"Peran penting Matematika dan Statistika dalam Pengembangan dan Terapan Interdisiplin dan Bioinformatika untuk bidang *Life Science*

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Universitas Andalas 2017

TREND in Mathematis & Science to "Human Developments and Advancements"

Astronomy

- Geography And Trading
- Science, Technology Manufacture and Industry
- Economics, Phsycology, Sociology, law
- Computational science, IT and Media
- ▶ Nano Material SCIENCE

- BIOINFORMATICS
- STATISTICAL GENETICS
- BIG DATA & DATA SCIENCTIST
- ACTUARY
- MODELLING & OPTIMIZATION

- Health science, pharmacy and medicine
- bioChemistry, biophysics, BioStatistics, BioMathematics
- Medical Physics
- Micro Biology AND Molecular bioscience
- neuroscience

- Mathematics
- Statistics
- Datascience
- Advanced computing







Banyak masalah nyata di dunia ini yang butuh analisa menggunakan pikiran logis dan aturan yang sistematis dan terukur untuk mendapatkan solusi yang terbaik/optimal (tepat, cepat, efisien).

COMPUTING



di masa lalu, seorang matematikawan bernama Alan turing membuat mesin matematis untuk memecahkan sandi german. Akhirnya blok sekutu memenangkan perang dunia

RESEARCH OPERATION --OPTIMIZATION



Kemacetan– Bagaimana mencari solusi optimal dalam bisnis yang mengandalkan sistem transportasi

STATISTICS



Anilis Data, Data Mining, Perancanaan Bisnis dan Forecasting, Biostatistics, Geostatistics





Saham– Manajemen Resiko dari bisnis jasa investasi keuangan, asuransi dll Otoritas Jasa Keuangan (OJK)

APPLIED & MULTIDISCIPLINARY



Bahkan masalah kesehatan dapat diselesaikan dengan matamatika

THE BOOK OF NATURE IS WRITTEN IN THE LANGUAGE OF MATHEMATICS

GALILEO GALILEI (1600)

History of Bioinformatics



Module detection

What does mathematics contribute to bioinformatics?

WINFRIED JUST DEPARTMENT OF MATHEMATICS OHIO UNIVERSITY

A new microscope and a new physics

In 2004 PLoS Biology published a paper by Joel E. Cohen

Mathematics Is Biology's Next Microscope, Only Better; Biology Is Mathematics' Next Physics, Only Better.

Really? How does this new microscope differ from the traditional ones? How to use it? Why did mathematicians become seriously interested in biology? And how is all this related to bioinformatics?

Mathematics and mathematicians

- 1. Mathematics is a great language for elucidating the common structure in apparently unrelated problems.
- 2. Mathematicians have a tendency to talk about complicated theories in their jargon instead of giving simple and concrete answers.
- 3. "Mathematical microscopes" often don't come with a simple user's manual. In order to successfully use them, one needs to understand to some extent how they work. The choice of the most appropriate "mathematical microscope" for a given biological problem often requires active cooperation between mathematicians and biologists.
- 4. The key to success in this type of cooperation is finding a common language and mutual understanding of and respect for the two different intellectual approaches.
- 5. Mathematical models form the basis for formulating hypotheses, often in the form of probabilities.
- 6. The final interpretation of these hypotheses and their experimental verification belongs to the biologists. Thus "mathematical microscopes" will not make the more traditional ones redundant.

In points 3-6, feel free to substitute "bioinformatics" for "mathematics."

Biomathematics vs. bioinformatics

Everything that has been said so far about "biomathematics" could also be said about "bioinformatics."

What is the difference between the two areas? *Biomathematics:* Applications of mathematics to biology. *Bioinformatics:* The design, implementation, and use of computer algorithms to draw inferences from massive sets of biomolecular data. It is an interdisciplinary field that draws on knowledge from biology, biochemistry, statistics, mathematics, and computer science.

More empirical observations

- NSF and NIH recently started to invest heavily in biomathematics.
- In 2002 the Mathematical Biosciences Institute (MBI, located at OSU) was founded; this is the first and so far only NSF institute dedicated exclusively to applications of mathematics in one other area.
- Several other new research institutes in biomathematics are supported from public or private sources.
- A number of new journals specializing in biomathematics got started.
- The job market for biomathematicians is currently rather favorable, both in academia and industry, especially in the pharmaceutical industry.

What is behind this trend?

And why do we observe this trend **now**, instead of 30 years ago or 30 years from now? There are two main reasons:

- 1. Contemporary biology generate a huge mountains of data. Drawing biologically meaningful inferences from these data requires analysis in the framework of good mathematical models. Hence mathematics has become a necessary tool for biology.
- 2. Currently available computer power allows us to investigate sufficiently detailed mathematical models to draw biologically realistic inferences. Thus mathematics has become a useful tool for biology.

"Big Data" is a relative term!

This is what a 5MB hard drive looked like in 1956



This is what a 5 TB (1 million times more) looks like in 2016



http://goo.gl/f1PkV

Bioinformatics on Big Data - Module 1

bioinformatics.ca



1599



on



Where are the genes?

Let us look, for example, at our own genome. The information about it is written in Genbank as a sequence $\pi \cdot 10^9$ liter that would fill a million of tightly typed pages, the equivalent of several thousand novels:

...actggtacctgtatatggacgctccatatttaatgcgcgatgcaggatctaaa...

Less than 1.5% of this sequence codes proteins. How to find these genes?

No human can read the whole sequence. A computer can read it easily, in a few seconds. So, maybe the computer will tell us where the genes are, where they start, and where they end.

But what is the computer supposed to compute???

Central dogma in molecular biology





Matematika/Statistika UI Jaman Now:

Bioinformatika Data Science Aktuaria Kombinatorik, Teori Graf dan Information Security

Studi Kasus

Beberapa Contoh Penelitian Bioinformatika di Matematika UI

Deep Learning in Data Science

Indonesia Kekurangan Aktuaris

Thank you



FAKULTAS MATEMATIKA DAN ILMU PENGETAHUAN ALAM

PENELITIAN KOMPUTASI BERKINERJA TINGGI UNTUK BIOINFORMATIKA DI FMIPA, UNIVERSITAS INDONESIA

ALHADI BUSTAMAM, S.Si., M.Kom., Ph.D.

Senin, 27 November 2017

Universitas Andalas

Padang

Roadmap Penelitian





Source: Performance Evaluation of Fast Smith-Waterman Algorithm for Sequence Database Searches using CUDA GPU-Based Parallel Computing. A Bustamam, G Ardaneswari, H Tasman, D Lestari Published in Journal of Next Generation Information Technology, 2014

Query Sequence	Query Sequence Length	Runtime (s)			
		Sequential Program	Parallel Program	Speed-up	Efficiency
Q6GZW1	119	1207,89	3,986	303,03	0,90
Q6GZW8	128	1261,47	4,079	309,26	0,92
Q6GZW5	137	1312,88	4,250	308,91	0,91
Q197D0	144	1389,45	4,259	326,24	0,97
Q6GZU1	153	1431,04	4,479	319,49	0,95
	Av	313,39	0,93		

Table 2. Speed-up and Efficiency of CUDA GPU-Based Implementations of Smith-Waterman Algorithm

The parallelization using combination of both models achieves an average speed-up of 313×

Source: Application of Hierarchical Clustering Ordered Partitioning and Collapsing Hybrid in Ebola Virus Phylogenetic Analysis. H Muradi, A Bustamam, D Lestari Published in ICACSIS - IEEE Proceeding, 2015

In our implementation, we applied global alignment process and used the combination of HOPACH-PAM clustering using the R open source programming tool.

In our results, we obtained maximum genetic distance is 0.6153407; meanwhile the minimum genetic distance is 0.

Furthermore, genetic distance matrix can be used as a basis for sequences clustering and phylogenetic analysis.

In our HOPACH-PAM clustering results, we obtained 10 main clusters with MSS value is 0.8873843. Ebola virus clusters can be identified by species and virus epidemic year.

Source: Clustering protein-protein interaction network of TP53 tumor suppressor protein using Markov clustering algorithm. TS Permata, A Bustamam Published in ICACSIS - IEEE Proceeding, 2015



Fig. 1. Protein-protein interaction (PPI) network of TP53 included 104 proteins and 477 protein interactions [20].

Source: Detection of Alzheimer's disease using advanced local binary pattern from hippocampus and whole brain of MR images. D Sarwinda, A Bustamam Published in IJCNN - IEEE Proceedings, 2016



Fig 2. Comparison of ALBP with different approach LBP for multiclass classification (Note: ALBPS-TOP: Advanced Local Binary pattern sign for three orthogonal planes; ALBPSM: Advanced local Binary pattern sign and magnitude) Source: Application of Quaternion in improving the quality of global sequence alignment scores for an ambiguous sequence target in Streptococcus pneumoniae DNA. D Lestari, A Bustamam, T Novianti, G Ardaneswari Published in ISCPMS - AIP Conference Proceedings, 2017

No.	Symbol	Meaning	Information	Quaternion form
1	0	There is no base	There is no base	(0,0,0,0)
2	Α	Α	Adenine	(1,0,0,0)
3	Т	Т	Thymine	(0,1,0,0)
4	G	G	Guanine	(0,0,1,0)
5	С	С	Cytosine	(0,0,0,1)
6	W	A or T	2 h bonding weak interaction	(1/2, 1/2, 0, 0)
7	R	A or G	purine	(1/2, 0, 1/2, 0)
8	Μ	A or C	Amino	(1/2, 0, 0, 1/2)
9	K	G or T	Keto	(0, 1/2, 1/2, 0)
10	Y	C or T	Pyrimidines	(0, 1/2, 0, 1/2)
11	S	C or G	3 h bond strong interaction	(0, 0, 1/2, 1/2)
12	D	A, G or T, not C	D after C in the alphabet	(1/3, 1/3, 1/3, 0)
13	Н	A, C or T, not G	H after G in the alphabet	(1/3, 1/3, 0, 1/3)
14	V	A, C or G, not T	V after U in the alphabet	(1/3, 0.1/3, 1/3)
15	В	C, G or T, not A	B after A in the alphabet	(0, 1/3, 1/3, 1/3)
16	N	Any base	Any base	(1/4, 1/4, 1/4, 1/4)

TABLE 1. Quaternion representation for the sixteen DNA base code

Source: Fundus Image Texture Features Analysis in Diabetic Retinopathy Diagnosis . D. Sarwinda, A. Bustamam , A. M. Arymurthy will be presented to International Conference on Sensing Technology - Sydney, 2017



Fig 1. Image sample of stage in DR [16]

Source: Implementation of CUDA GPU-Based Parallel Computing on K-Means Algorithm for Two-Phase Method Biclustering in Diabetic Retinopathy Gene Expression Data G. Ardaneswari, A. Bustamam, T. Siswantining Under review in AIP Conference Proceedings, 2017

Percobaan Running Time Sekuensial Running Time Paralel Speed-up (detik) (detik) ke-25,83270.7597 $34\times$ 29,72510.8742 $34\times$ $\mathbf{2}$ 25.62210.7321 $35\times$ 3 25,56960.7991 $32\times$ 25.07590.7375 $34\times$ 5 $34\times$ 26.35410.77516 26,20960.7708 $34\times$ 27.00130.8182 $33\times$ 8 $34\times$ 25,97610.76409 1026,64420.7401 $36 \times$ Rata-rata 26,4011 0,7771 $34 \times$

TABLE 3. Running Time by using Serial and Parallel K-Means

Source: Classification of Diabetic Retinopathy Through Texture Features Analysis B. Abdillah, A. Bustamam, D. Sarwinda Under review in AIP Conference Proceedings, 2017

In this research, we implemented global classification and local classification. This flowchart describes for local classification, that is classify the image into four classes, phase 0 as normal, phase 1 as mild, phase 2 as medium, and phase 3 as severe in diabetic retinopathy. Global detection only classifies images into two classes, phase 0 for normal and phase 1 for abnormal.



TERIMA KASIH

Matematika/Statistika Jaman Now: Indonesia Kekurangan Aktuaris



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PressReader - Jawa Pos - Industri Asuransi Krisis Aktuaris www.pressreader.com/indonesia/jawa-pos/.../TextVie... - Terjemahke koco iki Mar 18, 2015 - Saat ini Indonesia boleh dibilang darurat aktuaris, terutama menjelang berlangsungnya Masyarakat Ekonomi ASEAN (MEA). " Supply sangat ...

KRISIS PROFESI AKTUARIS - Bisnis.com finansial.bisnis.com/.../krisis-profesi-aktuaris-kerja-s... • Terjemahke koco iki Aug 31, 2014 - KRISIS PROFESI AKTUARIS: Kerja Sama Dengan Perguruan Tinggi Jadi ... Persatuan Aktuaris Indonesia (PAI) telah menggandeng lima ...

Indonesia Krisis Aktuaris | Beritasatu.com

Industri Asuransi Krisis Ahli Aktuaris | Neraca.co.id www.neraca.co.id/.../Industri-Asuransi-Krisis-Ahli-... Terjemahke koco iki Aug 21, 2013 - Namun sayangnya jumlah aktuaris di Indonesia masih minim. "Bahkan kebutuhan sebetulnya bisa mencapai ribuan. Dan sejauh ini hanya ada ...

Indonesia Sangat Kekurangan Aktuaris - Majalah SWA Online swa.co.id > Business Strategy Terjemahke koco iki Jul 10, 2013 - Minimnya tenaga aktuaris ini cukup mengherankan, sebab gaji seorang ... Krisis Ekonomi, Pelajaran Berharga untuk Indonesia · Desa Wisata ...

Tingkatkan Peran Statistik dan Aktuaria untuk Merevitalisasi ... www.ojk.go.id/tingkatkan-peran-statistik-dan-aktuar... Terjemahke koco iki Feb 20, 2015 - "Tantangan pertama yang harus kita sikapi bersama adalah masih rendahnya tingkat penetrasi asuransi dan dana pensiun Indonesia,, ...

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Actuary

From Wikipedia, the free encyclopedia

An **actuary** is a business professional who deals with the financial impact of risk and uncertainty. Actuaries provide assessments of financial security systems, with a focus on their complexity, their mathematics, and their mechanisms (Trowbridge 1989, p. 7). The name of the corresponding profession is actuarial science.

Actuaries mathematically evaluate the probability of events and quantify the contingent outcomes in order to minimize the impacts of financial losses associated with uncertain, undesirable events. Since many events, such as death, cannot be avoided, it is helpful to take measures to minimize their financial impact when they occur. These risks can affect both sides of the balance sheet, and require asset management, liability management, and valuation skills. Analytical skills, business knowledge, and understanding of human behavior and the vagaries of information systems are required to design and manage programs that control risk (BeAnActuary 2005a).

The profession has consistently ranked as one of the most desirable in various studies over the years. In 2006, a study by U.S. News & World Report included actuaries among the 25 Best Professions that it expects will be in great demand in the future (Nemko 2006). A study published by job search website CareerCast ranked actuary relative to other jobs in the United States as number 1 in 2010 (Needleman 2010), number 2 in 2012 (Thomas 2012), and number 1 in 2013 (Weber 2013). The study used five key criteria to rank jobs: environment, income, employment outlook, physical demands, and stress.



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Carole Bernard receives Professional Risk Managers International Association (PRMIA) award »

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- Current undergraduate students
- Current graduate students

Welcome to the Department of Statistics and Actuarial Science

The Department of Statistics and Actuarial Science is among the top academic units for statistical and actuarial science in the world and is

Meet our people



»

Aktuaris Itu Profesi Menjanjikan

Kamis, 25 September 2014 - 20:02 wib



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Thank you