
ICUMS Careers 101

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Computational Biology

Fu Xiang Quah (slides available on fxquah.com)

My Background

- A-Level in Biology, Chemistry & Math (2012-2013)
 - BSc Biotechnology, Imperial College (2013-2016)
 - MPhil in Computational Biology, Cambridge (2016-2017)
 - Research Assistant in Bioinformatics (2017-2018)
 - MRes + PhD in Wellcome Trust Mathematical Genomics and Medicine, Cambridge (2018-current)
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Definition (from Wikipedia)

Computational biology: the science of using biological data to develop algorithms/models to understand biological processes.

Bioinformatics: development of computational methods to understand biological data.

Involves coding, math and computer science.

Overview: computational biology

- Mainly a **data** driven science: with various types of data: DNA and protein sequences, expression data, images (microscopy/medical), 3D structures, etc.
 - Increasing opportunities to develop novel computational **methods**. These are more important than one may think!
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Research areas and fields

- Population genomics: how do germs spread?
- Cancer computational biology: many genes are mutated in cancer, which are important ones?
- Computational neuroscience: model the brain?
- Computational pharmacology: design better drugs using machine learning and modelling?

And many more...

Who is it for?

- Lovers of biology.
 - Wish to try something outside the lab.
 - And acquire transferable coding skills.
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What to do next?

CONSIDER AN INTERNSHIP/PLACEMENT/JOB/MASTERS

- Can be in academic or industry.
 - Email your favourite supervisor in your field of biology.
 - Some companies offer graduate training programmes. Or you can do a Masters (these tend to be broad).
 - Doesn't even need to be biology. Many startups do machine learning --- useful insight into coding.
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What to do next?

DO LEARN CODING AND MATH

- Textbooks are very underrated, especially for math. Can be expensive --- borrow them from a library.
 - Online courses can be useful, to learn coding.
 - Reading list and links at the end of presentation.
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What to do next?

YOU COULD (BUT DO NOT NEED TO) DO A PHD

- Fees in the UK (and US) are very expensive for internationals. But do consider Europe.
 - Aim for structured 1+3 programmes, which cover all living expenses and university fees.
 - Deadlines are early (around November-December a year in advance, for October entry).
 - You can apply directly to supervisor, but chances of full funding might vary.
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More information

Wikipedia has a throughout explanation about what computational biology is. Worth reading if you wish to know more than I can cover today:

https://en.wikipedia.org/wiki/Computational_biology

Useful links

- The EMBL-EBI website has a useful online training [section](#), featuring introductory courses like [this](#).
 - For genomics research, [list](#) of companies at the Wellcome campus at Hinxton, Cambridgeshire. Includes the [Sanger Institute](#) and [EBI](#) (both offer PhDs).
 - PhD programmes at [Cambridge](#), [Oxford](#) and [Imperial](#).
 - [AstroZeneca](#) is a biopharmaceutical company, offering graduate programme on [AI/data science](#) and [internships](#).
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Useful skills/courses/modules

Coding: R, Python, Julia, version control with **GitHub**

Math: **Statistics, Probability, Linear Algebra**, Differential Equations, Numerical Analysis

Computer Science: **Algorithms**, Databases, Complexity

Many fields (incl. outside computational biology) often have **machine learning, Bayesian inference** and **Markov chains**, which rely on strong math foundation.

Books

Bioinformatics Algorithms: An Active Learning Approach

Pavel A. Pevzner and Phillip Compeau

R for Data Science (also available [online](#))

Garrett Grolemund and Hadlet Wickham

Python Programming for Biology

Tim J. Stevens and Wayne Boucher

Books

Biological Sequence Analysis

Richard Durbin, Sean Eddy, Anders Krogh and Graeme Mitchison

Understanding Probability

Henk Tijms

Thank you

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