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A Survey on the Mathematical Emphasis in Brazilian Computer Science Curricula

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Outline

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- Trends in higher education
- Decreasing focus in mathematics

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- Mathematics in Brazilian CS programs

Conclusions

- Is math actually loosing space?

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Trends in CS education

Mission I

- Tackle current problems of society
- Focus on technical knowledge

Mission II

- Glimpse the future
- Focus on academic knowledge

"Universities should educate – employers should train"

> *Universities are primarily in the business of positive human development. They focus on enhancing the abilities of our graduates to **communicate clearly and effectively**, to **analyze**, to **confront ambiguity** with clear methods and confidence, to **break down problems** into manageable parts, to **think critically** and to **question deeply**.*
>
> — Max Blouw [1]

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[1] Blouw, M. (2013) "Universities should educate – employers should train." [Online; accessed Oct 14, 2013] Available:
http://www.theglobeandmail.com/commentary/
universities-should-educate-employers-should-train/article14078938/

The interplay between theory and practice

The technology area is a strong example on how **standard procedures** inside the industry are **constantly changing**.

Challenges

- How can the university enable one to reason when facing new problems?
- How *perennial*, fundamental should be the concepts taught?

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The interplay between theory and practice

*A fundamental aspect of computer science is the **balance between theory and practice and the essential link between them**. Graduates of a computer science program must understand not only the theoretical underpinnings of the discipline but also how that **theory influences practice**.*
— CS2008 [2]

[2] ACM/IEEE Joint Task Force (2008) "Computer Science Curriculum 2008: An interim revision of CS2001."

Decreasing focus on mathematics

- CS is a **broad field** that **connects to and draws from many disciplines**, including mathematics, electrical engineering, psychology, statistics, fine arts, linguistics, and physical and life sciences.

- The **role of mathematics** in reference curricula has been **decreasing gradually** since at least the 1960s, although at a lower rate today. [3] [4]

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[3] A. Ralston "Do we need any mathematics in computer science curricula?" *SIGCSE Bull.*, vol 37, no. 2, pp 6-9, Jun 2005.

[4] A. B. Tucker "Our curriculum has become math-phobic!" in *Proceedings of the Thirty-second SIGCSE Technical Symposium on Computer Science Education* ACM Press, 2001, pp. 243-247

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Case Study: Panorama on the study of mathematics in Brazil

- Overview of **how much math** is studied in eleven **well ranked Brazilian CS programs**
- Objective analysis through a **quantitative analysis**
- Comparison with reference curricula
- Useful for curriculum reforms

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Definition of mathematics

- Calculus
- Linear Algebra
- Geometry
- Set Theory

- Algebra
- Discrete mathematics
- Probability
- Statistics

Selected CS Programs

- Brazil has more than **350 CS programs**
- The **eleven** selected ones were ranked as **5-stars** by the *Guia do Estudante* ranking.
- The ranking consists of an **opinion poll** among professors, course coordinators and directors of departments.
- Each program is **graded by six different reviewers**, extremes are excluded
- Ranking audited by PricewaterhouseCoopers

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Figure: Map of Brazil with the studied universities [5]

[5] Image courtesy of Wikipedia, the Free Encyclopedia

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Table: Studied CS Programs Panorama

University	Period	Organization	Foundation
ICMC/USP	Diurnal	Public	1979
IME/USP	Diurnal	Public	1970
PUC-RS	Nocturnal	Private	1983
UFC	Diurnal	Public	1975
UFCG	Diurnal	Public	1977
UFMG	Diurnal	Public	1978
UFPE	Diurnal	Public	1974
UFRGS	Diurnal	Public	1983
UFRJ	Diurnal	Public	1974
UFSC	Diurnal	Public	1976
UNICAMP	Nocturnal	Public	1969

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Table: Studied CS Programs Panorama

University	Years	Students/year	Where is located
ICMC/USP	5	100	Institute of Mathematical Sciences and CS
IME/USP	4	50	Institute of Mathematics and Statistics
PUC-RS	4	60	Faculty of Informatics
UFC	4	60	Center of Sciences
UFCG	4	90	Center of Eletrical Engineering and Informatics
UFMG	4	80	Institute of Exact Sciences
UFPE	4.5	100	Center of Informatics
UFRGS	4.5	100	Institute of Informatics
UFRJ	4.5	50	Institute of Mathematics
UFSC	4	100	Institute of Informatics and Statistics
UNICAMP	5	50	Institute of Computing

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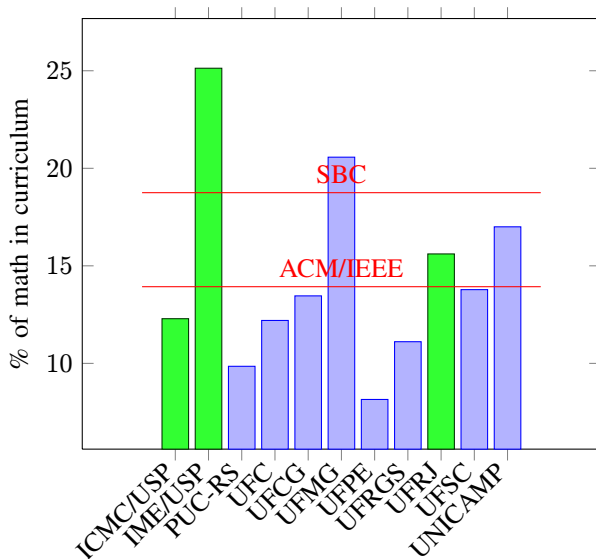
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Figure: The proportion of mathematics in each curriculum compared with the reference curricula

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Future work

- Reapply the analysis with **other rankings** (Eg. ENADE ranking made by the Brazilian Ministry of Education)
- Is there any **correlation** between being **well ranked** and the **amount of math** studied?
- How **useful** was mathematics after graduation? Apply **questionnaires** to analyze the strengths and weaknesses of a curriculum.

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This paper

- Analyzed the **different perspectives** of teaching at universities and **opinions** related
- Noted the **decline** of the teaching of **mathematics** in CS both as a trend in reference curricula and in eleven different CS programs in Brazil

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Thanks!
Questions?