

Introduction To Computer Science

In this section you will learn what is “Computer Science” and how different areas focus on different types of problems.

James Tam

Introduction To Computer Science

- What is Computer Science?



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Introduction To Computer Science

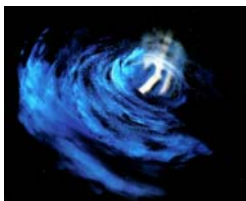
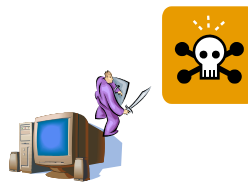
- What is Computer Science?



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Introduction To Computer Science

- Computer Science is about solving problems with technology.



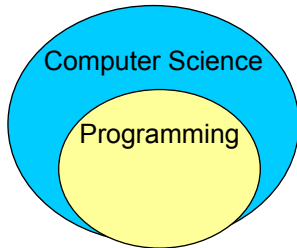
"Wormhole" from Star Trek: Deep space 9 ©
Paramount



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Computer Science Is Not The Same As Computer Programming

- Computer Science does require the creation of computer programs ('programming')



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Some Areas Of Study And Research In Computer Science

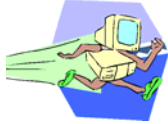
- Human-Computer Interaction
- Computer Graphics
- Information Visualization
- Databases
- Computer security
- Computer networking
- Computer Simulations
- Artificial Intelligence
- Computer Vision
- Software Engineering
- Games programming

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/cpsc_research

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Human-Computer Interaction (HCI)

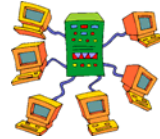
- Most of Computer Science deals with the ‘technical’ side of computers.



Run computers faster!



Make computers store more information!!



Increase the networking capabilities of computers!!!

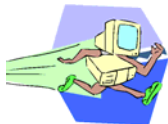
- These technical issues (and others) are all very important but something is still missing...

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

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Human-Computer Interaction

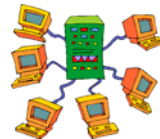
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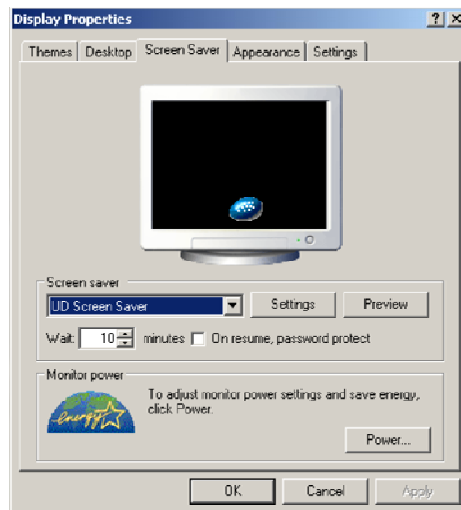
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Human-Computer Interaction

- ...but don't forget about the other side of the relationship.
- No matter how powerful the computer and how well written the software, if the user can't figure out how to use it then the system is useless.
- Technology should 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?

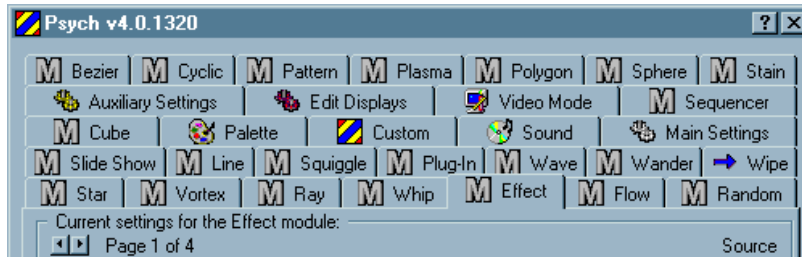
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Human-Computer Interaction: Not Just Common Sense Information



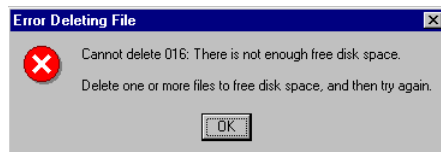
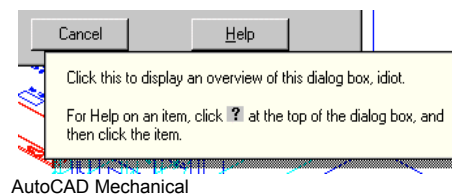
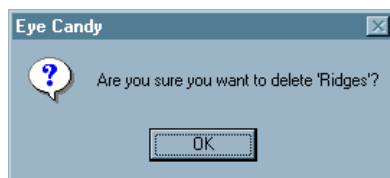
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Human-Computer Interaction: Not Just Common Sense Information (2)



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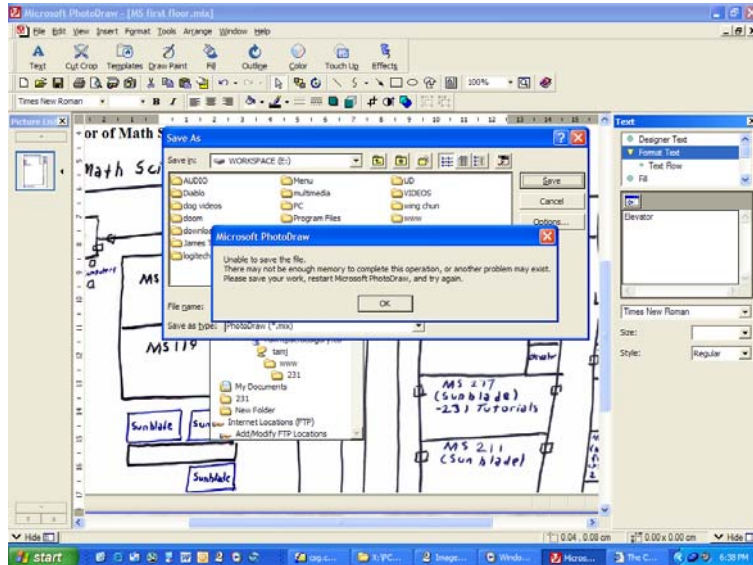
Human-Computer Interaction: Not Just Common Sense Information (3)



Windows 95

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



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Human-Computer Interaction: Issue

- What is simple and “easy” to use for one person may not be the optimal approach for another.



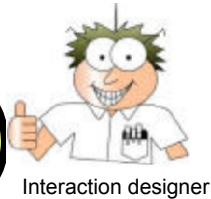
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One Simple Way Of Including The 'Human' In The Development Process

- Get in touch with real people who will be potential users of your system.
- Learn about the user's tasks:
 - Articulate concrete, detailed examples of tasks they currently complete or those that they want to complete (ones that they want to do but can't do with the existing system).
- Spend time with them discussing how the system might fit in to their work.



Accountants: what do they do?



Interaction designer

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Computer Graphics

- Producing images on the computer.



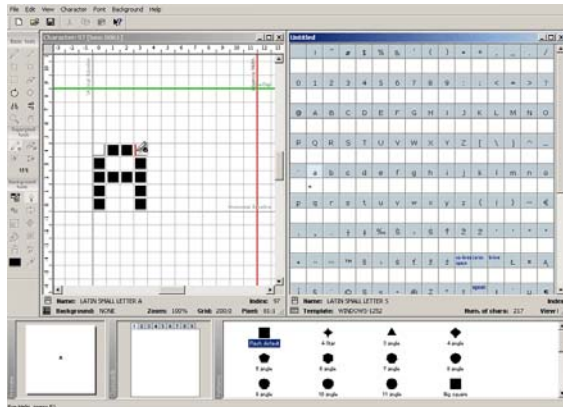
Gran Turismo 5 Prologue © Sony

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

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Computer Graphics (2)

- ‘Images’ include everything visual on the computer: pictures, text, animations etc.
- Images can be produced with a collection of pixels.



<http://www.simplefont.com/>

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Computer Graphics: Issue

- How to make the images look “real”?



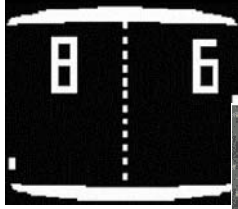
From <http://klamath.stanford.edu/~aaa/>



Final Fantasy: The spirits within © 2001 - Columbia Pictures

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Computer Graphics Have Come A Long Way!



Pong (Atari)



Mortal Kombat (Midway Games)

Zork (Infocom)

```
ZORK I: The Great Underground Empire
Copyright (c) 1981, 1982, 1983 Infocom
ZORK is a registered trademark of Infocom
Revision 88 / Serial number 840726

West of House
You are standing in an open field west
of a door.
There is a small mailbox here.

>
```



Final Fantasy XIII (Square Enix)

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Computer Graphics: Highly Mathematical

- Realistic images and effects are produced using complex calculations.



Ratatouille © The Walt Disney Company

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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



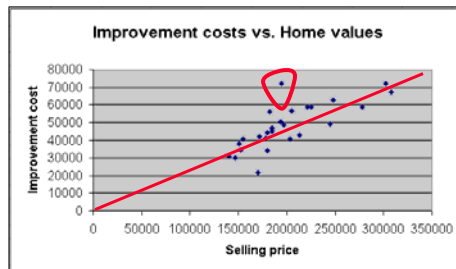
¹ From “The Tiger Experience” by Alain Fournier at the University of British Columbia

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Information Visualization

- Finding ways of representing information in a way that amplifies cognition.

	A	B
1	Market value (\$)	Improvement cost (\$)
2	140000	31120
3	147000	29980
4	151000	38120
5	152000	34360
6	155000	40710
7	170000	21620
8	172000	42100
9	178000	41070
10	180000	34210
11	180000	44090
12	182000	55960
13	185000	45170
14	185000	46820
15	193400	50200
16	194500	71860
17	197000	48460
18	203000	40720
19	205000	56600
20	213000	42780
21	221000	58770
22	225000	58960
23	245000	48910
24	248000	62620
25	278000	58580
26	302500	72200
27	308000	67320



Issue: What Is The “Best” Way Of Representing Information?

•An example medical prescription:

- Inderal.....1 tablet 3 times a day
- Lanoxin....1 tablet every a.m.
- Carafate...1 tablet before meals and at bedtime
- Zantac.....1 tablet every 12 hours (twice a day)
- Quinag.....1 tablet 4 times a day
- Couma.....1 tablet a day

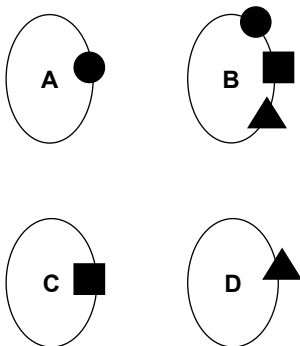
	Breakfast	Lunch	Dinner	Bedtime
Lanoxin	O			
Inderal	O	O	O	
Quinag	O	O	O	O
Carafate	O	O	O	O
Zantac		O		O
Couma				O

From “Things That Make Us Smart” By Don Norman

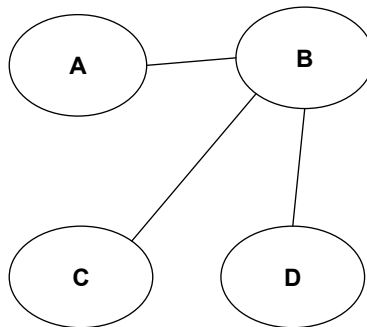
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Issues: What Is The “Best” Way Of Representing Information?

First representation



Second representation



From Information Visualization: Perception for Design by Colin Ware.

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Databases

- Concerned with the efficient storage, retrieval and distribution of information.
- It can be a difficult challenge!



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

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Databases (2)

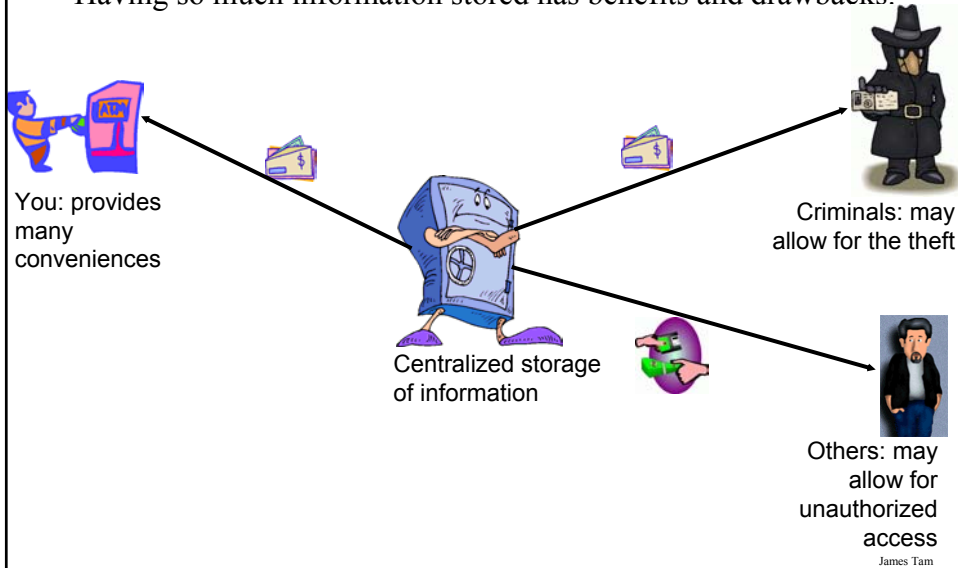
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Results 1 - 100 of about **199,000**. Search took **0.42** seconds.

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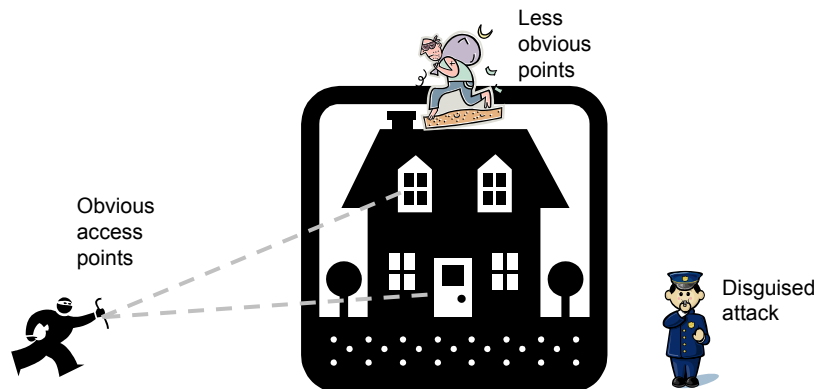
Databases: Issues

- Having so much information stored has benefits and drawbacks.



Computer Security

- Computer security has become increasingly important since the advent of the Internet.
- One approach to computer security: examine and understand the structure of a system to find its flaws.



Computer Security: Issue

- Often computer security involves a trade-off between security and convenience.



I hate grocery day!

From "Return of the King" © New line Cinema

James Tam

Cryptography

- One research area in computer security is cryptography.

Original information (e.g., Credit card #)

Encrypted data

J~:~>^@^@^@.^@9
^@^P^@^Y^G^@^
Z
^@^B^@^Y
^@^B^@^
^@^B^@^



For more information: <http://www.cpsc.ucalgary.ca/Research/qcc.php/>

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Computer Networking

- The advantages of working remotely (through a network or the Internet) are so obvious that it's now all taken for granted.



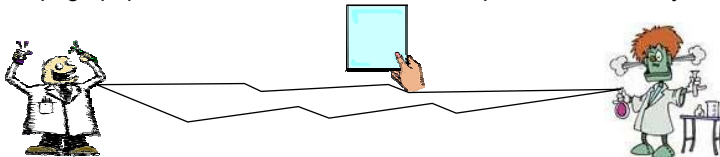
For more information: <http://grid.ualgary.ca/>, <http://www.westgrid.ca/>, <http://pages.cpsc.ualgary.ca/~zongpeng/>

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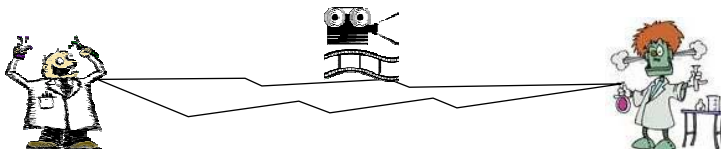
Computer Networking (2)

- This area of research focuses on ensuring the efficient transmission of electronic information while minimizing transmission problems.

10 page paper: Transmission rate: 2400 bits per second is okay



2 hour video: Transmission rate: 10,000,000 bits per second is still too slow



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Computer Networking: Issues

- Speed isn't the only issue... minimizing transmission problems



Terminator 2: Judgment Day © Lions Gate Home Entertainment

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Computer Networking: Issues

- Speed isn't the only issue... minimizing transmission problems



Terminator 2: Judgment Day © Lions Gate Home Entertainment

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Computer Networking: Issues

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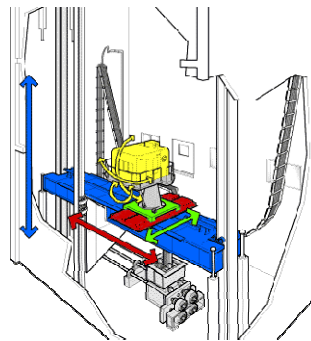


Terminator 2: Judgment Day © Lions Gate Home Entertainment

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Simulations

- Recreating behaviour by an analogous model or situation to gain information more conveniently or to train personnel.



Images from <http://www.simlabs.arc.nasa.gov/vs>.

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

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Simulations: Some Issues

- What information should be included in the simulation?
- How confident are we in the results of the simulation?
- Speed of the simulation.

James Tam

Artificial Intelligence

- What makes a person smart?
- How do we build a smart machine?
 - How to make a machine think like a person?
 - How to make a machine behave like a person?

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

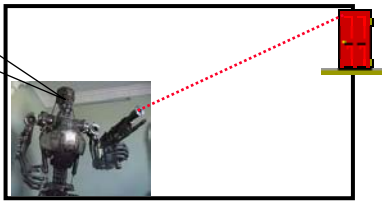
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Artificial Intelligence (2)

- Approaches:

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

Hasta la vista baby!



- 2) Trying to simulate what the person can do

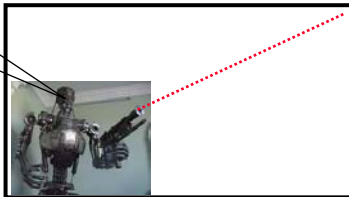
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Artificial Intelligence (2)

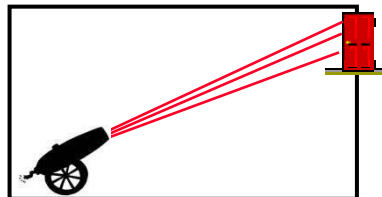
- Approaches:

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Hasta la vista baby!



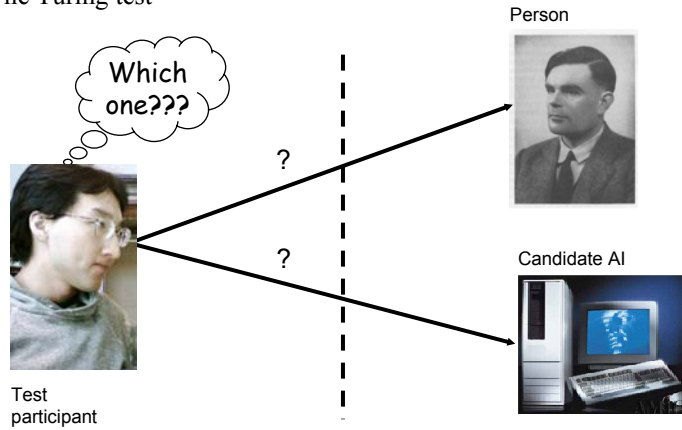
- 2) Trying to simulate what the person can do (weak equivalence)



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Artificial Intelligence (3)

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



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Artificial Intelligence (4)

- Much work still needs to be done



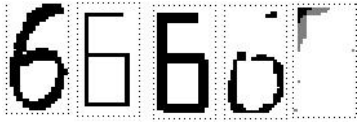
Photo from www.startrek.com © Paramount

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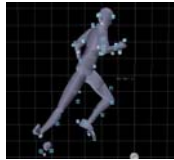
Computer Vision

- Identifying and analyzing visual information based on appearance.

- 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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Computer Vision (2)

- Some Issues:

- When is it okay and not okay to capture computer images and videos?



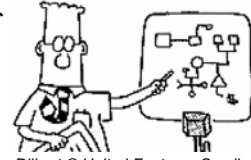
- What are the consequences of the computer misrecognizing something?



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Software Engineering

- Concerned with employing systematic ways of producing good software on time and within budget.



Dilbert © United Features Syndicate

For more information: <http://sem.ucalgary.ca/>

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Approaches To Developing Software

1. Bottom up (Software Engineering is not employed)
2. Top down (employs some Software Engineering)

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Bottom Up Design

1. Start implementing all details of a solution without first developing a structure or a plan.

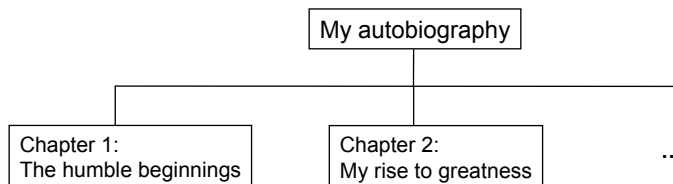
Here is the first of my many witty anecdotes, it took place in a "Tim Horton's" in Balzac..

- Potential problems:
 - (Generic problems): Redundancies and lack of coherence between sections.
 - (Programming specific problem): Trying to implement all the details of large problem all at once may prove to be overwhelming.

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Top Down Design

1. Start by outlining the major parts (structure).



2. Then implement the solution for each part making sure to check and test it first.

Chapter 1: The humble beginnings

It all started seven and one score years ago with a log-shaped work station...

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Pair Programming

- A new approach used in software development is ‘pair programming’:

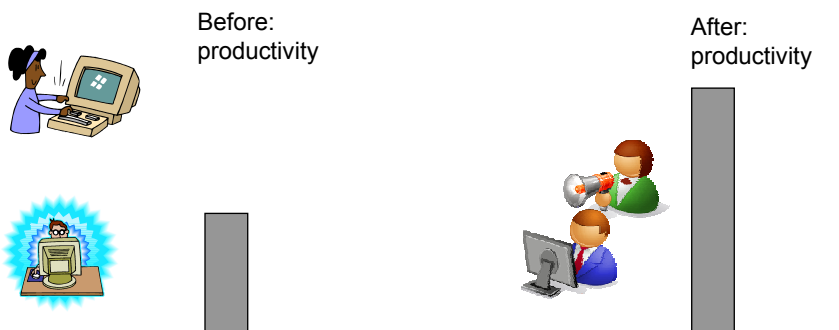


Image from <http://collaboration.csc.ncsu.edu/laurie>

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Software Engineering: Issue

- Proving that a particular approach has is more efficient or effective in actual practice.



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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

James Tam

You Should Now Know

- What is Computer Science and how it differs from computer programming.
- What are some of the areas of research and study in Computer Science and what is the main focus of each.

James Tam