Introduction
Support Vector Machine is a widely used predictive model for classification. Training a SVM model needs collection of data in a centralized environment, however, is not always possible in real-world scenarios due to privacy. We extend a previous published paper [1] to develop an easy-to-use web-service (http://132.249.64.226:8080/psvm/createtask.jsp) for multiple clients to collaborate and fulfill the learning task in a privacy-preserving manner.

Motivation
An important relationship between primal and dual forms of SVM is that feature weights $W$ are convertible from sample weights $\alpha$: $W = \sum_i y_i \alpha_i X_i$, see the next section for details.

Because $\alpha$ in the dual format of SVM can be learned using kernel matrix $K$, i.e., $K_{ij} = X_i^T X_j$, we can build a SVM model without sharing raw data $X$.

We used JSP as frontend to interact with “participating parties” and applet-to-servlet architecture to handle the backend computation.

Algorithm
Consider a training data $D = \{(X_1, y_1), \ldots, (X_n, y_n)\} \subset X \times R$, where $X$ denotes the space of inputs (e.g., $X = R^d$) and class labels $y_i \in \{-1, 1\}$. Here $d$ indicates the dimension of inputs while “+1” and “-1” correspond to positive and negative observations. A support vector machine (SVM) maximizes the geometric margin $||W||^2$ between two classes of data, as indicated in Fig. 1. The function being optimized can be written as:

**Primal form:**

$$\min_{w, \xi} \left[ \frac{1}{2} w^T w + C \sum_i \xi_i \right]$$

s.t. 

$$w^T X_i \geq 1 - \xi_i, \quad \xi_i \geq 0, \forall i$$

**Dual form:**

$$\max_{\alpha} \left[ \sum_{i=1}^{n} \alpha_i - \frac{1}{2} \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_i \alpha_j y_i y_j X_i^T X_j \right]$$

s.t. 

$$0 \leq \alpha_i \leq C, \forall i$$

$$\sum_i \alpha_i y_i = 0.$$