

# Computational approaches to virus evolution

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# Agenda

- You're stuck with me for 4 hours!
  - Who are you, where are you going?
1. Mapping virus evolution via antigenic cartography
  2. Thinking about programming
  3. Digging up ancient viruses
  4. Thinking about thinking

# Programming

- How many of you know how to program already?
- Who anticipates being in a situation where it would help?
- Can you cook spaghetti, make a salad, a sandwich, fruit salad, or follow a recipe? Is there a recipe book at home?
- Programming is not hard! It's just everyday common-sense thinking (that you may not realise you do), plus weird details.
- Learning to think carefully: how would I solve this problem without a computer?

# Programming

- If you can program you have a super-power. If you can't, you're really disadvantaged.
- It's a super-power because it's a tool to make tools.
- What happens when a non-programmer can't solve something in (e.g.) Excel?
- Let's look at thing just over the horizon of what you can do manually. Things that are very hard, error prone, and time-consuming by hand but easy & fast with a little code.

# Attitude

- Be fearless.
- Ask a million questions.
- Use the fact that you know nothing - it's an advantage!
- Don't think it's too much or too hard. It's not! Really.
- Don't be put off by the "culture".
- Programs start small, to scratch an itch, then grow.
- I look things up all the time!

# What to do

- Sign up to learn Python or R online.
- Download or buy a book.
- Pair up with someone and learn together.
- Don't go out for that extra beer. Skip Netflix and social media. Do something more useful. Don't be passive!
- Write a tiny program: make a graph, read an Excel or FASTA file. Example: gene status figure.

# Thinking about thinking

- Everything is probably (in part) wrong!
- Just look at the history of science
- Set your default view accordingly. Question dogma!
- *We must* build models - but how?
- Doing science with a computer?
- Be *very* skeptical!!!

# What about virology?

- It's like the wild West.
- Much of our knowledge is very recent, even the old things.
- Is the evolutionary pattern really tree-like?
- HGT, recombination, reassortment.
- Is there any such thing as “the” virus (for an RNA virus)?
- Viruses are always smaller than bacteria? What's even smaller?
- Interaction with bacteria (e.g., CRISPR).



# What about virology?

- Dark matter.
- Metagenomics.
- Algorithms can be wrong - e.g., substitution rates.
- Newly discovered small DNA viruses? Non-pathogenic viruses?
- Antigenic cartography does something radically different.
- Ancient viruses.
- Much remains unknown (i.e., to be discovered).