MRU COMP 5690
Senior Project

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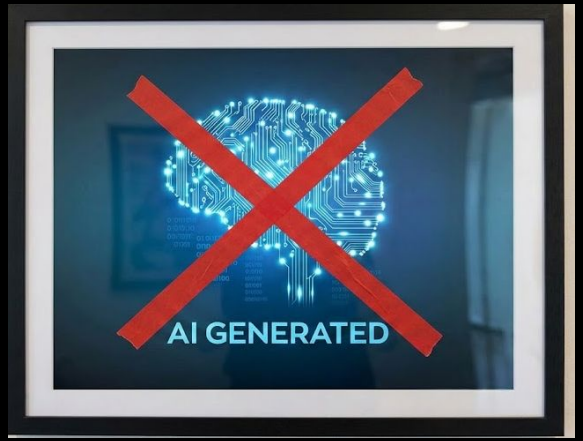
Professor: Charlotte Curtis

Unplanned Project

Originally going to do educational AI project in collaboration with a Social Studies teacher at Bishop Carroll, but decided on a more science based project.



Google. (2025). Google Gemini [Image generator]. https://gemini.google.com/

Plan to share project with one of the science teachers at Bishop Carroll

Motivation

I was looking for a flashcard app to help in knowledge retention for concept heavy biology classes and came across Anki

Screenshot from https://anki.en.softonic.com/download

The desktop version is free, but the mobile version is $34.99…

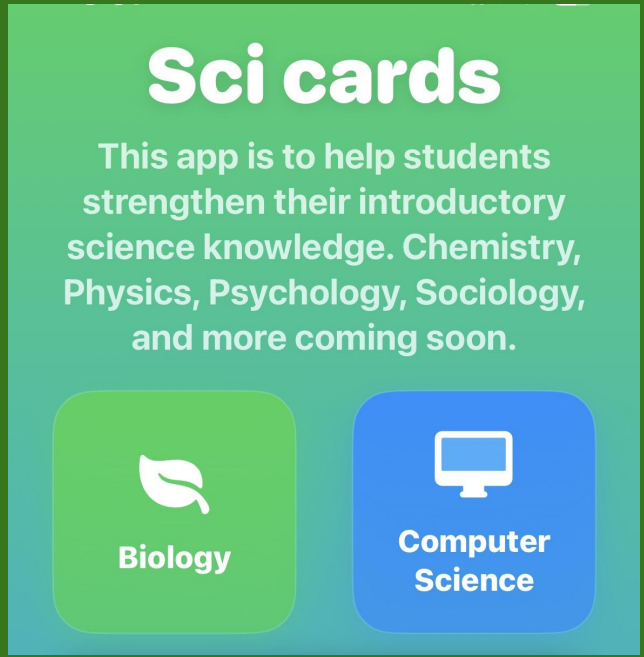
Screenshot from IOS App store

Sci cards MVP

A free open source IOS application that helps students reinforce their 1st year university science knowledge by strengthening active recall using digital flashcards

2 subjects at the moment with 3 more planned for summer 2026.

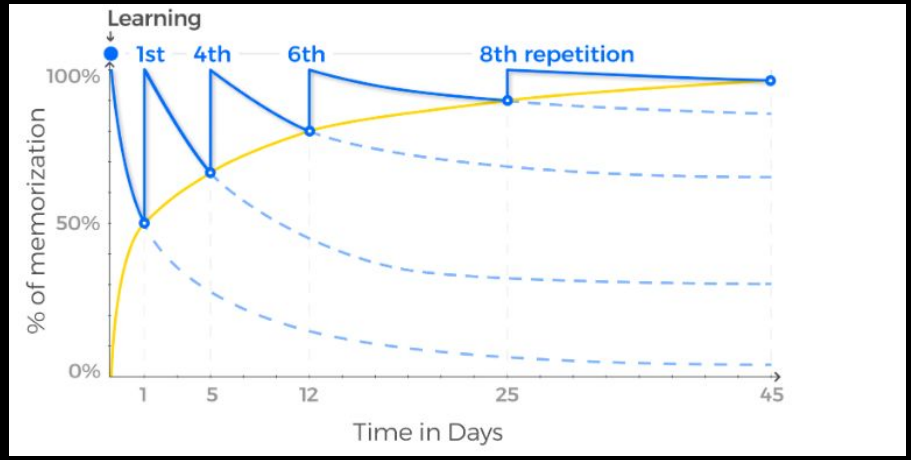
275 Biology questions across 12 topics and 22 fundamental Computer Science C++ questions



Active Recall Based Learning

Herman Ebbinghaus created a model for the relationship between time and forgetting recently learned information.

According to (Saravanan Jayaram, 2025) learners forget 40% of information within a few days and 90% within a month and a beneficial way to counteract this is with Active Recall



(Mateusz Wiącek, 2024)

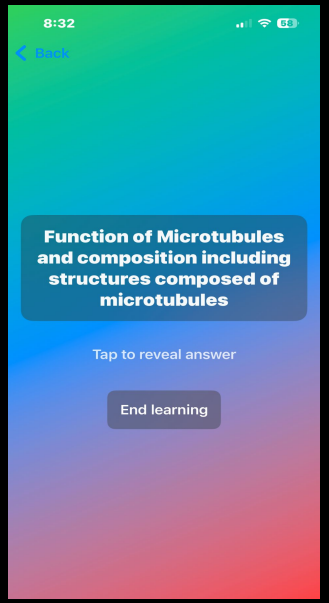
Active Recall Based Learning

Two different question types

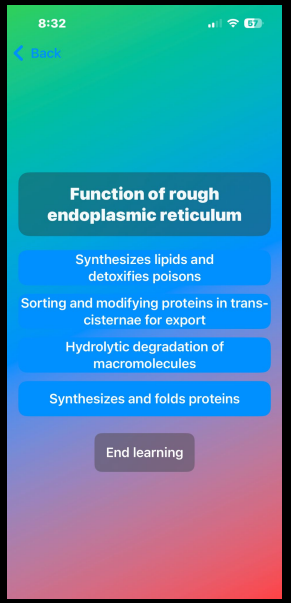
Self-Check questions that tests active recall more heavily

More fun and engaging multiple choice style questions

Self check



Multiple Choice



Benefit Over Others in Market

Apps like Anki don’t come preloaded with flashcards. You have to find high quality cards and import them yourself, or create your own.

Since its open source, anyone can contribute to the code by suggesting changes on the github https://github.com/ligdota/SciCards

Development

Developing a native application for IOS requires an apple product that can run Xcode. Being able to test directly on my Iphone was an advantage as well

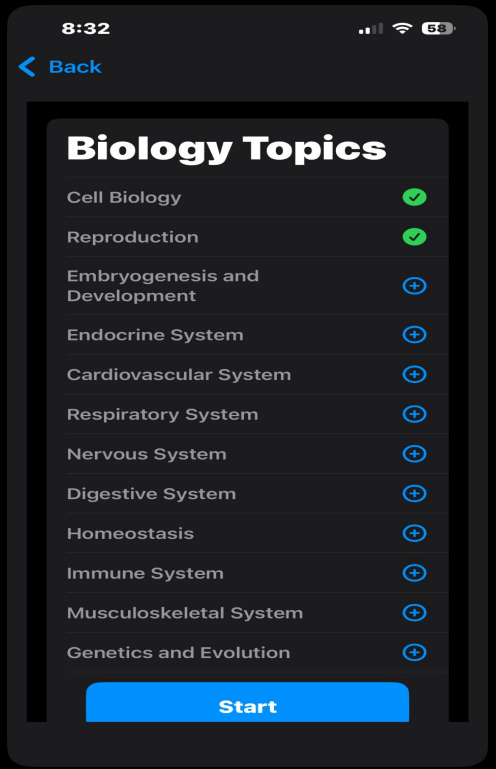
A database technology like SQLite seemed ideal for storing flash card info and querying.

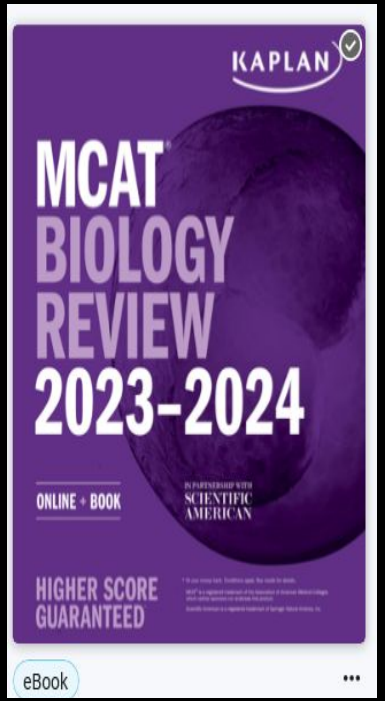
GRDB is an ORM wrapper when using Swift to make interacting with the SQLite database much easier

$400 refurbished Mac mini

Plan

Decide on the important topics I will include for Biology and then content review





(Vital Source Bookshelf, 2025)

Plan

Excel document to store the details for each flashcard

Subject	Topic	Format	Question	Answer	Incorrect1	Incorrect2	Incorrect3
Biology	Cell Biology	Self	What are the 4 mai	All living things are composed of cells, All living cells			

A python script to parse the excel doc and create the SQLite db

```
conn = sqlite3.connect("flashcards.db")
cur = conn.cursor()

cur.execute("""
CREATE TABLE IF NOT EXISTS Flashcards (
    id TEXT PRIMARY KEY,
    subject TEXT,
    topic TEXT,
    format TEXT,
    question TEXT,
    answer TEXT,
    wrong_answers TEXT -- JSON array of wrong options
)
""")
```

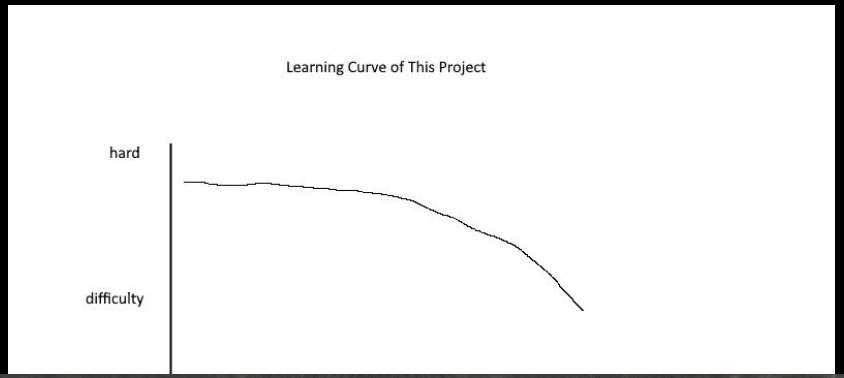
App Features

Cards don't appear in the same order over subsequent sessions on the same topic(s)

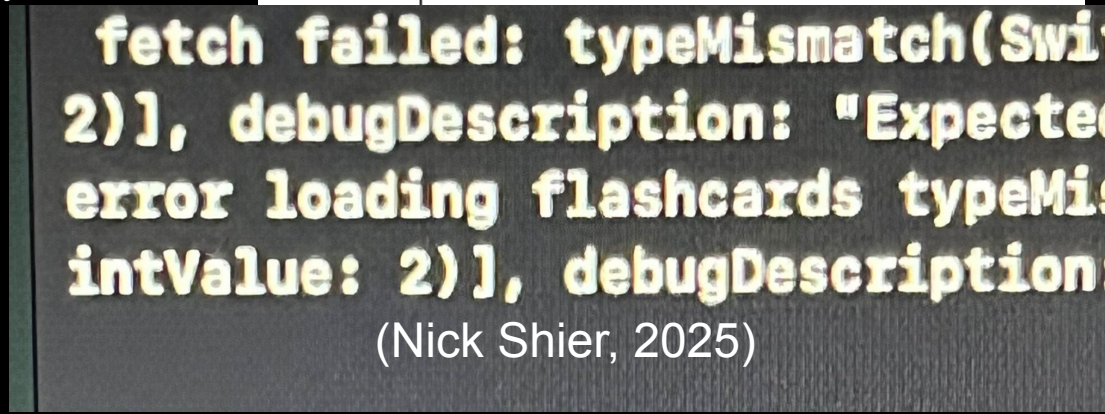
The Problems

I don't know how to use Swift, Xcode, Mac, GRDB, or SQLite.

I have never taken a web development course to learn UI or other important things like the async and await keywords

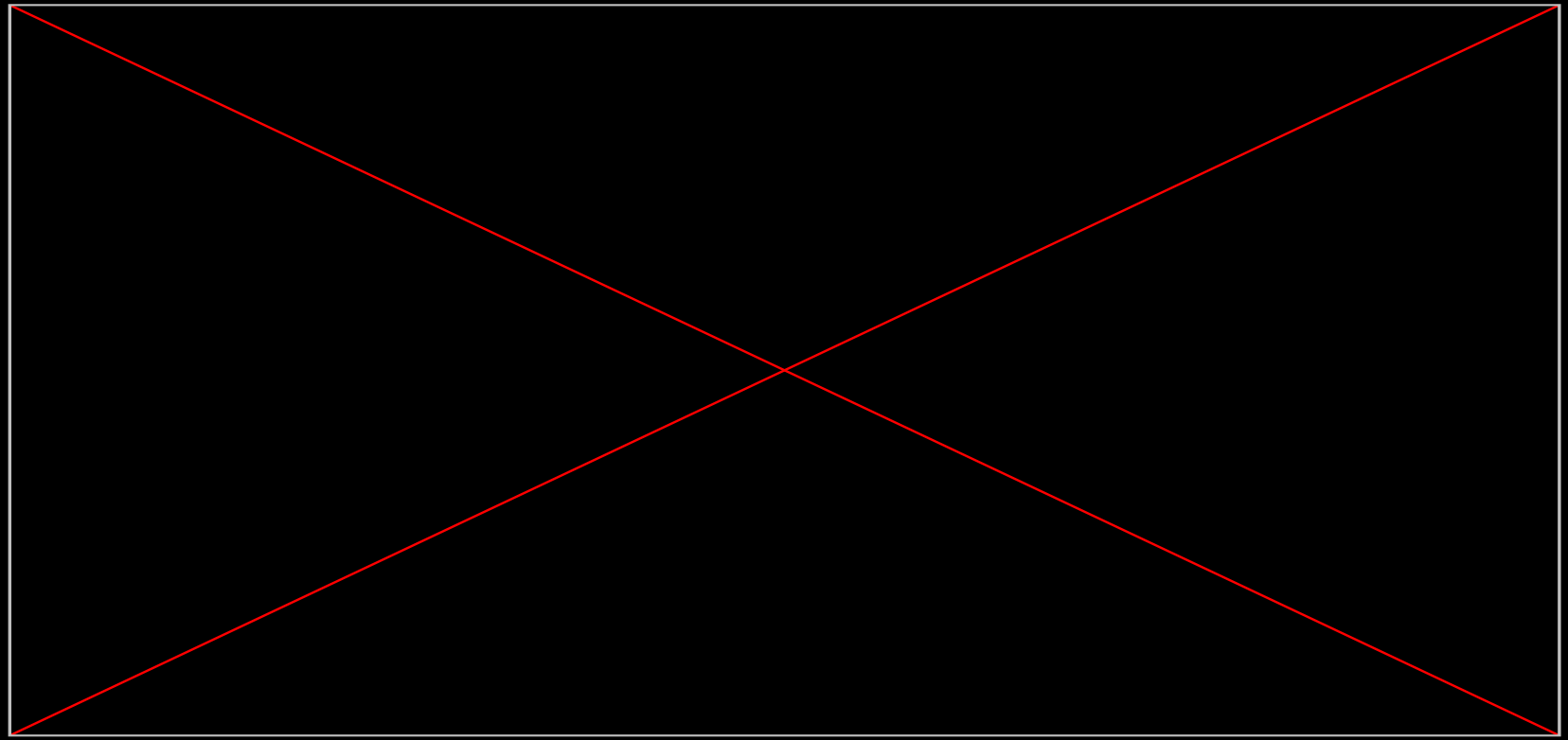


Lots of UI and database querying errors



(Nick Shier, 2025)

Application Demo



Benefits of Using This App

In a study by (Santos-Ferreira et al, 2024) they found that students using flashcards to study had higher median exam results ($P < 0.05$). And linear regression models showed a positive dose dependent relationship between the number of flashcards studied and the exam grade achieved by students.

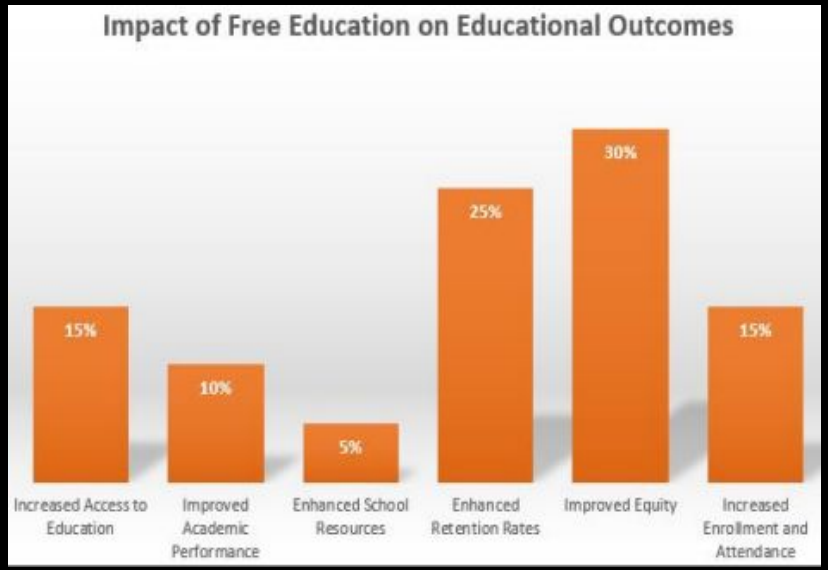
	Locomotor Physiology			Cardiovascular Physiology		
	Flashcard nonusers	Flashcard users	*P* value	Flashcard nonusers	Flashcard users	*P* value
1st exam	12.1 (7.5; 14.6)	14.6 (12.1; 17.1)	**<0.001**	9.5 (8.2; 11.9)	12.4 (9.4; 14.3)	**<0.001**
2nd exam	10.2 (6.7; 15.0)	13.1 (9.6; 15.8)	**0.026**	12.0 (9.2; 14.1)	12.8 (10.3; 14.5)	0.3
3rd exam	4.4 (1.9; 7.5)	9.4 (6.9; 11.6)	**<0.001**	7.7 (3.3; 9.7)	10.0 (7.2; 13.3)	**0.037**

Absolute numbers represented as median (interquartile range); *P* value for Wilcoxon rank-sum test or Pearson's χ^2 test, as appropriate. Significant *P* values are in bold.

(Santos-Ferreira et al, 2024)

Society Benefit

Studies have shown that providing free high quality educational content improves academic performance, school attendance and improves equity by up to 30%. (Thelma et al, 2024).



(Thelma et al, 2024)

Canada UN Sustainable Development Goal Contribution

In 2015 Canada committed to the UN 2030 sustainable development goals which includes goal 4 on providing quality education.

(isGlobal, n,d)

The Takeaways

Working with a new programming language (Swift), a new database (sqlite), a new ORM (GRDB), a new operating system (mac), a new IDE (Xcode), can get very confusing and overwhelming quickly when running into problems.

Swift styling for UI elements is similar to writing inline-CSS for a webpage, thus UI blocks can get messy very quickly.

What I Learned

How to use Swift to create a mobile IOS application that interacts with an SQLite database using the GRDB ORM

The importance of creating easier access to free quality higher education and open source software

UI/UX design experience

Math

Possible Future Additions

Sociology

One-Stop-App for undergraduate students to help prepare for the MCAT exam.

Note - This app is for after a student has finished their content review learning phase

An algorithm to implement spaced repetition so that cards committed to long term memory are seen later in time than harder cards

Progress stats for MC questions, saved and shown to user after a learning session

Chemistry

Psychology

Thank you

To Professor Charlotte Curtis And for all my professors at MRU during the journey of getting my Bachelor of Science in Computer Science.

References

https://www.isglobal.org/en/-/sdg-4-ensure-inclusive-and-equitable-quality-education-and-promote-lifelong-learning-opportunities-for-all (sdg4)

https://gemini.google.com/ (ai x photo)

https://www.sciencedirect.com/science/article/pii/S0165032724004245 (active recall)

https://www.taalhammer.com/the-forgetting-curve-hermann-ebbinghaus/ (forgetful image)

https://journals.physiology.org/doi/full/10.1152/advan.00138.2023?rfr_dat=cr_pub++0pubmed&url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org - dose dependent