**ASSIGNMENT**

**Q1.Discuss the main stages of JPEG compression.How is a JPEG file structured?**

**JPEG COMPRESSION STEPS**

**Step 1 (Transformation):** Color images are transformed from RGB into a luminance/chrominance image (Eye is sensitive to luminance, not chrominance, so that chrominance part can lose much data and thus can be highly compressed.

**Step 2 (Down Sampling):** The down sampling is done for colored component and not for luminance component .Down sampling is done either at a ratio 2:1 horizontally and 1:1 vertically (2h 1 V). Thus the image reduces in size since the ‘y’ component is not touched, there is no noticeable loss of image quality.

**Step 3 (Organizing in Groups):** The pixels of each color component are organized in groups of 8×2 pixels called “ data units” if number of rows or column is not a multiple of 8, the bottom row and rightmost columns are duplicated.

**Step 4 ( Discrete Cosine Transform):**Discrete Cosine Transform ( DCT) is then applied to each data unit to create 8×8 map of transformed components.DCT involves some loss of information due to the limited precision of computer arithmetic. This means that even without the map there will be some loss of image quality but it is normally small.

**Step 5 (Quantization):** Each of the 64 transformed components in the data unit is divided by a separate number called its ‘Quantization Coefficient (QC)’ and then rounded to an integer. This is where information is lost irretrievably, Large QC cause more loss. In general, the most JPEG implements allow use QC tables recommended by the JPEG standard.

**Step 6 (Encoding):** The 64 quantized transformed coefficients ( Which are now integers) of each data unit are encoded using a combination of RLE and Huffman coding.

**Step 7 (Adding Header):** The last step adds header and all the JPEG parameters used and output the result.

The compressed file may be in one of the 3 formats:

1. Interchange Format: In which the file contains compressed image and all the tables needed by the decoder. (Quantization table and Huffman code table).
2. Abbreviated Format: Where the file contains compressed image and may contain first a few table. (Since the same encoder-decoder pair is used and they have some tables built in)
3. Abbreviated format for table and specification data: Where the file contains just tables and number of compressed images. Since images compressed by same encoder and same tables, hence when it is to be decoded, they are sent to decoder preceded by one file with table specification data).

The JPEG decoder performs the reverse steps. Thus JPEG is a symmetric compression method.

# THE STRUCTURE OF JPEG PICTURES

The JPEG (Joint Photographic Experts Group) ISO standard is a lossy image compression mechanism developed before 1990, designed for compressing colour or gray-scale photo-realistic images (it performs poorly on line-art drawings). The JPEG mechanism is designed to exploit known limitations of the human eye, in particular the fact that colour changes are perceived less accurately than changes in brightness. Note that although the "baseline" JPEG format is patent-free, there are patents associated with some optional features, namely arithmetic coding and hierarchical storage. For this reason, these optional features are never used on the Web (good job, patent fans ...). JPEG refers only to a class of compression algorithms, not to a specific file format. In order to produce files with embedded JPEG streams, a number of file format (semi-)standards have been adapted or devised, some of which are listed in the [format section](https://metacpan.org/pod/distribution/Image-MetaData-JPEG/lib/Image/MetaData/JPEG/Structures.pod#A-SHORT-HISTORY-OF-JPEG-FILE-FORMATS). The structure of a well formed JPEG file can be described by the following pseudo production rules (for sake of simplicity, some additional constraints between tables and SOF segments are neglected).