



Aaron Li

ME227 Spring 2026

# Memory Keys

# Interpretation of the Prompt

## Prompt:

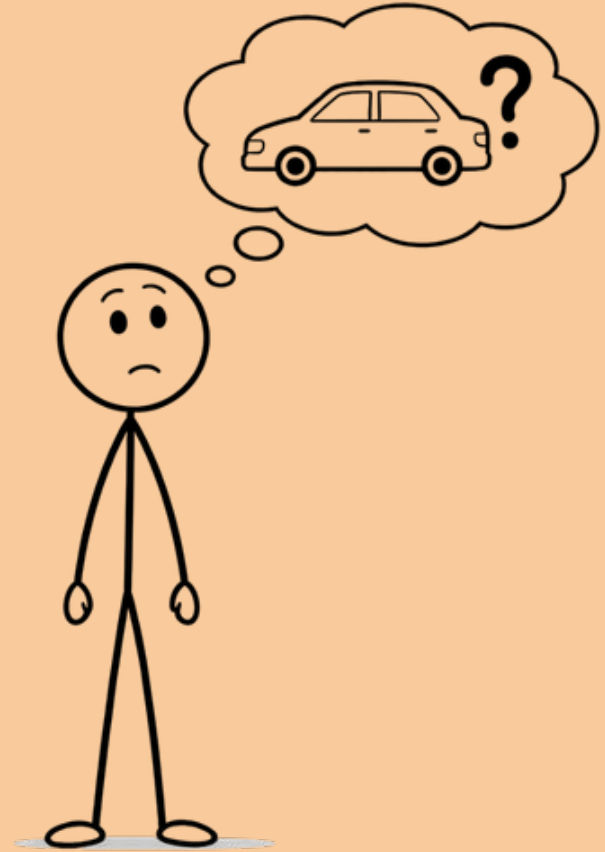
- Design a robust and intentional interface between two or more components using capabilities unique to additive manufacturing.

## Interpretation:

- Since print-in-place and mid-print insert assemblies were new to me, I wanted to use them in an effective way to solve a recent issue I was experiencing: forgetting the location of where I parked my car.

## Objective:

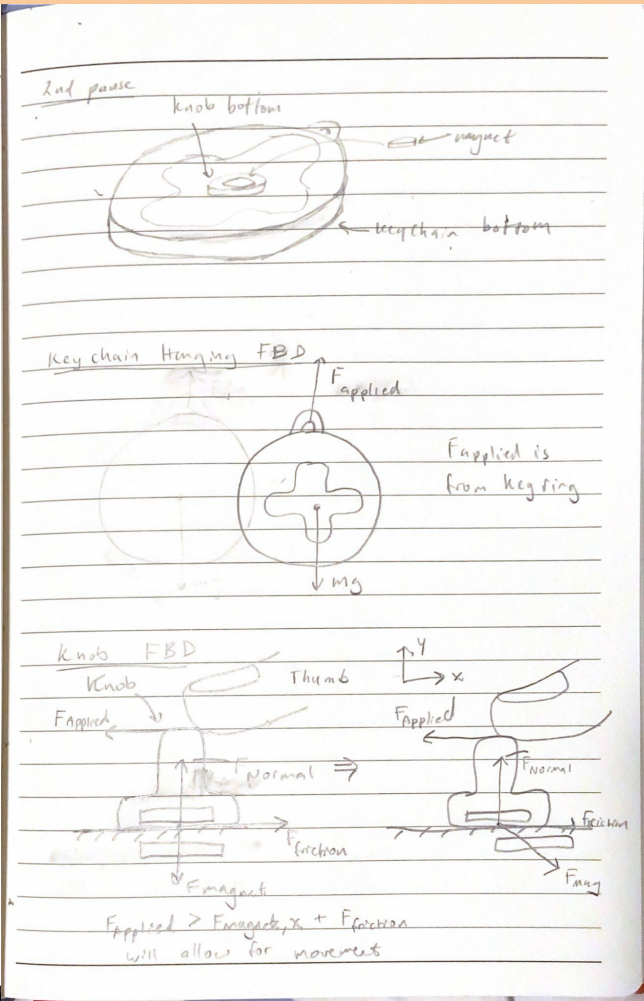
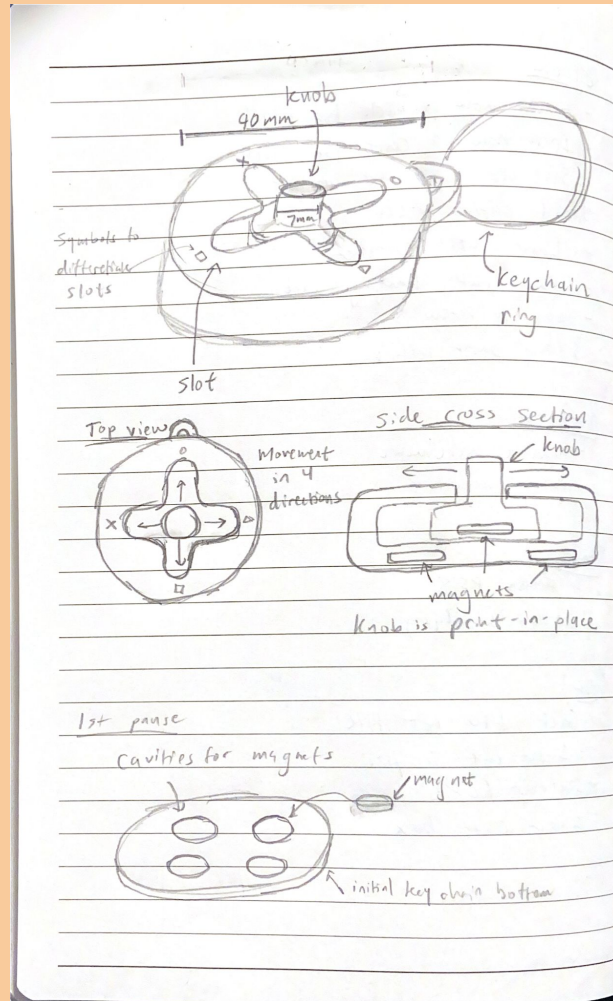
- Create a convenient way to help me remember where my car is parked based on 4 different usual locations



# Concept Sketches

## Sketch Contexts:

- Main design is a 4-slotted switch keychain
- Main AM assembly method is mid-print magnet inserts used to keep knob in-place with slots
- As a keychain, dimensions need to be smaller to allow for pocket fit
- Main applied forces are finger on knob and keychain ring on attachment loop (FBDs on bottom left sketch)
- Initial design was circular, but later changed to rectangular



# Method Analysis

## Method:

- Mid-print inserts of magnets to provide an attractive force between the knob and slots
- Print-in-place for knob within keychain body

## Advantages:

- Magnets secured in place
- Only one piece and print need to complete entire product
- No post-manufacturing assembly

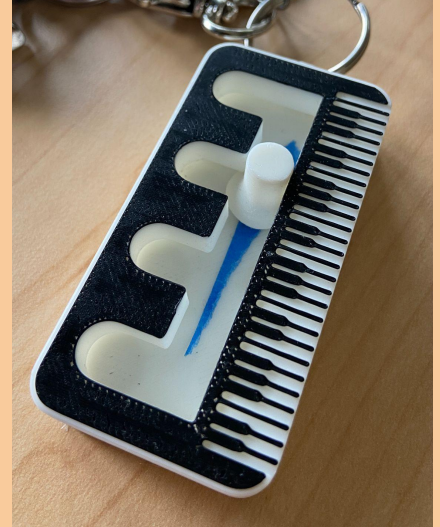
## Trade Offs:

- Long manufacturing time
- Minimal room for error (cannot remove magnets)
- Need to be present during printing process



*Example image of mid-print magnet inserts*

*Tape between knob and body during print-in-place assembly for easier removal*



*Single-piece print, no extra assembly!*

# Prototypes and Test Prints

*Quick & Dirty*



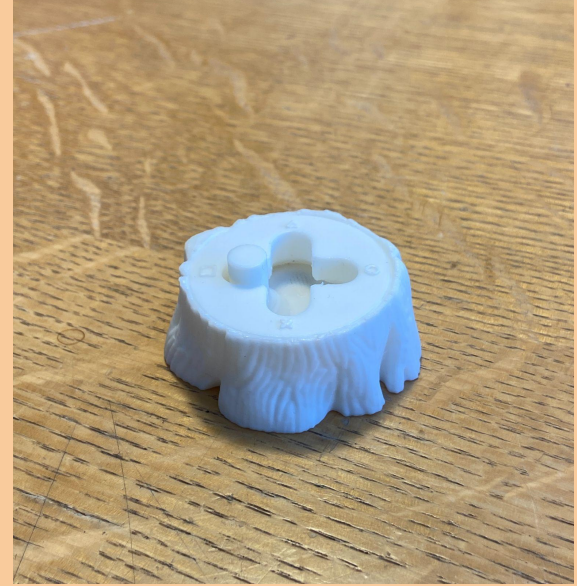
Design efficacy demonstrated and approximate dimensions determined from this prototype

*First Test Print\**



Magnetic slot mechanism tested and confirmed to work. However, tolerances between knob and slots were off and needed adjustment.

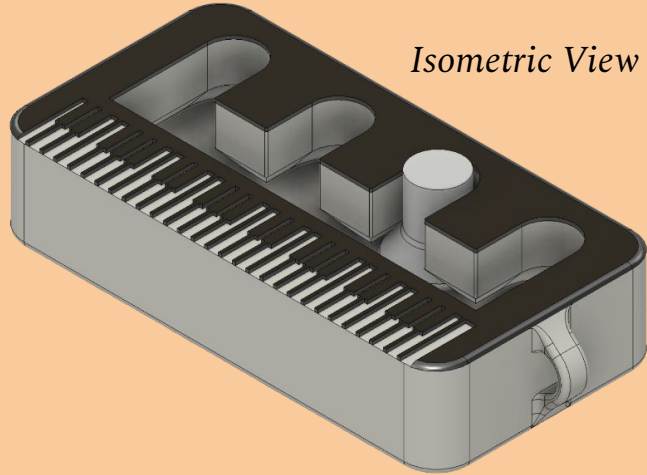
*Final Print of First Design*



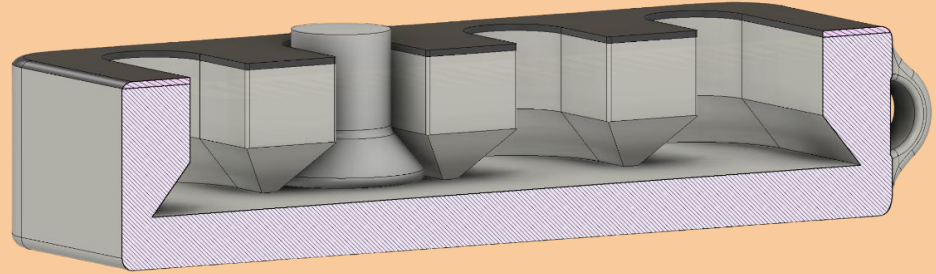
Final print of first design worked well after tolerance adjustments. However, knob could be easily knocked into different slot, leading to complete redesign.

\*Due to small size of piece, full prints were done for testing instead of individual parts.

# CAD Screenshots

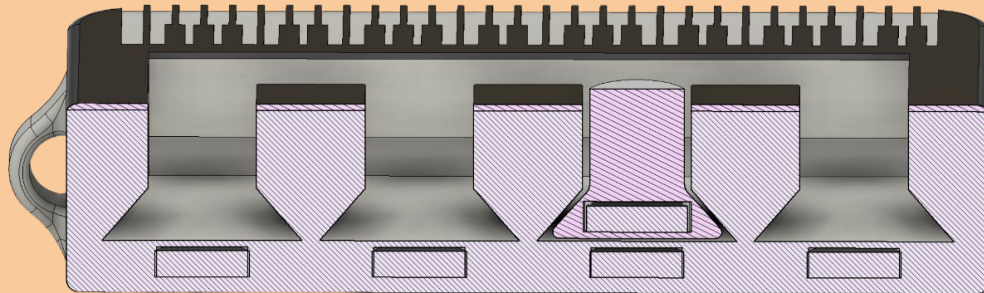


My second design features a rectangular form rather than circular to improve knob-slot positioning.

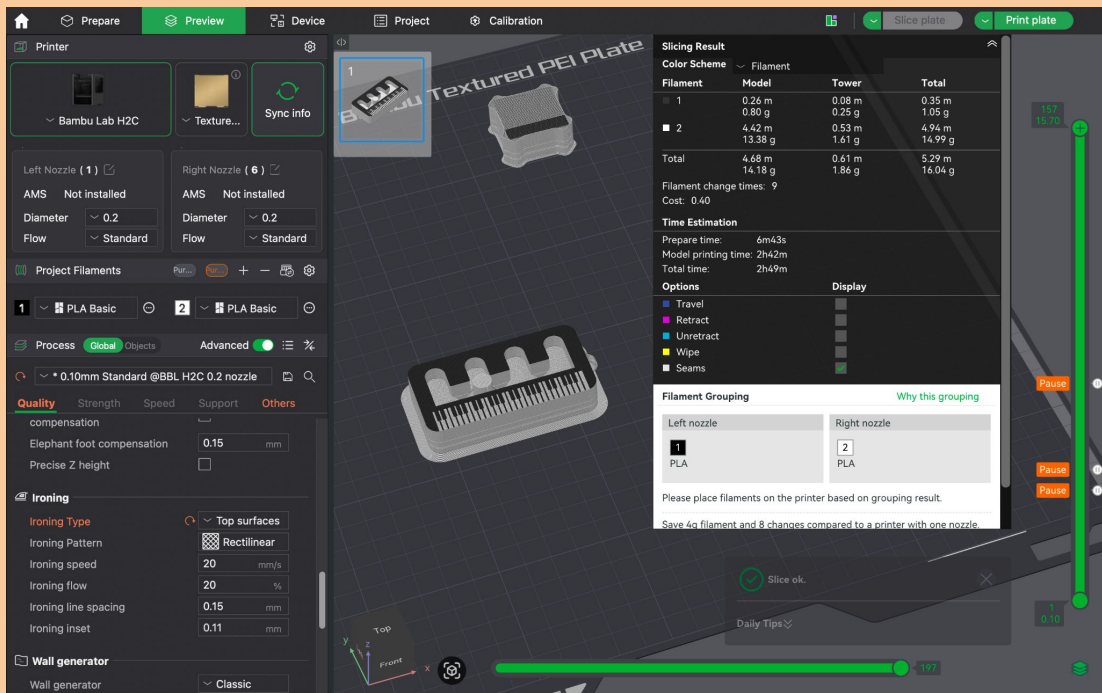


*Sectional View of Slots with Overhangs*

*Sectional View  
of Magnet  
Inserts*

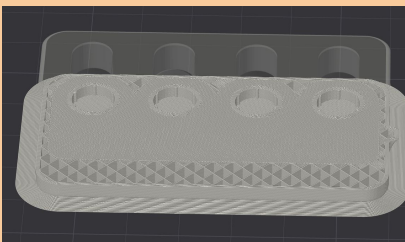


# Slicer Screenshots

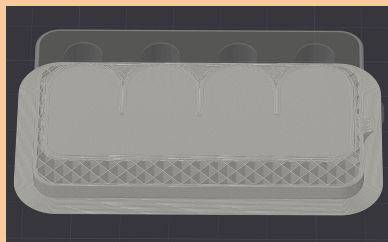


## Slicer Settings:

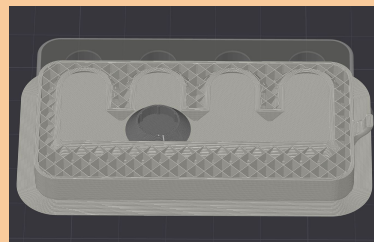
- Used Bambu Lab H2C printer
- White and black PLA used
- 3 pauses added (seen below)
- Added top surfaces ironing for better separation between body and knob
- Add brim for better bed adhesion
- No supports need due to low enough overhang angle



*First pause  
for magnets*



*Second pause  
for tape  
between body  
and knob*



*Third pause  
for last  
magnet*

# Performance Analysis

## Results:

- Knob slides into all 4 slots
- Knob is secured in all 4 slots by magnetic attraction
- Overhang in slots prevents knob from falling out
- Knob is easily movable within slots
- Attachment loop supports keychain ring
- Size is small enough to fit in pocket

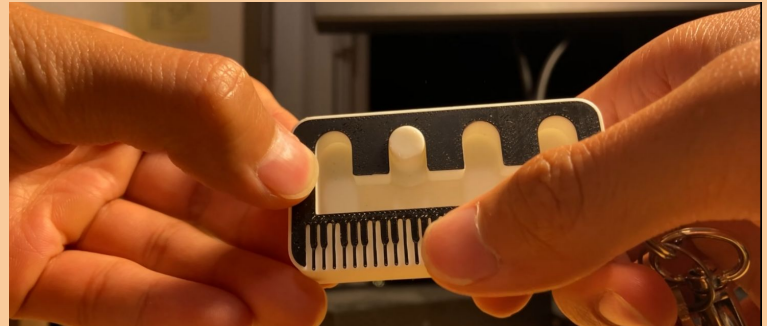
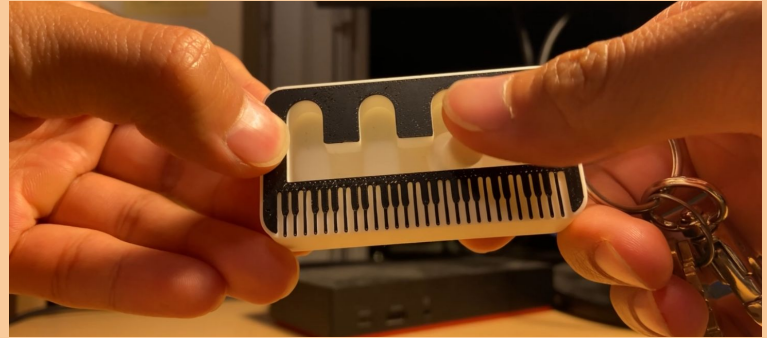
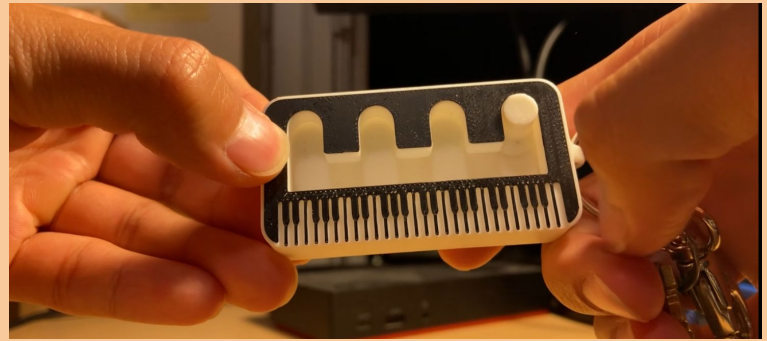
## Future changes:

- Test different slot shapes to optimize movement of knob between slots (sometimes the knob gets stuck and needs an extra push)



*Keychain hangs freely*

*Knob movement process*

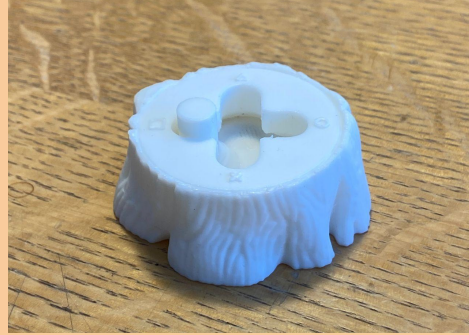


# Project Highlights

## Design Iteration:

- My first design was circular, featuring a tree trunk-style decorative exterior
- However, the first design's knob was easily knocked out of place and the tree trunk design wasn't original CAD
- My second design was rectangular, featuring an original piano keys decorative exterior and more robust knob-slot mechanism

*First Design Iteration*

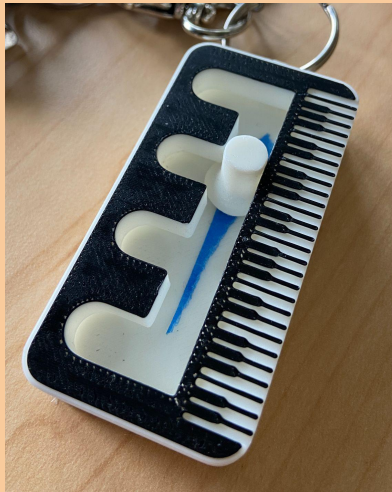


*Second Design Iteration*



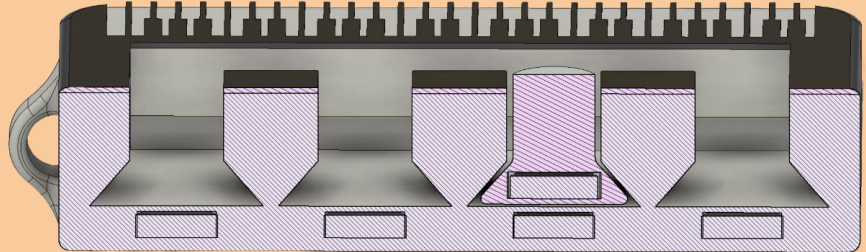
## Print-in-Place Part Separation:

- I used a piece of tape between print-in-place parts to prevent adhesion between the parts



## Slot Overhang

- I set my slot overhang at an angle to avoid using supports, allowing for knob to not fall out of the slots while also being able to move freely



# Reflection

## Takeaways:

- Project was well-scoped, features a simple yet robust mechanism and a sleek design
- First design might not always work, so get it done and tested as soon as possible
- If done again, flush out alternative designs in sketch/idea conception phase
- Take advantage of max overhang without supports
- Systematic design process from sketching to prototyping to test prints is effective!

## Total Time & Budget

### Time:

- Ideation/Sketching/CADing: ~ 8 hours
- Printing/Testing: ~ 6 hours
- Total: ~ 14 hours

### Budget:

- PLA: \$0 (all prints under \$3)
- Magnets: \$0.75 (15 total)
- Key ring: \$0 (from personal inventory)
- Total: \$0.75

