Homework 1

Adam Shelton

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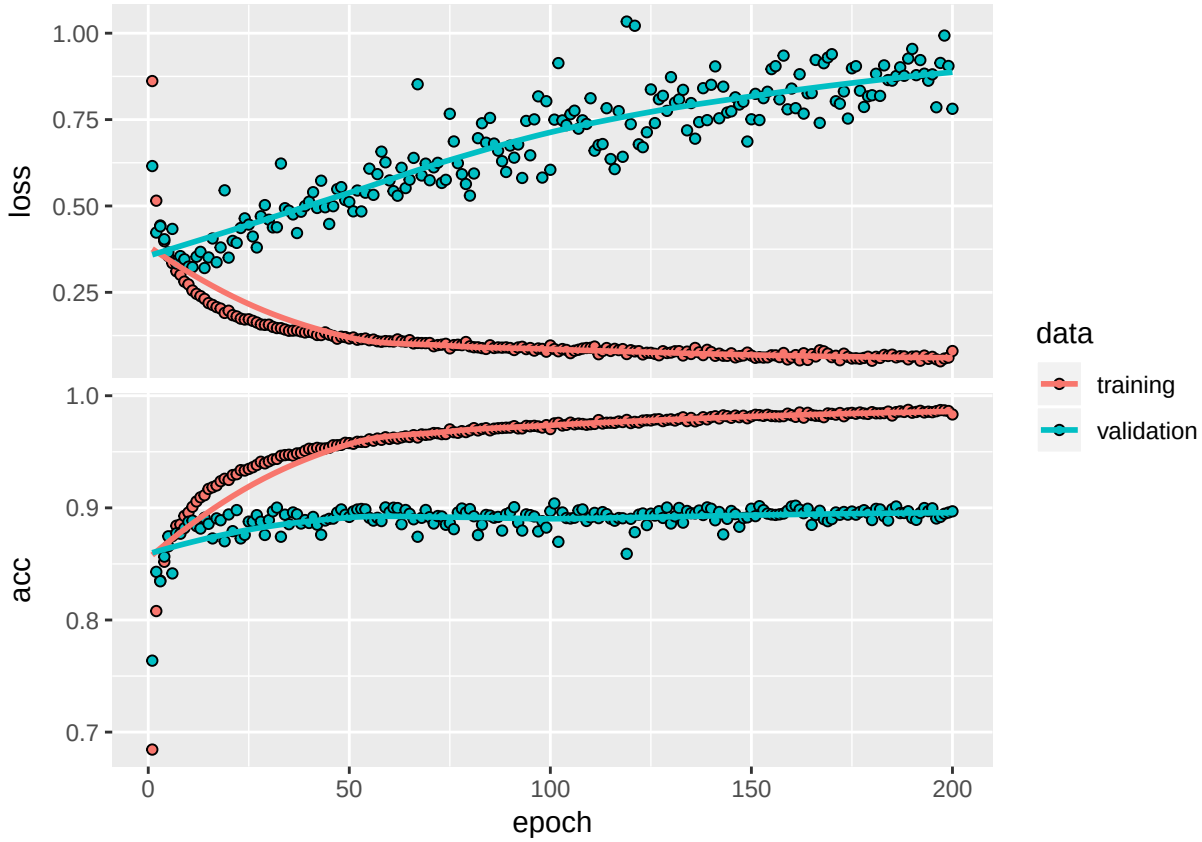
Getting Data

```
fashion_mnist = keras::dataset_fashion_mnist()

x_train = fashion_mnist$train$x
y_train = fashion_mnist$train$y

x_test = fashion_mnist$test$x
y_test = fashion_mnist$test$y

rm(fashion_mnist)

x_train = array_reshape(x_train, c(nrow(x_train), 28 * 28)) / 255
x_test = array_reshape(x_test, c(nrow(x_test), 28 * 28)) / 255

y_train = to_categorical(y_train, 10)
y_test = to_categorical(y_test, 10)
```

Initial test

```
model = keras_model_sequential()

model %>%
  layer_dense(units = 512, activation = 'relu', input_shape = c(784)) %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dense(units = 10, activation = 'softmax')

model %>% compile(
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = c('accuracy')
)

history_init = model %>% fit(
  x_train, y_train,
  epochs = 200, batch_size = 512,
  validation_split = 0.1666666666666667
)

plot(history_init)
```




```
model %>% evaluate(x_test, y_test)
```

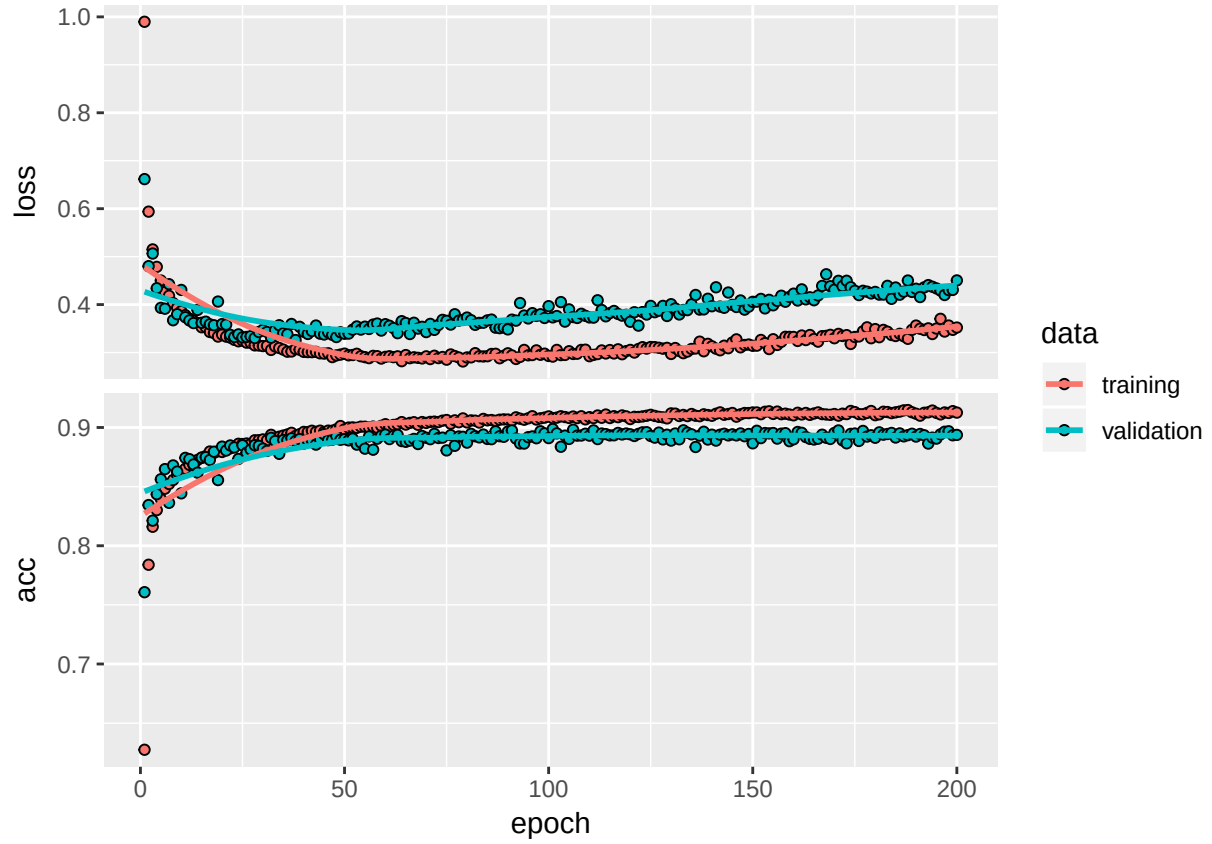
```
## $loss
## [1] 0.8245576
##
## $acc
## [1] 0.8918
```

The validation performance does not improve any further after 50 epochs.

Implementing Dropout

```
model = keras_model_sequential()

model %>%
  layer_dense(units = 512, activation = 'relu', input_shape = c(784)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu') %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 10, activation = 'softmax')

model %>% compile(
```

```
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = c('accuracy')
)

history_do = model %>% fit(
  x_train, y_train,
  epochs = 200, batch_size = 512,
  validation_split = 0.1666666666666667
)

plot(history_do)
```



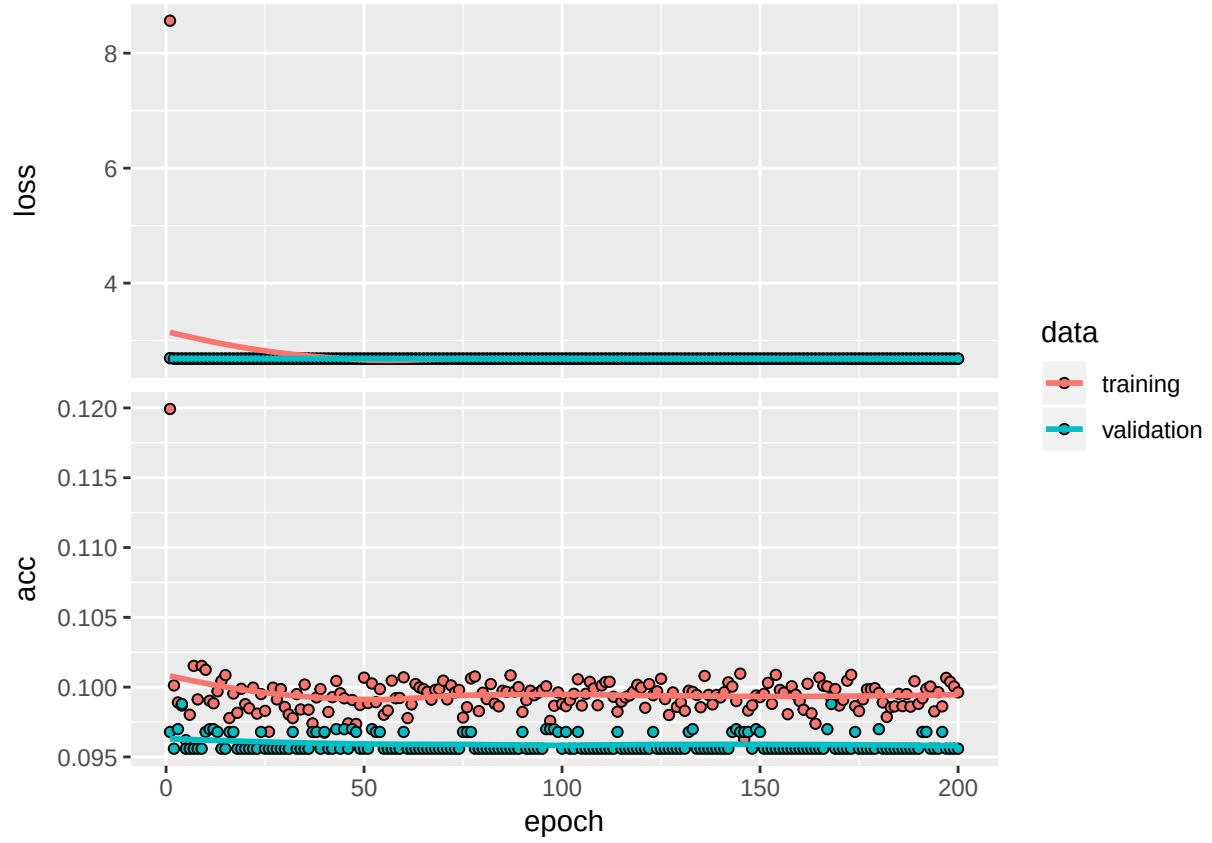

```
model %>% evaluate(x_test, y_test)
```

```
## $loss
## [1] 0.4908157
##
## $acc
## [1] 0.8847
```

Weight Regularization

```
model %>%
  layer_dense(units = 512, activation = 'relu', input_shape = c(784), kernel_regularizer = regularizer_l
  layer_dropout(rate = 0.5) %>%
```

```
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l1(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l1(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l1(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 10, activation = 'softmax')

model %>% compile(
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = c('accuracy')
)

history_l1 = model %>% fit(
  x_train, y_train,
  epochs = 200, batch_size = 512,
  validation_split = 0.1666666666666667
)

plot(history_l1)
```

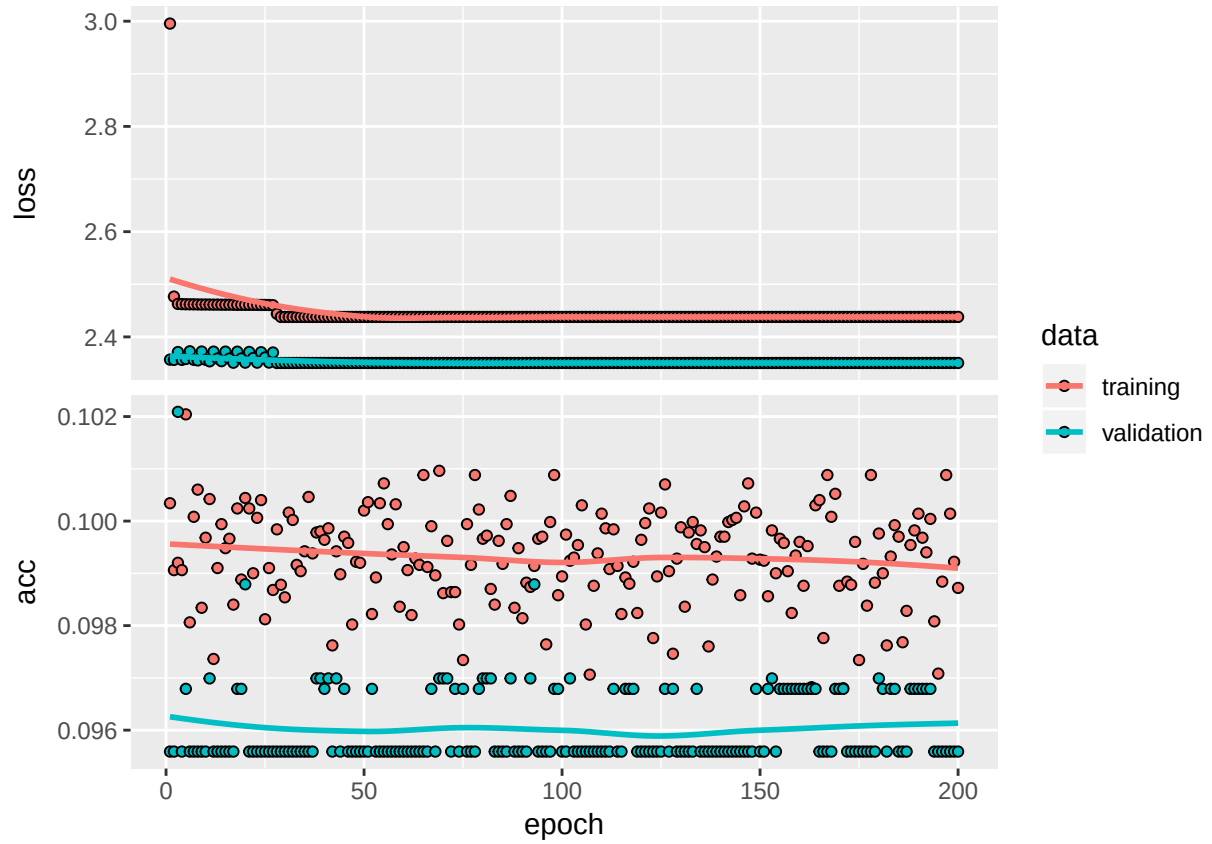



```
model %>% evaluate(x_test, y_test)
```

```
## $loss
## [1] 2.685974
```

```
##
## $acc
## [1] 0.1
```

```
model %>%
  layer_dense(units = 512, activation = 'relu', input_shape = c(784), kernel_regularizer = regularizer_
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l2(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l2(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 512, activation = 'relu', kernel_regularizer = regularizer_l2(0.001)) %>%
  layer_dropout(rate = 0.5) %>%
  layer_dense(units = 10, activation = 'softmax')

model %>% compile(
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = c('accuracy')
)

history_l2 = model %>% fit(
  x_train, y_train,
  epochs = 200, batch_size = 512,
  validation_split = 0.1666666666666667
)

plot(history_l2)
```




```
model %>% evaluate(x_test, y_test)
```

```
## $loss
## [1] 2.350299
##
## $acc
## [1] 0.1
```

Other Options

```
tune_grid = expand.grid(num_units = c(256, 512), bat_size = c( 512), epochs = c(50, 200), do_ratio = c(

hyper_param_tune = function(index, t_grid, model) {
  params = t_grid[index,]

  if (params$weight_method == 2) {
    model %>%
  layer_dense(units = params$num_units, activation = 'relu', input_shape = c(784), kernel_regularizer =
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l2(params$
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l2(params$
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l2(params$
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = 10, activation = 'softmax')
```

```
  } else{
    model %>%
  layer_dense(units = params$num_units, activation = 'relu', input_shape = c(784), kernel_regularizer =
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l1(params
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l1(params
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = params$num_units, activation = 'relu', kernel_regularizer = regularizer_l1(params
  layer_dropout(rate = params$do_ratio) %>%
  layer_dense(units = 10, activation = 'softmax')
  }


model %>% compile(
  loss = 'categorical_crossentropy',
  optimizer = optimizer_rmsprop(),
  metrics = c('accuracy')
)

history_l2 = model %>% fit(
  x_train, y_train,
  epochs = params$epochs, batch_size = params$bat_size,
  validation_split = 0.1666666666666667
)

model %>% evaluate(x_test, y_test) %>% as_tibble() %>% bind_cols(params) %>% return()
}

results = sapply(1:length(tune_grid$num_units), hyper_param_tune, tune_grid, model)
```

```
results %>% as.matrix() %>% t() %>% as_tibble() %>% kable()
```

loss	acc	num_units	bat_size	epochs	do_ratio	weight_pen	weight_method
2.44117228965759	0.100000001490116	256	512	50	0.25	0.001	1
2.72049002418518	0.100000001490116	512	512	50	0.25	0.001	1
2.49922211723328	0.100000001490116	256	512	200	0.25	0.001	1
2.78852991828918	0.100000001490116	512	512	200	0.25	0.001	1
2.56266311836243	0.100000001490116	256	512	50	0.5	0.001	1
2.84833684272766	0.100000001490116	512	512	50	0.5	0.001	1
2.62068822174072	0.100000001490116	256	512	200	0.5	0.001	1
2.90004103622437	0.100000001490116	512	512	200	0.5	0.001	1
2.58412923355103	0.100000001490116	256	512	50	0.25	0.001	2
2.56393820152283	0.100000001490116	512	512	50	0.25	0.001	2
2.57137410469055	0.100000001490116	256	512	200	0.25	0.001	2
2.5641436088562	0.100000001490116	512	512	200	0.25	0.001	2
2.57157302589416	0.100000001490116	256	512	50	0.5	0.001	2
2.56433843421936	0.100000001490116	512	512	50	0.5	0.001	2
2.57178347015381	0.100000001490116	256	512	200	0.5	0.001	2
2.5645475151062	0.100000001490116	512	512	200	0.5	0.001	2

Final Model