

EE/CprE/SE 491 WEEKLY REPORT 1

January 25, 2022 – February, 6, 2022

Group number: 12

Project title: *Creating DNA from scratch for DNA-based data storage*

Client &/Advisor: *Iowa State University / Meng Lu*

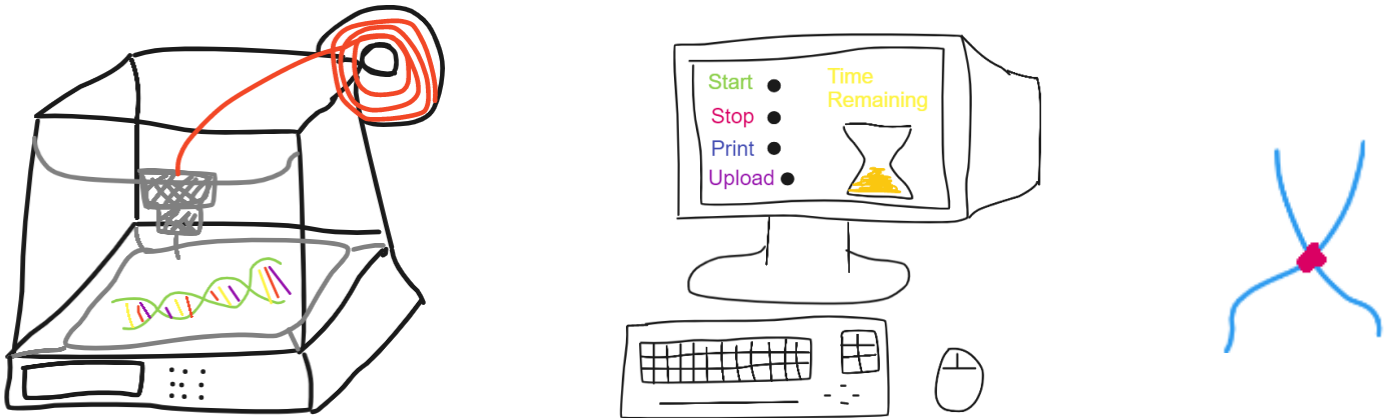
Team Members/Role: *Connor Larson/Software Engineer , Kyle Riggs/Software Engineer , Brandon Stark/Electrical Engineer , Nathan Armstrong/Electrical Engineer , & Lucas Heimer/Electrical Engineer*

- **Weekly Summary** *Read two documents provided by Meng talking about experiments: Error rate DNA libraries and OLS pool tests. Talked about what is needed for the project. There are two parts to this: programming a UI for the printer and modifying the printer for DNA.*

- **Past week accomplishments**
 - **Team Member 1 (Connor):** These past few weeks I worked on starting to learn the biology behind our project. With no prior knowledge in biology this has been hard to learn and tie into how software engineering will play a role in this project. But I believe I have gotten farther in my knowledge, learning about base pairs and how we will be printing layer by layer/pair by pair to achieve the creation of DNA. We have originally figured out we will most likely use Java for the user interface and C to command the electronics, but then we learned that we are programming the LCD display for the 3D printer. So I will have to get my hands on it to figure out what language I will need to use for it. The same issue persists for the hardware as we are currently planning to use C, but with the new found information this may need to be rethought.

 - **Team Member 2 (Kyle):** Much like my other team members, I too spent a good deal of time understanding the biology behind our project. Our Advisor Meng gave us some good material to read up on as well as some instruction on the broad picture of our project. I found this pretty interesting as I used to be a Biology major and it was cool to brush up on the information that I used to work with closely. Other than that I also brainstormed ways to implement the GUI because I believe as a Software Engineer on the project I will be working with that the most. I have thought and and believe that we will be using Java for the graphical side where the user sets the settings that they want (their preferred DNA sequence), and then we will most likely package this data into byte arrays to be sent over USB to some firmware. This firmware will be written in C most likely and this will take the info from the GUI and have it interact with the hardware (3D printer)

• **Team Member 3 (Brandon):**



- Created a rough sketch/idea of what the modified 3D printer and what the UI would look like.
- Researched what printer we would be working with and how it could be modified.

• **Team Member 4 (Nathan):** Read through papers provided to use by Dr. Lu, as well as reread concepts related to DNA. These include how DNA bases are formed and how they pair. Also, looked into the type of printer we would be using and how we would go about modifying the printer to meet our needs.

• **Team Member 5 (Lucas):** Worked on researching the processes we will be using to control the DNA synthesis. Light controlled synthesis was described in a couple papers provided by Dr. Lu. Some causes of error occurrence were also outlined in relation to light refraction through nucleotide molecules as well as light intensity affecting coupling rates to adjacent positions on the microarray.

○ **Pending issues**

• **Team Member 1 (Connor):** Am still working on understanding and learning the biology surrounding this project. Also, I need to figure out how to make a User Interface on the printer's LCD display to communicate with scripts that control the hardware for the printer.

• **Team Member 2 (Kyle):** There are no glaring issues for me because of how early we are into this project. However, because of the complicated nature of what we are doing, definitely more research needs to be done to really solidify a solid plan. Although the languages and techniques we will use are subject to change, I believe we have a solid foundation to work off of going forward.

• **Team Member 3 (Brandon):** I am also trying to wrap my head around the biology of this project. The last biology class I took was in sophomore year of high school.

- **Team Member 4 (Nathan):** Refreshing myself on the biology behind this project, as well as C coding since I think that is the language we are going to have to use for the 3D printer.

- **Team Member 5 (Lucas):** I am still working on gaining a full understanding of the necessary biology related to this project. I am also in the process of verifying the hardware components and the specifications for the 3D printer.

- **Individual contributions**

<u>NAME</u>	<u>Individual Contributions</u> <i>(Quick list of contributions. This should be short.)</i>	<u>Hours this week</u>	<u>HOURS cumulative</u>
Member 1 (Connor)	Brainstorm languages to use, research/readings about biology, learn about overall goals for project	6	6
Member 2 (Kyle)	Researched biology in regards to the project and brainstormed technology and languages we can use for it as well	6	6
Member 3 (Brandon)	Sketches, research, experiment readings	6	6
Member 4 (Nathan)	Research biology and DNA processes. Read about the printer we would use and its specifications.	6	6
Member 5 (Lucas)	Research biology concepts, read up on current literature and technology in the field, reviewed overall goals of project	6	6

- **Comments and extended discussion**

<https://miro.com/app/board/uXjVOR0jom4=/> - Workshop link

- **Plans for the upcoming week**

- **Team Member 1 (Connor):** Research the LCD screen and printer, will learn what language we will have to use to code the user interface for the printer. Will also continue to learn more about biology. I would also like to get access to the 3D printer and figure out a lab space.

- **Team Member 2 (Kyle):** I plan on looking more into the code that will be needed to communicate with the 3D printer. I am fairly confident that we will start with Java and communicate through USB to C code, however, this is not set in stone until learning more about the 3D printer.

- **Team Member 3 (Brandon):** More research on modifying 3D printers for DNA. Figure out workbench space.

- **Team Member 4 (Nathan):** Continue to research DNA bases. Find a workbench to begin hands-on evaluating.

- **Team Member 5 (Lucas):** Research the hardware components of the 3D printer for the light controlled synthesis of DNA. Gain a further understanding of biology.

- **Summary of weekly advisor meeting**

In our first weekly meeting we were provided a summary of the current technology being used to synthesize DNA which provided a comparison to the method we will take to approach our design. Dr. Lu gave us a general overview of the project starting with creating a user interface to control when a molecule will bond with a specific position on the microarray. Our goal for this semester will be to finish this user interface and create the hardware components for the light control by using a modified 3D printer. Next semester we will focus on creating a microfluidic system to pass individual nucleotides through our synthesis machine to create the final product.

Meanwhile, in our second weekly meeting with Dr. Lu we discussed the overall project. We talked and became more clear on how we will go about using the 3D printer to build DNA. We will take each nucleotide type and build layer by layer until we have created/printed the DNA we are seeking to make. We will need to have UV light from the printer only work on section by section of the microarray, so we are able to properly build each array.