



Software Engineering

1. Introduction | Thomas Thüm | October 20, 2021

Lecture Overview

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

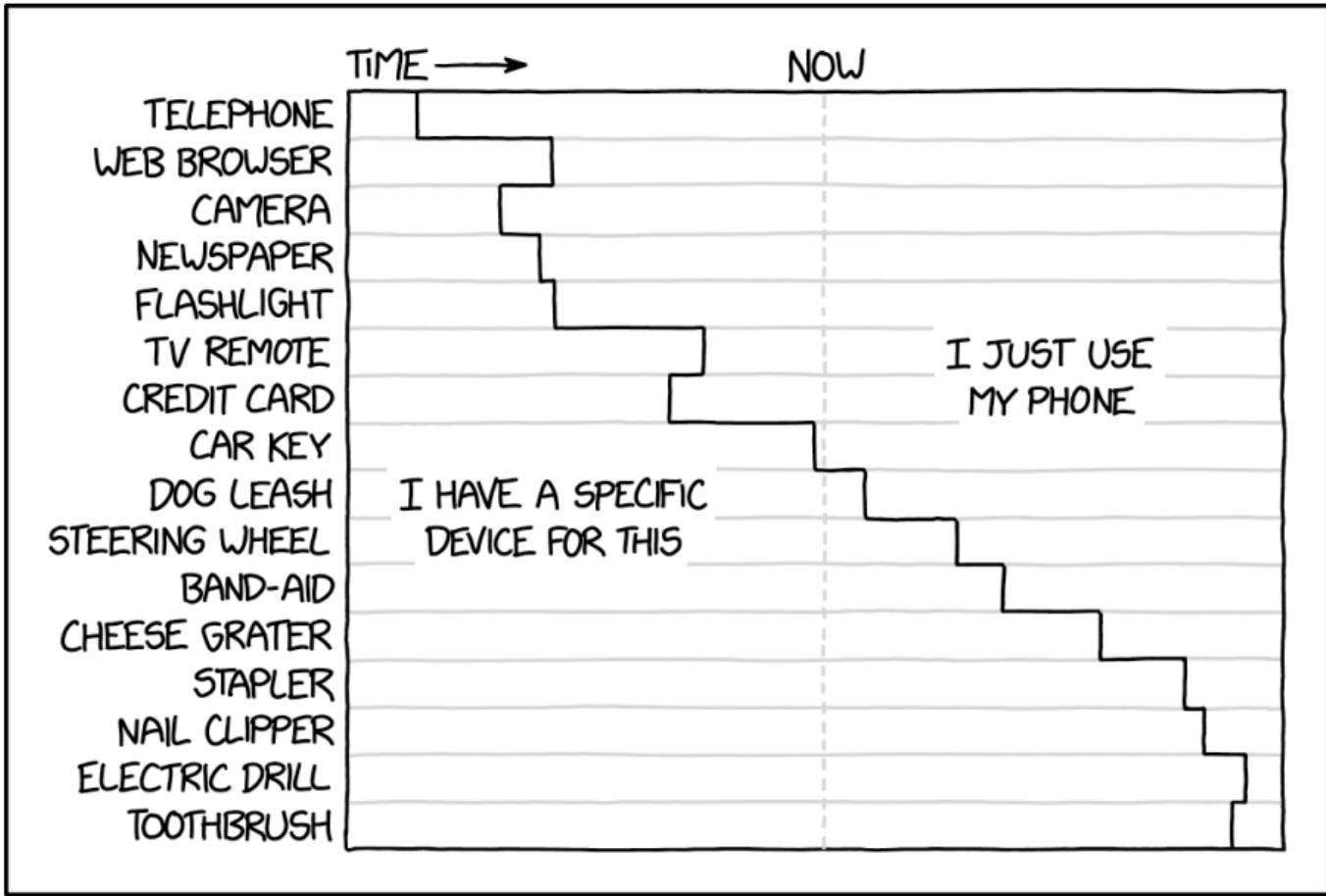
Lecture Contents

1. What is Software?

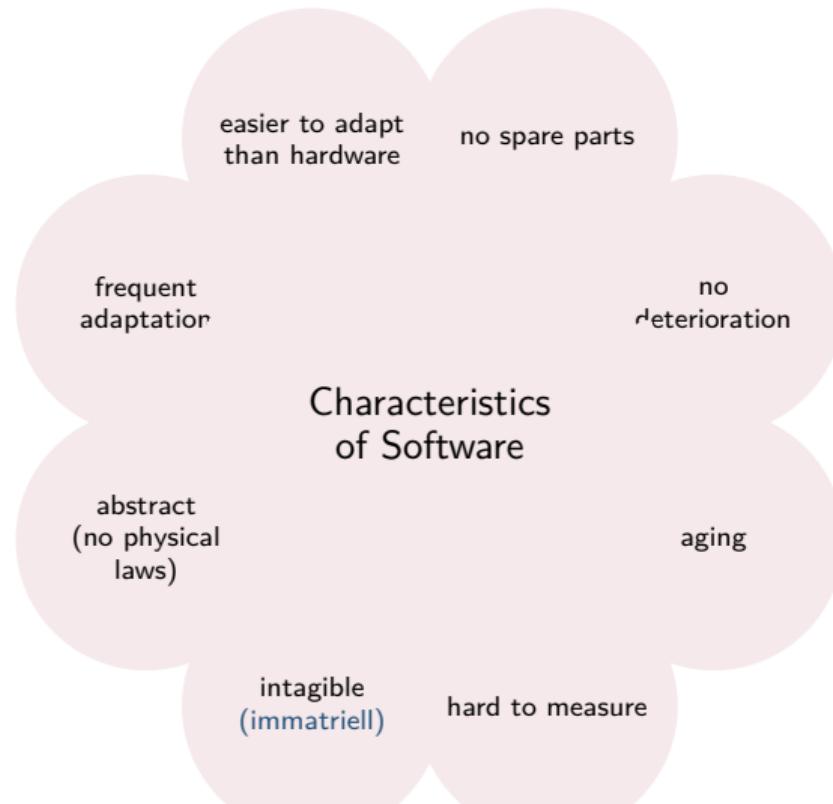
- Characteristics of Software
- Software
- Software Products
- Application and System Software
- Application Software
- Properties of Software
- Lessons Learned

2. How Relevant is Software?

3. What is Software Engineering Good For?



Characteristics of Software



Software

Software

[adapted from **Sommerville**]

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.

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

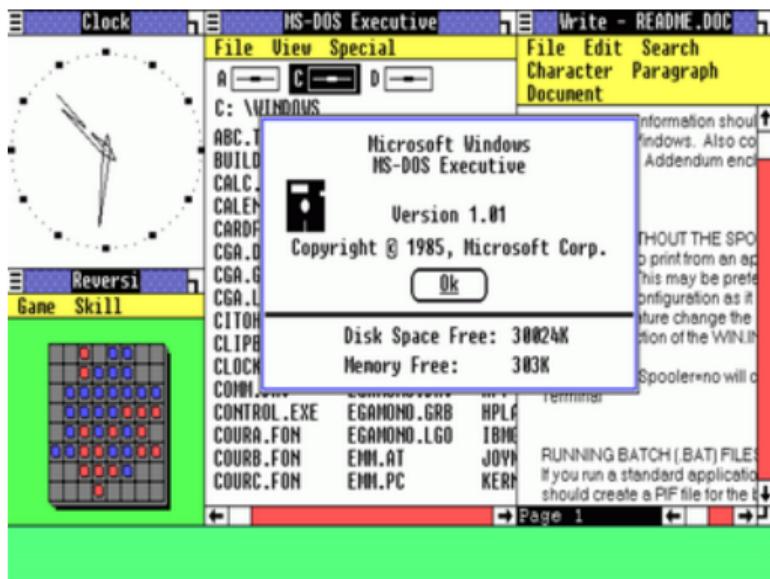
Classification Not Always Unique

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

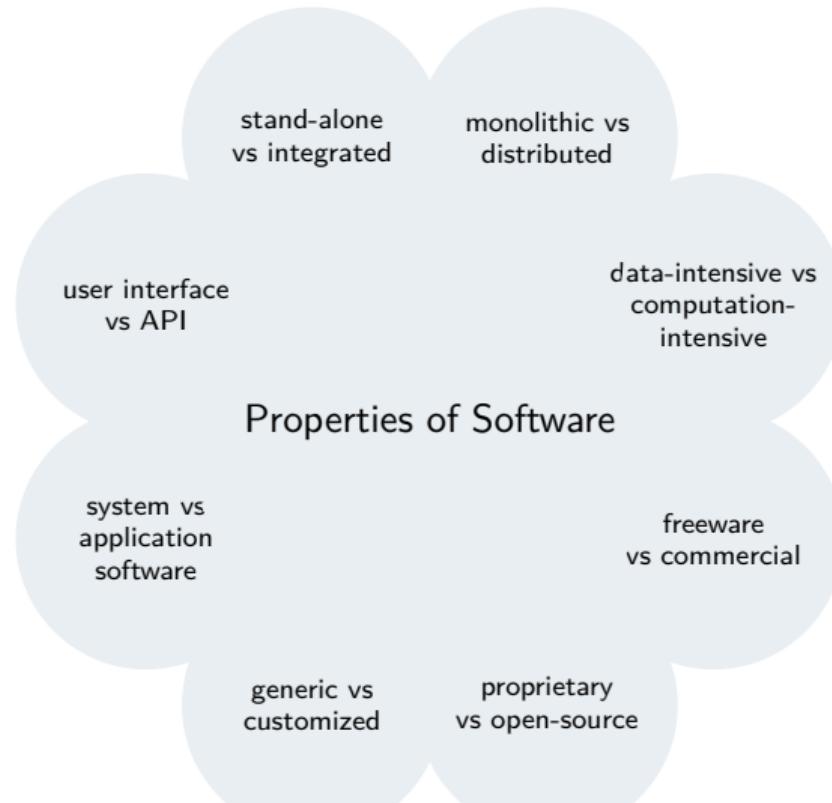
Ebay was born in 1995



Mobile Application or Mobile App or App

First iPhone released in 2007

Properties of Software



What is Software?

Lessons Learned

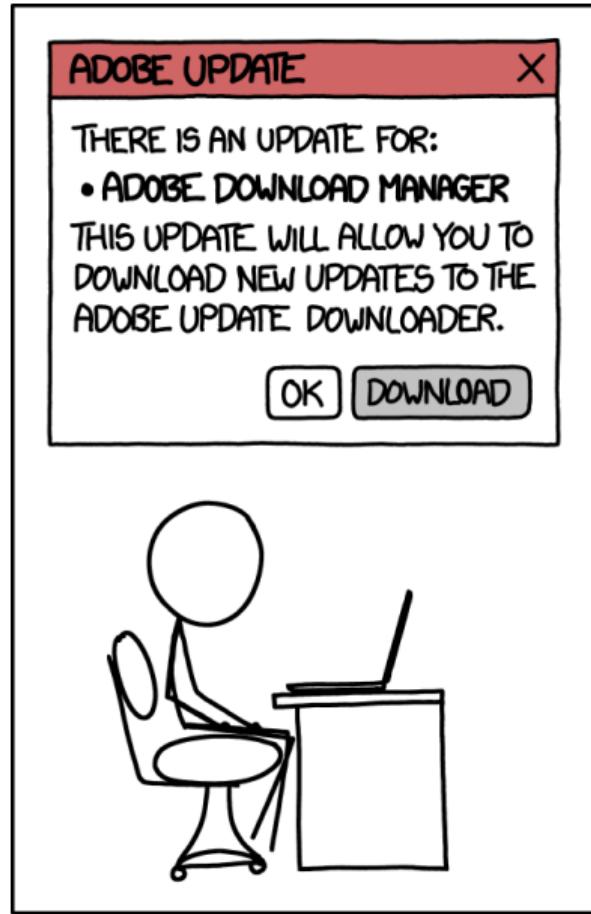
- What is software?
- What is the difference between program, software product, professional software, desktop/web/mobile app?
- Next: How does software influence our life?

Practice

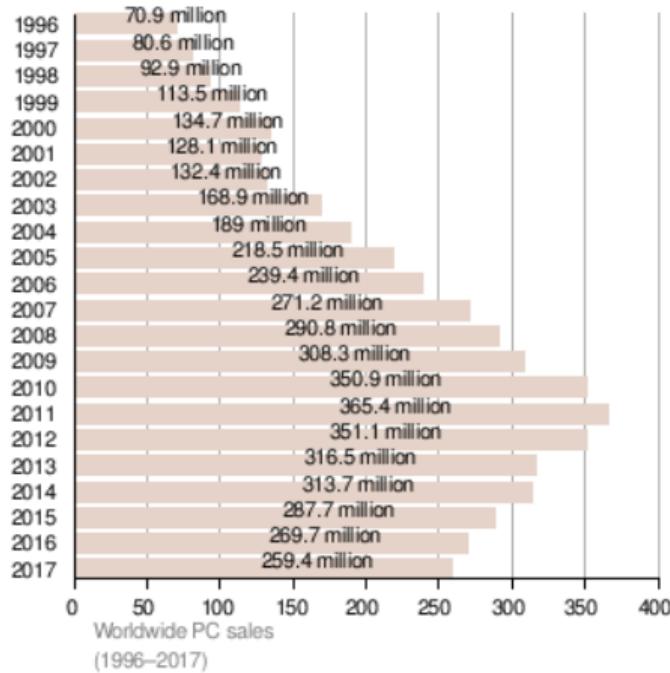
- See Moodle:
<https://moodle.uni-ulm.de/mod/moodleoverflow/discussion.php?d=3667>
- Questionnaire: What is your experience with software?
- Read about **Korean Air Flight 801** and **Ariane 5 Flight 501** in Wong et al.'s article on “Recent Catastrophic Accidents: Investigating How Software Was Responsible”

Lecture Contents

1. What is Software?
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?

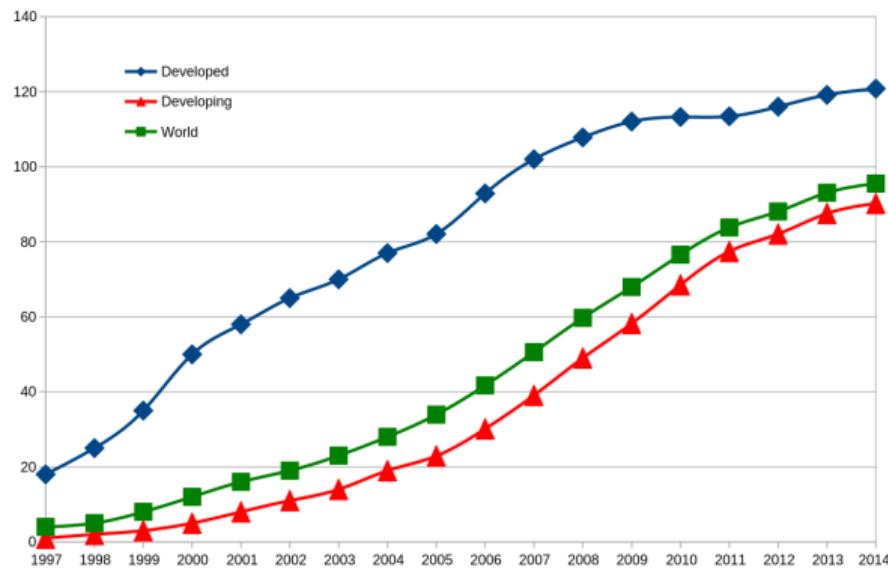


World-Wide PC Sales

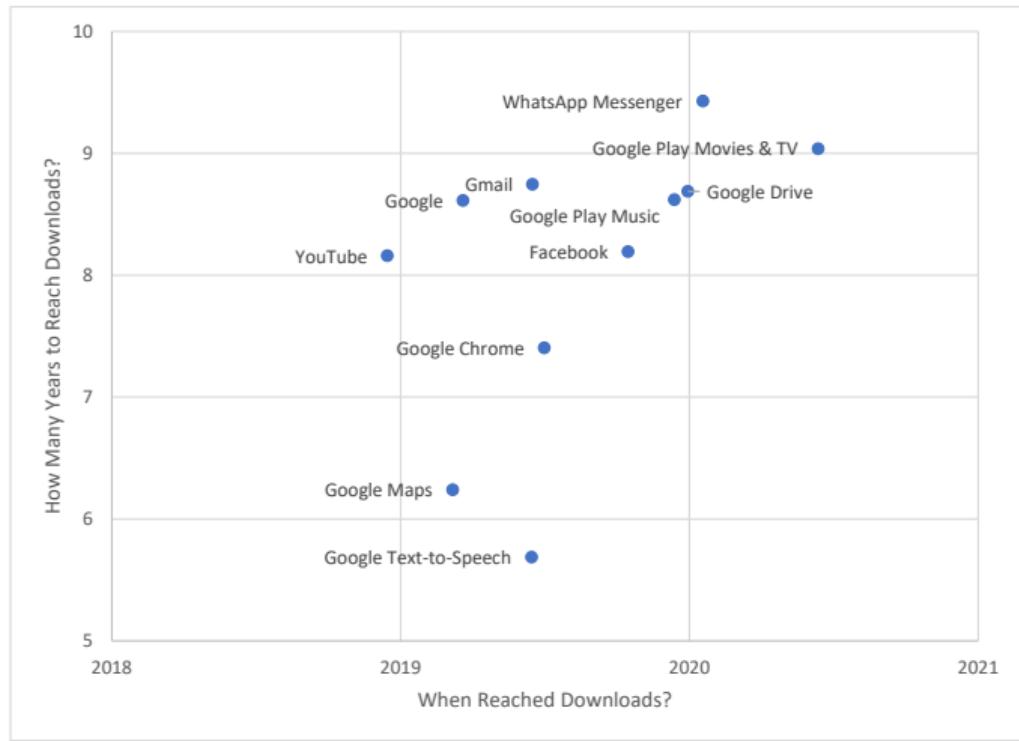


World-Wide Mobile Phone Subscriptions

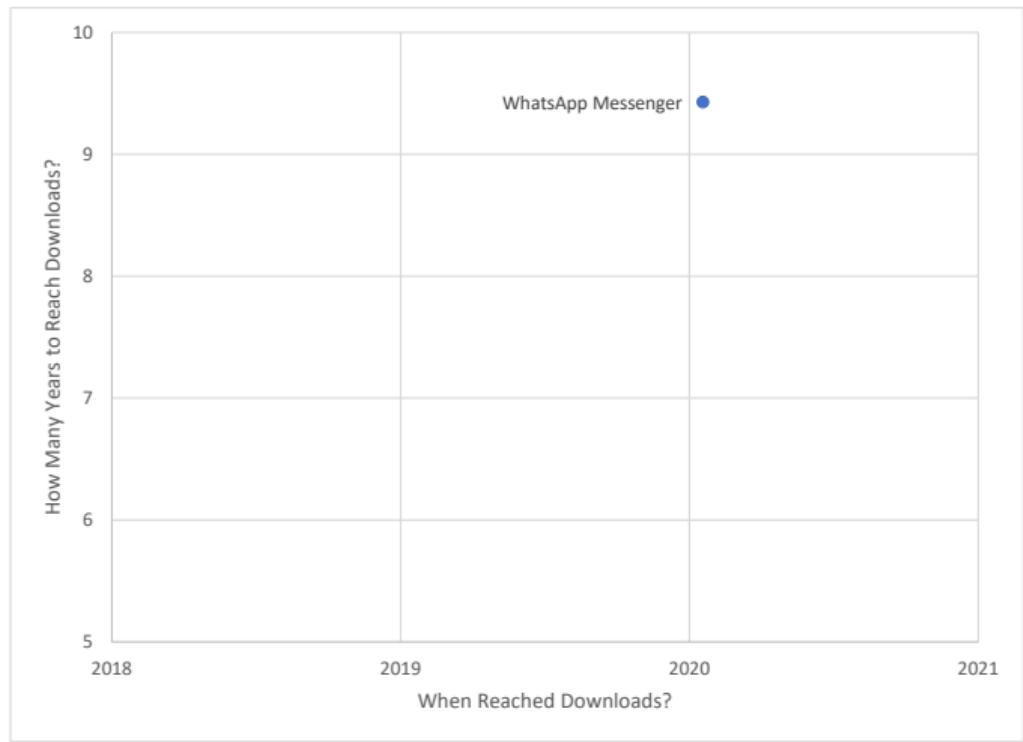
Mobile phone subscribers per 100 inhabitants 1997-2014



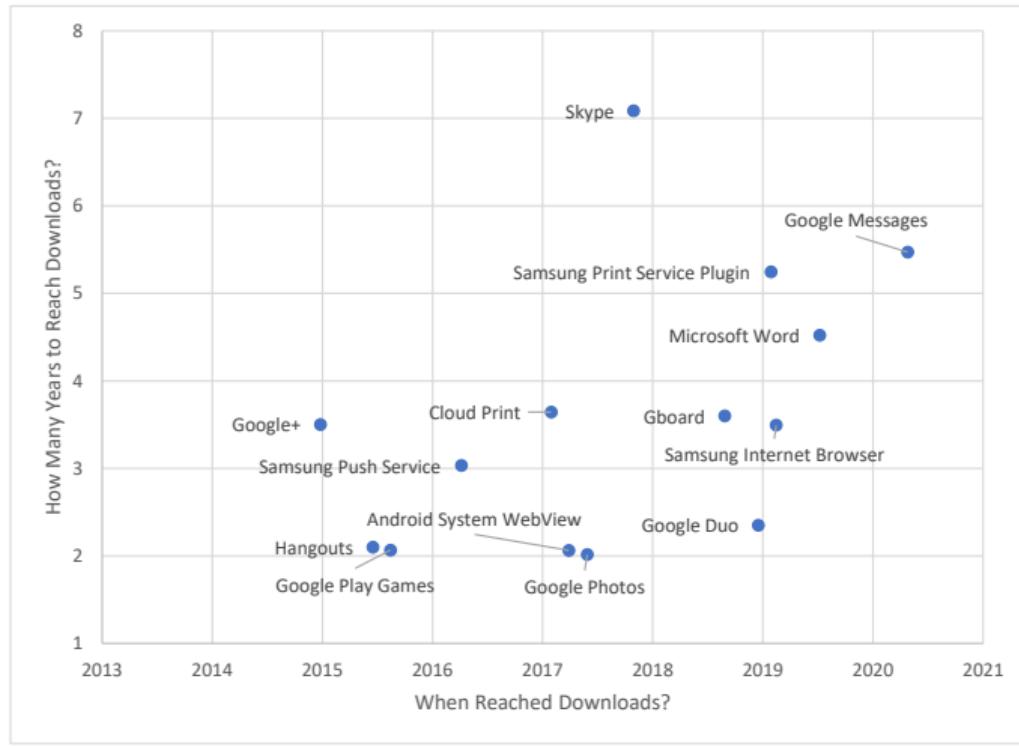
5 Billion Downloads of Android Apps



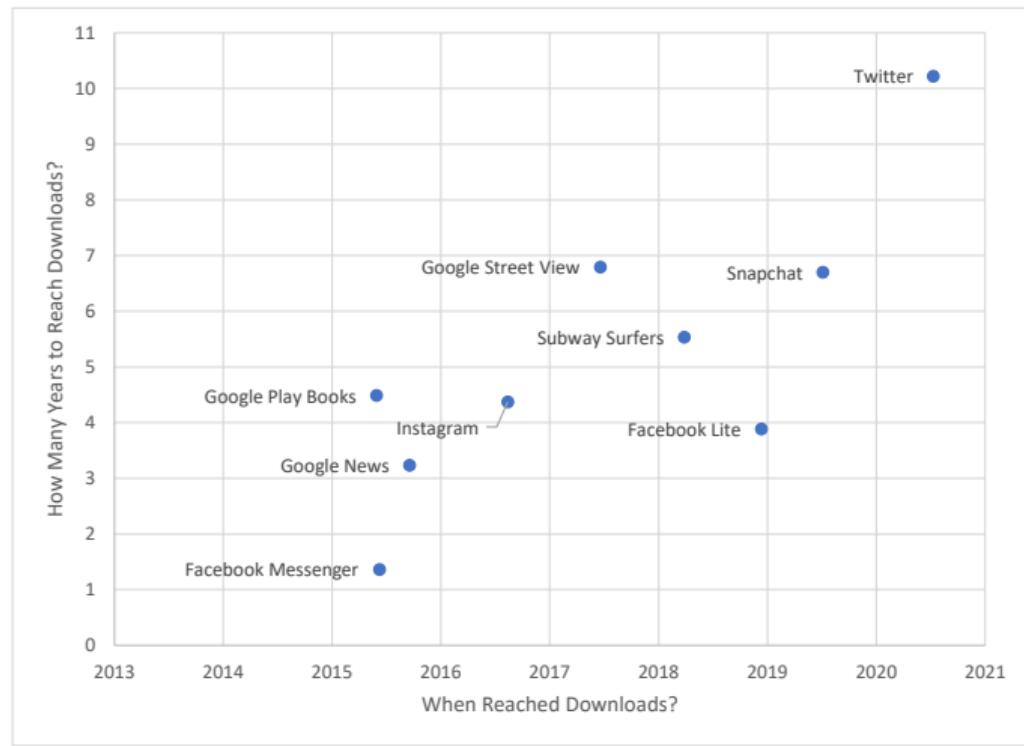
5 Billion Downloads of Android Apps



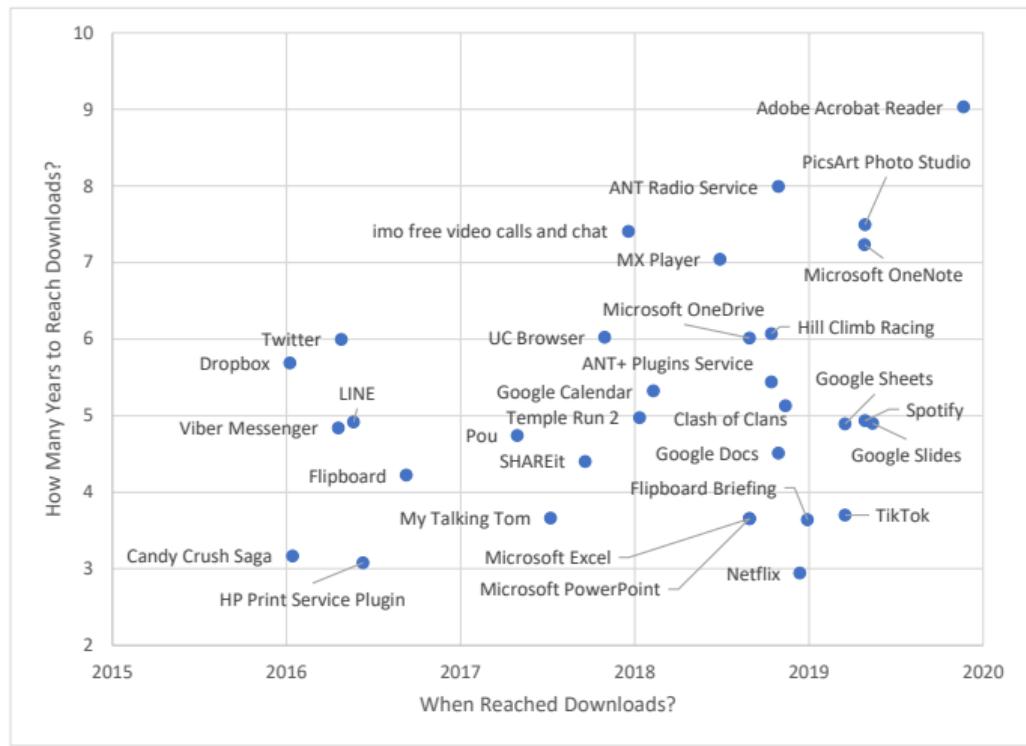
1 Billion Downloads of Android Apps



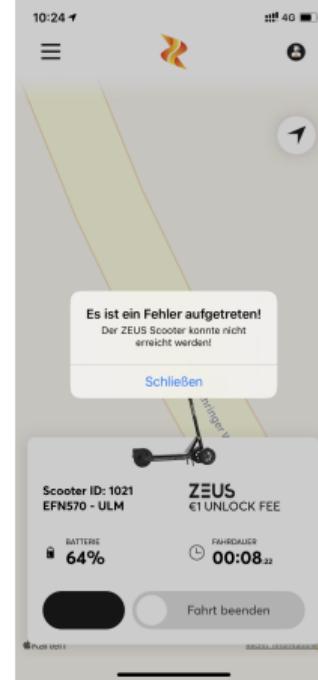
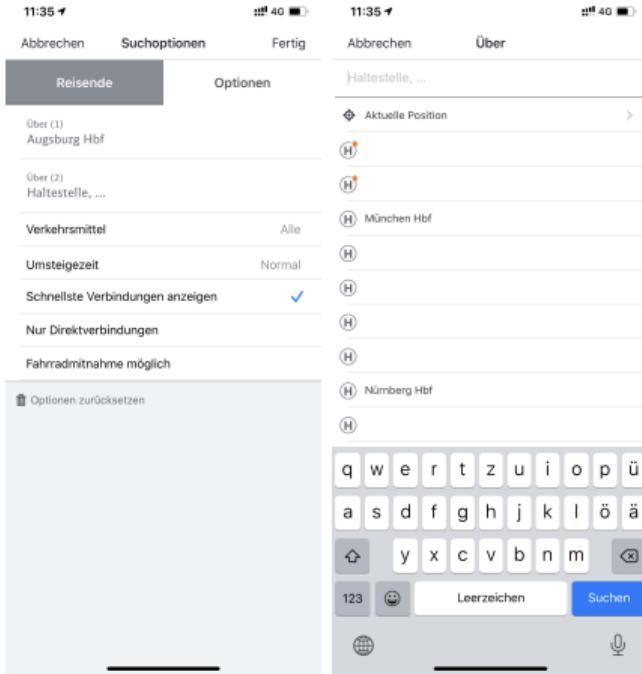
1 Billion Downloads of Android Apps



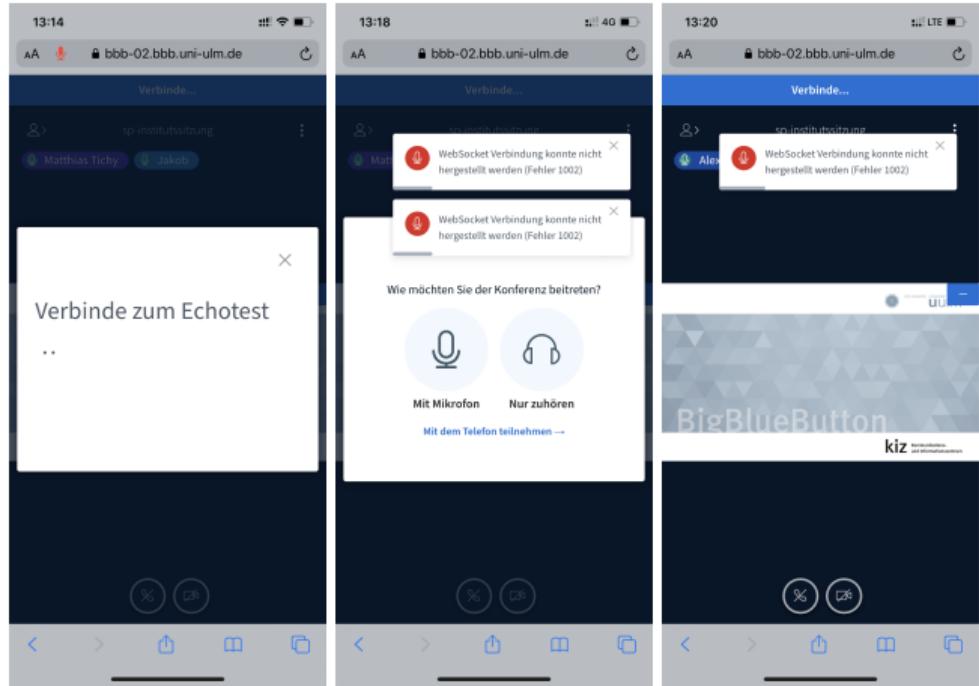
500 Million Downloads of Android Apps



Relevance of Software for Me



Relevance of Software for Me



Relevance of Software for Me

BigBlueButton.

ulm university

kiz Kommunikations- und Informationszentrum

Relevance of Software for Me

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

The screenshot shows a Zoom webinar interface. At the top, a video feed of Jackson Prado Lima is displayed, with the status "You are viewing Jackson Prado Lima's screen". Below the video, there is a slide titled "COLEMAN interacting with the CI Pipeline". The slide contains a diagram illustrating the interaction between Developers, a Source Control Server, and a CI Pipeline (represented by a box labeled "BUILD", "Test Set T available", "MAIL", and "Rewards"). A red arrow points from the "MAIL" section of the CI Pipeline box to a "COLEMAN" component. Below the diagram, there are three buttons: "check-in", "fetch changes", and "result". At the bottom of the slide, there are icons for Chat (with 3 notifications), Raise Hand, and Q&A. To the right of the slide, a separate "Zoom Cloud Meetings" window is open, showing a "Connecting..." message and a form to "Enter your email and name". The form fields are pre-filled with "Your email: Thomas Thüm" and "Remember my name for future meetings" is checked. There are "Join Webinar" and "Cancel" buttons at the bottom of the meeting window.

COLEMAN interacting with the CI Pipeline

Developers

Source Control Server

result

check-in

fetch changes

COLEMAN

BUILD

Test Set T available

MAIL

Rewards

Your email

Thomas Thüm

Remember my name for future meetings

Join Webinar Cancel

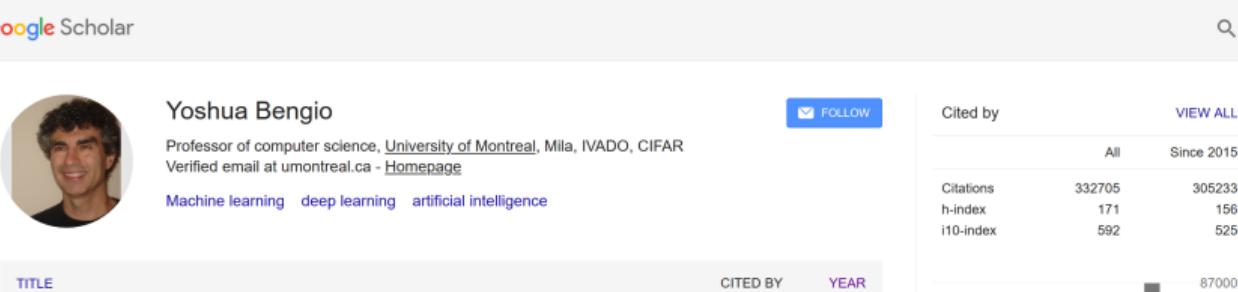
Audio Settings ▾

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
VIEW ALL

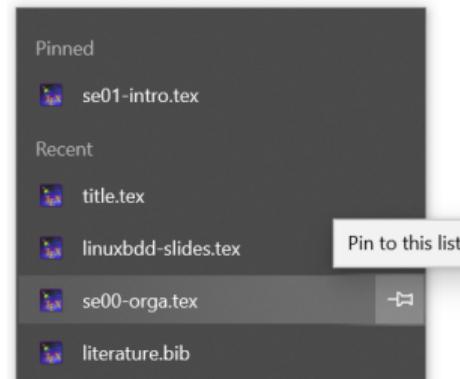
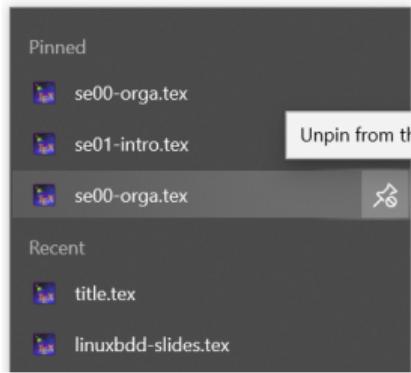
All	Since 2015
Citations 332705	305233
h-index 171	156
i10-index 592	525

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 consists of nodes labeled 1 through 6, connected by directed edges. The left page also features a sidebar with a list of topics related to BDDs and SAT-solving.

Title: Many Queries on BDDs are fast.

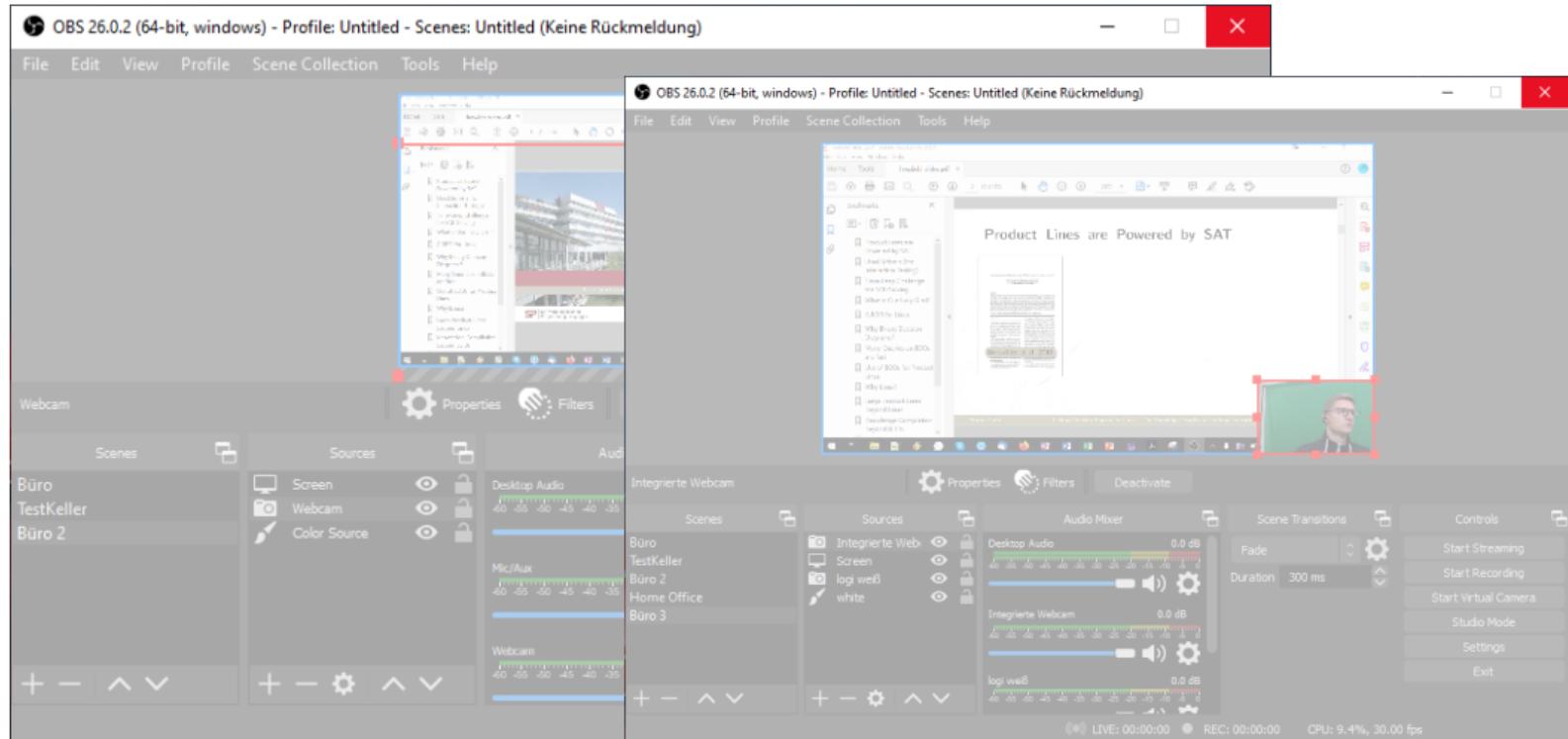
Diagram: A BDD diagram with nodes labeled 1 through 6. The nodes are arranged in layers, with node 1 at the top, followed by nodes 2 and 3, then 4, 5, and 6 at the bottom. Directed edges connect nodes between adjacent layers. The label "BDDs" is placed near the bottom of the diagram.

Reference: Bryant 1986

Topics Sidebar (Left Page):

- 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

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

- See Moodle:
<https://moodle.uni-ulm.de/mod/moodleoverflow/discussion.php?d=3668>
- What were reasons and consequences of the Facebook outage on October 4th, 2021?

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Software Engineering

Software Engineering vs Programming

Software Engineering vs Computer Science

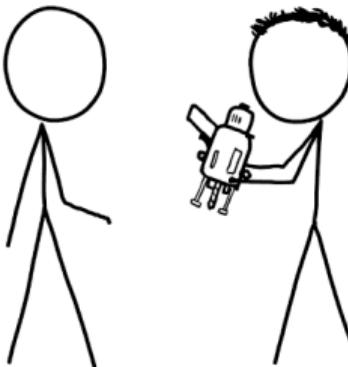
Software and System Engineering

(Software) Engineering

Lessons Learned

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

[Sommerville]

“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.”

Software Engineering vs Programming



Software Engineering vs Computer Science

SE vs CS

[Sommerville]

“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.”

Software and System Engineering

System Engineering

[Sommerville]

“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.”



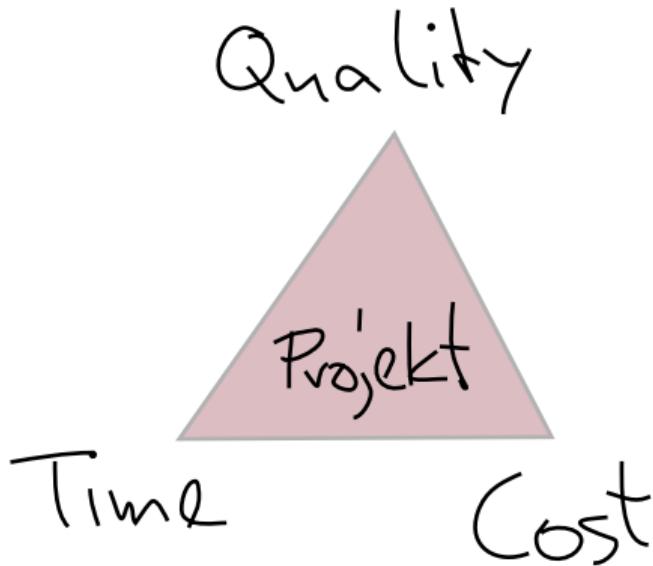
(Software) Engineering

Engineering

[Sommerville]

"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."

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

- See Moodle:
<https://moodle.uni-ulm.de/mod/moodleoverflow/discussion.php?d=3669>
- What is your connection to software engineering in 10 years?
- Read about ethics in software engineering: **Sommerville**, Chapter 1.2, p. 28–31