

Project 2 Part 2 Briefing

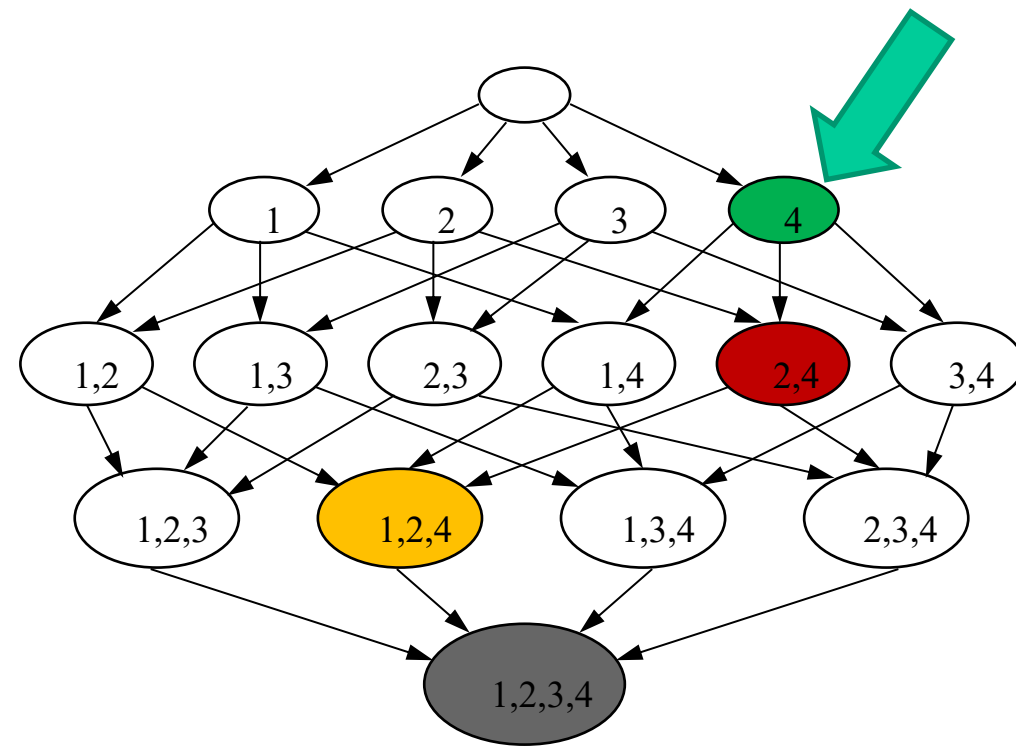
What are we doing at each node?

We are running k-fold cross validation

This is a special case, where k is the number of objects in our dataset
(also called *leave-one-out*)

Depending on the node, we will be using various subsets of the features.

However, let us start by using *all* the features. I will write Matlab guide code..



Predictive Accuracy I

- How do we *estimate* the **accuracy** of our classifier?

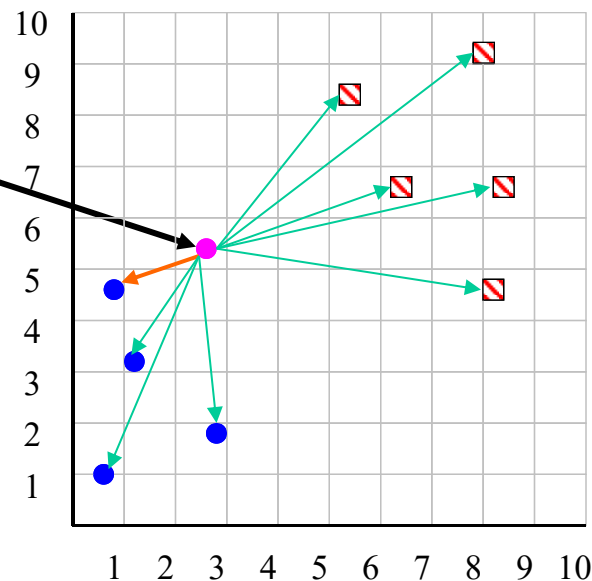
We can use ***K*-fold cross validation**

We divide the dataset into K equal sized sections. The algorithm is tested K times, each time leaving out one of the K section from building the classifier, but using it to *test* the classifier instead

$$\text{Accuracy} = \frac{\text{Number of correct classifications}}{\text{Number of instances in our database}}$$

$K = 10$

	Insect ID	Abdomen Length	Antennae Length	Insect Class
	1	2.7	5.5	Grasshopper
	2	8.0	9.1	Katydid
	3	0.9	4.7	Grasshopper
	4	1.1	3.1	Grasshopper
	5	5.4	8.5	Katydid
	6	2.9	1.9	Grasshopper
	7	6.1	6.6	Katydid
	8	0.5	1.0	Grasshopper
	9	8.3	6.6	Katydid
	10	8.1	4.7	Katydid



I am going to test on this smaller dataset...

C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt

```
*CS170_SMALLtestdata__1.txt - Notepad
File Edit Format View Help
2.0000000e+00 -6.9166525e-01 -2.9439622e-01 -2.9222408e-01 8.7251996e-01 1.0483219e+00 1.7276280e+00 7.0041931e-01 2.6027058e-01 -1.2629121e+00 -4.5493399e-01
2.0000000e+00 3.5759969e-01 1.7038206e+00 -3.6101920e-01 -1.5651900e+00 -9.9701270e-02 1.1223806e+00 5.8018449e-01 1.6704111e-01 -3.5613544e-01 -1.5703011e+00
2.0000000e+00 -9.5816598e-01 -5.7519342e-01 -8.4971686e-02 -1.4798905e+00 -1.2459724e+00 -2.5840596e-01 -1.5131340e-01 4.9895775e-01 -9.7547158e-01 -2.2054287e-01
2.0000000e+00 4.9196756e-02 1.0812071e+00 -4.0229175e-01 1.1777236e+00 1.8673751e+00 -1.5164985e+00 2.8407496e-01 -2.4645325e-01 1.1343136e+00 1.9491297e+00
2.0000000e+00 -9.0648264e-01 -1.8374881e+00 -5.6314718e-01 -1.5433132e-01 -8.9188705e-01 1.2967436e+00 1.8286947e-01 -2.1527100e+00 -7.4133082e-01 2.0938863e-01
2.0000000e+00 -7.0580439e-01 1.3649122e-01 -1.0517689e-01 1.0847079e+00 -1.8650784e+00 -9.3006226e-01 -1.1301964e+00 -8.9560480e-01 7.6732439e-01 6.0920281e-01
1.0000000e+00 -3.0865657e-01 1.2043833e+00 1.0649033e+00 7.7815796e-01 7.8430174e-01 -3.8209179e-01 8.7954164e-01 6.1868397e-01 1.0864255e+00 3.6058458e-01
2.0000000e+00 -7.3322120e-01 -9.6302493e-01 7.1013829e-01 -8.4558380e-01 9.0538127e-01 8.4227111e-01 1.5129852e+00 -1.2740488e+00 1.0542377e+00 -4.2429762e-01
1.0000000e+00 -1.2792150e+00 1.0055919e+00 4.9778108e-01 1.0333189e-01 -8.7944164e-02 -4.8000544e-01 4.9205187e-01 3.7381626e-01 -1.0142017e+00 -2.3190544e+00
2.0000000e+00 2.4917676e+00 -2.2507010e-01 -7.1492203e-01 4.8350054e-03 1.5717230e-01 2.5748456e-01 7.7375728e-02 -2.0335414e+00 1.8954952e-01 -1.8521299e+00
Ln 10, Col 108 100% Windows (CRLF) UTF-8
```



K = the number of rows

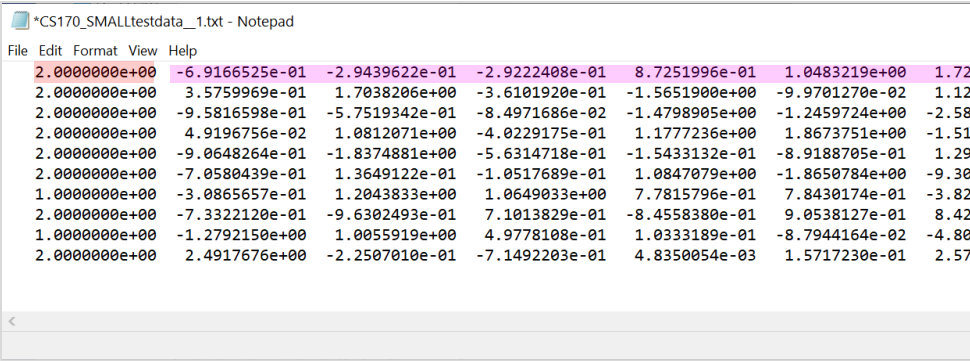


$K = 10$

	Insect ID	Abdomen Length	Antennae Length	Insect Class
	1	2.7	5.5	Grasshopper
	2	8.0	9.1	Katydid
	3	0.9	4.7	Grasshopper
	4	1.1	3.1	Grasshopper
	5	5.4	8.5	Katydid
	6	2.9	1.9	Grasshopper
	7	6.1	6.6	Katydid
	8	0.5	1.0	Grasshopper
	9	8.3	6.6	Katydid
	10	8.1	4.7	Katydid

```
function accuracy = cs170demo()  
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');  
  
for i = 1 : size(data,1)  
    object_to_classify = data(i,2:end);  
    label_object_to_classify = data(i,1);  
  
    disp(['Looping over i, at the ',int2str(i),' location']);  
    disp(['The ',int2str(i),'th object is in class ',num2str(label_object_to_classify)]);  
  
end  
end
```

Looping over i, at the 1 location
The 1th object is in class 2
Looping over i, at the 2 location
The 2th object is in class 2
Looping over i, at the 3 location
The 3th object is in class 2
Looping over i, at the 4 location
The 4th object is in class 2
Looping over i, at the 5 location
The 5th object is in class 2
Looping over i, at the 6 location
The 6th object is in class 2
Looping over i, at the 7 location
The 7th object is in class 1
Looping over i, at the 8 location
The 8th object is in class 2
Looping over i, at the 9 location
The 9th object is in class 1
Looping over i, at the 10 location
The 10th object is in class 2



2.0000000e+00	-6.9166525e-01	-2.9439622e-01	-2.9222408e-01	8.7251996e-01	1.0483219e+00	1.72
2.0000000e+00	3.5759969e-01	1.7038206e+00	-3.6101920e-01	-1.5651900e+00	-9.9701270e-02	1.12
2.0000000e+00	-9.5816598e-01	-5.7519342e-01	-8.4971686e-02	-1.4798905e+00	-1.2459724e+00	-2.58
2.0000000e+00	4.9196756e-02	1.0812071e+00	-4.0229175e-01	1.1777236e+00	1.8673751e+00	-1.51
2.0000000e+00	-9.0648264e-01	-1.8374881e+00	-5.6314718e-01	-1.5433132e-01	-8.9188705e-01	1.29
2.0000000e+00	-7.0580439e-01	1.3649122e-01	-1.0517689e-01	1.0847079e+00	-1.8650784e+00	-9.30
1.0000000e+00	-3.0865657e-01	1.2043833e+00	1.0649033e+00	7.7815796e-01	7.8430174e-01	-3.82
2.0000000e+00	-7.3322120e-01	-9.6302493e-01	7.1013829e-01	-8.4558380e-01	9.0538127e-01	8.42
1.0000000e+00	-1.2792150e+00	1.0055919e+00	4.9778108e-01	1.0333189e-01	-8.7944164e-02	-4.80
2.0000000e+00	2.4917676e+00	-2.2507010e-01	-7.1492203e-01	4.8350054e-03	1.5717230e-01	2.57

```
function accuracy = cs170demo()
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');


for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    for k = 1 : size(data,1)
        disp(['Ask if ',int2str(i),' is nearest neighbour with ', int2str(k)])

    end

end

end
end
```

Ask if 1 is nearest neighbour with 1 

Ask if 1 is nearest neighbour with 2

Ask if 1 is nearest neighbour with 3

Ask if 1 is nearest neighbour with 4

Ask if 1 is nearest neighbour with 5

Ask if 1 is nearest neighbour with 6


Ask if 1 is nearest neighbour with 7

Ask if 1 is nearest neighbour with 8

Ask if 1 is nearest neighbour with 9

Ask if 1 is nearest neighbour with 10

Ask if 2 is nearest neighbour with 1

Ask if 2 is nearest neighbour with 2 

Ask if 2 is nearest neighbour with 3

Ask if 2 is nearest neighbour with 4

Ask if 2 is nearest neighbour with 5

Ask if 2 is nearest neighbour with 6

Ask if 2 is nearest neighbour with 7


Ask if 2 is nearest neighbour with 8

Ask if 2 is nearest neighbour with 9

Ask if 2 is nearest neighbour with 10

Ask if 3 is nearest neighbour with 1

Ask if 3 is nearest neighbour with 2

Ask if 3 is nearest neighbour with 3 

```

function accuracy = cs170demo()
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');

for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    for k = 1 : size(data,1)
        if k ~= i % don't compare to yourself!!!
            disp(['Ask if ',int2str(i),' is nearest neighbour with ', int2str(k)])
        end
    end
end

end
end

```

Ask if 1 is nearest neighbour with 2
 Ask if 1 is nearest neighbour with 3
 Ask if 1 is nearest neighbour with 4
 Ask if 1 is nearest neighbour with 5
 Ask if 1 is nearest neighbour with 6
 Ask if 1 is nearest neighbour with 7
 Ask if 1 is nearest neighbour with 8
 Ask if 1 is nearest neighbour with 9
 Ask if 1 is nearest neighbour with 10
 Ask if 2 is nearest neighbour with 1
 Ask if 2 is nearest neighbour with 3
 Ask if 2 is nearest neighbour with 4
 Ask if 2 is nearest neighbour with 5
 Ask if 2 is nearest neighbour with 6
 Ask if 2 is nearest neighbour with 7
 Ask if 2 is nearest neighbour with 8
 Ask if 2 is nearest neighbour with 9
 Ask if 2 is nearest neighbour with 10
 Ask if 3 is nearest neighbour with 1
 Ask if 3 is nearest neighbour with 2
 Ask if 3 is nearest neighbour with 4

```

function accuracy = cs170demo()
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');

for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        disp(['Ask if ',int2str(i),' is nearest neighbour with ', int2str(k)])

        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end
end
end
end
end
end

```

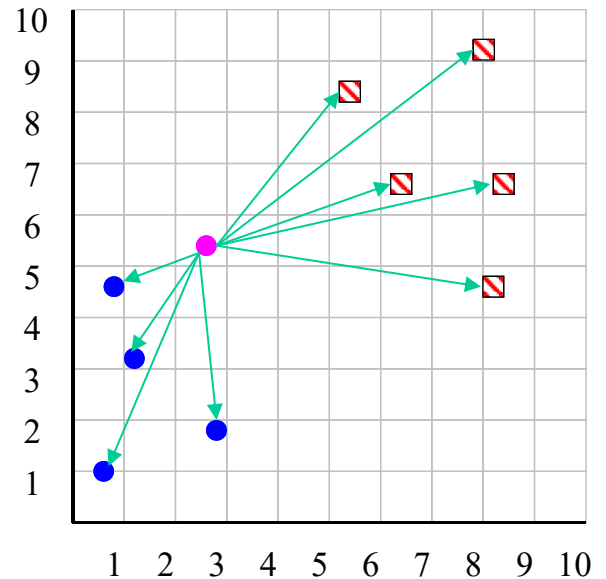
$$p = p_1, p_2, \dots, p_n$$

$$q = q_1, q_2, \dots, q_n$$

$$d(p, q) = \sqrt{(q_1 - p_1)^2 + (q_2 - p_2)^2 + \dots + (q_n - p_n)^2}$$

*CS170_SMALLtestdata__1.txt - Notepad

File	Edit	Format	View	Help
2.000000e+00	-6.9166525e-01	-2.9439622e-01		
2.000000e+00	3.5759969e-01	1.7038206e-01		
2.000000e+00	-9.5816598e-01	-5.7519342e-01		
2.000000e+00	4.9196756e-02	1.0812071e-01		
2.000000e+00	-9.0648264e-01	-1.8374881e-01		
2.000000e+00	-7.0580439e-01	1.3649122e-01		
1.000000e+00	-3.0865657e-01	1.2043833e-01		
2.000000e+00	-7.3322120e-01	-9.6302493e-01		
1.000000e+00	-1.2792150e+00	1.0055919e-01		
2.000000e+00	2.4917676e+00	-2.2507010e-01		




```

function accuracy = cs170demo()
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');

for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end
    disp(['Object ', num2str(i), ' is class ', num2str(label_object_to_classify)]);
    disp(['Its nearest_neighbor is ', num2str(nearest_neighbor_location), ' which is in class ',
num2str( nearest_neighbor_label )]);
end
end

```

```

end
end

```

Object 1 is class 2

Its nearest_neighbor is 9 which is in class 1

Object 2 is class 2

Its nearest_neighbor is 9 which is in class 1

Object 3 is class 2

Its nearest_neighbor is 9 which is in class 1

Object 4 is class 2

Its nearest_neighbor is 7 which is in class 1

Object 5 is class 2

Its nearest_neighbor is 8 which is in class 2

*CS170_SMALLtestdata__1.txt - Notepad

File	Edit	Format	View	Help
2.0000000e+00	-6.9166525e-01	-2.9439622e-01		
2.0000000e+00	3.5759969e-01	1.7038206e-01		
2.0000000e+00	-9.5816598e-01	-5.7519342e-01		
2.0000000e+00	4.9196756e-02	1.0812071e-01		
2.0000000e+00	-9.0648264e-01	-1.8374881e-01		
2.0000000e+00	-7.0580439e-01	1.3649122e-01		
1.0000000e+00	-3.0865657e-01	1.2043833e-01		
2.0000000e+00	-7.3322120e-01	-9.6302493e-01		
1.0000000e+00	-1.2792150e+00	1.0055919e-01		
2.0000000e+00	2.4917676e+00	-2.2507010e-01		

```

function accuracy = cs170demo()
data = load('C:\Users\eamon\Documents\MATLAB\CS170_SMALLtestdata__1.txt');
number_correctly_classified = 0;

for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end

    if label_object_to_classify == nearest_neighbor_label;
        number_correctly_classified = number_correctly_classified + 1;

    end

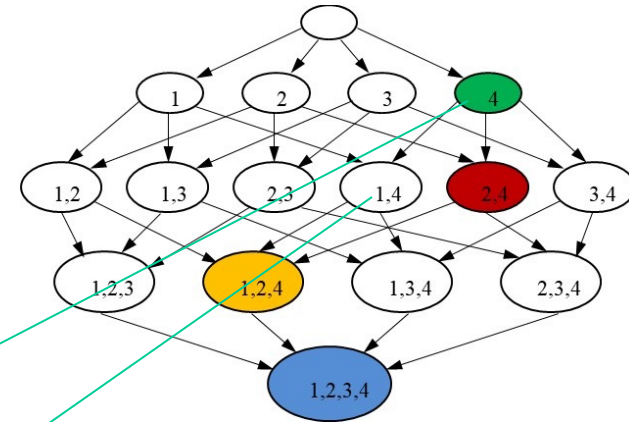
end
accuracy = number_correctly_classified / size(data,1);
end

```

The code above is 90% of what you need!!!

This function returns 0.4000

```
*CS170_SMALLtestdata_1.txt - Notepad
File Edit Format View Help
2.000000e+00 -6.9166525e-01 -2.9439622e-01 -2.9222408e-01 8.7251996e-01 1.0483219e+00 1.7276280e+00 7.0041931e-01 2.6027058e-01 -1.2629121e+00 -4.5493399e-01
2.000000e+00 3.5759969e-01 1.7038206e+00 -3.6101920e-01 -1.5651900e+00 -9.9701270e-02 1.1223806e+00 5.8018449e-01 1.6704111e-01 -3.5613544e-01 -1.5703011e+00
2.000000e+00 -9.5816598e-01 -5.7519342e-01 -8.4971686e-02 -1.4798905e+00 -1.2459724e+00 -2.5840596e-01 -1.5131340e-01 4.9895775e-01 -9.7547158e-01 -2.2054287e-01
2.000000e+00 4.9196756e-02 1.0812071e+00 -4.0229175e-01 1.1777236e+00 1.0673751e+00 -1.5164905e+00 2.8407496e-01 -2.4645325e-01 1.1363136e+00 1.9491297e+00
2.000000e+00 -9.0648264e-01 -1.8374881e+00 -5.6314718e-01 -1.5433132e-01 -8.9188705e-01 1.2967436e+00 1.8286947e-01 -2.1527100e+00 -7.4133082e-01 2.0938863e-01
2.000000e+00 -7.0580439e-01 1.3649122e-01 -1.0517689e-01 1.0847079e+00 -1.8650784e+00 -9.3006226e-01 -1.1301964e+00 -8.9560480e-01 7.6732439e-01 6.0920281e-01
1.000000e+00 -3.0865657e-01 1.2043833e+00 1.0649033e+00 7.7815796e-01 7.8430174e-01 -3.8209179e-01 8.7954164e-01 6.1868397e-01 1.0864255e+00 3.6058458e-01
2.000000e+00 -7.3322120e-01 -9.6302493e-01 7.1013829e-01 -8.4558380e-01 9.0538127e-01 8.4227111e-01 1.5129852e+00 -1.2740488e+00 1.0542377e+00 -4.2429762e-01
1.000000e+00 -1.2792150e+00 1.0055919e+00 4.9778108e-01 1.0333189e-01 -8.7944164e-02 -4.8009544e-01 4.9205187e-01 3.7381626e-01 -1.0142017e+00 -2.3190544e+00
2.000000e+00 2.4917676e+00 -2.2507010e-01 -7.1492203e-01 4.8350054e-03 1.5717230e-01 2.5748456e-01 7.7375720e-02 -2.0335414e+00 1.8954952e-01 -1.8521299e+00
Ln 10, Col 108 100% Windows (CRLF) UTF-8
```



```
function accuracy= leave_one_out_cross_validation(data,current_set,feature_to_add)

number_correctly_classified = 0;

for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end

    if label_object_to_classify == nearest_neighbor_label;
        number_correctly_classified = number_correctly_classified + 1;
    end

end

accuracy = number_correctly_classified / size(data,1);
end
```

```
*CS170_SMALLtestdata_1.txt - Notepad
File Edit Format View Help
2.000000e+00 -6.9166525e-01 -2.9439622e-01 -2.9222408e-01 8.7251996e-01 1.0483219e+00 1.7276280e+00 7.0041931e-01 2.6027058e-01 -1.2629121e+00 -4.5493399e-01
2.000000e+00 3.5759969e-01 1.7038206e+00 -3.6101920e-01 -1.5651900e+00 -9.9701270e-02 1.1223806e+00 5.8018449e-01 1.6704111e-01 -3.5613544e-01 -1.5703011e+00
2.000000e+00 -9.5816598e-01 -5.7519342e-01 -8.4971696e-02 -1.4798909e+00 -1.2459724e+00 -2.5840596e-01 -1.5131340e-01 4.9895775e-01 -9.7547158e-01 -2.2054287e-01
2.000000e+00 4.9196756e-02 1.0812071e+00 -4.0229175e-01 1.1777236e+00 1.8073751e+00 -1.5164905e+00 2.8407496e-01 -2.4645325e-01 1.1343136e+00 1.9491297e+00
2.000000e+00 -9.0648264e-01 -1.8374801e+00 -5.6314718e-01 -1.5433132e-01 -8.9188705e-01 1.2967436e+00 1.8286947e-01 -2.1527100e+00 -7.4133082e-01 2.0938863e-01
2.000000e+00 -7.0580439e-01 1.3649122e-01 -1.0517689e-01 1.0847079e+00 -1.8650784e+00 -9.3006226e-01 -1.1301964e+00 -8.9560480e-01 7.6732439e-01 6.0920281e-01
1.000000e+00 -3.0865657e-01 1.2043833e+00 1.0649033e+00 7.7815796e-01 7.8430174e-01 -3.8209179e-01 8.7954164e-01 6.1868397e-01 1.0864255e+00 3.6058458e-01
2.000000e+00 -7.3322120e-01 -9.6302493e-01 7.1013829e-01 -8.4558300e-01 9.0538127e-01 8.4227111e-01 1.5129852e+00 -1.2740488e+00 1.0542377e+00 -4.2429762e-01
1.000000e+00 -1.2792150e+00 1.8055919e+00 4.9778108e-01 1.0333189e-01 -8.7944164e-02 -4.8009544e-01 4.9205187e-01 3.7381626e-01 -1.0142017e+00 -2.3190544e+00
2.000000e+00 2.4917676e+00 -2.2507010e-01 -7.1492203e-01 4.8350054e-03 1.5717230e-01 2.57484561e-01 7.7375720e-02 -2.0335414e+00 1.8954952e-01 -1.8521299e+00
```

1 4 7
10

`function accuracy= leave_one_out_cross_validation(data,current_set,feature_to_add)`

Some code to do this...

```
*CS170_SMALLtestdata_1.txt - Notepad
File Edit Format View Help
2.000000e+00 -6.9166525e-01 8.7251996e-01 7.0041931e-01 -4.5493399e-01
2.000000e+00 3.5759969e-01 -1.5651900e+00 5.8018449e-01 -1.5703011e+00
2.000000e+00 -9.5816598e-01 -1.4798909e+00 -1.5131340e-01 -2.2054287e-01
2.000000e+00 4.9196756e-02 1.1777236e+00 2.8407496e-01 1.9491297e+00
2.000000e+00 -9.0648264e-01 -1.8374801e+00 1.2967436e+00 1.8286947e-01
2.000000e+00 -7.0580439e-01 1.0847079e+00 -1.8650784e+00 -8.9560480e-01
1.000000e+00 -3.0865657e-01 7.7815796e-01 7.8430174e-01 6.1868397e-01
2.000000e+00 -7.3322120e-01 -8.4558300e-01 9.0538127e-01 1.5129852e+00
1.000000e+00 -1.2792150e+00 1.8055919e+00 4.9778108e-01 1.0333189e-01
2.000000e+00 2.4917676e+00 4.8350054e-03 1.5717230e-01 2.57484561e-01
```

`number_correctly_classified = 0;`

```
for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end

    if label_object_to_classify == nearest_neighbor_label;
        number_correctly_classified = number_correctly_classified + 1;
    end

end

accuracy = number_correctly_classified / size(data,1);
end
```

```
*CS170_SMALLtestdata_1.txt - Notepad
File Edit Format View Help
2.000000e+00 -6.9166525e-01 -2.9439622e-01 -2.9222408e-01 8.7251996e-01 1.0483219e+00 1.7276280e+00 7.0041931e-01 2.6027058e-01 -1.2629121e+00 -4.5493399e-01
2.000000e+00 3.5759969e-01 1.7038206e+00 -3.6101920e-01 -1.5651900e+00 -9.9701270e-02 1.1223806e+00 5.8018449e-01 1.6704111e-01 -3.5613544e-01 -1.5703011e+00
2.000000e+00 -9.5816598e-01 -5.7519342e-01 -8.4971686e-02 -1.4798909e+00 -1.2459724e+00 -2.5840596e-01 -1.5131340e-01 4.9895775e-01 -9.7547158e-01 -2.2054287e-01
2.000000e+00 4.9196756e-02 1.0812071e+00 -4.0229175e-01 1.1777236e+00 1.8073751e+00 -1.5164905e+00 2.8407496e-01 -2.4645325e-01 1.1343136e+00 1.9491297e+00
2.000000e+00 -9.0648264e-01 -1.8374801e+00 -5.6314718e-01 -1.5433132e-01 -8.9188705e-01 1.2967436e+00 1.8286947e-01 -2.1527100e+00 -7.4133082e-01 2.0938863e-01
2.000000e+00 -7.0580439e-01 1.3649122e-01 -1.0517689e-01 1.0847079e+00 -1.8650784e+00 -9.3006226e-01 -1.1301964e+00 -8.9560480e-01 7.6732439e-01 6.0920281e-01
1.000000e+00 -3.0865657e-01 1.2043833e+00 1.0649033e+00 7.7815796e-01 7.8430174e-01 -3.8209179e-01 8.7954164e-01 6.1868397e-01 1.0864255e+00 3.6058458e-01
2.000000e+00 -7.3322120e-01 -9.6302493e-01 7.1013829e-01 -8.4558380e-01 9.0538127e-01 8.4227111e-01 1.5129852e+00 -1.2740488e+00 1.0542377e+00 -4.2429762e-01
1.000000e+00 -1.2792150e+00 1.8055919e+00 4.9778108e-01 1.0333189e-01 8.7944164e-02 -4.8009544e-01 4.9205187e-01 3.7381626e-01 -1.0142017e+00 -2.3190544e+00
2.000000e+00 2.4917676e+00 -2.2507010e-01 -7.1492203e-01 4.8350054e-03 1.5717230e-01 2.57484561e-01 7.7375720e-02 -2.0335414e+00 1.8954952e-01 -1.8521299e+00
```

1, 4, 7
10

`function accuracy= leave_one_out_cross_validation(data,current_set,feature_to_add)`

Some code to do this...

```
*CS170_SMALLtestdata_1.txt - Notepad
File Edit Format View Help
2.000000e+00 -6.9166525e-01 0 0 8.7251996e-01 0 0 7.0041931e-01 0 0 -4.5493399e-01
2.000000e+00 3.5759969e-01 0 0 -1.5651900e+00 0 0 5.8018449e-01 0 0 -1.5703011e+00
2.000000e+00 -9.5816598e-01 0 0 -1.4798909e+00 0 0 -1.5131340e-01 0 0 -2.2054287e-01
2.000000e+00 4.9196756e-02 0 0 1.1777236e+00 0 0 2.8407496e-01 0 0 1.9491297e+00
2.000000e+00 -9.0648264e-01 0 0 -1.5433132e-01 0 0 1.8286947e-01 0 0 2.0938863e-01
2.000000e+00 -7.0580439e-01 0 0 1.0847079e+00 0 0 -1.1301964e+00 0 0 6.0920281e-01
1.000000e+00 -3.0865657e-01 0 0 7.7815796e-01 0 0 8.7954164e-01 0 0 3.6058458e-01
2.000000e+00 -7.3322120e-01 0 0 -8.4558380e-01 0 0 1.5129852e+00 0 0 -4.2429762e-01
1.000000e+00 -1.2792150e+00 0 0 1.0333189e-01 0 0 4.9205187e-01 0 0 -2.3190544e+00
2.000000e+00 2.4917676e+00 0 0 4.8350054e-03 0 0 7.7375720e-02 0 0 -1.8521299e+00
```

`number_correctly_classified = 0;`

```
for i = 1 : size(data,1)
    object_to_classify = data(i,2:end);
    label_object_to_classify = data(i,1);

    nearest_neighbor_distance = inf;
    nearest_neighbor_location = inf;
    for k = 1 : size(data,1)
        if k ~= i
            distance = sqrt(sum((object_to_classify - data(k,2:end)).^2));
            if distance < nearest_neighbor_distance
                nearest_neighbor_distance = distance;
                nearest_neighbor_location = k;
                nearest_neighbor_label = data(nearest_neighbor_location,1);
            end
        end
    end

    if label_object_to_classify == nearest_neighbor_label;
        number_correctly_classified = number_correctly_classified + 1;
    end

end

accuracy = number_correctly_classified / size(data,1);
end
```

Done!!!!