

“Miracle” Group

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1 Goals for this quarter

Going into this quarter, there were two goals that we wanted to accomplish. The first, and easier, of the two goals was to present our research at the Student Research and Creative Activity Expo. This goal, whether good or bad, was done mid-May since the expo took place on May 13th. Our main goal for the quarter proved much more difficult. In an email at the beginning of the quarter, Dr. Mohlenkamp said that he had entitled the group comprised of Vusi and I as the “miracle” group for the quarter. Last quarter, among the three of us (Dr. M, Vusi, and I) had managed to come up with propositions to solve all known cases of our electron groups. However, solvable and efficient are not necessarily the same. So our goal was to come up with a way to reduce costs in our propositions.

2 Research Expo

Vusi and I had made a poster for the Pi Day poster session held by the math department in March. The Research Expo is university wide, however, so our information needed to be understandable to people outside of our department. We also needed to clean up our slides to make it more professional looking. Writing math formulas in \LaTeX is something I have been slacking on this year. Most of my work has been done with paper and pencil. We figured, that with our Pi Day poster as a base, it would be a piece of cake to get ready for the Expo. However, we needed a background, an abstract, we needed to add in what we had accomplished in the two months since Pi Day, and we needed more explanation in our slides. The explanation was easy, as was the current work to reduce costs. The background and abstract were terrible though. In high school, chemistry was only easy when I had to balance out an equation; the background and the theory were weak points for me. So, with this topic being a science application, I have basically zoned out on the background and focused on the math, which is the part I understand. This caused a problem for Vusi and I, and we had to get help from Dr. Mohlenkamp. It ended up taking us until the week of the expo to get our slides finalized. Our “poster” ended up just being color slides printed out instead of a professionally done poster like

many of the other posters there. Our topic and quantity of equations seemed to scare people off. People would walk by our poster, take a quick look, then look and walk away. Needless to say, we didn't win anything, but we learned some background information and because we had to explain our topic so many times, I felt more comfortable with the information.

3 Attempting a Miracle

While working on the poster for the expo, I found it hard to concentrate on trying to find a miracle for our costs. We began by reading some papers by people who had worked on this topic before. The first two papers were sent to Vusi and I by Dr. Mohlenkamp. We tried to find similar papers, or papers by the same authors, but had a hard time with this. I find it very difficult to find scholarly papers. I ran into this problem before when I was working on researching how other research groups function. This is definitely something that I need to work on. After hitting a brick wall with finding other papers, we began to look more closely at one of the ones Dr. Mohlenkamp had given us. The authors seemed to be working on our same topic, and had found a way that did seem to cost less than our way. They had used Gaussian Integrals, while we had not defined our functions at all. The case we were most worried about was

the triangle case: . In this case, after the first integration, we end up with a function that depends on two variables. The Gaussian Integrals let us reduce this first integration to a convolution and a function of one variable. However, the next integration then has a function of two variables, so our current miracle is only partial. We are now looking into whether we can split this two-variable function into something else. If we could get it to be a product of two functions of one variable each and another function of the difference of the two variables (a convolution) we would be able to avoid the higher cost again which would solve our problem.