

## Visualizations LDA coefficients

```
library(ggplot2)
```

```
## Warning: package 'ggplot2' was built under R version 4.0.5
```

```
library(dplyr)
```

```
## Warning: package 'dplyr' was built under R version 4.0.5
```

```
##
```

```
## Attaching package: 'dplyr'
```

```
## The following objects are masked from 'package:stats':
```

```
##
```

```
## filter, lag
```

```
## The following objects are masked from 'package:base':
```

```
##
```

```
## intersect, setdiff, setequal, union
```

```
library(tidyr)
```

```
## Warning: package 'tidyr' was built under R version 4.0.5
```

```
library("ggpubr")
```

```
## Warning: package 'ggpubr' was built under R version 4.0.5
```

```
library(LDATS)
```

```
## Warning: package 'LDATS' was built under R version 4.0.5
```

```
library(ggVennDiagram)
```

```
## Warning: package 'ggVennDiagram' was built under R version 4.0.5
```

```
library(stringr)
```

```
library(abind)
```

```
## Warning: package 'abind' was built under R version 4.0.3
```

```
library(patchwork)
```

```
## Warning: package 'patchwork' was built under R version 4.0.3
```

```
source("utils.R")
```

```
## Warning: package 'hash' was built under R version 4.0.5
```

```
## hash-2.2.6.1 provided by Decision Patterns
```

```
## Warning: package 'reticulate' was built under R version 4.0.5
```

```
## Warning: package 'berryFunctions' was built under R version 4.0.5
```

```
##
```

```
## Attaching package: 'berryFunctions'
```

```
## The following object is masked from 'package:ggVennDiagram':
```

```
##
```

```
## circle
```

```
## The following object is masked from 'package:dplyr':
```

```
##
```

```
## between
```

```
## Warning: package 'purrr' was built under R version 4.0.3
```

```
## Warning: package 'reshape2' was built under R version 4.0.3
```

```
##
```

```
## Attaching package: 'reshape2'
```

```
## The following object is masked from 'package:tidyr':
```

```
##
```

```
## smiths
```

Visualizations on three sets of networks. First set consists of networks trained in 30 replications on CIFAR 10 training set with 500 sample validation set extracted randomly in each replication. Second set consists of networks trained in a single replication on half of CIFAR 10 training set. Third set are networks trained in 10 replications on half of CIFAR 100 training set.

## CIFAR 10

```

base_dir <- "../data/data_train_val_c10"
repls <- 0:29
classes <- 10
lda_coefs <- load_lda_coefs(base_dir, repls)
net_pw_results <- read.csv(file.path(base_dir, "net_pw_accuracies.csv"))
ens_pw_results <- read.csv(file.path(base_dir, "ensemble_pw_accuracies.csv"))
ens_pw_cal <- read.csv(file.path(base_dir, "ensemble_pw_calibration.csv"))
ens_pw_irrel <- read.csv(file.path(base_dir, "ensemble_pw_irrelevant.csv"))
net_pw_results[, c("class1", "class2")] <- lapply(net_pw_results[, c("class1", "class2")], as.factor)
ens_pw_results[, c("class1", "class2")] <- lapply(ens_pw_results[, c("class1", "class2")], as.factor)
ens_pw_cal$bin_c <- (ens_pw_cal$conf_min + ens_pw_cal$conf_max) / 2
ens_pw_cal[, c("class1", "class2", "bin_c")] <- lapply(ens_pw_cal[, c("class1", "class2", "bin_c")], as.factor)
ens_pw_irrel[, c("class1", "class2")] <- lapply(ens_pw_irrel[, c("class1", "class2")], as.factor)

for (cl1 in 1:(classes - 1))
{
  for (cl2 in (cl1 + 1):classes)
  {
    lda_plt <- lda_coefs %>% filter(class1 == cl1 & class2 == cl2) %>% ggplot() + geom_boxplot(aes(x=conf, y=lda_coef)) +
      facet_wrap(~train_type) + ggtitle("LDA coefficients")

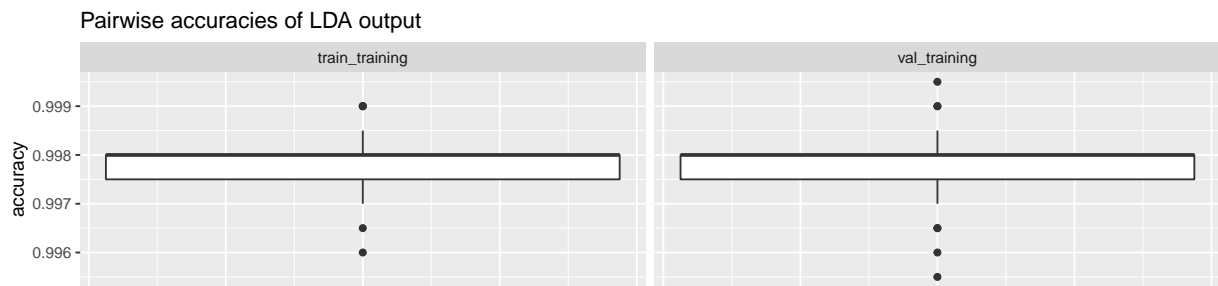
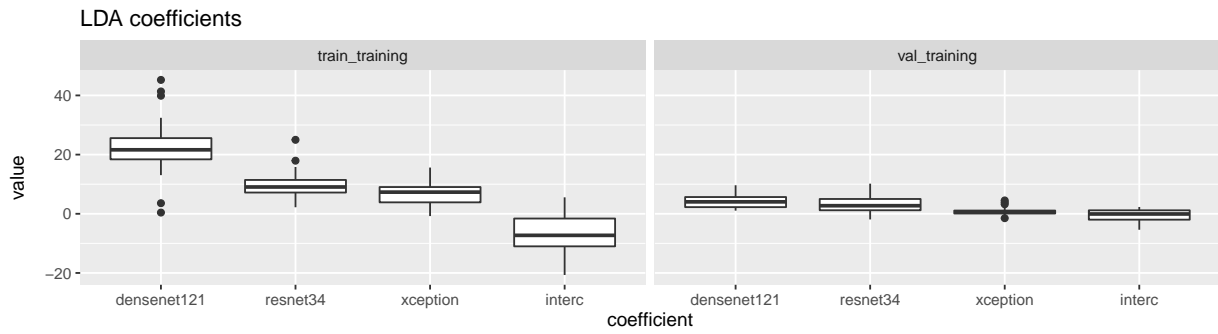
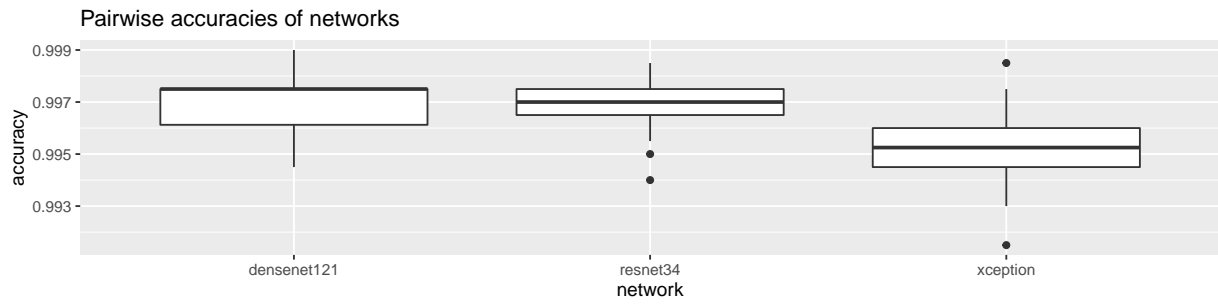
    acc_plt_net <- net_pw_results %>% filter(class1 == (cl1 - 1) & class2 == (cl2 - 1)) %>% ggplot(mapping=aes(x=acc, y=net_acc)) +
      geom_boxplot() + ggtitle("Pairwise accuracies of networks")

    acc_plt_ens <- ens_pw_results %>% filter(class1 == (cl1 - 1) & class2 == (cl2 - 1)) %>% ggplot(mapping=aes(x=acc, y=ens_acc)) +
      geom_boxplot() + facet_wrap(~train_set) + ggtitle("Pairwise accuracies of LDA output") +
      theme(axis.ticks.x=element_blank(), axis.text.x=element_blank())

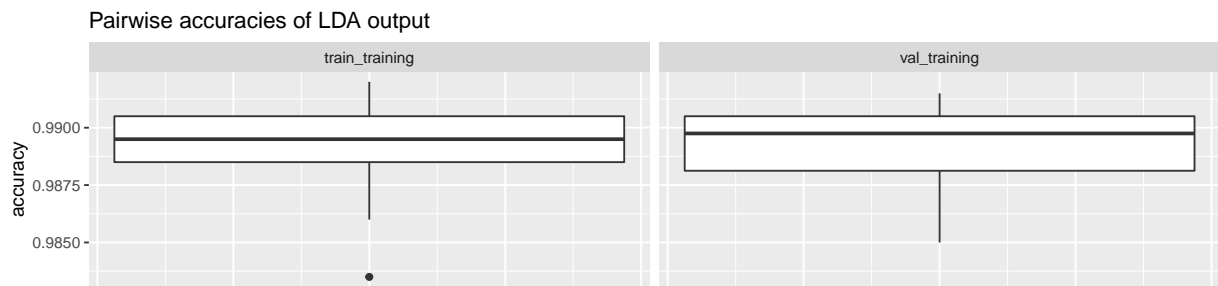
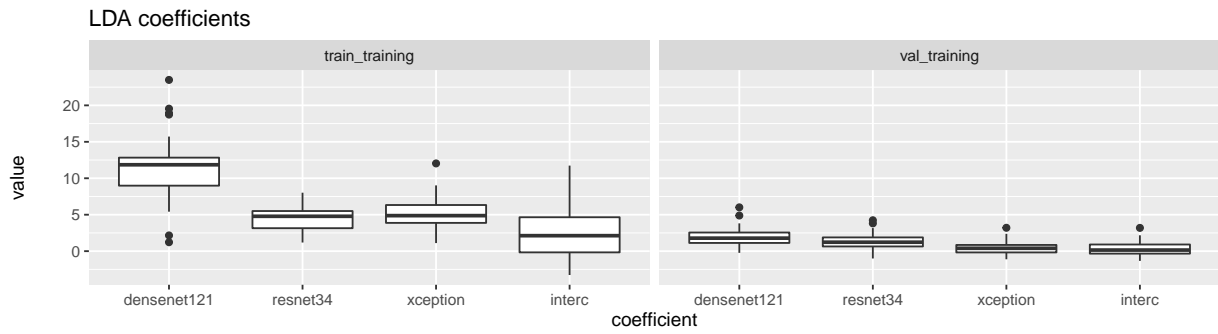
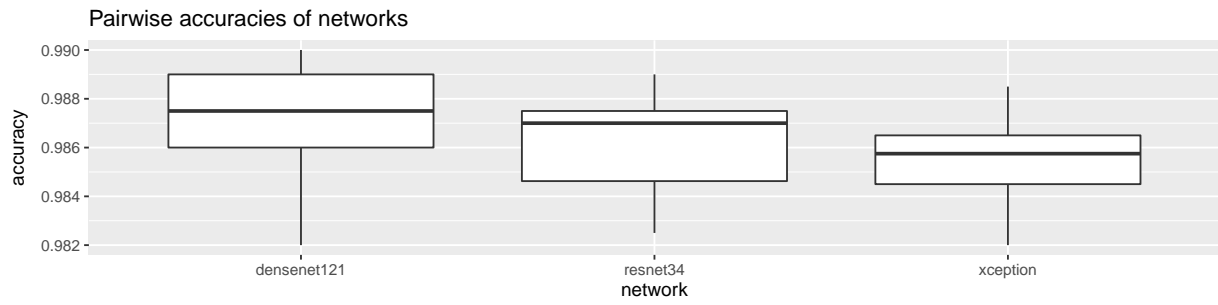
    print((acc_plt_net/lda_plt/acc_plt_ens) + plot_annotation(title=paste("Classes ", cl1, " vs ", cl2)))
  }
}

```

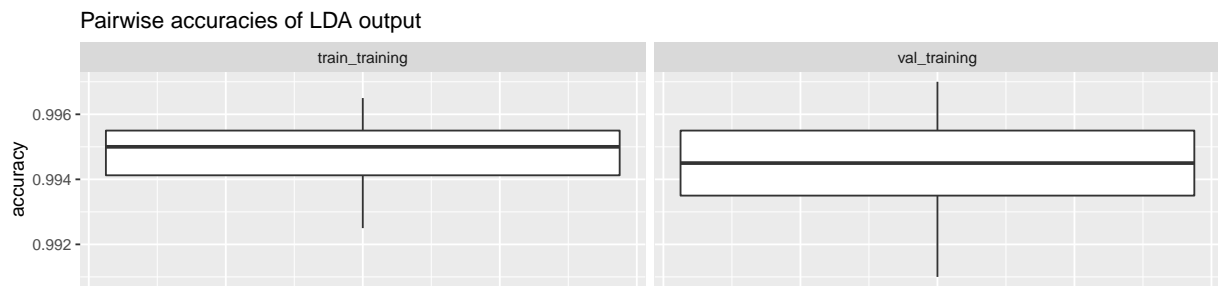
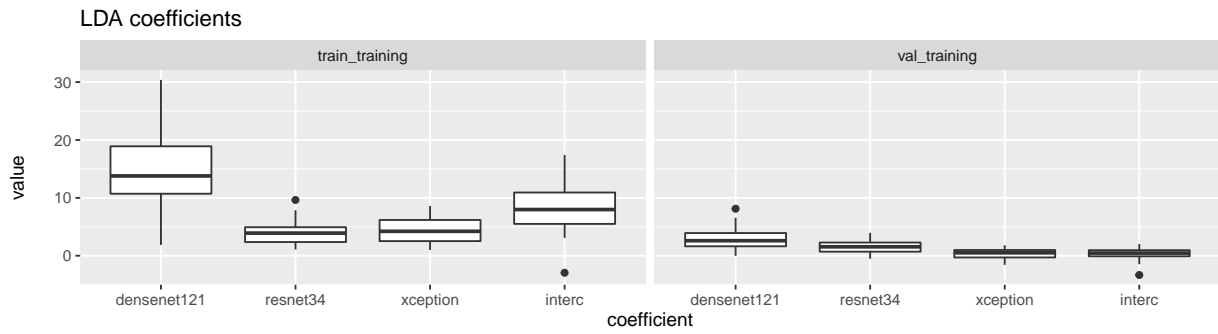
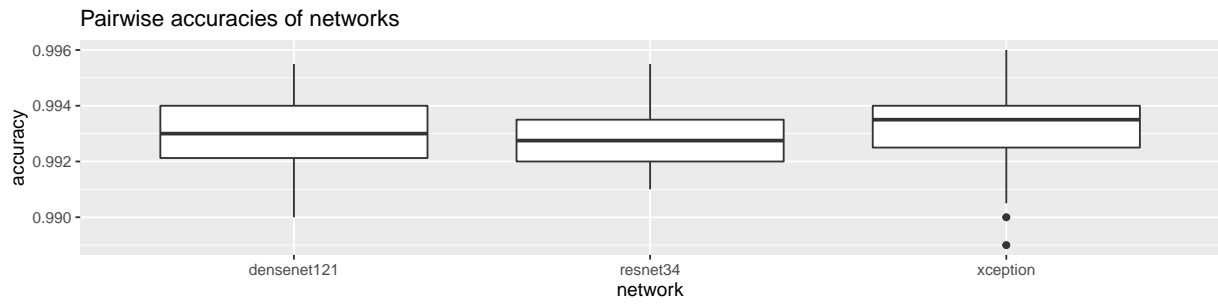
## Classes 1 vs 2



## Classes 1 vs 3

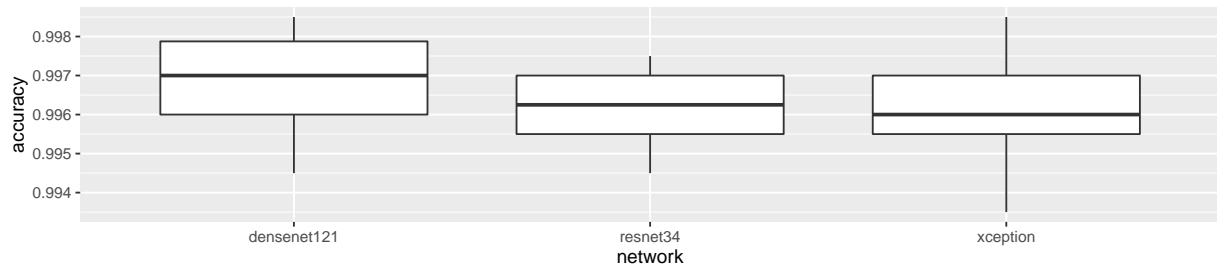


## Classes 1 vs 4

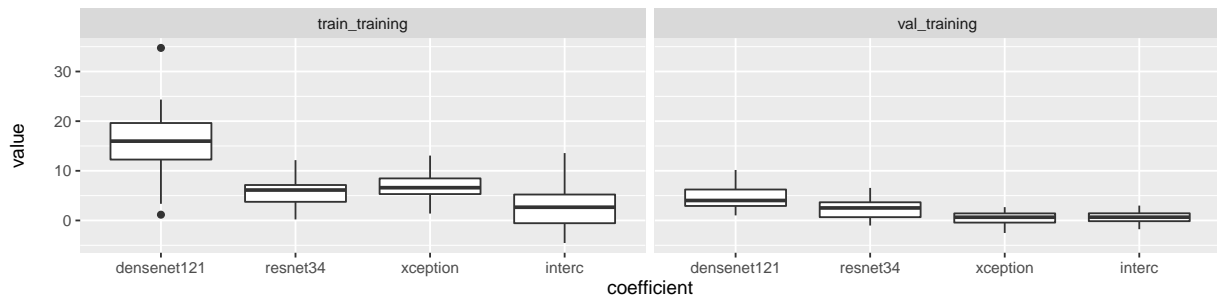


## Classes 1 vs 5

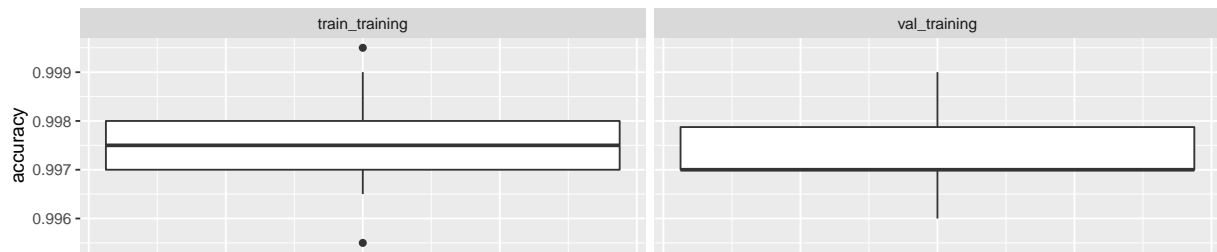
Pairwise accuracies of networks



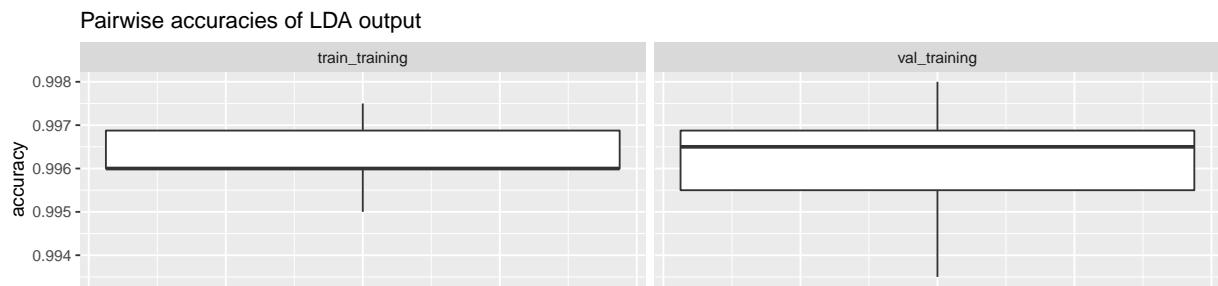
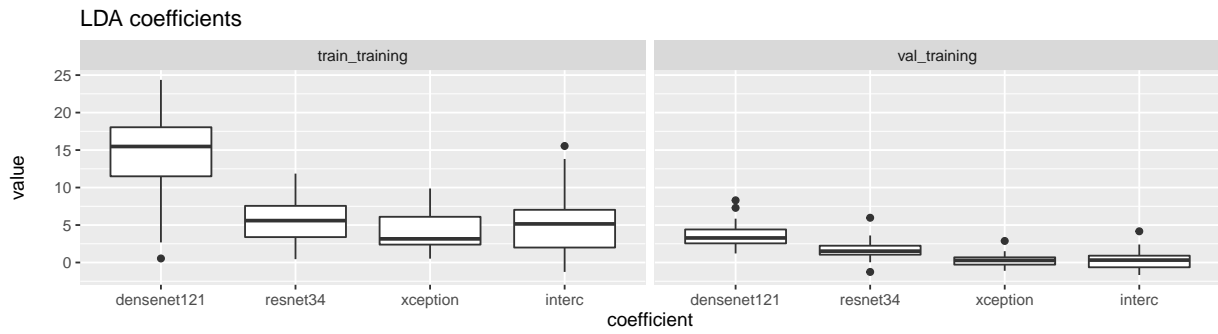
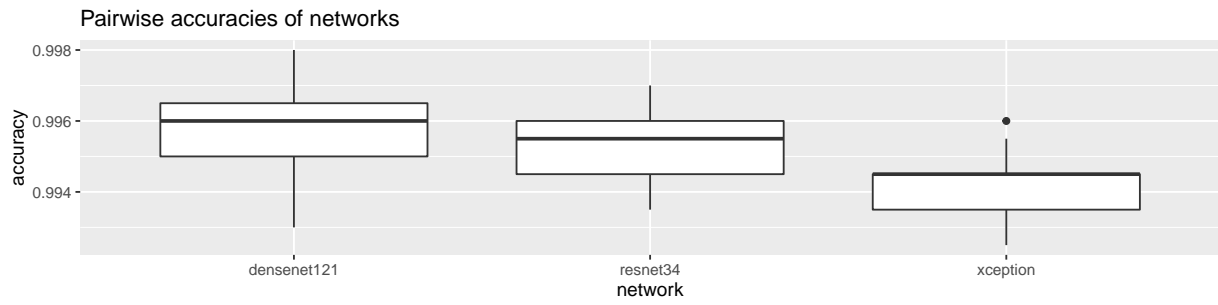
LDA coefficients



Pairwise accuracies of LDA output

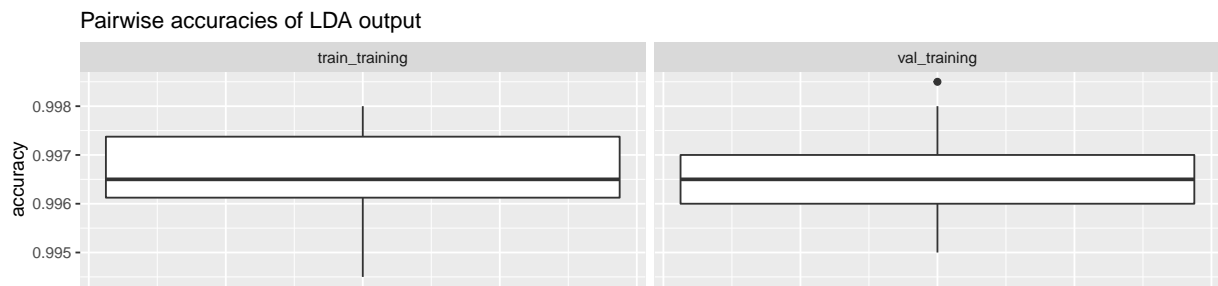
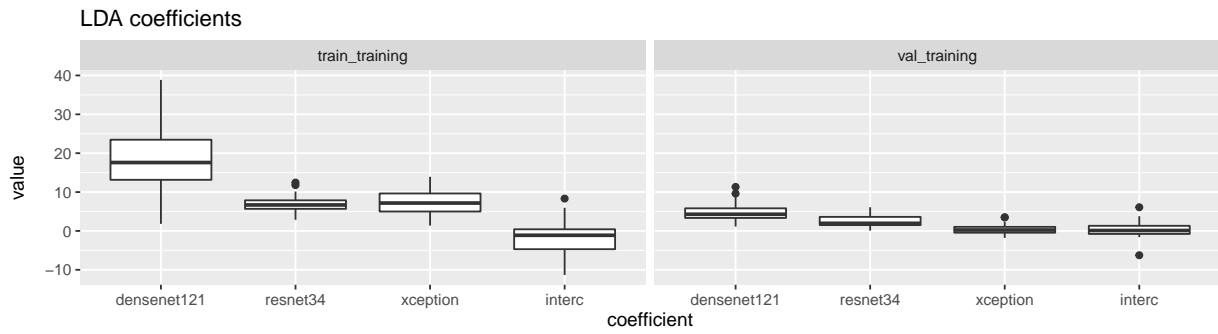
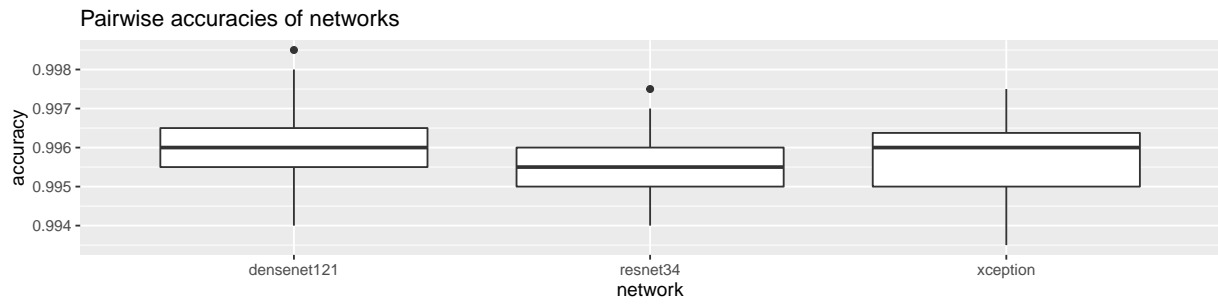


## Classes 1 vs 6

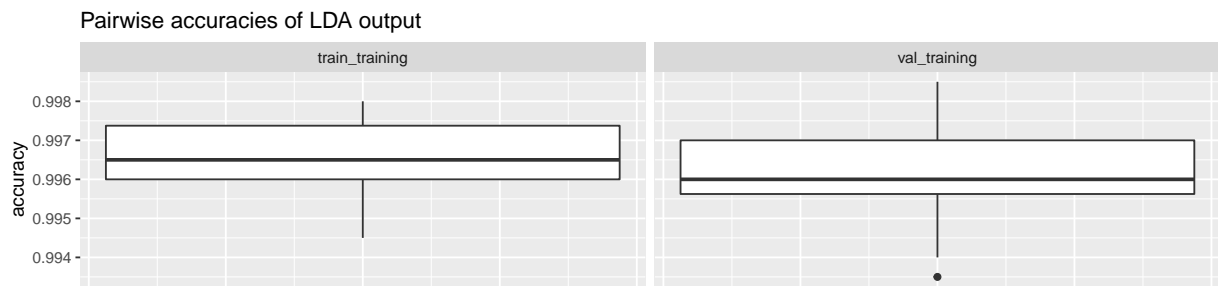
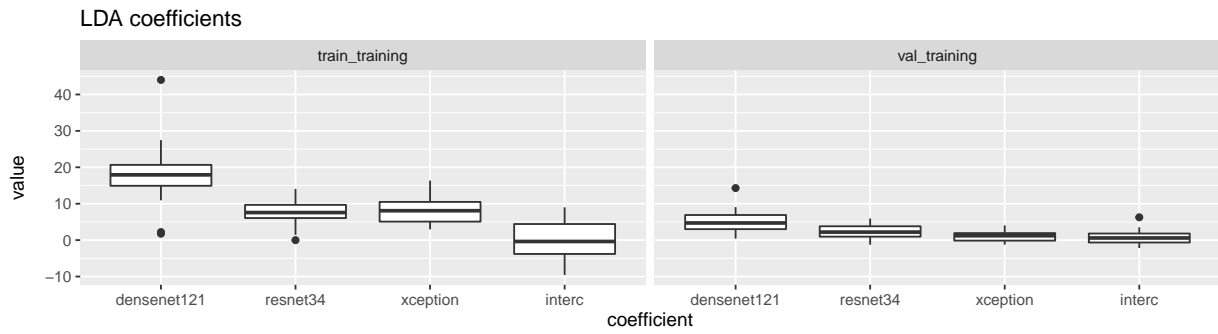
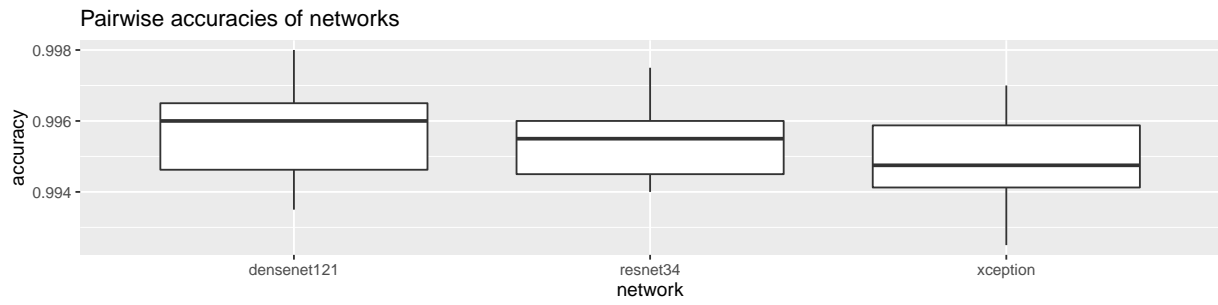




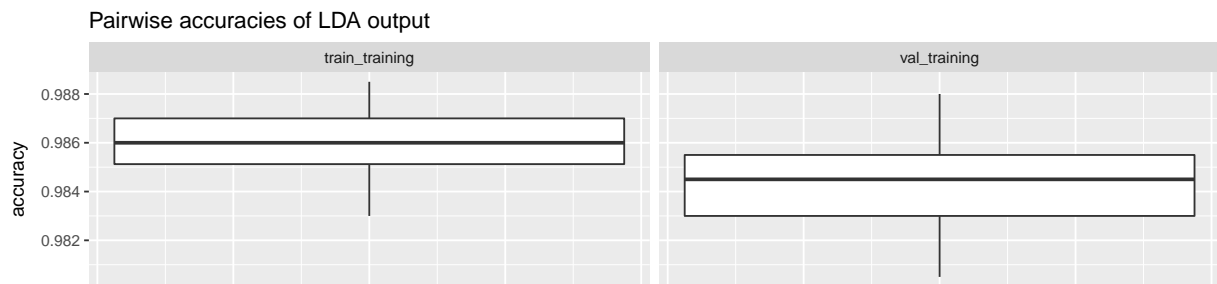
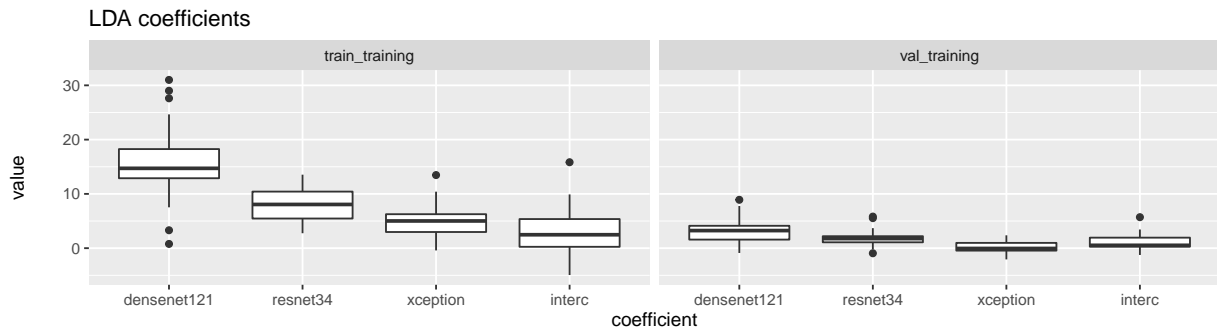
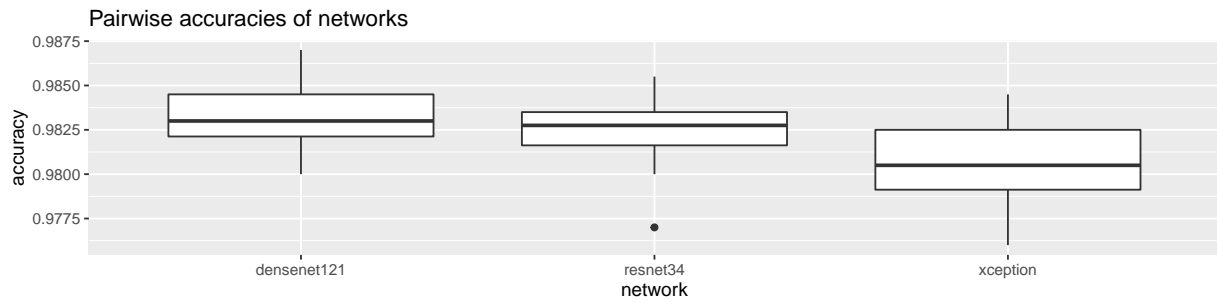
## Classes 1 vs 7



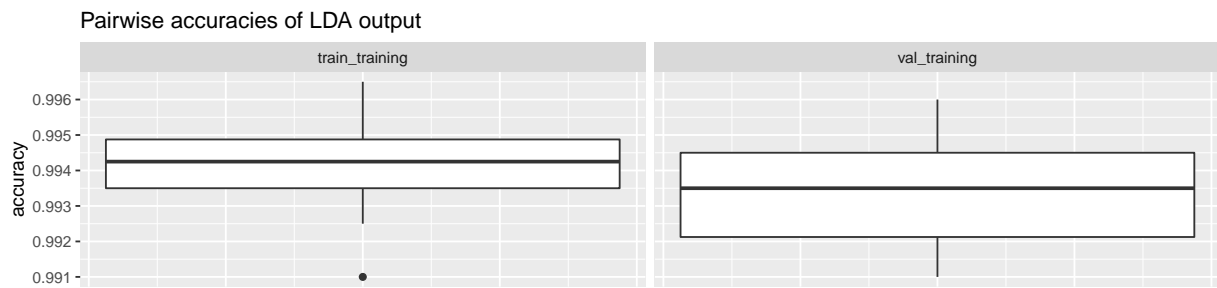
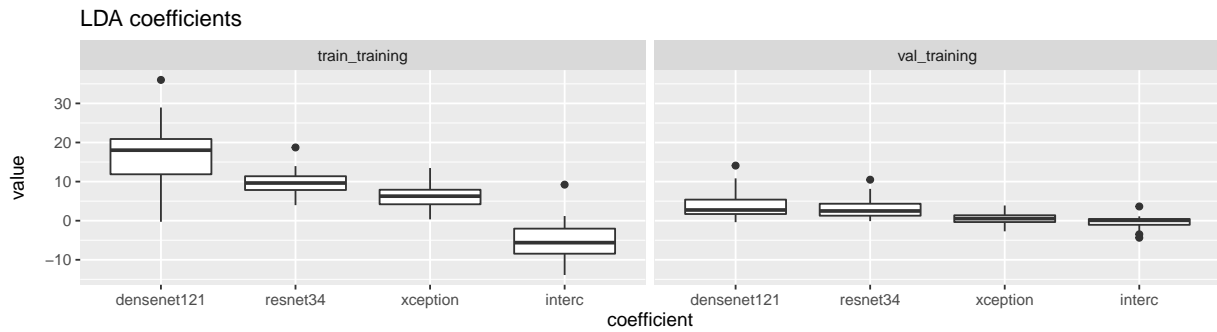
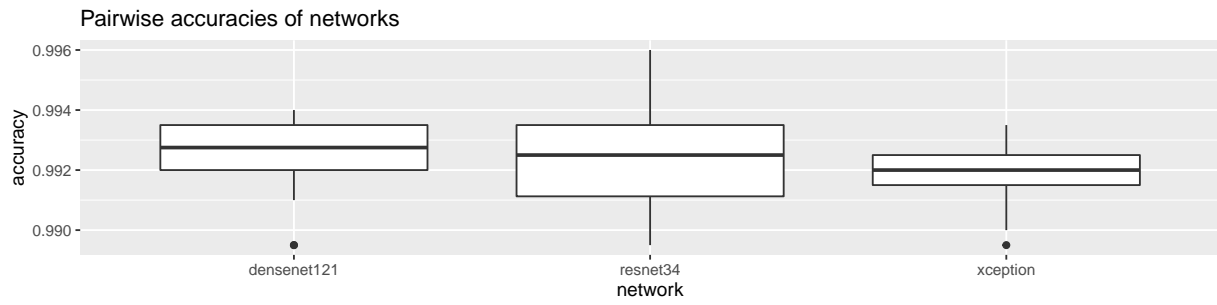
## Classes 1 vs 8



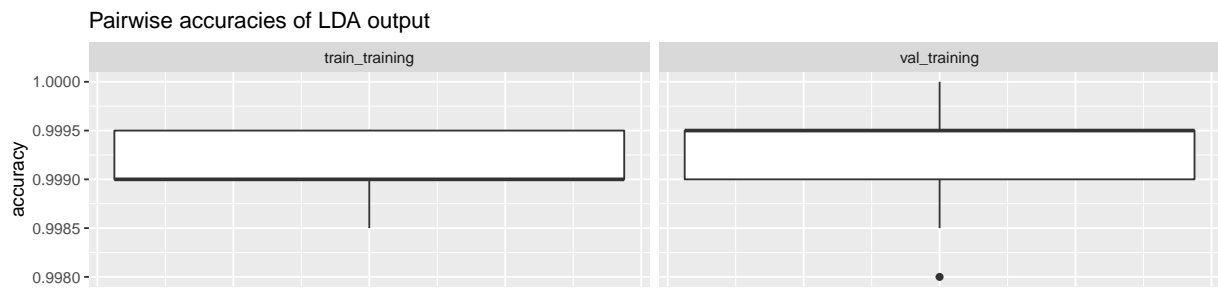
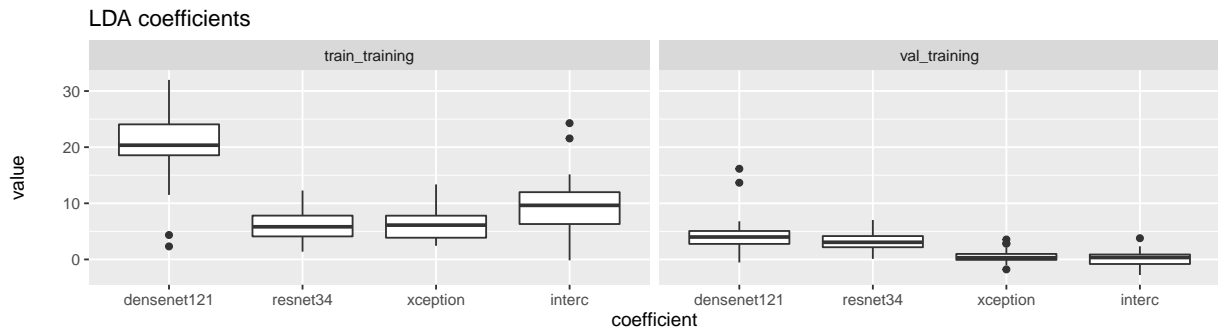
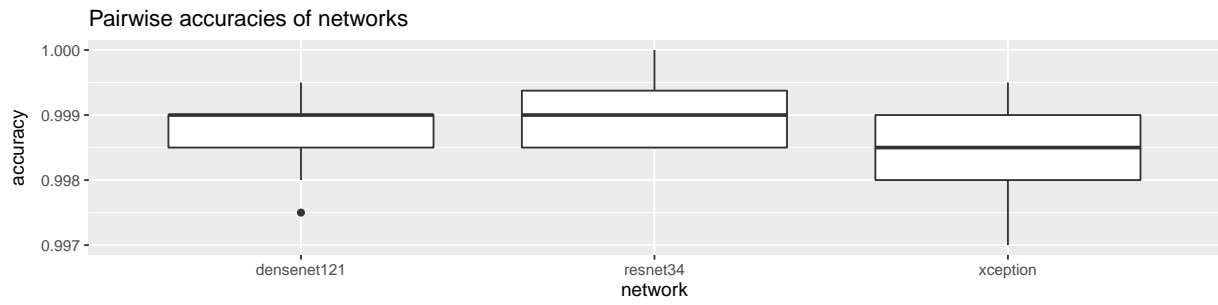
## Classes 1 vs 9



## Classes 1 vs 10

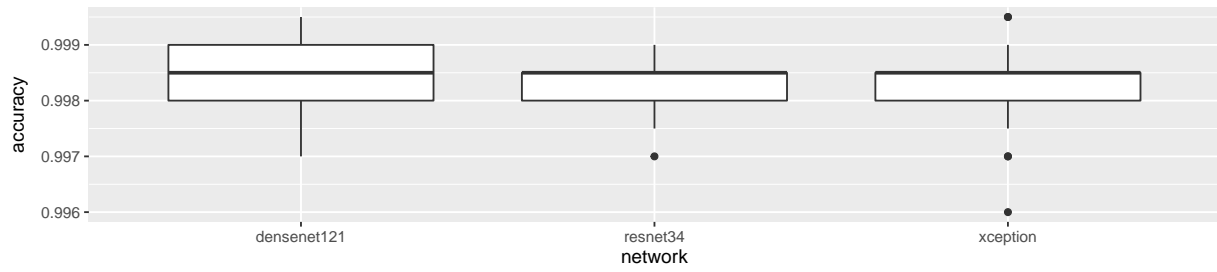


## Classes 2 vs 3

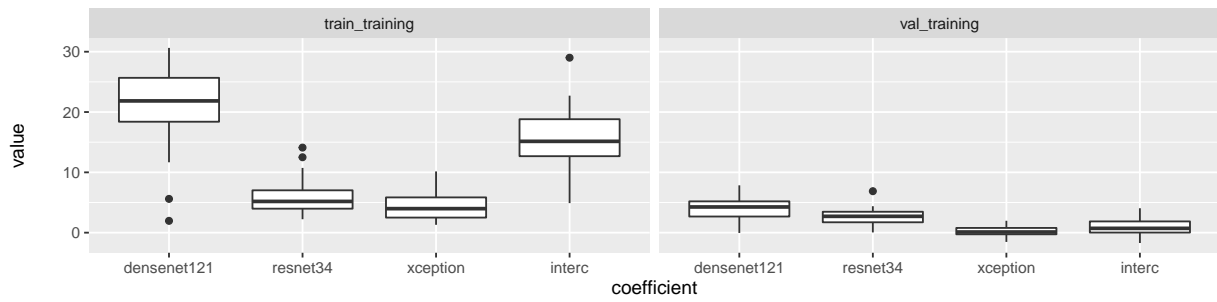


## Classes 2 vs 4

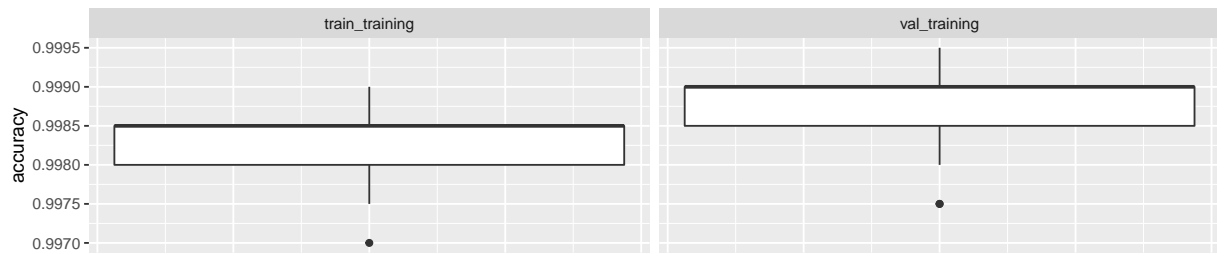
Pairwise accuracies of networks



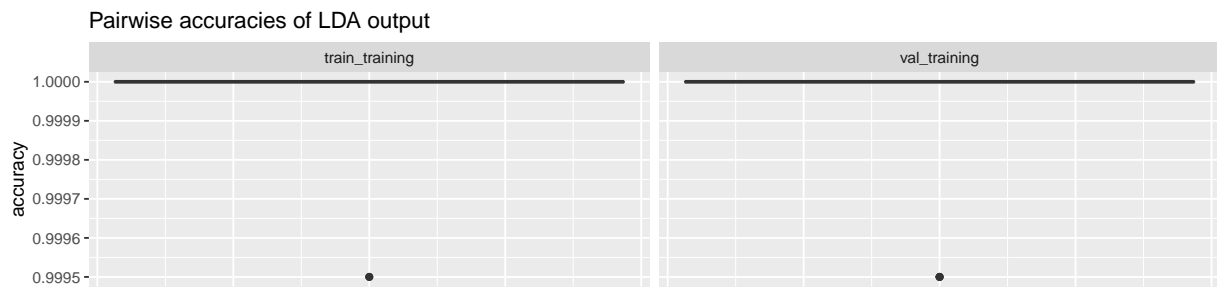
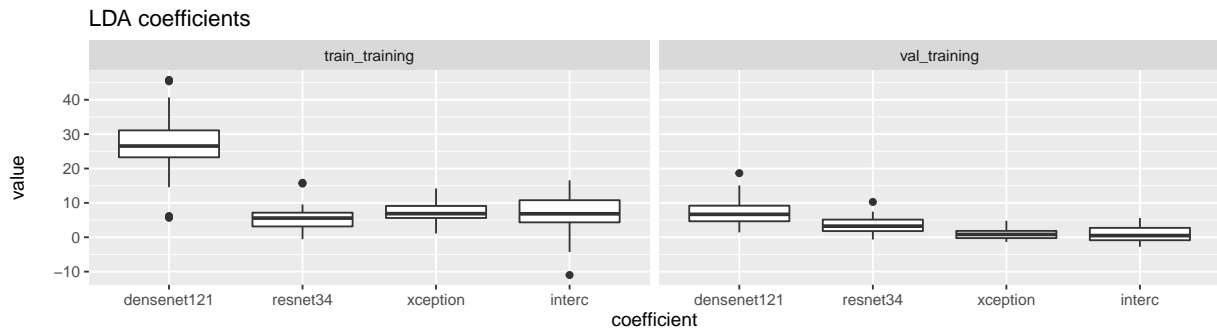
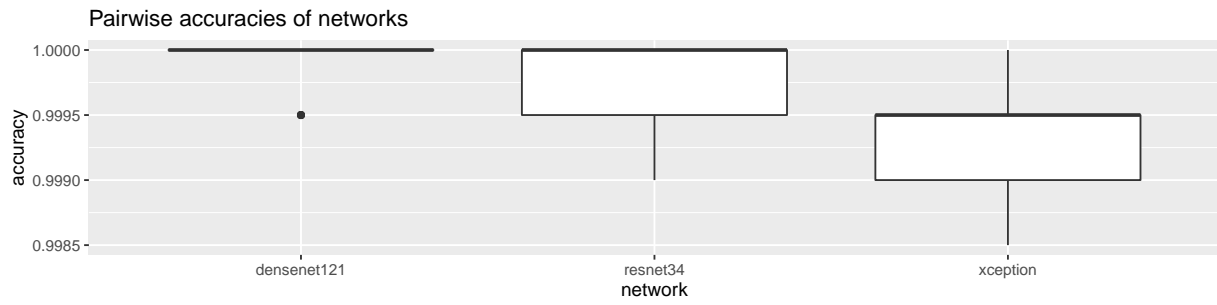
LDA coefficients



Pairwise accuracies of LDA output

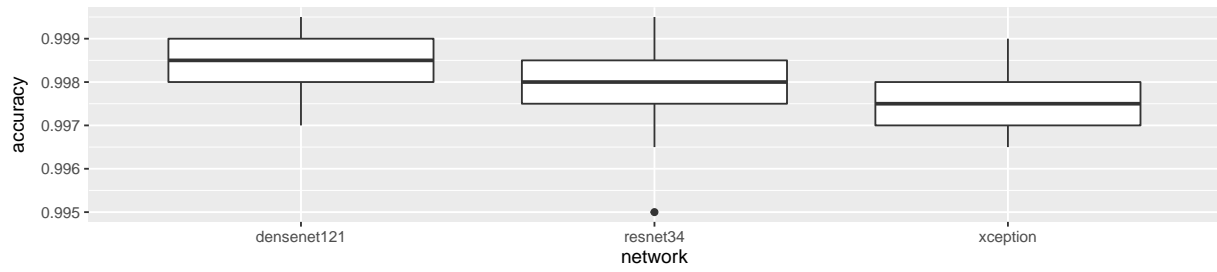


## Classes 2 vs 5

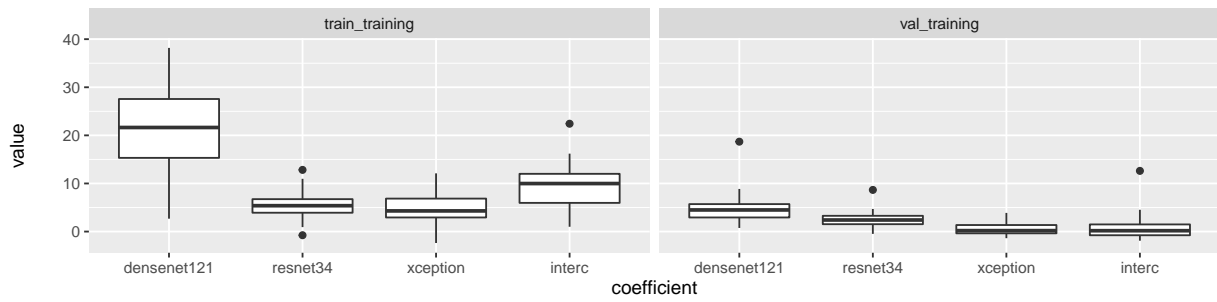


## Classes 2 vs 6

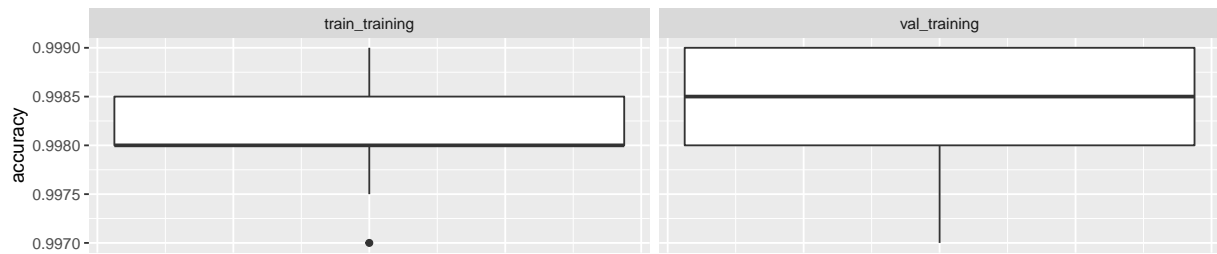
Pairwise accuracies of networks



LDA coefficients

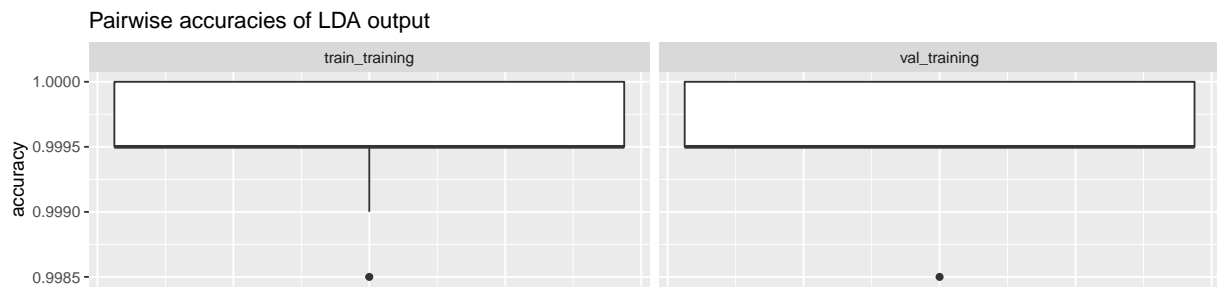
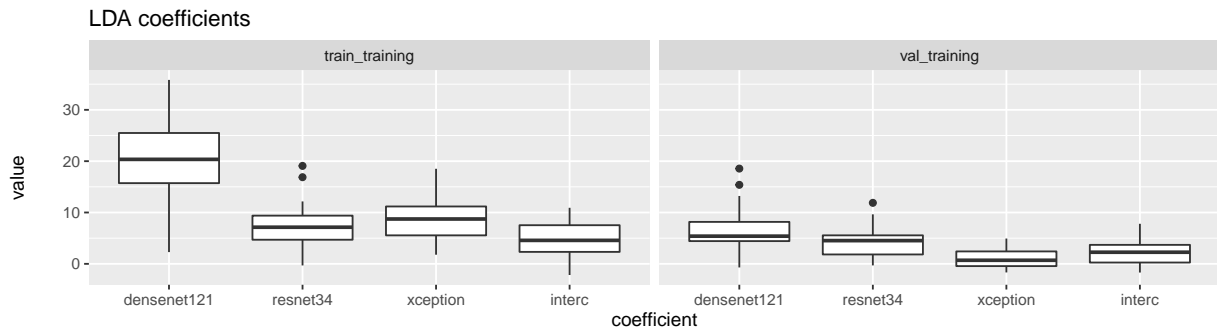
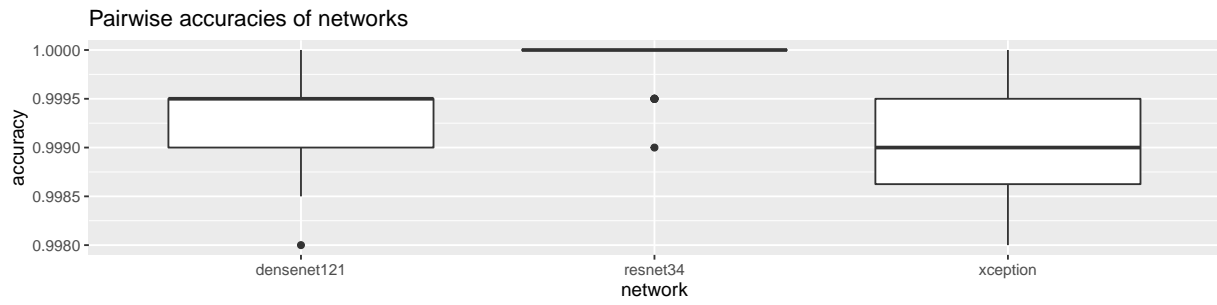


Pairwise accuracies of LDA output

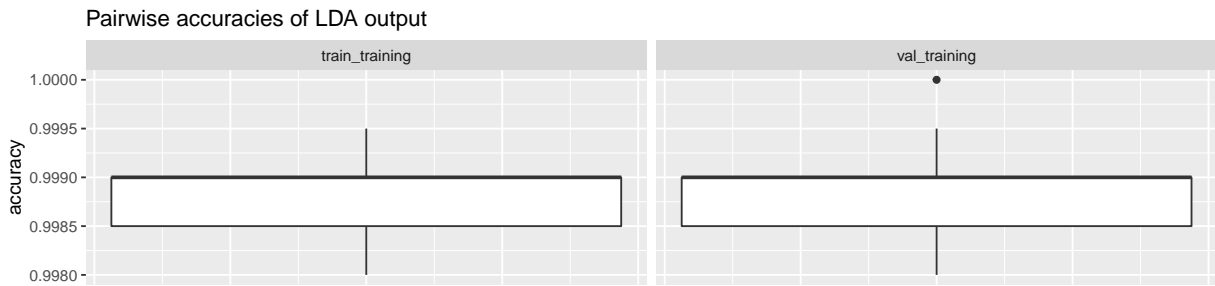
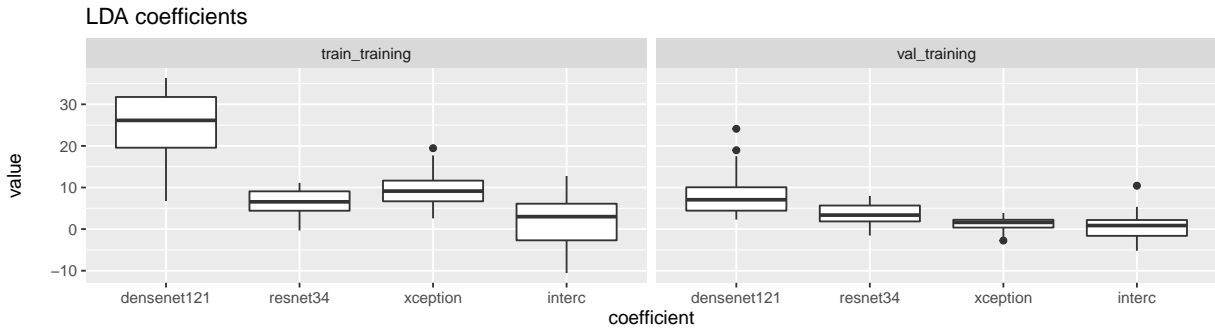
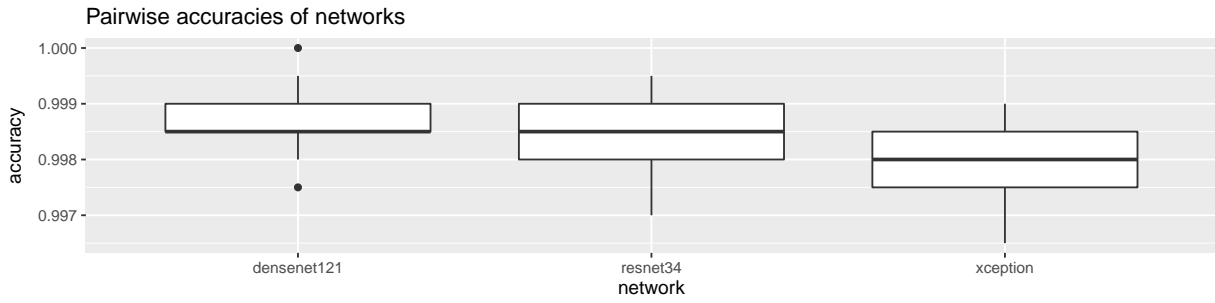




## Classes 2 vs 7

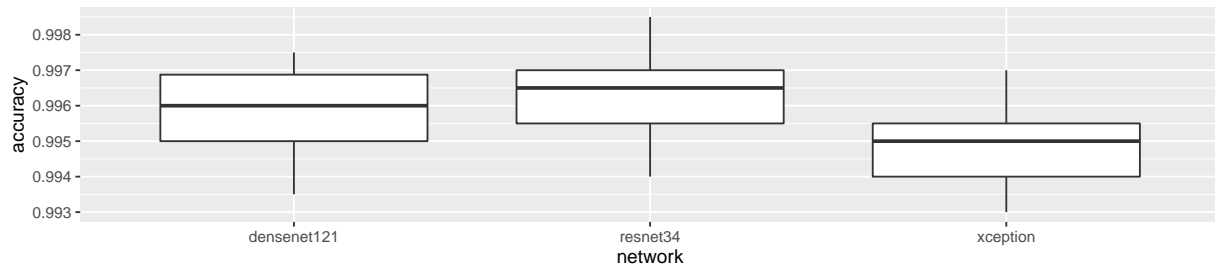


## Classes 2 vs 8

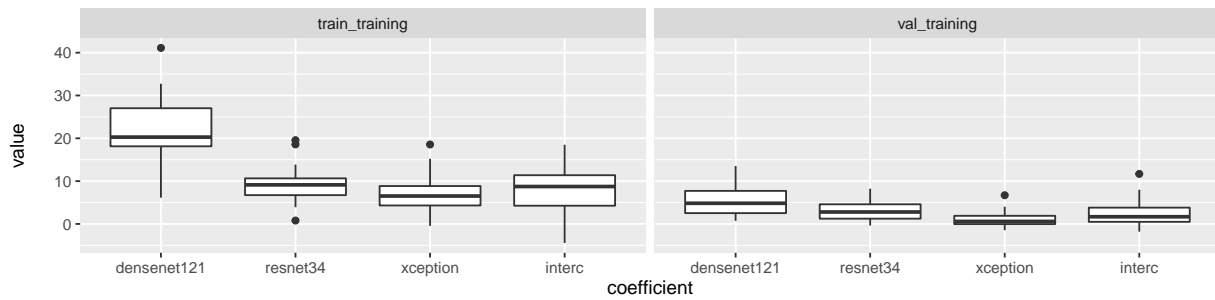


## Classes 2 vs 9

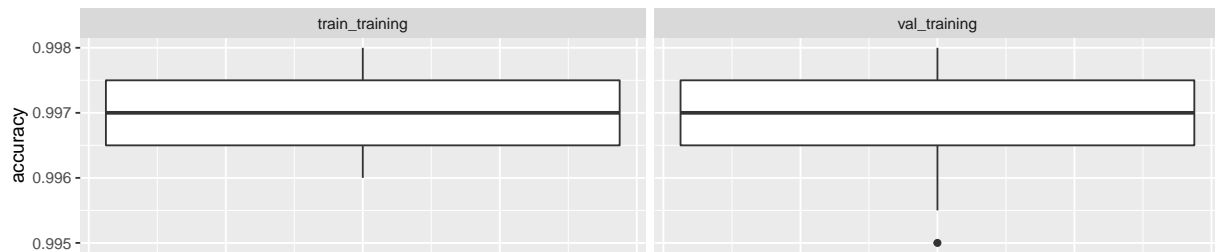
Pairwise accuracies of networks



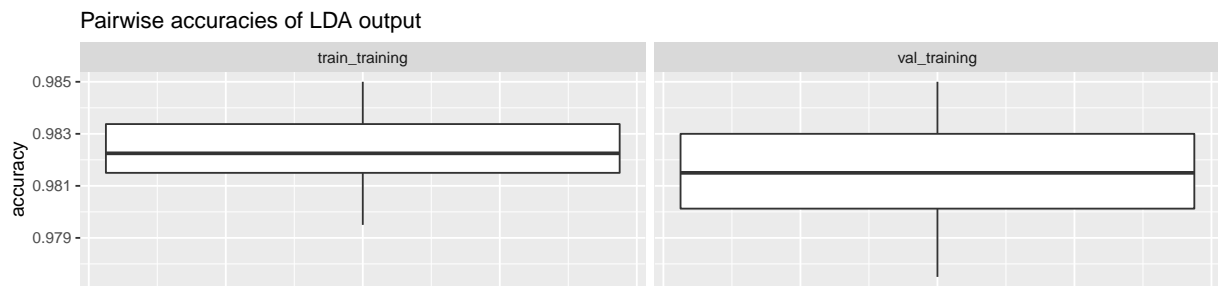
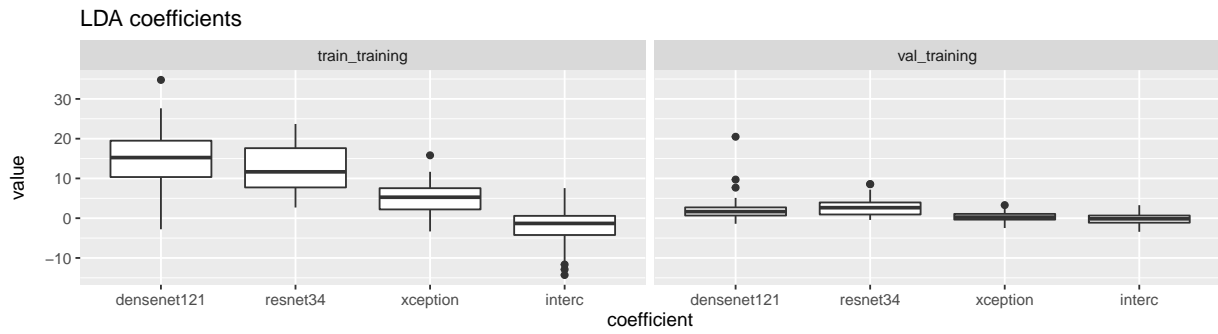
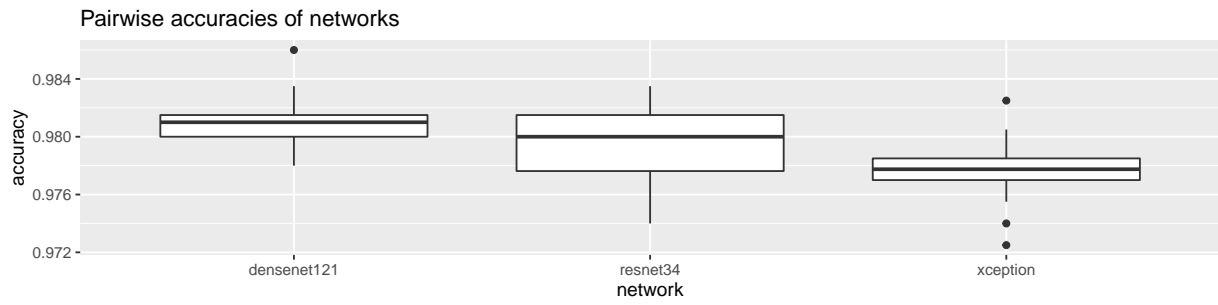
LDA coefficients



Pairwise accuracies of LDA output

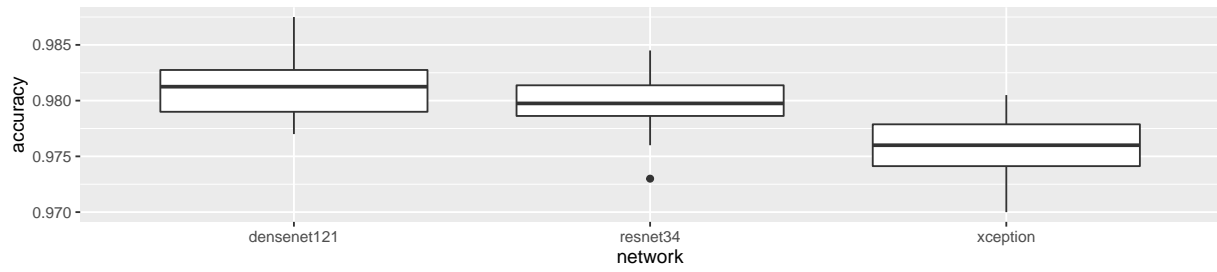


## Classes 2 vs 10

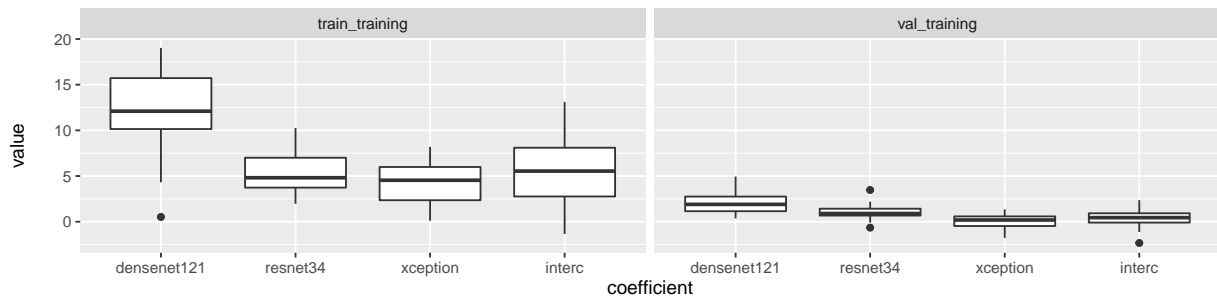


## Classes 3 vs 4

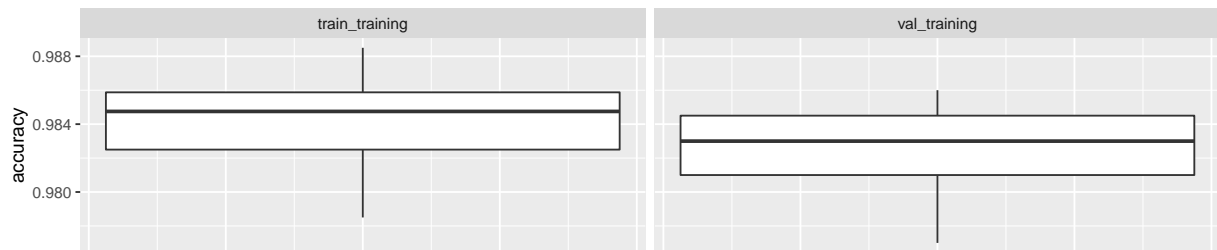
Pairwise accuracies of networks



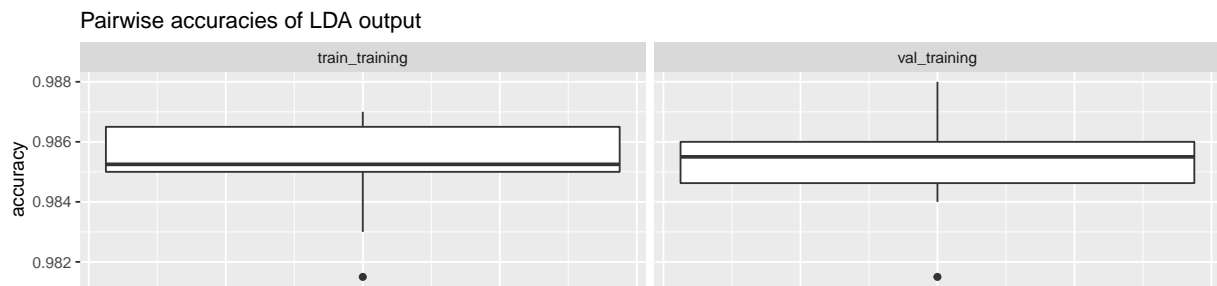
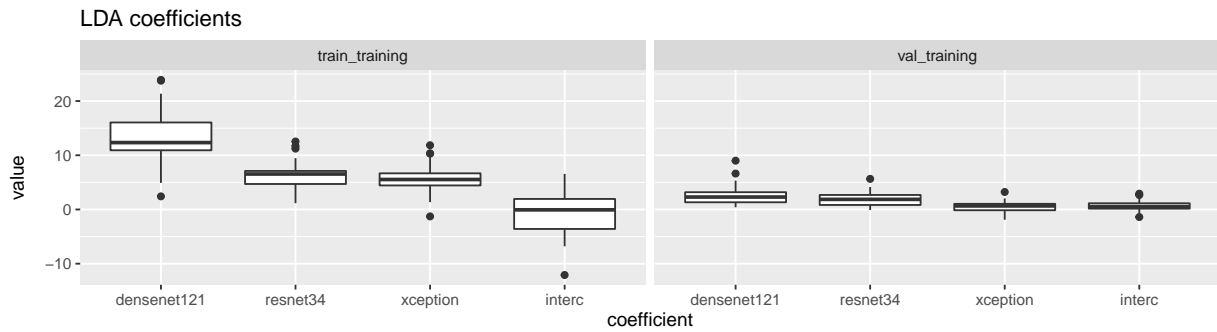
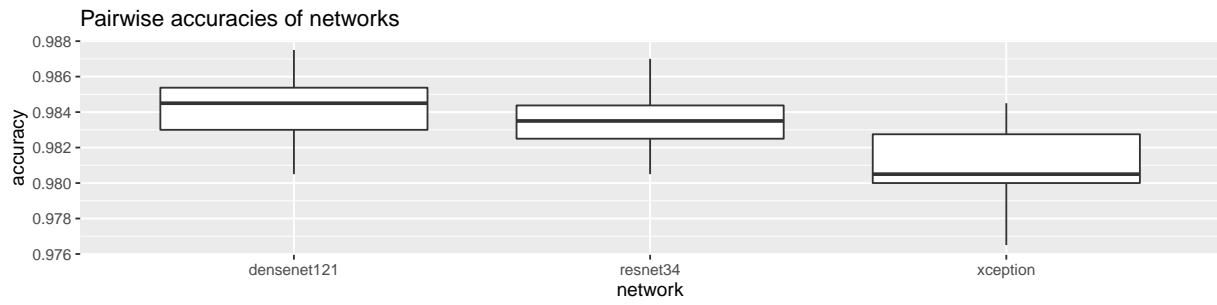
LDA coefficients



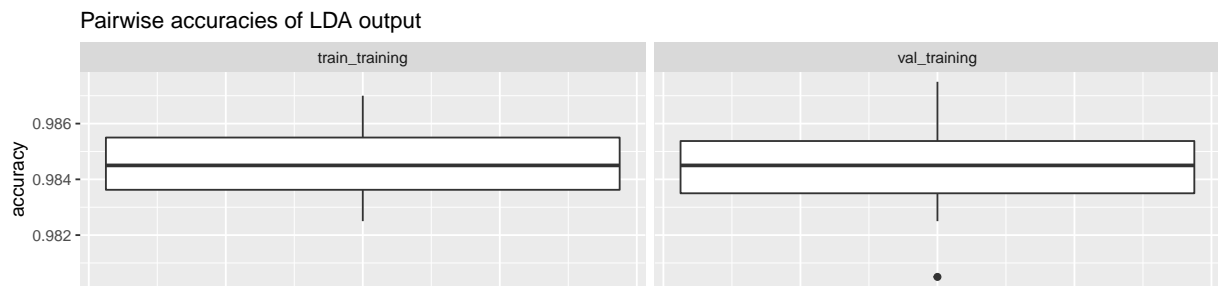
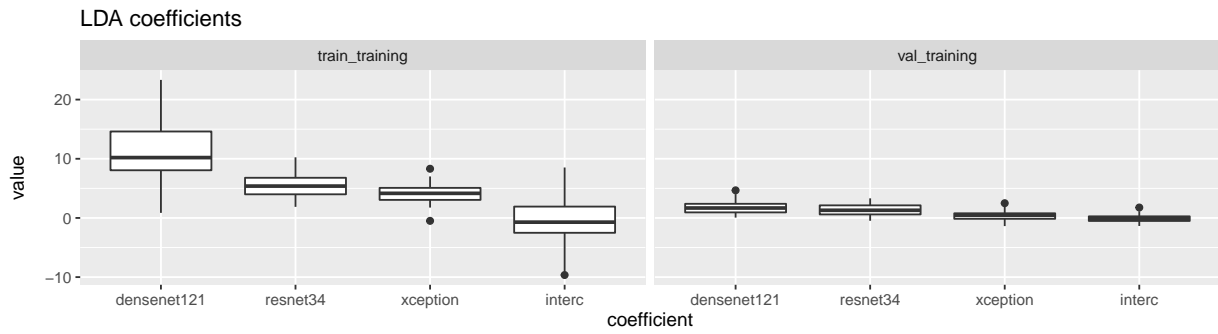
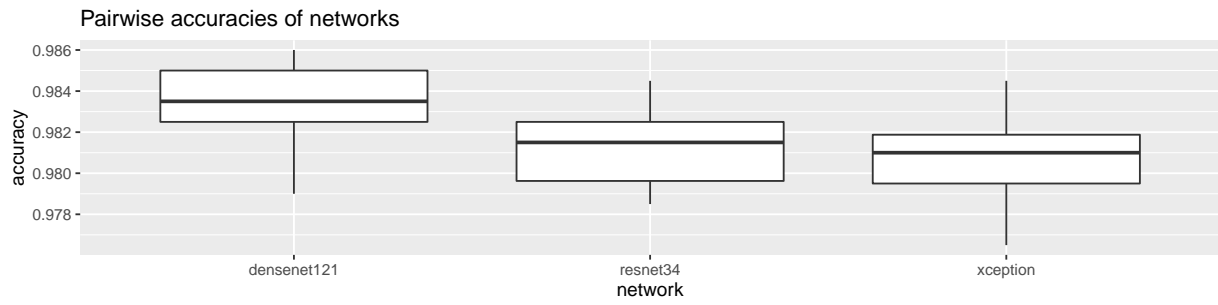
Pairwise accuracies of LDA output



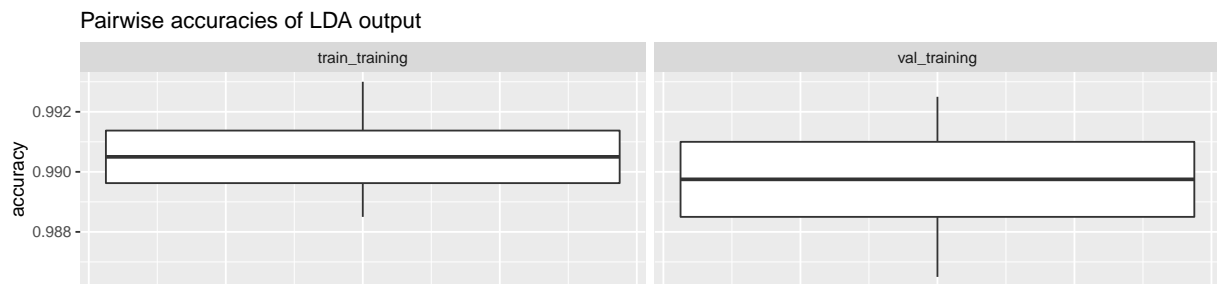
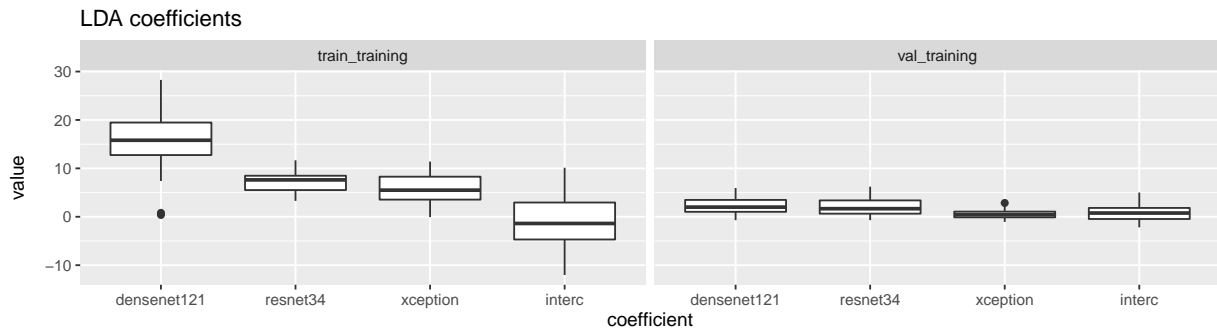
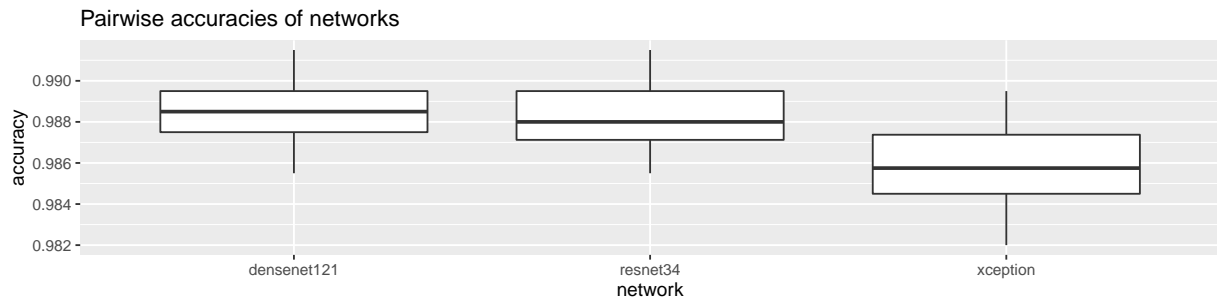
## Classes 3 vs 5



## Classes 3 vs 6

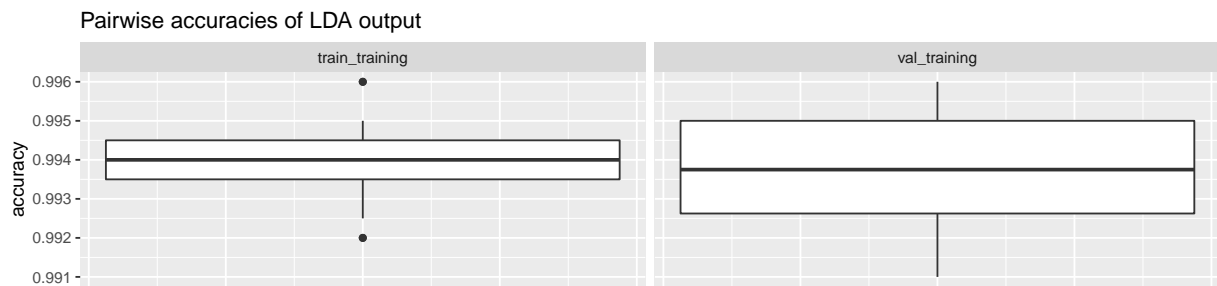
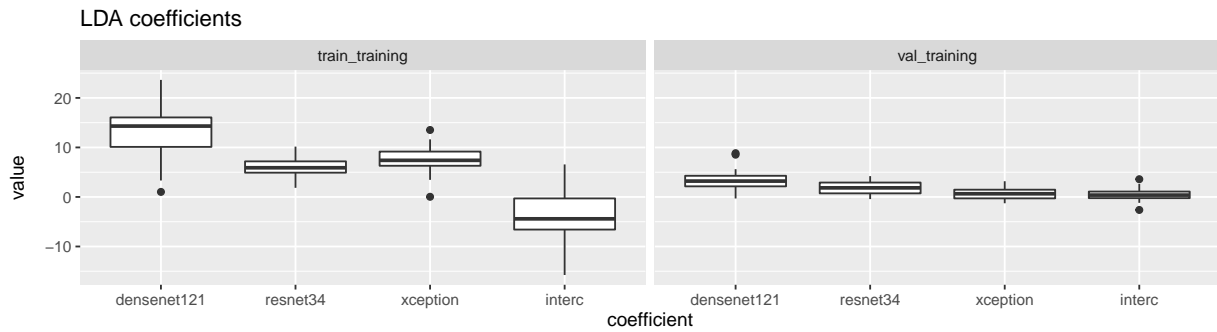
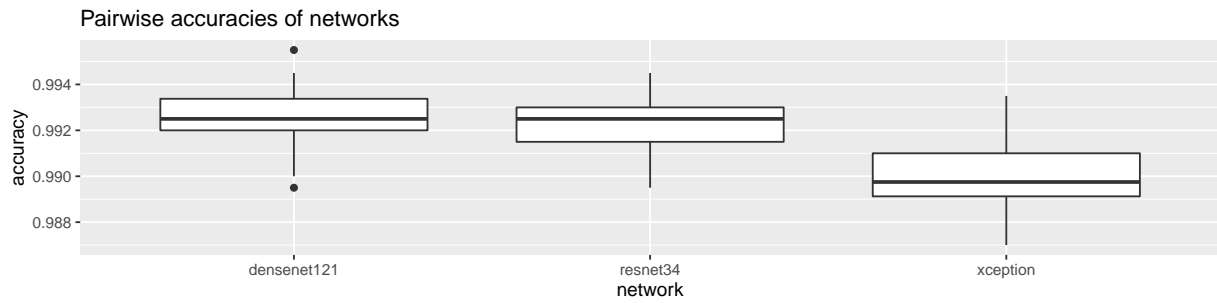


## Classes 3 vs 7

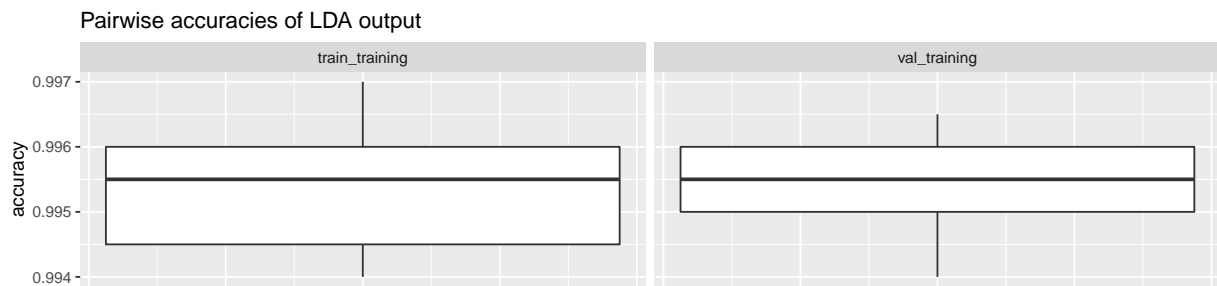
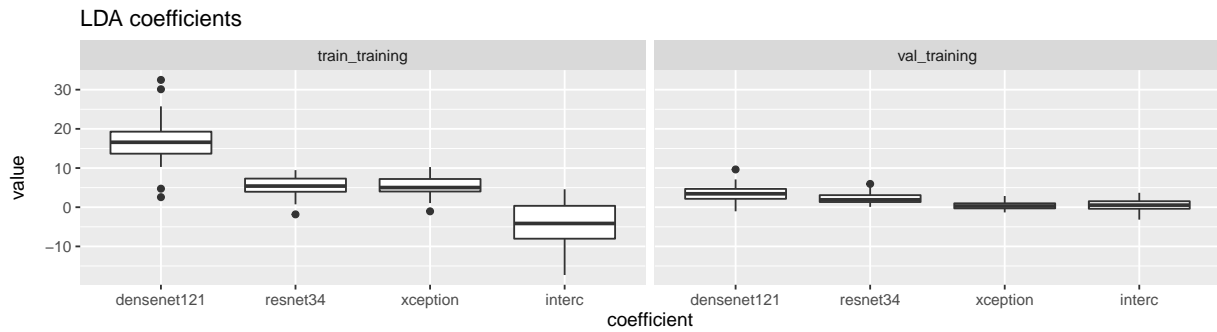
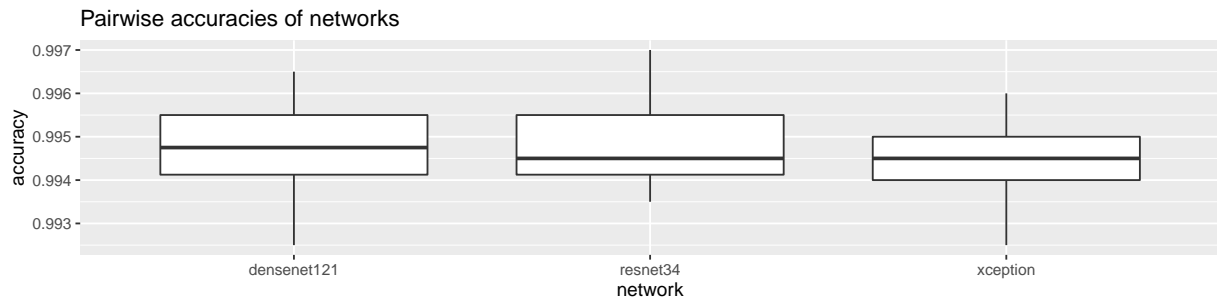




## Classes 3 vs 8

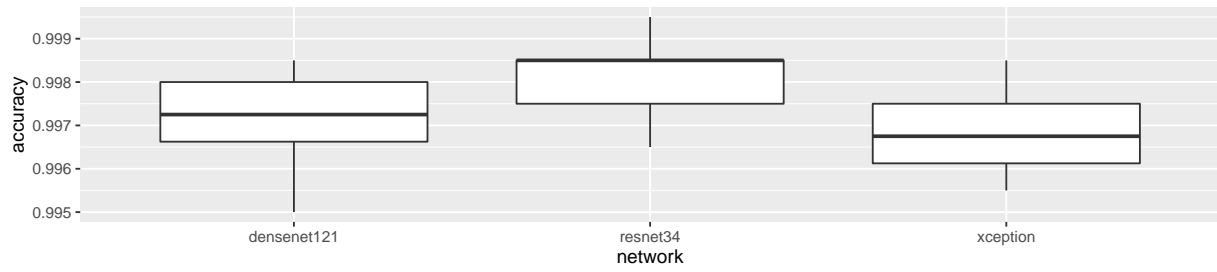


## Classes 3 vs 9

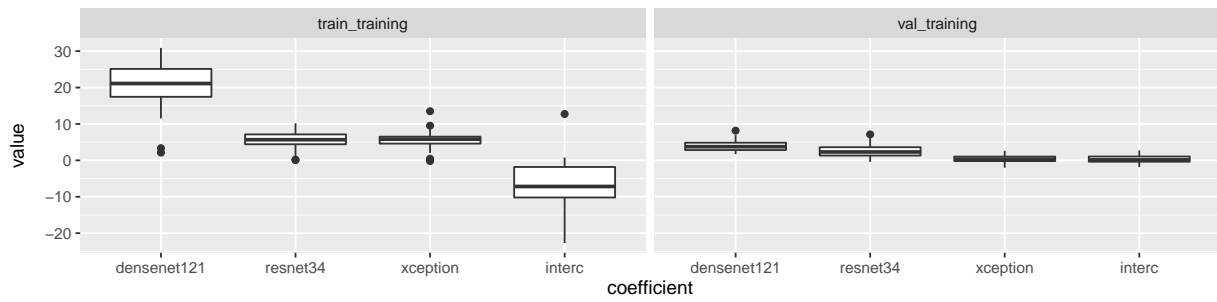


## Classes 3 vs 10

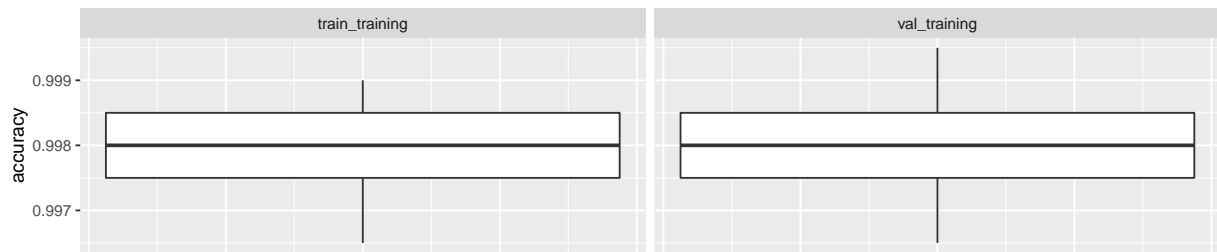
Pairwise accuracies of networks



LDA coefficients

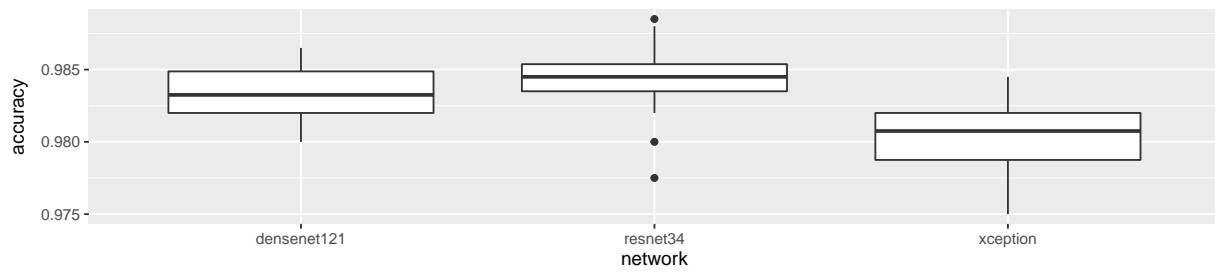


Pairwise accuracies of LDA output

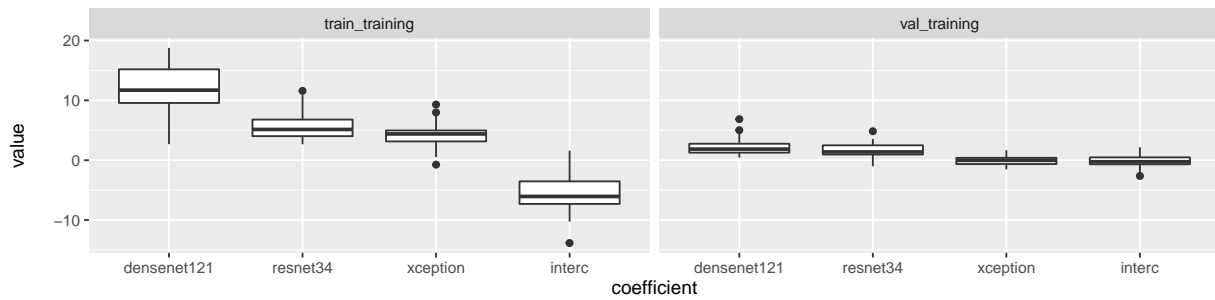


## Classes 4 vs 5

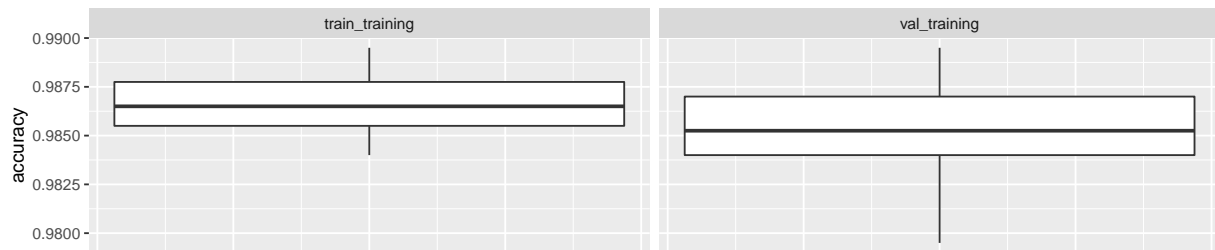
Pairwise accuracies of networks



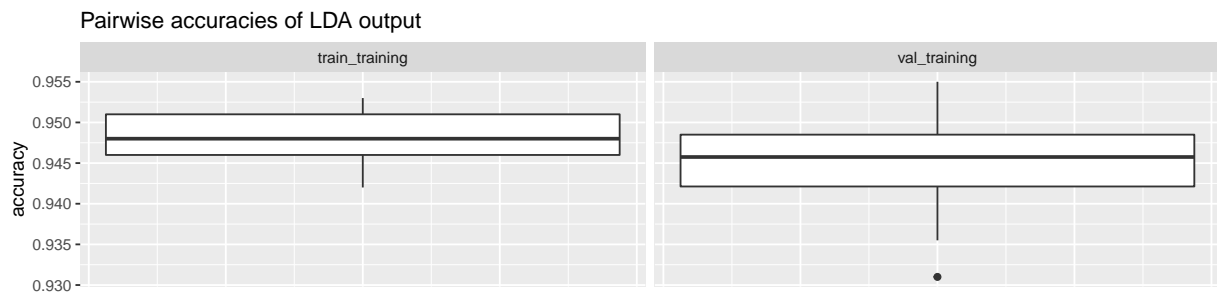
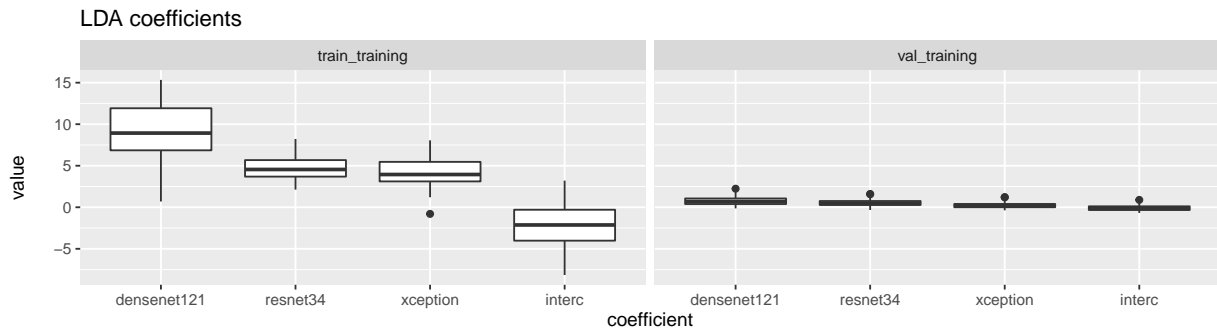
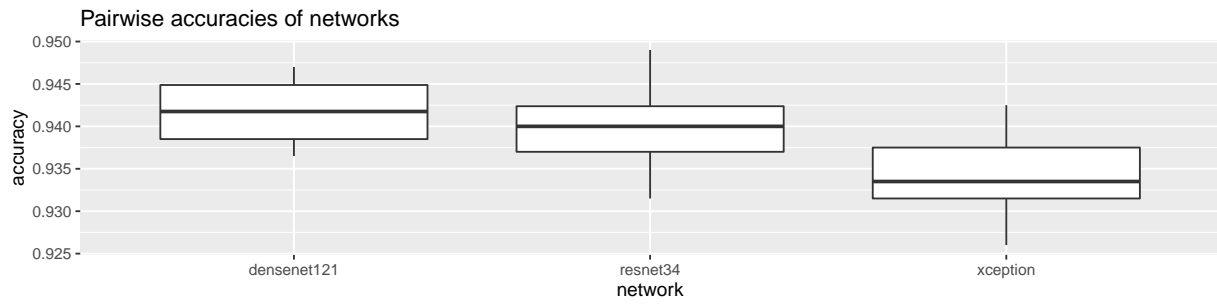
LDA coefficients



Pairwise accuracies of LDA output

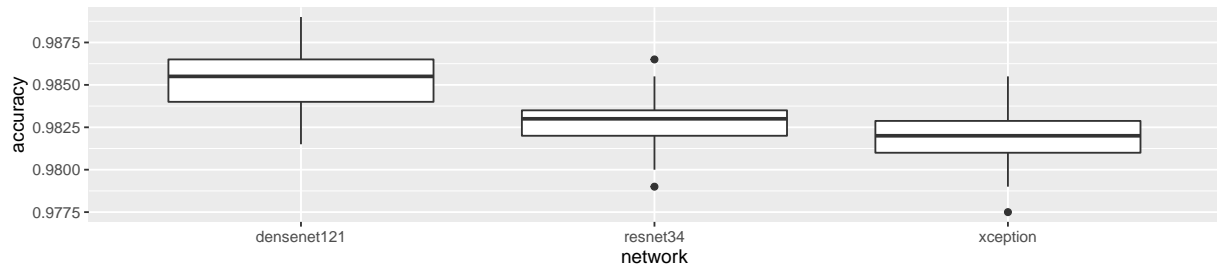


## Classes 4 vs 6

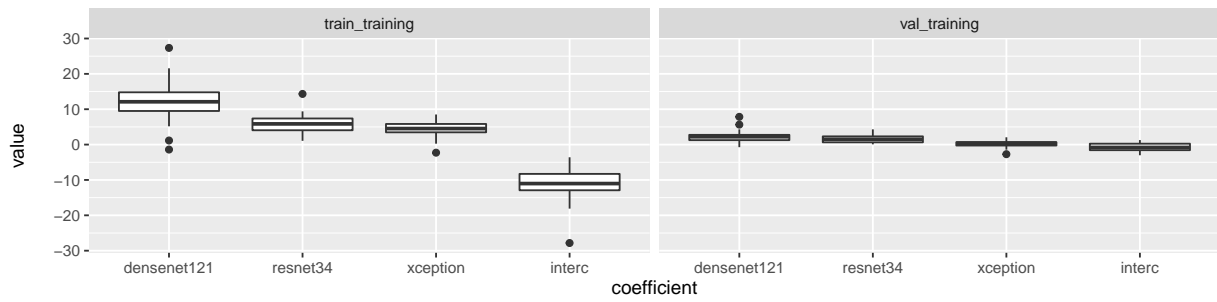


## Classes 4 vs 7

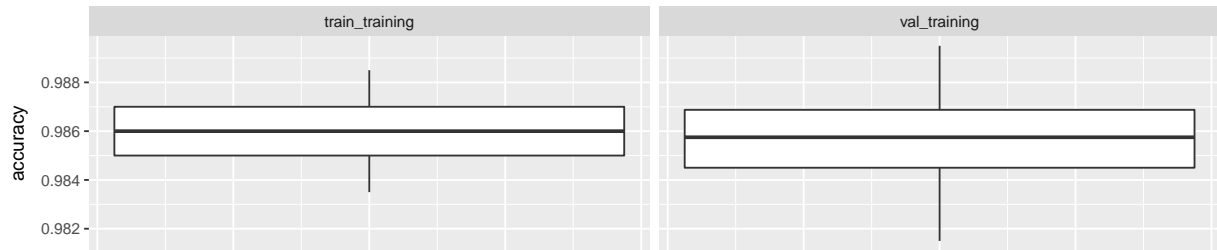
Pairwise accuracies of networks



LDA coefficients

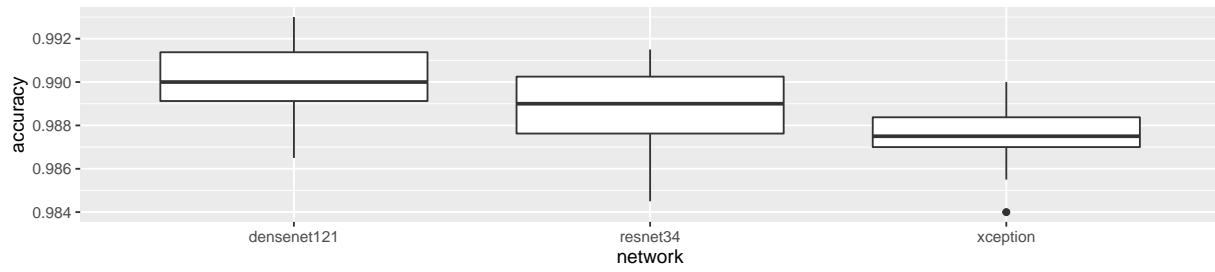


Pairwise accuracies of LDA output

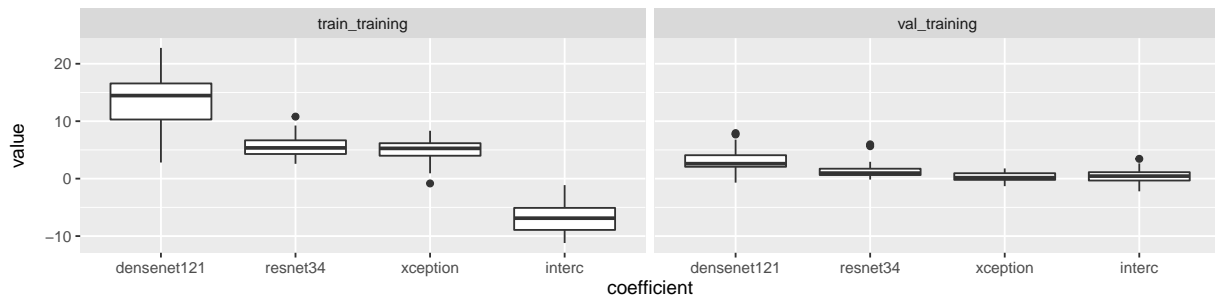


## Classes 4 vs 8

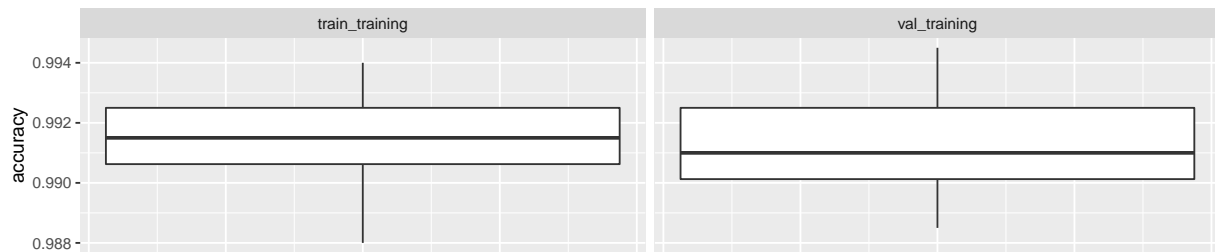
Pairwise accuracies of networks



LDA coefficients

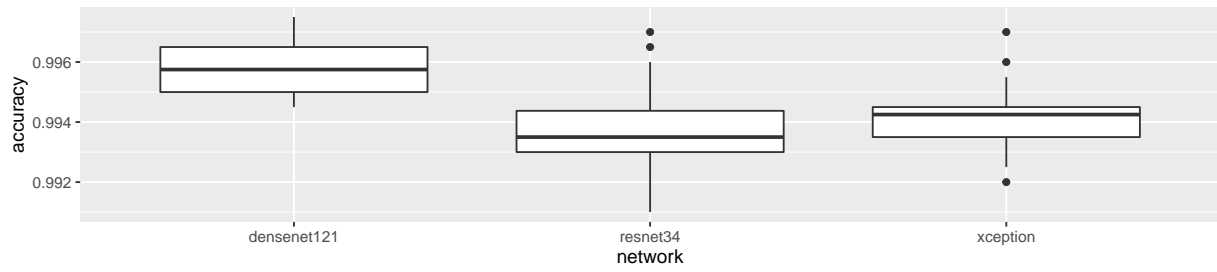


Pairwise accuracies of LDA output

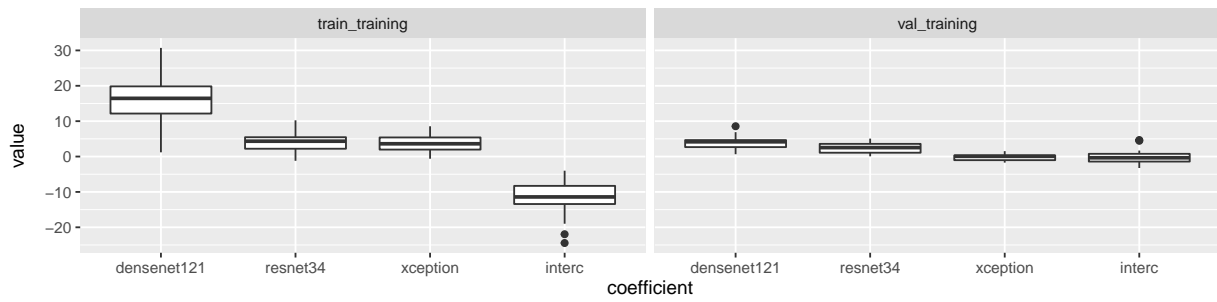


## Classes 4 vs 9

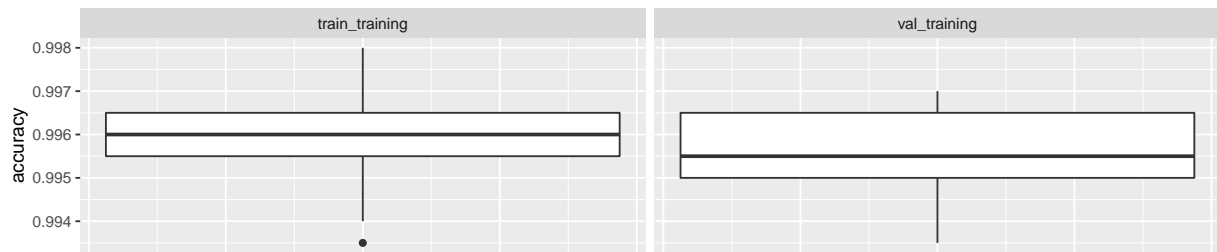
Pairwise accuracies of networks



LDA coefficients



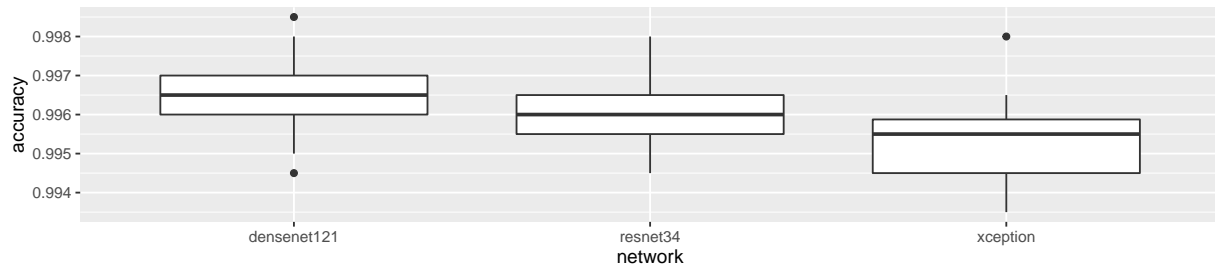
Pairwise accuracies of LDA output



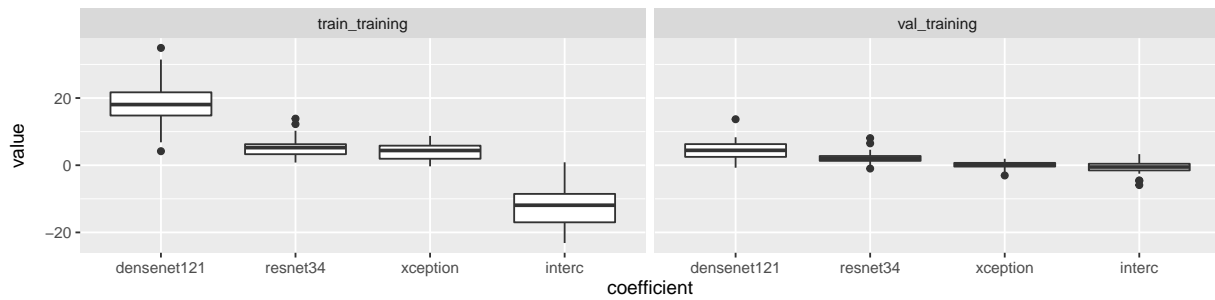


## Classes 4 vs 10

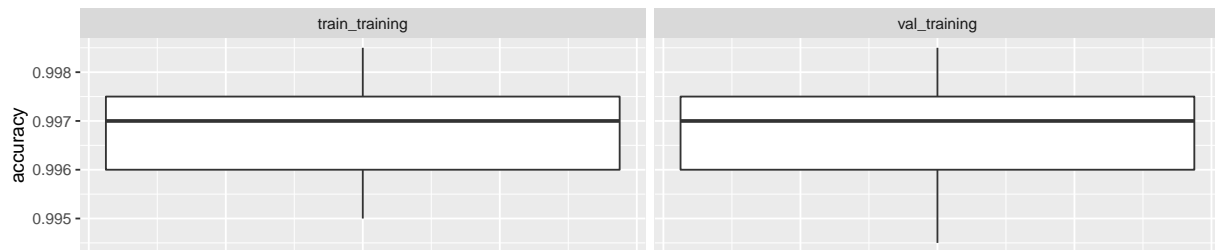
Pairwise accuracies of networks



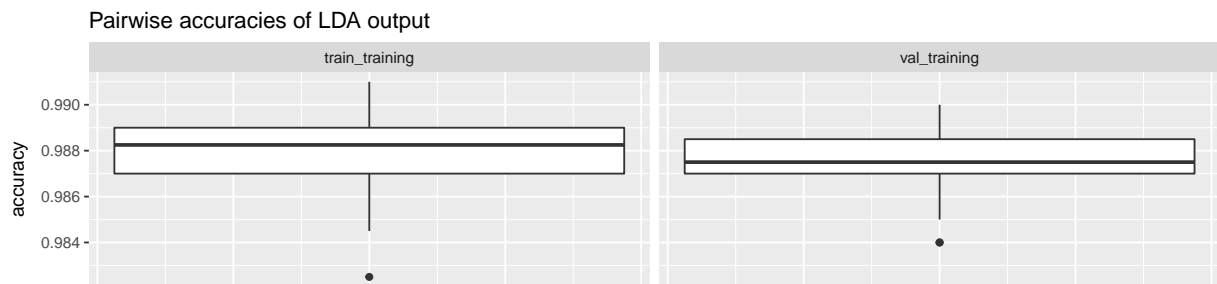
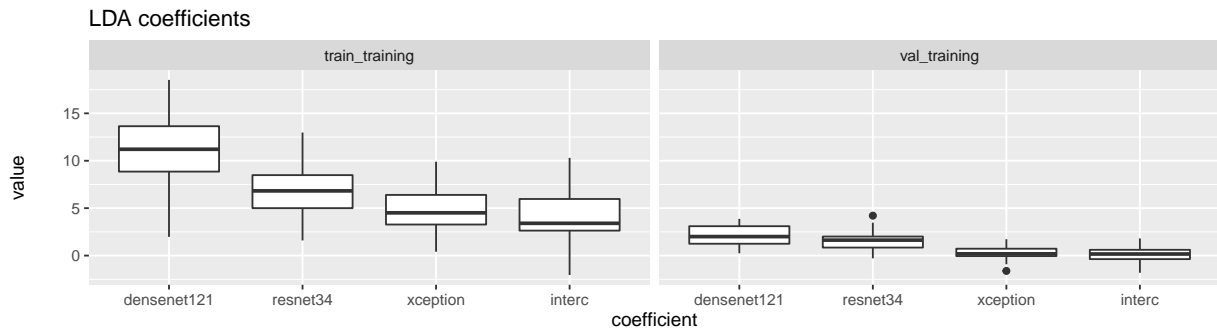
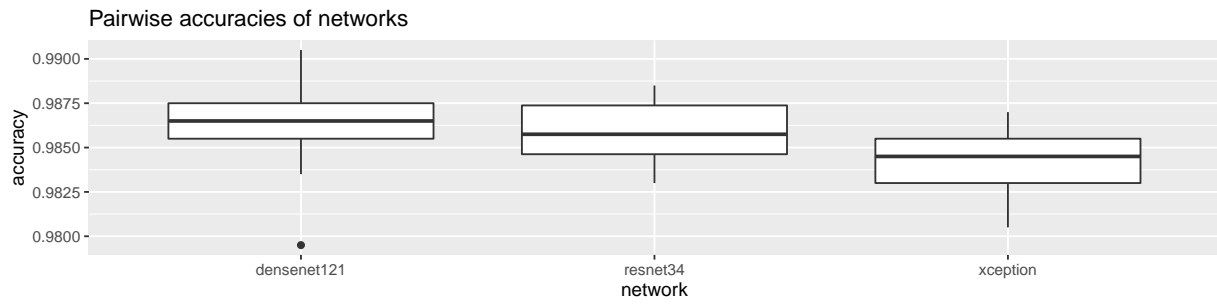
LDA coefficients



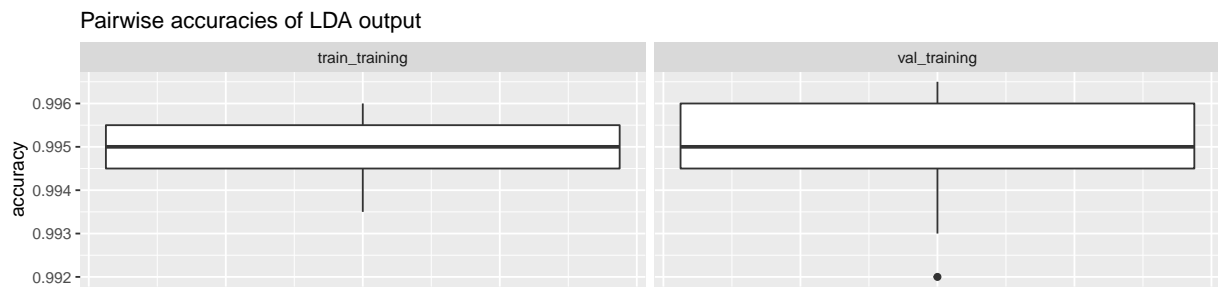
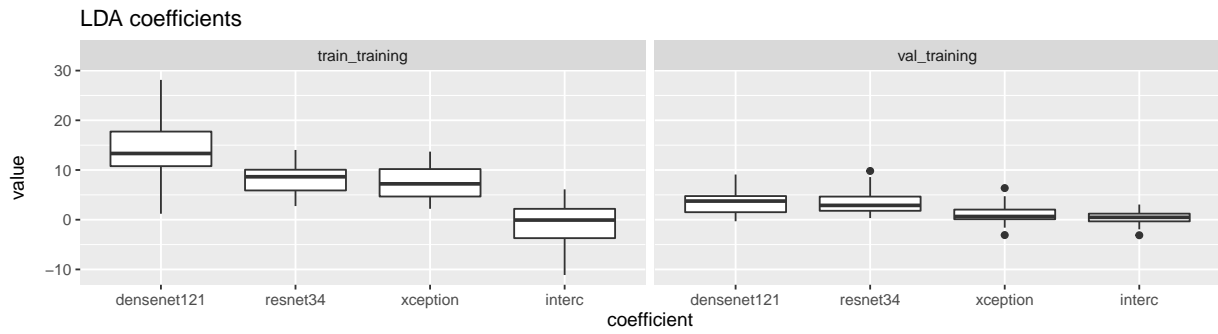
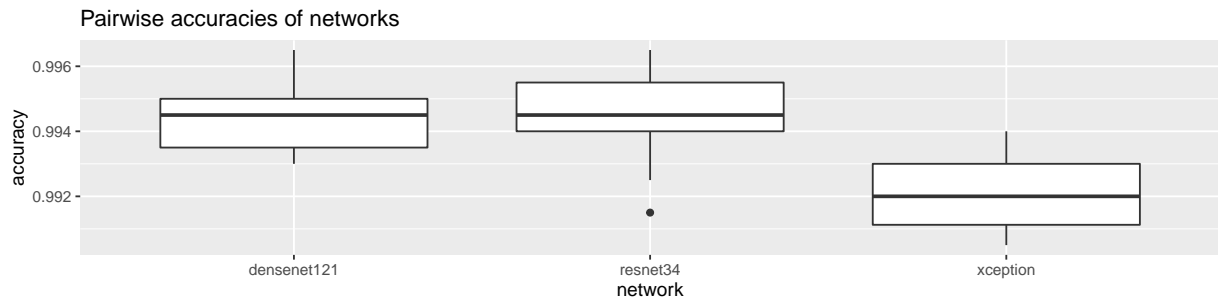
Pairwise accuracies of LDA output



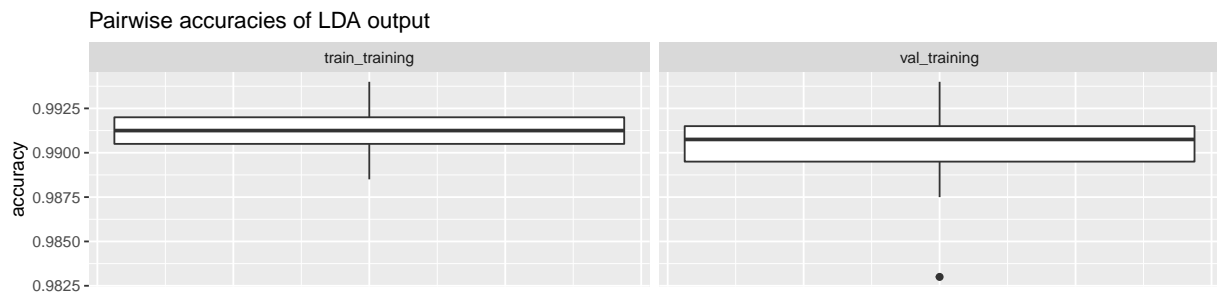
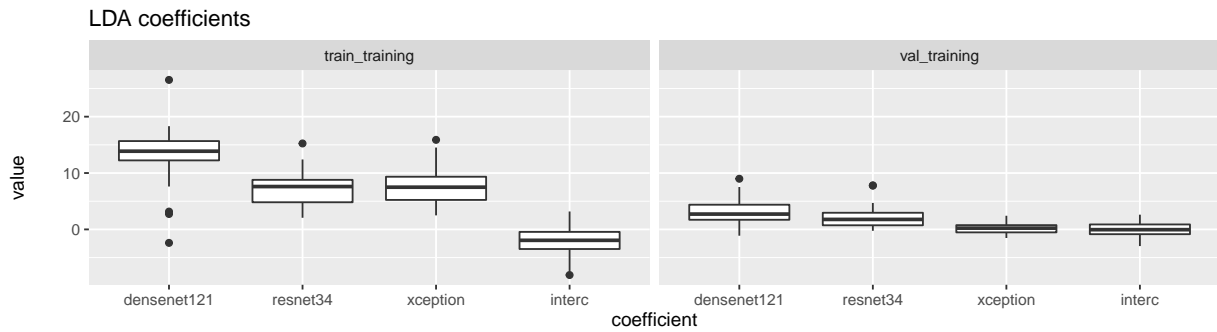
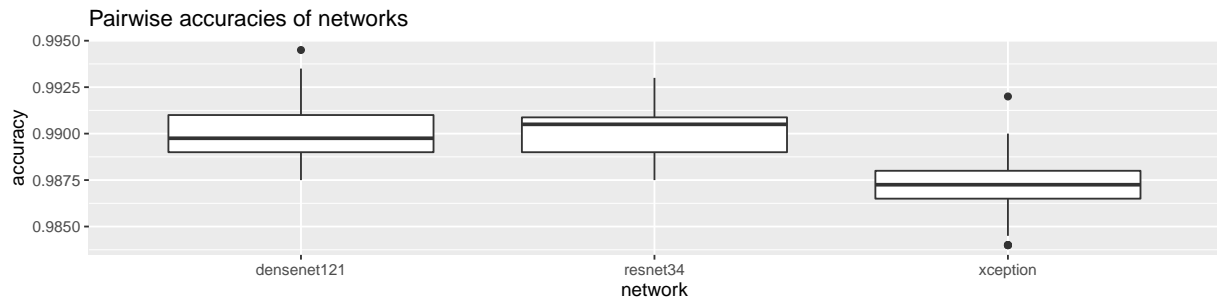
## Classes 5 vs 6



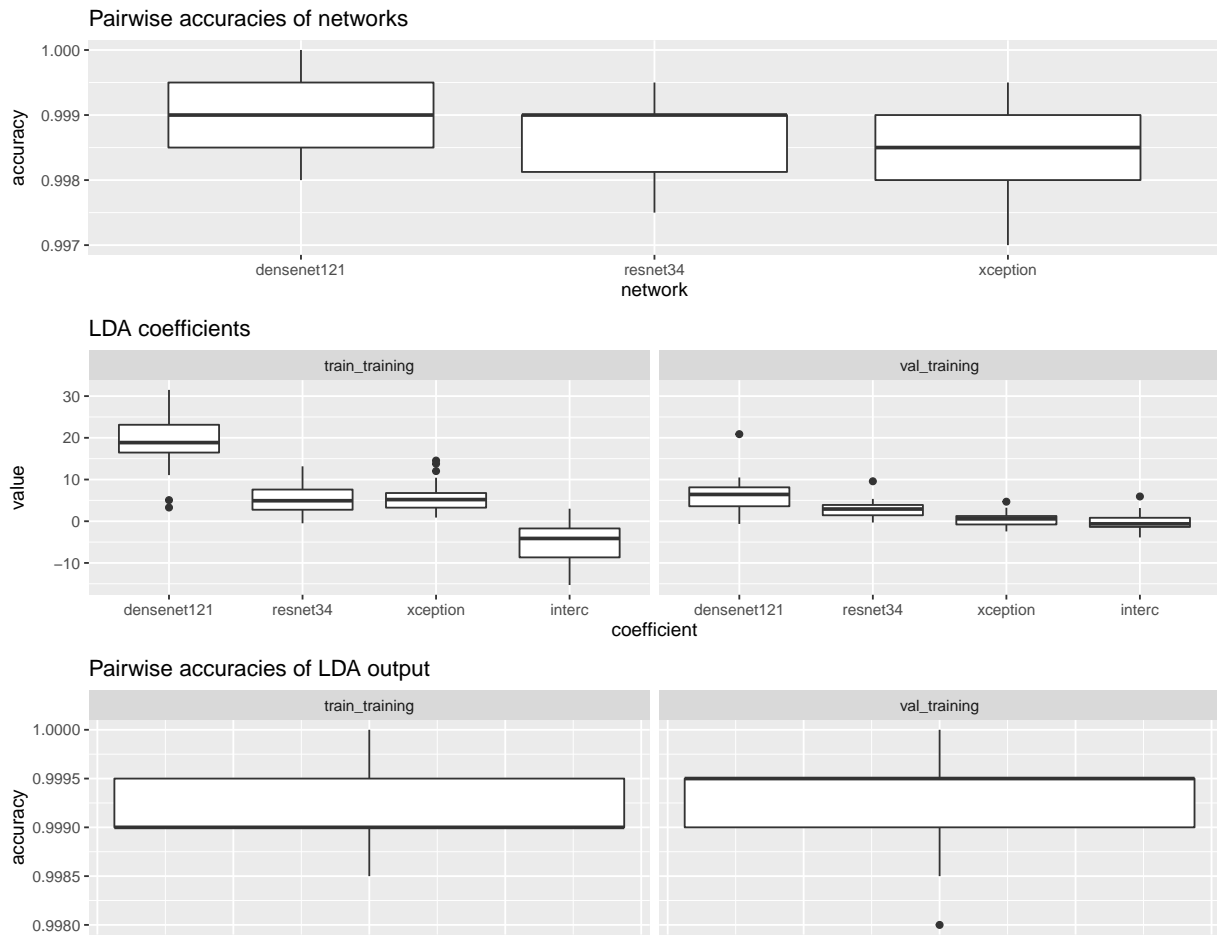
## Classes 5 vs 7



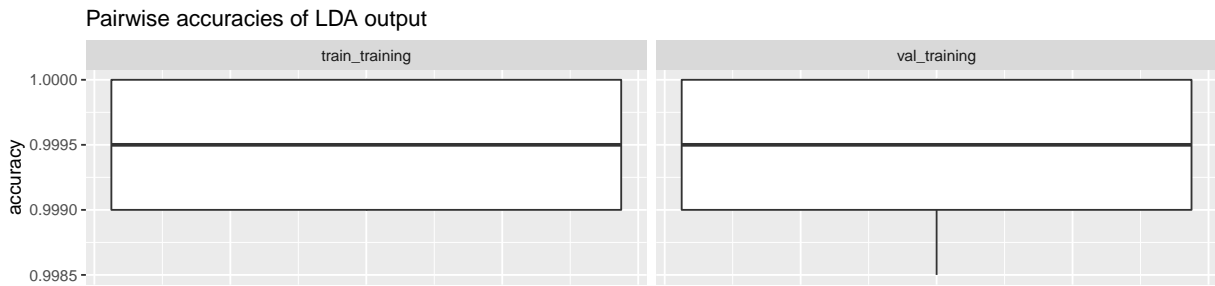
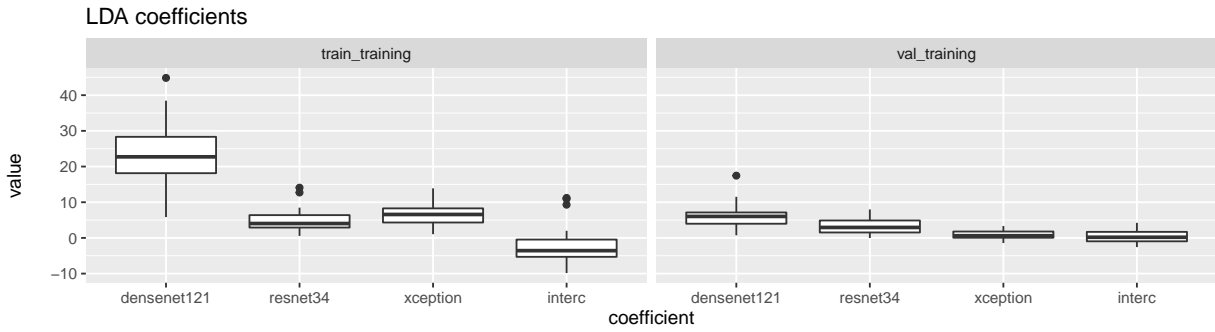
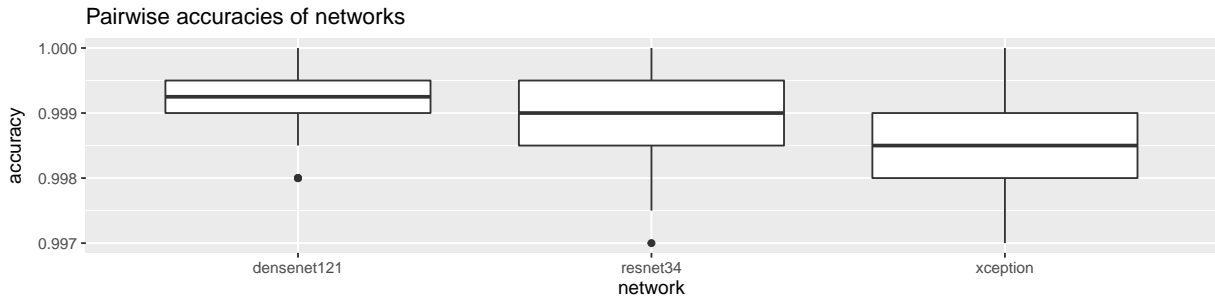
## Classes 5 vs 8



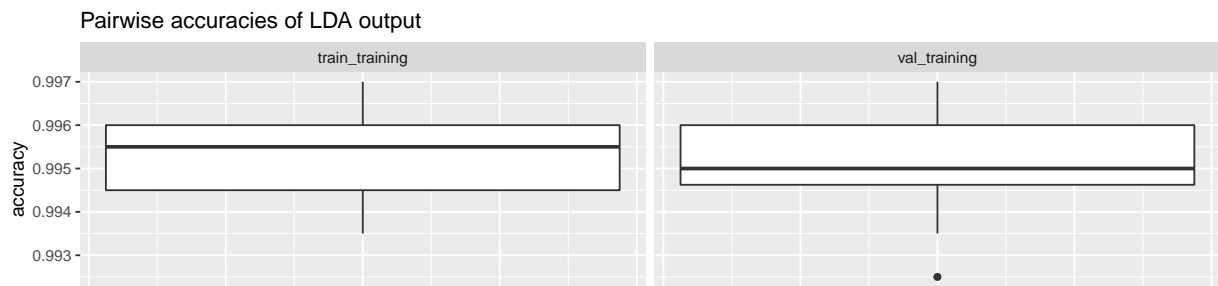
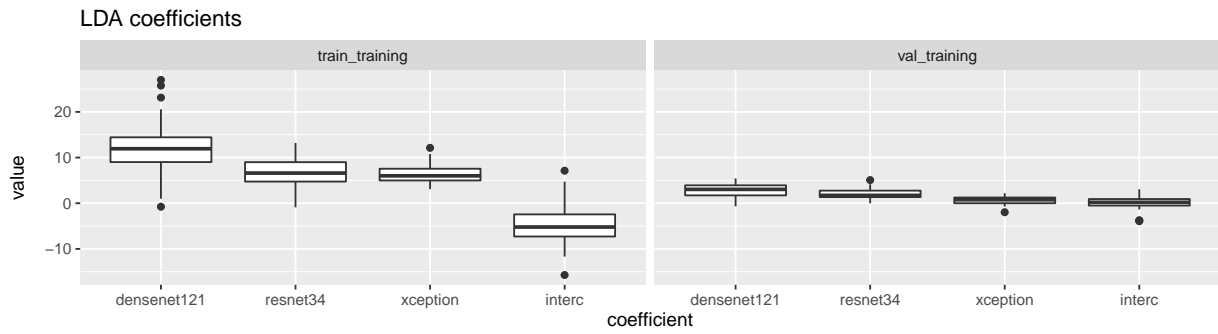
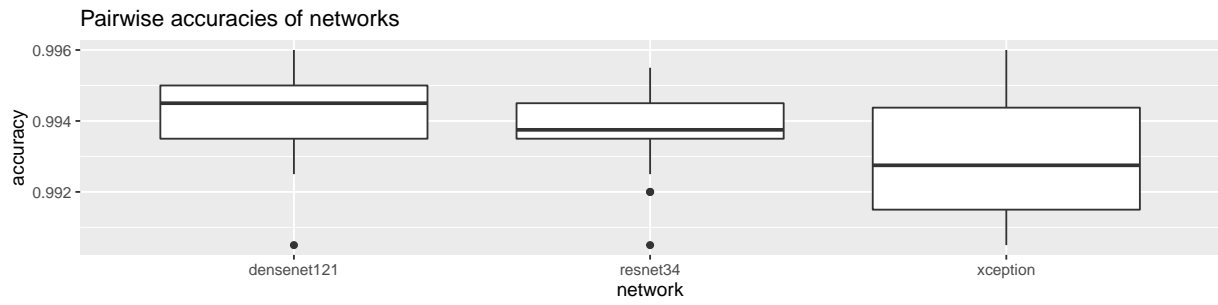
## Classes 5 vs 9



## Classes 5 vs 10

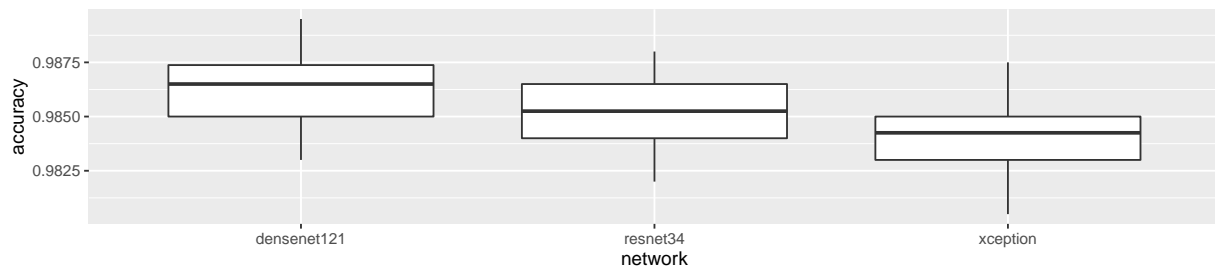


## Classes 6 vs 7

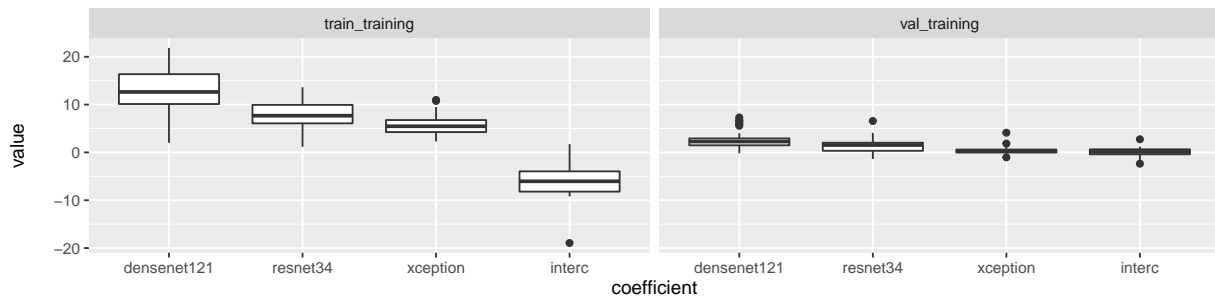


## Classes 6 vs 8

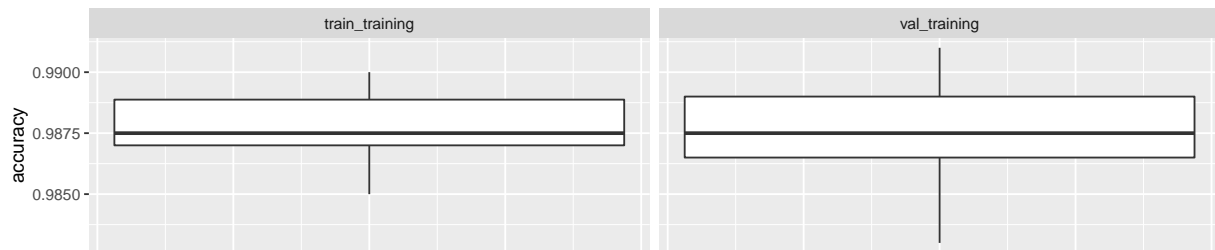
Pairwise accuracies of networks



LDA coefficients

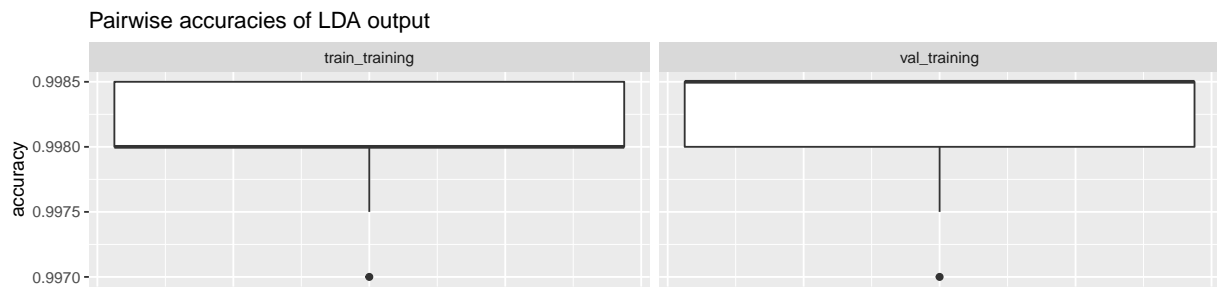
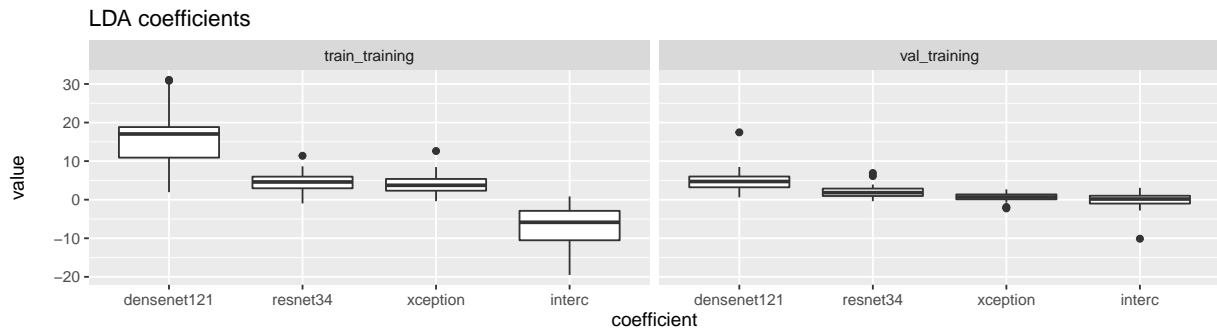
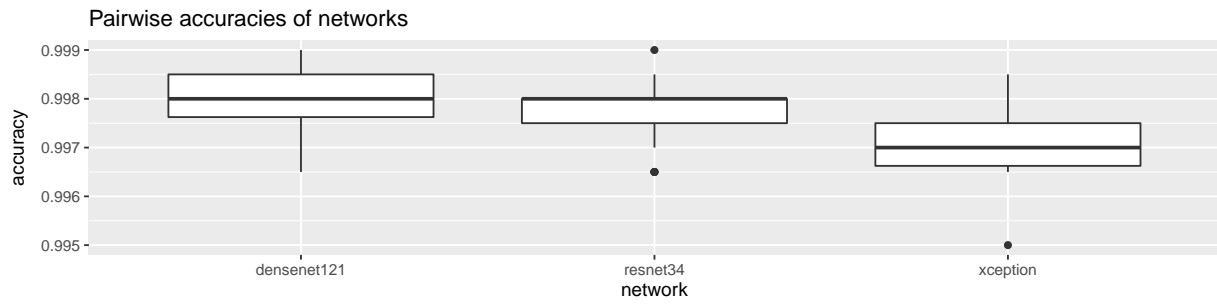


Pairwise accuracies of LDA output

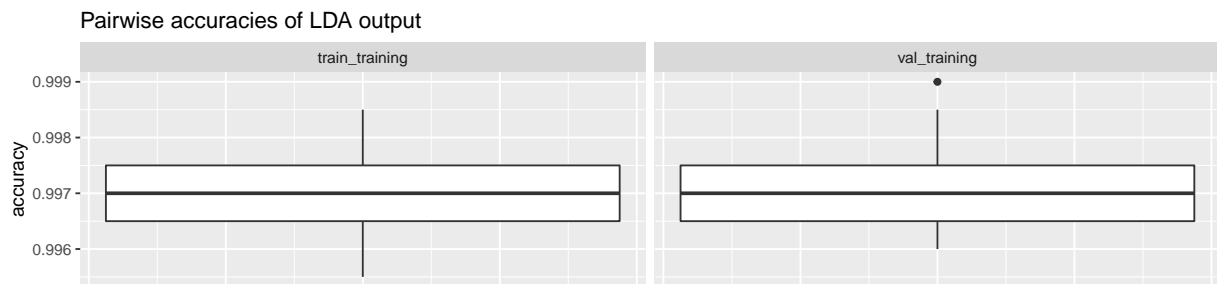
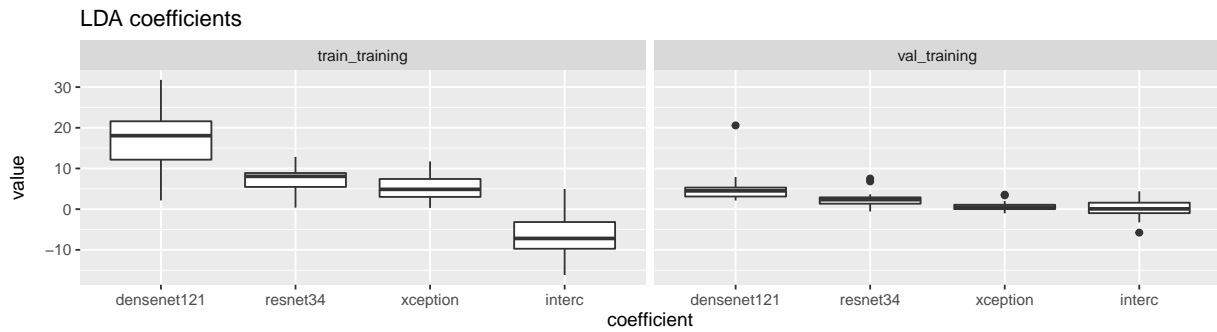
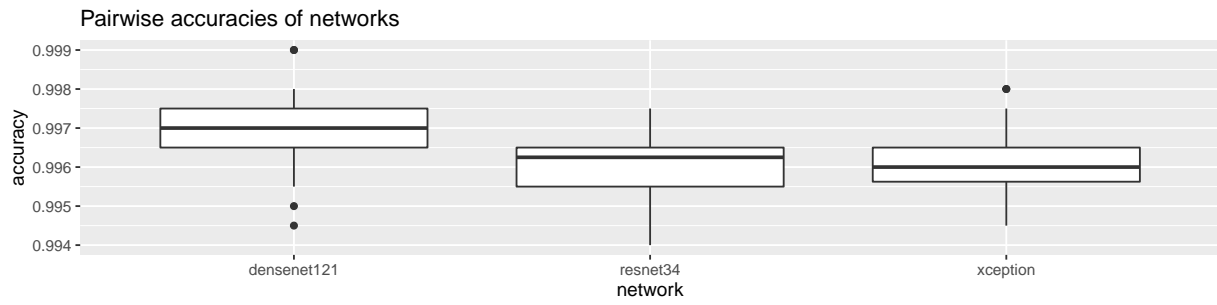




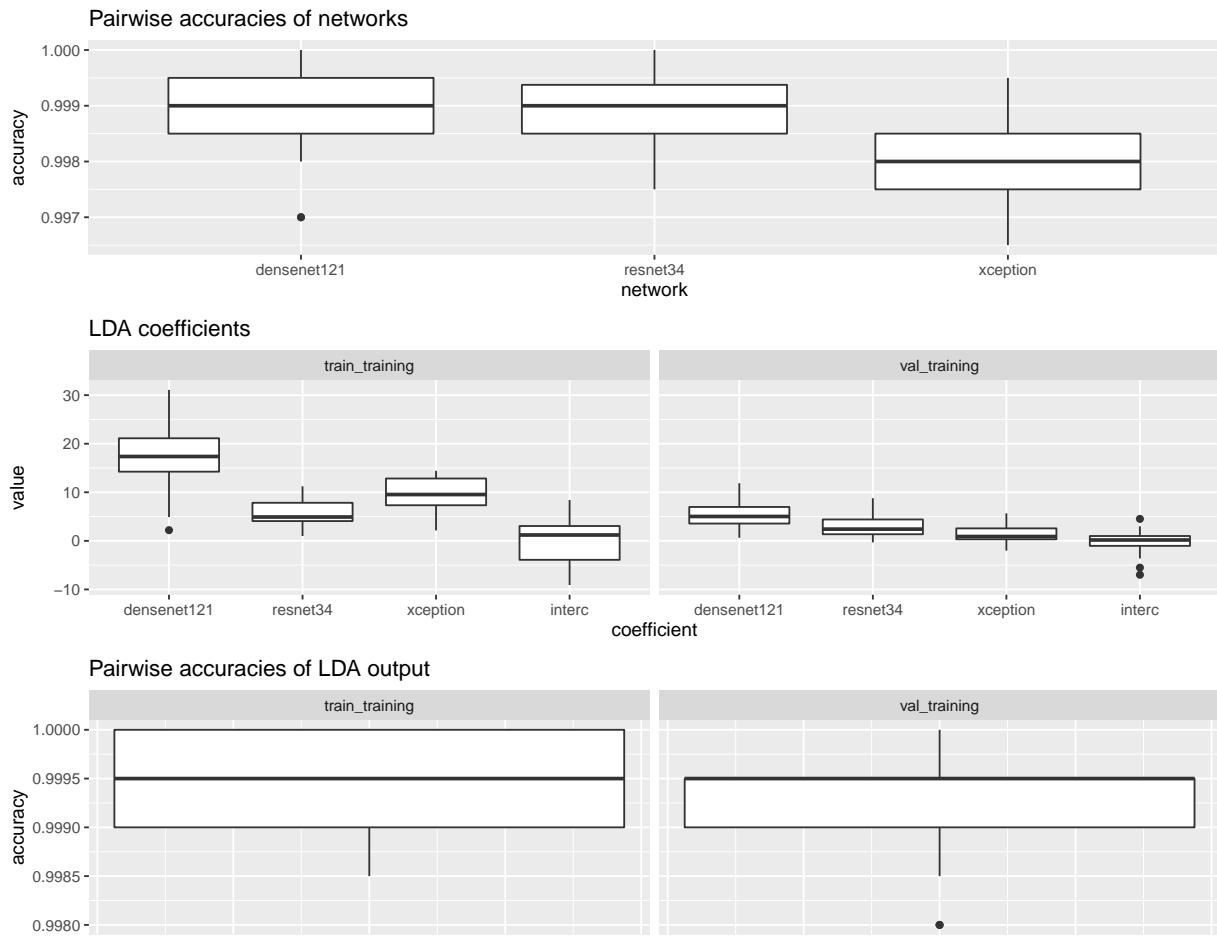
## Classes 6 vs 9



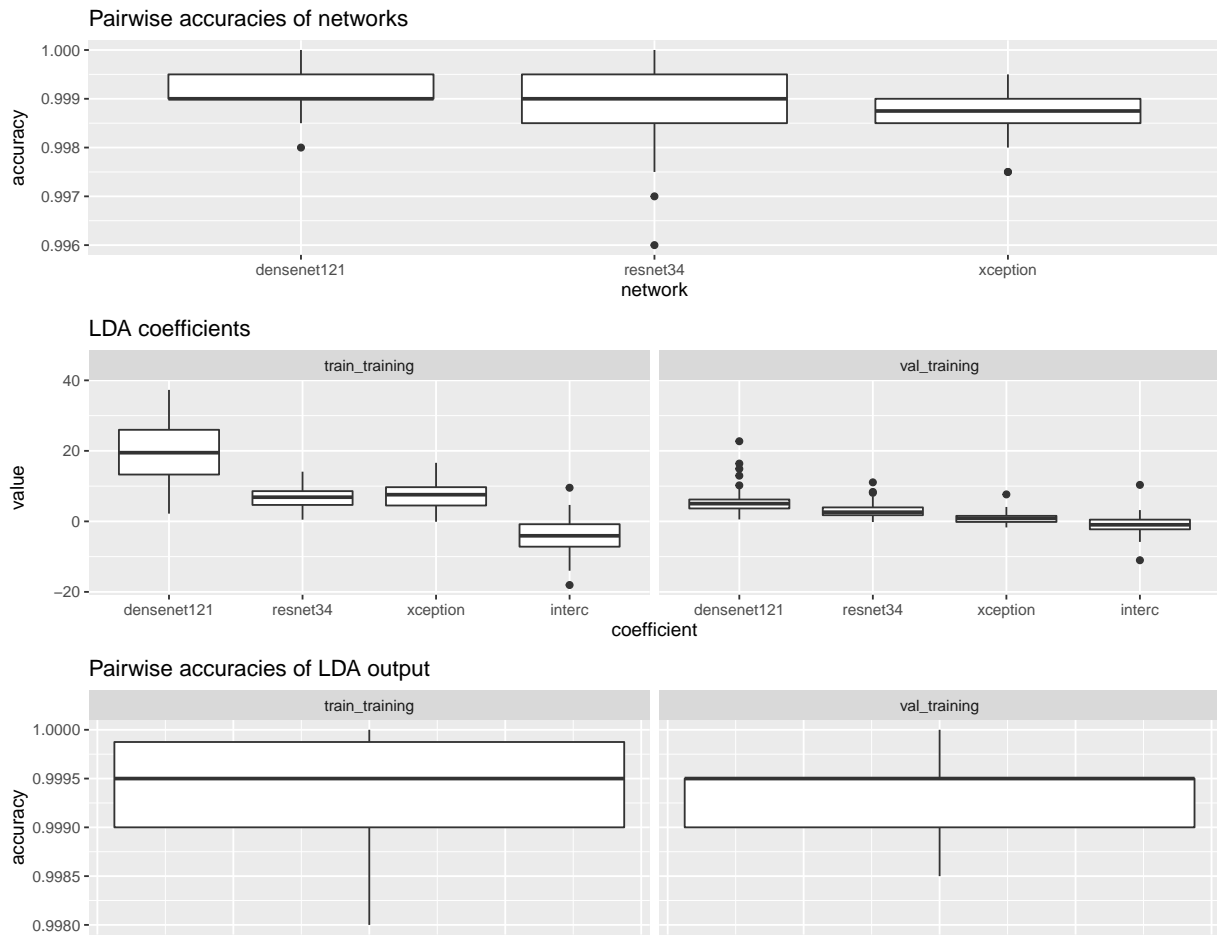
## Classes 6 vs 10



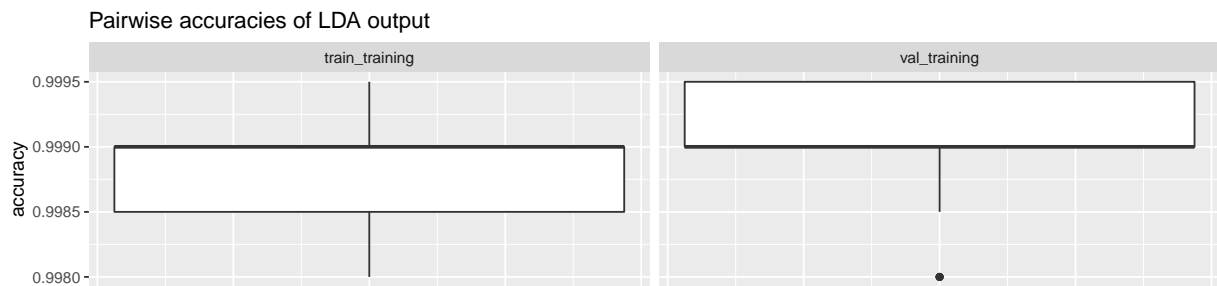
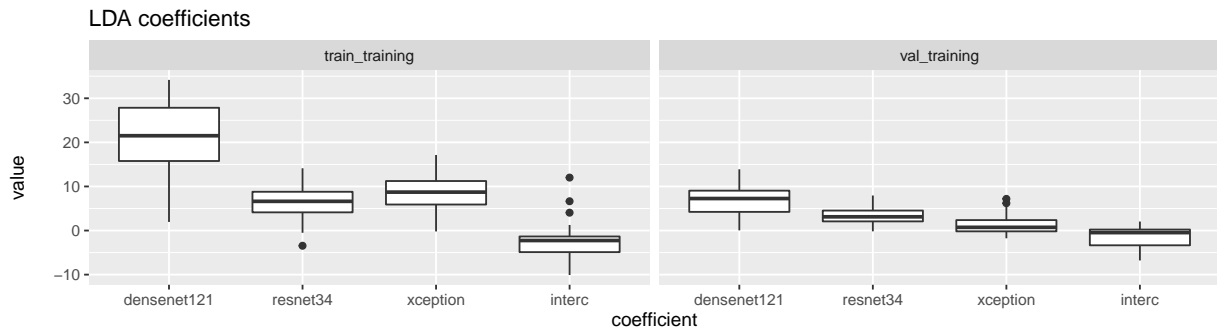
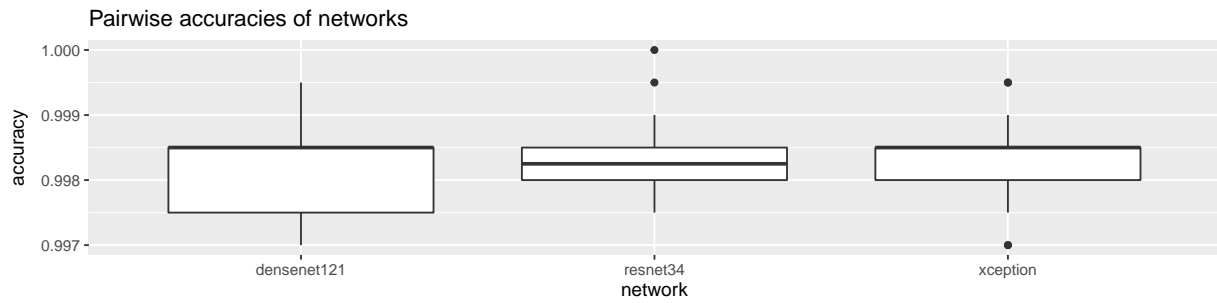
## Classes 7 vs 8



## Classes 7 vs 9

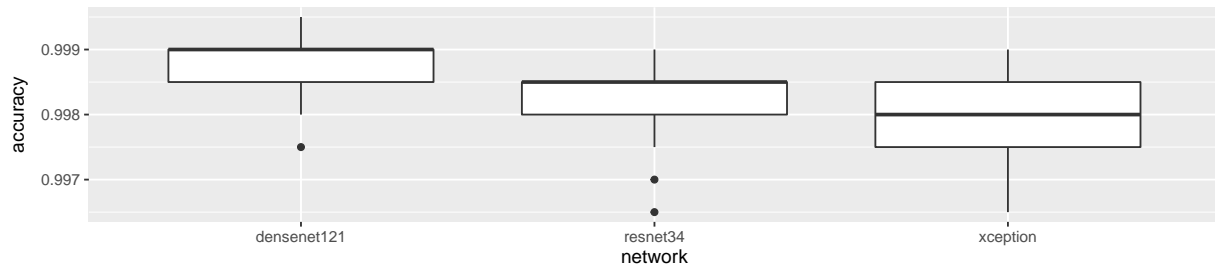


## Classes 7 vs 10

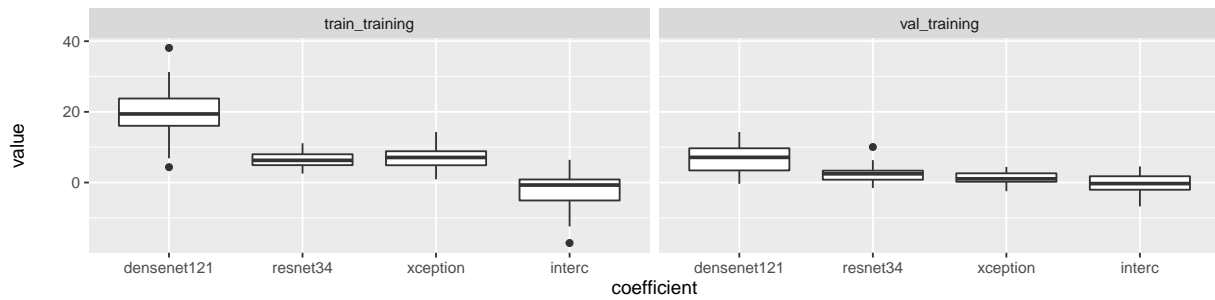


## Classes 8 vs 9

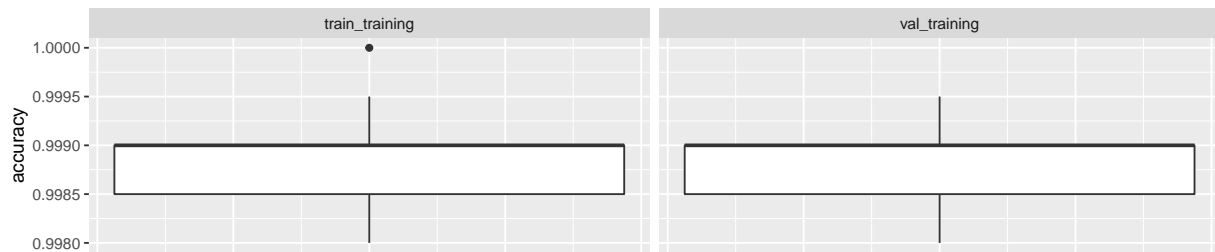
Pairwise accuracies of networks



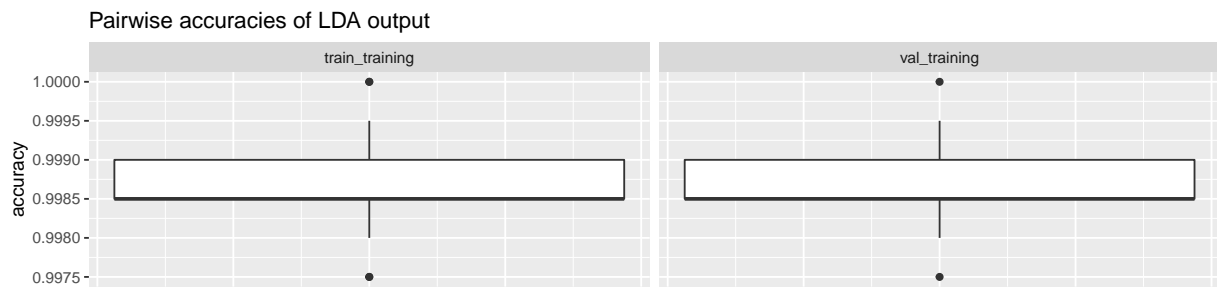
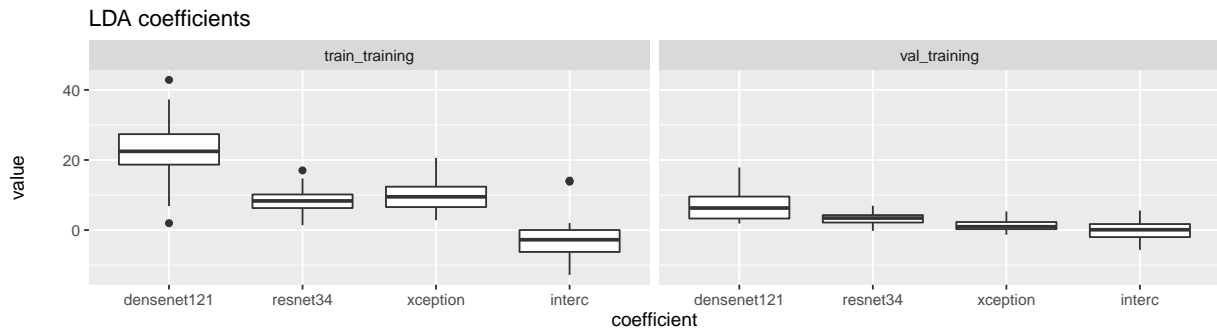
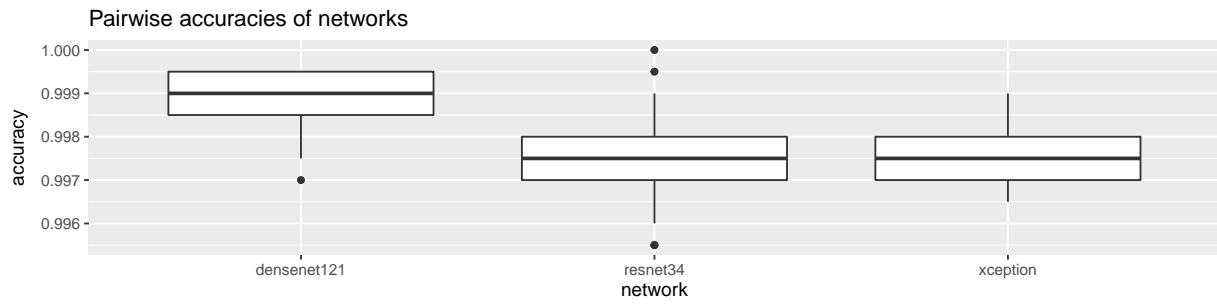
LDA coefficients



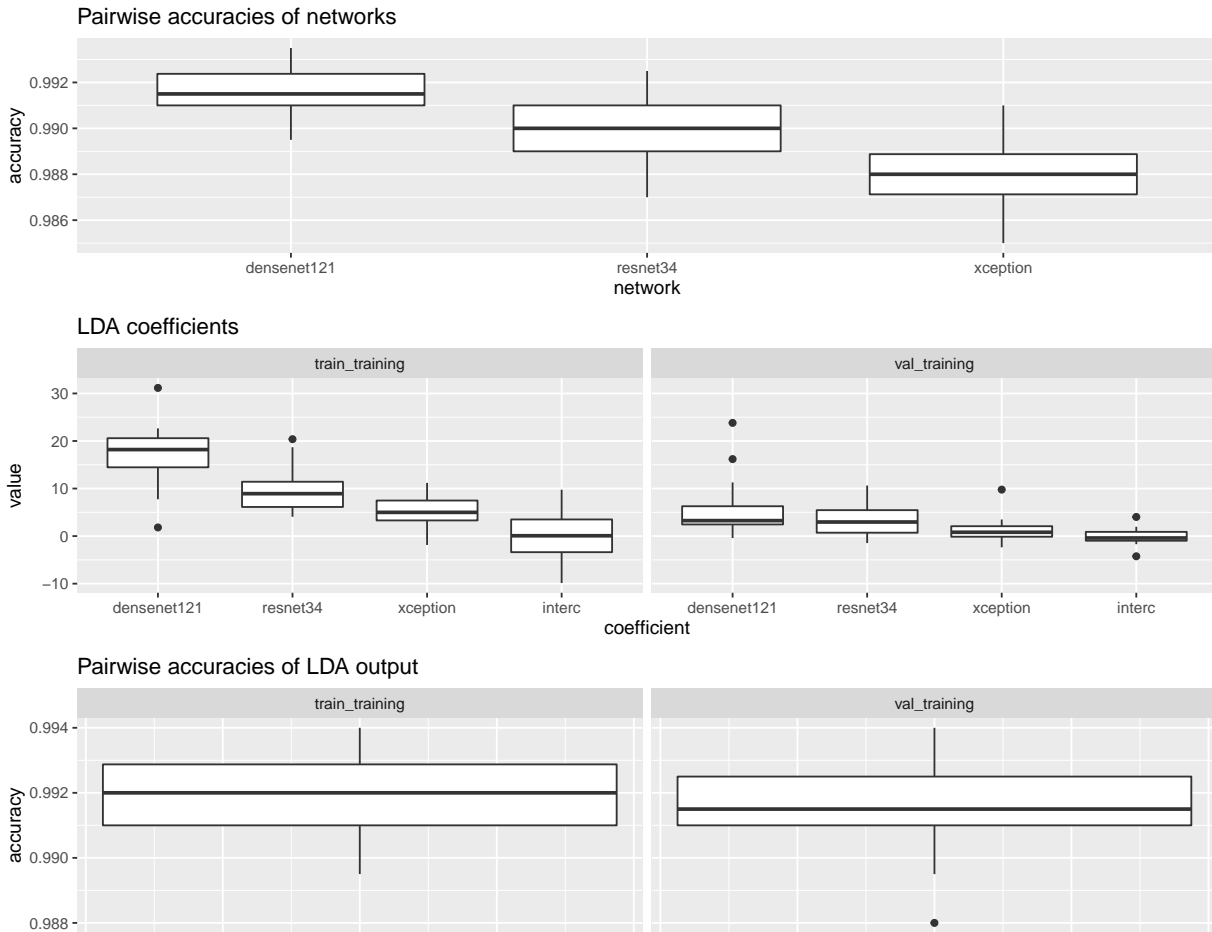
Pairwise accuracies of LDA output



## Classes 8 vs 10



Classes 9 vs 10



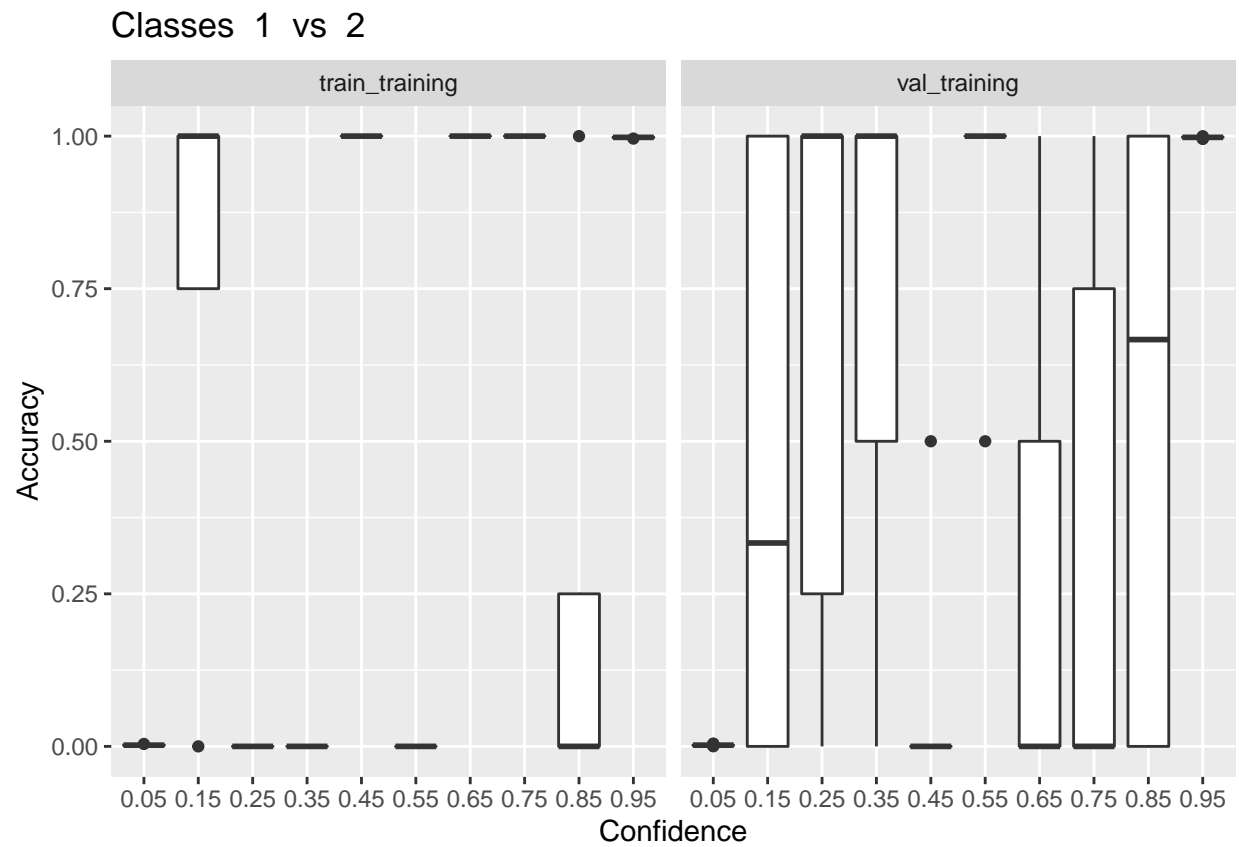
An attempt to visualize calibration of LDAs. Almost all elements are present near the zero and one probabilities, therefore the visualization is not very informative.

```
for (c11 in 1:(classes - 1))
{
  for (c12 in (c11 + 1):classes)
  {
    cal_plt <- ens_pw_cal %>% filter(class1 == (c11 - 1) & class2 == (c12 - 1)) %>% ggplot() +
      geom_boxplot(mapping=aes(x=bin_c, y=bin_accuracy)) + facet_wrap(~train_set) +
      ggtitle(paste("Classes ", c11, " vs ", c12)) + xlab("Confidence") + ylab("Accuracy")

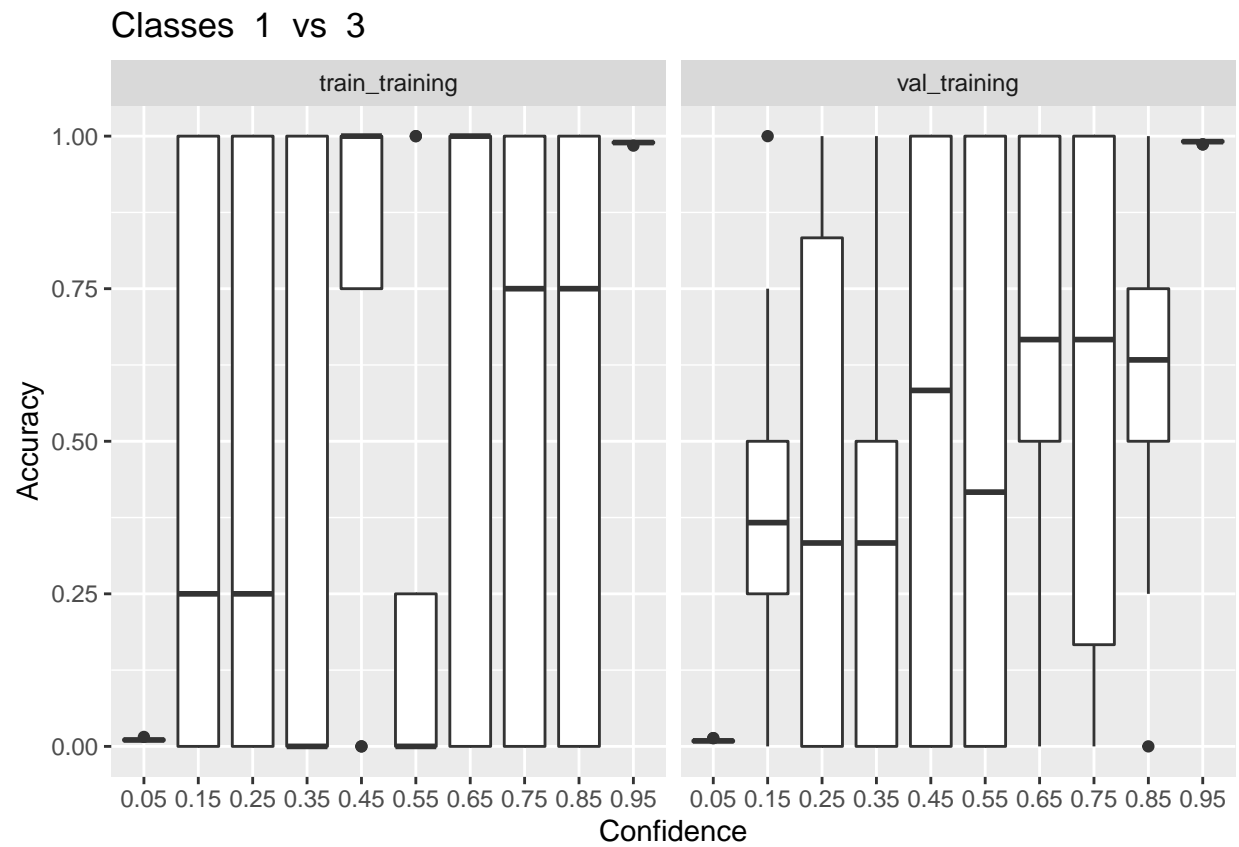
    print(cal_plt)
  }
}
```

## Warning: Removed 386 rows containing non-finite values (stat\_boxplot).

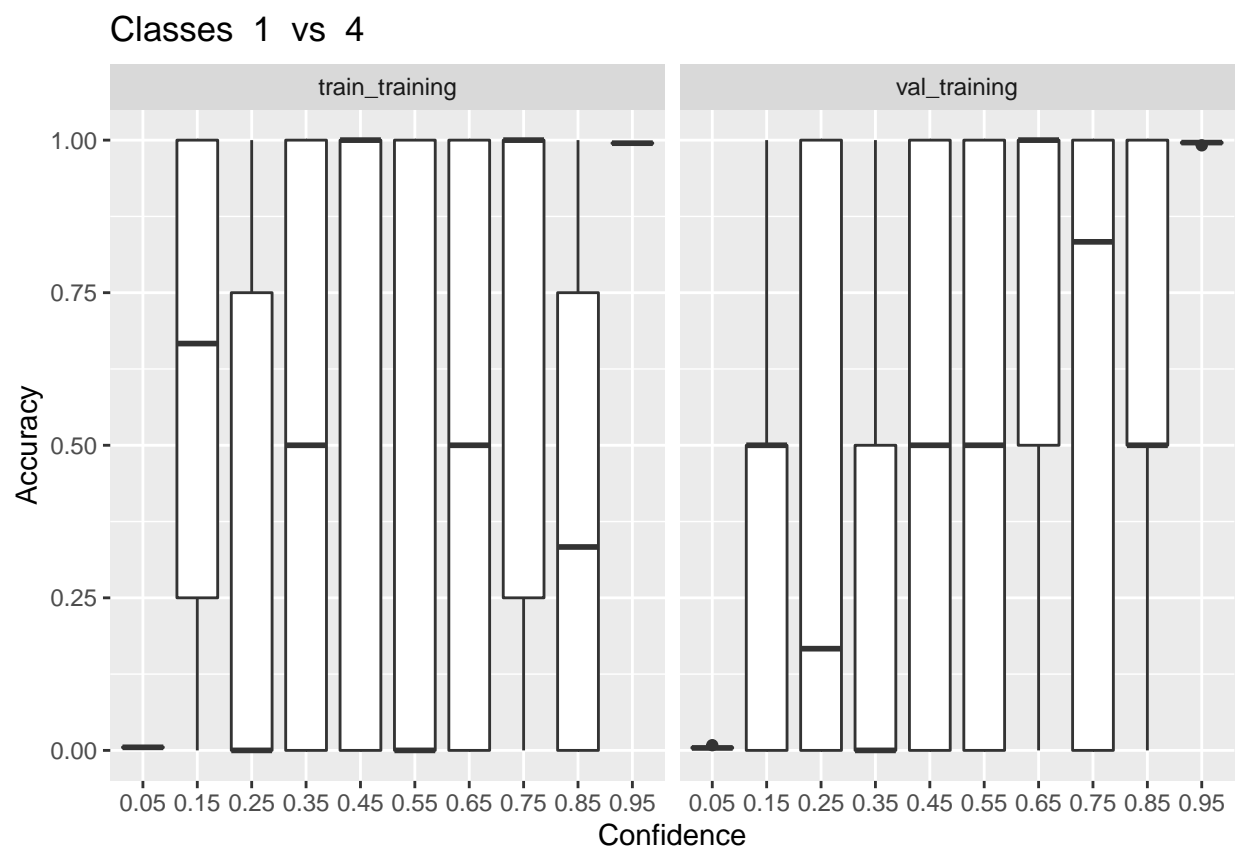




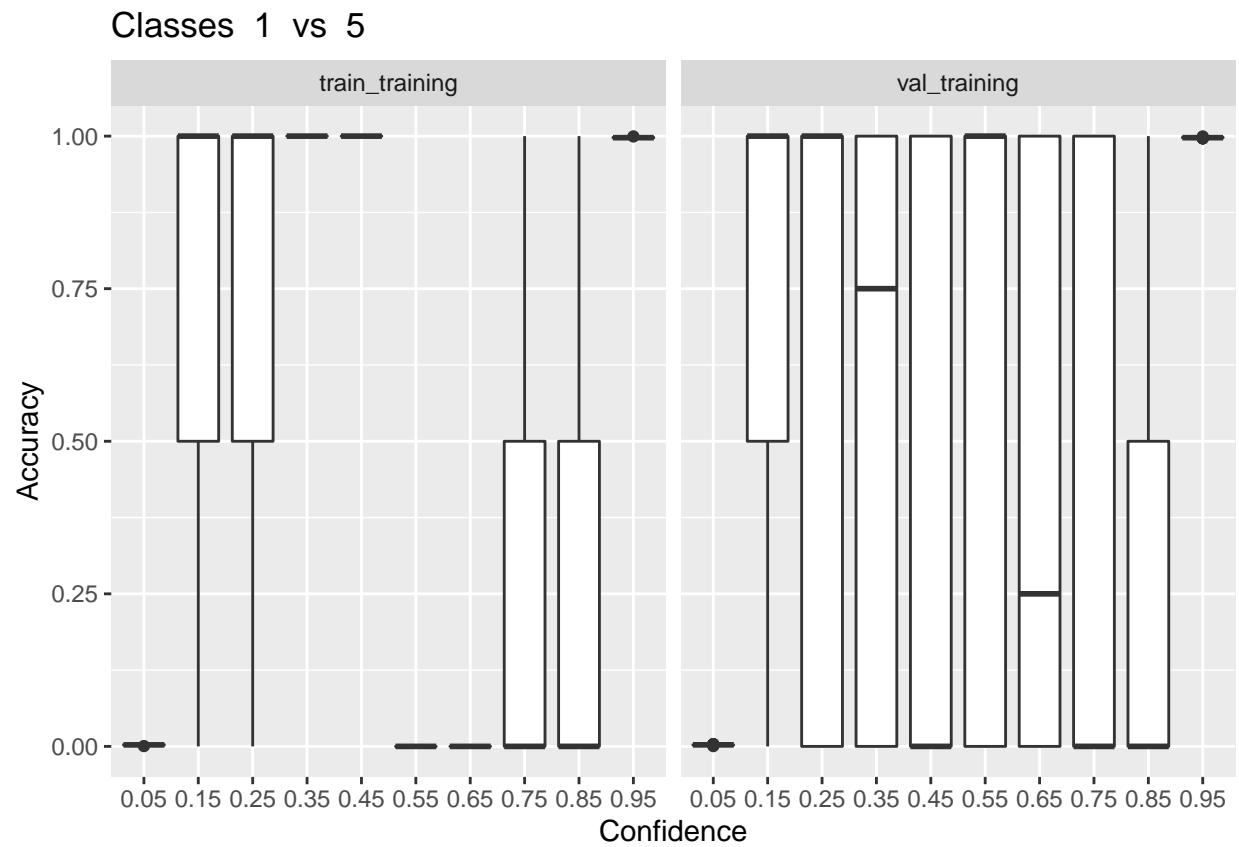
## Warning: Removed 214 rows containing non-finite values (stat\_boxplot).



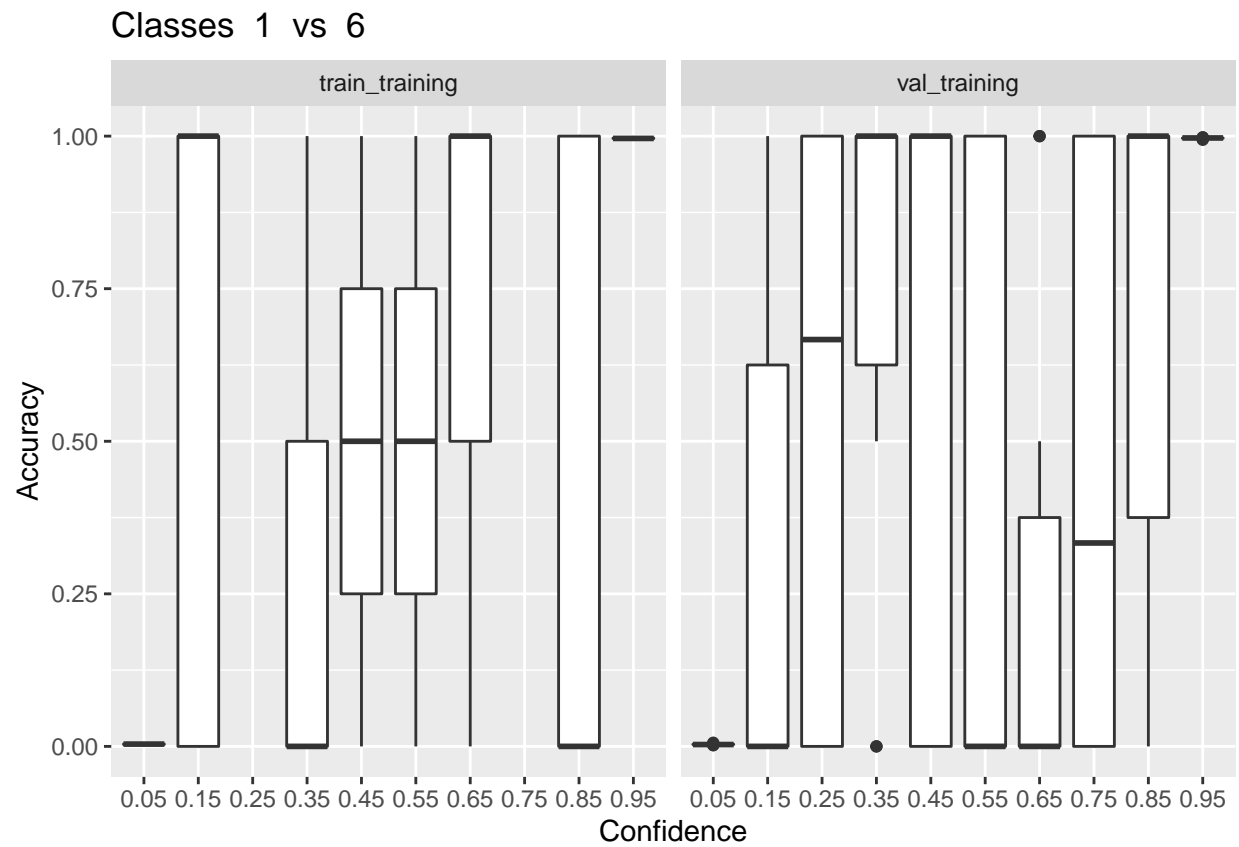
## Warning: Removed 246 rows containing non-finite values (stat\_boxplot).



## Warning: Removed 380 rows containing non-finite values (stat\_boxplot).

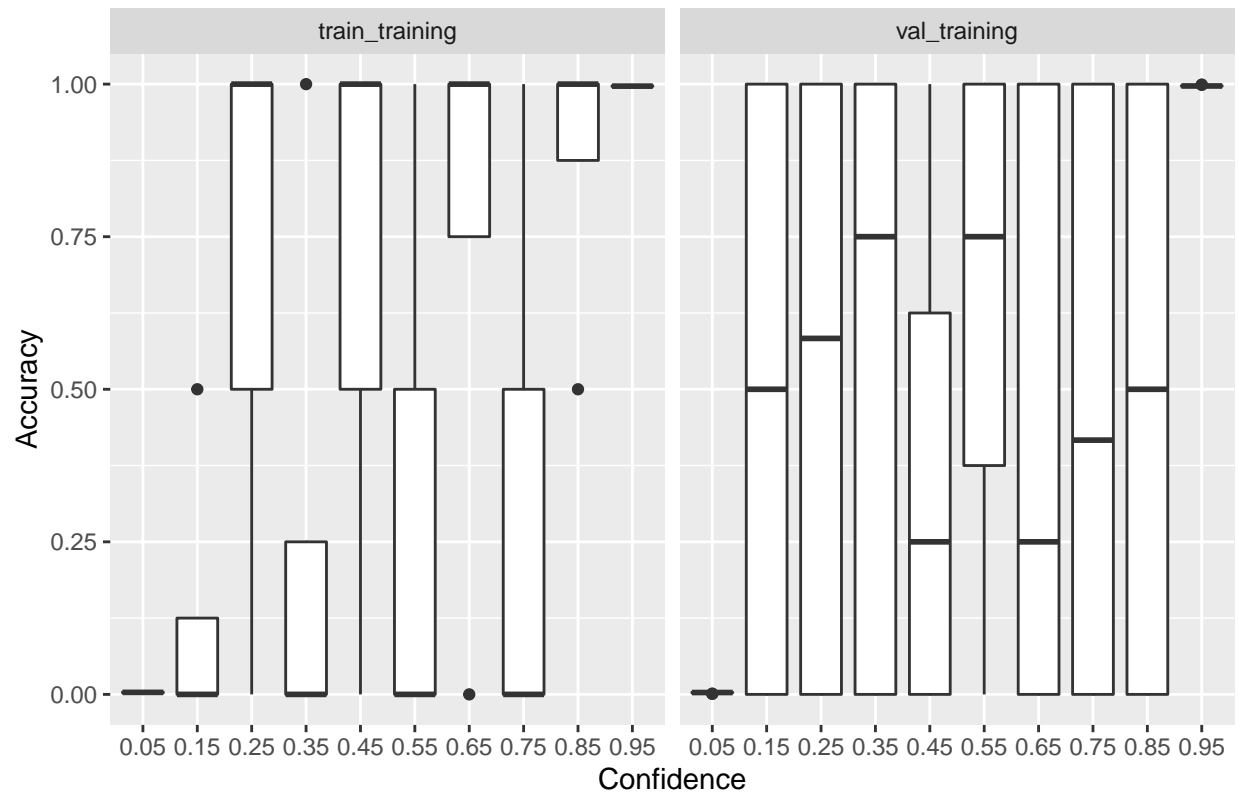


## Warning: Removed 362 rows containing non-finite values (stat\_boxplot).

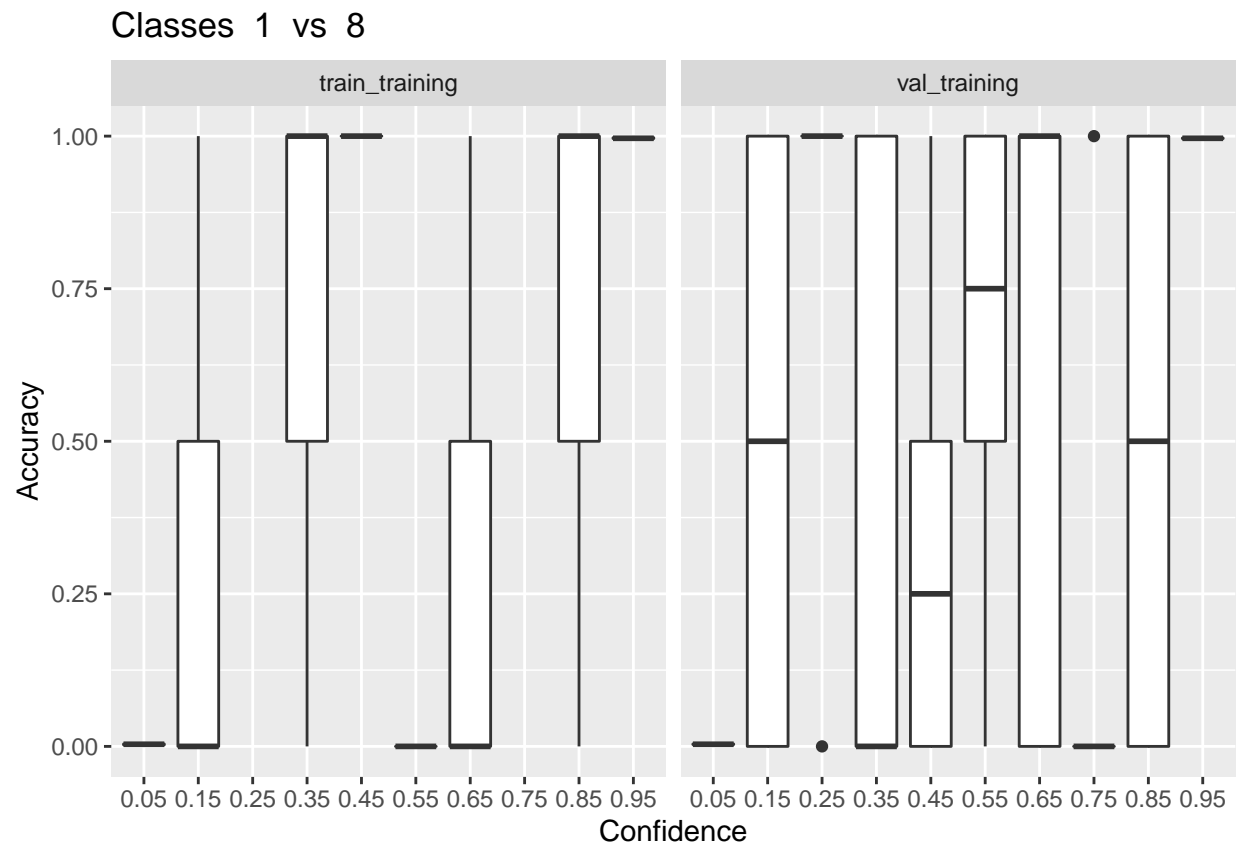


## Warning: Removed 350 rows containing non-finite values (stat\_boxplot).

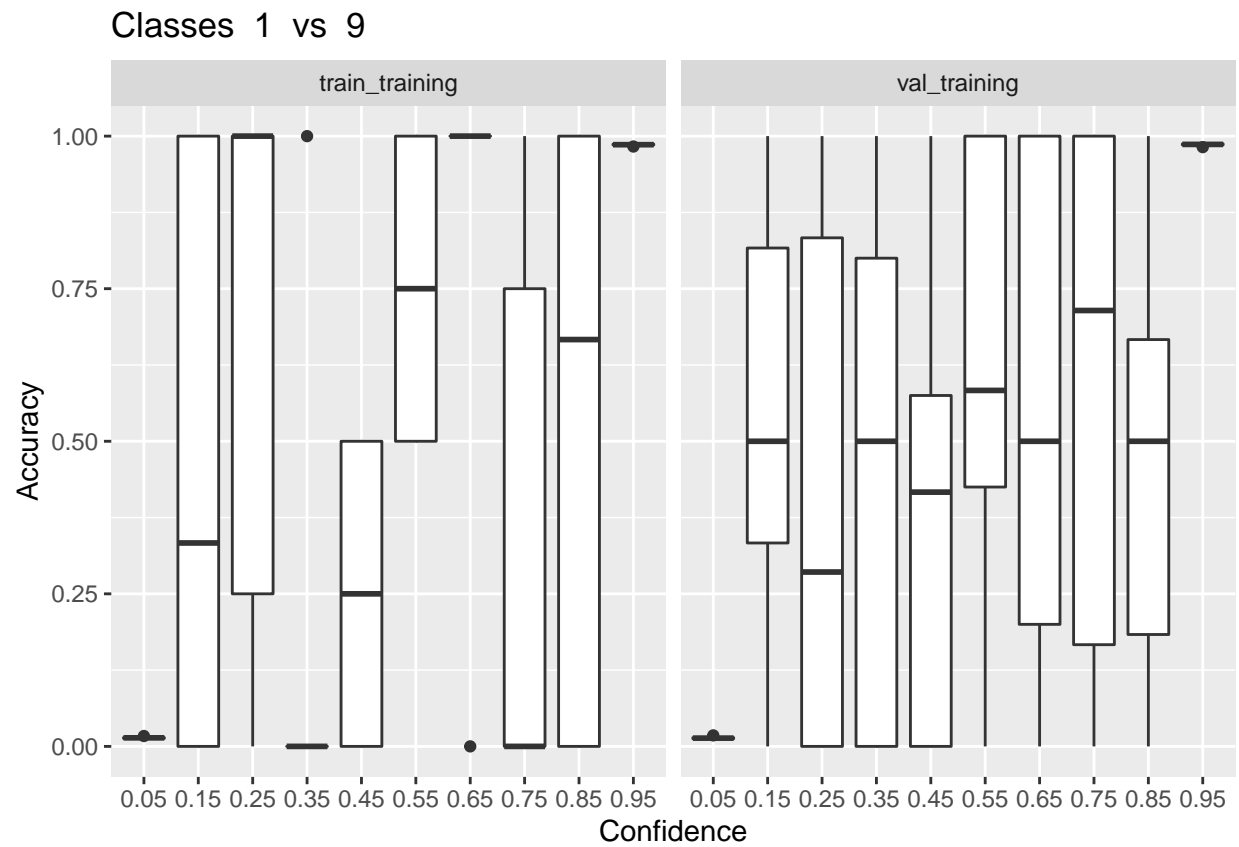
Classes 1 vs 7



## Warning: Removed 394 rows containing non-finite values (stat\_boxplot).

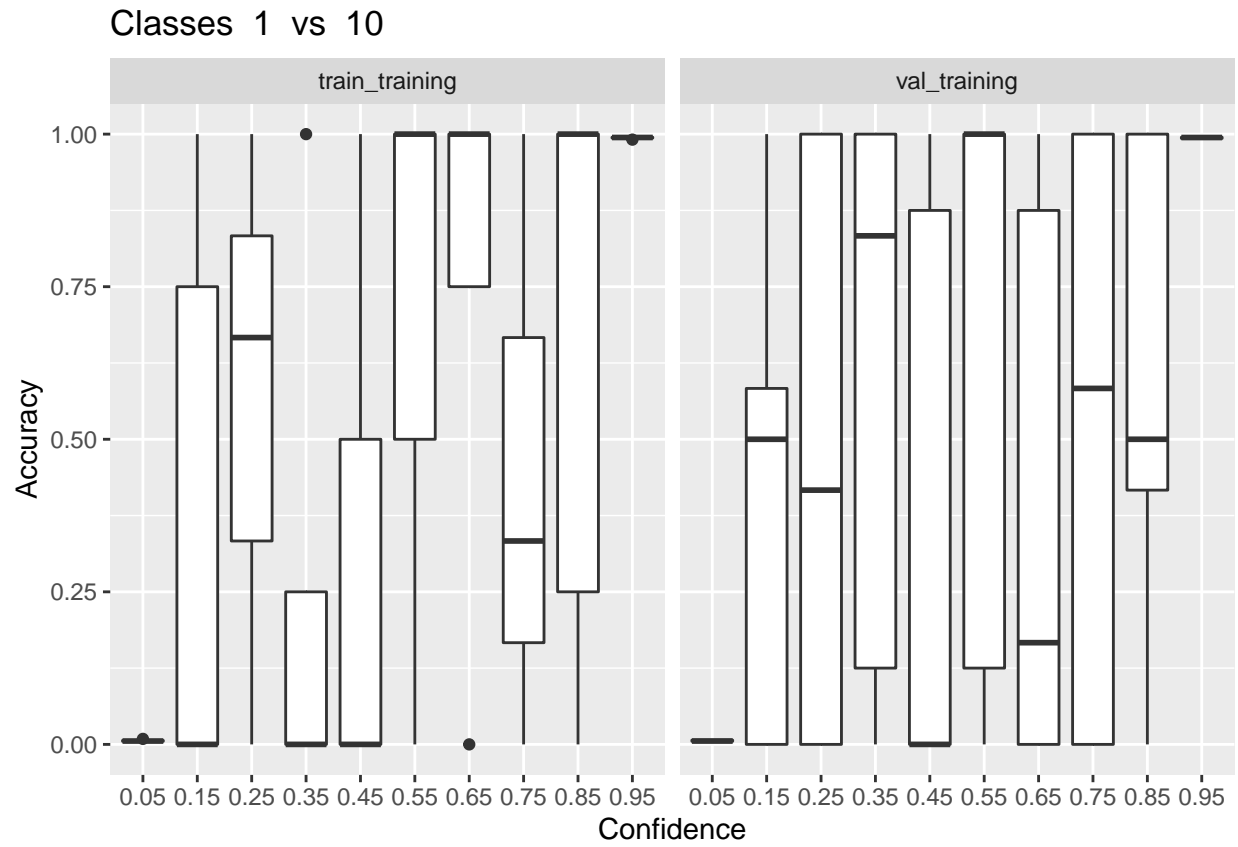


## Warning: Removed 230 rows containing non-finite values (stat\_boxplot).

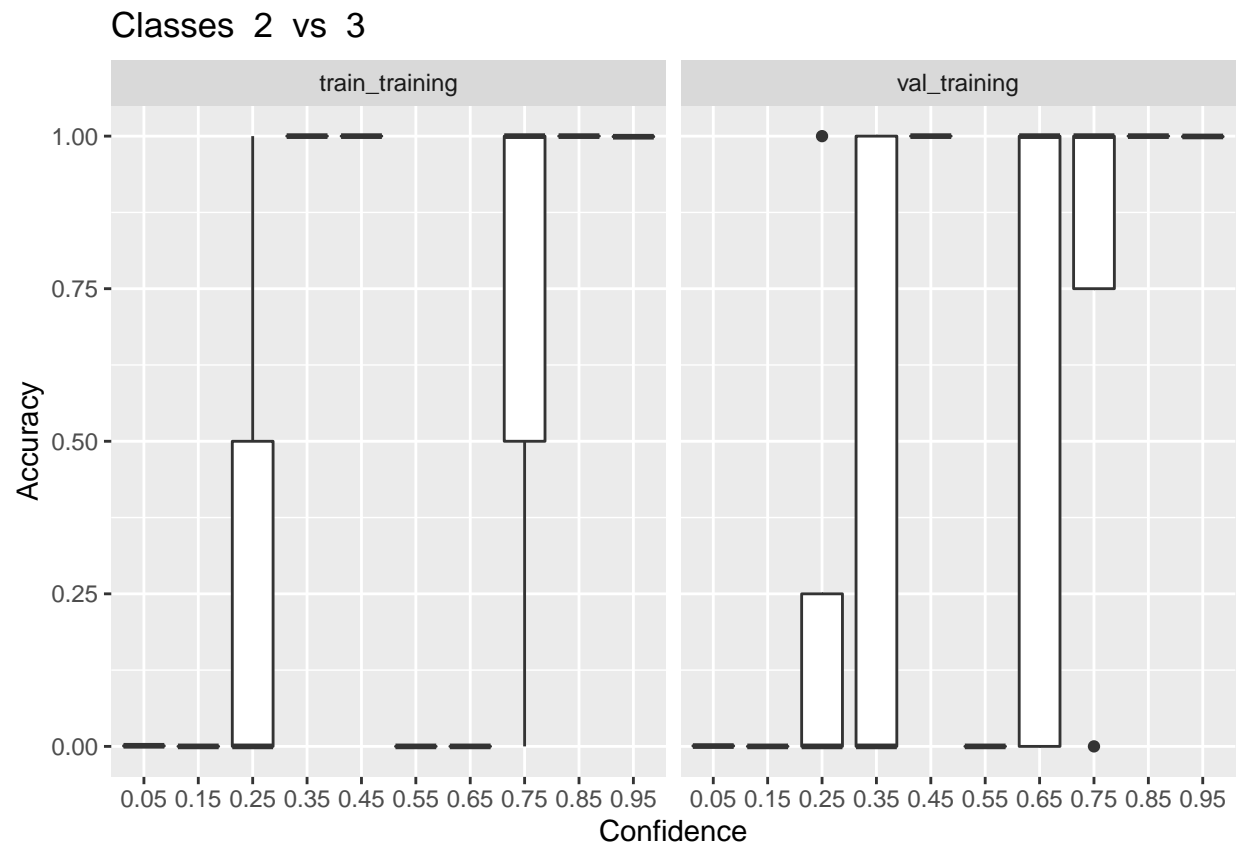


## Warning: Removed 330 rows containing non-finite values (stat\_boxplot).

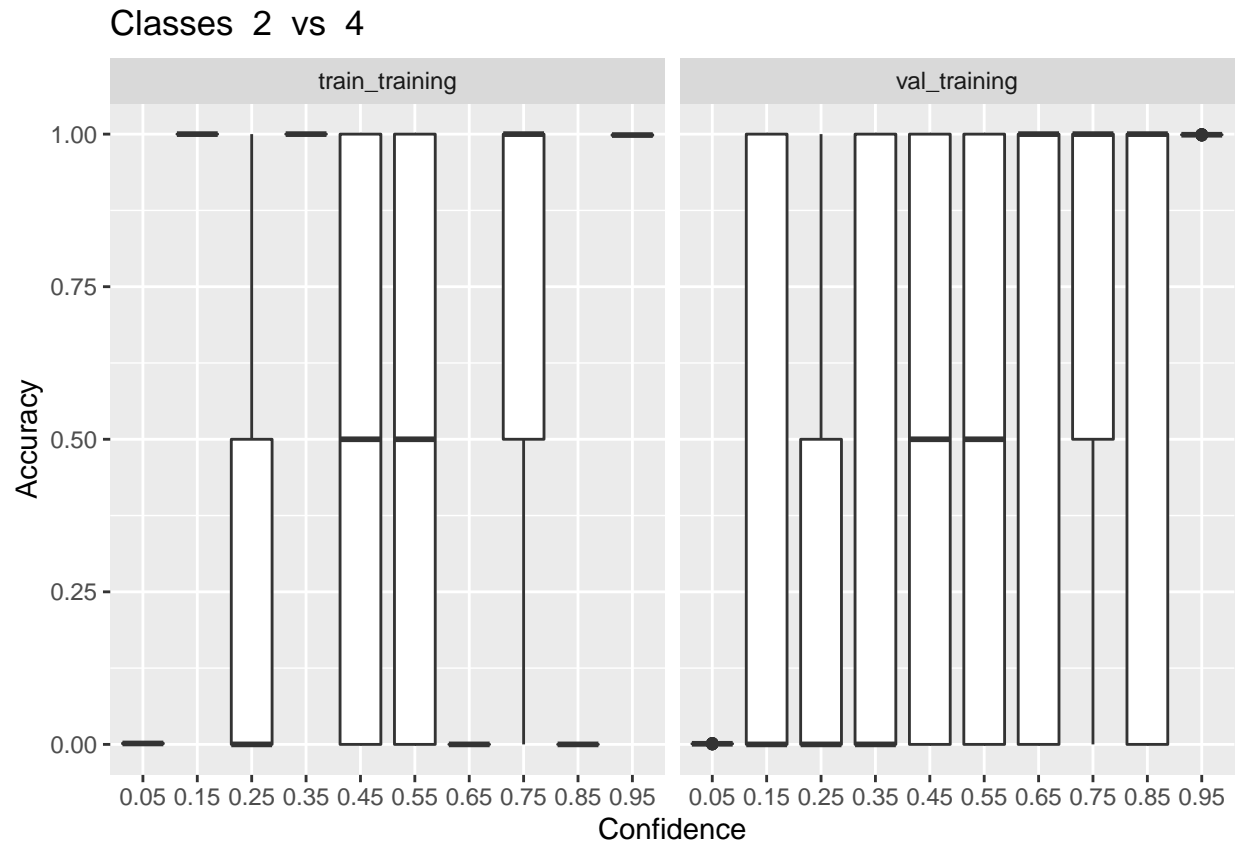




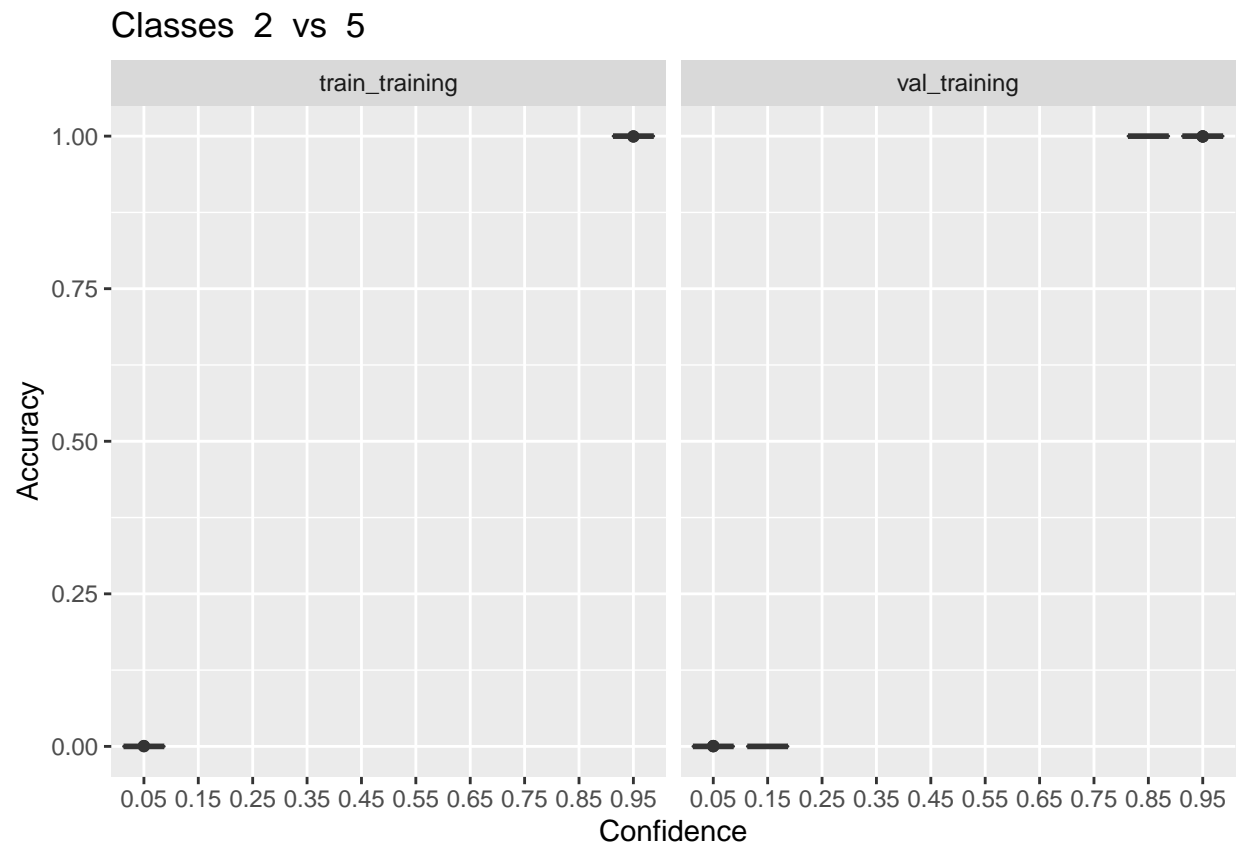
## Warning: Removed 436 rows containing non-finite values (stat\_boxplot).



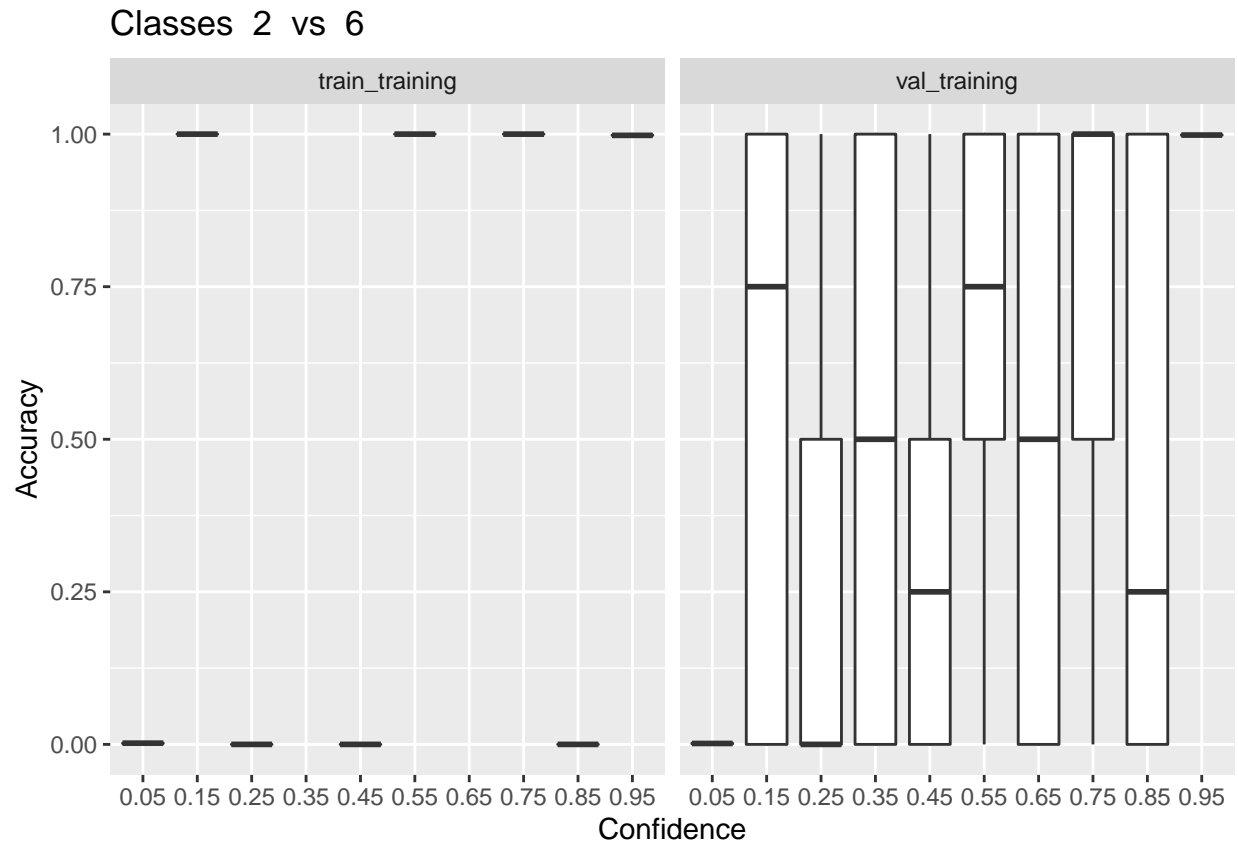
## Warning: Removed 390 rows containing non-finite values (stat\_boxplot).



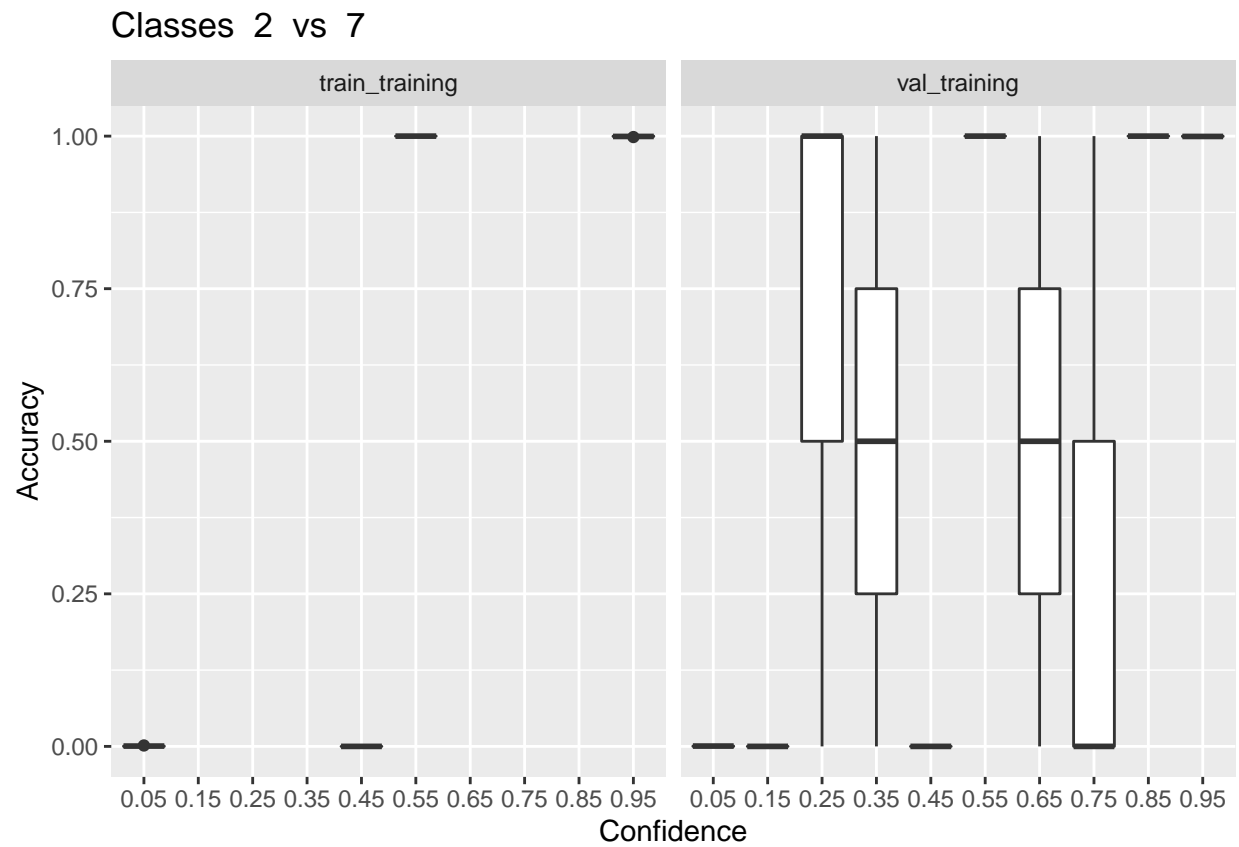
## Warning: Removed 478 rows containing non-finite values (stat\_boxplot).



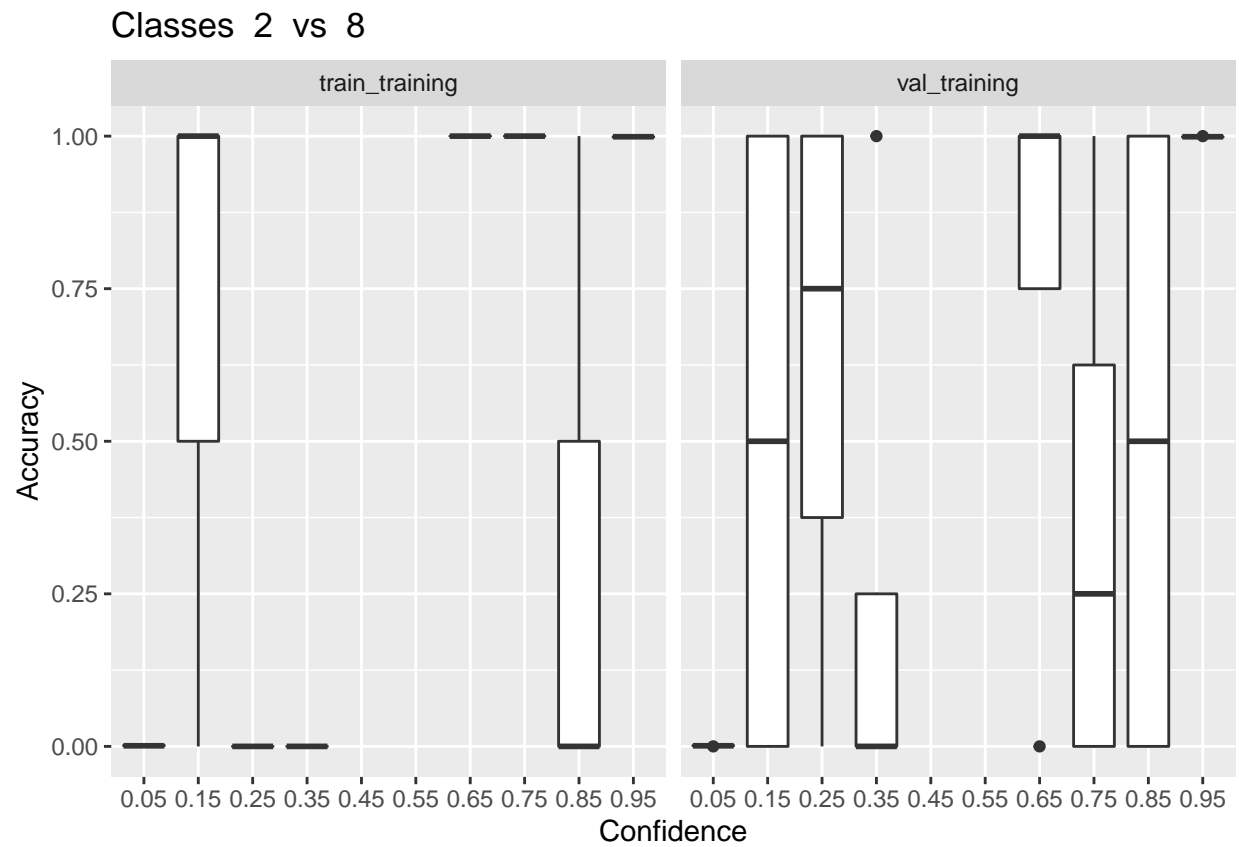
## Warning: Removed 416 rows containing non-finite values (stat\_boxplot).



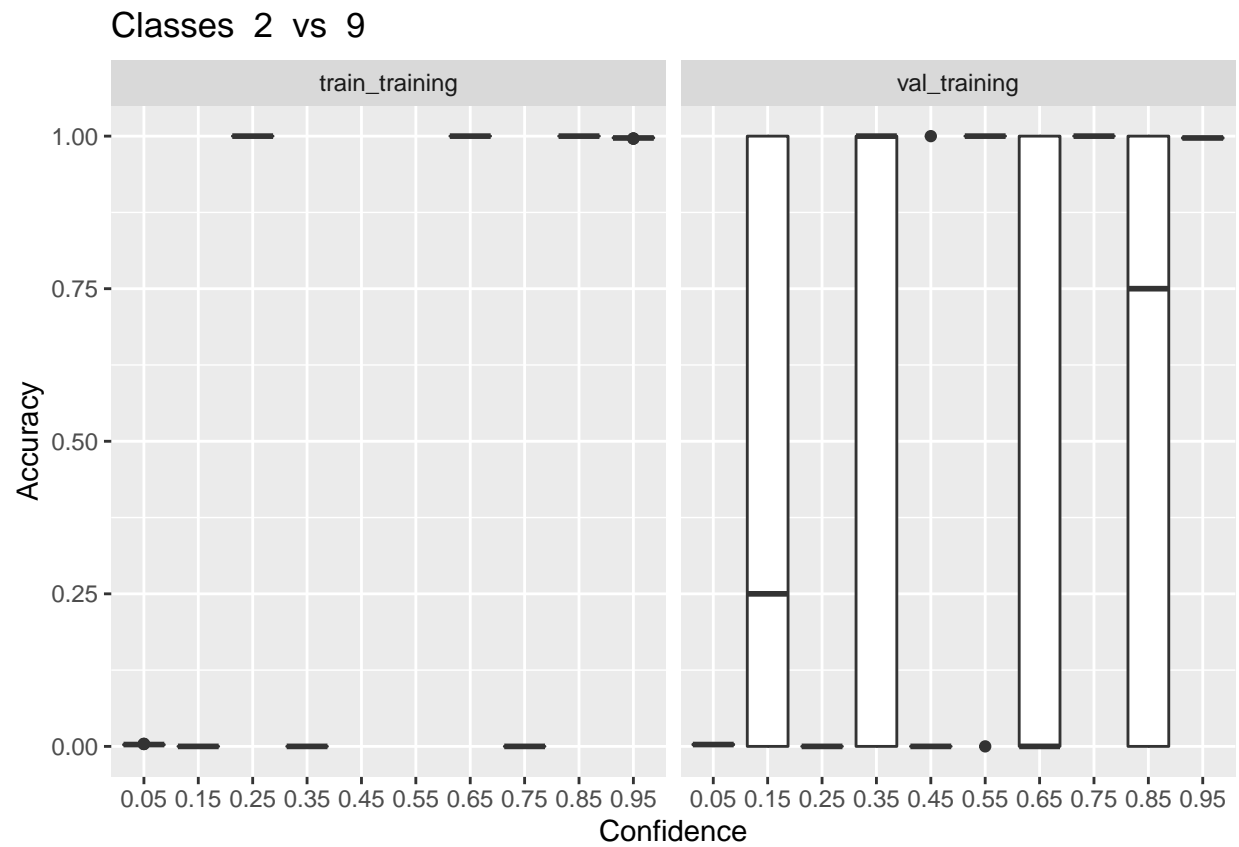
## Warning: Removed 460 rows containing non-finite values (stat\_boxplot).



## Warning: Removed 446 rows containing non-finite values (stat\_boxplot).

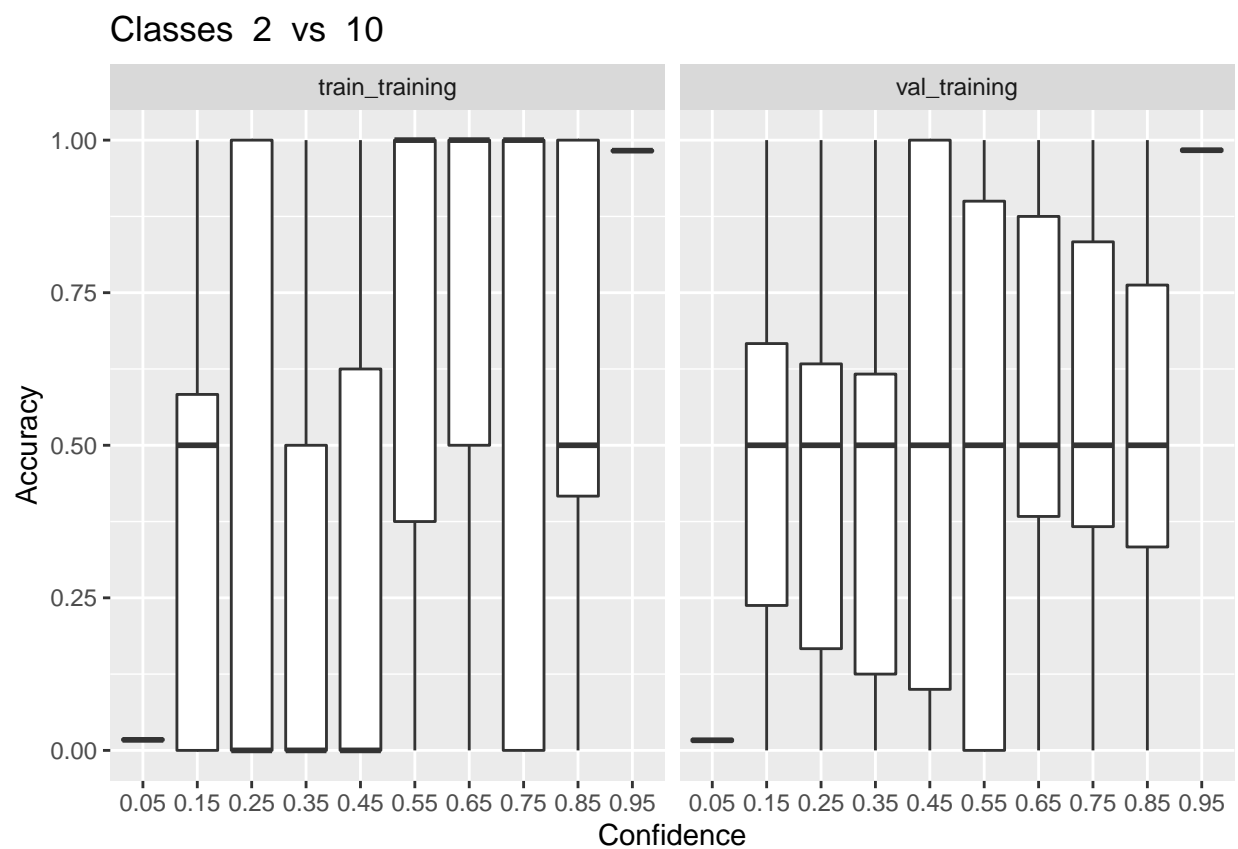


## Warning: Removed 408 rows containing non-finite values (stat\_boxplot).



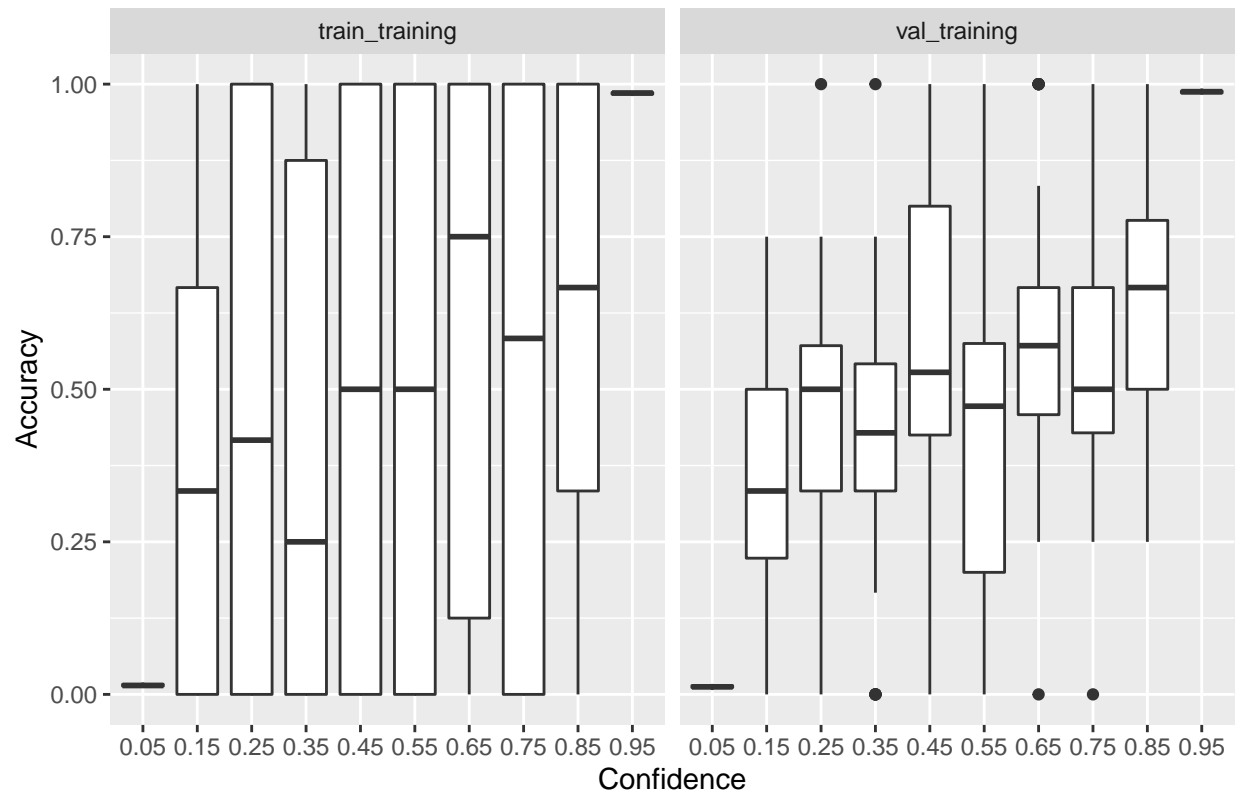
## Warning: Removed 226 rows containing non-finite values (stat\_boxplot).



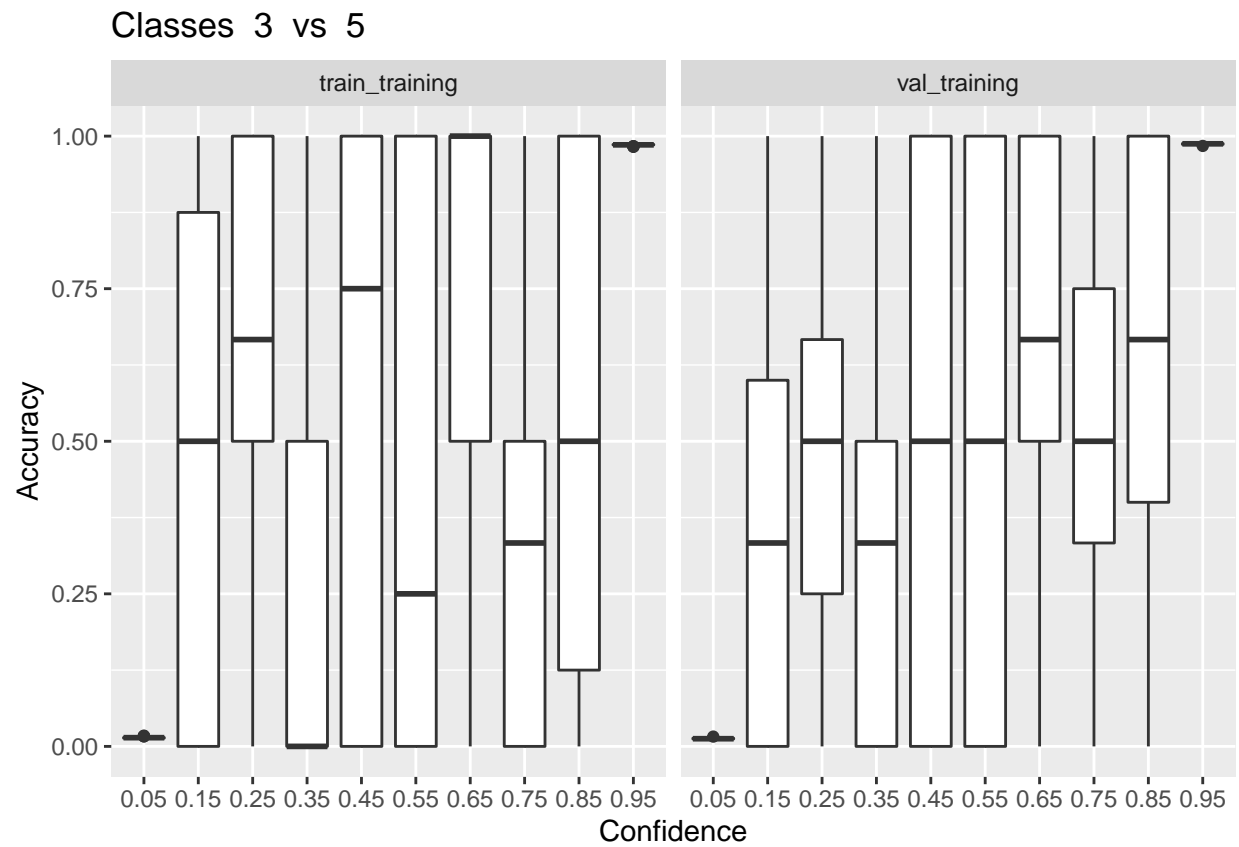


## Warning: Removed 122 rows containing non-finite values (stat\_boxplot).

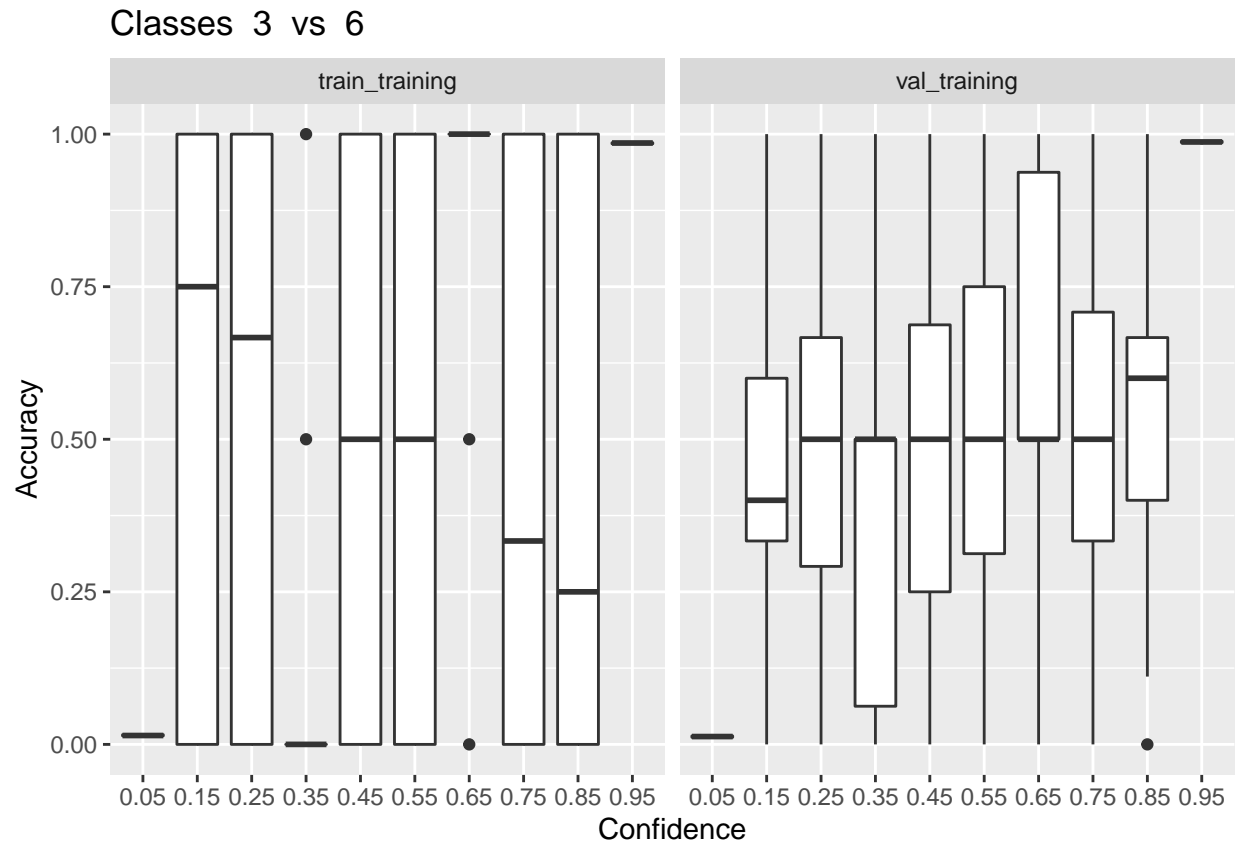
## Classes 3 vs 4



## Warning: Removed 204 rows containing non-finite values (stat\_boxplot).

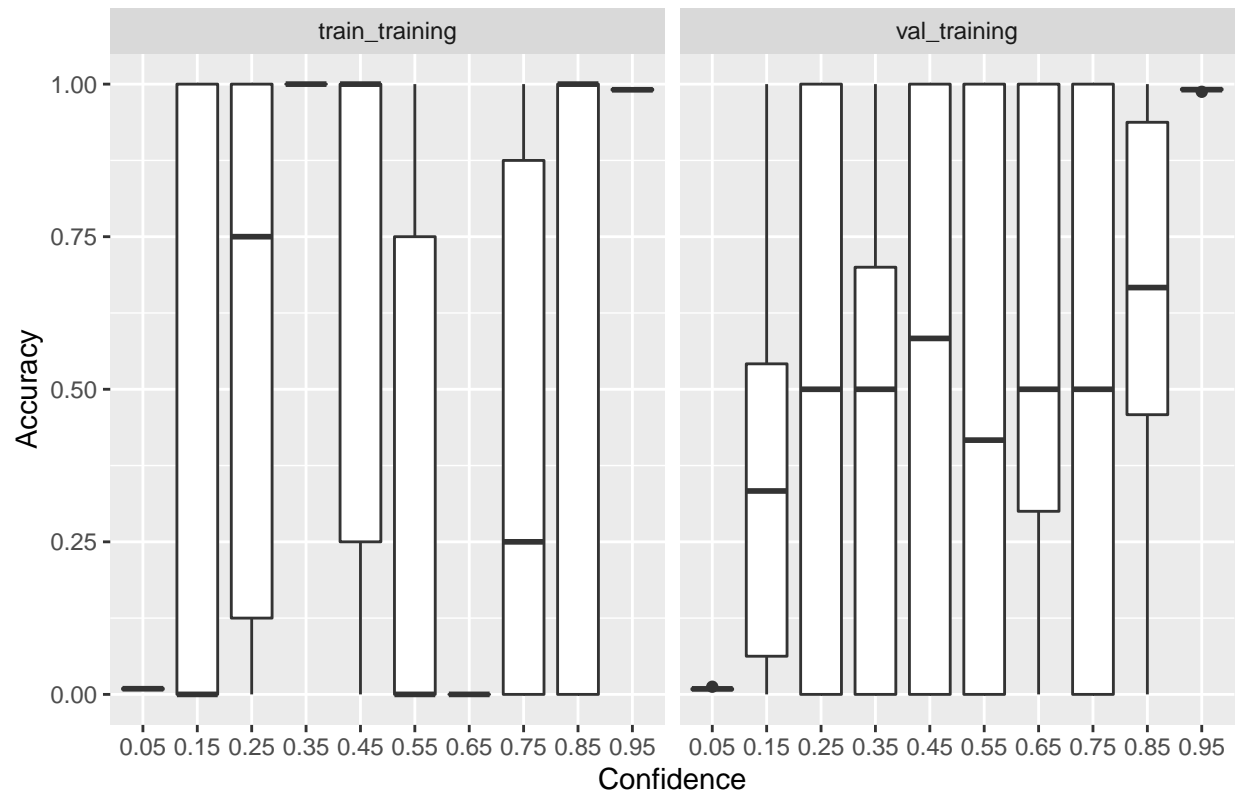


## Warning: Removed 148 rows containing non-finite values (stat\_boxplot).



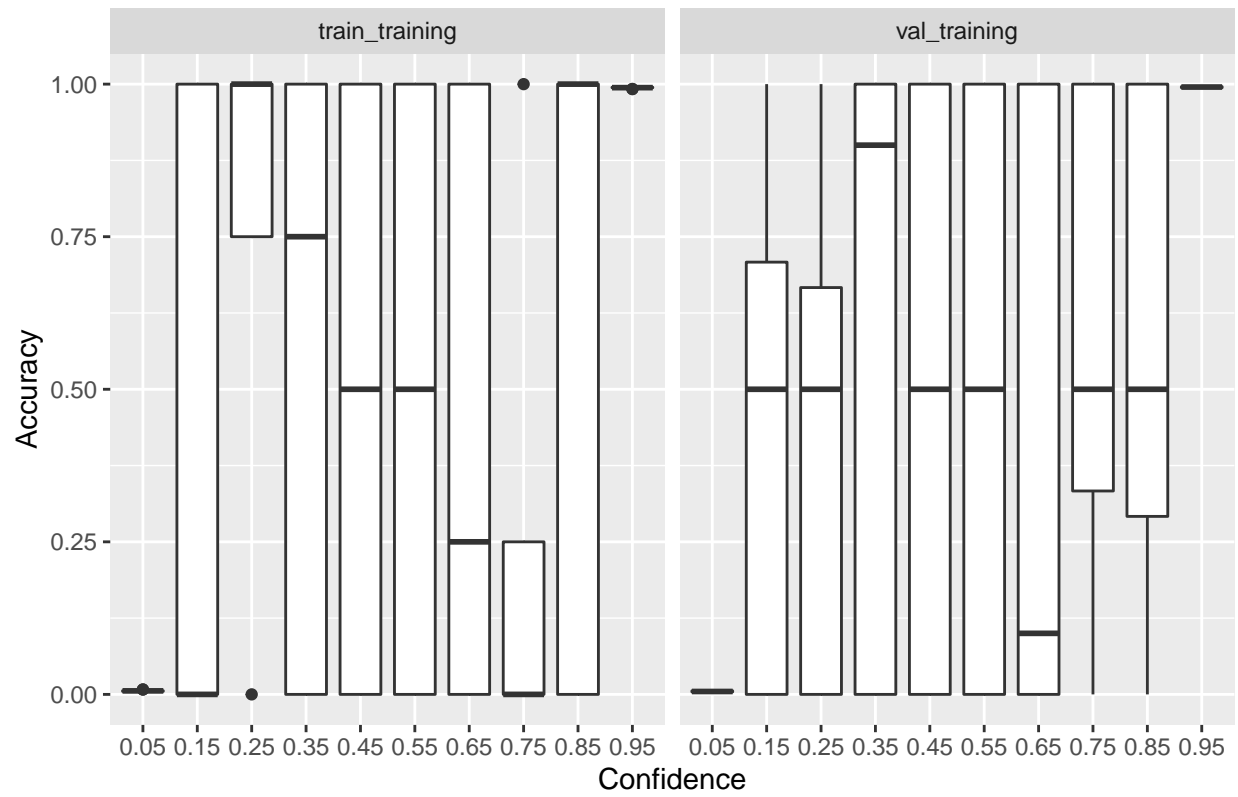
## Warning: Removed 256 rows containing non-finite values (stat\_boxplot).

## Classes 3 vs 7

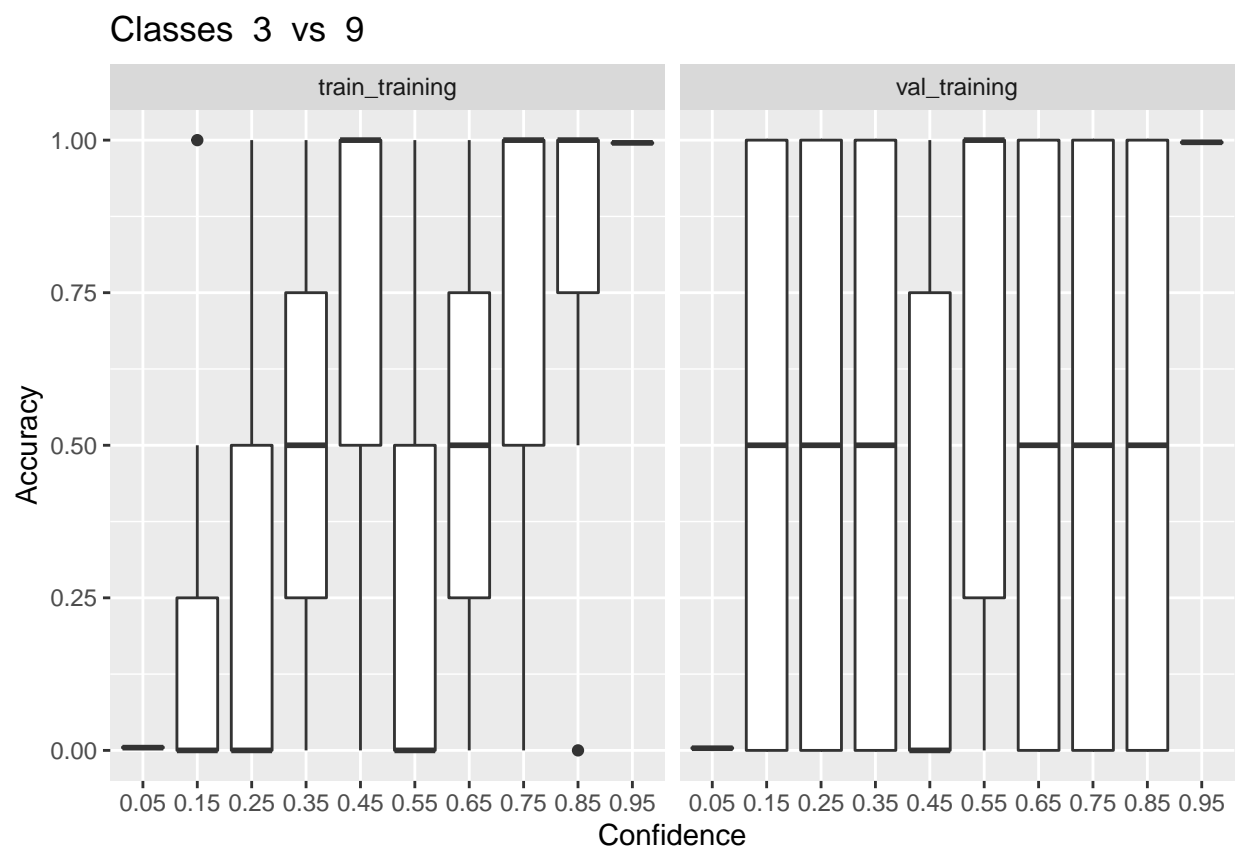


## Warning: Removed 254 rows containing non-finite values (stat\_boxplot).

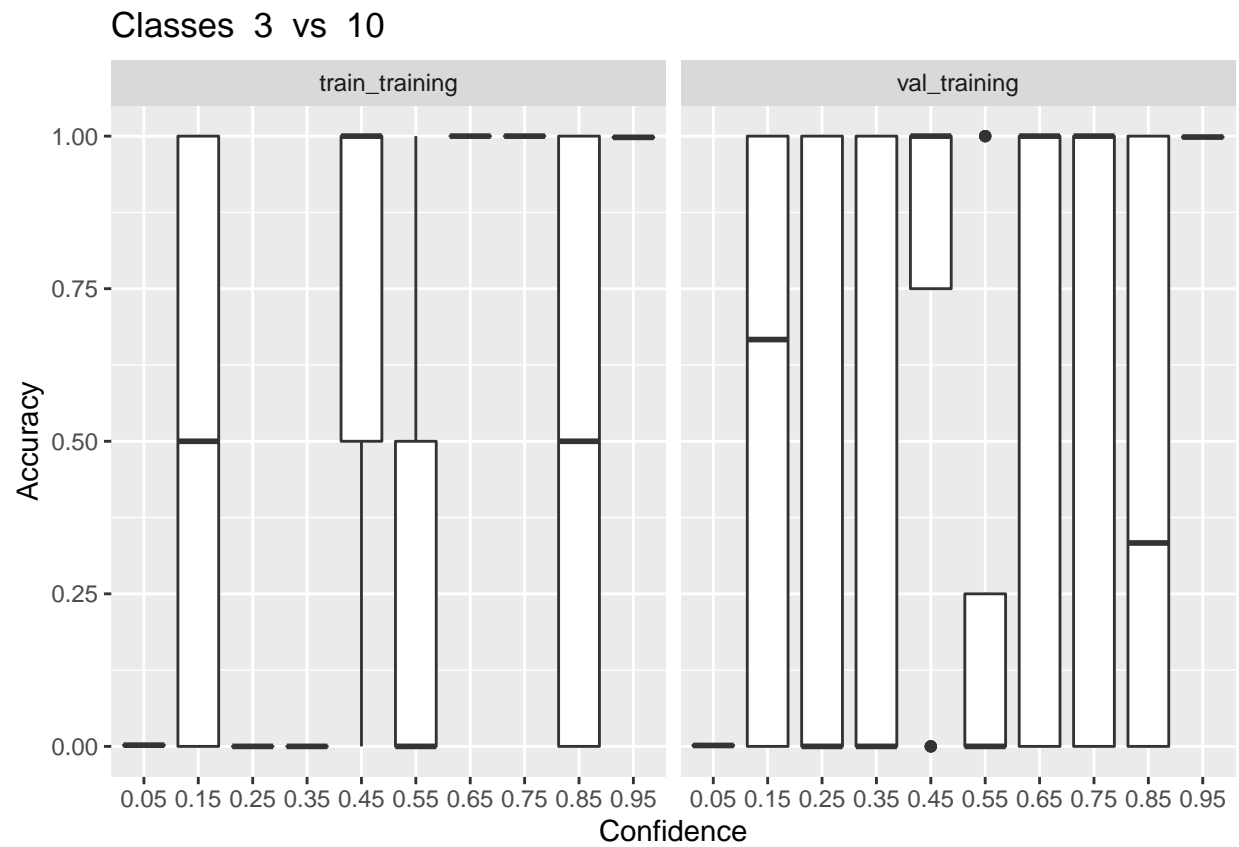
## Classes 3 vs 8



## Warning: Removed 308 rows containing non-finite values (stat\_boxplot).

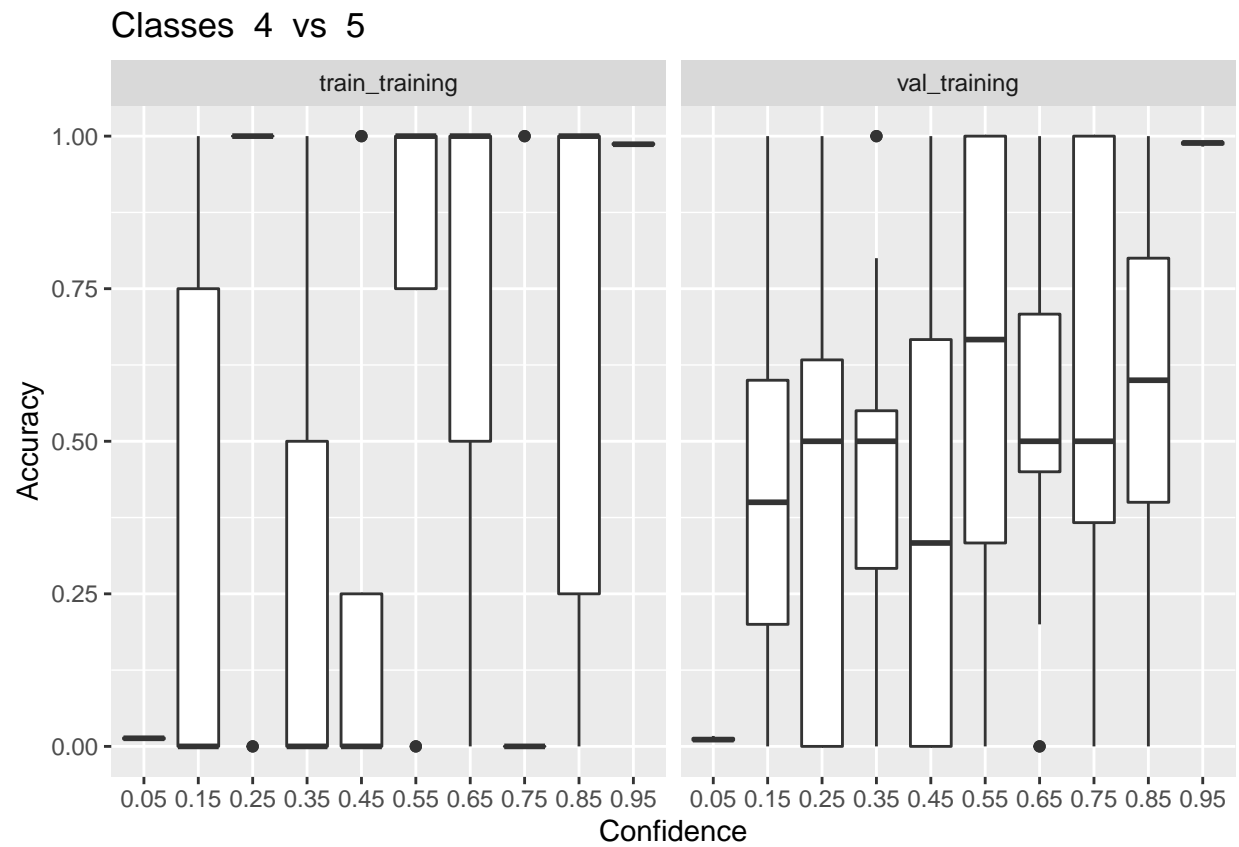


## Warning: Removed 376 rows containing non-finite values (stat\_boxplot).



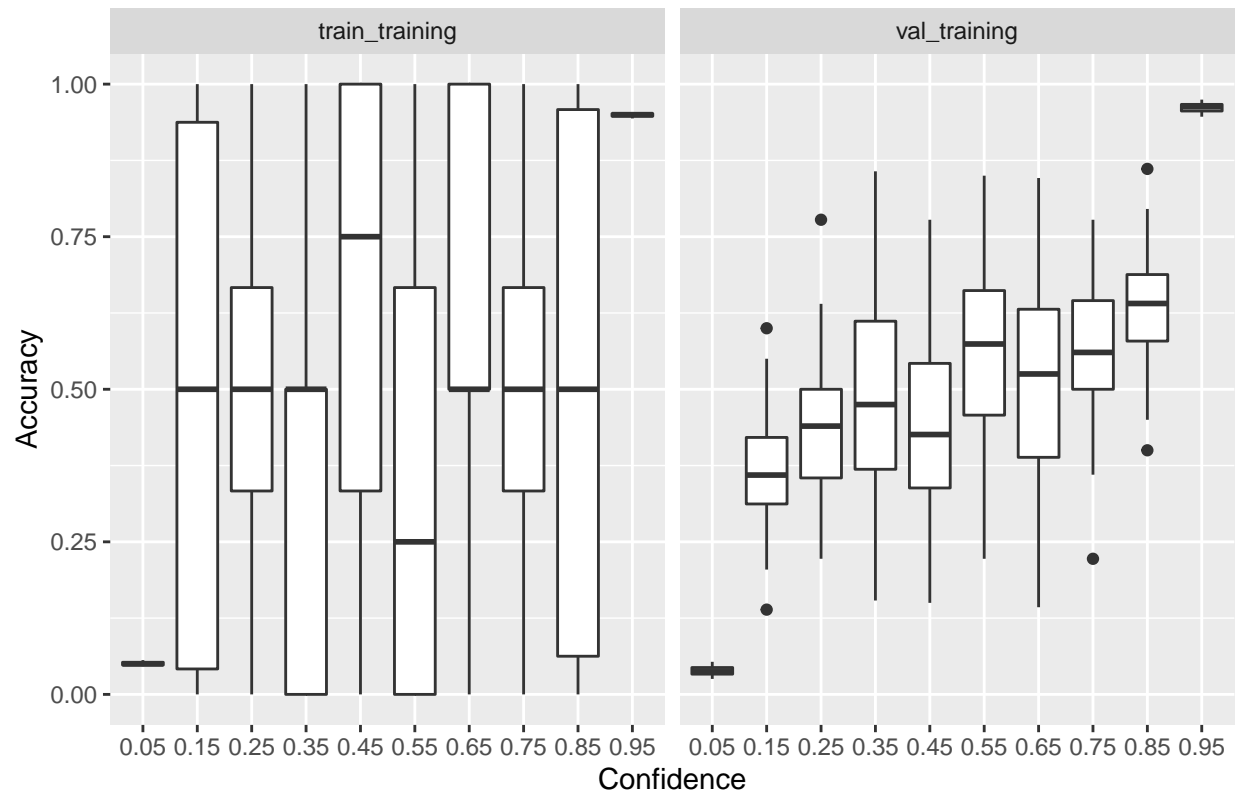
## Warning: Removed 182 rows containing non-finite values (stat\_boxplot).





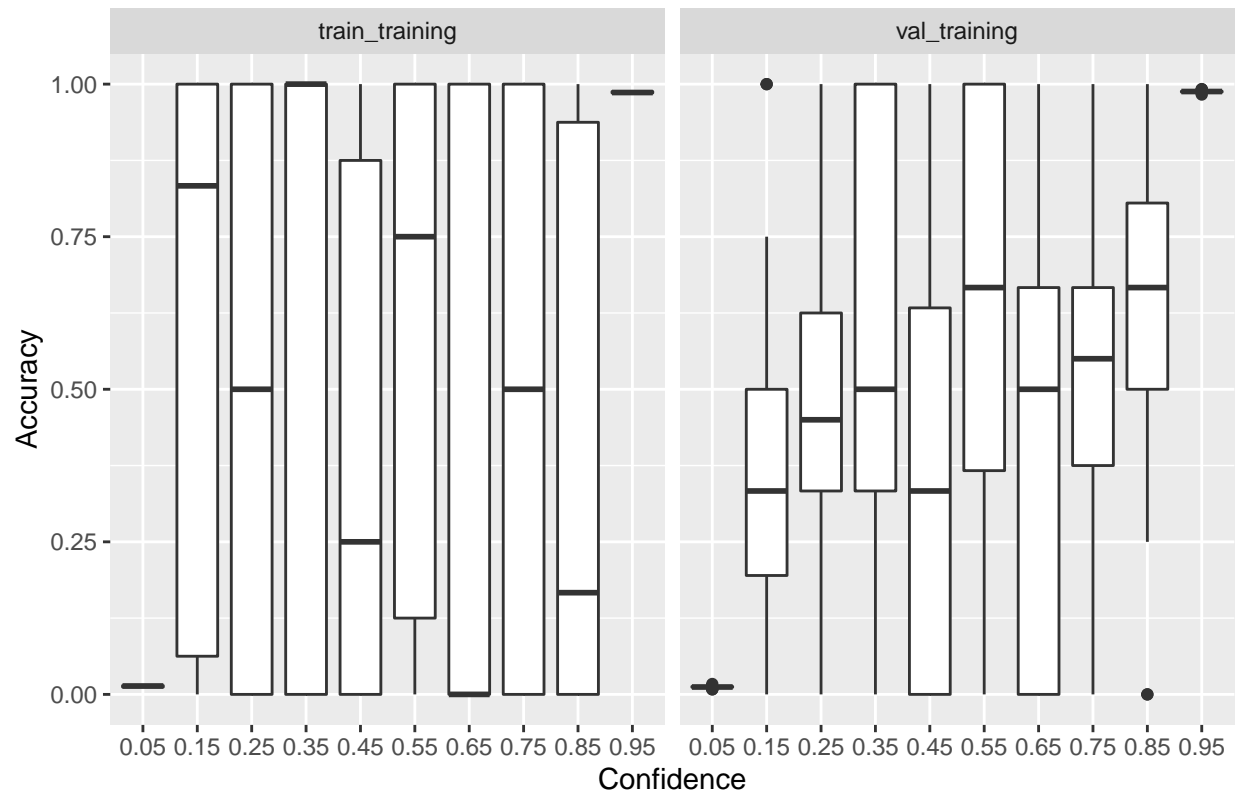
## Warning: Removed 44 rows containing non-finite values (stat\_boxplot).

## Classes 4 vs 6



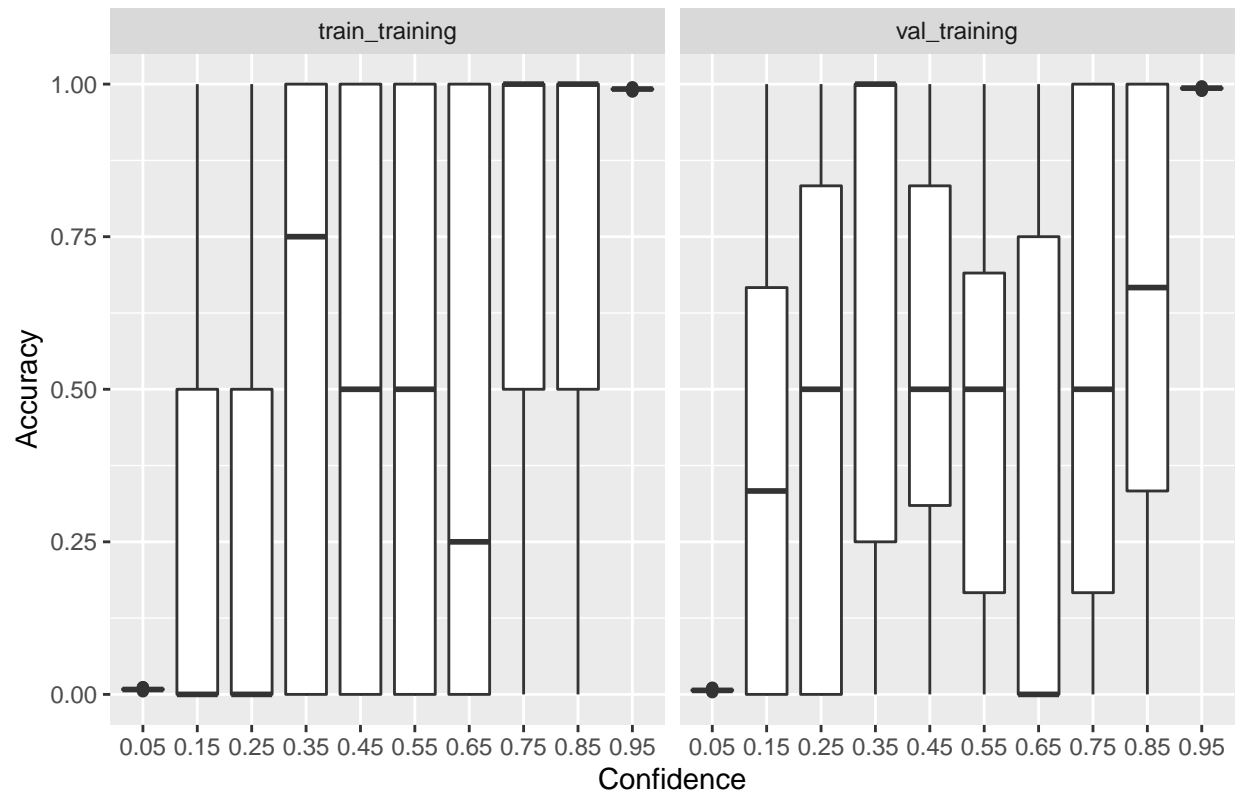
## Warning: Removed 162 rows containing non-finite values (stat\_boxplot).

## Classes 4 vs 7

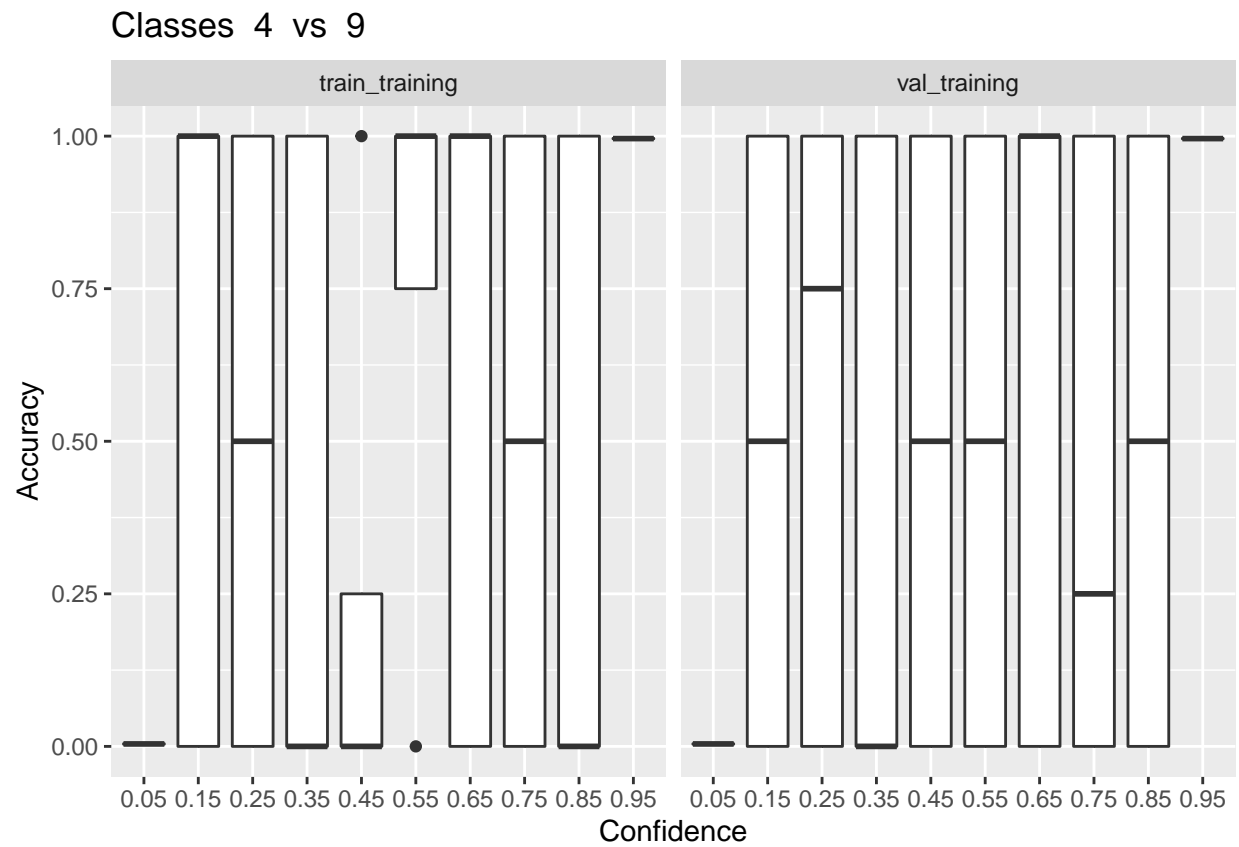


## Warning: Removed 232 rows containing non-finite values (stat\_boxplot).

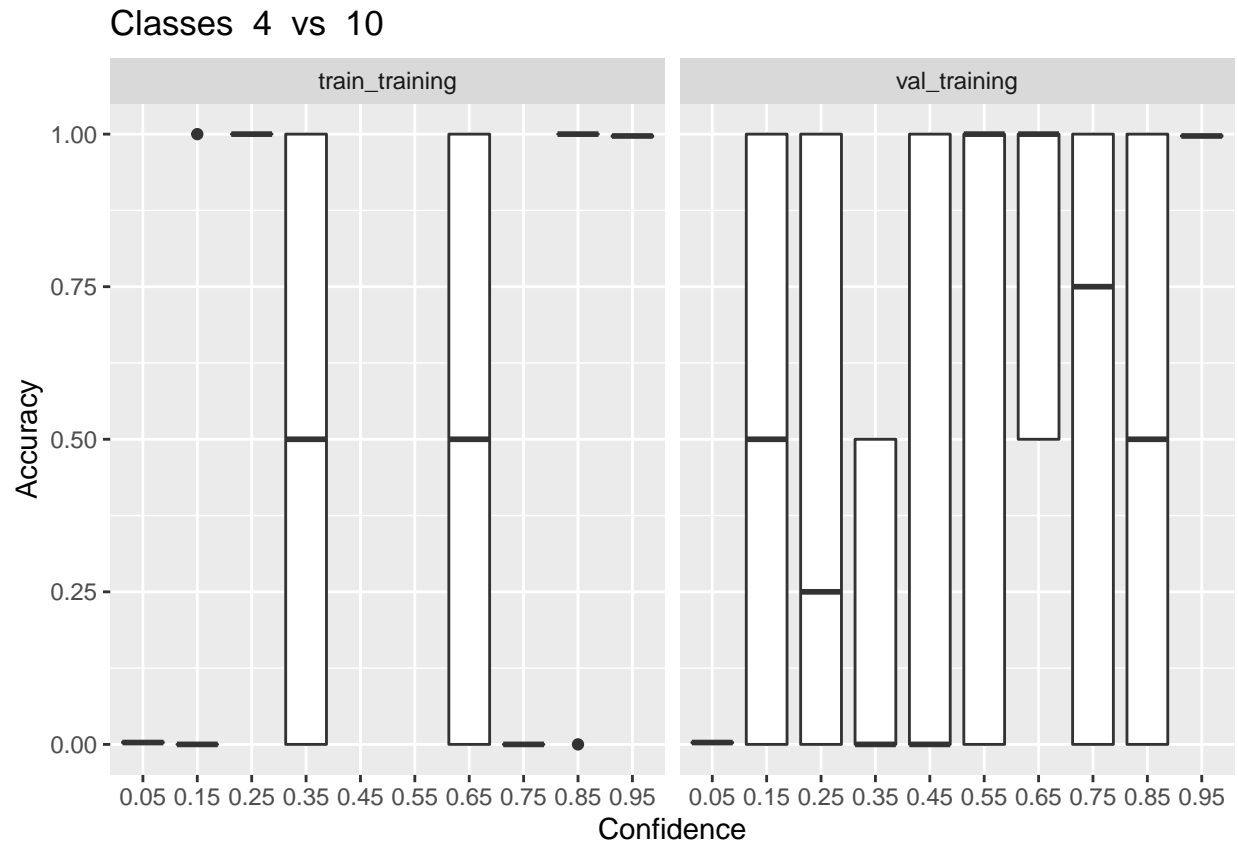
## Classes 4 vs 8



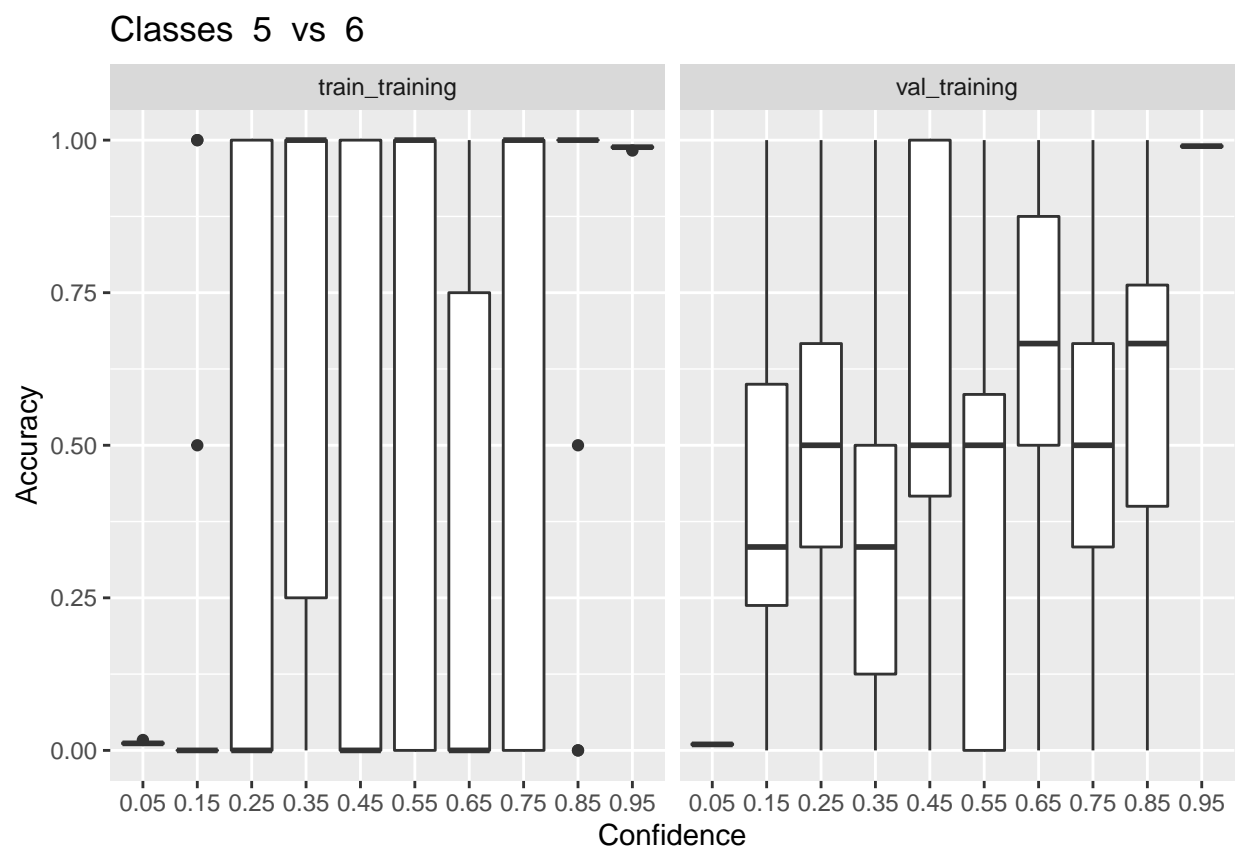
## Warning: Removed 344 rows containing non-finite values (stat\_boxplot).



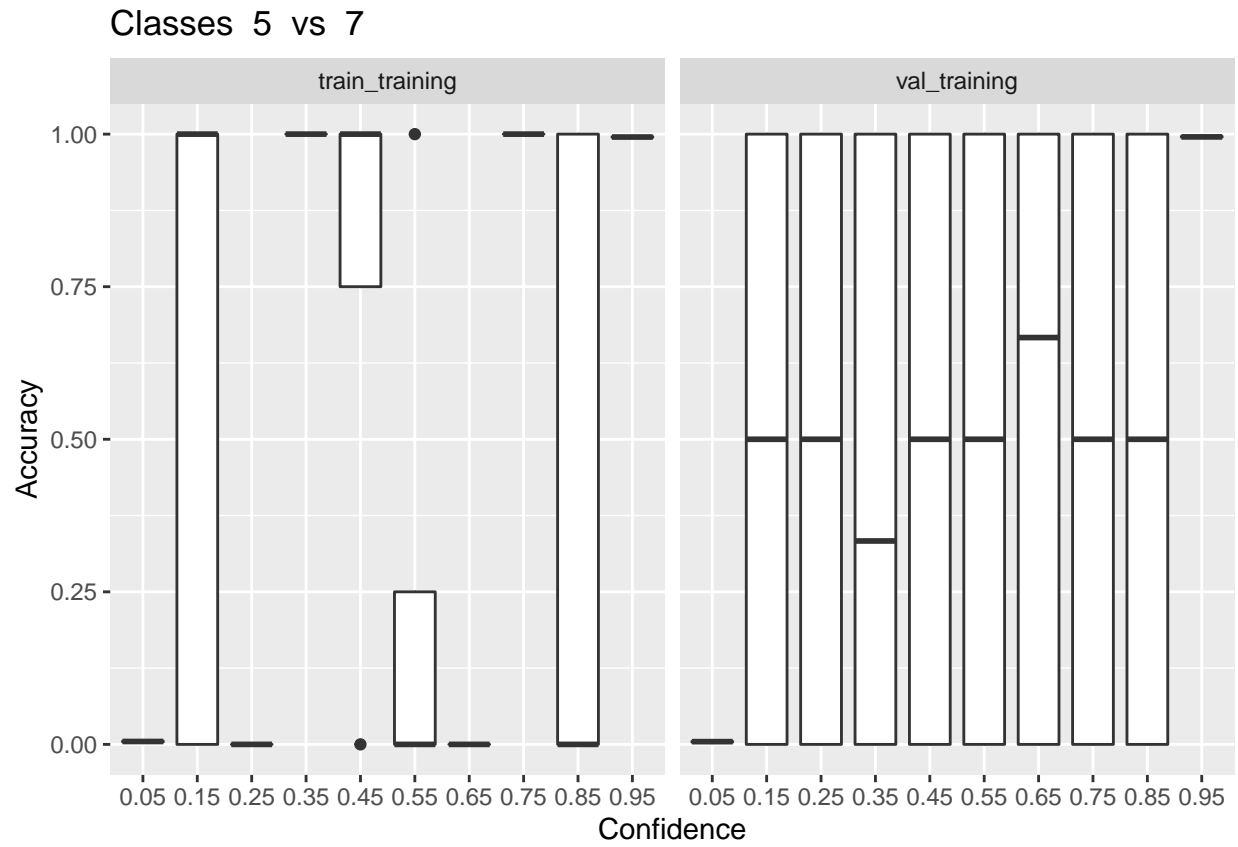
## Warning: Removed 370 rows containing non-finite values (stat\_boxplot).



## Warning: Removed 178 rows containing non-finite values (stat\_boxplot).

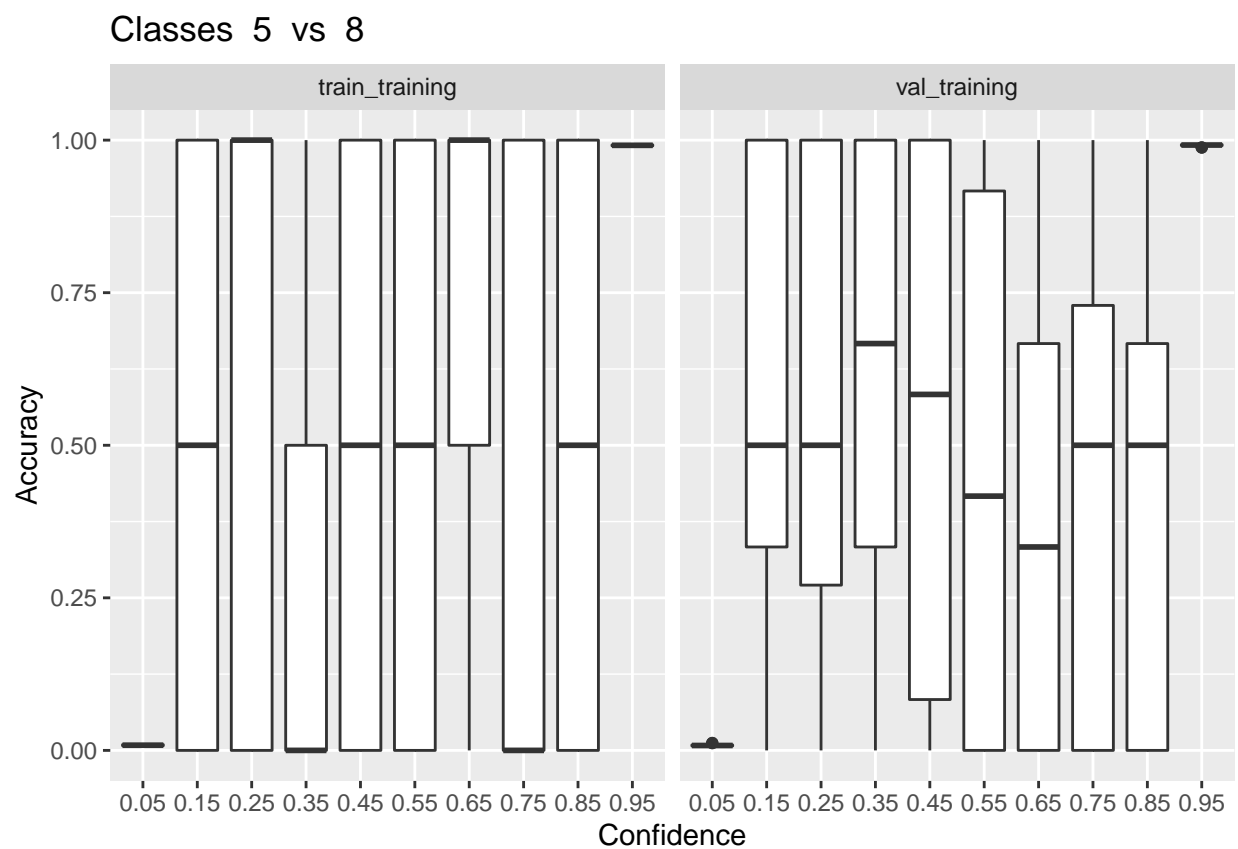


## Warning: Removed 344 rows containing non-finite values (stat\_boxplot).

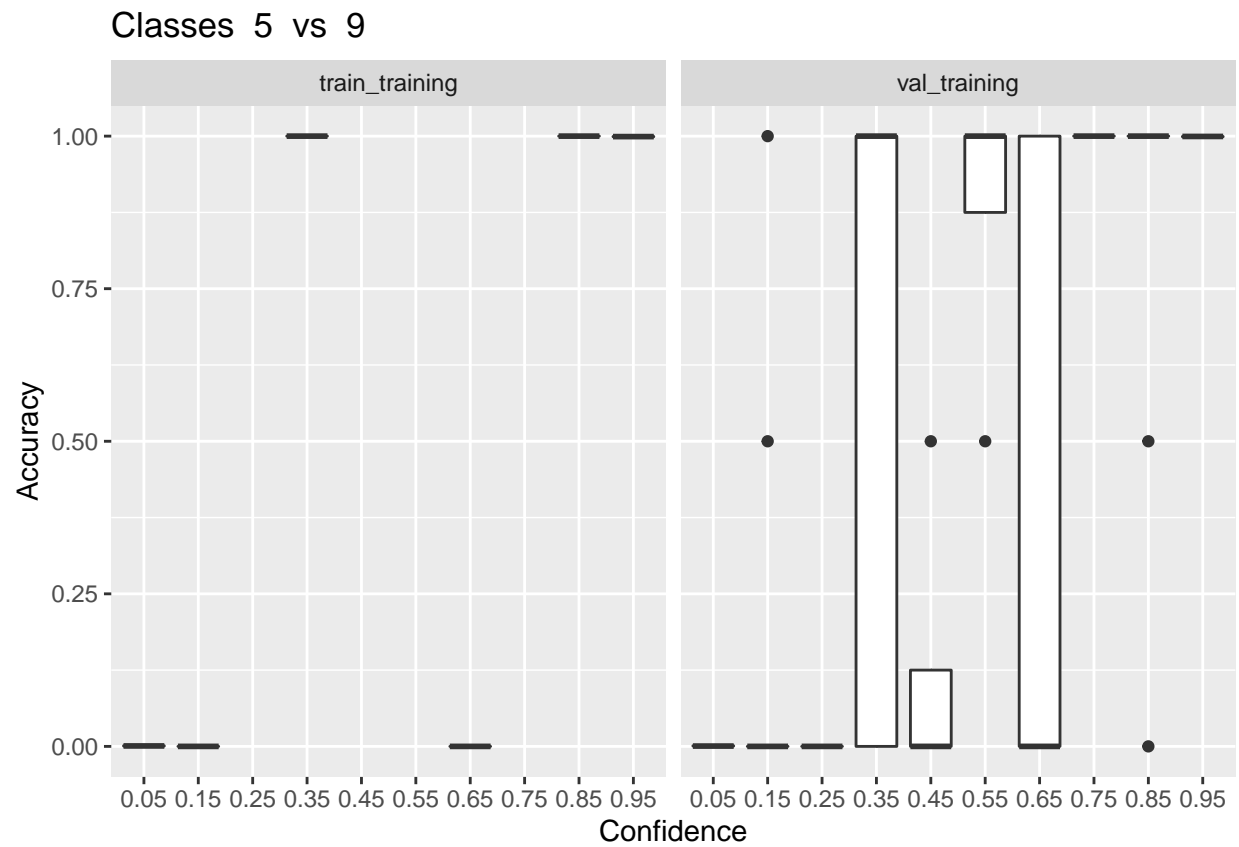


## Warning: Removed 252 rows containing non-finite values (stat\_boxplot).

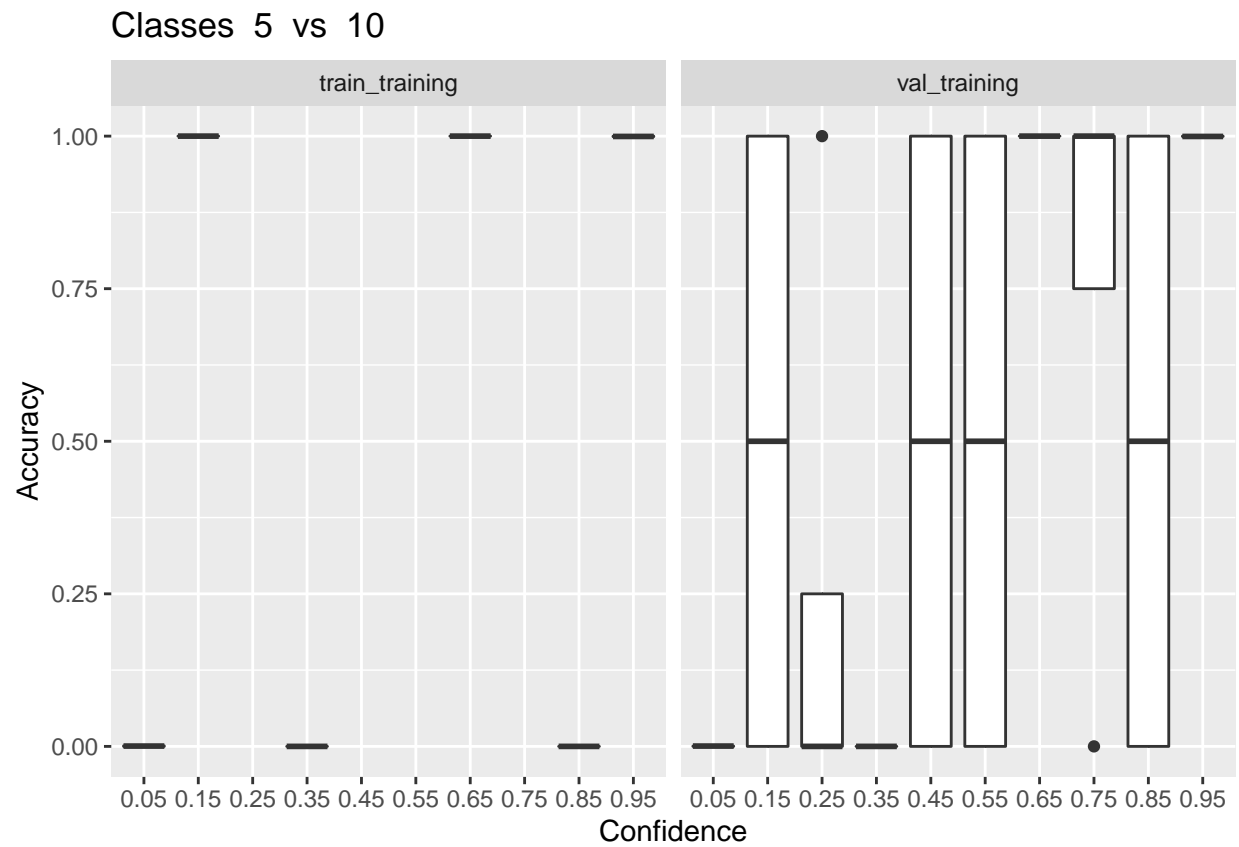




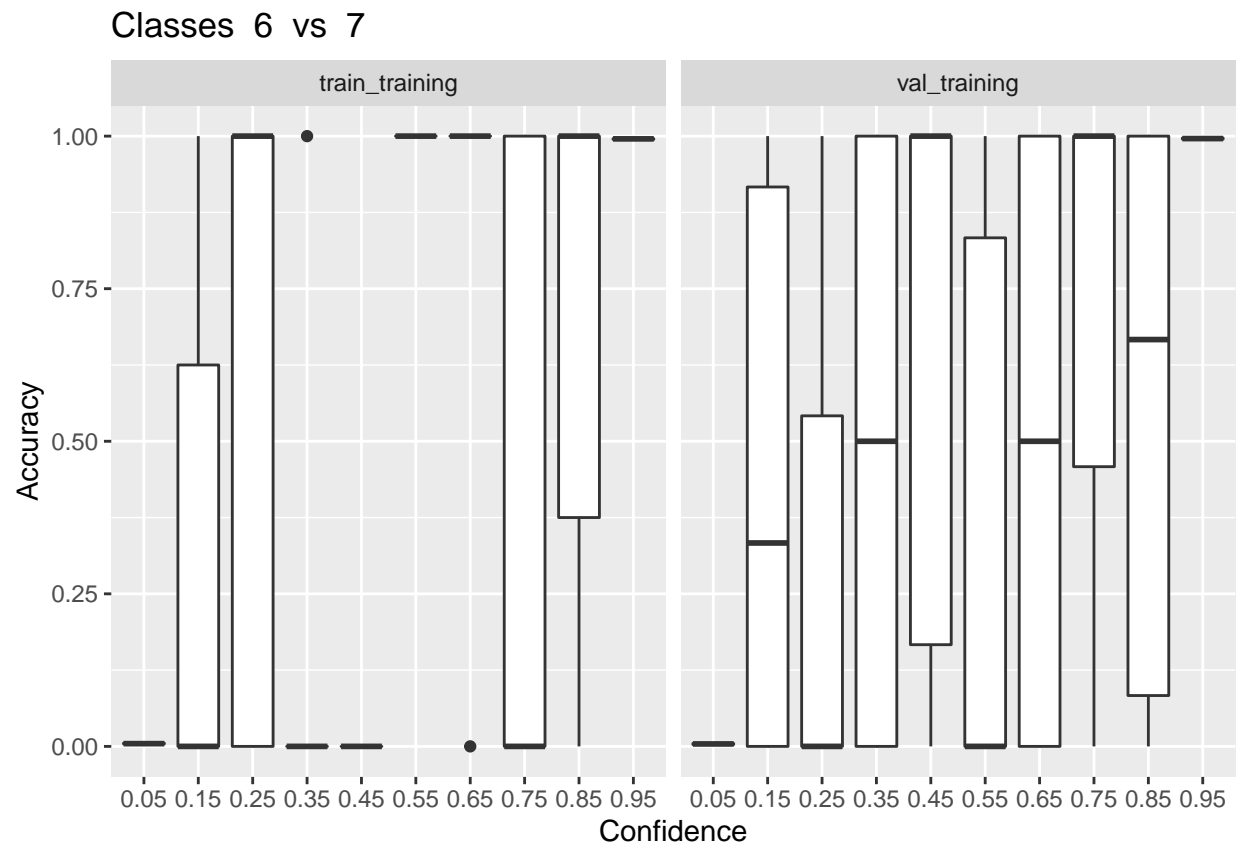
## Warning: Removed 432 rows containing non-finite values (stat\_boxplot).



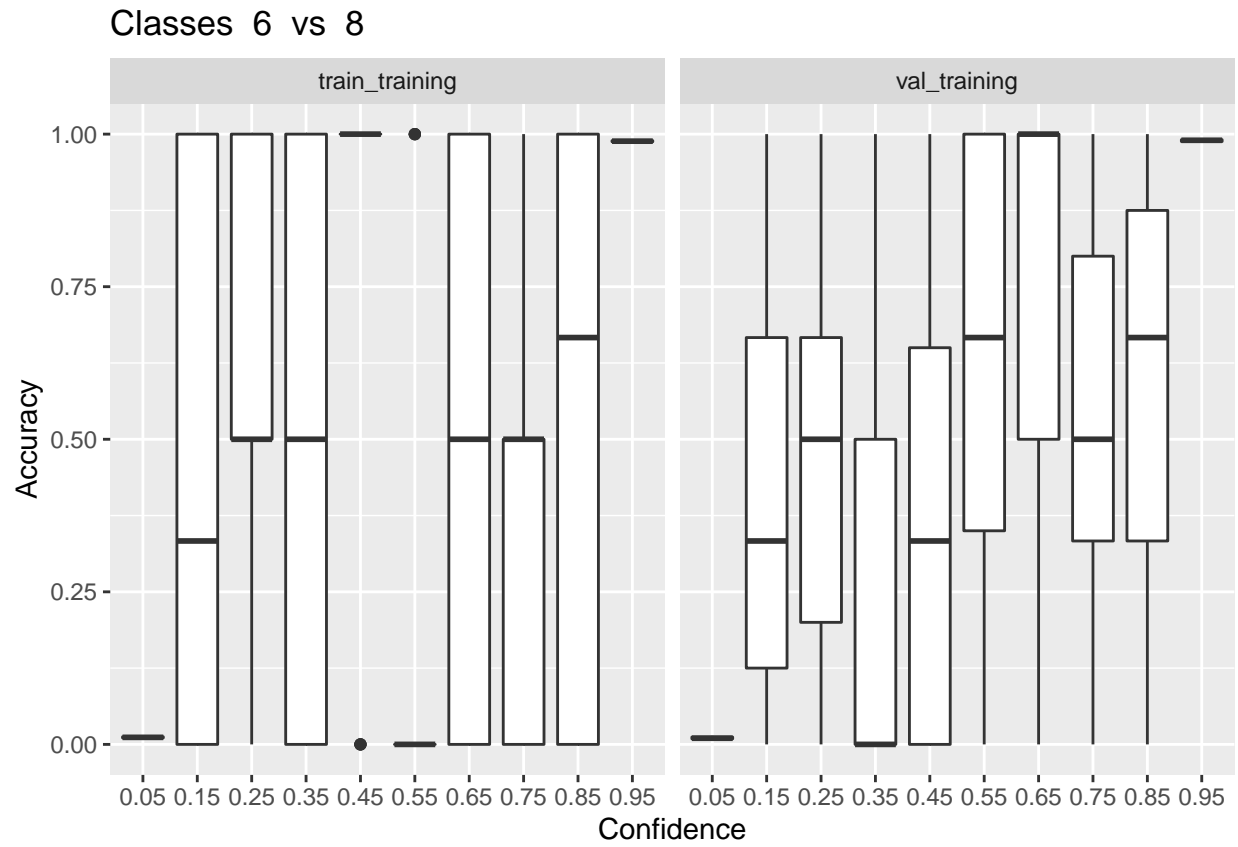
## Warning: Removed 428 rows containing non-finite values (stat\_boxplot).



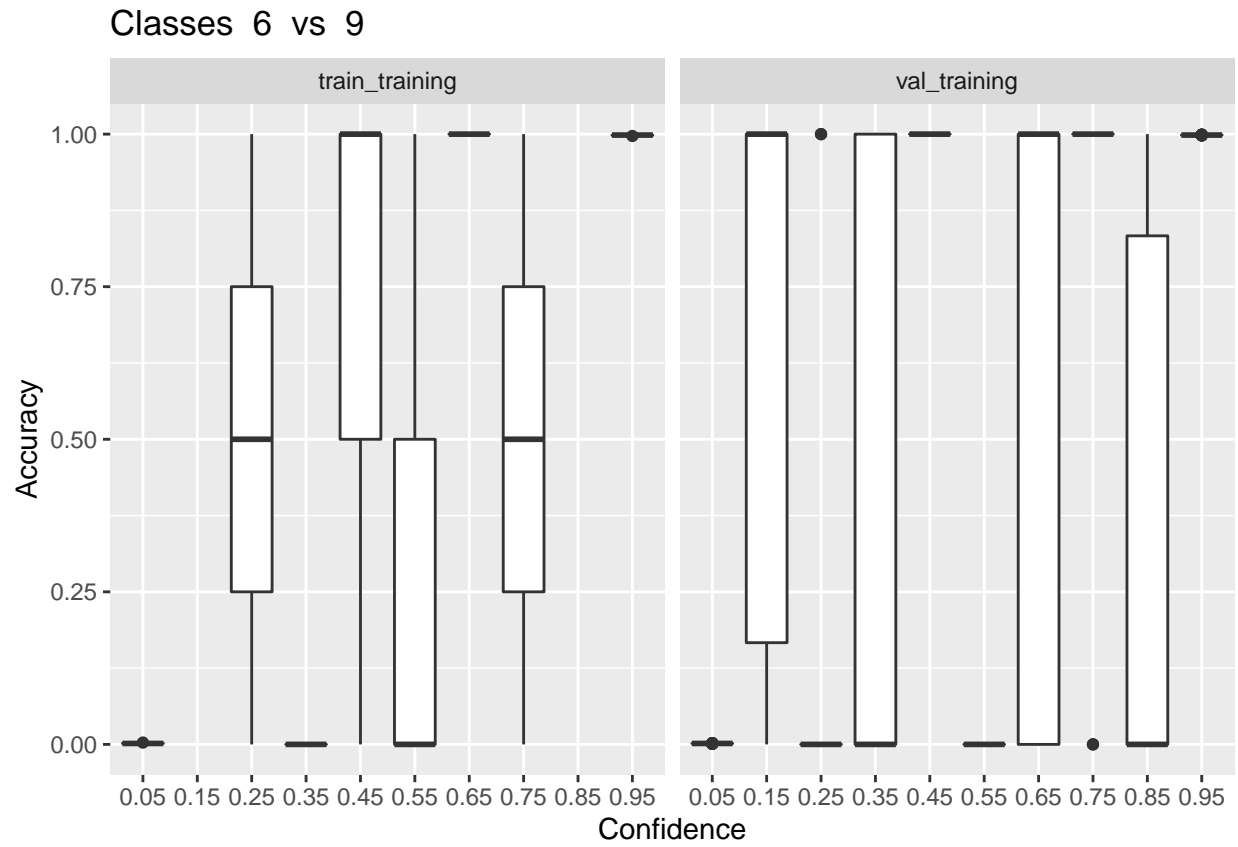
## Warning: Removed 282 rows containing non-finite values (stat\_boxplot).



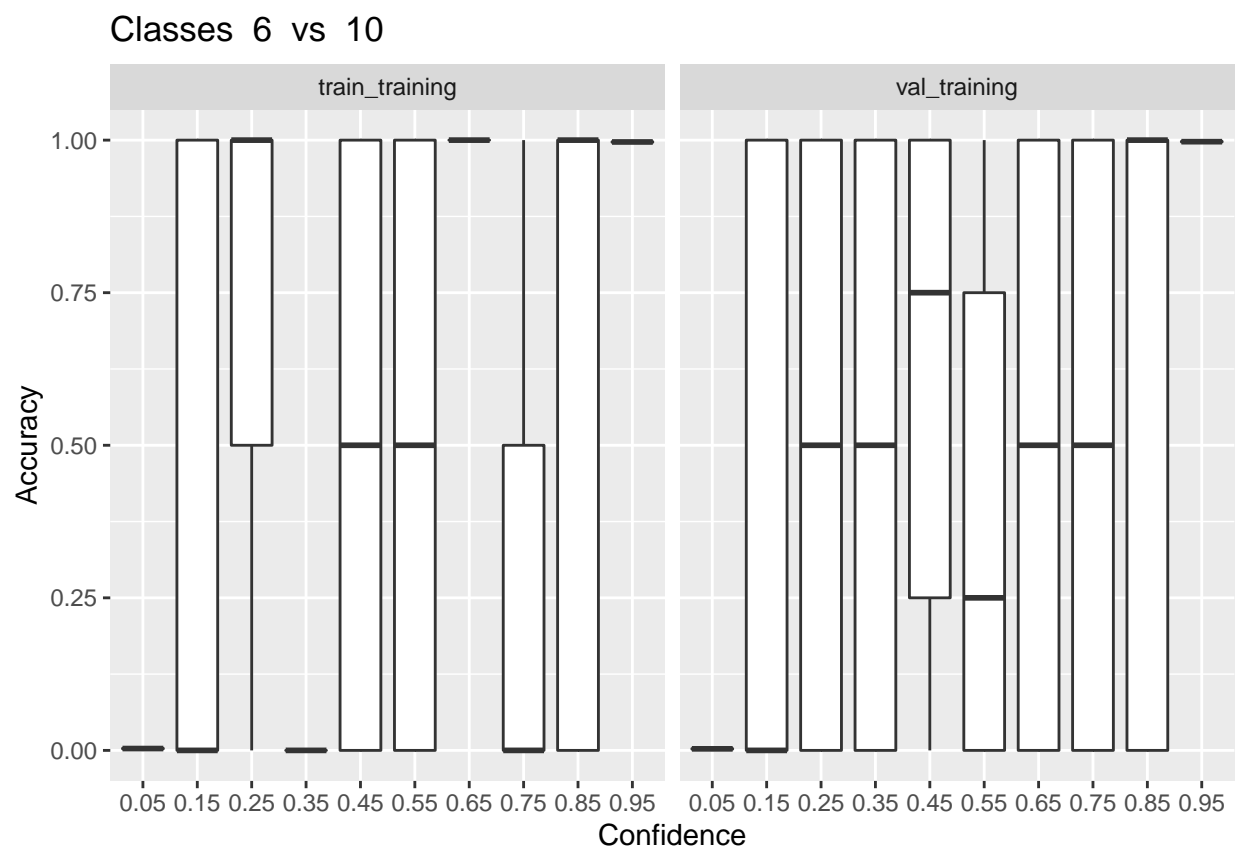
## Warning: Removed 184 rows containing non-finite values (stat\_boxplot).



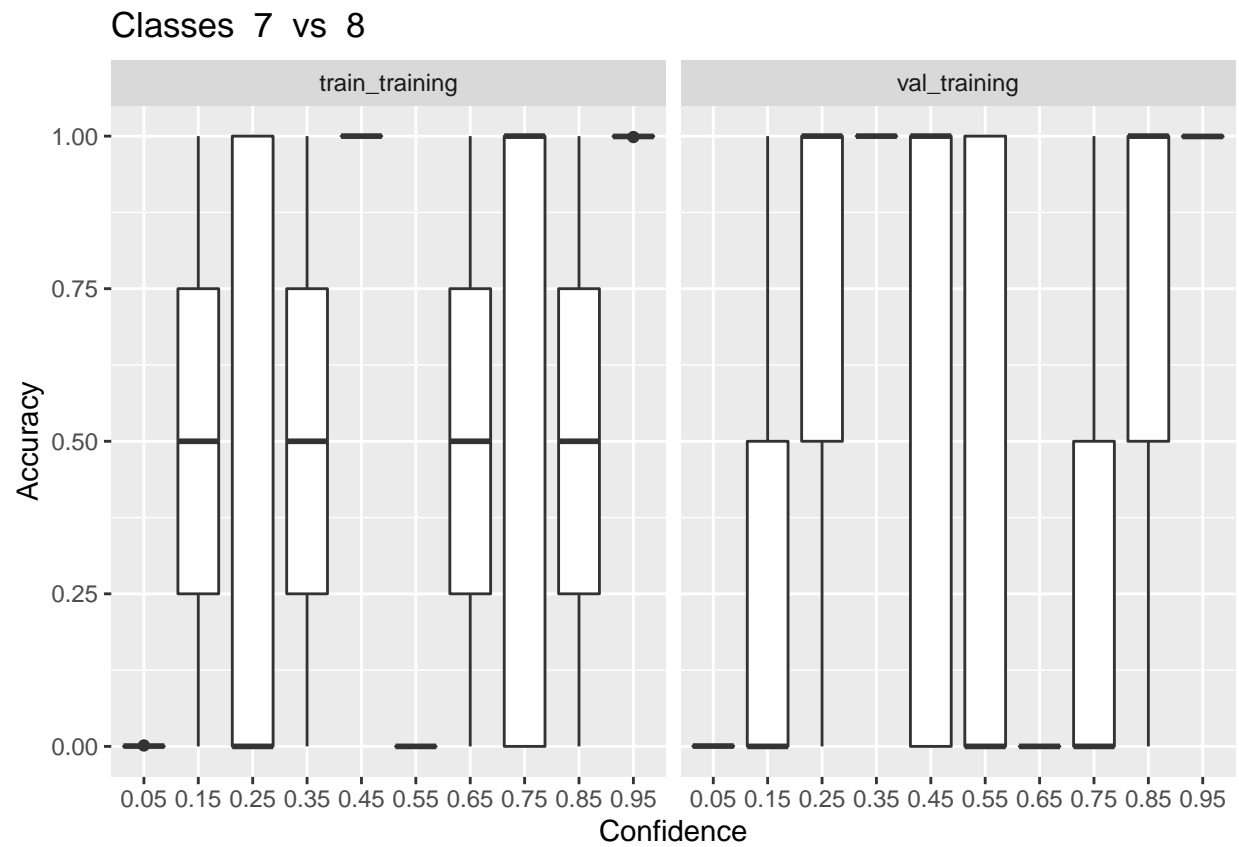
## Warning: Removed 402 rows containing non-finite values (stat\_boxplot).



## Warning: Removed 348 rows containing non-finite values (stat\_boxplot).

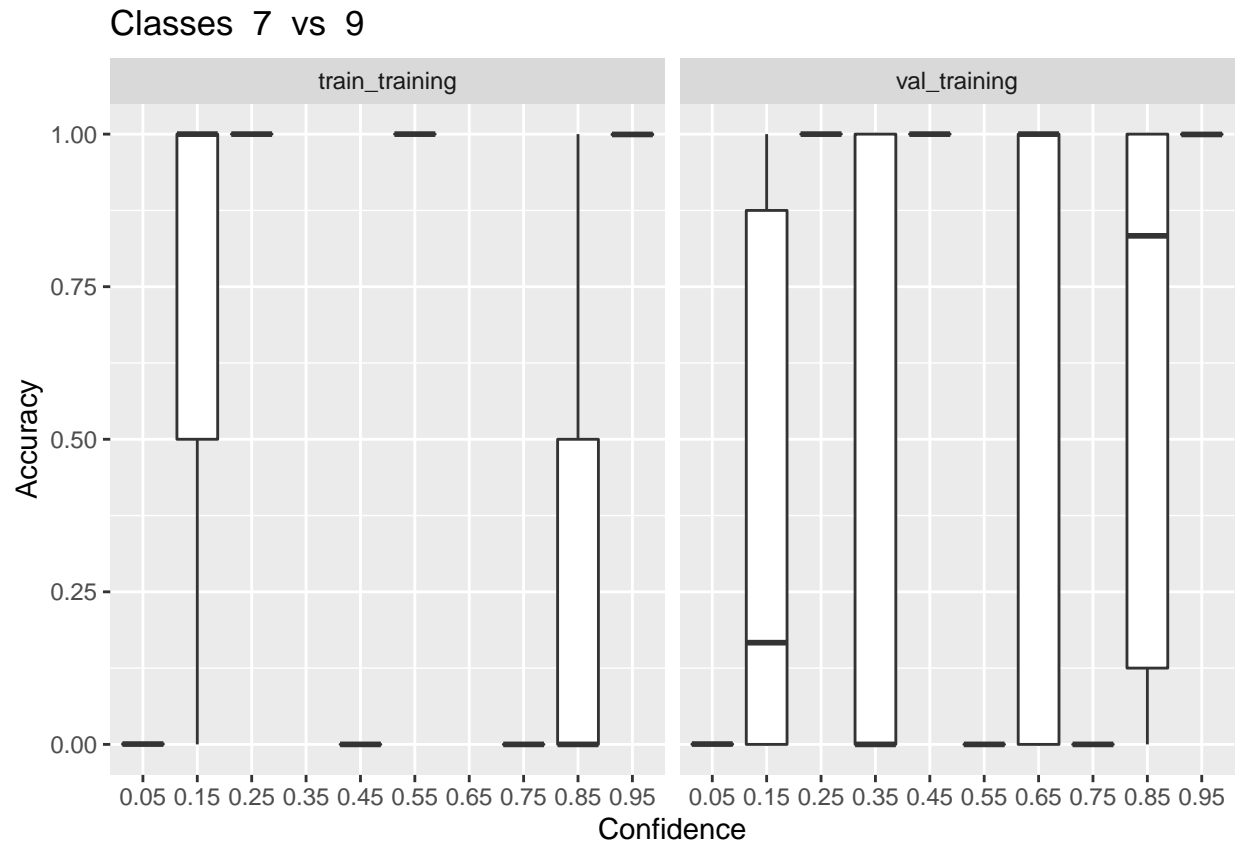


## Warning: Removed 410 rows containing non-finite values (stat\_boxplot).

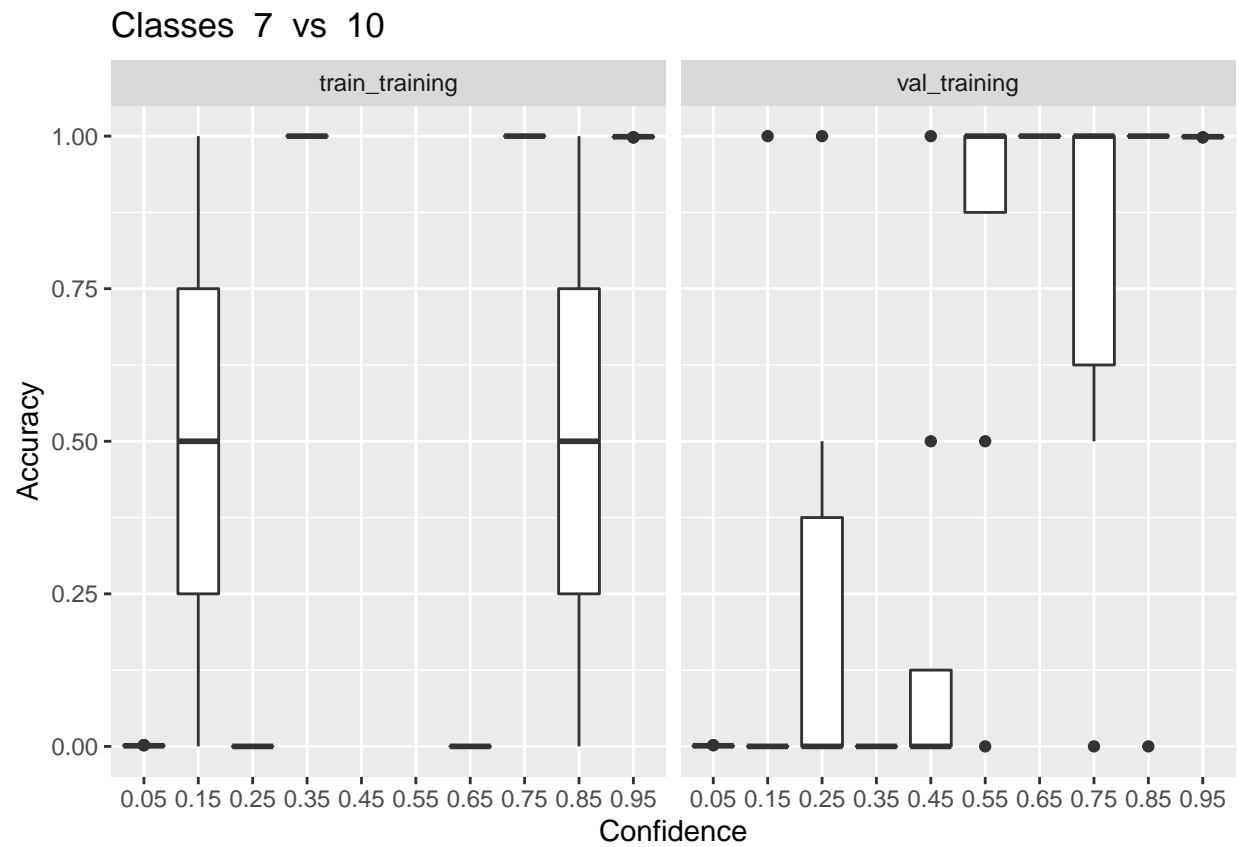


## Warning: Removed 432 rows containing non-finite values (stat\_boxplot).

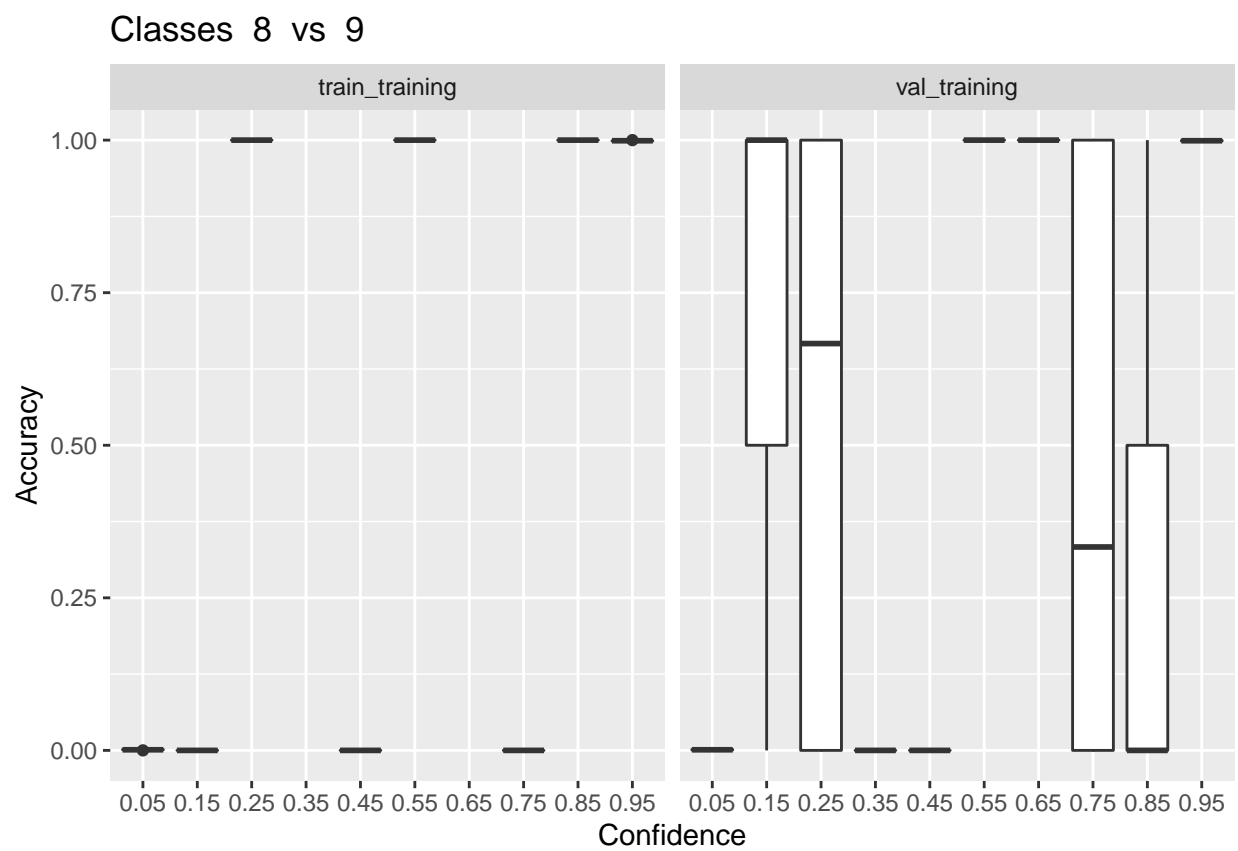




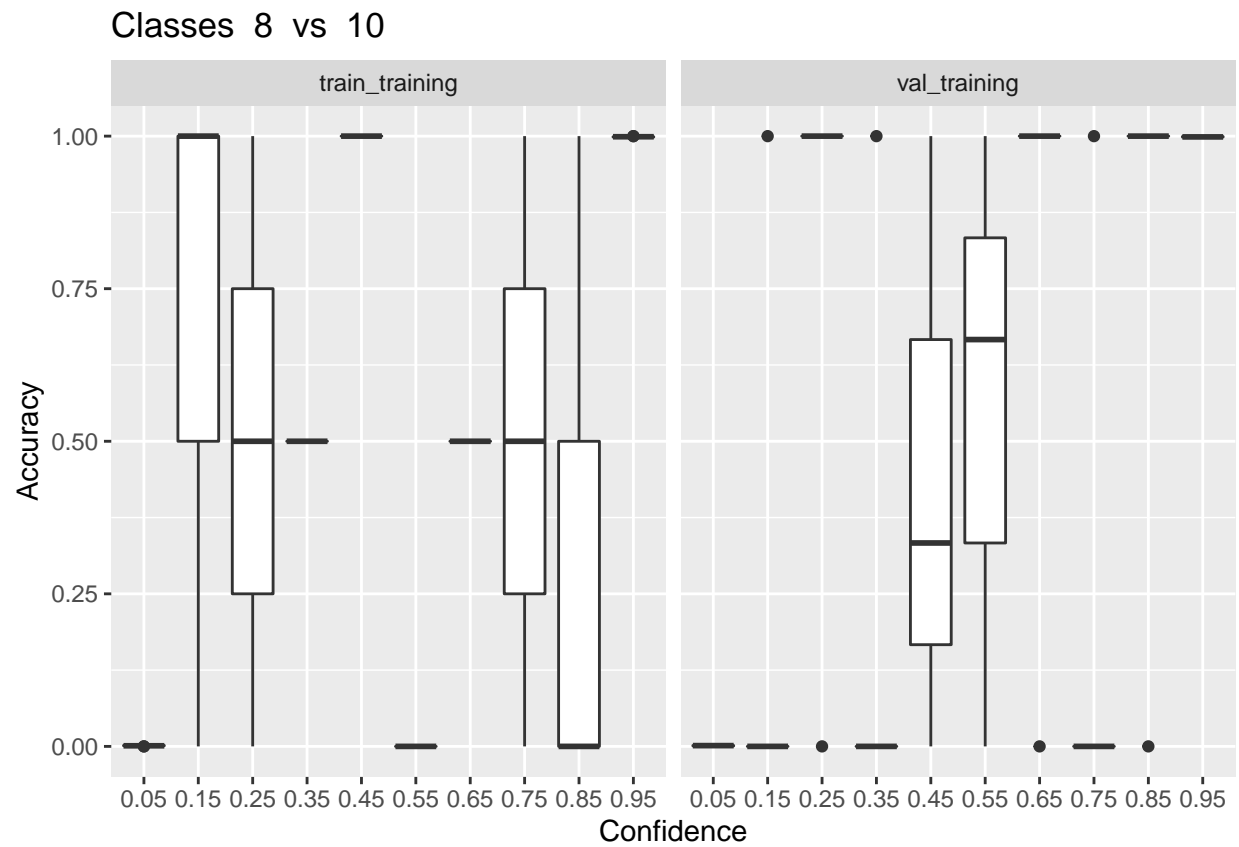
## Warning: Removed 422 rows containing non-finite values (stat\_boxplot).



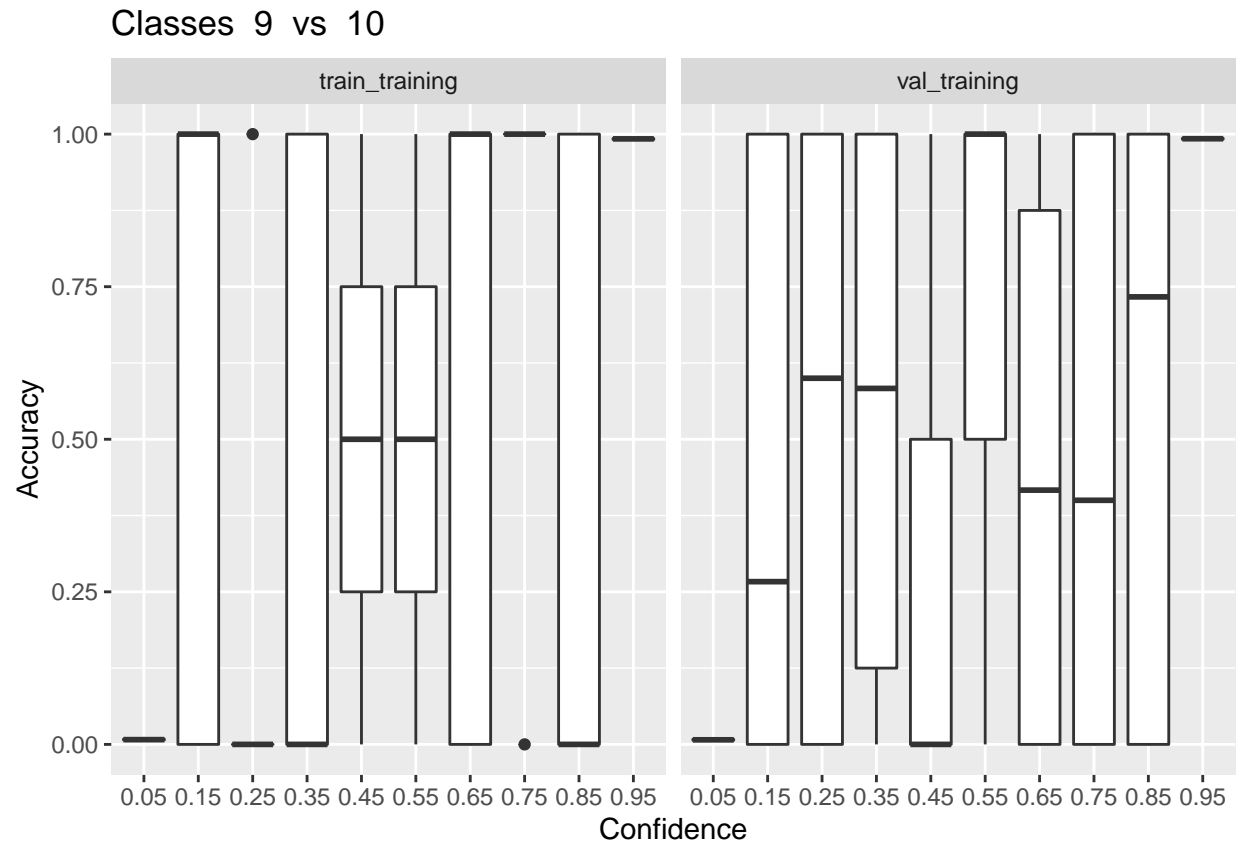
## Warning: Removed 432 rows containing non-finite values (stat\_boxplot).



## Warning: Removed 420 rows containing non-finite values (stat\_boxplot).



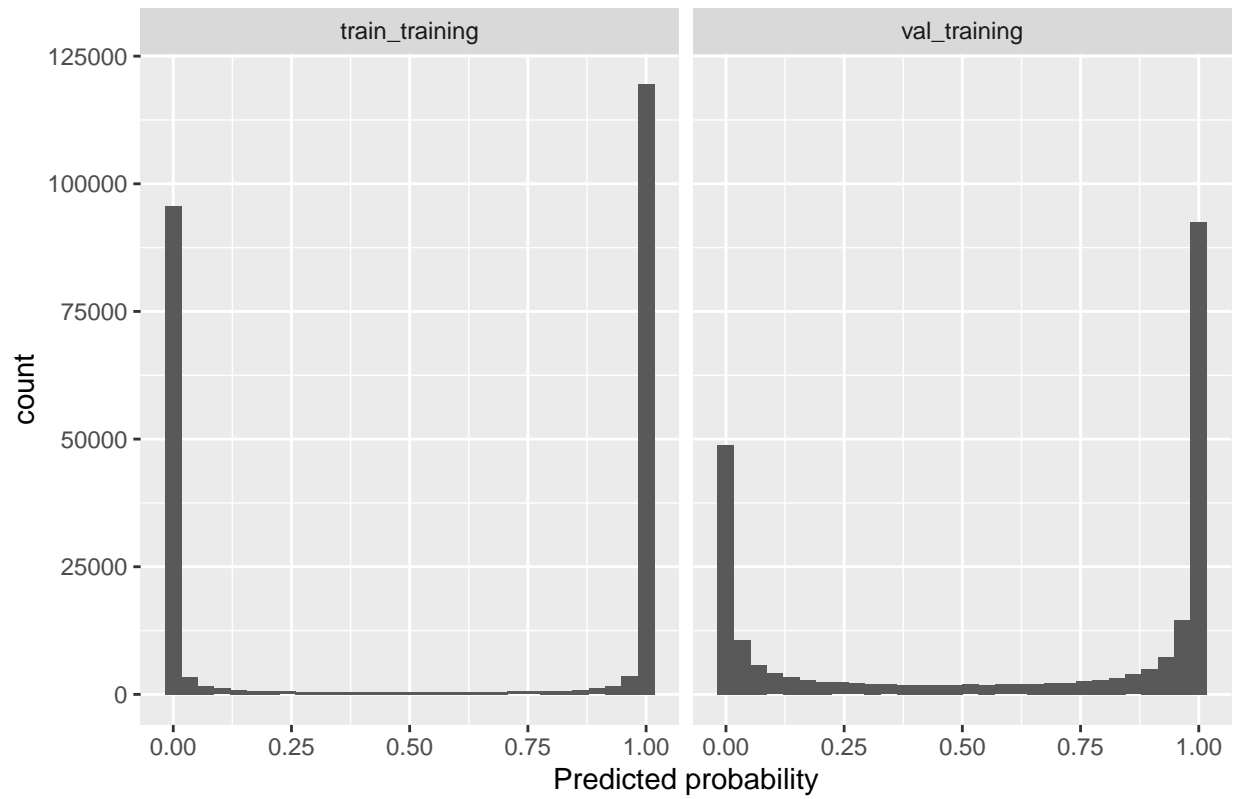
## Warning: Removed 316 rows containing non-finite values (stat\_boxplot).



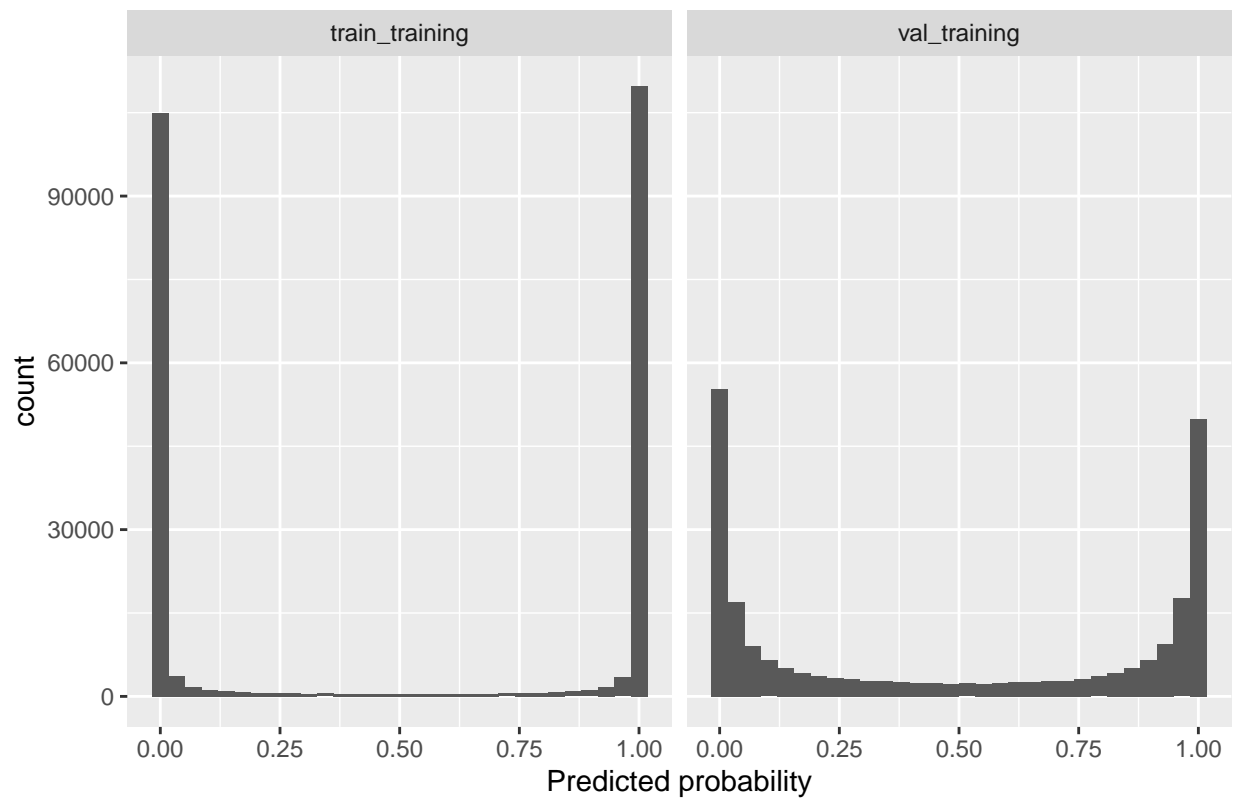
```
for (c11 in 1:(classes - 1))
{
  for (c12 in (c11 + 1):classes)
  {
    irrel_plt <- ens_pw_irrel %>% filter(class1 == (c11 - 1) & class2 == (c12 - 1)) %>% ggplot() +
      geom_histogram(mapping=aes(x=pred1), bins=30) + facet_wrap(~train_set) +
      ggtitle(paste("Predictions for irrelevant classes by LDA ", c11, " vs ", c12)) +
      xlab("Predicted probability")

    print(irrel_plt)
  }
}
```

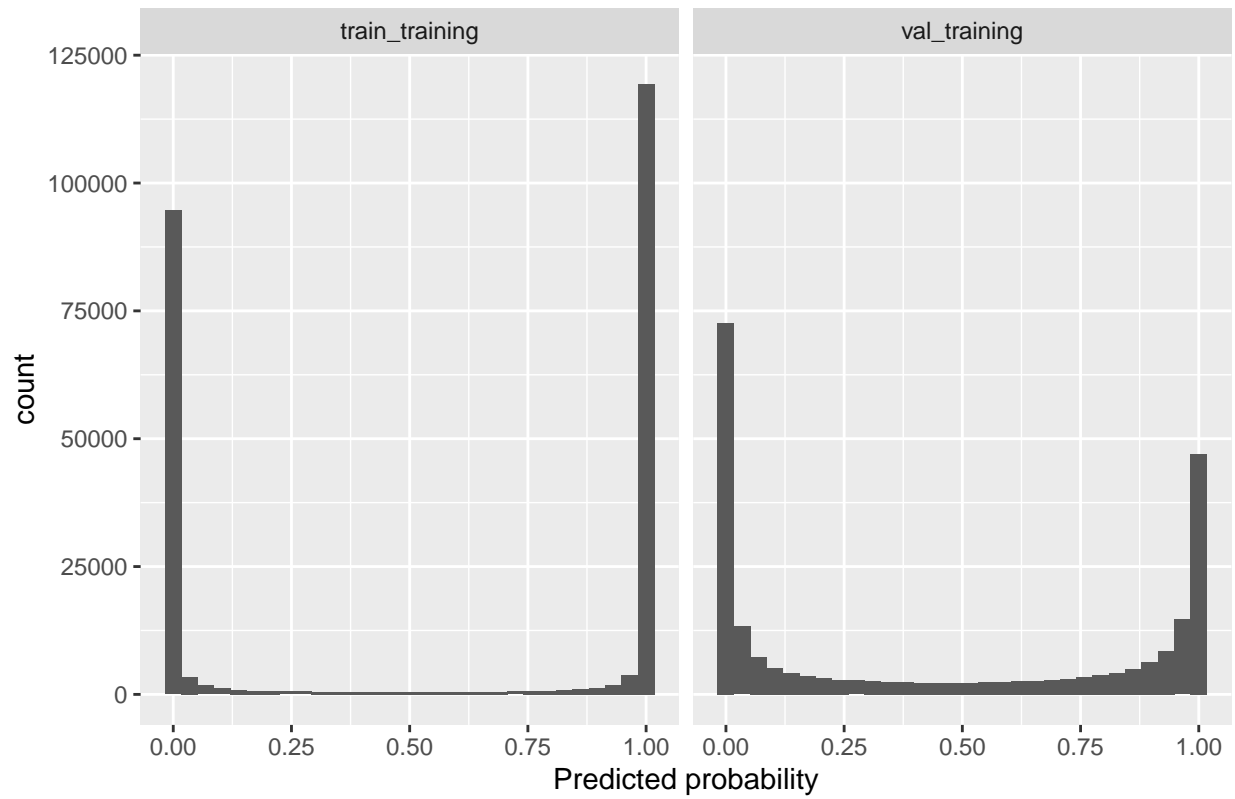
Predictions for irrelevant classes by LDA 1 vs 2



Predictions for irrelevant classes by LDA 1 vs 3

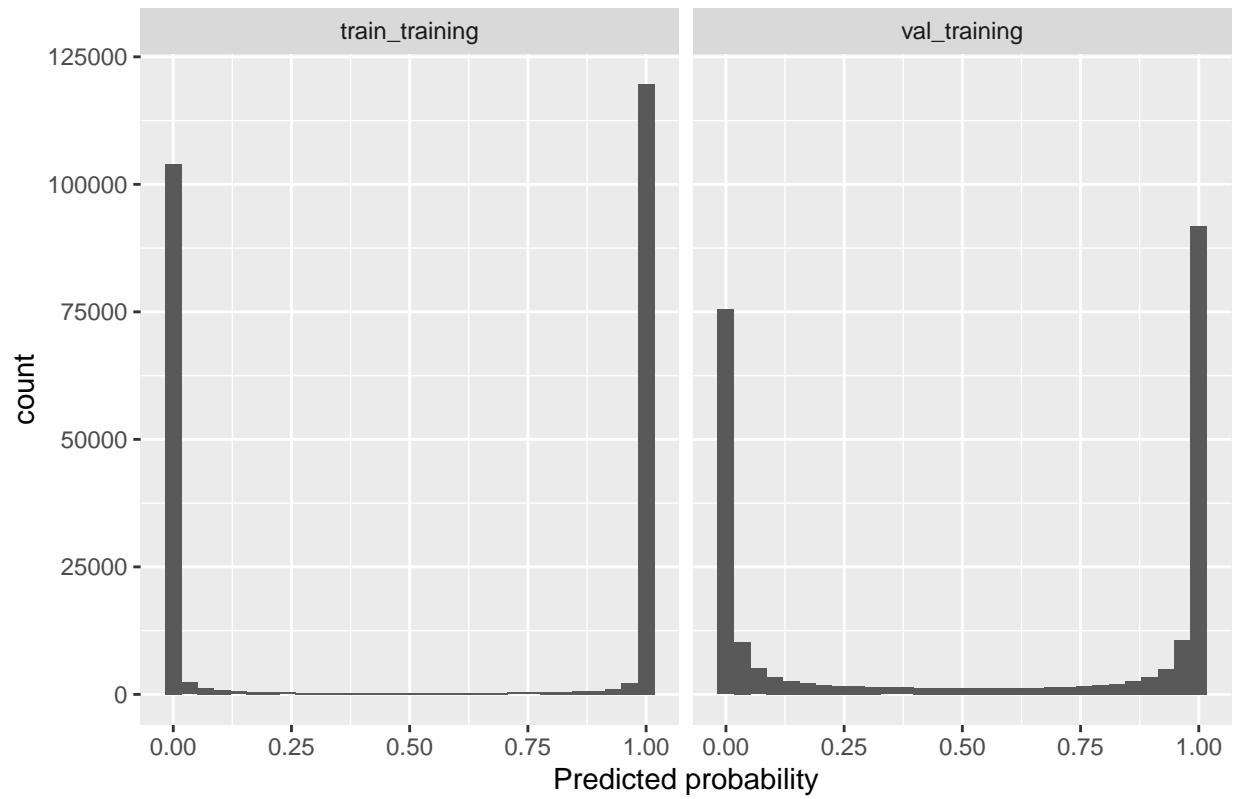


Predictions for irrelevant classes by LDA 1 vs 4

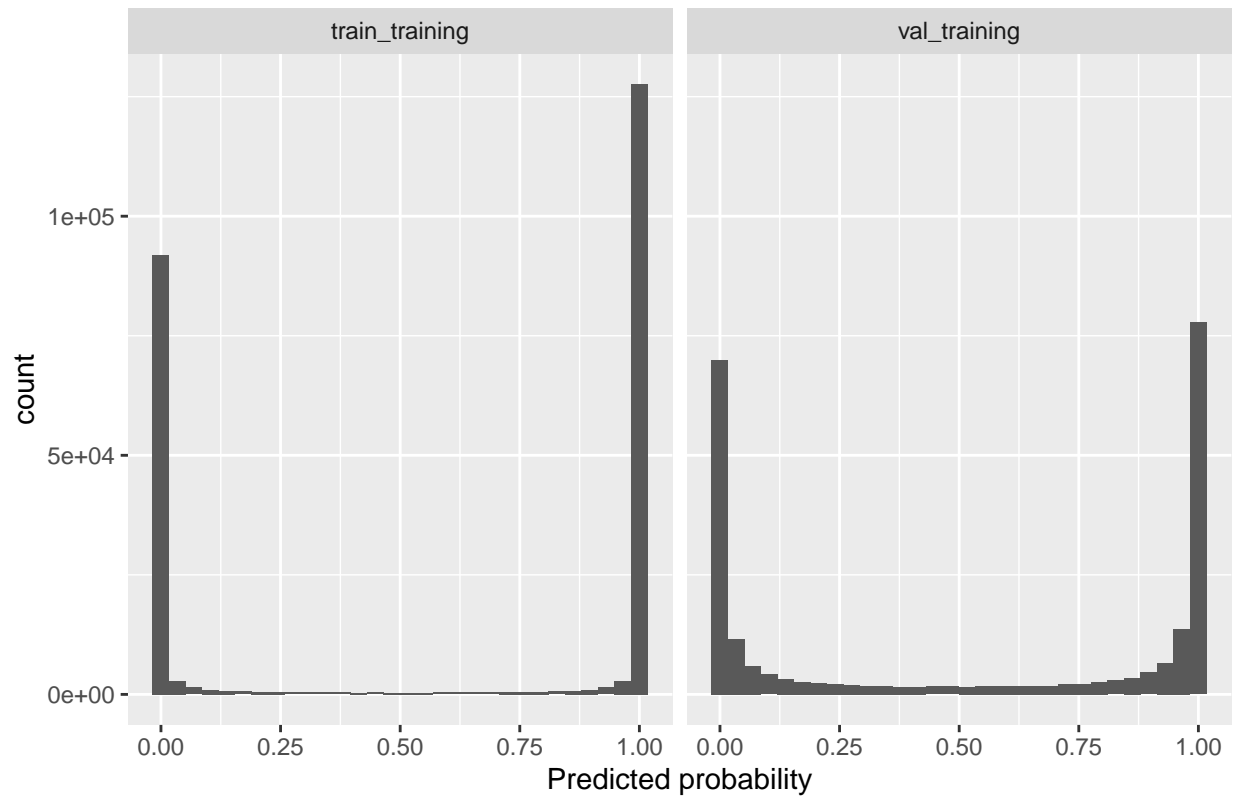




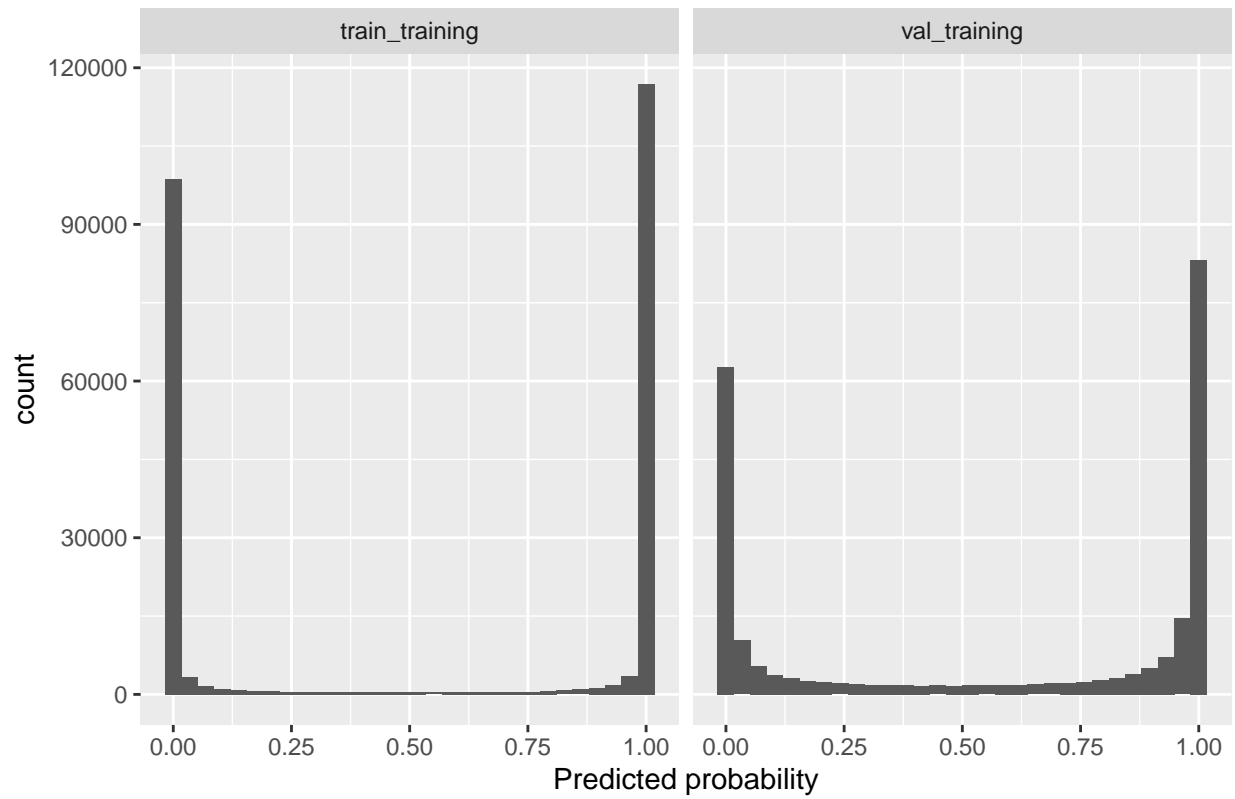
Predictions for irrelevant classes by LDA 1 vs 5



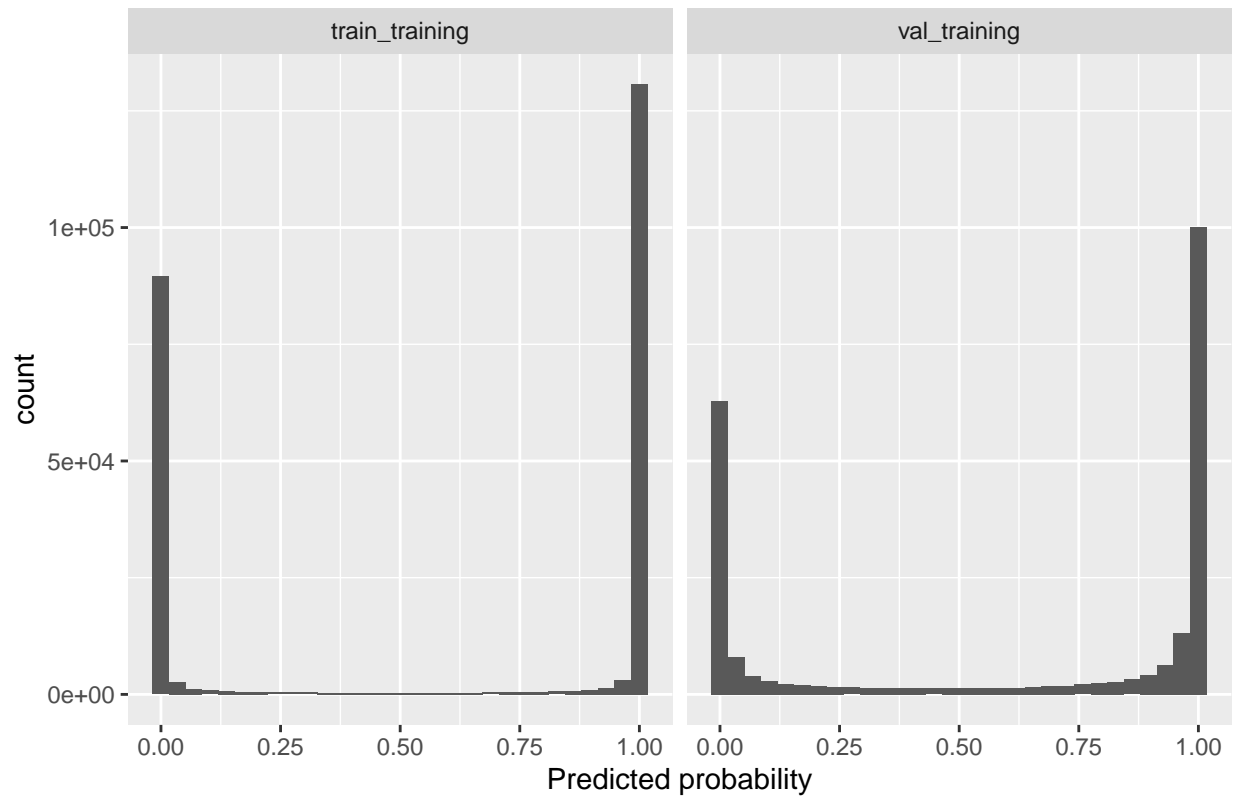
Predictions for irrelevant classes by LDA 1 vs 6

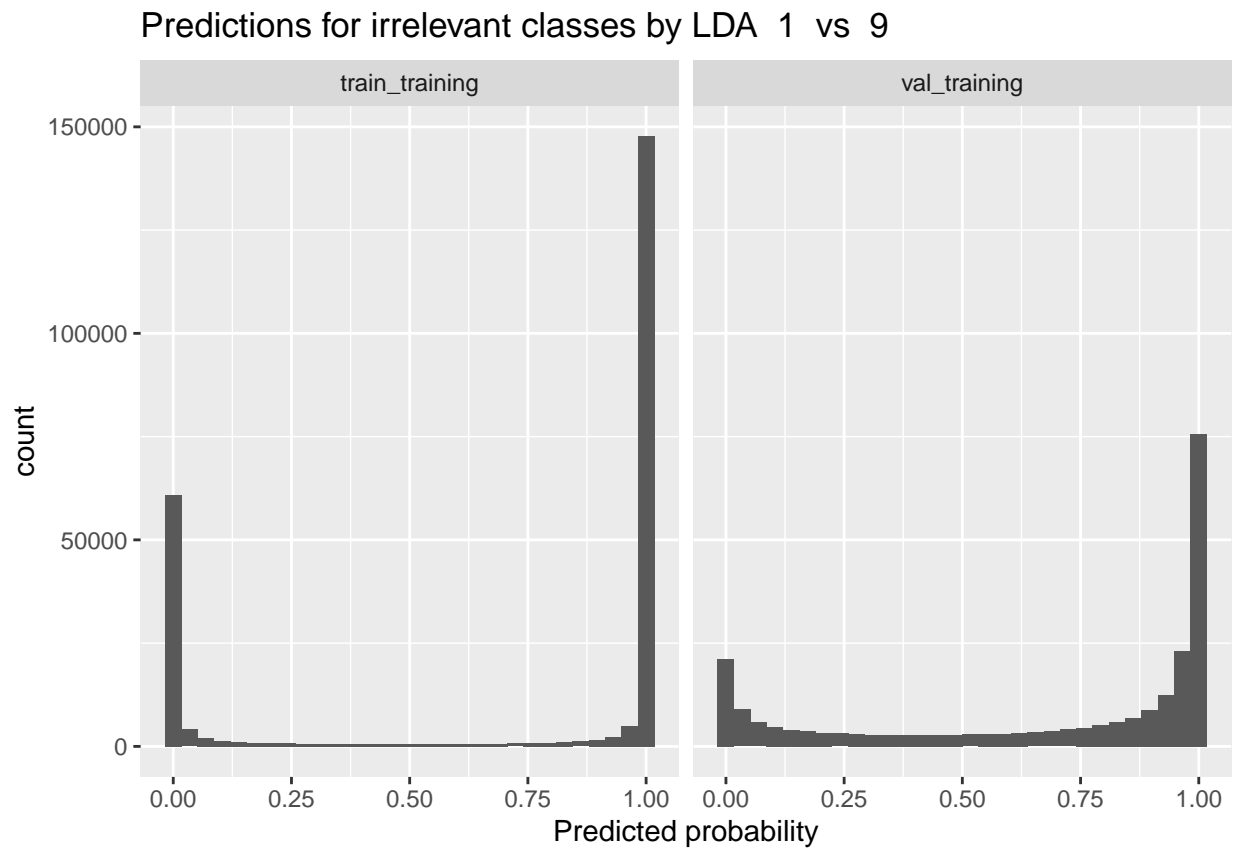


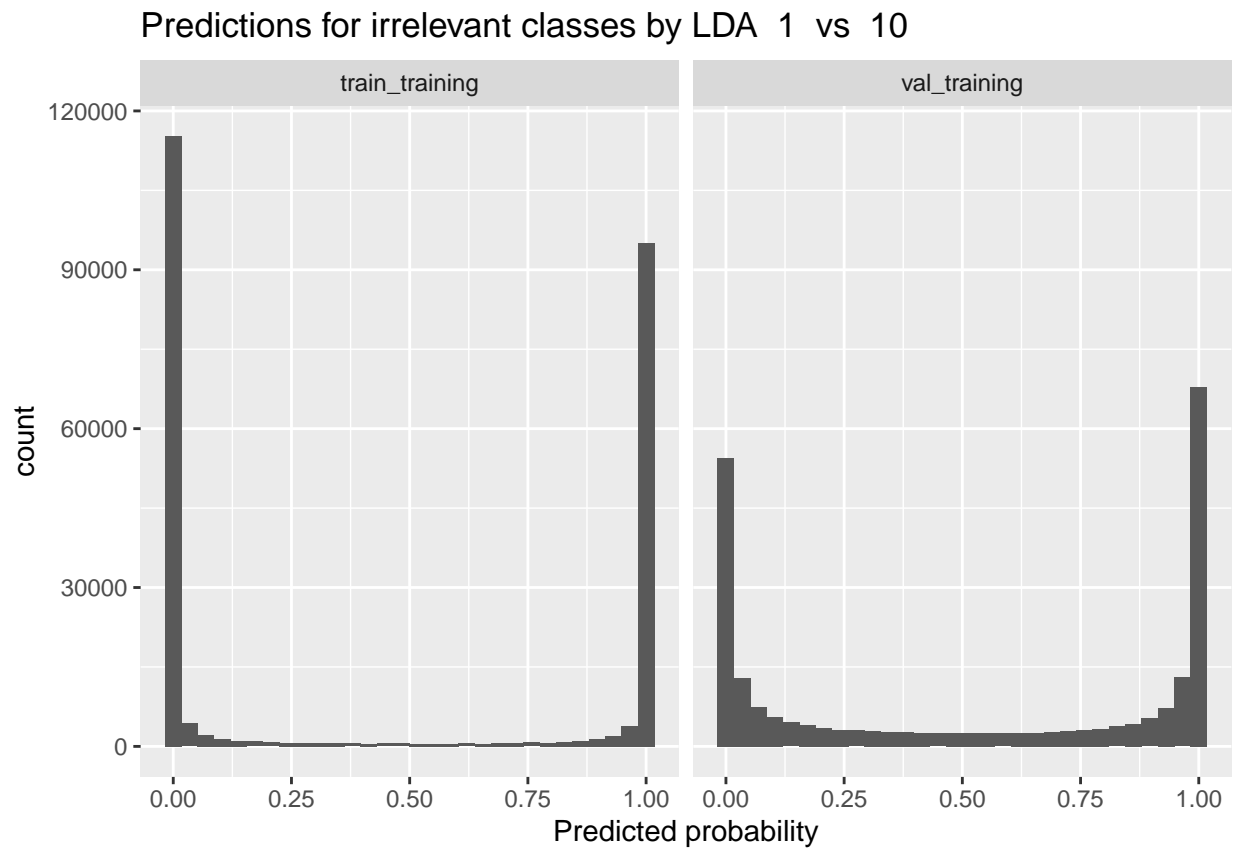
Predictions for irrelevant classes by LDA 1 vs 7



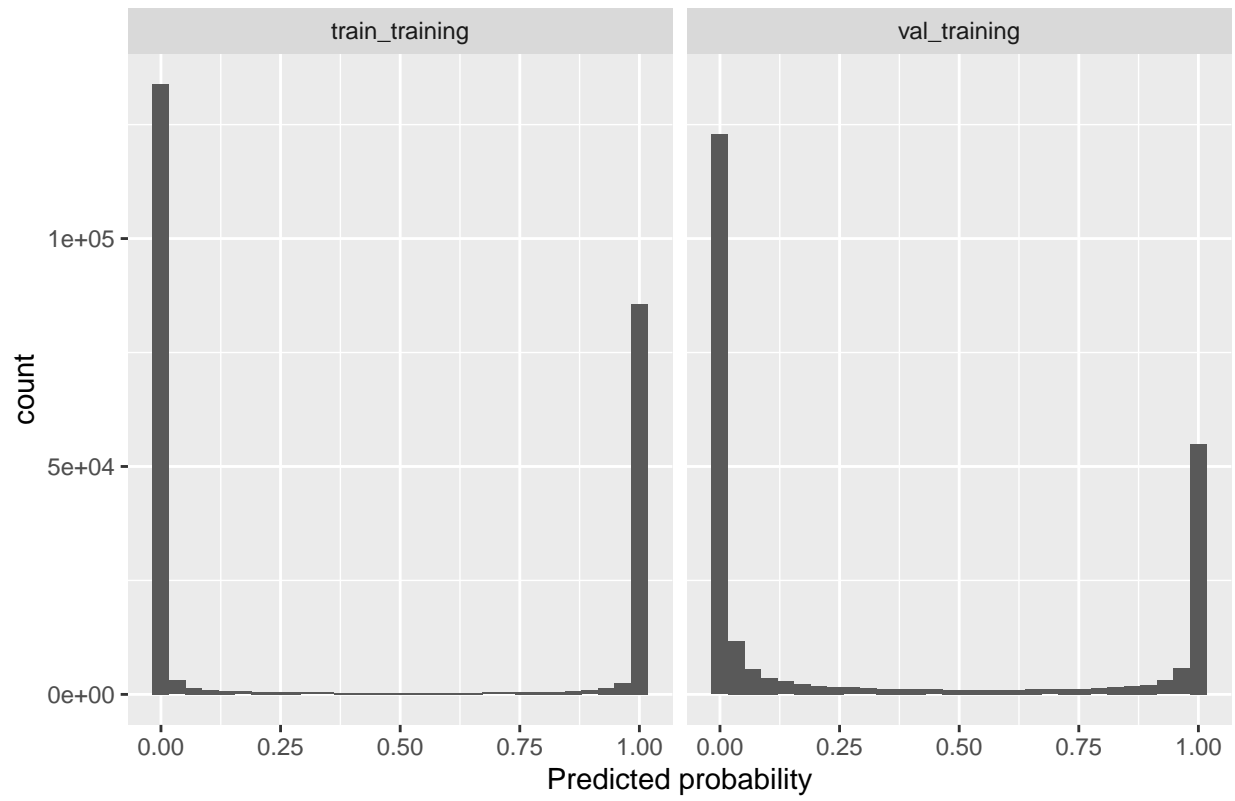
Predictions for irrelevant classes by LDA 1 vs 8



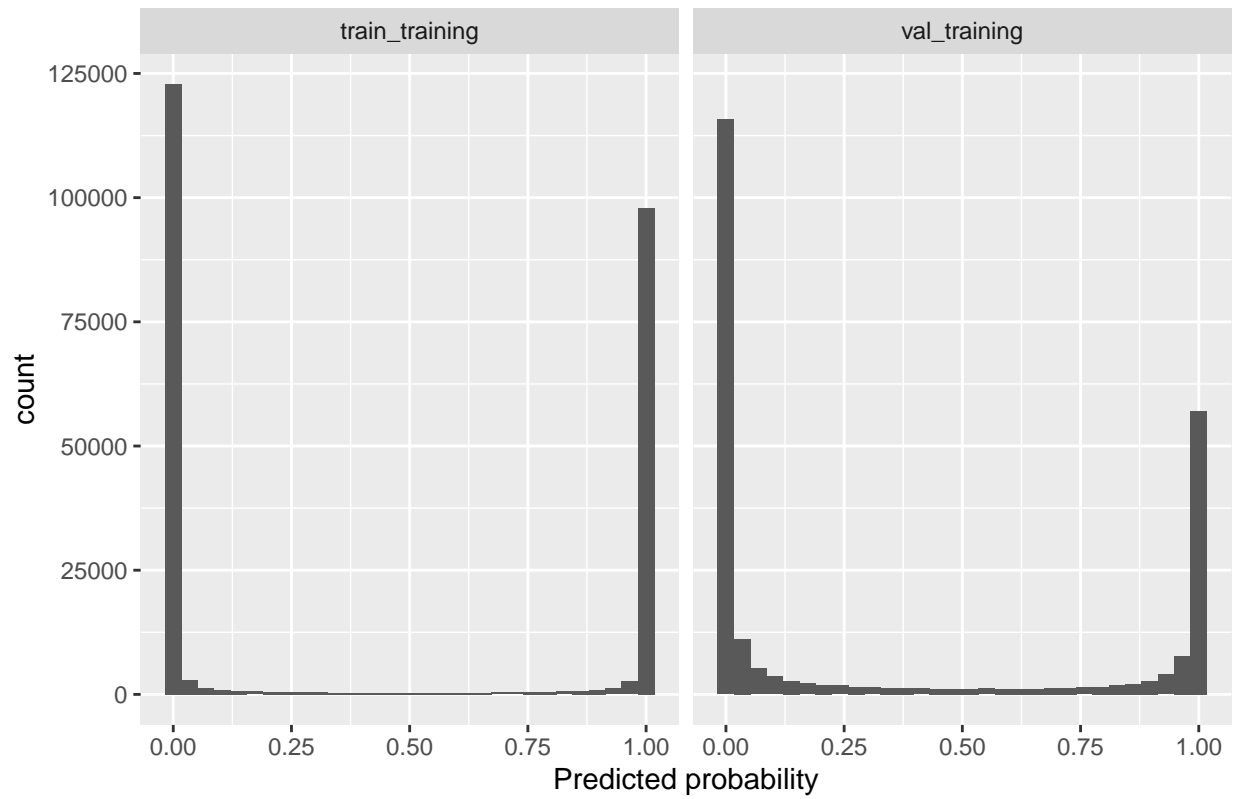




Predictions for irrelevant classes by LDA 2 vs 3

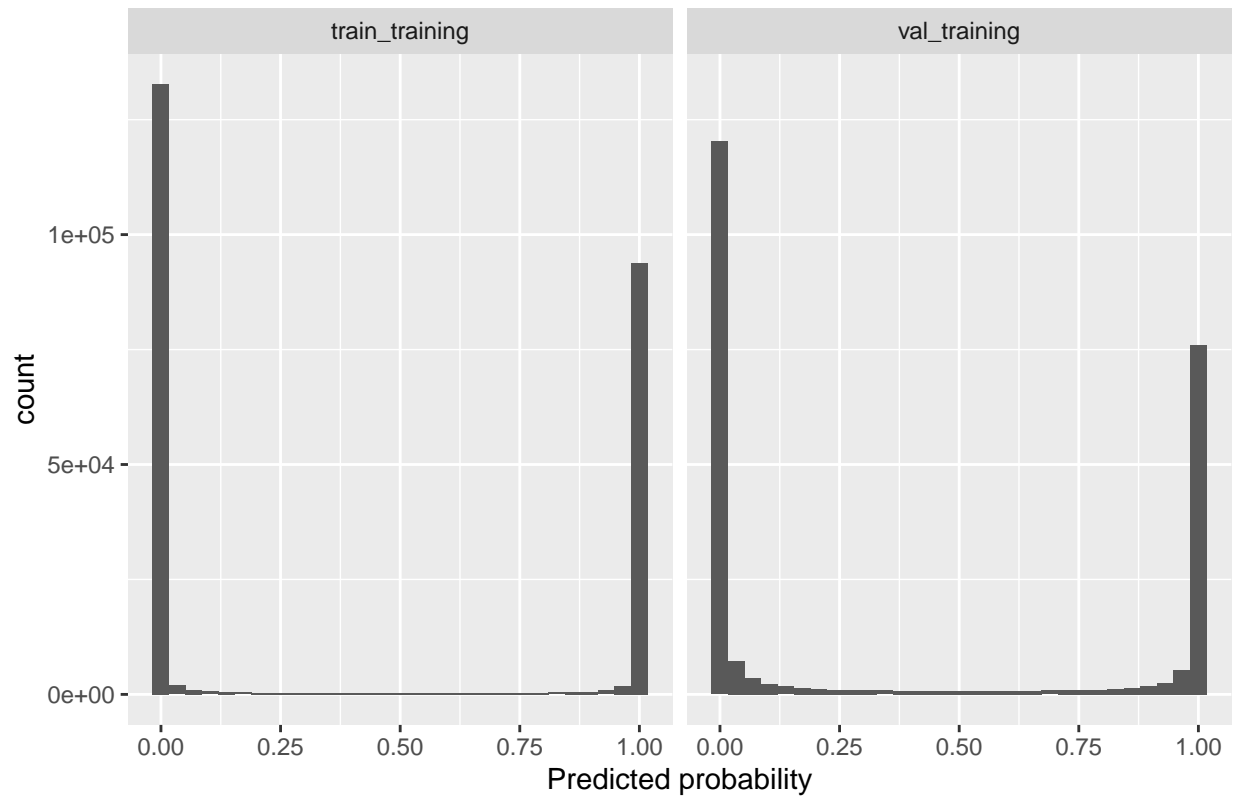


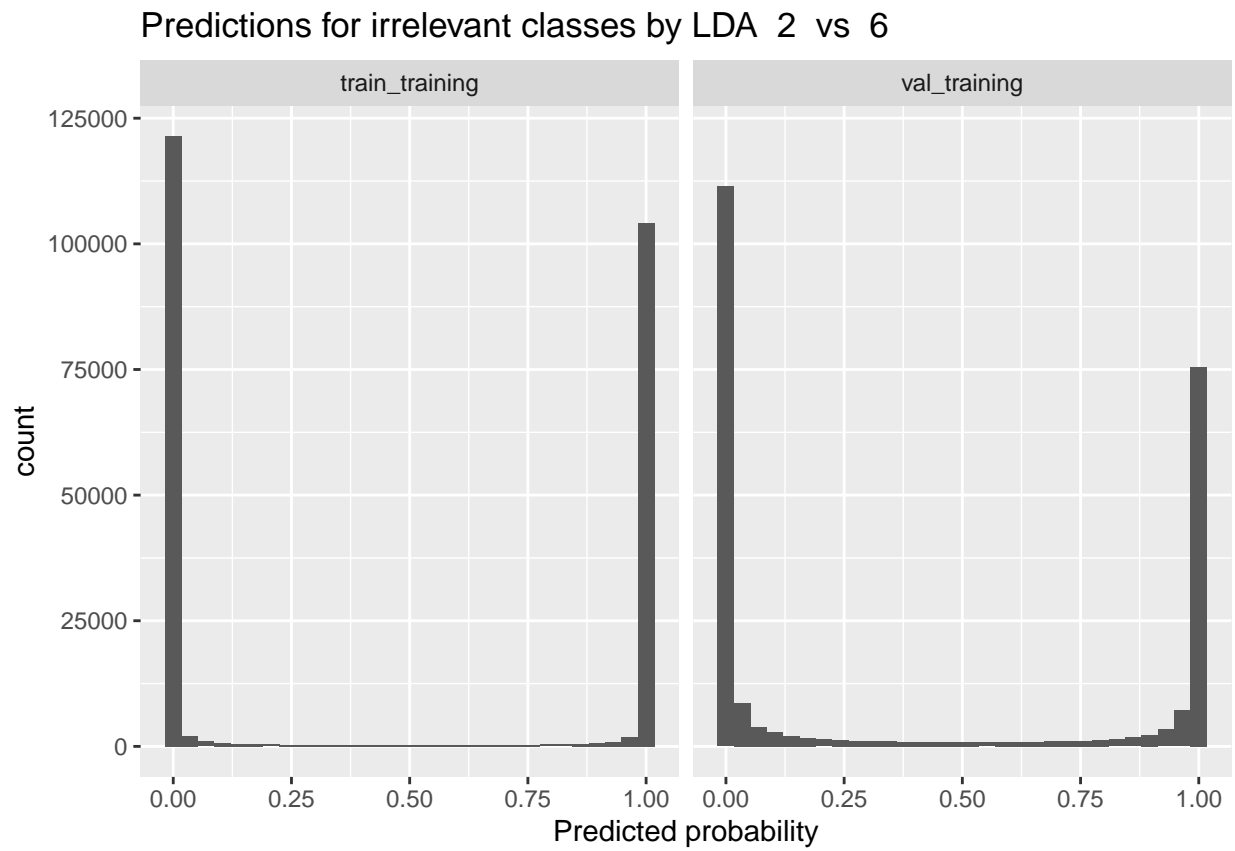
Predictions for irrelevant classes by LDA 2 vs 4

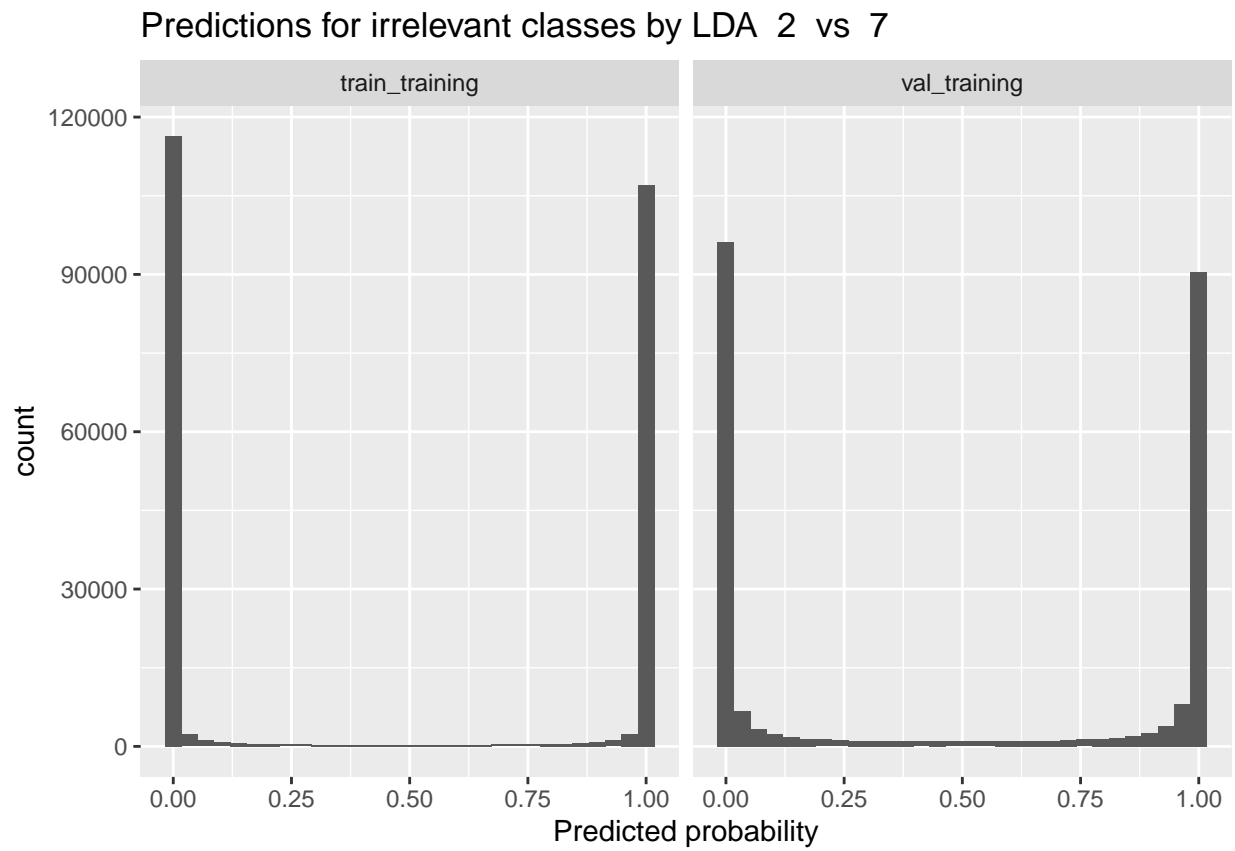


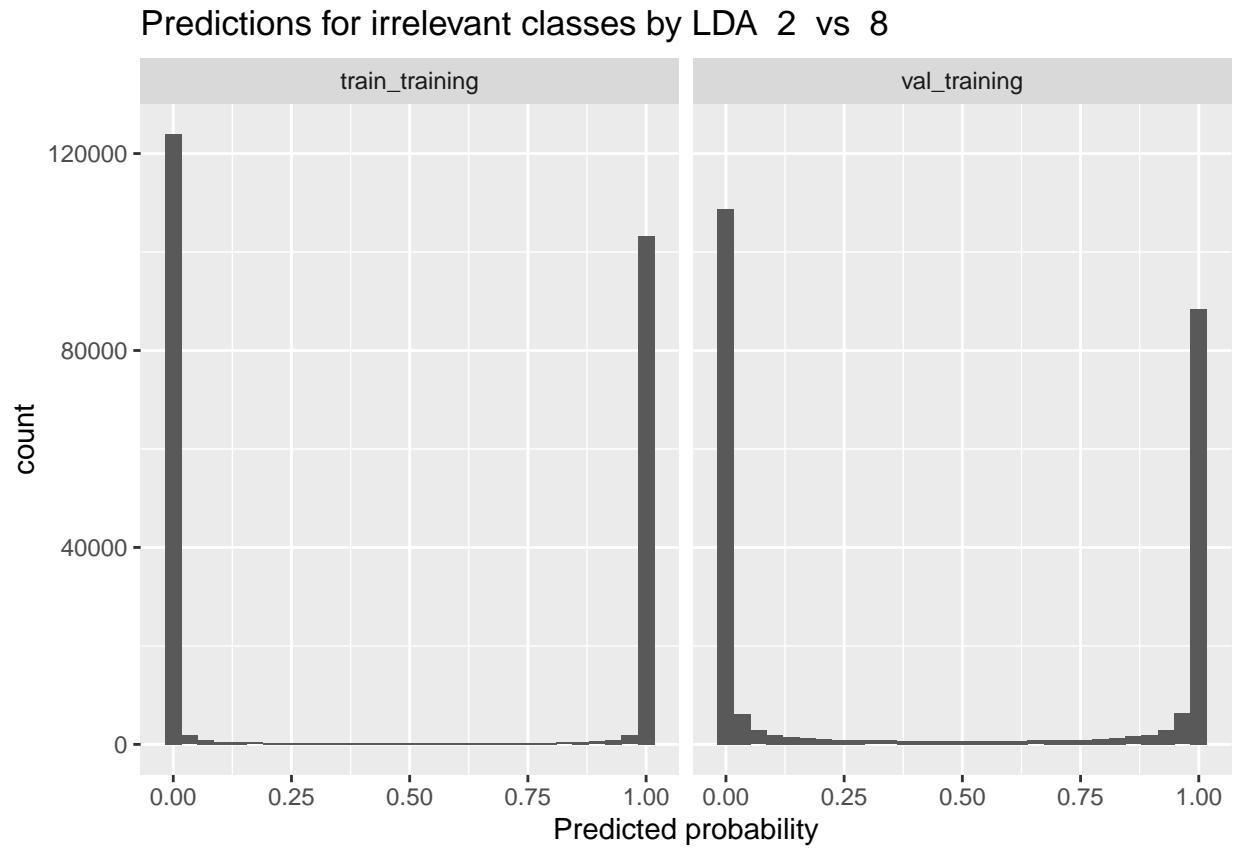


Predictions for irrelevant classes by LDA 2 vs 5

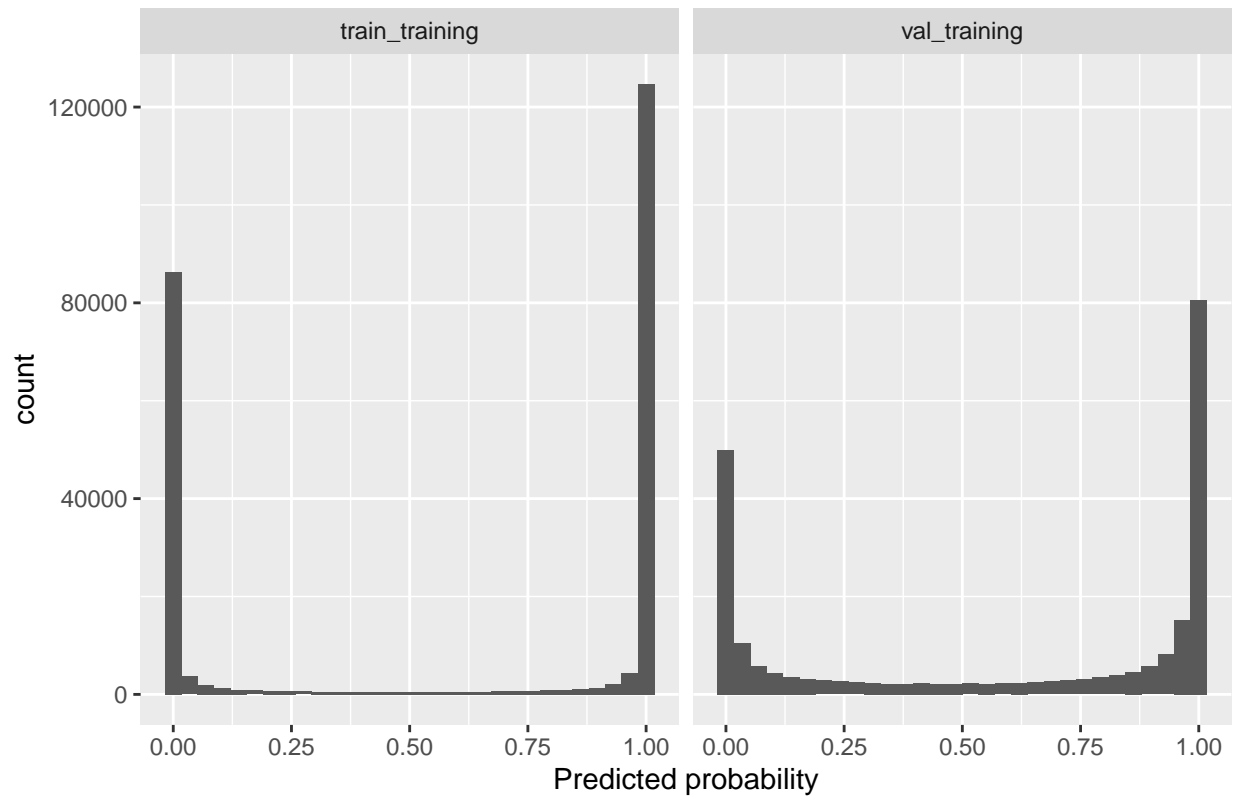




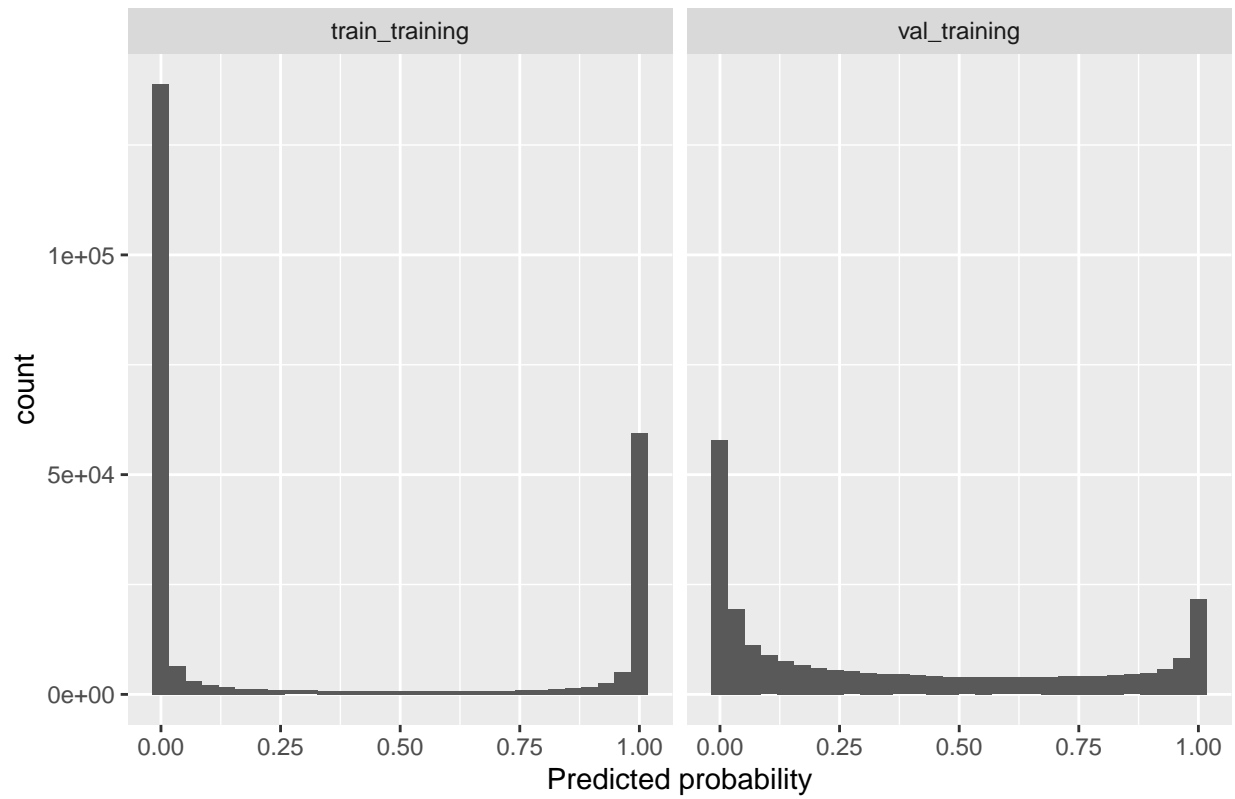




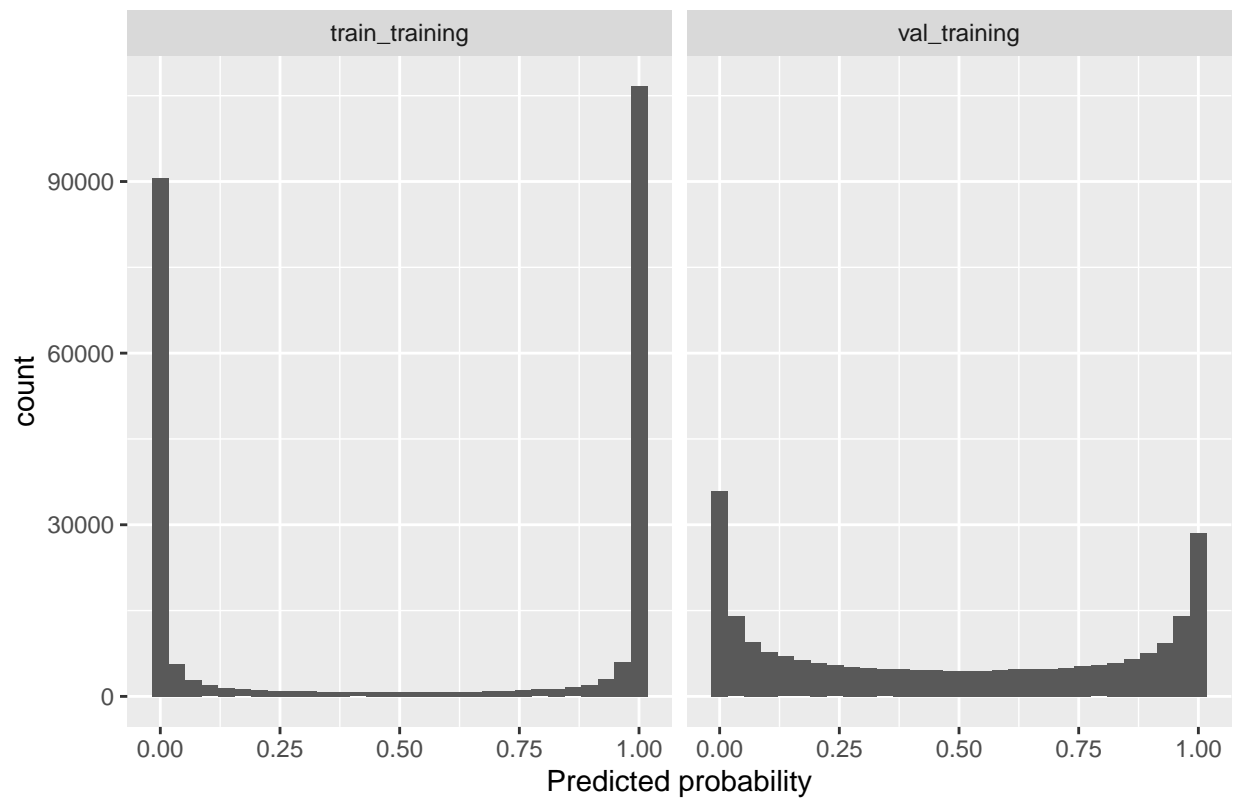
Predictions for irrelevant classes by LDA 2 vs 9



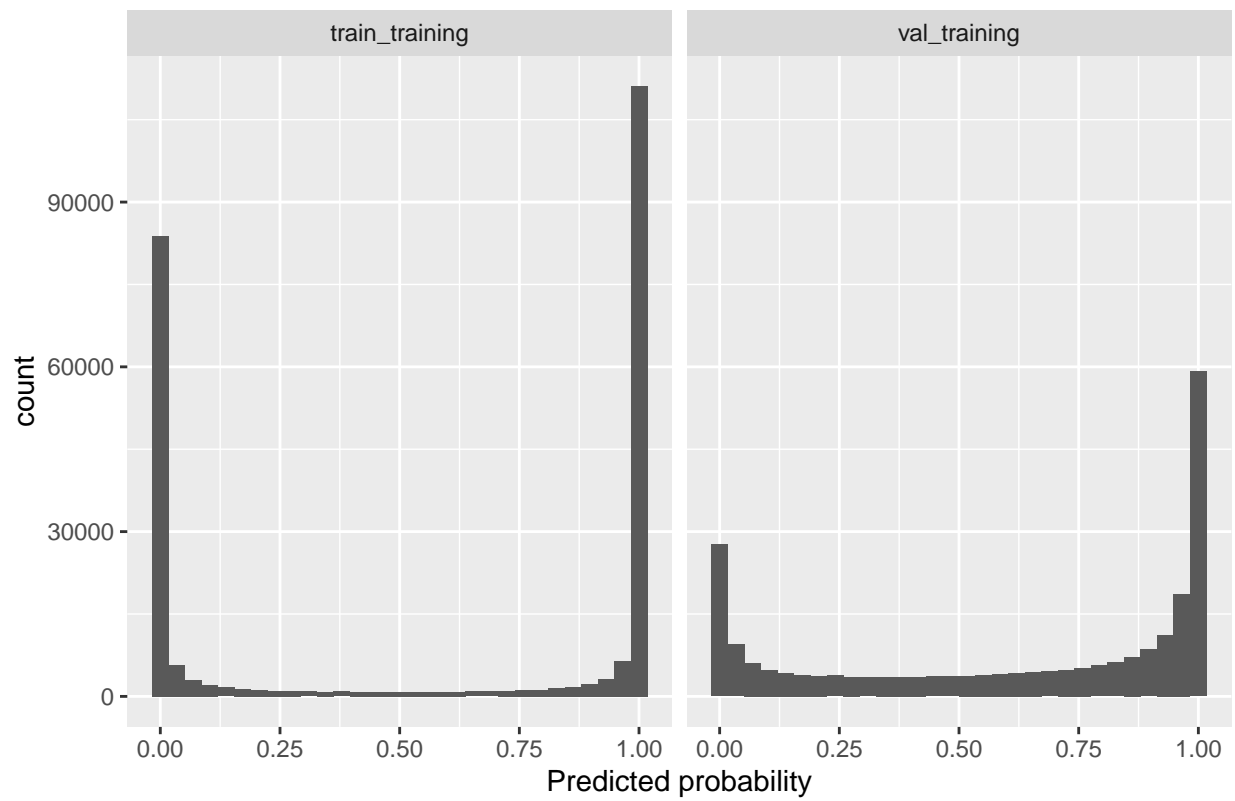
Predictions for irrelevant classes by LDA 2 vs 10



Predictions for irrelevant classes by LDA 3 vs 4

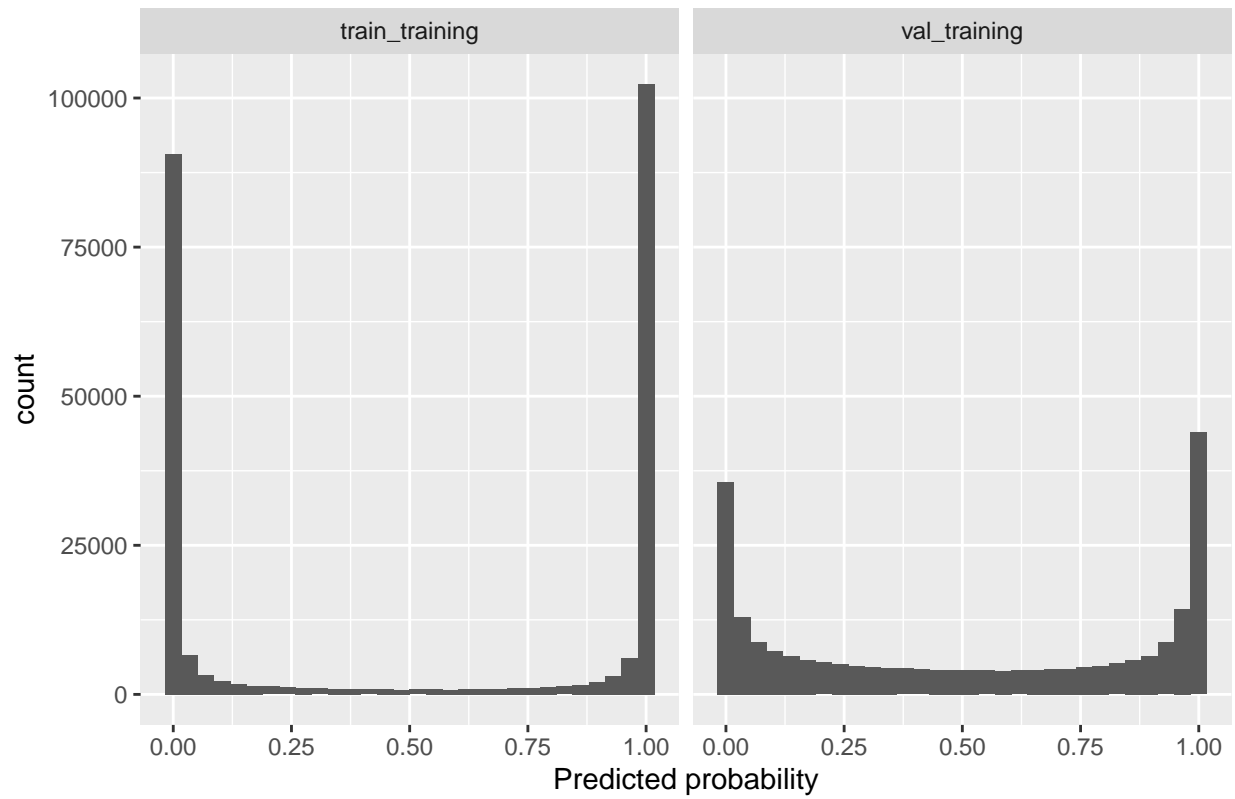


Predictions for irrelevant classes by LDA 3 vs 5

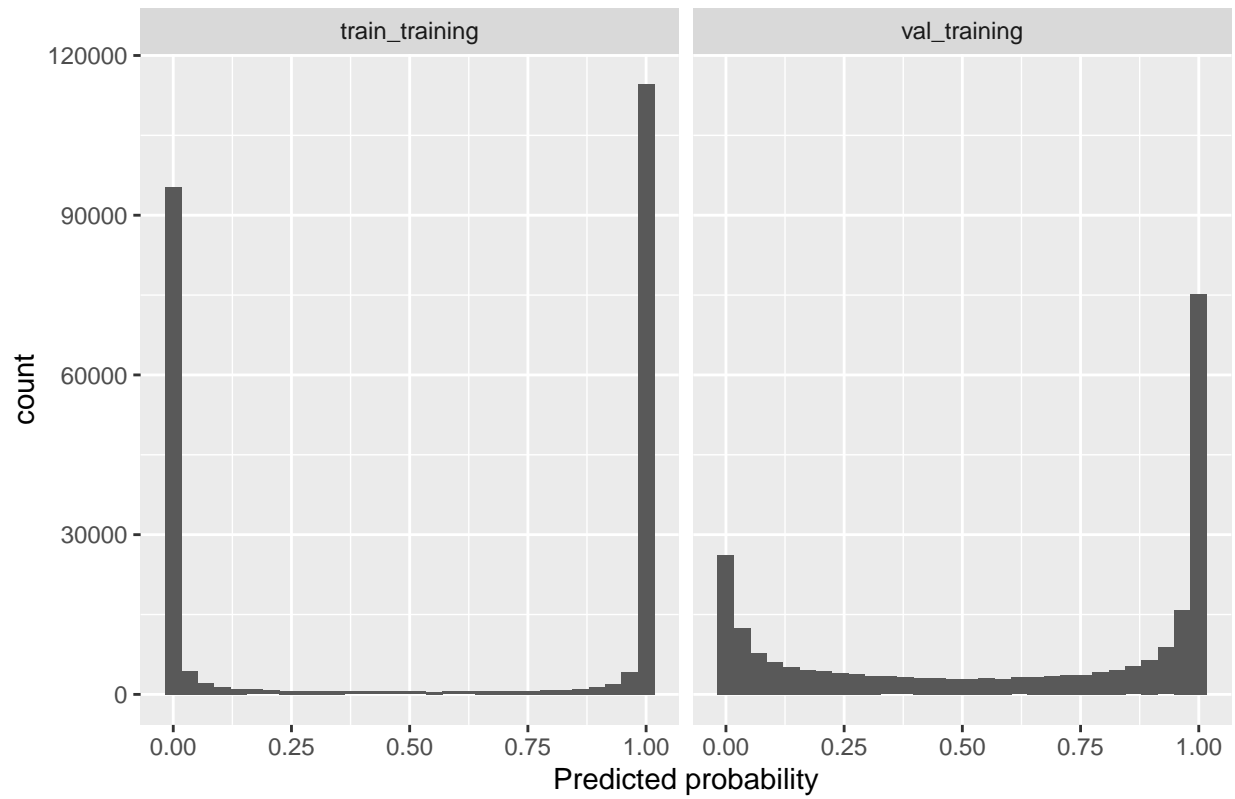




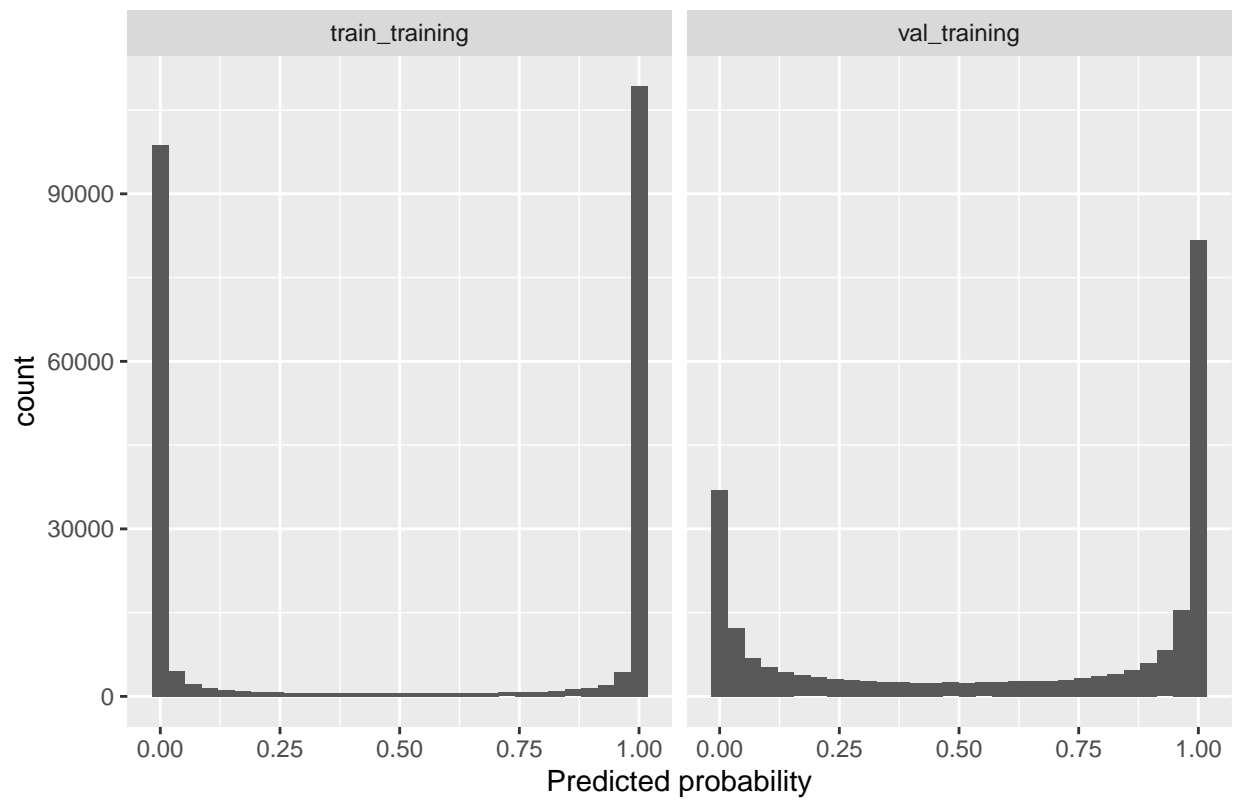
Predictions for irrelevant classes by LDA 3 vs 6



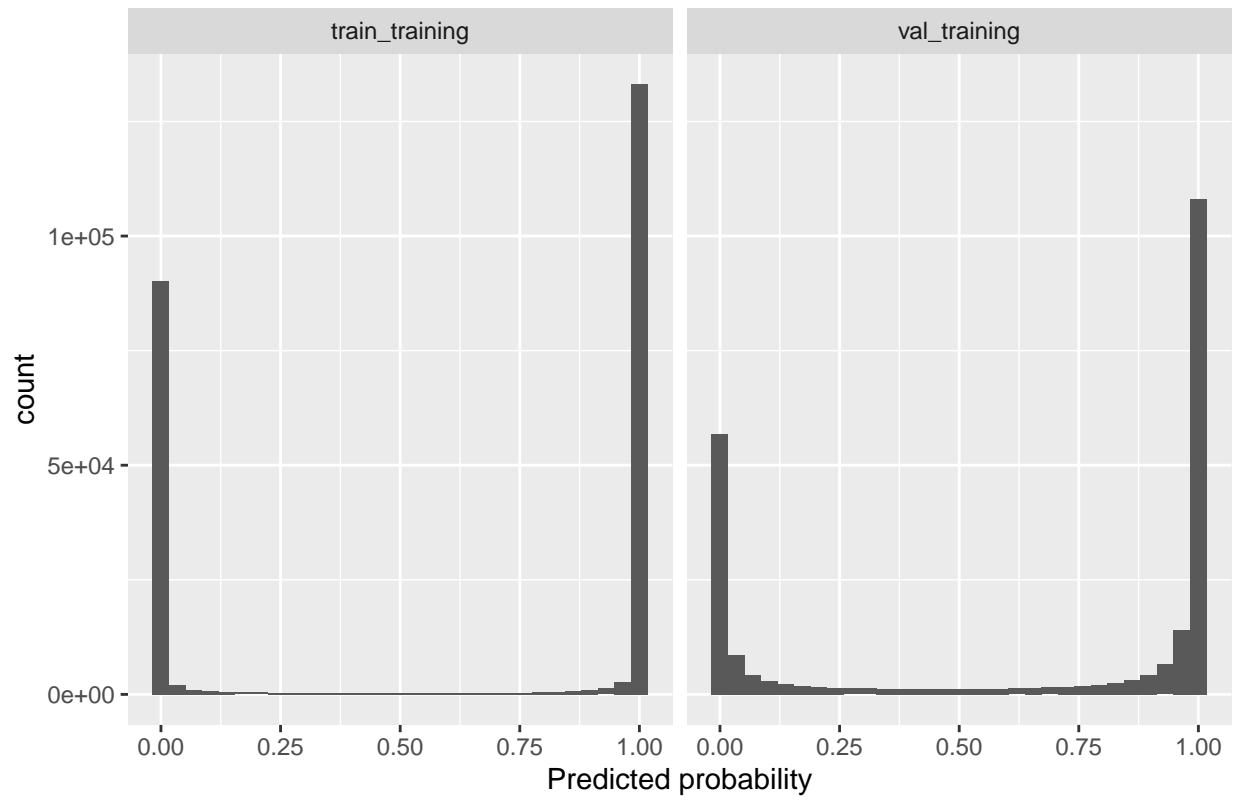
Predictions for irrelevant classes by LDA 3 vs 7



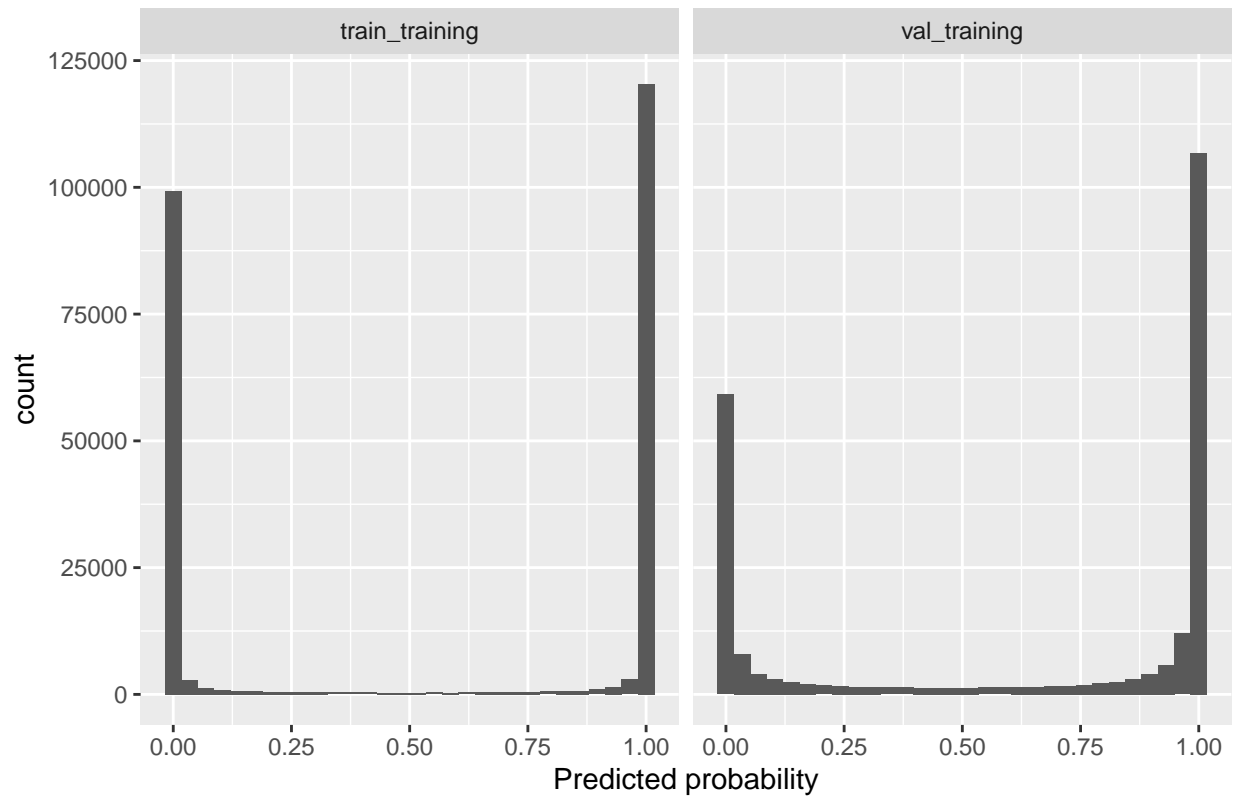
Predictions for irrelevant classes by LDA 3 vs 8



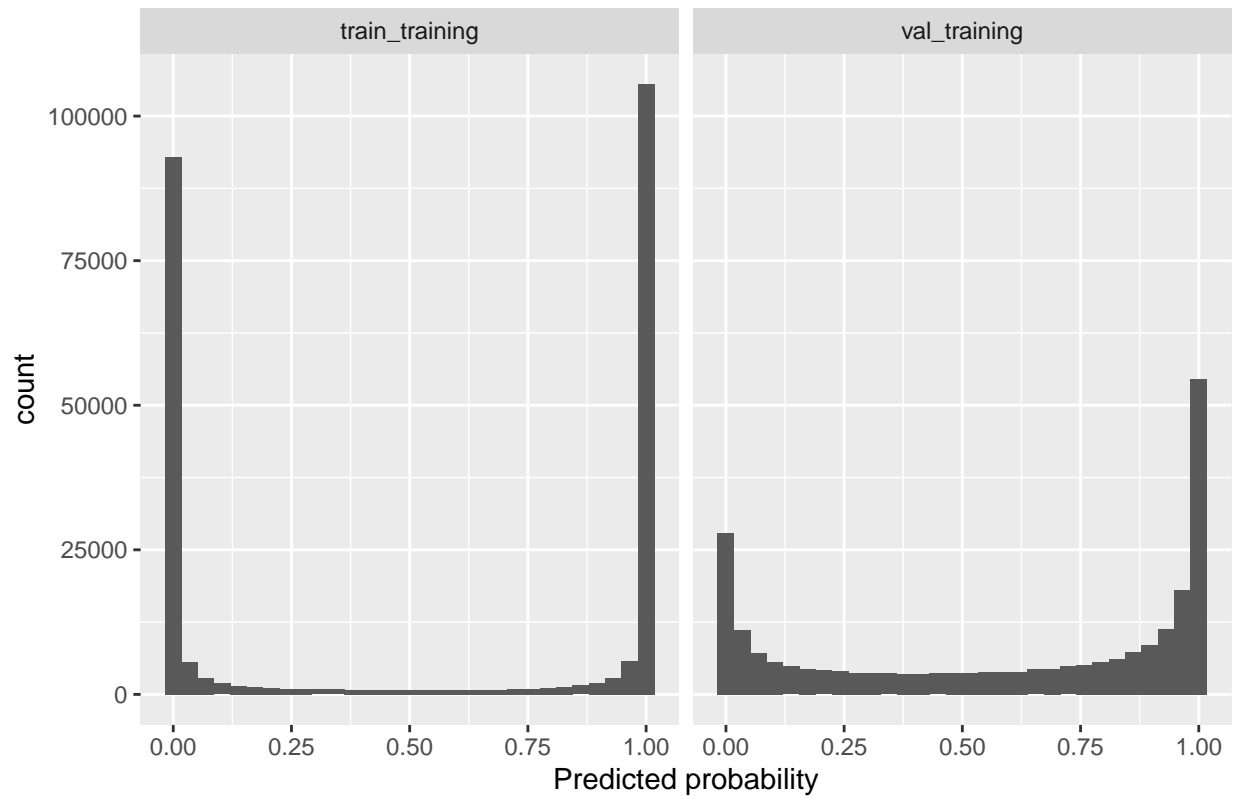
Predictions for irrelevant classes by LDA 3 vs 9



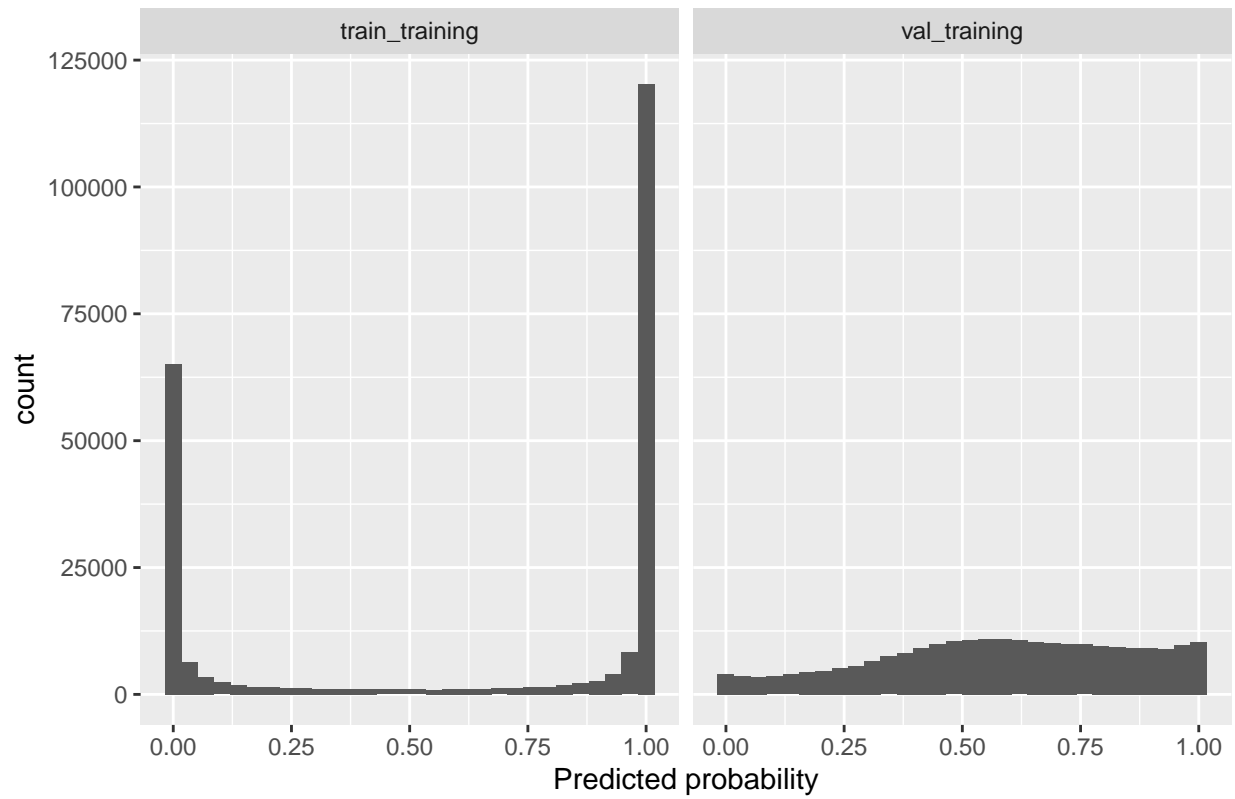
Predictions for irrelevant classes by LDA 3 vs 10



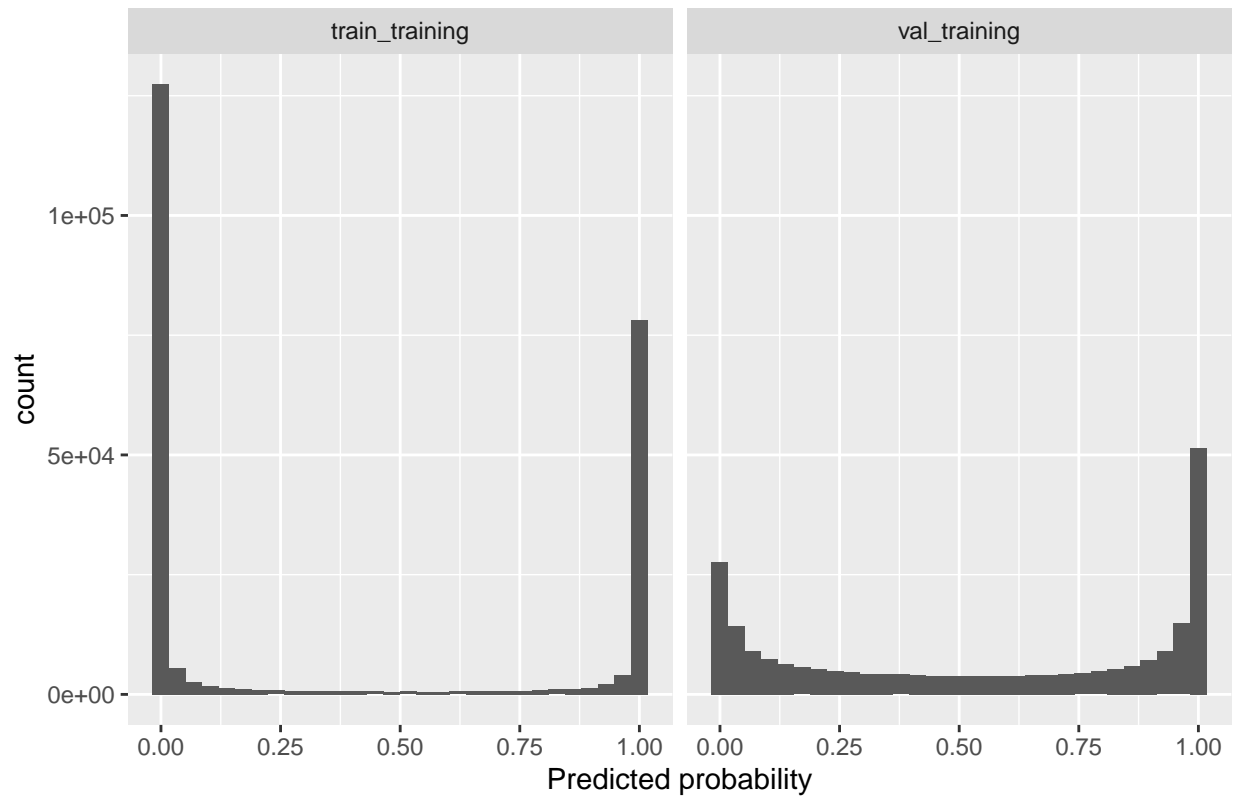
Predictions for irrelevant classes by LDA 4 vs 5



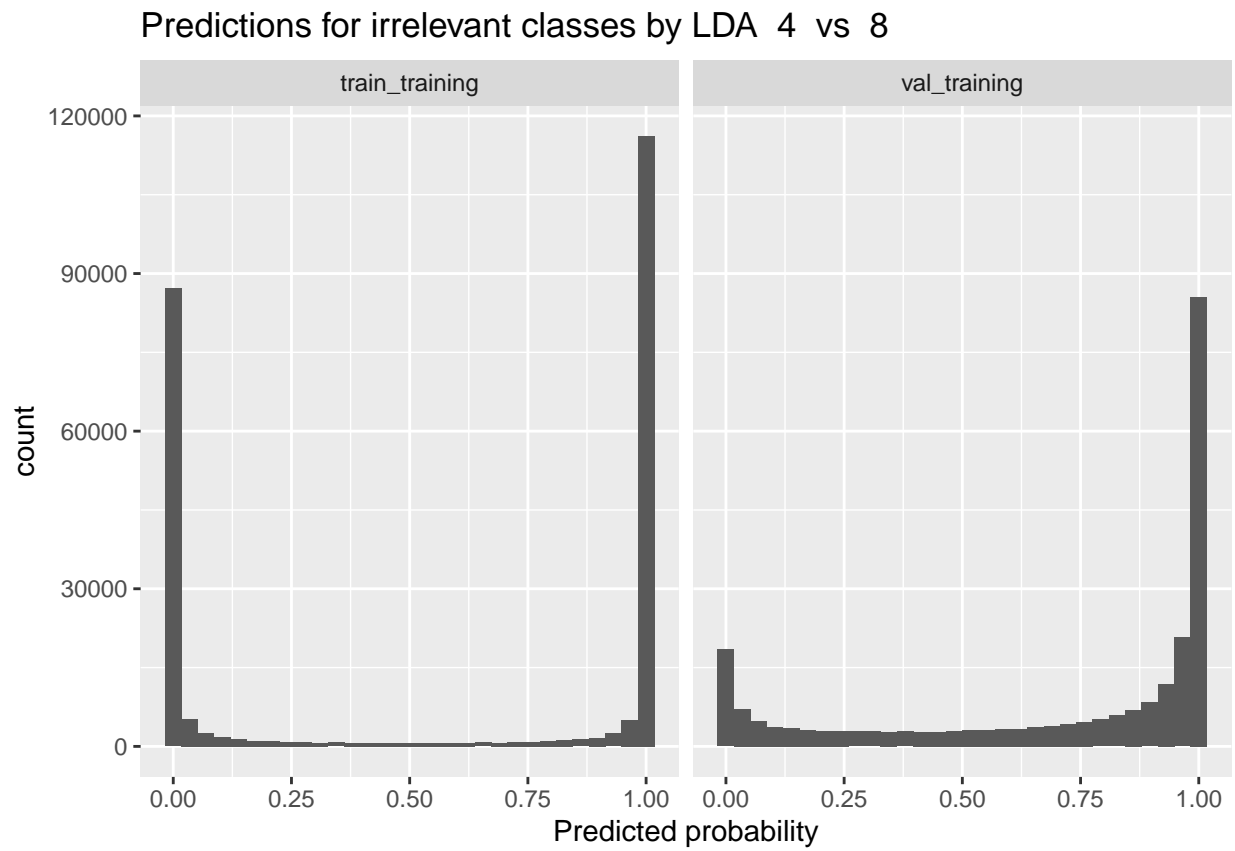
Predictions for irrelevant classes by LDA 4 vs 6



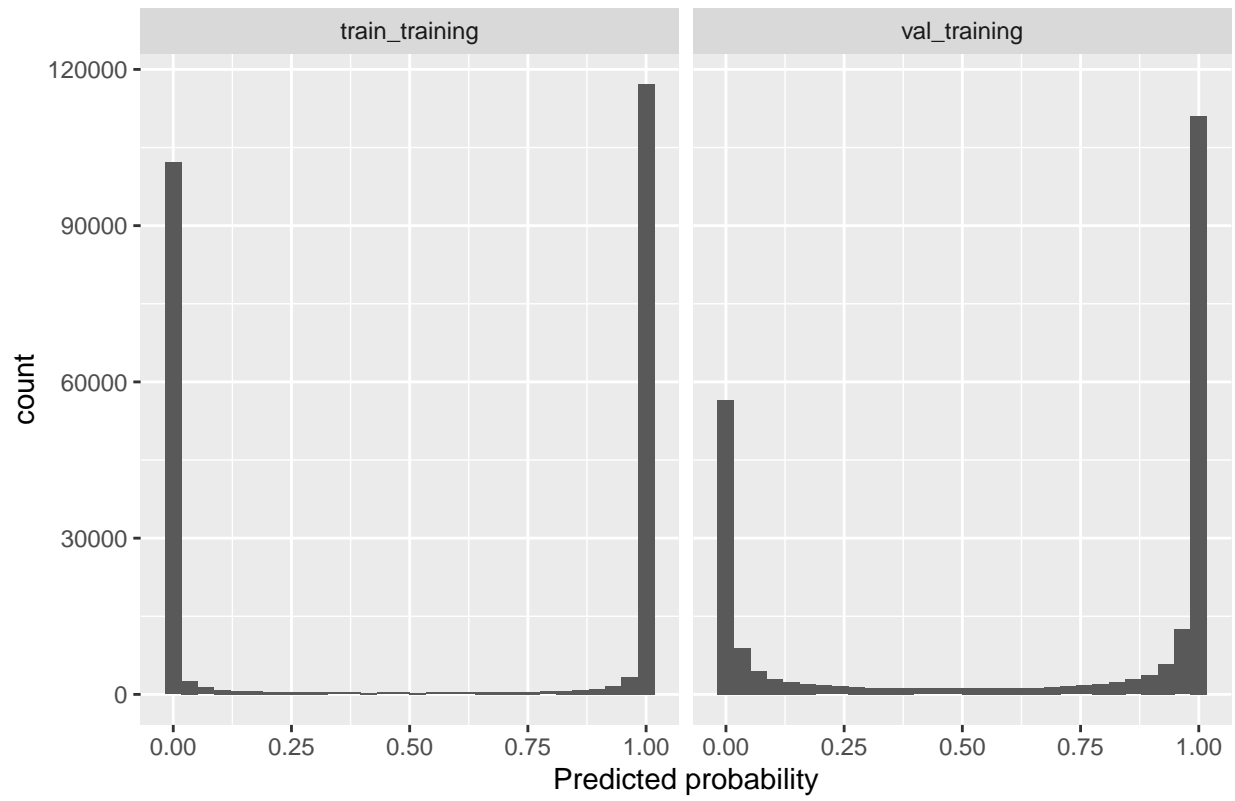
Predictions for irrelevant classes by LDA 4 vs 7



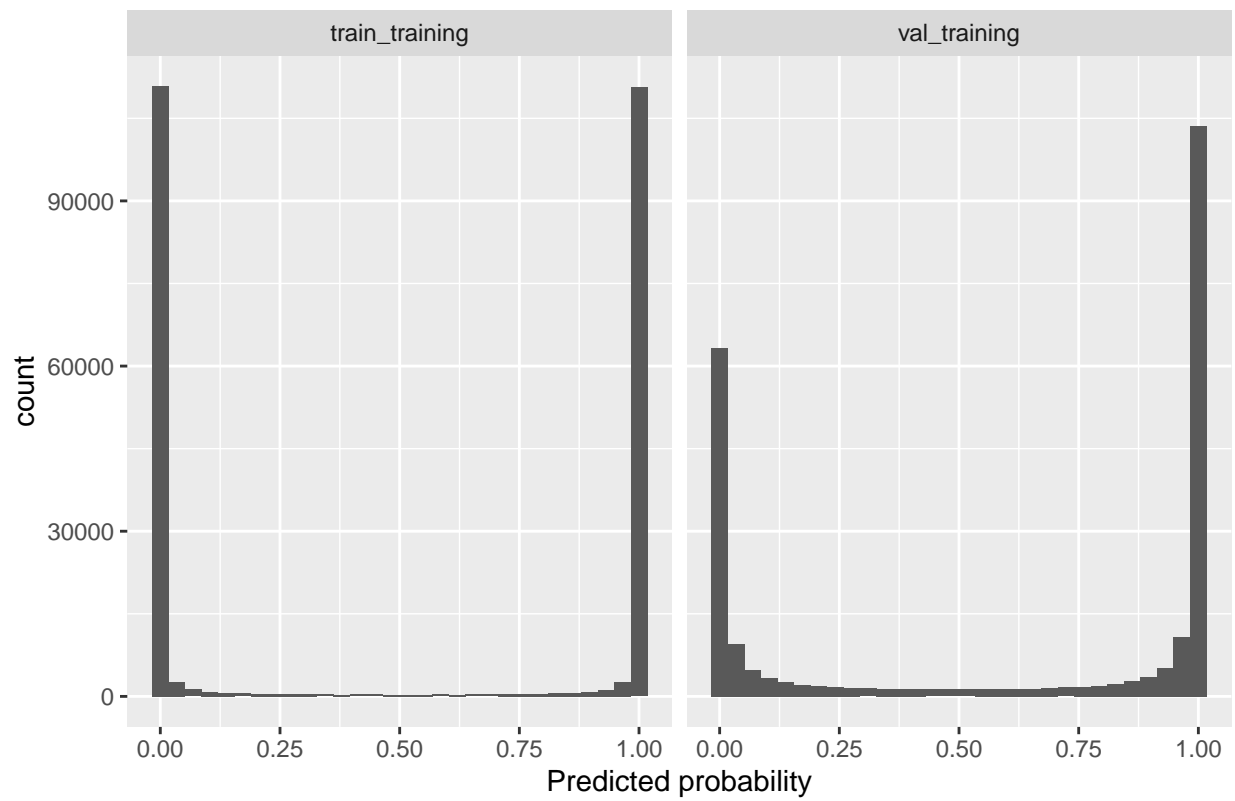




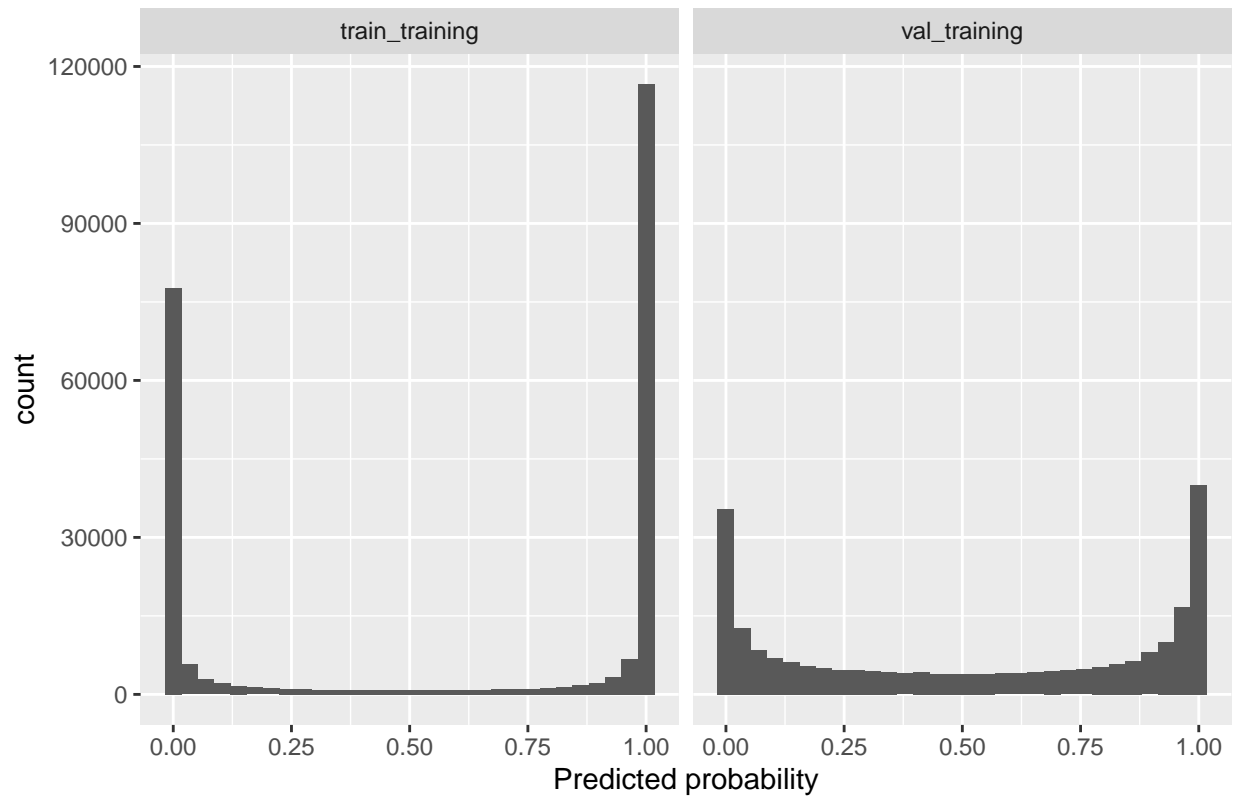
Predictions for irrelevant classes by LDA 4 vs 9



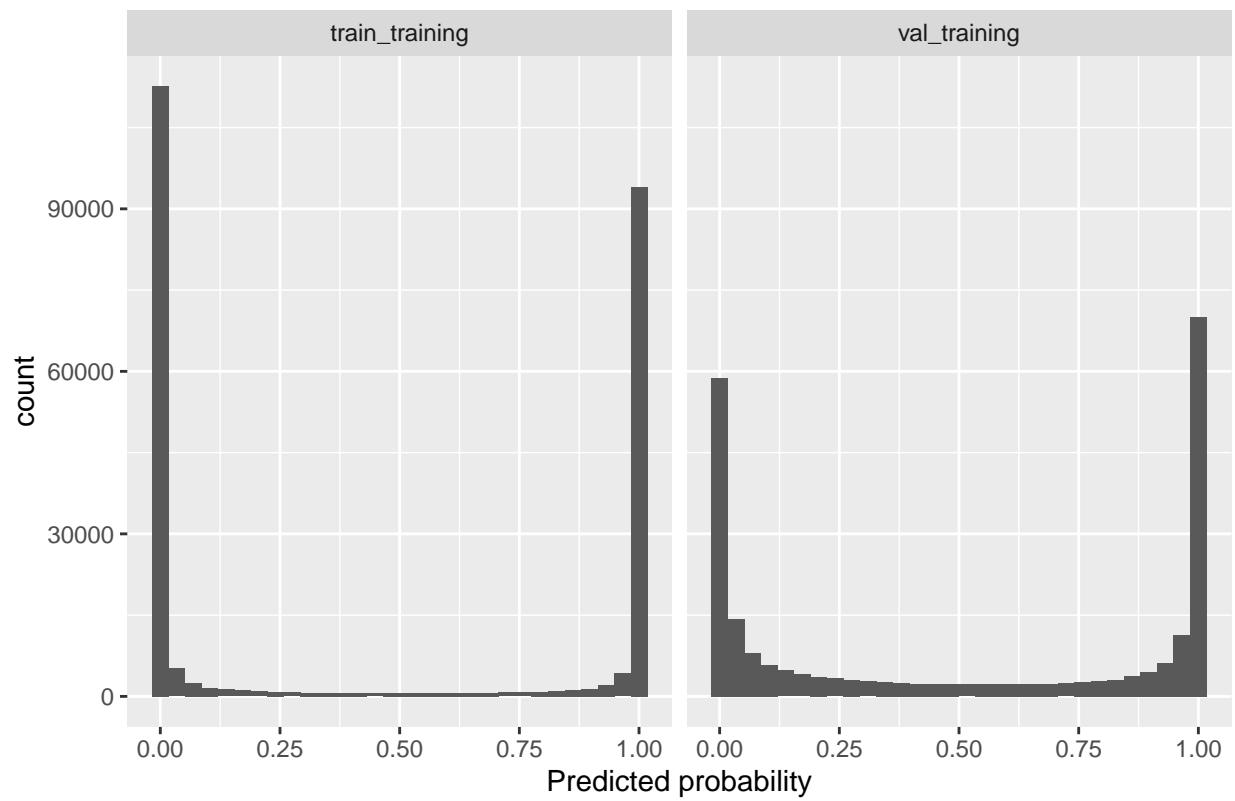
Predictions for irrelevant classes by LDA 4 vs 10



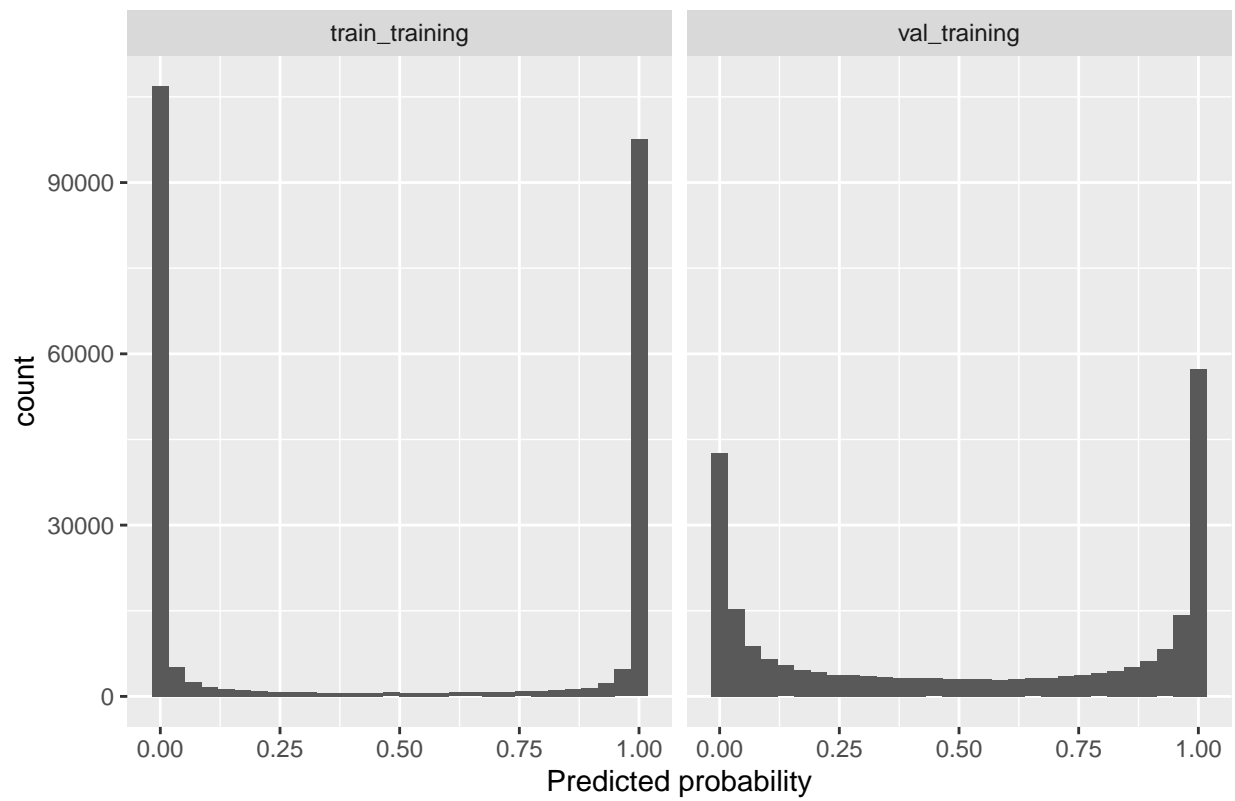
Predictions for irrelevant classes by LDA 5 vs 6

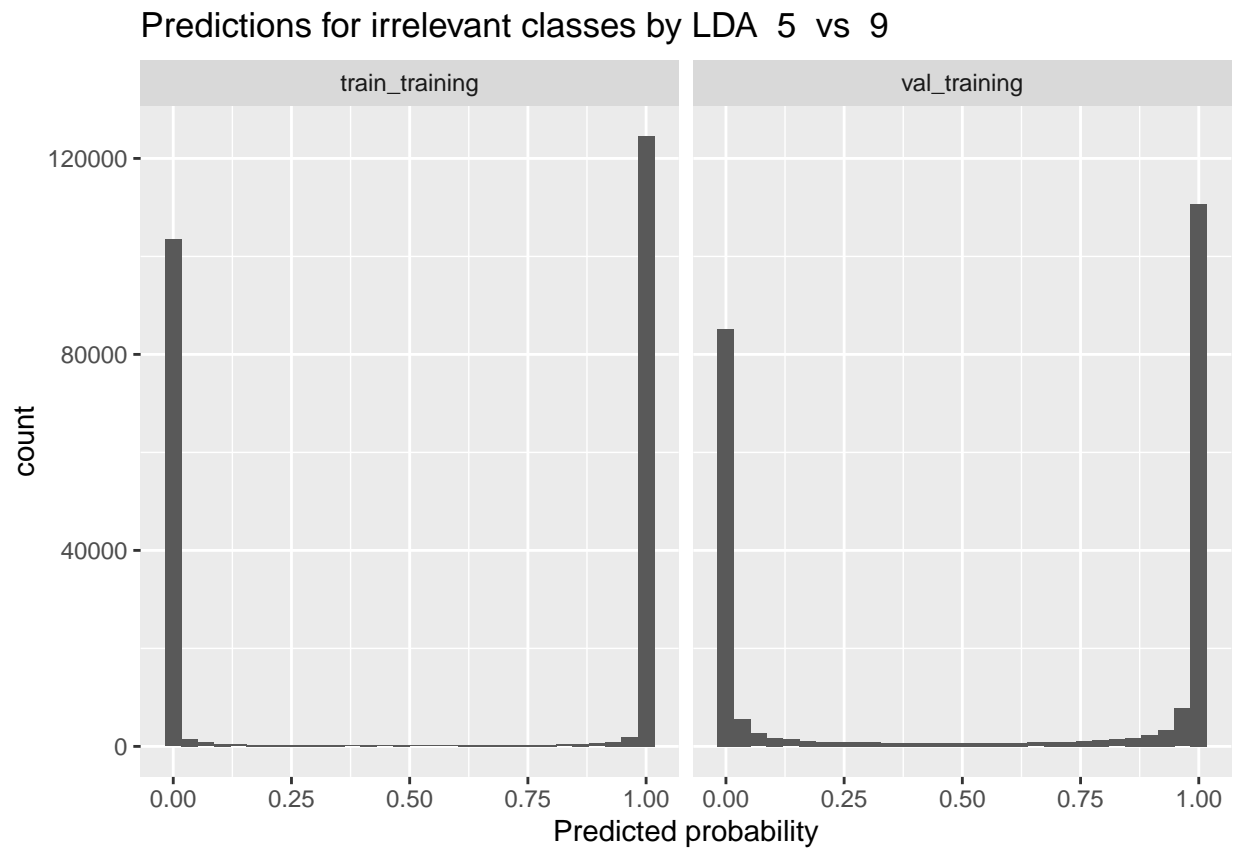


Predictions for irrelevant classes by LDA 5 vs 7

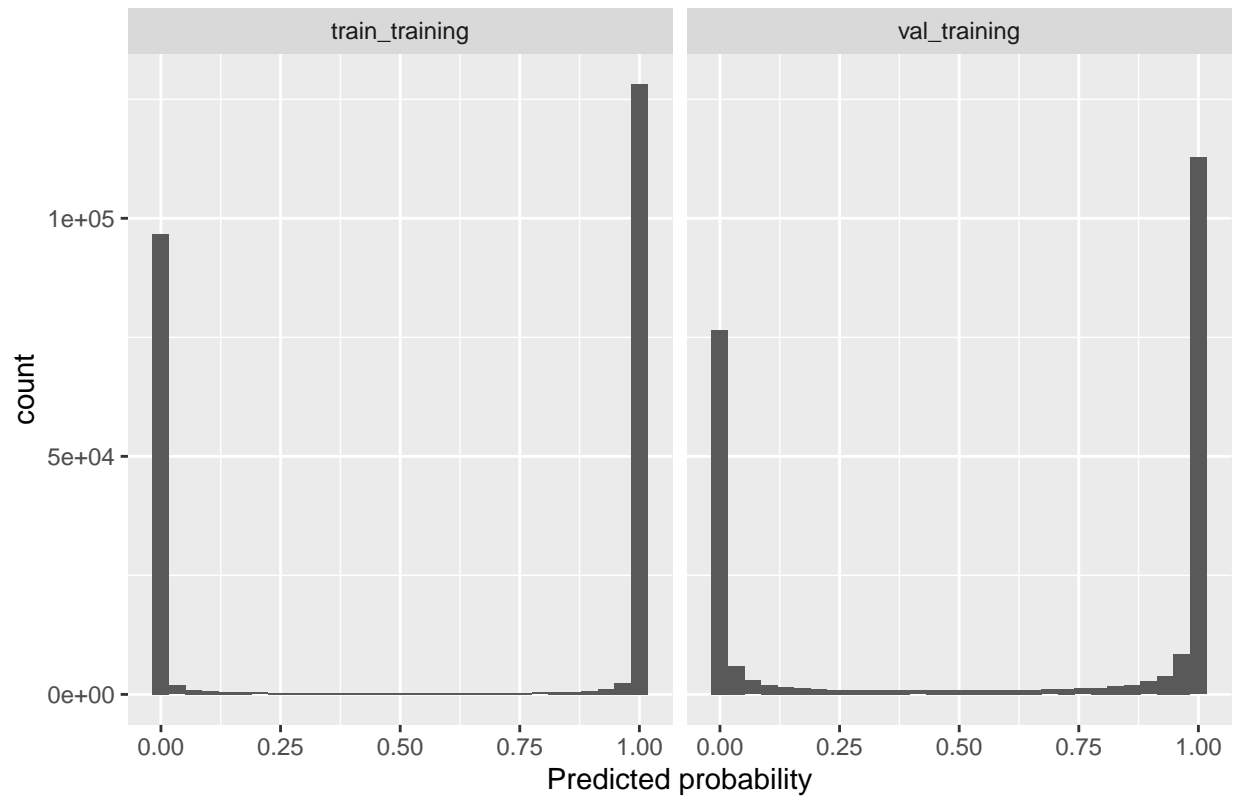


Predictions for irrelevant classes by LDA 5 vs 8



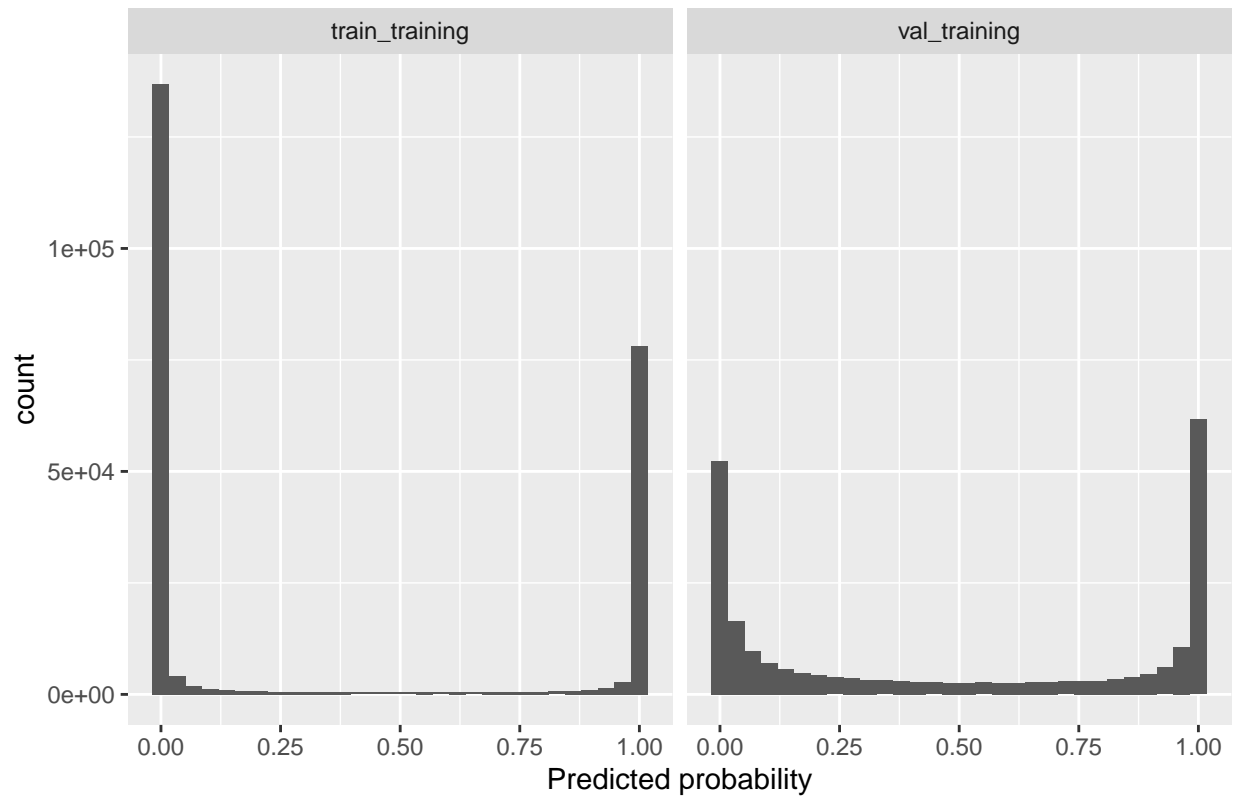


Predictions for irrelevant classes by LDA 5 vs 10

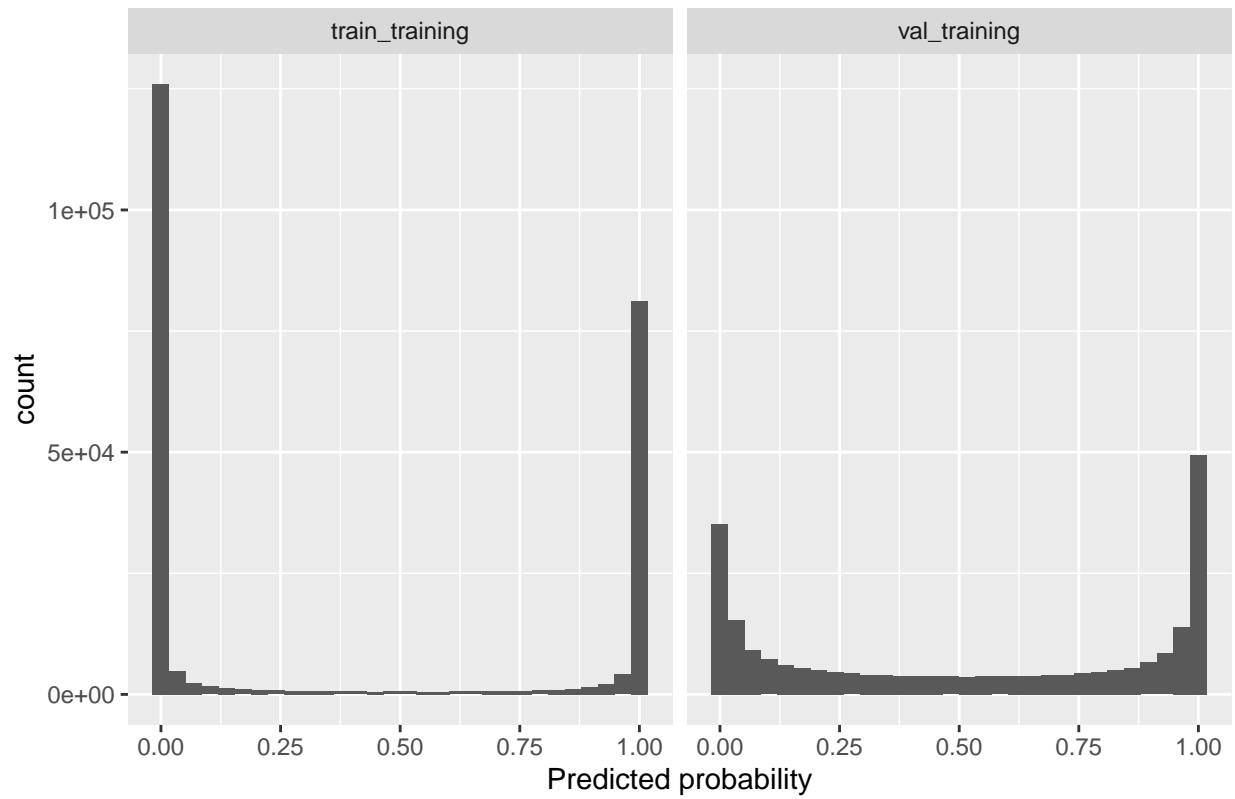




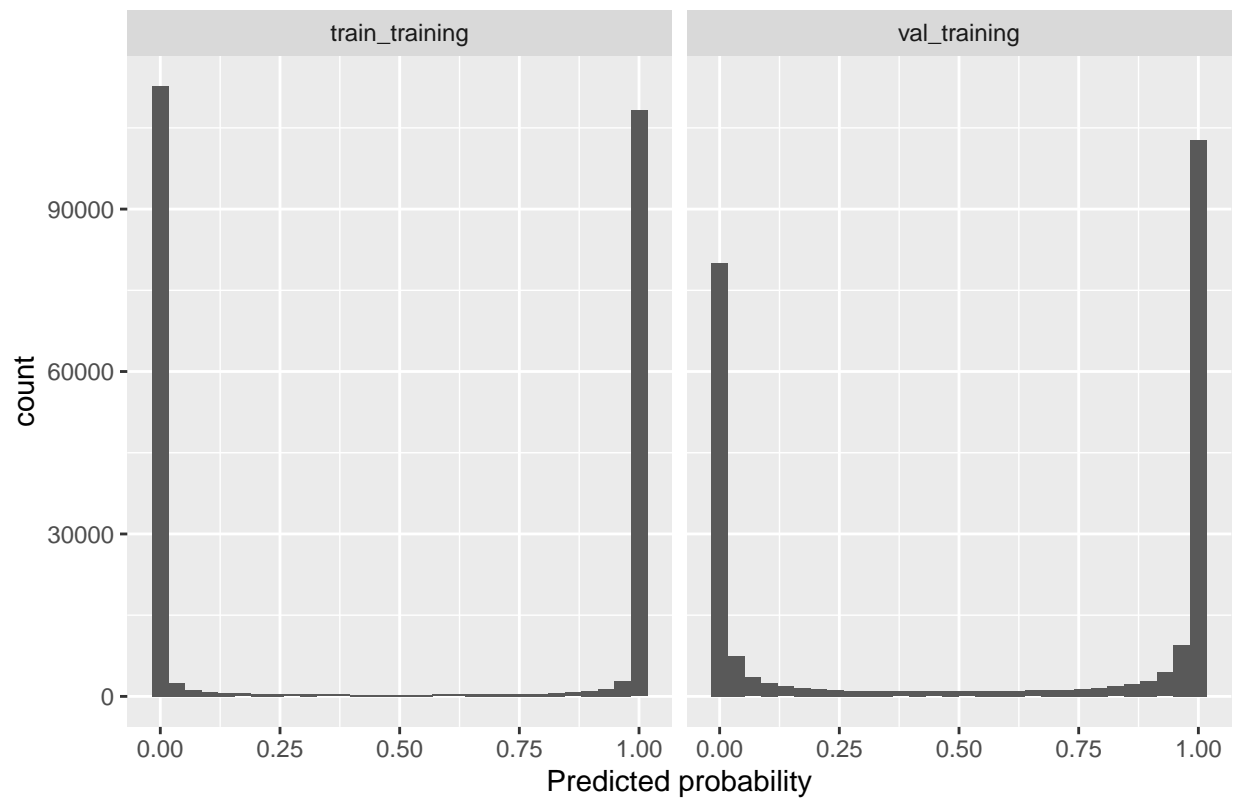
Predictions for irrelevant classes by LDA 6 vs 7



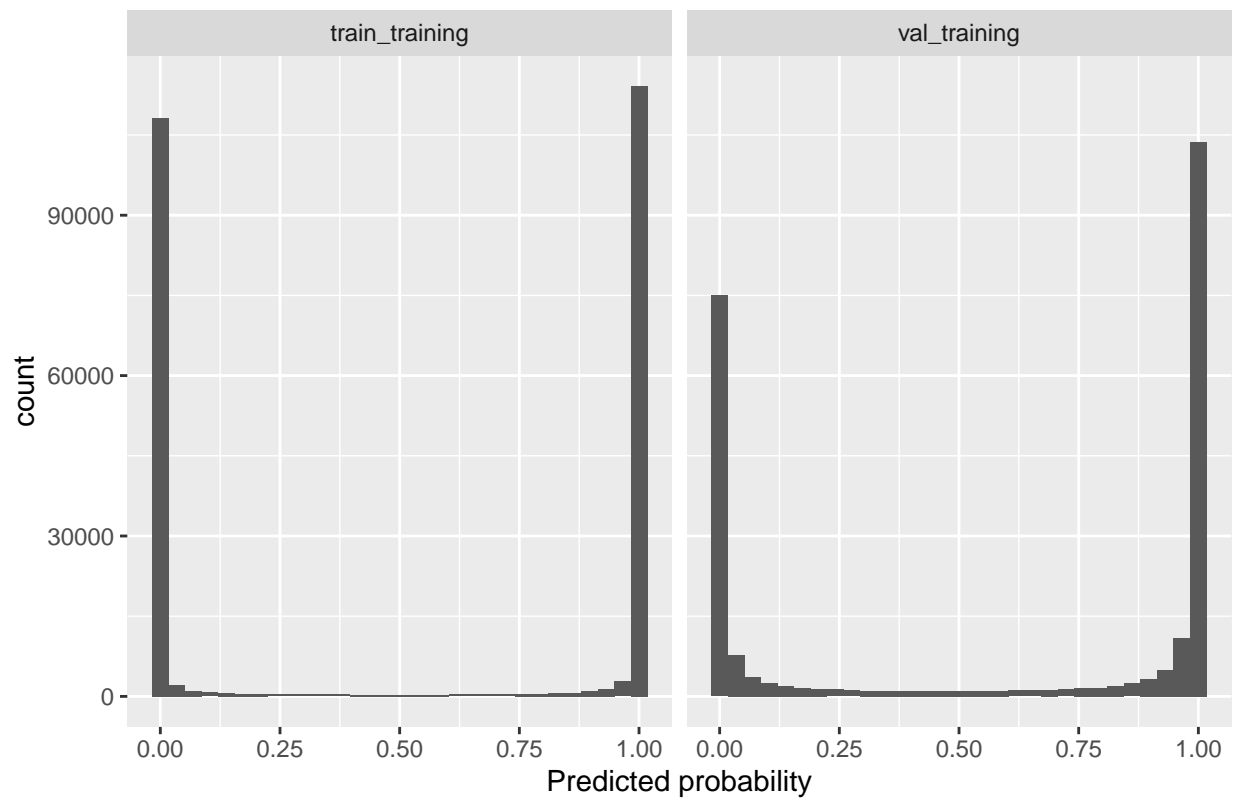
Predictions for irrelevant classes by LDA 6 vs 8



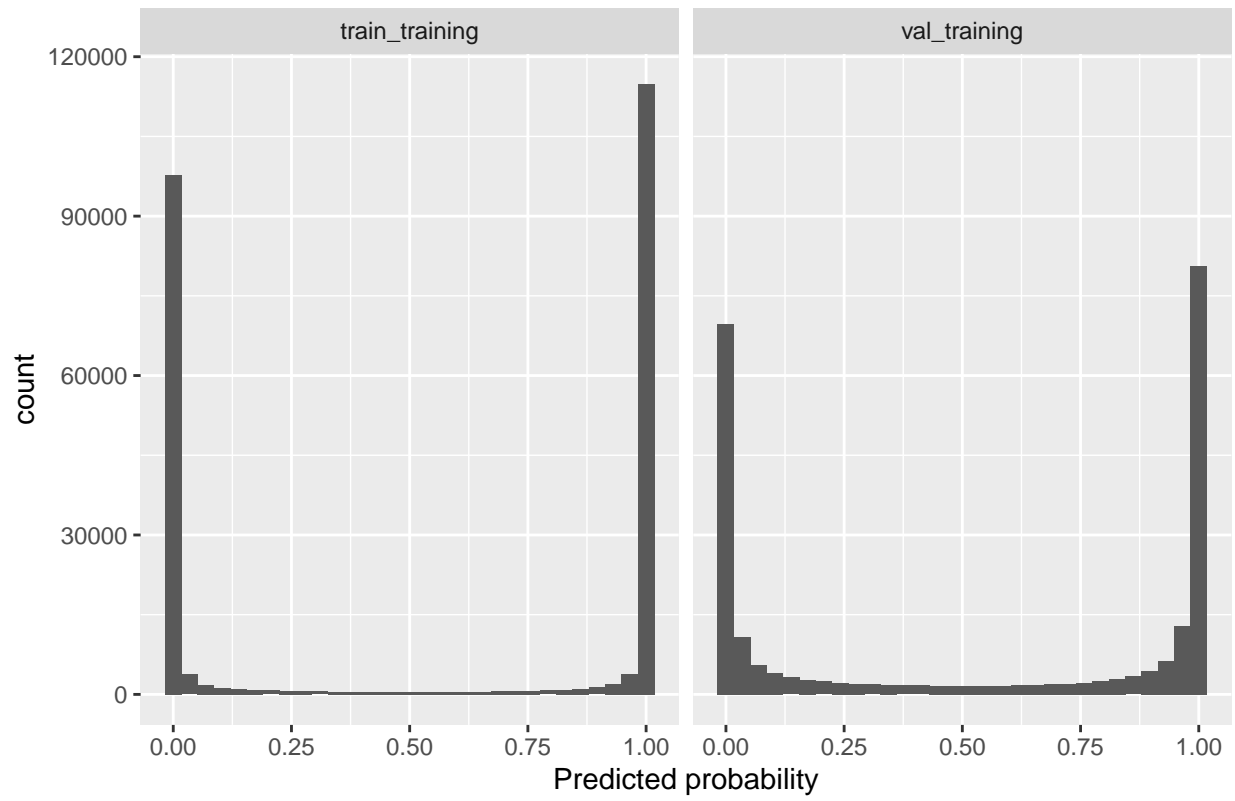
Predictions for irrelevant classes by LDA 6 vs 9



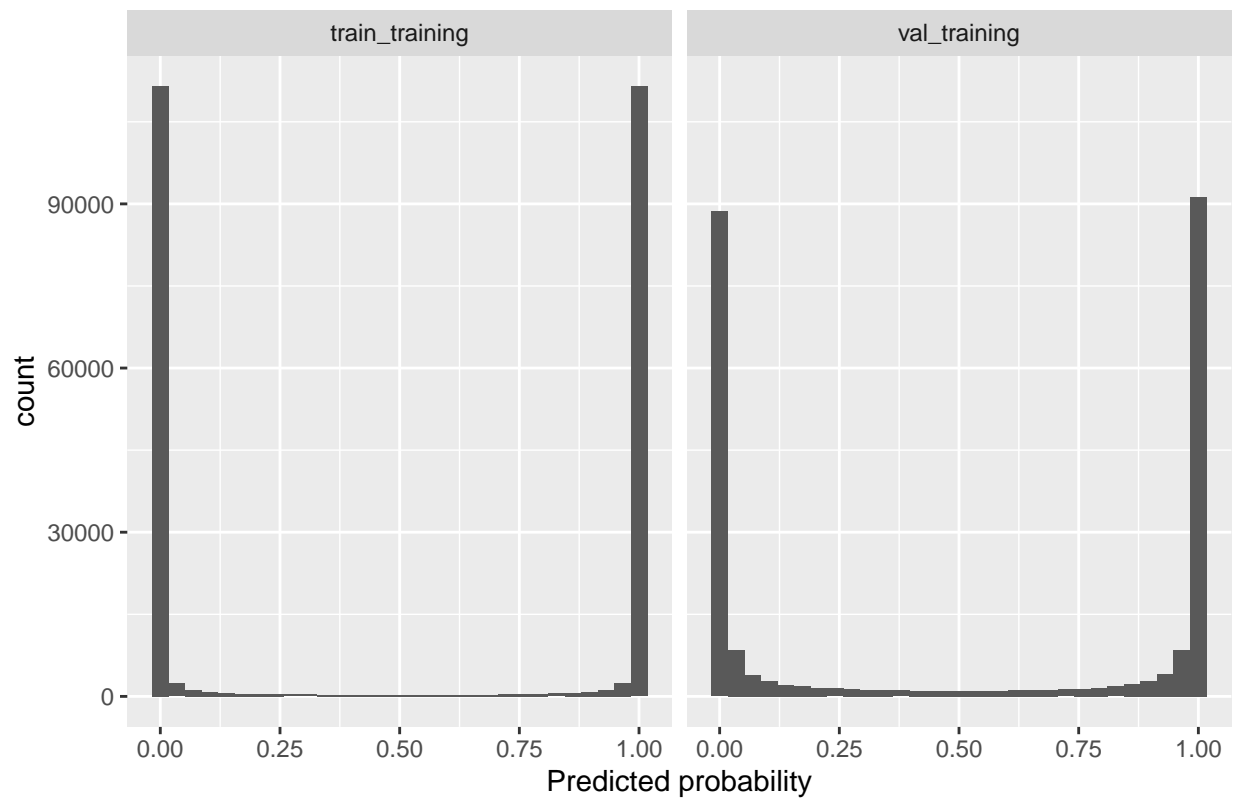
Predictions for irrelevant classes by LDA 6 vs 10

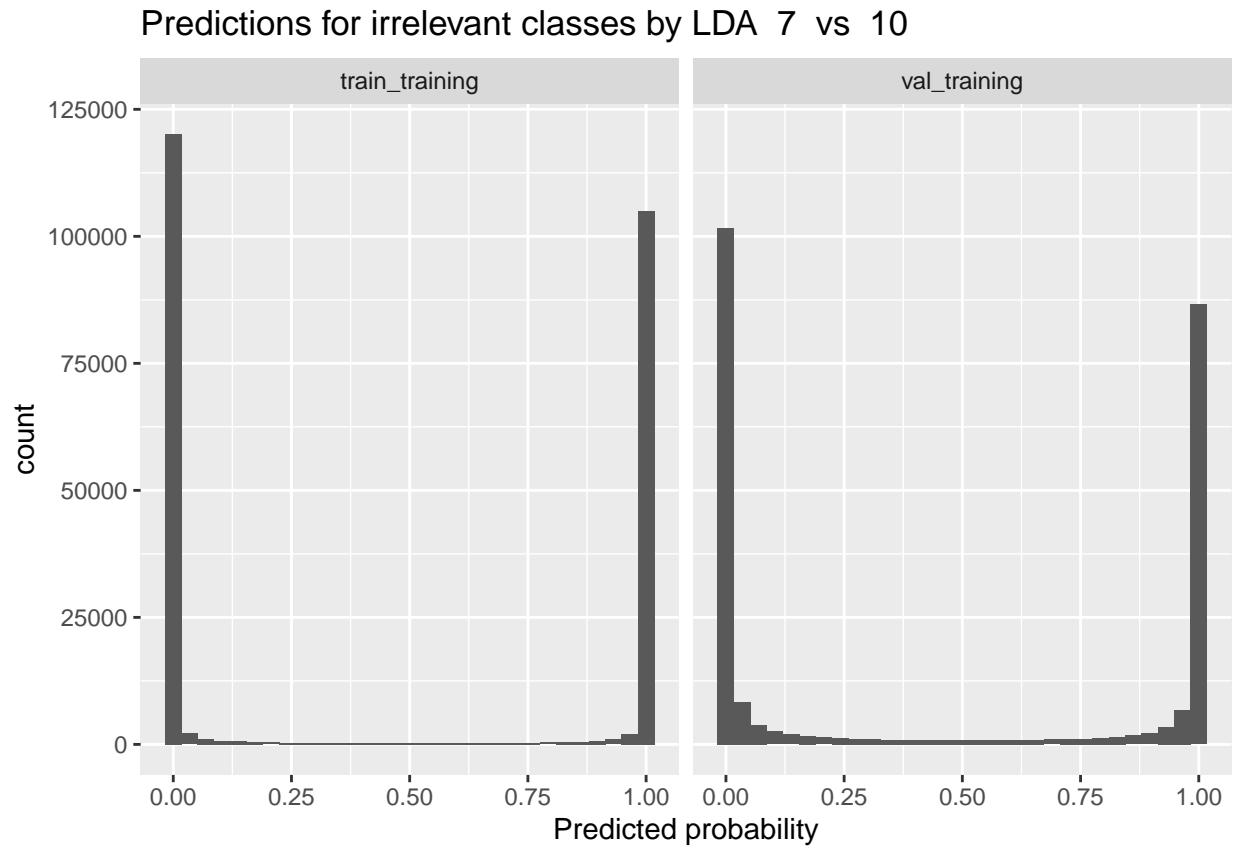


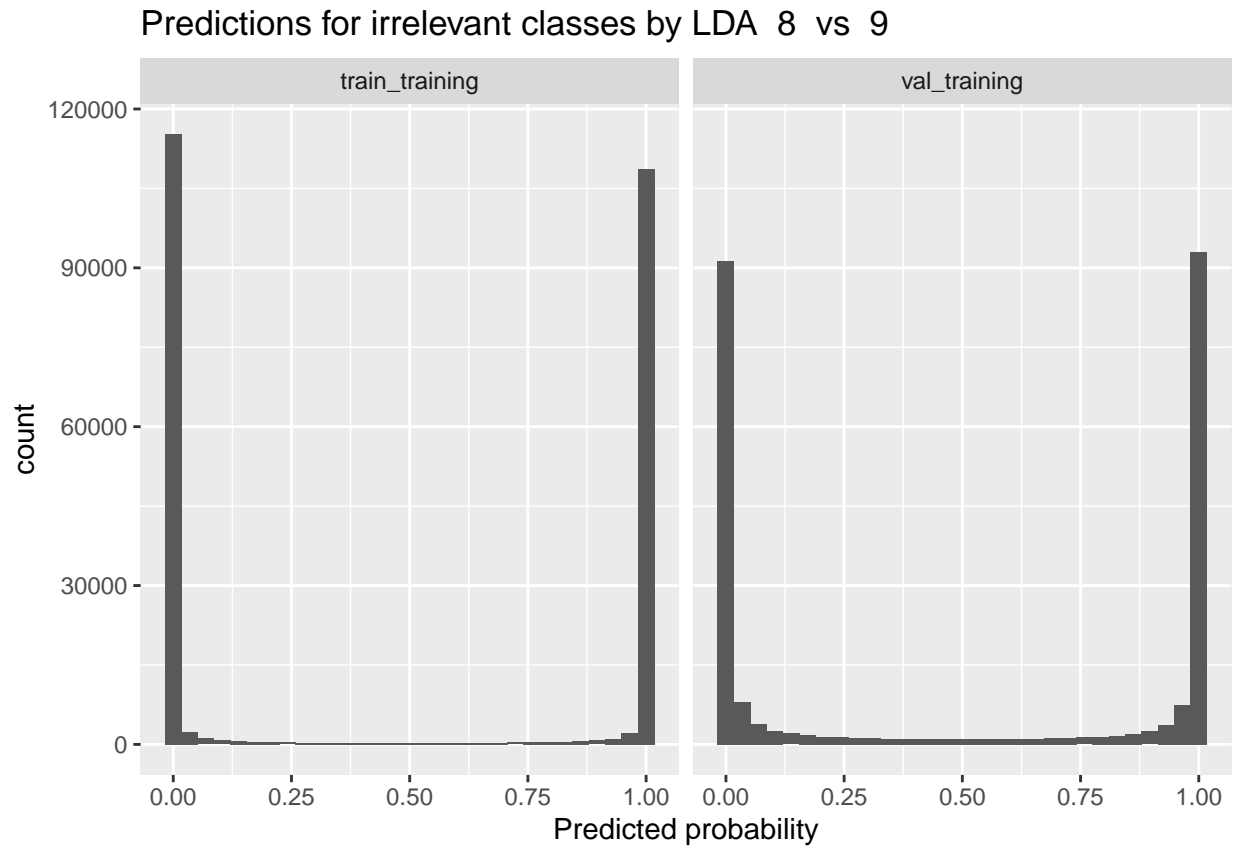
Predictions for irrelevant classes by LDA 7 vs 8



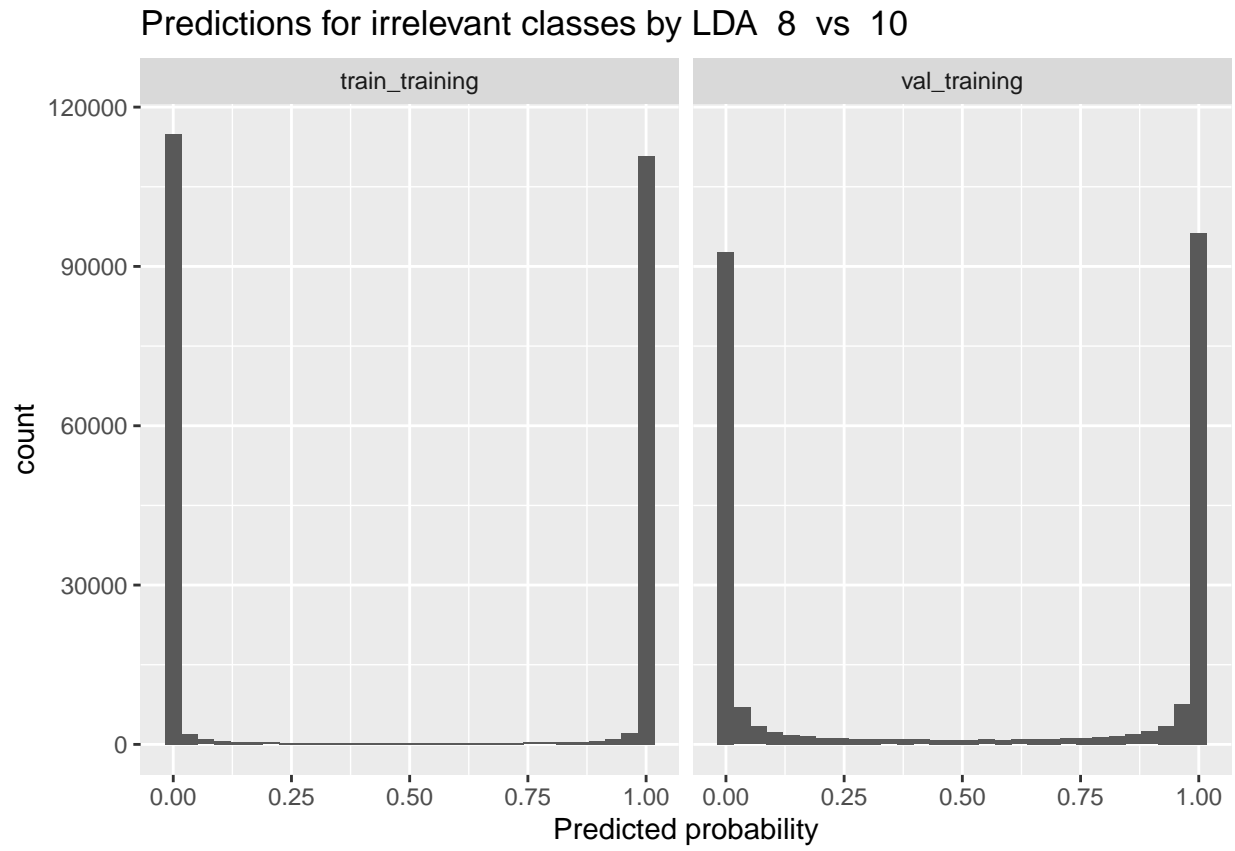
Predictions for irrelevant classes by LDA 7 vs 9

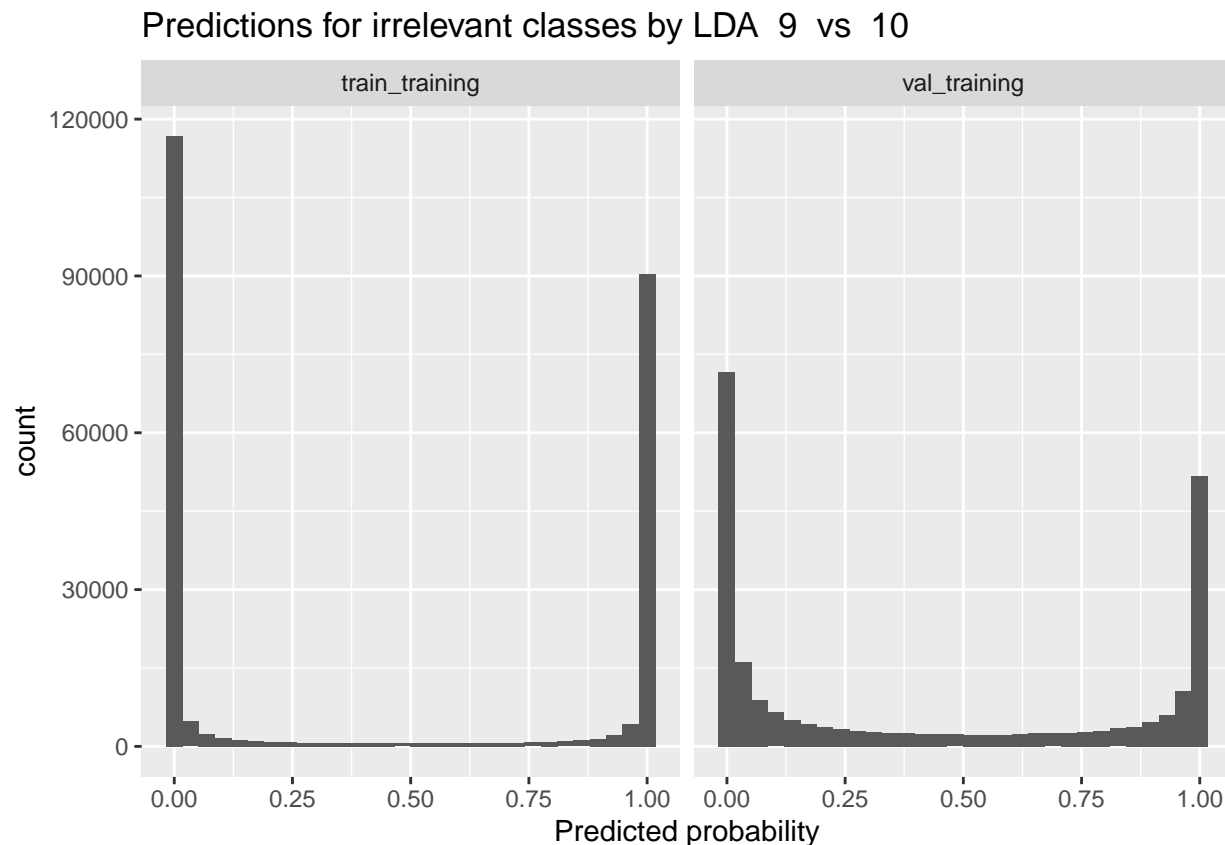












These histograms show, that even for unknown classes, LDA most often produces probabilities close to one and zero. One exception is val\_train LDA for class pair 4 and 6, where probabilities are divided evenly. Also the confidence plot for this LDA looks sensibly.

## CIFAR 10 half

```
base_dir <- "../data/data_train_val_half_c10"
repls <- 0:0
folds <- 0:49
classes <- 10
lda_coefs <- load_lda_coefs(base_dir, repls, folds)
net_pw_results <- read.csv(file.path(base_dir, "net_pw accuracies.csv"))
ens_pw_results <- read.csv(file.path(base_dir, "ensemble_pw accuracies.csv"))
net_pw_results[, c("class1", "class2")] <- lapply(net_pw_results[, c("class1", "class2")], as.factor)
ens_pw_results[, c("class1", "class2")] <- lapply(ens_pw_results[, c("class1", "class2")], as.factor)

for (cl1 in 1:(classes - 1))
{
  for (cl2 in (cl1 + 1):classes)
  {
    lda_plt <- lda_coefs %>% filter(class1 == cl1 & class2 == cl2) %>% ggplot() + geom_boxplot(aes(x=coef))
    facet_wrap(~train_type) + ggtitle("LDA coefficients")
    acc_plt_net <- net_pw_results %>% filter(class1 == (cl1 - 1) & class2 == (cl2 - 1)) %>% ggplot(mapping = aes(x=acc))
    geom_boxplot() + ggtitle("Pairwise accuracies of networks")
  }
}
```

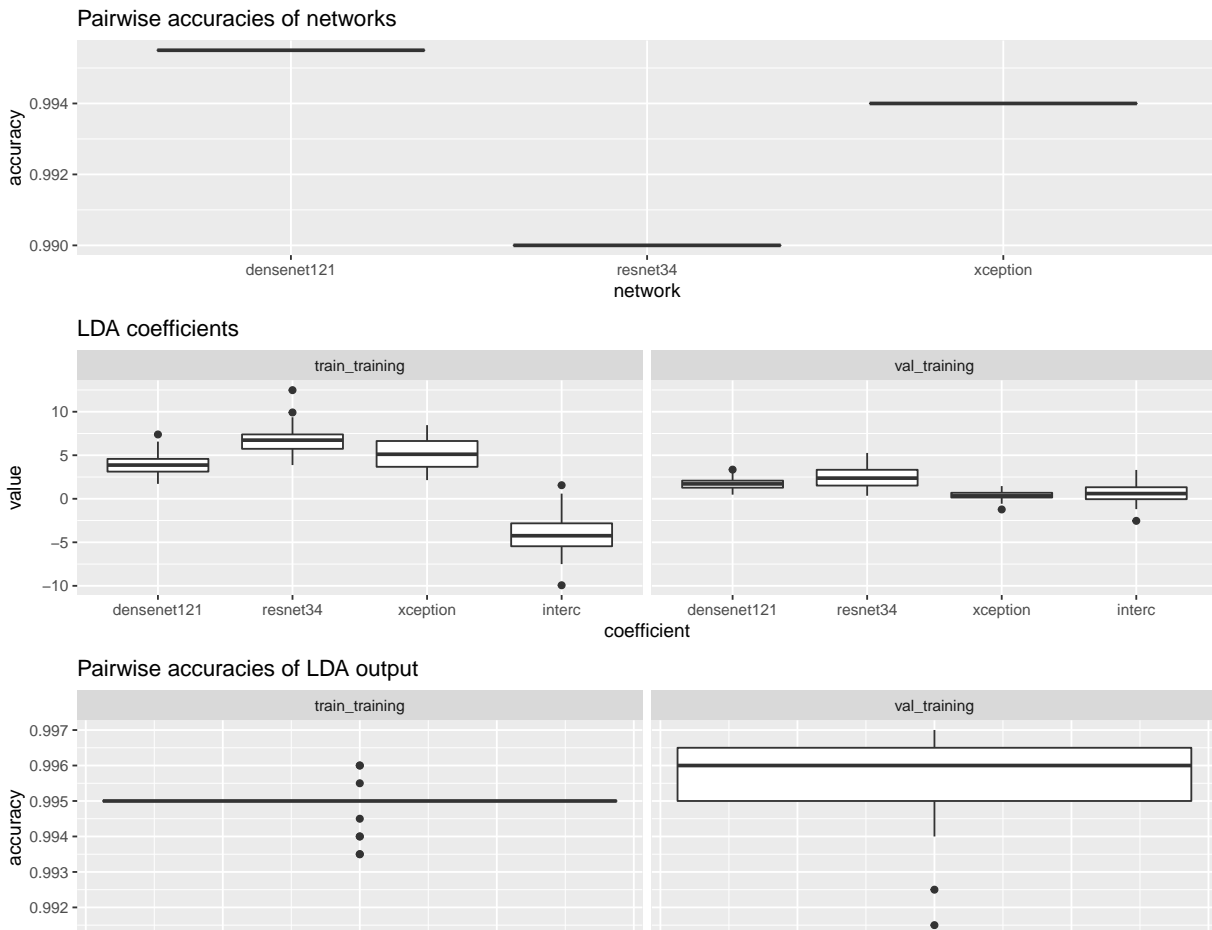
```

acc_plt_ens <- ens_pw_results %>% filter(class1 == (c11 - 1) & class2 == (c12 - 1)) %>% ggplot(mapping =
  geom_boxplot() + facet_wrap(~train_set) + ggtitle("Pairwise accuracies of LDA output") +
  theme(axis.ticks.x=element_blank(), axis.text.x=element_blank()))

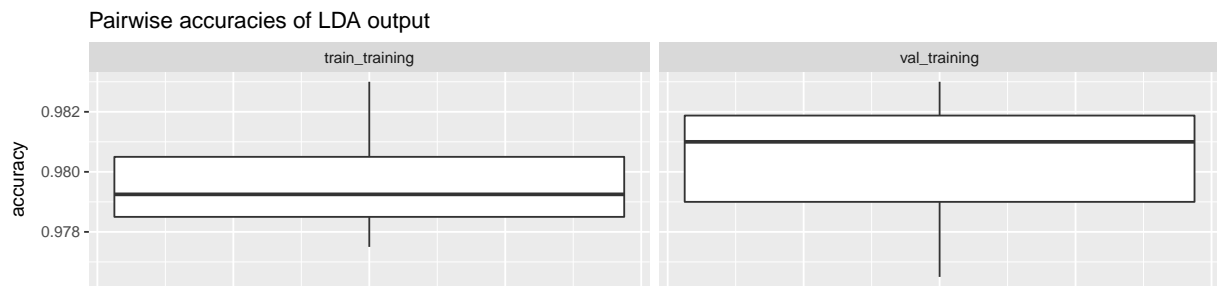
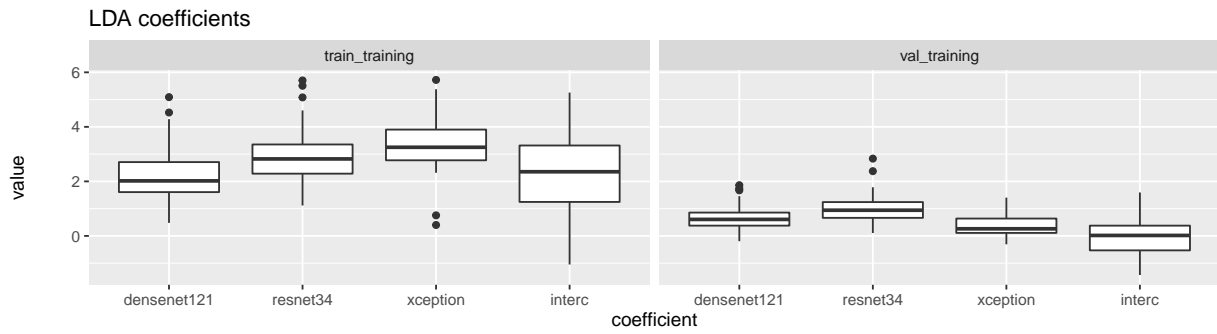
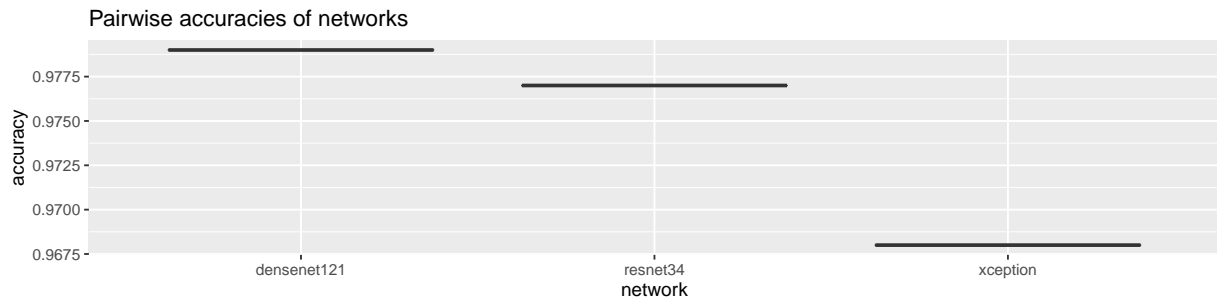
print((acc_plt_net/lda_plt/acc_plt_ens) + plot_annotation(title=paste("Classes ", c11, " vs ", c12)))
}
}

```

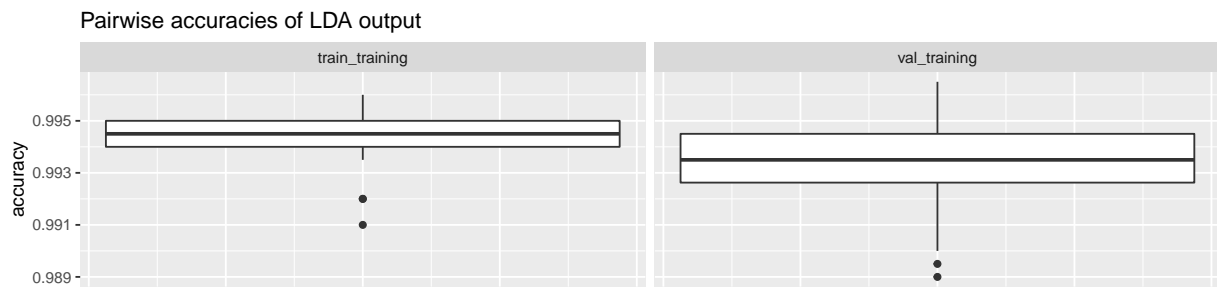
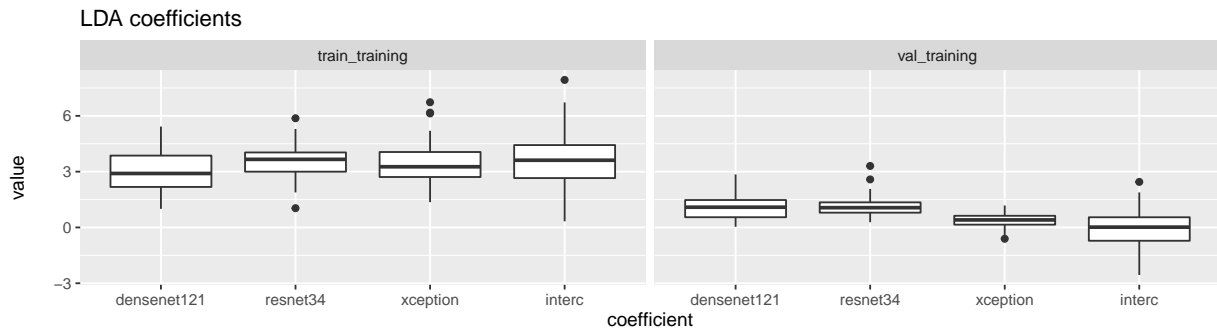
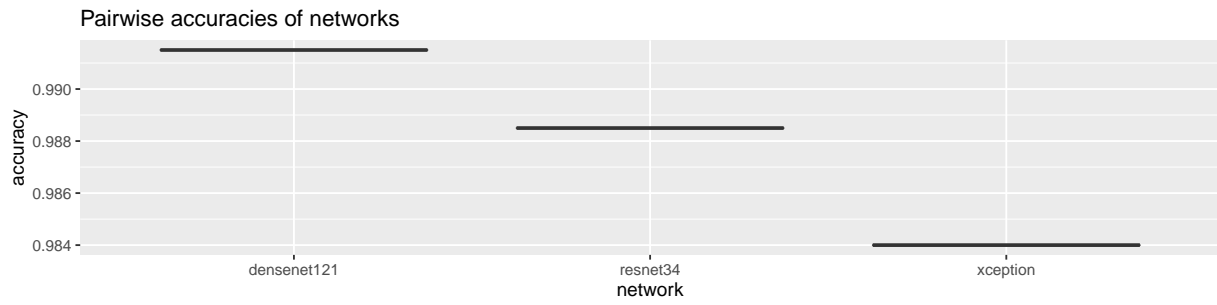
Classes 1 vs 2



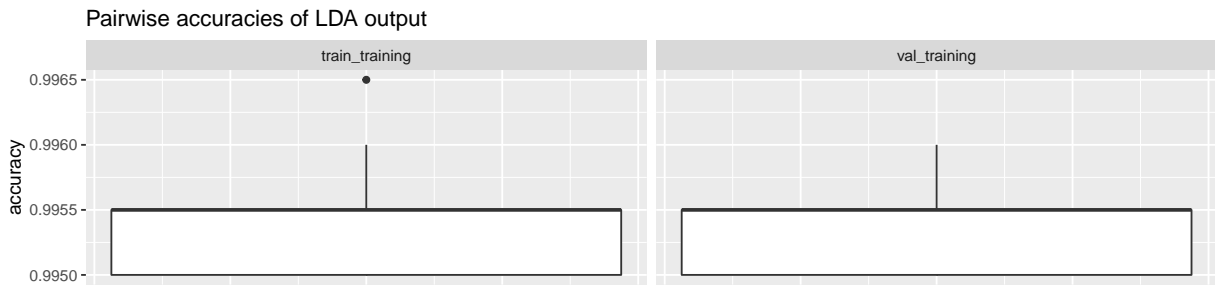
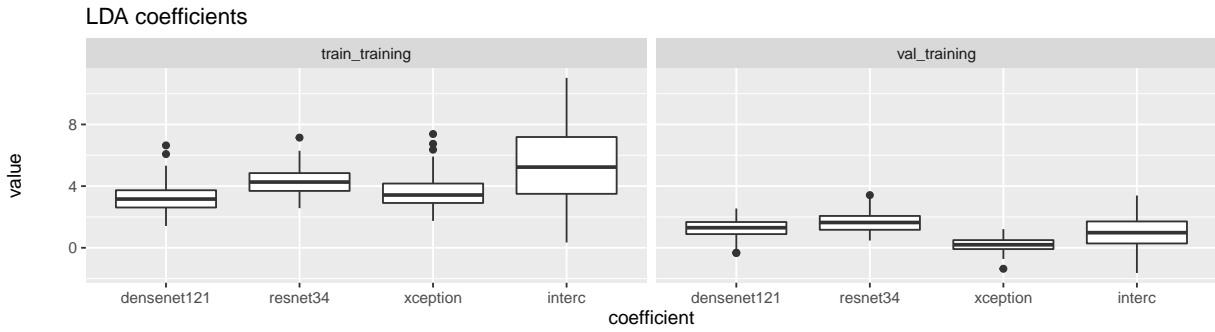
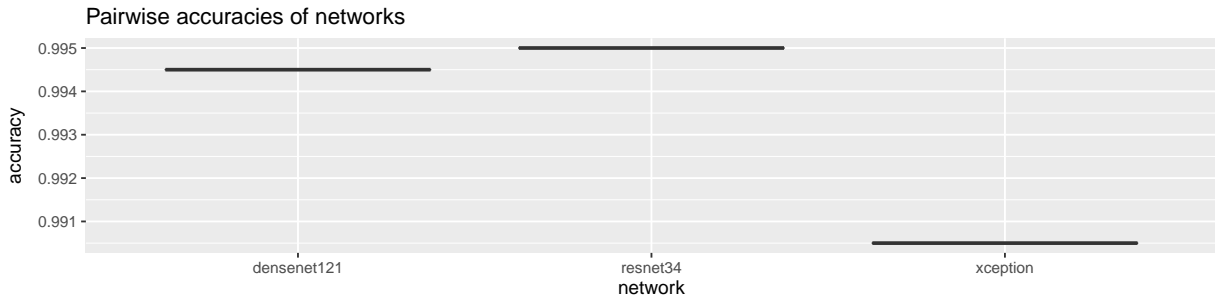
## Classes 1 vs 3



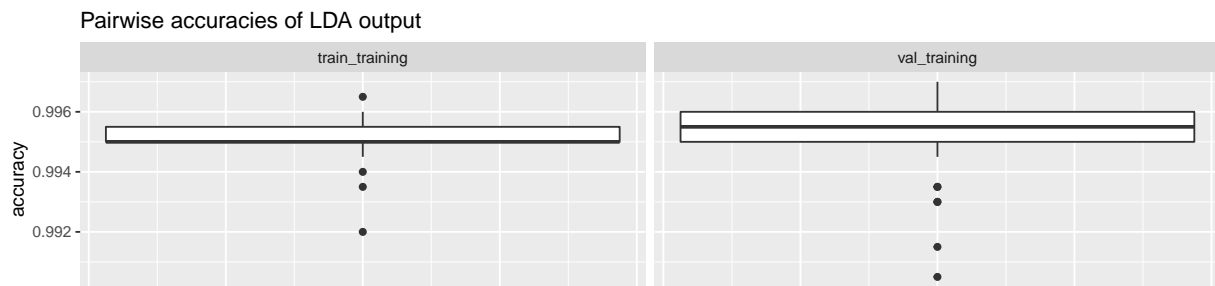
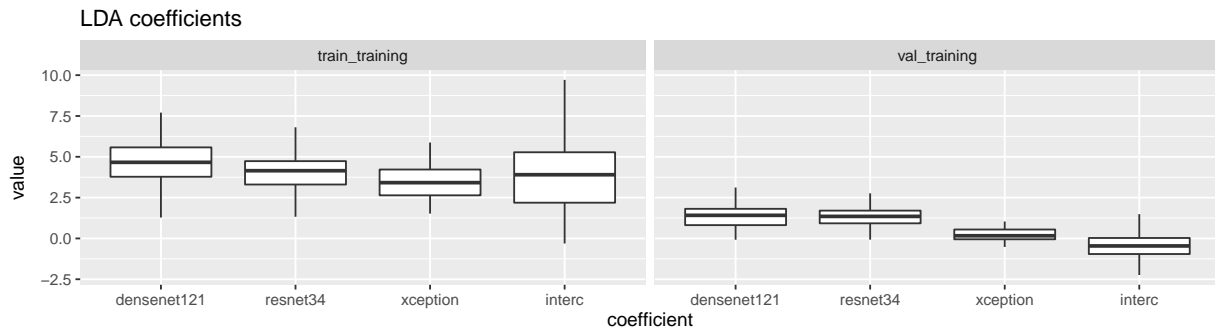
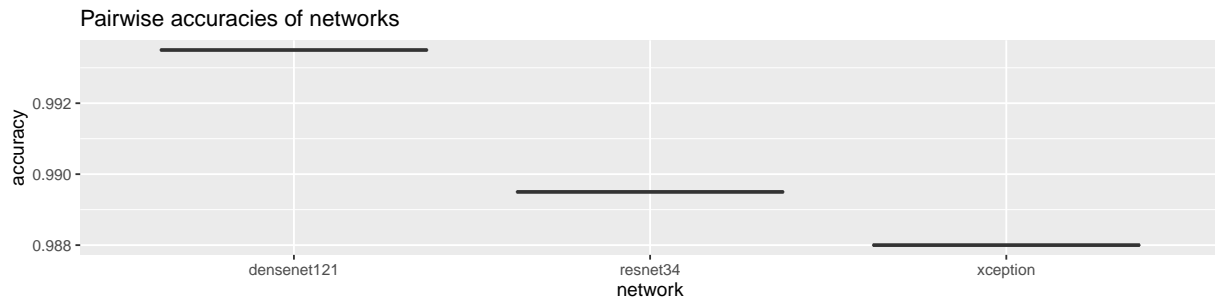
## Classes 1 vs 4



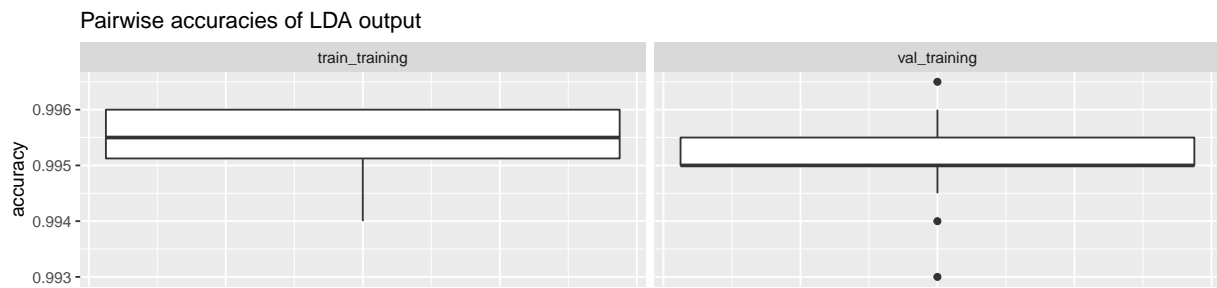
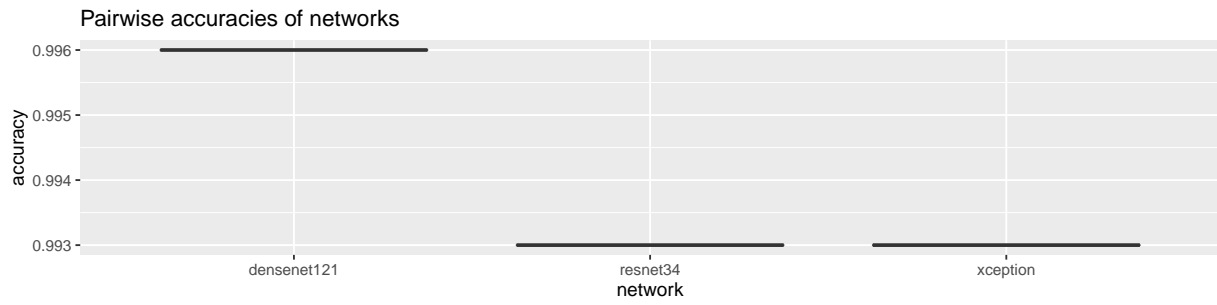
## Classes 1 vs 5



## Classes 1 vs 6

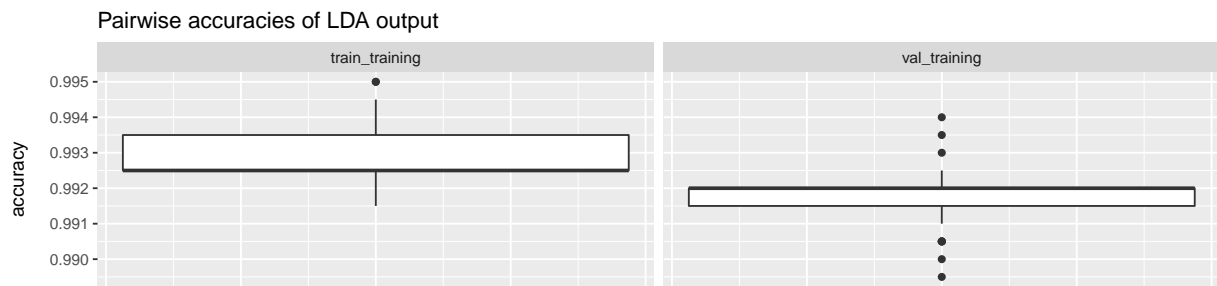
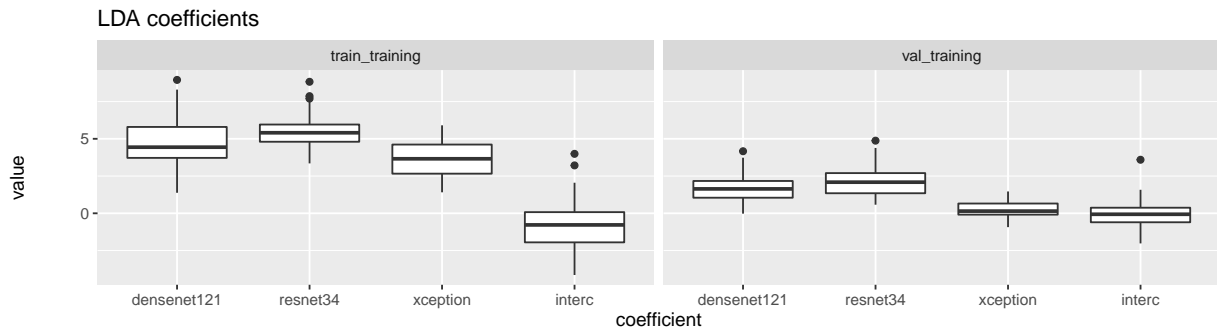
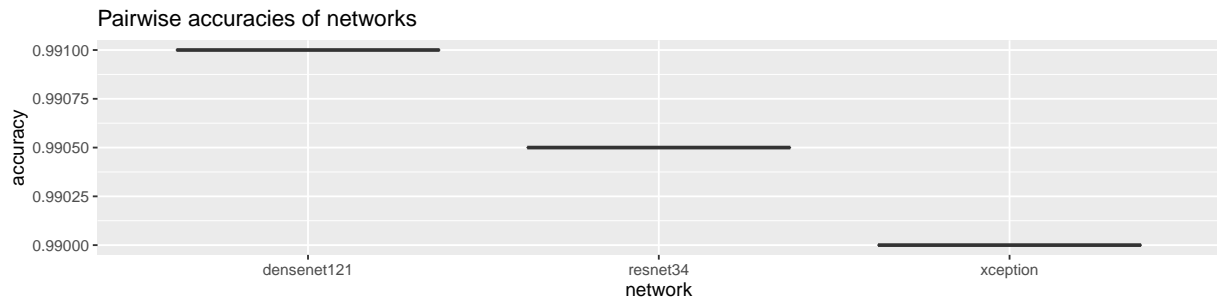


## Classes 1 vs 7

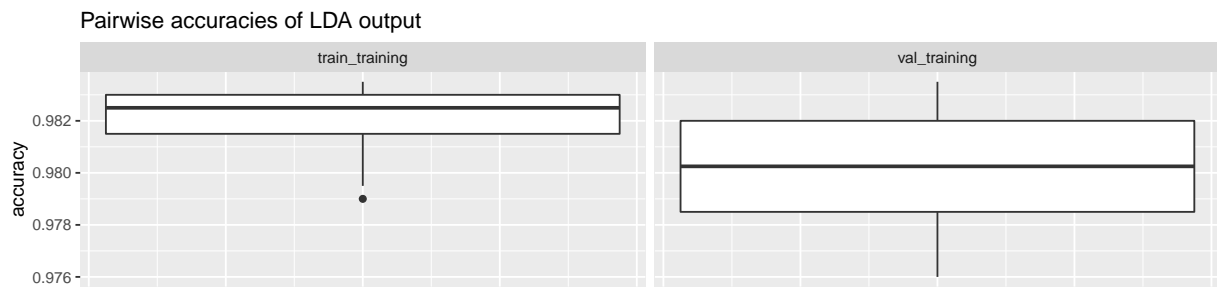
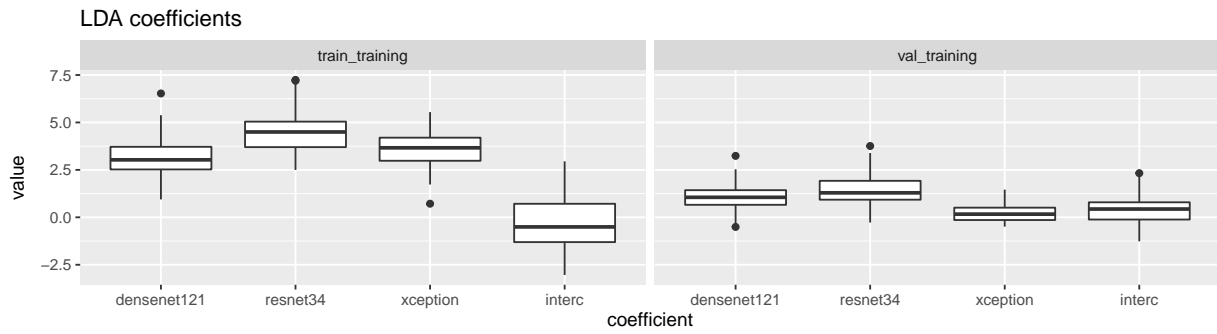
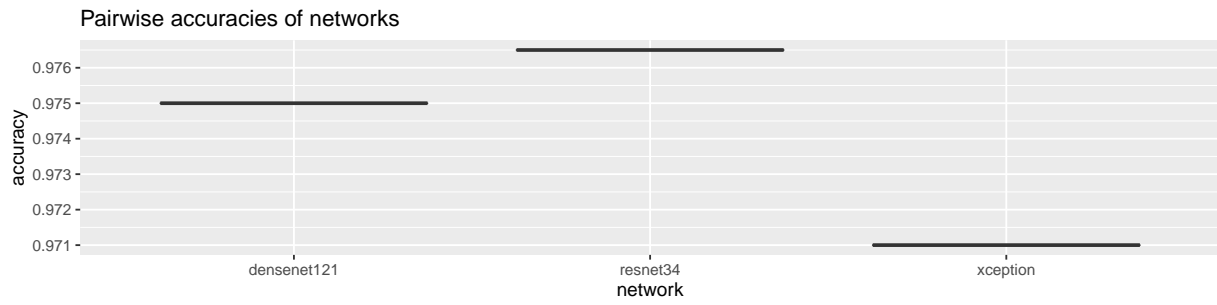




## Classes 1 vs 8

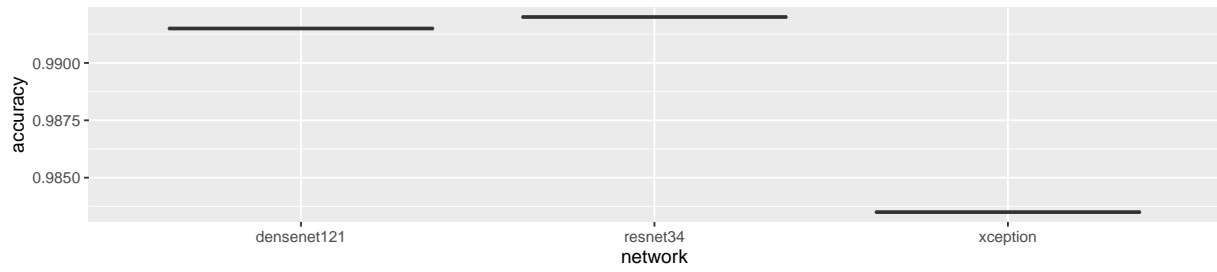


## Classes 1 vs 9

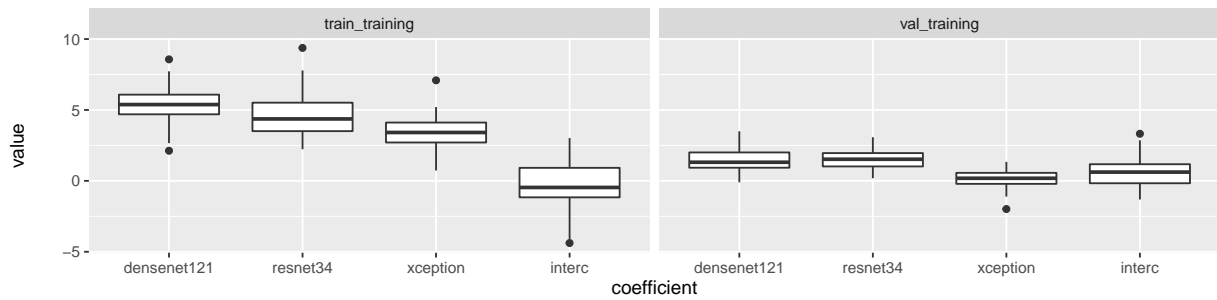


## Classes 1 vs 10

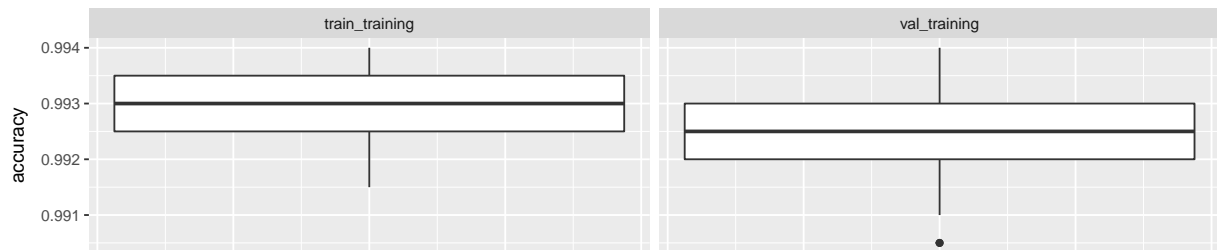
Pairwise accuracies of networks



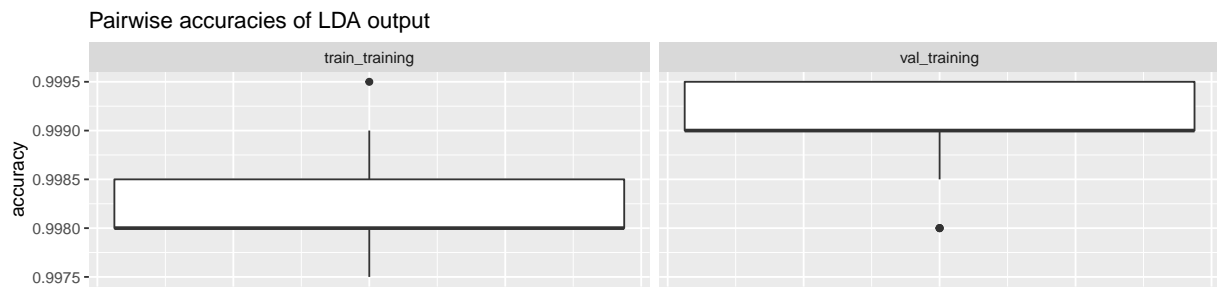
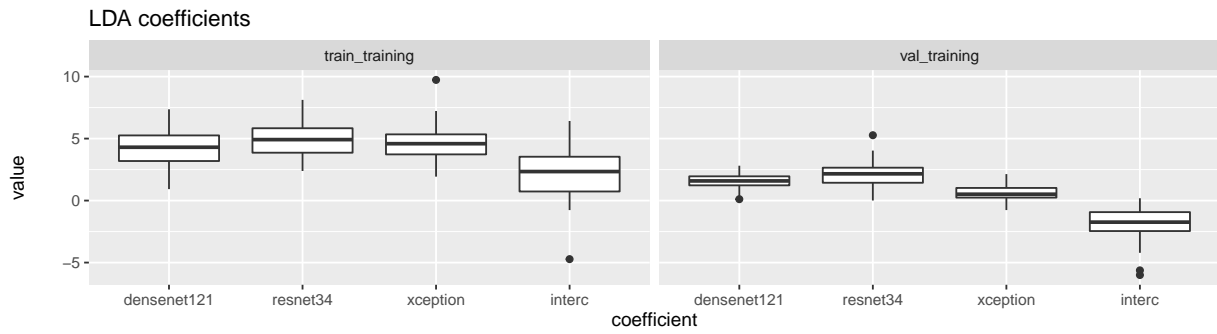
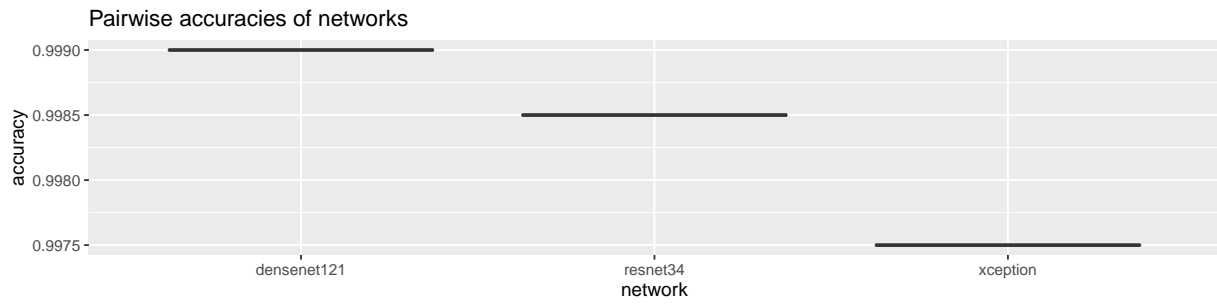
LDA coefficients



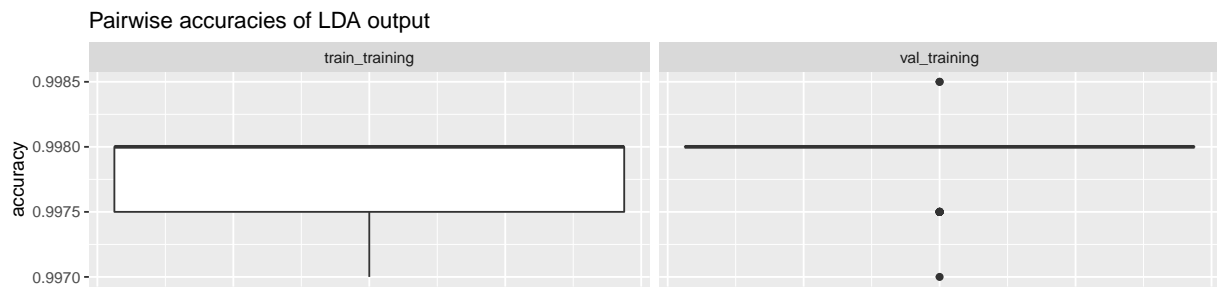
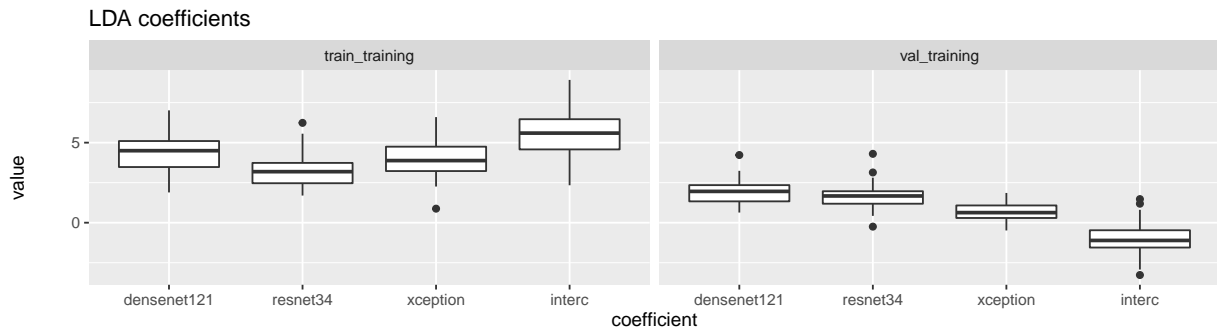
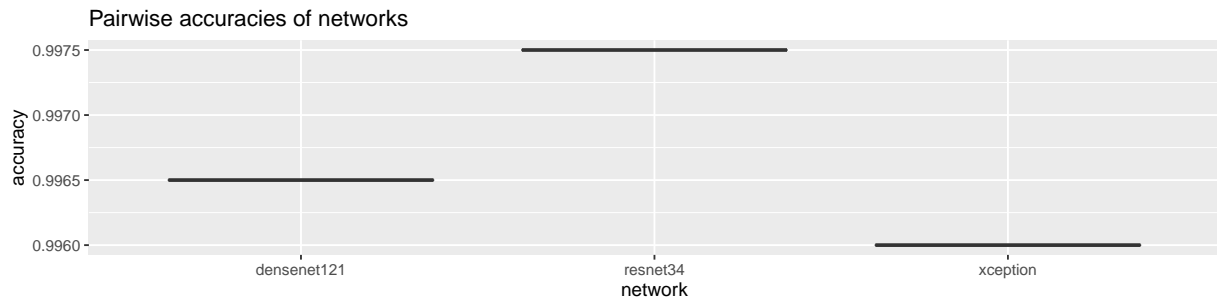
Pairwise accuracies of LDA output



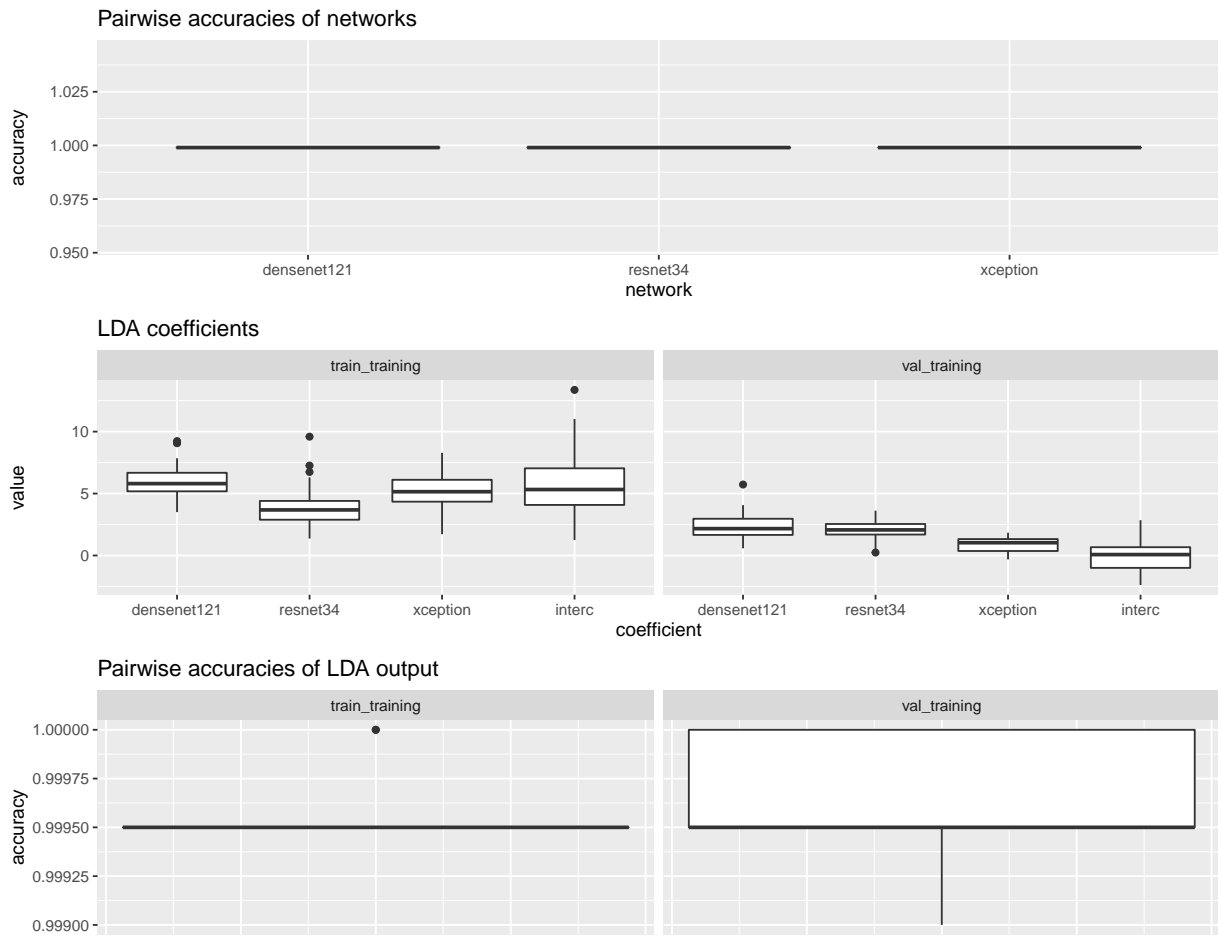
## Classes 2 vs 3



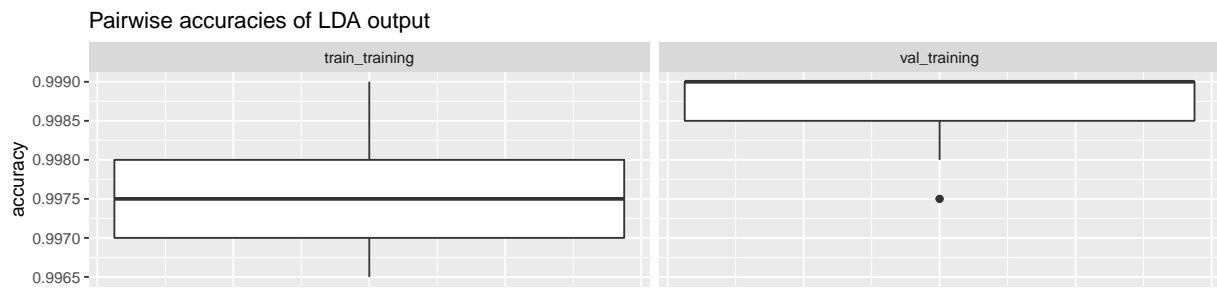
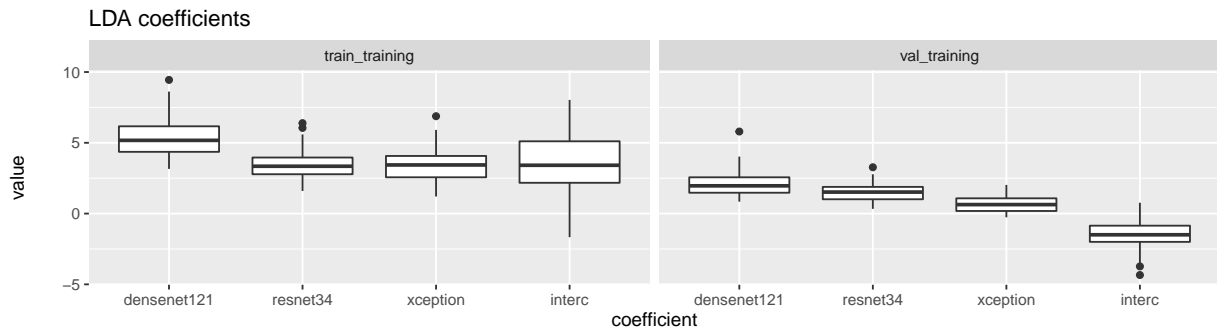
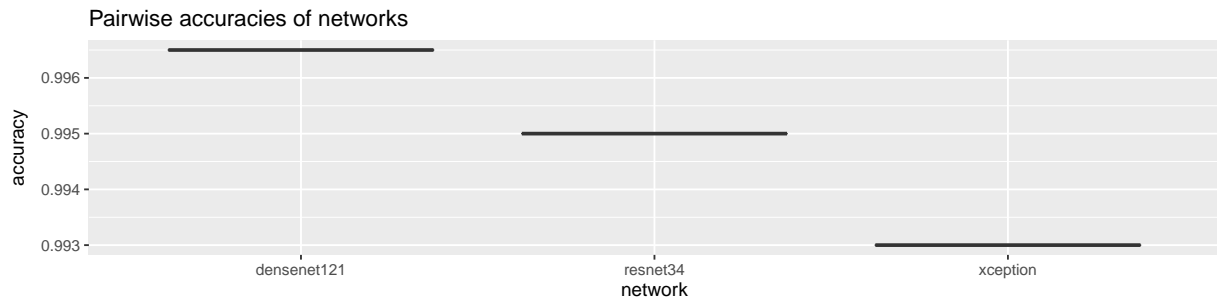
## Classes 2 vs 4



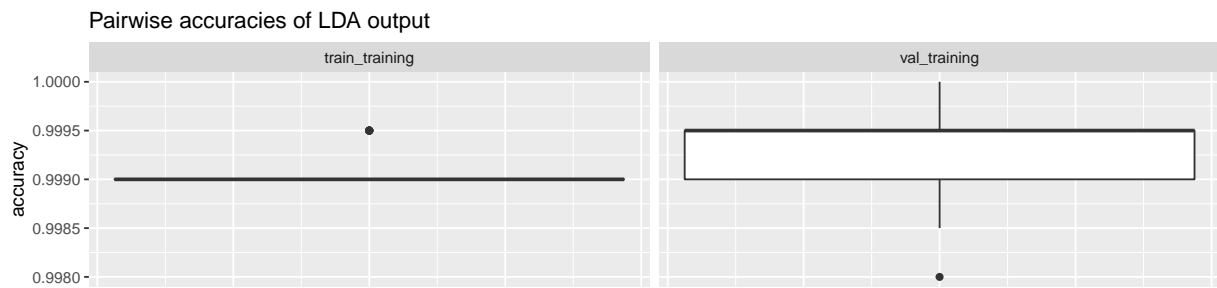
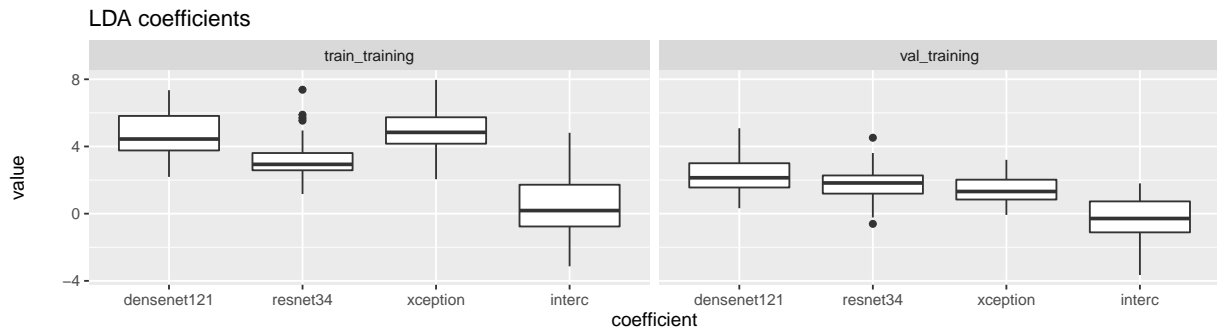
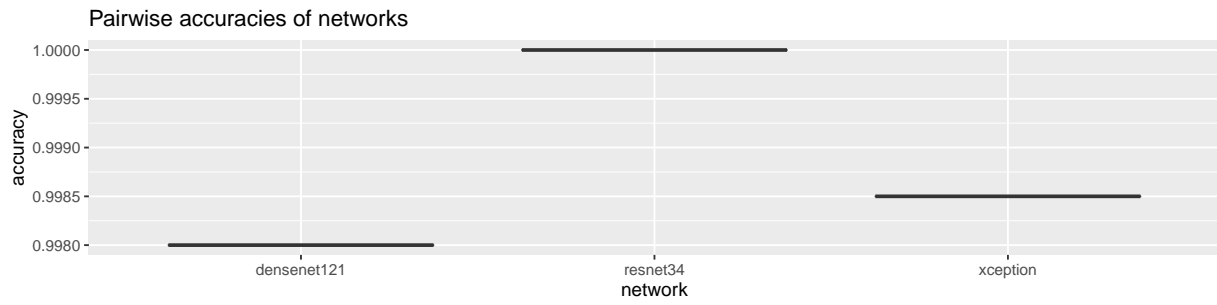
## Classes 2 vs 5



## Classes 2 vs 6

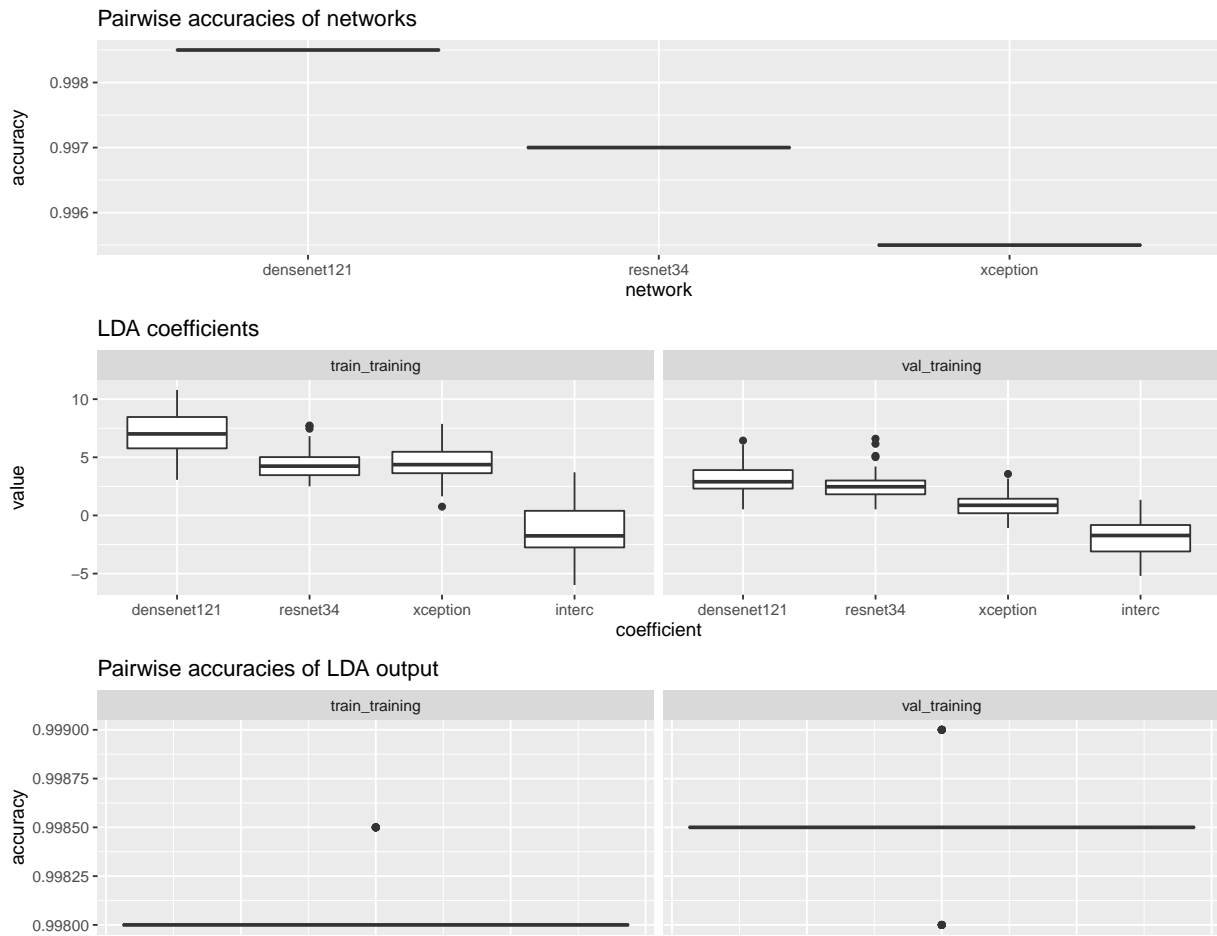


## Classes 2 vs 7

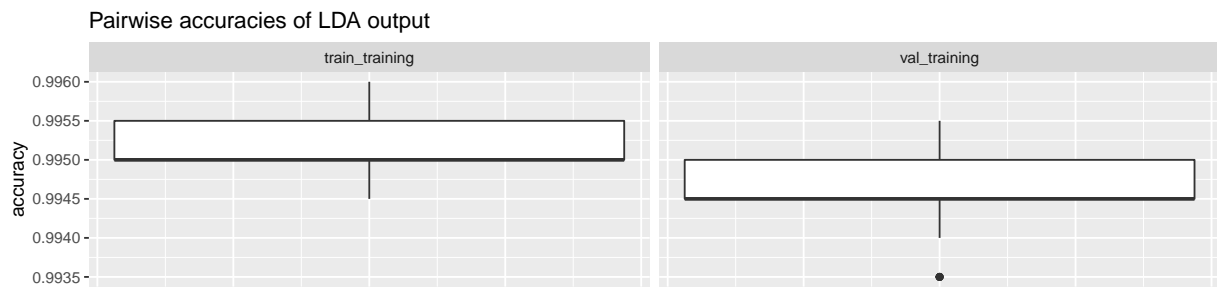
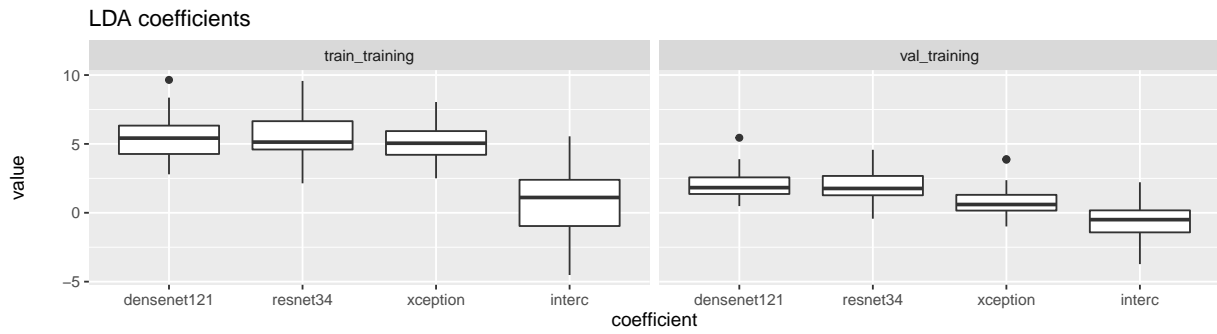
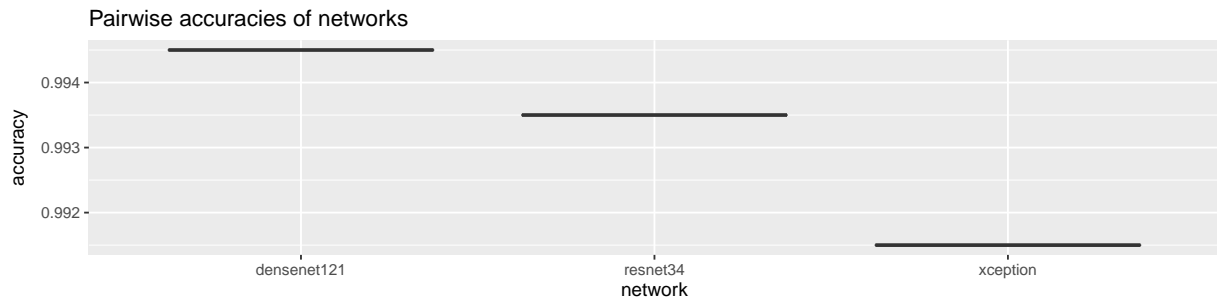




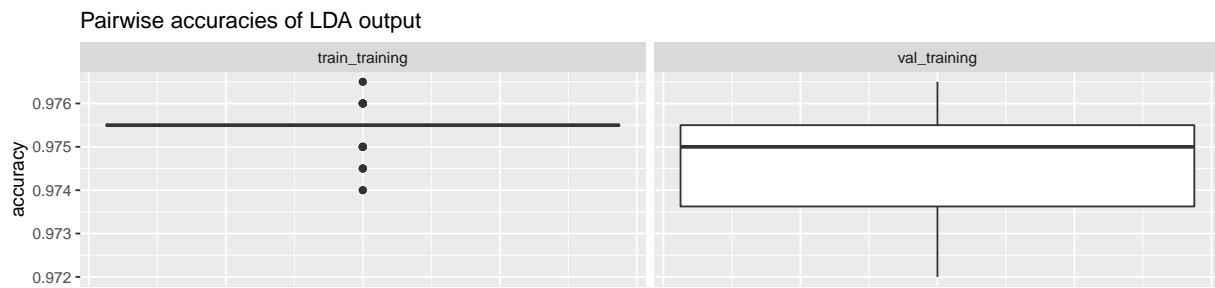
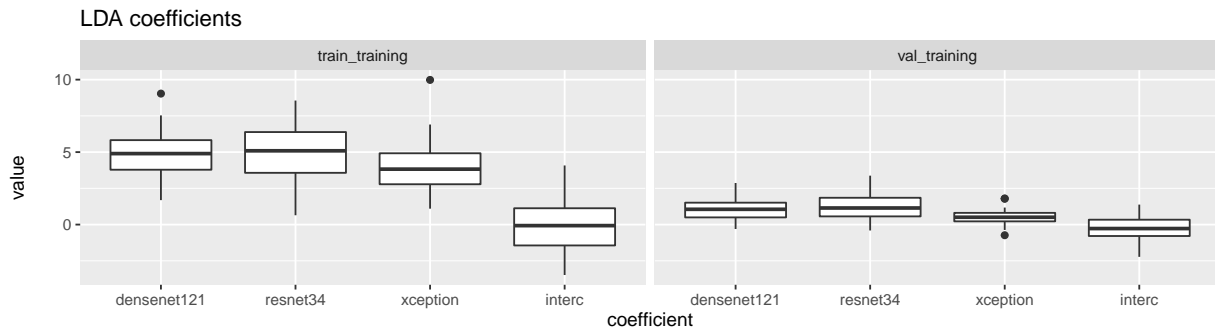
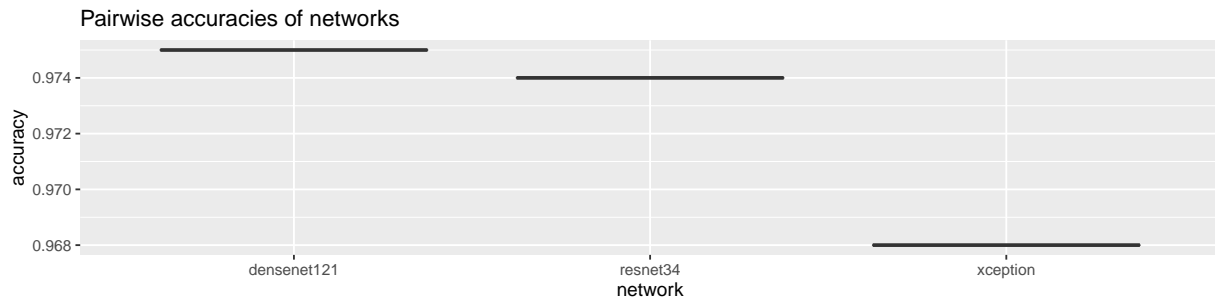
## Classes 2 vs 8



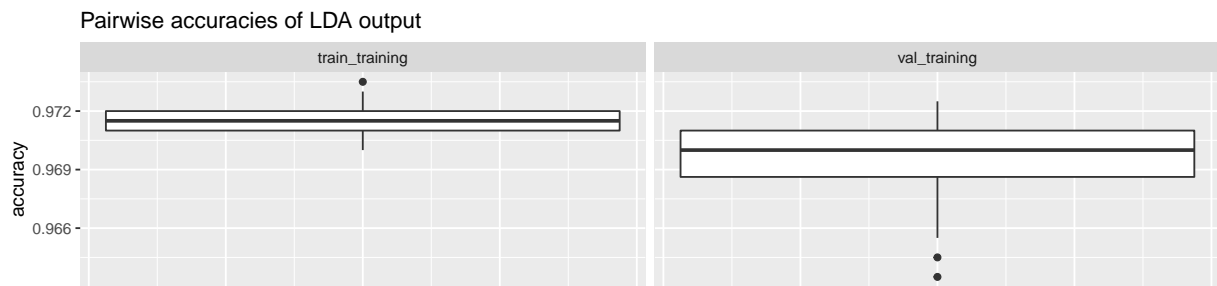
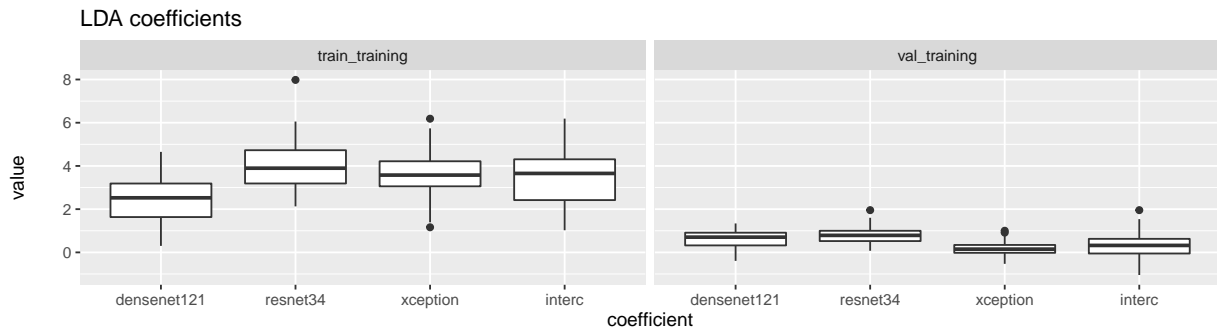
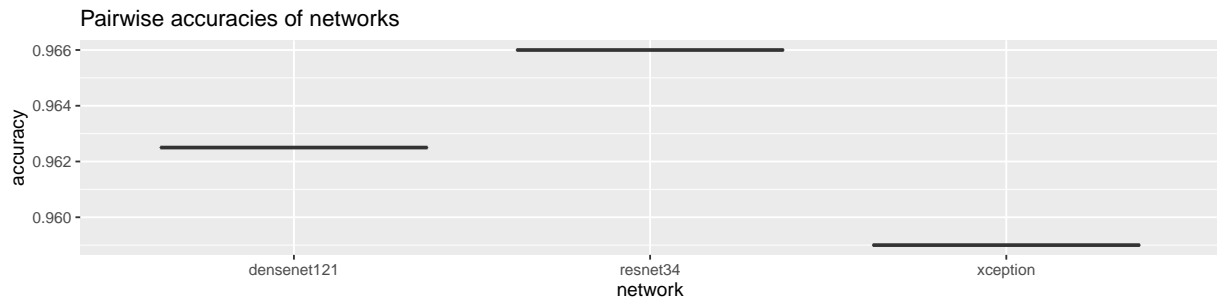
## Classes 2 vs 9



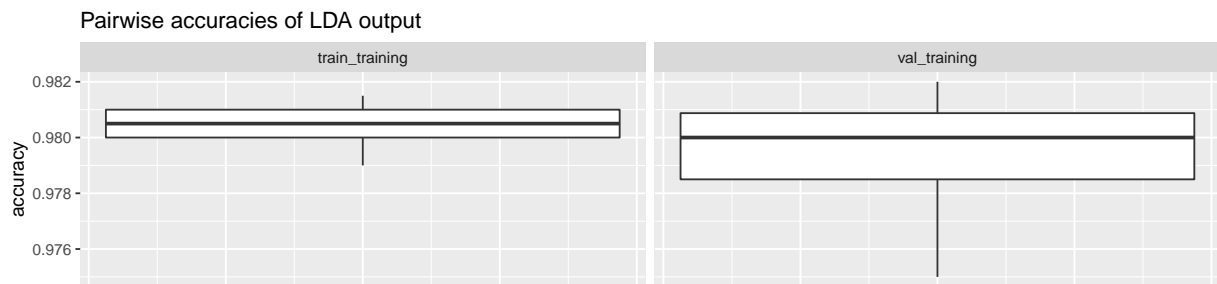
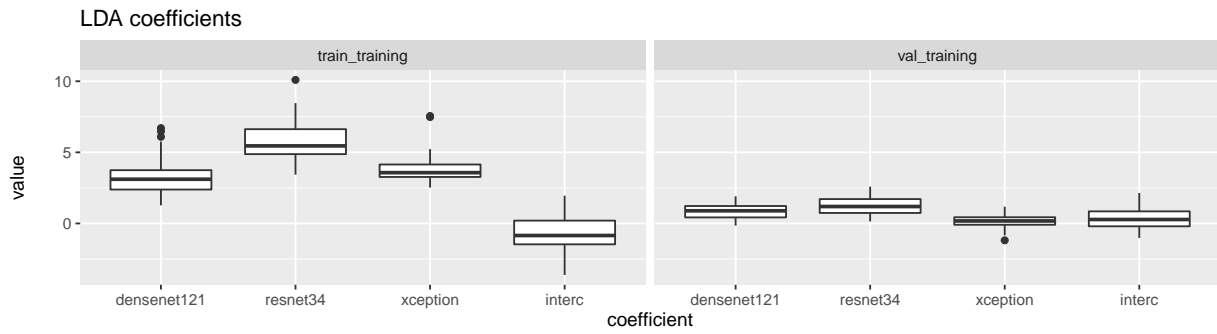
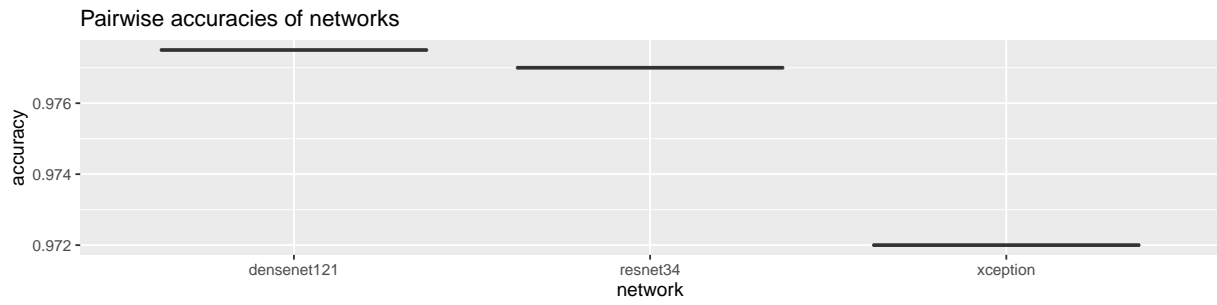
## Classes 2 vs 10



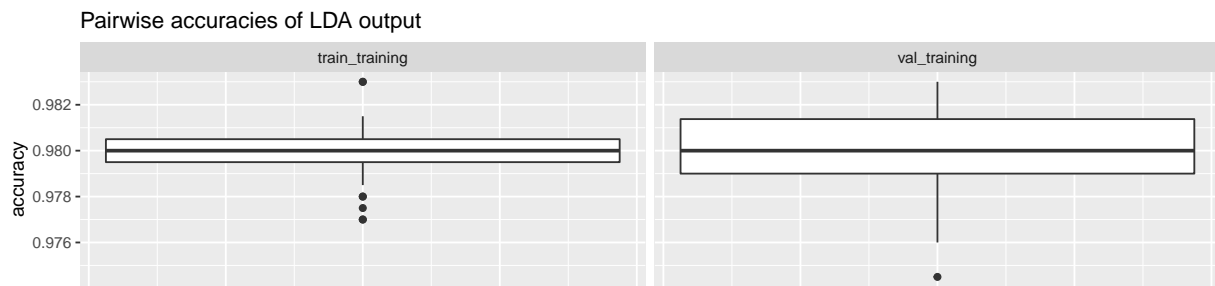
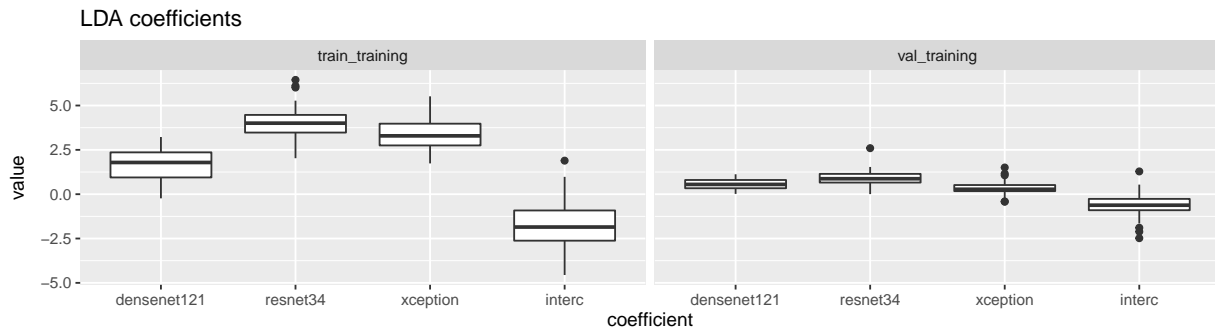
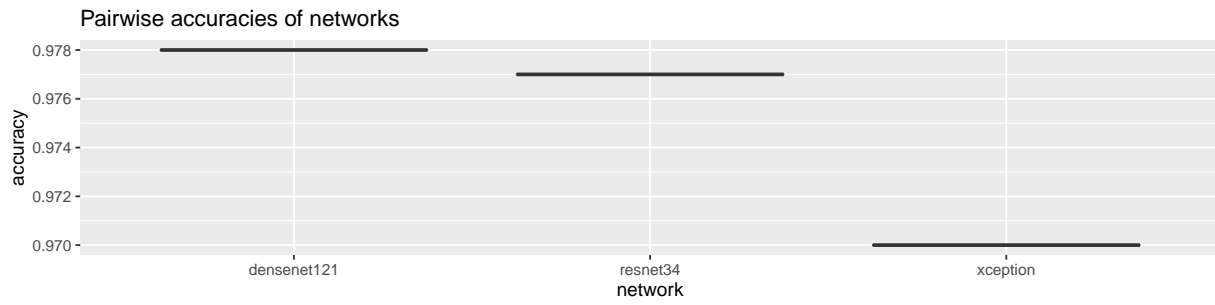
## Classes 3 vs 4



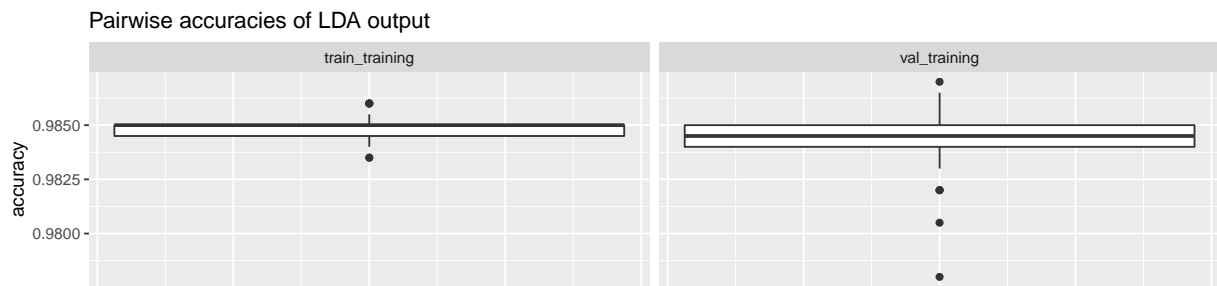
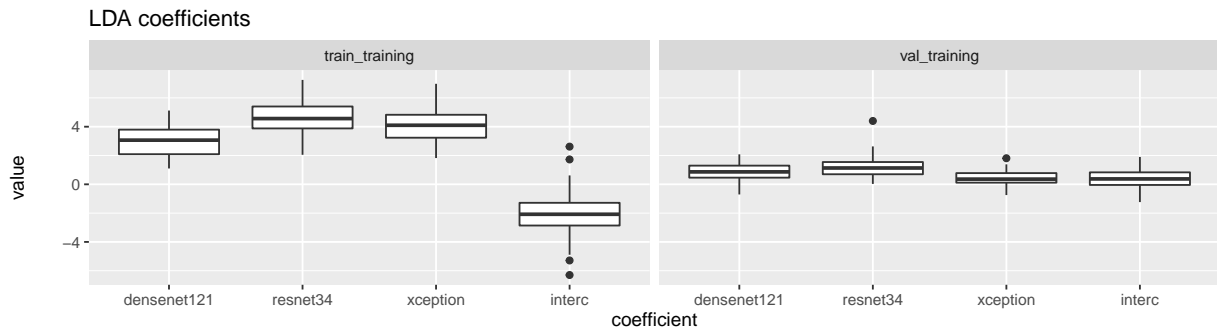
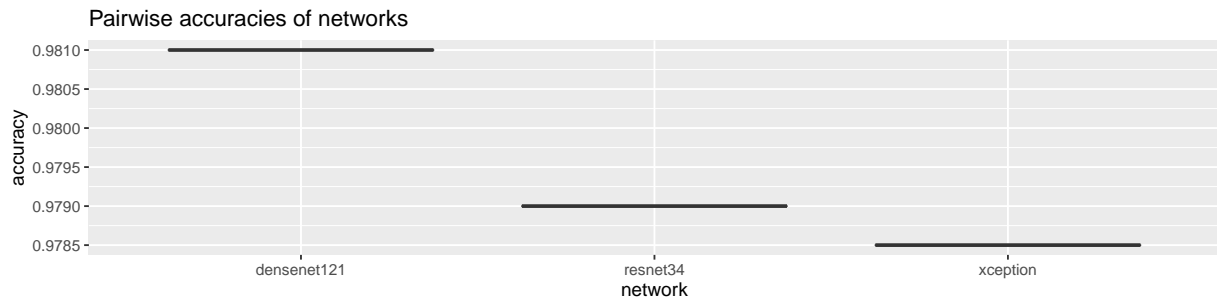
## Classes 3 vs 5



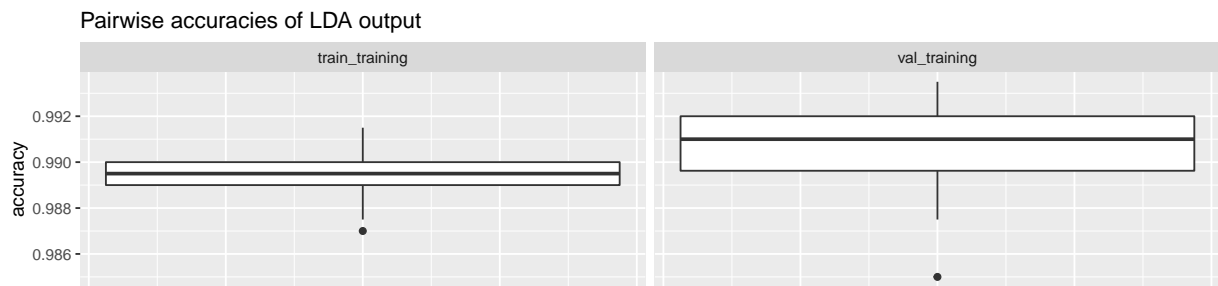
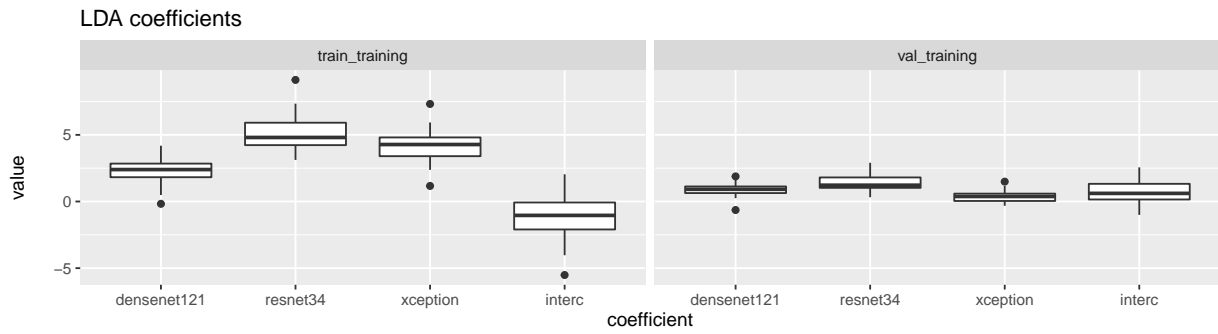
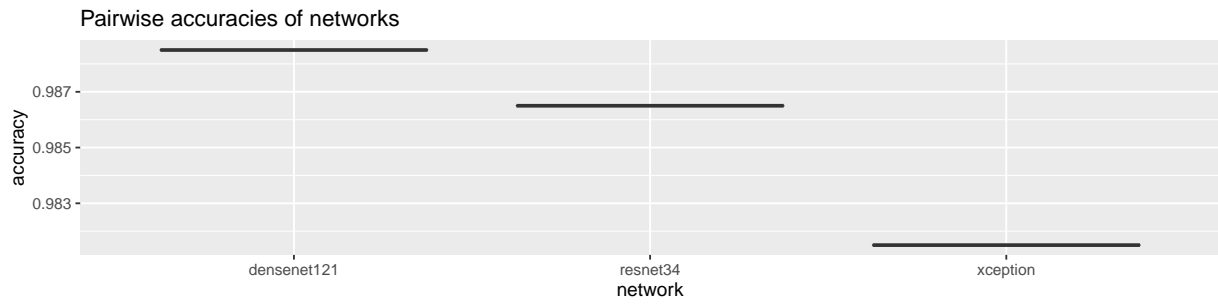
## Classes 3 vs 6



## Classes 3 vs 7

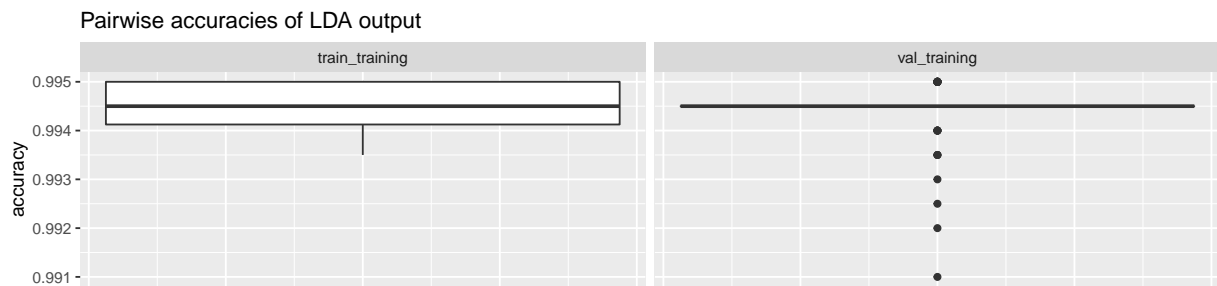
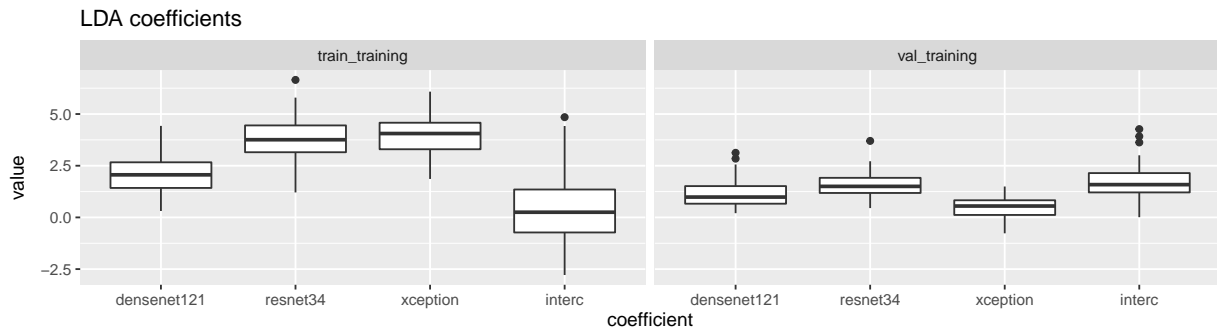
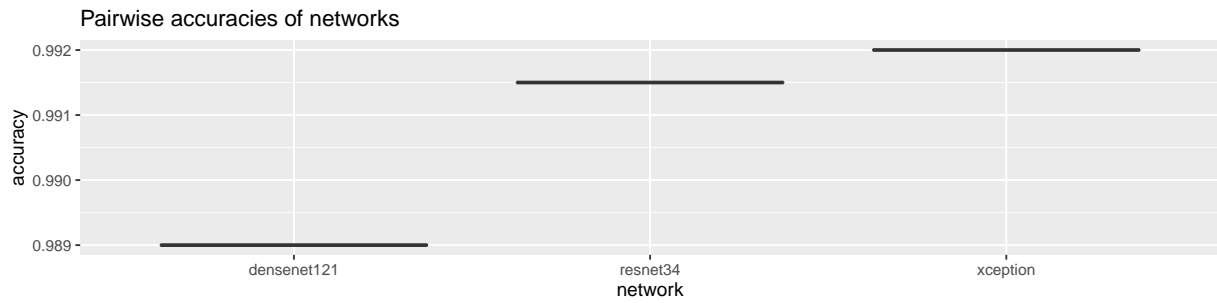


## Classes 3 vs 8

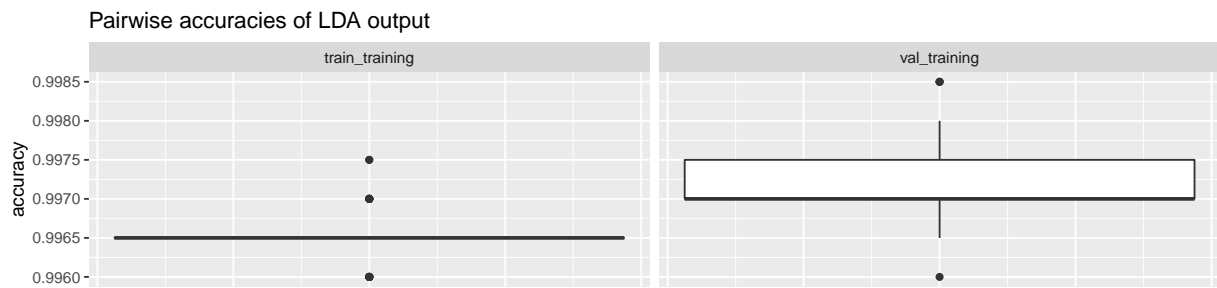
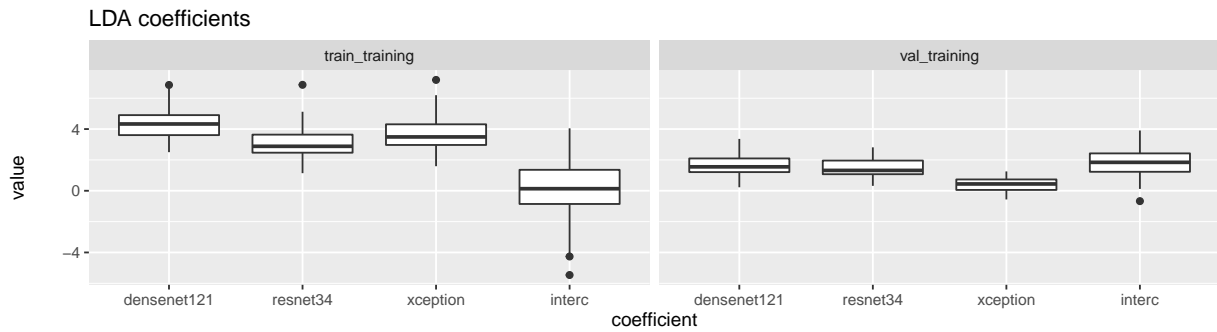
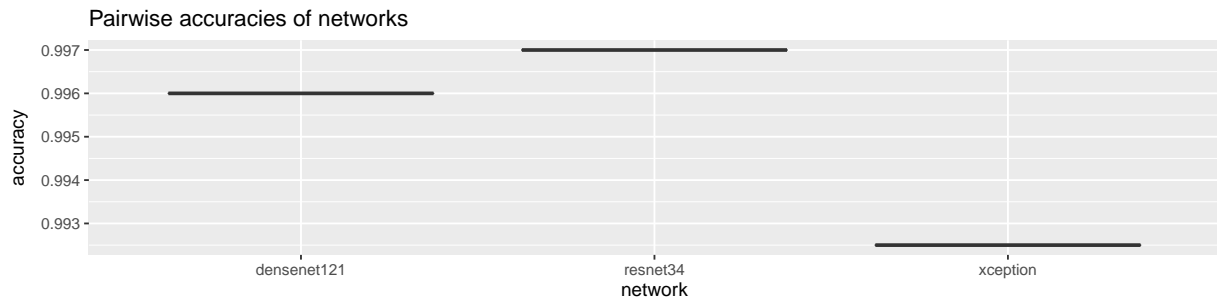




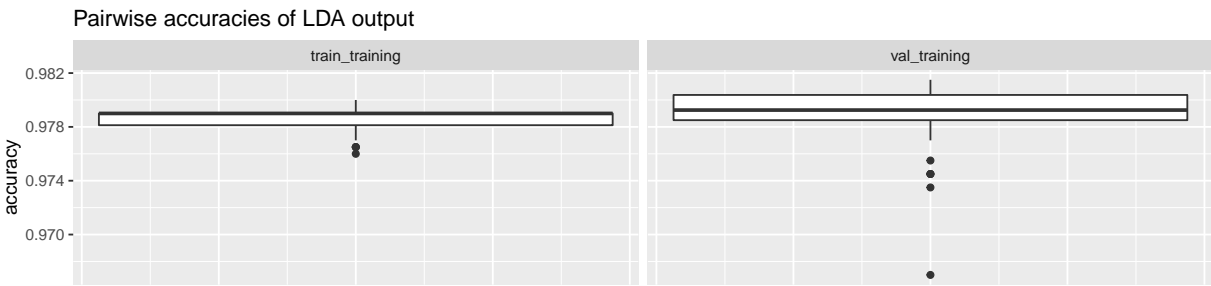
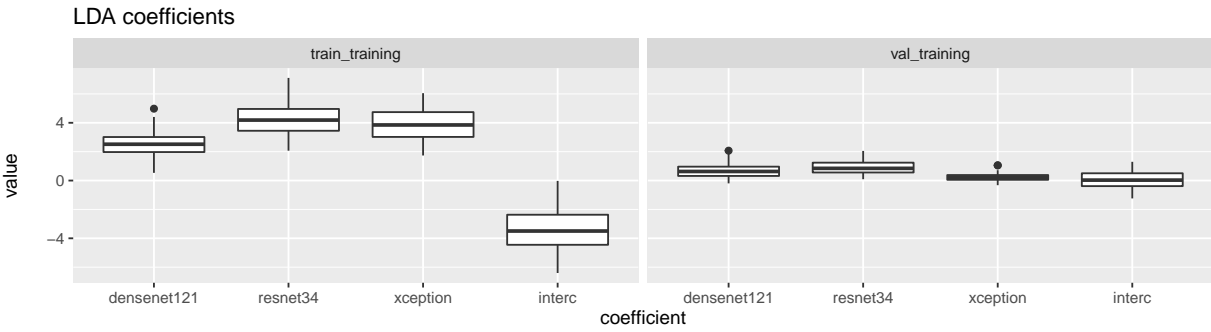
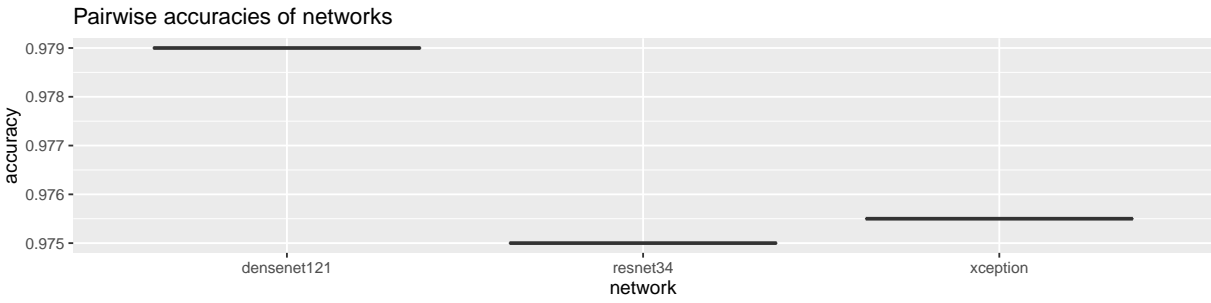
## Classes 3 vs 9



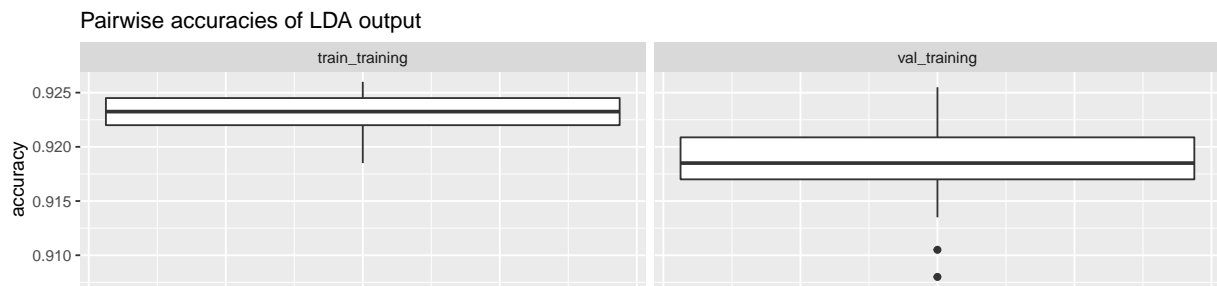
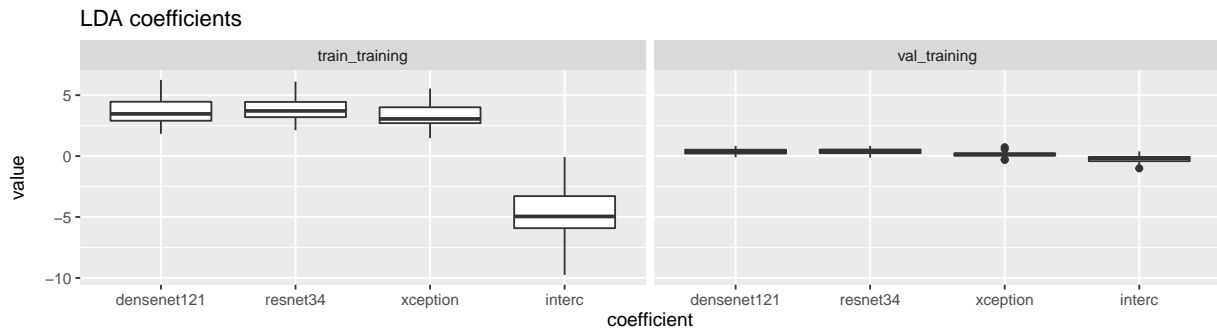
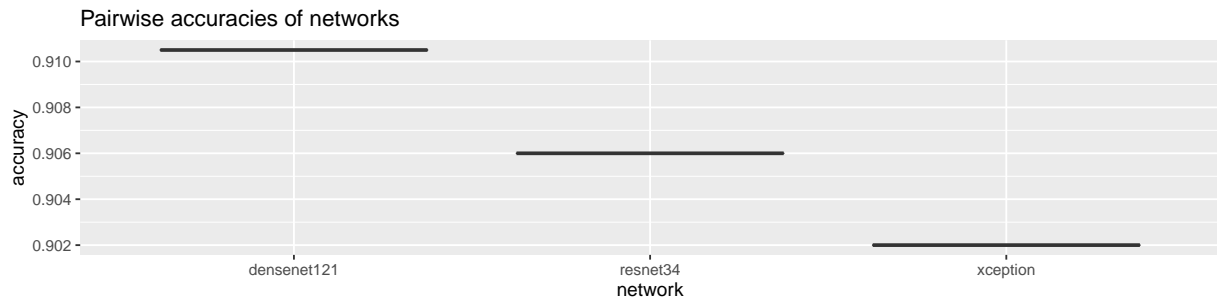
## Classes 3 vs 10



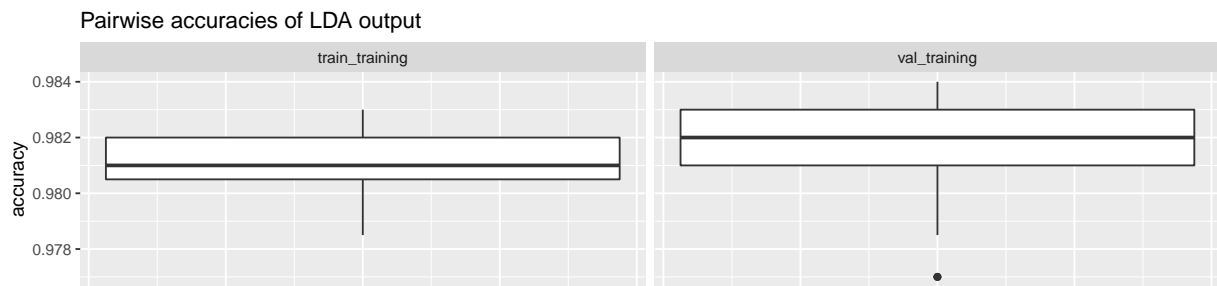
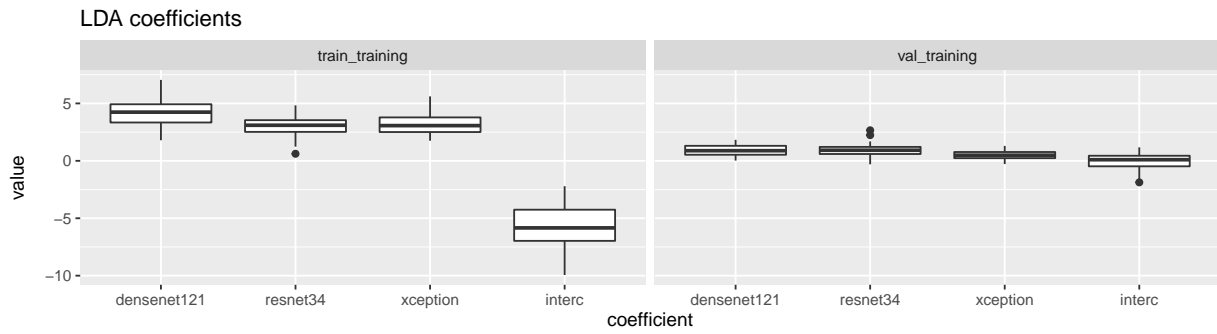
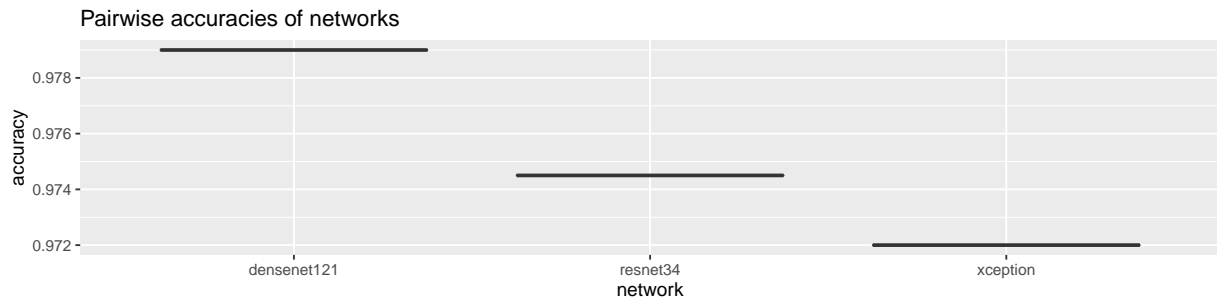
Classes 4 vs 5



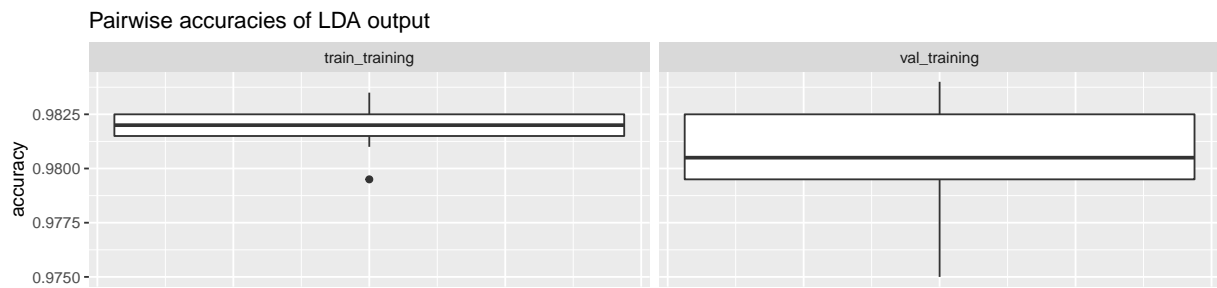
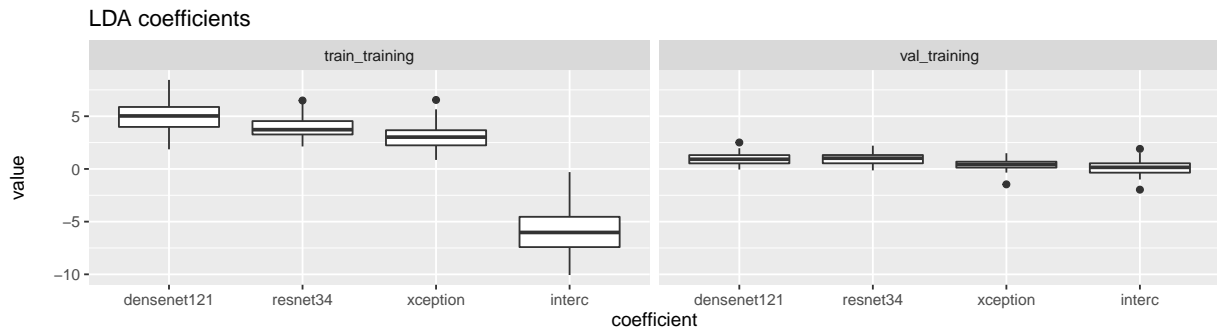
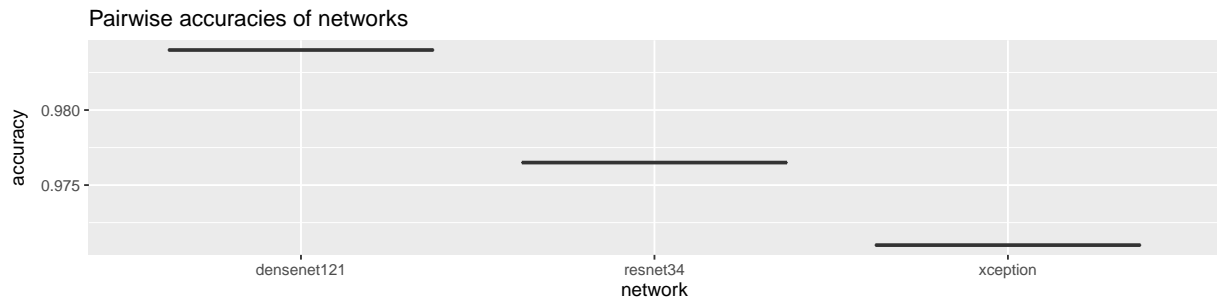
## Classes 4 vs 6



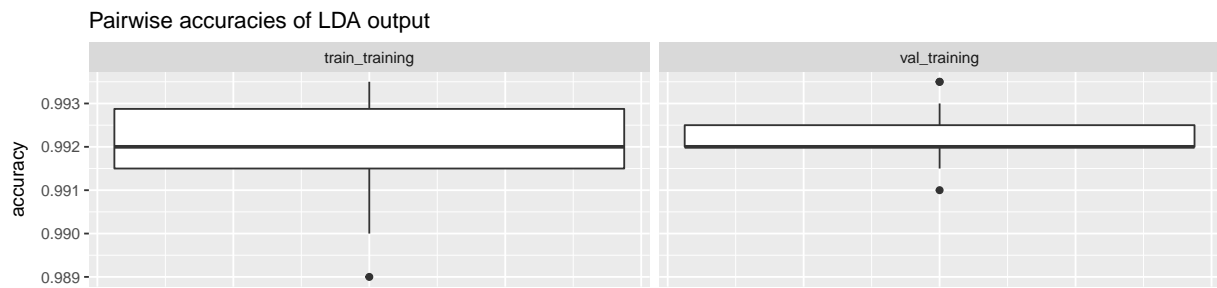
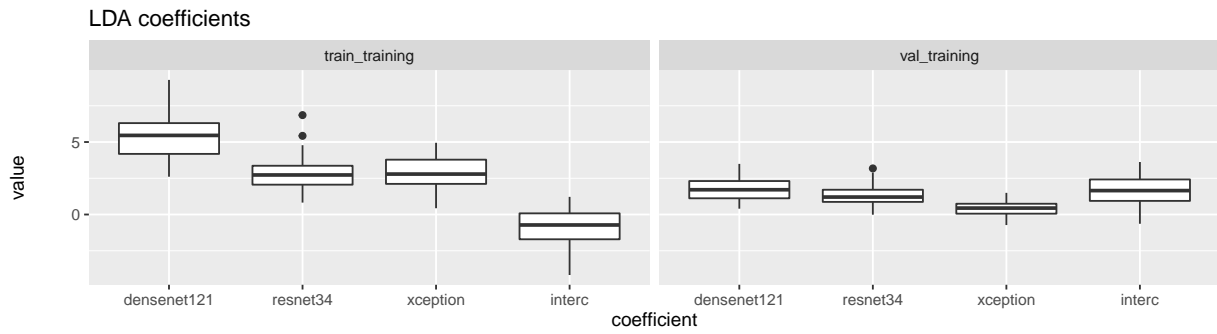
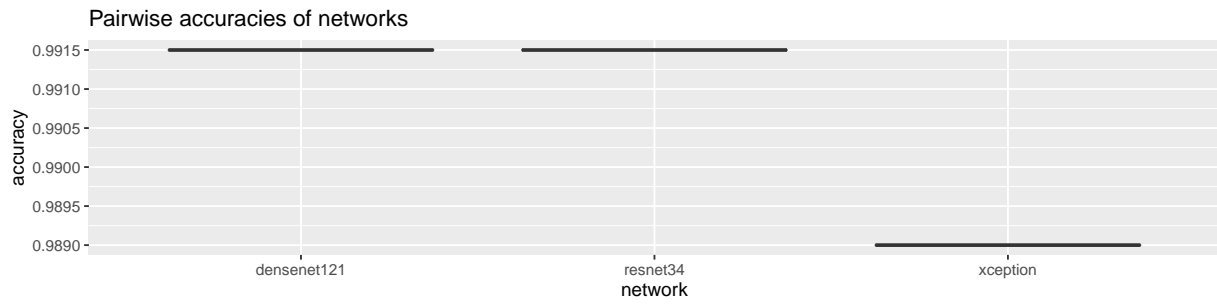
## Classes 4 vs 7



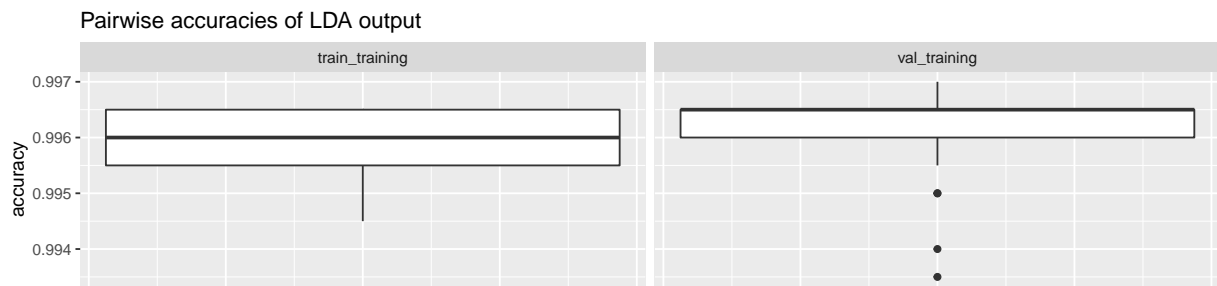
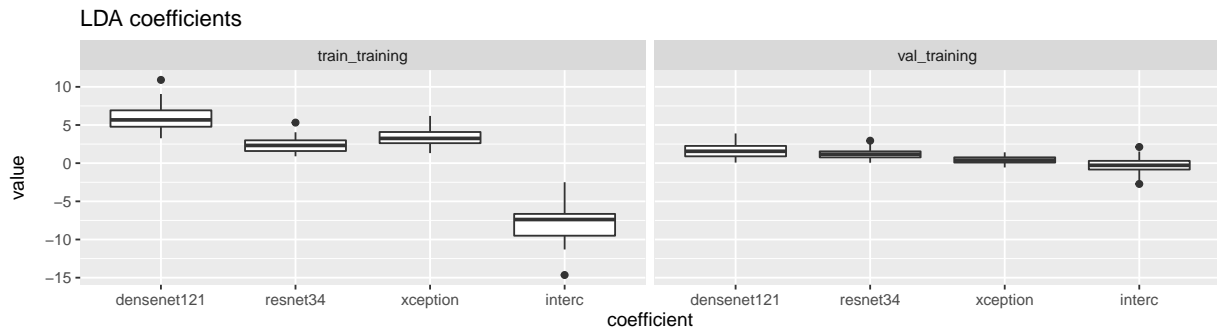
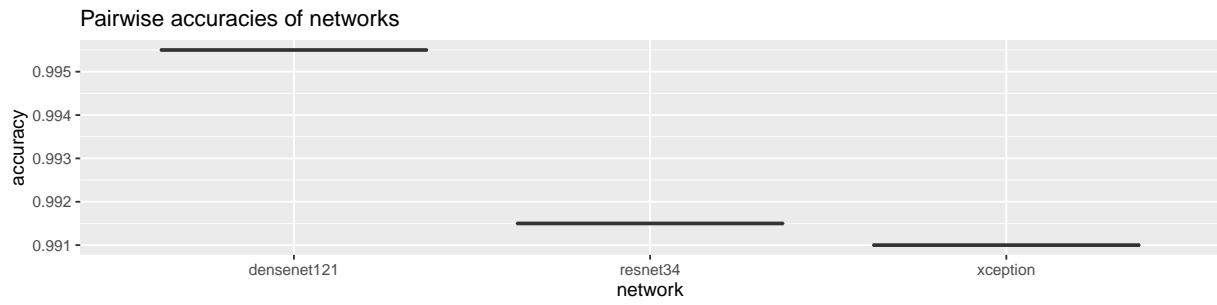
## Classes 4 vs 8



## Classes 4 vs 9

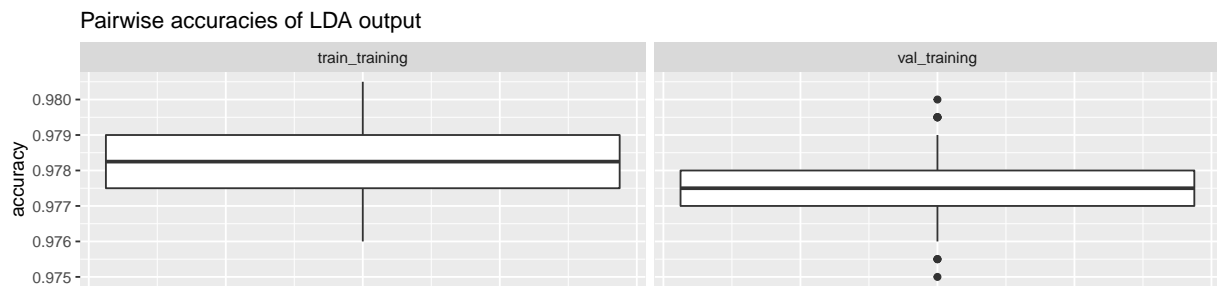
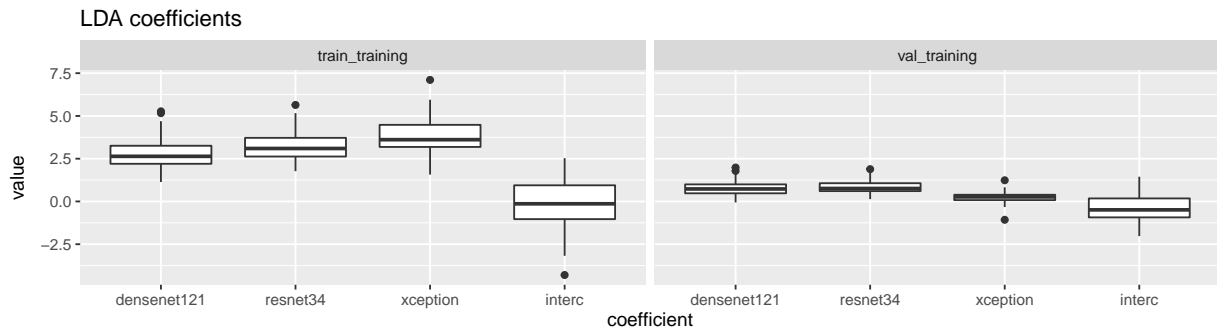
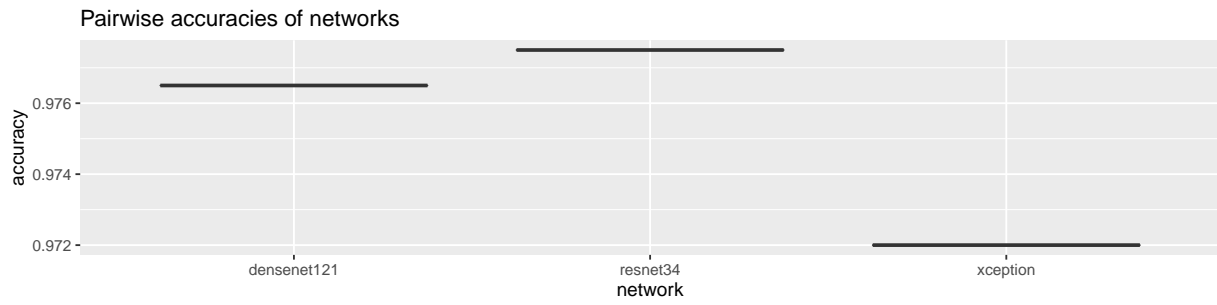


## Classes 4 vs 10

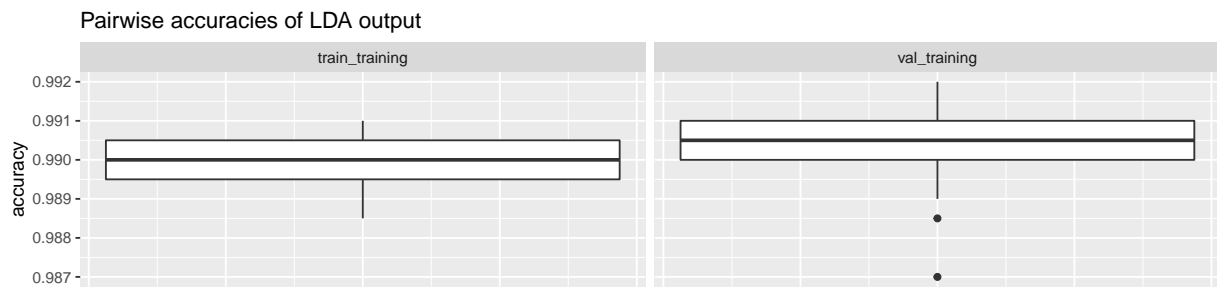
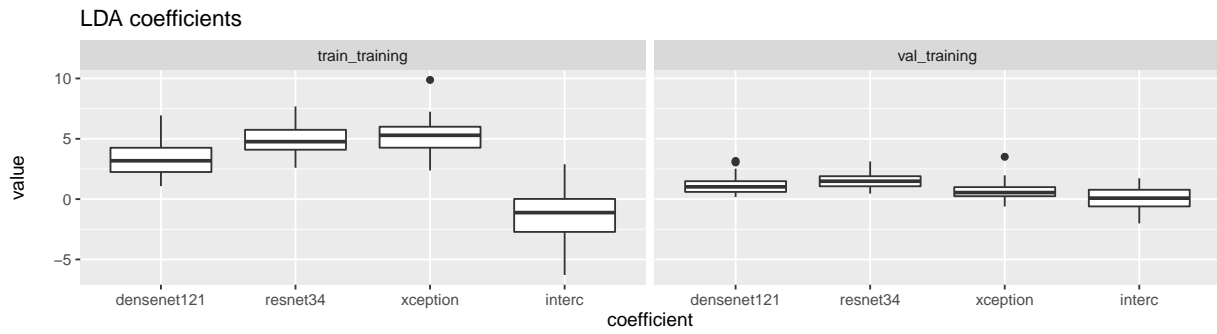
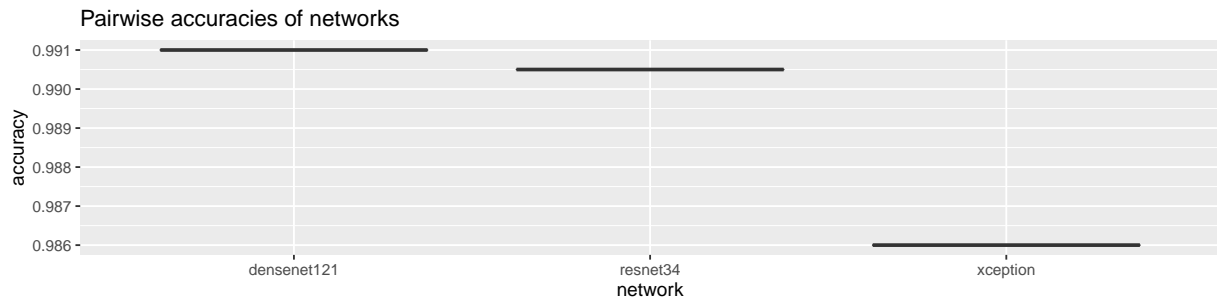




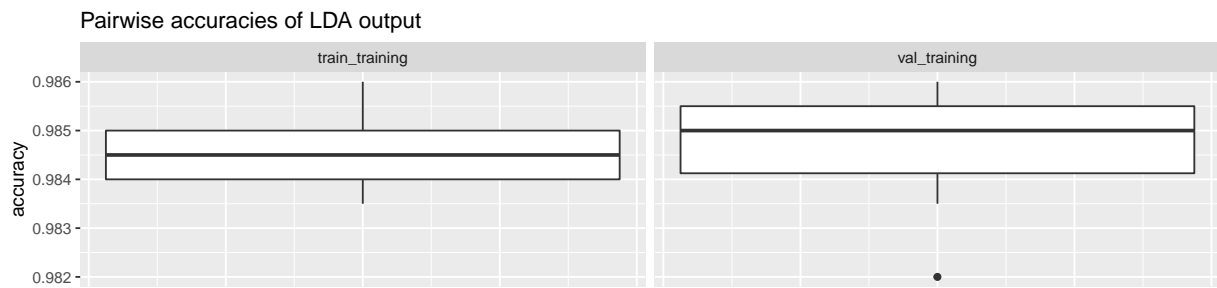
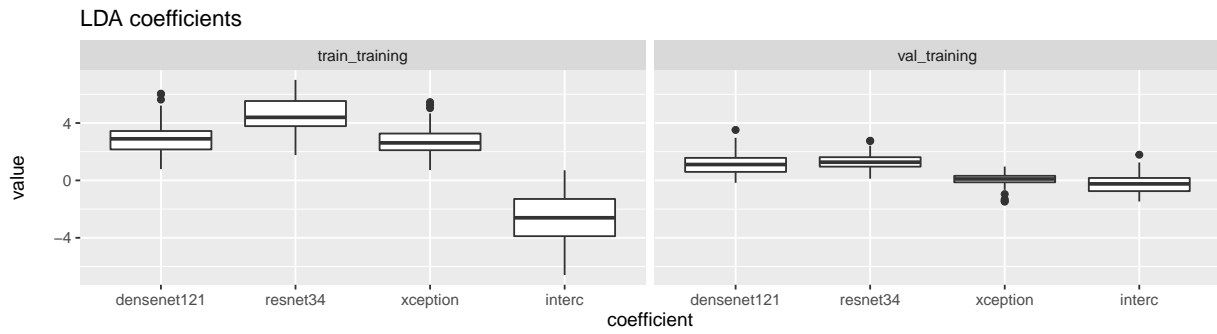
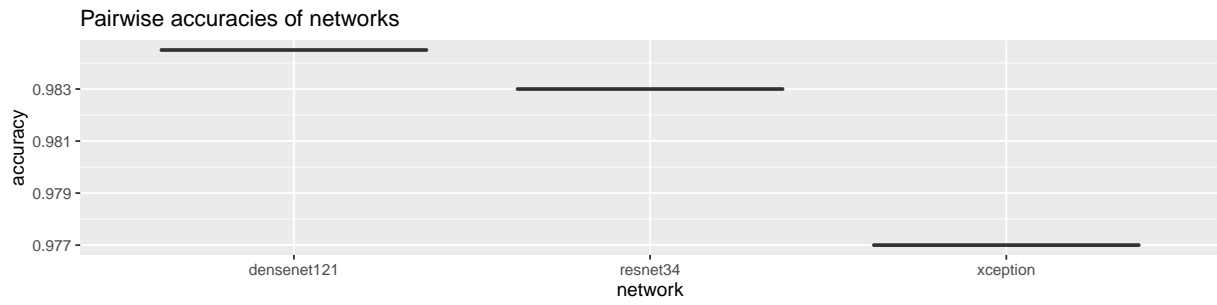
## Classes 5 vs 6



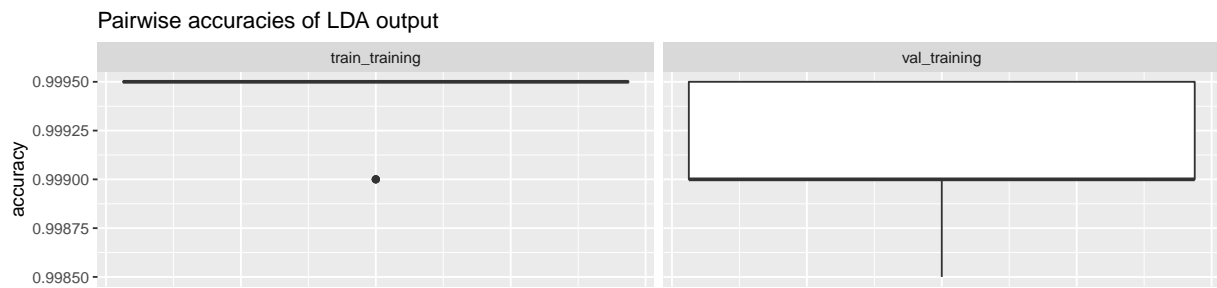
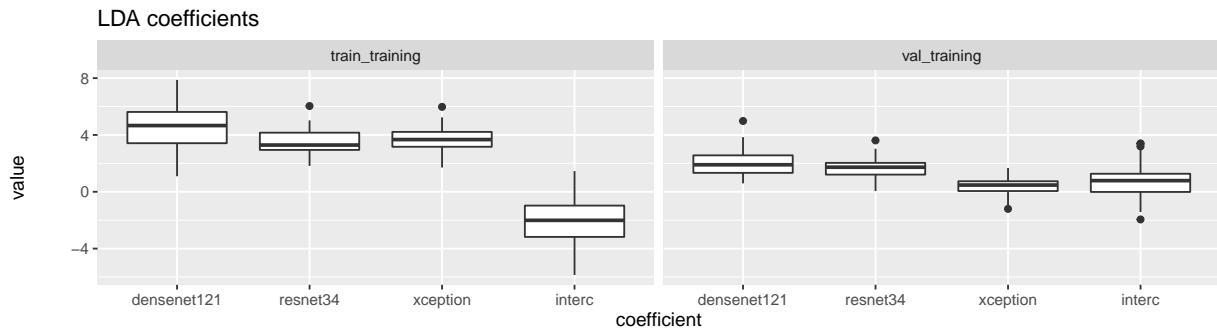
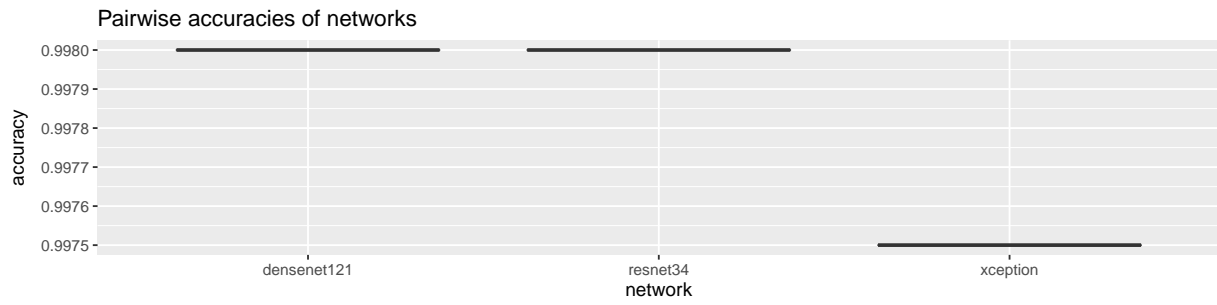
## Classes 5 vs 7



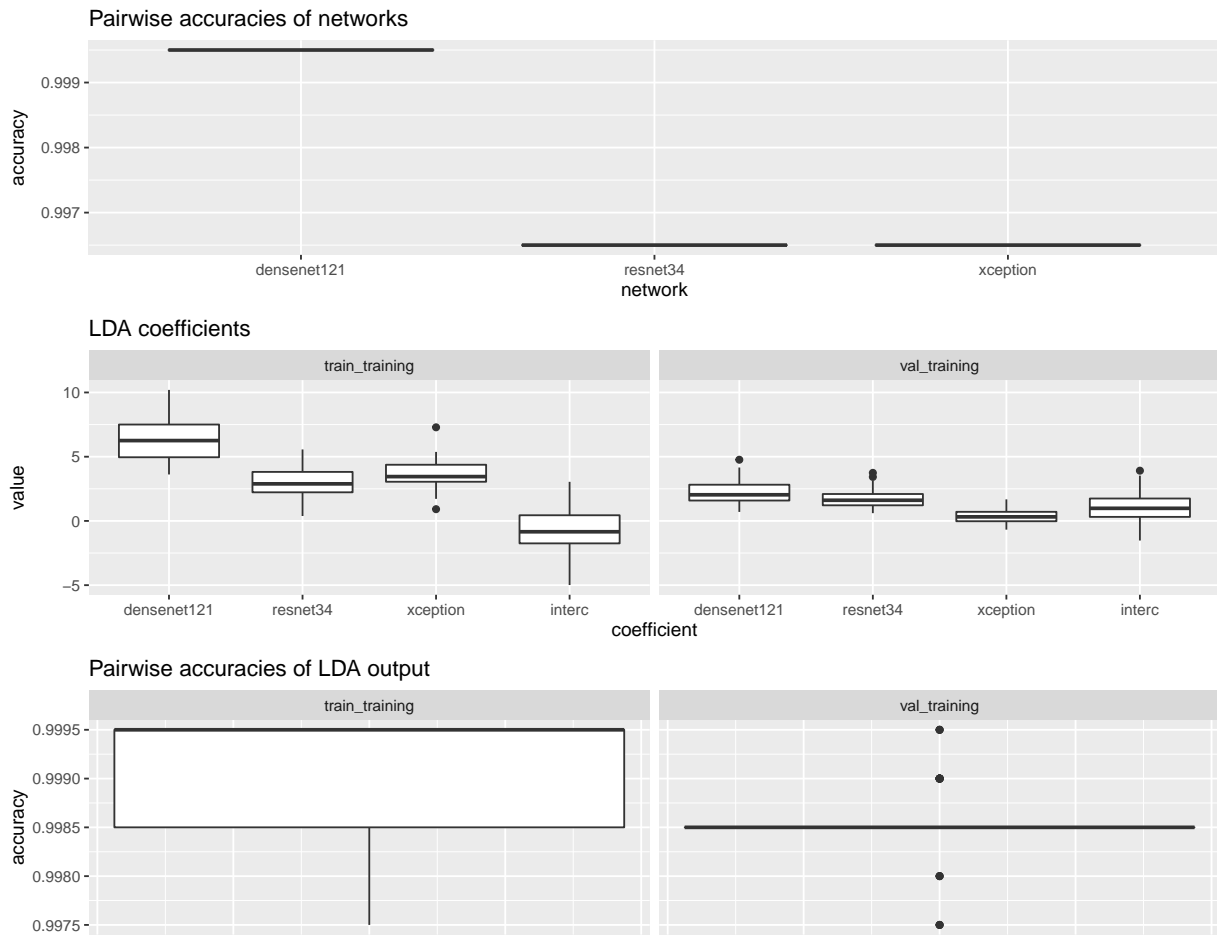
## Classes 5 vs 8



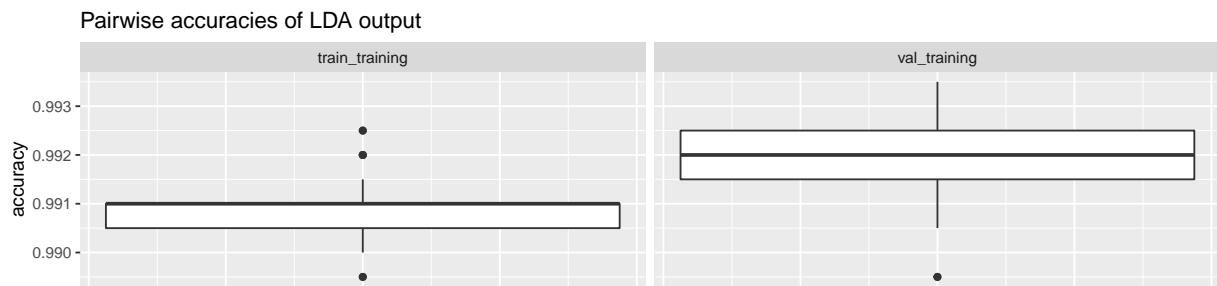
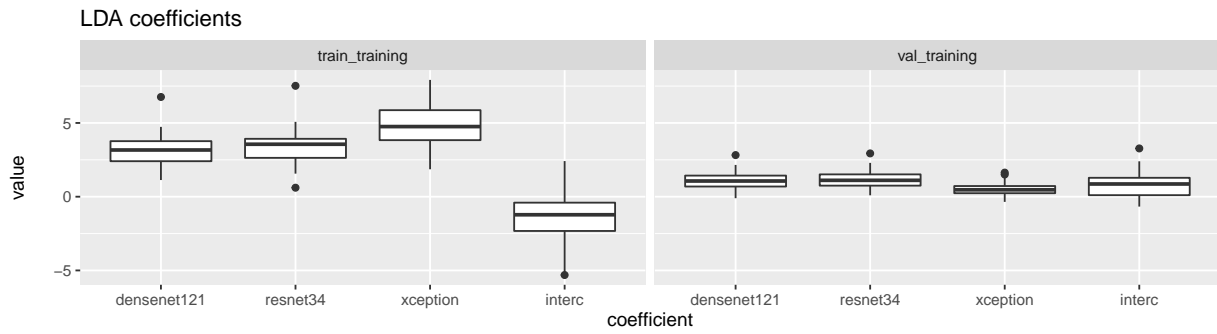
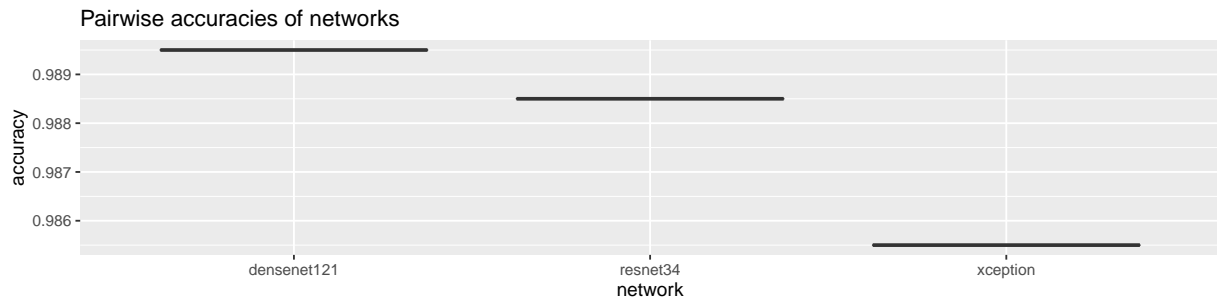
## Classes 5 vs 9



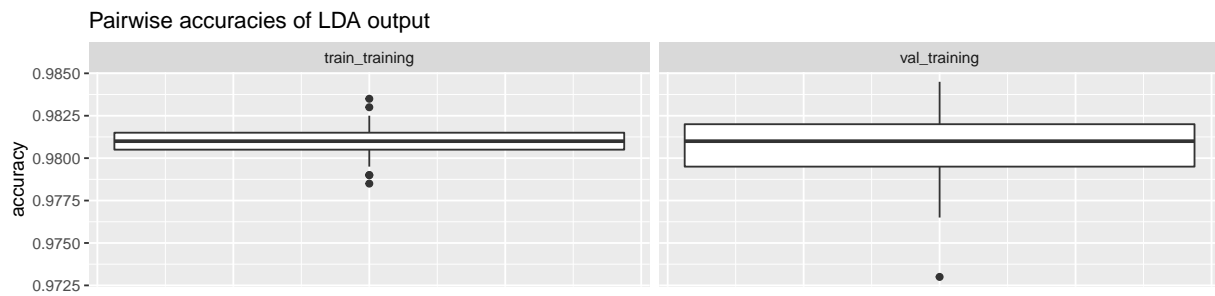
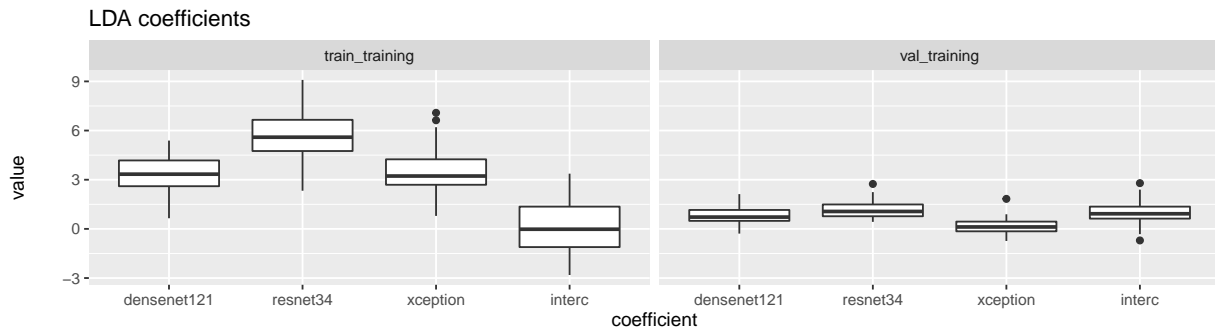
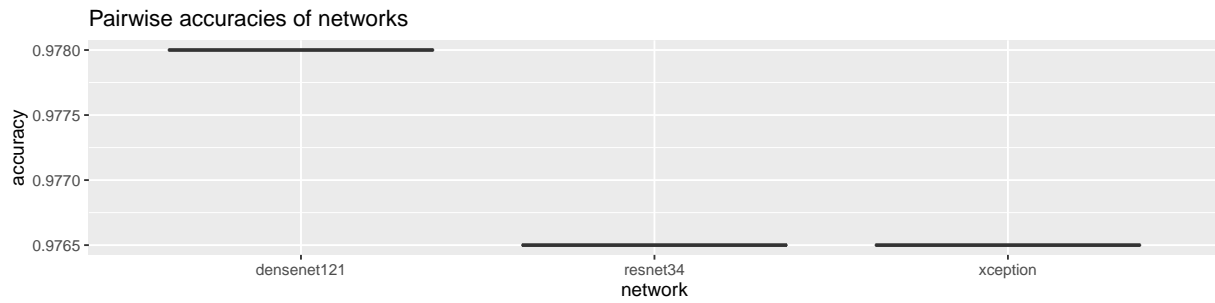
## Classes 5 vs 10



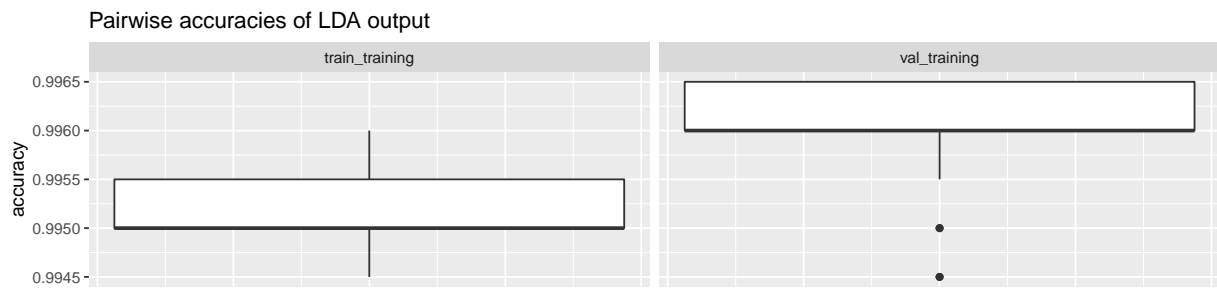
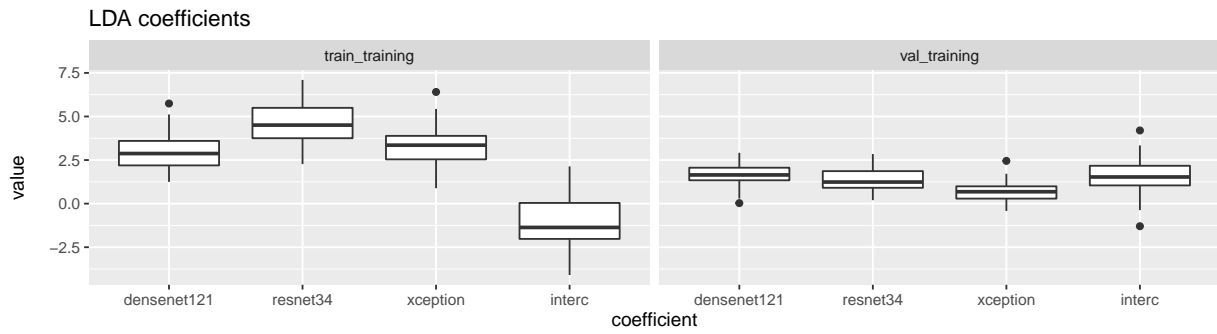
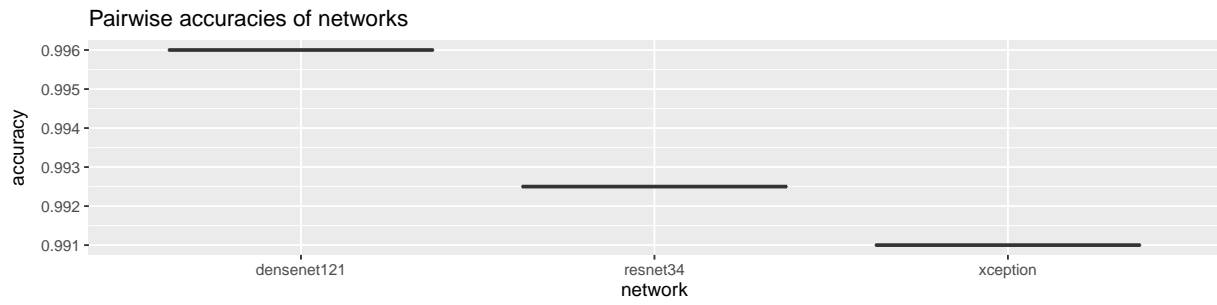
## Classes 6 vs 7



## Classes 6 vs 8

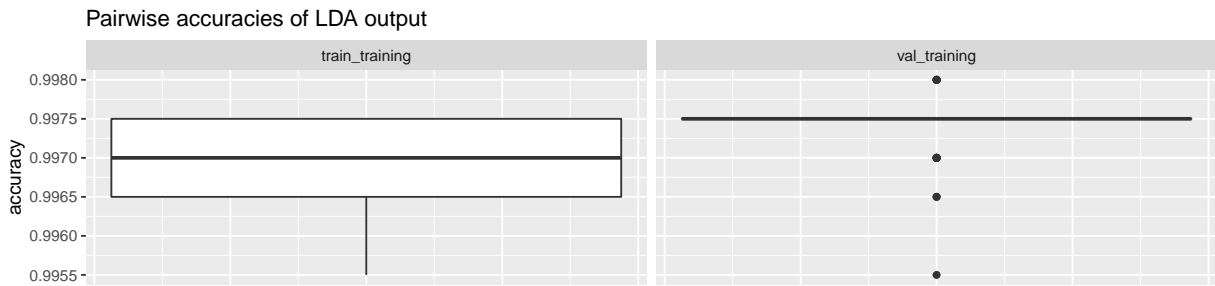
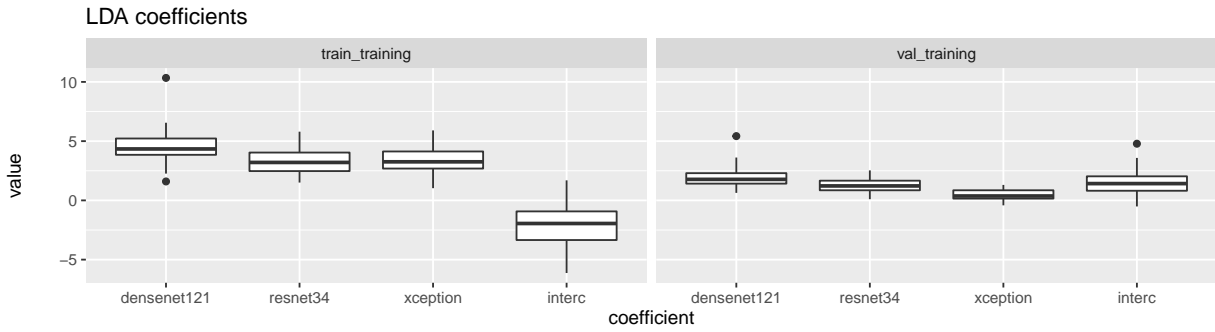
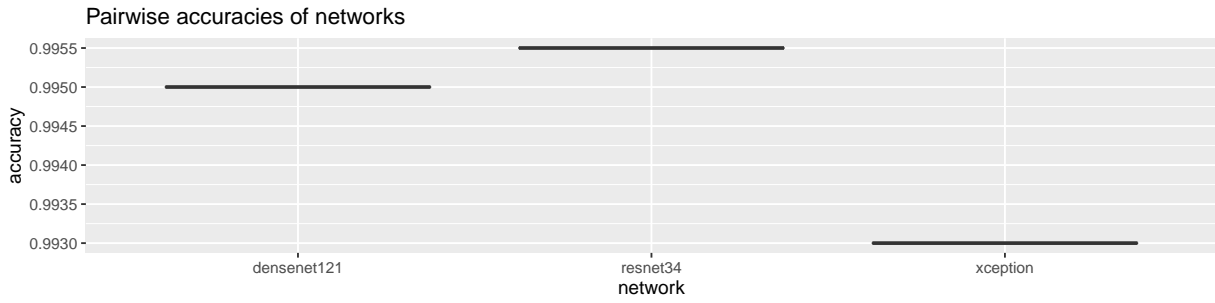


## Classes 6 vs 9

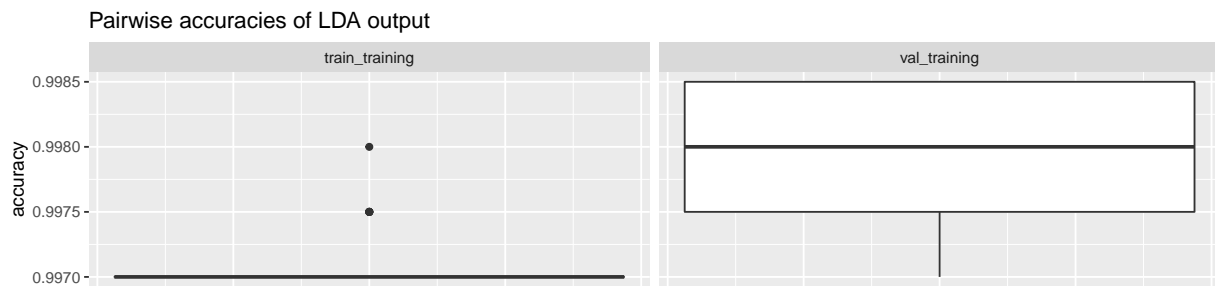
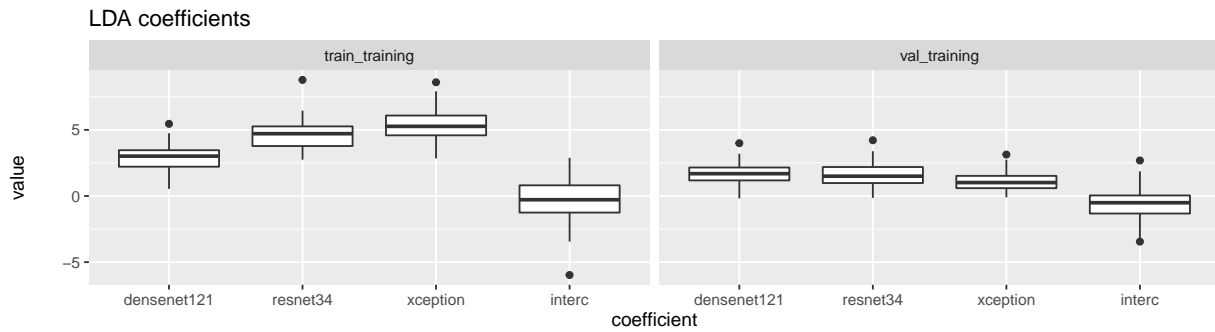
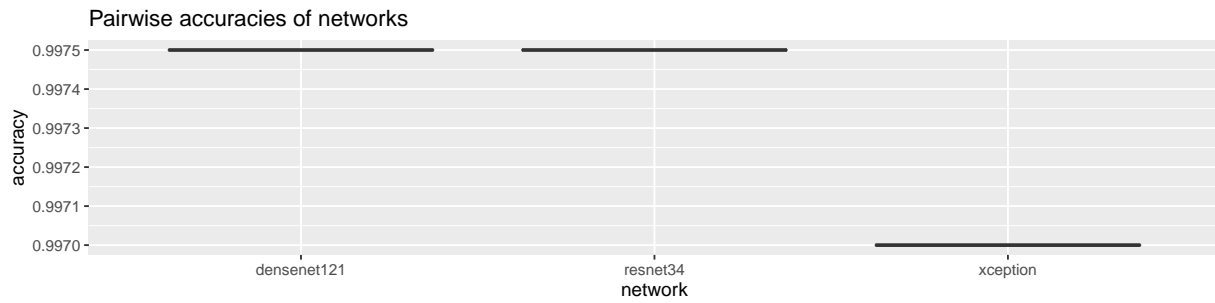




## Classes 6 vs 10

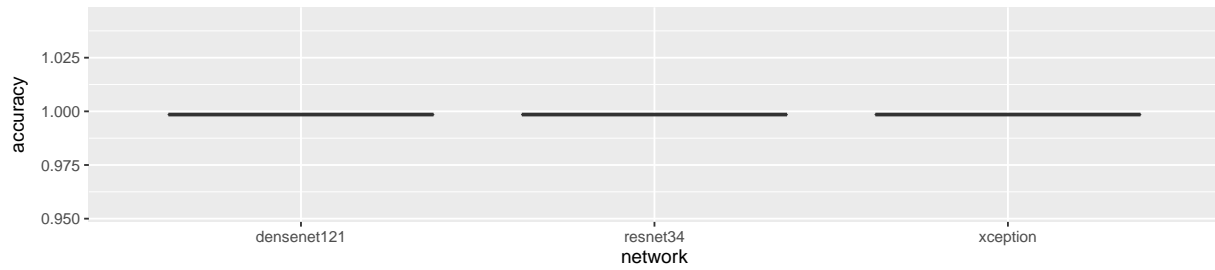


## Classes 7 vs 8

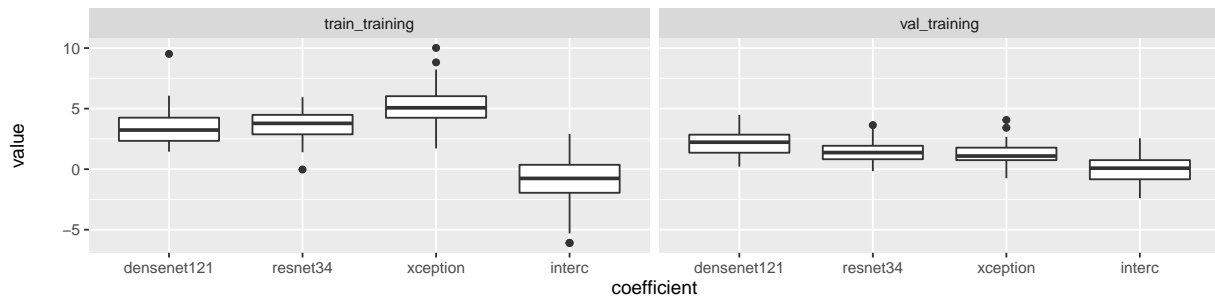


## Classes 7 vs 9

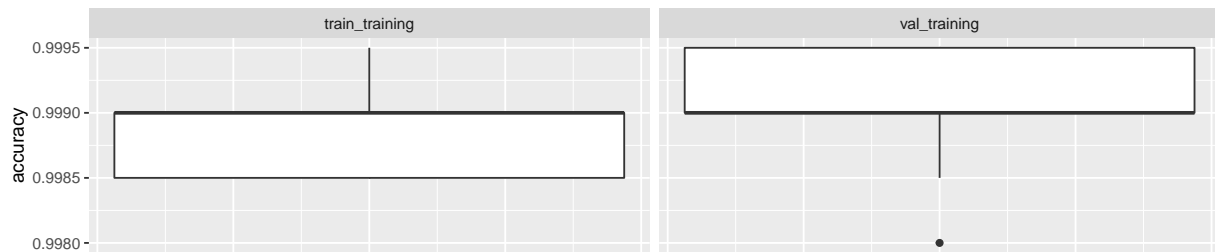
Pairwise accuracies of networks



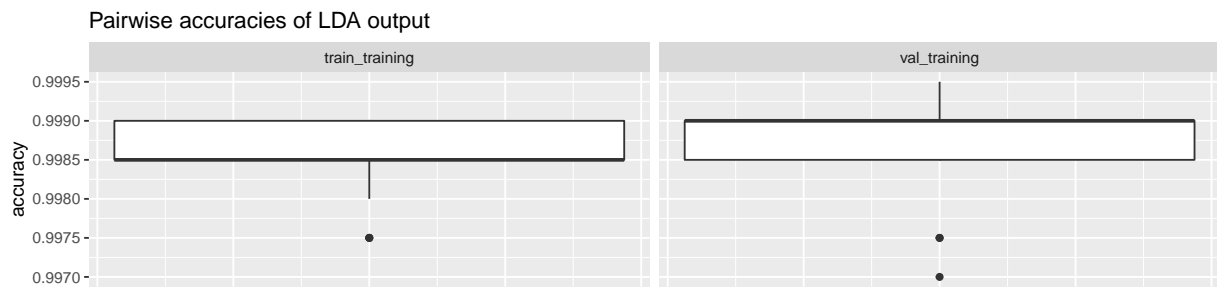
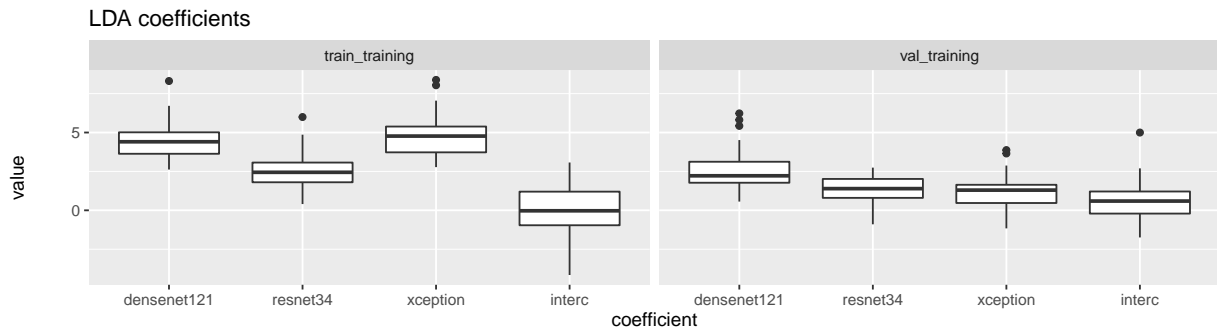
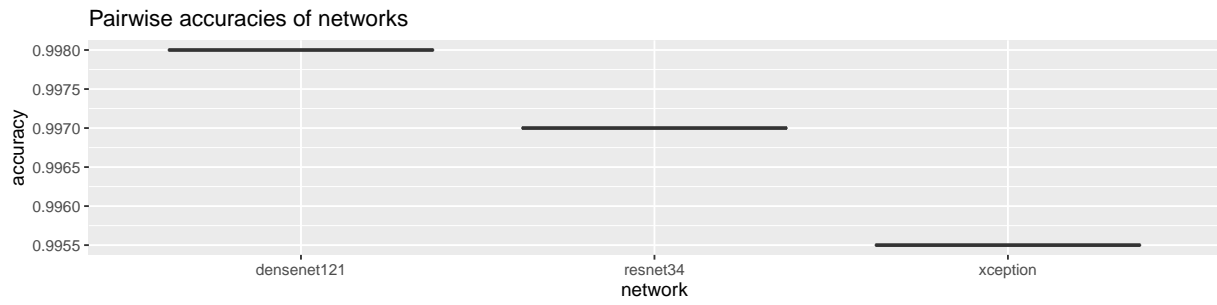
LDA coefficients



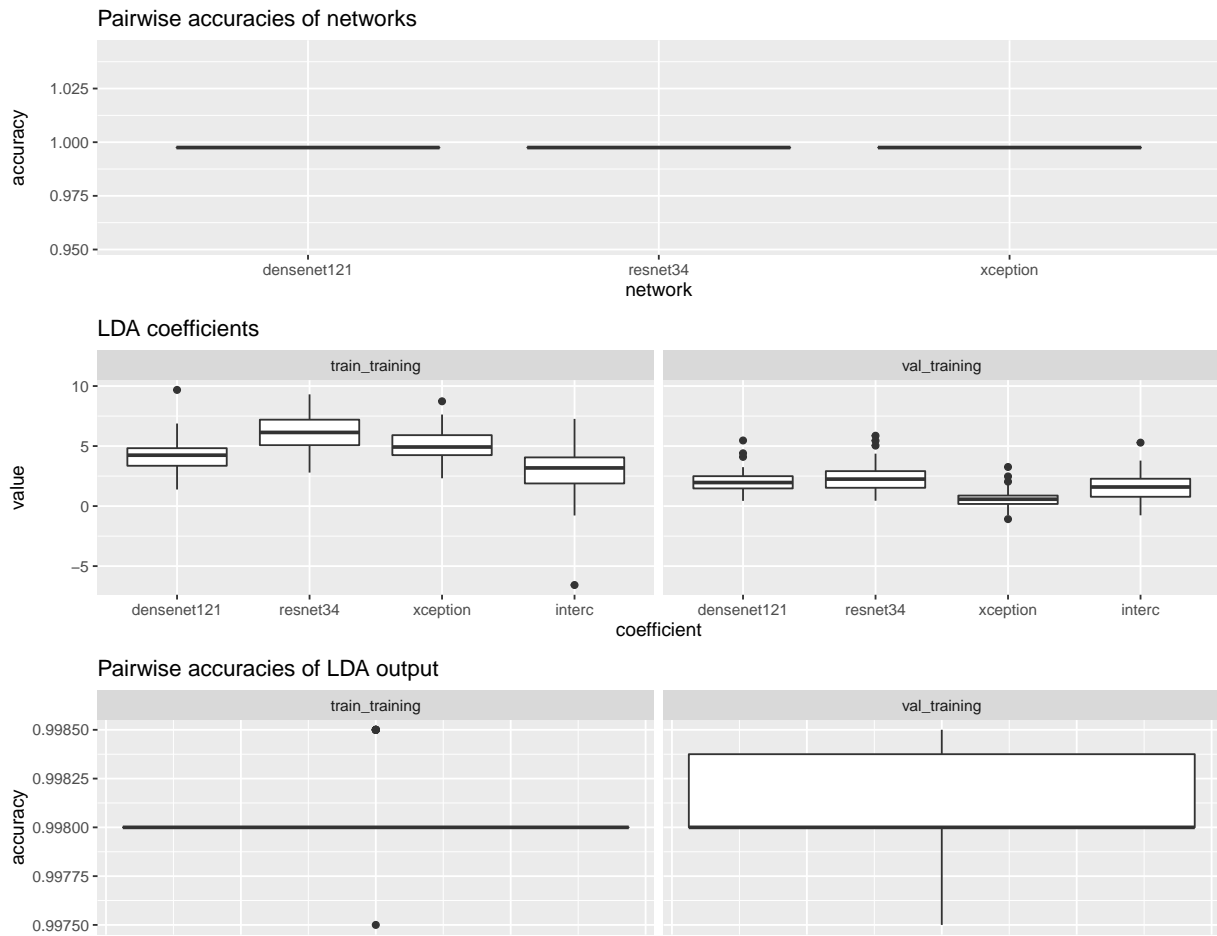
Pairwise accuracies of LDA output



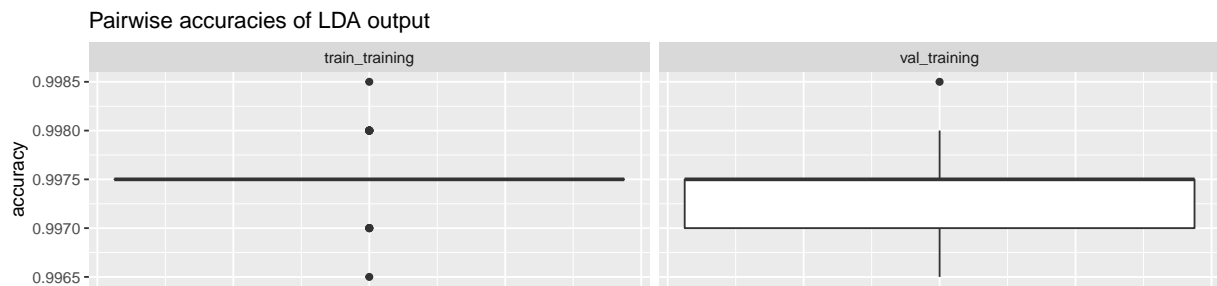
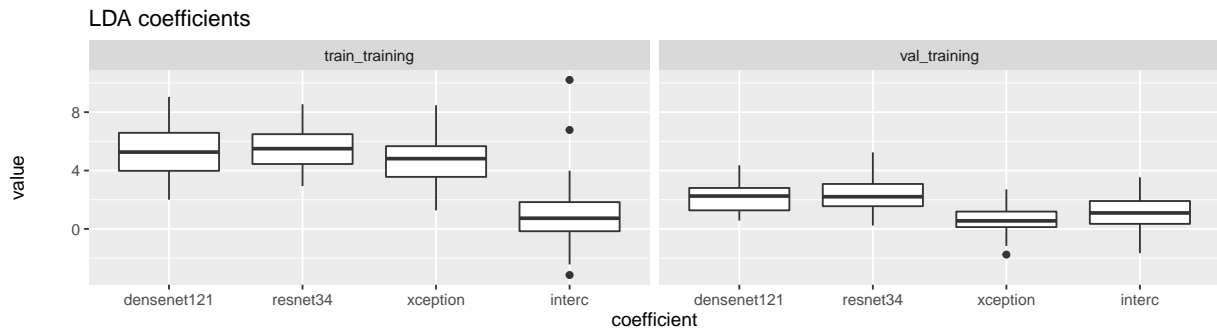
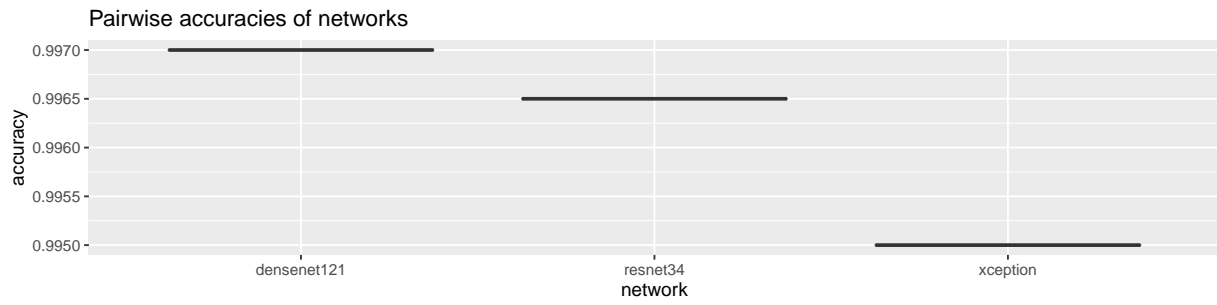
## Classes 7 vs 10



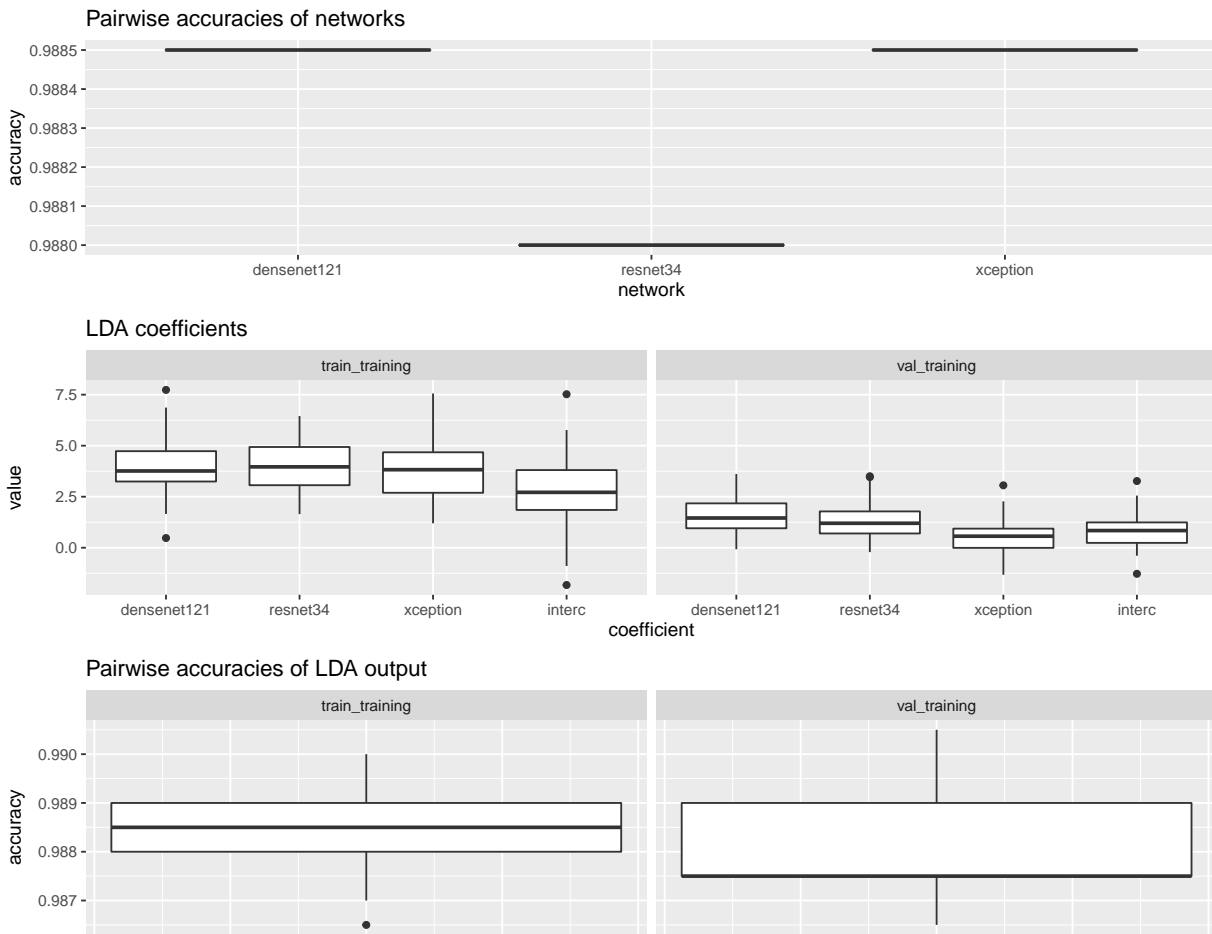
## Classes 8 vs 9



## Classes 8 vs 10



## Classes 9 vs 10



## CIFAR 100 half

```
base_dir <- "../data/data_train_val_half_c100"
repls <- 0:9
folds <- 0:4
classes <- 10
lda_coefs <- load_lda_coefs(base_dir, repls, folds)
net_pw_results <- read.csv(file.path(base_dir, "net_pw accuracies.csv"))
ens_pw_results <- read.csv(file.path(base_dir, "ensemble_pw accuracies.csv"))
net_pw_results[, c("class1", "class2")] <- lapply(net_pw_results[, c("class1", "class2")], as.factor)
ens_pw_results[, c("class1", "class2")] <- lapply(ens_pw_results[, c("class1", "class2")], as.factor)

for (cl1 in 1:(classes - 1))
{
  for (cl2 in (cl1 + 1):classes)
  {
    lda_plt <- lda_coefs %>% filter(class1 == cl1 & class2 == cl2) %>% ggplot() + geom_boxplot(aes(x=coefficient))
    lda_plt <- lda_plt + facet_wrap(~train_type) + ggtitle("LDA coefficients")
    acc_plt_net <- net_pw_results %>% filter(class1 == (cl1 - 1) & class2 == (cl2 - 1)) %>% ggplot(mapping = aes(x=network))
```

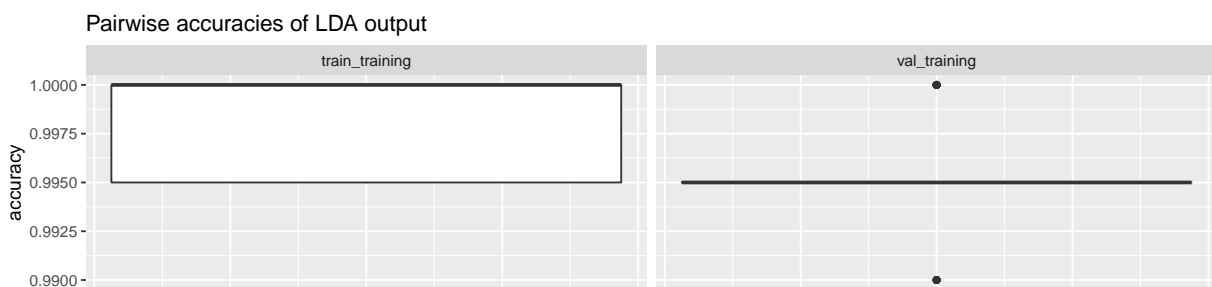
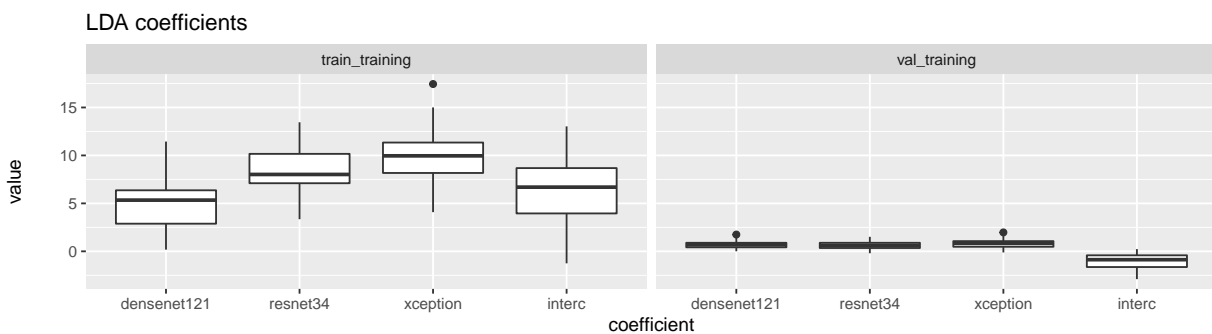
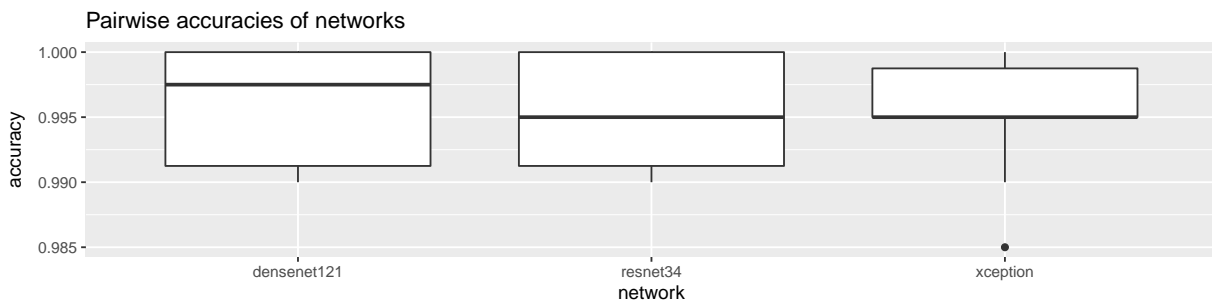
```

    geom_boxplot() + ggtitle("Pairwise accuracies of networks")
    acc_plt_ens <- ens_pw_results %>% filter(class1 == (c11 - 1) & class2 == (c12 - 1)) %>% ggplot(mapping = aes(x = network, y = accuracy)) +
      geom_boxplot() + facet_wrap(~train_set) + ggtitle("Pairwise accuracies of LDA output") +
      theme(axis.ticks.x=element_blank(), axis.text.x=element_blank())

    print((acc_plt_net/lda_plt/acc_plt_ens) + plot_annotation(title=paste("Classes ", c11, " vs ", c12)))
  }
}

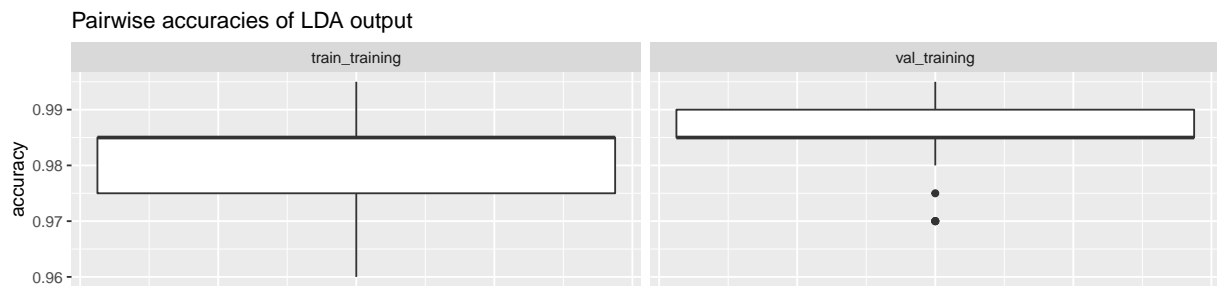
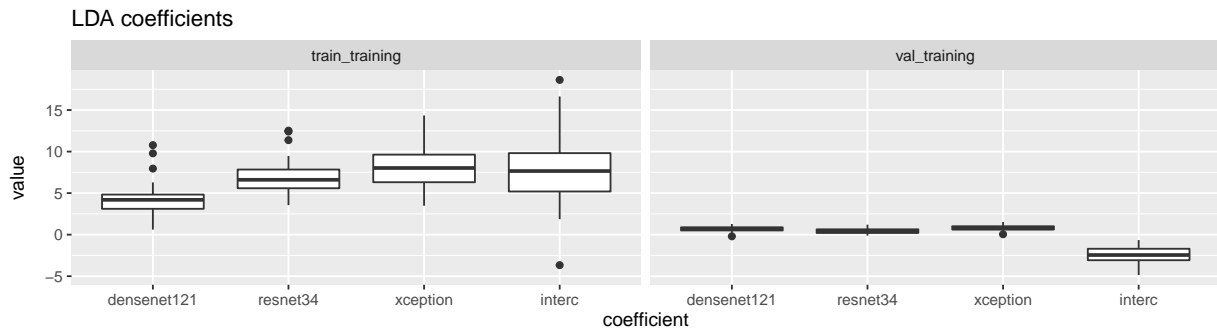
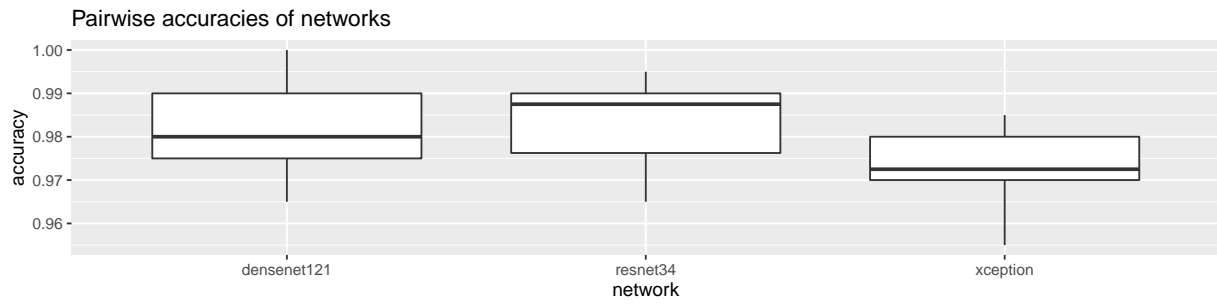
```

Classes 1 vs 2

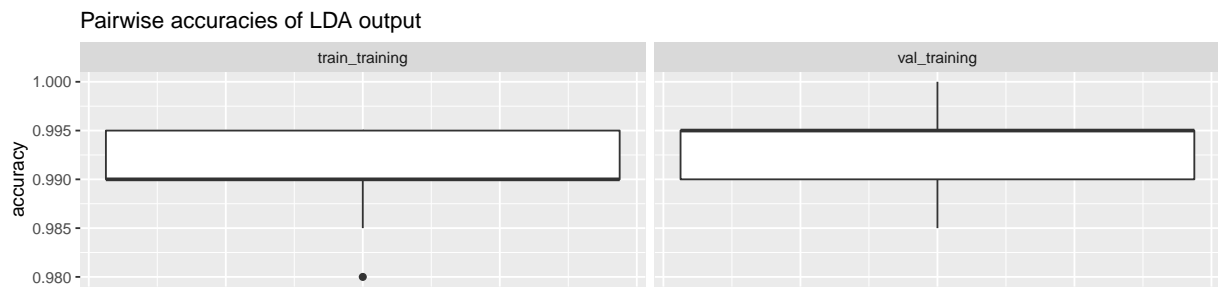
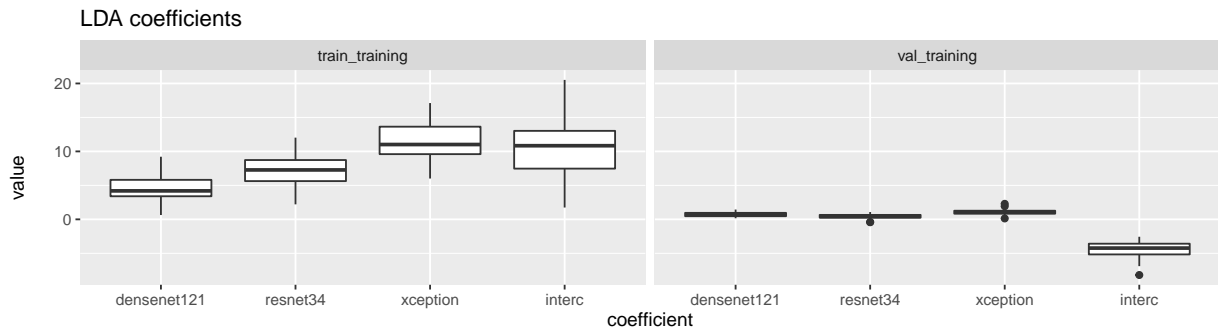
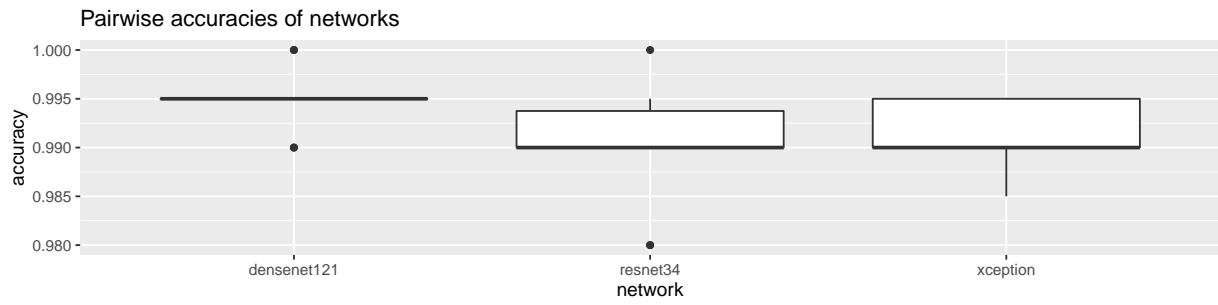




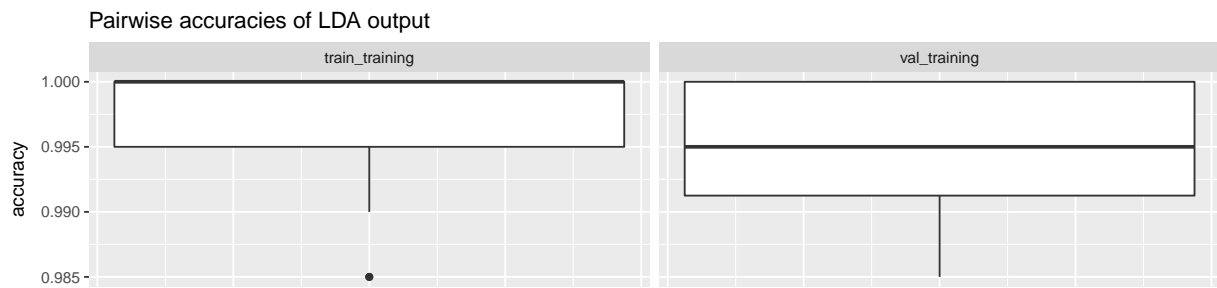
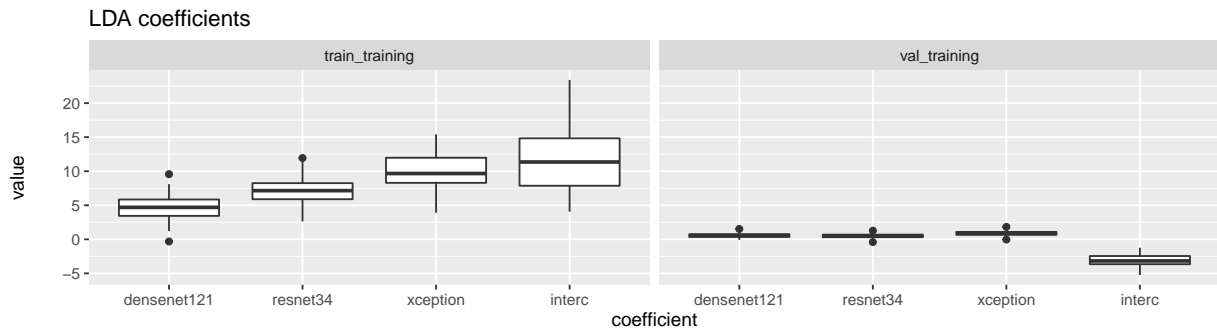
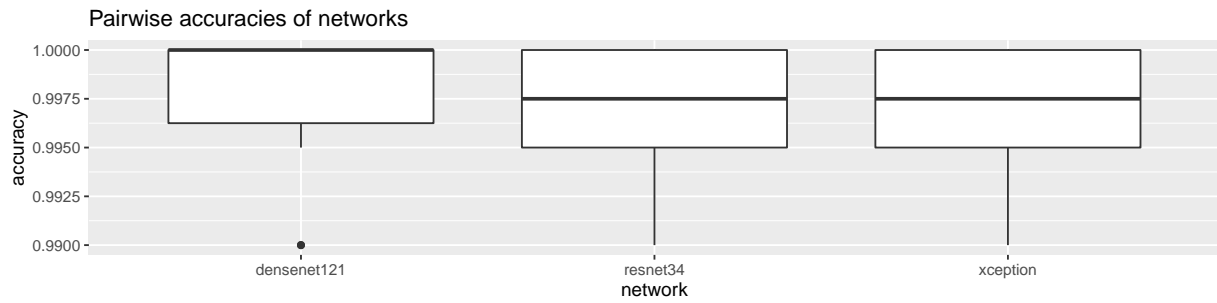
## Classes 1 vs 3



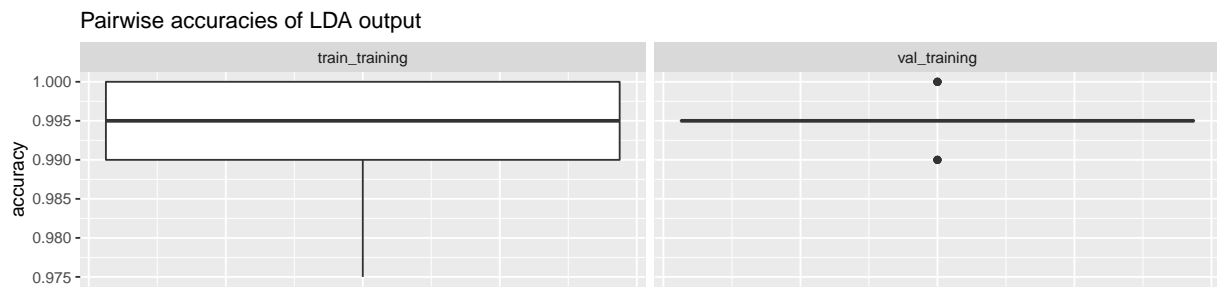
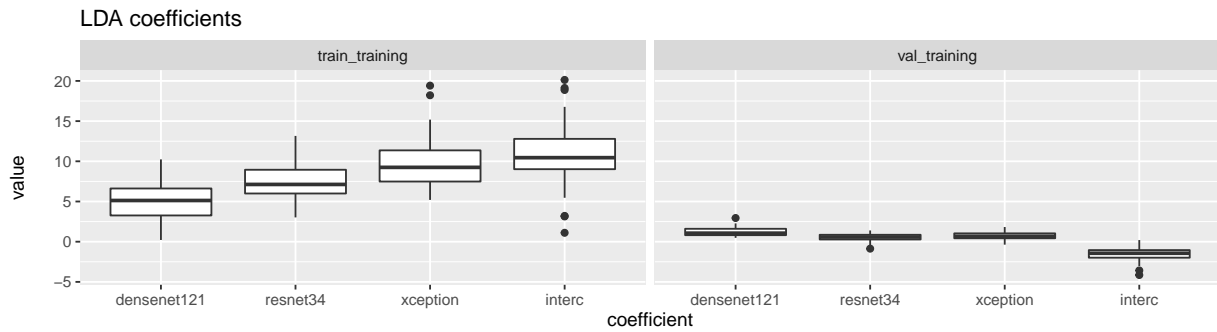
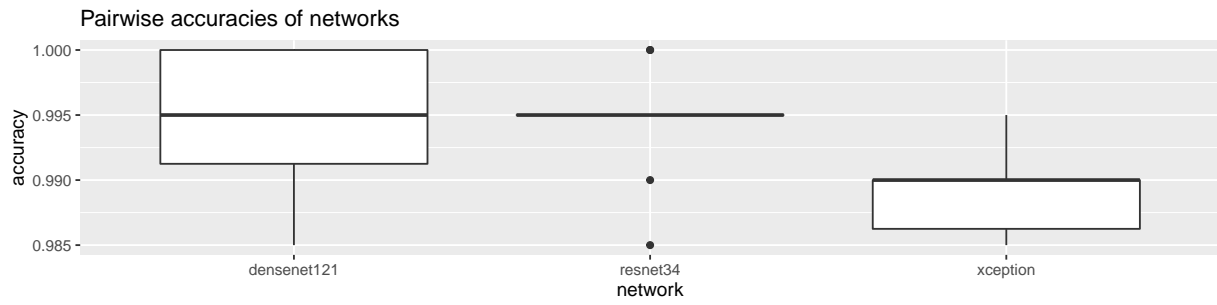
## Classes 1 vs 4



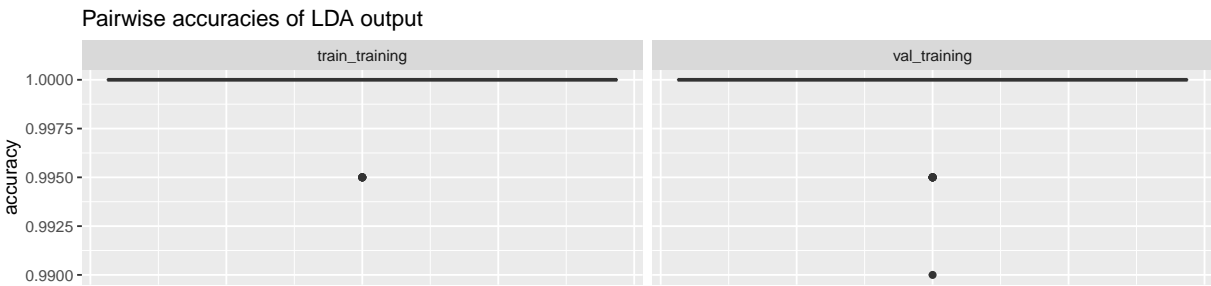
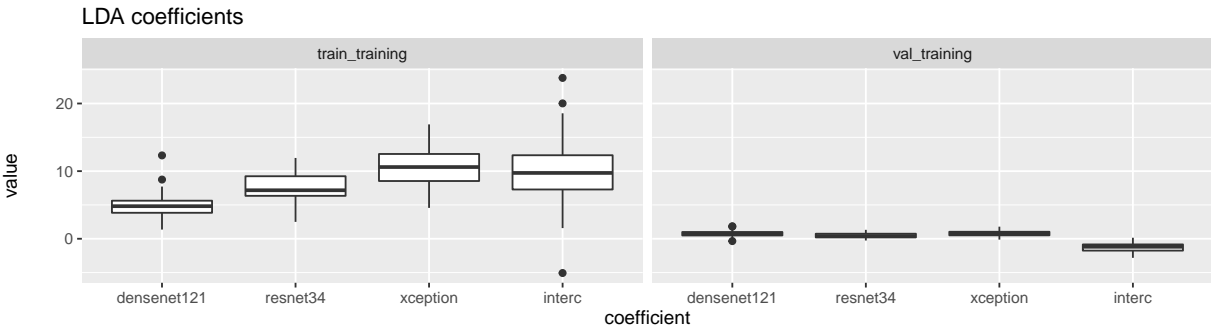
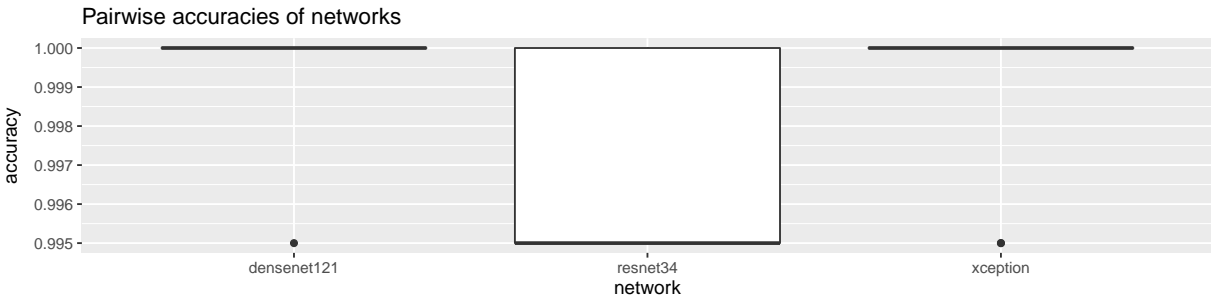
## Classes 1 vs 5



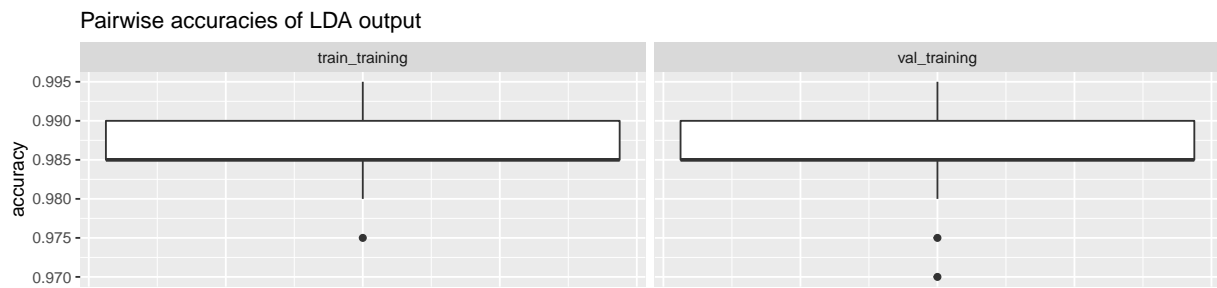
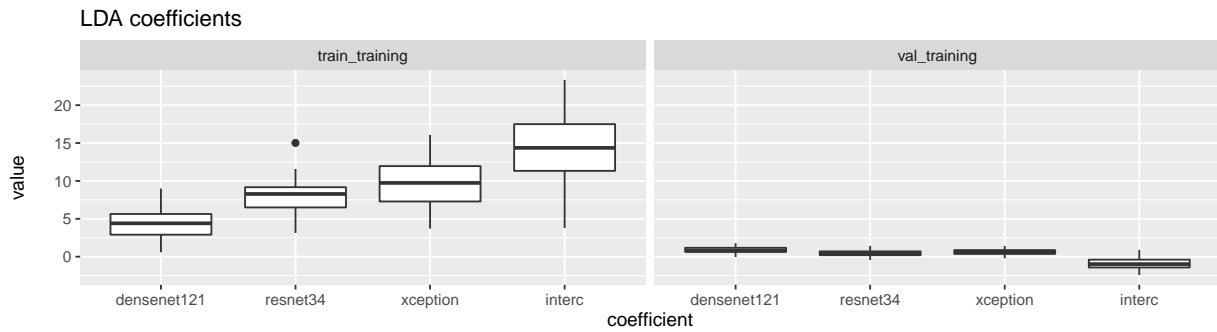
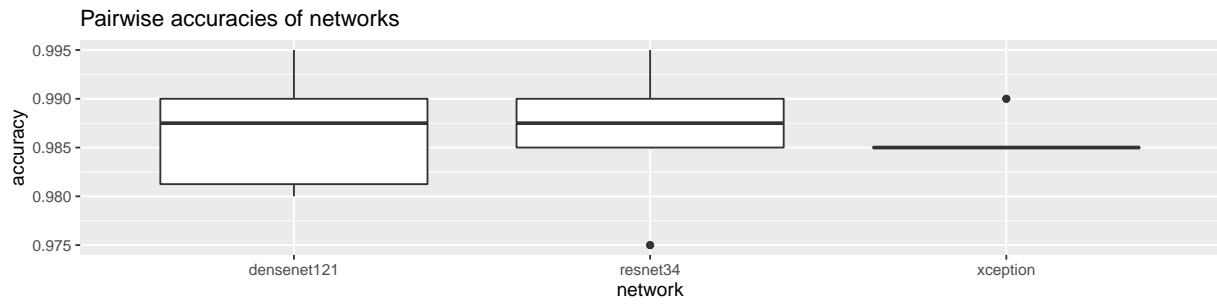
## Classes 1 vs 6



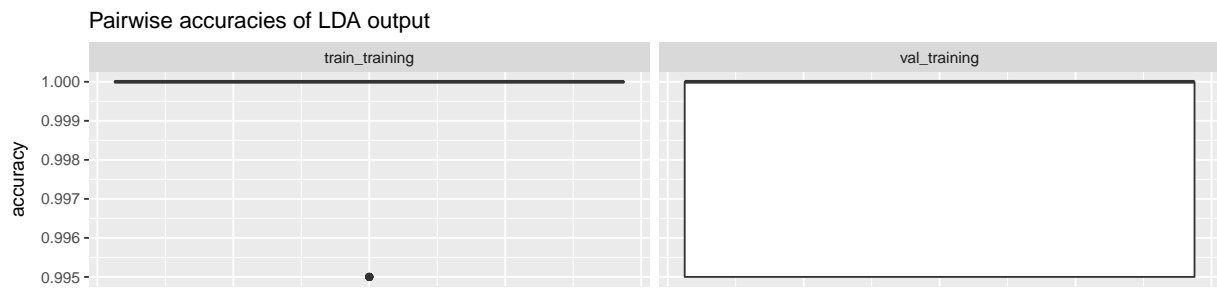
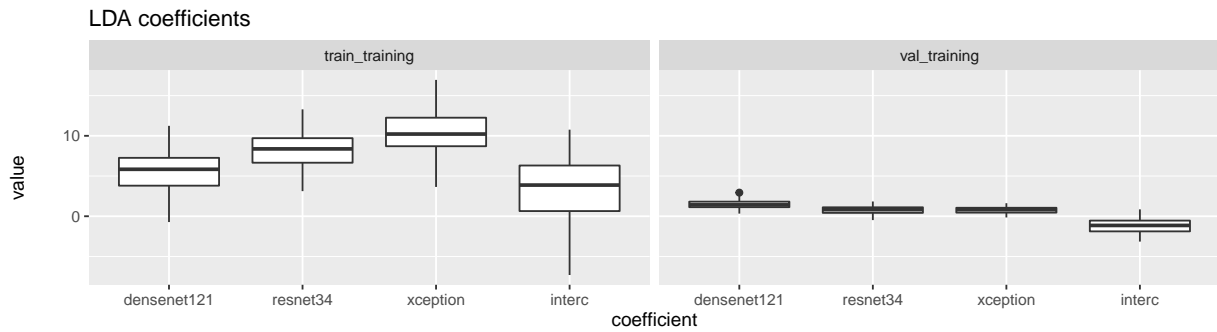
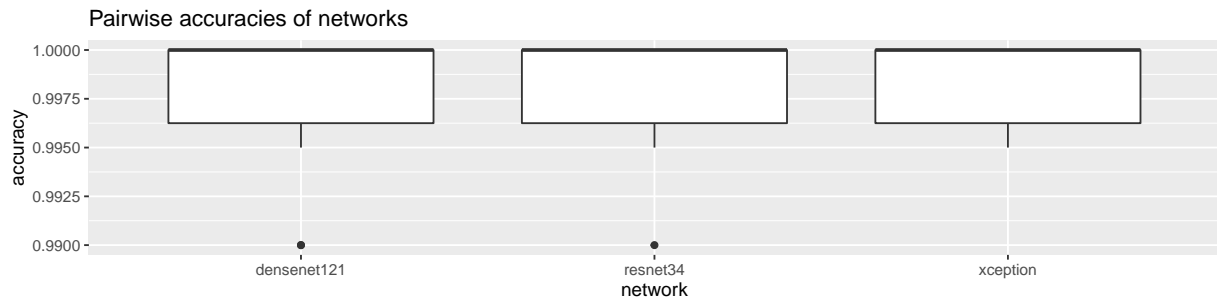
Classes 1 vs 7



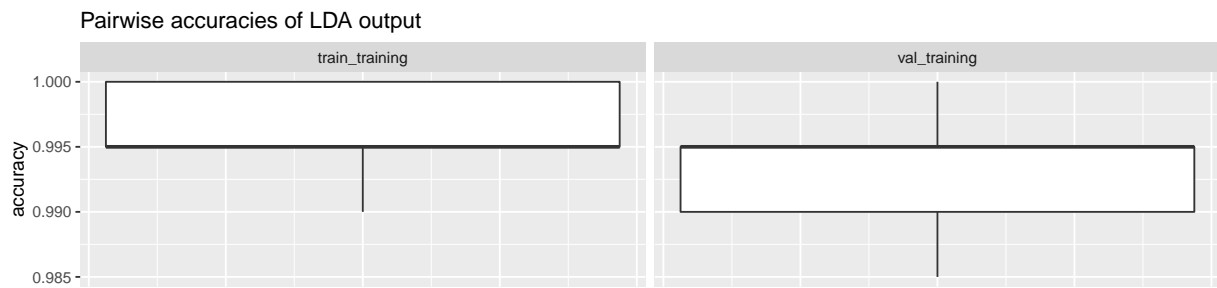
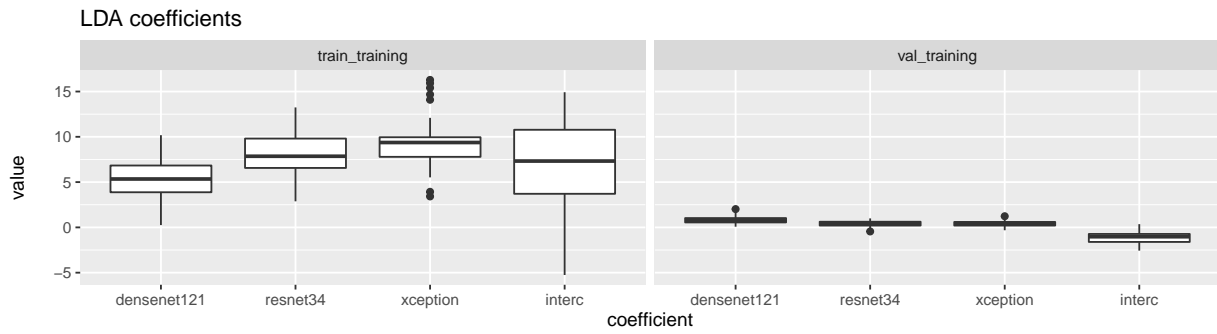
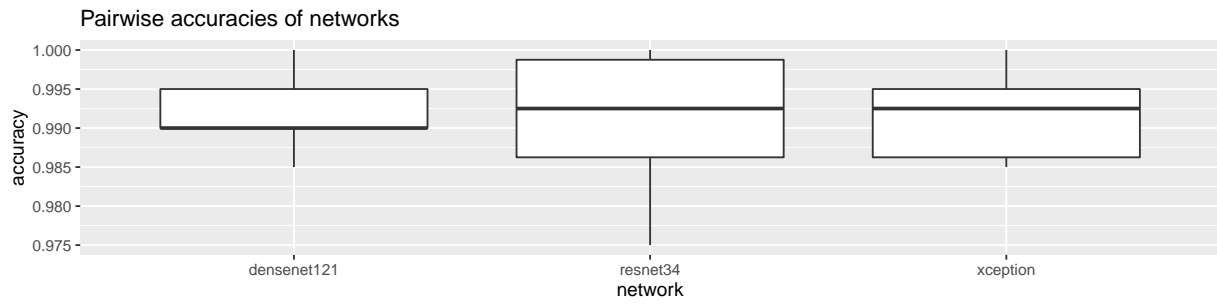
## Classes 1 vs 8



## Classes 1 vs 9

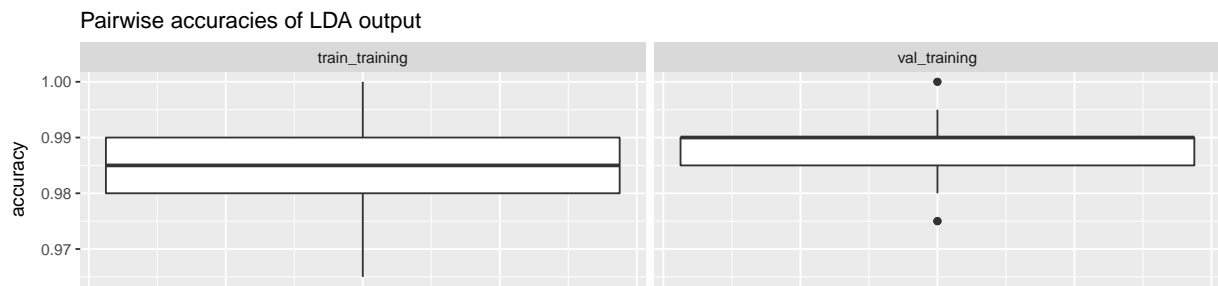
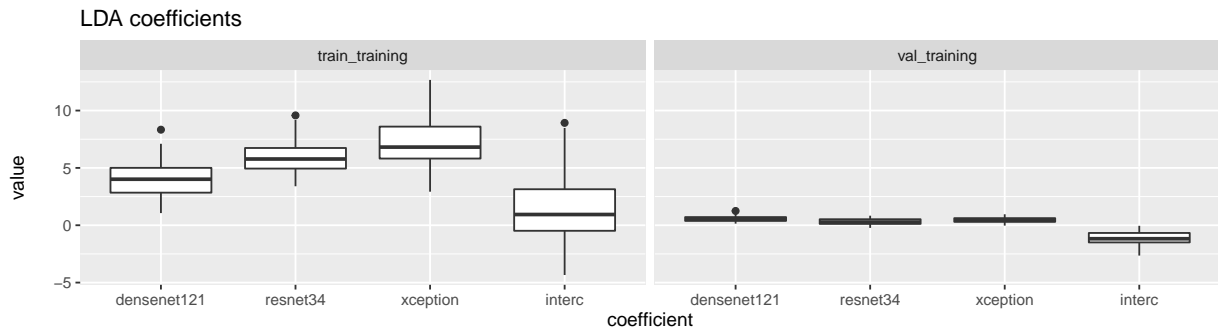
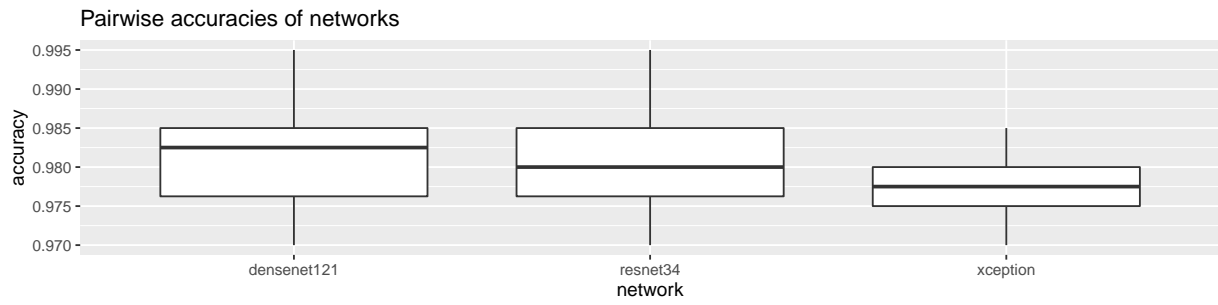


## Classes 1 vs 10

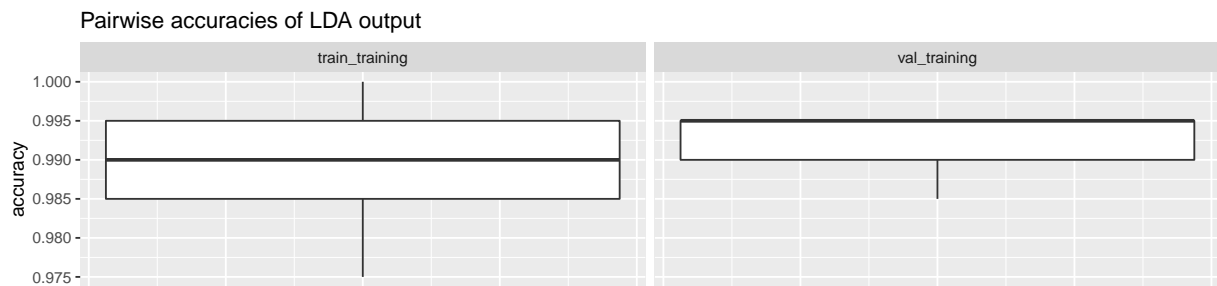
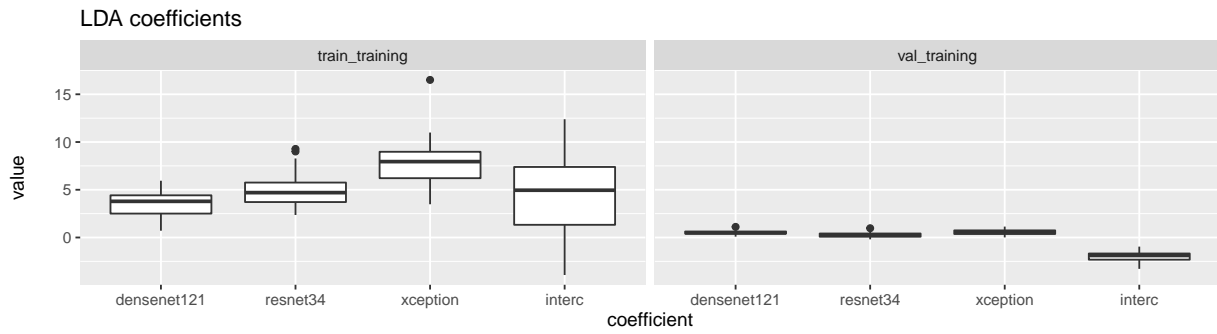
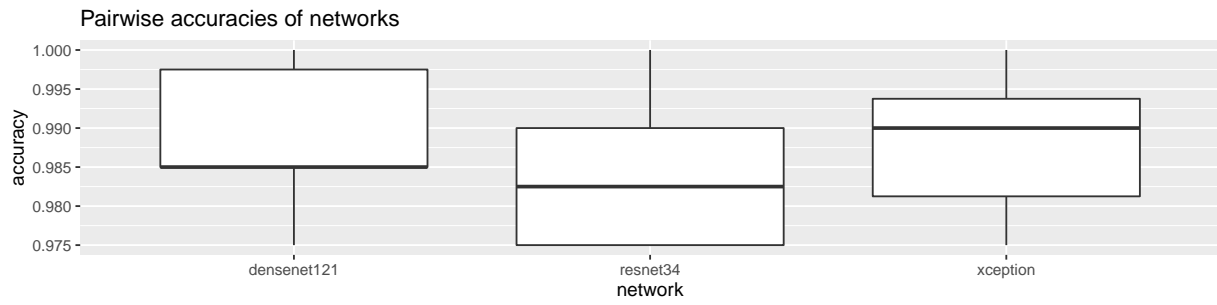




## Classes 2 vs 3

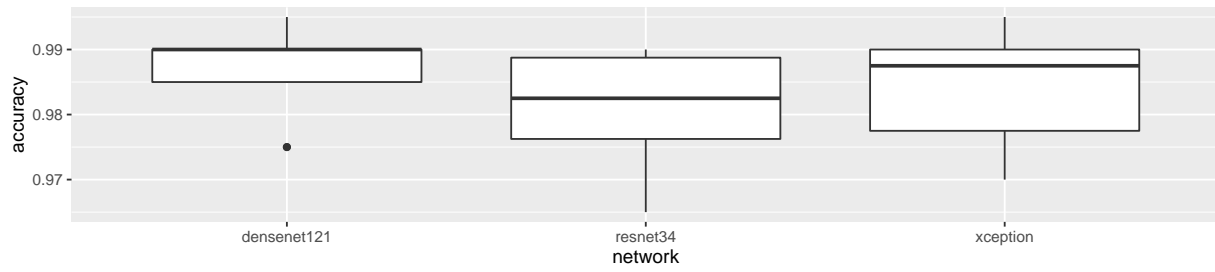


## Classes 2 vs 4

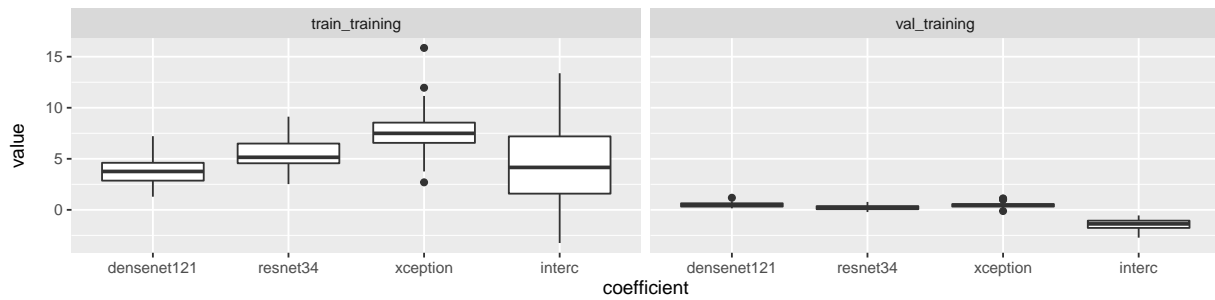


## Classes 2 vs 5

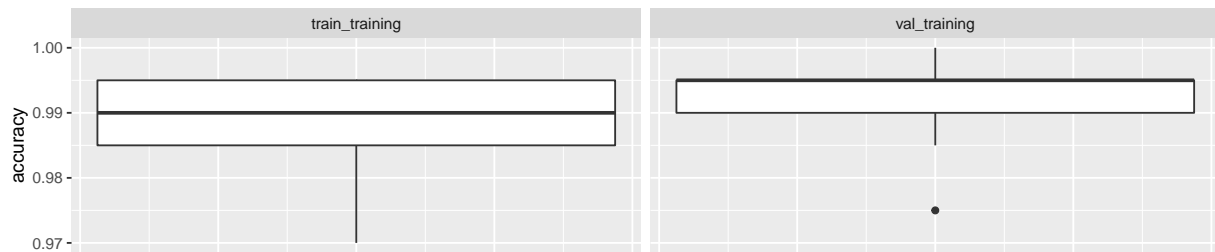
Pairwise accuracies of networks



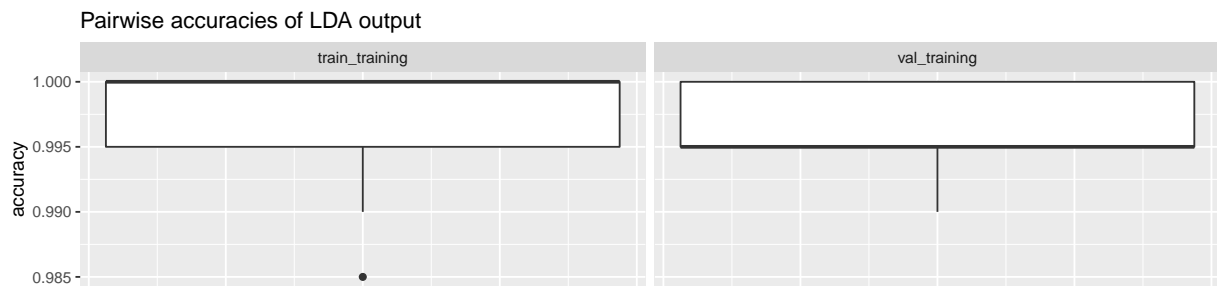
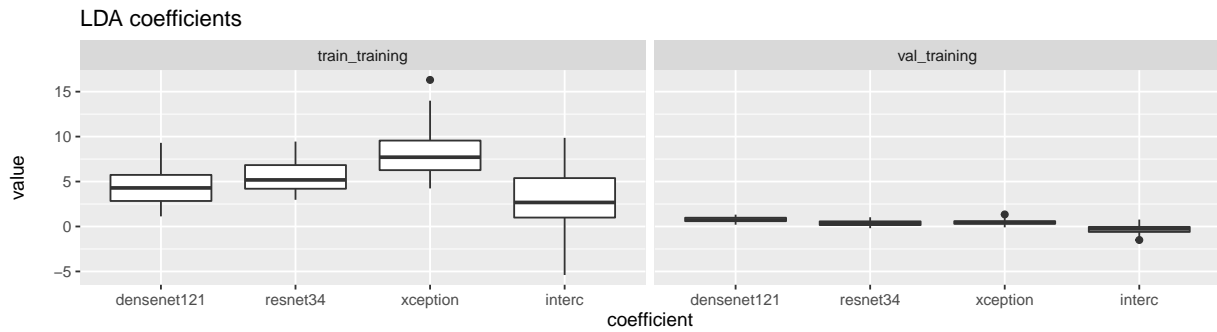
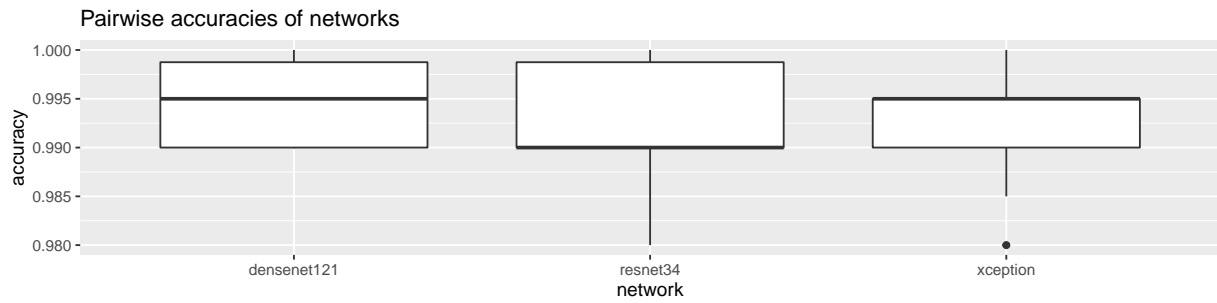
LDA coefficients



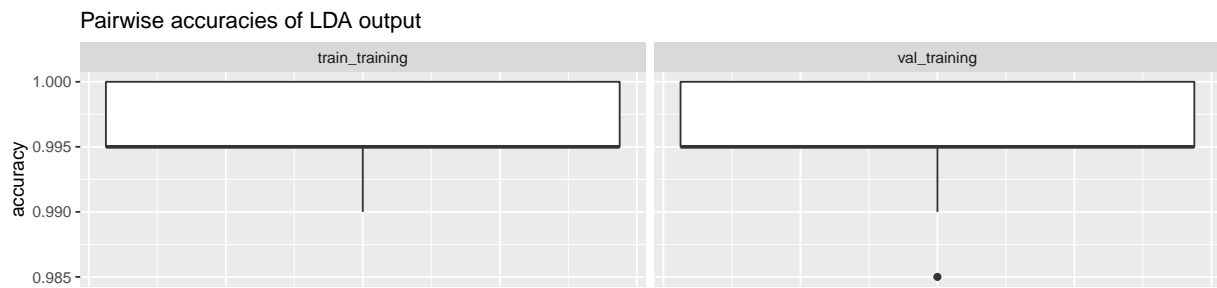
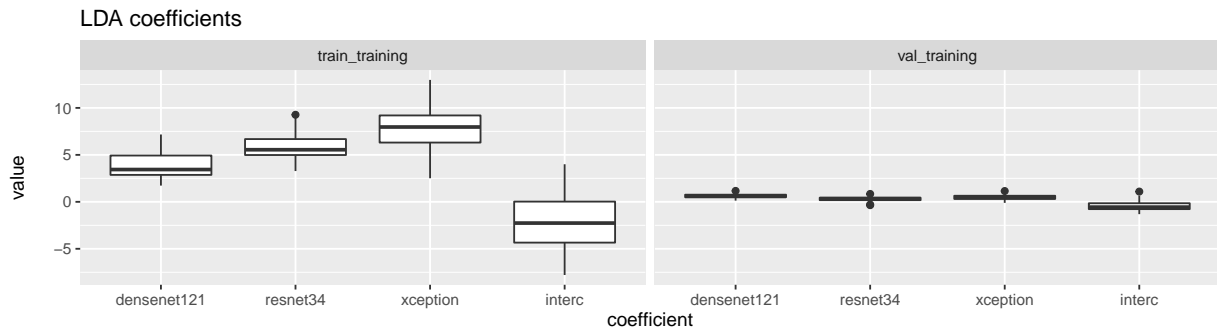
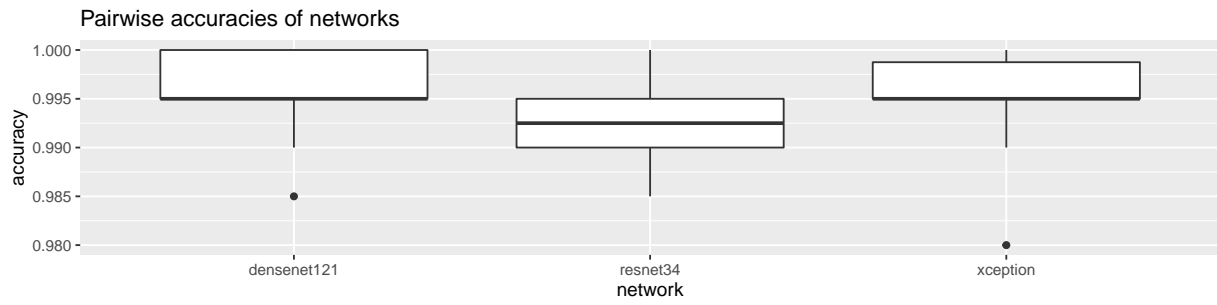
Pairwise accuracies of LDA output



## Classes 2 vs 6

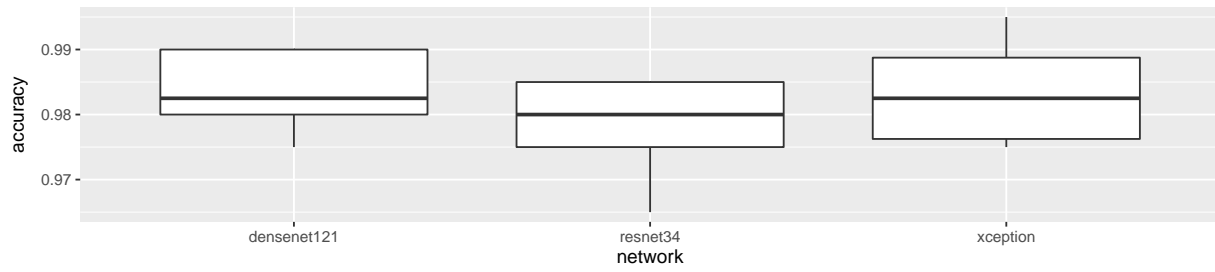


## Classes 2 vs 7

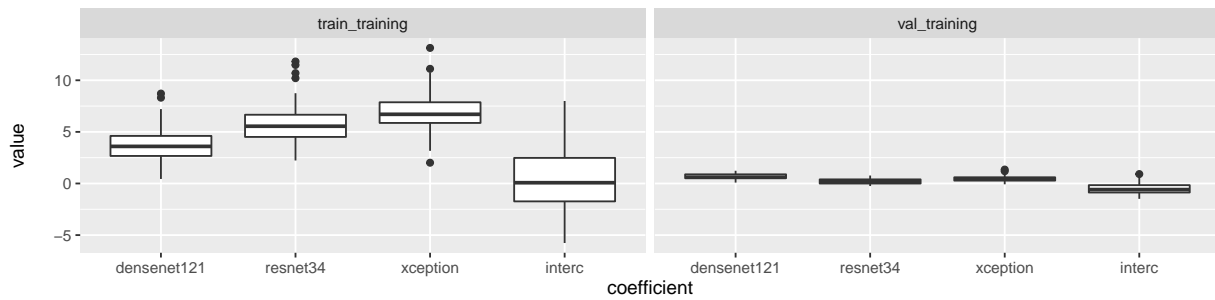


## Classes 2 vs 8

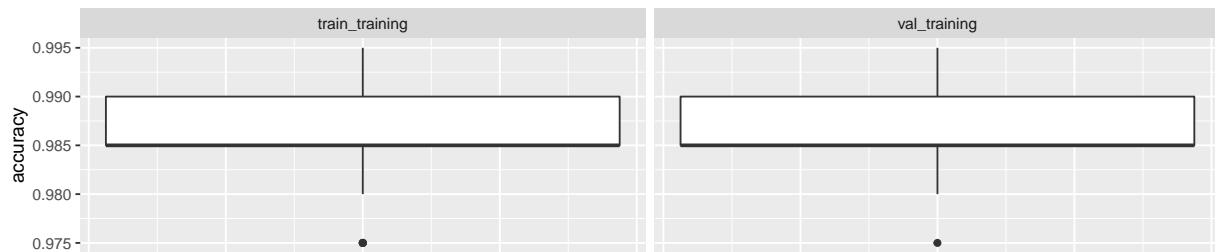
Pairwise accuracies of networks



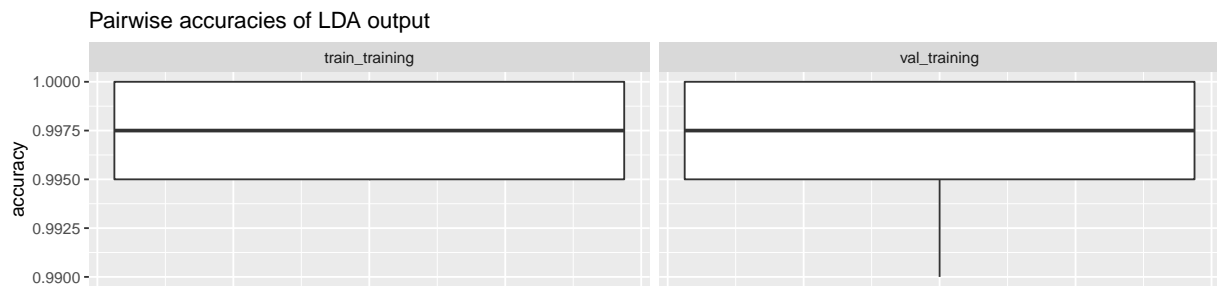
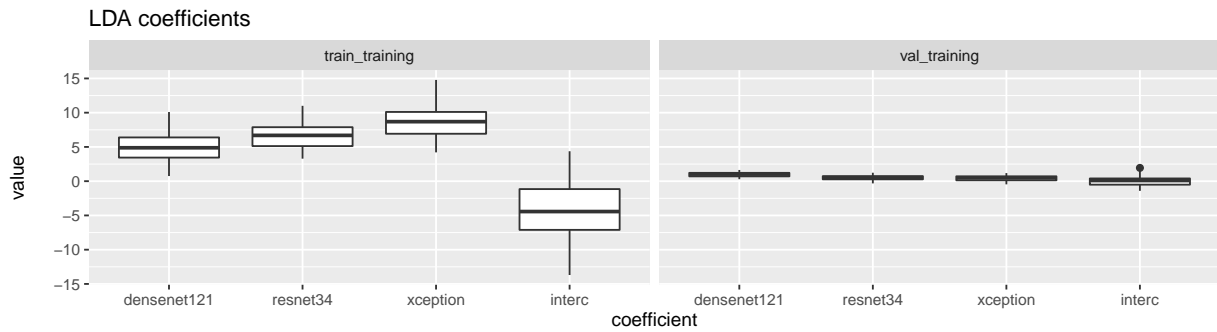
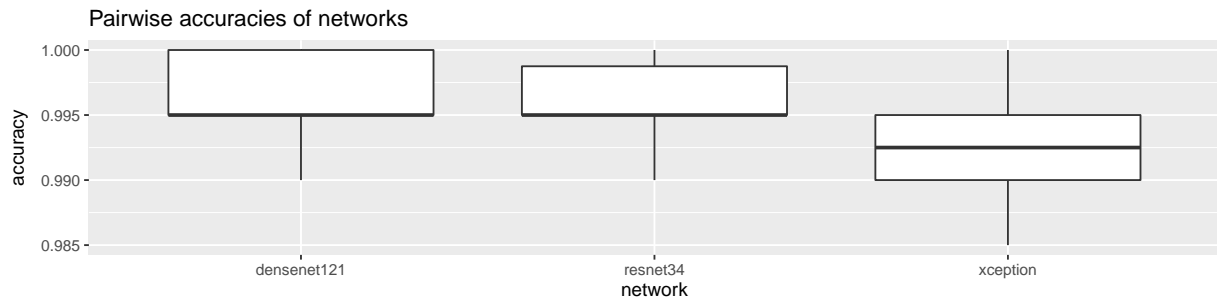
LDA coefficients



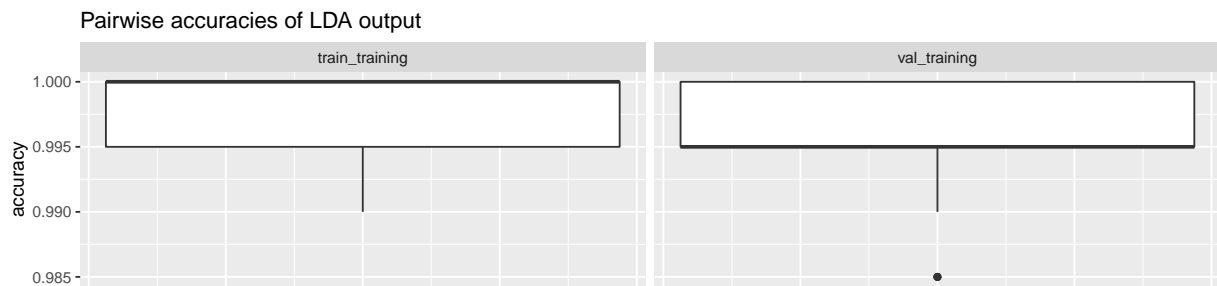
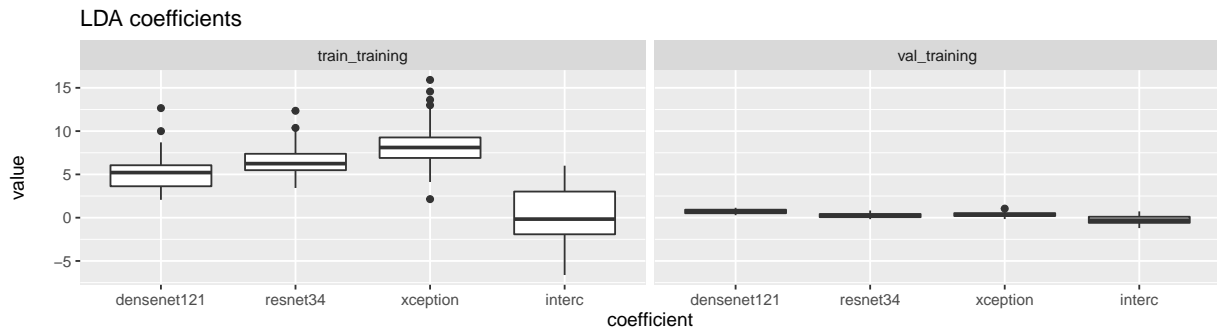
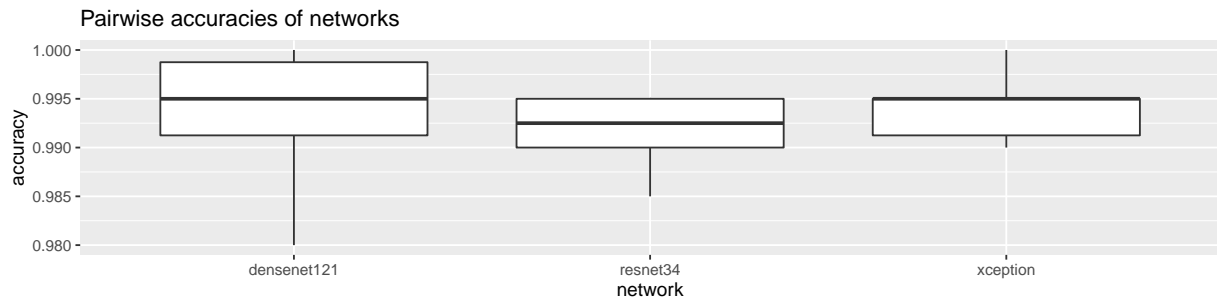
Pairwise accuracies of LDA output



## Classes 2 vs 9

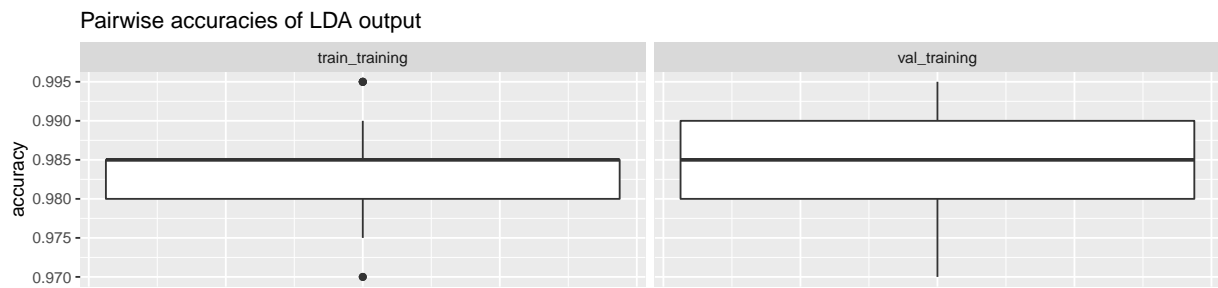
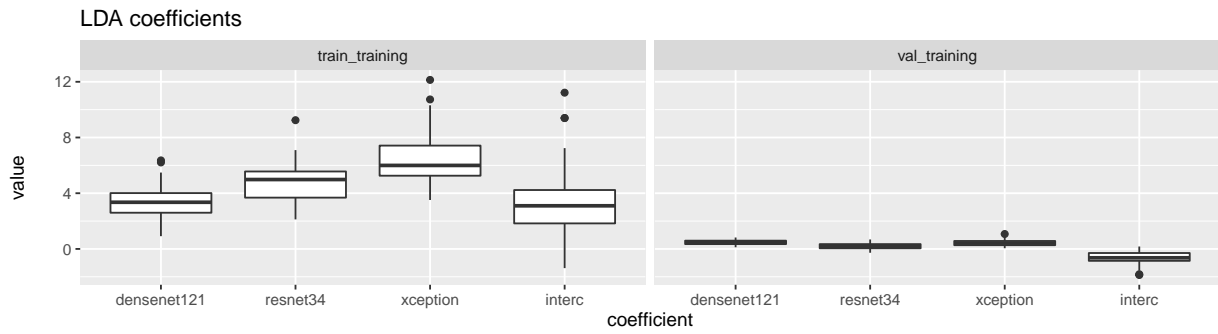
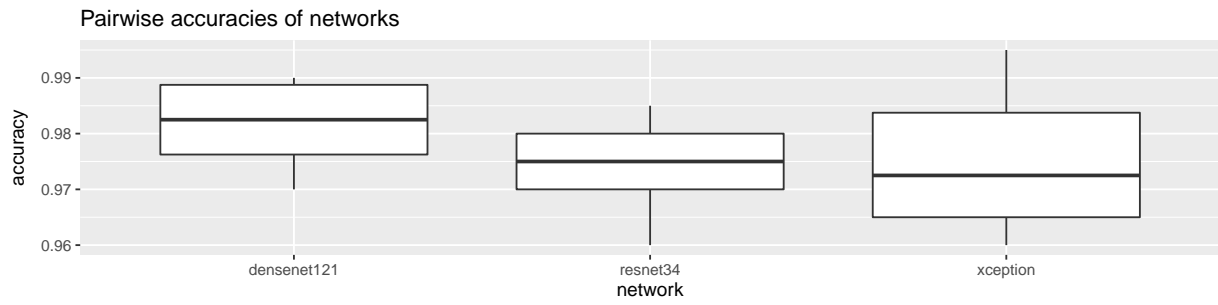


## Classes 2 vs 10

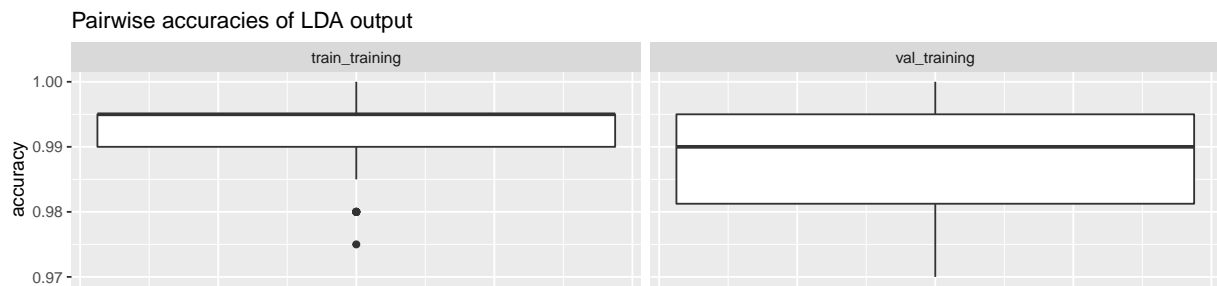
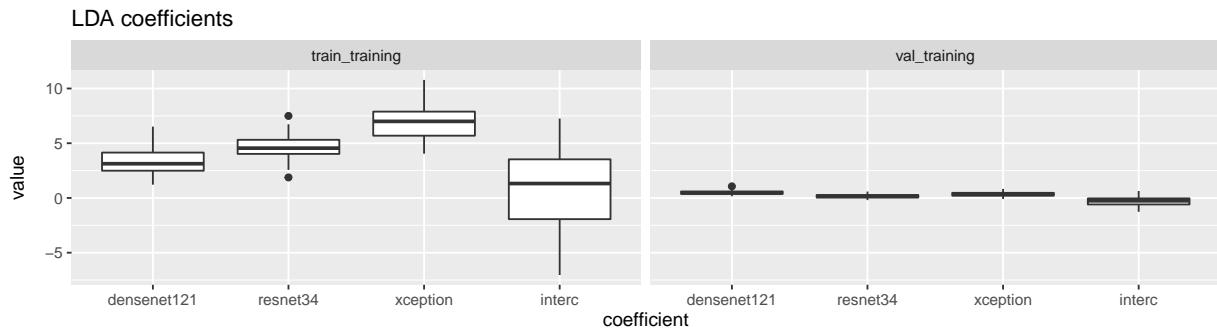
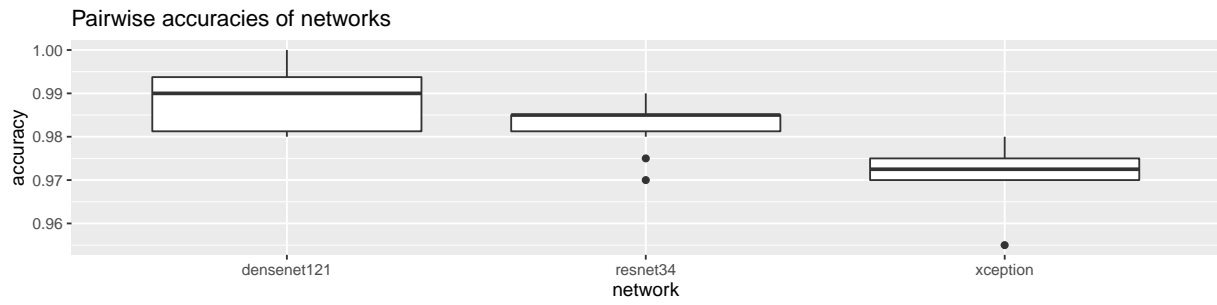




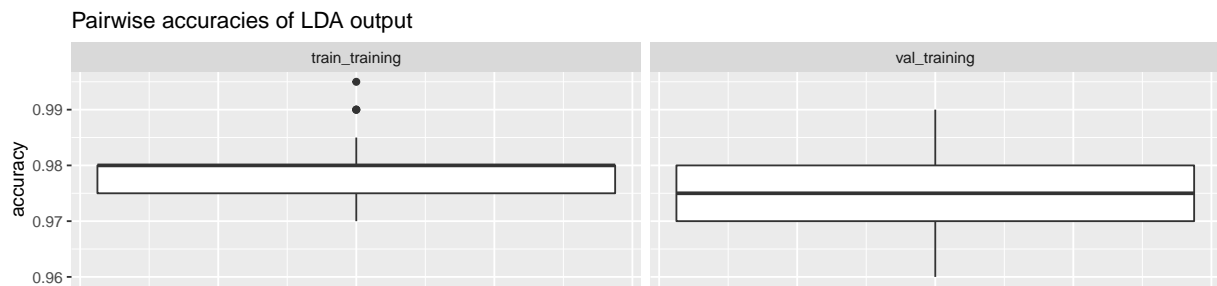
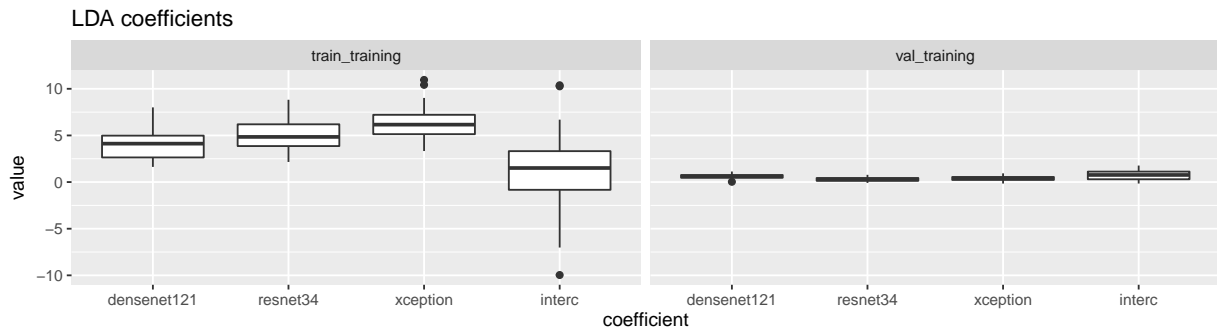
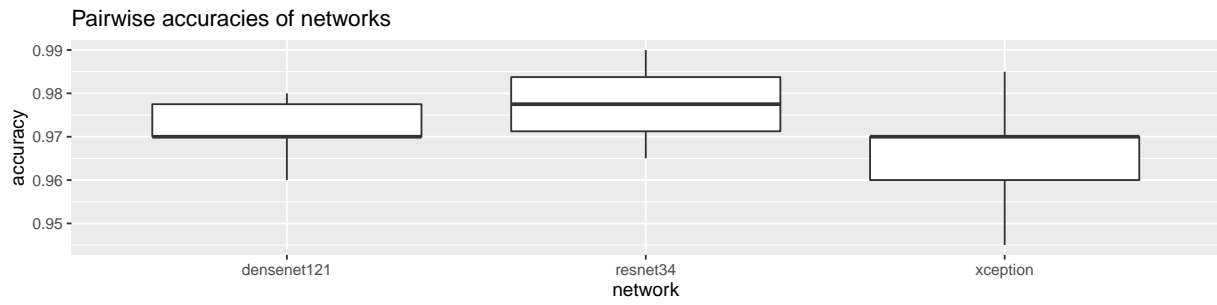
## Classes 3 vs 4



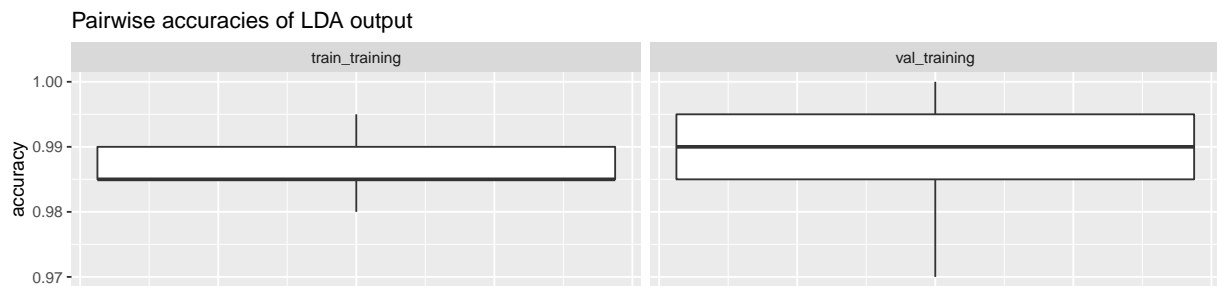
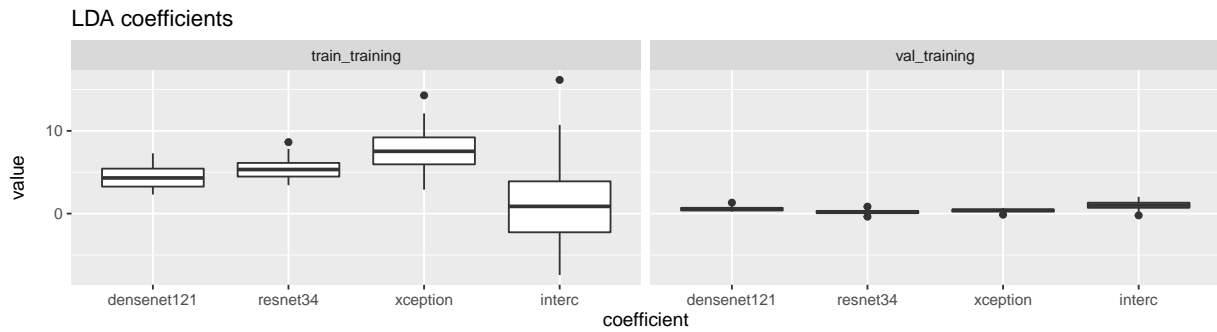
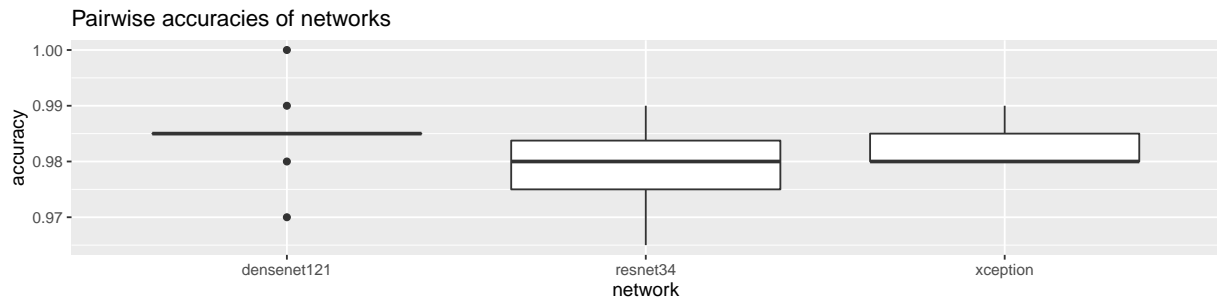
## Classes 3 vs 5



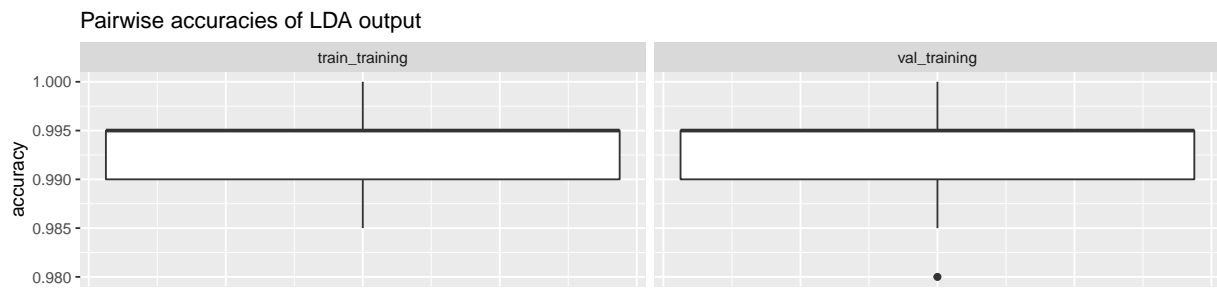
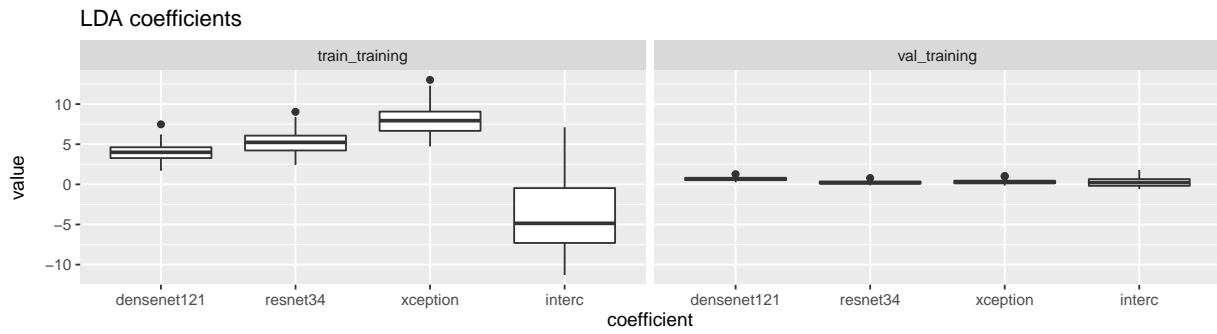
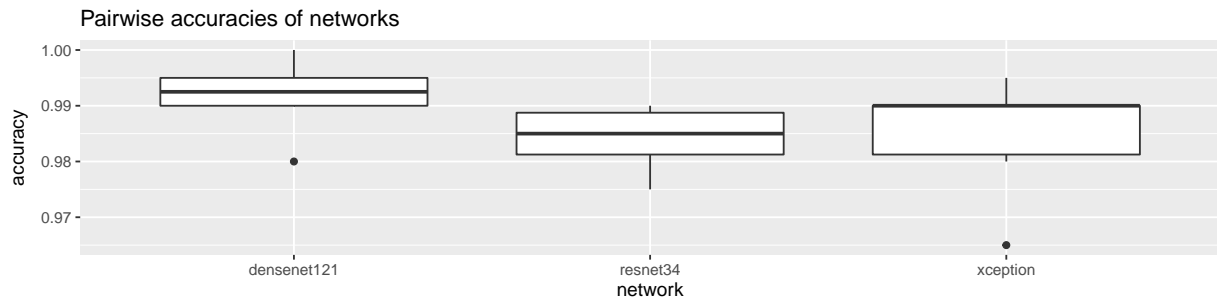
## Classes 3 vs 6



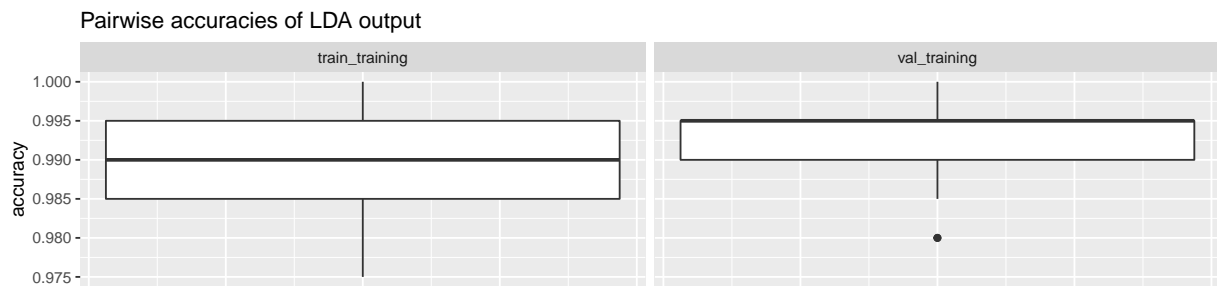
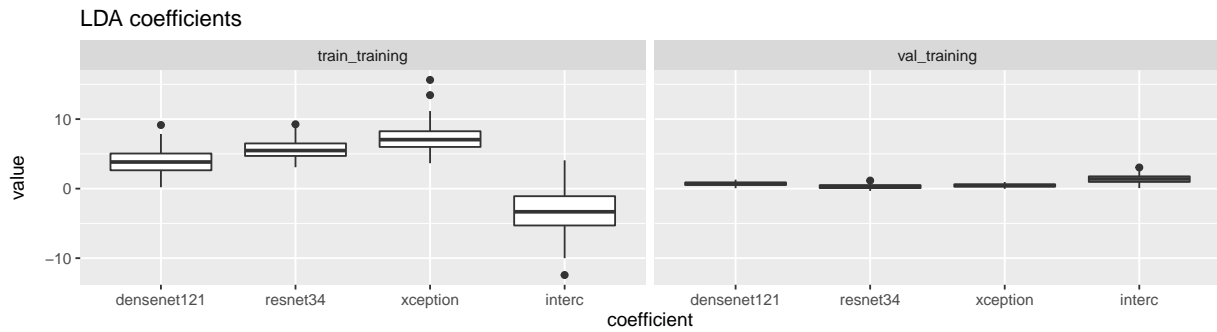
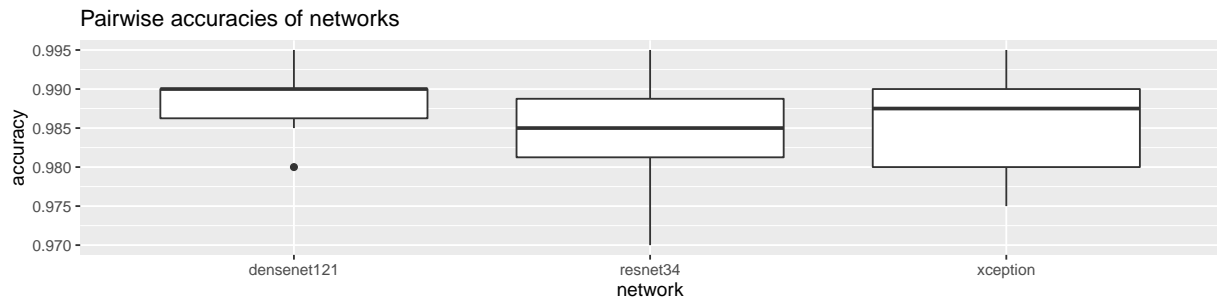
## Classes 3 vs 7



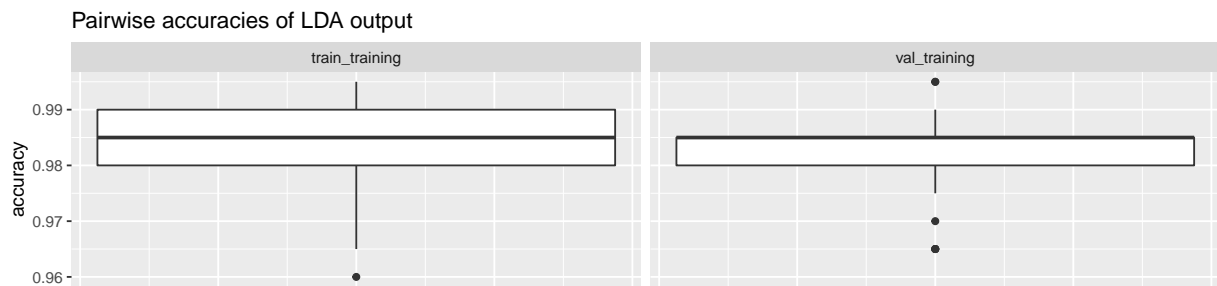
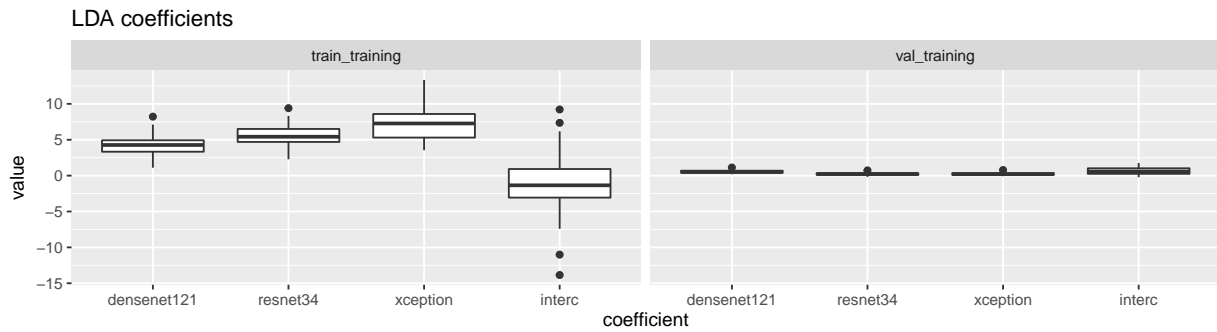
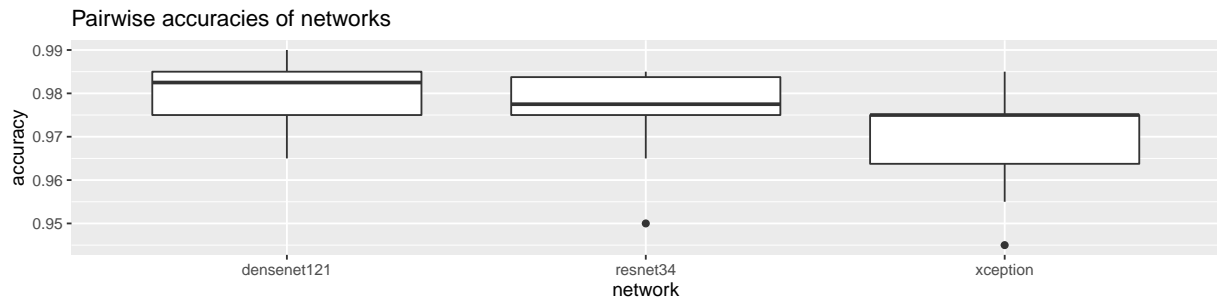
## Classes 3 vs 8



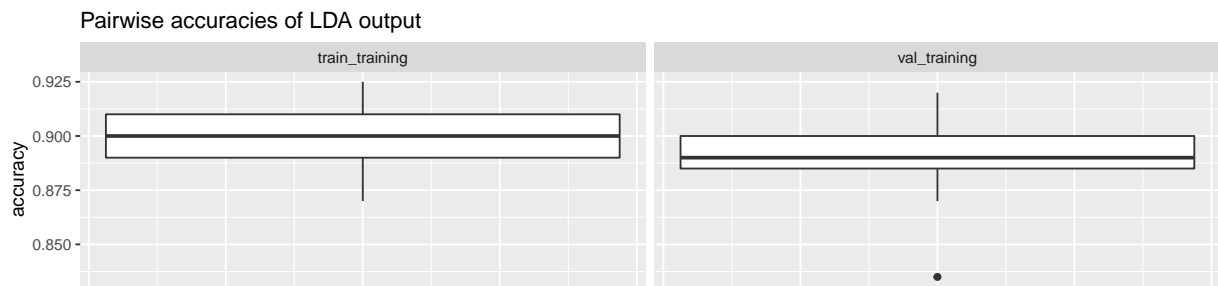
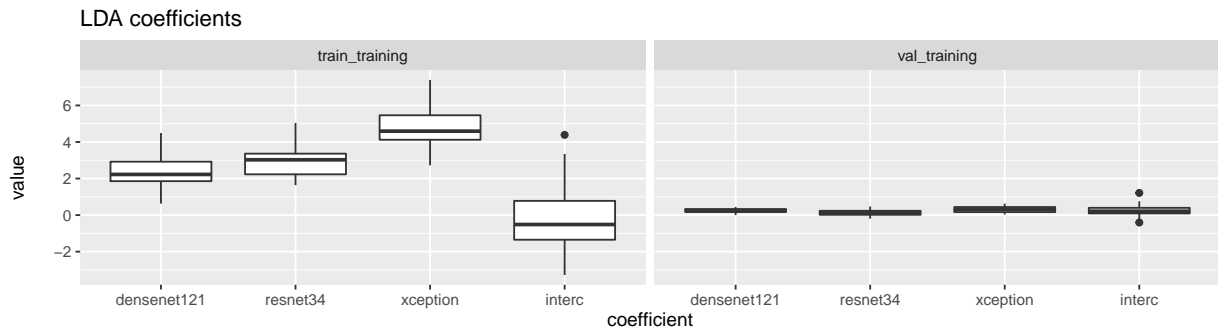
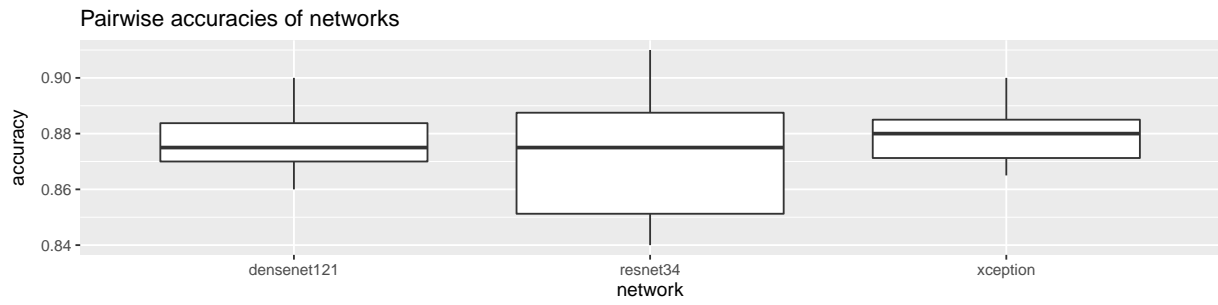
## Classes 3 vs 9



## Classes 3 vs 10

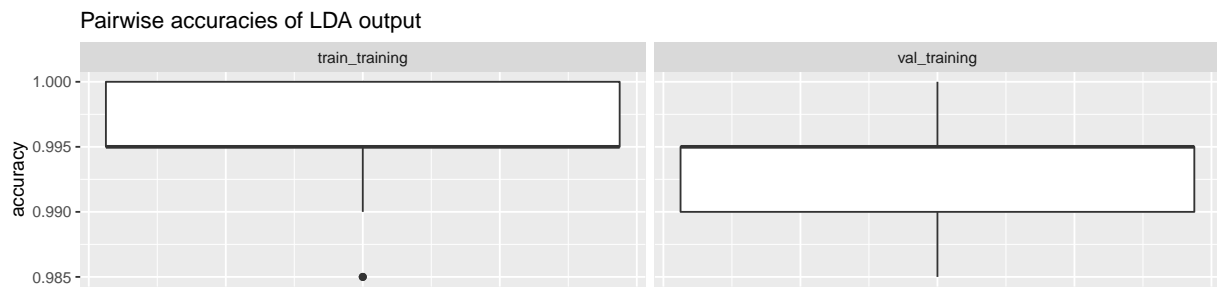
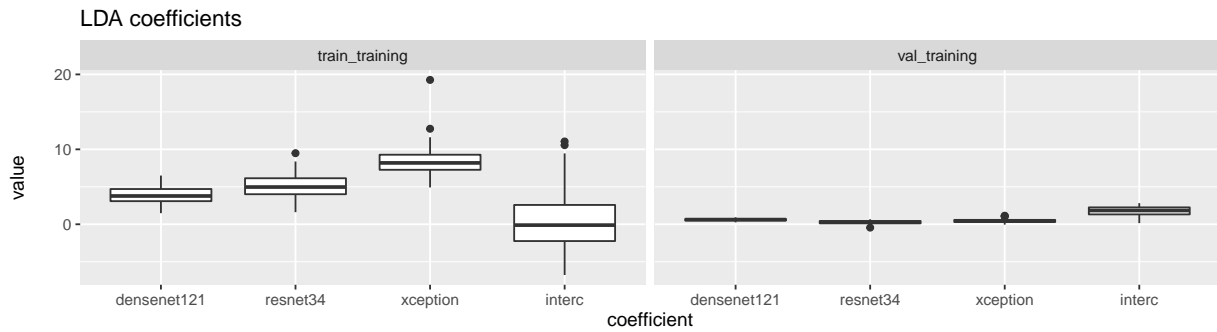
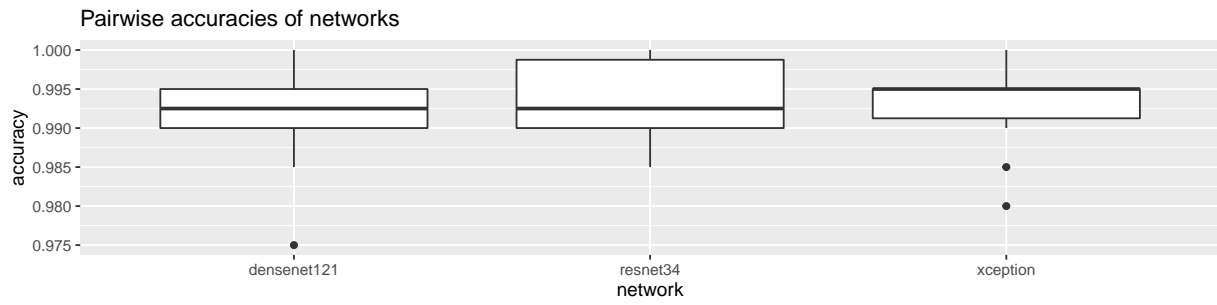


## Classes 4 vs 5

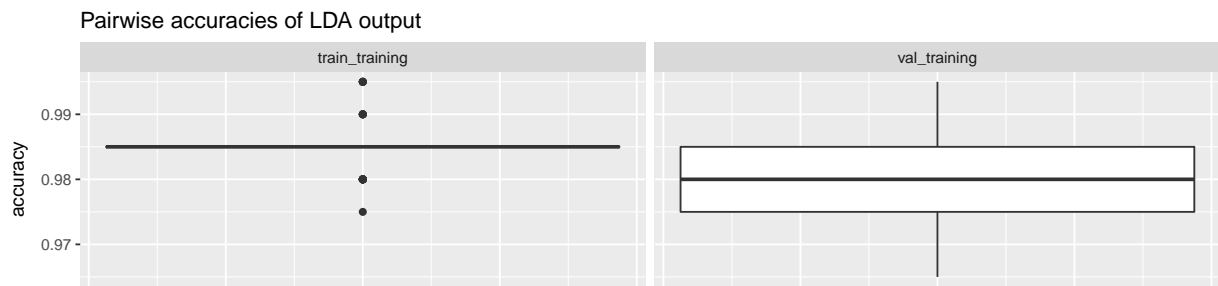
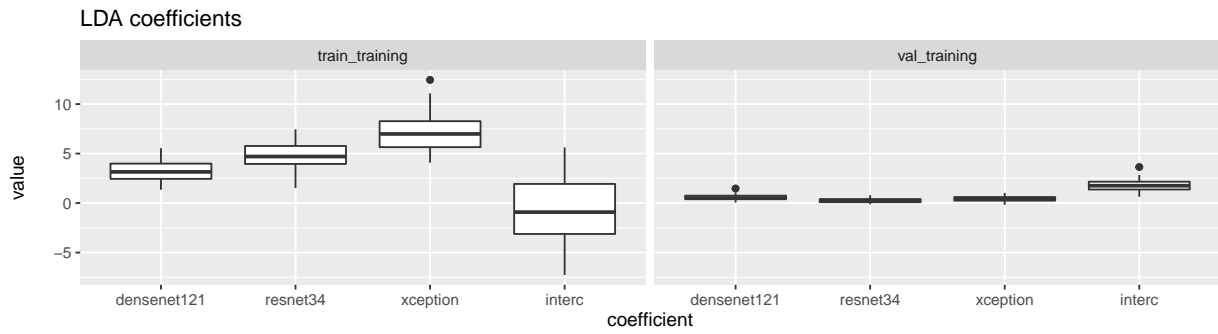
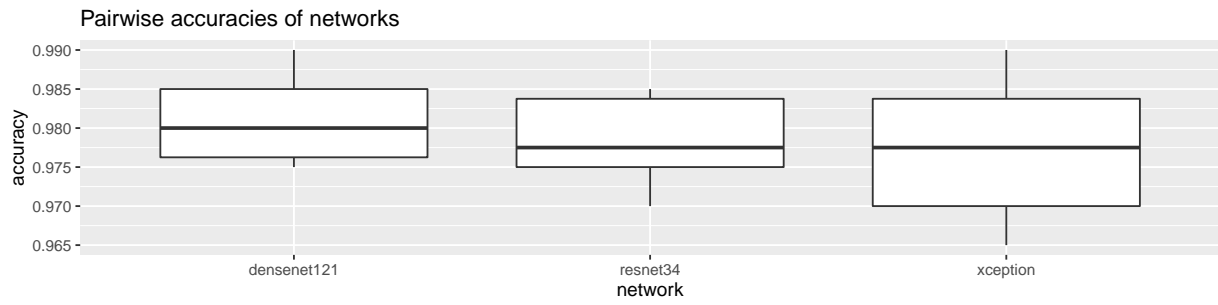




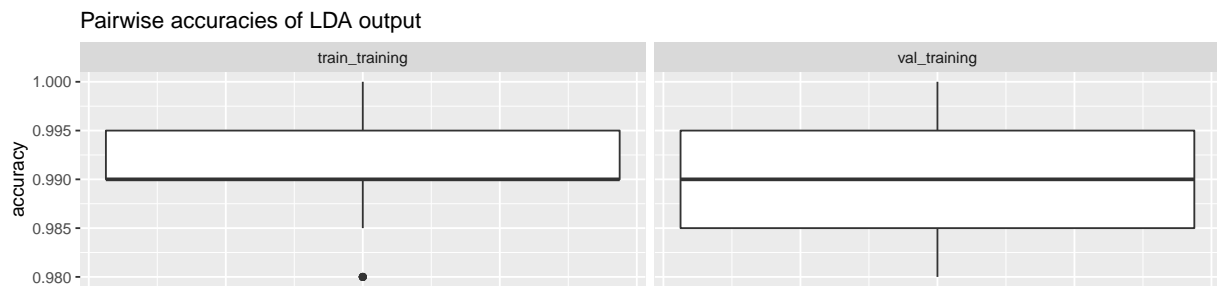
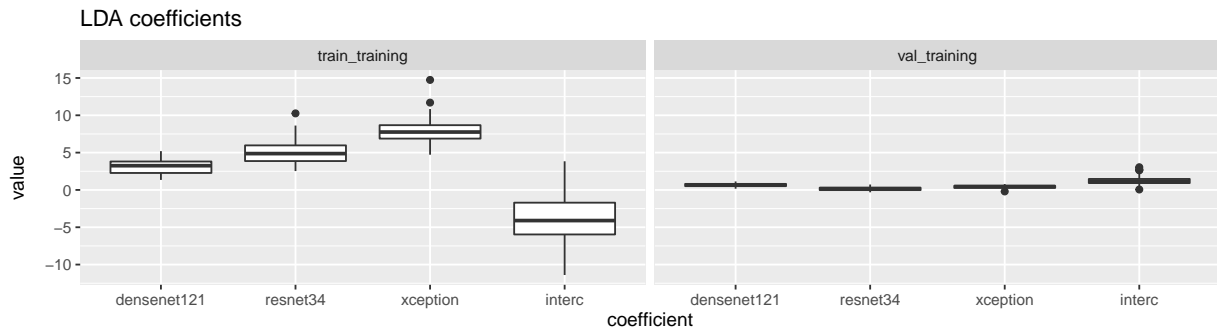
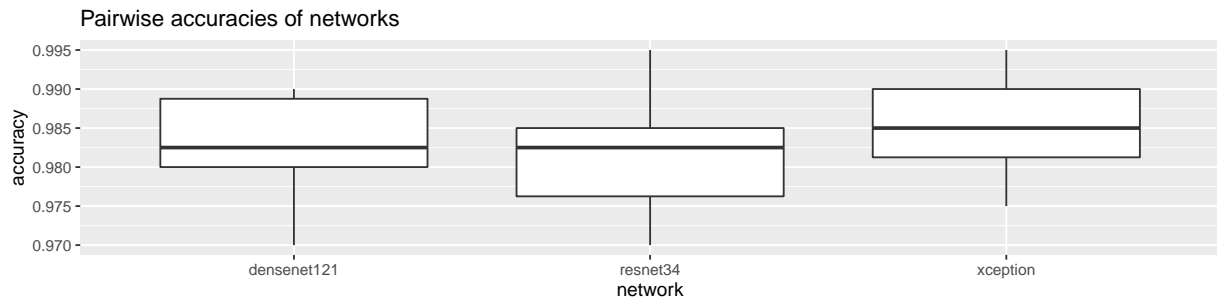
## Classes 4 vs 6



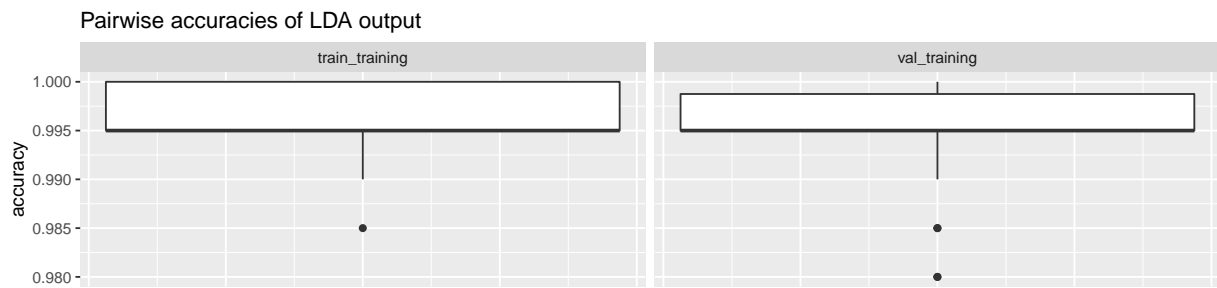
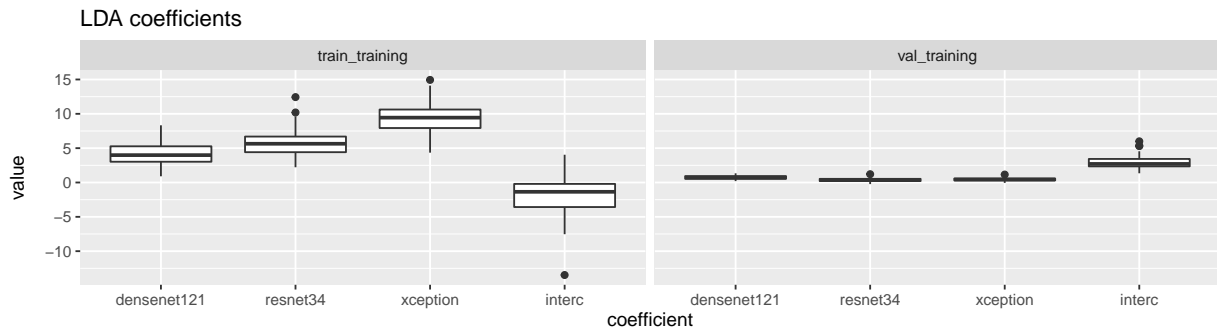
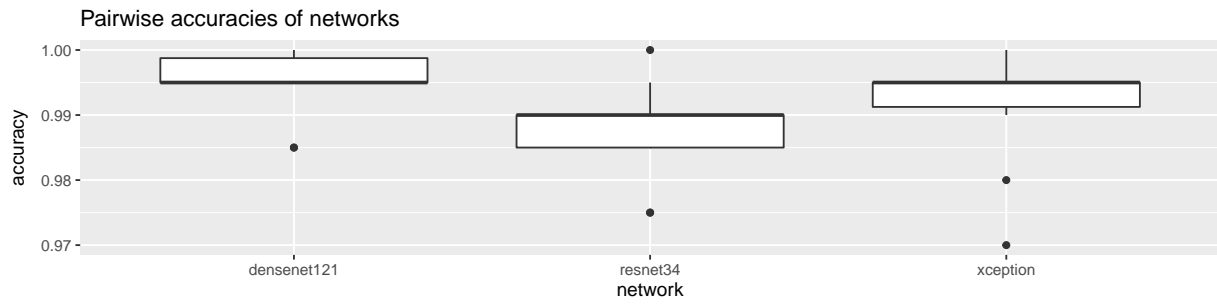
## Classes 4 vs 7



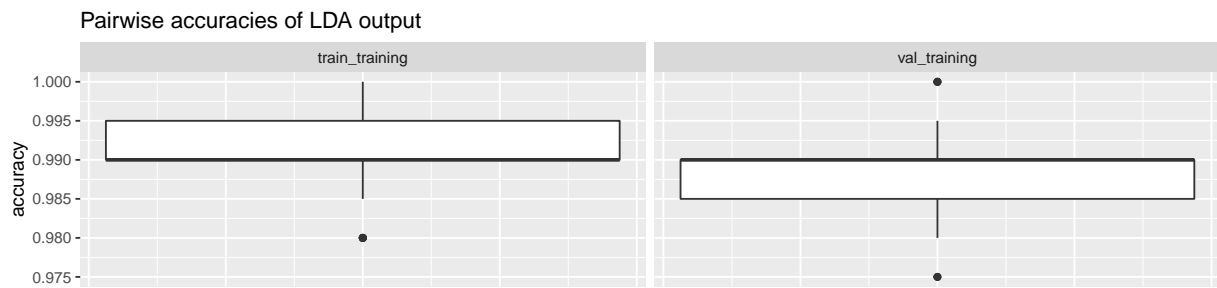
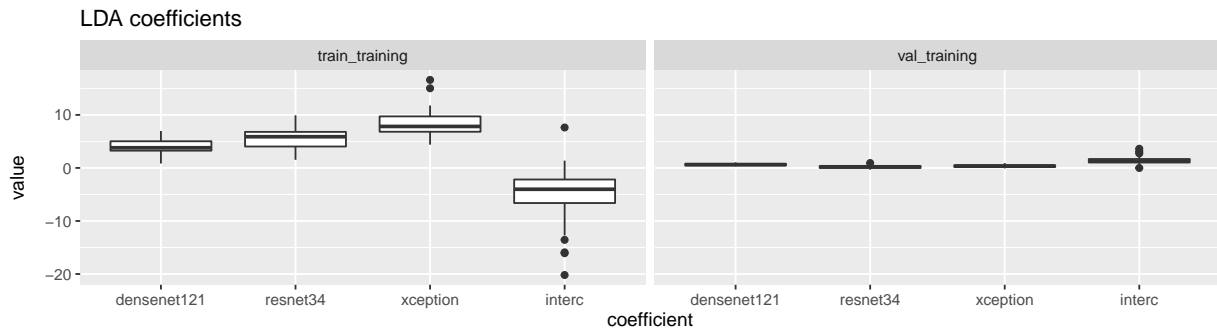
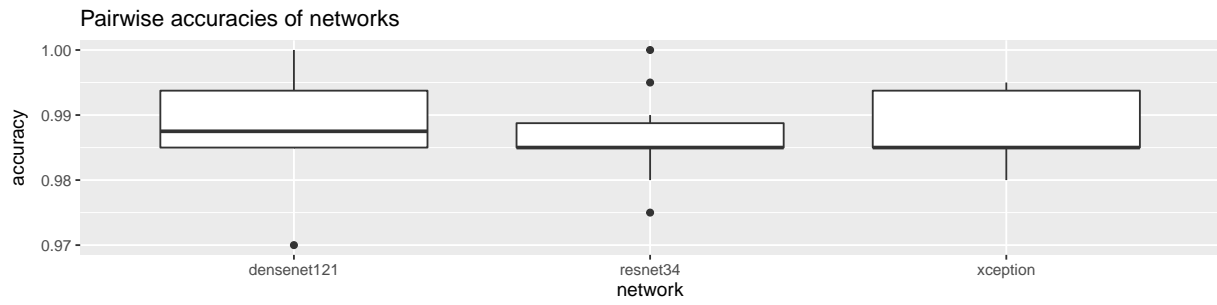
## Classes 4 vs 8



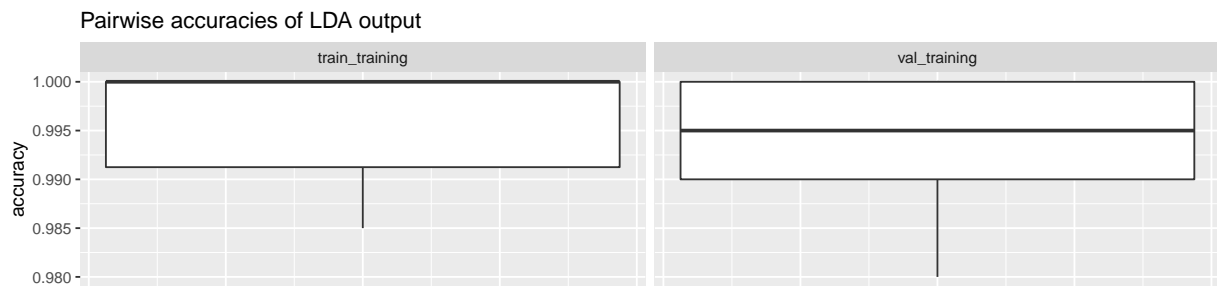
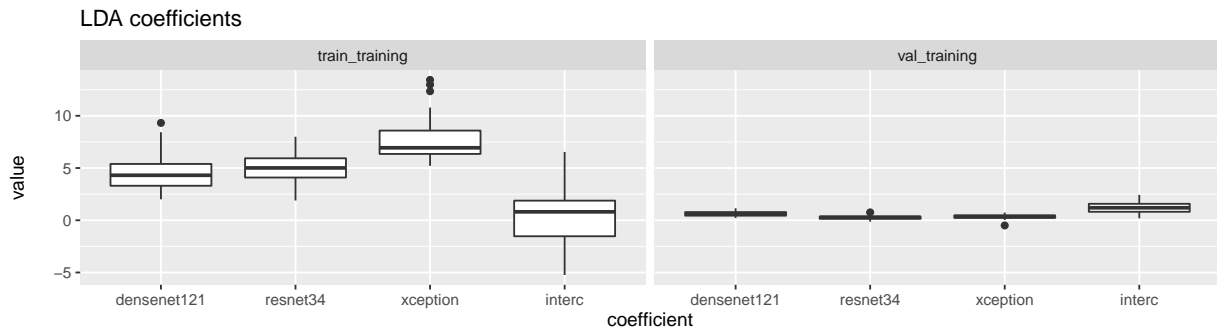
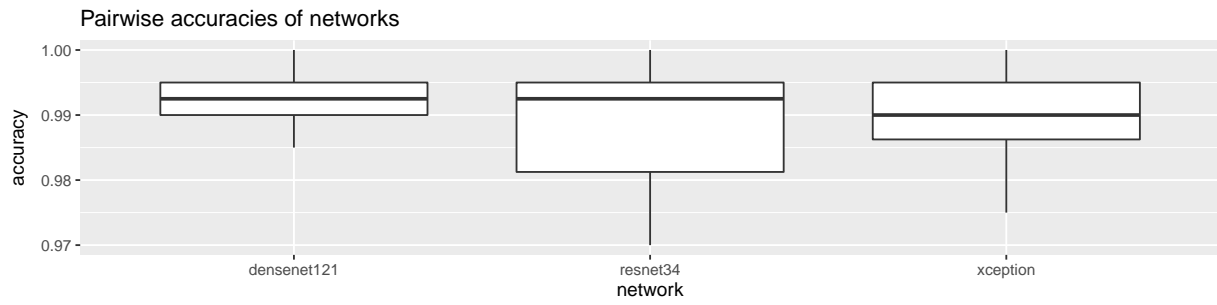
## Classes 4 vs 9



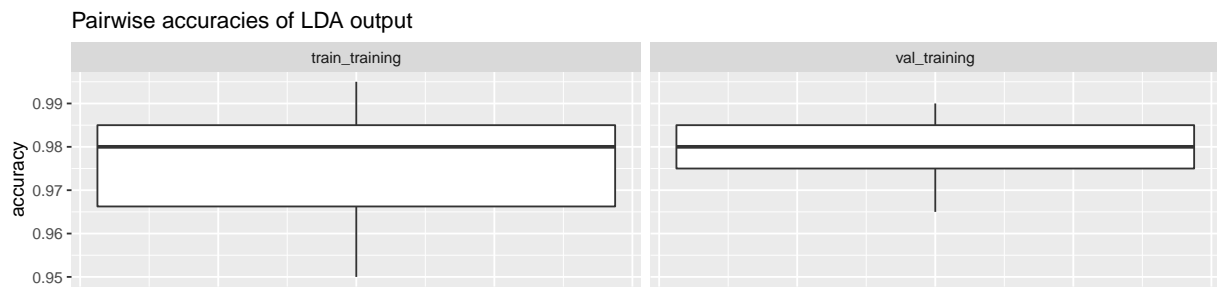
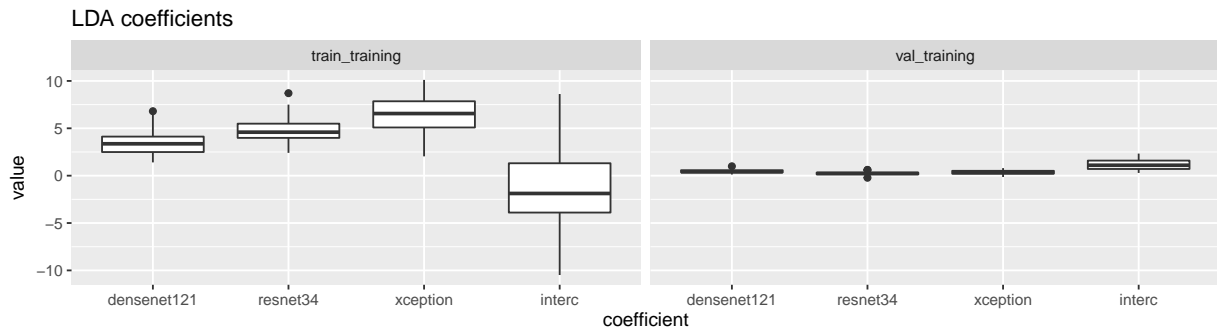
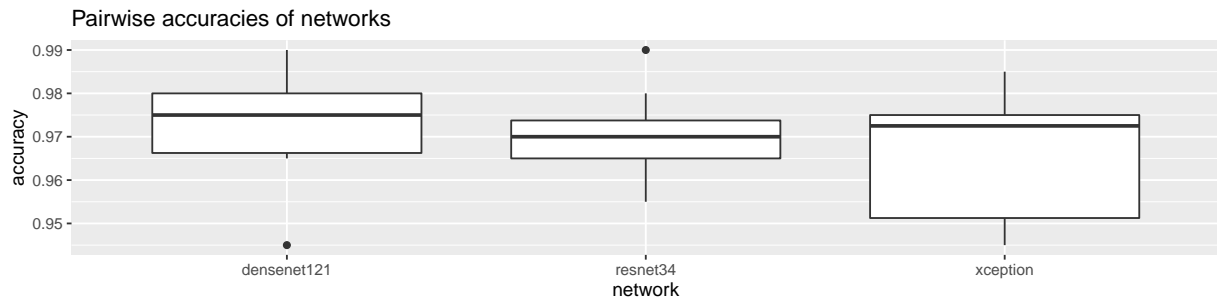
## Classes 4 vs 10



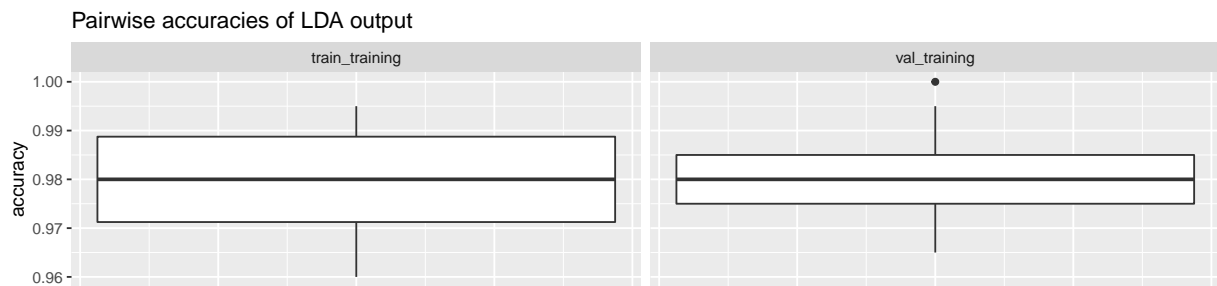
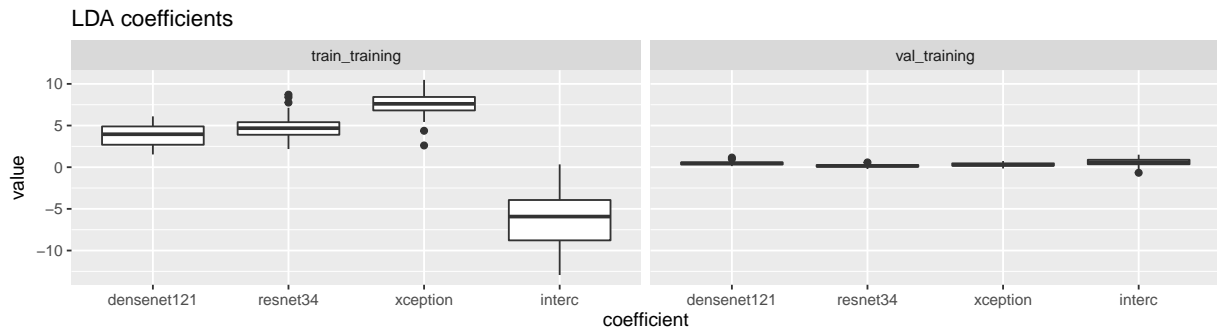
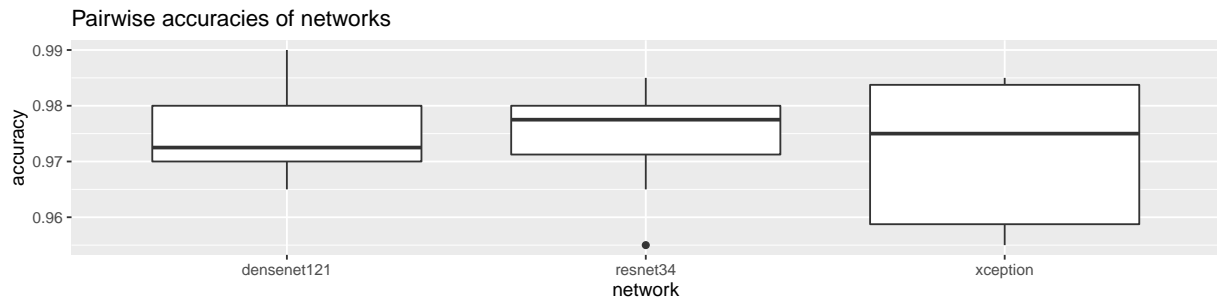
## Classes 5 vs 6



## Classes 5 vs 7

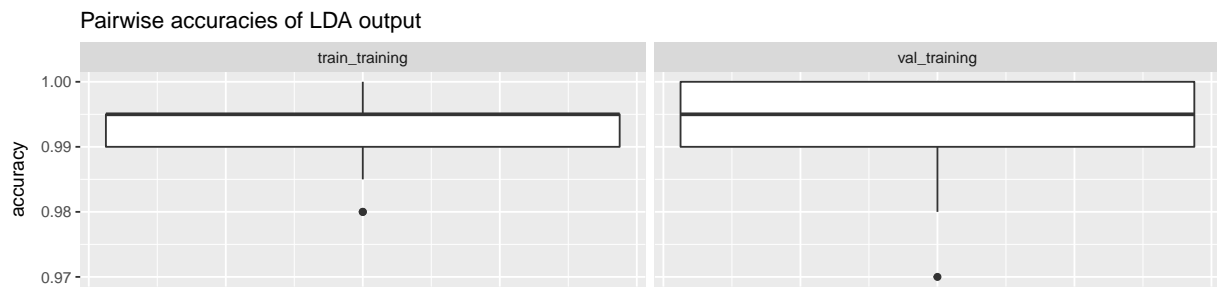
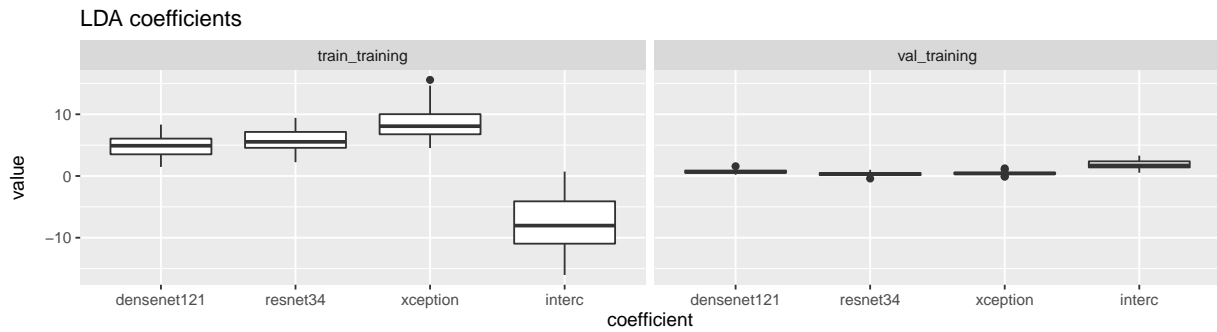
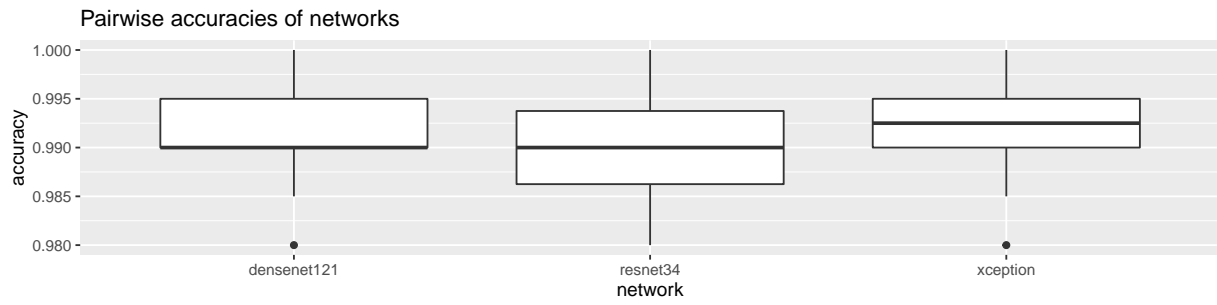


## Classes 5 vs 8

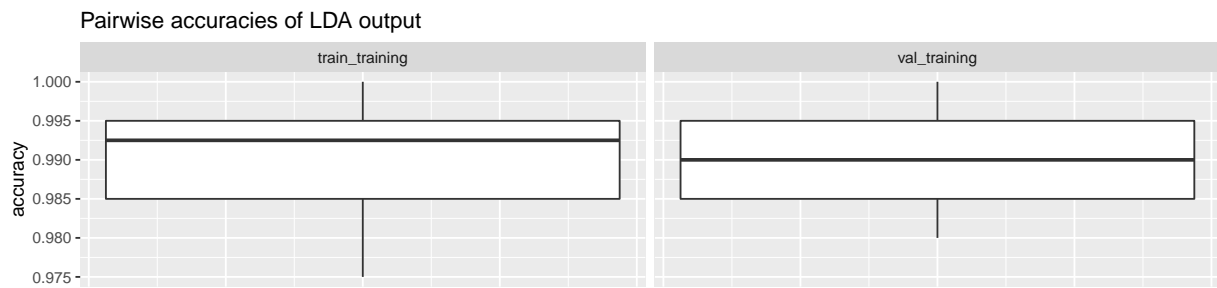
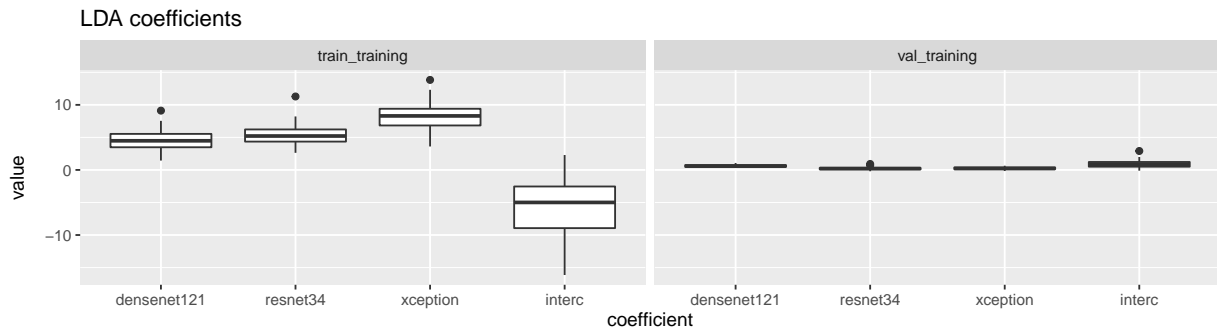
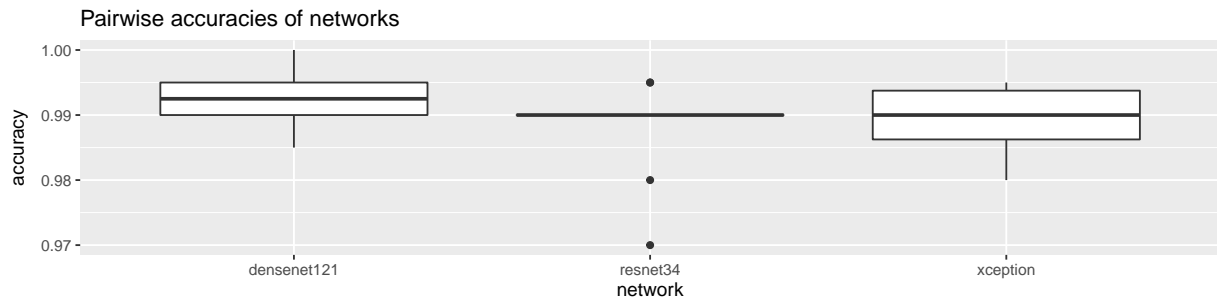




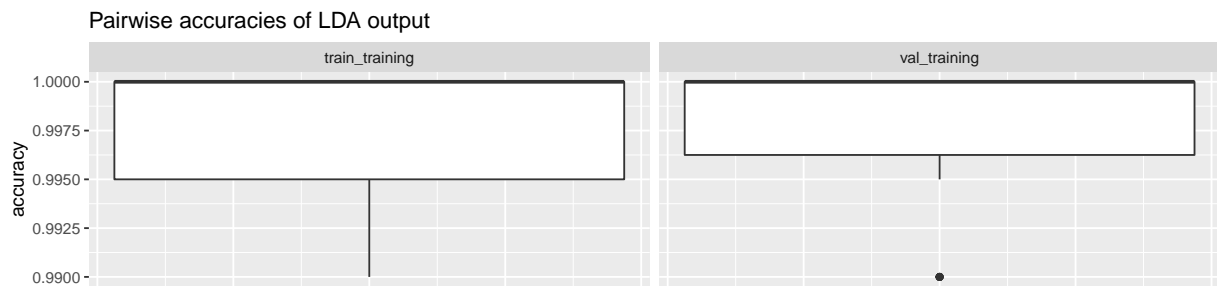
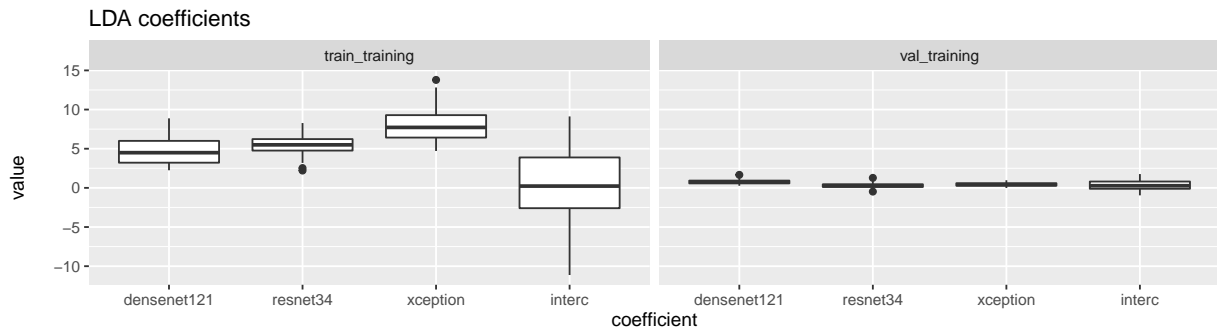
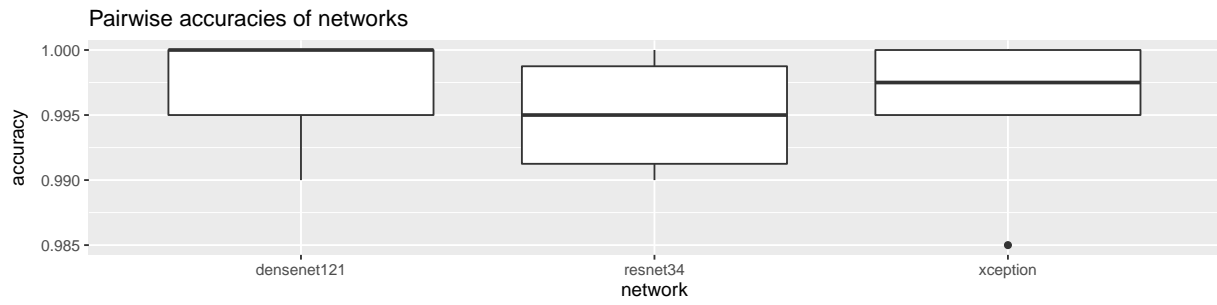
## Classes 5 vs 9



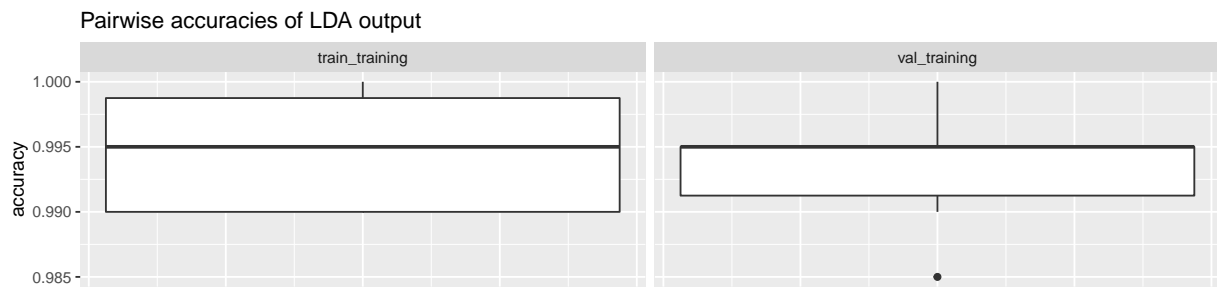
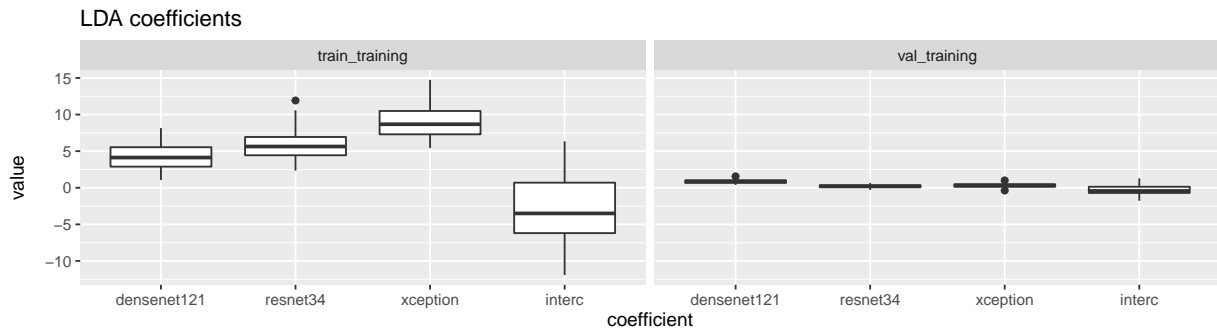
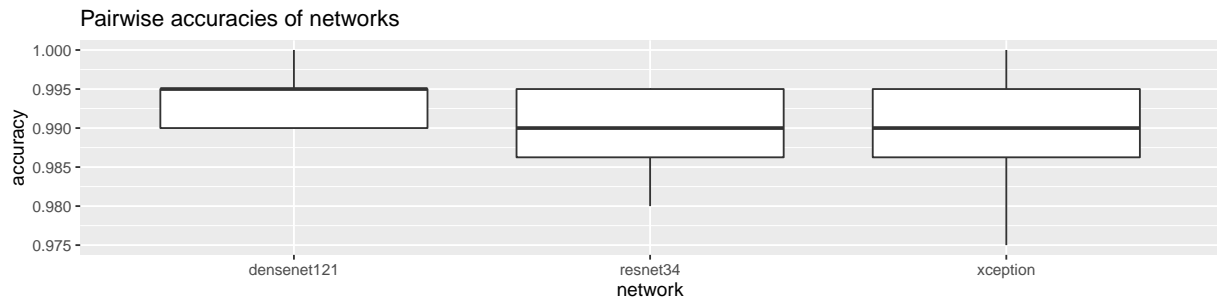
## Classes 5 vs 10



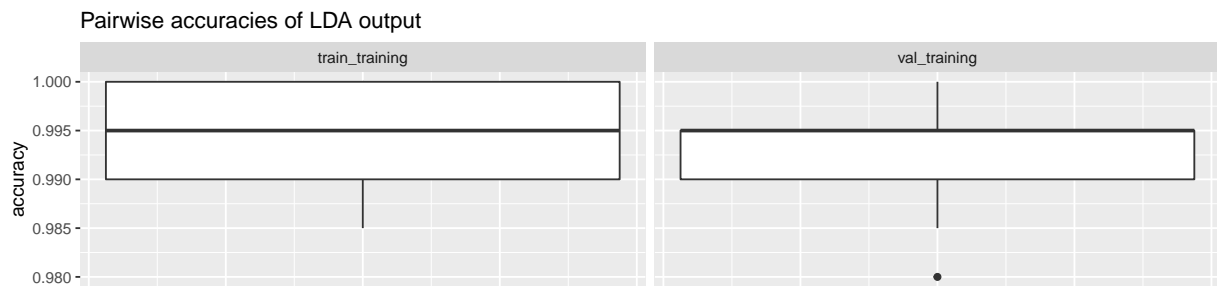
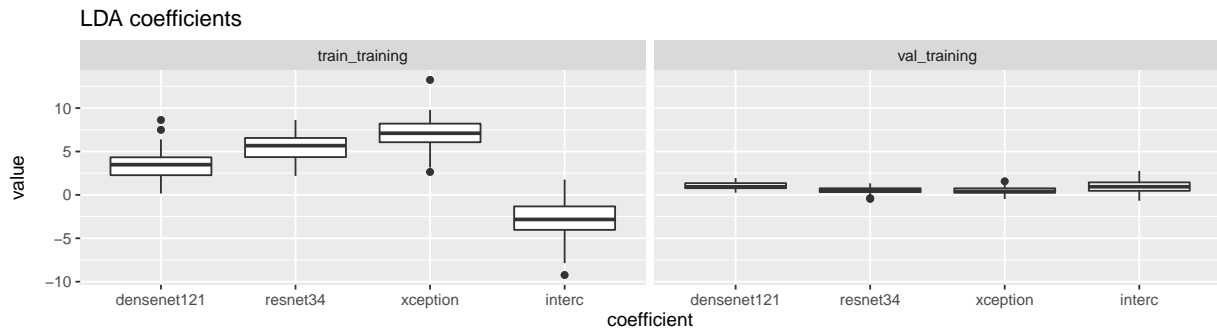
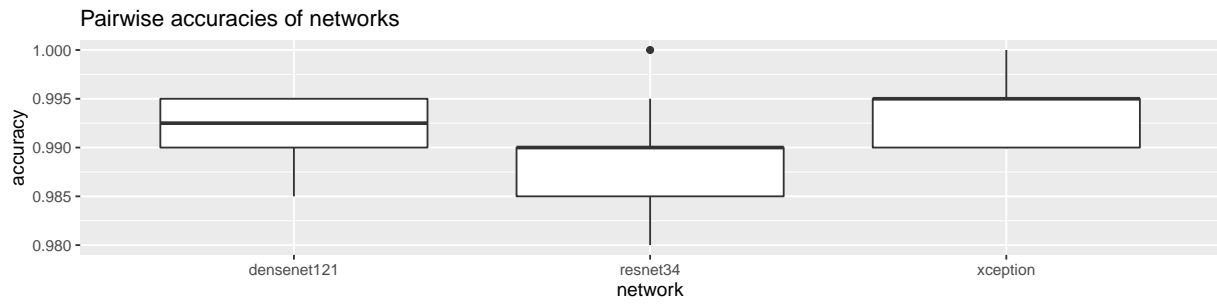
## Classes 6 vs 7



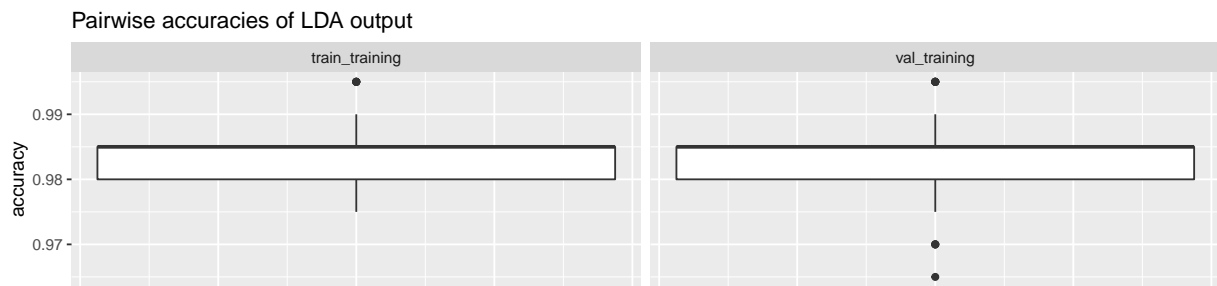
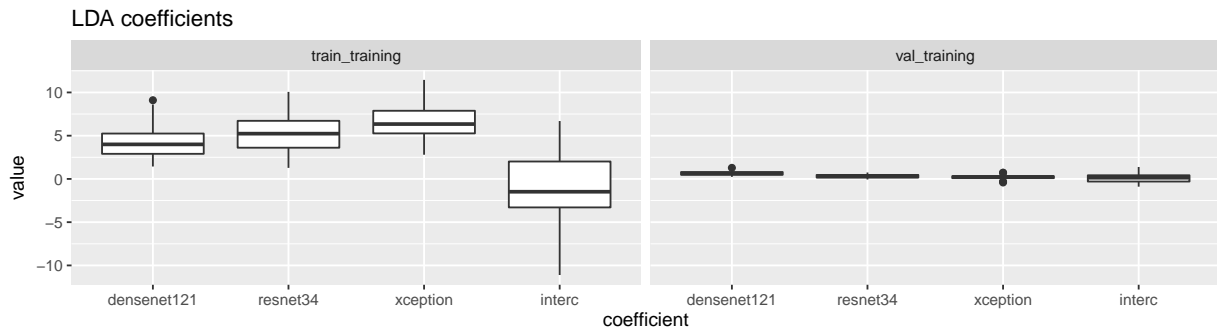
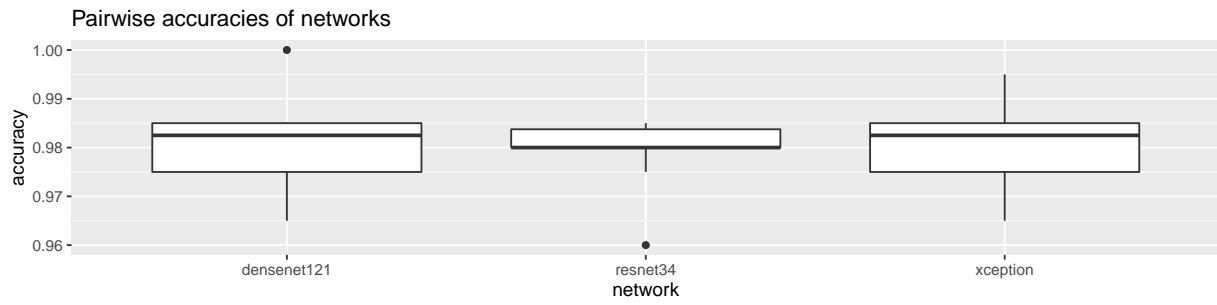
## Classes 6 vs 8



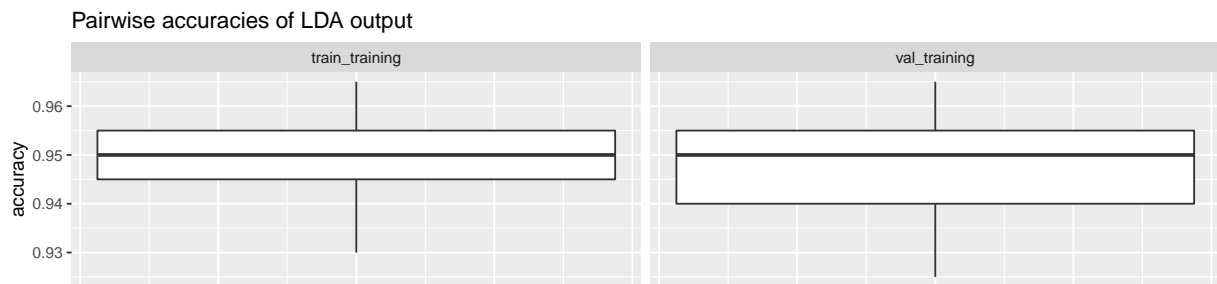
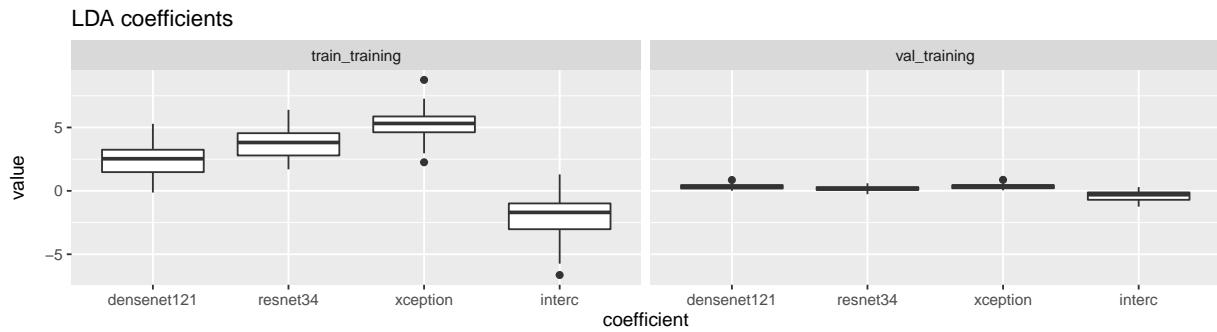
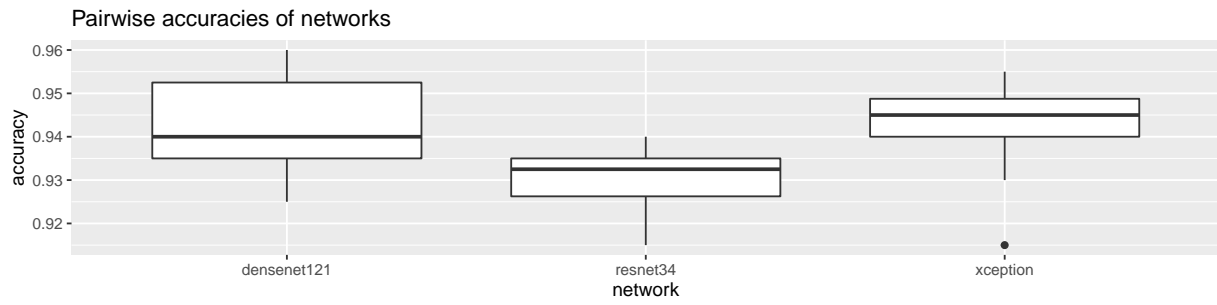
## Classes 6 vs 9



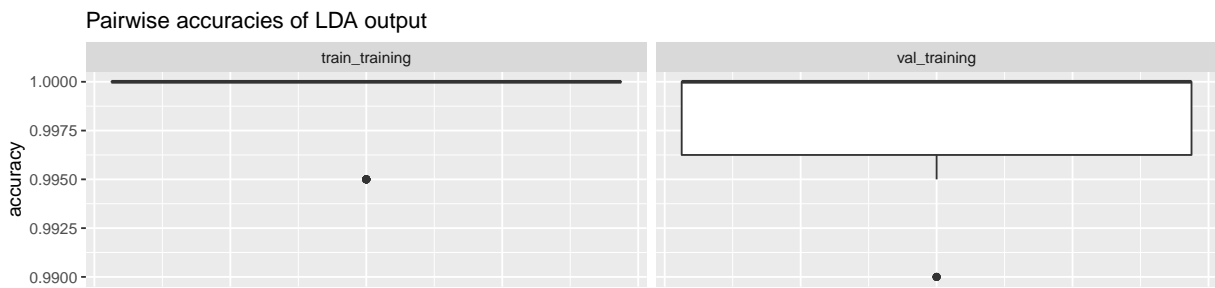
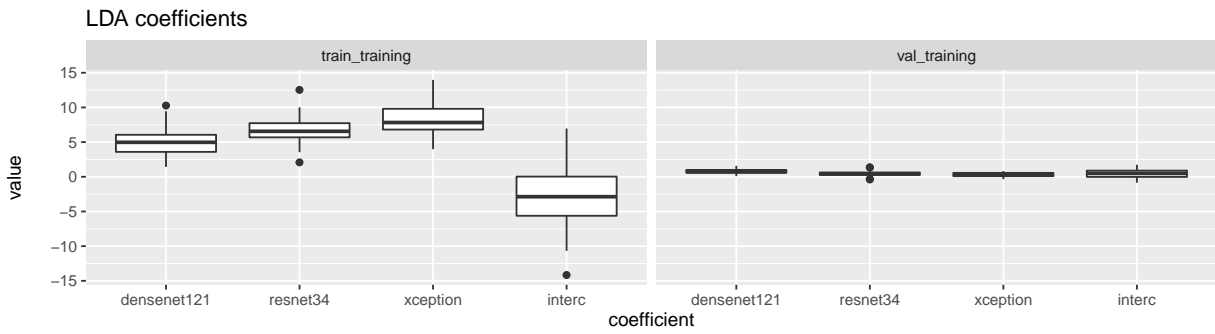
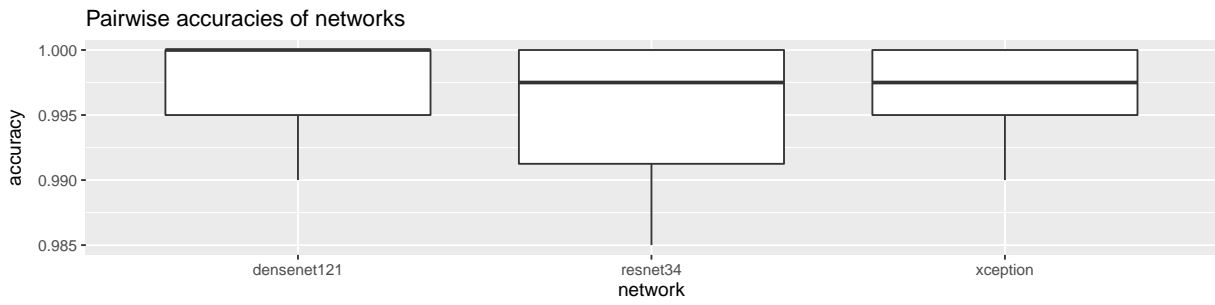
## Classes 6 vs 10



## Classes 7 vs 8

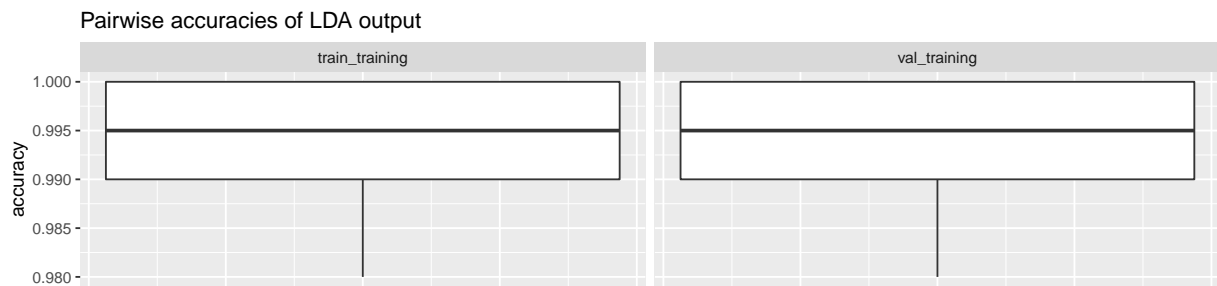
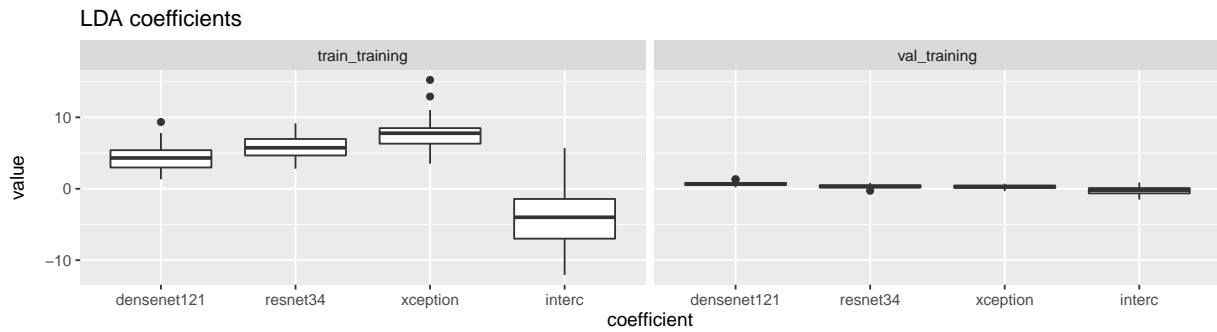
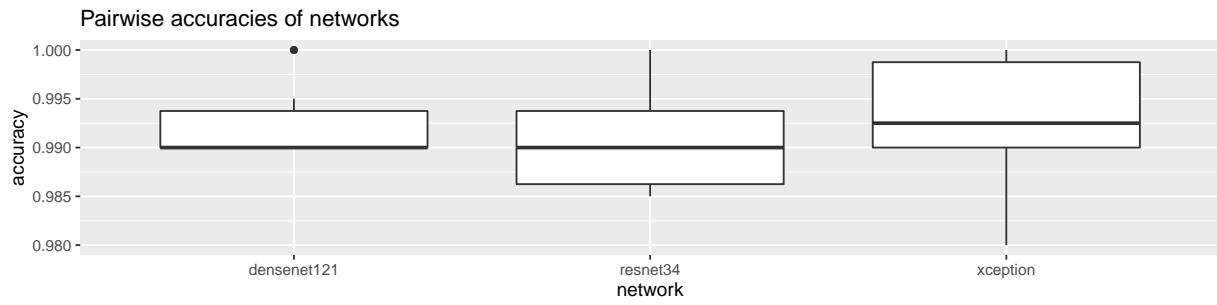


## Classes 7 vs 9



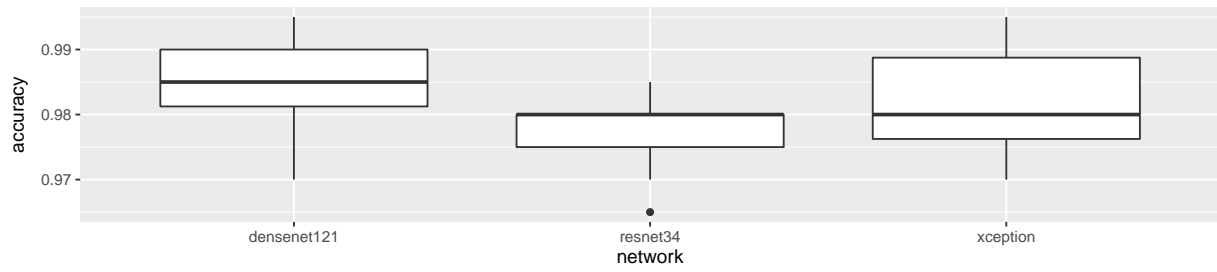


## Classes 7 vs 10

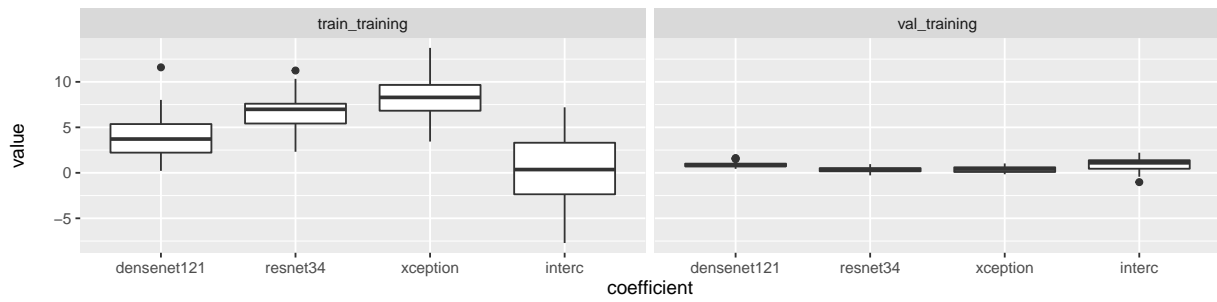


## Classes 8 vs 9

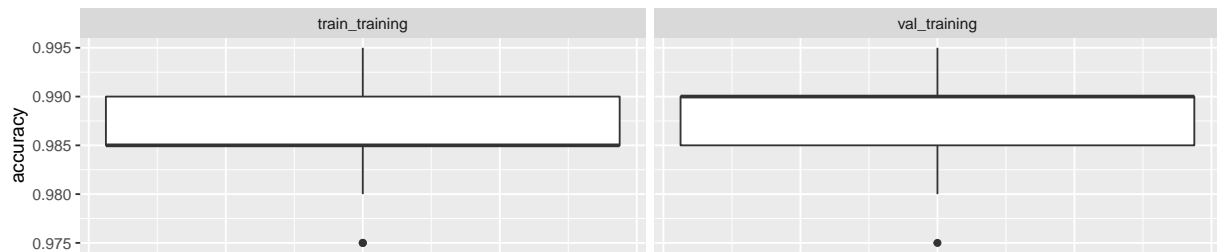
Pairwise accuracies of networks



LDA coefficients

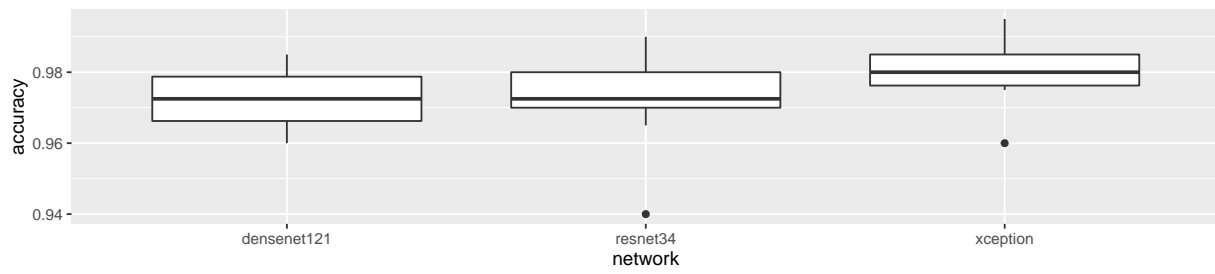


Pairwise accuracies of LDA output

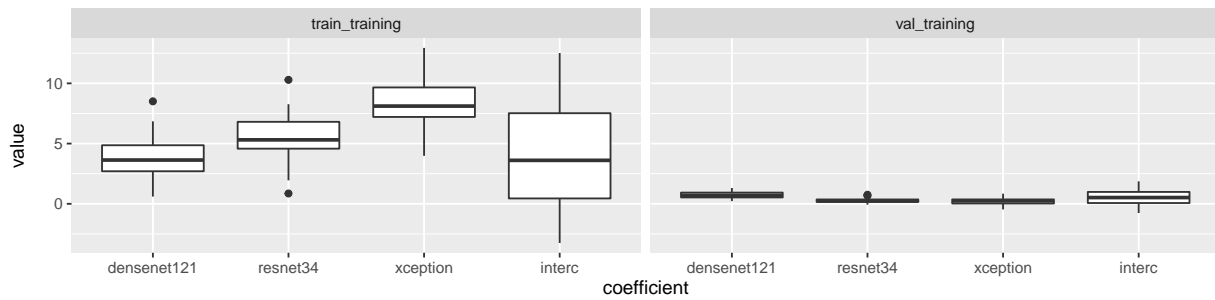


## Classes 8 vs 10

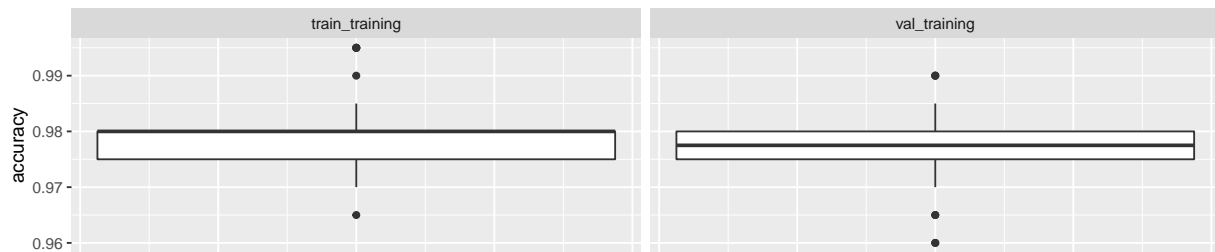
Pairwise accuracies of networks



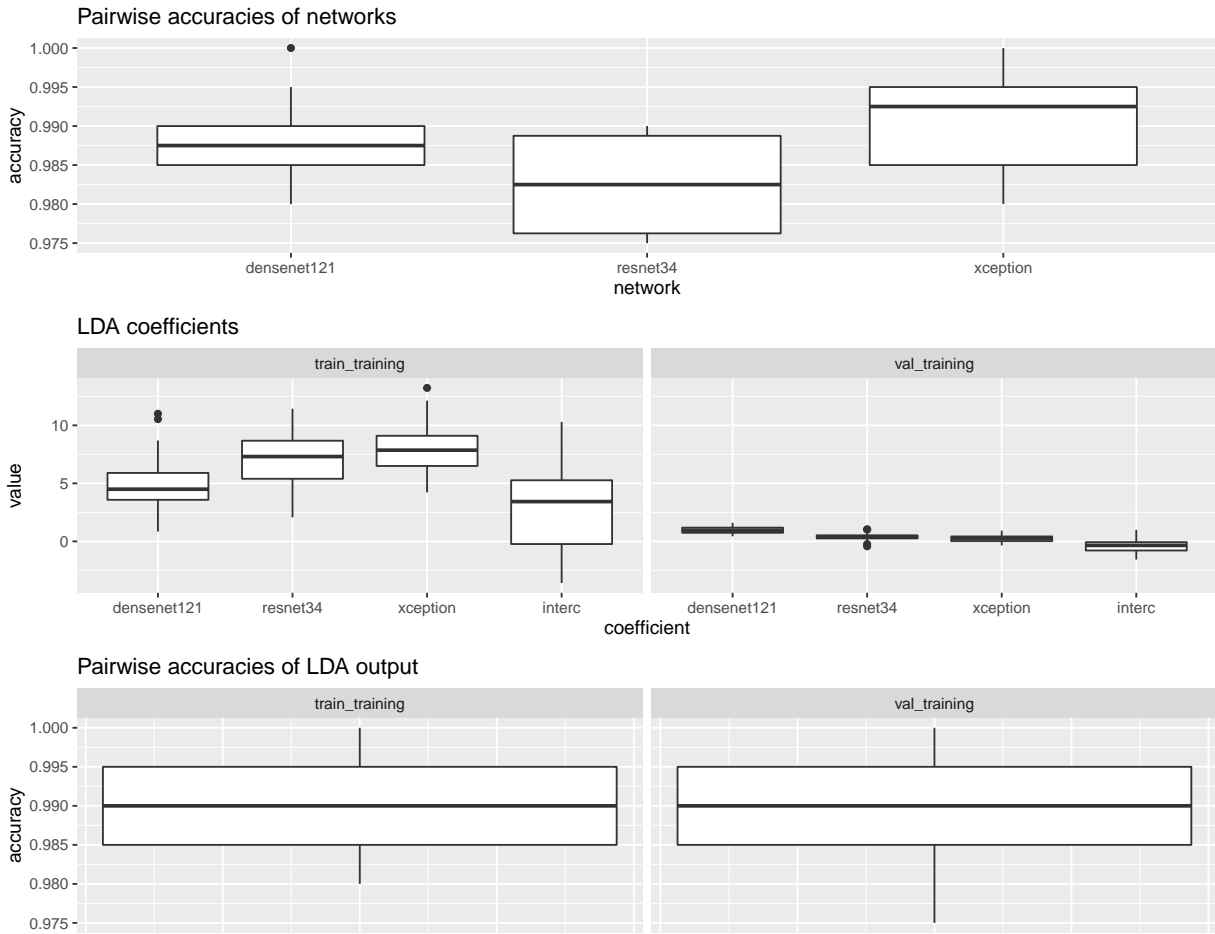
LDA coefficients



Pairwise accuracies of LDA output



## Classes 9 vs 10



Here are too many class pair combinations to draw them all. TODO: think of some criteria to draw interesting ones.