# Fall 2008 Journal

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## 2nd Week

Our current goal is to compute the determinant $|\mathbb{I}+\mathbb{A}+\mathbb{B}|$ with low cost the formula for the above determinant is

$$|\mathbb{I}+\mathbb{A}+\mathbb{B}| = \sum_{k_1=0}^{|\alpha_0|} \sum_{\substack{\alpha_1\subset\alpha_0,\\ |\alpha_1|=k_1}} \sum_{k_2=0}^{|\alpha_1|} \sum_{\substack{\alpha\subset\alpha_1,\,\beta\subset\alpha_1,\\ |\alpha|=|\beta|=k_2}} (-1)^{\sigma(\alpha\subset\alpha_1)+\sigma(\beta\subset\alpha_1)}\,|\mathbb{A}[\alpha_1\setminus\alpha;\alpha_1\setminus\beta]|\cdot|\mathbb{B}[\alpha;\beta]|$$

## 3rd Week

First we started with considering $\mathbb{A}$ and $\mathbb{B}$ as of rank-1 and tried to analyze the determinant for different cases (we considered different possible values for $k_1$ and $k_2$). In this week we are able to understand the different cases that Dr.Martin explained that we are going to consider in order to compute the determinant and I have got the general idea.

## 4th Week

In this week we discussed about the inner product definition that we are going to use in computing the determinant and also we discussed about the complicated case i.e Case $k_1$=2 and $k_2$=1 and discussed different sub cases for this case.

# 5th Week

On Thursday we discussed about all the cases and after putting all cases together we got the formula

$$|\mathbb{I}+\mathbb{A}+\mathbb{B}| = 1 + v^*u + y^*x + (v^*u)(y^*x) - (y^*u)(v^*x) = \begin{vmatrix} 1+v^*u & v^*x \\ y^*u & 1+y^*x \end{vmatrix}$$

which is already known to us.

# 6th Week

When $\mathbb{A}$ and $\mathbb{B}$ are of high rank we need to compute more inner products So we have decided to change our approach. In our new approach instead of formulas we make things smaller by using unitary matrices.

# 7th Week

We are presently working on a new approach that computes the determinant in equation-22 of the draft given by Dr.Martin. after relabeling the terms of equation-22

$$\mathbb{L}_{11}^{-1}\mathbb{L}_{12} = \mathbb{A}_{12} \tag{1}$$

equation-22 looks like

$$\sum_1\sum_2\sum_3 |\mathbb{L}_{11}||\mathbb{L}_{22}||\mathbb{L}_{33}| \begin{vmatrix} \mathbb{I} & \mathbb{A}_{12} & 0 \\ \mathbb{A}_{21} & \mathbb{I} & \mathbb{A}_{23} \\ 0 & \mathbb{A}_{32} & \mathbb{I} \end{vmatrix} \tag{2}$$

Now instead of treating it as a sum of 3 matrices our new approach treats this as product of determinant of 3 matrices and here we are using two unitary matrices and reducing the work to compute the determinant.

$$\left|\begin{bmatrix} \mathbb{I} & 0 & 0 \\ 0 & \mathbb{V}^* & 0 \\ 0 & 0 & \mathbb{U}^* \end{bmatrix}\begin{bmatrix} \mathbb{I} & \mathbb{A}_{12} & 0 \\ \mathbb{A}_{21} & \mathbb{I} & \mathbb{A}_{23} \\ 0 & \mathbb{A}_{32} & \mathbb{I} \end{bmatrix}\begin{bmatrix} \mathbb{I} & 0 & 0 \\ 0 & \mathbb{V} & 0 \\ 0 & 0 & \mathbb{U} \end{bmatrix}\right| = \begin{vmatrix} \mathbb{I} & \mathbb{V}^*\mathbb{A}_{12} & 0 \\ \mathbb{A}_{21}\mathbb{V} & \mathbb{I} & \mathbb{B}_{23} \\ 0 & \mathbb{B}_{32} & \mathbb{I} \end{vmatrix}$$

If we multiply a Unitary matrix with a matrix of rank-r(row span) we can make it as matrix with r rows consisting of nonzero elements and the rest of the elements in all

rows will become zero's.
We need to find one unitary matrix $\mathbb{U}_{23}$ so that

$$\mathbb{U}_{23}\mathbb{A}_{32} = \mathbb{B}_{32}$$

Here $\mathbb{B}_{23}$ is matrix with r rows consisting of nonzero elements and the rest of the elements are all zero's.

# 8th Week

In this week I prepared a report on the new approach that we are going to use. After discussing with Dr.Martin I have made some changes to the report. I discussed the topics that I need to include in my final presentation with Dr.Martin.

# 9th Week

In this week I prepared the final Presentation and made some corrections after discussing with Dr.Martin. And my final presentation was on Friday me and Benigno gave the presentation.