Graduate Studies in Computer Science at Dalhousie University

Evangelos Milios
Faculty of Computer Science
Dalhousie University
www.cs.dal.ca/~eem

Bird’s eye view of Halifax

Halifax Fun

Halifax, Nova Scotia

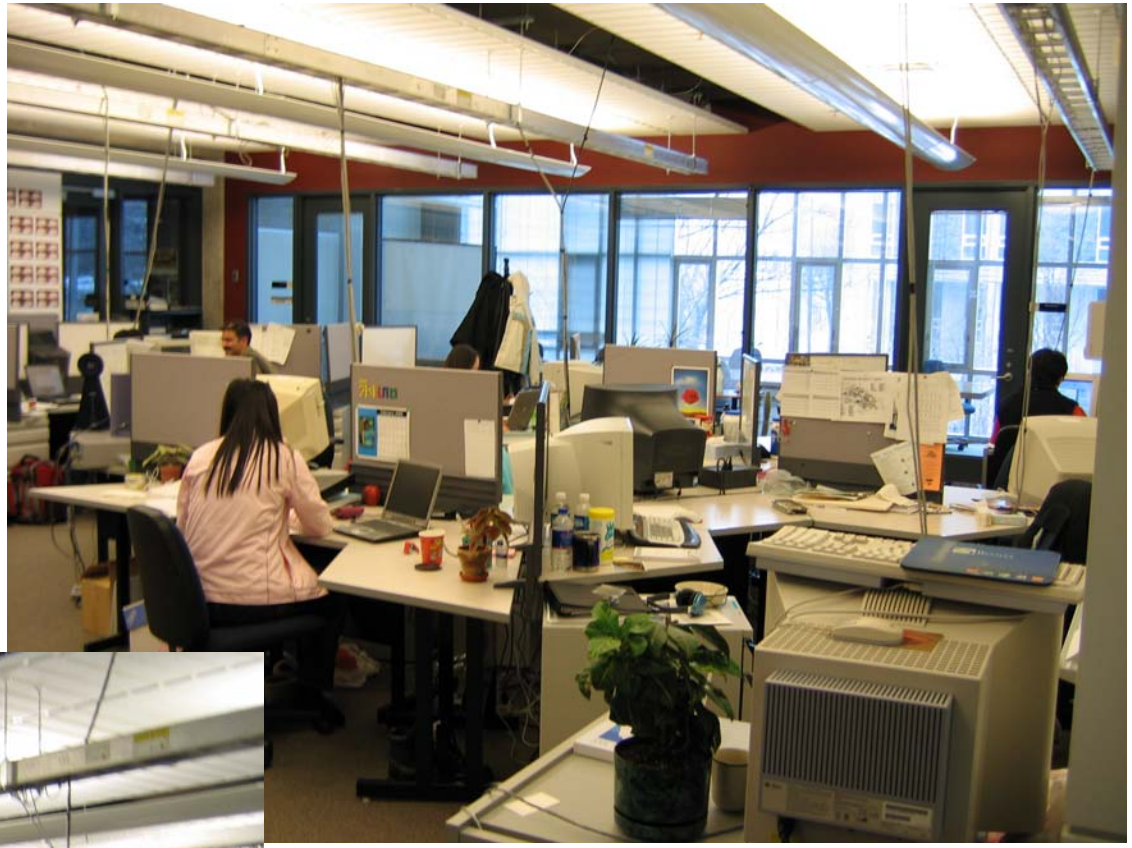
- Northernmost harbour that does not freeze in the winter
- Relatively mild climate
- Metropolis of Atlantic Canada (incl. Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland)
- Regional economic, cultural and research hub
- Settled by Europeans in the 18th century

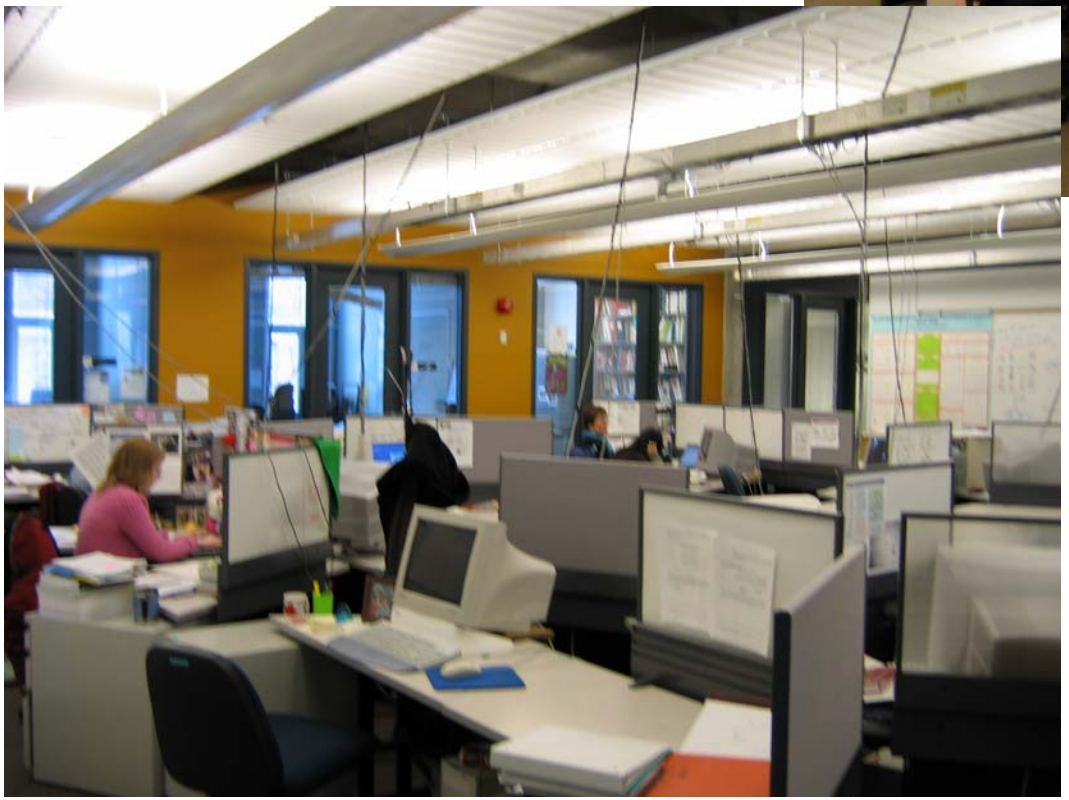
Dalhousie U. Facts

- Founded in 1818
- The smallest Medical/Doctoral university in Canada
  - Medical school
  - Law school
  - Engineering
  - Business school
- World class
  - Oceanography
  - Biology
  - Medicine
  - Sciences
- Regional Research Hub for Atlantic Canada

Faculty of Computer Science


SECOND CUP





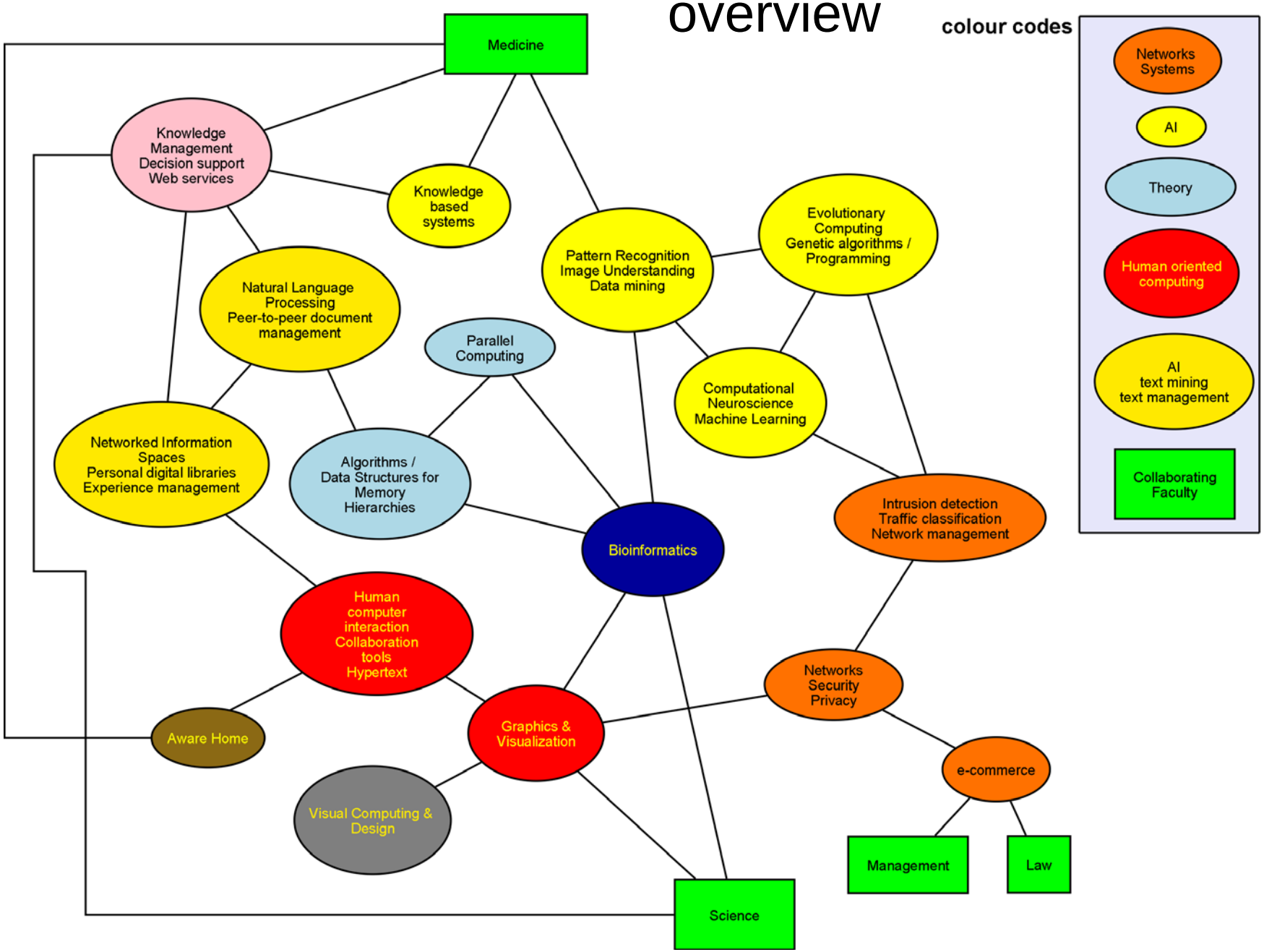
Faculty of Computer Science

- Established in 1997
- Strengths in:
  - Information retrieval, text mining
  - Health informatics & Knowledge management
  - Bioinformatics
  - Human-computer interaction
  - Computer networks, network management, intrusion detection
  - Algorithms, graph theory, parallel computation

Interdisciplinary outlook

- Master’s degrees in:
  - Computer Science
  - Health informatics (with Medicine)
  - Electronic commerce (with Business and Law)
  - Bioinformatics (with Biology)
- Joint research projects with
  - Mathematics
  - Engineering
  - Medicine
  - Business
  - Biology

Research overview



Research snippets

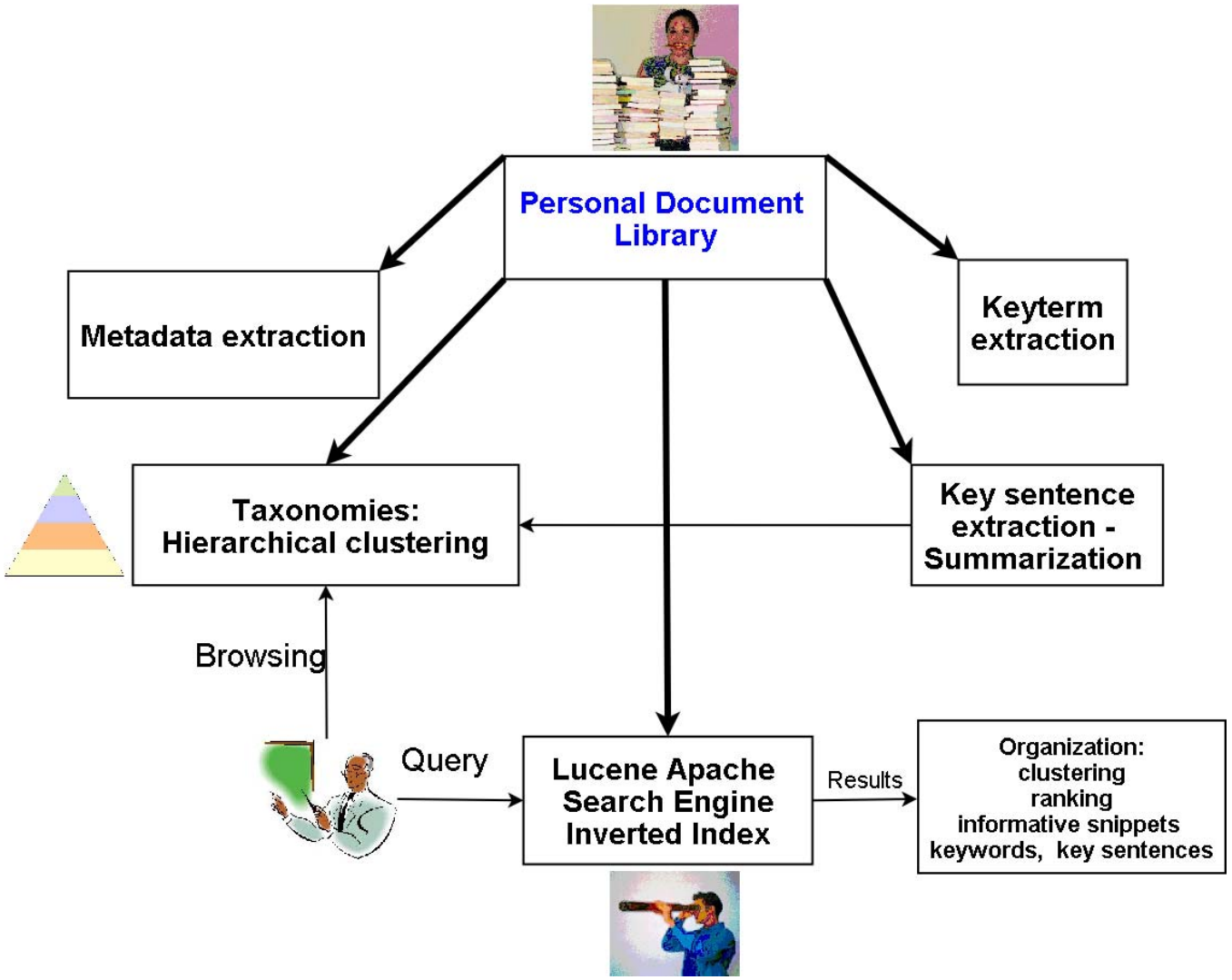
Networked Information Spaces:

Modelling and Mining

Documents are networked into information spaces

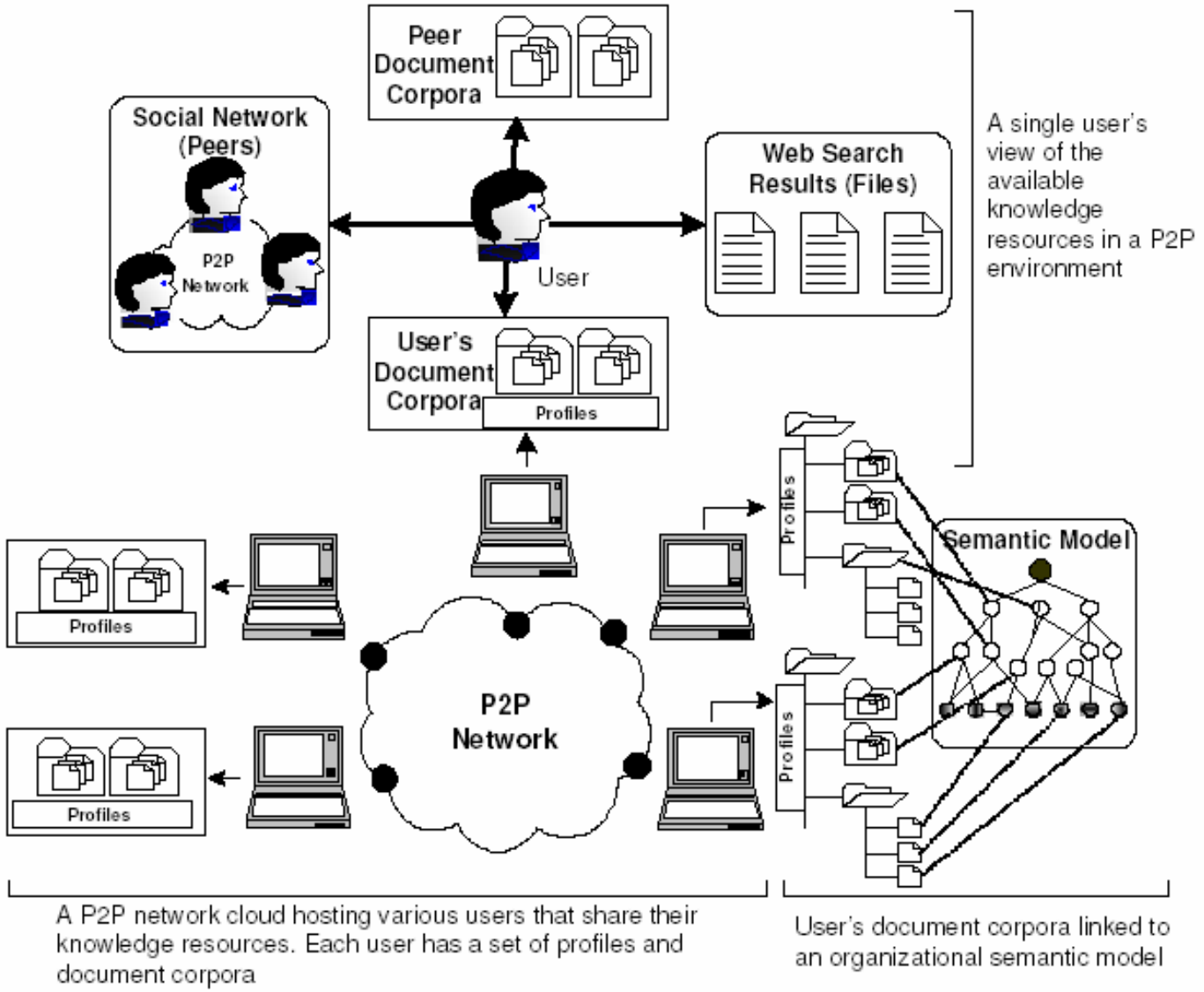
- World Wide Web
- Blog space
- Scientific and Medical Literature
- Patents
- Common Law

Desktop of the future



Peer-to-Peer Document Management

V. Keselj, E. Milios, S. Abidi



Automatic Topic Extraction

E. Milios

topic 1	topic 2	topic 3	topic 4	topic 5	topic 6	topic 7	topic 8	topic 9
error	neuron	image	analog	data	control	function	rule	distribution
generalization	neurons	images	circuit	clustering	model	functions	rules	probability
learning	synaptic	object	current	principal	motor	basis	set	gaussian
training	firing	recognition	figure	cluster	forward	linear	step	data
optimal	spike	face	chip	pca	inverse	regression	form	parameters
order	time	objects	voltage	set	dynamics	kernel	fuzzy	model
large	activity	hand	vlsi	algorithm	controller	space	problem	bayesian
average	rate	pixel	circuits	points	feedback	gaussian	relative	mixture
small	synapses	system	digital	approach	system	approximation	extraction	density
examples	potential	view	implementation	clusters	position	rbf	expert	likelihood

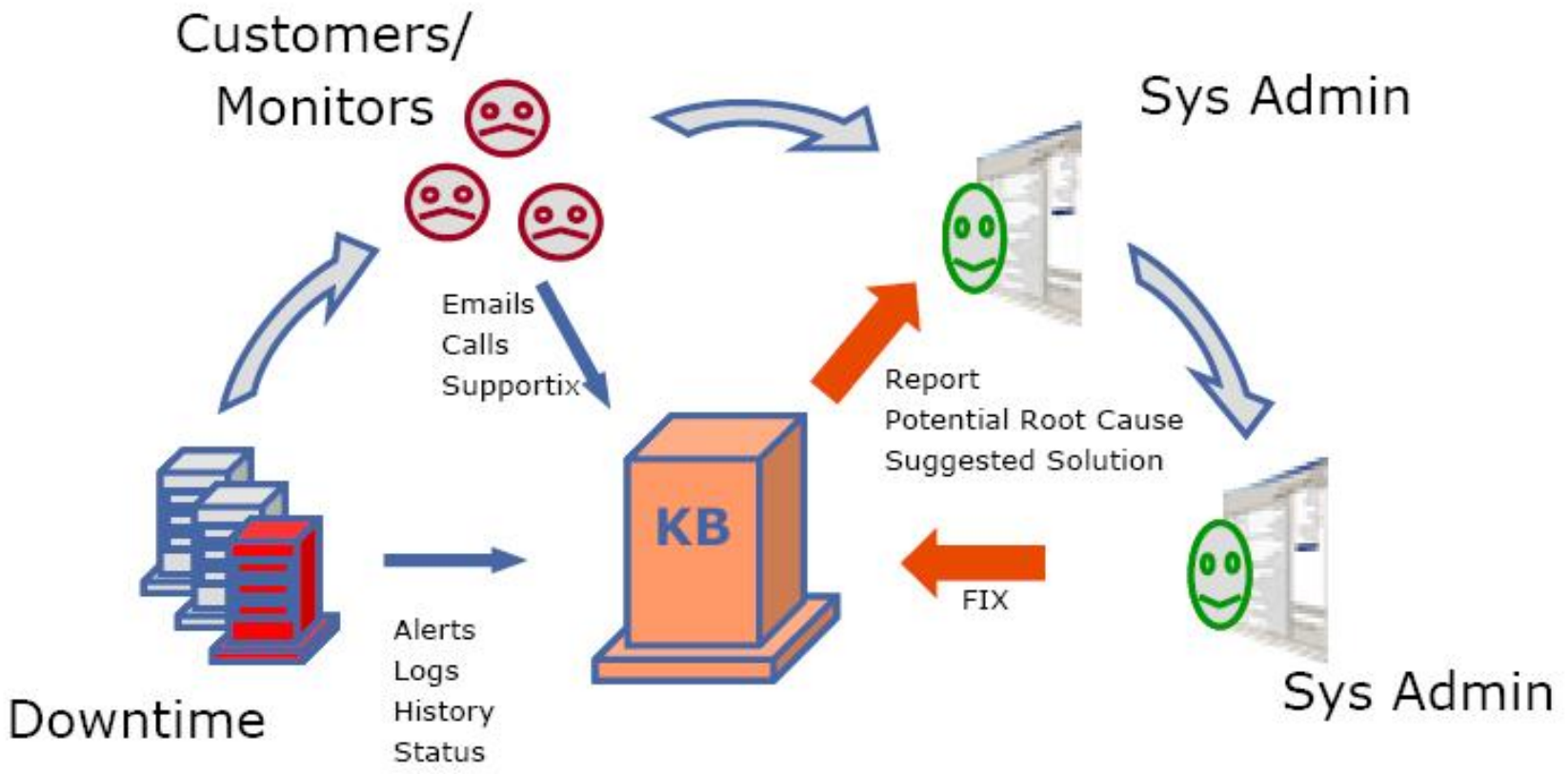
Figure 2. Example word-topics for the NIPS dataset

topic 1	topic 2	topic 3	topic 4	topic 5	topic 6	topic 7	topic 8	topic 9	topic 10
language	game	church	house	air	league	war	apollo	party	system
english	player	god	parliament	aircraft	football	german	earth	government	computer
greek	cards	christian	members	world	team	army	moon	president	game
languages	players	jesus	commons	force	world	soviet	lunar	political	games
word	games	christ	lords	military	club	battle	time	national	apple
russell	play	orthodox	bill	ship	home	germany	mission	minister	atari
century	card	baptism	act	gun	season	world	program	states	commodore
theory	hand	life	power	war	won	forces	module	united	home
words	round	catholic	chopin	ships	game	french	jpg	election	software
modern	played	roman	speaker	navy	major	union	crew	state	video

Figure 3. Example word-topics for the Wikipedia dataset

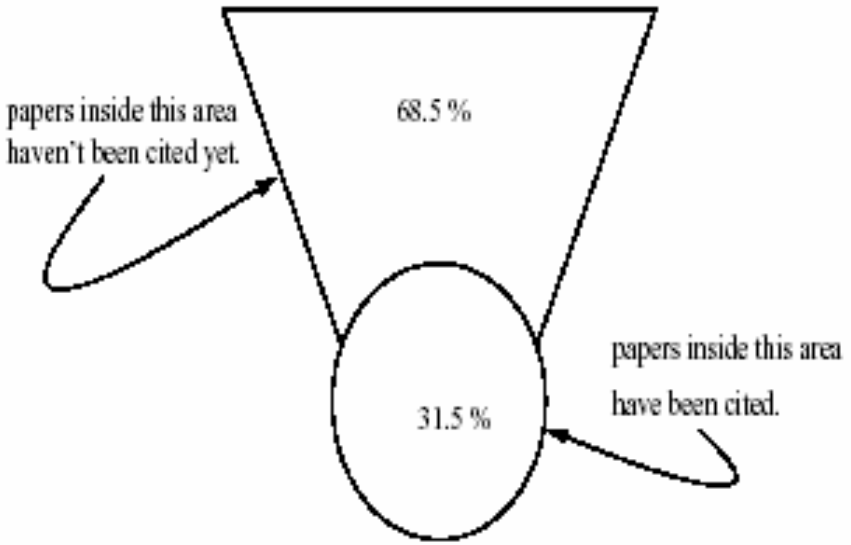
Experience Management

E. Milios, N. Zincir-Heywood

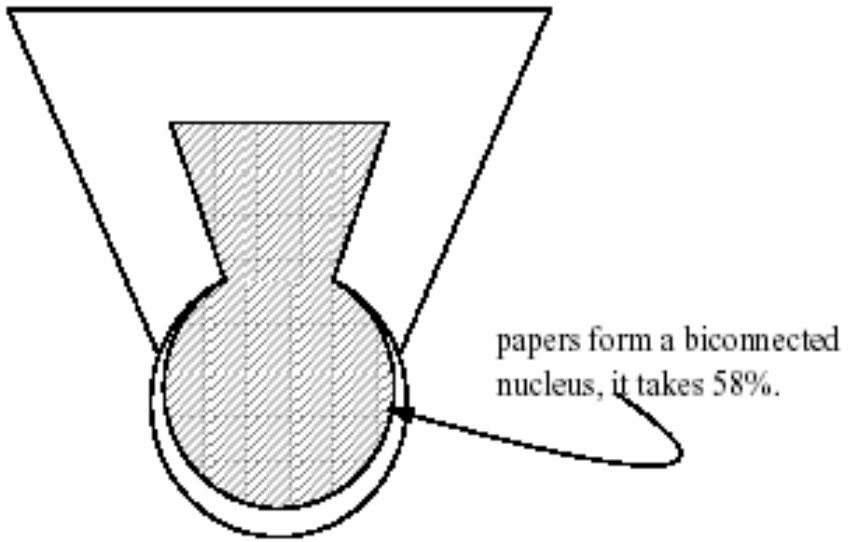


Connectivity of the Citation graph

J. Janssen, E. Milios



(a) 68.5% of the nodes have no incoming link



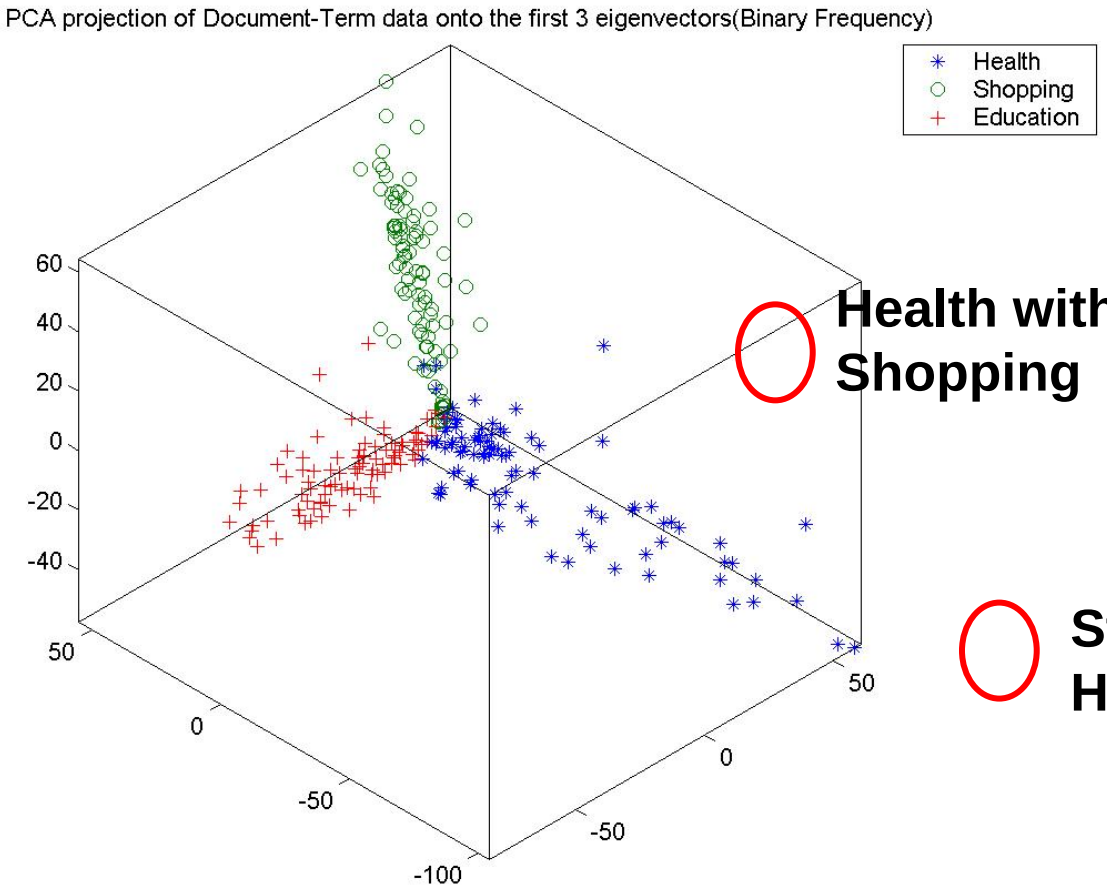
(b) 58% of the nodes in the giant Weakly Connected Component(WCC) account for a big Biconnected Component(BCC)

Web Page Categorization Using PCA

Michael Shepherd, Carolyn Watters, Jack Duffy ….

Web Information Filtering Lab (www.cs.dal.ca/wifl)

Recall and
Precision > 0.80

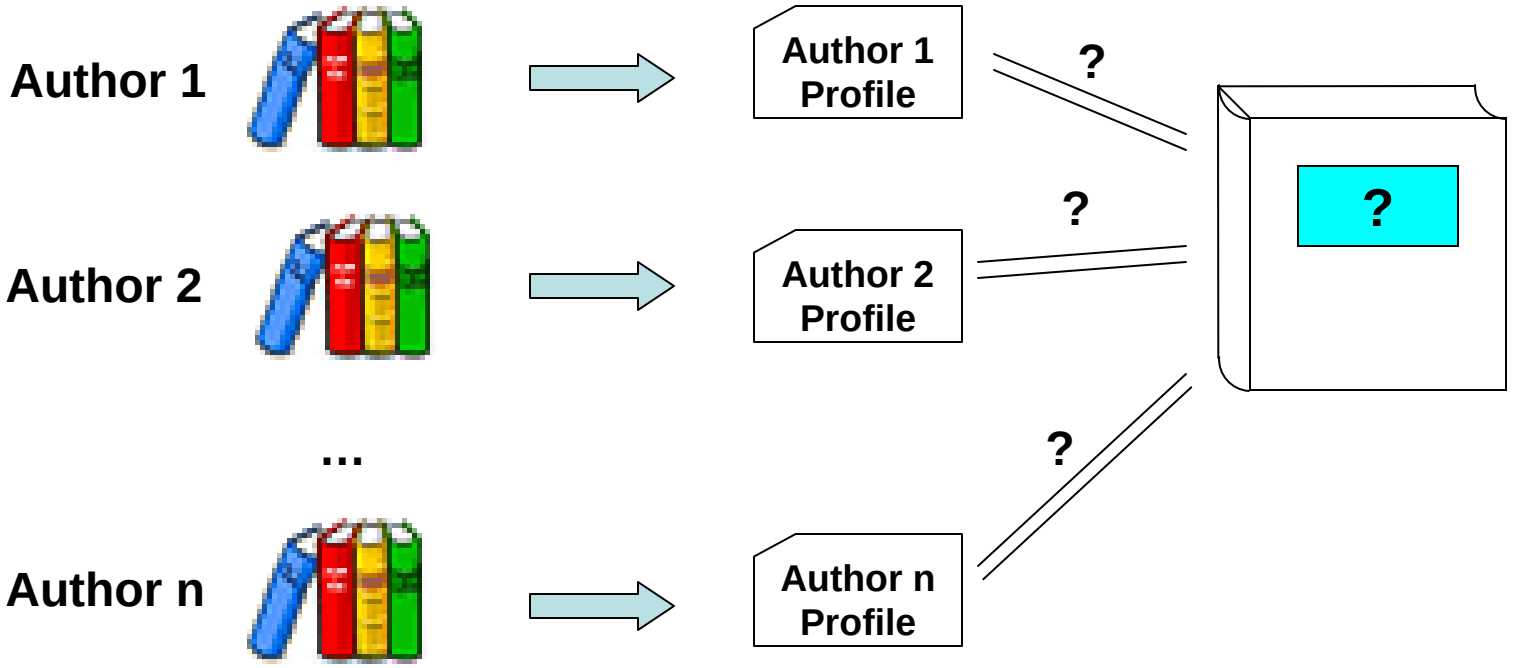


Health with Shopping

Strong Health

Authorship Attribution using Character N-grams

Vlado Keselj

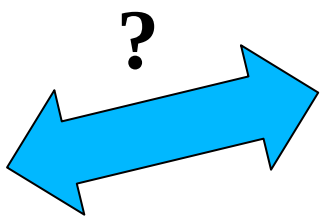


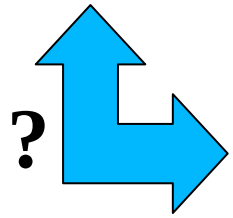
Dickens: A Tale of Two Cities

```
_th 0.016
the 0.014
he_ 0.012
and 0.007
nd_ 0.007
```

Dickens: Christmas Carol

```
_th 0.015
___ 0.013
the 0.013
he_ 0.011
and 0.007
```



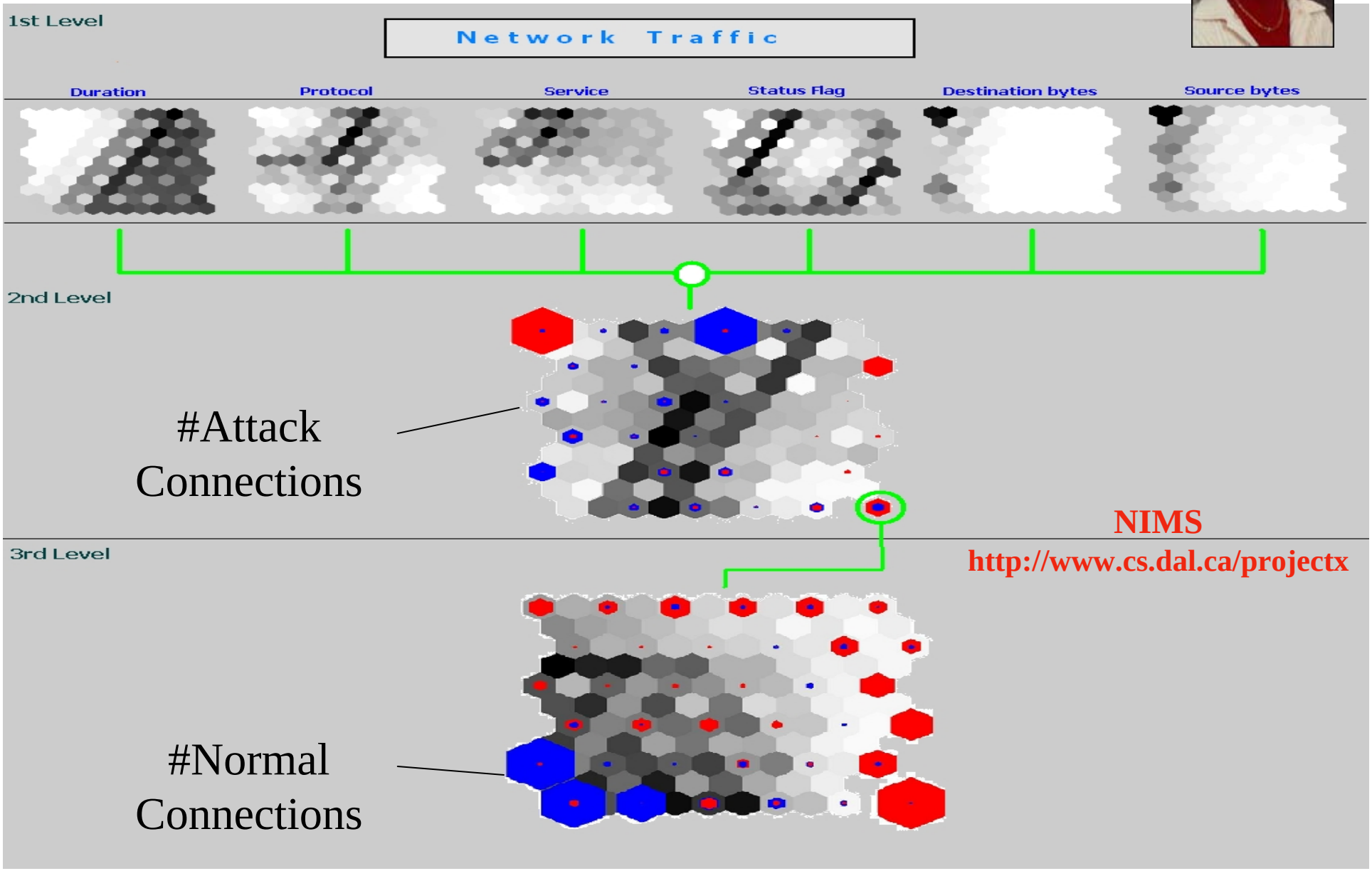


Carroll: Alice's adventures in wonderland

```
_th 0.017
___ 0.017
the 0.014
he_ 0.014
ing 0.007
```

Network Traffic Classification

Nur Zincir-Heywood



NIMS

http://www.cs.dal.ca/projectx

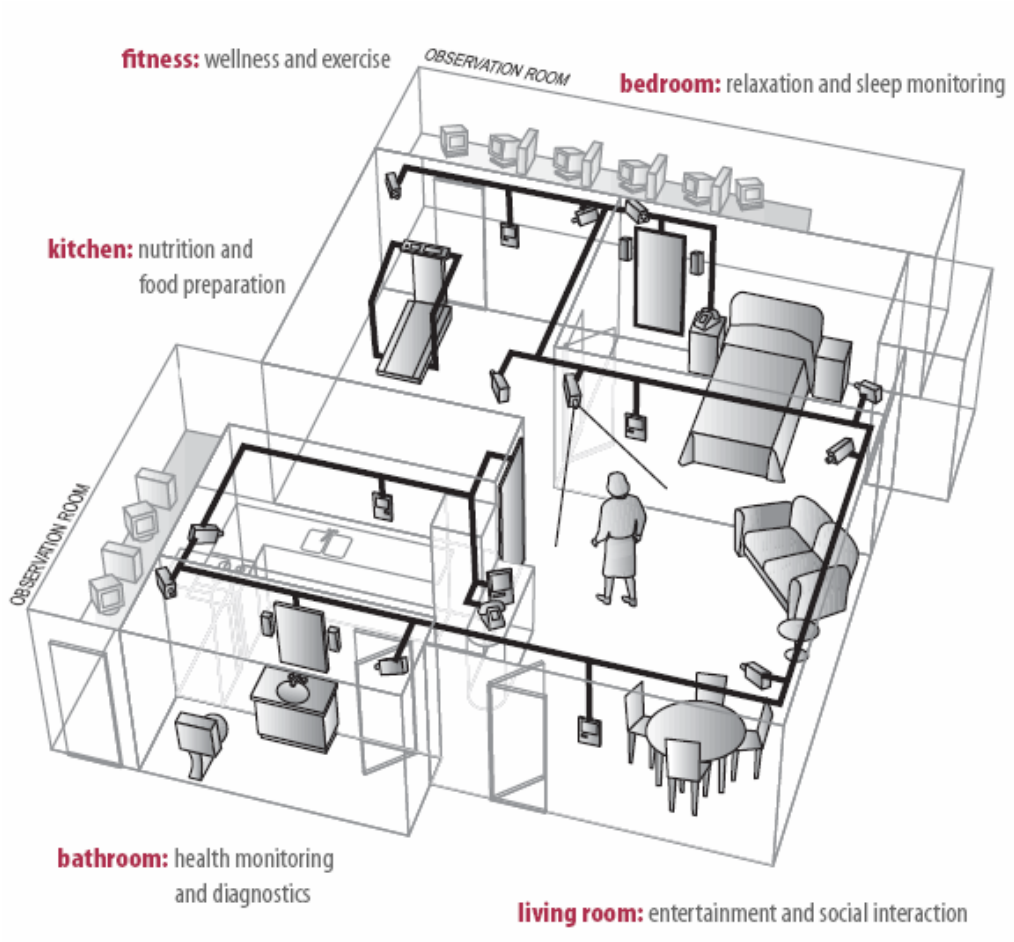
Enhancing Face-to-Face Collaboration

EDGE Lab
Dalhousie University
Dr. Kori Inkpen

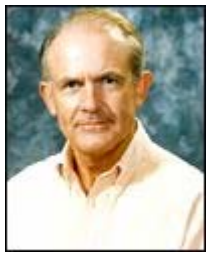
Exploring effective interaction techniques and input devices for rich face-to-face environments

Aware Home

Jacob Slonim

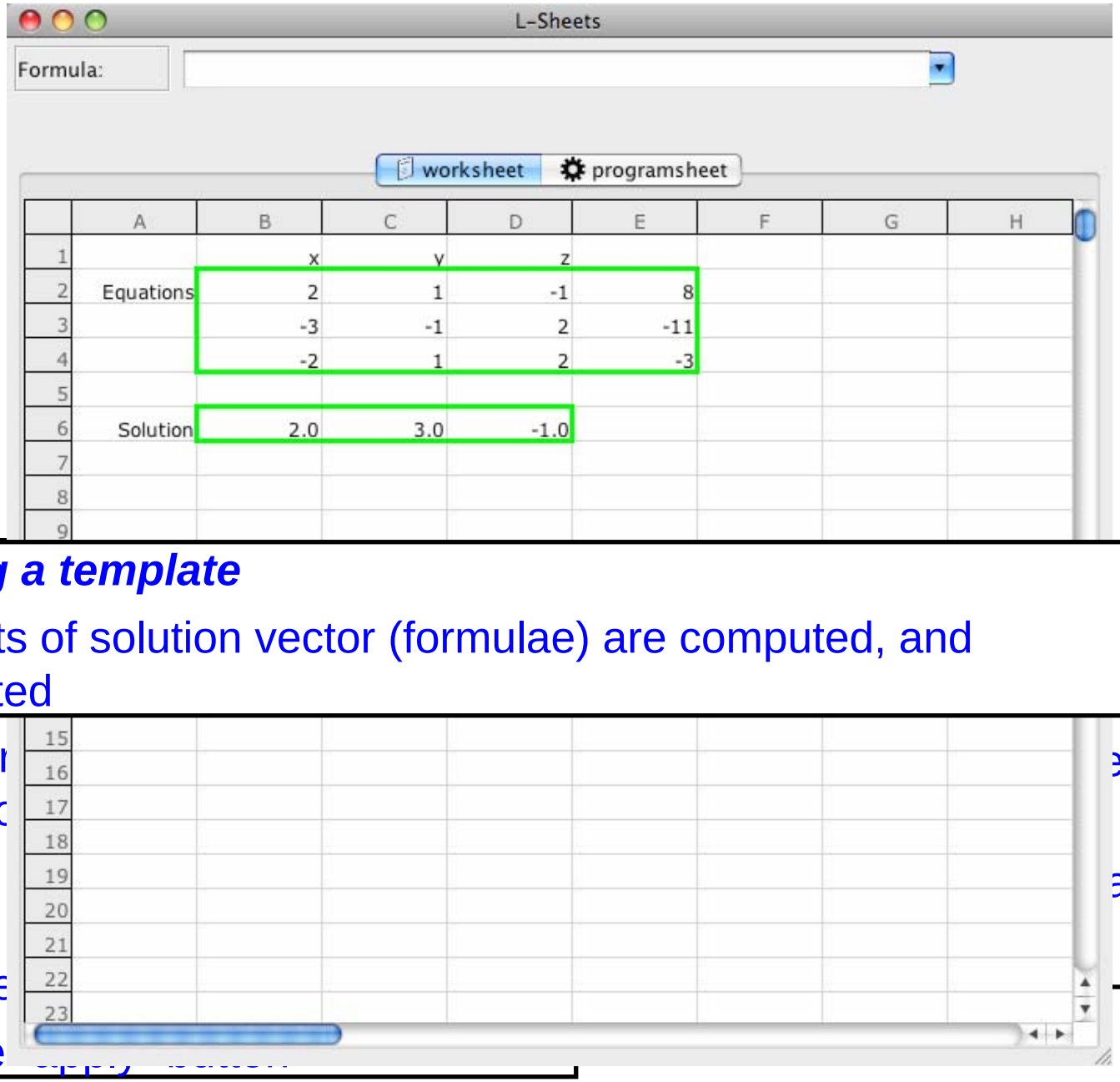


Visual Computing & Design



Phil Cox

- The role of visualisation in software development
  - Visual programming languages (VPL)
  - Visualisation of execution
  - End-user and domain-specific programming
- Some projects
  - Design of structured objects
  - Programming by demonstration
  - VPLs for industrial software development
  - Spreadsheet programming and templating
    - Example: Gaussian elimination for solving sets of linear equation (not a typical usual end-user application!)...



Applying a template

- contents of solution vector (formulae) are computed, and evaluated

- select ar
  corresp
  gauss
- outlines
  are acce
- click the

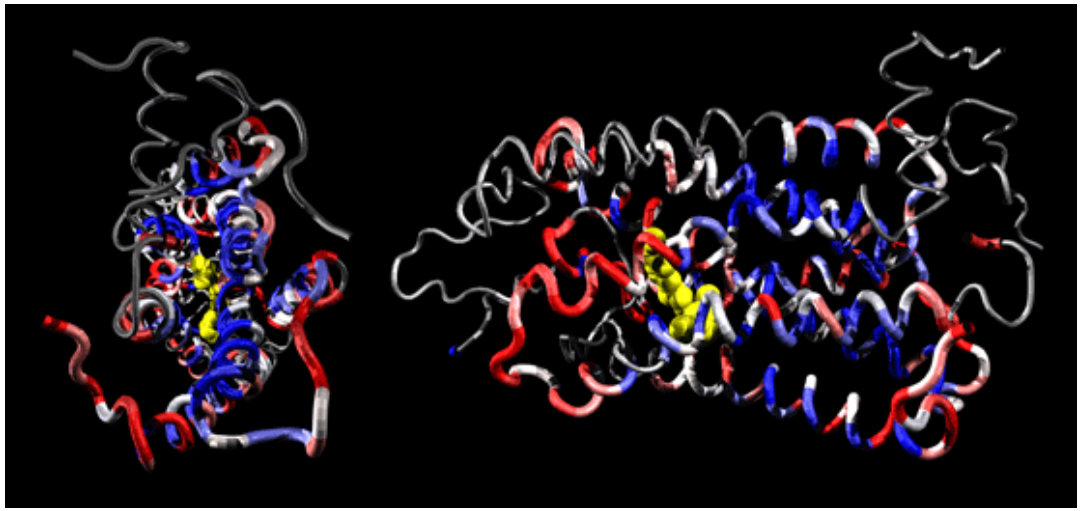
een

and

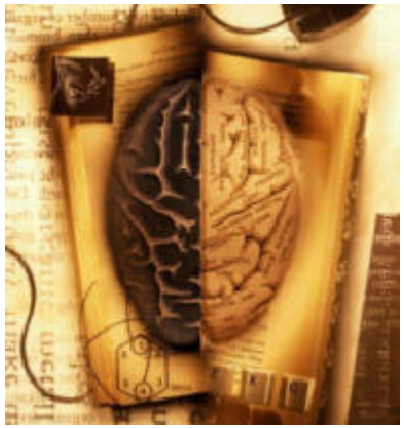
Bio-informatics

Dr. Christian Blouin

Optimizing confidence intervals in phylogeny
Parallel Computing in protein phylogeny
Sequence alignment curation using Artificial Intelligence
A C++ bioinformatics library
Interactive Phylogeny
Protein Biophysics and the substitution process
Structural Evolution
Folding of protein loops

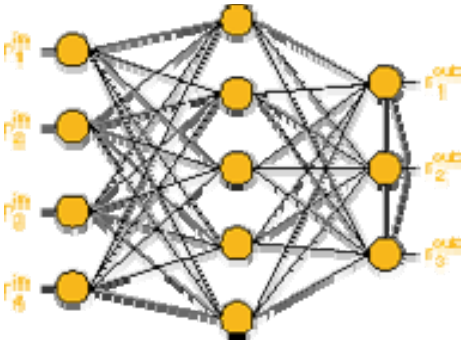


Computational Neuroscience

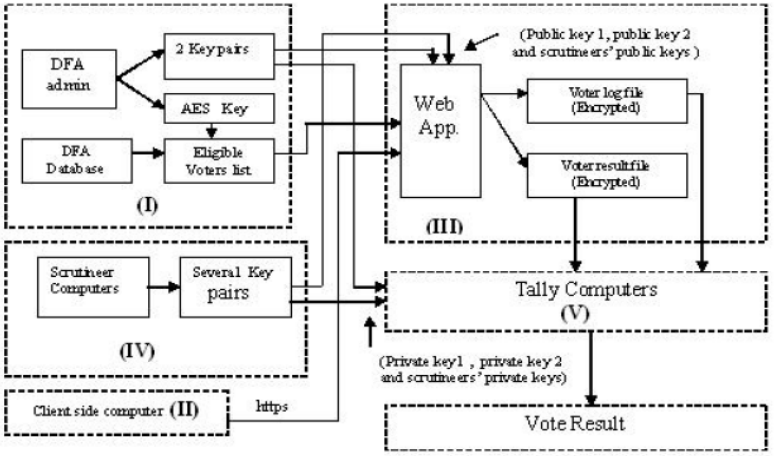


Dr. Thomas Trappenberg

Machine Learning & Data Mining



eCommerce



NICHE Research Group

(k**N**owledge **I**ntensive **C**omputing for **H**ealthcare **E**nterprises)

Raza Abidi

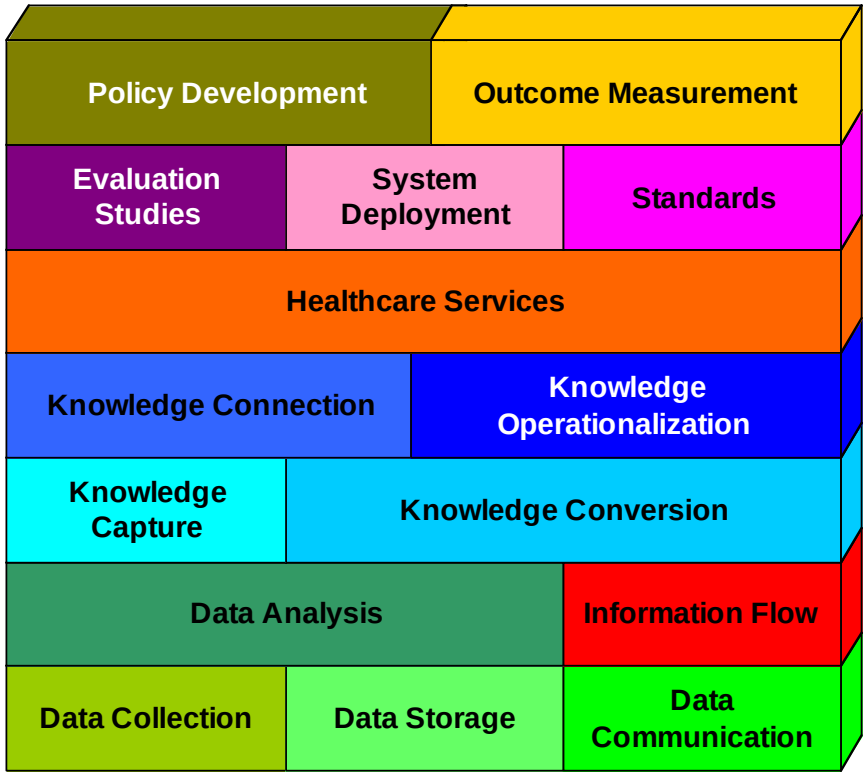
Research Focus is Interdisciplinary

- Computer Science
  - Knowledge management
    - Semantic Web & Ontologies
  - Intelligent personalization
    - Semantic web service composition
    - Dynamic context-sensitive information (content) personalization
- Health Informatics
  - Clinical decision support systems
  - Health knowledge modeling
    - Clinical practice guidelines
    - Clinical pathways
  - Knowledge translation
  - Health data mining

Key Health Informatics Projects

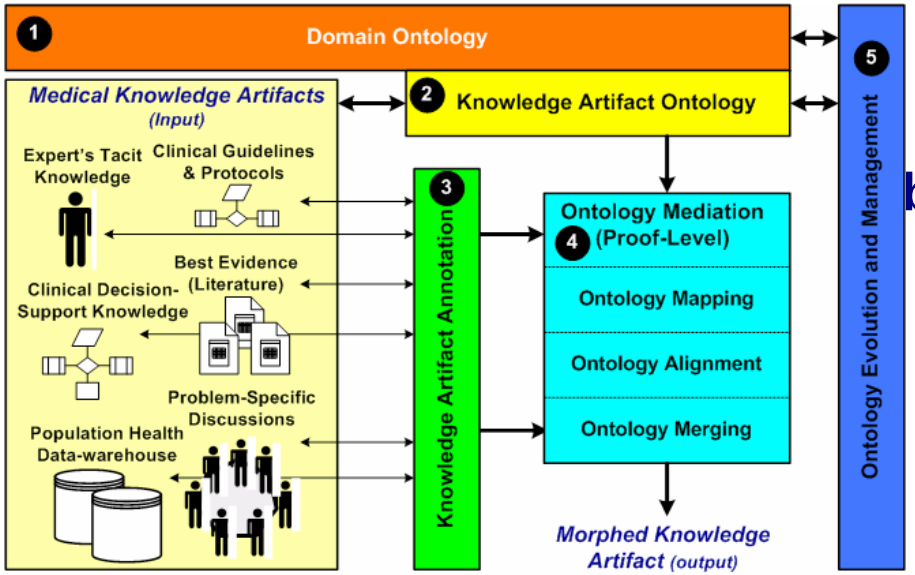
- Knowledge translation in pediatric pain
  - Web 2.0, Social network analysis
- Point-of-care decision-support system for breast-cancer follow-up
  - Semantic web, Reasoning engines
- Care planning for prostate cancer through Care Maps
  - Semantic web, planning systems
- Glaucoma detection from optic discs analysis
  - Data mining, Image analysis
- Knowledge sharing patterns in Emergency Department
  - Knowledge management
- Personalized patient educational program for cardiovascular diseases
  - Adaptive hypermedia, AI

Health Informatics Research Landscape

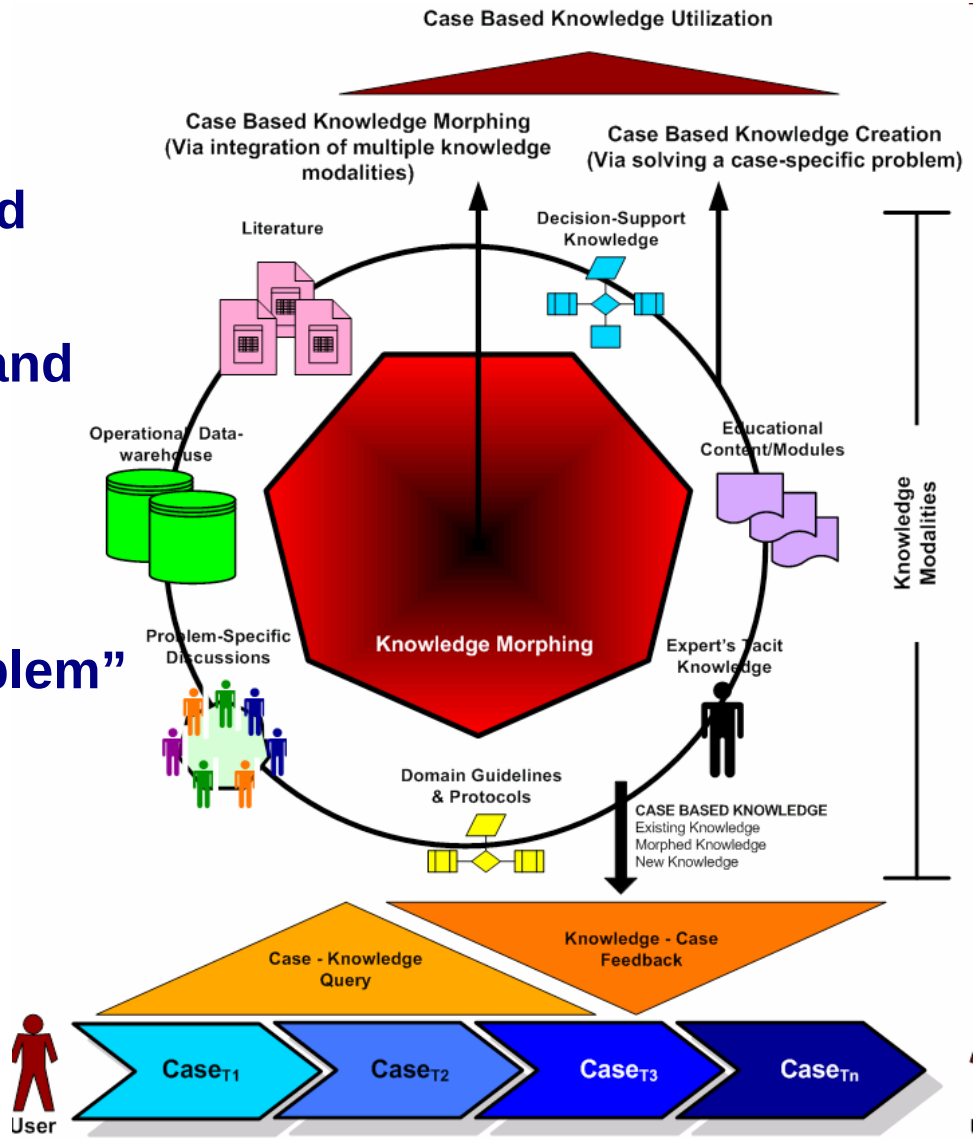


Knowledge Morphing

"The intelligent and autonomous fusion/integration of contextually, conceptually and functionally related knowledge objects **that may exist in different representation modalities and formalisms, in order to establish a**

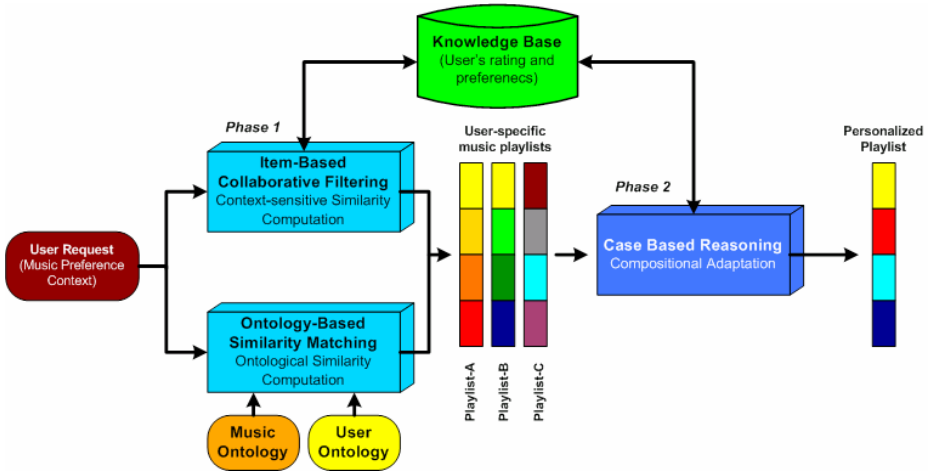


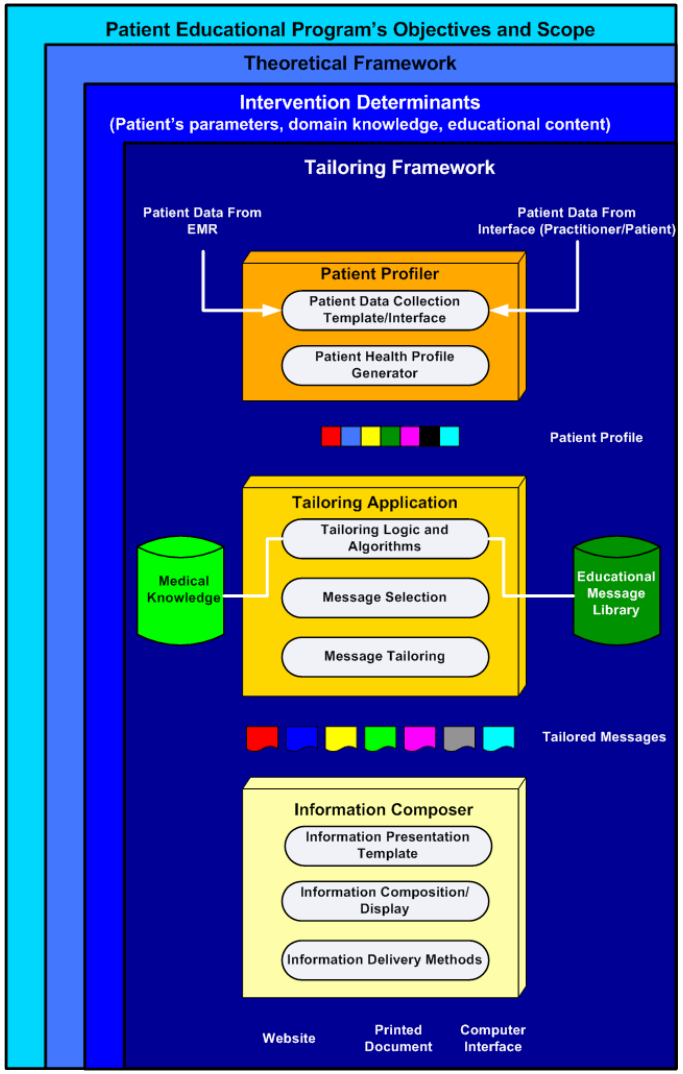
blem"



AdWISE: Adaptive Web Information and Services Environment

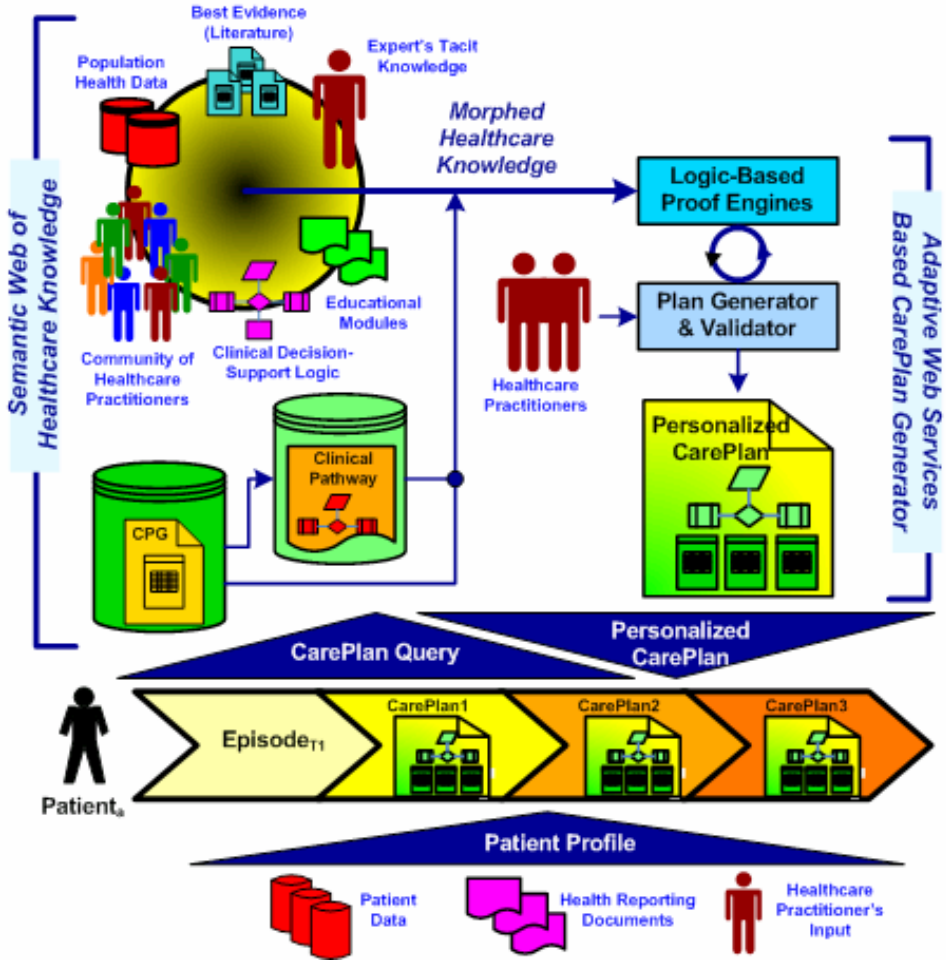
- Intelligent Content Personalization
  - AI Techniques
  - IR Techniques
- Applications
  - Personalized music playlists
  - Personalized news items
  - Personalized cardiovascular risk management recommendations





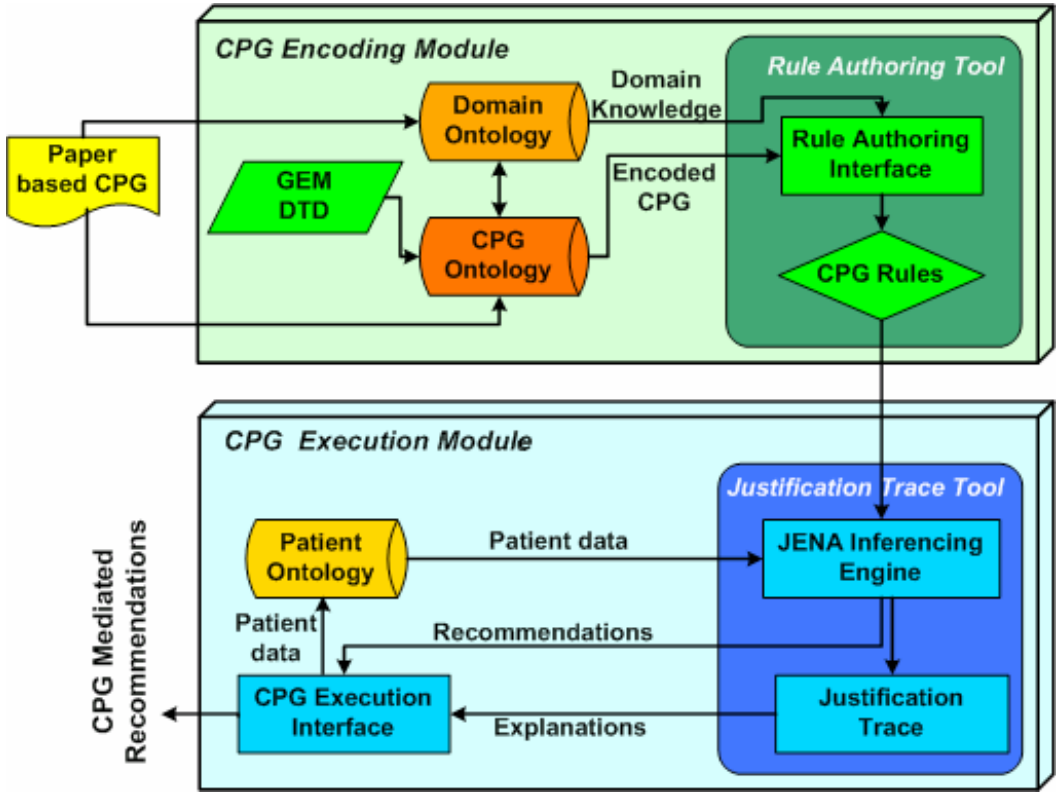
Adaptive Personalized Care Planning via a Semantic Web Framework

- CarePlan is a rich temporal, process-centric, patient-specific clinical pathway that manages the evolving dynamics of a patient to meet the patient's needs, institutional workflows and medical knowledge.



Decision Support Systems

- Semantic Web Approach
  - Knowledge Modeling
    - Ontologies
  - Knowledge Execution
    - Ontology based (logical) decision rules
    - Logic based proof engines
    - Trusted Solutions



The Dalhousie Graphics and Visualization Lab

GVLAB

The Graphics and Visualization Lab

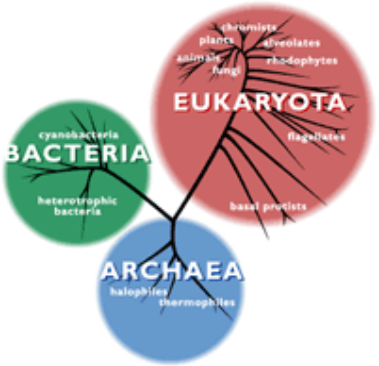
- The focus is on both:
  - the development of new graphical techniques, and
  - the application of those techniques, often in cross-disciplinary areas

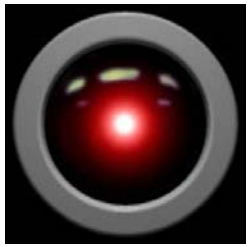
- Our lab incorporates expertise in areas such as:
  - image processing
  - 3D computer graphics
  - physically-based rendering
  - visualization
  - and, traditional art

Graduate Courses & Faculty Members

- Visualization (6406)
  - focuses on graphical techniques for data visualization that assist in the extraction of meaning from datasets
- Advanced Computer Graphics (6604)
  - covers topics in computer graphics, including rendering, geometric modeling, and computer animation
- Digital Image Processing (6602)
  - covers topics in digital picture processing such as visual perception, digitization, compression and enhancement

Genetic Programming





Problem
Decomposition

Co-evolutionary behaviors

Evolving Computer Programs

Game Strategy Learning

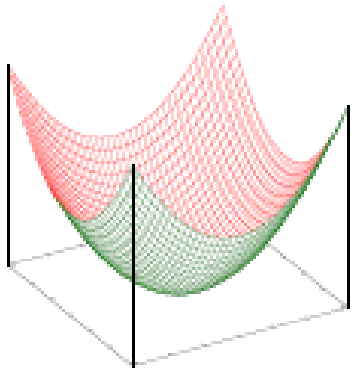
QuickTime™ and a
decompressor
are needed to see this picture.

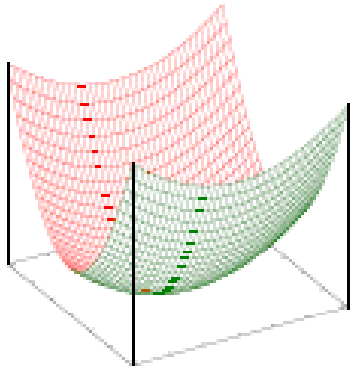
Malcolm
Heywood

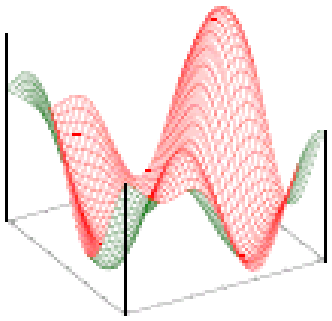
Evolutionary Computation

Dirk Arnold

- evolutionary algorithms are optimisation strategies “gleaned from nature”
- areas of application range from engineering design and control to financial forecasting and art
- research of Dalhousie’s Evolutionary Computation group focuses on understanding, improving, and developing adaptive strategies
- contact: Dr. Dirk Arnold (http://www.cs.dal.ca/~dirk)







Fault-tolerant networks

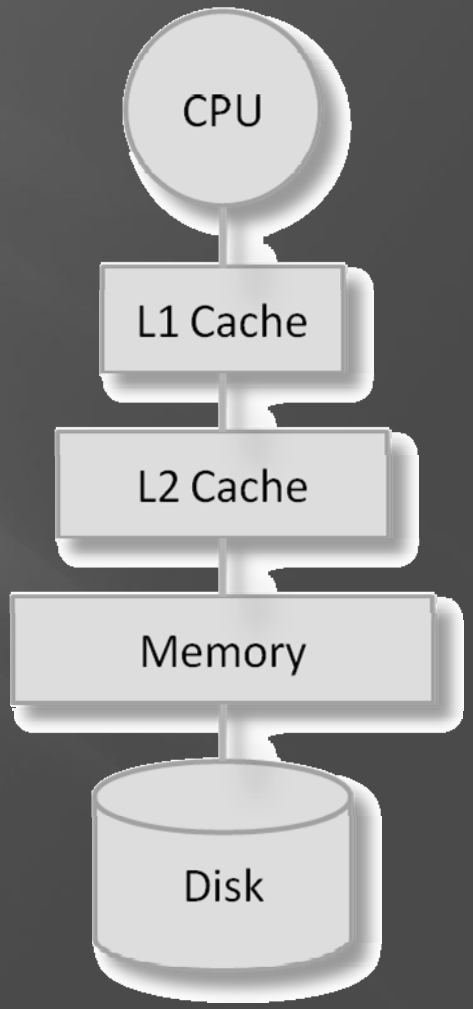
Zizo Farrag

- Design and Reconfiguration of fault-tolerant networks.
- Objectives: construct a network that
  - Can continue to operate in the presence of certain faults,
  - Is optimal or near-optimal in cost,
- Cost will depend on the parameters to be optimized
- Efficiency of reconfiguration measured by the time needed to identify a healthy sub-graph of the network (that excludes the defective components).

Algorithms and Data Structures for Memory Hierarchies

Norbert Zeh
Canada Research Chair in Algorithms for Memory Hierarchies

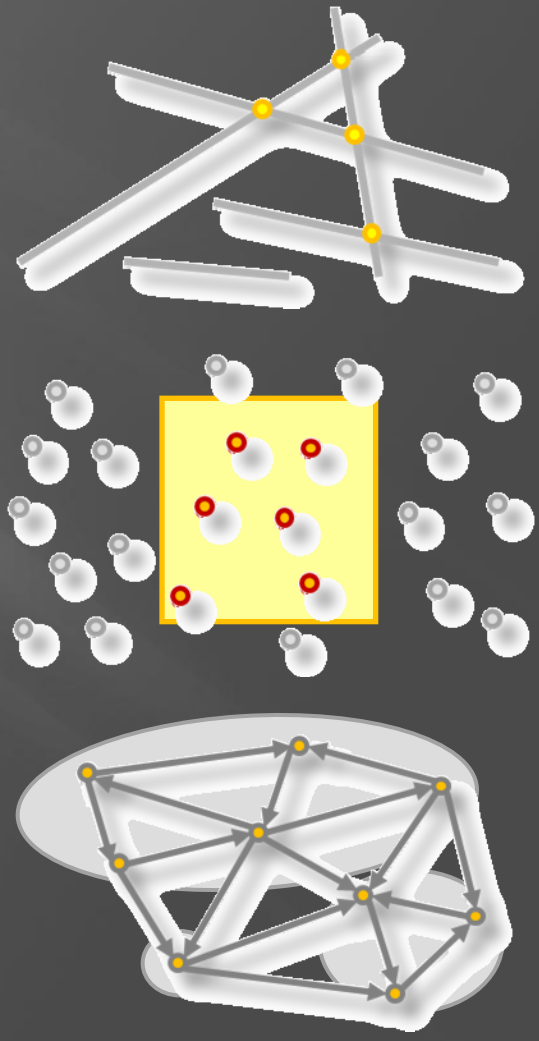
- Disk I/O bottleneck when processing massive datasets
- Low cache efficiency in traditional algorithms
- Need algorithms with high access locality to
  - Take advantage of caches
  - Take advantage of disk read-ahead
- **Techniques fundamentally different from traditional algorithms!**



Algorithms and Data Structures for Memory Hierarchies

Norbert Zeh
Canada Research Chair in Algorithms for Memory Hierarchies

- **Geometric problems**
  - Databases (range queries, etc)
  - GIS (map overlay, window queries, etc)
  - ...
- **Graph problems**
  - Web modeling
  - GIS (route planning, logistics)
  - Bioinformatics (protein clustering, etc)
  - ...



Graduate School Information

Admission requirements

- Grade point average at least 3.7 (on a 4.3 scale)
- Strong reference (recommendation) letters
- Publications highly desired (for the PhD program)
- TOEFL
- GRE (optional)

Application process

- Visit: http://www.cs.dal.ca/graduate/
- **Deadline**: January 10 (for September)
- Students need support from a prospective **supervisor** to be admitted
  - Feel free to contact faculty members in your areas of interest two weeks after you have sent your application
  - Acceptable to switch supervisors after admission
  - Minimal delay if done within the 8 months

How much money do I need?

EXPENSES	
Tuition+health ins.	8206
Housing+food	8400
Personal+books	2100
-- total	***18706***
SUPPORT	
Scholarship	6151
Research assistantship	9324
Teaching assistantship	3248
-- total	***18723***

How much money do I need?

- Cost of living differs among Canadian cities.
- **$20,000 in Halifax** is the same as:

City	Amount
Edmonton	23800
Vancouver	31000
Toronto	32600
Hamilton	22300
Montreal	30000
Ottawa	30600

Data from: http://www.usask.ca/cgsr/comparison.php

How to choose a thesis topic?

From: How to succeed in graduate school (by Marie deJardins, SRI International)

- a good thesis topic is interesting:
  - to you,
  - to your advisor, and
  - to the research community
- Professors may have
  - Well defined long-term research programs and expect their students to contribute directly
  - Much looser, but still related ongoing projects.
  - Tendency to take on anyone with an interesting idea (beware of advisor lack of commitment)

How to choose a thesis topic?

- Awareness & Reading
  - Be selective: you'll never be able to read everything that might be relevant
  - Become and stay aware of directly related research
- Topic options
  - narrow, well defined topic.
    - Plus: finish fast
    - Minus: it may not be as exciting
  - Exotic topic
    - Plus: potentially exciting
    - Minus: difficulty convincing people it's worthwhile.

How to choose a thesis topic?

- Solve a real problem, not a toy problem
- Choose:
  - a central problem that's solvable and acceptable,
  - with extensions and additions that are ``successively riskier and that will make the thesis more exciting.

For more information

- WWW: http://www.cs.dal.ca/graduate/
- Email: grad@cs.dal.ca
- Dalhousie Research Newsletter: http://www.dal.ca/research/outfront/
- Resources about graduate school, thesis writing, how to do research, how to give presentations, academic job interview preparation.
  http://users.cs.dal.ca/~eem/gradResources/gradResources.htm