

# CENG 466

## Fundamentals of Image Processing

Fall '2022-2023

### Take Home Exam 3

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Due date: December 21, 2022, Wednesday, 23:55

## 1 Specifications

In this assignment you will implement face detection and pseudocoloring. In addition to the solutions, you are required to prepare a report.

- Grading will be based on the quality of the outputs, script contents and the report
- The report should
  - be **maximum 10 pages** long and should be prepared in IEEE Conference Proceedings Template (**LATEX** is recommended) provided in the following link.  
[https://www.ieee.org/conferences\\_events/conferences/publishing/templates.html](https://www.ieee.org/conferences_events/conferences/publishing/templates.html)
  - clearly explain the methodology and rationale behind the algorithm design.
  - explain the difficulties encountered in the design, implementation and experimentation stages, and your solutions on them.
  - contain analysis of the results, and your comments on the results. Even if the results do not match your expectations you should discuss the encountered situation.
  - contain information on requirements of your code (libraries etc.)
- **Implementation:** Write your solutions to *the3\_solution.py*, you should structure the file similar to the one you are given in THE1.
- **Submission** Submission will be done via Odtuclass. Submit a single .zip file containing
  - the3\_solution.py
  - Outputs folder
  - Report

Only one member should submit the homework. Hence, do not forget to **write your names and student id's at the beginning of the scripts**.

## 2 Regulations

1. **Contribution to the Book:** The selected algorithms will be inserted to the book, "Fundamentals of Image Processing" by H. Mogultay, I. Onal and F.T. Yarman Vural with the consent of the owner students.
2. **Group:** You are required to do your assignment in a group of two students. If there is an unclear part in your code, we may ask any of the group member to describe that code segment. Also group members may get **different** grades. We reserve the right to evaluate some or all of the groups to determine the contribution of each group member to the assignment.
3. **Programming Language:** You must code your program in Python. Your submission will be tested on department lab machines. You are expected make sure your code runs successfully on department **lab machines**.
4. **Late Submission:** Late Submission is penalized by -20 points/day.
5. **Newsgroup:** You must follow the odtuclass for discussions and possible updates on a daily basis.

### Question 1 Face Detection(40 pts)

In this part, your task is to detect faces based on skin color. In order to complete this task follow the given steps:

- Step 1:** Propose an algorithm for face detection based on skin color. You can cluster the image colors using any color space. Then, try to detect the cluster(s), which correspond to skin colors. Your algorithm can take image specific parameters.
- Step 2:** Implement your algorithm as a function `detect_faces(...)` and test it on the provided 3 images: "1\_source.png", "2\_source.png", and "3\_source.png". Read input images from "./THE3\_Images/". In the outputs you can mark the faces with a red circle or square and save your results to "./Outputs/" folder with the names "1\_faces.png", "2\_faces.png", and "3\_faces.png".
- Step 3:** Report your results, and pros-cons of your algorithm. Include figures from intermediate steps of your algorithm to explain your work.

### Question 2 Pseudo-coloring (60 pts)

In this part, your task is to color the gray scale images given in 1. Your algorithm should read gray scale image (x\_.png) and its corresponding color source image (x\_source.png) from "./THE3\_Images/" and output an image in the "./Outputs/" folder as (X\_colored.png) which is the colored version.

In order to complete this task follow the given steps:

- Step 1:** What is Pseudo-coloring? Explain in your report.
- Step 2:** Propose an algorithm for pseudocoloring gray scale images. Provide pseudo code for the algorithm, that extracts a color map from a given RGB image and colors a gray scale image.
- Step 3:** Implement your algorithm as a function `color_images(...)` and test it on the provided 4 sets of images. Read input images from "./THE3\_Images/" and save your colored outputs to "./Outputs/" folder with the names "1\_colored.png", "2\_colored.png", "3\_colored.png", and "4\_colored.png".
- Step 4:** Report your results, and pros-cons of your algorithm. Include figures from the intermediate steps of your algorithm to explain your work.

**Step 5:** Plot HSI and RGB channels of the pseudo-colored images that you obtain at the outputs of your algorithm and compare them.

**Step 6:** Detect edges of the images on the provided color images: "1 source.png", "2 source.png", and "3 source.png" in RGB and HSI spaces using the gradients in a function *detect\_edges(...)*. Save edge maps to "./Outputs/" folder with names "X\_colored\_edges.png". Discuss the results.

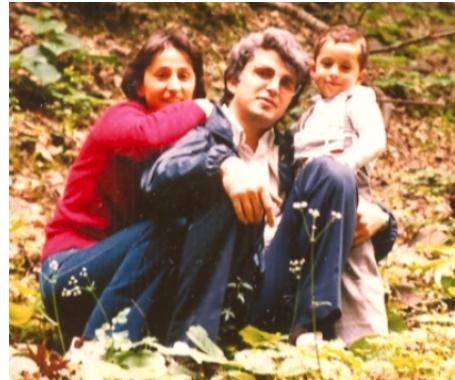
### 3 Cheating

We have zero tolerance policy for cheating. People involved in cheating will be punished according to the university regulations.

**Cheating Policy:** Students/Groups may discuss the concepts among themselves or with the instructor or the assistants. However, when it comes to doing the actual work, it must be done by the student/group alone. As soon as you start to write your solution or type it, you should work alone. In other words, if you are copying text directly from someone else - whether copying files or typing from someone else's notes or typing while they dictate - then you are cheating (committing plagiarism, to be more exact). This is true regardless of whether the source is a classmate, a former student, a website, a program listing found in the trash, or whatever. Furthermore, plagiarism even on a small part of the program is cheating. Also, starting out with code that you did not write, and modifying it to look like your own is cheating. Aiding someone else's cheating also constitutes cheating. Leaving your program in plain sight or leaving your computer without logging out, thereby leaving your programs open to copying, may constitute cheating depending upon the circumstances. Consequently, you should always take care to prevent others from copying your programs, as it certainly leaves you open to accusations of cheating. We have automated tools to determine cheating. Both parties involved in cheating will be subject to disciplinary action. [Adapted from <http://www.seas.upenn.edu/cis330/main.html>]



Image1



Color source of Image 1



Image2



Color source of Image 2



Image3



Color source of Image 3

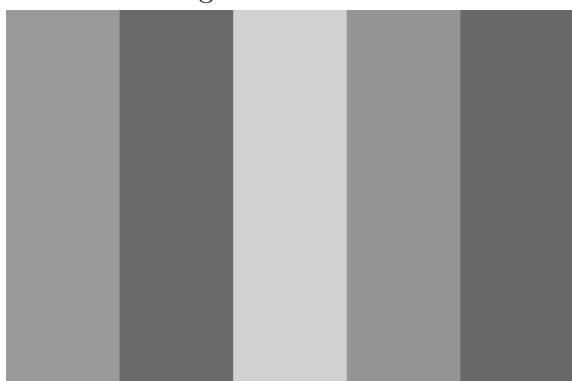
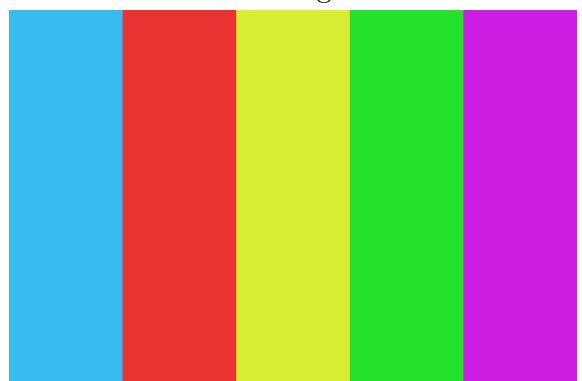


Image4



Color source of Image 4

Figure 1: THE3-Images