```
> principal_components$loadings

Loadings:
    Comp.1 Comp.2 Comp.3 Comp.4 Comp.5 Comp.6 Comp.7 Comp.8 Comp.9 Comp.10 Comp.11 Comp.12 Comp.13
X2   0.144 0.484 0.207   0.266 0.214   0.396 0.509 0.212   0.226   0.266
X3 -0.245 0.225   -0.537   0.537 -0.421   -0.309   -0.122
X4   0.316 -0.626 0.214 0.143 0.154 0.149 -0.170 -0.308   0.499   -0.141
X5 -0.239   -0.612   -0.101 0.287 0.428 0.200   -0.479
X6   0.142 0.300 -0.131 0.352 -0.727   -0.323 -0.156 0.271
X7   0.395   -0.146 -0.198 0.149   -0.406 0.286 -0.320 -0.304   0.304 -0.464
X8   0.423   -0.151 -0.152 0.109   -0.187   -0.163   0.832
X9 -0.299   -0.170 0.203 0.501 -0.259 -0.595 -0.233 0.196 0.216 -0.117   0.114
X10 0.313   -0.149 -0.399 -0.137 -0.534 -0.372 0.368 -0.209 0.134   0.237   -0.117
X11   0.530 0.137   -0.419 0.228   -0.291   -0.604
X12 0.297 -0.279   0.428 0.174 0.106 -0.232 0.437   -0.522   -0.259
X13 0.376 -0.164 -0.166 -0.184 0.101 0.266   0.137 0.524   -0.601 -0.157
X14 0.287 0.365 0.127 0.232 0.158 0.120   0.120 -0.576 0.162 -0.539
```
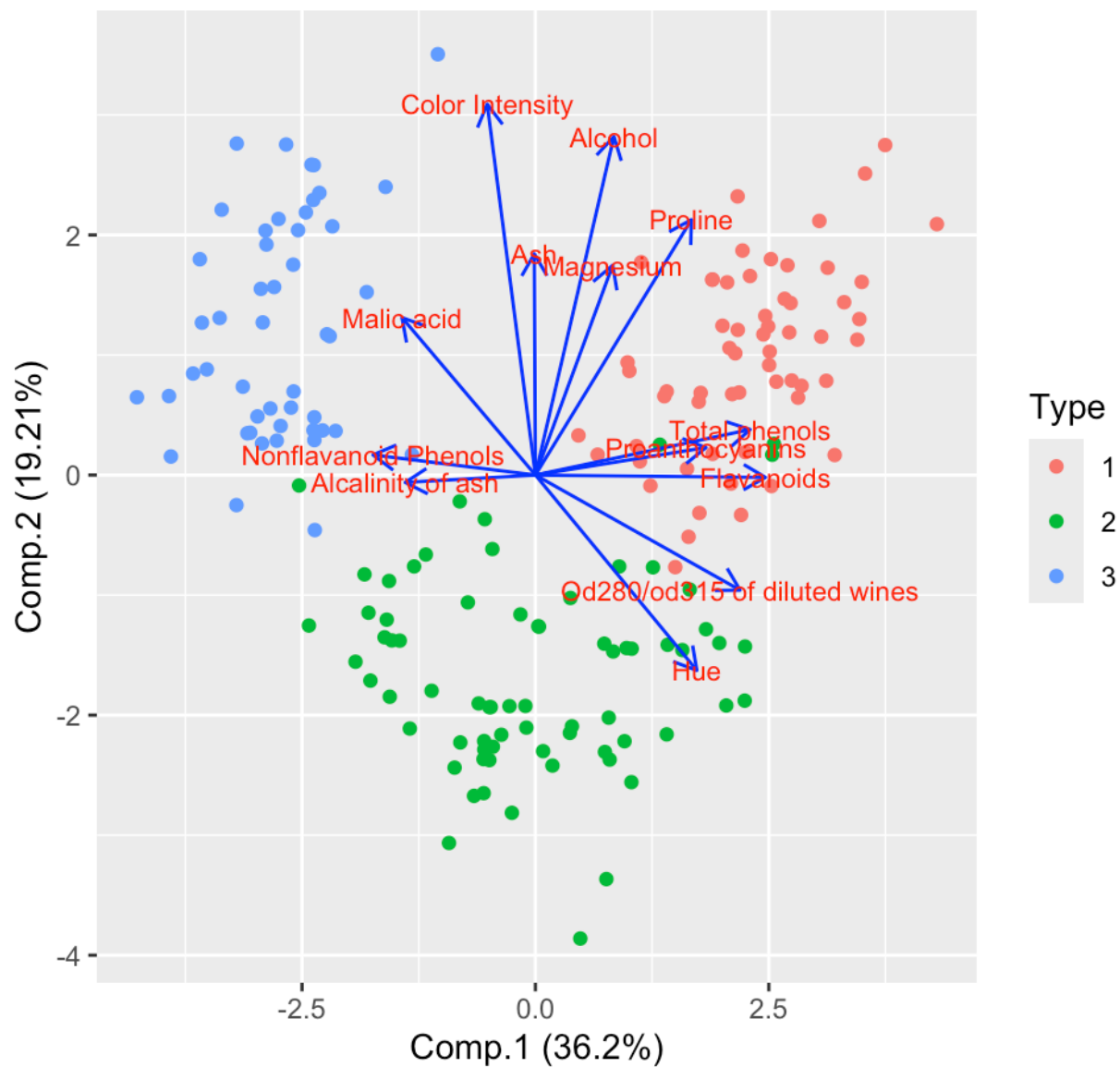


Flavanoids contribute to $1^{st}$ PC (0.423), and Color Intensity contribute to 2rd PC (0.530)

For KNN, I select 150 data as the training set and 28 data as test data with k=13.

For all features selected:

```
> print(tab1)
         actual
predicted  1  2  3
        1  0  0  5
        2  0  0 18
        3  0  0  5
> acc1 <- sum(diag(tab1)) / sum(tab1)
> precision <- mean(diag(tab1) / rowSums(tab1), na.rm = TRUE)
> recall    <- mean(diag(tab1) / colSums(tab1), na.rm= TRUE)
> f1        <- mean(2 * precision * recall / (precision + recall),na.rm = TRUE)
> cat("Accuracy of all features : ", round(acc1, 4), "\n", sep = "")
Accuracy of all features : 0.1786
> cat("Mean precision of all features : ", round(precision, 4), "\n", sep = "")
Mean precision of all features : 0.3333
> cat("Mean recall of all features : ", round(recall, 4), "\n", sep = "")
Mean recall of all features : 0.1786
> cat("Mean f1 of all features : ", round(f1, 4), "\n", sep = "")
Mean f1 of all features : 0.2326
```

For only the first two PCs:

```
> print(tab2)
          actual
predicted  1  2  3
        1  0  0  0
        2  0  0  0
        3  0  0 28
> acc2 <- sum(diag(tab2)) / sum(tab2)
> precision <- mean(diag(tab2) / rowSums(tab2), na.rm = TRUE)
> recall    <- mean(diag(tab2) / colSums(tab2), na.rm= TRUE)
> f1        <- mean(2 * precision * recall / (precision + recall),na.rm = TRUE)
> cat("Accuracy of first two PCs : ", round(acc2, 4), "\n", sep = "")
Accuracy of first two PCs : 1
> cat("Mean precision of first two PCs : ", round(precision, 4), "\n", sep = "")
Mean precision of first two PCs : 1
> cat("Mean recall of first two PCs : ", round(recall, 4), "\n", sep = "")
Mean recall of first two PCs : 1
> cat("Mean f1 of first two PCs : ", round(f1, 4), "\n", sep = "")
Mean f1 of first two PCs : 1
```