A Bioinformatics Pep Talk

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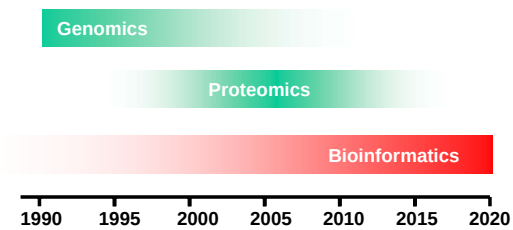
The 21st Century

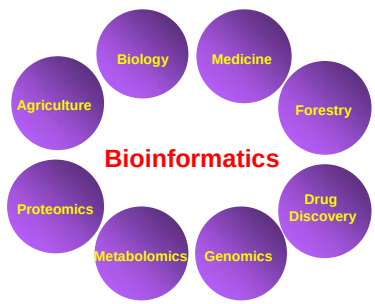
"Two technologies will dominate the 21st century, both industrially and scientifically -- information technology and biotechnology"

William H. Gates III

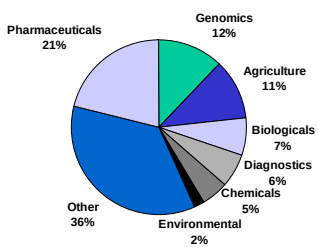
Bioinformatics



Bioinformatics



Bioinformatics Applications



Source: Nature and Burrill and Company.

Technology Areas Where Bioinformatics Is Used (US Data)

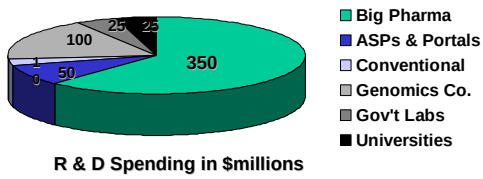
Bioinformatics Trends

- **Globally, bioinformatics should generate at least US$7 billion over the next three years**
- **Players in the computer industry are already riding the biotech wave. (IBM, Sun Hewlett-Packard)**
- **Bioinformatics market is forecasted to grow at a CAGR of 20% through 2006**

Growth Projections

- Databases comprise the largest product segment of the bioinformatics market (43% in 2006)
- The segment that stands to grow the fastest is analysis software (CAGR 2001-2006=26%).
- Genomics currently represents the largest application segment for bioinformatics spending (55% in 2001)
- Over the next five years significant growth is expected in proteomic (CAGR 2001-2006=39%) and pharmacogenomic (CAGR 2001-2006=38%) applications

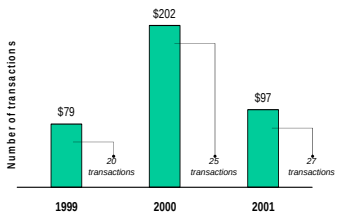
Bioinformatics $$$



R & D Spending in $millions

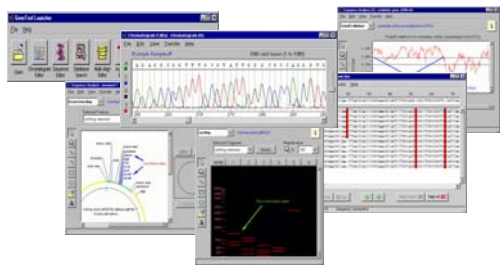
Canadian VC Investment in Bioinformatics

(Cdn $m; 1999-2001)



Source: Macdonald & Associates.

Traditional Bioinformatics



Traditional Bioinformatics

- GenBank Searching
- Sequence Alignment
- Property Prediction
- Property Plotting
- Plasmid Drawing
- Gel Simulation
- PCR Primer Design
- Sequence Assembly
- Sequence Translation
- Restriction Analysis
- Data Management
- Figure Preparation

The "New" Bioinformatics

- Everything on the Web
- C++, Java, Perl, Python ...
- Data mining/Self updating Databases
- Machine learning, Pattern Recognition
- Interactive/Visual Databases
- Laboratory Information Management
- Predictive, Prognostic Tools
- Large Scale Bioinformatics/Computing

Bioinformatics & Jobs

Job Choices

- Industry (private sector)
  - Big pharma, little pharma, Ag/Forestry, IT companies (IBM, Sun), software firms
- Academia (public sector)
  - Grad student, non-academic staff, academic staff
- Government (public sector)
  - Gov't labs, hospitals, research institutes
- Self-employed (private sector)

Industry

- High salaries ($70-$150K)
- Large budgets
- Cutting edge work
- Excellent facilities and infrastructure
- Excitement, competition
- Job volatility and instability (except in big Pharma)
- Not your own boss
- Projects lifetimes based on bottom line ($) not level of personal interest
- High pressure

Grad Student/PDF

- Set your own hours/schedule
- Great group dynamics/friends
- Cutting edge work
- Excellent facilities
- "Improving" yourself, getting educated
- Doesn't last forever – not a career
- Low salaries ($20K- 40K)
- Constant pressure to finish thesis, courses, papers, posters, etc.

Academic (Prof)

- You're the boss
- Set your own hours/schedule
- Cutting edge work
- Excellent facilities
- Cool interactions with students/staff
- Job security (tenure) and good benefits
- Long road to hoe
- Constant pressure to find money (grants & contracts)
- Modest salaries ($60K- 90K)
- Constant pressure to finish/teach courses, papers, posters, etc.

Gov't Employee

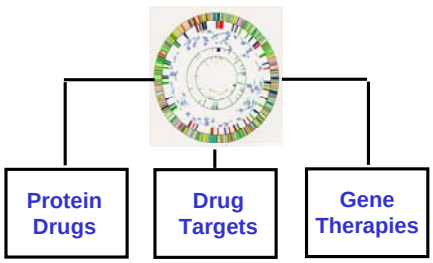
- Cutting edge work
- Excellent facilities
- Generally stable funding and support
- Job security (pseudo tenure) and good benefits
- Tough to get "in the door"
- Modest salaries ($60K- 90K)
- Gov't employee stigma
- Chasing money through grants

Self-employed Consultant

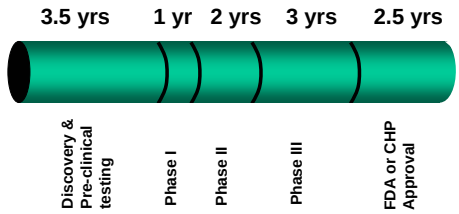
- You're the boss
- Set your own hours/schedule
- Cutting edge work (sometimes)
- Doing something you're passionate about
- Poor job stability
- Constant pressure to find money
- Modest salaries ($20K- 90K)
- Constant pressure to finish projects on time, under budget

Industry Outlook (Pharma)

Drugs from Genes



Drug Development Pipeline



A Major Gamble...

- 12 years/drug
- $700 million/drug
- Up to 3500 patient volunteers required
- Only 5 out of 5000 discovery compounds makes it to Phase I
- Only 1 of 5 Phase I drugs is ever FDA approved

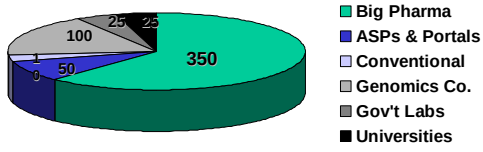
Bioinformatics & Pharma

- Potential to reduce the current time of drug discovery by approximately 30%, and to reduce annual costs by 33%
- Current applications are mainly in the preclinical stage, and a more significant role is expected in later (Phase III) clinical development
- Pharmacogenomics will be a main driver for use of bioinformatics in drug development

Bioinformatics Market

- **Bioinformatics spending can include in-house development and external purchase from commercial vendors.**
- **Pharmaceutical and biotech companies currently allocate approximately 39% to in-house development and 61% to external purchase**

Bioinformatics $$$



R & D Spending in $millions

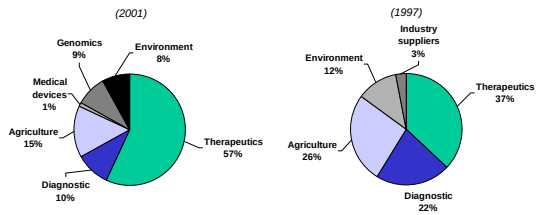
Canada's BioTech Industry

	CANADA			USA	Europe
INDUSTRY DATA	**1997**	**2000**	**2001**	**2001**	**2001**
Number of companies	227	350	400	1457	1879
Public Companies	59	77	85	342	104
Market Cap.	$8 billion	$26 billion	$20 billion	US$ 330 billion	$US 51 billion
FINANCIAL DATA	**1997**	**2000**	**2001**	**2001**	**2001**
*Revenues (Publicly traded firms)	$580 million	$959 million	$1.500 million	US$ 27.6 billion	$ US 7.5 billion
R&D expenses	185	534	725	15.6	$US 4.2 billion
Net profit (loss)	(147)	(667)	(784)	(4.7)	(608)

US = $27.6 billion, Europe = $7.5 billion, Canada = $1.5 billion

Sources: McKinsey & Company, Burrill and Company 2002, Ernst and Young 2002, BIO 2002.

Core Biotech Companies (Distribution by Sector)



Sources: Canadian Biotech News, Ernst & Young, 2002.

Private Biotech's in Canada

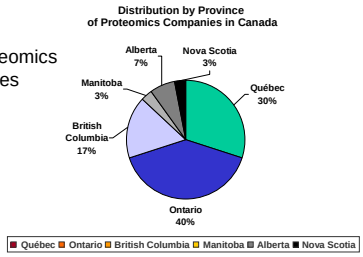
COMPANY NAME	Canadian VC $Announced (Thous. in 2002))
Xenon Genetics Inc.	67,500
Caprion Pharmaceuticals Inc.	50,100
Aegera Therapeutics Inc.	17,000
Kinetek Pharmaceuticals, Inc.	16,500
Galileo Genomics Inc.	16,500
Molecular Mining Corporation	12,496
MethylGene Inc.	11,327
Active Pass Pharmaceuticals	11,000
Viron Therapeutics	6,950
Procrea Biosciences Inc.	6,000
PhageTech Inc.	4,000
Inphogene Biocommunications Inc.	3,000
Cytochroma Inc.	2,100

Publicly Traded Canadian Biotech Companies

COMPANY NAME	SYMBOL: EXCHANGE	*MARKET CAPITALIZATION CDNS (millions)
ProMetic Life Sciences Inc.	PLI:TSE	117.0
Warnex	WNX (TSX)	31.5
Visible Genetics Inc.	VGIN:NASDAQ	27.8
Ecopia Biosciences Inc.	EIA:TSE	21.0
Tm Bioscience Corporation	TMC:CDNX	21.0
SignalGene Inc.	SGI:TSE	19.5
Chromos Molecular Systems Inc.	CHR:TSE	10.7
GLYCODesign Inc.	GD:TSE	7.7
Syn-X Pharma Inc.	SYY:CDNX	7.7
Chondrogene	YDG:CDNX	6.1
Prescient Neuropharma		3.8
Genomics One Corporation Inc.	GNX:MSE	1.1
TOTAL		493.1

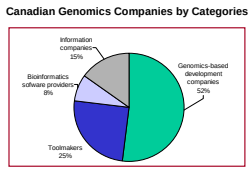
CDN Proteomics Companies

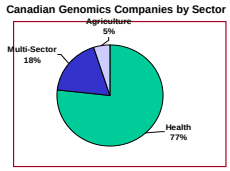
~30 proteomics companies



Source: Database Pence 2002.

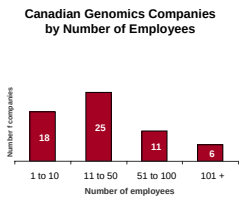
Genomics Companies in Canada

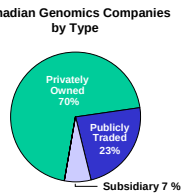




Source: Genome Canada, August 2002.

CDN Genomics Companies





Source: Genome Canada, August 2002.

Industry Outlook (IT Companies)

Canadian Bioinformatics Companies

- BioTools Inc. (Edmonton)
- Iobion Informatics LLC (Toronto)
- Predictive Patterns (Kingston)
- Chemical Computing Group (Montreal)
- United Bioinformatics International (Calgary)
- Kinexus (Vancouver)

Other Bioinformatics Companies

- Accelerys/Pharmacopaeia
- Applied Biosystems
- DNAStar
- Informax/Invitrogen
- Genamics
- 150+ companies listed at:
- http://dmoz.org/Science/Biology/Bioinformatics/Companies/

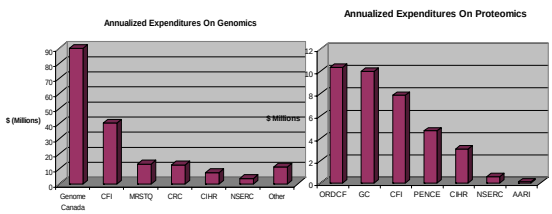
Canadian IT Companies with Bioinformatics Interest

- Sun Microsystems
- IBM and IBM life sciences
- SGI
- Hewlett Packard/Agilent

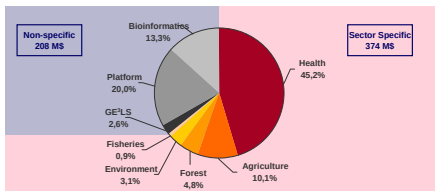
All have a life sciences initiative – software is used as a loss-leader

Academic & Government Outlook

Federal Funding to Genomics & Proteomics



Genome Canada Investment



	Fisheries	Gels	Environ.	Forest	Agri.	Bio-inf.	Platform	Health	Total
$ M	5	15	18	28	59	77	116	264	582
# Projects	1	5	3	4	5	8	4	26	56

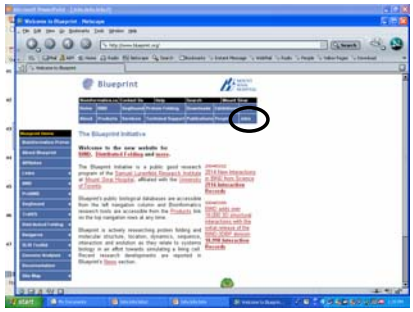
Genome Canada Investment

GOVERNMENT / NON PROFIT/ ACADEMIC	Can $ (millions)
National Human Genome Research Institute, NIH (USA)	$ 518
Genome Canada	$ 242
Wellcome Trust (UK)	$ 193
Science and Technology Agency (Japan)	$ 183
Biotechnology&Biol Sci Res Council, UK	$ 175
European Commission	$ 172
National Science Foundation, USA	$ 146
US Department of Energy	$ 141
Ministry of Education, Sports, and Culture (Japan)	$ 134
German microbial genomes&proteomics	$ 127
Ministry of Economy, Trade and Industy (Japan)	$ 116
Ministry of Health and Welfare (Japan)	$ 104
Netherlands genomics research	$ 95
American Cancer Society (USA)	$ 79
Knut and Alice Wallenberg Foundation (Sweden)	$ 56
GenHomme Program, France	$ 41
German Human Genome Project	$ 37
The SNP Consortium	$ 35
Cancer Genome Anatomy Program (NCI, NIH, USA)	$ 35
Howard Hughes Medical Institute (USA)	$ 32
Kazusa DNA Research Institute (Japan)	$ 23
Total	$ 2,683

Some Major Academic Initatives (jobs, jobs)

- BluePrint-BIND (Toronto)
  - $20 million, 100+ hires
- Genome Sequence Centre (Vancouver)
  - $40 million, 80+ bioinformaticians
- Toronto Structural Genomics Consortium (Toronto)
  - $90 million, 100+ hires

BluePrint/BIND



http://www.blueprint.org/

BC Genome Sciences Centre

http://www.bcgsc.bc.ca/

Toronto Structural Genomics Consortium

- International Partnership with Oxford, U of Toronto, GSK, Wellcome Trust & Genome Canada
- $90 million project – largest of its kind
- Fully operational in mid 2004
- Expect to hire ~100 personnel in the next year

Key SGC Players in Canada

Al Edwards
U of T

Cheryl Arrowsmith
U of T

Mirek Cygler
BRI

Kalle Gehring
McGill

Job Hunting Techniques

- Decide on the "type" of job you want and the "type" of company or organization you want to work for
- Get yourself noticed or known
  - develop a "killer" application
  - publish something
  - work in a company or lab
  - develop connections, network

Job Hunting Techniques

- Door knock (person-to-person)
- Avoid mass mailing, follow up with a phone call or an in-person visit
- Check job advertisements regularly
  - on the web
  - in "Nature", "Science"
- Attend conferences or workshops
  - ISMB (in Glasgow this year)
  - CPI (in Montreal)
  - CBW workshops (in Vancouver)

http://cmgm.stanford.edu/classes/csuh/intro/intro_jobs.html

http://www.nature.com/naturejobs/

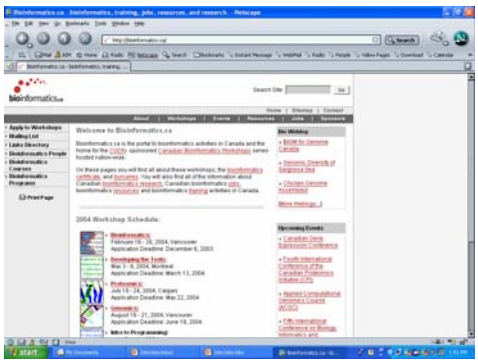
http://www.iscb.org/ismbeccb2004/

http://www.pence.ca/CPI/index.php

Job Hunting Techniques

- Get yourself on list serves or join newsgroups
  - Bioinformatics.org
  - Bioinformatics.ca
- Subscribe to industry newsletters and/or journals
  - Bioinform
  - Genome Canada Help Desk Newsletter

http://bioinformatics.org/



www.bioinformatics.ca

www.bioinformatics.ca/jobs

http://www.bioinform.com/index.htm

http://www.gchelpdesk.ualberta.ca

http://www.genomecanada.ca

http://123genomics.homestead.com/files/home.html

Conclusion

- **Bioinformatics is still growing**
- **Good chance that bioinformatics will become the “new biology”**
- **Bioinformatics needs are constantly changing – need to change with the field**
- **Keep current, keep informed**