Project Design Proposal

601.429 Functional Programming in Software Engineering

Fall 2023

Professor Smith

Group Advisor: Brandon Stride

Group: Hongyi Liu, Christopher Li

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Moebius Transformation in ASCII Art

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1. Overview of the purpose of the project:

- The purpose of this project is to create an animation of the Moebius transformation via a rasterizer. Users will be able to interact with the animation by setting parameters, and the animation will be displayed via ASCII art.
    a. The goal is to provide an intuitive and interactive visualization of the Moebius transformation and how it is related to the stereographic projection in the command line terminal via ASCII art.

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2. A list of libraries you plan on using
    a. Core
    b. Lwt
    c. **OUnit2**
    d. **ocaml-bimage**
        i. This will be for loading the images between `rasterizer.ml` and `ascii_printer.ml`.

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3. Drafts of commented module type declarations (`.mli` files):

rasterizer.mli

```
(*

open Core
open Math


val getImage : (mode:int -> camera_offset:int -> view_direction:Vec3 -> img_w:int ->
    alpha:float -> beta:float -> center:Vec3 -> viewsize:int -> bd:int
    -> half_edge:int -> line_w:float -> grid_size:int -> unit)

*)
```

(continued on next page)

math.mli

```
(*

open Core

(* basic types *)

module type Vec = (* N dimensional vector*)
  sig
    type t
    val n: int (* dimension *)
    val ( + ): t -> t -> t
    val ( - ): t -> t -> t
    val ( * ): float -> t -> t (* scaler multiplycation *)
    val length: t -> float
    val sqr_length: t -> float
    val create: float list -> t
    val unit: t -> t
    val dot: t -> t -> t
  end

module MakeNVec (_ : sig val n : int end) : Vec

module Vec2 : Vec
module Vec3 : Vec

val cross: Vec3 -> Vec3 -> Vec3

(* geometric maps *)

val stereoProj: Vec3 -> float -> Vec2
val istereoProj: Vec2 -> float -> Vec3

val mapMoebius: Vec2 -> alpha:float -> beta:float -> center:Vec3 -> Vec2

(* helper function *)
val rad: float -> float

*)
```

ascii_printer.mli

```
(*

open Core
open Bimage

(* This will turn a Bimage.Image.t into a 2D list of rgb 3-tuples,
   which is easier to work on with Core.List in OCaml *)
val list_list_of_image : Bimage.Image.t -> (float * float * float) list list

(* This is the main function is that is made available to be called
   so that images represented in the Bimage format can be printed to the terminal *)
val print_ascii_image : Bimage.Image.t -> unit

*)
```

user_interface.mli

```
(*

open Core
open Bimage

(* Maybe there will be a way to put these in a module *)

(* User can change alpha and beta parameters
   of the Moebius distribution *)
val prompt_user_change_alpha : unit -> unit
val prompt_user_change_beta : unit -> unit

(* User can change view position *)
val prompt_user_change_position : unit -> unit

(* User can change the type of view: sphere, plane, or
   both sphere and plane *)
val prompt_user_change_view_type : unit -> unit

(* User can start the predefined animation, and possibly enter parameters
   for the animation *)
val prompt_user_change_animation : unit -> unit

*)
```

4. Include a mock of a use of your application, along the lines of the Minesweeper example above but showing the complete protocol.

The ASCII-art display below is low resolution (terminal-width 40) in order to comfortably fit in this PDF document. In a real terminal application, the resolution would be much higher higher (e.g. 120 or 160 terminal columns).

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$ ./moebius.exe plane --alpha 45 --beta -30 --image_w 200
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$ ./moebius.exe sphere --alpha 45 --beta -30 --image_w 200
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```

```
$ ./moebius.exe sphere_and_plane --alpha 45 --beta -30 --image_w 200
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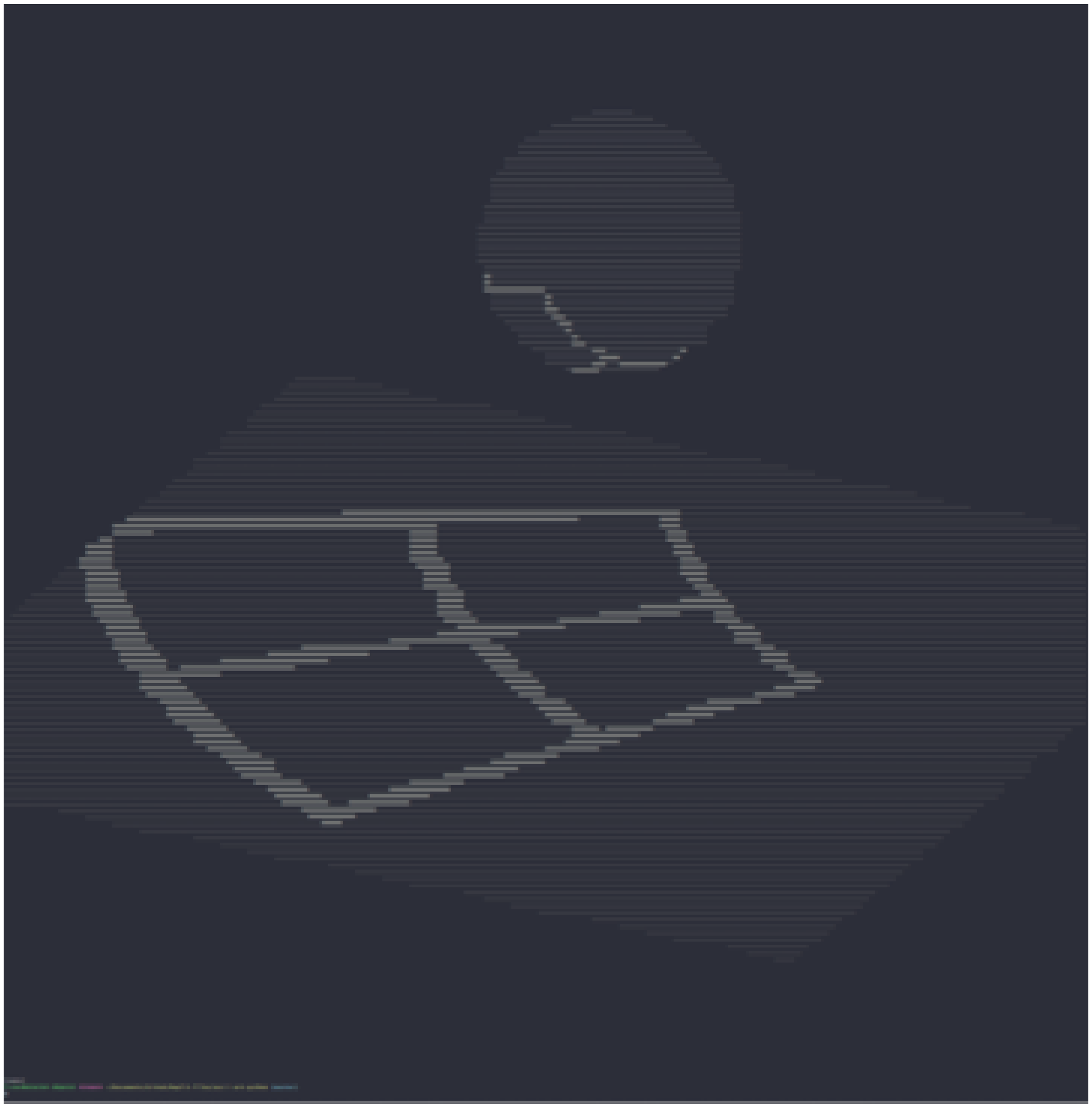
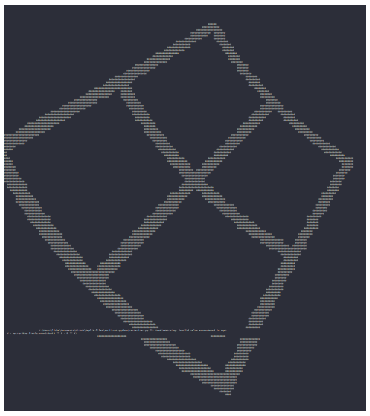
```

- There will also be an interactive "animation" component. If a user selects
  - `$ ./moebius.exe sphere_and_plane --animate --p_offset 0 0 1 --alpha 45 --beta -30 --image_w 200 --viewsize 4 --grid_size 2`
- Then there the ASCII art will continuously render and update to reflect the animation angles and progression that the user requested via command line arguments.
- Users will also be able to interrupt the script (e.g. via a KeyboardInterrupt) and input desired parameters while the program is running.

Higher resolution photos are below:





5. Also include a brief list of what order you will implement features.
    a. In roughly general order, we plan to implement:
        i. `rasterizer.ml`
        ii. `math.ml`
        iii. `ascii_printer.ml`
        iv. `user_interface.ml`

7. You may also include any other information which will make it easier to understand your project.

- We will try to create a command line application that is simliar in principle to the website at the below link, with our own modifications:
    - https://www.geogebra.org/m/GhaSJw3t