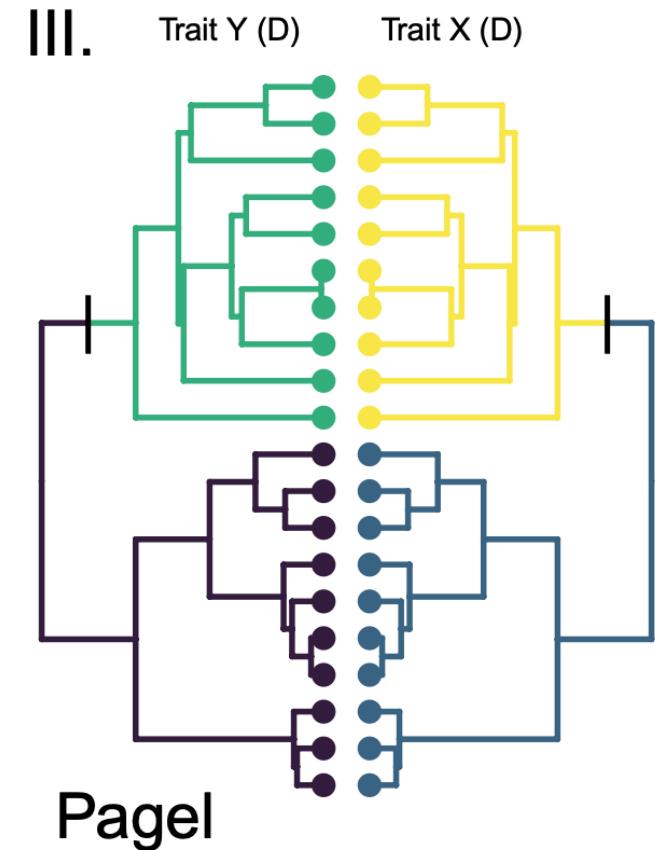
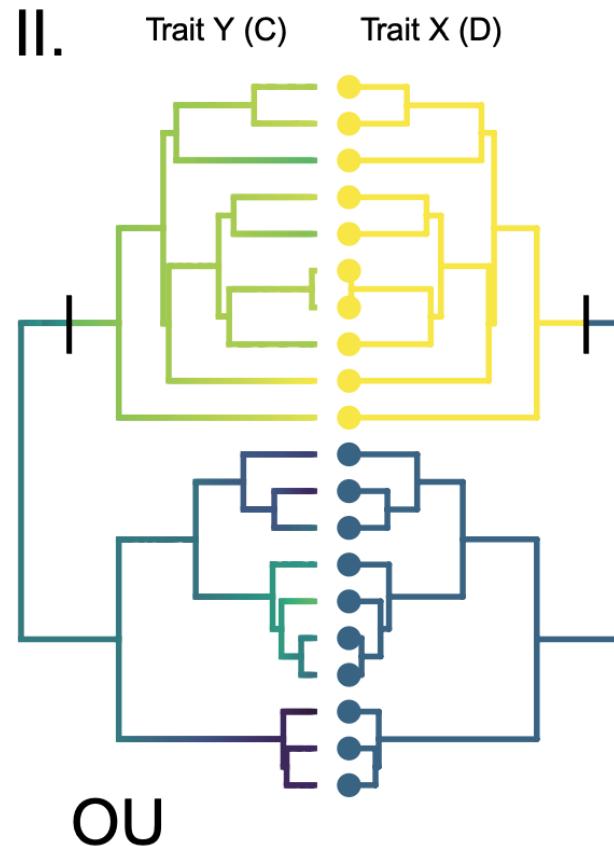


BIO 508 - Evolution and Biodiversity

Dr. Rosana Zenil-Ferguson

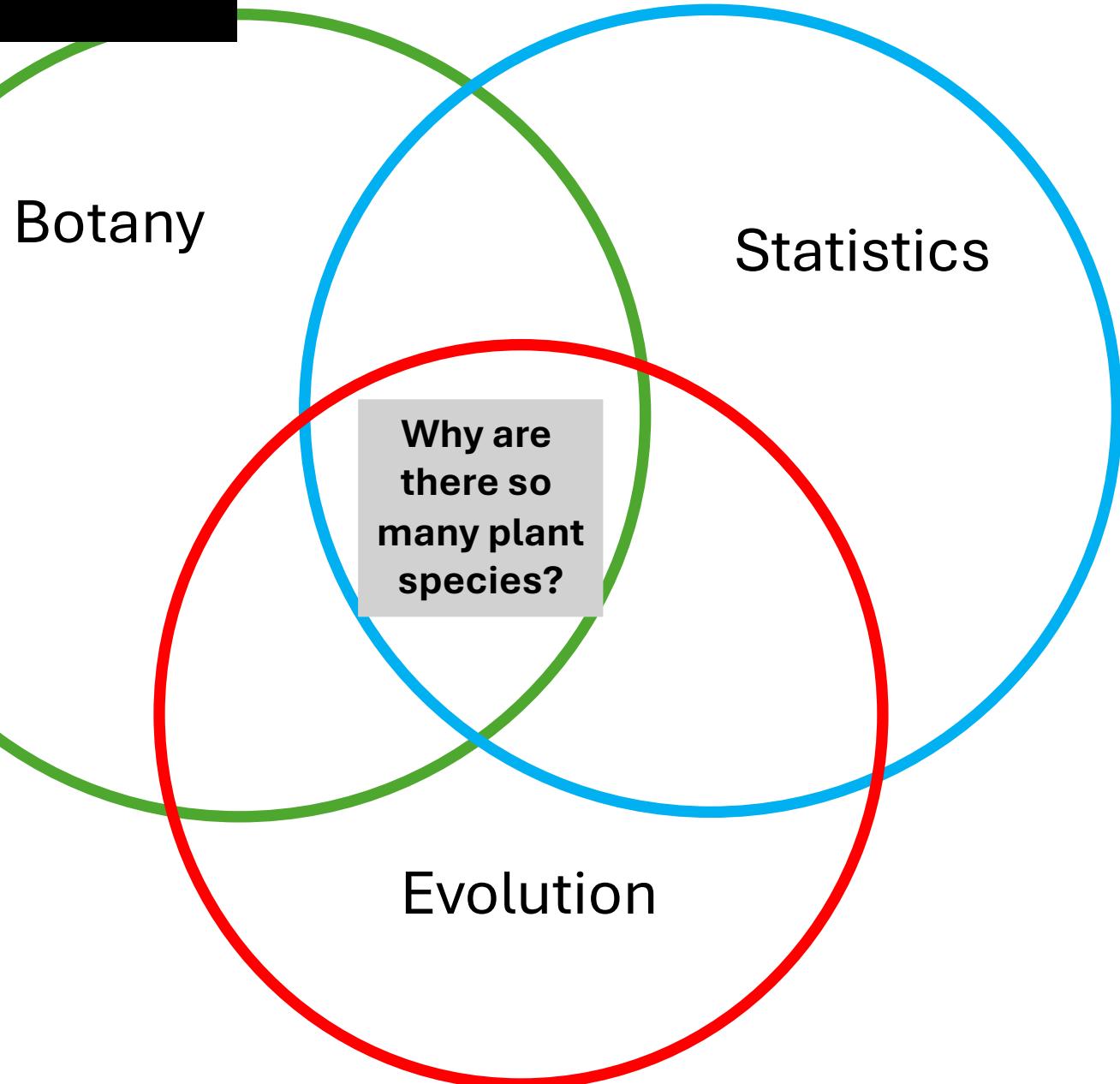
Welcome to BIO 508

- This is a three-credit course for advanced undergraduate and graduate students
- How traits evolve in the tree of life
- Phylogenetic comparative methods



The Zenil-Ferguson Lab

I prefer being called
Dr. Rosana or Dr. Z!



More than
400,000 vascular
plant species are
the result of
speciation and
extinction



Plant photography: RZF and Carrie Tribble



Office Hours

Dr. Rosana

- Wednesdays 2:30-3:30 in the Biology Learning Center (JSB 143)
- By appointment roszenil@uky.edu



Weekly work and all materials



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 - c [Final report \(max 7 pages\)](#)

<https://roszenil.github.io/BIO508-Evolution/about/>

Learning Outcomes

01

Understand how phylogenetic trees are built.

02

Develop basic computer skills to manipulate phylogenetic trees and traits.

03

Become familiar with the primary literature of comparative methods.

04

Develop quantitative reasoning to follow methods and results in scientific articles.

05

Infer correlations between traits using a phylogenetic tree as part of the modeling approach.

06

Model traits on a phylogeny and perform ancestral state estimation.

Grading Scheme

- | | |
|-----|---|
| 30% | Computer practicals |
| 20% | Participation and Reading Quiz |
| 20% | Midterm- Modeling plan and descriptive stats |
| 30% | Final report- Full comparative analysis with interpretation |

Grades will follow the standard scale: A = 90-100; B = 80-89.99; C = 70-79.99; D = 60-69.99; E <60.

Computer Practicals

30%

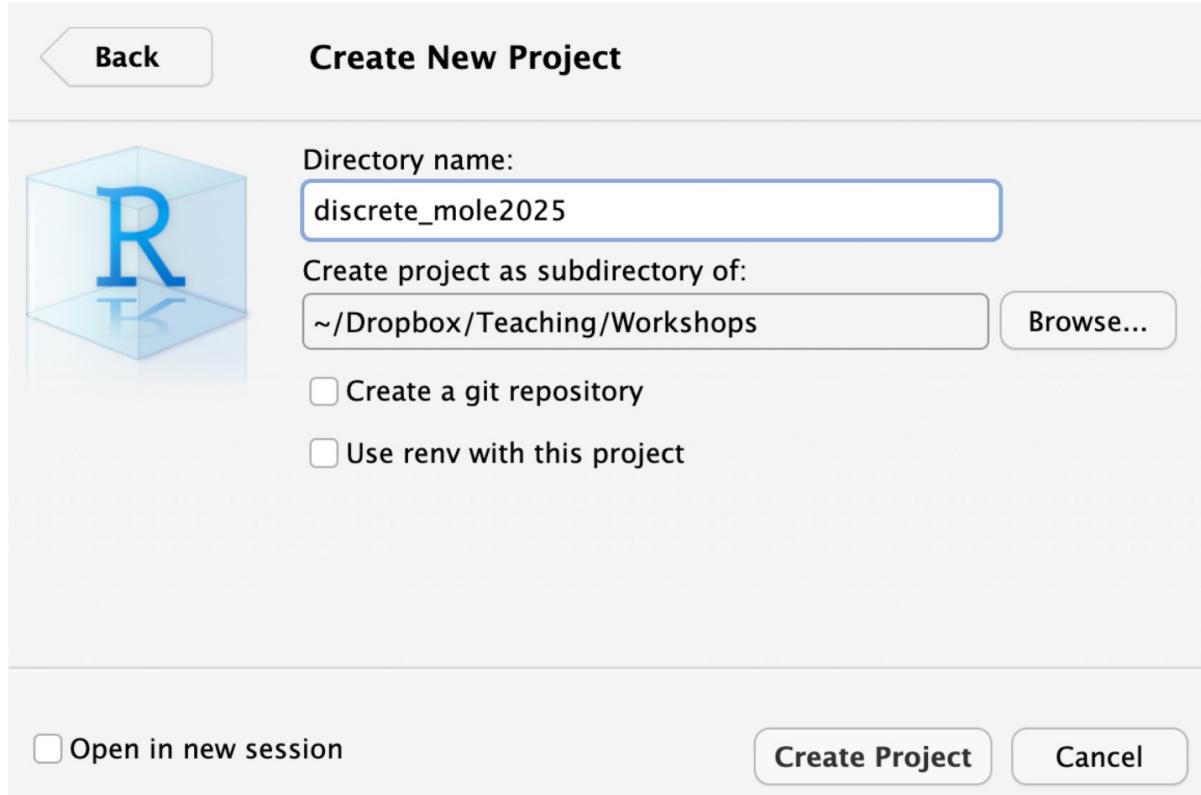
During class and independent work.
Submission through Canvas a week later

Setting up in your computer

There are two options to run smoothly this tutorial

Option 1

- 1 Make sure you have the most up-to-date R and RStudio in your personal computer.
- 2 Make sure you create a project by doing Files > Open new project > New directory > New project
- 3 Name your project something memorable like discrete_mole2025 and save it in a location where it will be safe. See image below



- 4 Download all the files in this tutorial in that exact folder and everything should work smoothly

Participation and Reading Quiz 20%

Warning: Lots of reading!

I will first introduce the topic, then you start the reading one week later a quiz in Canvas

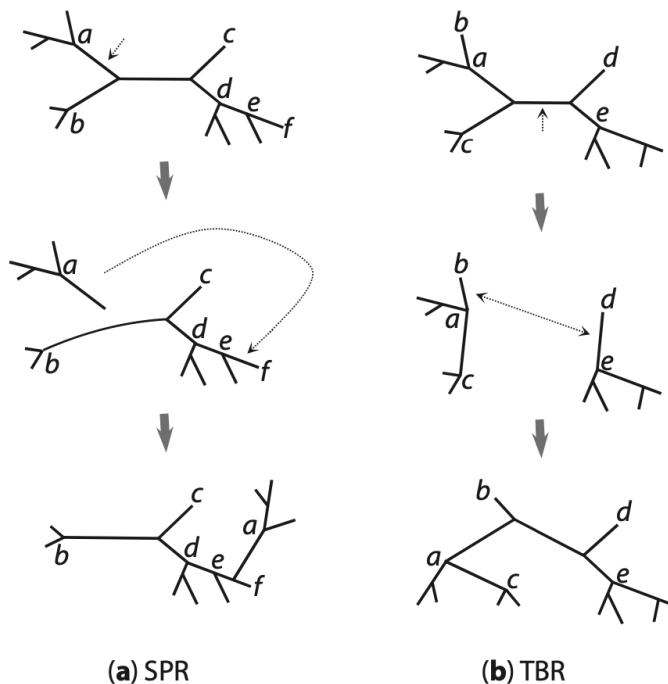


Fig. 3.16 (a) Branch swapping by SPR. A subtree (for example, the one represented by node a) is pruned, and then reattached to a different location on the tree. (b) Branch swapping by TBR. The tree is broken into two subtrees by cutting an internal branch. Two branches, one from each subtree, are then chosen and rejoined to form a new tree.

Midterm

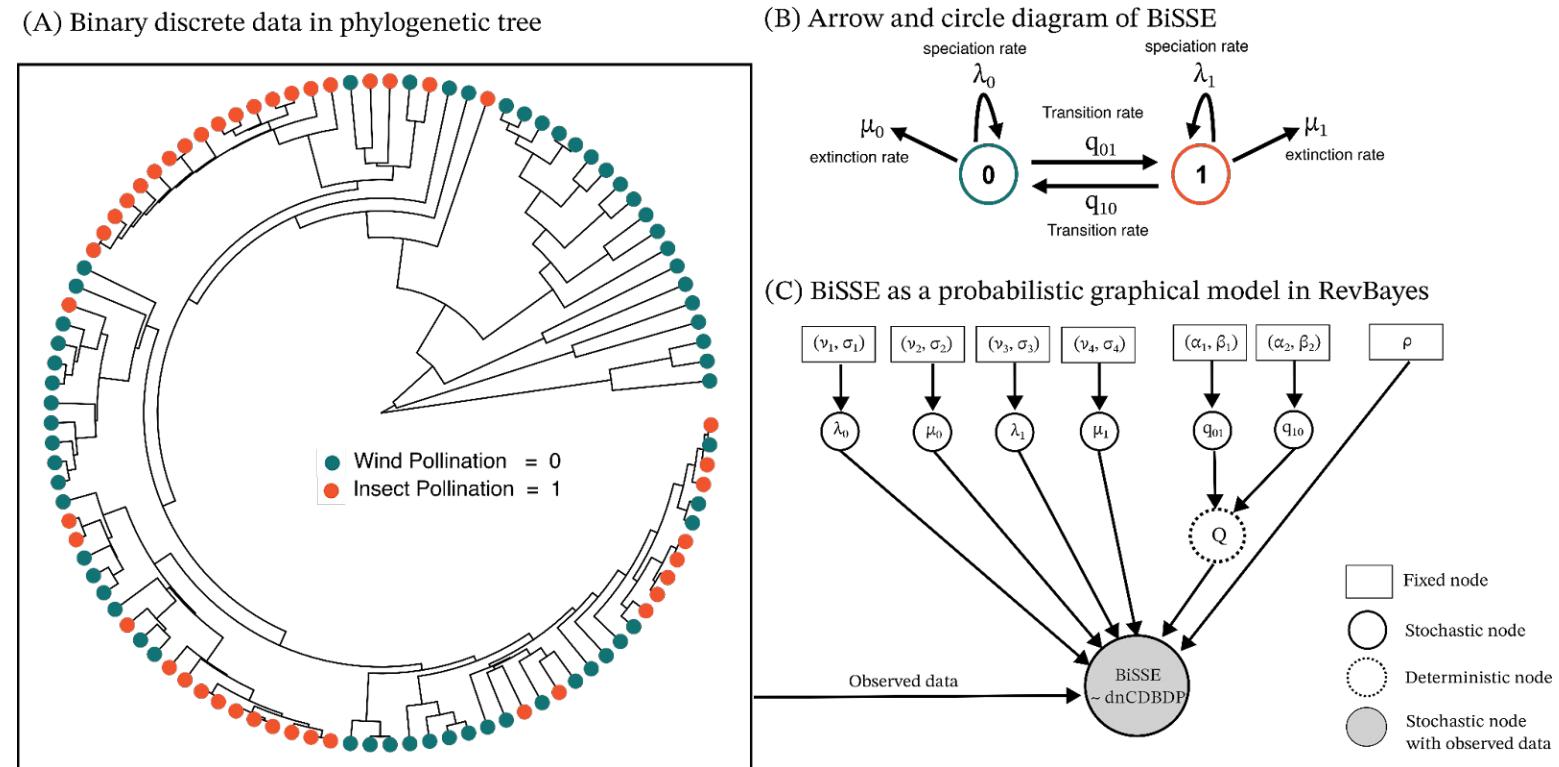
20%

October 16th, 2025

- Maximum 3 pages
- Descriptive statistics of phylogenetic tree and data
- Hypothesis or question
- Plan for analysis

Undergraduate and MSc students
will be provided datasets

PhD students
Find or bring your own



Final

30%

December 18th, 2025

9:00 AM

-
- Maximum 7 pages
 - What you had already written in the midterm +
 - Comparative analysis
 - Interpretation of your results

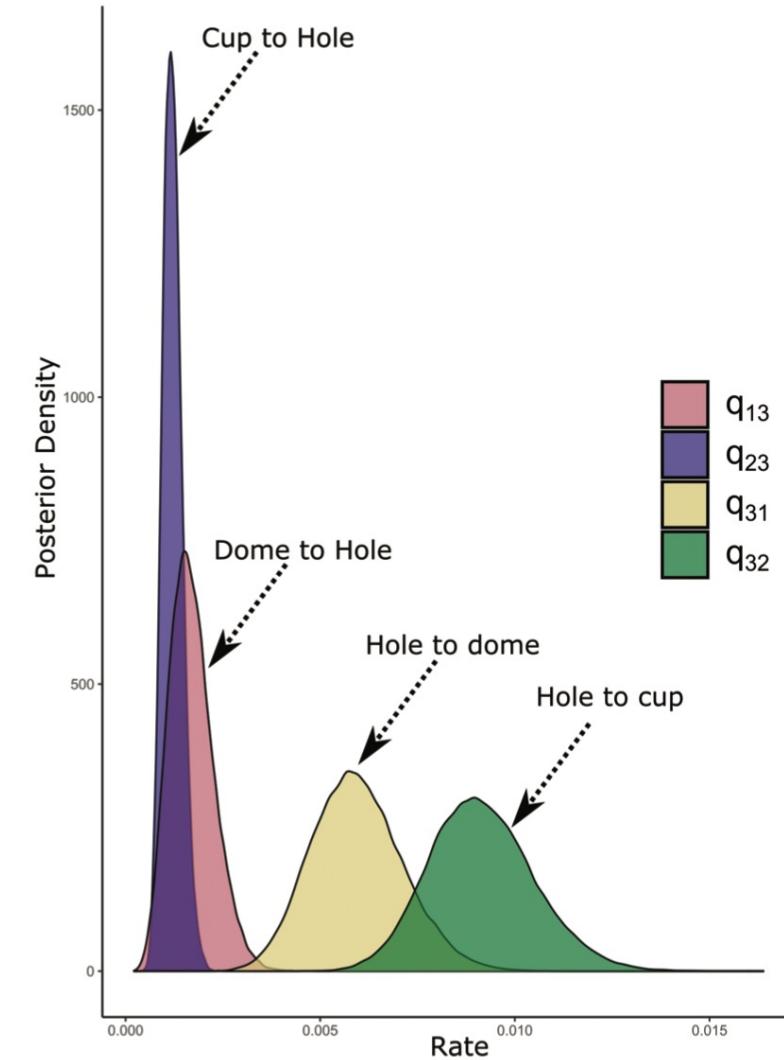


FIGURE 4. Transition rates between nest states for diversification-free models in the model with three states (Mk3). The posterior distribution for the rate from hole to cup is faster than any other rate to and from hole. We found that evolving out of hole is faster than into hole, with hole to cup faster than hole to dome.

Rules for communication

1. Early rather than later. Inform me quickly of an issue **in writing with one week of anticipation**. It is easier for me to get organized and find a solution if you missed part of the class. Of course, for illnesses, notify me as soon as possible. In general, late work should be made up within a week if your absence falls in the categories listed here <https://www.uky.edu/university-absences>. In short, these rules cover: significant illness, the death of family members, UK-sponsored trips, major religious holidays, and interviews for full-time jobs after graduation.
2. Report your issue directly to me or through email roszenil@uky.edu
3. If there is a true emergency, email me at roszenil@uky.edu with the title: EMERGENCY- BIO508!
4. After you report your issue, I will come up with a solution (a make-up when appropriate and justified). Please take the time to read the rules <https://www.uky.edu/universitysenate/excused-absences>.

Other considerations

Early rather than late!

Use of AI and ChatGPT policy

Yes* – simplify or solve coding issues

How do I plot a phylogeny using package ape?

Can you re-write this for loop to make it shorter?

No- Interpretation, critical thinking, substitution of learning

Write a paragraph about the importance of OU models

Interpret this figure

* How ChatGPT fails at the silliest of tasks

how to plot a meme on R

You can plot a meme in R by:

1. Loading an image (the meme base)
2. Overlaying text (the meme caption)
3. Saving the final plot

Here's a minimal example using the `magick` package (great for image manipulation in R).

Example: Adding Text to an Image in R

```
r

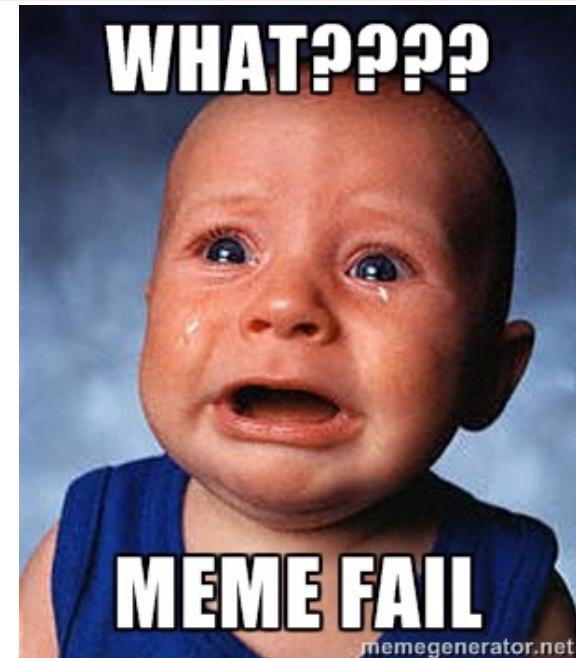
# Install if needed
install.packages("magick")

library(magick)

# Load an image from file or URL
meme <- image_read("https://i.imgur.com/30b1gx.jpg") # Change URL or file path

# Add top text
meme <- image_annotate(meme, "WHEN R CODE WORKS",
                       size = 50, gravity = "north", color = "white", stroke_color = "bla
```

Error in image_annotate(meme, "WHEN R CODE WORKS", size = 50, gravity = "north", :
unused argument (stroke_color = "black")



*How Google search solves it

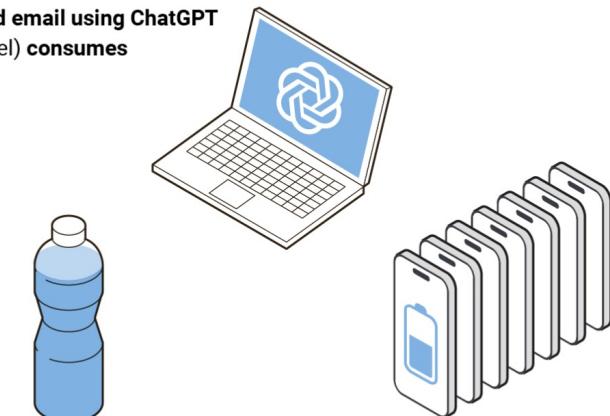
```
install.packages("meme")
font_pokemon()
library(meme)
u <- system.file("ash-pikachu.0.0.jpg", package="meme")
meme(u, "I can google ", "how to code!", font="Pokemon_Hollow", color="yellow")
```



AI water

Tech giants have significantly increased their water needs for cooling data centres due to the escalating demand for AI products

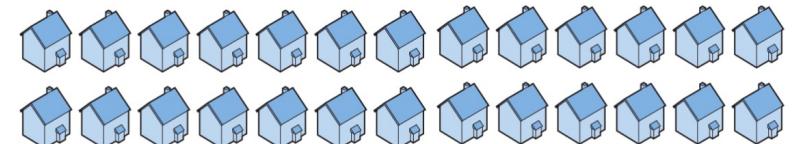
Writing a 100-word email using ChatGPT (GPT-4, latest model) consumes



1 x 500ml bottle
of water

It uses 140Wh of energy,
enough for 7 full charges
of an iPhone Pro Max

Creating GPT-3 (the training part) uses



5.4m litres of water, equivalent to the
annual water usage of 26 UK households
(based on a family of four people)

Other considerations

- I cannot accommodate for unexpected circumstances during the week before finals or after
- Incomplete work without justification will receive a zero grade.
- No late assignments are permitted unless agreed or justified absences
- If you use AI to write your midterm, final, or quizzes you will receive a zero grade
- After 3 missing practicals or reading quizzes, you will receive an E in this class

Have you learned how to drive an F1 car by watching Checo Pérez race?

- If you only listen to lectures and are not actively reading, engaging with content, and making notes you will not learn
- Practice many times the computer tutorials
- Find others in the class who can discuss ideas with you
- Seek for help early!



Getting to know each other

Let's take 5 minutes to get to know each other in our tables:

1. What is your name and how do you prefer we call you?
2. Where is home?
3. Why did you sign up for BIO 508?