

A programmer from a garage against a lord of theorems - Battle for those in the middle

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Motivation

- ▶ **Presentation inspired by**
 - ▶ the talk I had in December 2015 at the anniversary of Department of Mathematics at Faculty of Electrical Engineering and Computing, Zagreb
 - ▶ design of new curriculum at Faculty of Electrical Engineering and Computing, Zagreb
 - ▶ common statements (beliefs) about need for mathematical, physics, electronics, and other traditional engineering (but not CS, SE) topics

- ▶ **A fictional story in order to illustrate a problem that software engineering (and other IT areas) students and teachers must deal with**

Once upon a time in year 1*** ...

- ▶ Computers and calculators are still not invented
- ▶ Study of mathematics is part of a philosophy, and on their way to diploma students usually fail to pass
 - ▶ Theoretical and practical philosophy
 - ▶ Astronomy
 - ▶ ...
- ▶ In mathematics, geometry and trigonometry dominates
 - ▶ They are classical disciplines and foundation for practical use of mathematics in that time
 - ▶ Calculus is not studied (or maybe just theoretically at the end of the study)

...in the meantime

- ▶ There are many well payed jobs that requires knowledge of calculus
 - ▶ Students does not have (practical) knowledge of calculus, but they are smart so they will learn it
 - ▶ Various private schools offers studies of applied calculus
 - ▶ Anyone who solved an integral at least three times calls himself an integral master.
- ▶ Part of calculus jobs still requires broader mathematical knowledge and it must be performed by an educated mathematician.
 - ▶ There is a problem to find what kind of knowledge is required and how to integrate it into study programs
- ▶ There have been many job offers for both groups in last n years and there are no signs that the demand would decrease

...and what superiors mean about that?

- ▶ **Some think...**
 - ▶ that calculus is „primitive routine” job that should be left to private schools
 - ▶ that astronomy is foundation for this profession, although no one can establish link to calculus jobs
 - ▶ that philosophy courses are not useful in mathematics, but they form a character and serves as a drill
 - ▶ that other mathematical courses form a mathematician and that calculus would change through the time and that we should stick only to theoretical knowledge
 - ▶ additionally they claim that calculus techniques had already been changed several times and only professional mathematicians have survived the changes (unlike self educated „integral masters”)
 - ▶ and it is not appropriate to change „only correct” study by introducing applied calculus and „converting” institution into vocational school
- ▶ **What about this think people using calculus every day?**
 - ▶ probably the same what software engineers think today

Analogy with present time

- ▶ Claims and beliefs from the fictional story appears in software engineering context
- ▶ IT market offers well payed jobs
 - ▶ self educated programmers appears daily
 - ▶ who and what is „programmer”?
 - ▶ there are several private schools in computing
 - ▶ part of jobs does not require (or at least significant) knowledge of mathematics, physics, electronics, ...
 - ▶ part of jobs requires specific parts of mathematics, e.g. statistics, financial mathematics, graph theory, ...
- ▶ Students are having problems with so called „fundamental” courses, and have lack of specific knowledge
 - ▶ need to free up slots for new topics in computing and redefine what is really fundamental
- ▶ Engineer vs scientist
 - ▶ In order to use something, do we really need to know background in details?

Programmer from a garage vs lord of theorems

- ▶ **Two different extremes**
 - ▶ Programmer from a garage:
 - ▶ self educated programmer in order to enter lucrative IT market
 - ▶ student that left his study due to lack of previous knowledge, capacity or ambition (maybe he/she already has job or startup company)
 - ▶ Lord of theorems
 - ▶ a brilliant programmer that excels in math
 - ▶ those are rare and usually continues his/her career abroad
 - ▶ We cannot affect to much on either of these two extremes
 - ▶ Programmer from a garage would seek his/her diploma somewhere else
 - ▶ Lord of theorem probably would be excellent even without us, and we have too little to focus only on them
- ▶ **How to educate those between these two extremes?**

Computing and software engineering evolves quickly

- ▶ **Wrong perception that it is just usual programming that can (almost) everyone learn after he/she is formed as an engineer in a classical way**
 - ▶ shift from programming in 1970s for several order of magnitude
 - ▶ planning, methodologies, programming techniques, patterns, architectures, ...
- ▶ **Used in heterogeneous areas**
 - ▶ physics and mathematics are not the only area in which we use computing
 - ▶ biology, chemistry, law, finances, and many others
 - ▶ verbal and social skills (e.g. for business analyst)

Some examples of traditional (electrical) engineering education

- ▶ Present situation in some of the participants' institutions: FER Zagreb, ETF Belgrade, FINKI Skopje, ETF Sarajevo, FERl Maribor, FRI Ljubljana, FTN Novi Sad, UNIRI-Rijeka
- ▶ Electrical Engineering Fundamentals
 - ▶ All except FTN, UNIRI and FERl Maribor
- ▶ Physics:
 - ▶ all except FTN and FERl Maribor
 - ▶ FER, FINKI, ETF SA, UNIRI have 2 Physics courses
- ▶ Mathematical Analysis
 - ▶ Mostly in 1st semester, FTN 2nd, FRI 7th.
 - ▶ All except FERl Maribor, FTN Novi Sad, and FRI Ljubljana also teach advanced topics.
- ▶ Electronics
 - ▶ FER is going to drop it in next curriculum, ETF SA, FERl (5th semester)

Common beliefs (myths?)

- ▶ „Our alumni have survived technology changes because we had given them good foundations.”
 - ▶ Maybe, but maybe they were just best of what country had. And they have been learning new things all the time.
- ▶ „Mathematics, physics and electronics serve as a drill to filter students.”
 - ▶ We can also drill them in programming, which is slightly different way of thinking
- ▶ „Math is essential for an engineer (master).”
 - ▶ If so, how that there is no math after second year of study?
- ▶ „Physics and Electronics are foundations and general knowledge.”
 - ▶ How we can use topics from these courses in our work?
 - ▶ Philosophy is also general culture but we drop it from learning long time ago.
- ▶ „Introducing practical courses (e.g. programming for web and mobile devices) will turn us into vocational high school and decrease enrolment”
 - ▶ So instead we would learn them something that will never use in their careers and in the meantime we would expect of them to create web and mobile application for bachelor thesis?
 - ▶ Is our curriculum really better or it is a just matter of reputation and input quality?

Conclusion

- ▶ SE changes and it is used in heterogeneous areas
 - ▶ we can not learn everything
 - ▶ we have to redefine what is fundamental and really needed
- ▶ Non-computing courses should be a tool and not a purpose itself (especially at lower levels of study)
 - ▶ Diverge from classical (electrical) engineering education
 - ▶ There are better and more useful ways to drill students other than in math, physics, electronics, ...
- ▶ Need for more practical knowledge at bachelor level. When they are formed as „programmers” then it is a time for advanced and theoretical knowledge
 - ▶ advanced mathematical topics and techniques
 - ▶ preparation for master thesis and his future (scientific) career
 - ▶ specialization (minors?) in other areas (physics, biology, ...)
- ▶ Unfortunately things are not progressing as wanted and maybe we should be afraid that students would seek a better alternative

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- ▶ Thank you for your attention.
 - ▶ Questions?