Why should Electrical Engineers learn Software Engineering?

My Experience in the Netherlands

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1 Short Bio

- ▶ B.Tech in Electrical and Electronics Engineering, Amrita Vishwa Vidyapeetham, 2011- 2015
- ▶ Master of Science in Embedded Systems, Delft University of Technology, 2015-2017
- ▶ Student Teaching Assistant, TU Delft Faculty of Aerospace Engineering, 2017
- ▶ Embedded Systems Engineer, Inkless Printing Startup, 2015-2017
- ▶ Lead Software Design Engineer, ASML, 2018 - Present
- ▶ www.pranavsaileshmani.com
- ▶ I prefer to keep my presentations to less than 20 minutes. Anything more and people start sleeping.
- ▶ I'll be direct!

2 Inkless Printing

- ▶ Patented technology. Controlled burning of paper.
- ▶ Control algorithms implemented in SW.
- ▶ Embedded Controllers used to control the laser beam and stage movements.
- ▶ Featured in TechCrunch. Tech sold to a Spanish company.
- ▶ Search YT for Inkless Printing.

Figure: Prototype printer and sample print

- ▶ Extreme Ultraviolet(EUV) scanners are one of the most complex machines made by mankind!
- ▶ All fields of science and engineering are applied including optics, electrical, mechatronics and software engineering.
- ▶ The future of machines are powered by software.
- ▶ We use C/C++/Python as the major programming languages to implement software.
- ▶ See documentary: The Extreme Physics Pushing Moore's Law to the Next Level.

Figure: ASML lithography machines

- ▶ The design of the camera has remained the same throughout the years. A way to reduce the size of the camera would be to remove the lens out of the equation.
- ▶ These lenses can be replaced by masks/coded apertures.
- ▶ One of the additional steps in using coded-apertures is that additional computational steps need to be performed in order to reconstruct the image.
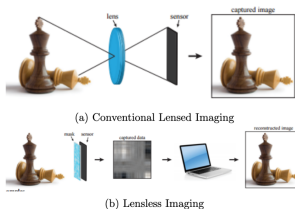- ▶ You can read my thesis online!

(a) Conventional Lensed Imaging

(b) Lensless Imaging

Figure: Lensed and lensless imaging

- ▶ An algorithm has five characteristics: Finiteness, definiteness, an input and an output. *Donald Knuth*
- ▶ An expression of a computational method in a computer language is called a program. *Donald Knuth*
- ▶ Programs are represented by means of programming languages.
- ▶ My experience says that programming languages can be categorized into three: Systems , Functional and Scripting.
- ▶ Systems: Closer to hardware. Examples: C, C++, Rust.
- ▶ Functional: Functions calling functions. Examples: Julia, Haskell.
- ▶ Scripting: Quick prototypes of ideas. Examples: Python, MATLAB.

3 Why learn SW?

- ▶ SW is an expression of an idea.
- ▶ We are in the information age.
- ▶ We are nearing the end of Moore's law.
- ▶ Software is the future, not hardware.
- ▶ Software is used to create hardware. High Level Synthesis.
- ▶ Algorithms are everywhere!
- ▶ AI is taking over the world!

- ▶ A solid programming language, that will teach you the fundamentals. Start with C. Understand memory management and other critical concepts. Transition to C++.
- ▶ Practice your language skills on an online platform like codeforces, codechef, etc.
- ▶ Read books on clean code.
- ▶ Start learning about software architecture.
- ▶ You can ask me which and what resources to read. I can suggest based on your experience.
- ▶ Build an embedded system as it teaches you about both hardware and software.

- ▶ You are no less smarter than someone from an IIT, MIT or any fancy university.
- ▶ Work ethic is everything.
- ▶ Learn how to learn! A mind for numbers by Barbara Oakley.
- ▶ Knowledge is the key, not the grades or a nice job. Once you have the knowledge, the others follow.
- ▶ For software, you can learn anything and everything from everywhere! Find the right communities online.
- ▶ Learn mental models of thinking, and not memorize!
- ▶ A little money is needed for compute power!

Example

Everything around you that you call life was made up by people that were no smarter than you. And you can change it, you can influence it Once you learn that, you'll never be the same again. - Steve Jobs