Laboratory of Natural Information Processing
DA-IICT Gandhinagar

DNA Image Pro

User Manual

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Credits & Team

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General Information

1. Introduction

Algorithmic self-assembly is main aspects of the DNA computing and tile assembly. There are various tile assembly models like "abstract Tile Assembly Model" (aTAM) and the "kinetic Tile Assembly Model" (kTAM) which is implemented by Xgrow. It simulates the tile assembly for the given set of the tile sets. Tile assembly models can be used for the understanding the concept of algorithmic growth and processing of various system. One of the areas is image generation where the tile assembly plays roles to understand the image formation and processing. The pattern for the image processing if understood can be processed by algorithmic tile assembly. DNA Image Pro provides a platform to understand the image generation and processing with prospective of algorithmic tile assembly.

2. Overview

DNA Image Pro includes the modified version of Xgrow where user is free to choose any tile set color. Unlike the previous version, where the tile were assigned the fix values of color set, DNA Image Pro facilitates different color assignment to the tiles which helps in identifying the tile assembly more preciously. Along with this, it can be used for the tile assembly for any given image. DNA Image Pro helps to generate tile set for any image and allows running the assembly using Xgrow. The alpha version of DNA Image Pro provides few image optimization algorithms for image processing with tile assembly.

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3. Product Scope

This software provides the user with:

- Selecting the tile set colors of their own choice.
- With the specified parameters of the tile assembly, it will generate the tile file automatically
- Tile file generated can be run directly from the DNA Image Pro.
- Image generation by algorithmic tile assembly with the tile set associated with the image.

4. Product Perspective

This product's main aim is to make the process of making the computerization and computation of algorithmic tile assembly user friendly.

System Summary

Operating Systems – Linux, Mac

This software requires the system to have specifications similar to: - 2.4 GHz Core 2 Duo, 100 MB Hard Disk, 2GB Random Access Memory and Basic peripherals like keyboard, mouse etc.

Getting Started

Once you have installed DNA Image Pro, unzip the file. Open the command window and go the DNA Image Pro folder. Now compile the java files with "**javac *.java"**. To build new version of Xgrow on your machine go to xgrow_new folder and type **"make"**. Go to the DNA Image Pro folder and then run the file with "**java dnaImagePro".** GUI of DNA Image Pro will appear. It has menu with the following option:

- ✓ Uniform Shift Generator
- ✓ Non Uniform Shift Generator
- ✓ Transformation Generator
- ✓ Image Tile Generator
- ✓ Run a Tile File

1. Uniform Shift Generator

This option is available under the tools menu of the menu bar. This will generate the **NxN** tile sets on the basis of the seed tile sets specified. User should specify the flakes tile set that is the base row for the tile assembly. It will generate the tile assembly uniformly with given value of the shift operator. It will have uniform pattern for the tile assembly. This may be helpful in the image processing where there is uniform shift in the pixel value. If the image has uniform pattern, this technique can be used in the image tile generation uniformly. When the user clicks on **"Uniform Shift generator"**, the dialogue box will appear with text box with value number of tiles N and file name for the tile set. Followed by this, user has to enter the shift variable for the tile generation. After this, user can change the tile color by clicking on the tile. The window will appear with different color, user can select any color for the given tile set. To run the simulation, select **"Run a tile file"** from the menu. It will run the simulation of tiles in the Xgrow as shown in the Figure 1.

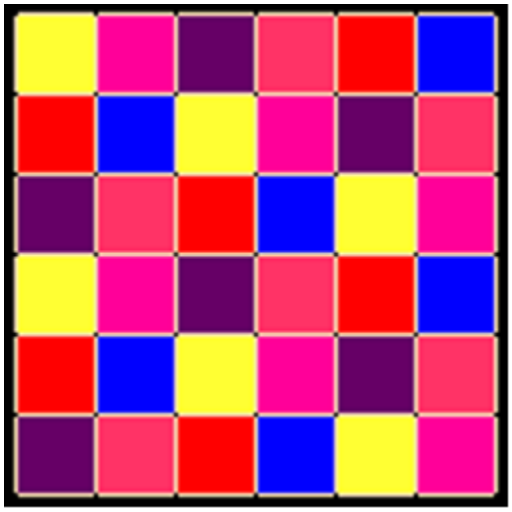

Figure 1: Enter uniform shift operator value 2. It will shift the tiles by 2 in each row.

Tile shifted by 2 from the base row

2. *Non Uniform Shift Generator*

This option is available under the tools menu of the menu bar. It is similar to uniform generator. This will generate the **NxN** tile sets on the basis of the seed tile sets specified. User should specify the flakes tile set that is the base row for the tile assembly. It will generate the tile assembly non uniformly with given value of the shift operators. Unlike uniform generator, there will be shift operator for each of tile. So the number of shift operator will be N-1. This may be helpful in the image processing where there is non-uniform shift in the pixel value. When the user clicks on **"Non Uniform Shift generator"**, the dialogue box will appear with text box with value number of tiles N and file name for the tile set (see Fig 2). Followed by this, user has to enter the shift variables for the tile generation as shown in the Figure 5. After this, user can change the tile color by clicking on the tile. The window will appear with different color, user can select any color for the given tile set. To run the simulation, select **"Run a tile file"** from the menu. It will run the simulation of tiles in the Xgrow as shown in the Figure 3.

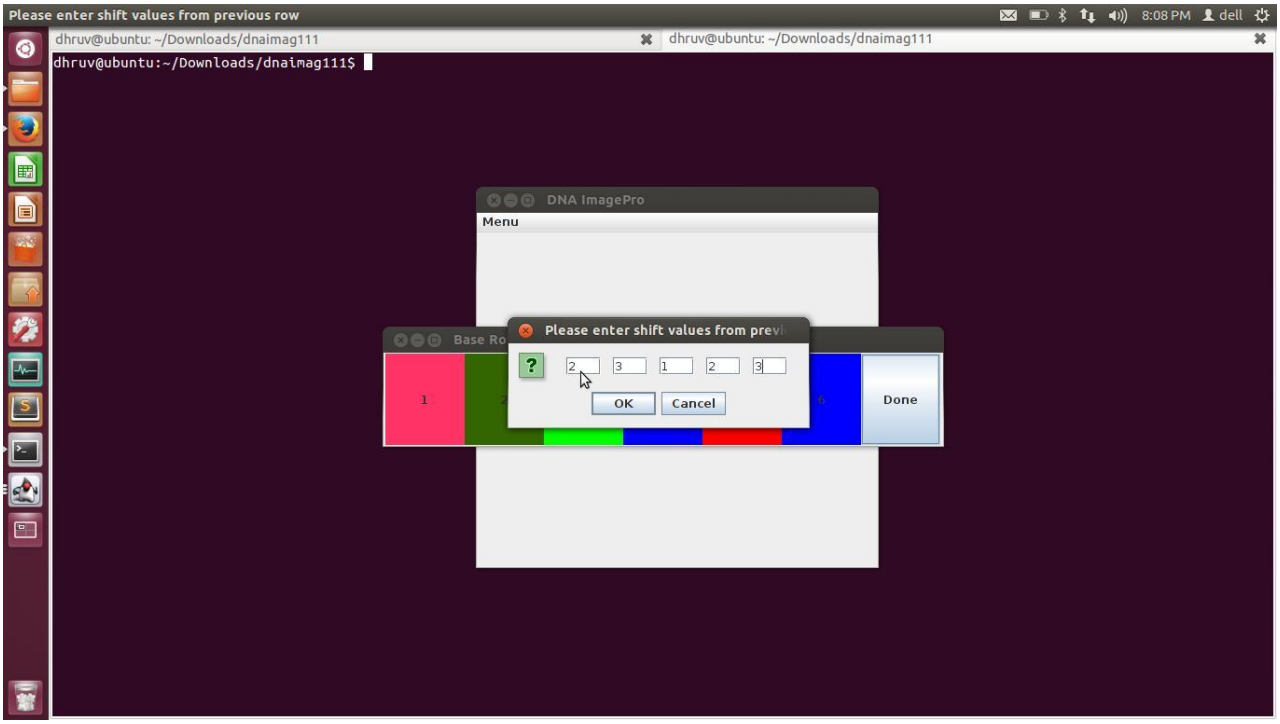

Figure 2: Enter the non-uniform shift operator. In this we have use shift operator 2, 3,1,2,3 respectively. It will shift the tiles by 2 then by 3 and respectively with the given shift operator.

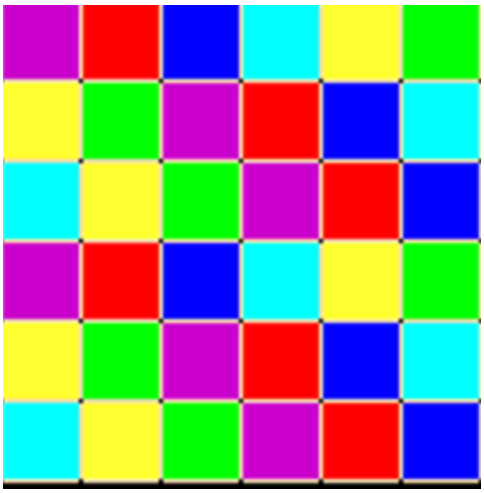

Figure 3: Simulation of tile assembly with non-uniform shift generator in the Xgrow. In this we have use shift operator 1,2,3,1,2 respectively. It will shift the tiles by 1 then by 2 and respectively with the given shift operator.

3. *Transformation Generator*

This option is available under the tools menu of the menu bar. It is similar to non-uniform generator along with the row transformation on the base tiles. This will generate the **NxN** tile sets on the basis of the seed tile sets specified. It will generate the tile assembly by applying the row transformation on the base row tile set. With given value of the shuffle variables tiles get transformed non uniformly. Unlike uniform generator, there will be shift operator for each of tile and shuffling operator for each of N (each row in the tile set). This may be helpful in the image processing where there is row transformation on the pixel value. When the user clicks on **"Transformation Generator"**, the dialogue box will appear with text box with file name for the tile set and value number of tiles N respectively. Followed by this, user has to enter the shift variables for the tile generation as shown in the Figure 4. After selecting the shift values, enter the shuffle values for each row to be transformed. All the shuffle values should be unique within the range of N. To run the simulation, select **"Run a tile file"** from the menu. It will run the simulation of tiles in the Xgrow.

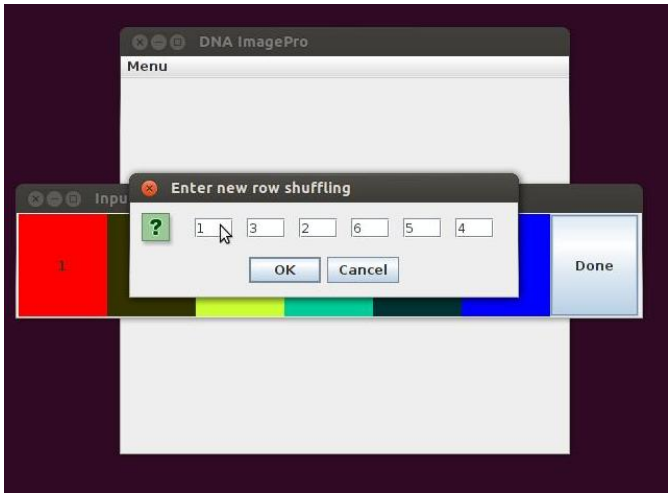

Figure 4: Enter the shift variables for the non uniform shift. Here the shift for the 6 rows is 2, 3,2,3,1 respectively.

4. *Image Tile Generator*

This option is available under the tools menu of the menu bar. This generated the image by tile assembly. It enables the user to select any image and generates the tile assembly for it. By rendering the image selected, software will generate the tile sets. Once the user clicks on **"Image Tile Generator",** user needs to select the image. Once the image is selected, there will be two options available as mentioned below and in Figure 5. Followed by this, one has to select any one option and tile set for the image will be generated. One can run the simulation, select **"Run a tile file"** from the menu. It will run the simulation of tiles in the Xgrow as shown in the Figure 6.

1. *Rapid Image Generation*

This will compress the image file size to 35x35. It will generate the tile set for the image by reducing the pixel value and faster compare to standard image generation. This option is recommendable for quick tile assembly.

2. *Standard Image Generation*

It will not compress the image and will generate the tile assembly for the given standard image size. It will take very long time for the tile assembly.

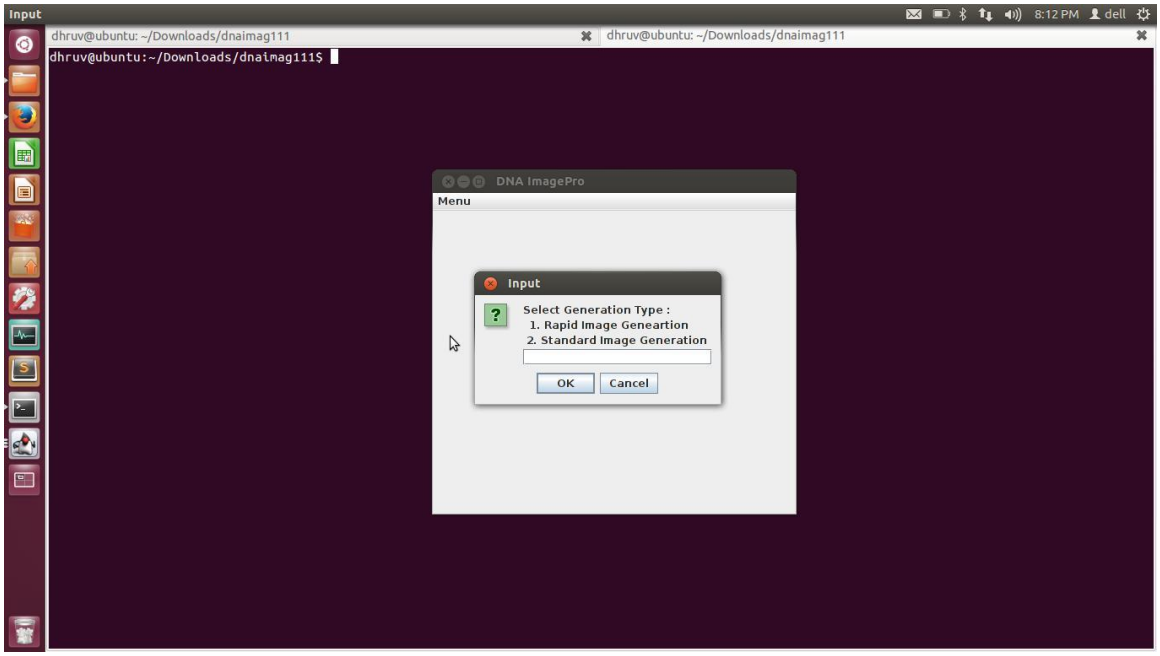

Figure 5: Select one of the options for the image generation. Rapid generation will compress the image and will generate the tile assembly for the image faster than standard image generation.

Figure 6: Tile assembly for the selected image of smiley emotion by rapid image generation in Xgrow.

Support and Feedback

Users are requested to contact team at the email: dnaimagepro [at] guptalab.org for feedback and any other issues with the software. Linux specific installers are available on the project home page along with source code with open source license agreement.