

Steganography

Team Emertxe




Introduction

Steganography

What?

A practice of concealing a file, message, image, or video within another file, message, image, or video

Source: Wiki



Steganography

vs Cryptography



Cryptography or cryptology is the practice and study of techniques for secure communication in the presence of third parties called adversaries

Source: Wiki



Steganography

vs Cryptography

1
6
3
5
2

7
5
9
3
8
5
7
3

- Imagine you want to send the password over a transmission medium, you would literally change the password using some cryptic code before sending!
- The code is visible to all who are looking into it. This would add unwanted attention to hackers

Steganography

vs Cryptography



1	Kg Onions
6	Kg Beans
3	Kg Tomatos
5	Cucumbers
2	Coconuts

1 Kg Onions
6 Kg Beans
3 Kg Tomatos
5 Cucumbers
2 Coconuts

- In this case we send the password clubbed with another message
- When being transmitted you might think some one is sending an grocery list ;), give less attention to the message
- Only the transmitter and receiver would know something is hidden in it

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Why?

- Hide secret credentials
 - Detect data forgery
 - Message Passing
- etc ..

Steganography

Where?

- Military
- Intelligence agencies
- On line elections
- Internet banking
- Medical-imaging and so on.

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How?

- Physical
- Prints and paints
- Puzzles
- Digital



Steganography

Digital



- Though there are different possible methods available, we would go with digital steganography
- In digital method the message is concealed within the lowest bits of images or sound files
- The current project expects us to implement LSB (Least Significant Bit) Image Steganography on a .bmp file
- Next, we need to understand some terminologies before implementation as put in the next slides

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LSB



- Consider the below byte with value 0

Binary

0 0 0 0 0 0 0 0

MSB

LSB

0 0 0 0 0 0 0 1

1 0 0 0 0 0 0 0

Decimal

0

1

128

Modifying LSB doesn't change the magnitude of the number much, Hence called as least significant

Modifying MSB changes the magnitude of the number to double!! Hence called as most significant

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An Image



- A file which contains a picture elements (pixels)
- Fixed number of rows and columns of pixels
- These pixels would be grouped along with different informations and forms a format

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An Image - Pixel



- A pixel is the smallest individual element, holding antiquated values that represent the brightness of a given color at any specific point.
- A pixel also can be said as a smallest addressable element in an all points addressable display device; so it is the smallest controllable element of a picture represented on the screen.
- Each pixel is a sample of an original image; more samples typically provide more accurate representations of the original.

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An Image - Pixel



- The intensity of each pixel is variable.
- In color imaging systems, a color is typically represented by three or four component intensities such as red, green, and blue (RGB), or cyan, magenta, yellow, and black (CMYK).

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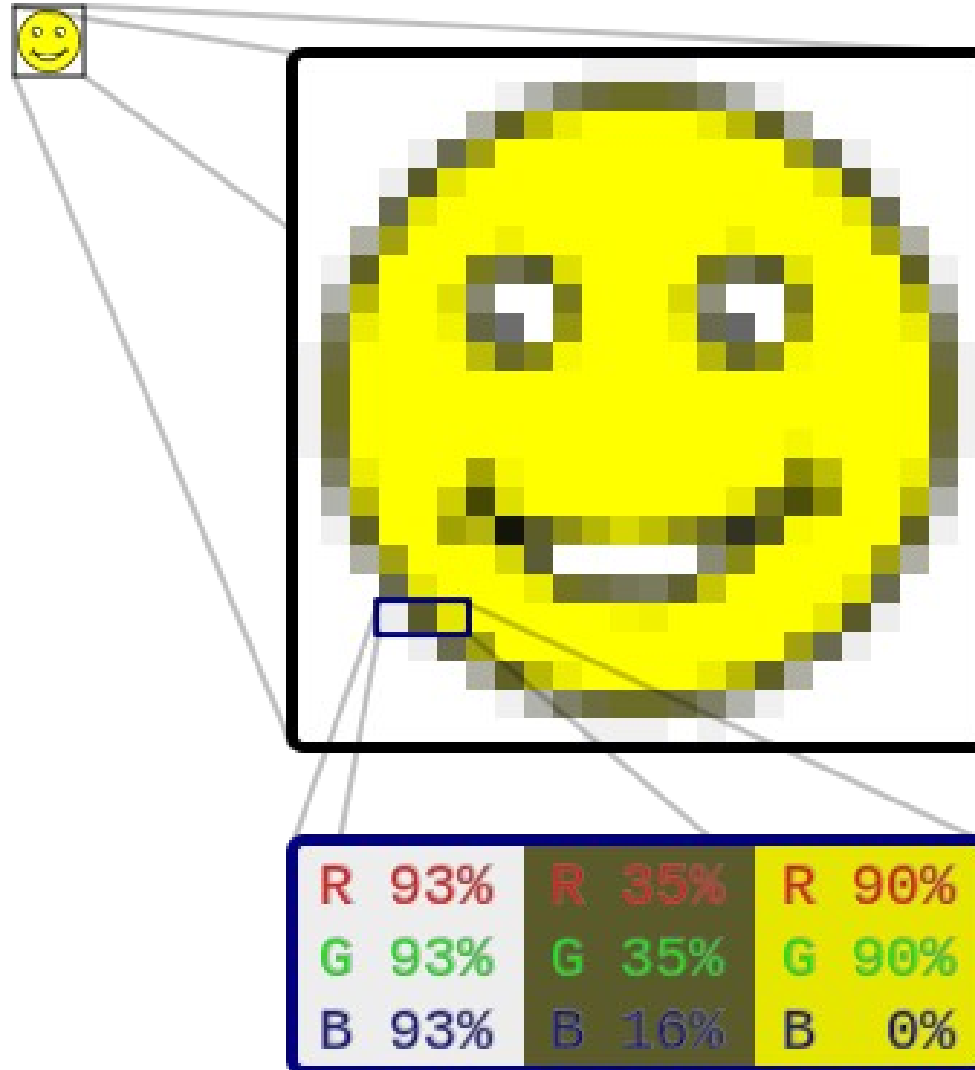
An Image - Format



- Image file formats are standardized means of organizing and storing digital images
- Image files are composed of digital data in one of these formats that can be rasterized for use on a computer display or printer.
- An image file format may store data in uncompressed, compressed, or vector formats.
- Once rasterized, an image becomes a grid of pixels, each of which has a number of bits to designate its color equal to the color depth of the device displaying it

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An Image - Format



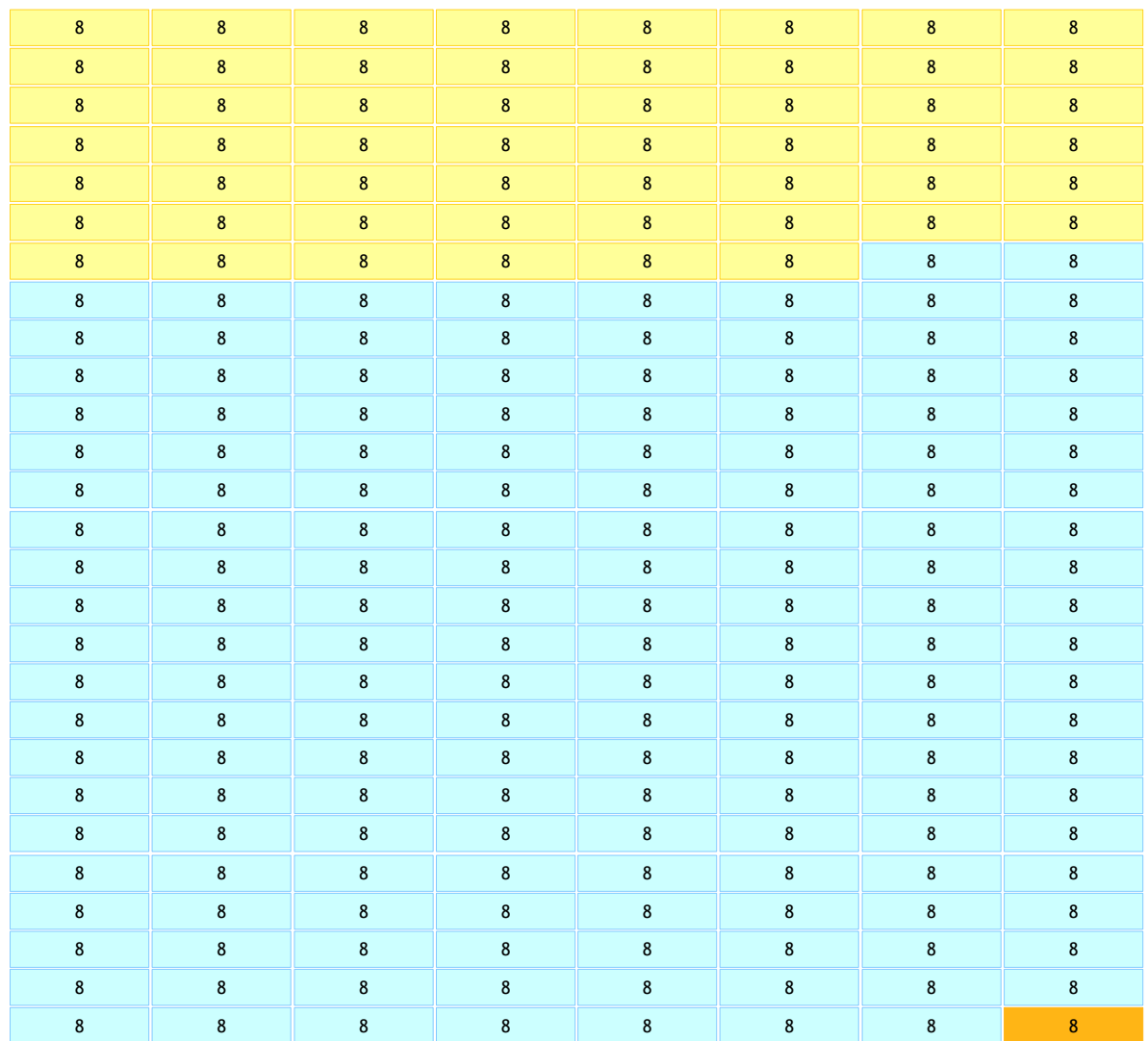
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An Image - Format - BMP



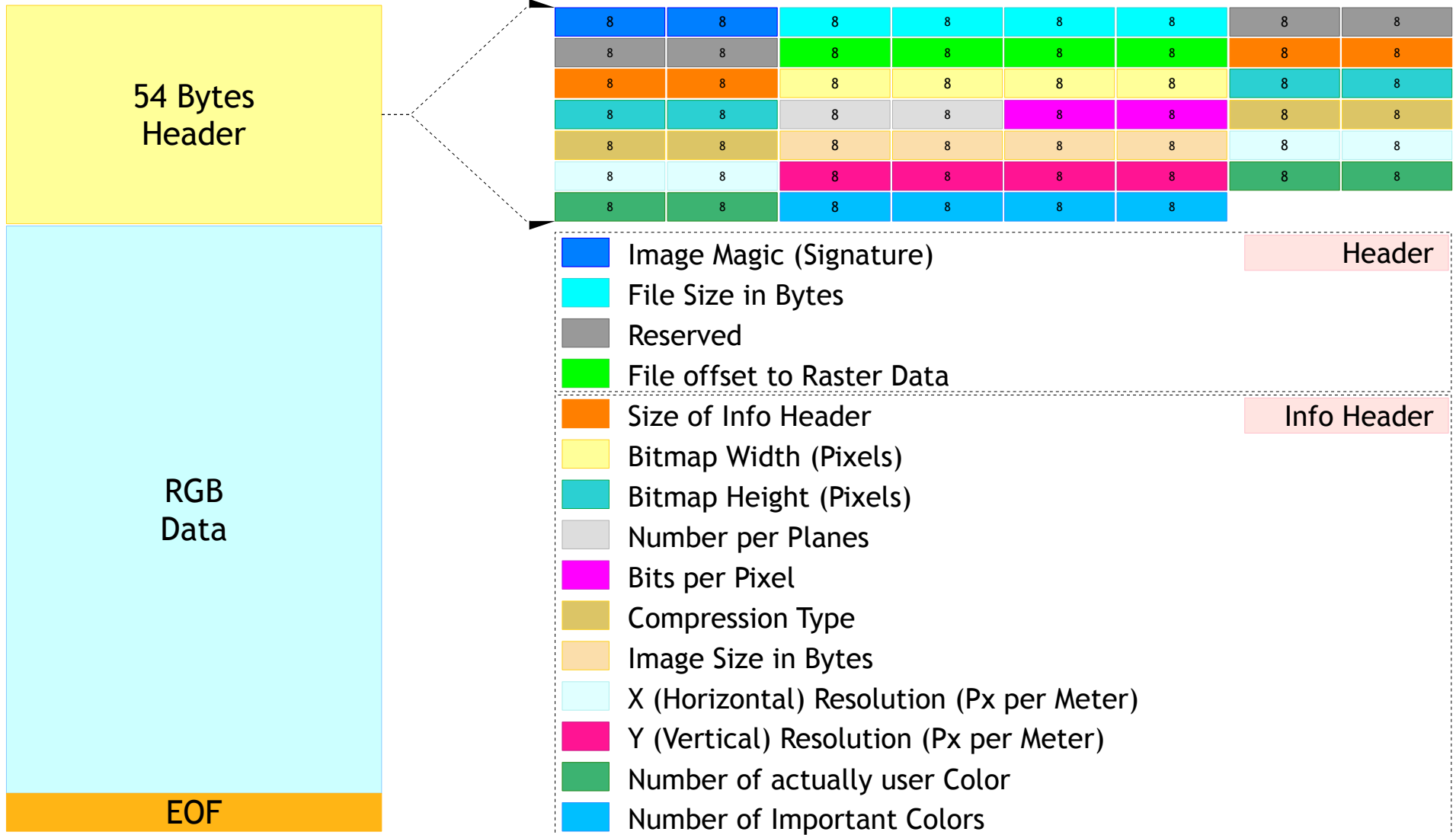
- The BMP file format (Windows bitmap) handles graphic files within the Microsoft Windows OS.
- Typically, BMP files are uncompressed, and therefore large and lossless; their advantage is their simple structure and wide acceptance in Windows programs

An Image - Format - BMP



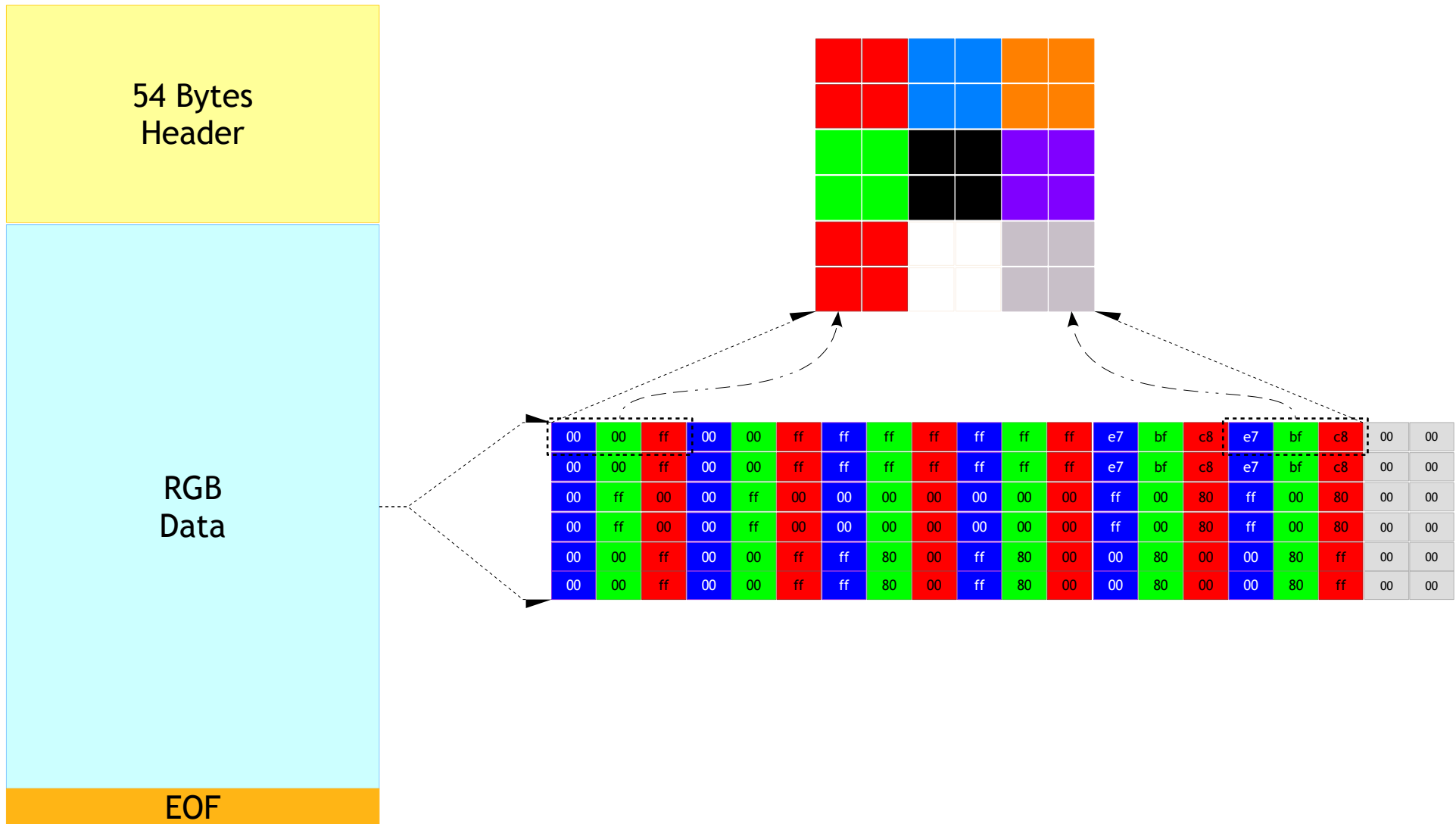
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An Image - Format - BMP - Header



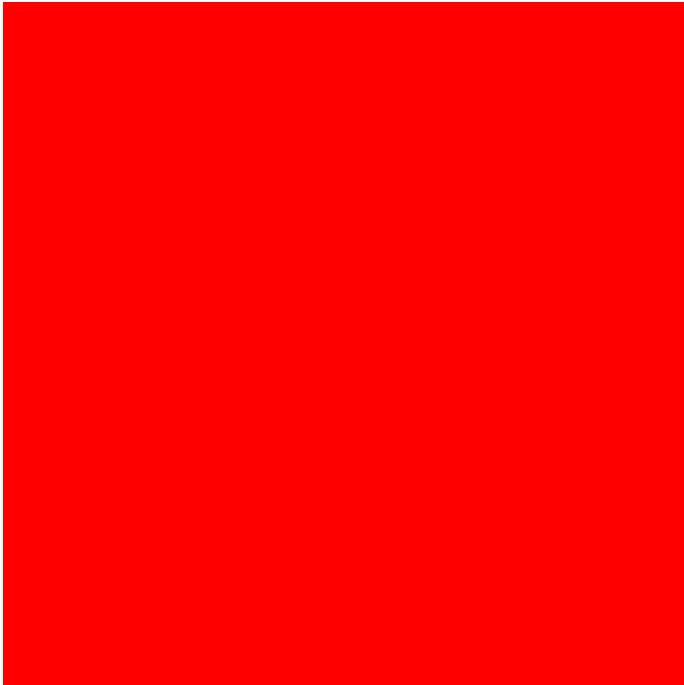
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An Image - Format - BMP - RGB Data



Steganography

An Image - Format - BMP - RGB Data



256x256_red_block.bmp

- The hex file of this image is provided with this slide
- Lets try changing the MSB of the RED element of a Pixel and see the effect
- You may do it as mentioned below

Screen Shot

```
user@user:~] sed -i '33,$s/ff/7f/g' 256x256_red_block.hex
user@user:~] xxd -r -p 256x256_red_block.hex test.bmp
user@user:~] eog test.bmp
```

- You may observe the result

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An Image - Format - BMP - RGB Data



256x256_red_block.bmp

- It is evident that by changing the MSB there is a huge difference in output
- Now let's do same by changing the LSB of the RED element of a Pixel

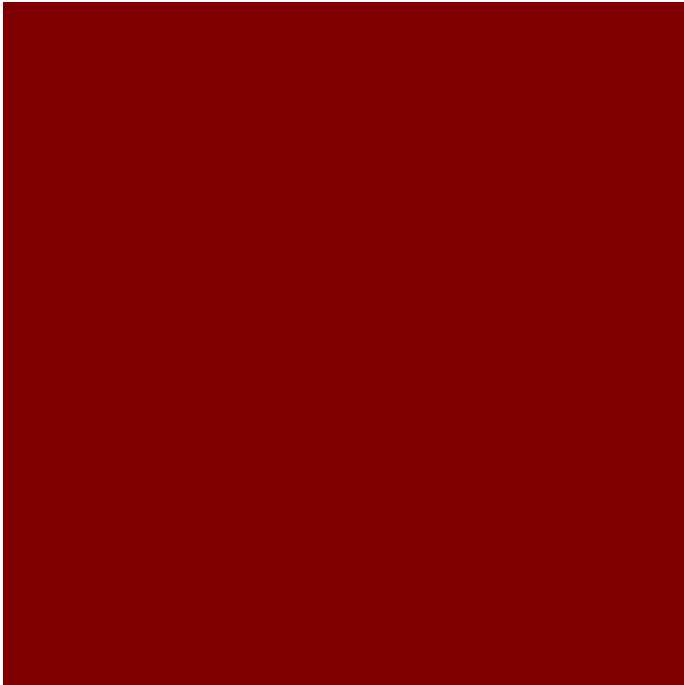
Screen Shot

```
user@user:~] sed -i '33,$s/7f/7E/g' 256x256_red_block.hex
user@user:~] xxd -r -p 256x256_red_block.hex test.bmp
user@user:~] eog test.bmp
```

- You may observe the result

Steganography

An Image - Format - BMP - RGB Data



256x256_red_block.bmp

- Can you find the difference now??
- If yes!! you are super human 😊

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Summary



- This project expects us to Encode a message such a way that the quality of the image doesn't change much.
- So from the previous analysis we can do encoding of bits from the message in the LSB of the RGB data

Requirements

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Usage - Help



Screen Shot

```
user@user:~] ./lsb_steg
./lsb_steg: Encoding: ./lsb_steg -e <.bmp_file> <.text_file> [output file]
./lsb_steg: Decoding: ./lsb_steg -d <.bmp_file> [output file]
user@user:~]
```

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Usage - Encoding



Screen Shot

```
user@user:~] ./lsb_steg -e SkeletonCode/beautiful.bmp secret.txt
INFO: Opening required files
INFO: Opened SkeletonCode/beautiful.bmp
INFO: Opened secret.txt
INFO: Done
INFO: ## Encoding Procedure Started ##
INFO: Checking for secret.txt size
INFO: Done. Not Empty
INFO: Checking for SkeletonCode/beautiful.bmp capacity to handle secret.txt
INFO: Done. Found OK
INFO: Output File not mentioned. Creating steged_img.bmp as default
INFO: Copying Image Header
INFO: Done
INFO: Encoding Magic String Signature
INFO: Done
INFO: Encoding secret.txt File Extension Size
INFO: Done
INFO: Encoding secret.txt File Extension
INFO: Done
INFO: Encoding secret.txt File Size
INFO: Done
INFO: Encoding secret.txt File Data
INFO: Done
INFO: Copying Left Over Data
INFO: Done
INFO: ## Encoding Done Successfully ##
user@user:~]
```

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Usage - Encoding

Screen Shot

```
user@user:~] eog SkeletonCode/beautiful.bmp steged_img.bmp &  
[1] 4103  
user@user:~]
```



Original File



Encoded File

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Usage - Decoding



Screen Shot

```
user@user:~] ./lsb_steg -d steged_image.bmp
INFO: ## Decoding Procedure Started ##
INFO: Opening required files
INFO: Opened steged_img.bmp
INFO: Decoding Magic String Signature
INFO: Done
INFO: Decoding Output File Extension
INFO: Done
INFO: Output File not mentioned. Creating decoded.txt as default
INFO: Opened decoded.txt
INFO: Done. Opened all required files
INFO: Decoding File Size
INFO: Done
INFO: Decoding File Data
INFO: Done
INFO: ## Decoding Done Successfully ##
user@user:~] cat secret.txt
Kattappa killed Bahubali !!
user@user:~] cat decoded.txt
Kattappa killed Bahubali !!
user@user:~]
```

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Usage - Error Handling



Screen Shot

```
user@user:~] ./lsb_steg -e SkeletonCode/beautiful
lsb_steg: Encoding: lsb_steg -e <.bmp file> <.txt file> [output file]
user@user:~]
```

Screen Shot

```
user@user:~] ls -l SkeletonCode/beautiful.bmp secret.txt
-rw-r--r-- 1 user user 2359350 Nov 14 17:19 SkeletonCode/beautiful.bmp
-rw-rw-r-- 1 user user 29982720 Nov 14 20:06 secret.txt
user@user:~]
user@user:~] ./lsb_steg -e SkeletonCode/beautiful.bmp secret.txt
INFO: Opening required files
INFO: Opened SkeletonCode/beautiful.bmp
INFO: Opened secret.txt
INFO: Done
INFO: ## Encoding Procedure Started ##
INFO: Checking for secret.txt size
INFO: Done. Not Empty
INFO: Checking for SkeletonCode/beautiful.bmp capacity to handle secret.txt
ERROR: "SkeletonCode/beautiful.bmp" doesn't have the capacity to encode "secret.txt"
user@user:~]
```

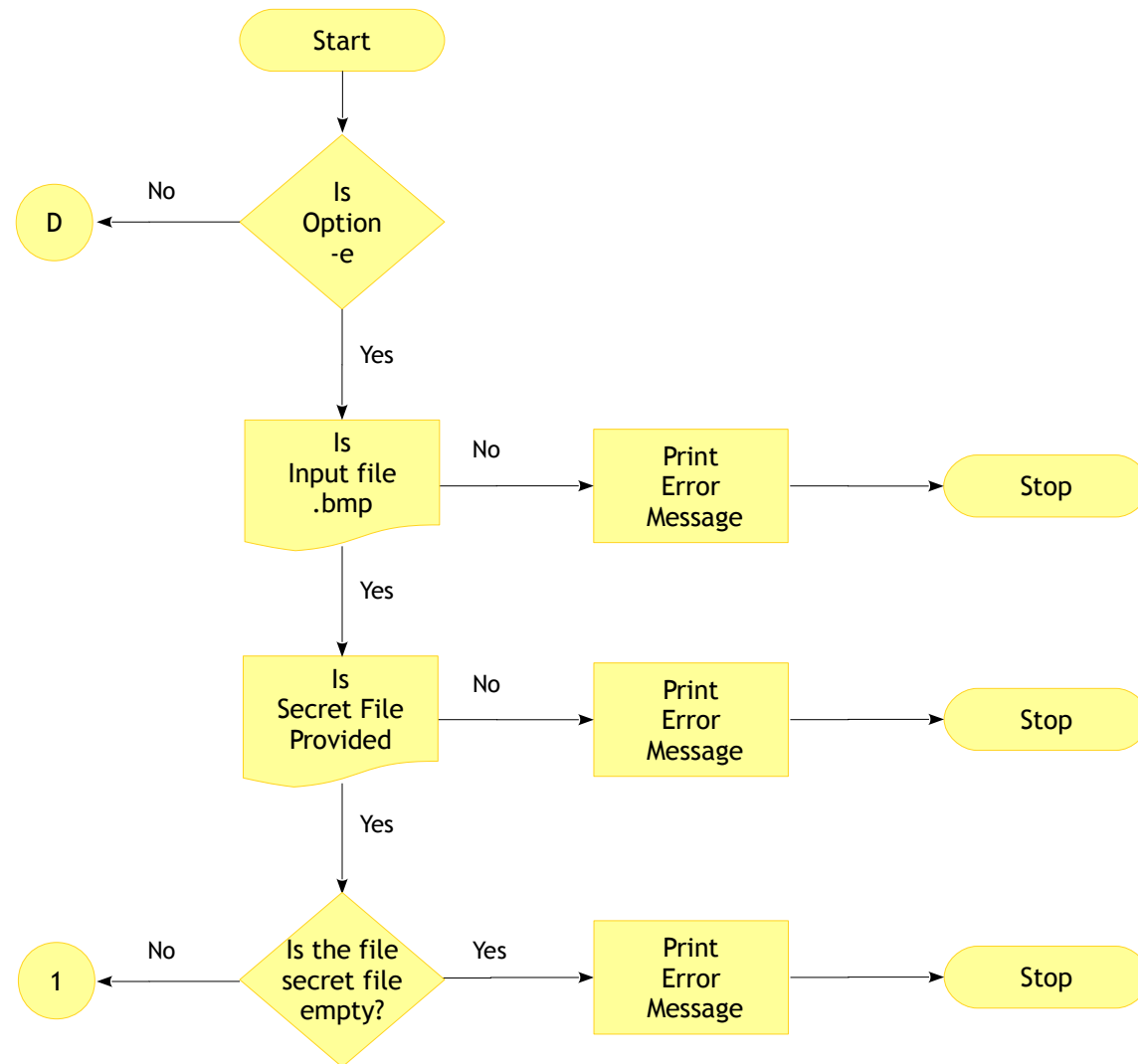
- The above are few, you may handle all possible error.

Design



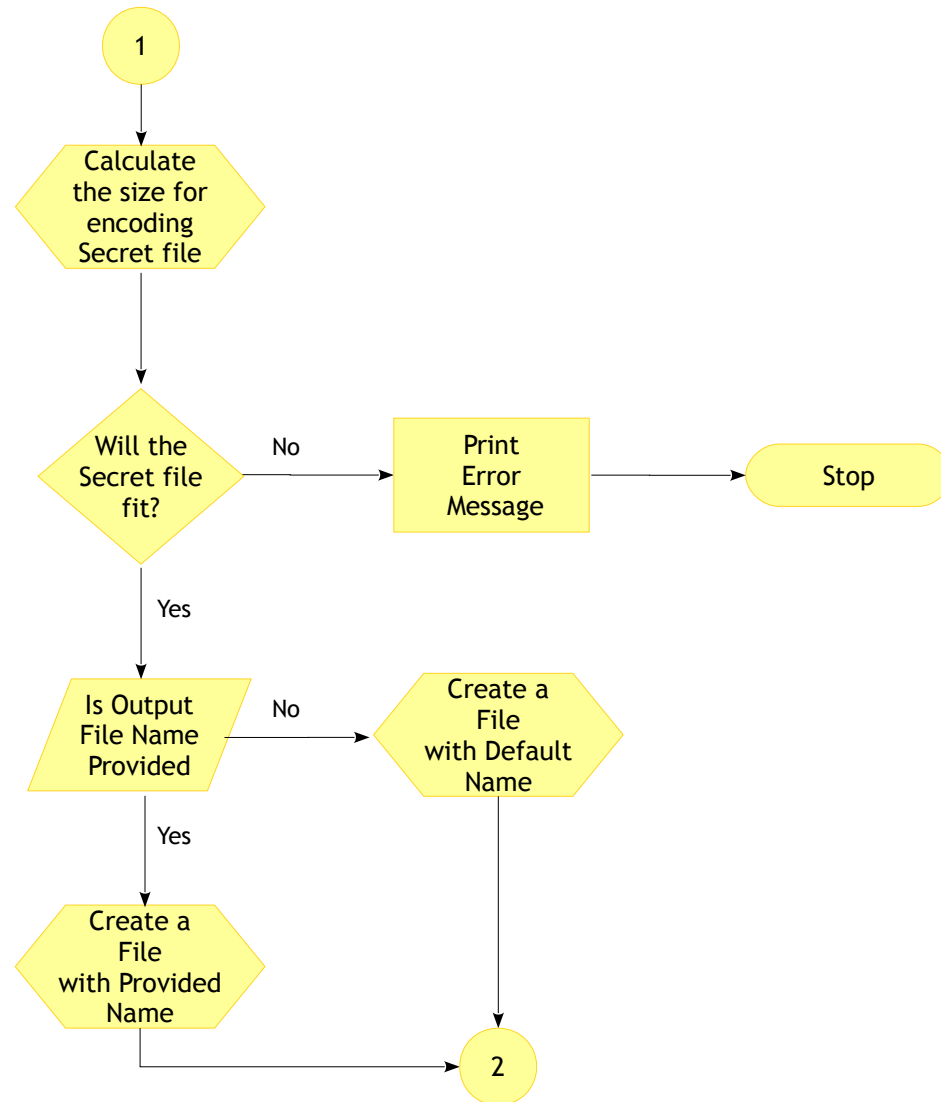
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Design - Encoding



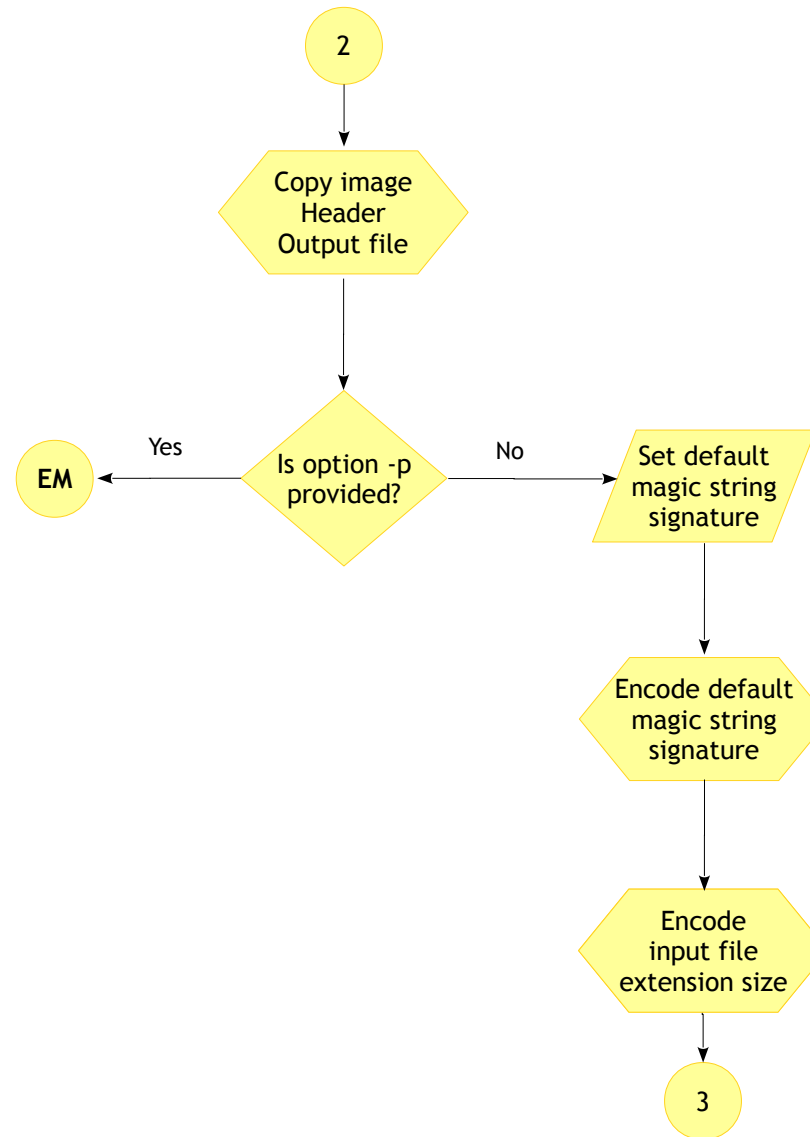
Steganography

Design - Encoding



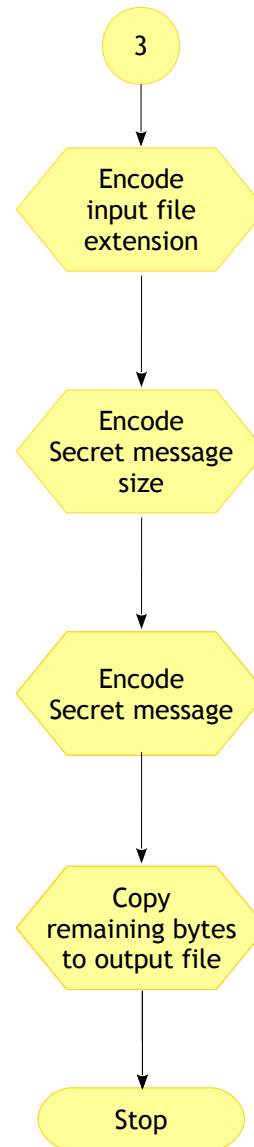
Steganography

Design - Encoding



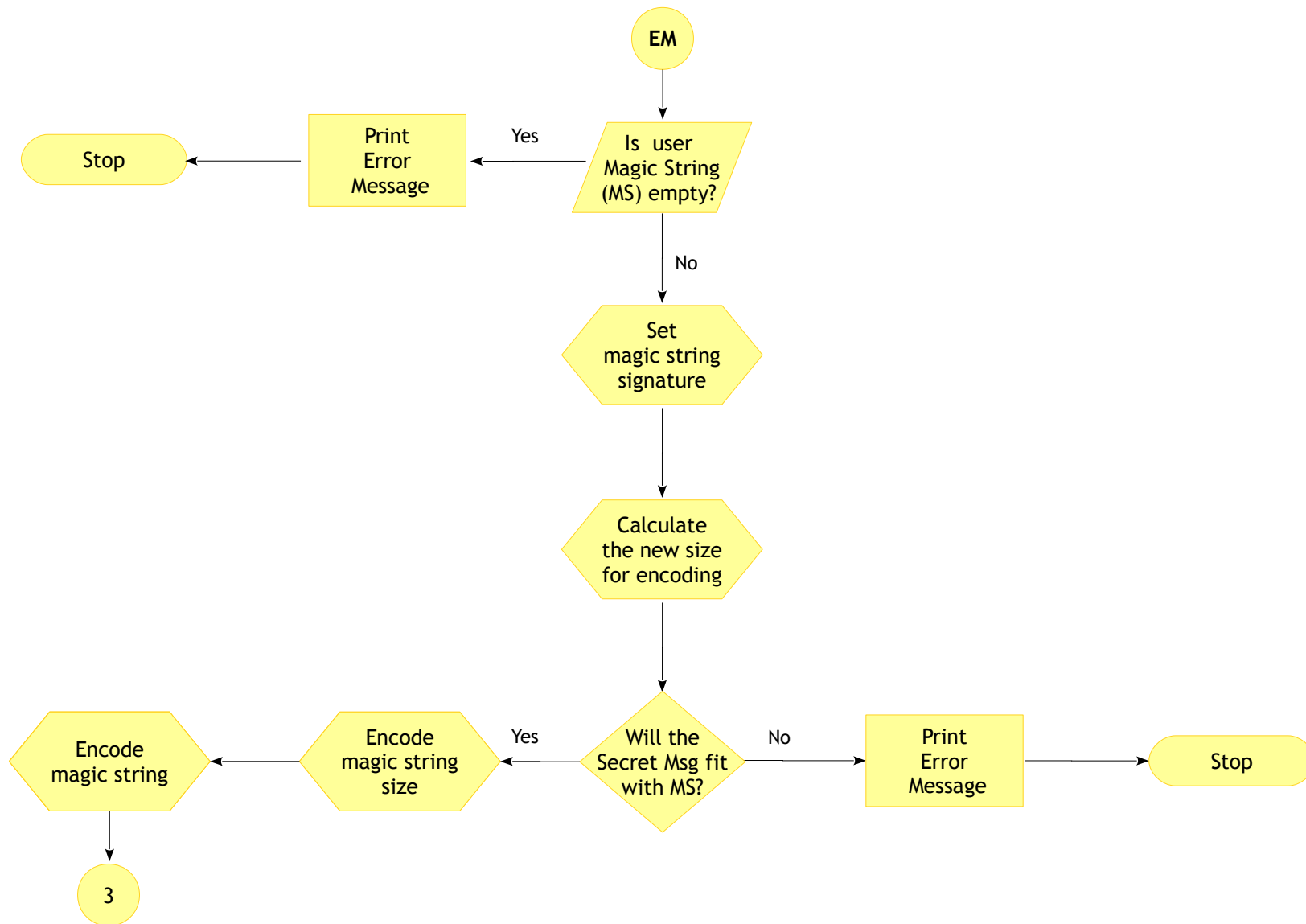
Steganography

Design - Encoding



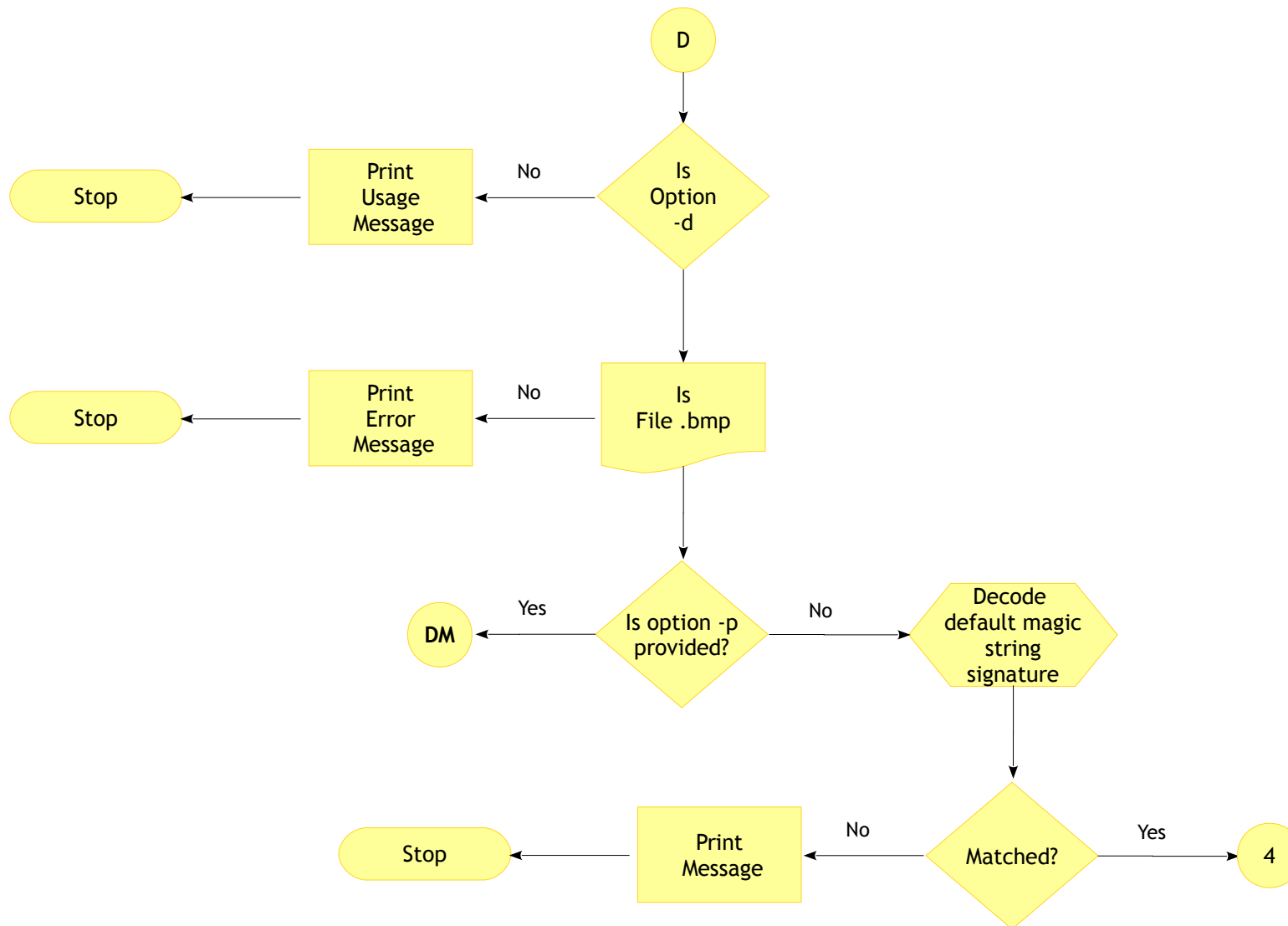
Steganography

Design - Encoding



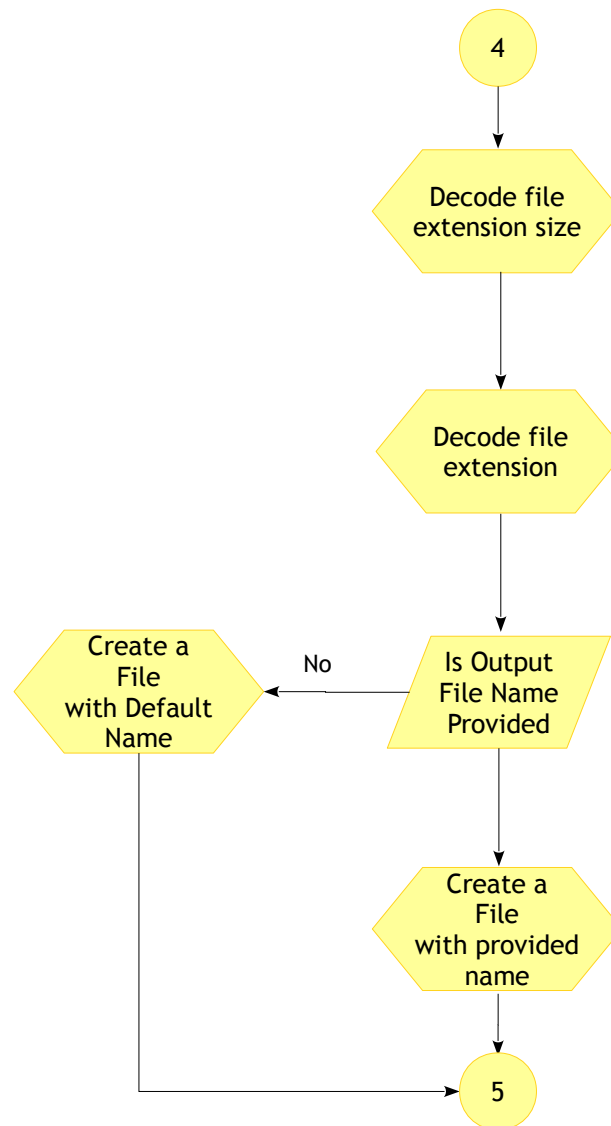
Steganography

Design - Decoding



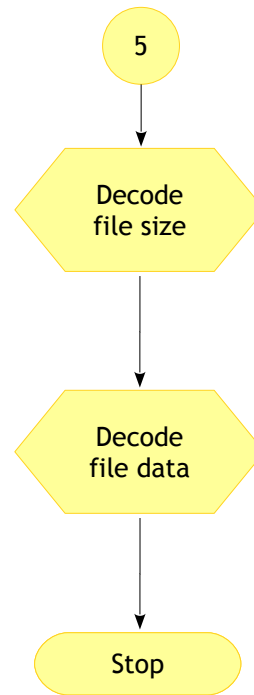
Steganography

Design - Decoding



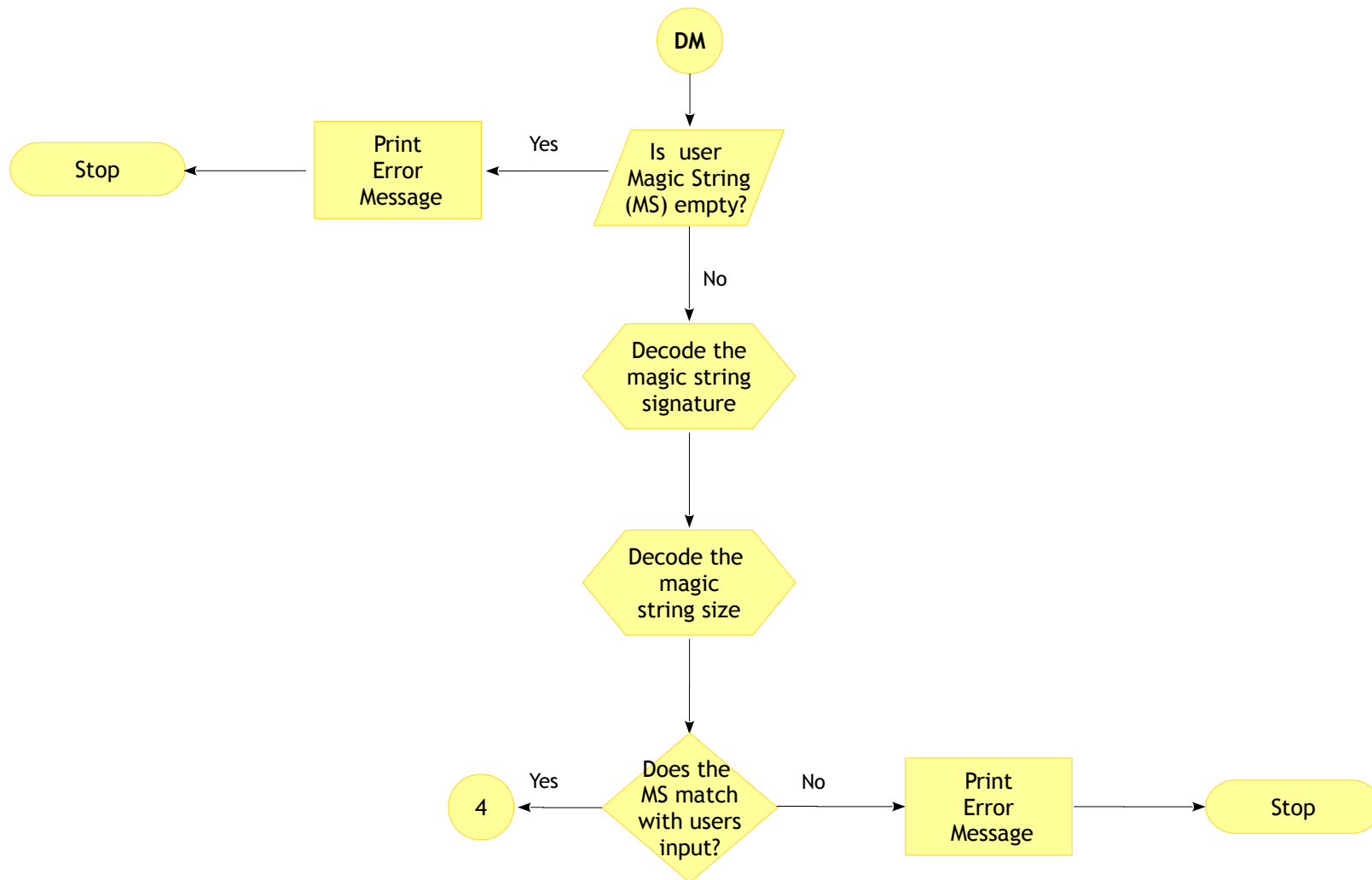
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Design - Decoding



Steganography

Design - Decoding



Code Skeleton

Steganography

Code Skeleton

- Please refer the provided code skeleton with these documents

References



References

- <https://en.wikipedia.org/wiki/Steganography>
- <https://en.wikipedia.org/wiki/Pixel>
- Header Informations
 - http://www.ue.eti.pg.gda.pl/fpgalab/zadania.spartan3/zad_vga_struktura_pliku_bmp_en.html
- Image Reference
 - <https://engineering.purdue.edu/ece264/15au/hwimages>
 - <http://graphicatoz.blogspot.in/>