

Introduction To Computer Science

In this section you will get an overview of some areas of Computer Science.

James Tam

Introduction To Computer Science

- Computer Science is about problem solving



Graphics



Interactive displays



Robotics:
acceptance of
domesticated
robots



Artificial Intelligence
FIFA © Electronic Arts.

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Some Areas Of Study And Research In Computer Science

- Human-Computer Interaction
- Computer Graphics
- Information Visualization
- Databases
- Computer theory
- Computer networking and distributed systems
- Artificial Intelligence
- Computer Vision
- Software Engineering
- Computer Security
- Games programming

This list provides only a brief introduction to the different areas of Computer Science and is far from comprehensive:
For a more updated list: <http://www.cpsc.ucalgary.ca/Research/>

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Some Areas Of Study And Research In Computer Science

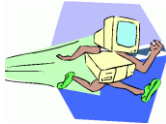
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Human-Computer Interaction (HCI)

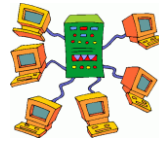
- Most of Computer Science deals with the ‘technical’ side of computers.



Run computers faster!



Make computers store more information!!



Increase the networking capabilities of computers!!!

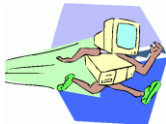
- These technical issues (and others) are all very important but something is still missing...

For more information: <http://ilab.cpsc.ualqarv.ca/>

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Human-Computer Interaction

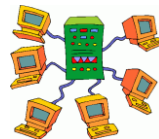
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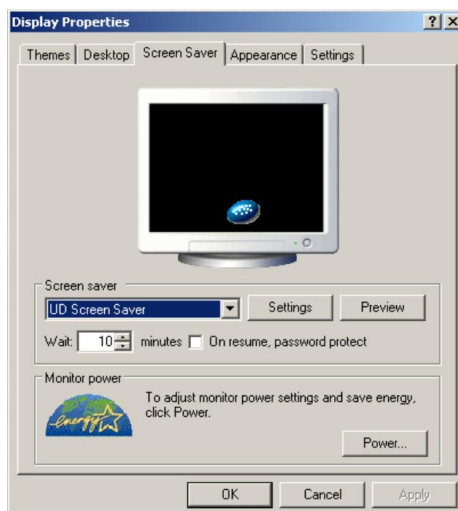
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Human-Computer Interaction

- ...but don't forget about the other side of the relationship.
- No matter how powerful the computer and how well written is the software, if the user of the program can't figure out how it works then the system is useless.
- Software should be written to make it as easy as possible for the user to complete their task. (Don't make it any harder than it has to be).
- This is just common sense and should/is always taken into account when writing software?

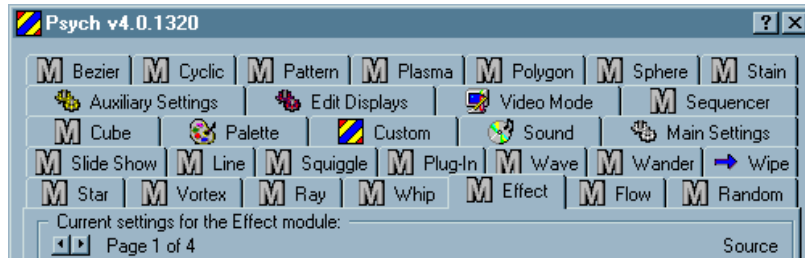
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Human-Computer Interaction: Not Just Common Sense Information



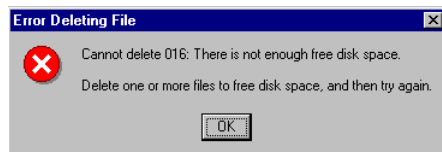
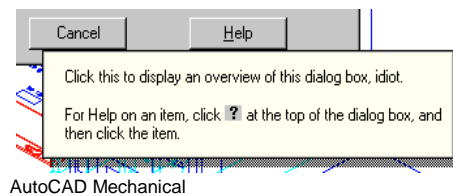
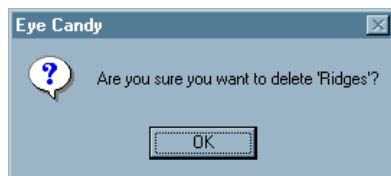
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Human-Computer Interaction: Not Just Common Sense Information (2)



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Human-Computer Interaction: Not Just Common Sense Information (3)



Windows 95

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What Is Human-Computer Interaction?

~~Difficult to use~~

Easy to use ✓

Or at least easier to use ✓

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Heuristics

- You have already learned one set of design principles used to make ‘user-friendly’ software:
- Jakob Nielsen’s 10 usability heuristics from the book “*Usability Engineering*”
 1. Minimize the user’s memory load
 2. Be consistent
 3. Provide feedback
 4. Provide clearly marked exits
 5. Deal with errors in a helpful and positive manner

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Computer Graphics

- Concerned with producing realistic looking images on the



Gran Turismo © Sony

For more information: <http://jungle.cpsc.ucalgary.ca/>

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Computer Graphics: Issues

- How to make the images look “real”?

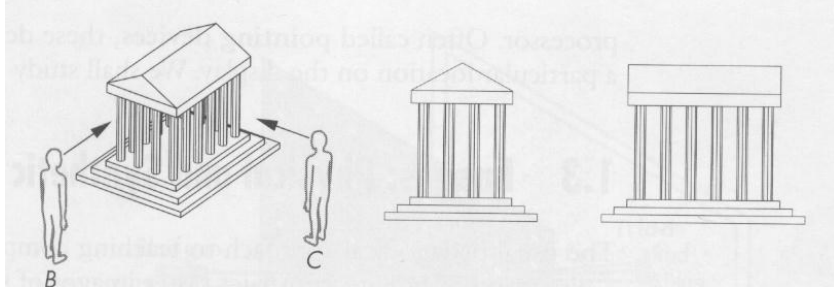


From <http://klamath.stanford.edu/~aaa/>

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Computer Graphics: Highly Mathematical

- Highly mathematical



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Computer Graphics: Still A Long Way To Go

- “Even though modeling and rendering in computer graphics have been improved tremendously in the past 35 years, we are still not at the point where we can model automatically, a tiger swimming in the river in all it’s glorious details.”¹



¹ From “The Tiger Experience” by Alain Fournier at the University of British Columbia

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Artificial Intelligence

- Trying to build technology that appears to be ‘intelligent’
- What makes a person smart?

For more information:

<http://pages.cpsc.ucalgary.ca/~jacob/AI/>

<http://pages.cpsc.ucalgary.ca/~denzinge/>

<http://pages.cpsc.ucalgary.ca/~kremer/>

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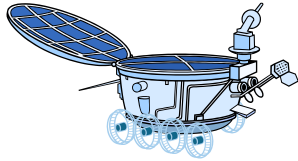
Fields Of Artificial Intelligence

- Machine learning
- Experts systems
- Neural networks

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Machine Learning

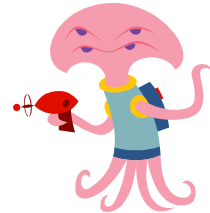
- The focus is on designing a computer that has the ability to learn and adapt to new situations (rather than just apply a fixed set of rules).



Pre-set rules: terrain



New scenario: life form encountered



Pre-set rules: terrain



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Expert Systems

- The focus is on capturing the knowledge of a human expert as a set of rules stored in a database.
- The expert system can then answer questions, diagnose problems and guide decision making.
- Example applications: medicine, computer repair

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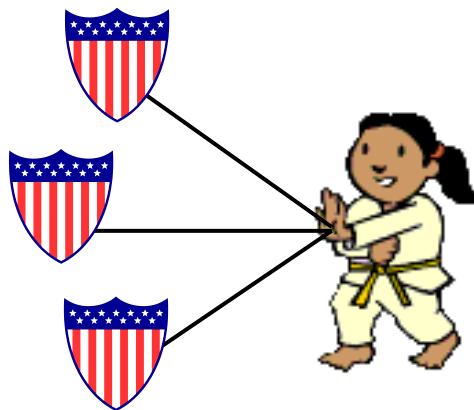
Neural Networks

- The focus is on building structures that function the way that neurons (and their connections in the brain) function.
- (Simplified overview):
 - Neurons take electrical pulses as input and send electrical pulses as output.
 - A required level of input is required before the output is fired.
- This approach has been applied to problems which involve pattern recognition (e.g., visual, voice).

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Priming (Teaching) A “Neural Network”

- Example: A fighting simulation
- Defender analyzes the pattern of attacks and eventually adjusts the defense employed.

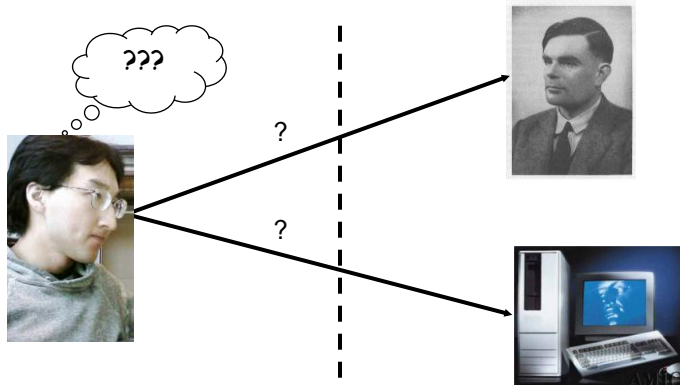


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Artificial Intelligence: Mission Accomplished?

- How do we know we have a "smart machine"?

- The Turing test



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An Artificial Intelligence: Won't Be Created In The Foreseeable Future

- Much work still needs to be done

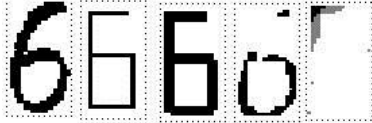


Photo from www.startrek.com © Paramount

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Computer Vision

- The focus is on interpreting and understanding visual information.
- Hand writing recognition: six?



- Analyzing digital video: studying running styles (i.e., not just still images)

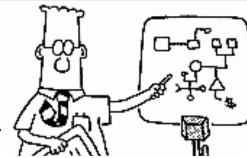


For more information:

<http://pages.cpsc.ucalgary.ca/~boyd/pmwiki/pmwiki.php?n=Main.Research>

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Software Engineering



Dilbert © United Features Syndicate

- Concerned with employing systematic ways of producing good software on time and within budget.
- A typical person can only hold ~7 concepts in their mind at a time.
 - A typical computer program consists of more than 7 'parts'.
- Consequently mechanisms for dealing with this complexity are needed.
 - Top down approach break a large (hard to conceive) problem into smaller more manageable parts.

For more information:

http://www.cpsc.ucalgary.ca/cpsc_research/areas/evolutionary

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One Technique Employed In Software Engineering

•Pair Programming

The 'navigator'



The 'driver'



- More efficient problem solving
- Syntax errors found more quickly
- Fewer logic errors

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Computer Security

•Involves the creation of malicious software ('malware')



Spam generators



Spyware



Virus software



- Purpose: learn about how malicious software is created and distributed.
- Goal: develop countermeasures to protect computer systems

For more information:

<http://icis.cpsc.ualgary.ca/>

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Games Programming

- Pulls together many areas of Computer Science
- The University of Calgary was the first Canadian university to offer this area of study.

<< Warning!!! >>

Blatant
advertisement

<< Warning!!! >>



"Scarface: The World is Yours" © Radical Entertainment

Sound byte: © "The Simpsons" Fox

For more information: http://www.cpsc.ucalgary.ca/undergrad/courses_progression/concentration?conc=game

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