**Algorithm 1** Acquiring codebooks for images with soft compression algorithm

**Training stage:**

Initialize the set of shapes $\mathcal{S}$

**For** a multi-component image $I$ in the training set **do**

Divide $I$ into $m$ single component images

Perform reversible component transformation to generate $I_1, I_2, ..., I_m$

**For** each component $I_1, I_2, ..., I_m$ **do**

1) Obtain prediction error by using prediction coding
2) Map prediction error to non-negative value
3) Layer separation to get the shape layer and detail layer
4) Search and dynamically update shapes and their frequency in the shape layer
5) Gain the frequency of intensity values in the detail layer

Generate the codebook for **shape layer** according to the frequency and size of each shape

Generate the codebook for **detail layer** according to the frequency of each intensity value