**k-fold Cross Validation**

*k*-fold cross validation is a common technique for estimating the performance of a classifier. Given a set of *m* training examples, a single run of *k*-fold cross validation proceeds as follows:

1. Arrange the training examples in a random order.

2. Divide the training examples into *k* folds. (*k* chunks of approximately *m*/*k* examples each.)

3. For *i* = 1, ..., *k*:
   - Train the classifier using all the examples that do not belong to Fold *i*.
   - Test the classifier on all the examples in Fold *i*.
   - Compute *n*_i, the number of examples in Fold *i* that were wrongly classified.

4. Return the following estimate to the classifier error:

\[ E = \frac{\sum_{i=1}^{k} n_i}{m} \]

To obtain an accurate estimate to the accuracy of a classifier, *k*-fold cross validation is run several times, each with a different random arrangement in Step 1. Let \( E_1, \ldots, E_t \) be the accuracy estimates obtained in *t* runs. Define:

\[ e = \frac{\sum_{j=1}^{t} E_j}{t}, \quad V = \frac{\sum_{j=1}^{t} (E_j - e)^2}{t - 1}, \quad \sigma = \sqrt{V} \]

The estimate for the algorithm performance is an error of *e* with standard-deviation of *σ*. 