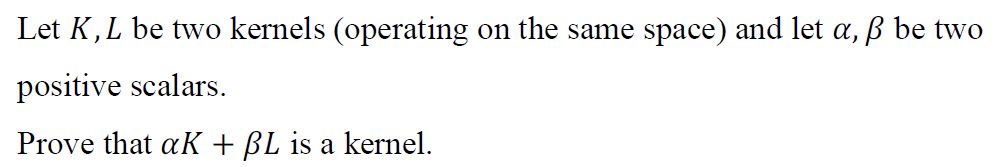
**HW5**

**Question 1**



Proof:

Denote be the kernels.

By kernel definition,

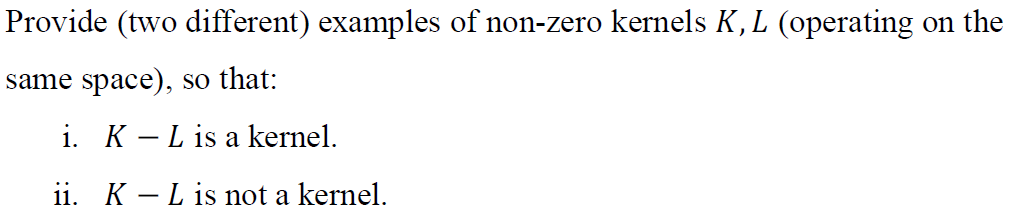
We’ll define the following function as follows:

Explanation:

The value of returns values which calculated as follow – mark the values returned from as and the values returned from as . Multiply all values is S by and all values of by and mount the multiplied values of on top of the multiplied values of .

Now note that:

Which means is a kernel.



1. Let , the 1st degree homogenous polynomial kernel is:

For , it holds that:

and as such,

The function holds:

Thus is a kernel.

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For , it holds that:

and as such, :

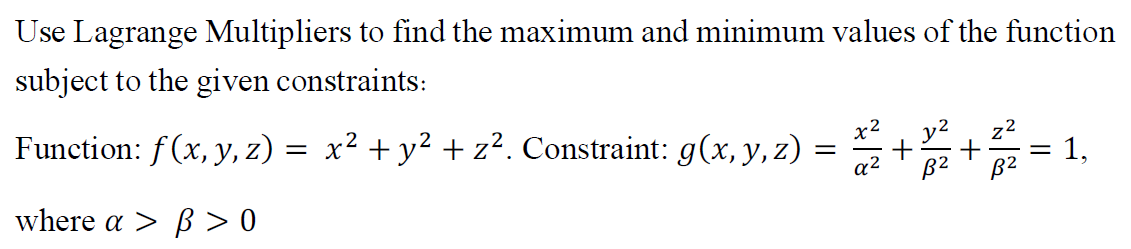
Assume by contradiction that is a kernel, thus there is a function such that it holds:

But, for :

But an inner product is always contradiction.

Thus is not a kernel.

**Question 2**



Note that:

From the 1st equation, look at two cases:

1st case:

Assume the following –

From we get:

And by plugging the above into the 2nd and 3rd equations, we get:

By plugging the above into the 4th equation, we get:

Thus, the points are extremum points, and:

2nd case:

Now we assume the following –

From the 2nd equation, look at two sub-cases:

Sub1:

Assume , which means can be any numbers that keeps the 4th equation:

And therefore, for any .

Sub2:

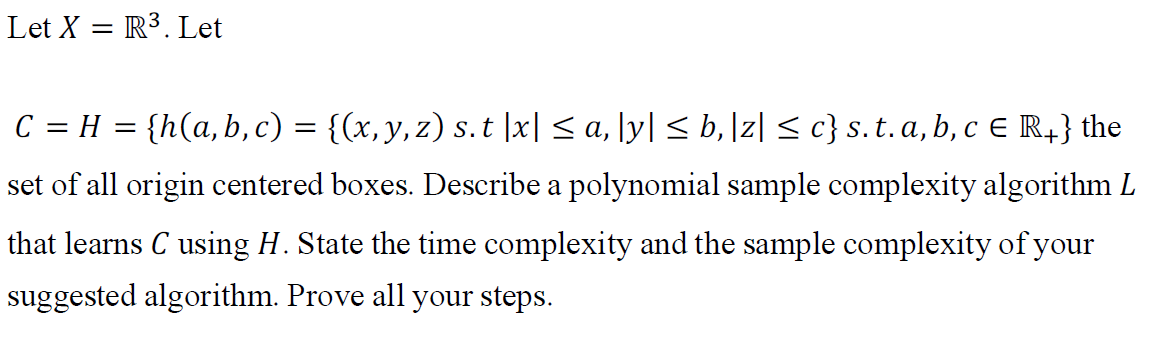
Assume and plug it into the 4th equation and get:

Thus, the points are extremum points, and:

We know that . Thus minimum points are – for example

And the maximums are

**Question 3:**



**Consistent Learner:**

Let be a sample data set.

Define:

Explanation:

will be the smallest origin centered box that contains all points such that .

Return .

Proof of correction:

Let and assume , we’ll prove that , note that by the selection of , it holds that:

Therefore, the point is inside the centered box which means

Now let and assume , we’ll prove that , note that by the definition of C and the selection of , it holds that:

Therefore, the point is outside the centered box which means

**Time Complexity:**

**Sample Complexity:**

Let be the values of the target origin centered box, meaning:

Note that there is a simple and efficient way to come up with the hypothesis as we defined above.

We will now bound all training datasets, , that can lead to with error rate into a union of sets characterizable by regions that they do not visit.

We will build cuboid on each face of the cuboid with volume such that the probability for an instance to be in that cuboid is .

For we now have a cuboid such that .

Consider a training data :

And note that with sample size , we get:

**Illustration – blue cubiod is h, larger cudboid is C:**

