



Computer Science- A Language of Technology

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Which languages one should acquire ?

Mother tongue
International language
Language of Art
Language of Science
Language of Technology

**Is Computer Science
one of them?**

Why not teach Computer Science in high school?

- We do not have the budget.
- This is only for smart students.
- Better learn it at the university.
- I am here and I did not study computer science!

Why must we teach Computer Science in high school ?

We'll try to answer this question.

How Should We Portray CS ?

- The field of computer science has been rapidly developing since its recognition as a stand-alone discipline.
- The dynamics of the field led to its inadequate public image and posed challenges regarding how to make computer science studies more appealing to students.

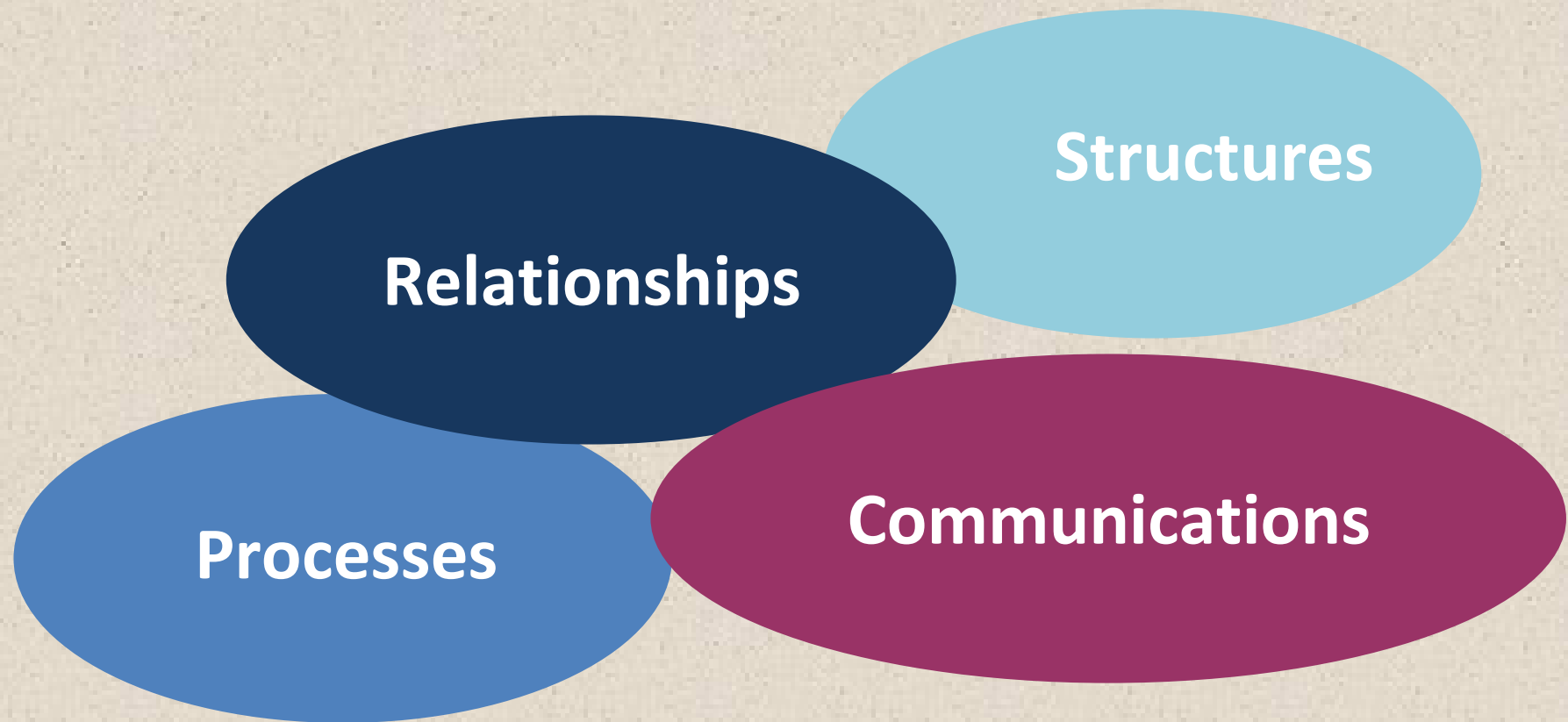
Recently, computer science has been
recognized as a language
of natural sciences,
and its synergy with these sciences
became noteworthy.

**This paper illuminates another facet of
computer science**

We call for the acknowledgement of
computer science as:

***A scientific paradigm,
which is a language of technology.***

The language describes:



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Computer science –
A language of technology

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CS - A Language of Technology



We believe that this view
legitimizes the status of CS

as a *basic language*

that is essential for acquiring

Scientific and Technological Fluency.

Why study CS ?

- Educators agree that it is important to ensure that high-school graduates will be ready to meet the demands of tomorrow's high-tech society.

Recently, the importance
of all students becoming
computer savvy, not merely computer literate
has become increasingly recognized.

Why study CS ?

The CSED community have stated that computer science provides the knowledge and skills foundation for contemporary technological advances:

Maintaining our ability to meet present and future challenges requires us to acknowledge CS as a core element of all STEM initiatives*

**science, technology, engineering, and mathematics*

[Stephenson et al., 2005]

How Should We Portray CS ?

The increasing complexity of the field led
to an inadequate external image,
and
poses new challenges in motivating
students pursuing computer science as a
career choice or a course of study in
which to major.

How Should We Portray CS ?

- Along with the rapid development of computer science, many efforts have been made to make it more understandable for:
 - prospective students
 - stakeholders and policy makers.

How Should We Portray CS ?

- The authors of this paper have personally experienced difficulties in convincing policy makers in the K-12 education system about the increasing importance of computer science as part of the required knowledge base of every citizen in a technological and global society.

How Should We Portray CS ?

- Strengthening the status of computer science as a full-fledged and self-contained subject in the educational system is most important.
- CS should be taught (like mathematics) as an essential core subject.
- This mission is not yet simple to achieve due to the field's public image.

Portraying Computer Science as a Language

Is Computer Science a language?

- The concept of a language is not so simple to define:
language is a system of communication or reasoning using representation along with metaphor and some manner of logical grammar.
- Languages use gestures, sounds, symbol, or words, and aim at communicating concepts, ideas, meanings

Does CS have the characteristics common to a language ?

Original description of CS:

The discipline of computing is the systematic study of algorithmic processes that describe and transform information [Denning et al., 1989].

- CS provides a means of expressiveness, reasoning, and communicating by use of conventional symbols that can be employed to describe:
 - processes, structures, relationships and communications.

CS – a language of Science

- Computer science *"is constantly contributing to other fields by demonstrating how to model their processes as information processes."*

[Denning, 2005]

- Computer science is *"poised to become as fundamental to science, and in particular the natural sciences, as mathematics has become to science, and in particular the physical sciences."*

[Towards Science 2020, 2006]

CS – a language of Science

*CS concepts and theorems are starting to
prove fundamental in explaining natural
and
physical phenomena.*

[Towards Science 2020]

CS – a language of Science

- CS concepts provide levels of abstraction
"allowing scientists from different fields to:
 - *understand and learn from each other's solutions,*
 - *acquire a set of widely applicable complex problem solving capabilities, based on the use of a generic computational environment,*
 - *in the same way that they learn universally applicable mathematical skills"*

[Towards Science 2020]

CS and Technology

- Even though algorithms have been known since the ninth century, the need to define computer science as a stand-alone discipline arose only in the early 1940s, with the invention of the first electronic computers.
- Apparently, this matched timing of events has clarified the essential linkage between computer science and technology and implies that:

*Technology reached the stage
where it needed a language
that describes it.*

In spite of Dijkstra's famous statement:

*Computer science is no more
about computers than
astronomy is about telescopes*

one cannot ignore that the term
"Computer Science" evolved from the
technology that created the need.

Why computer science is a language of technology?

The answer follows from the notion of the concept *Technology* and from the status of contemporary computer science .

Technology is the need to solve the practical problems of the intelligent man.

It is the application of scientific and other knowledge, tools, and skills

to solve practical problems and extend human capabilities.

Contemporary Computer Science

The *Science 2020* report refers to the status of contemporary computer science:

Computer science teaching and research is currently at an awkward crossroads where it needs to decide whether it is something that serves other disciplines, is an engineering exercise, or a real science in its own right.

Towards Science 2020

*Conceptual and technological tools developed
within computer science are starting to have
wide-ranging applications outside the subject
in which they originated,
especially in sciences
investigating complex systems.*

Towards Science 2020

*Integration of computing, computer science
and mathematics*

*leads to integration of modelling, experimental
and theoretical approaches in science.*

*In particular, scientific computing platforms and
infrastructure are making possible*

new kinds of experiments

(that would have been impossible to conduct only 10 years ago),

changing the way scientist do science.

Conclusion

- Besides being a science in its own right, computer science serves as a platform for applying scientific and other knowledge to practical tasks (compatible with the notion of technology).
- We believe that these arguments are a basis for recognizing computer science as a language of technology.

CS – a language of Technology

The language describes:

*Structures, Processes,
Relationships, and Communications.*

It supports:

*Abstraction, Formalization,
and Knowledge Representation.*

CS – a language of Technology

Since computational concepts are deeply
embedded
into everyday thinking in many fields,

The language facilitates
Doing and understanding technology.

Why we should not be afraid of relating Computer Science to Technology?

- Computer science has been suffering from an *underestimated self-image*, and has fought to be recognized as a science.
- This situation, along with trying to diminish the common misconception:
Computer Science Equals Technology
explains the reluctance to relate computer science to technology.

Why we should not be afraid of relating Computer Science to Technology?

Nowadays, recognition of computer science as *a real science in its own right* is becoming a fact.

Computer science studies information processes both artificial and natural. It helps other fields study theirs too.

[Denning, 2005]

Why we should not be afraid of relating Computer Science to Technology?

Recognition of CS
as a science
should encourage us to relate
to the relationship
between CS and technology
in an unthreatening way.

We should not conceal the fact that computers
and technology
are essential for

*Enabling the evolving synergy between
computer science and natural information
processes.*

Presenting computer science as a language of
technology
illuminates essential linkages and
cross-fertilization between both realms.

Educating the citizens of tomorrow

- Computer science has increasingly become a core knowledge requirement for all educated citizens.
- Like the more traditional sciences, it provides an essential understanding of the world around us.
- Computers are part of almost every aspect of our lives and it is vital that we understand their capabilities and their limitations.

Educating the citizens of tomorrow

- It is our responsibility as CS educators to assist all students in:

bridging the gap between using and understanding computers.

- CS education should be planned and adapted for and various populations:
 - all students
 - students who wish to obtain expertise in the field
 - scientists of tomorrow

Switching the focus

- We agree that the misconception *computer science equals technology* should be diminished and eventually discarded.
- However, we strongly recommend that the connection of computer science to contemporary technology should be illuminated.
- Specifically, it is important that the students be better educated regarding the long-standing fundamental principles of the discipline (emphasizing that they are above specific technologies) while illustrating linkages between contemporary computing and its applications.

Switching the focus

- The description of computer science as a scientific domain that is a language of technology can attract newcomers.
- Important to convince:
 - CS provides the knowledge and skills foundation essential for contemporary technological advances *[Stephenson et al, 2006]*
 - CS may enhance understanding other subjects as well *[Wing, 2006]*

Summary

**Computer science should be introduced as a high-level
scientific language**

**for problem solving,
knowledge representation,
and formalization of processes**

as well as

**a language for understanding technology
and performing
technology-related processes.**

Thank You

