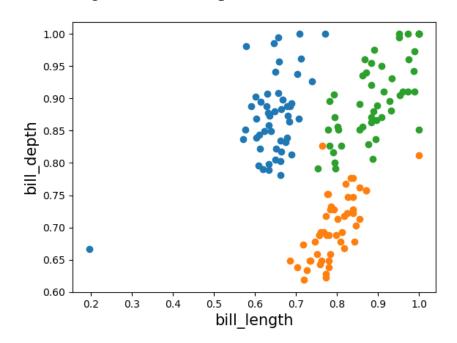
## Data Visualization:

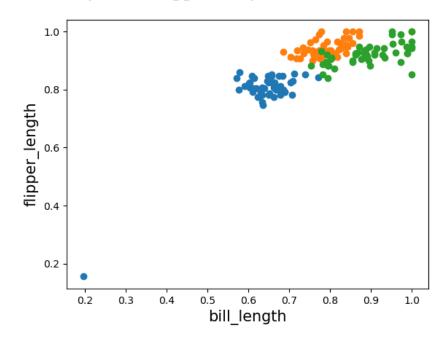
First visualize between all Penguins species by:

Blue: Adelie Orange: Gentoo Green: Chinstrap

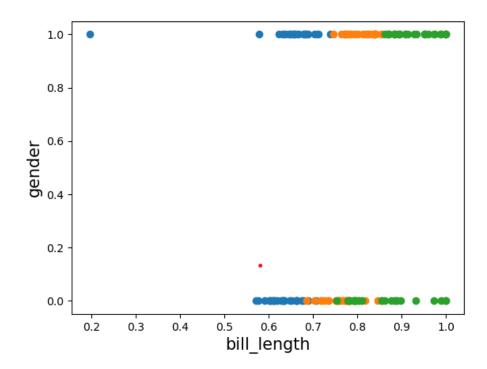
• Bill\_length and bill\_depth



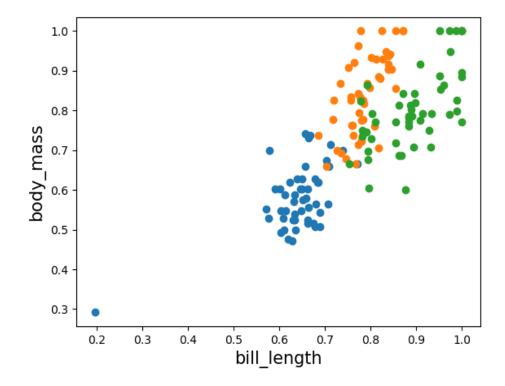
• Bill\_length and flipper\_length



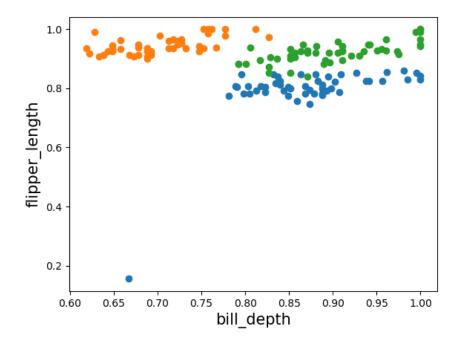
## • Bill\_length and gender



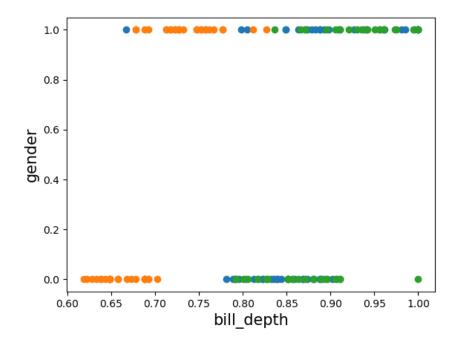
## • Bill\_length and body\_mass



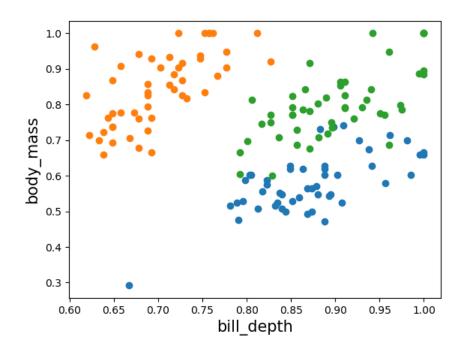
## • Bill\_depth and flipper\_length



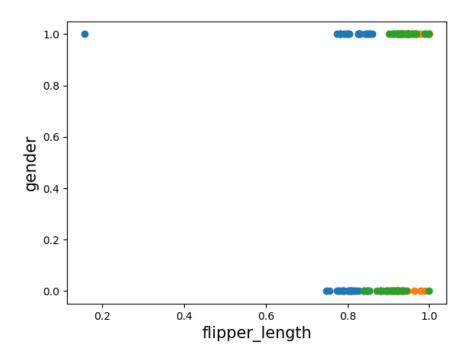
## • Bill\_depth and gender



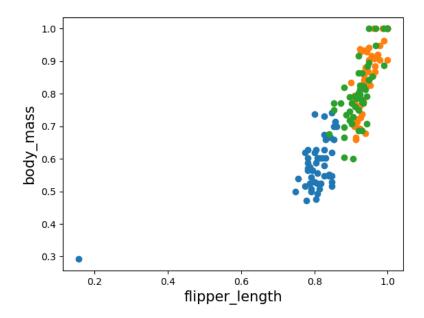
## • Bill\_depth and body\_mass



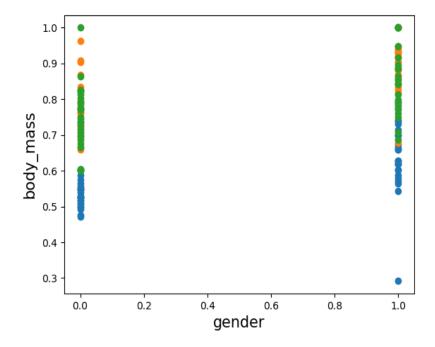
## • flipper\_length and gender



## • flipper\_length and body\_mass



# gender and body\_mass



- when using Bill\_length and bill\_depth we find that the 3 classes are linearly separable
- when using Bill\_length and flipper\_length
  we find that we can separate between class Adelie and
  class Chinstrap with line and we can separate between
  class Adelie and class Gentoo with line
- when using Bill\_length and gender
   we can not separate 3 classes with each other
- when using Bill\_length and body\_mass we can separate class Adelie and class Chinstrap
- when use Bill\_depth and flipper\_length we can separate 3 classes
- when using Bill\_depth and gender
  we can not separate 3 classes because they are not
  linearly separable
- when using Bill\_depth and body\_mass
   we can separate 3 classes because they are linearly separable
- when using flipper\_length and gender
   we can hard separate between 3 classes because they
   are not linearly separable
- when using flipper\_length and body\_mass
   we can separate class Adelie and class Chinstrap only
- when using gender and body\_mass
  we can not separate 3 classes because they are not
  linearly separable

#### **Preprocessing techniques:**

- Reading the features from the dataset and filling the NA.
- features in gender we used the normalize equation to normalize the data from 0 to 1.
- converted the three classes into 3 numbers from (1 to 3) to make it easier in the code.

#### **NOTE:**

For all next result make epoch = 2000 and Learning Rate = 0.01

# Visualization between each two Penguins:

#### "Adelie" and "Gentoo":

Features	Accuracy	plot
bill_length and bill_depth:	Without bias:97.5%	0.0 0.0 0.0 0.70 0.75 0.0 0.0 0.0 0.0 0.0 1.00
om_depui.	With bias: 97.5%	10 0.9 0.8 0.7 0.60 0.65 0.70 0.75 0.80 0.85 0.50 0.55 1.00
bill_length and flipper lenght	Without bias:50.0%	1.6 - 1.4 - 1.2 - 1.0 - 0.8 - 0.90 0.95 1.00 0.95 1.00
	With bias: 97.5%	10 08 06 04 02 060 065 0/0 0/5 080 085 090 095 100
		05-
	Without bias:50.0%	-0.51.01.52.0
bill_length and gender	With bias:95.0%	

		10-
bill_length and	Without bias: 75.0%	0.8 0.7 0.6 0.5 0.5 0.6 0.7 0.8 0.9 1.0
body_mass	With bias:92.5%	20 15 10 05 -0.5 -1.0 -1.5 0.5 0.6 0.7 0.8 0.9 1.0
Bill_dipth and	Without bias: 97.5%	1.05 1.00 0.05 0.00 0.85 0.00 0.075 0.05 0.05 0.075 0.05 0.05 0
flipper_length	With bias:97.5%	14 12 10 0.8 0.6 0.4 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
	Without bias:50.0%	10 - 0.8 - 0.6 - 0.4 - 0.6 - 0.8 - 10 - 0.2 - 0.4 - 0.6 - 0.8 - 10
Bill_dipth and gender	With bias: 90.0%	50 - 0
Bill_dipth and	Without bias:100.0%	1.0 0.9 0.8 0.7 0.6 0.5 0.6 0.7 0.8 0.9 1.0
body_mass	With bias: 95.0%	3- 2- 1- 0- -1- -2- 0.5 0.6 0.7 0.8 0.9 1.0

flipper_length and	Without bias:50.0%	10 03 60 -0.5 -1.0 -1.5 -2.8
gender	With bias: 100.0%	2
flipper_length and body_mass	Without bias:85.0% With bias: 97.5%	10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Gender and body_mass	Without bios:50.0% With bias: 100.0%	2.0 1.5 1.0 0.0 0.0 0.0 0.2 0.4 0.6 0.8 1.0 1.0 0.0 0.0 0.0 0.0 0.0 0.0

The best features to distinguish between 'Adelie' and 'Gentoo':

- flipper\_length and gender
- bill\_length and bill\_depth
- Bill\_dipth and body\_mass

# between "Adelie" and "Chinstrap":

Features	Accuracy	plot
bill_length and bill_depth	Without bias:97.5%	11-
	With bias: 100%	0.60 0.65 0.70 0.75 0.80 0.85 0.90 0.95 1.00
bill_length and flipper lenght	Without bias:85.0%	11 10 03 08 07 080 085 0.70 0.75 0.80 0.85 0.90 0.95 1.00
	With bias: 100%	1.95 - 1.90 - 1.85 - 1.80 - 1.85 - 1.90 - 1.
bill_length and gender		0.8
	Without bias:50.0%	0.4 - 0.2 - 0.4 0.6 0.8 1.0
	With bias:100%	2 1 0 -1 -2 -3 -4 -5 0.0 0.2 0.4 0.6 0.8 1.0

	1	T
bill_length and	Without bias: 50.0%	10- 0.9- 0.8- 0.7- 0.8- 0.3- 0.4- 0.3- 0.5- 0.6- 0.7- 0.8- 0.9- 1.0
body_mass	With bias:95.0%	15 - 10 - 05 - 06 07 0.8 09 10
Bill_dipth and flipper_length	Without bias: 82.5%	0.95 - 0.80 - 0.85 - 0.90 - 0.95 1.00 1.00 - 0.95 - 0.95 1.00 1.00 - 0.95 1.00 1.00 1.00 1.00 1.00 1.00 1.00 1.0
impper_iengui	With bias:87.5%~92%	0.80 0.83 0.50 0.92 1.00
Bill_dipth and	Without bias:50.0%	1.0 0.5 -0.5 -1.0 -1.3 0.0 0.2 0.4 0.6 0.8 1.0
gender	With bias: 60.0%	0.0 -0.5 0.4 0.6 0.8 1.0
Bill_dipth and body_mass	Without bias:87.5%	10 09 08 07 08 09 10 10 09 08 09 10 08 09 10
	With bias: 92.5%	03- 06- 03- 04- 03- 03- 05- 06- 07- 08- 09-10

		10
flipper_length and gender	Without bias:50.0%	-0.51.01.52.0 0.0 0.2 0.4 0.6 0.8 1.0
	With bias: 100.0%	10
flipper_length and body_mass	Without bias:75.0% With bias: 80.0%	10 09 08 07 08 09 10 05 06 07 08 09 10
Gender and body_mass	Without bias: 50.0% With bias: 97.5%	0.5

The best features to distinguish between "Adelie" and "Chinstrap":

- flipper\_length and gender
- bill\_length and bill\_depth
- Gender and body\_mass

# between "Gentoo" and "Chinstrap":

Features	Accuracy	plot
bill_length and	Without bias:85.0%	1.00 - 0.95 - 0.90 - 0.85 - 0.90 - 0.95 - 1.00
bill_depth:	With bias: 90%	1.00 - 0.95 - 0.90 - 0.90 - 0.95 - 0.90 - 0.95 - 0.90 - 0.
bill_length and flipper lenght	Without bias:87.5%	1.15 1.10 1.05 1.00 0.95 0.90 0.85
	With bias: 92.5%	1.00 - 1.00 - 0.95 - 0.90 0.85 0.90 0.95 1.00
		1.0 -
bill_length and gender	Without bias:50.0%	0.2 - 0.0 - 0.2 0.4 0.6 0.8 1.0
	With bias:77.5%	2 - 024681012 - 0.0 0/2 0/4 0/6 0/8 1/0

bill_length and body_mass	Without bias: 50.0% With bias:80.0%	10 0.0 0.8 0.7 0.6 0.5 0.6 0.7 0.8 0.9 0.9 0.8 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9 0.9
Bill_dipth and flipper_length	Without bias: 97.5% With bias:92.5%	11
Bill_dipth and gender	Without bias: 50.0% With bias: 85.0%	0 4 3 4 0 6 0 8 10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
Bill_dipth and body_mass	Without bias:87.5% With bias: 95%	0.0 0.2 0.4 0.6 0.8 1.0  1.0 0.9 0.8 0.9 0.95 0.80 0.85 0.90 0.95 1.00  1.0 0.8 0.8 0.85 0.70 0.75 0.80 0.85 0.90 0.95 1.00

flipper_length and gender	Without bios:50.0%  With bias: 50.0%	10 08 06 06 08 10 00 02 04 06 08 10 00 02 04 06 08 10
flipper_length and body_mass	Without bias: 50.0% With bias: 47.5%	1.0 - 0.9 - 0.8 - 0.70 0.75 0.80 0.85 0.90 0.95 1.00 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 - 0.2 - 0.4 - 0.0 - 0.2 -
Gender and body_mass	Without bias: 50.0% With bias: 97.5%	10 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

The best features to distinguish between "Adelie" and "Chinstrap":

- Bill\_dipth and flipper\_length
- Bill\_dipth and body\_mass
- Gender and body\_mass