Computer Science for All in Swiss High Schools

Current State, Issues, and Perpectives

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Context

Computer Science in Swiss School Curricula

Primary / secondary [1, 2]

No (fundamental) computer science
Tool usage (sometimes…)
No dedicated time in schedule
No specialist teachers

High school [3]

In some cantons: teaching of ICT
Whole country: CS as optional field for a few students

Anticipated: CS might enter as mandatory field for all students

Split of Subdomains

Three-pillar approach to a **comprehensive education in computer science** [4]:

Formal and applied science — *Not a science* — *Social science*

Cartography of Computer Science

Main Subdomains of Computer Science

↕ Position on vertical axis denote estimated empirical predominance of *theory* or *application* for a subdomain
↔ Position on horizontal axis bears no significance
— Edges denote *conceptual proximity* of subdomains

Why is such a map important?

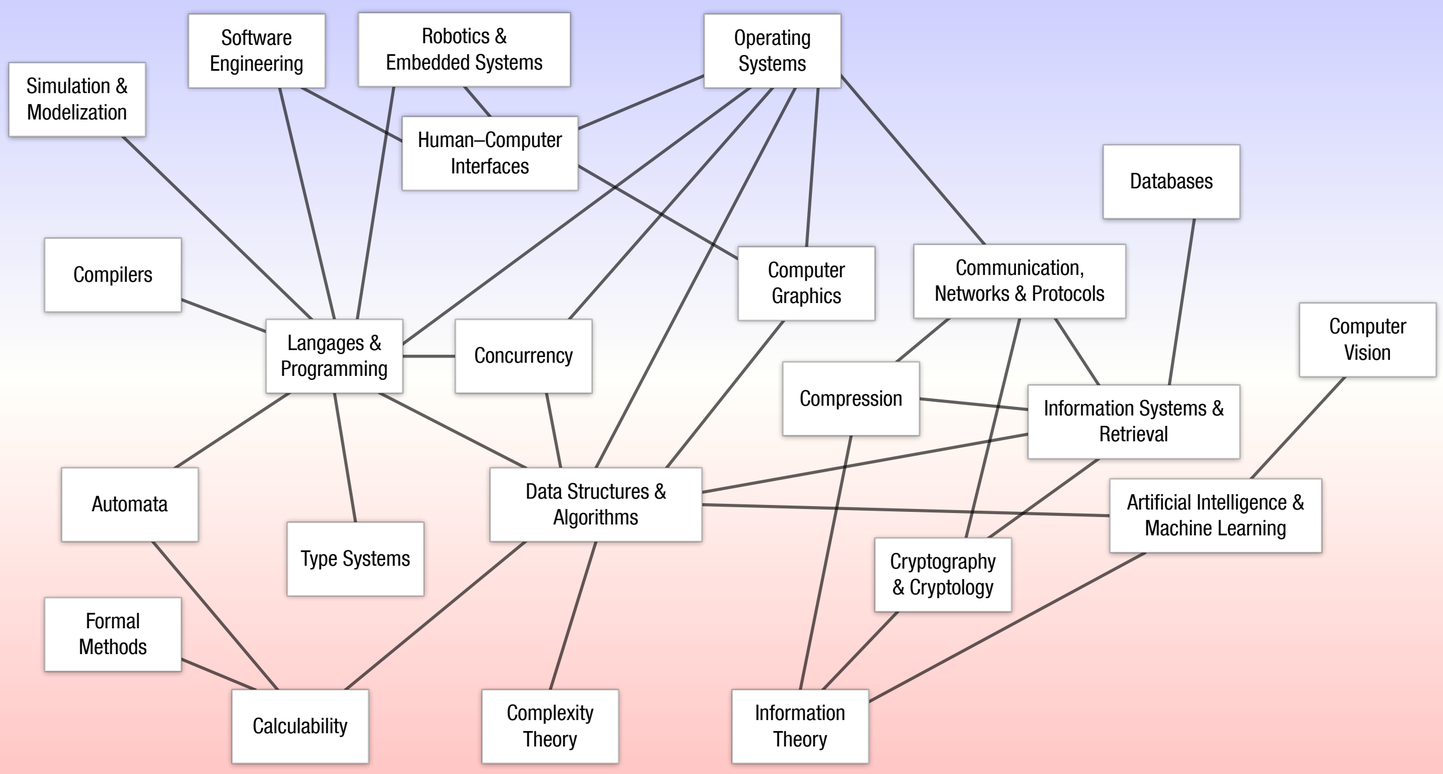
- Identify the areas we want to cover
- Argue why those that we do not cover are left out
- Determine possible high-level pedagogical paths to follow in curriculum

Downsides

- Exhaustivity is impossible to reach unanimously
- Granularity can be discussed at length
- Predominance of theory or application is not well defined

This graph is a variation of another one constructed by the authors while readying a curriculum proposal for "CS for all in high schools" with members of SVIA/SSIE/SSII, the Swiss association of CS teachers.

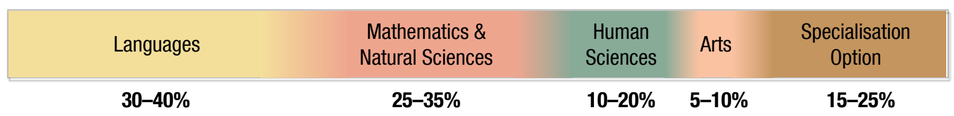
SV!A / SS!E / SS!I



Issues at Stake

Classification in Curricula

Split of domains in high schools *(prescriptive; nationwide; 1995)* [2]**:**



Fact: No room for **applied sciences / engineering sciences.** Whole domains missing!

STEM = Science, Technology, Engineering and Math
MINT = Mathematik, Informatik, Naturwissenschaften und Technik

Result: Spurious classifications of CS within this framework *or* outright dismissal

Need: Rethink the split to make room for missing STEM domains

Pedagogical Approach

Computer science has to be taught as a **field on its own**

→ CS **!=** applied mathematics

Major objective of CS for all: get students **interested**

→ **experimentations**, inductive approach, problem-based learning [5]

→ **not** a "theory-first" approach

Need: Comprehensive concept map & didactic transposition [6]

Teacher Education

Current ICT teachers **mostly !=** computer science **specialists**

→ teachers from **other fields**, good ICT users

→ lack of CS **academic** and **didactic** training

→ impact on CS teaching

→ more **ICT** than CS

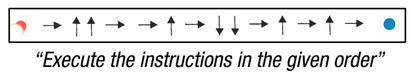
Need: Attract engineers to teaching & give technical education to current teachers

And *Before* High School?…

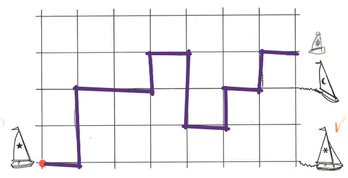
ICT user skills/digital literacy are not taught early enough

→ free high schools from teaching ICT → more time for **computer science**

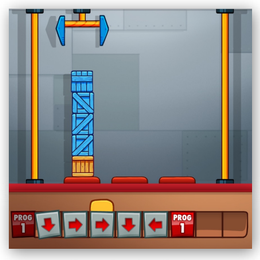
Elements of **Computational Thinking** can be introduced in primary school already



"Execute the instructions in the given order"



(Primary school math assignment, 1988)



(Cargo-Bot, free iPad app, 2012)

Need: A name & place of their own for these concepts, which are not new, *but* the tools are new

References

[1] Deutschschweizer Erziehungsdirektoren-Konferenz (2014). *Lehrplan 21*.

[2] Conférence internationale de l'instruction publique de la Suisse romande et du Tessin (2009), *Plan d'études romand*.

[3] *Verordnung des Bundesrates/Reglement der EDK über die Anerkennung von gymnasialen Maturitätsausweisen* (1995).

[4] Kleiner, P. (2014). *Was ist Informatik?* Schriftenreihe der Hasler Stiftung.

[5] Kay, J., et al. (2000). *Problem-based learning for foundation computer science courses*. Computer Science Education, 10(2), 109-128.

[6] Chevallard, Y. (1992). *Concepts fondamentaux de la didactique*. Recherche en didactique des mathématiques, 12(1), 73-112.