CS4497/6497- Fall 2019 - Project 1: Color

Due on CANVAS before class on 09/17/2019

Teams must include: 1 student, 2 grads or 2 undergrads (unless approved)

Overview

*The **first goal** of this project is to invent, design, implement, and assess a color selection tool which, given two colors, A and B, chosen by the user, will propose a matching third color, C. We will explore doing this in for three different **objectives**: (1) When we want C to be a **blend** of A and B and use it to paint a band between two regions colored in A and B, so as to soften the transition at their border. An example may be a discreet belt between pants and shirt of very different color. (2) When we want C to be the color of the **background** on which we will display two objects colored A and B. An example may be the selection of the background color for a screen with two square buttons of predefined color. (3) When we want C to be an **accent** that contrast equally with A and B. An example may be a tie or scarf that contrasts a shirt and suit of very different (and possibly ill-matched) colors, and somehow helps the viewer make sense of—even appreciate—the difference between A and B. (4) When we want C to **match** A and B so that the **triad** (A,B,C) is perceived as aesthetically pleasing and all three colors appear to have similar weights and functions (none of them is perceived as a blend of the other two or an accent color). In fact, we may consider the additional **symmetry** challenge to define C, so that a viewer will not be able to guess which of these three colors was computed from the other two. Examples of applications of such matching triads include wardrobe (skirt, blouse, jacket of different colors) and interior decorations (paint the ceiling and two adjacent walls in three matching colors). Web-design objectives may include selecting several blend, background, accent, or match colors for the different functionalities.*

*The **second goal** of this project is for each one of the four objectives, to allow the **user** to **suggest** an initial color for C, and have your program take this suggestion into account and propose one (or a small number) of suggestions for **improving** the result (while appearing to have understood and considered the user's suggestion). A user may not be pleased if the improvement is far from what she was going for. So, blending between the C suggested by the user and the C computed as discussed above, may not be satisfactory. In fact, you should provide an example of such a naïve approach and contrast it with your solution. Meeting this second goal is not mandatory, but if you do, you will receive **extra credit**, the amount of which will depend on how interesting your solution is, but will not exceed 20% of the numeric score that you will receive for addressing the first goal.*

*The **third goal** of this project is to make optimal choices for C, so that the triad (A,B,C) will still satisfy the selected objective (blend, background, accent, or match), even if the **brightness is changed** consistently for all three colors. For example, in the room with matching ceiling and walls, we may want the triad to work well bot on sunny and on cloudy days. Or, we may want a webpage to look aesthetically pleasing even when the user has dimmed the screen brightness. Part of this challenge is to clarify what exactly do we mean by a consistent change of brightness for a triad. To show your results, I suggest showing three version of the triad: (1) at the initial brightness, (2) darker (but not too dark), and (3) brighter (but not too bright). Only **grad** teams are required to address this goal. Not addressing it, may cost them 40% of the grade. **Undergrad** teams addressing it you will receive **extra credit**, the amount of which will depend on how interesting your solution is, but will not exceed 20% of the numeric score that you will receive for addressing the first goal.*

*Much has been written and is available online for addressing these challenges in various applications (art, interior decoration, web-design, video-games, movies). Including a concise yet clear **summary of known rules** that you have understood and believe to be useful (and including the references and links to them) may give you additional extra credit points.*

*One limitation of much of this prior art is that it does not consider the **three-dimensional aspect of color** (see https://www.google.com/search?q=color+picker). Your solution should. In fact, on your Processing canvas, you should not only show the three triads (A,B,C) with different brightness levels as three hexagons, each divided into 3 parallelogram quads, but you should also show these three triads in 3D as color-gradient triangles with a ball of A, B, or C colors at each vertex. By default, you should use **(r,g,b) coordinates** for this visualization, but, when your solution exhibits a geometric construction in a different (possibly **perceptual**) **color-space**, you should allow the user to switch to visualize the construction and the result in that space.*

*I suggest that, for each objective, and for each goal, you implement two solution: (1) one that is based on **simple geometric constructions (as discussed in class)** and (2) a variant of these or a completely different solution that you invented. For example, the geometric construction of a matching triad will ensure that the triangle (A,B,C) is equilateral in a perceptual color space, or as equilateral as possible when we want to select a C so that the triad looks nice when we change brightness.*

You can, but do not have to, implement this in Processing and also can, but do not have to, start with the sketch provided, which includes mappings between color spaces and geometric primitives.

1 Scheduling your progress

Start ASAP. Ask (TA, Instructor) for help as needed, in class or during office hours.

Plan ahead when you will implement which module/functionality.

Save/backup your sketch often and carefully.

Plan to be finished a few days before the deadline, just in case. Bad things do happen each semester to more than one team.

Do not hesitate to implement graphics and interaction tools just to validate and debug each construction step. For example, if you construct a vector in 3D, display it as an arrow and see whether your construction works. Use a GUI to move the input points to ensure that the construction works properly as the inputs are edited.

2 Ethics

You can ask other students or colleagues for help about Processing or about where to look for prior art, but you cannot ask for help with the technical parts of the project. You should solve them yourself. If you cannot, you may (without penalty) look for solutions or **inspirations** online or in prior art, but, if you find any, you MUST report exactly what you found and where AND you also MUST include a clear and detailed **tutorial** that could be used to help someone else derive these results without looking at the solution. (The idea here is to have you study and understand that inspiration so clearly that you could teach others how to derive it. You may use an additional page in the report or an additional minute of the video for each one of these.)

3 Deliverables (sketch and PDF report)

Each team should submit a short report, 3-page (10-pt New Times Roman) PDF with the math derivations and figures. Remember to use points, vectors, and the operators discussed in class for explaining the details of your geometric constructions.

The report must include (on front page) a header:

Project title: "GaTech CS-???? Fall 2019 Project 1: Third Color Selection"

Authors: Pictures with the faces of the authors and, below, their First LAST names

Additionally, the paper must include:

- A clear and concise description of the main, overarching **goal**
- Overview of the architecture of your solution and its components/modules: what each one does
- For each one of the two most challenging components: The detailed problem statement, the **derivation** of the solution, and results (pictures showing the geometric construction in 3D and the resulting triads).
- The detailed list of all **inspirations**: origin (paper citation, URL, people), content (what is useful there), detailed and clear explanation/derivation (in your own language)
- Examples of results (images for several test cases).

Please try NOT to use coordinates or matrices in your derivations. Instead, use points, vectors, and operators on them to formulate tests and constructions steps. Try to formulate all optimizations using scalar variables for which you derive and solve simple equations, of which the coefficients are computed using points and vectors. Include the math of each non-trivial derivation and justify (briefly) each non-trivial step. Number equations if this helps with clarity.

4 Tips for good writing: The 7 C's

Your report should, as much as possible, satisfy the 7 Cs:

- **Concise**: Avoid unimportant details and redundant words
- **Concrete**: Use simple and intuitive concepts instead of (or to illustrate) abstractions, which may be ambiguous to the reader
- **Clear**: Strive to make the structure and explanations clear to the intended reader (students, TA, instructor, future boss)
- **Correct**: Make sure that your math, statements, derivations are correct and all terms defined unambiguously
- **Convincing**: Include convincing arguments for statements that you believe to be true (or label them as "conjectures")
- **Complete**: Mention all cases. Say that you omit some cases for lack of space, but say briefly how they could be addressed.
- **Clever**: Try to simplify the solution or derivation by a clever choice of parameters, approaches or concepts

5 Resources

Some color theory and some resources on colors will be discussed in class. A copy of the slides will be posted on DropBox.