**[HW5](https://ualearn.blackboard.com/webapps/assignment/uploadAssignment?content_id=_4638427_1&course_id=_164945_1&group_id=&mode=view)**

**Learn to use support vector machines**

**All students:**

1. Study [LibSVM for MATLAB](http://www.csie.ntu.edu.tw/~cjlin/libsvm/" \t "_blank). If after reading the [documentation](http://www.csie.ntu.edu.tw/~cjlin/papers/guide/guide.pdf) you still have any questions regarding LibSVM usage, I recommend on-line tutorials:  [Tutorial](http://openclassroom.stanford.edu/MainFolder/DocumentPage.php?course=MachineLearning&doc=exercises/ex7/ex7.html)

2. Use linear SVM to recognize the digits in the optdigits dataset. Use cross-validation to find SVM parameters.

**Graduate students:**

3. Use kernel SVM to recognize the digits in the optdigits dataset. Use cross-validation to find SVM parameters. Compare the accuracy with step 2, explain.

4. Study how the validation accuracy and number of the support vectors depend on:

- SVM kernel function (try at least 2)

- parameters of the kernel function and SVM cost parameter

- dimensionality of the data

In the report, provide quantitative analysis (using tables or graphs), explain.

**All students:**

5. Bonus 5pts. Implement a GUI to draw a digit with the mouse on the screen. Use the classifier from step 3 to recognize the image.

**Hints:**

- use a [confusion matrix](https://en.wikipedia.org/wiki/Confusion_matrix) to express the accuracy of a multi-class classifier.

- use a [grid search procedure](http://www.csie.ntu.edu.tw/~cjlin/papers/guide/guide.pdf) to find the SVM parameters

- use your favorite dimensionality reduction method to generate 3-4 reduced feature sets (e.g. with 64, 32, 16, 8, 4 dimensions)