

Iris dataset

Clear workspace

```
clear all; clc; close all;
```

Initialize variables

Load table

```
iris = readtable('Iris.csv')
```

```
iris = 150x6 table
```

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 1 | 1 | 5.1000 | 3.5000 | 1.4000 | 0.2000 |
| 2 | 2 | 4.9000 | 3 | 1.4000 | 0.2000 |
| 3 | 3 | 4.7000 | 3.2000 | 1.3000 | 0.2000 |
| 4 | 4 | 4.6000 | 3.1000 | 1.5000 | 0.2000 |
| 5 | 5 | 5 | 3.6000 | 1.4000 | 0.2000 |
| 6 | 6 | 5.4000 | 3.9000 | 1.7000 | 0.4000 |
| 7 | 7 | 4.6000 | 3.4000 | 1.4000 | 0.3000 |
| 8 | 8 | 5 | 3.4000 | 1.5000 | 0.2000 |
| 9 | 9 | 4.4000 | 2.9000 | 1.4000 | 0.2000 |
| 10 | 10 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 11 | 11 | 5.4000 | 3.7000 | 1.5000 | 0.2000 |
| 12 | 12 | 4.8000 | 3.4000 | 1.6000 | 0.2000 |
| 13 | 13 | 4.8000 | 3 | 1.4000 | 0.1000 |
| 14 | 14 | 4.3000 | 3 | 1.1000 | 0.1000 |
| 15 | 15 | 5.8000 | 4 | 1.2000 | 0.2000 |
| 16 | 16 | 5.7000 | 4.4000 | 1.5000 | 0.4000 |
| 17 | 17 | 5.4000 | 3.9000 | 1.3000 | 0.4000 |
| 18 | 18 | 5.1000 | 3.5000 | 1.4000 | 0.3000 |
| 19 | 19 | 5.7000 | 3.8000 | 1.7000 | 0.3000 |
| 20 | 20 | 5.1000 | 3.8000 | 1.5000 | 0.3000 |
| 21 | 21 | 5.4000 | 3.4000 | 1.7000 | 0.2000 |
| 22 | 22 | 5.1000 | 3.7000 | 1.5000 | 0.4000 |
| 23 | 23 | 4.6000 | 3.6000 | 1 | 0.2000 |
| 24 | 24 | 5.1000 | 3.3000 | 1.7000 | 0.5000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 25 | 25 | 4.8000 | 3.4000 | 1.9000 | 0.2000 |
| 26 | 26 | 5 | 3 | 1.6000 | 0.2000 |
| 27 | 27 | 5 | 3.4000 | 1.6000 | 0.4000 |
| 28 | 28 | 5.2000 | 3.5000 | 1.5000 | 0.2000 |
| 29 | 29 | 5.2000 | 3.4000 | 1.4000 | 0.2000 |
| 30 | 30 | 4.7000 | 3.2000 | 1.6000 | 0.2000 |
| 31 | 31 | 4.8000 | 3.1000 | 1.6000 | 0.2000 |
| 32 | 32 | 5.4000 | 3.4000 | 1.5000 | 0.4000 |
| 33 | 33 | 5.2000 | 4.1000 | 1.5000 | 0.1000 |
| 34 | 34 | 5.5000 | 4.2000 | 1.4000 | 0.2000 |
| 35 | 35 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 36 | 36 | 5 | 3.2000 | 1.2000 | 0.2000 |
| 37 | 37 | 5.5000 | 3.5000 | 1.3000 | 0.2000 |
| 38 | 38 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 39 | 39 | 4.4000 | 3 | 1.3000 | 0.2000 |
| 40 | 40 | 5.1000 | 3.4000 | 1.5000 | 0.2000 |
| 41 | 41 | 5 | 3.5000 | 1.3000 | 0.3000 |
| 42 | 42 | 4.5000 | 2.3000 | 1.3000 | 0.3000 |
| 43 | 43 | 4.4000 | 3.2000 | 1.3000 | 0.2000 |
| 44 | 44 | 5 | 3.5000 | 1.6000 | 0.6000 |
| 45 | 45 | 5.1000 | 3.8000 | 1.9000 | 0.4000 |
| 46 | 46 | 4.8000 | 3 | 1.4000 | 0.3000 |
| 47 | 47 | 5.1000 | 3.8000 | 1.6000 | 0.2000 |
| 48 | 48 | 4.6000 | 3.2000 | 1.4000 | 0.2000 |
| 49 | 49 | 5.3000 | 3.7000 | 1.5000 | 0.2000 |
| 50 | 50 | 5 | 3.3000 | 1.4000 | 0.2000 |
| 51 | 51 | 7 | 3.2000 | 4.7000 | 1.4000 |
| 52 | 52 | 6.4000 | 3.2000 | 4.5000 | 1.5000 |
| 53 | 53 | 6.9000 | 3.1000 | 4.9000 | 1.5000 |
| 54 | 54 | 5.5000 | 2.3000 | 4 | 1.3000 |
| 55 | 55 | 6.5000 | 2.8000 | 4.6000 | 1.5000 |
| 56 | 56 | 5.7000 | 2.8000 | 4.5000 | 1.3000 |
| 57 | 57 | 6.3000 | 3.3000 | 4.7000 | 1.6000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 58 | 58 | 4.9000 | 2.4000 | 3.3000 | 1 |
| 59 | 59 | 6.6000 | 2.9000 | 4.6000 | 1.3000 |
| 60 | 60 | 5.2000 | 2.7000 | 3.9000 | 1.4000 |
| 61 | 61 | 5 | 2 | 3.5000 | 1 |
| 62 | 62 | 5.9000 | 3 | 4.2000 | 1.5000 |
| 63 | 63 | 6 | 2.2000 | 4 | 1 |
| 64 | 64 | 6.1000 | 2.9000 | 4.7000 | 1.4000 |
| 65 | 65 | 5.6000 | 2.9000 | 3.6000 | 1.3000 |
| 66 | 66 | 6.7000 | 3.1000 | 4.4000 | 1.4000 |
| 67 | 67 | 5.6000 | 3 | 4.5000 | 1.5000 |
| 68 | 68 | 5.8000 | 2.7000 | 4.1000 | 1 |
| 69 | 69 | 6.2000 | 2.2000 | 4.5000 | 1.5000 |
| 70 | 70 | 5.6000 | 2.5000 | 3.9000 | 1.1000 |
| 71 | 71 | 5.9000 | 3.2000 | 4.8000 | 1.8000 |
| 72 | 72 | 6.1000 | 2.8000 | 4 | 1.3000 |
| 73 | 73 | 6.3000 | 2.5000 | 4.9000 | 1.5000 |
| 74 | 74 | 6.1000 | 2.8000 | 4.7000 | 1.2000 |
| 75 | 75 | 6.4000 | 2.9000 | 4.3000 | 1.3000 |
| 76 | 76 | 6.6000 | 3 | 4.4000 | 1.4000 |
| 77 | 77 | 6.8000 | 2.8000 | 4.8000 | 1.4000 |
| 78 | 78 | 6.7000 | 3 | 5 | 1.7000 |
| 79 | 79 | 6 | 2.9000 | 4.5000 | 1.5000 |
| 80 | 80 | 5.7000 | 2.6000 | 3.5000 | 1 |
| 81 | 81 | 5.5000 | 2.4000 | 3.8000 | 1.1000 |
| 82 | 82 | 5.5000 | 2.4000 | 3.7000 | 1 |
| 83 | 83 | 5.8000 | 2.7000 | 3.9000 | 1.2000 |
| 84 | 84 | 6 | 2.7000 | 5.1000 | 1.6000 |
| 85 | 85 | 5.4000 | 3 | 4.5000 | 1.5000 |
| 86 | 86 | 6 | 3.4000 | 4.5000 | 1.6000 |
| 87 | 87 | 6.7000 | 3.1000 | 4.7000 | 1.5000 |
| 88 | 88 | 6.3000 | 2.3000 | 4.4000 | 1.3000 |
| 89 | 89 | 5.6000 | 3 | 4.1000 | 1.3000 |
| 90 | 90 | 5.5000 | 2.5000 | 4 | 1.3000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|-----|-----|---------------|--------------|---------------|--------------|
| 91 | 91 | 5.5000 | 2.6000 | 4.4000 | 1.2000 |
| 92 | 92 | 6.1000 | 3 | 4.6000 | 1.4000 |
| 93 | 93 | 5.8000 | 2.6000 | 4 | 1.2000 |
| 94 | 94 | 5 | 2.3000 | 3.3000 | 1 |
| 95 | 95 | 5.6000 | 2.7000 | 4.2000 | 1.3000 |
| 96 | 96 | 5.7000 | 3 | 4.2000 | 1.2000 |
| 97 | 97 | 5.7000 | 2.9000 | 4.2000 | 1.3000 |
| 98 | 98 | 6.2000 | 2.9000 | 4.3000 | 1.3000 |
| 99 | 99 | 5.1000 | 2.5000 | 3 | 1.1000 |
| 100 | 100 | 5.7000 | 2.8000 | 4.1000 | 1.3000 |
| : | | | | | |

Get a preview and some general stats

```
summary(iris)
```

Variables:

Id: 150×1 double

Values:

| | |
|--------|------|
| Min | 1 |
| Median | 75.5 |
| Max | 150 |

SepalLengthCm: 150×1 double

Values:

| | |
|--------|-----|
| Min | 4.3 |
| Median | 5.8 |
| Max | 7.9 |

SepalWidthCm: 150×1 double

Values:

| | |
|--------|-----|
| Min | 2 |
| Median | 3 |
| Max | 4.4 |

PetalLengthCm: 150×1 double

Values:

| | |
|--------|------|
| Min | 1 |
| Median | 4.35 |
| Max | 6.9 |

```
PetalWidthCm: 150x1 double
```

Values:

| | |
|--------|-----|
| Min | 0.1 |
| Median | 1.3 |
| Max | 2.5 |

```
Species: 150x1 cell array of character vectors
```

Change Species column to categorical

```
iris.Species = categorical(iris.Species)
```

```
iris = 150x6 table
```

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 1 | 1 | 5.1000 | 3.5000 | 1.4000 | 0.2000 |
| 2 | 2 | 4.9000 | 3 | 1.4000 | 0.2000 |
| 3 | 3 | 4.7000 | 3.2000 | 1.3000 | 0.2000 |
| 4 | 4 | 4.6000 | 3.1000 | 1.5000 | 0.2000 |
| 5 | 5 | 5 | 3.6000 | 1.4000 | 0.2000 |
| 6 | 6 | 5.4000 | 3.9000 | 1.7000 | 0.4000 |
| 7 | 7 | 4.6000 | 3.4000 | 1.4000 | 0.3000 |
| 8 | 8 | 5 | 3.4000 | 1.5000 | 0.2000 |
| 9 | 9 | 4.4000 | 2.9000 | 1.4000 | 0.2000 |
| 10 | 10 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 11 | 11 | 5.4000 | 3.7000 | 1.5000 | 0.2000 |
| 12 | 12 | 4.8000 | 3.4000 | 1.6000 | 0.2000 |
| 13 | 13 | 4.8000 | 3 | 1.4000 | 0.1000 |
| 14 | 14 | 4.3000 | 3 | 1.1000 | 0.1000 |
| 15 | 15 | 5.8000 | 4 | 1.2000 | 0.2000 |
| 16 | 16 | 5.7000 | 4.4000 | 1.5000 | 0.4000 |
| 17 | 17 | 5.4000 | 3.9000 | 1.3000 | 0.4000 |
| 18 | 18 | 5.1000 | 3.5000 | 1.4000 | 0.3000 |
| 19 | 19 | 5.7000 | 3.8000 | 1.7000 | 0.3000 |
| 20 | 20 | 5.1000 | 3.8000 | 1.5000 | 0.3000 |
| 21 | 21 | 5.4000 | 3.4000 | 1.7000 | 0.2000 |
| 22 | 22 | 5.1000 | 3.7000 | 1.5000 | 0.4000 |
| 23 | 23 | 4.6000 | 3.6000 | 1 | 0.2000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 24 | 24 | 5.1000 | 3.3000 | 1.7000 | 0.5000 |
| 25 | 25 | 4.8000 | 3.4000 | 1.9000 | 0.2000 |
| 26 | 26 | 5 | 3 | 1.6000 | 0.2000 |
| 27 | 27 | 5 | 3.4000 | 1.6000 | 0.4000 |
| 28 | 28 | 5.2000 | 3.5000 | 1.5000 | 0.2000 |
| 29 | 29 | 5.2000 | 3.4000 | 1.4000 | 0.2000 |
| 30 | 30 | 4.7000 | 3.2000 | 1.6000 | 0.2000 |
| 31 | 31 | 4.8000 | 3.1000 | 1.6000 | 0.2000 |
| 32 | 32 | 5.4000 | 3.4000 | 1.5000 | 0.4000 |
| 33 | 33 | 5.2000 | 4.1000 | 1.5000 | 0.1000 |
| 34 | 34 | 5.5000 | 4.2000 | 1.4000 | 0.2000 |
| 35 | 35 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 36 | 36 | 5 | 3.2000 | 1.2000 | 0.2000 |
| 37 | 37 | 5.5000 | 3.5000 | 1.3000 | 0.2000 |
| 38 | 38 | 4.9000 | 3.1000 | 1.5000 | 0.1000 |
| 39 | 39 | 4.4000 | 3 | 1.3000 | 0.2000 |
| 40 | 40 | 5.1000 | 3.4000 | 1.5000 | 0.2000 |
| 41 | 41 | 5 | 3.5000 | 1.3000 | 0.3000 |
| 42 | 42 | 4.5000 | 2.3000 | 1.3000 | 0.3000 |
| 43 | 43 | 4.4000 | 3.2000 | 1.3000 | 0.2000 |
| 44 | 44 | 5 | 3.5000 | 1.6000 | 0.6000 |
| 45 | 45 | 5.1000 | 3.8000 | 1.9000 | 0.4000 |
| 46 | 46 | 4.8000 | 3 | 1.4000 | 0.3000 |
| 47 | 47 | 5.1000 | 3.8000 | 1.6000 | 0.2000 |
| 48 | 48 | 4.6000 | 3.2000 | 1.4000 | 0.2000 |
| 49 | 49 | 5.3000 | 3.7000 | 1.5000 | 0.2000 |
| 50 | 50 | 5 | 3.3000 | 1.4000 | 0.2000 |
| 51 | 51 | 7 | 3.2000 | 4.7000 | 1.4000 |
| 52 | 52 | 6.4000 | 3.2000 | 4.5000 | 1.5000 |
| 53 | 53 | 6.9000 | 3.1000 | 4.9000 | 1.5000 |
| 54 | 54 | 5.5000 | 2.3000 | 4 | 1.3000 |
| 55 | 55 | 6.5000 | 2.8000 | 4.6000 | 1.5000 |
| 56 | 56 | 5.7000 | 2.8000 | 4.5000 | 1.3000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|----|----|---------------|--------------|---------------|--------------|
| 57 | 57 | 6.3000 | 3.3000 | 4.7000 | 1.6000 |
| 58 | 58 | 4.9000 | 2.4000 | 3.3000 | 1 |
| 59 | 59 | 6.6000 | 2.9000 | 4.6000 | 1.3000 |
| 60 | 60 | 5.2000 | 2.7000 | 3.9000 | 1.4000 |
| 61 | 61 | 5 | 2 | 3.5000 | 1 |
| 62 | 62 | 5.9000 | 3 | 4.2000 | 1.5000 |
| 63 | 63 | 6 | 2.2000 | 4 | 1 |
| 64 | 64 | 6.1000 | 2.9000 | 4.7000 | 1.4000 |
| 65 | 65 | 5.6000 | 2.9000 | 3.6000 | 1.3000 |
| 66 | 66 | 6.7000 | 3.1000 | 4.4000 | 1.4000 |
| 67 | 67 | 5.6000 | 3 | 4.5000 | 1.5000 |
| 68 | 68 | 5.8000 | 2.7000 | 4.1000 | 1 |
| 69 | 69 | 6.2000 | 2.2000 | 4.5000 | 1.5000 |
| 70 | 70 | 5.6000 | 2.5000 | 3.9000 | 1.1000 |
| 71 | 71 | 5.9000 | 3.2000 | 4.8000 | 1.8000 |
| 72 | 72 | 6.1000 | 2.8000 | 4 | 1.3000 |
| 73 | 73 | 6.3000 | 2.5000 | 4.9000 | 1.5000 |
| 74 | 74 | 6.1000 | 2.8000 | 4.7000 | 1.2000 |
| 75 | 75 | 6.4000 | 2.9000 | 4.3000 | 1.3000 |
| 76 | 76 | 6.6000 | 3 | 4.4000 | 1.4000 |
| 77 | 77 | 6.8000 | 2.8000 | 4.8000 | 1.4000 |
| 78 | 78 | 6.7000 | 3 | 5 | 1.7000 |
| 79 | 79 | 6 | 2.9000 | 4.5000 | 1.5000 |
| 80 | 80 | 5.7000 | 2.6000 | 3.5000 | 1 |
| 81 | 81 | 5.5000 | 2.4000 | 3.8000 | 1.1000 |
| 82 | 82 | 5.5000 | 2.4000 | 3.7000 | 1 |
| 83 | 83 | 5.8000 | 2.7000 | 3.9000 | 1.2000 |
| 84 | 84 | 6 | 2.7000 | 5.1000 | 1.6000 |
| 85 | 85 | 5.4000 | 3 | 4.5000 | 1.5000 |
| 86 | 86 | 6 | 3.4000 | 4.5000 | 1.6000 |
| 87 | 87 | 6.7000 | 3.1000 | 4.7000 | 1.5000 |
| 88 | 88 | 6.3000 | 2.3000 | 4.4000 | 1.3000 |
| 89 | 89 | 5.6000 | 3 | 4.1000 | 1.3000 |

| | Id | SepalLengthCm | SepalWidthCm | PetalLengthCm | PetalWidthCm |
|-----|-----|---------------|--------------|---------------|--------------|
| 90 | 90 | 5.5000 | 2.5000 | 4 | 1.3000 |
| 91 | 91 | 5.5000 | 2.6000 | 4.4000 | 1.2000 |
| 92 | 92 | 6.1000 | 3 | 4.6000 | 1.4000 |
| 93 | 93 | 5.8000 | 2.6000 | 4 | 1.2000 |
| 94 | 94 | 5 | 2.3000 | 3.3000 | 1 |
| 95 | 95 | 5.6000 | 2.7000 | 4.2000 | 1.3000 |
| 96 | 96 | 5.7000 | 3 | 4.2000 | 1.2000 |
| 97 | 97 | 5.7000 | 2.9000 | 4.2000 | 1.3000 |
| 98 | 98 | 6.2000 | 2.9000 | 4.3000 | 1.3000 |
| 99 | 99 | 5.1000 | 2.5000 | 3 | 1.1000 |
| 100 | 100 | 5.7000 | 2.8000 | 4.1000 | 1.3000 |

:

All columns with explicative variables

```
X = iris(:,[2:end-1]);
xnames = X.Properties.VariableNames

xnames = 1x4 cell
'SepalLengthCm' 'SepalWidthCm' 'PetalLengthCm' 'PetalWidthCm'
```

Get categorical variable possible values

```
categories = unique(iris.Species)
```

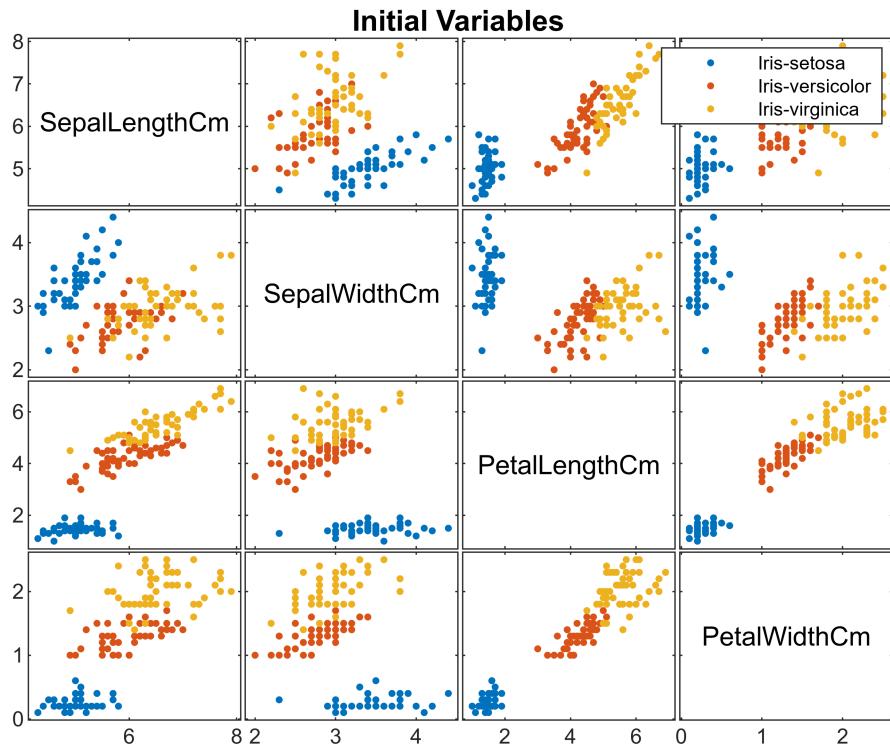
```
categories = 3x1 categorical
Iris-setosa
Iris-versicolor
Iris-virginica
```

```
color = lines(size(categories))
```

```
color = 3x3
 0    0.4470    0.7410
 0.8500   0.3250    0.0980
 0.9290   0.6940    0.1250
```

GGplot to see each variable against another scatter plots

```
[h, ax] = gplotmatrix(table2array(X),[],iris.Species,color,[],[],[],'variable',xnames);
title('Initial Variables')
```



```
% saveas(gcf,'01_Iris/Initial_vars.png')
```

Generate some derived variables which may be useful

```

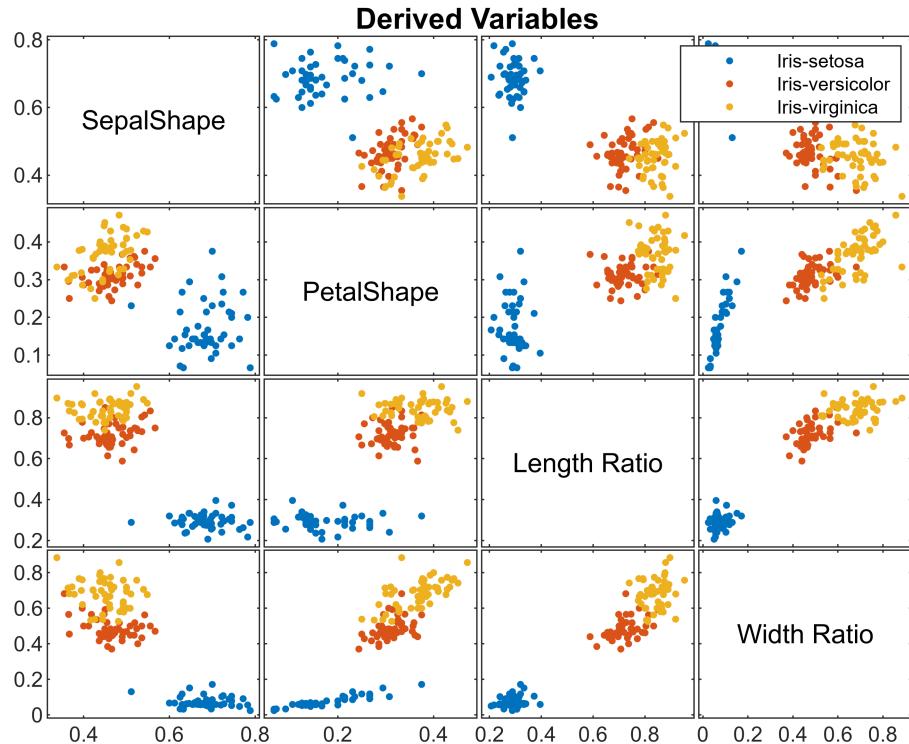
SepalShape = X.SepalWidthCm ./ X.SepalLengthCm;
PetalShape = X.PetalWidthCm ./ X.PetalLengthCm;

Length_PvsS = X.PetalLengthCm ./ X.SepalLengthCm;
Width_PvsS = X.PetalWidthCm ./ X.SepalWidthCm;

Y = [SepalShape PetalShape Length_PvsS Width_PvsS];
ynames = {'SepalShape', 'PetalShape', 'Length Ratio', 'Width Ratio'};

figure
[h, ax] = gplotmatrix(Y,[],iris.Species,color,[],[],[],'variable',ynames);
title('Derived Variables')

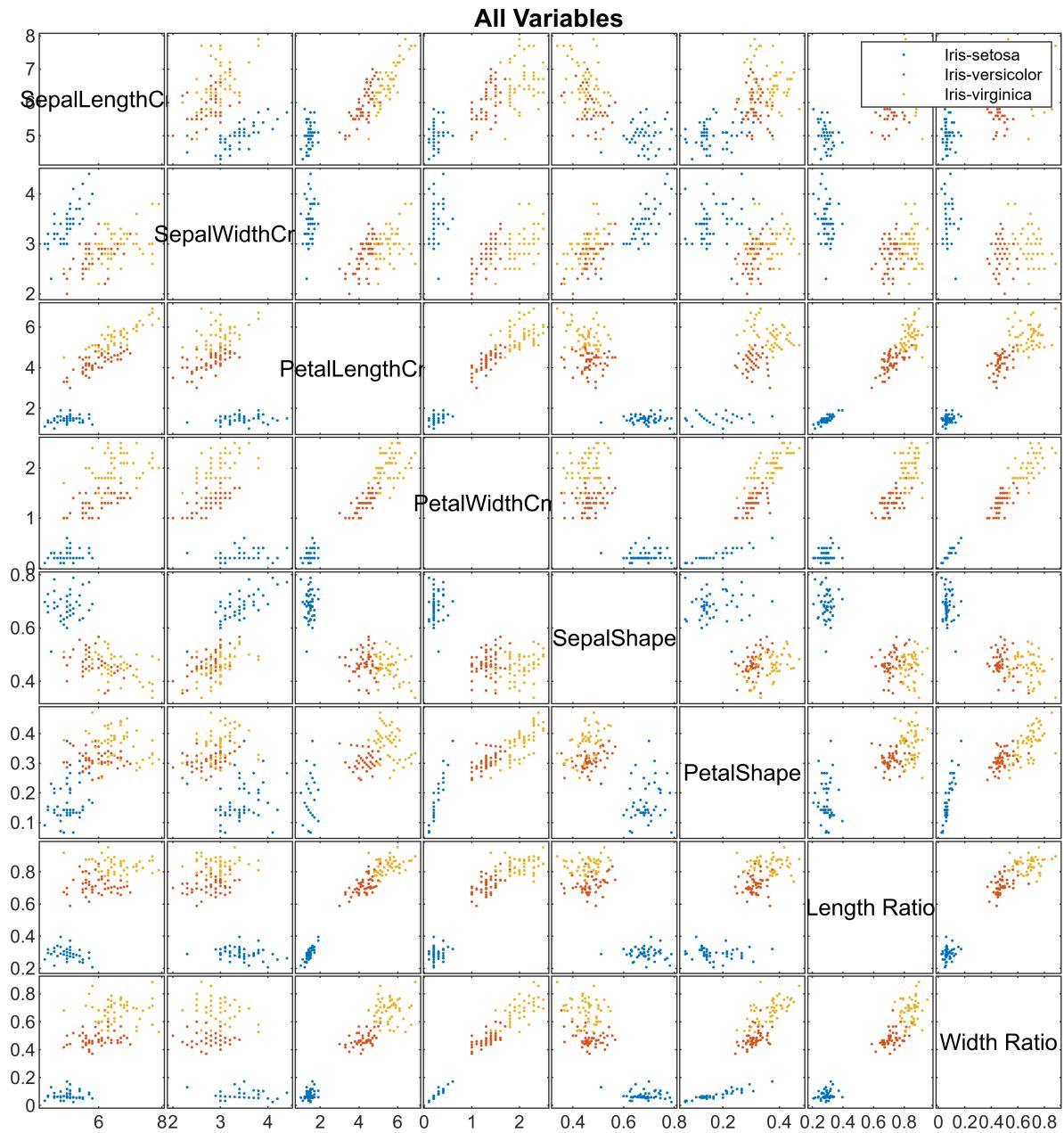
```



```
% saveas(gcf,'01_Iris/Derived_vars.png')
```

Analyse all the variables

```
Z = [X.SepalLengthCm X.SepalWidthCm X.PetalLengthCm X.PetalWidthCm SepalShape PetalShape Length  
znames = {'SepalLengthCm', 'SepalWidthCm', 'PetalLengthCm', 'PetalWidthCm', 'SepalShape', 'PetalShape', 'Length', 'Width'}  
  
figure  
[h, ax] = gplotmatrix(Z,[],iris.Species,color,[],[],[],'variable',znames);  
title('All Variables')  
set(gcf, 'Position', [100, 100, 1200, 1200])
```

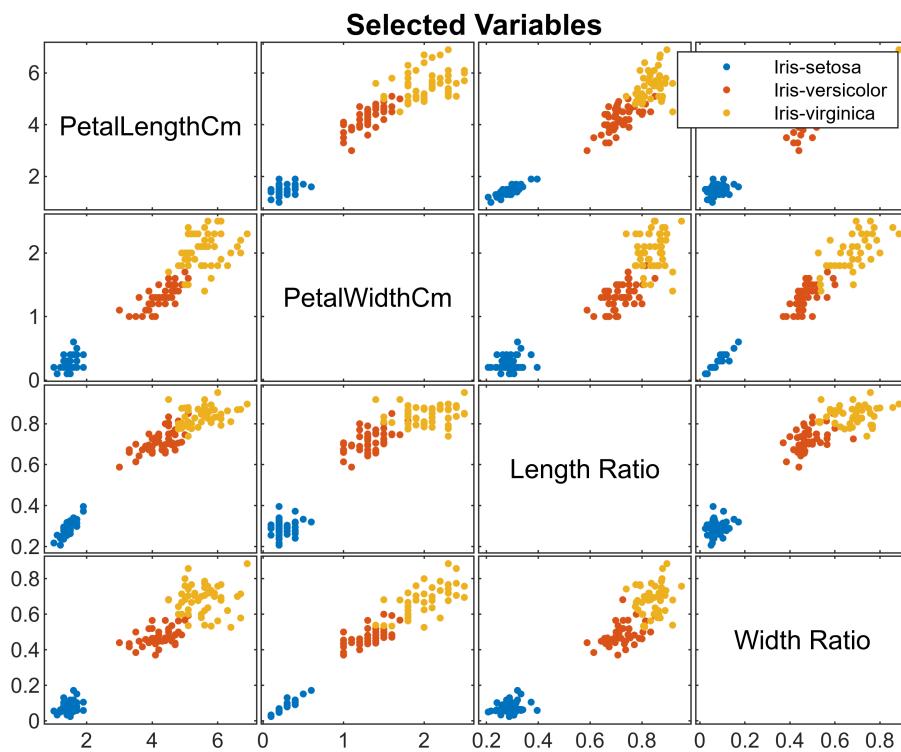


```
% saveas(gcf, '01_Iris/All_vars.png')
```

Select the ones which seem better suited

```
Vars = [X.PetalLengthCm X.PetalWidthCm Length_PvsS Width_PvsS];
vnames = {'PetalLengthCm', 'PetalWidthCm', 'Length Ratio', 'Width Ratio'};
figure
```

```
[h, ax] = gplotmatrix(Vars,[],iris.Species,color,[],[],[],'variable',vnames);
title('Selected Variables')
```

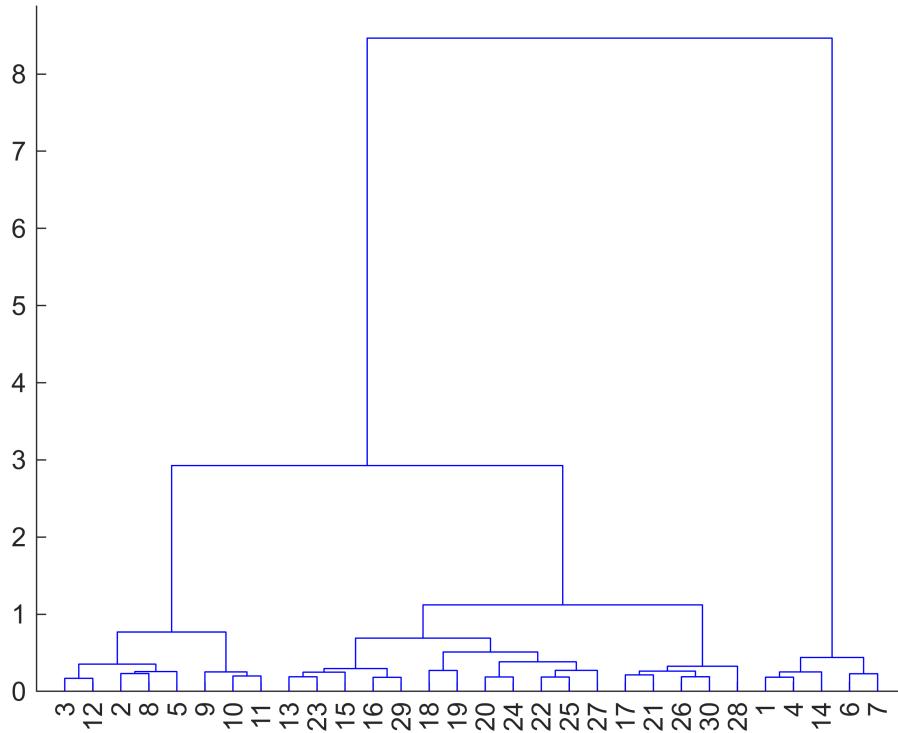


```
% saveas(gcf,'01_Iris/Selected_vars.png')
```

Try clustering methods

Hierarchy

```
norm_factors = [1/max(X.PetalLengthCm) 1/max(X.PetalWidthCm) 1 1];
figure
hierarchy = linkage(Vars.*norm_factors, 'Ward');
dendrogram(hierarchy)
```



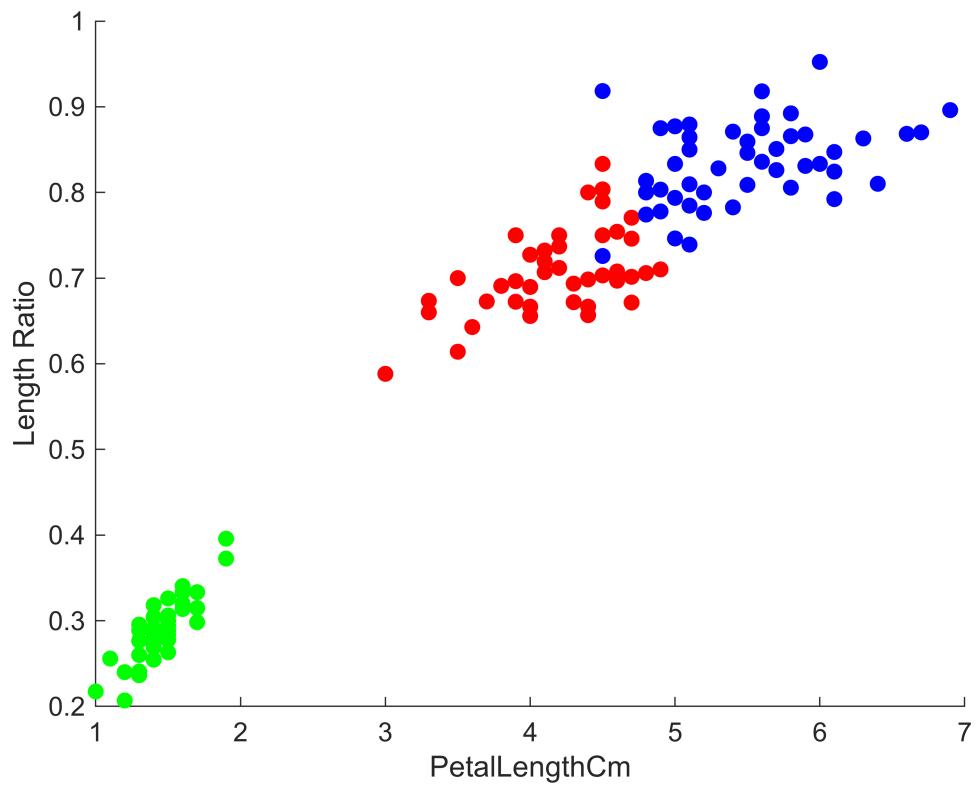
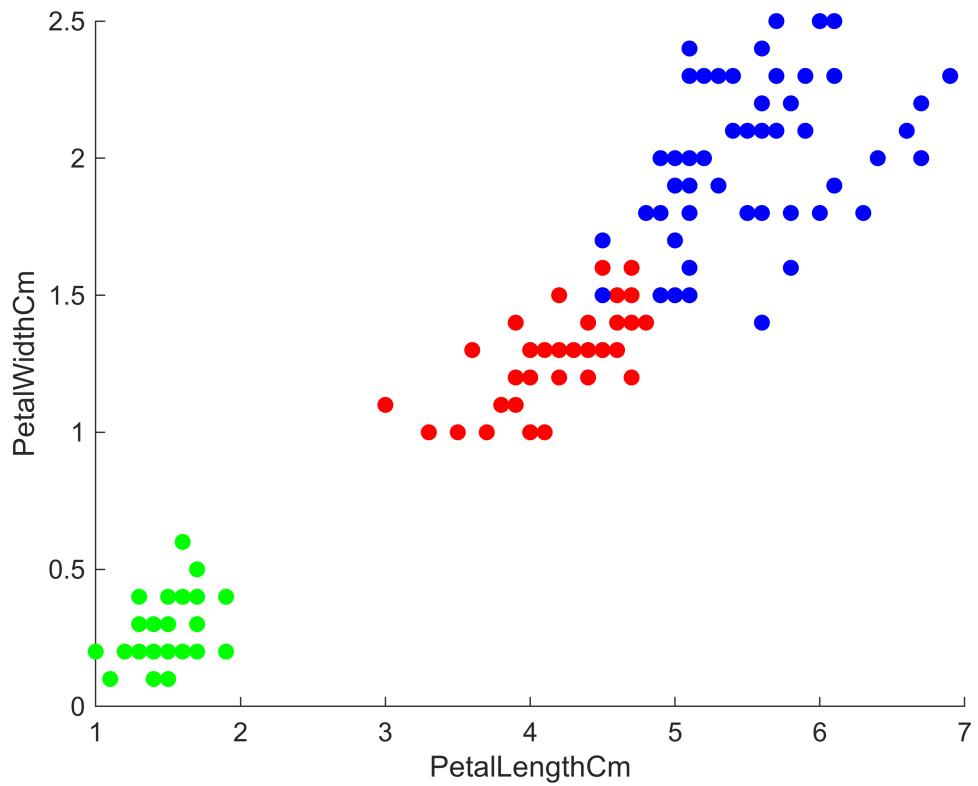
```
% saveas(gcf,'01_Iris/Hierarchy_tree.png')
```

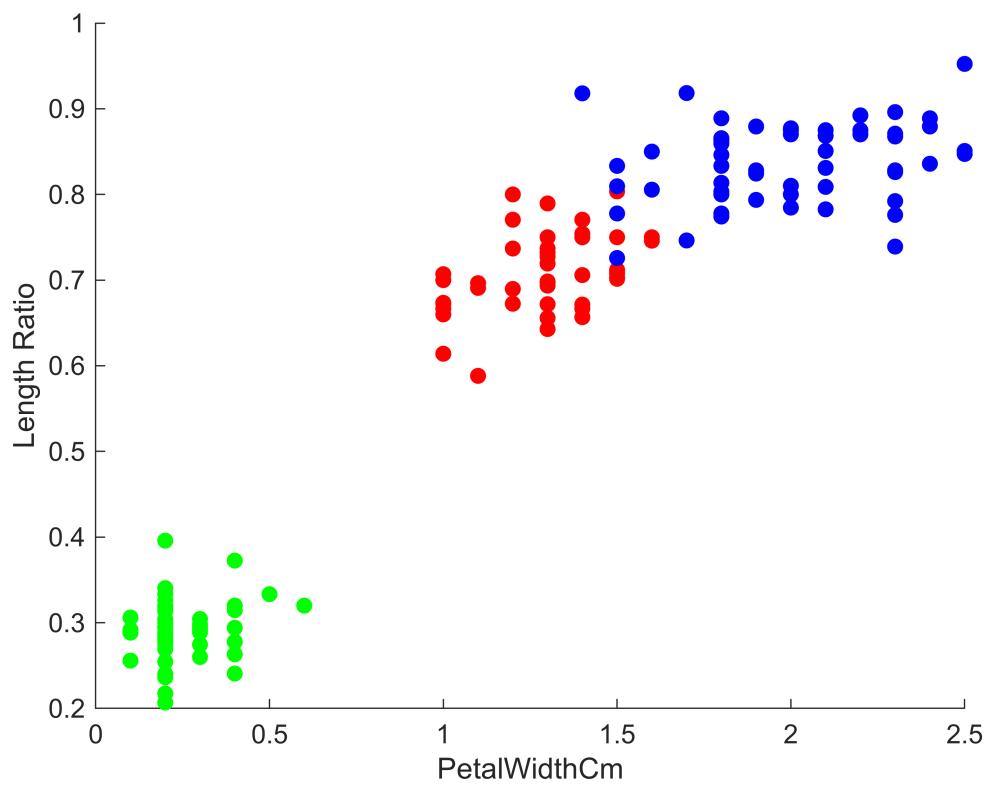
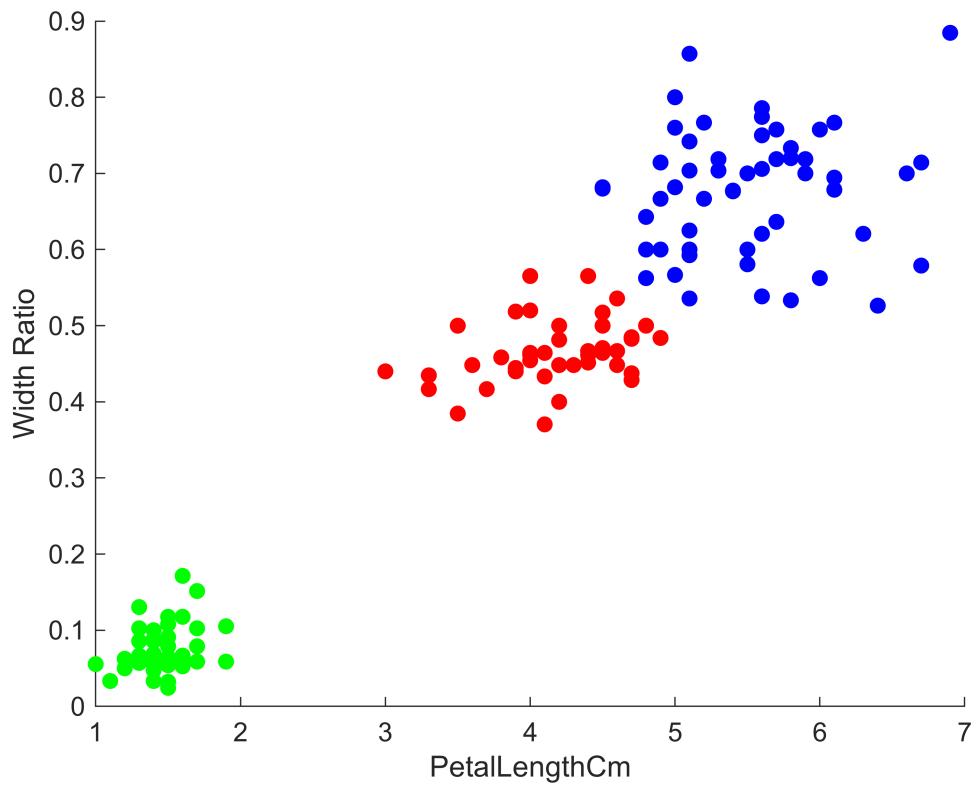
Plot the clusters obtained with this hierarchy method when considering the 3 major branches

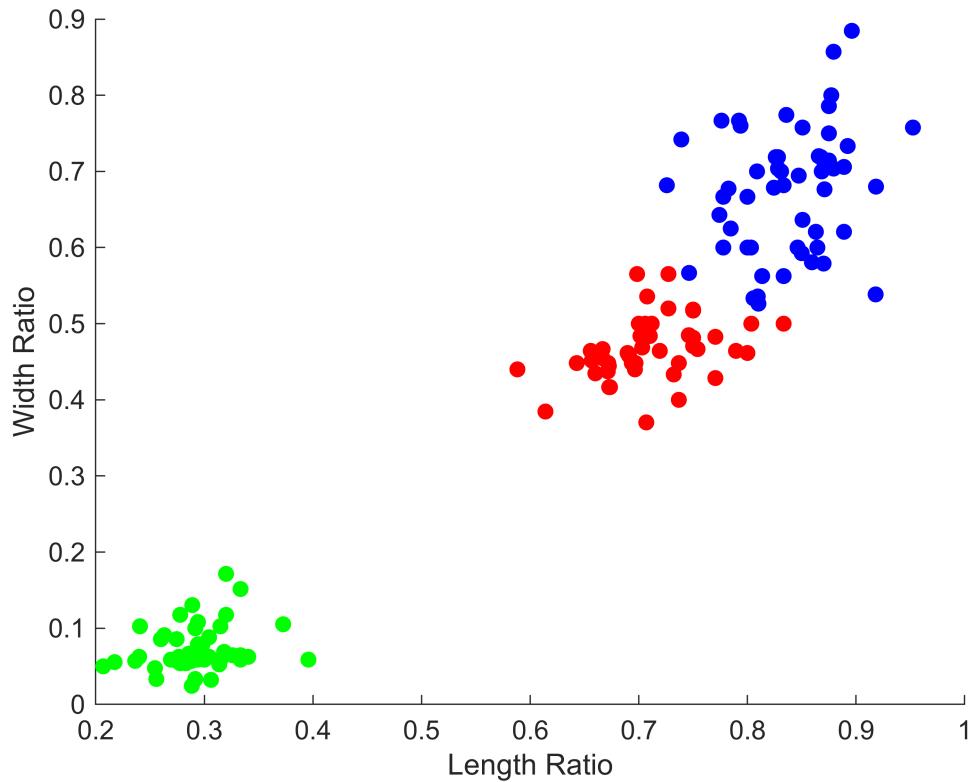
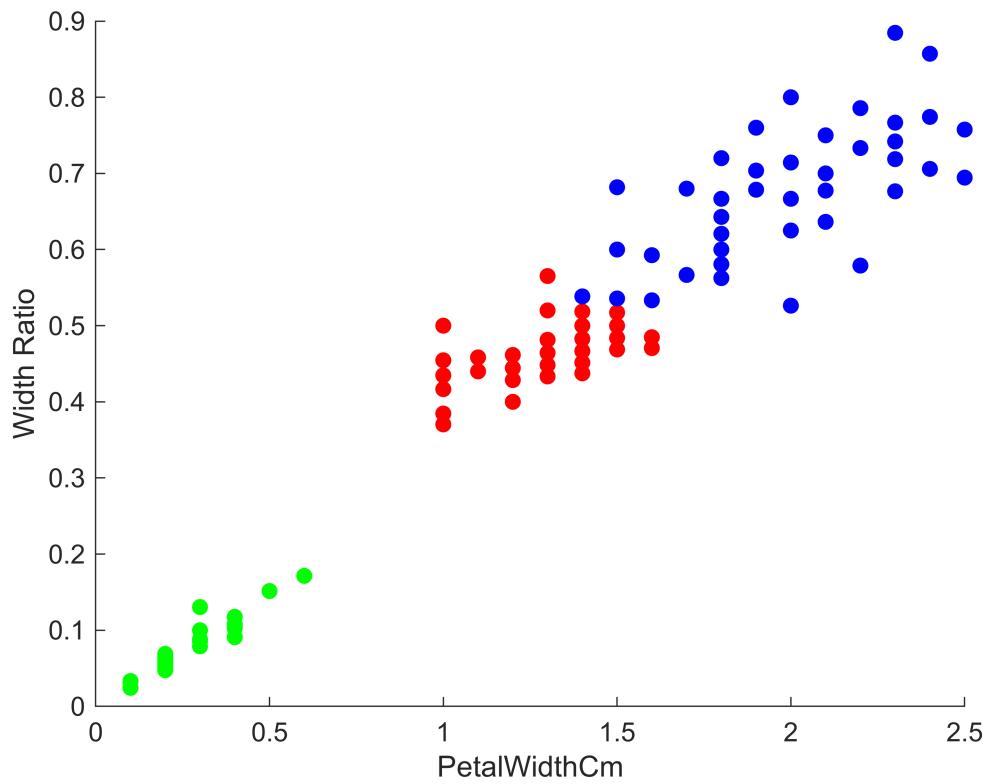
```
T = cluster(hierarchy,'maxclust',3);

g1 = T==1;
g2 = T==2;
g3 = T==3;

for ii=1:3
    for jj=ii+1:4
        figure
        clf
        hold on
        % Represent cluster elements
        scatter(Vars(g1,ii),Vars(g1,jj),'ro',filled='s')
        scatter(Vars(g2,ii),Vars(g2,jj),'bo',filled='s')
        scatter(Vars(g3,ii),Vars(g3,jj),'go',filled='s')
        xlabel(vnames{ii})
        ylabel(vnames{jj})
        hold off
        % saveas(gcf,strcat('01_Iris/Hierarchy_scatter_', vnames{ii}, '_', vnames{jj}, '.png'))
    end
end
```



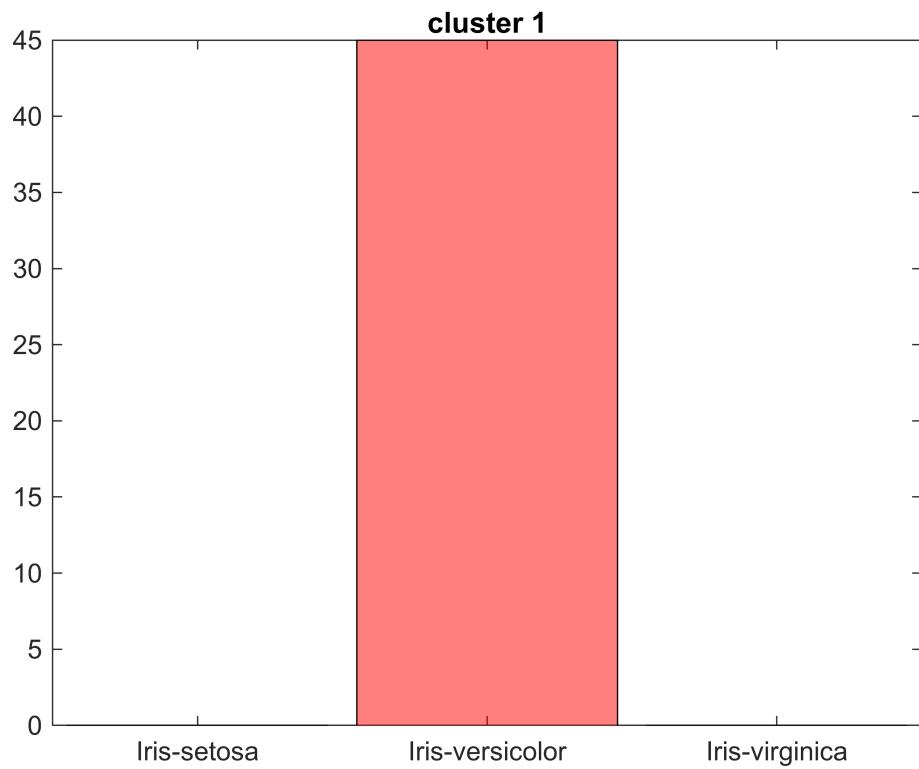




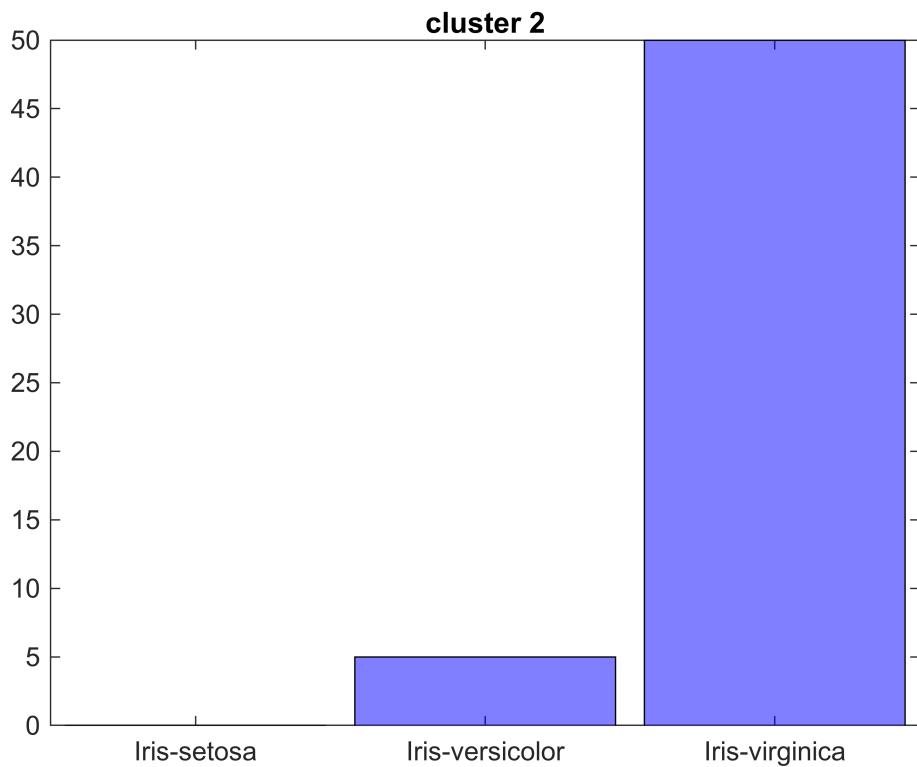
How good the clustering has been?

figure

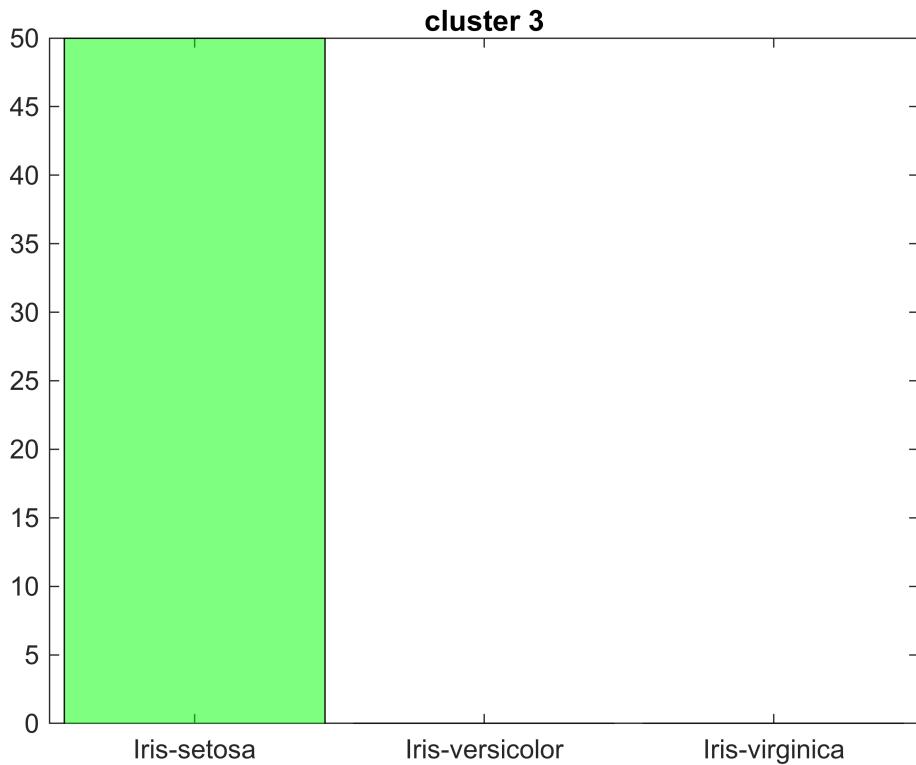
```
histogram(iris.Species(g1), FaceColor='r', FaceAlpha=0.5)
title('cluster 1')
```



```
% saveas(gcf,'01_Iris/Hierarchy_cluster1.png')
figure
histogram(iris.Species(g2), FaceColor='b', FaceAlpha=0.5)
title('cluster 2')
```



```
% saveas(gcf,'01_Iris/Hierarchy_cluster2.png')
figure
histogram(iris.Species(g3), FaceColor='g', FaceAlpha=0.5)
title('cluster 3')
```



```
% saveas(gcf,'01_Iris/Hierarchy_cluster3.png')
```

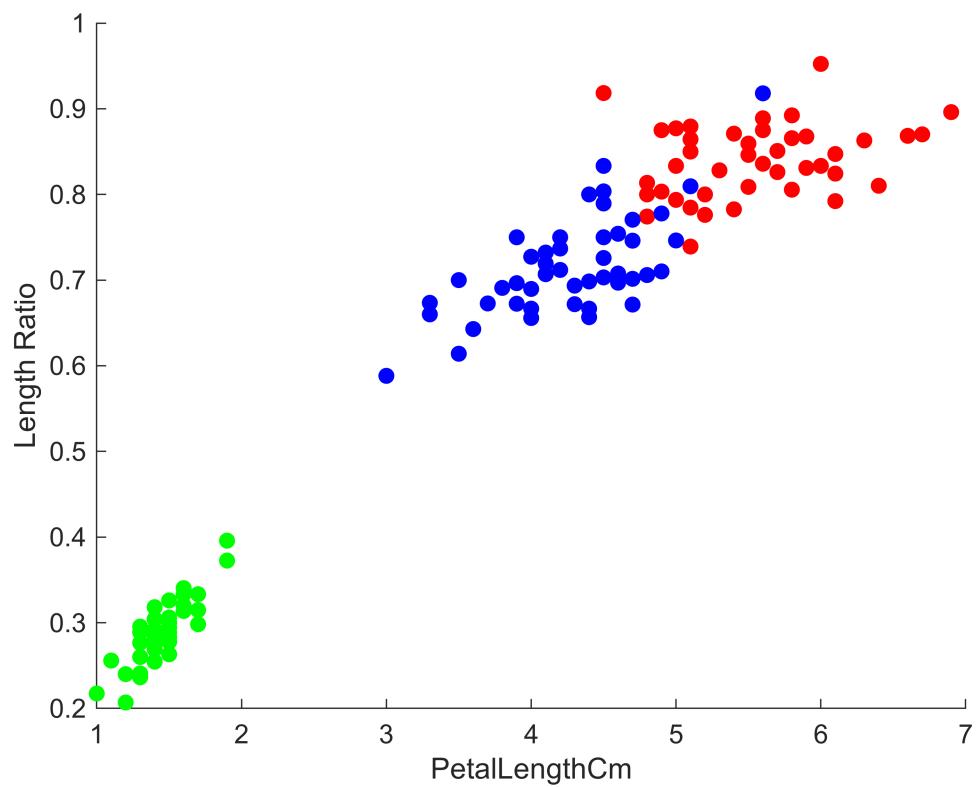
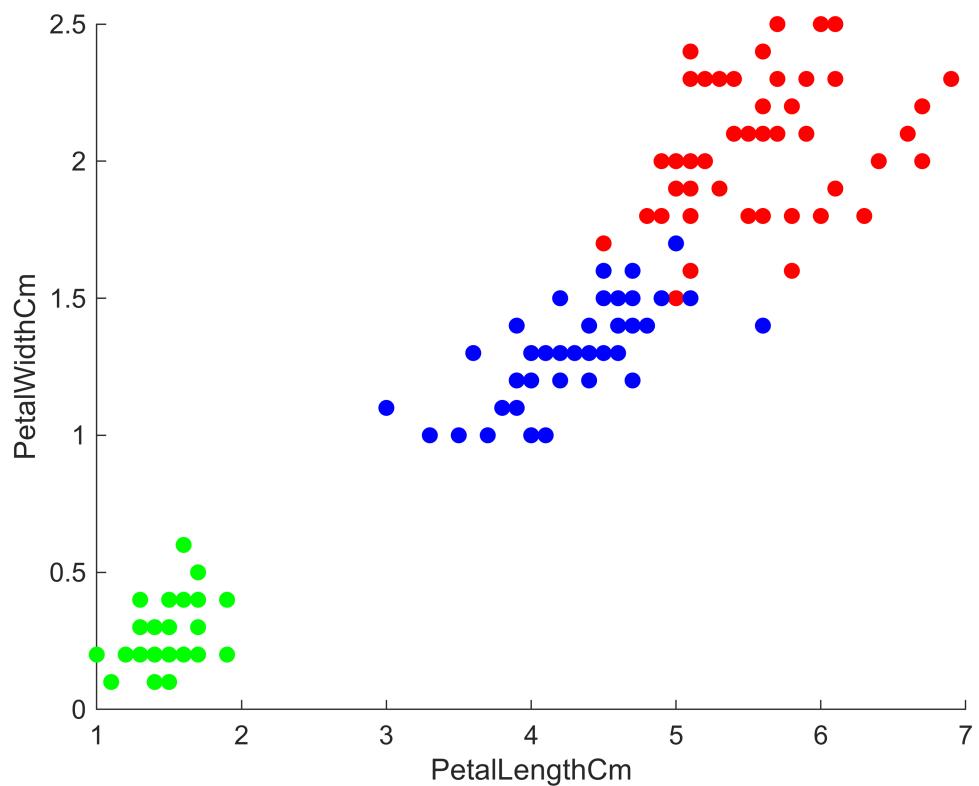
K-means

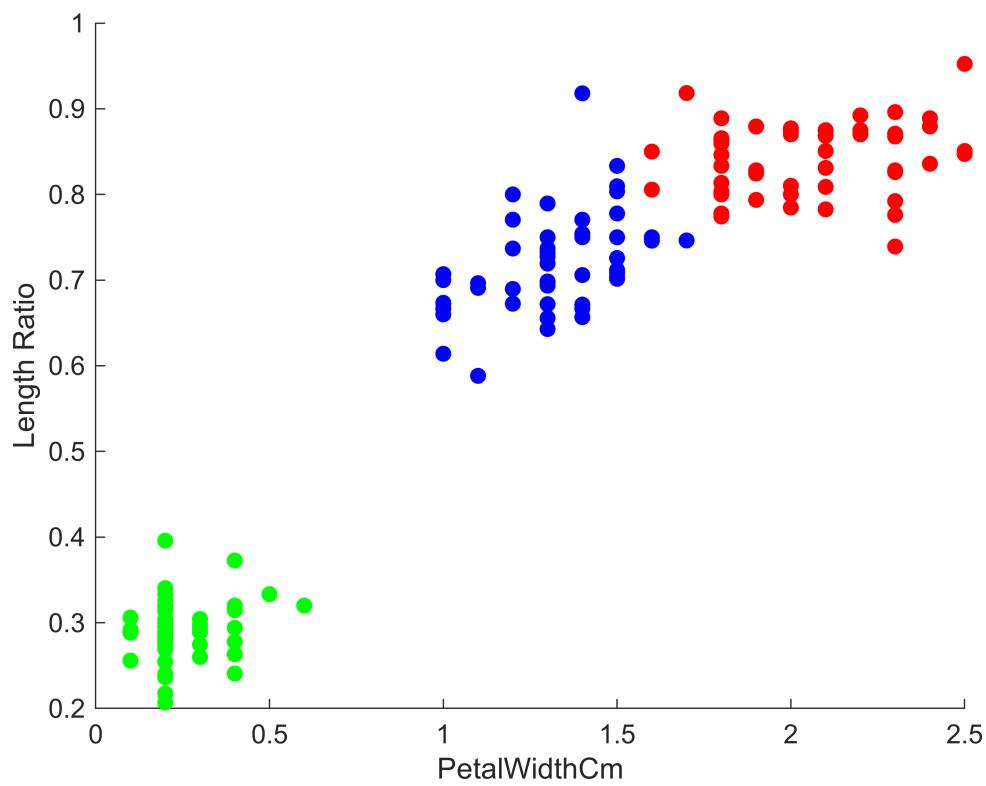
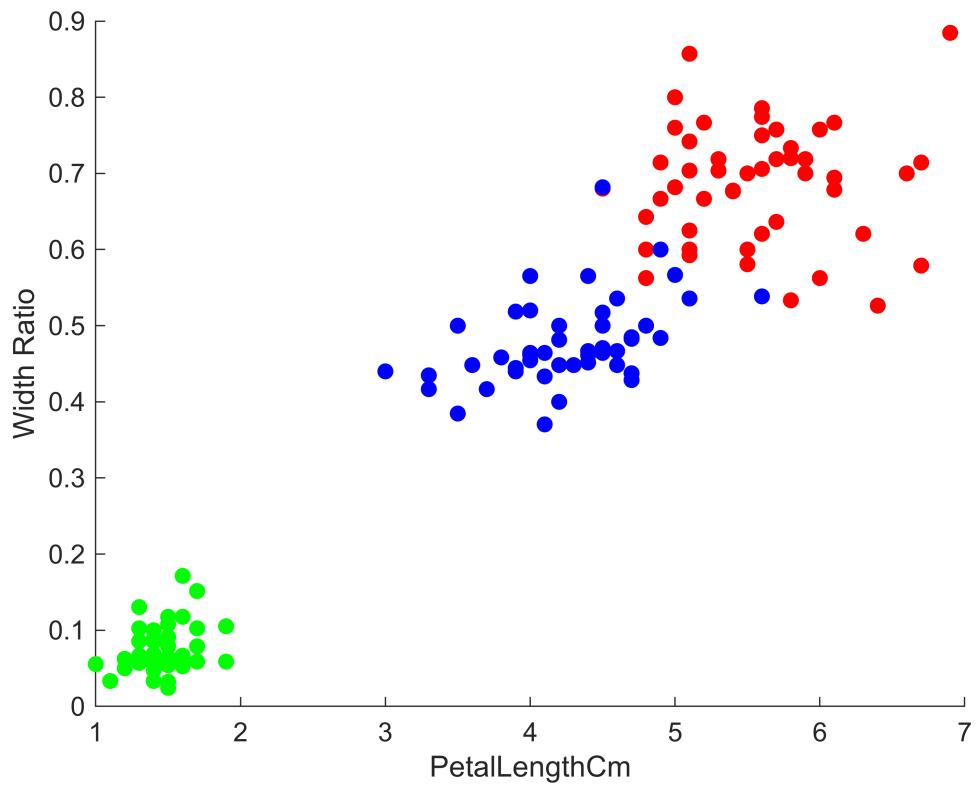
```
[idx,C,sumd,D] = kmeans(Vars.*norm_factors,3);

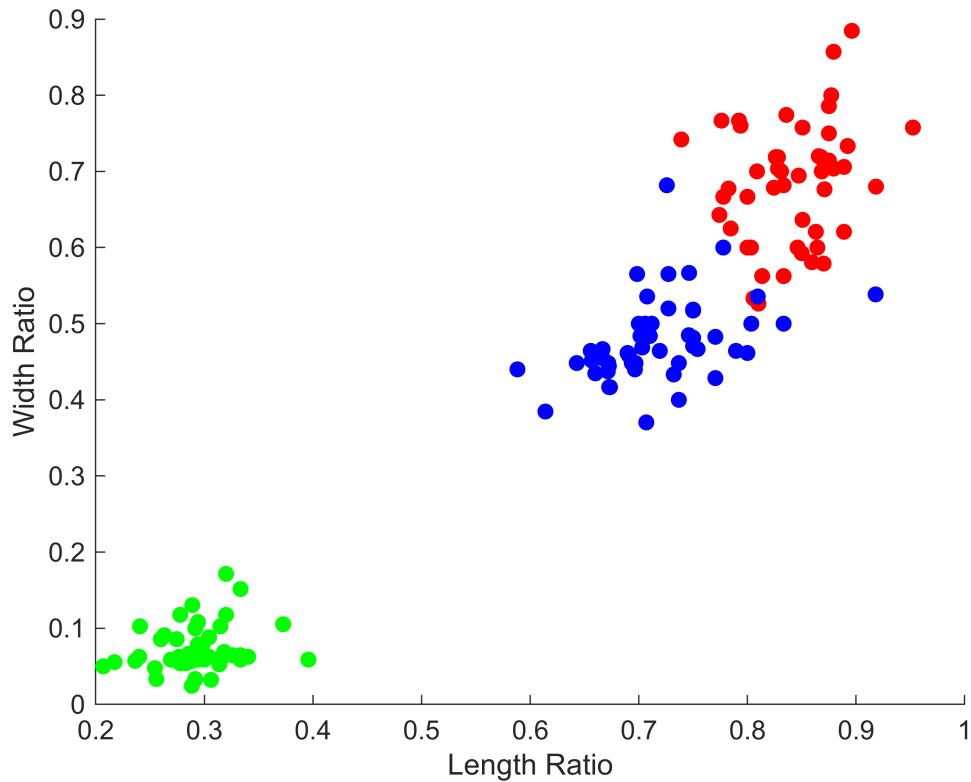
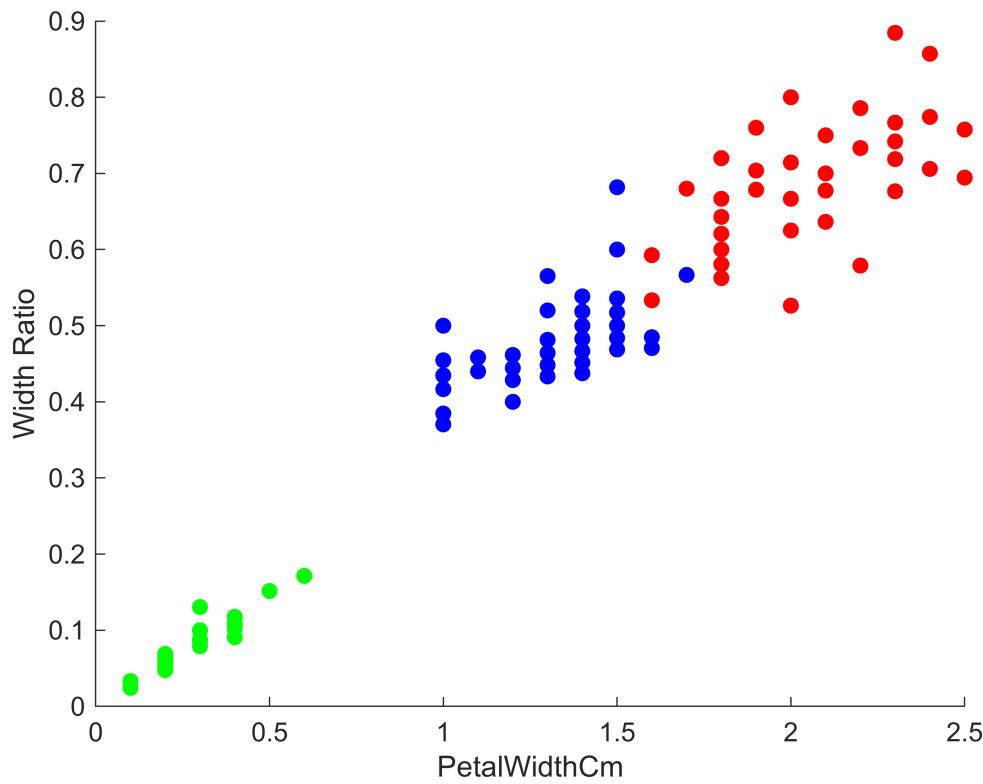
g1 = idx==1;
g2 = idx==2;
g3 = idx==3;

for ii=1:3
    for jj=ii+1:4
        figure
        clf
        hold on
        % Represent cluster elements
        scatter(Vars(g1,ii),Vars(g1,jj),'ro',filled='s')
        scatter(Vars(g2,ii),Vars(g2,jj),'bo',filled='s')
        scatter(Vars(g3,ii),Vars(g3,jj),'go',filled='s')
        xlabel(vnames{ii})
        ylabel(vnames{jj})
        hold off
    %       saveas(gcf,strcat('01_Iris/Kmeans_scatter_', vnames{ii}, '_', vnames{jj}, '.png') )
    end
end
```

end



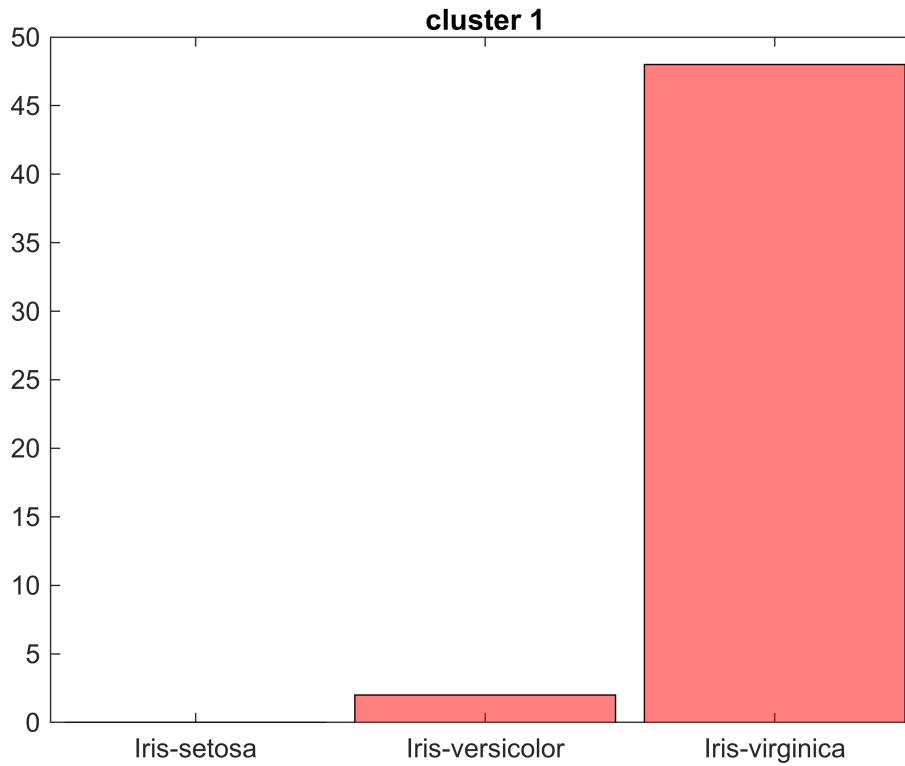




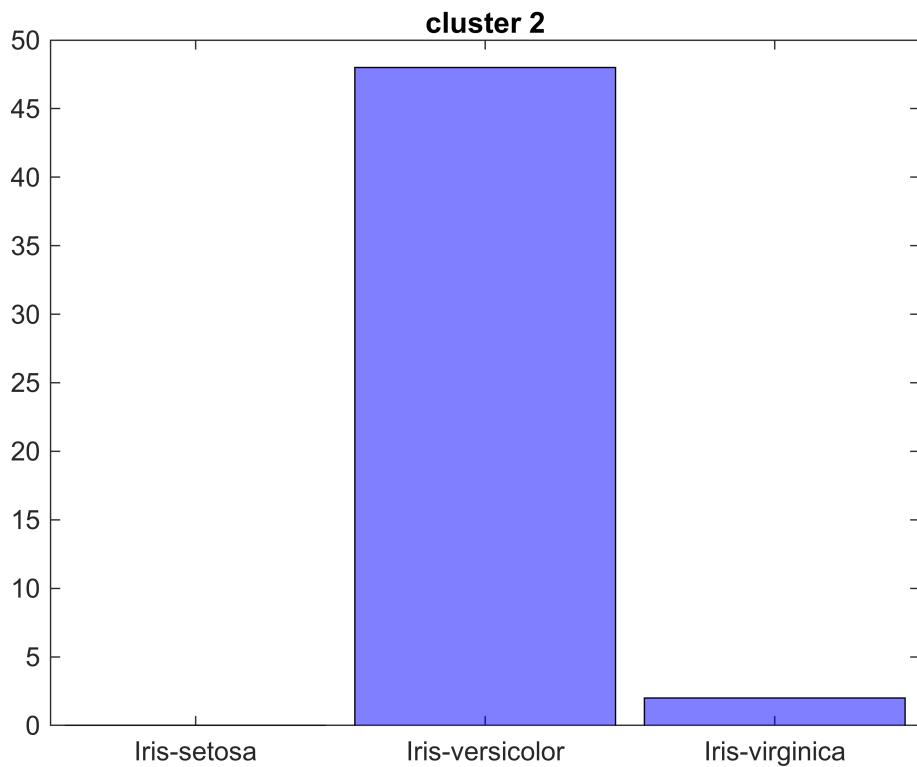
How good the clustering has been?

figure

```
histogram(iris.Species(g1), FaceColor='r', FaceAlpha=0.5)
title('cluster 1')
% saveas(gcf,'01_Iris/Kmeans_cluster1.png')
```



```
figure
histogram(iris.Species(g2), FaceColor='b', FaceAlpha=0.5)
title('cluster 2')
% saveas(gcf,'01_Iris/Kmeans_cluster2.png')
```



```
figure  
histogram(iris.Species(g3), FaceColor='g', FaceAlpha=0.5)  
title('cluster 3')  
% saveas(gcf,'01_Iris/Kmeans_cluster3.png')
```

