Computing: The Science Of Nearly Everything

See http://www.cs.bham.ac.uk/research/projects/cogaff/talks/#talk78

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1. Familiar facts:

Everyone knows that developments in hardware and software technology have had and will have tremendous impacts on all our lives, in many different ways, in industrial, medical, social, educational, financial, and other applications; **and** that computing products include not only practical applications but also games, toys, new opportunities for artistic activities, and many kinds of collaborative fun.

Some also know that developing programming languages, algorithms, and software tools and applications can be enormous fun, and intellectually challenging.

Those are all good reasons for expanding teaching of programming at all educational levels.

2. Another aspect:

Not everyone knows there is another profoundly important aspect of computing that is not well understood:

in addition to matter and energy, the universe includes information.

3. Natural Information processing systems:

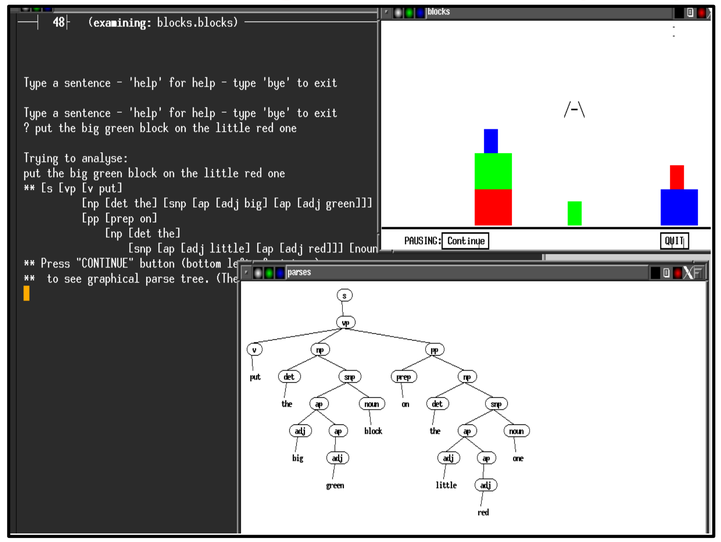
Long before humans developed information-processing machines, biological evolution was doing so, in enormously varied and powerful ways, most of which we do not yet understand.

Micro-organisms process immed-iately available information in controlling their behaviour.
More complex animals (and plants) have more varied ways of acquiring and using information to select options -- e.g. about which way to move, what to eat, how to avoid being eaten, ...

Some animals use information collected and transformed over a period of time and stored for future use, e.g. where things are, which actions have which consequences, what things are unpleasant to eat, and how other animals behave.

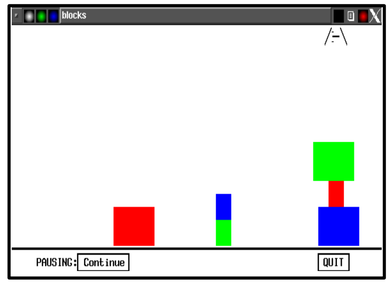
Some even use information about their own information processing and help their offspring to do the same.

Learning how to make "thinky", as opposed to "bumpy" mobile objects, based on Winograd's SHRDLU (1971)



Above: how the machine understands a command "put the big green block on the little red one" -- showing the structure of the sentence diagrammatically. Having understood, it then makes a plan to achieve the goal.
(The /-\ represents a hand!)

Below: The scene after executing the plan.



4. We don't do that as well as we should!

Understanding such things is of great importance in philosophy, psychology, neuroscience, education, social science, linguistics, biology, and other fields.
We still have much to learn about how the competences, work, how they develop in individuals, how they evolved, and which species have which competences.

The research, and the teaching, are both hard to do well! But not impossible.

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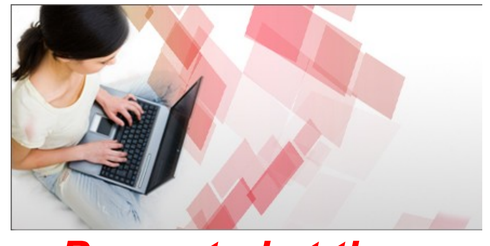
5. Understanding through programming

Understanding is enriched by trying to model processes, often best done with programming languages and tools specially developed for the purpose. AI languages, help us produce systems that, in ddition to their visible, behaviours also have 'thinky' abilities: they can perceive, learn, reason, formulate questions, generate desires & feelings, make plans, build theories, and communicate.
The talk introduces some examples that could be included in teaching programming, both elementary and advanced, using an AI language designed for the purpose, though other languages could also be used.
Some examples are available here:

http://www.cs.bham.ac.uk/research/projects/poplog/examples



Presented at the Computing at School Conference July 2010 University of Birmingham