Q1.

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| **Attribute** | **Binary /Discrete/ Continuous** | **Reasoning** |
| Time in terms of AM and PM | Discrete | Time has finite values from 0 to 12 |
| Brightness as measured by a light meter | Continuous | Measuring of light can be decimal values and have long range |
| Brightness as measured by people's judgments | Binary | By taking dark as `1` and bright as `0` |
| Temperature as measured in Fahrenheit | Continuous | Can have decimal values and can rise till large values (in Billions) |
| Bronze, Silver, and Gold medals awarded at the Olympics | Discrete | Can have 3 values |
| Height above sea level | Continuous | Can have decimal values and can rise till large values |
| Number of patients in a hospital | Discrete | Have numerical values |
| ISBN numbers for books | Discrete | Fixed range with numerical values |
| Ability to pass light in the terms of the following values | Discrete | Have only 3 values (Opaque-0, Translucent-1, Transparent-2) |
| Military rank | Discrete | Have numerical values |
| Latitude/Longitude values | Continuous | Have a fixed range of values |
| Volume of a substance in cubic centimeter | Continuous | Can have decimal values and no limit |
| Coat check number | Discrete | Have numerical values |

|  |  |  |
| --- | --- | --- |
| **Attribute** | **Qualitative /Quantitative** | **Reasoning** |
| Time in terms of AM and PM | Quantitative (Interval) | There is no `0` time and time can be greater or less than |
| Brightness as measured by a light meter | Quantitative (Ratio) | Measurements can have 0 values and can be nominal, ordinal, interval and ratio |
| Brightness as measured by people's judgments | Qualitative (Nominal) | Have only two values 0 or 1 as we have taken dark and bright |
| Temperature as measured in Fahrenheit | Quantitative (Interval) | There is no `0` temperature in Fahrenheit and we can’t judge half or double hot/cold |
| Bronze, Silver, and Gold medals awarded at the Olympics | Quantitative (Ratio) | If we take number of medals awarded for each category than it can be nominal, ordinal, interval and ratio |
| Height above sea level | Quantitative (Ratio) | Measurements can have 0 values and can be nominal, ordinal, interval and ratio |
| Number of patients in a hospital | Quantitative (Ratio) | Number of patients can be compared by greater/less, twice/half |
| ISBN numbers for books | Quantitative (Interval) | There is no `0` value as they are unique identification values |
| Ability to pass light in the terms of the following values | Qualitative (Ordinal) | As can only be greater or less than 1 |
| Military rank | Qualitative (Ordinal) | As can only be greater or less than lieutenant |
| Latitude/Longitude values | Quantitative (Interval) | Does not have 0 latitude values |
| Volume of a substance in cubic centimeter | Quantitative (Ratio) | Measurements can have 0 values and can be nominal, ordinal, interval and ratio |
| Coat check number | Quantitative (Interval) | There is no `0` value as they are unique identification values |

Q2.

**(i)**

Since our Initial Pixel values are n a range of 290 to 3000, we have to perform Normalization for Contrast Stretching them to enhance it to 0 to 65535 range.

Let’s take I as initial dataset, where,

Max = 3000 (Maximum pixel value in the set)

Min = 290 (Minimum pixel value in the set)

Now, to normalize the data,

where, *I= Any random value which we want to normalize*

*NewMax = Maximum intensity value of new Intensity range*

*NewMin = Minimum intensity value of new Intensity range*

*Max = Maximum intensity pixel value of given range*

*Min = Minimum intensity pixel value of given range*

We have,

NewMax = 65,535

NewMin = 0

Max = 3000

Min = 290

Therefor,

For example,

(1) I = 3000

*I’ = 65535*



(2) I = 300

*I’ ≈ 242*

(3) I = 1000

*I’ ≈ 17,170*

In the above problem we learned that Contrast Stretching Normalization is a transformation technique used in Image Processing, in which we enhance or diminish the the pixel intensity of our greyscale image from the given range to desired range. In our problem we have 290 to 3000 as our given pixel range and 0 to 65535 as desired pixel range (As we want to represent in a 16-Bit binary number. So, it’s range is 0-65535). So, we are enhancing the quality of our image by representing it in a 16 bpp image in such a way that every bit of our display is filled by a pixel and making the image more clear.

**(ii)**

We are given,

x = (-∞,∞)

and we have to transform our data values into the range of (0,1)

To perform our transformation we will use Min-Max Scaling to normalize our data.

In Min-Max-Scaling,

where, *xi = value in the range we want to normalize*

*xmin = minimum value in the range*

*xmax = maximum value in the range*

Let’s take an example,

x = (-100,100)

here,

xmin = -100

xmax = 100

But xi can’t be -100 or 100 as it is an open set.

(1) Take x1=50



*z1= 0.75*

(2) Take x2=-90



*z2 = 0.05*

Here, x1>x2 and we get z1>z2. Therefore, condition satisfied and we will get unique values for every value of x.