```
(*                    Computer Graphics with Applications of Dr. Makhanov.
                                        Lab 4:
                          Basic Image Processing with Mathematica *)
```

```
SetOptions[{ListPlot3D, Histogram, Plot}, ImageSize → Small];
```

```
SetOptions[EvaluationNotebook[], ShowCellLabel → False];
```

```
(* Problem (1) Define the mage val_2021.
 png and output the dimensions and the channels   *)
```

```
(* Set up your directory where you uploaded the images*)
```

```
SetDirectory["E:\\Computer Graphics\\Lab4\\Lab4"]
```

E:\Computer Graphics\Lab4\Lab4

```
T0 := Import["val_2022.png"]
```

```
ImageDimensions[T0]
```

{101, 102}

```
(* Usually the color image has RG and B channels *)
```

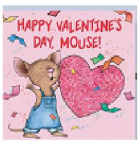
```
ImageChannels[T0]
```

3

```
(* Problem (2) Split T1 the RGB components. *)
```

```
(* If you get 4 channels then RemoveAlphaChannel *)
```

```
T1 = RemoveAlphaChannel[T0]
```



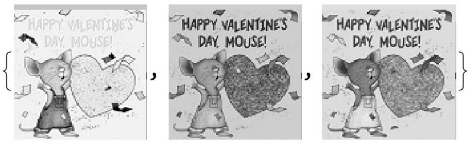

```
(* convert into the gray level image *)
```

```
{TG = ColorConvert[T1, "Grayscale"]}
```

{  }

```
(* Problem (3) Evaluate each color~matrix and combine
 them back into the color image in a different order *)
```

```
{CRed, CGreen, CBlue} = ColorSeparate[T1]
```



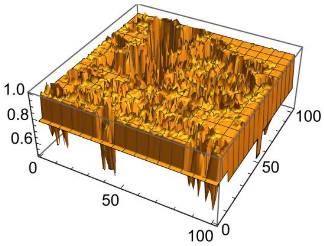

```
(* Let us combine them into the image in a different way  *)
```

```
{T3 = ColorCombine[{CGreen, CRed, CBlue}]}
```


```
(* Obtain gray levels of the image Cred as a matrix
   and show them  using ListPlot3D. Can take some time....  *)
```

```
M3 = ImageData[CRed];
```

```
ListPlot3D[M3, ImageSize → Small] (* this may take some time *)
```



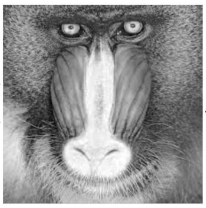
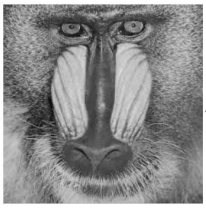
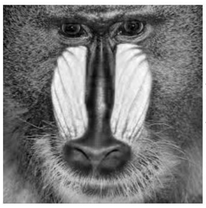

```
(* Convert M3 back into the image *)
```

```
{M3Image = Image[M3]}
```


```
(* Problem (4) Import baboon.jpg. Swap the red and the green matrices *)
```

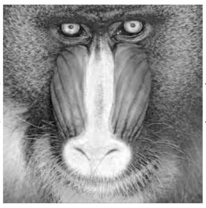
[redacted]

[redacted]

{  ,  ,  }

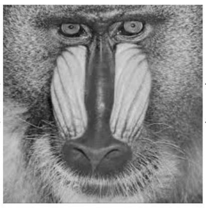
```
(* Red *)
```

[redacted]

{  }

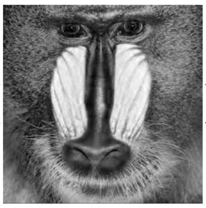
```
(* Green *)
```

[redacted]

{  }

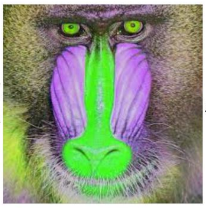
```
(* Blue *)
```

[redacted]

{  }

```
(* Swap and combine. Compare  *)
```

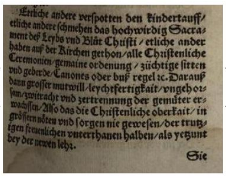
[redacted]

{, }

```
(* Binarization splits the gray levels into
 black and white regions depending on a given threshold *)
```

```
(* Problem (5) Read the image textold1.jpg
 and binarize it with an appropriate threshold*)
```

```
{T5 = Import["textold.jpg"]}
```

{}

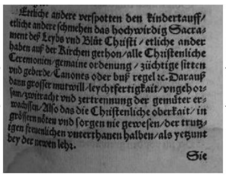
Etliche andere verspotten den kindertauff/
etliche andere schmehen das hochwirdig Sacra-
ment deß Leybs vnd Blůt Christi / etliche ander
haben auß der Kirchen gethon/alle Christenliche
Ceremonien/gemaine ordenung / züchtige sitten
vnd geberde/Canones oder buß regel ꝛc. Darauß
dann grosser mutwill/leychtfertigkait/vngehor-
sam/zwitracht vnd zertrennung der gemüter er-
wachssen/Also das die Christenliche oberkait/ in
grössern nöten vnd sorgen nie gewesen/der trutz-
igen frevenlichen vnterthanen halben/als yetzunt
bey der newen lehr.
Sie

```
ImageDimensions[T5]
```

{332, 254}

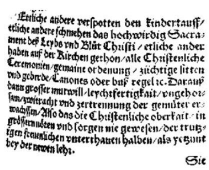
```
T5GL := ColorConvert[T5, "Grayscale"]
```

```
{T5GL}
```

{}

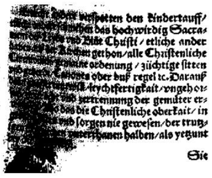
```
T5B := Binarize[T5GL, 0.2];
```

```
{T5B}
```

{}

```
(* Problem (6) Use slider for solving Problem (5) *)
```

{Dynamic[Binarize[T5GL, Tre]]}

{  }

```
(* Design the slider *)
```

[redacted]

{[slider], 0.35}

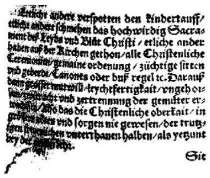
```
(* Finding the Threshold automatically  *)
```

Tre6 = FindThreshold[T5GL]

0.301961

T6 := Binarize[T5GL, Tre6]

{T6}

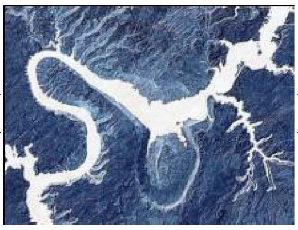
{  }

```
(* Problem (7) Find an appropriate threshold to binarize the
 satellite image river1.jpg  to remove details and visualize the
 river flow. Use ColorNegate[Image] to obtain the negative image *)
```

```
(* Import the image *)
```

R1 := Import["river1.JPG"]

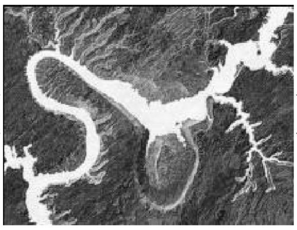
{R1}

{}

```
(* Convert into the gray level  *)
```

[redacted]

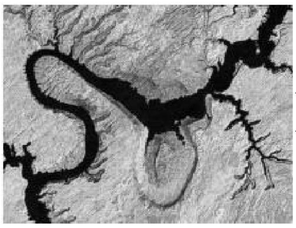
{R2}

{}

```
(* Use ColorNegate to obtain negative of the image R2
  Use M-13 help to find this function  *)
```

[redacted]

{R3}

{}

{Dynamic[Binarize[R3, Tr3]]}

{}

```
(* Design the slider for Tr3*)
```

[redacted]

{ , 0.518}

```
(* Binarize with a fixed threshold selected by slider and save in R4*)
```

[redacted]

{Null}

{R4}

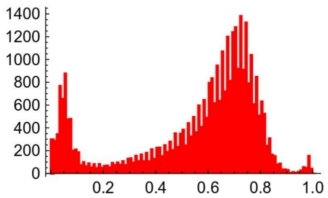
```
(* Gray level histogram shows for each gray level the number of pixels in the image
 that have this gray level The one~dimensional histogram functions return a
 vector N elements long containing the number of intensity levels in each bin *)
```

```
(* Problem (7') Binarize image river1.jpg using a slider and a histogram *)
```

```
(* Convert into data and flatten the image *)
```

```
RF3 = Flatten[ImageData[R3]];
```

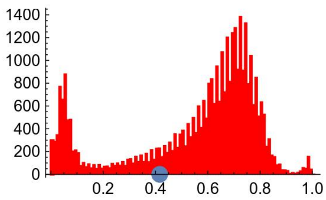
```
HP = Histogram[RF3, {0.01}, ChartStyle → Red]
```




```
{Slider[Dynamic[TreP], Background → LightBlue], Dynamic[TreP]}
```

{ , 0.416}

```
Dynamic[Show[HP, ListPlot[{{TreP, 0}}, PlotStyle → PointSize[0.06]]]]
```

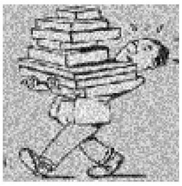



```
{RH4 = Dynamic[Binarize[R3, TreP]]}
```

{  }

```
(* Problem (8) Remove the background noise from image in
 Heavy_load_noisy.jpg using the method applied in Problem (7') *)
```

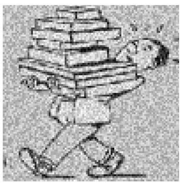
```
HL1 = Import["Heavy_load_noisy.jpg"]
```



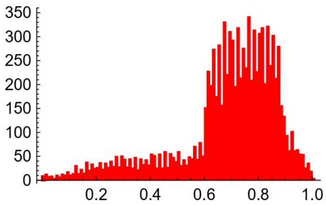
```
ImageChannels[HL1]
```

3

[redacted]

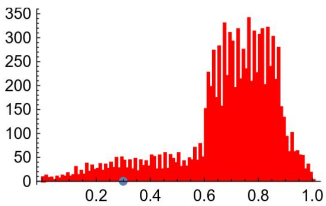


[redacted]



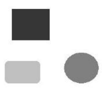
```
{Slider[Dynamic[TreHL], Background → LightBlue], Dynamic[TreHL]}
```

[redacted]

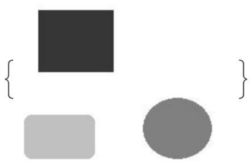


[redacted]

```
(* Binarize[image, {t1,t2}] creates a binary image by replacing all values
 in the range t1 through t2 (two thresholds) with 1 and others with 0. This
 is used to segment an object with the gray levels in a specified interval.
  The image is imported by "cut-and-paste".
 *)
```

T12 := 

```
{T9 = ColorConvert[T12, "Grayscale"]}
```



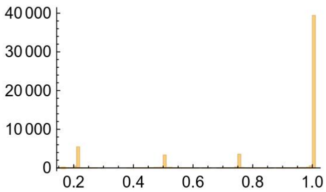
```
(* Problem (9) Binarize image T9 using a histogram and binarization
 with the two thresholds so that only one object appears at the time *)
```

```
(* Flatten[ImageDatap[]] *)
```

```
T9F := Flatten[ImageData[T9]]
```

```
(* Find the histogram *)
```

```
HP9 = Histogram[T9F, {0.01}]
```




```
(* Use  Binarize[image,{t1,t2}] *)
```

[redacted]

[redacted]

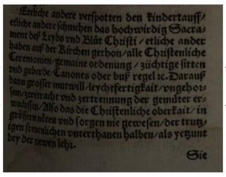
[redacted]

{}

```
(* Turning the gray level up and down *)
```

```
(* Gray level down by 0.5 *)
```

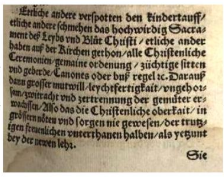
```
{Tdown = ImageMultiply[T5, 0.5]}
```

{}

Etliche andere verspotten den Kindertauff/
etliche andere schmehen das hochwirdig Sacra-
ment deß Leybs vnd Blůt Christi / etliche ander
haben auß der Kirchen gethon/alle Christenliche
Ceremonien/gemaine ordenung / züchtige sitten
vnd geberde/Canones oder buß regel ꝛc. Darauß
dann grosser mutwill/leychtfertigkait/vngehor-
sam/zwitracht vnd zertrennung der gemüter er-
wachssen/Also das die Christenliche oberkait/ in
grössern nöten vnd sorgen nie gewesen/der trutz-
igen freuenlichen vnterthanen halben/als yetzunt
bey der newen lehr.
Sie

```
(* Gray level up 1.5 with the automatic adjustment to [0,1] *)
```

```
{Tup = ImageMultiply[T5, 1.5]}
```

{}

Etliche andere verspotten den Kindertauff/
etliche andere schmehen das hochwirdig Sacra-
ment deß Leybs vnd Blůt Christi / etliche ander
haben auß der Kirchen gethon/alle Christenliche
Ceremonien/gemaine ordenung / züchtige sitten
vnd geberde/Canones oder buß regel ꝛc. Darauß
dann grosser mutwill/leychtfertigkait/vngehor-
sam/zwitracht vnd zertrennung der gemüter er-
wachssen/Also das die Christenliche oberkait/ in
grössern nöten vnd sorgen nie gewesen/der trutz-
igen freuenlichen vnterthanen halben/als yetzunt
bey der newen lehr.
Sie