



EON

Epitome of Nature



**TS DR
NOR'AISHAH
HASAN**

SRIKANDI TEKNOLOGI

**OMEGA-3
PERANAN IKAN**

**MAKMAL
MEGA
PERANAN DALAM
BIOLOGI MOLEKUL**

**CANVA
MAKMAL
KOMPUTER MAYA?**

**TEKNOLOGI
PLASTIK
APAKAH KESANNYA?**

**RISK
MANAGEMENT IN
MICROBIOLOGY
LABORATORY**

**KENALI PENYAKIT
IKAN DALAM
MAKMAL**

**PLOGGING:
A NEW TREND IN
ENVIRONMENT?**

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Makalah Akademia

COMPUTATIONAL BIOLOGY: WHERE NATURE MEETS TECHNOLOGY

By

TS FAKAH BINTI AWANG @ ISMAIL¹
AND TS MOHAMAD SHAHRIMI
BIN HASHIM²

¹Pusat Pengajian Biologi, UiTM Cawangan
Negeri Sembilan, Kampus Kuala Pilah,
Pekan Parit Tinggi, 72000 Kuala Pilah,
Negeri Sembilan

²Pusat Pengajian Teknologi Industri, UiTI
Cawangan Negeri Sembilan, Kampus
Kuala Pilah, Pekan Parit Tinggi, 72000
Kuala Pilah, Negeri Sembilan

faikah7450@uitm.edu.my

EDITOR: DR NURHAMIMAH ZAINAL ABIDIN

It all began in the early 1970s when basic artificial intelligence was developed to create the neural network model for the human brain to generate new algorithms. Data that are being gathered helps the researchers to evaluate and compare the large data set to predict the variable in human brain function. The best use of computational biology began in 1990 known as the "Human Genome Project" and by 2003, the project had mapped around 85% of the human genome. This becomes the main big data analysis to predict human evolution. This is very important as it helps to gather the information for genetic therapy, especially for a disease that is classified as hereditary diseases such as neurological disease and cancer.

The main applications for Computational Biology are Computational Anatomy, Data and Modelling, Systems Biology, Evolutionary Biology, Computational Genomics, Computational Neuroscience, Computational Pharmacology and many more.

Computational anatomy is the study of anatomical shape and form of the visible or gross anatomical structure. It involves the development of a computational mathematical and data-analytical method for modelling and simulating biological structures. It focuses on the anatomical structure that is being imaged and it becomes the subfield of medical imaging and bioengineering for extraction of the anatomical structure and making it feasible to be viewed in 3D images.

As we know biology is a study of nature and before computer analysis become a norm, most of the data gathered were analysed manually and needed to be carefully organized to ensure the quality of the data and the reporting process are less tedious. Nowadays, with the technology of artificial intelligence and supercomputer, data gathering, analysis and reporting become more manageable and accessible for benefit of humankind. The field of study that specializes in those data analysis was known as Computational Biology. Computational Biology is where the intersection of computer science, biology, chemistry, genetics, and big data analysis.

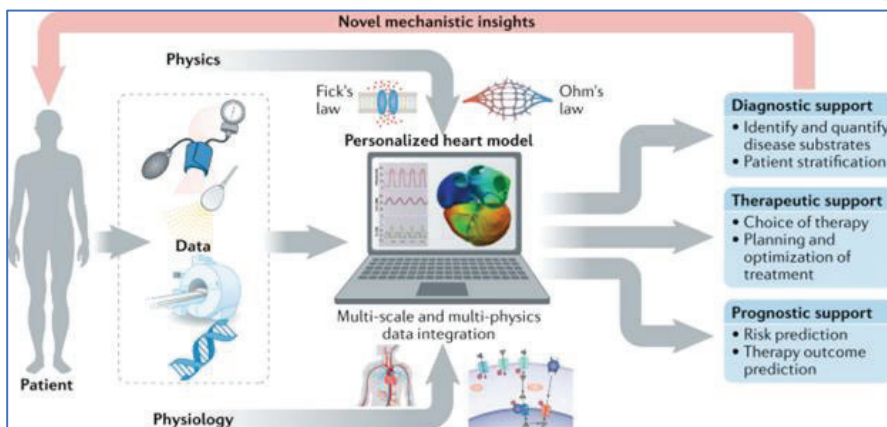


Figure 1. Example of application of Computational Biology to an understanding of the nature of a disease.

Source: <https://www.scienceopen.com/computational-biology-development-in-the-field-of-medicine>

Evolutionary Biology is the field where computational algorithms are used to reconstruct the tree of life using DNA data, known as computational phylogenetics. It is used to fit the population genetics models to DNA data to make it suitable for demographic or selective evolution.

Population genetics will help the researchers to understand and predict the likelihood of evolution to occur according to the change in the environment.

Data and Modelling are where mathematical biology was used to create a model of living organisms to examine the systems that govern the structure, development, and behaviour in the biological system. This approach helps to create databases and data management methods including data storing, retrieving, and data analysis which usually known as bioinformatics. Data mining become a growing research field with the increasing size and quality of the dataset, and it works together with computational biomodelling as the data set from data mining will be used to build up visual simulations in the biological systems. This allows the researcher to predict the outcomes gather from different environments thus it will enable certain corrective or preventive measures to take place.

System Biology consists of computing the interaction between various systems ranging from the cellular level to an entire diversity and population. It involves the biological modelling of cell signalling and metabolic pathway as this field studies these interactions via dynamical systems in molecular biology.

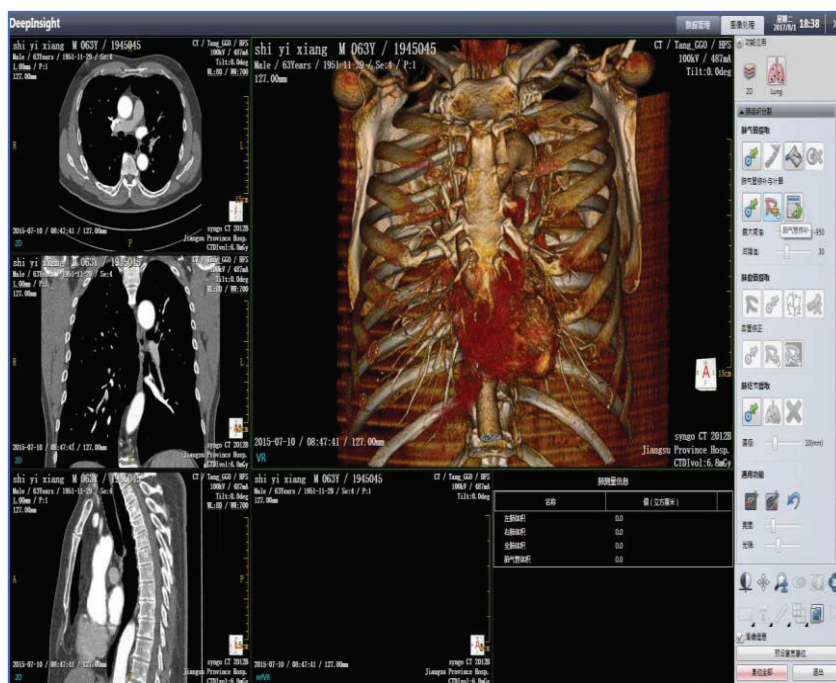


Figure 2. 3D images of a lung using the Computational Anatomy algorithm.

Source: <http://www.cvnis.net/caimi/indexenglish.html>

Computational Genomics is the study of the genomes of cells and organisms and their related data including both DNA and RNA sequences. When combined with statistical approaches, it helps to produce the data set that focus on using whole genomes to understand the principles of how DNA of a species controls its biology at the molecular level and beyond.

The Human Genome project is an example of Computational Genomics which helps medical professionals with personalized medicine, prescribing treatment based on an individual's gene.

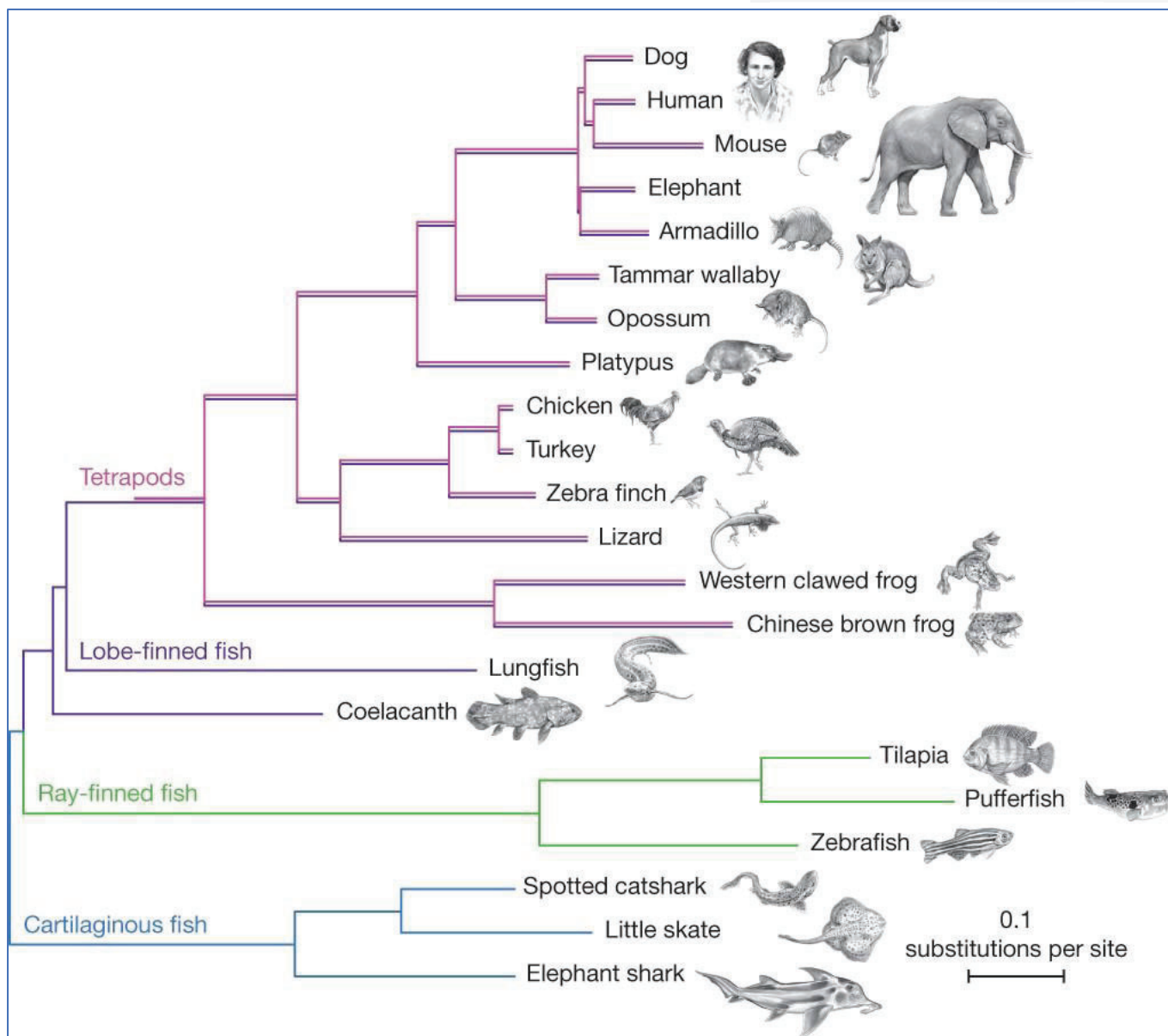


Figure 3. Phylogenetic tree for the evolutionary history of a tetrapod.

Source: <https://plato.stanford.edu/entries/phylogenetic-inference/>

Computational neuroscience is the study of brain function in the nervous system. There are two types of brain models that are normally used which is Realistic Brain Models and Simplifying Brain Models. The Realistic Brain Models provide the most information about the brain, however, it did not take an account the cellular structure of the brain, it is more expensive and required a long time for data processing. Meanwhile Simplifying Brain Models is focus on a specific physical property of the neurological system and it reduces the time and cost for image processing, however, it cannot provide a detailed image of the structure of the brain. Computational Pharmacology is the study of the effect of genomic data to find links between specific genes and diseases as they react toward drugs administered under study.

Here the pharmacologist can use the data collected to predict and prescribe the drug that is customized to the need of their patients. In the future, it will help the pharmacist to design a drug that has a lower percentage of side effects and reduce the cost due to drug resistance. As more we discover about the nature of the world around us, more important questions will arise, thus the need for multidisciplinary experts across all disciplines becomes more vital. Biology is a study of life and we need all the disciplines to help us understand life