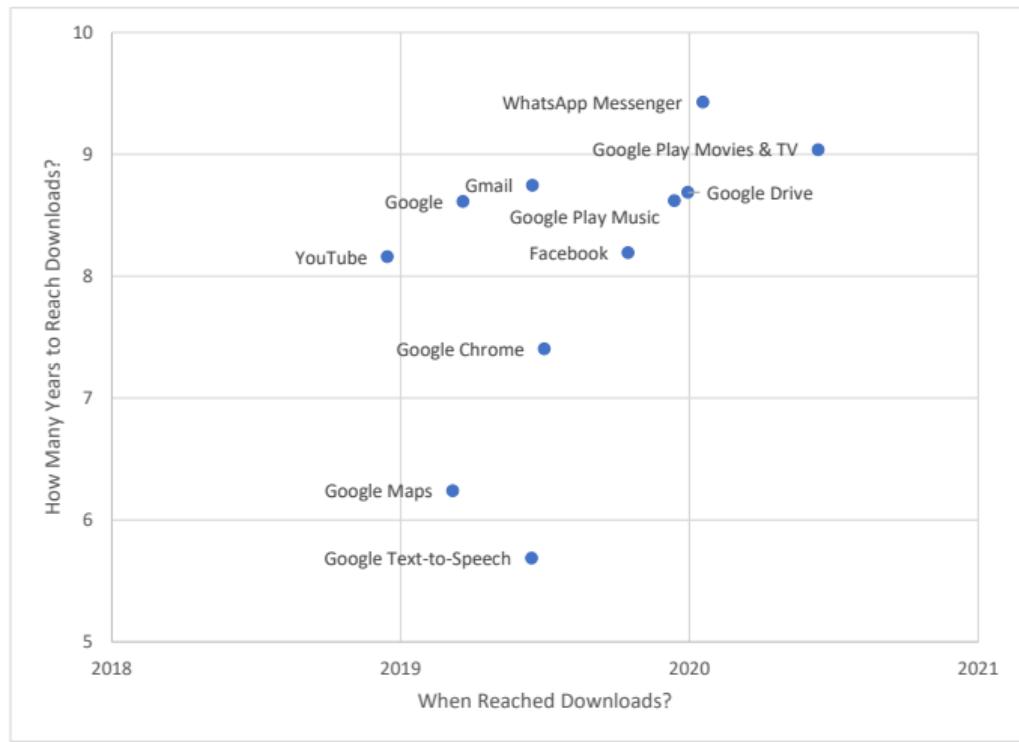


# World-Wide Mobile Phone Subscriptions

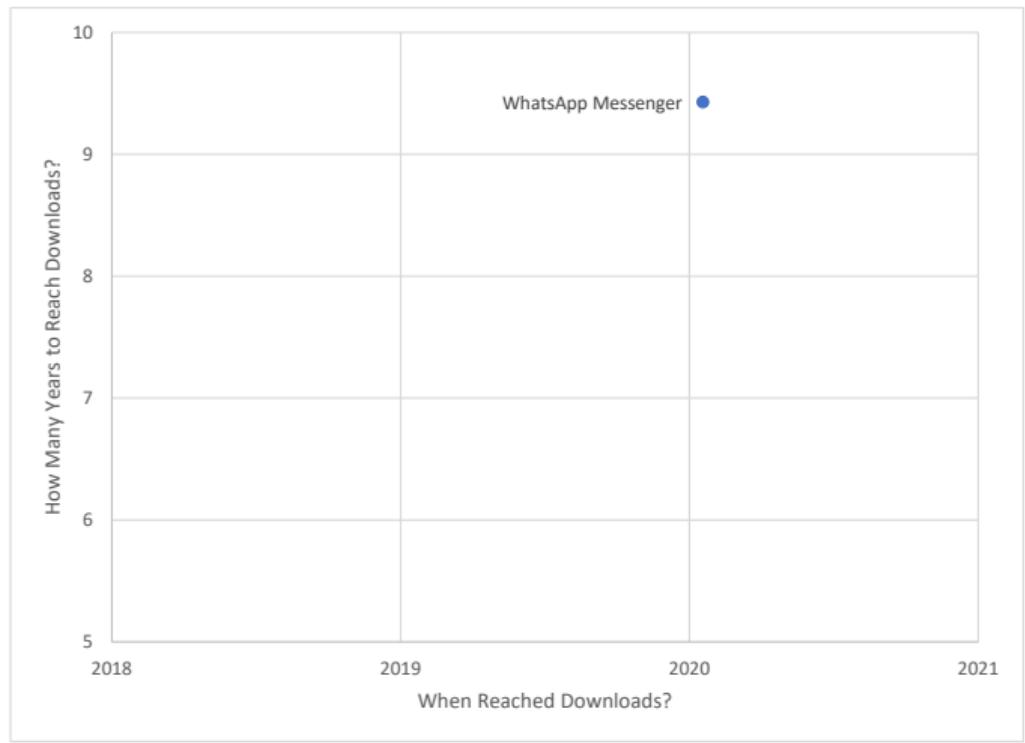
Mobile phone subscribers per 100 inhabitants 1997-2014



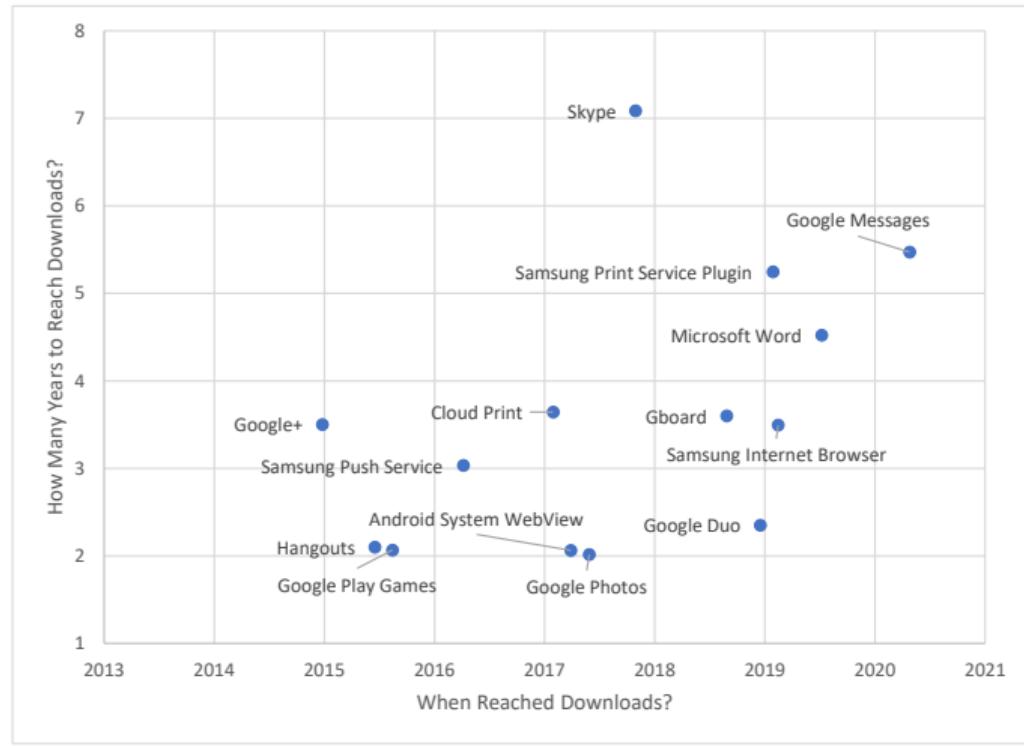
# 5 Billion Downloads of Android Apps



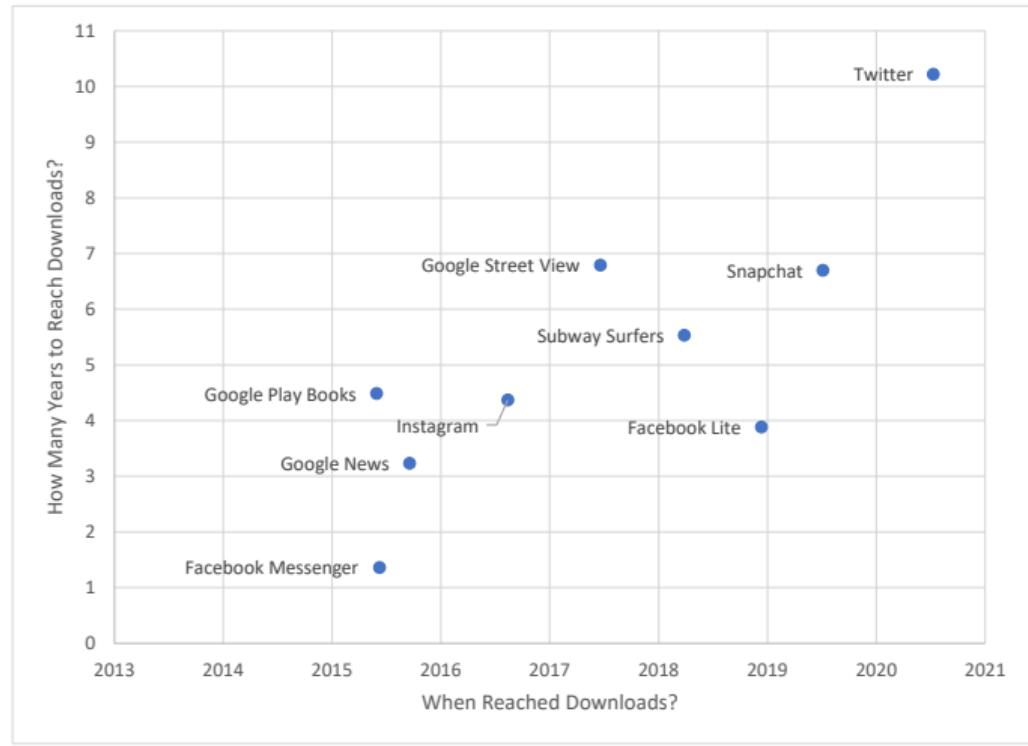
# 5 Billion Downloads of Android Apps



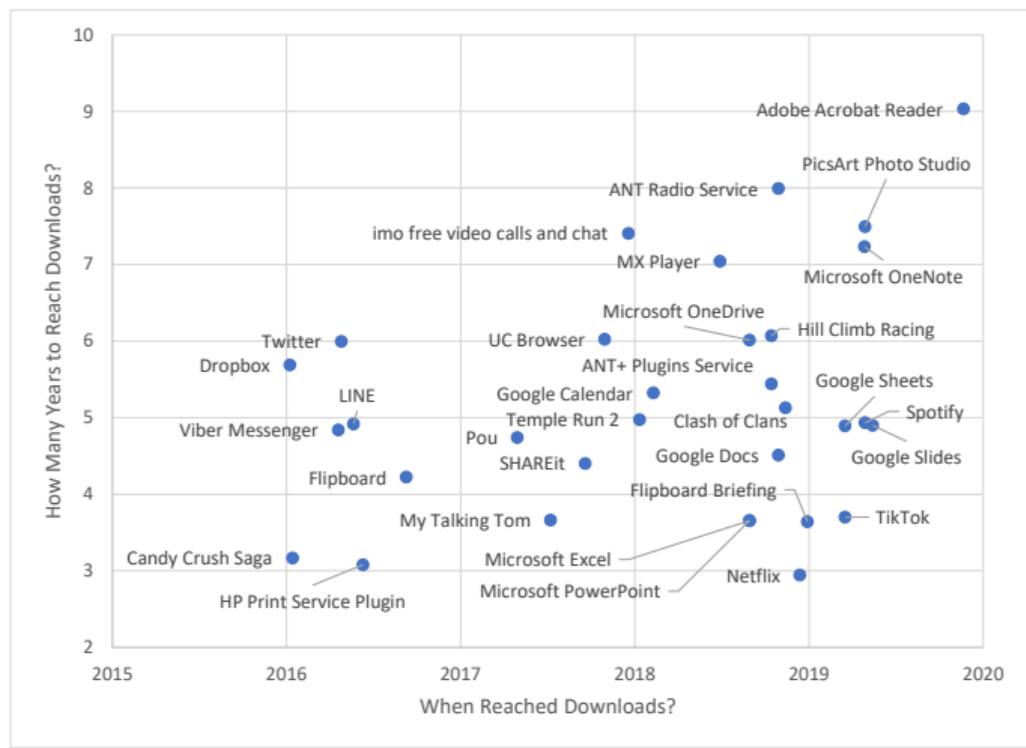
# 1 Billion Downloads of Android Apps



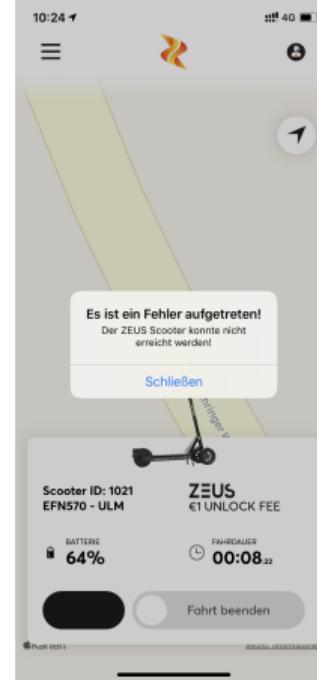
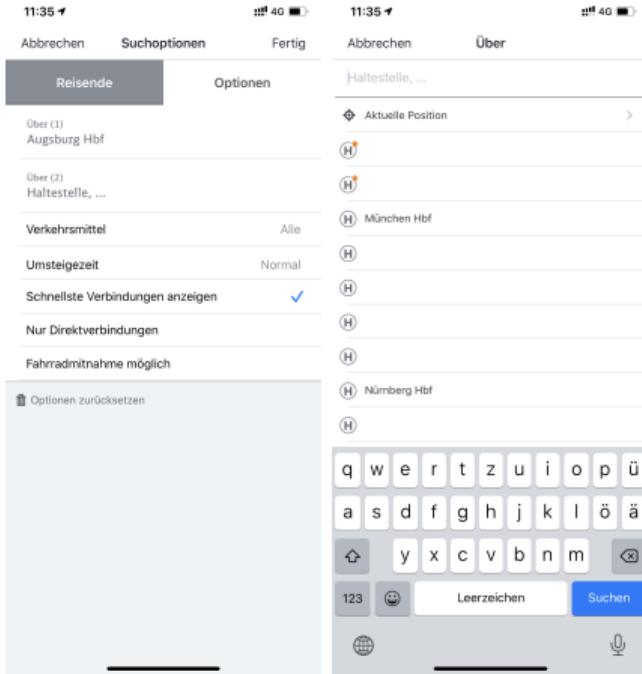
# 1 Billion Downloads of Android Apps



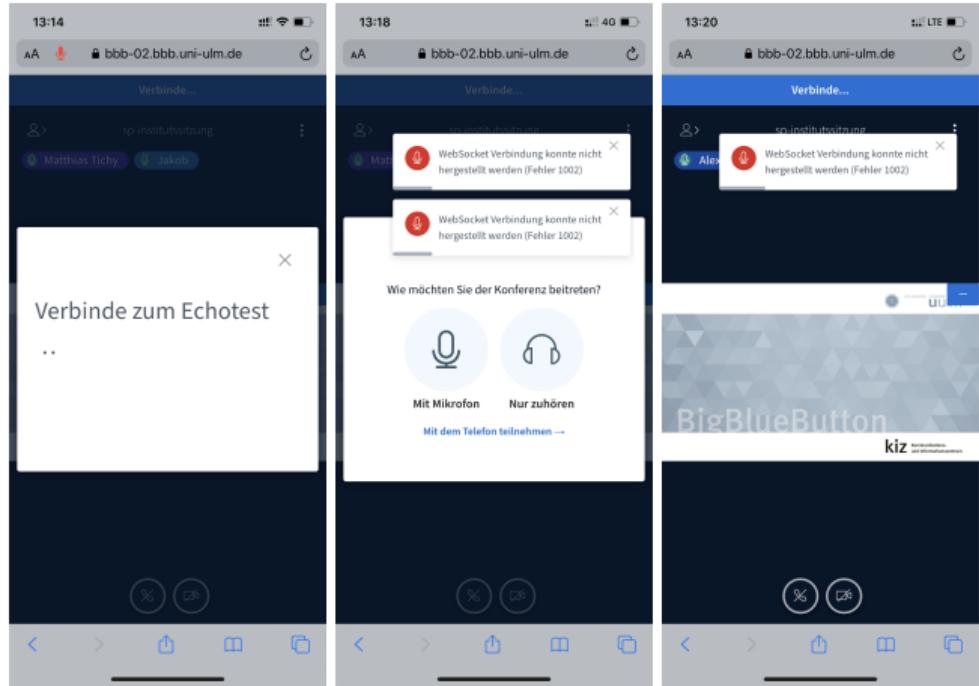
# 500 Million Downloads of Android Apps



# Relevance of Software for Me



# Relevance of Software for Me



# Relevance of Software for Me

BigBlueButton.

ulm university

kiz Kommunikations- und Informationszentrum

Slide 1

# Relevance of Software for Me

Zoom Webinar You are viewing Jackson Prado Lima's screen View Options ▾

COLEMAN interacting with the Source Control Server

The diagram illustrates the interaction between Developers, a Source Control Server, and the COLEMAN system. Developers interact with the Source Control Server via check-in and fetch changes. The Source Control Server interacts with COLEMAN via a result. COLEMAN interacts with the Source Control Server via a Test Set T available message. COLEMAN also interacts with Developers via a BUILD message. A red arrow points from the COLEMAN interface in the diagram to the COLEMAN interface in the Zoom meeting window.

Developers

Source Control Server

result

check-in

fetch changes

COLEMAN

BUILD

Test Set T available

MAIL

Rewards

Zoom Cloud Meetings Connecting...

Enter your email and name

Your email

Thomas Thüm

Remember my name for future meetings

Join Webinar Cancel

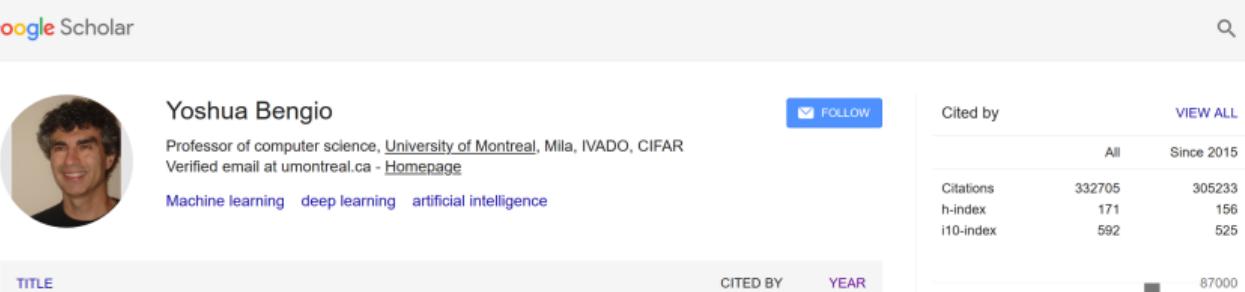
Audio Settings ^

Chat 3 Raise Hand Q&A

Privacy & Legal Policies

# Relevance of Software for Me

Google Scholar



Yoshua Bengio  
Professor of computer science, University of Montreal, Mila, IVADO, CIFAR  
Verified email at umontreal.ca - [Homepage](#)  
Machine learning deep learning artificial intelligence

TITLE CITED BY YEAR

TITLE	CITED BY	YEAR
Deep learning Y LeCun, Y Bengio, G Hinton nature 521 (7553), 436-444	31	2015
Gradient-based learning applied to document recognition Y LeCun, L Bottou, Y Bengio, P Haffner Proceedings of the IEEE 86 (11), 2278-2324	30	2015
Generative adversarial nets I Goodfellow, J Pouget-Abadie, M Mirza, B Xu, D Warde-Farley, S Ozair, ... Advances in neural information processing systems, 2672-2680	25	2015
Deep learning I Goodfellow, Y Bengio, A Courville, Y Bengio MIT press 1, 2	20	2015
Neural machine translation by jointly learning to align and translate D Bahdanau, K Cho, Y Bengio arXiv preprint arXiv:1409.0473	14	2015

Cited by  
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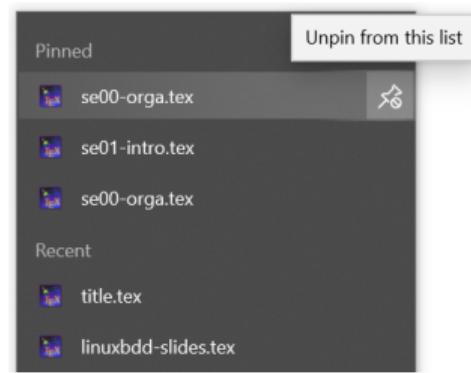
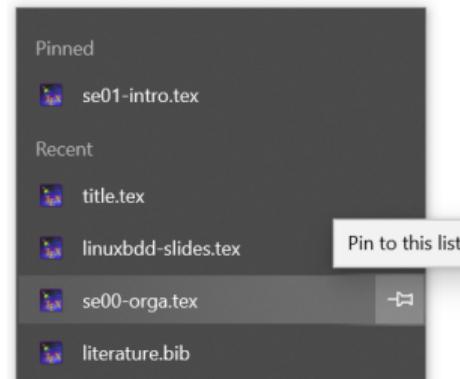
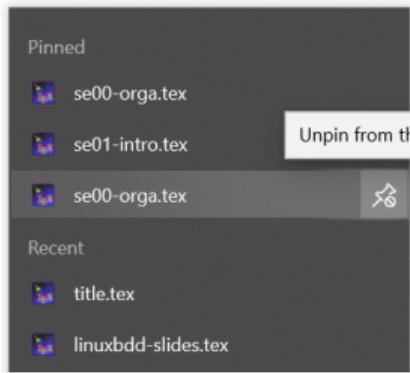
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Citations 332705	305233
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87000



31  
**Google**  
500. That's an error.  
The server encountered an error and could not complete your request.  
If the problem persists, please [report](#) your problem and mention this error message and the query that caused it.  
That's all we know.

# Relevance of Software for Me



# Relevance of Software for Me

The screenshot shows a double-page spread in Adobe Acrobat Pro 2020. Both pages display the same content: a title slide with the text "Many Queries on BDDs are fast." and a diagram of a Binary Decision Diagram (BDD) labeled "BDDs". The BDD diagram consists of nodes labeled 1 through 6, connected by directed edges. The left page also features a sidebar with a list of bookmarks related to BDDs and other topics like SAT-solving and Linux. The right page includes a sidebar with various PDF editing tools.

linuxbdd-slides.pdf - Adobe Acrobat Pro 2020

File Edit View Window Help

Home Tools linuxbdd-slides.pdf

Bookmarks

- Product Lines are Powered by SAT
- Used Solvers (for Interaction Testing)
- Time-Leap Challenge for SAT-Solving
- What is Our Holy Grail?
- A BDD for Linux.
- Why Binary Decision Diagrams?
- Many Queries on BDDs are fast.
- Use of BDDs for Product Lines
- Why Linux?
- Large Product-Lines Beyond Linux
- Knowledge Compilation Beyond BDDs
- What is the Goal of this Challenge?
- What is the Scope of this Challenge?
- Knowledge Compilation Challenge for Variability

Many Queries on BDDs are fast.

$x_1 \cdot x_2 + x_3 \cdot x_4 + x_5 \cdot x_6$

$x_1 \cdot x_4 + x_2 \cdot x_5 + x_3 \cdot x_6$

BDDs

Bryant 1986

Search tools

Create PDF

Edit PDF

Search tools

Create PDF

Edit PDF

Export PDF

Comment

Organize Pages

Scan & OCR

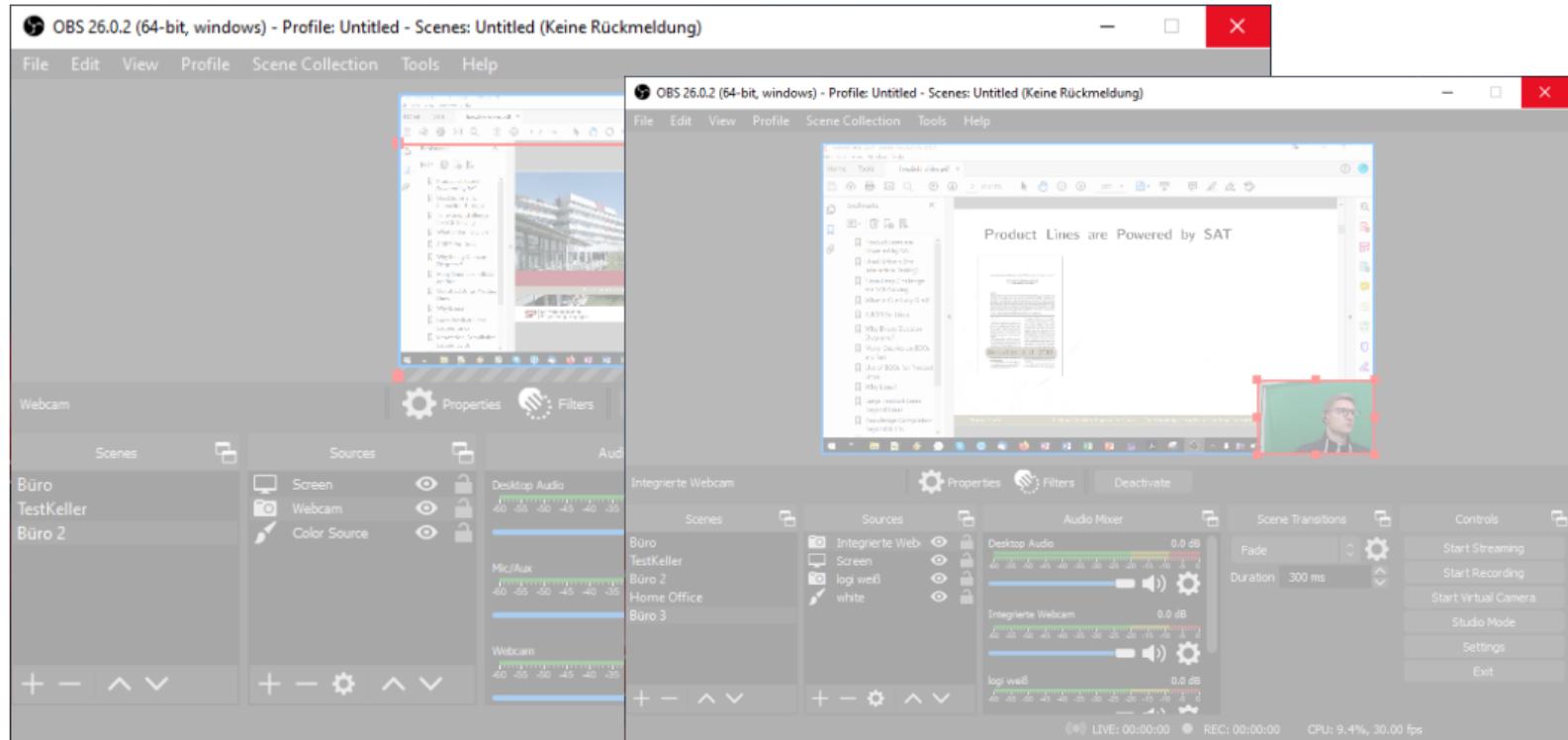
Protect

Fill & Sign

Prepare Form

More Tools

# Relevance of Software for Me



# How Relevant is Software?

## Lessons Learned

- What is the impact of software?
- How relevant is software for us?
- Next: What has software to do with engineering?

## Practice

- Write a short paragraph about a software failure that you have experienced in the past:  
<https://moodle.uni-ulm.de/mod/moodleoverflow/discussion.php?d=1871>
- Later: document all software failures that you experience until the end of the term:  
<https://moodle.uni-ulm.de/mod/moodleoverflow/discussion.php?d=1872>

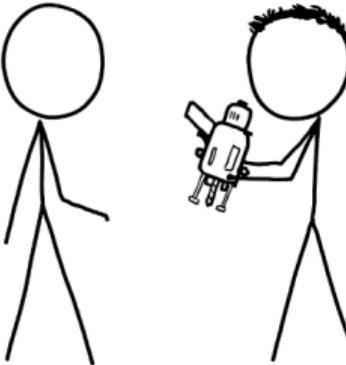
# Lecture Contents

1. What is Software?
2. How Relevant is Software?
  - World-Wide PC Sales
  - World-Wide Mobile Phone Subscriptions
  - Downloads of Android Apps
  - Relevance of Software for Me
  - Lessons Learned
3. What is Software Engineering Good For?

## What is Software Engineering Good For?

WE NEED TO MAKE 500 HOLES IN THAT WALL,  
SO I'VE BUILT THIS AUTOMATIC DRILL. IT USES  
ELEGANT PRECISION GEARS TO CONTINUALLY  
ADJUST ITS TORQUE AND SPEED AS NEEDED.

GREAT, IT'S THE PERFECT WEIGHT!  
WE'LL LOAD 500 OF THEM INTO  
THE CANNON WE MADE AND  
SHOOT THEM AT THE WALL.



HOW SOFTWARE DEVELOPMENT WORKS

# Software Engineering

## Software Engineering

“Software engineering is an engineering discipline that is concerned with all aspects of software production from initial conception to operation and maintenance. [...] Software engineering is not just concerned with the technical processes of software development. It also includes activities such as software project management and the development of tools, methods, and theories to support software development.” [Sommerville]

# Software Engineering vs Programming



# Software Engineering vs Computer Science

## SE vs CS

“Computer science focuses on theory and fundamentals; software engineering is concerned with the practicalities of developing and delivering useful software. [...] Computer science theory, however, is often most applicable to relatively small programs. Elegant theories of computer science are rarely relevant to large, complex problems that require a software solution.”

[Sommerville]

# Software and System Engineering

## System Engineering

“System engineering is concerned with all aspects of computer-based systems development including hardware, software and process engineering. Software engineering is part of this more general process.” [Sommerville]

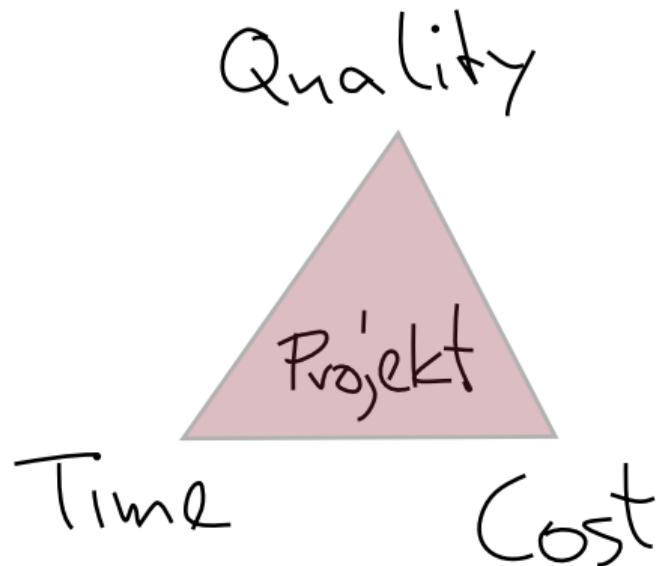


# (Software) Engineering

## Engineering

“Engineering is about getting results of the required quality within schedule and budget. [...] Engineers make things work. They apply theories, methods, and tools where these are appropriate. However, they use them selectively and always try to discover solutions to problems even when there are no applicable theories and methods. Engineers also recognize that they must work within organizational and financial constraints, and they must look for solutions within these constraints.”  
[Sommerville]

Spannungsdruck



# What is Software Engineering Good For?

## Lessons Learned

- What is software engineering?
- Which trade-off is crucial to software engineering?
- Further Reading: Sommerville, Chapter 1.1, p. 19–28
- Next: How to develop the right thing?

## Practice

- What is your connection to software engineering in 10 years?  
<https://moodle.uni-ulm.de/mod/questionnaire/view.php?id=274419>
- Read about ethics in software engineering:  
Sommerville, Chapter 1.2, p. 28–31

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1. What is Software?
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Software Engineering

Software Engineering vs Programming

Software Engineering vs Computer Science

Software and System Engineering

(Software) Engineering

Lessons Learned