

## Speech buckets

- Limitations or unfinished work
  - S1 reflective - "I really haven't started diving deep yet, I just wanted to get some of the main ideas that we want to cover in our presentation"
  - C1 reflective - "And I guess we're making a sentence. Uh, I didn't actually get the input part in, I would have done that, but I didn't. And as a first step, I just wanted to try to build a random sentence from all the existing words, but making sure that the chosen word was put in there. So I was just getting index positions of things so that I can pull them out later."
  - M1 concurrent - "I'm not going to build it in the same orientation cause it'll be a pain in the ass just to keep things in the same plane. Because tinkercad isn't great with that kind of stuff"
  - M1 concurrent - "I guess ideally if I was building all this, it's mostly referential. Like, I wouldn't ever sort of model a lens this way cause I don't know actually how I'd go about building a Lens. The glass and metal and stuff will be a much larger manufacturing task. Um, but something I would do would be quickly sketch something out in order to be like a placeholder for design and it would be a representational like sign in the real world. So like I would probably start off by like looking for like blueprints or something like that. So I could like reference like really accurately. Um, but if I was just doing sort of quick and dirty, I might do something kind of like this just to um, um, I guess like visually fill in the space if I was trying to figure out, um, like alignments or how things might work together. Another reason you might do this is if you're trying to figure out, um, distances, angles, I guess like if I was actually trying to build this camera, there might be a question of like, well how far does the lens need to be from the film in order to have the right size scale? And things like that. So there's a chance that you might mock something like this up if you're trying to answer some of those sort of technical questions. Um, or I guess if you were just trying to figure out like, oh, you know, how, how big a sheet of plywood will I need in order to make this?"
  - M1 concurrent - "Could do the same on the inside, but I don't want to"
  - M3 reflective - "Um, so basically with this model there is a little bit of an issue with the chin and the neck connection that's getting a little tight, which needs to clean up. Um, the head also needs to be scaled proportionally to the body and so do the arms. There's some tension around the arms in terms of the torso and shoulder area. Um, that needs to be refined and the back needs to be defined a little better and closer to the sketch."
  - M3 concurrent – "The head still needs to be scaled down, but his torso is looking ok, at least more acceptable than before."
  - M4 concurrent – "so I'm just trying to get the bulk shape in place, probably going to need more details afterwards... Just to get the main shape in."
  - C2 reflective – "the top is unfinished, but it's where it, um, the program would ask for the user input to find the file to sort the text"

- C3 reflective – “Um, this one is not completed yet cause I want to adjust the layout to to be like aligned to the end a little bit. Just like this one. Um, so this is to do.”
- C3 reflective – “And again, for the footer this, this part is haven't completed yet. Um, so I basically wanted to look like this”
- S2 reflective – “Um, the only other item, you know, in, in PowerPoint, you know, there are some, you can make notes in here, but you know, this is really for content. It's not for creation.”
- C4 reflective – “Um, it's currently in a state of transition between one design, one style and the other.”
- S3 reflective – “So, um, actually this is just the process, so I didn't really, uh, do anything for, um, how it looks. So it's very raw.”
- S3 reflective – “And it's very raw. So, um, I think for, or someone to really understand these slides, they have to know about this. Um, or if they want, if they want to show this to someone, then they really have to add their comments and talk about the slides because like this, it's very, um, very, um, just ideas and just keywords. So, um, I think if someone doesn't understand it, it wouldn't be very useful.”
- S3 reflective – “I think if I would have more time I would add, uh, probably pictures and some, some other examples like this one on the design side to make it more clear what I'm talking about, but as a, as, um, and also like for example, adding uh notes would be very useful.”
- S4 reflective – “I mean I didn't have time to finish this”
- S4 reflective – “Um, and you know, this, this is just, this is just like structure. We don't even, we're not even getting into the history of.”
- Talking about the nature of the artifact/notes
  - S4 reflective – “Um, and you know, this, this is just, this is just like structure. We don't even, we're not even getting into the history of.”
  - S4 reflective – “Um, so yeah, so I think there's a lot to say, but you know, this gives you uh kind of an outline of how it would work plus like a sense of how I would want it to be put together.”
- Intended audience, or what additional info/context is needed to understand the artifact
  - S3 concurrent – “So I think for this slide deck would be, would be useful to, um, for anyone to really use it and understand it to, um, to research what, um, is, um, design process that I mention here. So I think what I would suggest for them is to go and see ideals or, um, the Stanford design schools, um, process because this is just an just an outline of um, how, how it looks like a very, very raw outline”
  - S3 concurrent – “adding uh notes would be very useful. I usually, that's what I do, but because this is like a slide deck, I wouldn't expect anybody to understand all of this. Uh, just I [unintelligible: rethink?] this and um, uh, I'm not treating slide decks as, uh, the only thing to understand what's in it. It's always, it always needs some context, like somebody talking or the, the, notes, um, that would be

useful. Or, um, yeah, probably that's the two that I would, I would really, um, that somebody would really need to understand what I'm writing about."

- S4 concurrent – "let's assume this is for like a high school audience or something like that"
- S4 concurrent – "You know what, I'm going to actually create a source cited, uh, so this'll be useful for people who, whoops, that'll be useful for people who want to [unintelligible: follow along...?]"
- Frustrations, difficulties, confusion; or indication something isn't working
  - M1 concurrent - "Trying to move stuff around and get things lined up, which can be a pain with tinker cad"
  - M2 concurrent - "Interesting"
  - M2 concurrent - "Hmm, this is very strange. It's moving in a direction that I did not select."
  - M2 concurrent - "Fusion's being very strange with this. Alright I'll look into that later."
  - M3 concurrent - "Uh, no, that got a little too messy."
  - M3 concurrent - "oh man"
  - M3 concurrent - "Still seem to have problems with this tense area, but it's getting a little better."
  - M3 concurrent – "Just gonna see if I can try to protect it somehow. No [clicks tongue] or maybe I'll do this. Trying to select the specific area I wanna work with as opposed to exposing all of it. There we go, let's see if that makes it better or easier. Nope. That does not do anything."
  - M3 concurrent – "Hmm" or exasperation
  - M3 concurrent – "I just want to try to select the head as opposed to other things. There we go. Now I can finally scale it down. Oh, no, I can't. Hhm. Of course."
  - M4 concurrent – "Uh hmmm"
  - M4 concurrent – "Hmm, 'insert edge', 'insert edge', where did it go"
  - M4 concurrent – "Uh that doesn't look right"
  - S2 concurrent – "Is that the right one here. Insert. I want a square one."
  - C4 concurrent – "Nope, that is not the right command"
  - C4 concurrent – "Border dash? Still not working. What did I have before? Oh"
- Challenges, things that are tricky
  - M3 concurrent - "Here the real challenge is to spread that volume all around." – not sure if general challenge, or specific to this instance
  - S2 concurrent – "That was a little tricky there, but because I my my I have a white background, I have to tweak this a little bit. So now it has the right colored text."
- Says they'll get back to something later; may or may not do something temporary
  - M2 concurrent - "Fusion's being very strange with this. Alright I'll look into that later."
  - S2 concurrent – "And because someone may be editing it, what I'll probably do ... but at the very end I'll do something."

- S2 concurrent – “I’ll just put in some sample text for now cause I just want to make sure for for size and whatnot. So maybe I’ll put down, um locations”
- S2 concurrent – “I’ll just type in test for now.”
- S2 concurrent – “We’ll put a nice MEC logo, cool places to ride, put a trail map, add some text in there later.”
- S2 concurrent – “I’ll just make it up like for now, [https://<link-anonymized>/can/getHealthy](https://can/getHealthy). I just made that up. But that's the idea”
- S2 concurrent – “I can probably tweak the text a little bit later, but I think that's good”
- C4 concurrent – “This can probably be put into a loop, an array at some point, but for now this is probably faster for me to do since I have limited time to get something working.”
- C4 concurrent – “I’m just going to make it incomplete for now so we can test a couple digits.”
- C4 concurrent – “Oh yeah, that becomes a problem. I should not have done it with a single second in between because I can't control the segments on the right side. Um, but okay. Let's just leave it that for now. It'll be a slightly stylistic clock.”
- High-level description
  - M2 reflective - “this is a tool holder rack for CNC tools”
  - C2 reflective – “so this program is pretty simple”
  - C3 concurrent – “And I want to do a, like a photo gallery that displays pictures for maybe some animals like dogs.”
- Motivation, background for making this artifact, or some part of it
  - S2 concurrent – “Recently found out that uh, you can actually get a bike as part of a benefit for work. So I will take advantage of that.”
  - S2 concurrent – “So this one here, I'm going to try riding group at work for bikes. So maybe this one. Cause I'm going to use a slack channel I'll just Google slack, grab a slack channel cause I might do something at work.”
- Requirements/end-goals/intent for the artifact
  - S1 reflective - “so basically I want to communicate that it’s essential to start off with some facts to ground everyone”
  - S1 reflective - “And then after I think we can go into some of the more Egyptian mythology, so that’s the idea of this slide here, Orion The Warrior, and try to ground the later parts of our presentation, kind of on how the Egyptians were thinking in that time. Obviously it’s hard to empathize with how they were thinking or what they were really doing, but I think trying to understand that will help with these previous 2 slides as well, just to kind of ground people in what were those times like, what were their lives like, and how were they coordinating themselves with what they were observing out in the universe”
  - C1 concurrent - “And then this should return a dictionary” [noted before running the script]
  - M1 reflective - “So like this piece here, I would intend to be able to move forward and back and in space here it's like a focusing mechanism. So if I was

going to convey that to someone else, like you need to also understand like the tolerances and stuff. So if this is meant to slide inside, that if you're going to go and make it, you'd want to make sure that there's enough space that, that the two materials wouldn't sort of, bind on each other, they'd be able to move back and forth, but also not so much space that you'd let light in and kind of ruin the cameras being light tight. So all the tolerances and stuff that become really important as well as indicating like what pieces need to move across other pieces and what the ranges are. So like, you know, maybe this needs to go back this far and he used to come forward this far, but you wouldn't, you know, it could move further forward, would fall out. So it's sort of describing sort of the intended movements of different things would be important as well as like something like this, which is like intended to be a slide. So you'd slide that in and out of this piece. So you'd want the same thing. You'd want to be able to move past that edges, um, without like getting stuck or whatever. But you also wouldn't want it to be loose that it would be letting light in and it would be kind of loose in here."

- M1 reflective - "I tried to make things, um, sort of with a like a laser cutting flat pack idea in mind. So like, you know, this piece is the same width as this piece. So ideally you would be able to like stack, you'd have like a box here but you'd be able to stack up like one and two on top of that to create the lift that would this. But it's all basically made out of the same stock."
- M2 concurrent - "So I just have to make sure that it lines up to be multiple of 20."
- M2 reflective - "so that they're held with the tools up and off of the flat surface below it"
- M4 concurrent - "the idea is to build uh car parts"
- C2 reflective - "So what this program does actually takes a file, text file, loads it up, breaks it into lines and sorts the lines. Lines that are empty are discarded. So it just sorts the lines that have text inside of them."
- C2 concurrent - "We don't want to open a directory, that's for sure."
- C3 reflective - "And also for the footer um, I want to have two buttons one's for 'like' and one's for 'adopt'."
- C3 reflective - "for the container I made it display flex and the flex direction's row and I wanted to wrap when we're, uh, adjusting the size of the window. I want it to be responsive. So that is wrap and I used justify-content spaced-evenly to to have some space between each other and made it looks better."
- S4 concurrent - "Um, and then I'd want a sidebar something about like, um, the, um, antikythera mechanism"
- S4 concurrent - "Dah dah dah dah. Earth. Here's the, um, dah dah dah dah [unintelligible] heliocentric. Okay. So Galileo and Kepler, which is the two ones I wanted to get to."
- S4 reflective - "so some of the notes would be, um, I want to alternate um a discussion of something. Um. You know, sort of localizing people in time with, um, something that's interesting and cool"

- S4 reflective – “Well, I mean, you know, I did talk about, you know, making sure you have interesting sidebars so that, you know, people don't just deal with a barrage of facts [unintelligible].”
- S4 reflective – “And I also want like there to be an appreciation that, you know, the ancients, people living in ancient Greece were pretty fucking smart, and could do smart things like, you know, create extremely sophisticated calculators, the calculations to predict, uh, the movement of the planets, um, in a way that is astonishing. And that the fact that we invented telescopes and computers doesn't mean that we're any smarter than those people. Um, so that's one thing that I would want to point out.”
- Requirements/pickiness
  - S4 concurrent – “I don't want a reconstructed one.”
- Warnings
  - M1 concurrent - “This would be a dangerous lens to use, cause you'd always drop it on stuff and scratch the front of it”
  - C3 reflective – “if this is a product that our teams gonna work on, I want to make sure the photos don't have any uh, copyright issues. Cause now I'm just downloading randomly from the Internet. Probably we need to have the photos from a reliable source.”
  - S2 reflective – “So a lot of googling of images. Hopefully it's not traderright-able but you know it's ok for now cause it's just a quick presentation.”
- Explaining how some already written code works, or how some model was created, or some content on a slide, or in general something that's been done already
  - C1 concurrent - “One extra note, I guess about, this is just the way of checking because I want to increment the count of a word, if I see it again, then I got to do, but I guess I'm referencing this and adding to it, but if it doesn't exist, this will give an error because again, this doesn't exist. So that's what the 'if' is for, to check for that.”
  - C1 reflective - “I guess the first step was that I wanted to put both the order and count together instead of separate. So I did something, I guess here where, in this function, all I did was take the dictionary keys and order them and print it out”
  - C1 reflective – “An extra word clean up. Uh, again, that's just looping through a set of those set of words. There already exists some set of punctuation in string punctuation and some other function that will remove string from, or remove characters from a string. So I just did that to clean up the word.”
  - M2 concurrent - “So I was going to, if I was going to pass this off to someone else, I'd want to explain like the way that I got the internal volumes and stuff here is by creating a cube of the size that I wanted and then subtracting it from a cube that's a little bit bigger”
  - M2 concurrent - “So I was creating a reference here to match with the table that's on the machine. So I'm gonna use this to integrate onto the machine table itself and they have alternating goals on 20mm centers”

- M2 reflective - "what I've done here is first, so, modified based on an existing design so that they're held with the tools up and off of the flat surface below it"
- M2 reflective - "in modeling the tool holders themselves, um, we basically used it to just combine or boolean out the kind of negative of that."
- C2 reflective – "Uh, and then the rest is just using, uh, uh, important python things like, uh, this 'with' command 'with open(INPUT\_FILE' as a read only file."
- C2 reflective – "Uh, this first line just reads the lines and then the most complex line in this program, uh, the comment basically says what it does, it eliminates the white space and doesn't include empty lines. So there's two parts to it. I have this map command that I've highlighted. What it does is it takes every line and strips it of white space. So if there was uh like, a line that consisted of white space, it would become the empty string. And then the next thing, uh, with the resulting, uh, list, it runs it through a filter where it makes sure that whatever value is not empty gets included in the, in the list. So in essence, this eliminates white space and doesn't include the empty lines. And finally we sort the list in place. And just to verify here, uh, again for testing, I'm just printing the top 59 lines to make sure it's sorted properly."
- C2 concurrent – "So this is going to loop until we get uh input valid is True, which only happens if the user types in Q to exit or, uh, provides a path that exists"
- C3 reflective – "I have, uh, created a structure called dog and it has two properties, name and photo. So in my gallery component I have a list of dogs and for every dog I gave it the name and also the link to the image that I'm gonna display. And uh, in the gallery.component.html I have a, uh, have a parent div which, which has the class container and I created every card, created the card for every dogs so I use ngFor to loop through the list of dogs and uh, in this card I basically have several sections from the uh, header and then a picture and also the uh, footer and uh in the header, uh, I give it the title, subtitle and also a image and then later on in the content I have, which is a line of description and another photo that's bigger than the previous one, but also displays the same image."
- C3 reflective – "Um, and also for the style I'm limiting the max width and max height for each image"
- C3 reflective – "for the container I made it display flex and the flex direction's row and I wanted to wrap when we're, uh, adjusting the size of the window. I want it to be responsive. So that is wrap and I used justify-content spaced-evenly to to have some space between each other and made it looks better."
- C3 reflective – " I have also a margin between, uh, at the top, the bottom and left and right that's uh, 20 pixels."
- C3 reflective – "In the app component, um, I basically have just a title and also insert the gallery component that we just implemented. And for this title I also adjusted that a little bit. I changed the color and also the background for all the dogs. And I adjusted to the center of this section."
- C3 reflective – "And another thing is I'm using like angular material. So I'm importing a lot of modules from Angular material, um, but if other people have

to work on it, um, so first of all, the installation or setup guide is not that easy there are four to five steps that, uh, I have to follow. So I did some, uh, I downloaded some package and also, uh, imported some modules to make the Angular material components like card and angular style patterns work and for every, um, for every material component that I imported I want to use that was imported here and uh, also declare that in the input section.”

- S4 reflective – “Like this is a diagram, the way somebody actually would have tried to calculate the epicycles.”
- S4 reflective – “So I mean this is actually, you know, what, what Galileo sketched, [unintelligible] Saturn, similarly with the sketch of Saturn.”
- High-level description of their process and thoughts; possibly including challenges/pitfalls they faced
  - S2 reflective – “a lot of the times I was, I was working on this, I just tried to download images as I went through. I mean I went as quickly as I could. At least I have a really good idea of what I wanted to talk about. So a lot of googling of images”
  - S2 reflective – “Um, but I think it was just spending time tweaking it and going through it. I mean, as long as you have the content ready to go, you can hopefully use the same template over and over again. Make changes accordingly.”
  - S2 reflective – “I think Google cloud, I would, you know, the Google apps like in the cloud would have the same idea, but, you know, initially I did it locally and then once I'm kind of okay to finish it, you know, put it in the cloud and then other people can look at it. It's as they need to. But yeah it just depends, depends on who, what they're what app they're really good at, you know, [unintelligible].”
  - C4 reflective – “I wasn't exactly 100% sure how I was going to design the digital display. Um, so I kind of had in mind just trying, uh, a bunch of divs and adjusting the borders based on, um, whatever I wanted to display. But then I realized I needed a middle segment and I probably should write this in a much nicer manner rather than copying and pasting all this code. So I started creating some functions, um, to, uh, uh, to generate each one of the displays in the digital clock.”
- What they would do differently in the future/with more time
  - S2 reflective - “If I was to, you know, redo it again, I would probably, for me, I mean I went and saved a lot, but you know, maybe in the future, if I was doing it locally, I would probably maybe go to properties and change it to read only so that if I hit save it would save versions of the file. But you know, that's okay.”
- Todo items or delegating
  - S1 reflective - “so we need to do a lot of adding images, formatting, making it look pretty”
  - S1 concurrent - “I want person X to kind of do a deeper dive, and maybe go to the library, find some books on Egyptian mythology and really try to understand the most important concepts...”



- M4 reflective – “So obviously we need to go back to the reference. Ideally we should add the reference image of the back ground image plane, and uh, move [unintelligible] and points accordingly.”
- C2 concurrent – “If it's a file then we see, we ask the use if they want to overwrite it.”
- C3 reflective – “Um, this one is not completed yet cause I want to adjust the layout to to be like aligned to the end a little bit. Just like this one. Um, so this is to do.”
- C3 reflective – “if this is a product that our teams gonna work on, I want to make sure the photos don't have any uh, copyright issues. Cause now I'm just downloading randomly from the Internet. Probably we need to have the photos from a reliable source.”
- C3 reflective – “And if that's a project that our team is working on, I want to make sure the color's not so random.”
- S2 concurrent – “And I think at this point it's just a matter of like tweaking the design.”
- S3 reflective – “Um, I think if anybody wants to edit it or use it probably would be useful to make it prettier. I mean like um more pleasing to the eye regarding design.”
- S3 reflective – “I think if I would have more time I would add, uh, probably pictures and some, some other examples like this one on the design side to make it more clear what I'm talking about, but as a, as, um, and also like for example, adding uh notes would be very useful.”
- S4 reflective – “Uh, so, you know, I think they'll, what we're gonna, what you would want to do is just, you know, show some images. Uh, you know, be sure to show images from primary sources, um the two plates, the image of pluto was shown.”
- S4 reflective – “So, I mean, I think what we would want to do is like, you know, talk about, uh, the order of the discovery of the planets, order of astronomy. What else would we?...”
- S4 reflective – “Then we'd want to talk about, um, uh, you know, showing images of sort of the modern conception of solar system. I mean, this is a big topic. I think you could probably do [unintelligible] because then you sort of go into the fly-bys and, uh, you know, various mechanisms, Voyager going to, um, Mars and so on and so forth, Jupiter, et cetera. So, you know, I think you could probably do a whole bit here about planetary astronomy, mmm. Uh. And Voyager et cetera. Um, but, um, you know, then there'd be sort of next steps, like, you know, there are actually robots on Mars, there are, you know, planned voyages to x and y, and then, you know, do we need people people out there or are our sophisticated robots enough. Um, and you know, there's, they're very telegenic the Mars rovers, so, um, you know, and then we can, oh, there's just so much to talk about, geez, then, you know, I think there would be a whole thing on, um, moons of planets, the large ones, the giant gas giants. [Unintelligible] and the Titan. [Unintelligible]. Pictures. Titan. Of Saturn. The only other body

with an atmosphere. Um, yeah. And then one thing, so we've talked about planets and then the moons. And then I think we probably want to talk about comets briefly. What are they. Or Asteroids. What are they. Where are they found."

- Process suggestions/opinions, or things to do just to be safe; tips
  - S1 concurrent – "It's also, it's also important for the team to know that, um, when you, when you're online you'll be like, I just came across this kid site. Um, so if you're doing any online research, please check the source."
  - C1 concurrent - "I forget if this is python two or three. So in Python two, this returns a list python three returns some iterable thing. So just to be on the safe side, putting a list around that."
  - M4 reflective – "Um, if we are going to save this model to be reused in other car parts, uh, would be a good idea to start building assets, uh, obviously all cars will have seats. Just move a little bit of [unintelligible: cvs?] here and there to be repurposed."
  - M4 reflective – "And when saving, make sure the naming is done properly and sequenced. So for example, carSeats001 or workInProgress001."
  - C2 reflective – "Uh, and then the rest is just using, uh, uh, important python things like, uh, this 'with' command 'with open(INPUT\_FILE' as a read only file. I like using this clause because I don't have to remember to close the file as soon as we exit this 'with' clause here, which lasts all the way to here. The uh, the file descriptor will be closed, so no resources are leaked that way."
  - C3 reflective – "And the other thing is for this, um, class dog. I originally didn't add the, uh, the visibility public. So, um, I want, I also want to other people to note that this is a keyword that must have to make, make the bindings work. Uh, I think that's all I want to say."
  - S2 concurrent – "oh, another thing too, what I always do is I'll just kind of get started on this, kind of save the file on my PC. Call it... On my desktop."
  - S2 concurrent – "And because I want to be able to put this where I want to put my text body for the other ones I usually just copy copy that text box into the other slides."
    - Later on says "Again I'm going to go in here and just copy this"
  - S2 concurrent – "Now it's all just text boxes so I can just go into text like that"
  - S2 concurrent – "Usually for these ones here I just try and make it light, not too much detail. I can tweak the text a little bit later."
  - C4 concurrent – "I'm gonna add this because I want to guarantee that it's an integer even though I'm dividing hours here."
  - S4 reflective – "So I mean, I always think it's important and interesting in the history of science to go back to primary sources. That's why I'm like, I'm trying to show the epicycle stuff here."
  - S4 reflective – "so these are important primary documents in the history of science. And I think that, um, generally the science that I grew up did a poor job of showing us the why. They would just tell us what happened. Um, but if we can go, um, back to the primary sources, that's always very good."

- S4 reflective – “Uh, so, you know, I think they'll, what we're gonna, what you would want to do is just, you know, show some images. Uh, you know, be sure to show images from primary sources, um the two plates, the image of pluto was shown.”
- Following/not following best practices
  - C1 concurrent – “I've heard a lot of people say not to use type names in variables but it helps me, so, take that.”
- Overview of work done
  - S1 reflective - “And then after I think we can go into some of the more Egyptian mythology, so that's the idea of this slide here, Orion The Warrior”
  - S3 reflective – “But pretty much what I did is just, um, going through the design thinking, the design process for design thinking. So, um, it follows a clear pattern. And then for each slide, um, which is not a title slide I, I added some information that I thought would be useful to understand better that, um, that stage of the process.”
- What the user is currently doing/about to do; intermediate goal; maybe will include approach for achieving it
  - S1 concurrent - “So I'm gonna add some new slides here”
  - C1 concurrent - “Yeah, so I might as well start with creating a test file so that if I'm going to be organizing words, might as well have some words in here.”
  - C1 concurrent - “I'm going to do the counting part now, or I guess counting on organizing by letter”
  - C1 concurrent - “so I'm gonna start with the most basic form, which is sorting everything, even though there's multiple words, just to make sure that works. That works, so, great.”
  - C1 concurrent - “So might as well do something here” [Talking about where in the code file to write some code
  - M1 concurrent - “so I'll start just like building here and I'll just build up and if you imagine this would be like a lens, just like sitting on his front end, an element that could like go in here, but I'm just going to basically play with cylinders and stuff like that.”
  - M1 concurrent - “starting to add some details now”
  - M1 concurrent - “So I'll make the inside a little bit smaller”
  - M1 concurrent – “So I'm gonna move this out of the way just so I can see how it aligned”
  - M1 concurrent - “What I'm thinking here is I want to create a bit of like a spherical rounded front to the camera. So I'm going to make just a little lip here”
  - M1 concurrent - “This is just aesthetics now”
  - M1 concurrent - “Then group them.”
  - M2 concurrent - “Maybe I'll move this”
  - M2 concurrent - “Making countersinks now for the [unintelligible] that will bolt to the table.”
  - M3 concurrent - “Um, so basically I'm trying to shrink the, sort of thickness of this arm here or maybe it's worthwhile to extend it, uh, or extend like the

[unintelligible: later] bits of it, I think I'll just try to make them match the shoulder a little bit cause this guy's very, um, very not proportional."

- M3 concurrent - "Just increasing the brush size in order to capture more realistic, yeah, this is good, probably lower it down to three."
- M3 concurrent - "Gonna smooth that edge out at least till the line and use 'flatten' instead"
- M3 concurrent - "Add a little bit right here. Flatten here"
- M3 concurrent - "Should probably try to get to some uniform volume in here."
- M3 concurrent - "Just gonna, try to even them out from the sides too."
- M3 concurrent - "it's got this weird shape that I'm trying to even out."
- M3 concurrent - "Just gonna see if I can try to protect it somehow. No [clicks tongue] or maybe I'll do this. Trying to select the specific area I wanna work with as opposed to exposing all of it. There we go, let's see if that makes it better or easier. Nope. That does not do anything."
- M3 concurrent - "I'm just gonna try to scale ahead of here, and turn off mirroring. There we go."
- M3 concurrent - "I just want to try to select the head as opposed to other things. There we go. Now I can finally scale it down. Oh, no, I can't."
- M3 concurrent - "basically gonna keep sculpting until I can get to a point where I have to scale the head down again"
- M3 concurrent - "Again, just trying to give him a more... [unintelligible: sort of local around?]....[unintelligible: fewer of?] those bumps."
- M3 concurrent - "[unintelligible] this line going through so I'm just trying fix that, this dividing line."
- M4 concurrent - "so I'm just trying to get the bulk shape in place, probably going to need more details afterwards... Just to get the main shape in."
- C2 concurrent - "So the next part of this program is to collect uh user input for what file you want to sort. So here I'm just uh prompting the user. Now I want to make sure that the results that I got are actually a file that exists. So that's easy. [types some code, and says it under his breath ('if os.path.exists... input text')]. So if it's not a path it'll tell me while it doesn't exist. [says under breath while coding/about to write some code: exists.... text]"
- C2 concurrent - "Uh, so I kind of want to put this in a loop where, um, I continue to ask for input text until I get a path that exists and uh, otherwise I should just exit or have a, have a key to exit. So I'm going to change this a bit. Put in here this 'q to exit', right, uh, [says under breath as coding: if input text is equal to q, exit 0, else, if it doesn't exist, we need to redo this again. So this should be some kind of while loop."
- C2 concurrent - "So while the input's not valid, we ask for a file. If the input resulted in 'quit' then we exit."
- C2 concurrent - "If the input's valid... [types] True. [unintelligible] In here else if the path does not exist, we can say here 'print input is not a valid file path'."

- C2 concurrent – “so now here we are, where the path does not exist, we're going to assume that it's a valid path [types + speaks comment: "assume the user gave a valid path"]
- C3 concurrent – “So I want to create a new component to start.”
- C3 concurrent – “And now I want to create a class called dog that will include the name of the dog that I'm gonna display the picture for and uh, probably a link to the image.”
- C3 concurrent – “Mhm and I want to have a list of dogs that I can display”
- C3 concurrent – “I guess I'm gonna download some images.”
- C3 concurrent – “I just created a div for, that's going to be a container and I want to have a, display every dog's image and also their information and so I'm going to use uh, a part from Angular material.”
- C3 concurrent - “I'm going to create a card for every dog I have so I want to use ngFor, again I want to make sure this syntax is correct”
- C3 concurrent – “And I want to have a little icon for every dog.... I have the link to the image for every dog, so I can use that.”
- C3 concurrent – “Now I'm going to add the card content”
- C3 concurrent – “Then maybe show a large photo for that dog”
- C3 concurrent – “I'll just use the same picture to make it simple.”
- C3 concurrent – “And now I'll adjust the layout a little bit.”
- S2 concurrent – “so maybe part of it is, you know, you have to have like, uh, some template that will kind of get you started. So I'll just kind of check use this darker theme here and hit create and then I'll just say my, bike for HR approval. Ehhhhh. [Participant name].”
- S2 concurrent – “Need to Google some images. Google some images. Images. We need some images to put in the slides.”
- S2 concurrent – “I'm going to take out this.”
- S2 concurrent – “Because this is a white background, I'm going to maybe insert a nice white box because...”
- S2 concurrent – “Delete that”
- S2 concurrent – “Fill. White.”
- S2 concurrent – “So now I have to make a couple of slides just to start off so I don't make any mistakes. So I have like kind of like the starting ones so I can paste a couple of sides in. It's gonna be my template.”
- S2 concurrent – “And cause it's for work, maybe I'll put down like extracurricular. And then proposal. I can delete that one.”
- S2 concurrent – “So I'm going to quickly, kind of drag this image in here, make it a little bit bigger or something like that.”
- S2 concurrent – “I need to insert another text box.”
- S2 concurrent – “I need to need to type something in there. Make the text black.”
- S2 concurrent – “So I'm just kind of prepping my image here.”
- S2 concurrent – “so I'll like maybe I'll do bike trail Toronto. Scenic images”

- S2 concurrent – “it this looks like there's a bad text box. So I'm just gonna delete that.”
- S2 concurrent – “And in this case I'm just going to again retweak this.”
- S2 concurrent – “So this case, I'm going to copy this text box because it's now a bit more bigger, and I'm just going to delete it. This test box and just repaste that you know, it's like mountain bikes to [spelling? Sayokayso].”
- S2 concurrent - “Again I'm going to go in here and just copy this”
- S2 concurrent – “Again, I'll just I'll bullet these now really quickly.”
- C4 concurrent – “gonna start writing the function that will actually modify the, the divs to display whatever value it is”
- C4 concurrent – “Now I'm gonna add a slightly different, uh, thing. As an example for one of the segments in it, so 2 has a [unintelligible: lab top?].”
- C4 concurrent – “And let's make it actually update. It should probably be done with a, uh, request frame, but I'm just going use setTimeout.”
- C4 concurrent – “So, until we add a few more digits, this will not work. So I'm just gonna add, fill in a few more digits.”
- S3 concurrent – “Yeah, sure. Um, so, um, yeah, I actually, um, I'm almost at the last stage of the process, so, um, now I'm editing the, the prototype section and I was just trying to think about other methods for to decide how to, which idea to prototype.”
- S4 concurrent – “So this becomes sort of a thinking about what am I want to do, table of contents. So I can sort of say, um, alright, so let's say what we'll cover”
- S4 concurrent – “So we can say something like, um, the planets have been known since ancient times, moving stars, um, visible ones visible at night against a field of more-or-less fixed stars”
- S4 concurrent – “And this is like, um, anyway, it's super cool that there was this astronomical computer, um, with gears, tooth gears and wheels in ancient Greece. Um, so 87 BC, so 2000, 1500 years before this happened. Um, anyway, so, um, were known, so I guess, you know, with a high degree of accuracy and that's where I probably put the sidebar”
- S4 concurrent – “Alright, Copernican, Galileo, so let's throw it an image in just for the fun of it. I want to do something [unintelligible]”
- S4 concurrent – “Just stick that in there. Actually, I'll just make this a new slide. Well, I'll just stick that on here anyway.”
- S4 concurrent – “And then I'll just throw a text box in here.”
- S4 reflective – “Cite for the Pluto plates”
- Speaking verbatim what they're currently typing, or the action they're performing
  - [This also happened for coding tasks]
  - S2 concurrent – “I'll just say my, bike for HR approval. Ehhhhh. [Participant name].”
  - S2 concurrent – “Insert shape”
  - S2 concurrent – “Fill. White.”
  - S2 concurrent – “Design. Insert”
  - S2 concurrent – “Undo, undo.”

- S2 concurrent – “Proposal Features”
- S2 concurrent – “Mountain bike. Shimano. Images.”
- S2 concurrent – “Save Image as. Desktop. Shimano.”
- S2 concurrent – “Cool places to ride”
- S2 concurrent – “<Company-anonymized>, um, supports being healthy. You can use your health benefit to get a bike.”
- S2 concurrent – “mountain bike, good for street and trails, entry level parts.”
- C4 concurrent – “Digit 0. Oh.”
- S4 concurrent – “Um, so, okay, so then you can just make new slides with something like history of discovery.”
- S4 concurrent – “So we can say something like, um, the planets have been known since ancient times, moving stars, um, visible ones visible at night against a field of more-or-less fixed stars”
- S4 concurrent – “Venus Mars Jupiter Saturn”
- S4 concurrent – “although it certainly isn't the only, um, it wasn't the only such translator or, paste you, Antikythera”
- S4 concurrent – “With a known high degree of accuracy, predicting such things... Conjunctions, astrology, position, planets”
- S4 concurrent – “European... solar system post....”
- S4 concurrent – “Copernican first published account of.... solar system um. Built. Ruled for 1000 years. Copernican.”
- S4 concurrent – “Dialogue Concerning the Chief World Systems, right.”
- S4 reflective – “Uh, so, you know, I think they'll, what we're gonna, what you would want to do is just, you know, show some images. Uh, you know, be sure to show images from primary sources, um the two plates, the image of pluto was shown.”
- S4 reflective – “Uh, other interesting facets such as, uh, early telescopes how they compare to [unintelligible].”
- Making a quick, maybe arbitrary decision
  - S2 concurrent – “Sure. This one.”
  - S2 concurrent – “Sure I'll put this in there.”
  - S3 concurrent – “So um actually, I'm trying to make it nice, but these are not very, uh appealing. Um, yeah. Okay. Let's go with this.”
  - S4 reflective – “So, Herschel and let's just call it 1781.”
- Trying to make the artifact (e.g., slides) more fun/interesting
  - S4 concurrent – “Alright, Copernican, Galileo, so let's throw it an image in just for the fun of it. I want to do something [unintelligible]”
- Simplification/trick they're using, or something that's messy/probably not ideal
  - C3 concurrent – “I'll just use the same picture to make it simple.”
  - C4 concurrent – “This can probably be put into a loop, an array at some point, but for now this is probably faster for me to do since I have limited time to get something working.”
  - C4 concurrent - “Very messily remove all the other classes”
- Uncertainty about content

- S2 concurrent – “Um, best place. I don't know if it's the best, but I'll just put it as best place to get biking supplies.”
- C4 concurrent – “I'm removing this, uh, uh, let's not remove this yet because I'm not sure if I'll need it or not.”
- S4 concurrent – “This is like Ptolmaic. I don't know if I'm actually saying that right, so I'm just gonna go look”
- S4 concurrent – “Hmm, I don't know if I can do a fixed-shifting. That's pretty good.”
- Saying what can be modified
  - S1 concurrent - “So I'm just going to leave these here, write 'Mythology' on them, feel free to change the title to whatever makes sense”
- Encountering an error/mistake or an edge case, something unexpected, and possibly making a fix
  - S1 concurrent - “Also just realized, I forgot to put the, how old it is in the facts, and do that now.”
  - M1 concurrent - “Probably way too big. Just gonna make this smaller.”
  - M1 concurrent - “Let's see. It looks like it's a little oblong”
  - M2 concurrent - “Little rough around the sides”
  - M4 concurrent – “ooh, we have a bug”
  - C2 concurrent – “So this is going to loop until we get uh input valid is True, which only happens if the user types in Q to exit or, uh, provides a path that exists, not only should it exist, it should also be a file.
  - C2 concurrent – “So that's looking good so, let's try that as it is. Oh, forgot a paren there”
  - C2 concurrent – “Ah okay. So here's a little caveat. Need to find out if it exists if it exists, it could be a directory. So in that case we need to”
  - C3 concurrent – “I probably made a mistake in the constructor here, so it didn't load properly.”
  - C3 concurrent – “The last one didn't look properly so I'm going to check, uh yes [unintelligible] Going to name it as jpg.”
  - C3 concurrent – “That's too large now.”
  - S2 concurrent – “Maybe not this one. I want a square box”
  - S2 concurrent – “Cool places to ride. Ride in Toronto. Or maybe I'll do T.O. to make it fill nicely.”
  - S2 concurrent – “So maybe, oh I don't want this. I can just delete it. It's fine.”
  - S2 concurrent – “so, um, type oh, text is white, so I'm gonna change that.”
  - S2 concurrent – “Oops.”
  - S2 concurrent – “Uh, in this case I'm going to look up Mars because Mars, I need the Mars logo. Mars district. Here you go.”
  - C4 reflective – “But then I realized I needed a middle segment and I probably should write this in a much nicer manner rather than copying and pasting all this code. So I started creating some functions, um, to, uh, uh, to generate each one of the displays in the digital clock.”



- C4 concurrent – “Looks like not all my borders are getting set. Um, so I'm currently having an issue. It's not setting, um, all my borders and I'm not exactly sure why.”
- C4 concurrent – “Oh wait. Because that's not how border-width works. Um. Instead, let's do it a different way.”
- C4 concurrent – “And that's getting moved to the top because the [unintelligible] order. Oh that's not right.”
- C4 concurrent – “Oh yeah, that becomes a problem. I should not have done it with a single second in between because I can't control the segments on the right side. Um, but okay. Let's just leave it that for now. It'll be a slightly stylistic clock.”
- C4 concurrent – “Sorry it's setInterval not setTimeout”
- S3 concurrent – “No”
- S4 concurrent – “Oops, sorry, that's not heliocentric, that's geocentric. This is heliocentric.”
- S4 concurrent – “Oops.”
- S4 reflective – “Um, oh yeah. There's the mathematical thing model of distances. And what is that mathematical of the solar system called? It's been awhile. Yeah. It is called [inaudible]. Celestial mechanics. But there was this thing that actually, no, it's not quite what I meant. There's, um, that's not what I wanted. There's actually a formula of the distance of the planets. Which I remember learning about, um, Titus-Bode law. That's the one.”
- Doing some cleaning/refactoring of the artifact (e.g., the code)
  - C4 concurrent – “I'm just rearranging the code a little bit to make it a bit neater.”
- Retrying something
  - S2 concurrent – “Try that again. Design. Insert ... is it under Home, I need a text box...Oh yeah, there it is.”
- Changing/deleting something existing (e.g., code) due to some change in needs or creator having better clarity
  - C2 concurrent - “Uh, alright, so now we have an input file. So we're not going to need these two lines.”
- Talking about a change/refactoring that needs to be made (i.e., due to change in requirements)
  - C1 concurrent - “So initially we did that, but because we're putting it into a dictionary here, the sorting is kind of not doing anything. So instead, I'll do, I don't know, pretty print or something? Yes. What am I gonna do? Gonna do both the prints and count at the same time.”
- Planning, decision making, thinking
  - S1 concurrent - “It's interesting. It seems that there's some old, some contested beliefs about when it was built”
  - C1 concurrent - “So instead, I'll do, I don't know, pretty print or something? Yes. What am I gonna do? Gonna do both the prints and count at the same time.”
  - M2 concurrent - “I guess I should first decide what part I will nest on this fixturing plate. Uhhh I'll just say we'll put a bunch of these on there.”

- M2 concurrent - "Alright, we will have to do something other than patterns."
- M3 concurrent - "Um, so basically I'm trying to shrink the, sort of thickness of this arm here or maybe it's worthwhile to extend it, uh, or extend like the [unintelligible: later] bits of it, I think I'll just try to make them match the shoulder a little bit cause this guy's very, um, very not proportional."
- C2 concurrent - "So this should be some kind of while loop. MMM. Let's see how we can do it, 'while', let's say, clear the input text variable... 'while'... let's say 'input valid' is false, and while not input valid, we're going to stay in this loop."
- C2 concurrent - "Let's see if there's a way we can do this even better."
- S2 concurrent - "So I'll put down like maybe this one will be for features. Or proposal."
- S2 concurrent - "So now I have to think about what I want to talk about. So this is the proposal. Maybe this one would be like features. My bike. Features. Uh. Cool places to ride. Ride in Toronto. Or maybe I'll do. T.O. to make it fill nicely. We got proposal, features, cool places. Spare parts slash service."
- S2 concurrent - "So what do I want to type in here. We'll just put down."
- S2 concurrent - "maybe I'll Google another image. It's a mountain bike. Features."
- C4 concurrent - "I'm removing this, uh, uh, let's not remove this yet because I'm not sure if I'll need it or not."
- C4 concurrent - "Oh wait. Because that's not how border-width works. Um. Instead let's do it a different way."
- S3 concurrent - "now I'm editing the, the prototype section and I was just trying to think about other methods for to decide how to, which idea to prototype. So actually I think I might Google this, but I don't know if, um, so if the goal is just to have some, and I probably would, just keep these two that I already added and, yeah, I think I'll just go and, um create the, the last part so I can be done with that."
- S4 concurrent - "So I'm just thinking about how to approach the subject, um, and just sort of making notes to myself about what I might want to, you know, talk about in the guise of, you know, in the guise of making a subtitle. So this becomes sort of a thinking about what am I want to do, table of contents."
- S4 concurrent - "Um, so, okay, so then you can just make new slides with something like history of discovery."
- S4 concurrent - "So then we would probably say something about, you know, heliocentric versus, you know, so competing theories of, um, planetary movement"
- S4 concurrent - "You know what, I'm going to actually create a source cited, uh, so this'll be useful for people who, whoops, that'll be useful for people who want to [unintelligible: follow along...?]"
- S4 concurrent - "But if I go here and talk about, let's see, Ptolmaic astronomy, um, so geocentrium. So Ptolmaic is, okay."
- S4 concurrent - "Just stick that in there. Actually, I'll just make this a new slide. Well, I'll just stick that on here anyway."

- S4 concurrent – “Um, I have a whole bunch of stuff on antikythera mechanism. What is this thing? Yeah. Da da da. So it's actually showing when various, maybe this isn't the best one to do. There are other ones. Yeah. I do you want to talk about Venus. That's the eclipse mechanism to Saros Cycle. MMM. Yeah. There are pointers for each of the planets. I think that'll probably be enough, so.”
- S4 concurrent – “I should put a nice little drawing of that in there. [Unintelligible: that'd be fun?].”
- S4 reflective – “I think I can probably just pluto...”
- S4 reflective – “Then I would probably go a little farther and then talk about the organization of the solar system.”
- Skimming/reading the web for relevant content
  - S4 concurrent – “Dah dah dah dah. Earth. Here's the, um, dah dah dah dah [unintelligible] heliocentric. Okay. So Galileo and Kepler, which is the two ones I wanted to get to.”
  - S4 concurrent – “Dialogue Concerning the Chief World Systems, right.”
  - S4 concurrent – “Um, I have a whole bunch of stuff on antikythera mechanism. What is this thing? Yeah. Da da da. So it's actually showing when various, maybe this isn't the best one to do. There are other ones. Yeah. I do you want to talk about Venus. That's the eclipse mechanism to Saros Cycle. MMM. Yeah. There are pointers for each of the planets. I think that'll probably be enough, so.”
  - S4 reflective – “Yeah no wonder I didn't [unintelligible murmuring, gal blah blah blah] honor goes to Galileo, huh, that's cool.”
  - S4 reflective – “Discovery of the, pluto discovery plates,”
  - S4 reflective – “Um, oh yeah. There's the mathematical thing model of distances. And what is that mathematical of the solar system called? It's been awhile. Yeah. It is called [inaudible]. Celestial mechanics. But there was this thing that actually, no, it's not quite what I meant. There's, um, that's not what I wanted. There's actually a formula of the distance of the planets. Which I remember learning about, um, Titus-Bode law. That's the one.”
- Realization
  - C4 concurrent – “So yeah, I'll need the mapping.”
  - C4 concurrent – “Oh wait. Because that's not how border-width works. Um. Instead let's do it a different way.”
  - C4 concurrent – “Oh yeah, that becomes a problem. I should not have done it with a single second in between because I can't control the segments on the right side. Um, but okay. Let's just leave it that for now. It'll be a slightly stylistic clock.”
  - S4 concurrent – “Um, oh, that's why it didn't work, because there was no return there.”
- Testing/trying something out; checking the accuracy of something (e.g., by googling)
  - C1 concurrent - “Just to check, I think the default split will split by all white space. So that's what I'm doing now. Yep.”
  - M1 concurrent – “Just make sure it's not going inside the envelope of the, the inside at all.”

- C2 concurrent – “So that's looking good so, let's try that as it is. Oh, forgot a paren there”
- S2 concurrent – “That's bulleted, bulleted.”
- C4 concurrent – “I'm just going to make it incomplete for now so we can test a couple digits.”
- C4 concurrent – “That should work”
- S4 reflective – “Um, I don't think that was true of Uranus just let me check that. Uhhh, yep. As a comet. Okay. Right. Okay.”
- Prediction about the outcome (e.g., of some code)
  - C1 concurrent - “And then this should return a dictionary” [noted before running the script]
- Checking their work
  - C2 concurrent – “So I'm just running through the logic myself again, we sorted and now we need to find a valid file...[continues on]”
- Explanation of program input/output
  - C2 reflective – “Uh, so, uh, for testing, I have this input file here, but uh, in the completed program, the text is going to come from, um, the user input. We'll provide a file for input and maybe a file for the output.”
- Indicating that something is done now, or commenting on the output
  - C1 concurrent – “Cool. So those are the words.”
  - C1 concurrent - “Cool. There's two the's, exciting.
  - M3 concurrent - “Uh let's see yeah okay that will do”
  - M3 concurrent - “There we go. These arms are finally becoming chunkier”
  - M3 concurrent – “ok cool”
  - C2 concurrent – “Then if that works, then we're good.”
  - C2 concurrent – “Uh, alright, so now we have an input file.”
  - C3 concurrent – “Yes, yes I got names.”
  - S2 concurrent – “So I think that's good.”
  - S2 concurrent – “Save image as Mars. Done”
  - C4 concurrent – “That should work”
  - C4 concurrent – “That's better.”
- Explanation for why they're doing something (for functional or stylistic reasons)
  - C1 concurrent - “Here I'll have a separate variable. Makes it easier for changing things later.”
  - M1 concurrent – “So I'm gonna move this out of the way just so I can see how it aligned”
  - M3 concurrent – “I just want to try to select the head as opposed to other things. There we go. Now I can finally scale it down. Oh, no, I can't. Hhm. Of course.”
  - S2 concurrent – “And cause it's for work, maybe I'll put down like extracurricular.”
  - S2 concurrent – “That was a little tricky there, but because I my my I have a white background, I have to tweak this a little bit. So now it has the right colored text.”

- C4 concurrent – “And that's getting moved to the top because the [unintelligible] order. Oh that's not right.”
- S2 concurrent – “So here, you know, so the basics of, I always like trying to make it smaller. Focus on that.”
- S2 concurrent – “So part of this here I want to maybe make a consistent slide.”
- S2 concurrent – “And I want to put in a text box over here so that it's all the same in every slide.”
- S2 concurrent – “Having images is important I always find it, it makes the description a little bit easier when you're trying to convey the idea.”
- Explanation of what a current action enables
  - M1 concurrent - “I guess for this I want to group these so now I could do something like actually move this whole thing forward”
  - M2 concurrent - “So I was creating a reference here to match with the table that's on the machine. So I'm gonna use this to integrate onto the machine table itself and they have alternating goals on 20mm centers”
- Questions/comments related to study environment
  - S3 concurrent – “now I'm editing the, the prototype section and I was just trying to think about other methods for to decide how to, which idea to prototype. So actually I think I might Google this, but I don't know if, um, so if the goal is just to have some, and I probably would, just keep these two that I already added and, yeah, I think I'll just go and, um create the, the last part so I can be done with that.”
  - S3 concurrent – “Do I have to say like, what am I'm doing? Or just additional comments?”
  - S3 concurrent – “Um actually, I want you to ask if it has to be like useful or just, [unintelligible: look nice?], or just, um, I can, create whatever and it doesn't matter.... No, what I should so like for the whole presentation, is it like, its purpose is to be informative or look nice.”
  - S3 concurrent – “Um, yeah. I don't know if that answered the, the second part, but yeah.”
  - S4 concurrent – “antikythera mechanism, you ever heard about that?”
  - S4 concurrent – “You heard of that before or you're not supposed to say anything during this?”
  - S4 concurrent – “Hope this wasn't too boring for you.”
  - S4 concurrent – “usability type setting to watch us do very boring things. This feels boring to me. I mean, even though I love the subject”
  - S4 concurrent – “Yeah. You probably want to, okay.”
- Meta comments about think-aloud
  - C1 concurrent - “I don't have any comments for this, just uh, reading some text, I mean making it into a function, nothing too special.”
  - C1 reflective - “So where do I start? I guess, well, since I wrote more comments, I know where I started with that.” [Trying to figure out the first thing he hadn't explained yet (i.e., first thing from this 15min chunk)]

- C1 reflective - "Um, what did I want to do?" [trying to remember what he did, in order to reflect on it]
- C1 reflective - "in this function, all I did was take the dictionary keys and order them and print it out. I guess. Yeah. There's not much to say there."
- M4 concurrent - "Sorry, I'm not talking"
- C4 reflective - "Um. That's basically it."
- S4 reflective - "Uh, yeah. So I mean that's the, that's the note I would want to make"
- S4 reflective - "I don't believe in just talking, I have to write it down"
- S4 reflective - "So maybe that's all I wanted to say."
- Meta discussion about conveying a design, handing it off to others
  - M1 concurrent - "this would be a pretty tough thing to convey if I was going to hand it off. Um, because it's just sort of like a process of like validating a design idea. It's not actually like I'm not actually making this for manufacture yet."
  - M1 concurrent - "So like if I was collaborating on a project to someone, you might want to try to walk them through the way that you thought about the problem in order to solve it."
  - M1 concurrent - "if I was going to pass this on, I would probably..."
  - M1 concurrent - "So if I was going to like, sort of set this up in a way where a bunch of designers, could work on it, I'd probably try to think of it more modular way where I would lay out like, you know, here's the size for the backslide and that and just a couple of parameters that would change depending on if anything changed"
  - M1 concurrent - "so I guess part of this would be, would be sharing that type of information and explaining like, um, you know, this piece here, you know, is a real world thing that I purchased in this thing. Here is something that I purchased and everything else is sort of me figuring out how to fit those pieces together, the right sort of spaces and volumes between"
  - M1 concurrent - "So I guess if I was to pass this off. I would probably figure out the distances that needs things to be able to move forward and back and then mark them off in some way. Just like indicators of minimal maximal focus range. Um, but realistically I would probably do that with trial and error. I would don't think I do that, like with math, I'd probably build prototype and then just test it. Just, just figure out where the focuses are and then just make marks on them. I don't think I'd actually capture that in the cad"
  - M1 concurrent - "Like I guess if I was passing us off, I probably want a way of like annotating things like adding notes on stuff. Um, it'd be really useful cause like right now if I was, you know, going to pass on any of this, I would, I would have like a, you know, a cad file like this, but I would also probably pass along in the email or like a note or something. I'd be like, Oh, you know, you know, here's some notes on the sizing. Or here's the order of operations that did stuff in or, or whatever. But it'd be really nice to be able to sort of have that more in context. So you know, it even if I had like a timeline or had some sort of way of like

adding in some notes to explain like where things were or how they got there. Um, that would be useful tool here to, to pass along information.”

- M1 concurrent - “if I was going to pass this on, I would probably want to think of it more like a modular kind of way. So you'd say like, Oh, you know, this is a component and no matter what size the cameras, you know, this is how this component fits that. And then you'd have a parameter that says, okay, the cameras, you know, a B or c size. And depending on that, it would change, um, like how this aligns to the middle, but it wouldn't change sort of this component that would be the same.”
- General discussion of creation process
  - M1 concurrent - “In the past when I've done sort of three d printed cameras or, or laser cut cameras, a lot of it is sort of a trial and error process. Like you might lay out your, like figure out the rough ideas like, oh, if the lens is here in the film's here, this is how much space I'm going to need and I'm going to need this much movement through that space for focusing. So you know, the sheet is going to need to be this big and, and you just sort of work through the math just, you know, with a physical object help make those kinds of decisions, which probably is more an indication of sort of how I think and how I worked through problems.”
- Environment config, or basic software interactions
  - C1 concurrent - “Tabs need to be replaced by spaces”
  - C3 concurrent – “So I've already created an empty angular application for me to get started. So it's just an empty one.”
  - C3 reflective – “And another thing is I'm using like angular material. So I'm importing a lot of modules from Angular material, um, but if other people have to work on it, um, so first of all, the installation or setup guide is not that easy there are four to five steps that, uh, I have to follow. So I did some, uh, I downloaded some package and also, uh, imported some modules to make the Angular material components like card and angular style patterns work and for every, um, for every material component that I imported I want to use that was imported here and uh, also declare that in the input section.”
  - S2 concurrent – “But anyways, I will reopen this file.”
  - S2 concurrent – “I'll just go full screen now so I can see it a little bit better.”
  - S2 reflective – “If I was to, you know, redo it again, I would probably, for me, I mean I went and saved a lot, but you know, maybe in the future, if I was doing it locally, I would probably maybe go to properties and change it to read only so that if I hit save it would save versions of the file. But you know, that's okay. But I think for me the biggest step, you know, because I use a lot of with office products, which is nice, I can upload it to the cloud and then share it with people and, and usually when it's in the cloud you can, um, you can save versions of the file. So you know, the good thing is anyone you know I created a folder and then basically I can share it with anybody. And then this file, you know, it'll version automatically in the cloud so anyone can edit it, which is a nice thing. So they can be basically use the same template over and over again, in the cloud.”

- S2 reflective – “I think Google cloud, I would, you know, the Google apps like in the cloud would have the same idea, but, you know, initially I did it locally and then once I'm kind of okay to finish it, you know, put it in the cloud and then other people can look at it. It's as they need to. But yeah it just depends, depends on who, what they're what app they're really good at, you know, [unintelligible].”
- Discussing how they would share their artifact with others, collaborate with others
  - S2 reflective – “If I was to, you know, redo it again, I would probably, for me, I mean I went and saved a lot, but you know, maybe in the future, if I was doing it locally, I would probably maybe go to properties and change it to read only so that if I hit save it would save versions of the file. But you know, that's okay. But I think for me the biggest step, you know, because I use a lot of with office products, which is nice, I can upload it to the cloud and then share it with people and, and usually when it's in the cloud you can, um, you can save versions of the file. So you know, the good thing is anyone you know I created a folder and then basically I can share it with anybody. And then this file, you know, it'll version automatically in the cloud so anyone can edit it, which is a nice thing. So they can be basically use the same template over and over again, in the cloud.”
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- Things to keep in mind, or that would need to be changed, for different environments, different configs, different materials, different parameters; or explaining that something was built to allow flexibility or satisfy some requirements wrt other parts/objects
  - C1 concurrent - “I forget if this is python two or three. So in Python two, this returns a list python three returns some iterable thing. So just to be on the safe side, putting a list around that.”
  - M1 reflective - “So if you're going to change this from like a four by five camera to an eight by 10 camera or something, a lot of that would have to be driven from the internal shapes and the internal volumes that are required. So you just start off saying like, oh, I know exactly, you know how big I need this back piece to be. And that could be, that could drag a lot of the other elements of the design.”
  - M1 reflective - “the opening of the front of the camera would depend on the lens you're using. So you'd want almost have this be a parameter that can be driven by not only the film size, but also what lenses you're going to use”
  - M1 reflective - “okay, so if this camera's being set up for, you know, eight by 10 film, it's going to need a, you know, a type three Copel shuttler shutter or something. So you'd end up having all these parameters that would be driven by sort of your intended use of the design.”
  - M1 reflective - “So you need to work on all the tolerances and all that would depend on your manufacturing methods. So if you're going to go and you know



three d print this, your, your tolerance has to be a little bit different than if you were going to make it out of plywood with the laser cutter and assemble it all together.”

- M1 reflective - “So if you were going to go and make this out of like orange plywood or something, it should all kind of fit together or if you're going to make it a thicker wood, same kind of thing”
- M1 reflective - “So if they went to change something like what the stock was they were going to use, they would need to adjust all these measurements because they've been sort of designed with, with a certain stock in mind”
- M2 reflective - “I've patterned the tool holders themselves wide enough to make sure we have a bit of clearance.”
- M2 reflective - “Sometimes the front, which is not modeled here, can be a little bit wider. So leave a bit of a buffer of five to 10 millimeters between each piece.”
- M2 reflective - “if we wanted to get tight clearance, that would work. If you want it to be a little bit looser than we can offset these faces in order to make a little bit of a looser fit, make them easier to take in and out.”
- M2 reflective - “the hole placement for the mounting in the bottom was to match the drawers that these will be going into. There are a hole pattern on the drawers themselves. So we can adjust that hole better as need be.”
- M2 reflective - “And then otherwise, uh, I made sure not to go too deep on this extrusion on the back because they are, again, not modeled, um, but there are a, there's a pullstub that, that comes off the back here, so I'm making sure that we keep below half in order to leave a bit of room in the holder itself.”
- M2 reflective - “And then last thing is just making sure this, so we did six wide and that's to match the width of the drawer itself. So again, just pattern based on the gap between each piece. But we want to make sure that we can set this in the drawers. So that's why we kept it at six.”
- Explaining decisions related to manufacturing intentions and needs
  - M2 reflective - “I made sure to leave at least three millimeters for all the of the finished surfaces because this will be three d printed and we want to make sure we have enough material to actually keep the strength in it.”
- Commenting on the state of something (e.g., variable/input arg, model feature)
  - C1 concurrent - “So yeah, from the dictionary it has all the words in it and how many counts.”
  - M3 concurrent – “The head still needs to be scaled down, but his torso is looking ok, at least more acceptable than before.”
  - C3 concurrent – “That's too large now.”
  - C3 concurrent – “Okay. Still doesn't look very good.”
  - C4 reflective – “Um, it's currently in a state of transition between one design, one style and the other.”
  - C4 concurrent – “So, until we add a few more digits, this will not work. So I'm just gonna add, fill in a few more digits.”
- Sharing their opinion about the state of the artifact
  - S3 concurrent – “Okay no.”

- S3 concurrent – “So um actually, I'm trying to make it nice, but these are not very, uh appealing. Um, yeah. Okay. Let's go with this.”
- S4 concurrent – “Hmm, I don't know if I can do a fixed-shifting. That's pretty good.”
- S4 concurrent – “It doesn't take a long time to actually do something interesting about this.”
- S4 concurrent – “Looks stupid....Don't need to worry about it.”
- Sharing opinions/facts about the content; tangents about content
  - S4 concurrent – “Um, and then I'd want a sidebar something about like, um, the, um, antikythera mechanism, you ever heard about that? That thing is super cool. Um, they actually, it was actually made in ancient Greece and it traces the movements of the the, uh, antikythera mechanism”
  - S4 concurrent – “Um, it's, so it was to predict astronomical positions and eclipses. It actually had gears that they made themselves. And this is like, um, anyway, it's super cool that there was this astronomical computer, um, with gears, tooth gears and wheels in ancient Greece. Um, so 87 BC, so 2000, 1500 years before this happened.”
  - S4 concurrent – “And this is like, um, anyway, it's super cool that there was this astronomical computer, um, with gears, tooth gears and wheels in ancient Greece. Um, so 87 BC, so 2000, 1500 years before this happened. Um, anyway, so, um, were known, so I guess, you know, with a high degree of accuracy and that's where I probably put the sidebar”
  - S4 concurrent – “although it certainly isn't the only, um, it wasn't the only such translator or, paste you, Antikythera”
  - S4 concurrent – “It's really a big topic”
  - S4 concurrent – “You know, he did, he did really cool sketches of this stuff.”
  - S4 reflective – “I think this kind of blew my mind, but I learned about the Antikythera mechanism that the fact that Ancient Greece had something like this.”
  - S4 reflective – “Discovery of the, pluto discovery plates, very famous bit in the history of science. Um, so that, you know, he could, he could actually point out that this tiny little speck had started here and ended up here after a couple of days. Um, so that's a pretty cool thing.”
  - S4 reflective – “You know, we grew up with nine planets then it's become”
- Short utterances, talking to self
  - C1 concurrent - “So, let's do that.”
  - M1 concurrent - “What do I want to make”
  - M1 concurrent - “So that's coming together pretty well”
  - M4 concurrent – “Okay”
  - C3 concurrent – “Ok, um.”
  - C3 concurrent - “Public”
  - S2 concurrent – “Sure. This one.”
  - C4 concurrent – “Oh”
  - C4 concurrent – “Cool”

- S3 concurrent – “Okay no.”
- S4 concurrent – “I really hate this, I really hate windows 10.”
- S4 concurrent – “Um, so, okay”
- S4 concurrent – “Oh, [unintelligible: where/why] did I go there?”
- S4 reflective – “Cool stuff”
- S4 reflective – “Um, oh yeah. There's the mathematical thing model of distances. And what is that mathematical of the solar system called? It's been awhile. Yeah. It is called [inaudible]. Celestial mechanics. But there was this thing that actually, no, it's not quite what I meant. There's, um, that's not what I wanted. There's actually a formula of the distance of the planets. Which I remember learning about, um, Titus-Bode law. That's the one.”
- S4 reflective – “So, I mean, I think what we would want to do is like, you know, talk about, uh, the order of the discovery of the planets, order of astronomy. What else would we?...”
- Design decisions (e.g., regarding implementation, modularity, placement of slide content)
  - C1 concurrent - “Now, I could sort this. Might as well use the existing function. In case I decide to add to that sort.”
  - C4 reflective – “But then I realized I needed a middle segment and I probably should write this in a much nicer manner rather than copying and pasting all this code. So I started creating some functions, um, to, uh, uh, to generate each one of the displays in the digital clock.”
  - S4 concurrent – “And this is like, um, anyway, it's super cool that there was this astronomical computer, um, with gears, tooth gears and wheels in ancient Greece. Um, so 87 BC, so 2000, 1500 years before this happened. Um, anyway, so, um, were known, so I guess, you know, with a high degree of accuracy and that's where I probably put the sidebar”
- Reference to something external (e.g., library, part)
  - C1 reflective - “There already exists some set of punctuation in string punctuation”
  - M1 concurrent - “a lot of these types of projects are sort of dependent on external things. So like I might say, okay, I'm going to build a camera but I'm not going to make a lens. So I have, I went and purchased the Lens. So now I have like a real world sort of anchor and I can go and measure that and with some calipers and figure out a bunch of measurements and then work around that and figure out, okay, well if you know, this is the ones I own and this is how big it is. Now here at least is, is the first step of the design process kind of done and I can build around that”
  - M2 reflective - “modified based on an existing design”
- Info about tool/software or how to use it
  - M1 reflective - “tinkercad's really based around like sort of a boolean operations. So you have like primitive shapes, they take stuff away”
  - M1 concurrent - “as for like actually like using Tinkercad, like I'm just using primitive shapes and just like duplicating them and then just like grouping things

together. So that's, that's kind of the basic process. You can get into fancy like shape generators and start getting into ways of like creating custom shapes. But I'm not really doing anything that requires that yet."

- C3 reflective – "And the other thing is for this, um, class dog. I originally didn't add the, uh, the visibility public. So, um, I want, I also want to other people to note that this is a keyword that must have to make, make the bindings work. Uh, I think that's all I want to say."
- Talking about tool usage
  - M3 concurrent - "Just increasing the brush size in order to capture more realistic, yeah, this is good, probably lower it down to three."
  - M3 concurrent - "Gonna smooth that edge out at least till the line and use 'flatten' instead"
  - S2 concurrent – "I'll grab this little part here, like that."
- Talking about the tool, opinions about it
  - S3 concurrent – "So um actually, I'm trying to make it nice, but these are not very, uh appealing. Um, yeah. Okay. Let's go with this."
  - S4 concurrent – "I really hate this, I really hate windows 10."
  - S4 concurrent – "uh, yeah, this is a problem about, um, [unintelligible: the thing about] the Internet is that you never have to spell anything."
- Talking to software/computer, usually with some dissatisfaction
  - S4 concurrent – "Oops. Don't squish it. Don't do that, don't do that"
- References some documentation, or says they need to check documentation
  - C2 concurrent – "If it's a regular file, this follows symbolic links. Okay, great."
  - C3 concurrent – "I just need to check the syntax for creating a new class. Hmmm. Should be here."
  - C3 concurrent – "[says under breath: constructor]"
  - C3 concurrent – "I'm going to create a card for every dog I have so I want to use ngFor, again I want to make sure this syntax is correct"
- Gets distracted during thought/task, moves on to something else; interjection
  - S4 concurrent – "We'll probably show it. You know what, I'm going to actually create a source cited, uh, so this'll be useful for people who, whoops, that'll be useful for people who want to [unintelligible: follow along...?]"
  - S4 reflective – "so, you know, when we talk about Herschel and uh Lowell, who discovered Neptune? Um no uh, uh, I forget the Neptune explorer. Who discovered Canada!"
  - S4 reflective – "Um, oh yeah. Okay. So mathematical, that's actually the key thing."