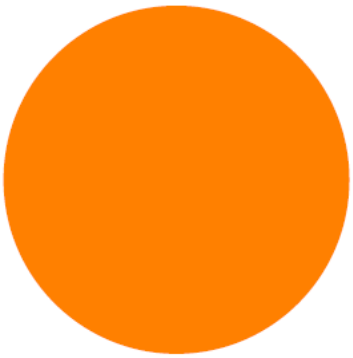
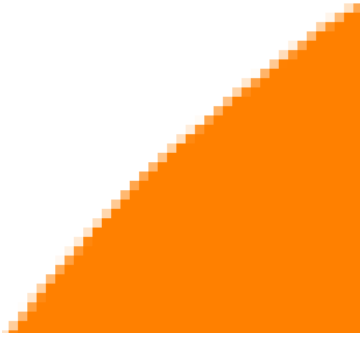
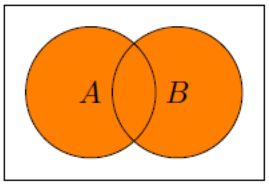
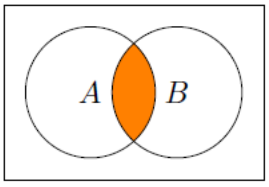
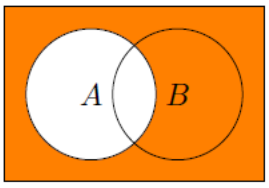
Chapter 01: Key Concepts, Notation, Set Theory, Relations, and Functions

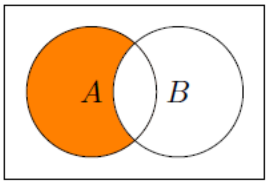


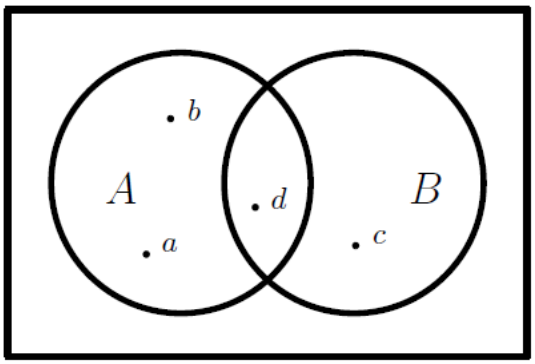


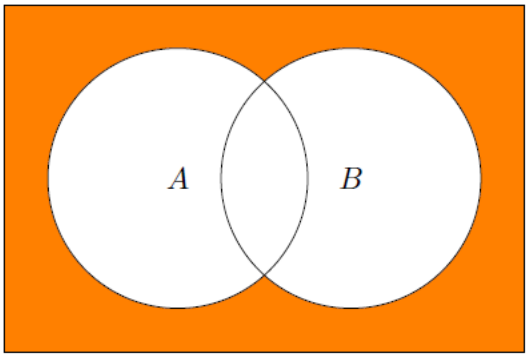


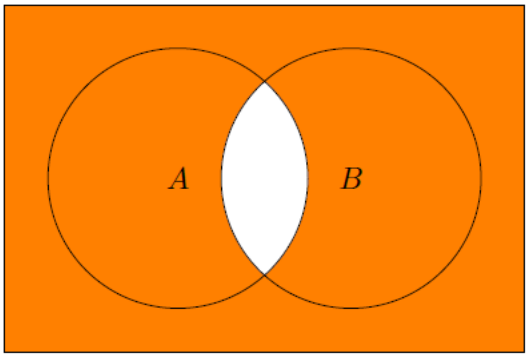


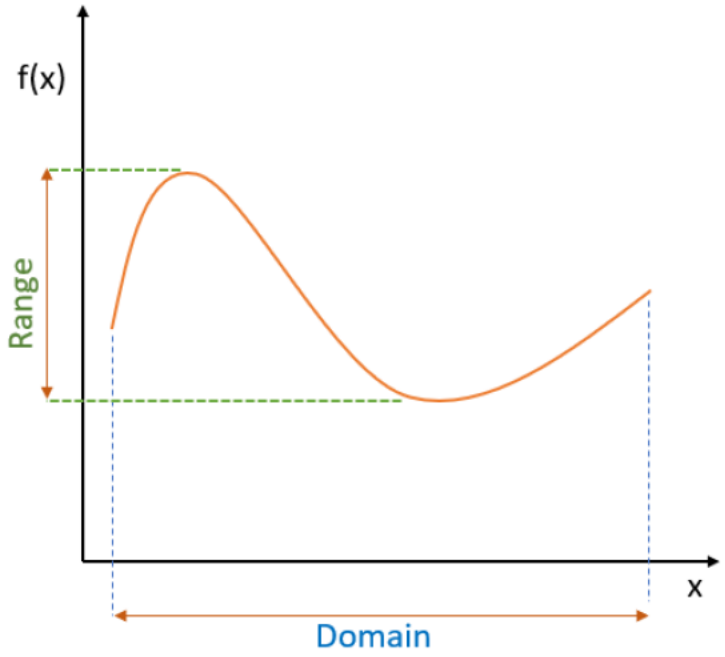



A
B

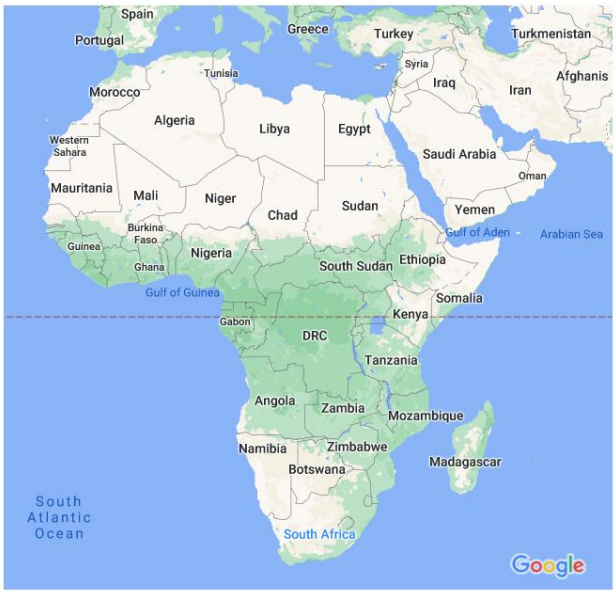

b
A
d
B
a
c

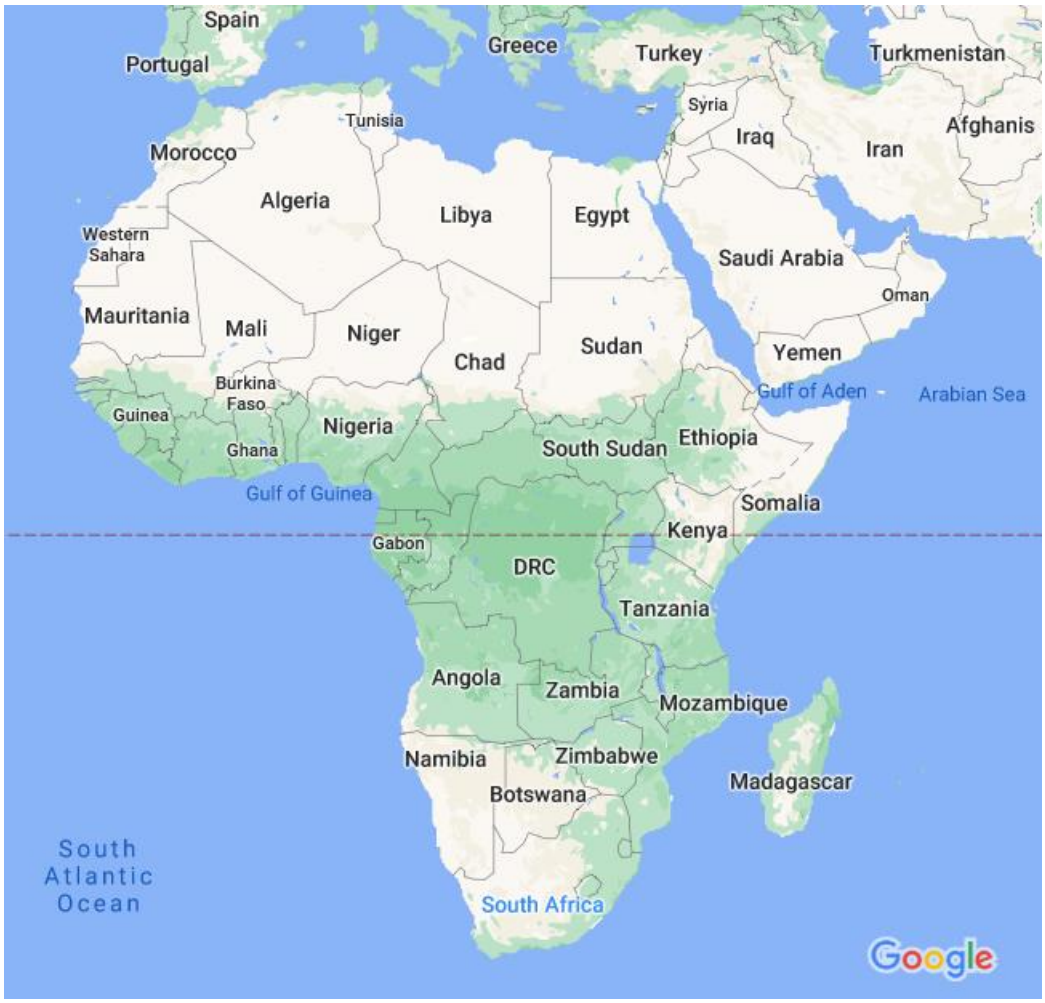

A
B


A
B


f(x)
Range
x
Domain

Chapter 02: Formal Logic and Constructing Mathematical Proofs




Spain
Portugal
Greece
Turkey
Turkmenistan
Syria
Tunisia
Iraq
Afghanis
Iran
Morocco
Algeria
Libya
Egypt
Western Sahara
Saudi Arabia
Oman
Mauritania
Mali
Niger
Chad
Sudan
Yemen
Gulf of Aden
Arabian Sea
Burkina Faso
Guinea
Nigeria
South Sudan
Ethiopia
Ghana
Gulf of Guinea
Somalia
Kenya
Gabon
DRC
Tanzania
Angola
Zambia
Mozambique
Namibia
Zimbabwe
Madagascar
Botswana
South Atlantic Ocean
South Africa
Google

Connective	Notation	English Equivalent
Negation	$\sim p$	not p
Conjunction	$p \wedge q$	p and q
Disjunction	$p \vee q$	p or q
Conditional	$p \rightarrow q$	if p, then q
Biconditional	$p \leftrightarrow q$	p if and only if q

p	$\sim p$
0	1
1	0

Conjunction

p	q	$p \wedge q$
0	0	0
0	1	0
1	0	0
1	1	1

Disjunction

p	q	$p \vee q$
0	0	0
0	1	1
1	0	1
1	1	1

Conditional

p	q	$p \rightarrow q$
0	0	1
0	1	1
1	0	0
1	1	1

Biconditional

p	q	$p \leftrightarrow q$
0	0	1
0	1	0
1	0	0
1	1	1

p	q	$p \to q$	$q \to p$	$(p \to q) \leftrightarrow (q \to p)$
0	0	1	1	1
0	1	1	0	0
1	0	0	1	0
1	1	1	1	1

p	q	r	$p \to q$	$q \to r$	$(p \to q) \wedge (q \to r)$	$p \to r$	$(p \to q) \wedge (q \to r) \to (p \to r)$
0	0	0	1	1	1	1	1
0	0	1	1	1	1	1	1
0	1	0	1	0	0	1	1
0	1	1	1	1	1	1	1
1	0	0	0	1	0	0	1
1	0	1	0	1	0	1	1
1	1	0	1	0	0	0	1
1	1	1	1	1	1	1	1

p	q	$p \wedge q$	$\sim(p \wedge q)$	$\sim p$	$\sim q$	$\sim p \vee \sim q$	$\sim(p \wedge q) \leftrightarrow (\sim p \vee \sim q)$
0	0	0	1	1	1	1	1
0	1	0	1	1	0	1	1
1	0	0	1	0	1	1	1
1	1	1	0	0	0	0	1

p	q	$p \vee q$	$\sim(p \vee q)$	$\sim p$	$\sim q$	$\sim p \wedge \sim q$	$\sim(p \vee q) \leftrightarrow (\sim p \wedge \sim q)$
0	0	0	1	1	1	1	1
0	1	1	0	1	0	0	1
1	0	1	0	0	1	0	1
1	1	1	0	0	0	0	1

p	q	$p \rightarrow q$	$\sim p$	$\sim q$	$\sim q \rightarrow \sim p$	$(p \rightarrow q) \leftrightarrow (\sim q \rightarrow \sim p)$
0	0	1	1	1	1	1
0	1	1	1	0	1	1
1	0	0	0	1	0	1
1	1	1	0	0	1	1

$0.5 \rightarrow \frac{1}{2}$

$\frac{10}{100} \rightarrow \frac{1}{10}$

$\frac{40}{2} \rightarrow \frac{20}{1}$

$-\frac{1291034}{12812008} \rightarrow \frac{-645517}{6406004}$

$3 \rightarrow \frac{3}{1}$

$\frac{\pi}{2\pi} \rightarrow \frac{1}{2}$

$0 \rightarrow \frac{0}{1}$

p_1 : $1 = \frac{1(1+1)}{2}$

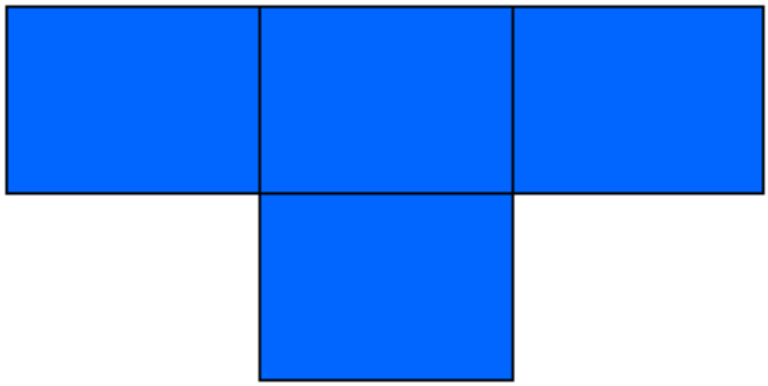
p_2 : $1 + 2 = \frac{2(2+1)}{2}$

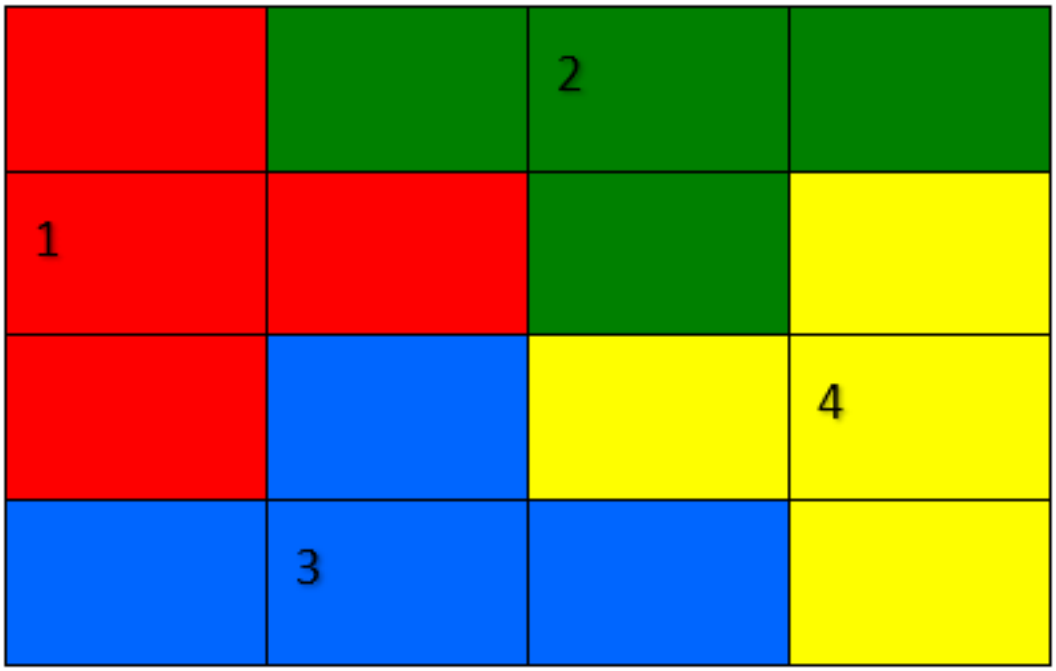
p_3 : $1 + 2 + 3 = \frac{3(3+1)}{2}$

⋮ ⋮

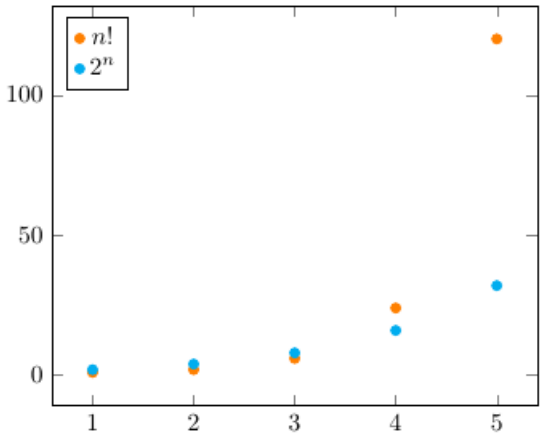
p_{i-1} : $1 + 2 + 3 + \cdots + (i-1) = \frac{(i-1)((i-1)+1)}{2}$

⋮ ⋮



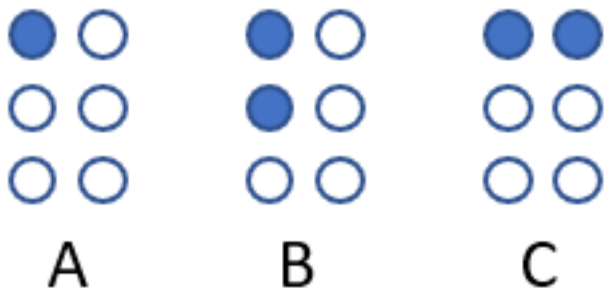


Grid of dimensions $2^{i-1} \times 2^{i-1}$	Grid of dimensions $2^{i-1} \times 2^{i-1}$
Grid of dimensions $2^{i-1} \times 2^{i-1}$	Grid of dimensions $2^{i-1} \times 2^{i-1}$

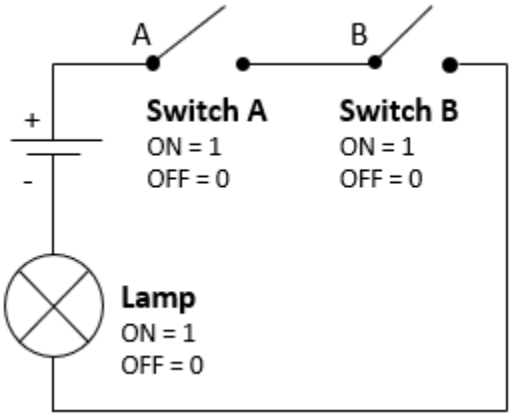

$n!$
2^n
100
50
0
1
2
3
4
5

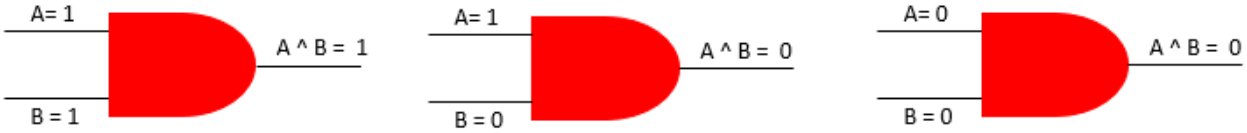
Chapter 03: Computing with Base-n Numbers

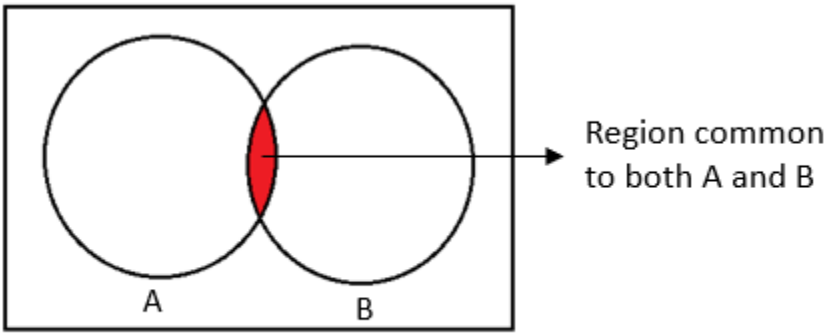
Name	Radix (n value)	Symbols used
Binary	2	0 and 1
Trinary	3	0, 1 and 2
Quadrary	4	0, 1, 2 and 3
Octal	8	0, 1, 2, 3, 4, 5, 6 and 7
Decimal	10	0, 1, 2, 3, 4, 5, 6, 7, 8 and 9
Hexidecimal	16	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A (10), B (11), C (12), D (13), E (14) and F (15)



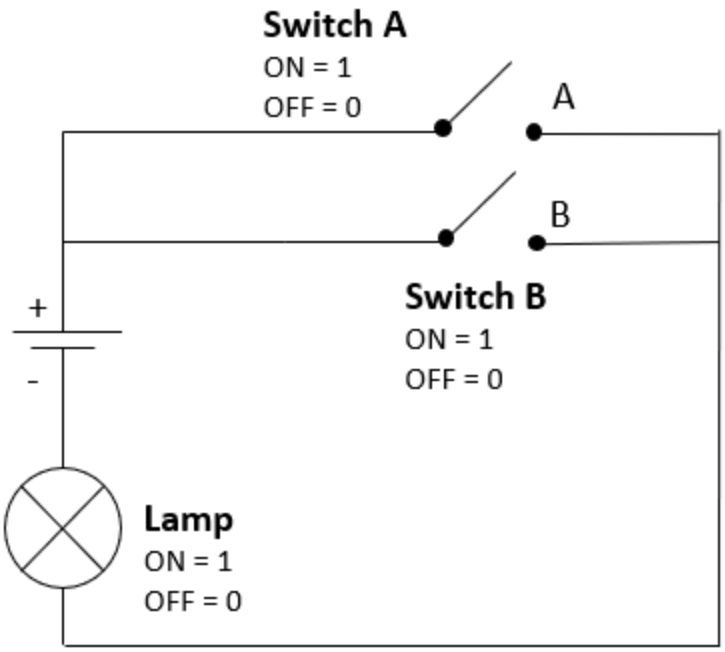
Multiple of bytes			
Value	Metric system	Value	Binary system
1000	kilobyte (kB)	1024	kibibyte (KiB)
1000^2	megabyte (MB)	1024^2	mebibyte (MiB)
1000^3	gigabyte (GB)	1024^3	gibibyte (GiB)
1000^4	terabyte (TB)	1024^4	tebibyte (TiB)
1000^5	petabyte (PB)	1024^5	pebibyte (PiB)
1000^6	exabyte (EB)	1024^6	exbibyte (EiB)
1000^7	zettabyte (ZB)	1024^7	zebibyte (ZiB)
1000^8	yottabyte (YB)	1024^8	yobibyte (YiB)

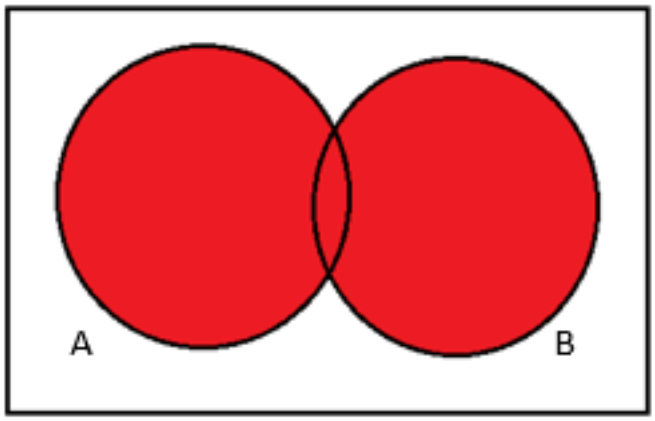






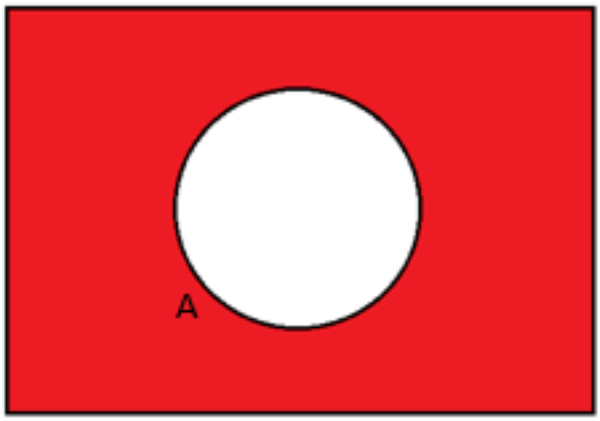
A ^ B (AND)



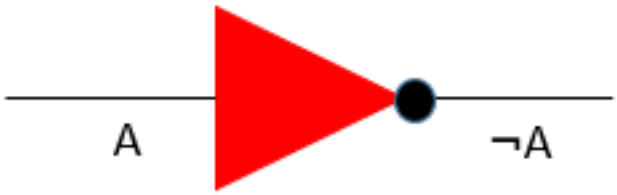


A ∨ B (OR)

A	B	A ^ B	A V B
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	1



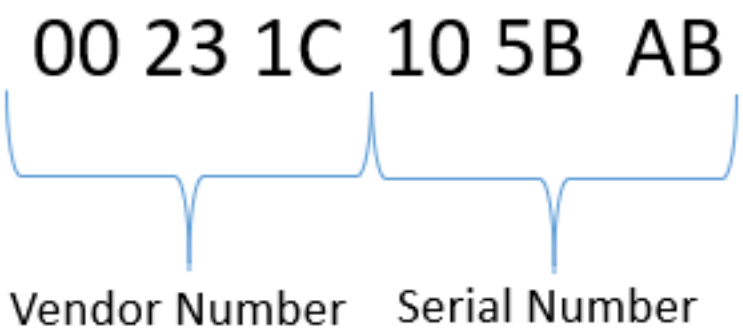
¬A



A	¬A
0	1
1	0

CustomerlD	Country	State	City	Zip Code
1	USA	Georgia	Atlanta	30332
2	USA	Georgia	Atlanta	30331
3	USA	Florida	Melbourne	30912
4	USA	Florida	Tampa	30123
5	India	Karnataka	Bangalore	560001
6	India	Maharashtra	Mumbai	578234
7	India	Karnataka	Hubli	569823
8	India	Maharashtra	Mumbai	578234
9	Germany	Bavaria	Munich	80331
10	Canada	Ontario	Toronto	M4B 1B3

Hexadecimal	Decimal	Hexadecimal	Decimal
0	0	11 = (1 x 16) + 1	17
1	1	12 = (1 x 16) + 2	18
2	2	13 = (1 x 16) + 3	19
3	3	14 = (1 x 16) + 4	20
4	4	15 = (1 x 16) + 5	21
5	5	16 = (1 x 16) + 6	22
6	6	17 = (1 x 16) + 7	23
7	7	18 = (1 x 16) + 8	24
8	8	19 = (1 x 16) + 9	25
9	9	1A = (1 x 16) + 10	26
A	10	1B = (1 x 16) + 11	27
B	11	lC = (1 x 16) + 12	28
C	12	10 = (1 x 16) + 13	29
D	13	lE = (1 x 16) + 14	30
E	14	l F = (1 x 16) + 15	31
F	15	20 = (2 x 16) + 0	32
1 0 = (l x 16) + 0	16		



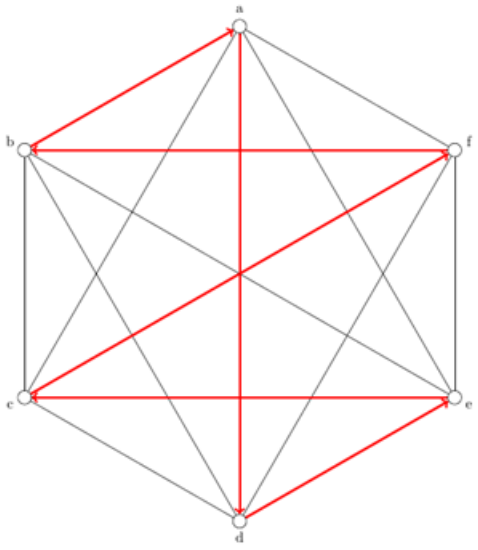
Color	Red Value	Green Value	Blue Value	Hexadecimal
Red	255 (FF)	0 (00)	0 (00)	#FF0000
Green	0 (00)	255 (FF)	0 (00)	#00FF00
Blue	0 (00)	0 (00)	255 (FF)	#0000FF
Yellow	255 (FF)	255 (FF)	0 (00)	#FFFF00
Orange	255 (FF)	165 (A5)	0 (00)	#FFA500
Aqua	0 (00)	255 (FF)	255 (FF)	#00FFFF
Navy Blue	0 (00)	0 (00)	128 (80)	#000080
Black	0 (00)	0 (00)	0 (00)	#000000
White	255 (FF)	255 (FF)	255 (FF)	#FFFFFF

Chapter 04: Combinatorics using PyPI

	a_1	a_2
b_1	(a_1, b_1)	(a_2, b_1)
b_2	(a_1, b_2)	(a_2, b_2)

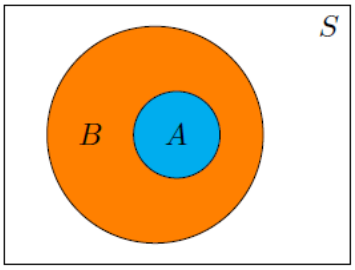
n	*n*!	*n*	*n*!
1	1	6	720
2	2	7	5,040
3	6	8	40,320
4	24	9	362,880
5	120	10	3,628,800

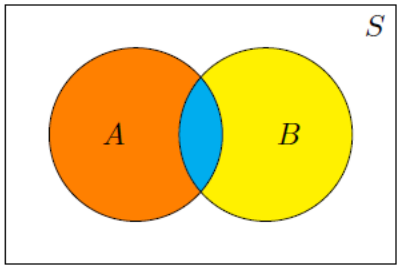
plaintext	A	B	C	···	U	V	W	X	Y	Z
ciphertext	E	F	G	···	Y	Z	A	B	C	D



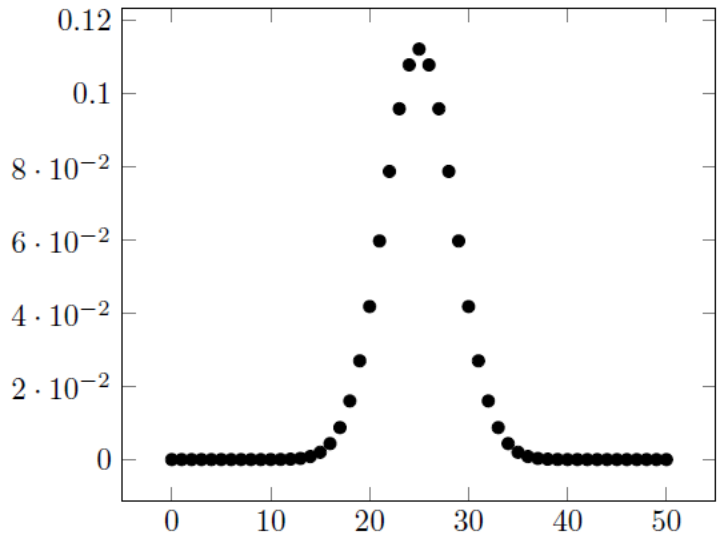
Chapter 05: Elements of Discrete Probability

TTH	TTH	THT	THH
HTT	HTH	HHT	HHH



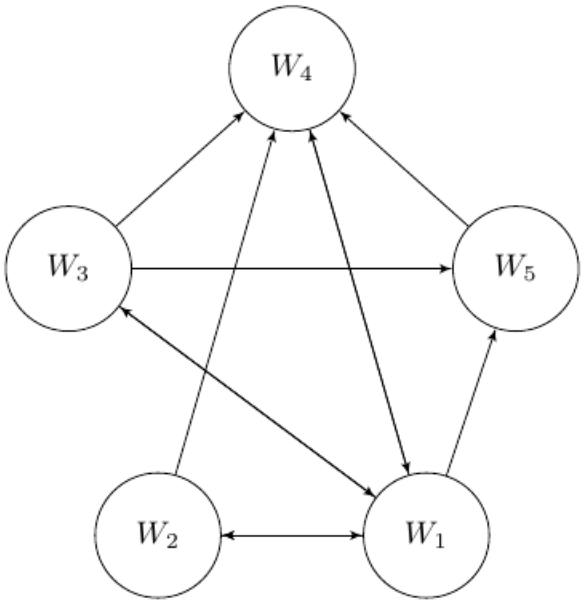


TTH	TTH	THT	THH
HTT	HTH	HHT	HHH



Temperatures	Frequency	Rain Frequency
51-60	4	1
61-70	12	5
71-80	13	10
81-90	20	8
91-100	3	1
Totals	50	25

Value	1	2	3	4	5	6	7	8	9	10
Frequency	129	242	53	16	57	95	228	33	101	46
Proportion	0.129	0.242	0.053	0.016	0.057	0.095	0.228	0.033	0.101	0.046



$$PR(W_1) = \frac{1-d}{N} + d\left(\frac{PR(W_2)}{C(W_2)} + \frac{PR(W_3)}{C(W_3)} + \frac{PR(W_4)}{C(W_4)}\right) = 0.34$$

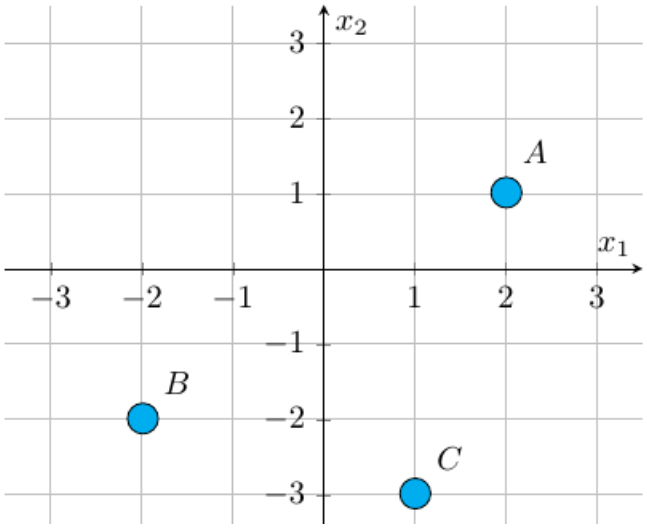
$$PR(W_2) = \frac{1-d}{N} + d\left(\frac{PR(W_1)}{C(W_1)}\right) = 0.07$$

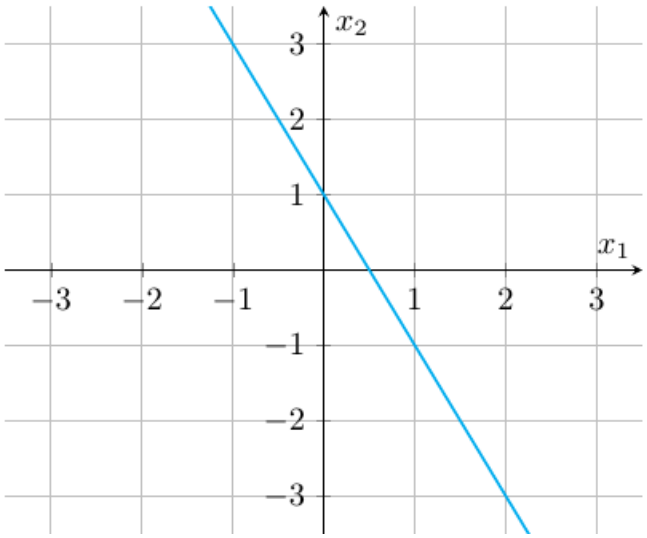
$$PR(W_3) = \frac{1-d}{N} + d\left(\frac{PR(W_1)}{C(W_1)}\right) = 0.07$$

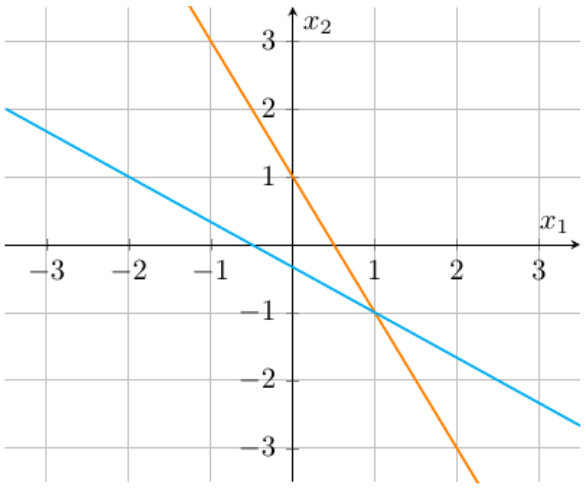
$$PR(W_4) = \frac{1-d}{N} + d\left(\frac{PR(W_1)}{C(W_1)} + \frac{PR(W_2)}{C(W_2)} + \frac{PR(W_3)}{C(W_3)} + \frac{PR(W_5)}{C(W_5)}\right) = 0.38$$

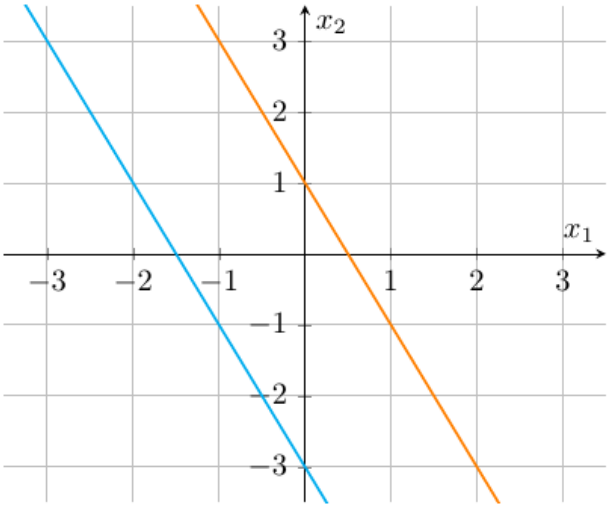
$$PR(W_5) = \frac{1-d}{N} + d\left(\frac{PR(W_1)}{C(W_1)} + \frac{PR(W_3)}{C(W_3)}\right) = 0.13$$

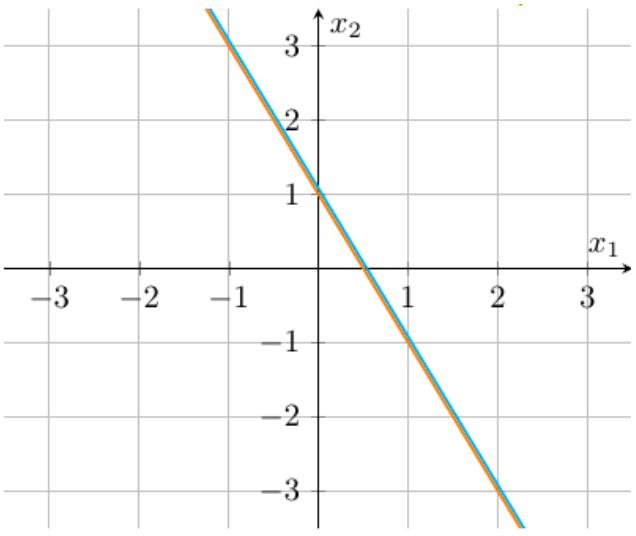
Chapter 06: Computational Algorithms in Linear Algebra



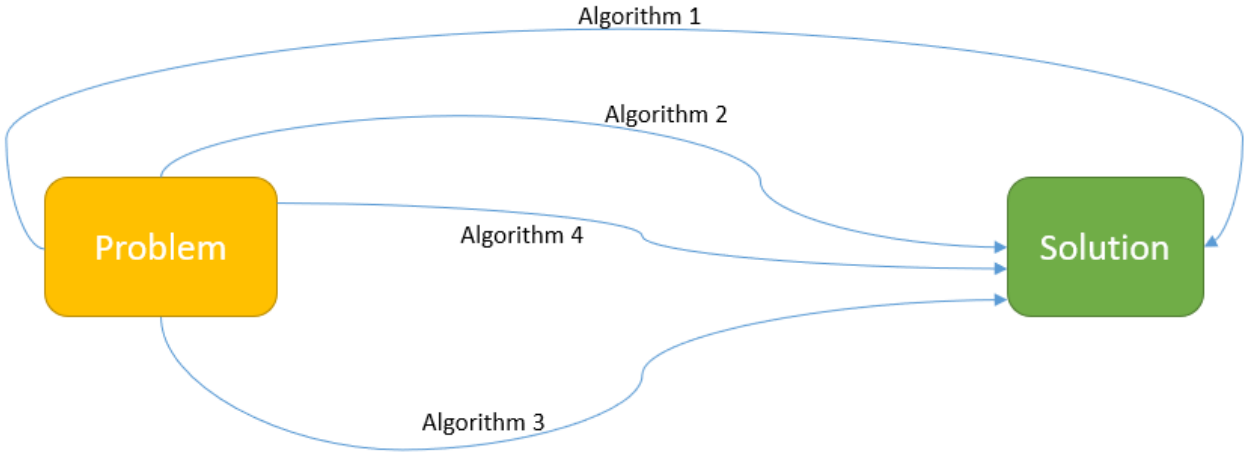



x_2
x_1
3
2
1
−1
−2
−3
−3
−2
−1
1
2
3


x_2
x_1
3
2
1
−1
−2
−3
−3
−2
−1
1
2
3

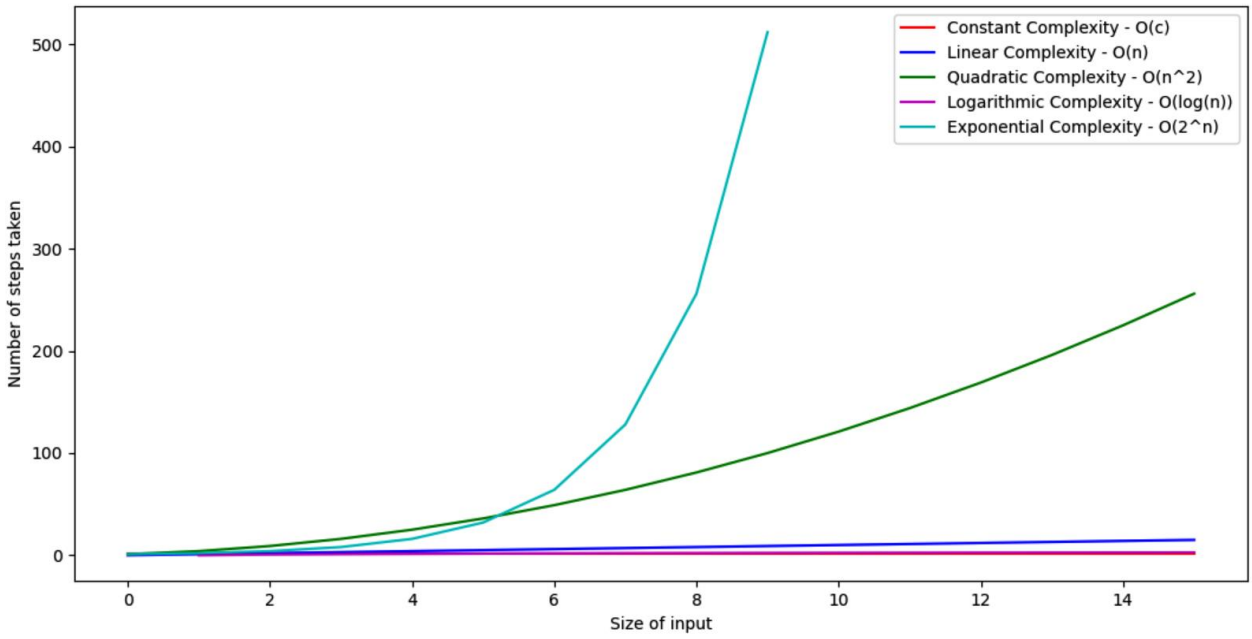

x_2
x_1
3
2
1
−1
−2
−3
−3
−2
−1
1
2
3

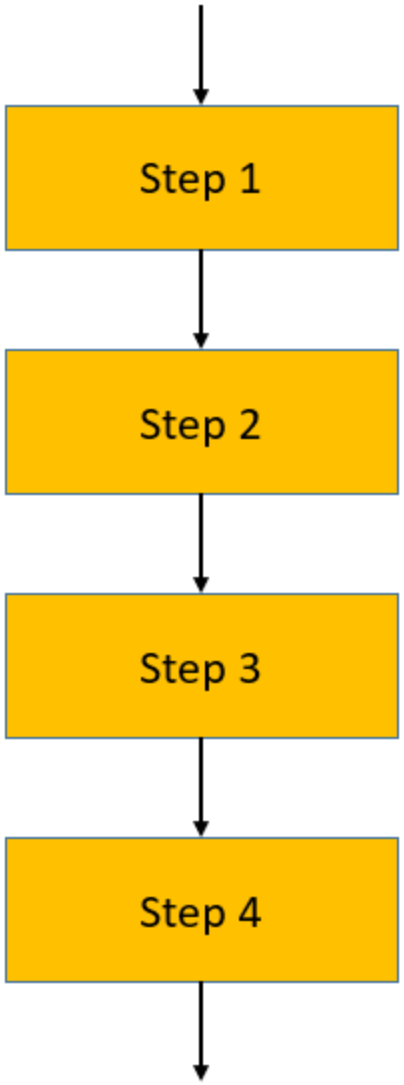
Chapter 07: Computational Requirements for Algorithms

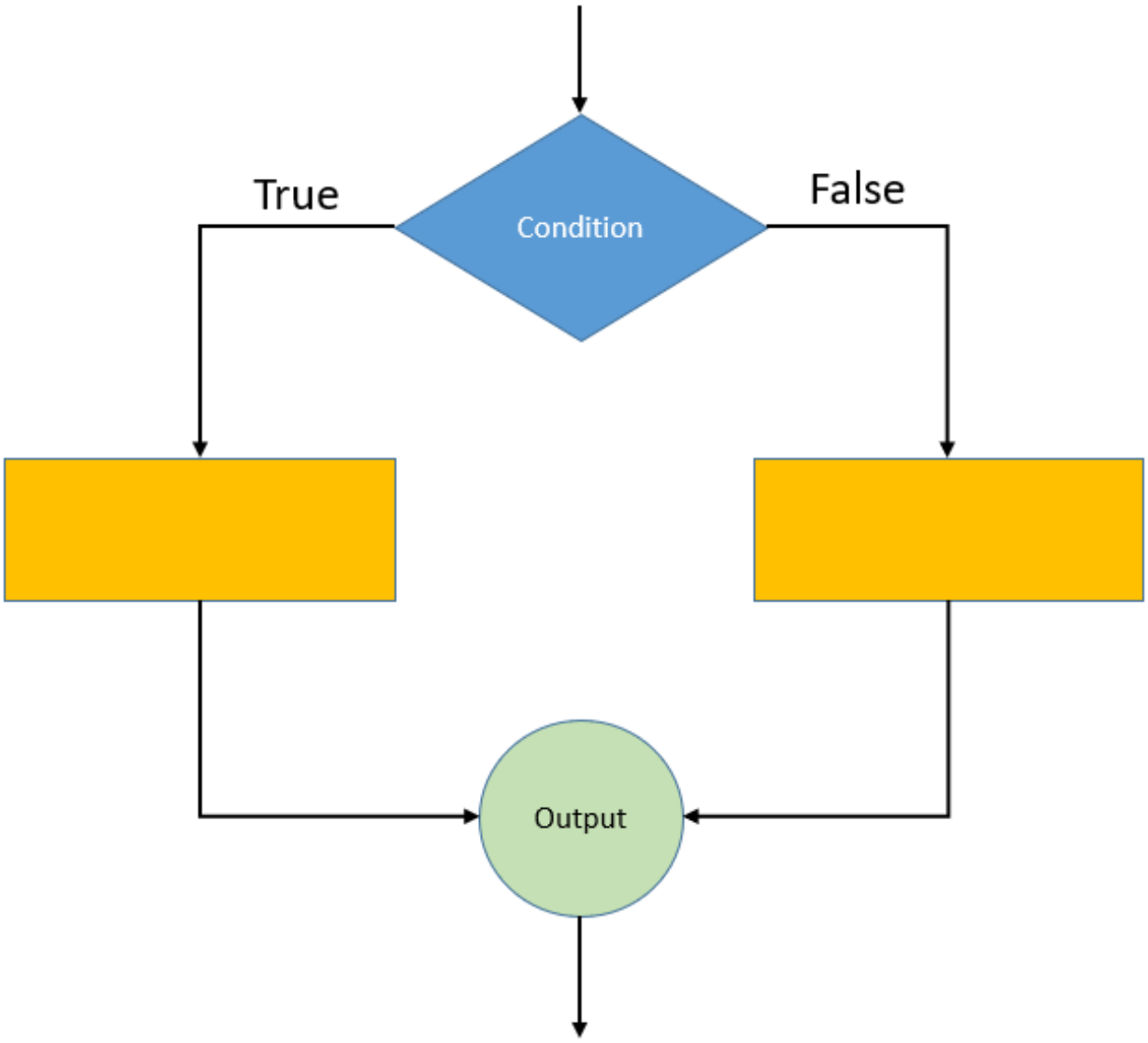


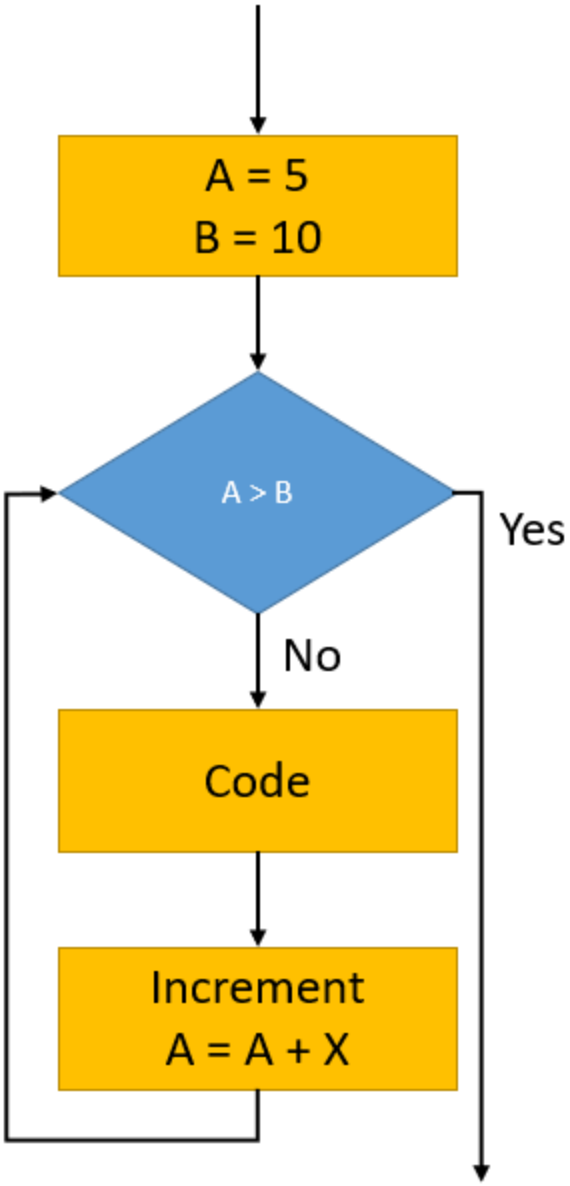
Relationship between input and steps taken by algorithm	Big-O Notation
Constant	O(constant)
Linear	O(n)
Quadratic	$O(n^2)$
Cubic	$O(n^3)$
Exponential	$O(2^n)$
Logarithmic	O(log(n))
Log Linear	O(n*log(n))

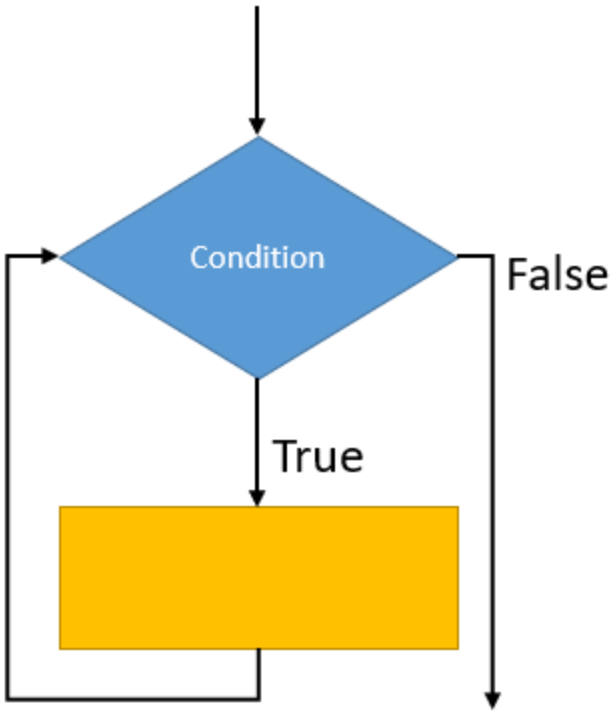
n	100 * n	$n^2/100$
10^2	10^4	10^2
10^3	10^5	10^4
10^4	10^6	10^6
10^5	10^7	10^8
10^6	10^8	10^{10}
10^7	10^9	10^{12}




Step 1
Step 2
Step 3
Step 4

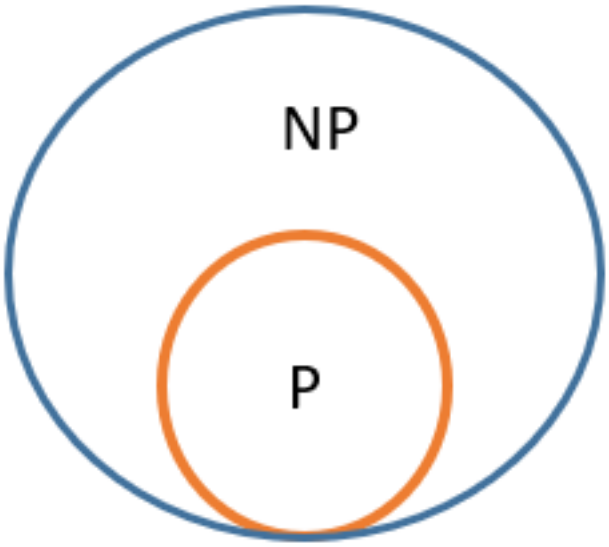

True
Condition
False
Output


A = 5
B = 10
A > B
Yes
No
Code
Increment
A = A + X

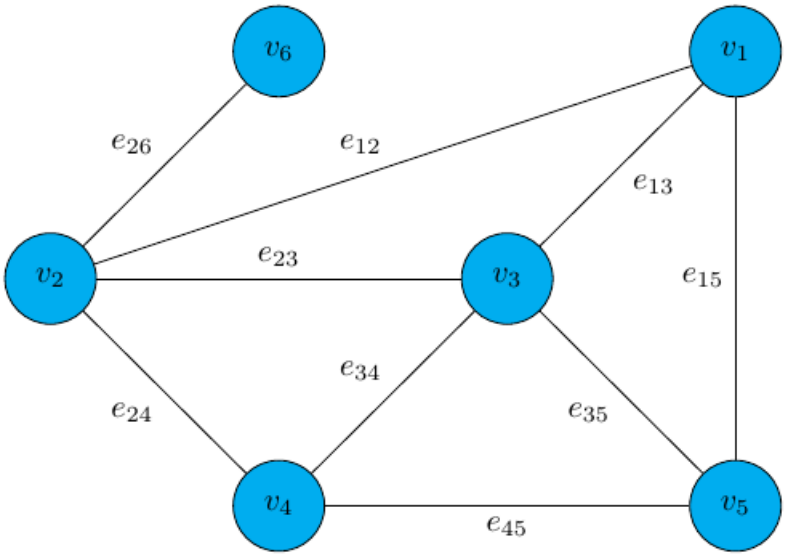


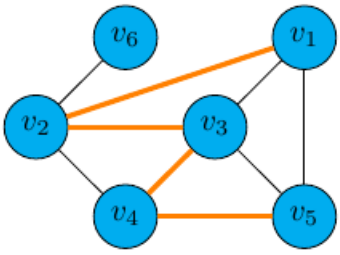
Type of search	Best Case	Worst Case	Average Case
Linear Search	O(1)	O(n)	O((n+1)/2)
Binary Search	O(1)	O(log n)	O(log n)

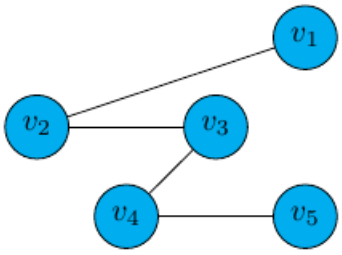
n	n^2 steps	2^n steps
2	0.00000002 msec	0.00000002 msec
5	0.00000015 msec	0.00000019 msec
10	0.00001 msec	0.0001 msec
20	0.0004 msec	0.10 msec
50	0.00025 msec	31.3 hours
100	0.001 msec	9.4×10^{11} years
1000	0.100 msec	7.9×10^{282} years

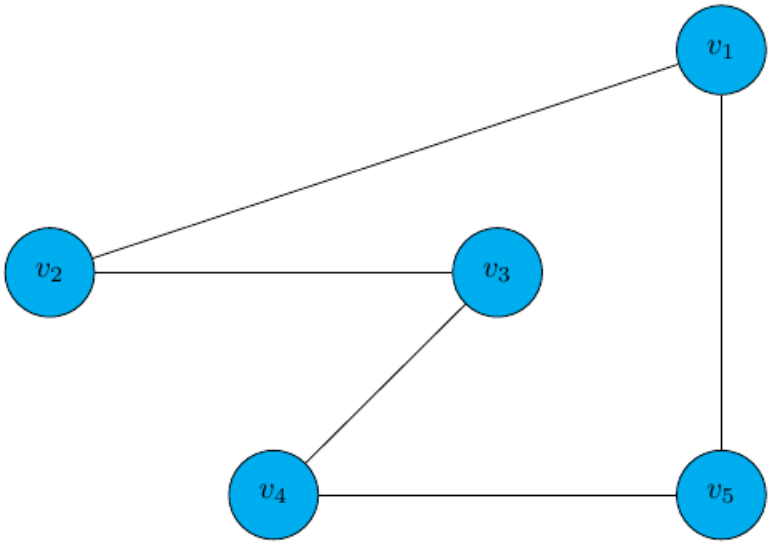

NP
P

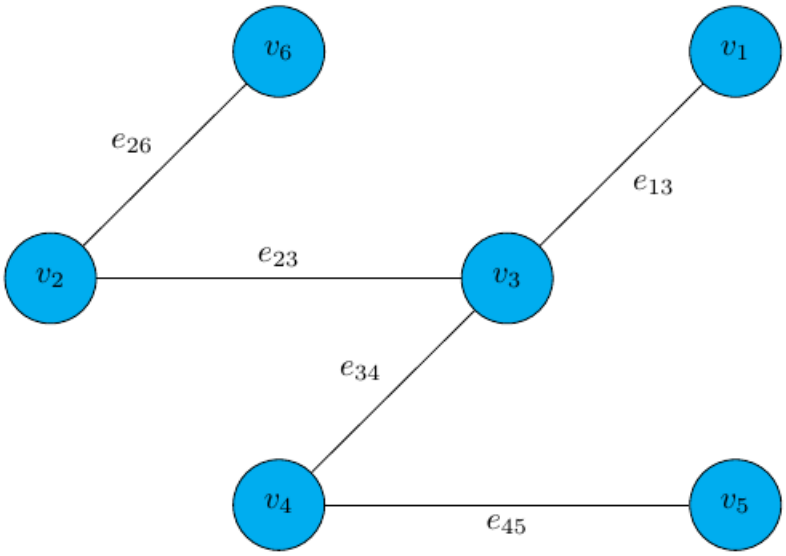
Chapter 08: Storage and Feature Extraction of Graphs, Trees, and Networks

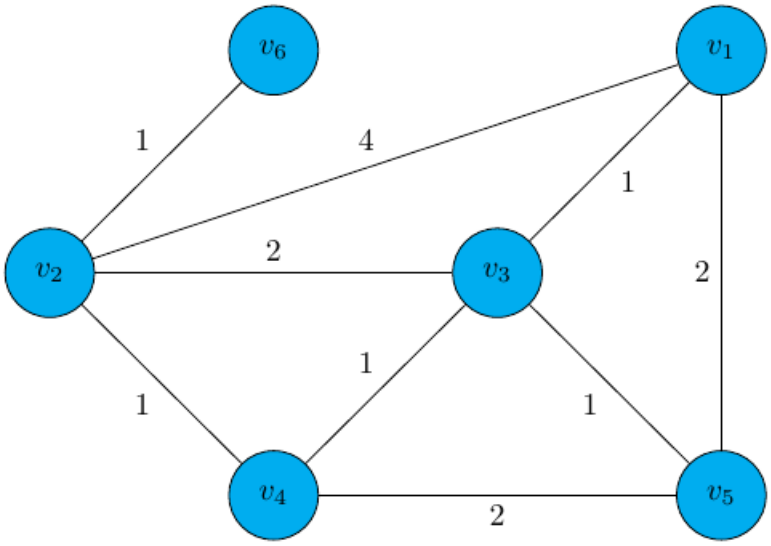


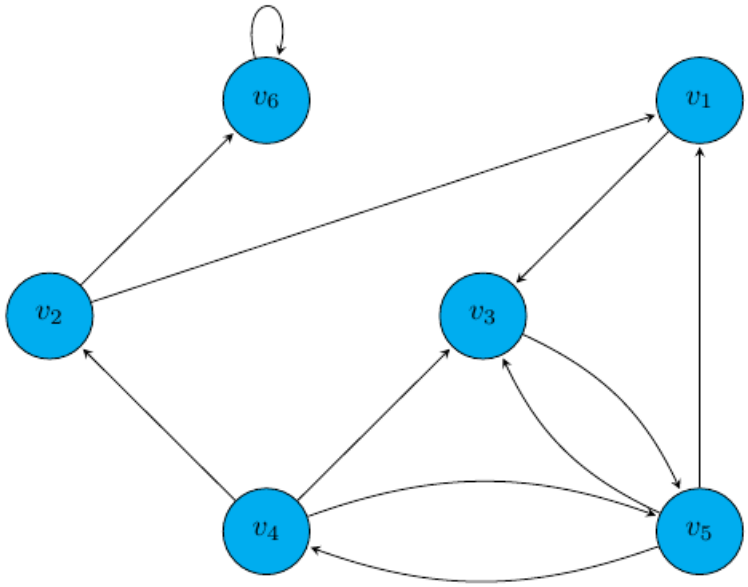


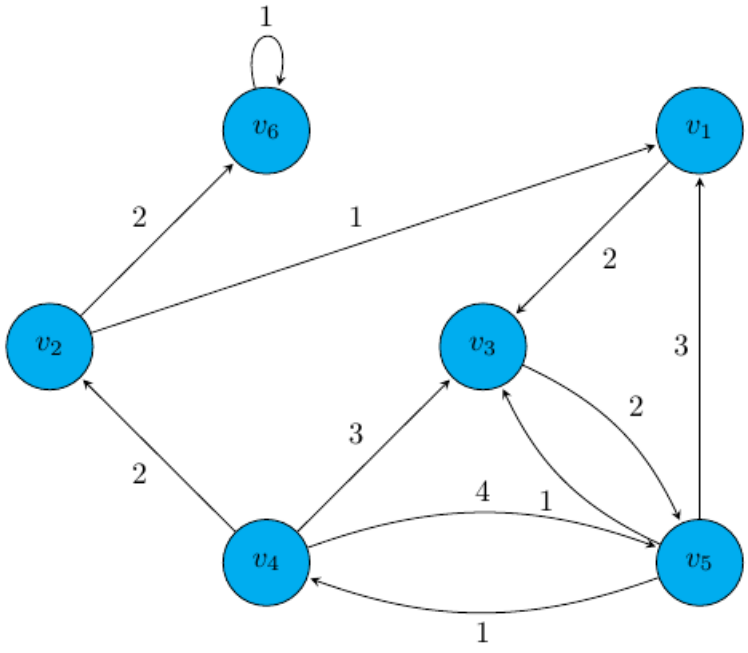


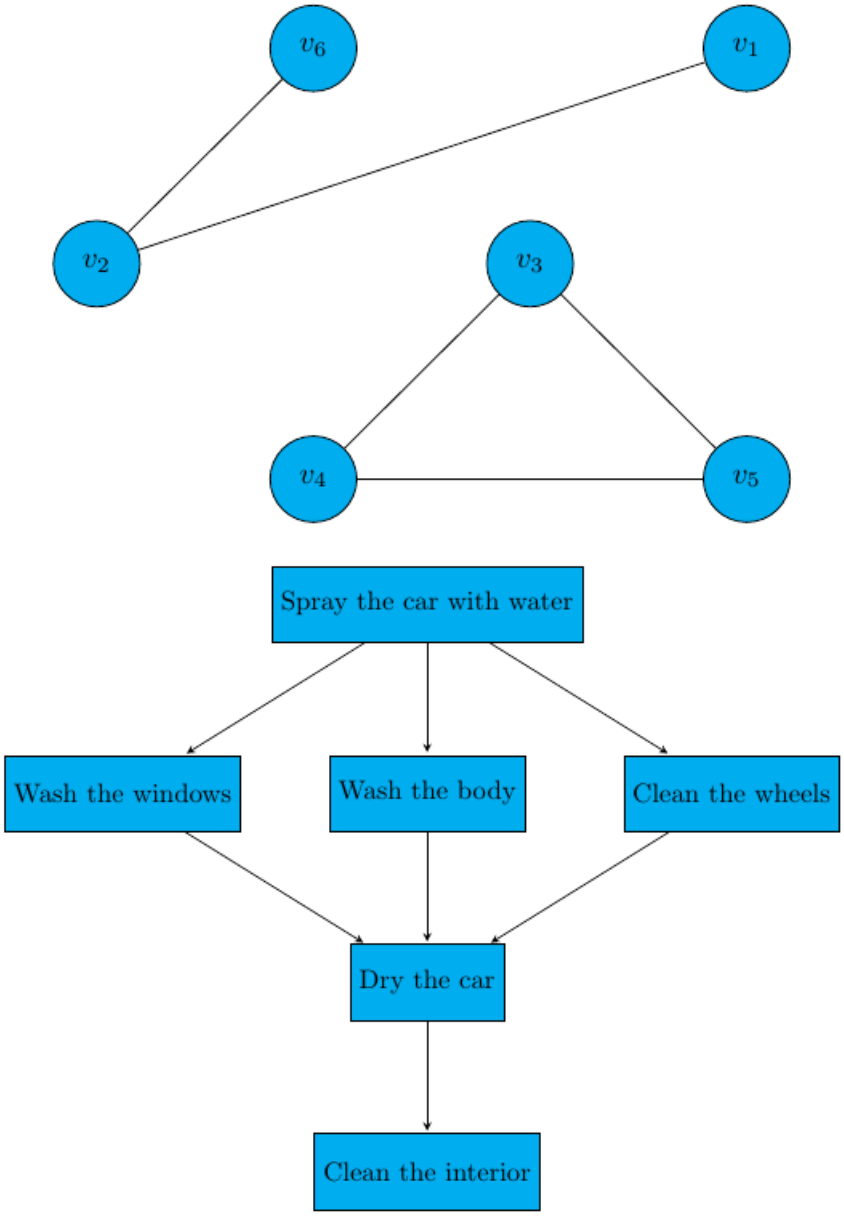


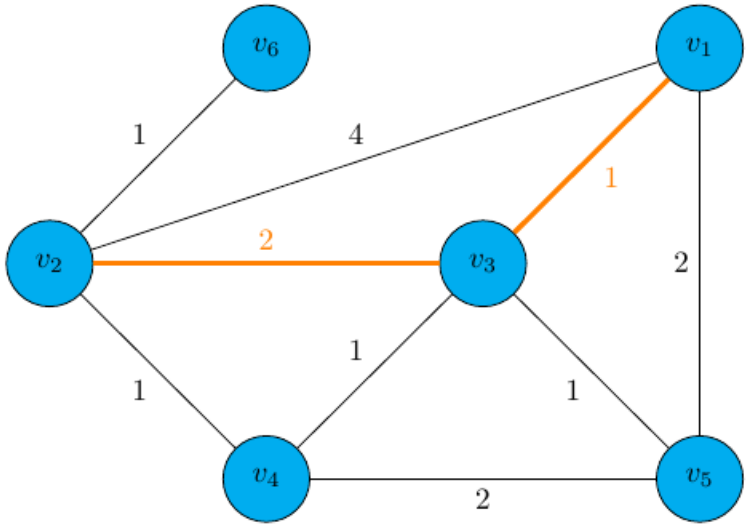

v_6
v_1
e_{26}
e_{13}
v_2
e_{23}
v_3
e_{34}
v_4
v_5
e_{45}

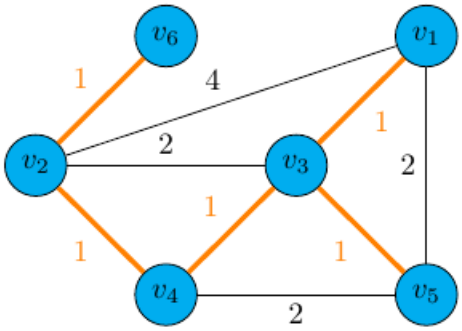

v_6
v_1
1
4
1
v_2
2
v_3
2
1
1
1
v_4
v_5
2

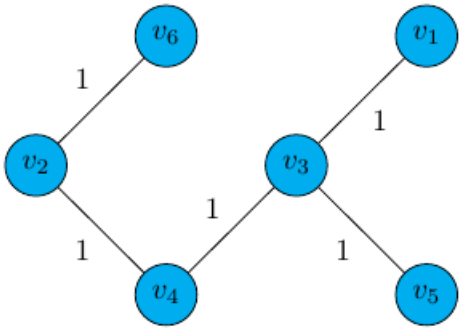

v_6
v_1
v_2
v_3
v_4
v_5


1
v_6
v_1
2
1
2
v_2
v_3
3
2
3
2
4
1
v_4
v_5
1


v_6
v_1
v_2
v_3
v_4
v_5
Spray the car with water
Wash the windows
Wash the body
Clean the wheels
Dry the car
Clean the interior







$$\mathbf{A}_1 = \begin{array}{c} \\ v_1 \\ v_2 \\ v_3 \\ v_4 \\ v_5 \\ v_6 \end{array} \begin{array}{c} \begin{array}{cccccc} v_1 & v_2 & v_3 & v_4 & v_5 & v_6 \end{array} \\ \begin{bmatrix} 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 \\ 1 & 1 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix} \end{array}$$

$$\mathbf{A}_2 = \begin{bmatrix} 0 & 1 & 0 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 0 \\ 0 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

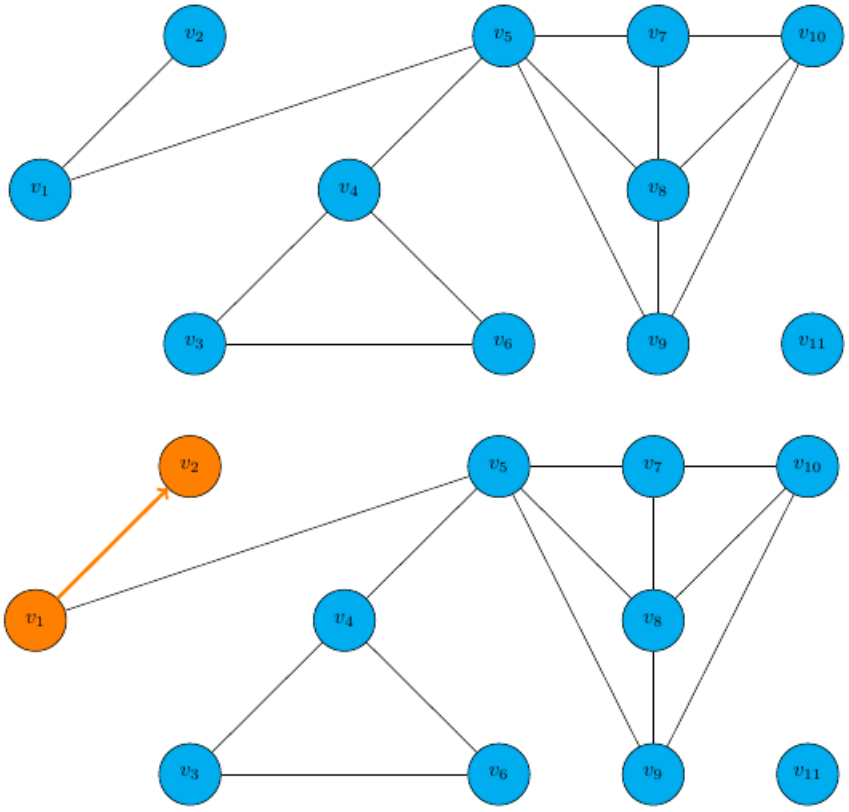
$$\mathbf{A}_3 = \begin{bmatrix} 0 & 0 & 1 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 0 & 1 & 0 \\ 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

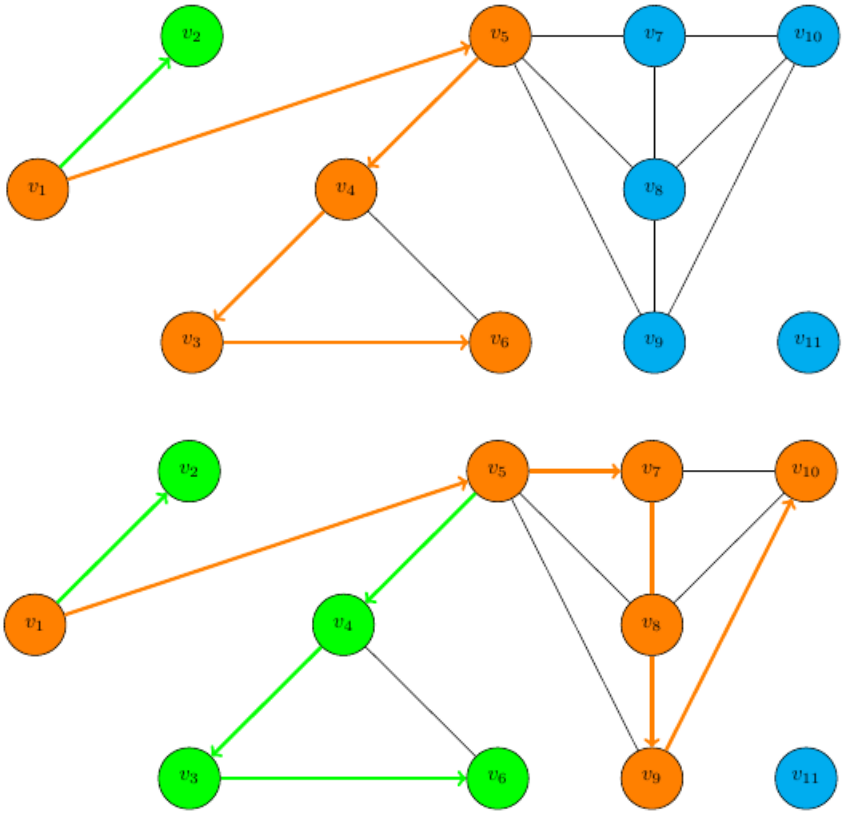
$$\mathbf{W}_1 = \begin{bmatrix} 0 & 4 & 1 & 0 & 2 & 0 \\ 4 & 0 & 2 & 1 & 0 & 1 \\ 1 & 2 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 2 & 0 \\ 2 & 0 & 1 & 2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

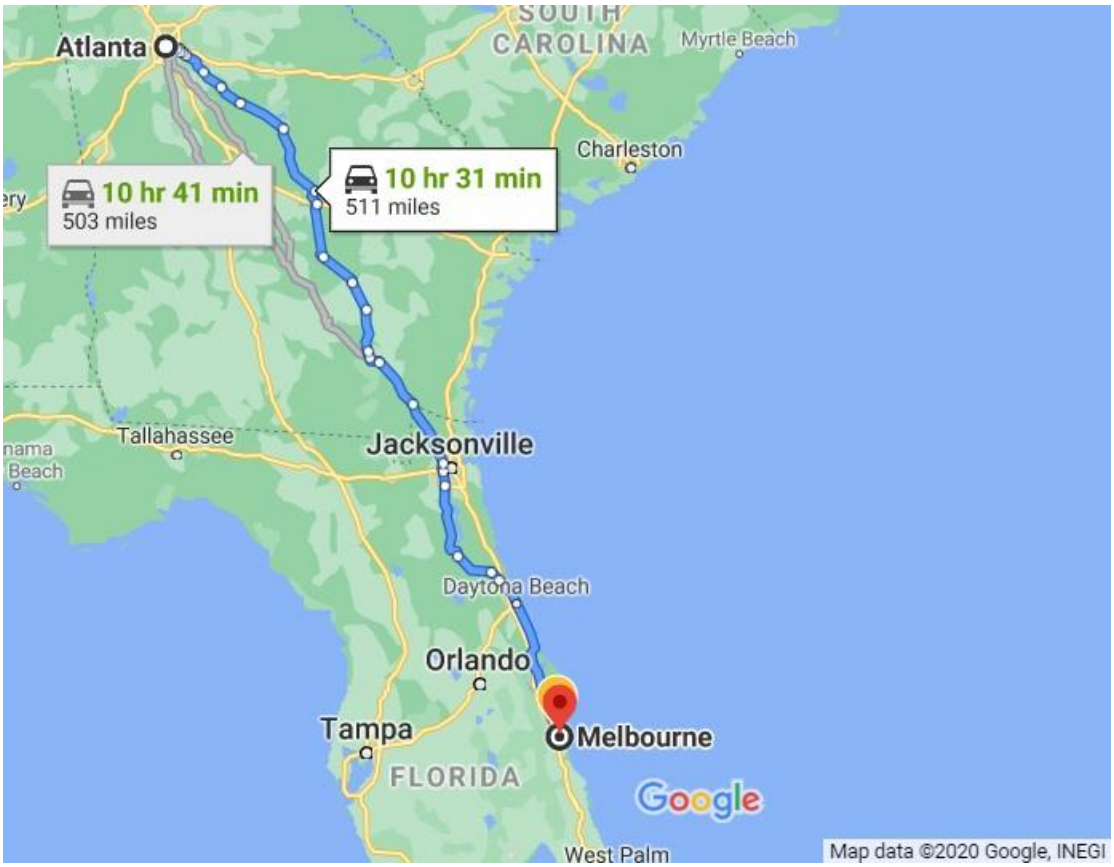
$$\mathbf{W}_2 = \begin{bmatrix} 0 & 0 & 2 & 0 & 0 & 0 \\ 1 & 0 & 0 & 0 & 0 & 2 \\ 0 & 0 & 0 & 0 & 2 & 0 \\ 0 & 2 & 3 & 0 & 4 & 0 \\ 3 & 0 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

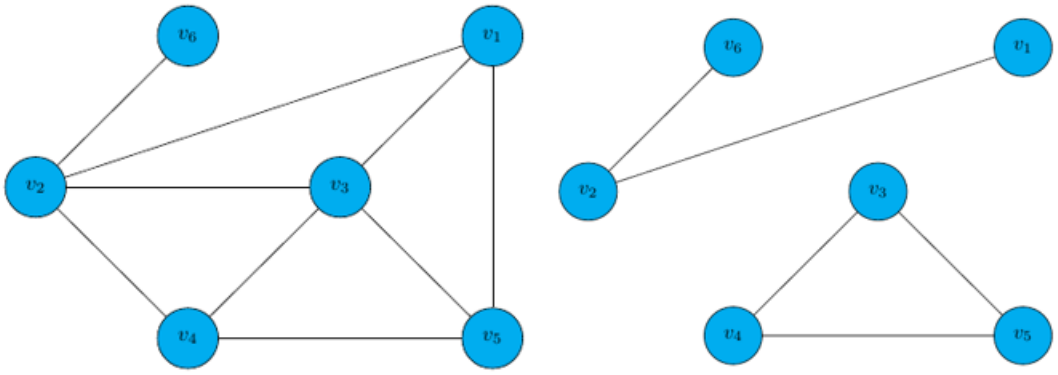
$$\mathbf{A}_1^2 = \begin{bmatrix} 3 & 1 & 2 & 3 & 1 & 1 \\ 1 & 4 & 2 & 1 & 3 & 0 \\ 2 & 2 & 4 & 2 & 2 & 1 \\ 3 & 1 & 2 & 3 & 1 & 1 \\ 1 & 3 & 2 & 1 & 3 & 0 \\ 1 & 0 & 1 & 1 & 0 & 1 \end{bmatrix}$$

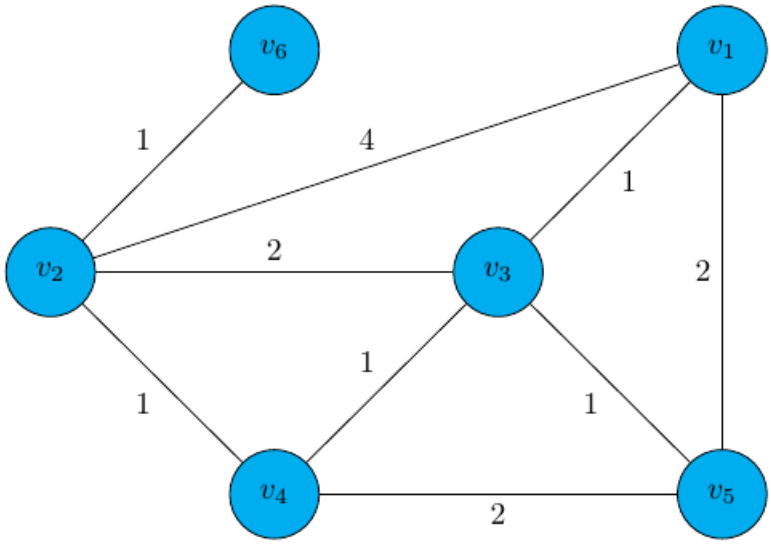
Chapter 09: Searching Data Structures and Finding Shortest Paths



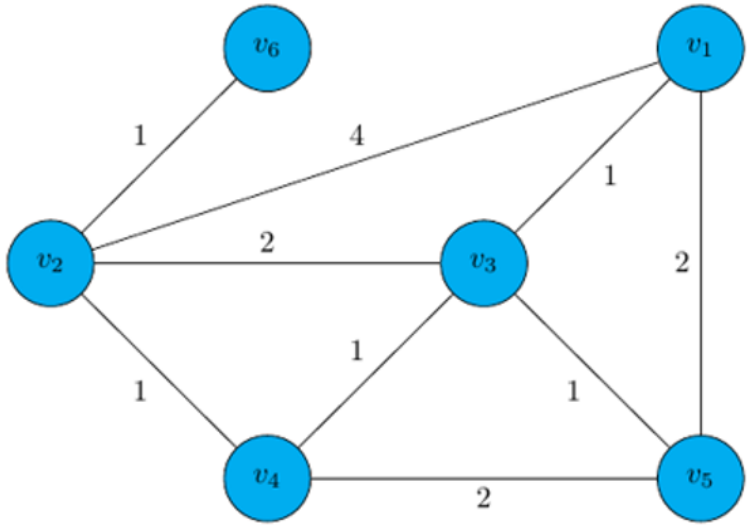

v_1
v_2
v_3
v_4
v_5
v_6
v_7
v_8
v_9
v_{10}
v_{11}
v_1
v_2
v_3
v_4
v_5
v_6
v_7
v_8
v_9
v_{10}
v_{11}


Atlanta
SOUTH CAROLINA
Myrtle Beach
Charleston
10 hr 41 min
503 miles
10 hr 31 min
511 miles
Tallahassee
Jacksonville
Daytona Beach
Orlando
Tampa
Melbourne
FLORIDA
Google
West Palm
Map data ©2020 Google, INEGI


v_6
v_1
v_2
v_3
v_4
v_5
v_6
v_1
v_2
v_3
v_4
v_5

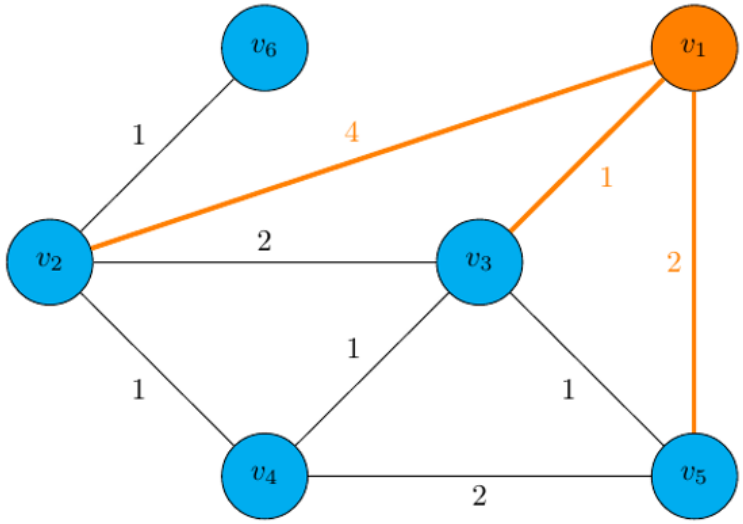


Paths from v_1 to v_2	Path Lengths
$v_1 - v_2$	4
$v_1 - v_3 - v_2$	1 + 2 = 3
$v_1 - v_3 - v_4 - v_2$	1 + 1 + 1 = 3
$v_1 - v_3 - v_5 - v_4 - v_2$	1 + 1 + 2 + 1 = 5
$v_1 - v_5 - v_3 - v_2$	2 + 1 + 2 = 5
$v_1 - v_5 - v_4 - v_2$	2 + 2 + 1 = 5
$v_1 - v_5 - v_4 - v_3 - v_2$	2 + 2 + 1 + 2 = 7



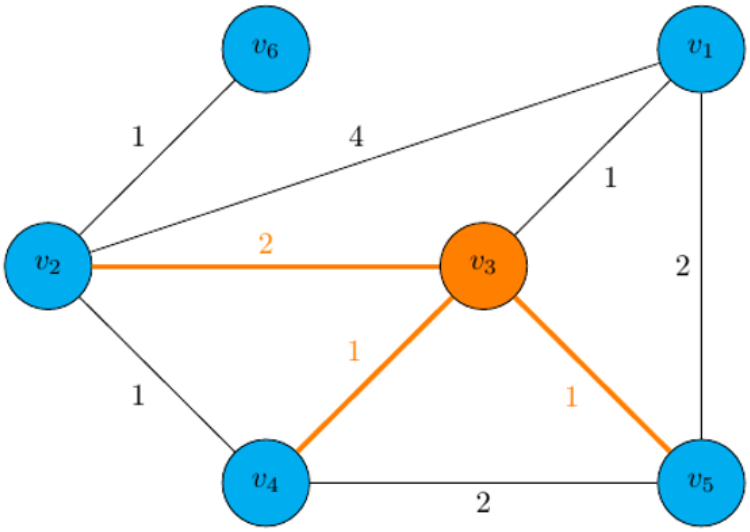
Vertex	Shortest Distance	Previous Vertex
v_1	∞	
v_2	∞	
v_3	∞	
v_4	∞	
v_5	∞	
v_6	∞	

Visited Vertices	Unvisited Vertices
	v_1, v_2, v_3, v_4, v_5, v_6



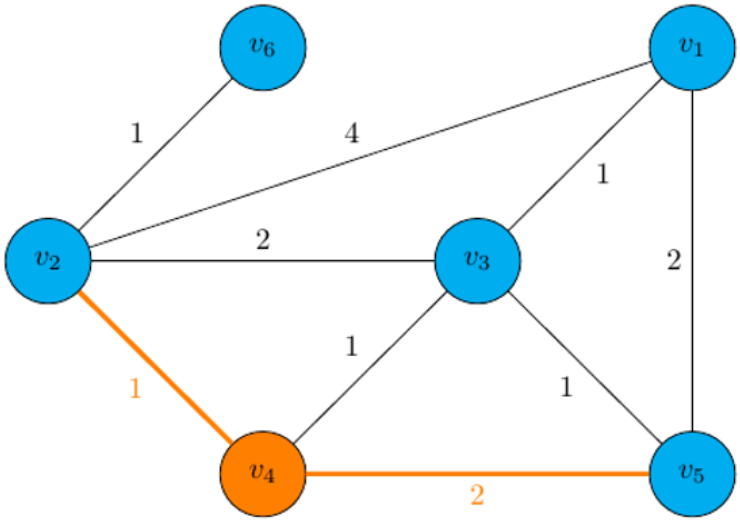
Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	4	v_1
v_3	1	v_1
v_4	∞	
v_5	2	v_1
v_6	∞	

Visited Vertices	Unvisited Vertices
v_1	v_2, v_3, v_4, v_5, v_6



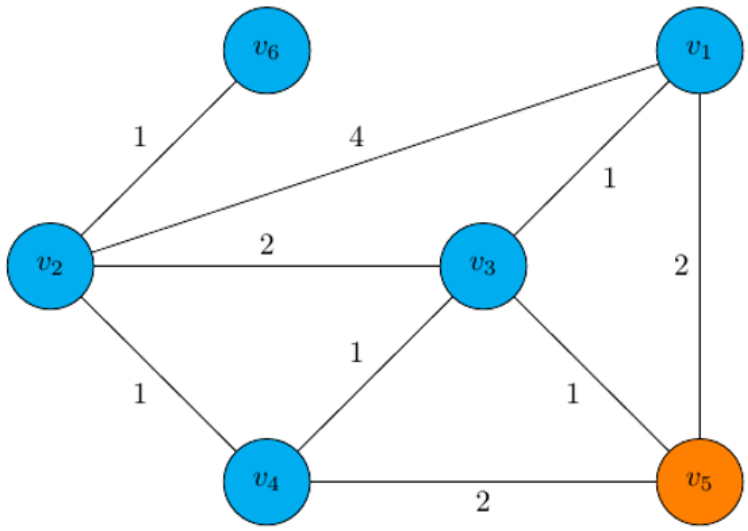
Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	1 + 2 = 3	v_3
v_3	1	v_1
v_4	1 + 1 = 2	v_3
v_5	2	v_1
v_6	∞	

Visited Vertices	Unvisited Vertices
v_1, v_3	v_2, v_4, v_5, v_6



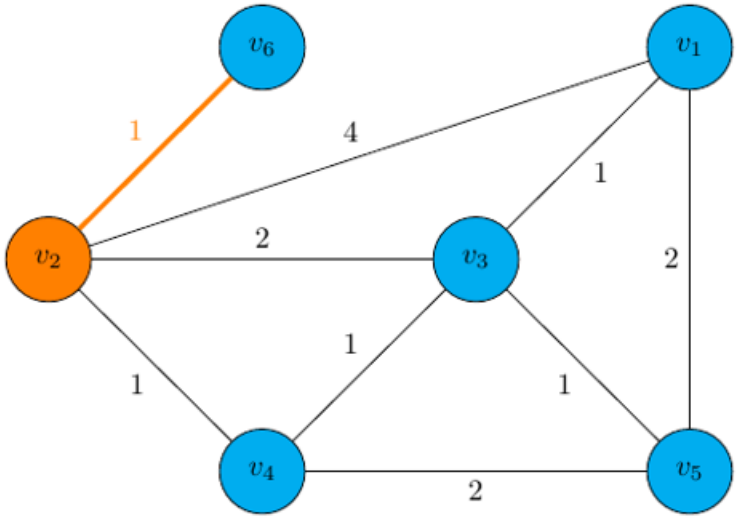
Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	3	v_3
v_3	1	v_1
v_4	2	v_3
v_5	2	v_1
v_6	∞	

Visited Vertices	Unvisited Vertices
v_1, v_3, v_4	v_2, v_5, v_6



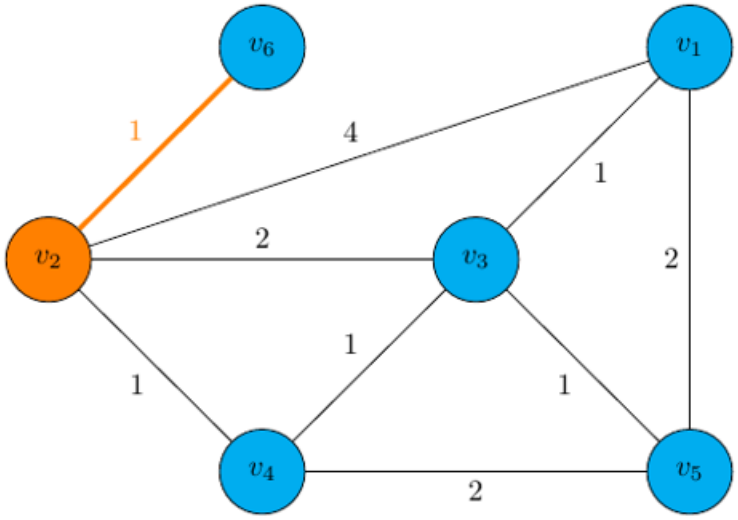
Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	3	v_3
v_3	1	v_1
v_4	2	v_3
v_5	2	v_1
v_6	∞	

Visited Vertices	Unvisited Vertices
v_1, v_3, v_4, v_5	v_2, v_6



Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	3	v_3
v_3	1	v_1
v_4	2	v_3
v_5	2	v_1
v_6	3 + 1 = 4	v_2

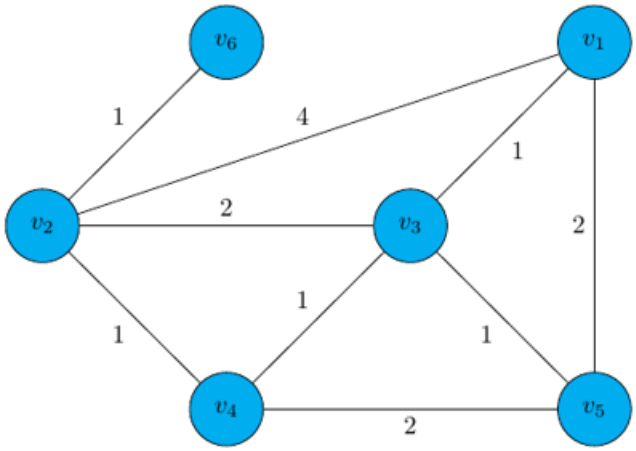
Visited Vertices	Unvisited Vertices
v_1, v_2, v_3, v_4, v_5	v_6



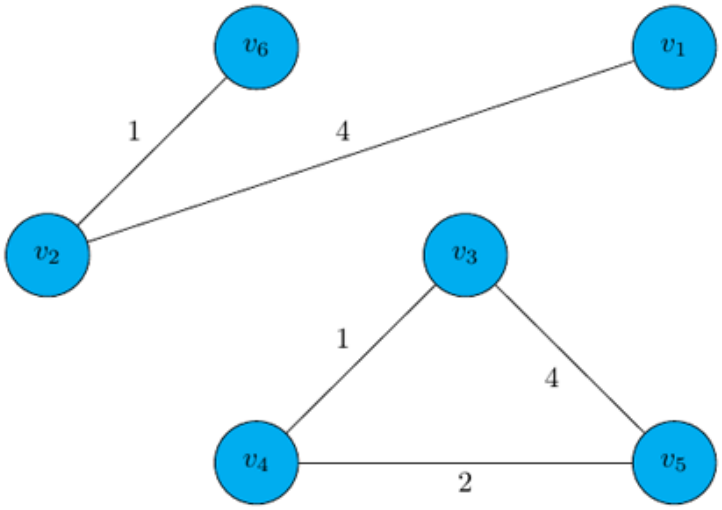
Vertex	Shortest Distance	Previous Vertex
v_1	0	
v_2	3	v_3
v_3	1	v_1
v_4	2	v_3
v_5	2	v_1
v_6	4	v_2

Visited Vertices	Unvisited Vertices
v_1, v_2, v_3, v_4, v_5, v_6	

Destination	Path	Distance
v_2	v_2 <– v_3 <– v_1	3
v_3	v_3 <– v_1	1
v_4	v_4 <– v_3 <– v_1	2
v_5	v_5 <– v_1	2
v_6	v_6 <– v_2 <– v_3 <– v_1	4

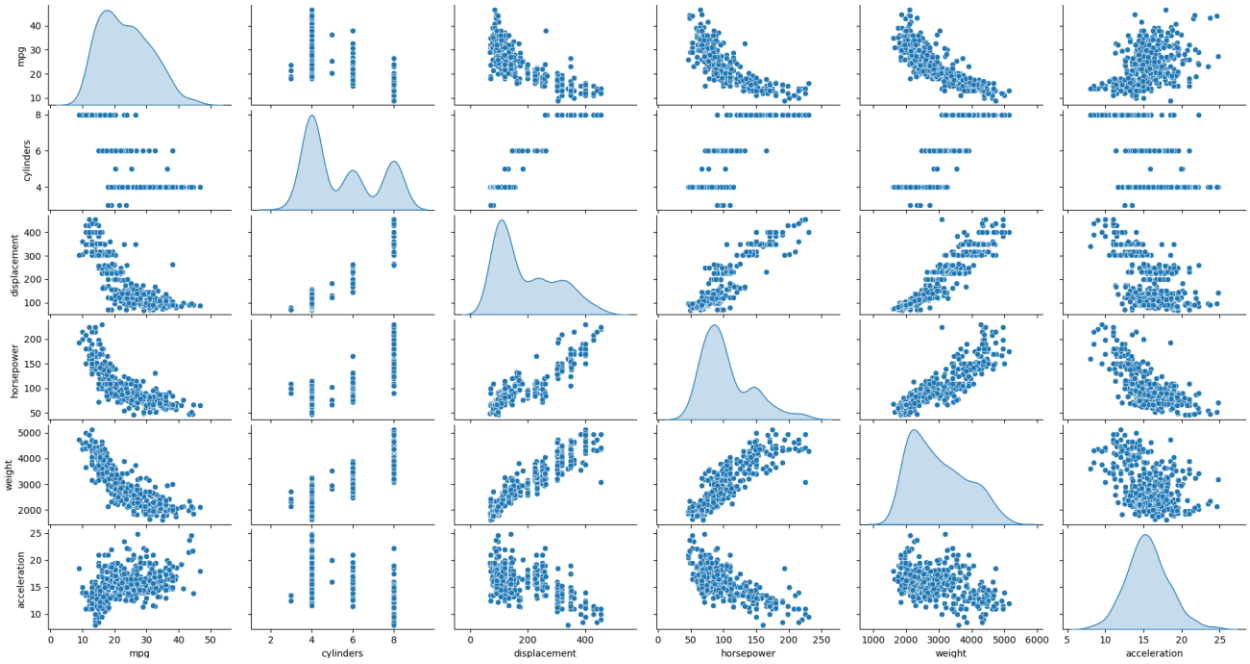


$$\mathbf{W}_1 = \begin{bmatrix} 0 & 4 & 1 & 0 & 2 & 0 \\ 4 & 0 & 2 & 1 & 0 & 1 \\ 1 & 2 & 0 & 1 & 1 & 0 \\ 0 & 1 & 1 & 0 & 2 & 0 \\ 2 & 0 & 1 & 2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

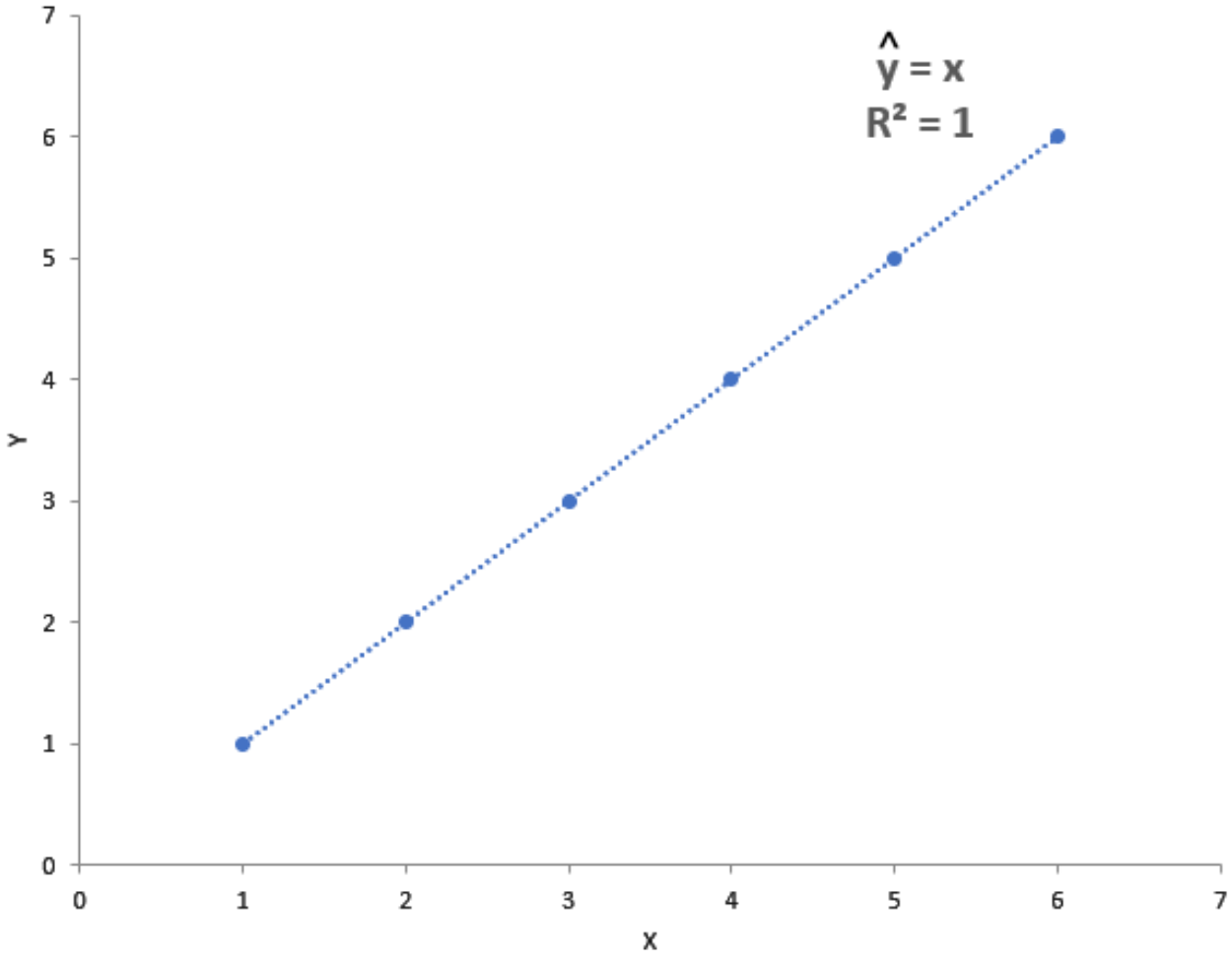


$$\mathbf{W}_2 = \begin{bmatrix} 0 & 4 & 0 & 0 & 0 & 0 \\ 4 & 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 1 & 4 & 0 \\ 0 & 0 & 1 & 0 & 2 & 0 \\ 0 & 0 & 4 & 2 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 \end{bmatrix}$$

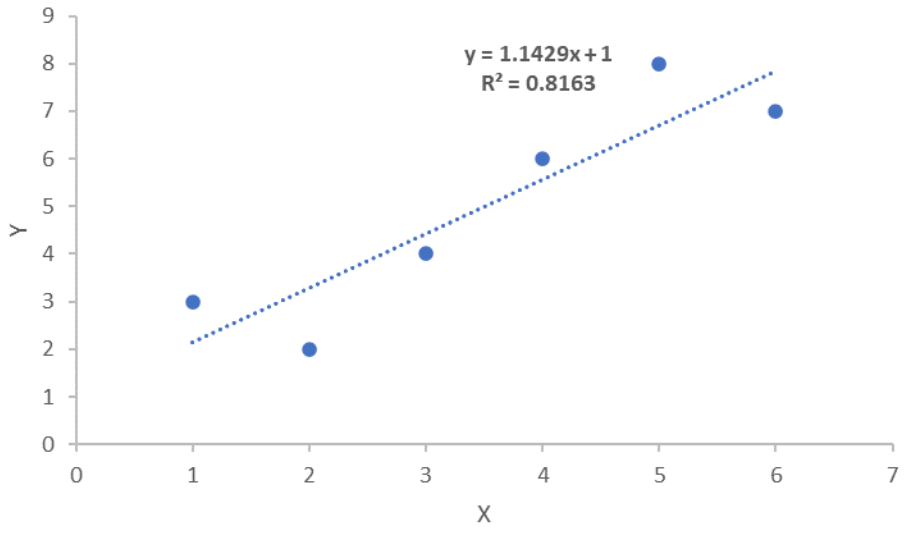
Chapter 10: Regression Analysis with NumPy and Scikit-Learn

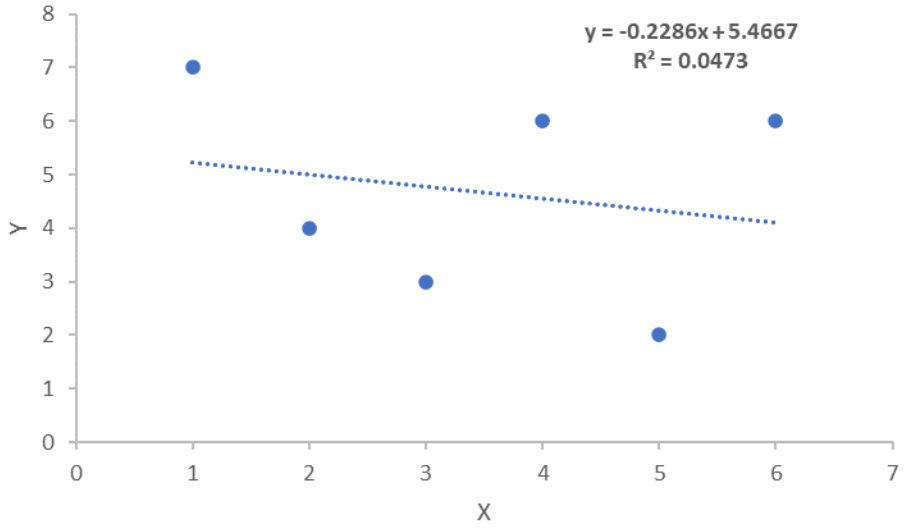


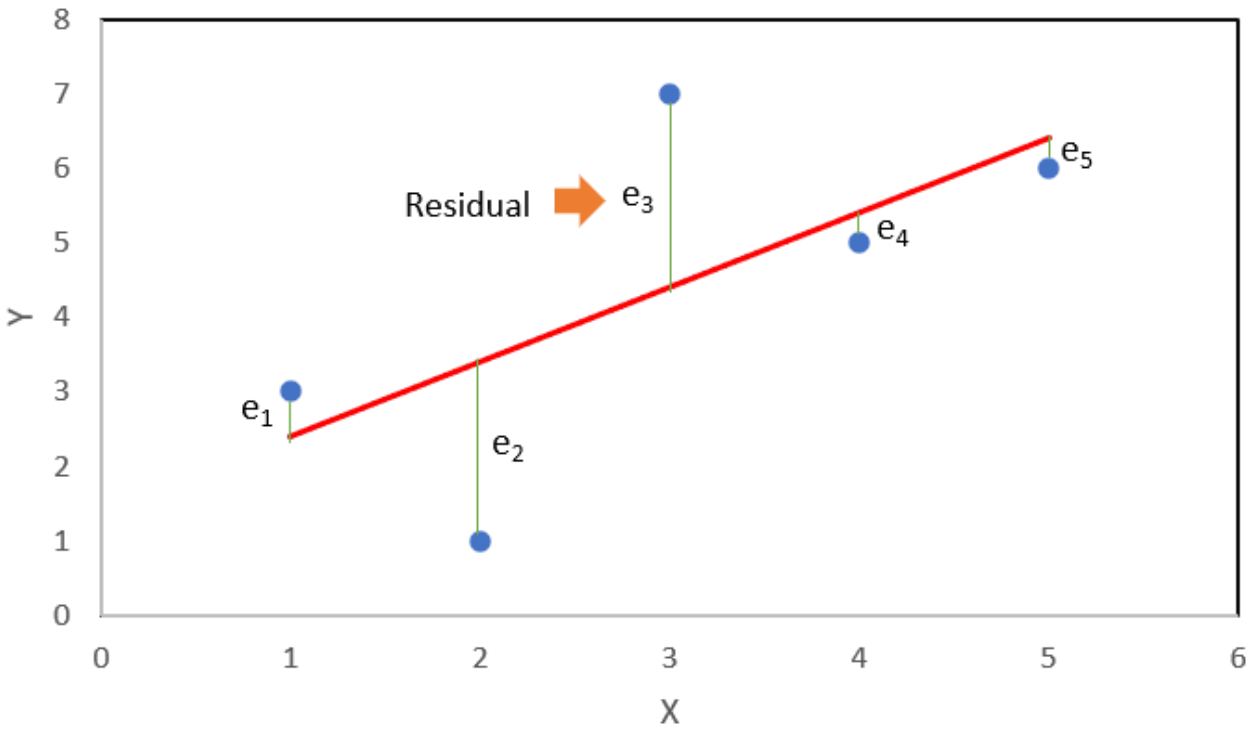
X	Y
1	1
2	2
3	3
4	4
5	5
6	6

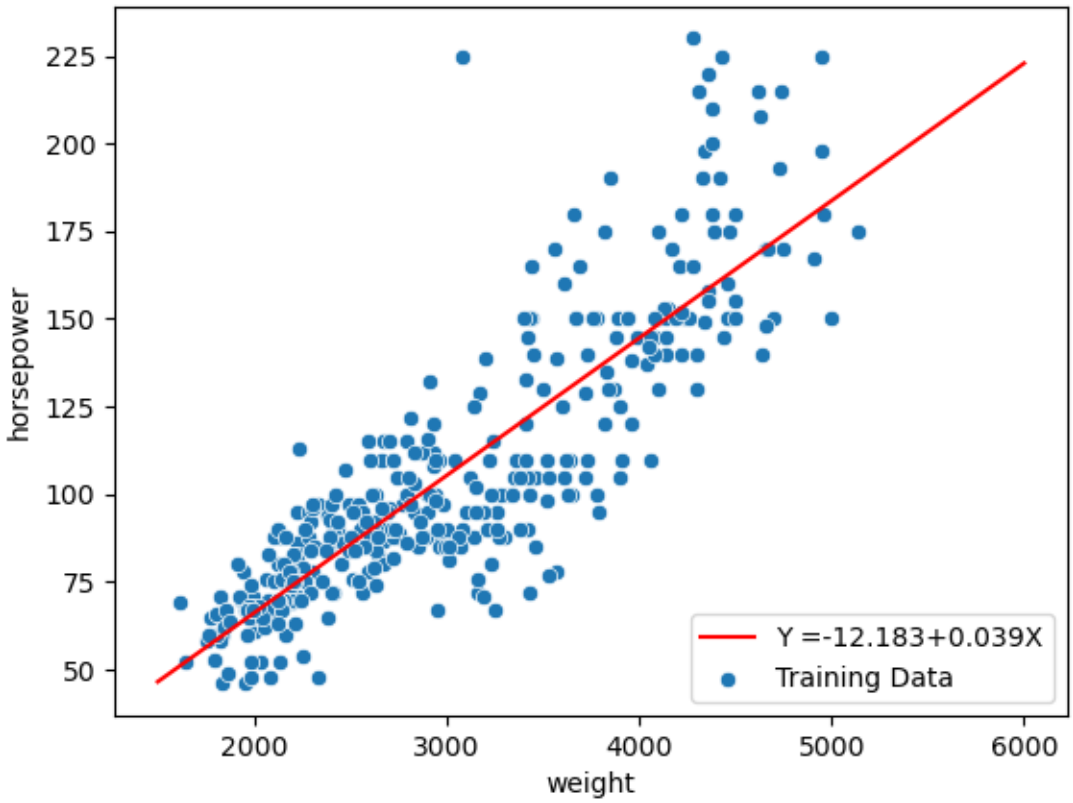

ŷ = x
R² = 1
y
x
0
1
2
3
4
5
6
7

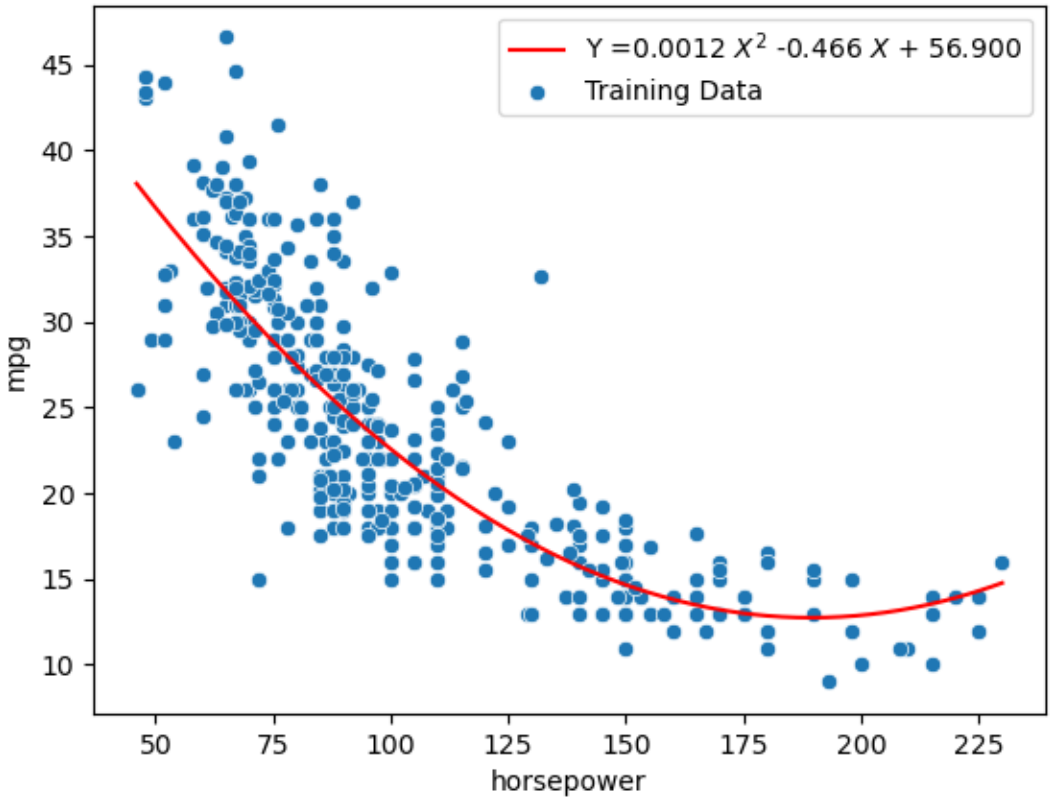
X	Y
1	3
2	2
3	4
4	6
5	8
6	7

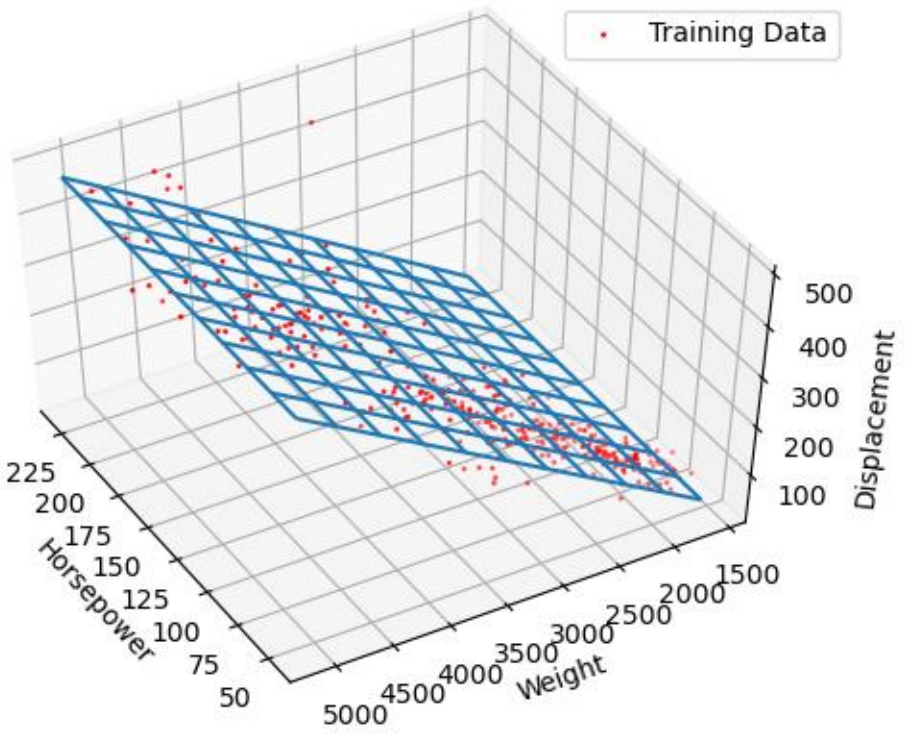




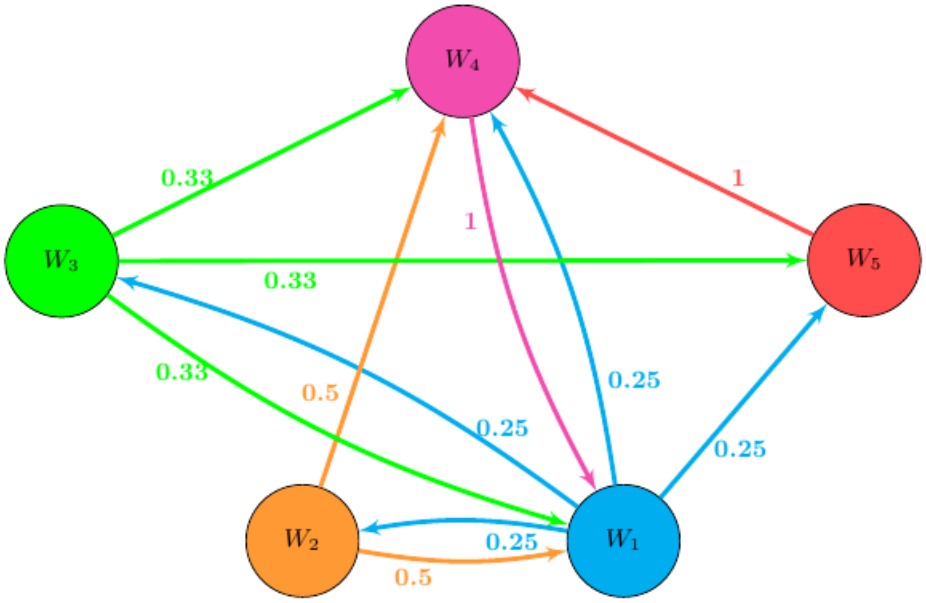

Residual
e1
e2
e3
e4
e5
Y
X
0
1
2
3
4
5
6
7
8


horsepower
weight
Y =-12.183+0.039X
Training Data
50
75
100
125
150
175
200
225
2000
3000
4000
5000
6000


Y =0.0012 X^2 -0.466 X + 56.900
Training Data
mpg
horsepower
45
40
35
30
25
20
15
10
50
75
100
125
150
175
200
225


Training Data
Horsepower
Weight
Displacement
225
200
175
150
125
100
75
50
5000
4500
4000
3500
3000
2500
2000
1500
500
400
300
200
100

Chapter 11: Web Searches with PageRank

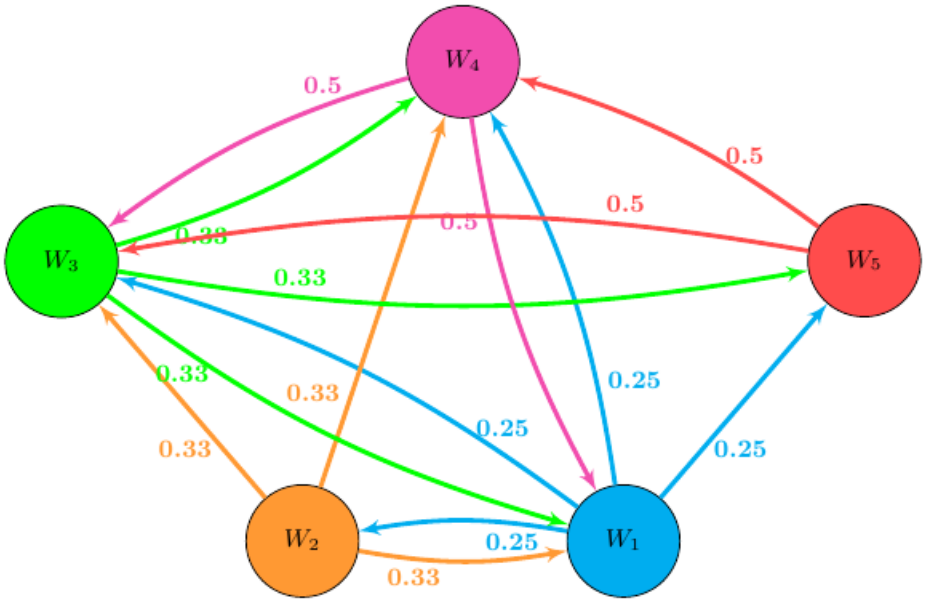


$$\mathbf{A} = \begin{bmatrix} 0 & 0.25 & 0.25 & 0.25 & 0.25 \\ 0.5 & 0 & 0 & 0.5 & 0 \\ 0.33 & 0 & 0 & 0.33 & 0.33 \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \end{bmatrix}$$

$$\mathbf{v}_0 = \begin{bmatrix} 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \\ 0.2 \end{bmatrix}$$

$$\mathbf{U} = d\mathbf{A}^T + \frac{1-d}{N} \begin{bmatrix} 1 & \cdots & 1 \\ \vdots & \ddots & \vdots \\ 1 & \cdots & 1 \end{bmatrix}$$

$$\mathbf{v}_{10} = \begin{bmatrix} 0.354 \\ 0.105 \\ 0.105 \\ 0.293 \\ 0.134 \end{bmatrix}$$



	Destination
4391	http://search.ucdavis.edu/
1488	http://www.ucdavis.edu/
997	http://www.gene.com/ae/bioforum/
2408	http://www.lib.uci.edu/
8051	http://vision.berkeley.edu/VSP/index.shtml
1489	http://www.uci.edu/
718	http://www.students.ucr.edu/
211	http://spectacle.berkeley.edu/
17	http://www.calacademy.org/
4795	http://www.scag.org

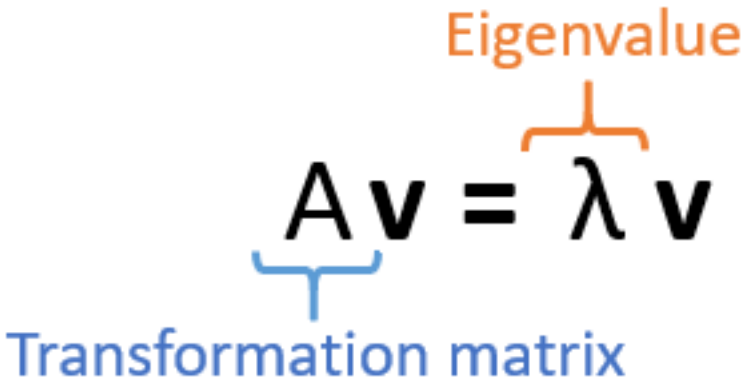
Chapter 12: Principal Component Analysis with Scikit-Learn

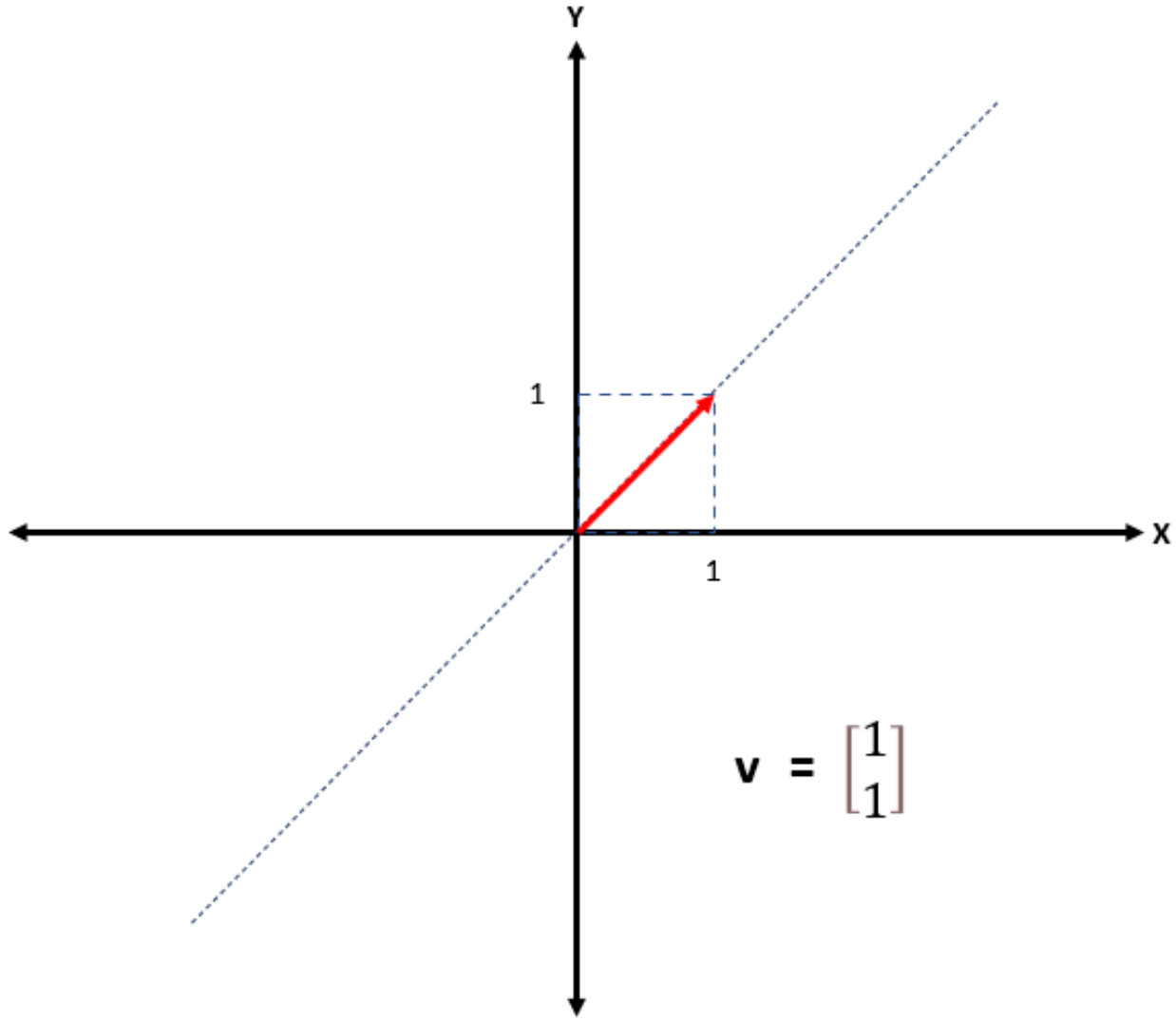
7 feature variables

Brand	Moisture	Protein	Fat	Ash	....
A	27.82	21.43	44.87	5.11	....
A	28.49	21.26	43.89	5.34	....
A	28.35	19.99	45.78	5.08	....
A	30.55	20.15	43.13	4.79	
....	....	....	....	....	....

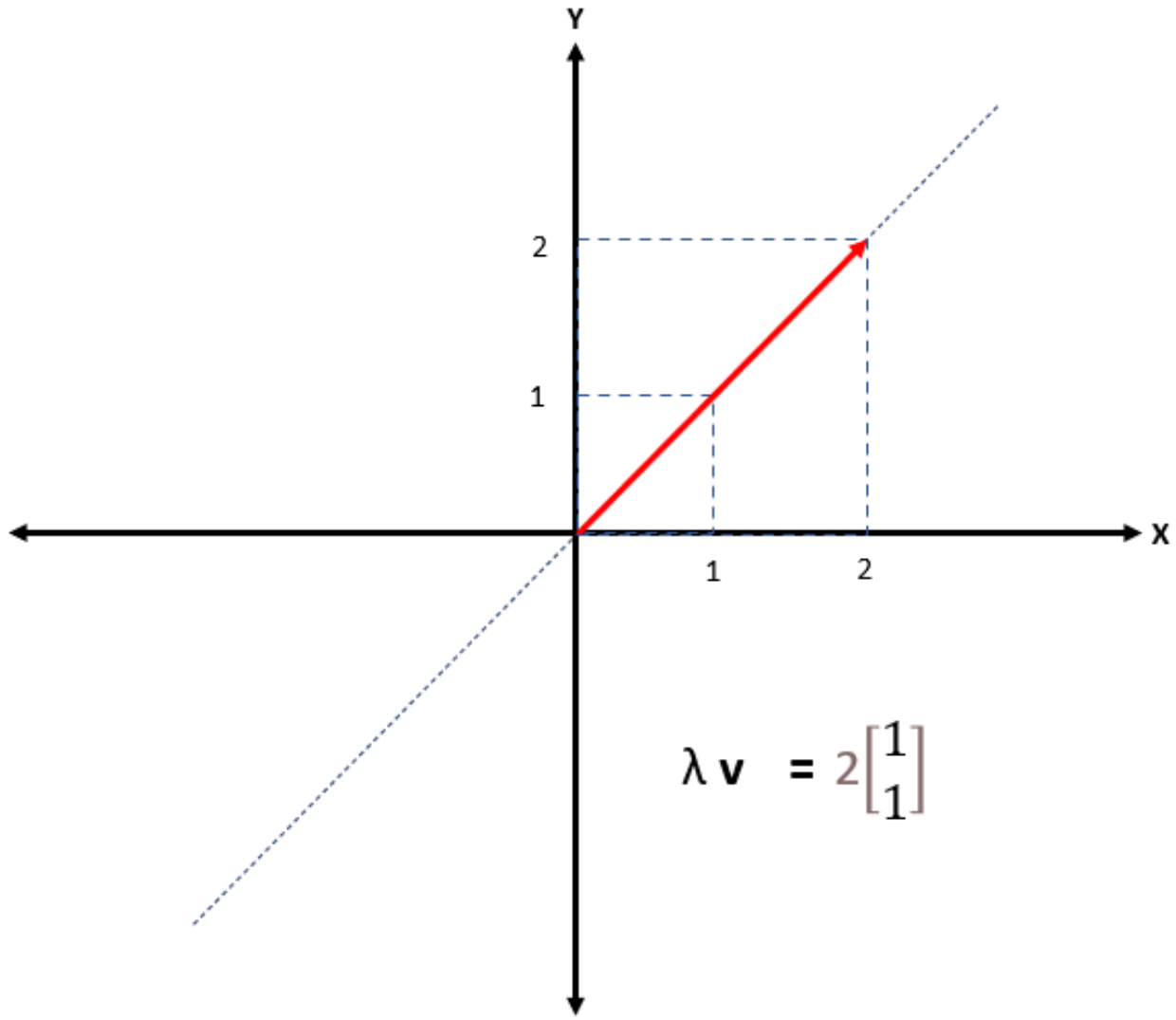
300 observations

	Moisture	Protein	Fat	Ash	....
Moisture	1.000	0.360	-0.171	0.266	....
Protein	0.360	1.000	0.498	0.824	....
Fat	-0.171	0.498	1.000	0.792	....
Ash	0.266	0.824	0.792	1.000	
....	....	....	....	....	....

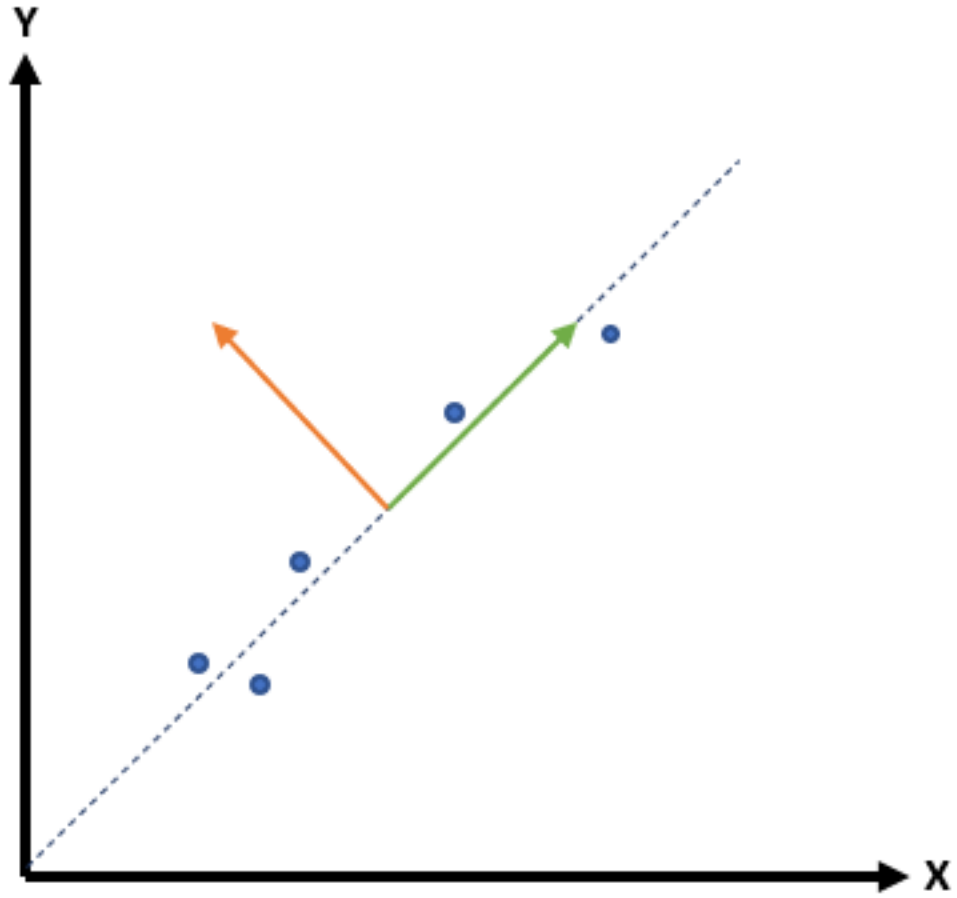


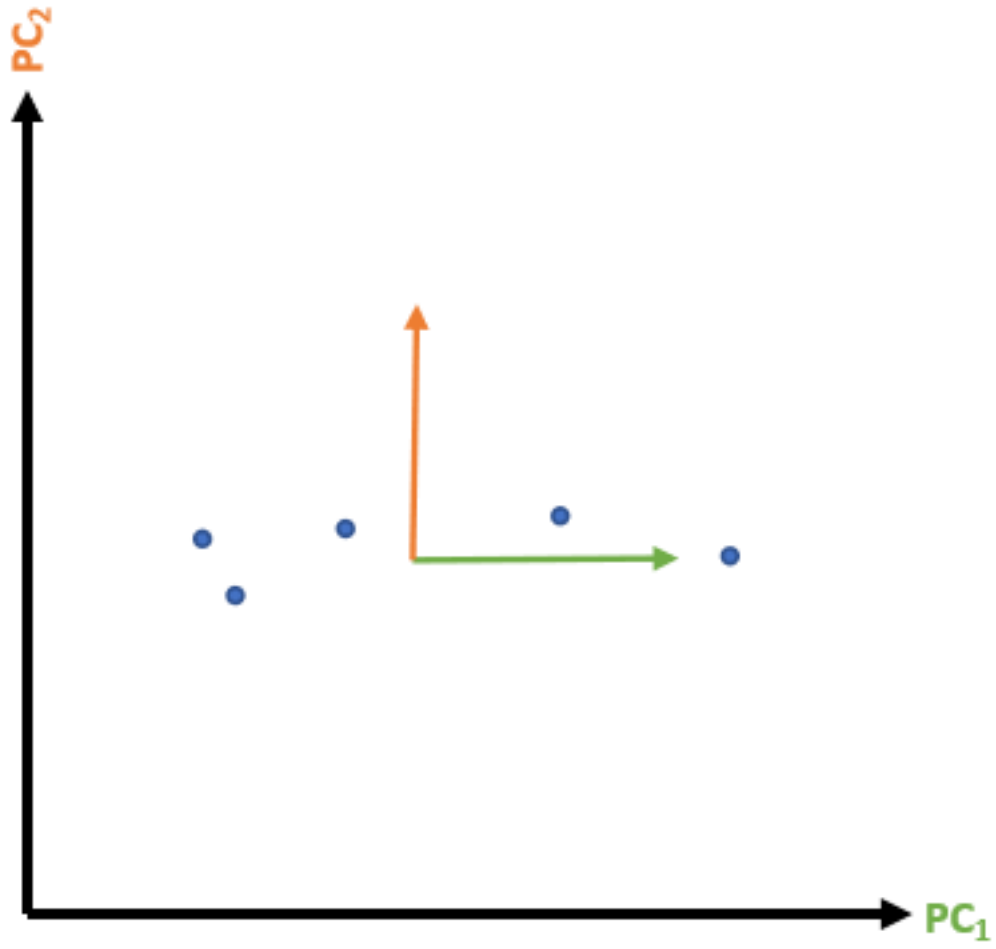


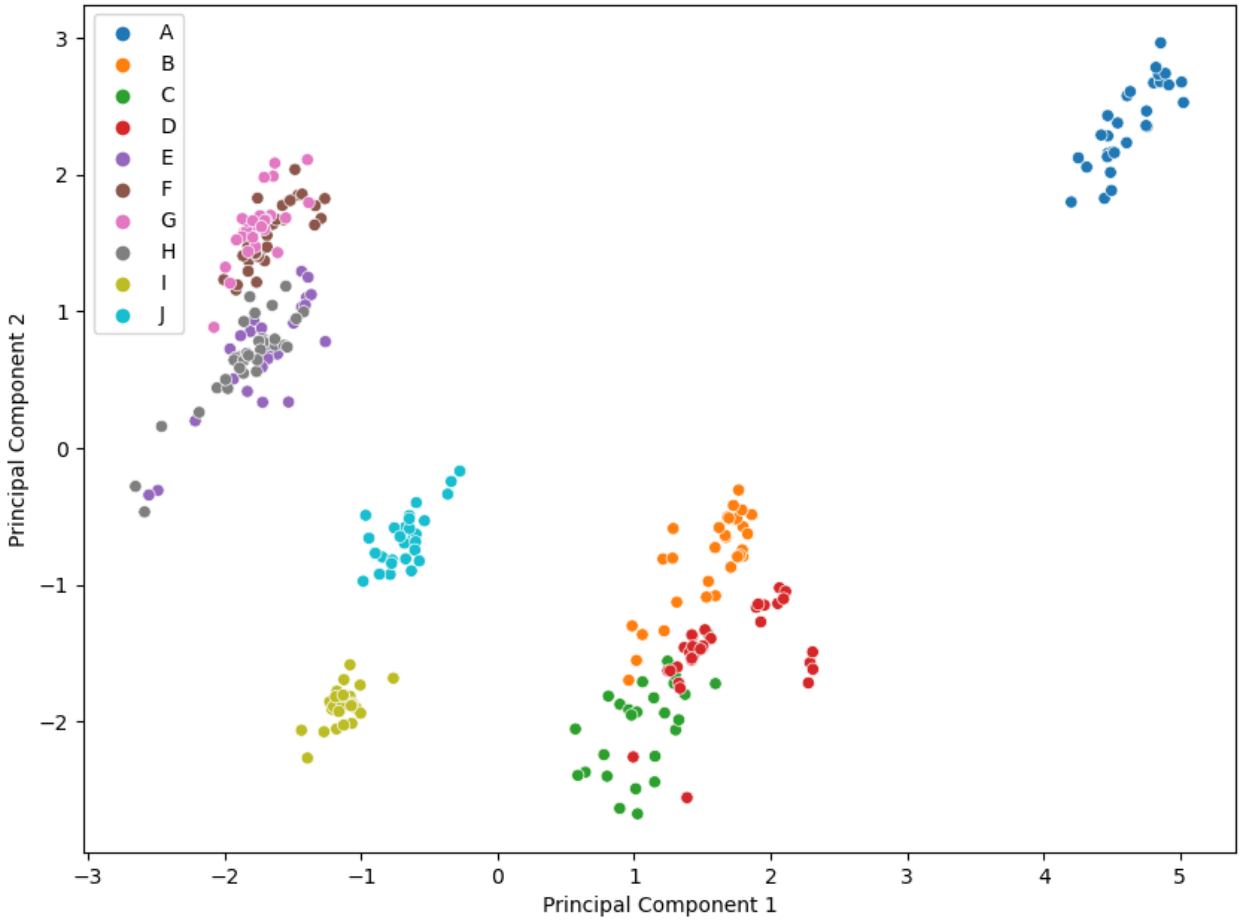
$$\mathbf{v} = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

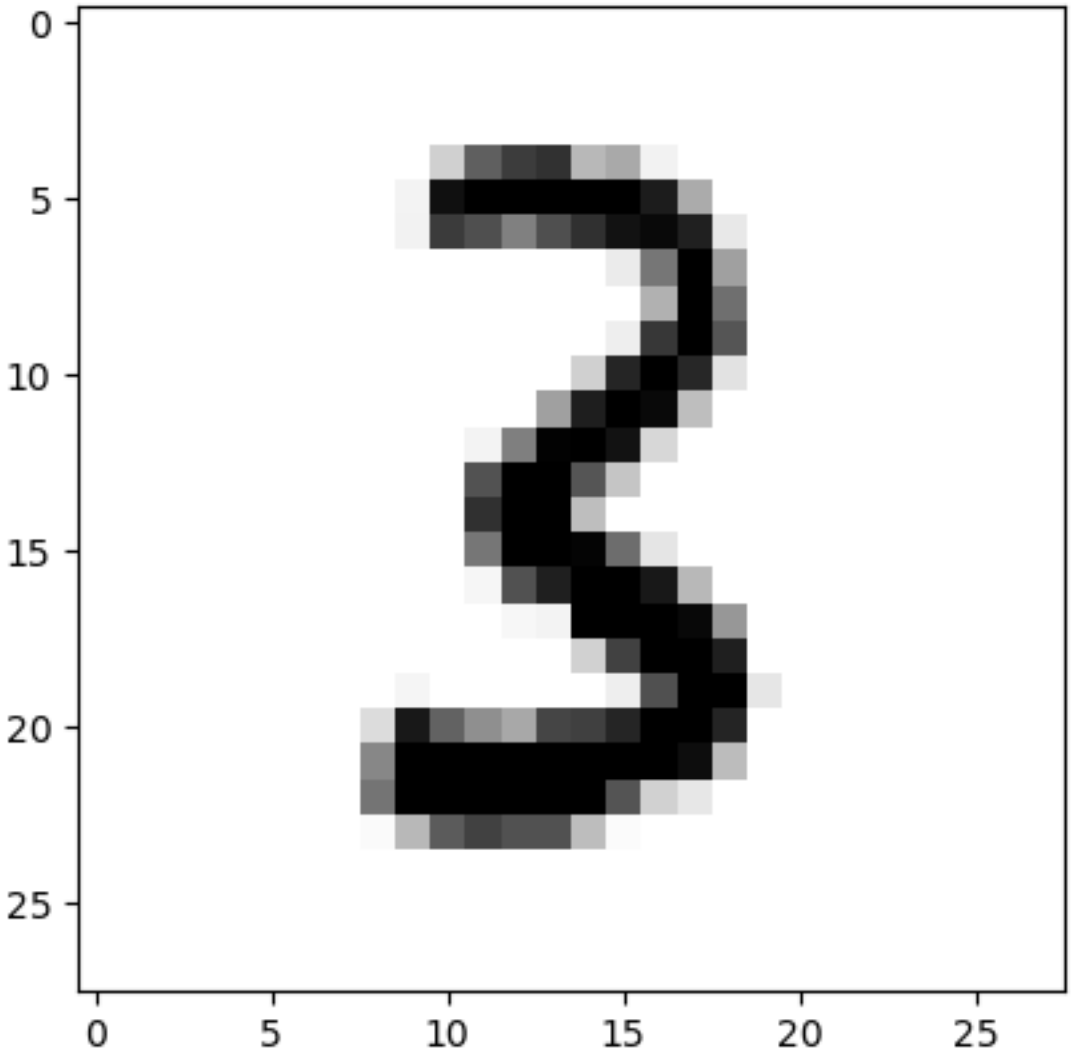


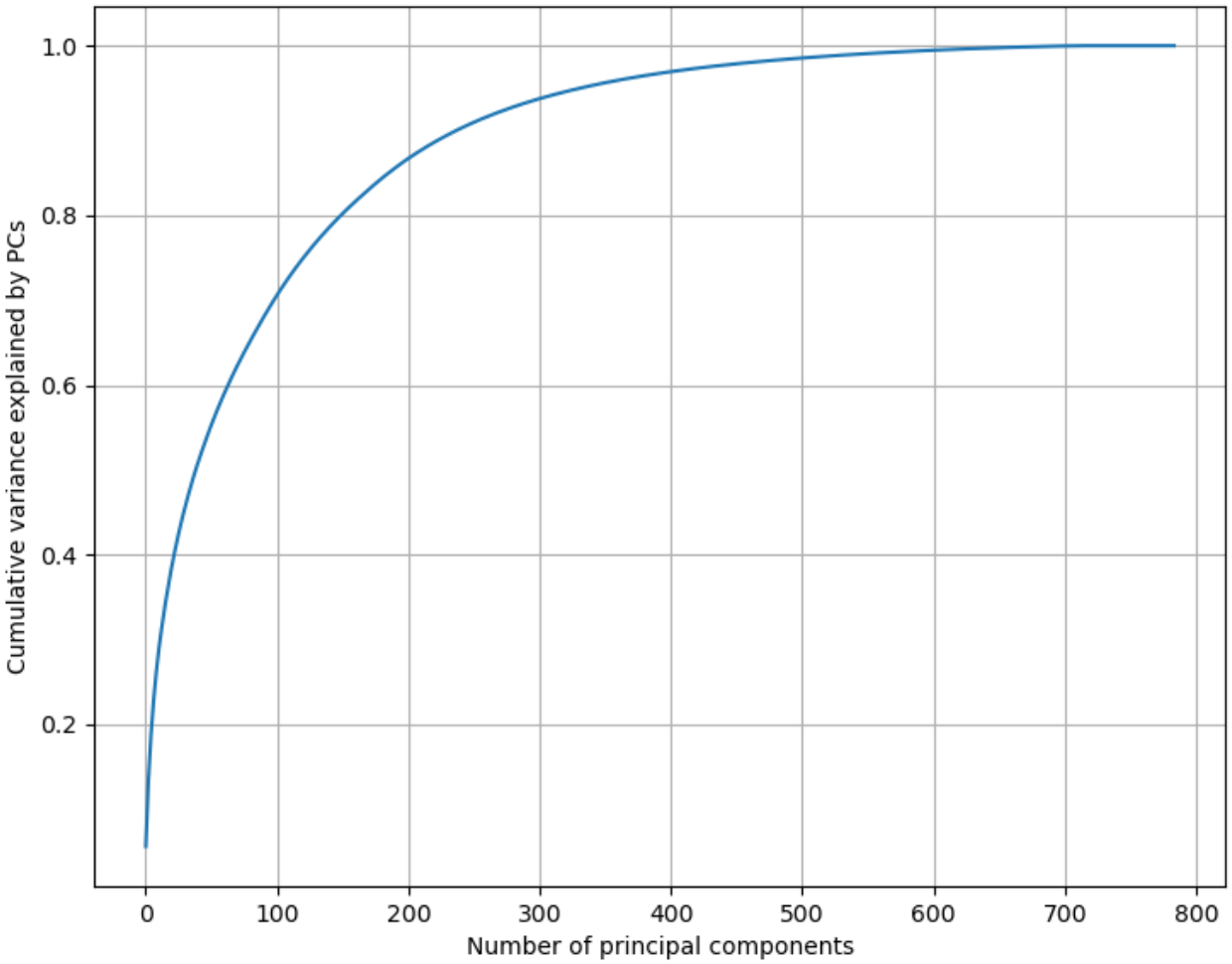
$$\lambda \mathbf{v} = 2\begin{bmatrix}1\\1\end{bmatrix}$$


Y
X


PC2
PC1


A
B
C
D
E
F
G
H
I
J
Principal Component 2
Principal Component 1
3
2
1
0
−1
−2
−3
−2
−1
0
1
2
3
4
5


0
5
10
15
20
25
0
5
10
15
20
25


1.0
0.8
0.6
0.4
0.2
Cumulative variance explained by PCs
0
100
200
300
400
500
600
700
800
Number of principal components