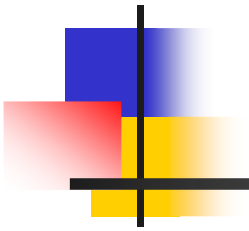

Outreach to Prospective Informatics and Computer Engineering Students

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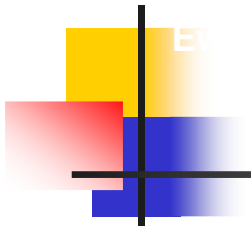


Plan

- outreach, ICT *versus* Informatics
- motivation – Computer Science in crisis?
- USA: initiatives STEP, NETP, NSF
- informatics education in Poland in last 45 years!
- outreach in Poland:
  - national curriculum
  - competitions
  - project: Informatics +
  - workshops for students and teachers (Toruń)
  - new technology standards for teachers
- conclusions

Outreach

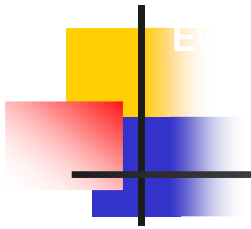
Outreach – the act of reaching out, beyond usual limits

An effort by an organization or a group to connect its ideas and practice to the efforts of other organization, groups, specific audiences, or the general public

Computer Science (informatics) outreach enlightens prospective students (and their schools) and the public about the importance of computer science knowledge and attractiveness of the computer related professions in the information society

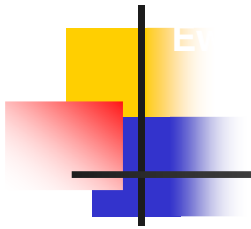
In particular, organization = university

other organizations = schools



Informatics (CS) *versus* ICT

- Informatics (CS) is concerned with designing and creating informatics 'products' and 'tools', such as: algorithms, programs, application software, systems, methods, theorems, computers, …
- ICT – applications of CS (computing) – concentrates on how to use and apply informatics and other information technology tools in working with information



Computer science (education) in crisis?

Q: Is computer science in crisis? a dying discipline?

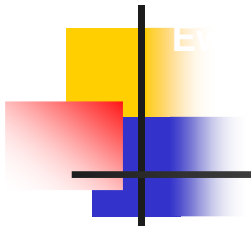
A crisis in university computer science (in the US):

- the number of students enrolled in CS has fallen for several years: in 2007 dropped 49% from 2001/2002
- impact on degree „production”: the number of bachelor’s degrees fell 43% between 2003/04 and 2006/07

On the other hand – there is still a demand for experts and specialists in computer use and applications

Similar figures for UK

In Poland: declining interests in high school informatics, in „matura” in informatics and in university CS and CS career



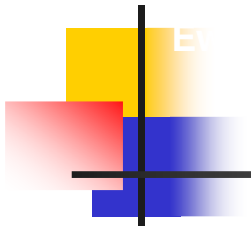
Computer science education in crisis

some answers

A:

- students have tested enough ICT in their upbringing and they want something different at Uni level
- the traditional curriculum in computing is unattractive to present-day students
- students (not only) do not distinguish between using and studying (computer tools)
- opposed to a vocational qualification, the mission of uni is to develop understanding, rather than skills

The lack of adequate CS education in high schools



USA – STEM

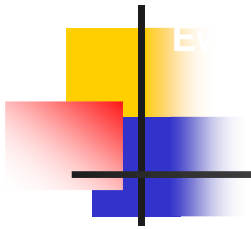
STEM – Science, Technology, Engineering, Mathematics:

In 2006, George W. Bush announced the American Competitiveness Initiative, which called for … an increase in U.S. higher education graduates within STEM disciplines

Barak Obama (Nov, 2009): several nationwide programs

ACM:

- there is a tendency in STEM education to look at technology and computers as tools in support of education
- distinguish between the use of educational technology (ICT) to support learning and CS education as an academic discipline
- CS should be explicitly identified as a STEM disciplines



USA – NETP

National Education Technology Plan – March 2010

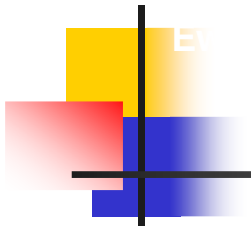
Five goals:

- learning
- assessment
- teaching
- infrastructure
- productivity

Students: to use technology for personalized learning

Teachers: to connect with networks to ensure their knowledge and methods are up to date

112 pages: CS mentioned only once – students have no opportunity to learn in any depth about technology



USA – NSF initiative

CSTA: CS is on the decline in high schools, in 1100 schools:

- pre-AP CS classes: 65% in 2009 – 73% in 2007 – 78% in 2005
- AP CS classes: 27% in 2009 – 32% in 2007 – 40% in 2005

NSF: Transforming High School Computing (2010):

CS/10 000 Project: 3-course high school computing curriculum:

- Introductory (Pre-AP) Course – designed for all students
- „Gold Standard" New AP Course – will show the „magic" of computing
- existing AP CS A Course – programming-centric course

New curriculum will be taught:

- by 10 000 newly prepared teachers
- in 10 000 classrooms across the US

Poland History: B.PC.

computers in education

1965: First regular classes in two high schools in Wrocław

Subject: Numerical methods and programming

Content: polynomials, root finding, integration, interpolation, errors

Programming: assembler, autocode Mark III, Algol

Computer: Elliott 803 (UK)

CS

History: 1985 – 1995
computers in education

1985 … The time of Logo

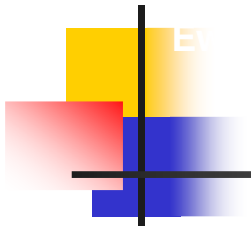
In fact, it was misunderstanding of Papert's idea: Logo was used as a programming language instead of a learning environment

1988 … Pascal era in schools …

Content: numerical calculations + combinatorics, complexity, data base, text editing, spreadsheet calculations

Programming: Pascal, Turbo Pascal, …, Delphi

Computers: 8-bit micro, PC, …



History: 1965 – …

computers in education

1965 … 1985 …

Informatics curricula and teaching – computer science – there was no information technology

beginning of 90’

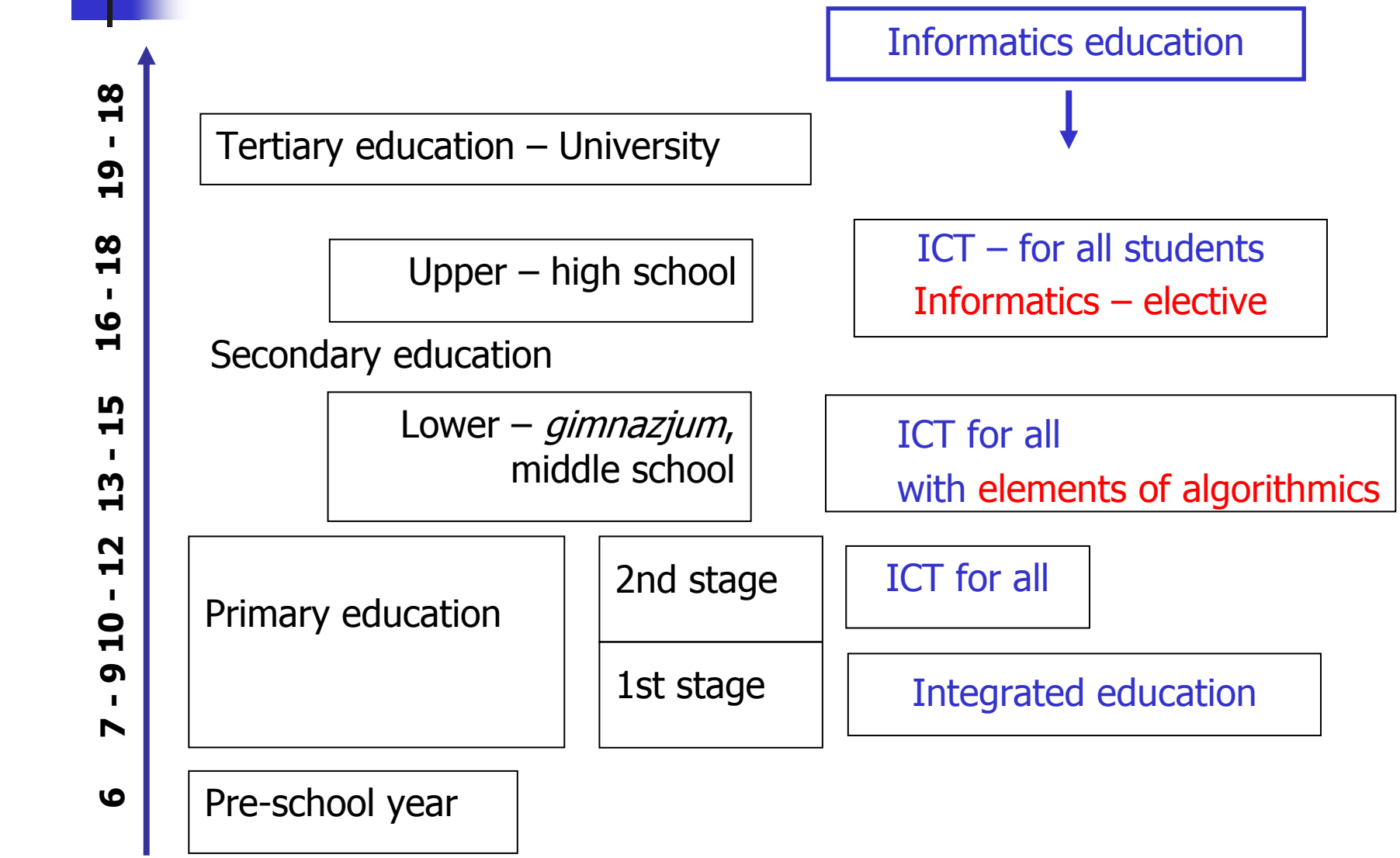
moves in education:

computer science → information technology

constructing computer solutions → using ready-made tools

computer science for some students → information technology for all

The Education System in Poland



Poland – outreach activities, 1

New National Curriculum (2008):

Primary education (1-6 grades), all students

- computer lessons (1 hour/week)

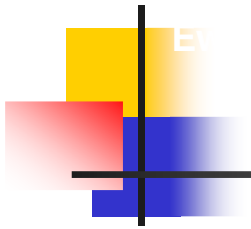
Middle school (Gimnazjum, 7-9 grades), all students

- informatics with elements of algorithmics and [illegible] 2.0

High School (10-12 grades)

- informatics (1 hour/week for a yea[illegible] all students
- informatics (3 hours/week for [illegible]rs) – elective
- *matura* (final exam) – ma[illegible]n solving algorithmic problems

Informatics as a mandatory subject

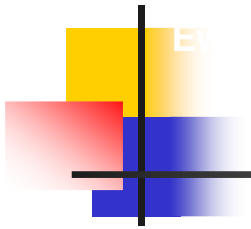


Informatics education

approach

- *60' – 90':* algorithmic thinking when creating programs, programming
- *90' – ICT era:* step back: basic computer literacy – the capability to use today's technology
- *beginning of 2000:* fluency with ICT – the capability to use new technology as it evolves
- J. Wing, 2006: computational thinking – competencies built on the power and limits of computing:

3R + computational thinking



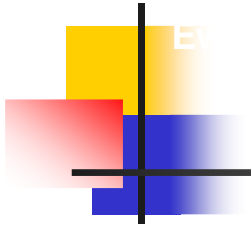
Computational thinking
in informatics for all

Includes a range of mental tools:

- reduction and decomposition of complex problems
- approximation, when exact solution is impossible
- recursion: inductive thinking
- representation and modeling
- heuristic reasoning

The influence on other disciplines – in mathematics:
the purpose of computing is insight not numbers
[R.W.Hemming]

Applied to other disciplines

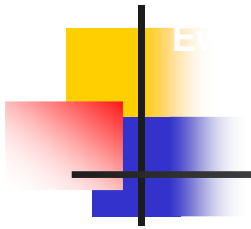


Computational thinking

Implementation

General approach:

- elements of style in using ICT, supported by program options
- algorithmic (computer) problem solving methodology applied to any problem to be solved with the help of a computer.



Computational thinking

old notions, extended meaning

Extended meaning of two notions:

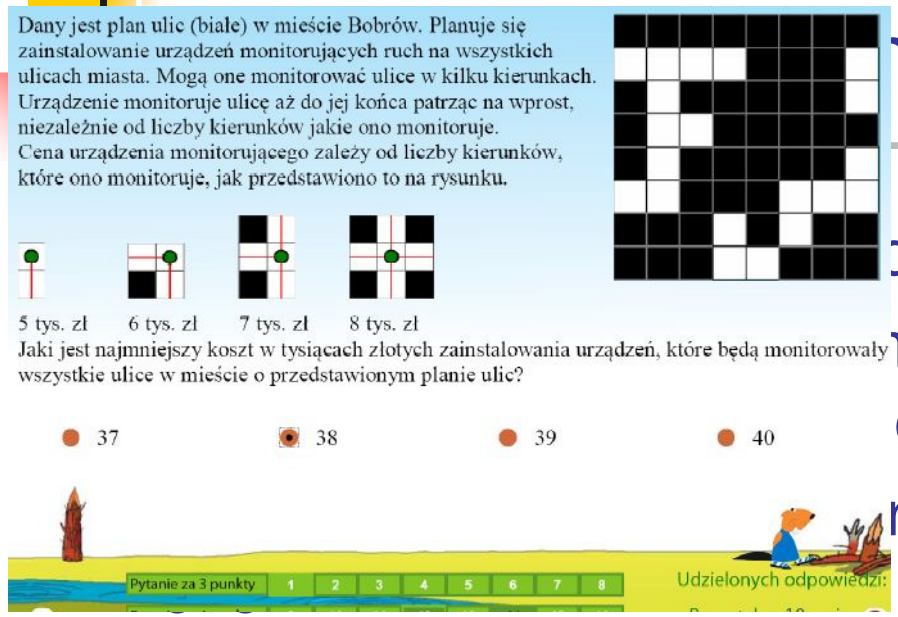
- a problem – in a wider context, not necessarily algorithmic – occurs when one has to provide a solution based on what one has learned but is not told how to do it;
- programming – giving a computer something to do, since it only runs programs; hence, we have the following ‘programs’: spreadsheet, data base, presentation, website, documents, … ; a program – not necessarily an effect of using a programming language

Computer science / Information technology

creating computer products

Methodology of generating good computer solutions (from various areas): correct, readable, efficient, consists of 6 stages (ex.: bicycle club website):

- problem situation (collecting information, goals)
- specification (content and links)
- design (which computer application, plan)
- coding (construction of a website)
- testing (testing the website)
- presentation (to other students, a teacher)



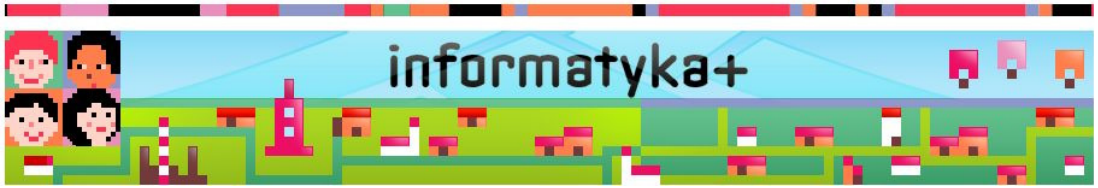
Participating Countries

The following countries organize their own participate in the Bebras initiative:

- Austria (2009: 6 302 participants)
- Czech Republic (2009: 10 351 participants)
- Estonia (2009: 3 482 participants)
- Germany (2009: 82 779 participants)
- Italy (2009: 310 participants)
- Latvia (2009: 828 participants)
- Lithuania (2009: 10 358 participants)
- The Netherlands (2009: 8 326 participants)
- Poland (2009: 10 344 participants)
- Slovakia (2009: 13 942 participants)
- Ukraine (2009: 13 114 participants)

- Beaver (Kangaroo in informatics) – 10 000 students in 2009:
  - logical and algorithmic thinking
  - different subjects (topics) used in tasks
- Our students are very successful in IOI – 5 students are among the top 30 performers in the history – it is mainly due to individual supervising of talented students

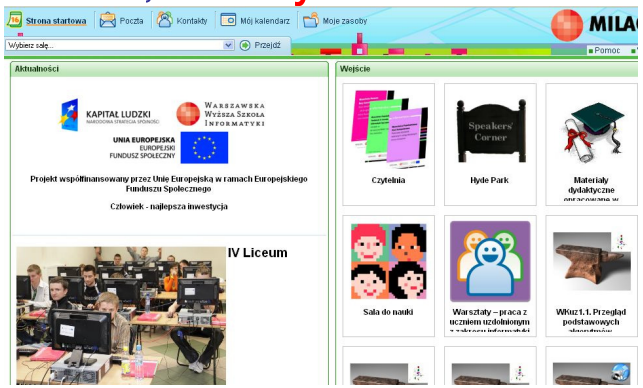
Poland – outreach activities, 3



Informatics + Project, financed by EU

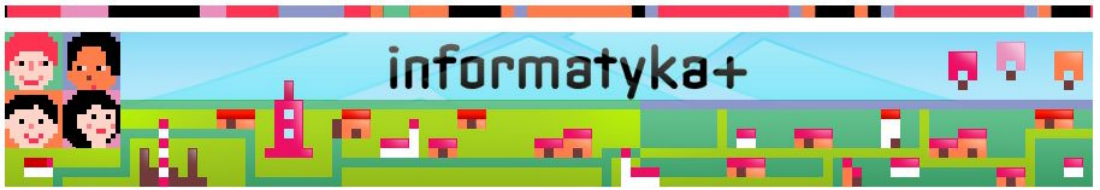
Project in 5 regions, 15 000 students from high schools, for 3 years

- lecture (2 hours) and computer lab (3 hours)
- lectures in schools (2 hours)
- workshops (24 hours)
- workshops for gifted students (24 hours)
- teacher training



- Educational Platform – Fronter:
  - tests and evaluation; educational materials,
- Polska Wszechnica Informatyczna –
  - 60 recorded lectures – open to all students

Poland – outre



Algorithmics and Programming: Searching and sorting – the power of order, Simple computer calculations – can all be computed, Algorithmic techniques, Shortest paths and trees, Data structures and their use (advanced), Advanced algorithms, Matura (final examination) in informatics.

Data Base: Data base – fundamentals, SQL language (basic and advanced level), XML documents in data base, Technology ADO.Net, Data mining, T-SQL language.

Graphics, Multimedia, Internet techniques: Graphics editor – GIMP, Working with multimedia, Searching for multimedia in Internet, Creating dynamic Internet services, Making movies.

Computer Networks: Computer networks – basic principles of construction and operating, Networks as communication media, Network security, Wireless networks, LAN and WAN.

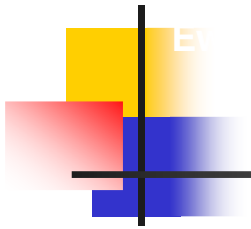
New Tendencies in Informatics and its Applications: Algorithms of Internet, Can computers make business, Concurrency in informatics and in our life, Data exploration, JavaScript, Is P = NP or how to win million dollars in Sudoku, Enigma and contemporary cryptography, Past and the future of informatics – elements of history of informatics, Logic and computers, Introduction to neural networks, Medical informatics.

Poland – outreach activities, 3

Question	Yes definitely	Yes	No	No definitely	No answer
Are you interested in studying informatics in the future?	33%	33%	24%	10%	0%
Do you think that participation in the project will influence your future decision about your career?	22%	42%	26%	9%	1%
Has the course improved your knowledge and skills in informatics?	41%	47%	9%	3%	0%
Has the course encouraged you to develop your knowledge and skills in informatics by yourself?	26%	49%	22%	3%	0%
Have the materials been useful in the course?	55%	36%	7%	2%	0%

Poland – outreach activities, 3

Question	Yes	No	NA
After taking part in the project, have you improved your grades in informatics?	46%	33%	21%
After taking part in the project, have you improved your grades in information technology?	46%	31%	23%
Has your choice of informatics related study been influence by the project?	62%	38%	–



Poland – outreach activities, 4

Workshops for students and teachers – University of Toruń

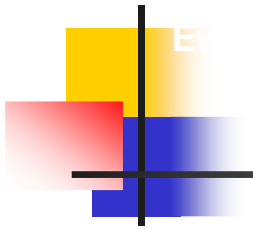
Regular workshops for students – twice a month a new material on programming; e-learning platform OLAT

Classes in the middle and in the high schools run by the University – AP courses taught at the University

Lectures at the University for students and teachers

Seminars and workshops for teachers from schools, topics:

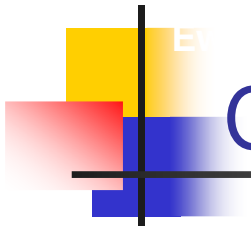
- new curriculum
- recursion
- text algorithms
- networks
- next year: implementation of the national curriculum



Poland – outreach activities, 5

Educational Technology Standards for Teachers, as the most important „technology”

- guide for teachers
  - all teachers
  - teachers of informatics courses
- will be used to define „pedagogical ECDL” – certificates based on activities in classroom
- standards used also for designing courses for teachers – future teachers, in-service courses



Computer science/Information technology

Conclusions

We presented a number of activities in Poland which could be considered as the outreach projects run nationwide and locally

We expect that these activities will increase motivation and preparation of school students for their future decisions to study CS or related fields and become a computer specialists

Outcomes of these projects and expectations will be the subject of our research in the near future

World Conference on Computers in Education
Toruń, July 2 – 5, 2013