Metacognition

Intro to Metacognition

What Is Metacognition?

Metacognition is thinking about thinking, typically to improve or control thought. Students with better metacognition perform better in school, work, and social groups. Here is an example of how living with metacognitive skills can impact your life:

When Rollo was in college, he had difficulty paying attention in lectures. He asked his friends what they did to pay attention in class. He tried their advice of taking notes, drinking lots of caffeine, recording the lecture, but found they only helped a little. Eventually, Rollo realized he didn’t care about what the professor was saying, but he did care about how he could apply the concepts to his personal projects. This made the lectures interesting, and helped him learn the material.

Rollo applied metacognition by: 1. Identifying the problem: He couldn't pay attention, 2. Learning: he talked to his friends, 3. Trying: doing new things, 4. Reassessing: reviewing what worked and why.

It's easy to miss how mistakes relate to each other. Struggling to do your homework? It might be related to motivation, attention, or time management. You can promise yourself to 'try harder next time' but unless you take time to recognize the pattern and look for solutions, the underlying problem will remain. Understanding why you're making mistakes and addressing them early helps you improve in many aspects of life, including this Circuits course. Metacognition takes practice, so in this course we'll practice explicitly. However, we also encourage you to practice this in other classes and in life in general.

How to Use Metacognition

1. Identification: What do you want to do? Have you done this in the past? What is this most closely related to? How did it go? Does this happen a lot? What about in other parts of your life?
2. Learn: Think about what happened last time. Look up suggestions online. Ask a friend. Ask a mentor.
3. Try: Try whatever you think is best.
4. Reassess: Did it go better or worse than last time? Why do you think that? What are you going to do differently next time?

Practice in This Course

Metacognition is helpful, but only if you actually practice and apply it. As such we're incentivizing these in this class. Keeping a regular journal that is complete will be counted as extra credit (value and placement of extra credit will be decided toward the end of the course). To get it you must have at least 3 entries for each Milestone for Omega Labs or 3 entries per unit for Alpha Labs. Course-specific reflections have no minimum or maximum number of entries. They are a reflection on any activity in the course that impacted you in some way. They can be rare or frequent. The plus, delta, kaizen exercise concisely expresses your reaction and action plan as a result of something done in the course!

Metacognition Lab-related entries must include:

- The date
- What task are you doing?
- What is something new worth trying?

After you're done, append to the end of the entry:

- How did it go? And how do you know?
- Did your new strategy work?
- What else do you need to learn?
- What are you going to try next time?

Course-Specific Reflection must include (these can be rare or frequent):

- The date
- Topic and/or name of content
- Plus
    - Anything that was great about an exercise, class, or assignment
        - (***Be honest, hurting feelings or gaining some advantage by being nice is not possible here!***
    - Anything you learned that you didn't know
    - Anything you knew but really resonated with you and you got a deeper understanding

- Delta
    - Anything that could be improved
    - Anything statement made you disagreed with
    - Any question you have that wasn't addressed that should be addressed
    - Anything you were confused about or was too high level to understand
- Kaizen
    - One thing you plan to do or take action about because of the in-class exercise or topic
        - Look up a definition
        - Look up the research page
        - Review material from a class you already took
        - Talk to Sawyer, TA, or other professor (Braunstein is great too!)

Entries (Start here after reading background above!)

Overarching, no particular date or topic

Just an overall way I've been thinking throughout the whole course, applying it to any number of different topics at different times: Everything in this course is an abstraction. From nodal analysis to bode plots, even including simple current and voltage, everything, is really just an abstraction. If I'm getting confused by a topic, just slow it down for a minute, stop thinking about current and voltage and complex topics, and go down to the simple physics of electrons, resistivity, electric fields, and magnetic fields. From there, build up to the problem or topic step by step, and I'll have a much better understanding of what happens and why it happens.

2/11, Lab 1, general circuits

I find myself often just thinking through how something feels like it should work or what a value should approximately be, but occasionally that's wrong and I'm left confused about my answer, often with sign errors in particular. I need to think more about equations when I do this rather than simply how components act, as I can sometimes get values that make sense, but I'll get which direction is positive mixed up and label something backwards.

2/13, Lab 1, general circuits

I feel like I often don't pay enough attention to how connected components affect each other. For example, when you have one voltage divider powered by another voltage divider, the second one must have much higher resistance so the impact on the first is smaller. I initially had this setup with everything in the 400 ohm range, which resulted in one voltage divider having a large effect on the other, leading to strange outputs. I'll do better to consider how components affect their neighbors in the future.

2/14, exam 1/Lab 1, nodal/mesh/kcl kvl

This exam should have been easy. I like hobby electronics, I've known a lot of these basics for years and learned to solve with matrices in intro ECSE, yet I really struggled on the exam. I've realized that I never really used nodal or mesh or KVL KCL by themselves the way we do so in class, I usually use some jumbled mix of them that works fine, but isn't exactly what the exam asks for. For example, when I do "nodal", I don't actually solve for the voltages at nodes! I've always just solved for voltages across resistors and then summed my way up from ground to get my answers. I was confused and stressed during the test, but I calmed myself down, forgot everything that I usually do, and used the equations on the crib sheet. During the test feels a little late to be learning how to use those equations, so on future tests I did a better job at sitting down and studying the methods more methodically, rather than just finding something that works, since that will usually get you more consistent results that are more comparable to anyone you work with.

Don't remember the day…, spiderman and wooden block and bowl discussion

Sorry to give the negative feedback on this… but none of those examples were overdamped. Sound is oscillation, so if you're overdamped, there will only be a single sound wave at most, which is very hard to both create and precieve. Putting spiderman in the bowl certainly damps the sound more, but we can clearly hear it resonating because it's still quite underdamped.

3/29 ish, Lab 2, opamps

While working with another group in EHC, and they had found a simple way to generate PWM and control duty cycle with voltage, something that I had tried and failed to work out how to do in my head before. It was as simple as using the capacitor voltage from a 555 timer (which counts as op amps) to get a triangle wave, and then use a comparator with an adjustable voltage to flip the digital output on/or at varying points in the triangle wave cycle. I also saw some of the issues they had, which we eventually figured out came down to non ideal opamps. The comparator was drawing enough current to discharge the capacitor more quickly, leading to a higher frequency signal.

4/25, Lab 3, phasors and complex power

I decided to use a full bridge rectifier for phasors and complex power, which is pretty simple in concept, as all you need to do is take the absolute value of the real component, but I'm struggling to find a good way to represent this symbolically. The regular absolute value bars imply magnitude since we're in a vector context, so the best I could do would likely be a peacewise function? But that's not very clear or understandable

4/01 ish, Lab 3, researching voltage regulators

Our initial idea for lab 3 was a variable power supply, so I was researching voltage regulators, and at one point finally realized it's actually just a voltage controlled resistor. It uses an op amp in a way that's new to me, so I looked into exactly how this configuration worked, and it expanded my understanding of how to use op amps in a variety of applications.

4/24, Lab 3, general experimentation

I learned a good bit about the equipment in EHC and mercer lab. I didn't know all grounds were shared between probes, even between devices due to their grounding. This was surprising since I've also seen issues occur when not all probes were directly grounded together, implying they didn't have a shared ground. We solved this issue by using battery powered devices and differential pairs. I wonder if this is in any part due to the fact that we were running at 60hz, while these issues I've seen with a lack of grounding usually occurred at higher frequencies. I'll definitely do some experimenting with EHC and mercer lab devices over the summer!