Algorithm 1: Bag of Feature for image classification

Input: N, Number of descriptors/clusters

Data: $X_{Train}^{(j)}, X_{Test}, Y_{Train}$, where $j = 0, 1, ..., \#Class$

Result: Classification prediction for X_{Test}, $\hat{Y_{Test}}$

begin

    i $\longleftarrow \#\mathrm{X}_{Train}$

    foreach $x_i \in X_{Train}$ **do**

        Step 1 : Feature extraction

- Extract regions

- Compute descriptors

        Add extracted descriptors, $\{d_{i1}, d_{i2}, \cdots\}$ into **descriptor sets**, D

    Step 2 : Feature Dictionary

    For D, find N cluster using clustering method s.t. descriptor dictionary has N clusters

    foreach $d \in D$ **do**

        Assign descriptors $\{d_{i1}, d_{i2}, ..., d_{..}\}$ cluster label $\implies$
        $\{d_{i1}^{(0)}, d_{i2}^{(3)}, ..., , d_{..}^{(j)}\}$, where $j \in \{0, 1, ..., N-1\}$

        Feature Dictionary, F_j contains descriptors with cluster label j

    for i **do**

        Step 3 : Compute Frequencies

        Compute frequencies of extracted descriptors in the Feature Dictionary, F

        foreach j **do**

            $S_{ij} = \#\left\{d_{i\cdot}^{(j)} \in F_j\right\}$

    Step 4 : Test data classification

    foreach $x \in X_{Test}$ **do**

        Perform **Step 1 + Step 3** $\implies$ Classifier (*e.g.* SVM)

        Append classifier result to $\hat{Y_{Test}}$

    return $\hat{Y_{Test}}$