Chang Snyder, Haven Whitney, Vryan Feliciano
EDUC 432, Winter 2025
Dr. Hariharan Subramonyam
14 February 2025

Assignment 2: GenAI Augmented Design of Explorable Explanation

How do bats navigate and find food in the dark?

Code | GenAI Chat Logs | Explorable

0. Concepts Behind How Bats Navigate and Find Food in the Dark?

To understand how bats navigate and find food in the dark, a learner would need to grasp the following key scientific concepts:

1. Sound Waves & Echoes

- **Wave properties:** Sound waves have frequency (pitch) and amplitude (loudness).
- **Reflection:** When sound waves hit an object, they bounce back as an **echo**.
- **Speed of Sound**: Sound travels at different speeds through air, water, and solid objects, affecting how quickly echoes return.

2. Echolocation

- **Active vs. Passive Sensing:** Unlike passive hearing (just listening to sounds in the environment), echolocation is an active process where bats emit sounds and analyze the returning echoes.
- **Time Delay & Distance Calculation:** The time it takes for an echo to return tells the bat how far an object is.
- **Doppler Effect:** Moving objects (like flying insects) cause a frequency shift in the returning sound, helping bats detect motion and speed.

3. Sensory Adaptations in Bats

- **Ultrasound:** Many bats use **high-frequency sounds (ultrasound, 20 kHz–100+ kHz)**, which humans can't hear, for detailed echolocation.
- **Specialized Ears:** Bats have highly sensitive ears with adaptations to process tiny time differences between echoes.

- **Brain Processing:** The bat's auditory cortex is highly developed to interpret complex echo patterns instantly.

4. Predator-Prey Interaction

- **Stealth vs. Detection:** Some insects have evolved ways to detect bat calls and evade capture (e.g., moths that hear ultrasound and take evasive action).
- **Different Hunting Strategies:** Some bats track insects in the air, while others "glean" stationary prey off leaves using lower-frequency calls.

5. Evolutionary Adaptations

- **Co-evolution:** The arms race between bats and their prey has led to evolutionary adaptations in both species.
- **Species Diversity:** Different bat species have different echolocation methods and hunting techniques based on their habitat and diet.

1. Learner Profile

- 6-8th grade (middle school)
- Prior Knowledge?
    - May be familiar with echoes/waves but not necessarily echolocation

2. Learning Objectives

- Students will be able to explain the phenomenon of echolocation to orient oneself.
    - **Sound Waves & Echoes**
        - **Wave properties:** Sound waves have frequency (pitch) and amplitude (loudness).
            - Going through different mediums; waves will move more quickly through air, for example, than solid rock
        - **Reflection:** When sound waves hit an object, they bounce back as an **echo**
        - **Speed of Sound:** Sound travels at different speeds through air, water, and solid objects, affecting how quickly echoes return.
    - **Time Delay & Distance Calculation:** The time it takes for an echo to return tells the bat how far an object is.

3. What Hypothesis Do We Want Learners Do?

- Descriptive
    - Text Boxes describing what we see.

- Explanatory
    - Ask students to hypothesize why things are interacting the way that they are.
- Procedural
    - “Take a guess as to what will happen next, and explain why…”

4. What does the experiment space look like?

- Could emit a sound, wait, then hear back an echo, then hear another echo later
    - Ask the student which one reflected first? Must have been closer?
    - Also make volume relate to amplitude of the waves

5. Guiding Exploration

What interactivity do we want for each section?

Martini to communicate prerequisite logic

Sound Waves & Echoes

- **Wave properties**
    - Pitch
    - Amplitude
- **Time Delay & Distance Calculation**

Lesson Draft

Introduction: Have you ever wondered how echoes work?

- brief intro into echoes; sound reflecting back

Body: Go into echolocation

- explain how echo changes depending on:
    - size of room,
    - distance of objects,
    - properties of material (e.g. air, water, and solid objects) sound passes through
- experiment, ask students which of two echoes they hear was closer/further away based on speed and volume

Evaluation: Go into larger explorable, trying to find food within the cave

- “Great work! You did a job!”
- Let’s summarize what we learned today.

Bookend every section with reiteration of learning goal for that section

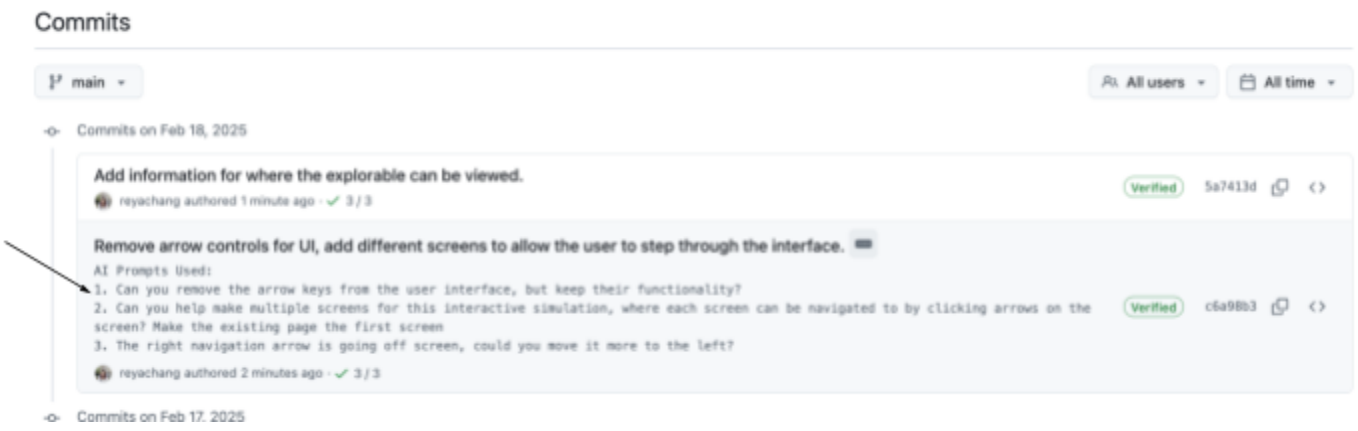
6. Evaluation

Prompts

ChatGPT Logs

1. https://chatgpt.com/share/67ae3e10-40fc-800f-bfbf-658b4ff6fbae - GPT log that generated code for a bat explorable
2. https://chatgpt.com/share/67ae3e10-40fc-800f-bfbf-658b4ff6fbae - a different GPT attempt that only provided ideas.
3. https://chatgpt.com/share/67ae45bf-1d24-8011-a48c-21a980471cd4 – After asking it for sound.

Cursor AI prompts can be found in our commit history in the Github commit message, see example below:



Screenshots

From ChatGPT log 1