

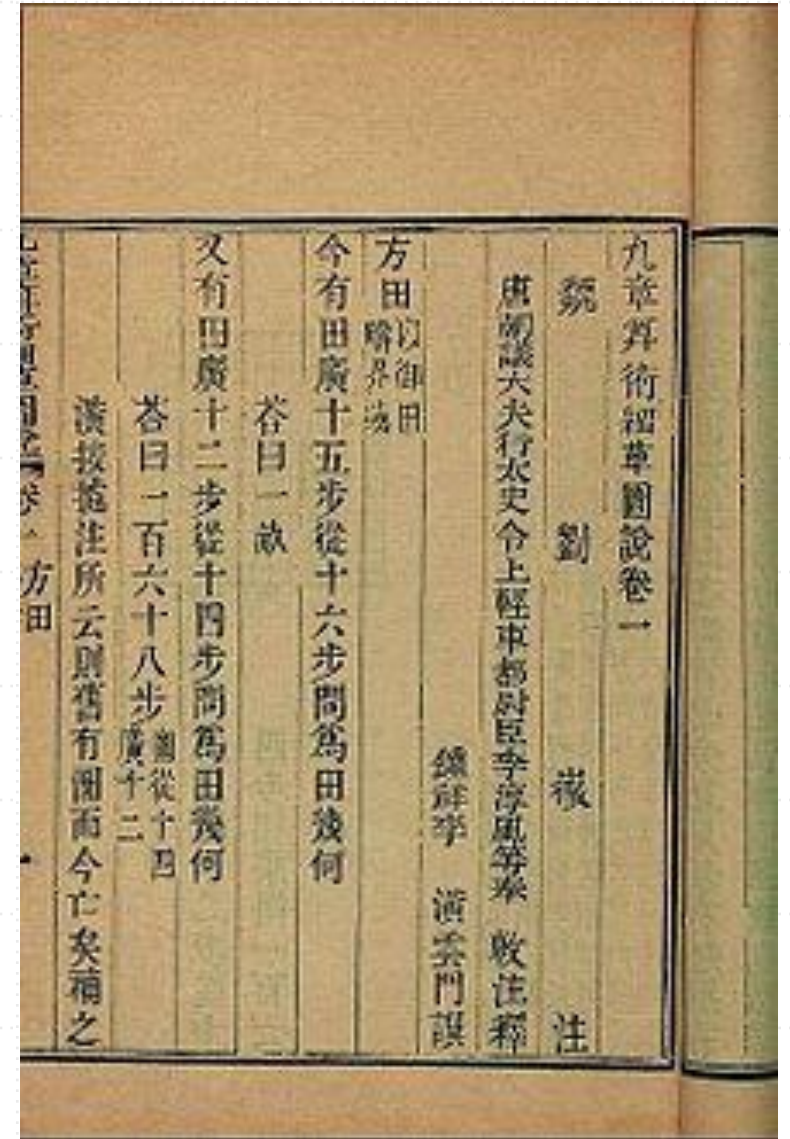
Matrices and Their Uses in Computer Science

Yesenia Vargas Galindo



History of Matrices

- First documented between 300 BC and 200 AD in Chinese text called *Nine Chapters of Mathematical Art*
- Discussed determinants and solving systems of equations with matrices
- Traces of this in contemporary methods such as Gaussian Elimination
- Further developed by Sylvester and Cayley in 1851
- Established more concrete concepts now used in many subjects such as Linear Algebra
- Focused on determinants and rules for how to solve for them



What is a Matrix

$$A = \begin{matrix} & \begin{matrix} n & \text{columns} \end{matrix} \\ \begin{matrix} a_{11} & a_{12} & a_{13} & \dots & a_{1n} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{i1} & a_{i2} & a_{i3} & \dots & a_{in} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & a_{m3} & \dots & a_{mn} \end{matrix} & \begin{matrix} \\ \\ \\ \\ \\ \end{matrix} \\ \begin{matrix} \\ \\ \\ \\ \\ \end{matrix} & \begin{matrix} m \\ \text{rows} \end{matrix} \end{matrix}$$

- A grid of numbers representing equations, data, and much more
- Originally used in linear algebra to organize linear equations
- Applications in physics, statistics, computer science, and more
- a_{ij} is used to describe the elements in a matrix
- Have n column and m rows
- Have many methods to solve depending on its use

Uses in Computer Science

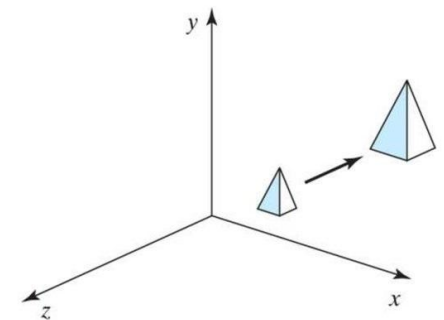
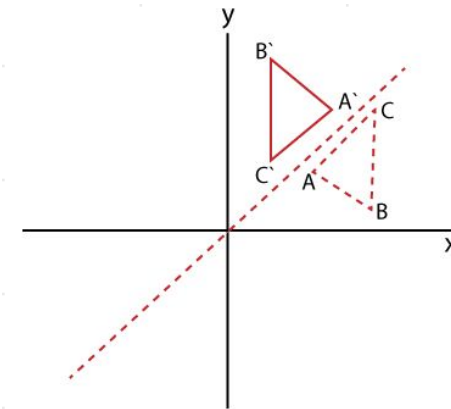
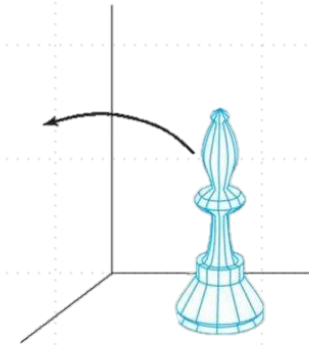
Computer
Graphics

Development of
Artificial
Intelligence and
Machine Learning

Identifying and
Analyzing Images

Computer Graphics

- Rotations
 - Viewing object from different locations
- Reflections
 - Reflection over a line
- Scaling
 - Changes the sizing of objects
- And many more transformations can be represented using matrices



Artificial Intelligence and Machine Learning

- Multiple types are used in AI such as
 - Row Matrices
 - Column Matrices
 - Triangular Matrices
- Can be used show different operations and operators
- Can be used in subjects such as
 - Natural Language Processing
 - Image Processing

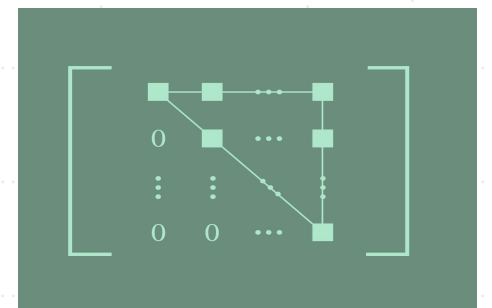
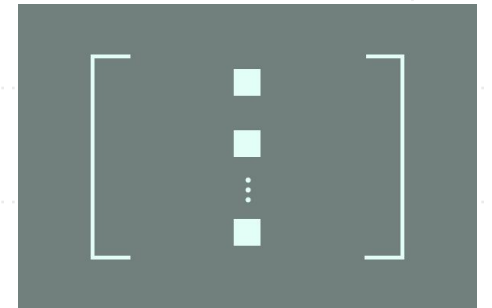
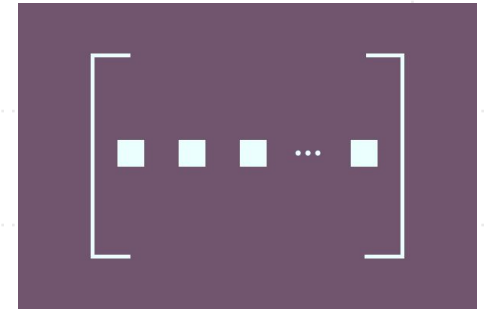
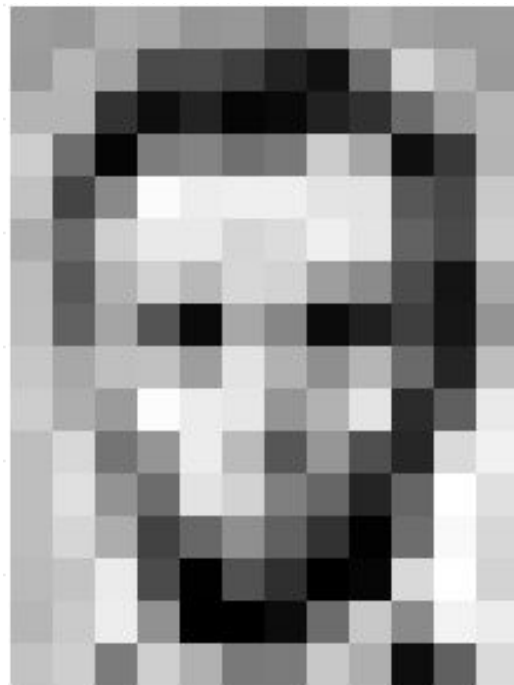


Image Recognition and Analysis



157	153	174	168	150	152	129	151	172	161	155	156
155	182	163	74	75	62	83	17	110	210	180	154
180	180	50	14	34	6	10	33	48	105	159	181
206	109	5	124	131	111	120	204	165	15	56	180
194	68	157	251	237	239	239	228	227	87	71	201
172	105	207	233	233	214	220	239	228	98	74	206
188	88	179	209	185	215	211	158	139	75	20	169
189	97	165	64	10	168	134	11	31	62	22	148
199	168	191	193	158	227	178	143	182	105	36	190
205	174	155	252	236	231	149	178	228	43	95	234
190	216	116	149	236	187	85	150	79	38	218	241
190	224	147	108	227	210	127	102	35	101	255	224
190	214	173	65	103	143	95	50	2	109	249	215
187	196	235	75	1	81	47	0	6	217	255	211
183	202	237	145	0	0	12	108	200	138	243	236
195	206	123	207	177	121	123	200	175	13	96	218

- Matrices represent data that can be associated with certain pixels
- Sorted by color, location
- Filters
- Examples of Algorithms
 - Scale-invariant Feature Transform(SIFT)
 - Speeded Up Robust Features(SURF)
 - PCA(Principal Component Analysis)

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