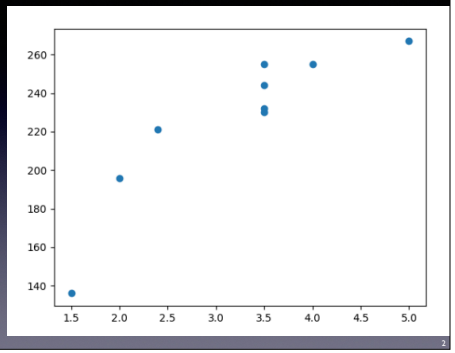
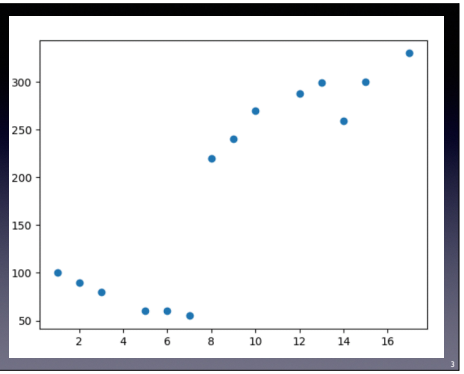
Week 5

[Un]supervised Learning,
Space-Time Tradeoffs
and
Calgary Drop-In Centre

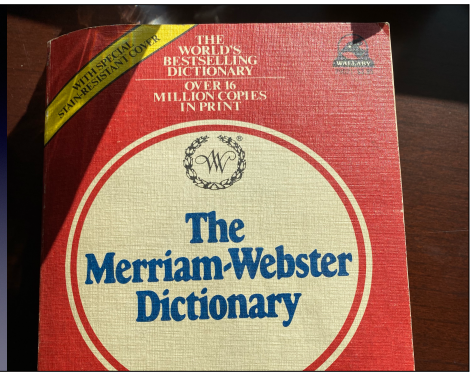
Example of Supervised Machine Learning via Regression



Example of Unsupervised Machine Learning via Clustering



Locating a Particular Piece of Data

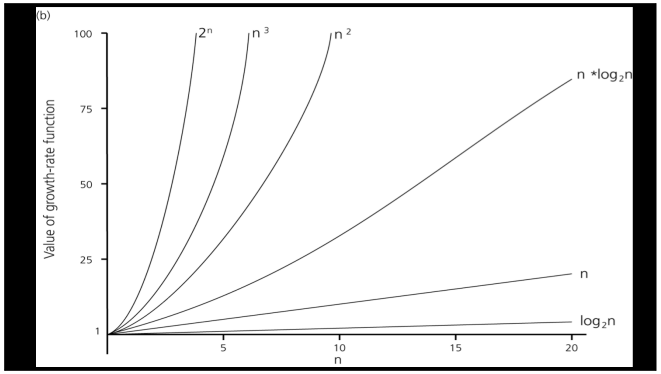


Growth-rate Functions

- $O(1)$ – **constant** time, the time is independent of n, e.g. *array look-up*
- $O(\log n)$ – **logarithmic** time, usually the log is base 2, e.g., *binary search*
- $O(n)$ – **linear** time, e.g. *linear search*
- $O(n*\log n)$ – e.g. efficient sorting algorithms
- $O(n^2)$ – **quadratic** time, e.g. *selection sort*
- $O(n^k)$ – **polynomial** (where k is some constant)
- $O(2^n)$ – **exponential** time, very slow!

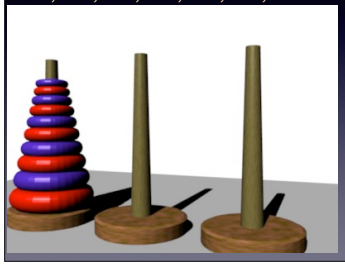
Comparison of Growth-rate Functions

n	10	100	1,000	10,000	100,000	1,000,000
1	1	1	1	1	1	1
$\log_2 n$	3	6	9	13	16	19
n	10	10^2	10^3	10^4	10^5	10^6
$n*\log_2 n$	30	664	9,965	10^5	10^6	10^7
n^2	10^2	10^4	10^6	10^8	10^{10}	10^{12}
n^3	10^3	10^6	10^9	10^{12}	10^{15}	10^{18}
2^n	10^3	10^{30}	10^{301}	$10^{3,010}$	$10^{30,103}$	$10^{301,030}$



Intractable Algorithm

18,446,744,073,709,551,615



"In the great temple of Benares … rests a brass plate in which are fixed 3 diamond needles, each a cubit high and as thick as the body of a bee. On one of these needles, at the creation, God placed 64 disks of pure gold, the largest disk resting on the brass plate, and the others getting smaller and smaller up to the top one. This is the Tower of Brahmah … When the 64 disks shall have been transferred from the needle on which at the creation God placed them, to one of the other needles, tower, temple, and Brahmins alike will crumble into dust, and with a thunderclap the world will vanish!"

Part of ASCII / Unicode Table

065	101	041	01000001	A	
066	102	042	01000010	B	
067	103	043	01000011	C	
068	104	044	01000100	D	
069	105	045	01000101	E	
070	106	046	01000110	F	
071	107	047	01000111	G	
072	110	048	01001000	H	
073	111	049	01001001	I	
074	112	04A	01001010	J	
075	113	04B	01001011	K	
076	114	04C	01001100	L	
077	115	04D	01001101	M	
078	116	04E	01001110	N	
079	117	04F	01001111	O	
080	120	050	01010000	P	
081	121	051	01010001	Q	
082	122	052	01010010	R	
083	123	053	01010011	S	
084	124	054	01010100	T	
085	125	055	01010101	U	
086	126	056	01010110	V	
087	127	057	01010111	W	
088	130	058	01011000	X	
089	131	059	01011001	Y	
090	132	05A	01011010	Z	
091	133	05B	01011011	[	(left/opening bracket)
092	134	05C	01011100	\	(back slash)
093	135	05D	01011101	]	(right/closing bracket)
094	136	05E	01011110	^	(caret/cirumflex)
095	137	05F	01011111	_	(underscore)
096	140	060	01100000	`	
097	141	061	01100001	a	

Hashing Explained

Find Ada Ada = 8 ?

Ada

myData = Array(8)

https://www.youtube.com/watch?v=KyUTuwz_b7Q

Jan	Tim	Mia	Sam	Leo	Ted	Bea	Lou	Ada	Max	Zoe
0	1	2	3	4	5	6	7	8	9	10

Calgary Drop-In Centre's Donor Information System

Abstract

In the spring of 2016, the director of finance and administration for
Centre was frustrated with the organization's legacy donor and volu
director was concerned that issues with the organization's informat
its ability to maintain positive relationships with existing donors and
supporters-ultimately, that it could have an impact on the agency's
the community. He was contemplating three options to solve this pr

- *build a new in-house system to replace the current Microsoft Ac*
- *purchase customer relationship management software specifica*
  fundraising and relationship management — and install this on p
  in the offices; or
- *adopt a cloud-based fundraising solution, where the organizatio*
  secure, shared platform administered by the vendor.

Additional References

More on the technical aspects of database index technology:

https://docs.oracle.com/cd/E11882_01/server.112/e40540/indexiot.htm#CNCPT721

The EU General Data Protection Regulation (GDPR) is the most important change in data privacy regulation in 20 years. See

https://gdpr.eu

GDPR Requirements

1. **Right to Access** - Data subjects have the right to request a copy of their personal data.
2. **Right to be Informed** - Data subjects have the right to be informed of how personal data pertaining to them is being processed, and for what purpose. They have the right to know how long the personal data will be stored and who it will be shared with. (Article 13+ 14)
3. **Right to Rectification** - Data subjects have the right to fix inaccurate or incomplete personal data. (Article 16)
4. **Right to be Forgotten** - Data subjects have the right to request their personal data be erased from the data controller, and stop further dissemination of the data. (Article 17)

GDPR Requirements, part 2

5. **Right to Restrict Processing** - Data subjects have the right to request restriction or suppression of their personal data. This is analogous to the Right to be Forgotten, but the data remains stored, rather than erased, and only applies in special cases, such as the data is inaccurate and is in the process of being rectified. (Article 18)
6. **Right to Data Portability** - Data subjects have the right to request a copy of their personal data in a machine-readable format. (Article 20)
7. **Right to Object** - Data subjects have the right to object to the processing of their data in certain circumstances, with the specific mention of direct marketing. (Article 21)
8. **Rights related to Automated Decision Making** - Data subjects have the right to request not to be profiled or be subject to automated decision-making processes that do not involve human intervention. (Article 22)