

Introduction To Computer Science

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

James Tam

Introduction To Computer Science

- What is Computer Science?



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Introduction To Computer Science

- What is Computer Science?



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Introduction To Computer Science

- Computer Science is about problem solving



Graphics



Interactive displays



Robotics:
acceptance of
domesticated
robots

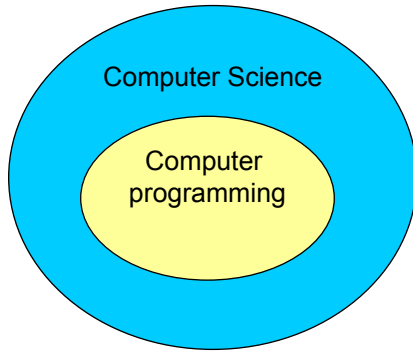


Artificial Intelligence
FIFA © Electronic Arts.

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Computer Science Is Not The Same As Computer Programming

- Computer Science does require the creation of computer programs ('programming') but goes beyond that.



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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

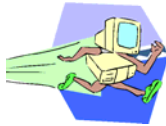
- **Human-Computer Interaction**
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Human-Computer Interaction (HCI)

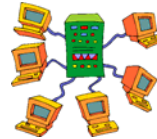
- Most of Computer Science deals with the ‘technical’ side of computers.



Run computers faster!



Make computers store more information!!



Increase the networking capabilities of computers!!!

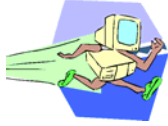
- These technical issues (and others) are all very important but something is still missing...

For more information: <http://grouplab.cpsc.ualgary.ca/> or <http://pages.cpsc.ualgary.ca/~ehud/Research.html>

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Human-Computer Interaction

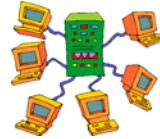
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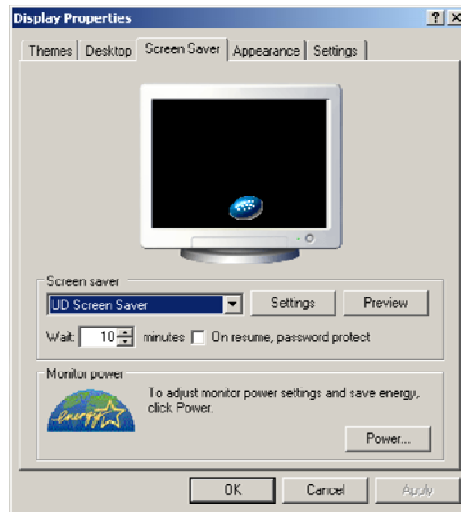
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Human-Computer Interaction

- ...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?

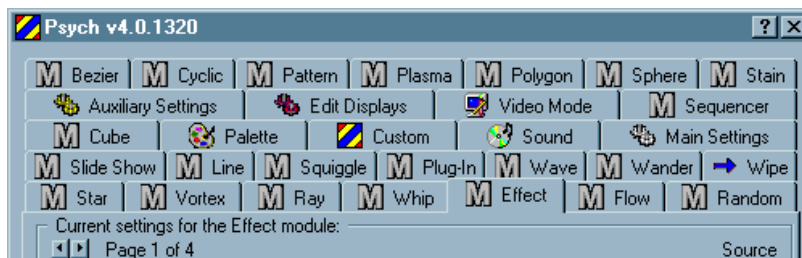
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Human-Computer Interaction: Not Just Common Sense Information



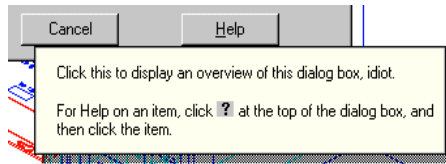
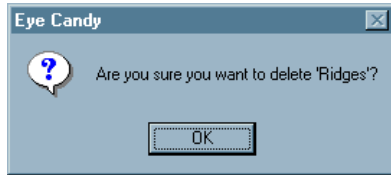
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Human-Computer Interaction: Not Just Common Sense Information (2)

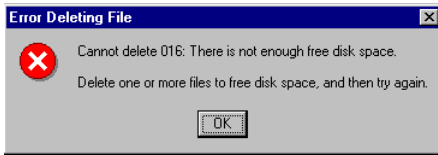


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Human-Computer Interaction: Not Just Common Sense Information (3)



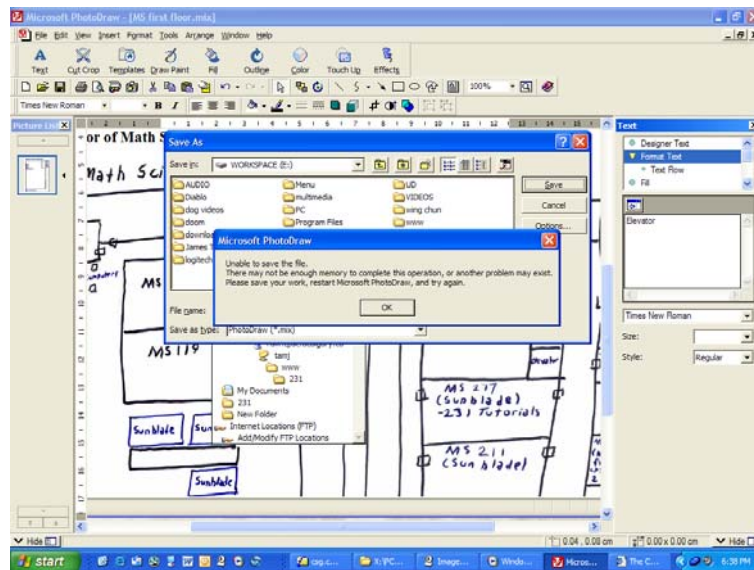
AutoCAD Mechanical



Windows 95

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Human-Computer Interaction: Not Just Common Sense Information (4)



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Ways Of Including The 'Human' In The Development Process (2)

1. At the very least, talk to users
 - It's surprising how many designers don't!
2. Contextual Inquiries
 - Key characteristics:
 - Interview users in their usage place (e.g., office), as they are going about their normal routine (e.g., using your system while working)
 - Purpose:
 - Used to discover the user's culture, requirements, expectations, etc.



Ways Of Including The 'Human' In The Development Process (3)

- 3) Create prototypes
 - It's hard to comment on something that doesn't yet exist



- Users are good at giving feedback for something that is even partially built



Computer Graphics

- Concerned with producing images on the computer.



Gran Turismo 5 Prologue © 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/>

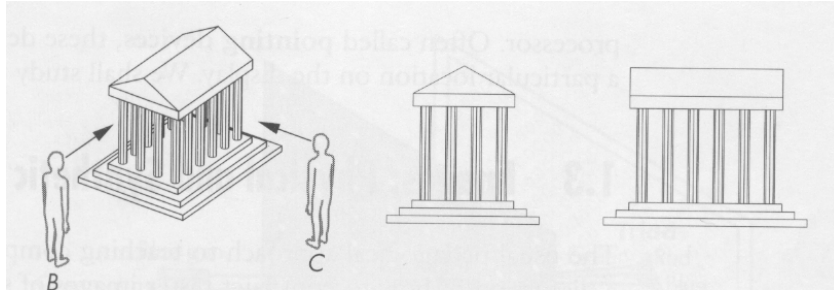


Final Fantasy: The spirits within © 2001 - Columbia Pictures

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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?

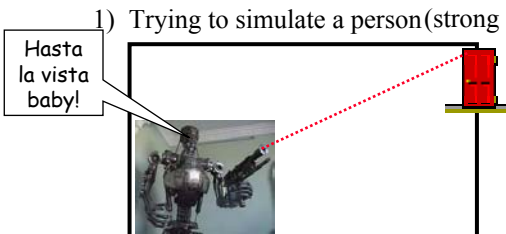
“We don’t truly understand what intelligence is, but we hope we know it when we see it.” – Kenneth Hoganson (Concepts in Computing): Jones and Bartlett 2008)

For more information: <http://pages.cpsc.ucalgary.ca/~jacob/AI/> or <http://pages.cpsc.ucalgary.ca/~denzinge/>

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Artificial Intelligence (2)

- Approaches:
 - 1) Trying to simulate a person (strong equivalence)



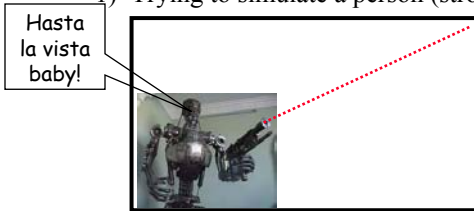
- 2) Trying to simulate what the person can do

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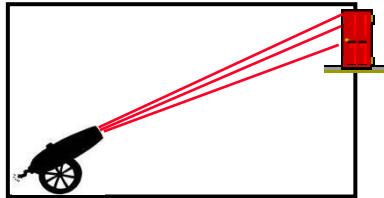
Artificial Intelligence (2)

- Approaches:

1) Trying to simulate a person (strong equivalence)



2) Trying to simulate what the person can do (weak equivalence)



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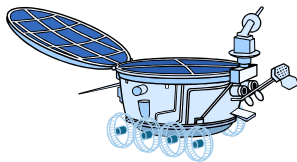
Fields Of Artificial Intelligence

- Machine learning
- Expert systems
- Neural networks
- Fuzzy logic

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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).



Marvin the Martian © Warner Brothers

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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.
 - The simulated neurons must be trained to fire off impulses under the correct scenarios like a biological brain.
- This approach has been applied to problems which involve pattern recognition (e.g., visual, voice).

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Fuzzy Logic

- People can make decisions when faced with uncertainty.
- The standard logic of computer programs (true/false) cannot be easily applied when relationships can be applied with only a degree of probability.

- Standard computer program:

if X then Y

e.g., if temperature ≥ 50 then decrease temperature by 10 degrees



- Fuzzy logic is reasoning with probabilities

- Fuzzy logic programs:

If close enough to X then Y

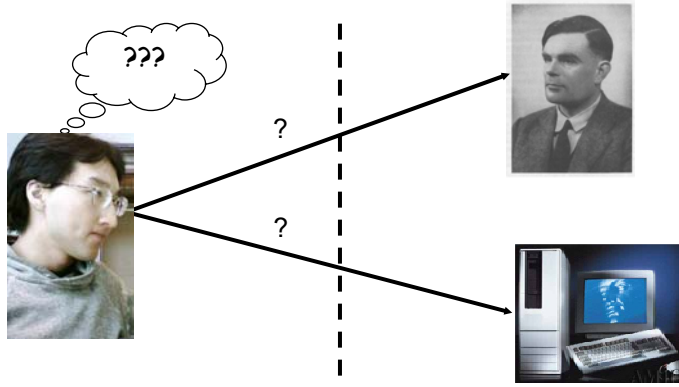
E.g., if temperature is too hot then make temperature less hot



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Artificial Intelligence: Mission Accomplished?

- How do we know we have a "smart machine"?
 - The Turing test



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

- Much work still needs to be done



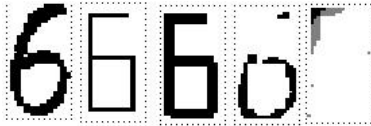
Photo from www.startrek.com © Paramount

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Computer Vision

- The focus is on interpreting and understanding visual information.

- Hand writing recognition: six?



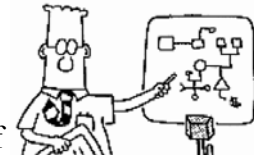
- Analyzing digital video: studying running styles



For more information: <http://pages.cpsc.ucalgary.ca/~parker/DML/welcome.html> or
<http://vma.cpsc.ucalgary.ca/projects>

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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.seng-decisionssupport.ucalgary.ca/>
<http://ase.cpsc.ucalgary.ca/>

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Software Engineering (2): Techniques

- Extreme programming
- Agile development
- Design patterns

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Extreme Programming

- The focus is on developing prototypes very quickly with extensive testing and user communication.
- With the traditional approach to software development: specifications (what the software is supposed to do) is determined at the start and fixed throughout the project.
- With extreme programming: specifications can and will change.
 - It's argued that it's impossible to correctly envision all the issues associated with a large project at the onset so the changing approach employed using extreme programming is necessary.
 - There is however greater risk that the software will run into 'dead ends' and it has to be redesigned.

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Agile Programming

- Related to extreme programming.
- The focus is on reducing risk by producing a new 'iteration' of the software in a short period of time (~1 – 4 weeks).
- The project is then evaluated.
 - The emphasis is on real time and face-to-face communication between developers over written documentation.
 - Everyone associated with the project is brought together: developers, software testers, project managers and end users.
 - Benefit: reduced development time with fewer misunderstandings.
- Traditional development: formal processes are followed such as heavily documenting program code.

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Agile Programming (2)

- Traditional approaches work well for extremely large projects that require a high degree of reliability.
- Agile programming works well for smaller (although still large) projects where having a shorter development time is crucial.

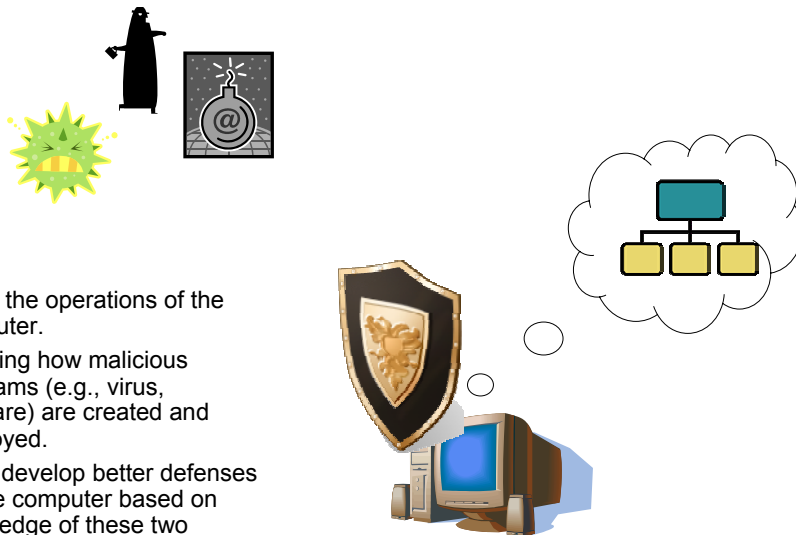
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Design Patterns

- Simple definition: a way of documenting past approaches to a problem that have shown to be successful.
- More detailed description: a way of implementing a part of the software that has been shown to be sound under a number of different contexts.

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Computer Security



1. Study the operations of the computer.
2. Learning how malicious programs (e.g., virus, spyware) are created and employed.
3. Goal: develop better defenses for the computer based on knowledge of these two things.

For more information: <http://pages.cpsc.ucalgary.ca/~aycock/virus-info.html> OR <http://cisac.ucalgary.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

For more information: http://pages.cpsc.ucalgary.ca/~parker/cpsc585-radical/the_site_2/CPSC585.html

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You Should Now Know

- What is Computer Science and how does it differ from computer programming
- What is the focus of each of the research areas of Computer Science that were discussed

James Tam