



ML Session - 1

Jaswanth Reddy K

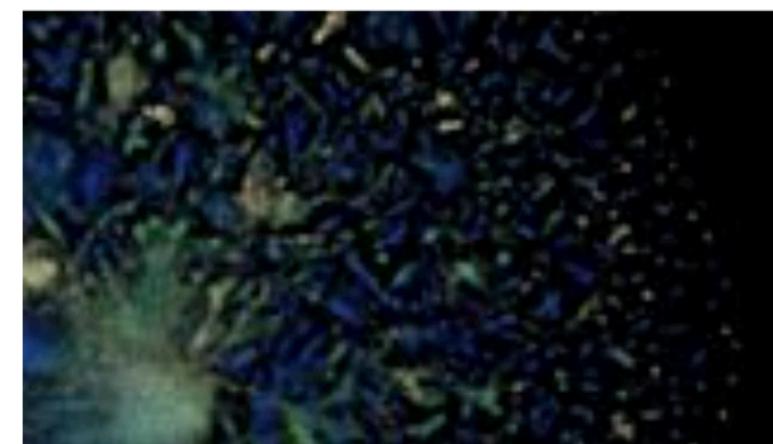
Coordinated by Dr. G Mamatha, SDIC

Assignment 1 : Survey

- OpenAI
- Tesla
- Meta - Facebook
- Deepmind
- SpaceX
- Netflix
- Amazon Cloud Services, Google Cloud Platform, Microsoft Azure
- Disney AI/ML Research
- Alexa

Recent ML Advancements

- Machine Learning and Artificial Intelligence are daily headlines.



Perceptron: AI that sees with sound, learns to walk and predicts seismic physics

Research in the field of machine learning and AI, now a key technology in practically every industry...



Perceptron: AI saving whales, steadyng gaits and banishing traffic

Research in the field of machine learning and AI, now a key technology in practically every industry...



Will Robots Save The Future Of Work?

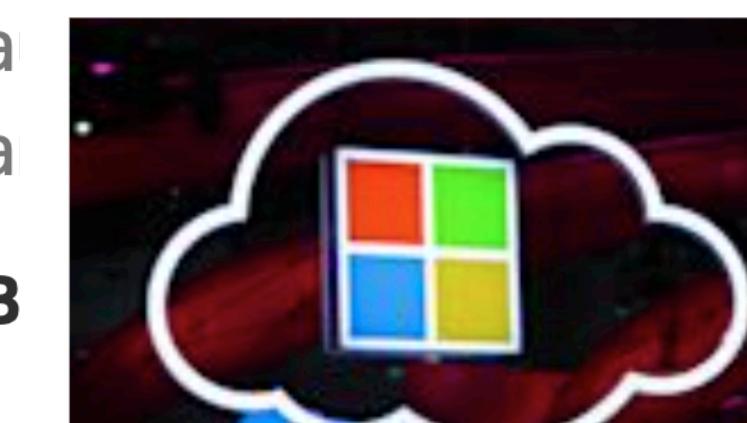
Alastair Bathgate is CEO of robotic process



Salesforce researchers are working on an AI economist for more equitable tax policy

tax policy is surely a complex beast, and depending on your political leanings, you probably have...

By Ron Miller | April 29, 2020



Microsoft and Nvidia team up to build new Azure-hosted AI supercomputer

Roughly two years ago, Microsoft announced a partnership with OpenAI, the AI lab with which it has a...

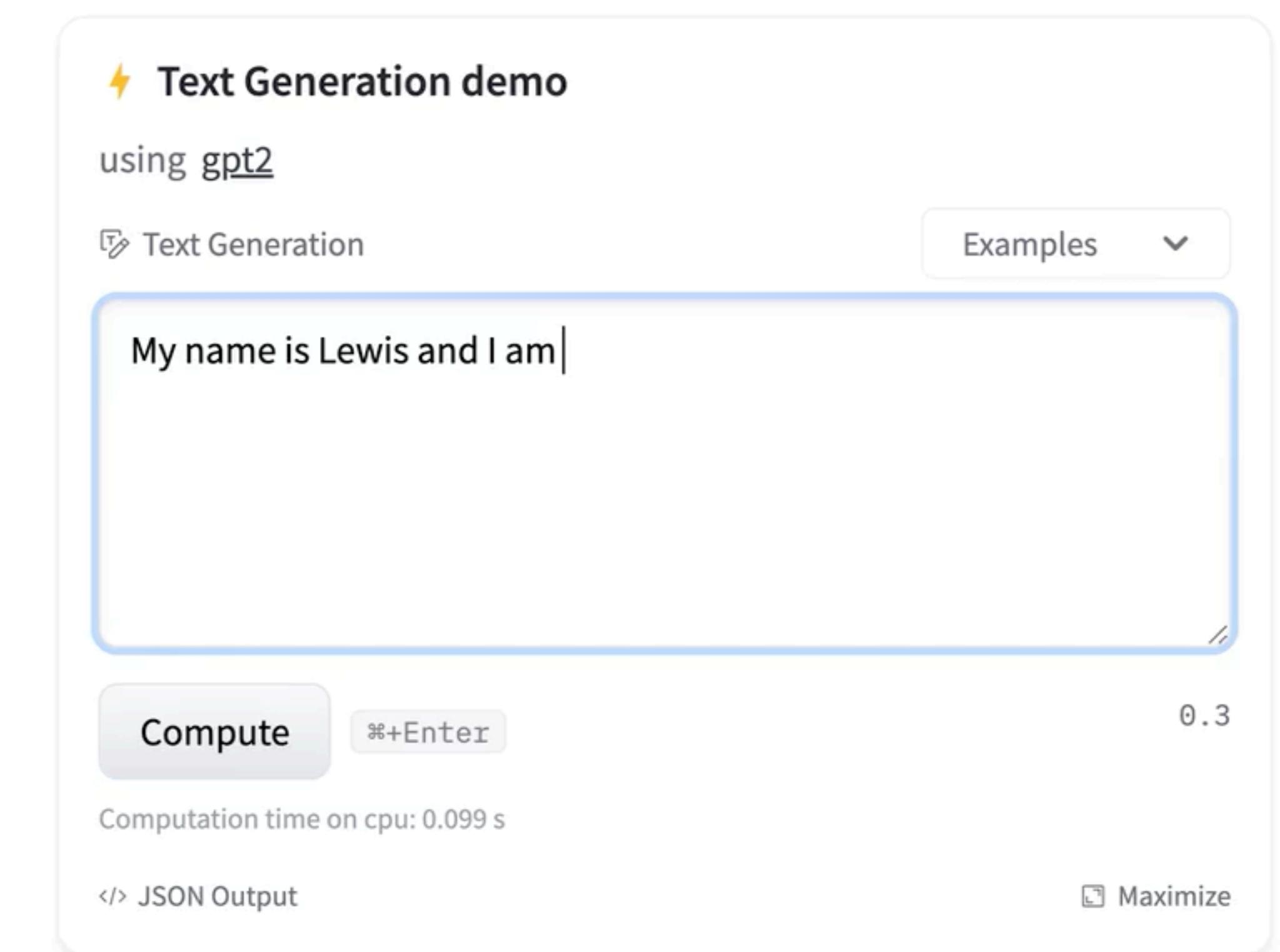
By Kyle Wiggers | November 16, 2022

Recent ML Advancements : Text

- My name is Lewis and I am a student at the University of Iowa. I'm going to be working a two-week summer program to complete my PhDs in computer science.
- My name is Lewis and I am a working professional, getting up early and having a career and helping others. I am a mobile phone addict but also own an old Nokia phone that still works. I just use it as an alarm clock.

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Recent ML Advancements : Image

Image captioning



"man in black shirt is playing guitar."



"construction worker in orange safety vest is working on road."



"two young girls are playing with lego toy."

Source : <https://towardsdatascience.com/image-captioning-in-deep-learning-9cd23fb4d8d2>

Image generation



Prompt : **John Snow sitting on the iron throne**

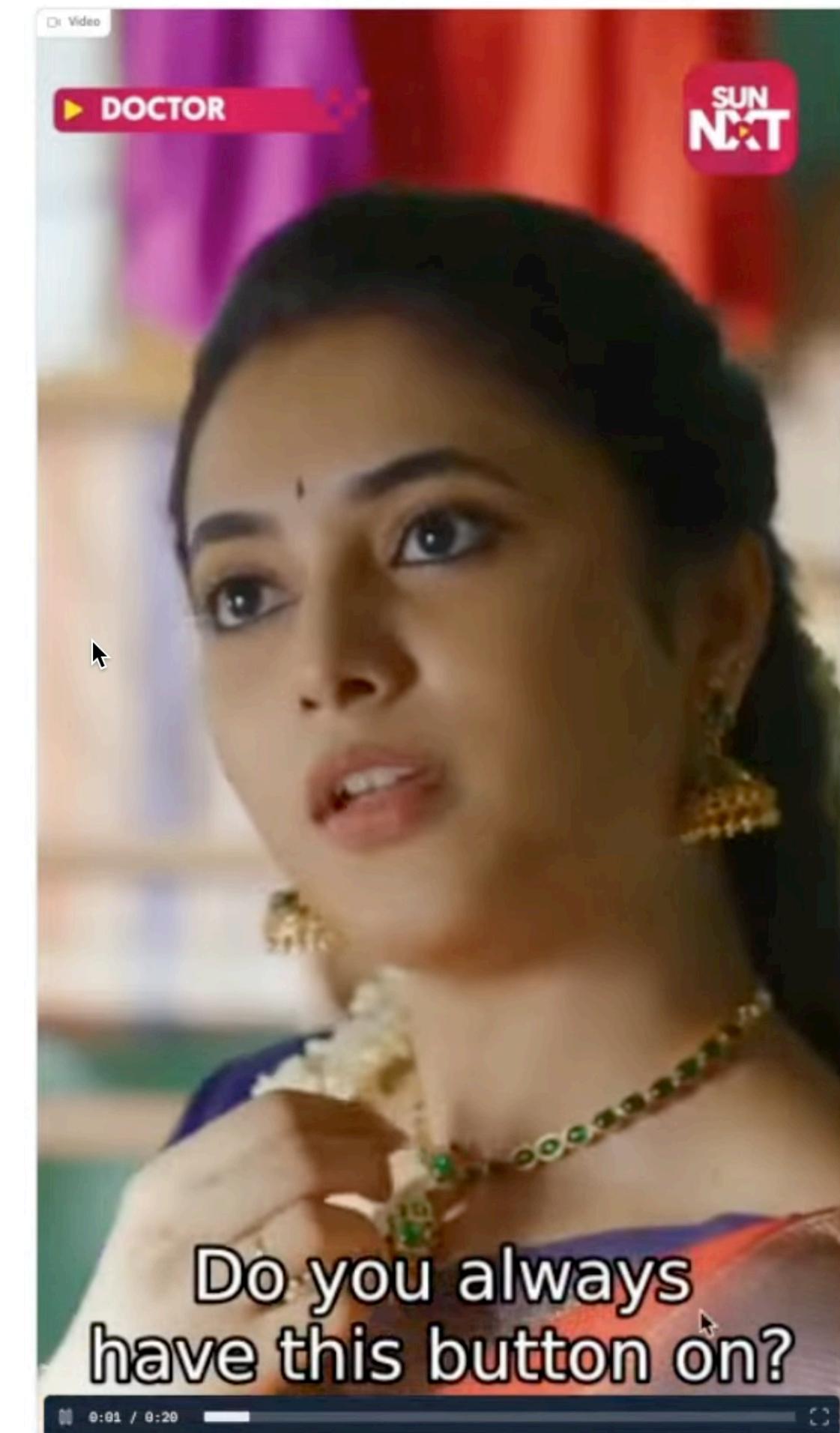
Recent ML Advancements : Audio

Audio Transcription

transcription

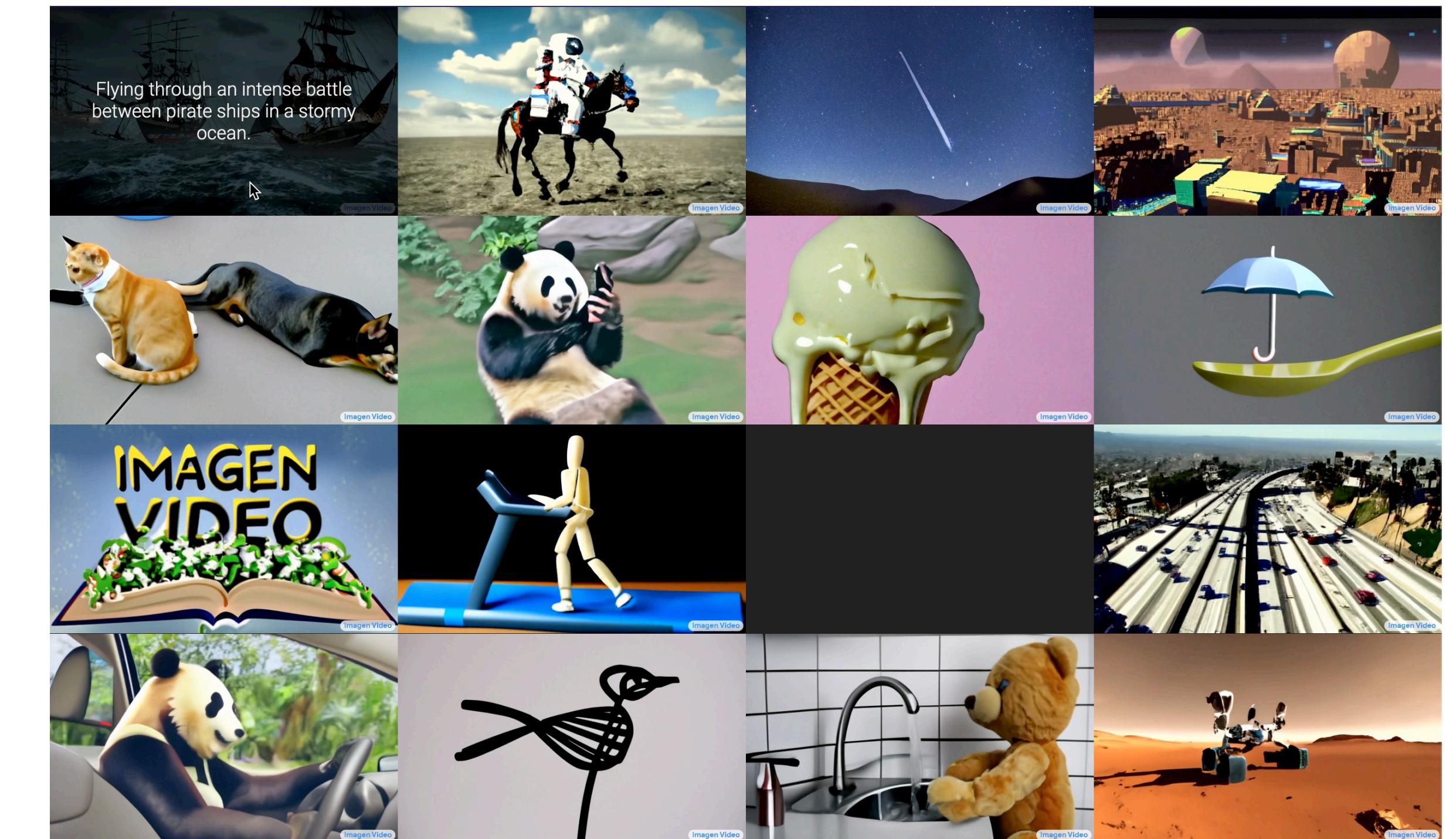
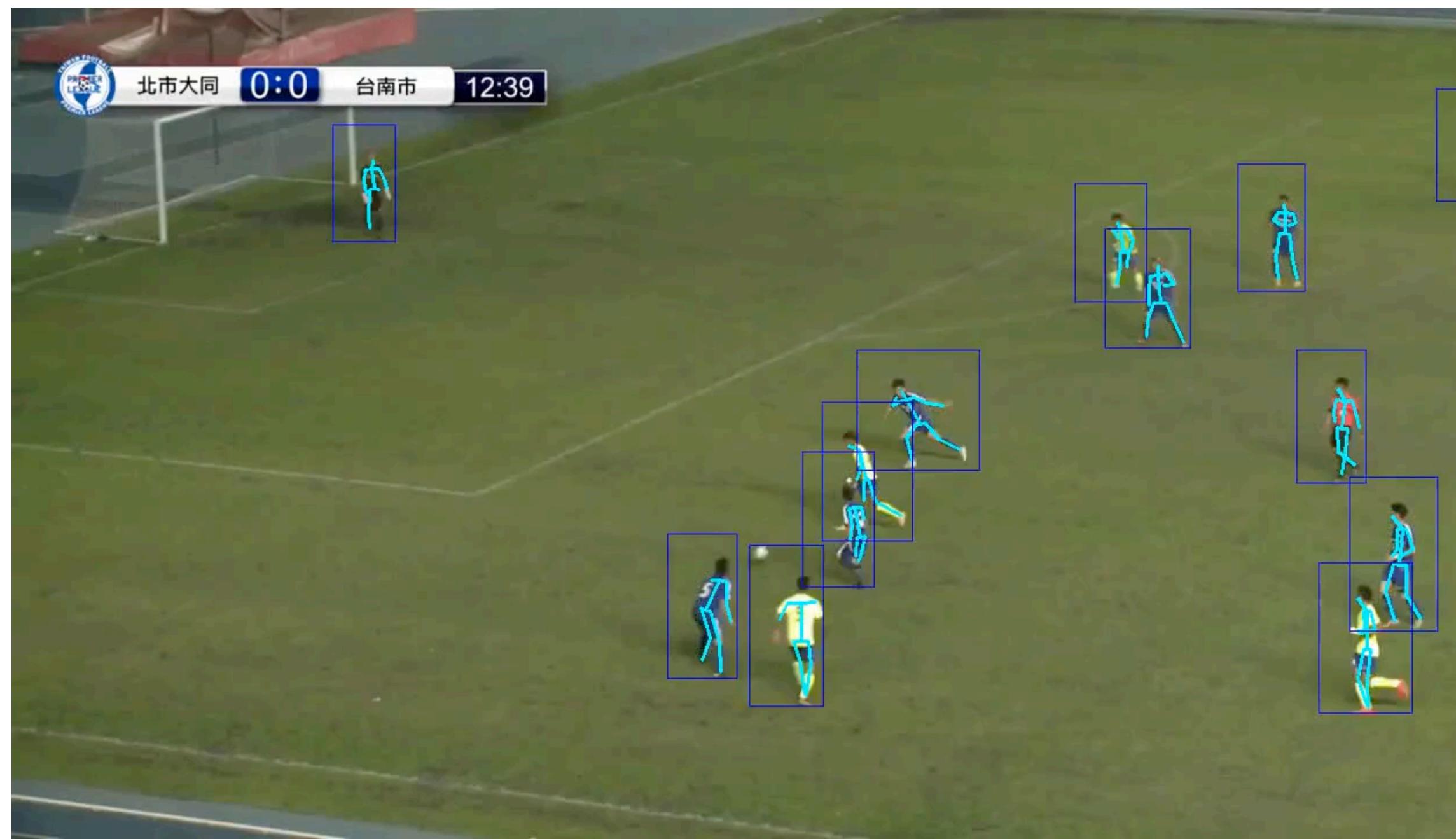
The little tales they tell are false. The door was barred, locked, and bolted as well. Ripe pears are fit for a queen's table. A big wet stain was on the round carpet. The kite dipped and swayed, but stayed aloft. The pleasant hours fly by much too soon. The room was crowded with a mild wob. The room was crowded with a wild mob. This strong arm shall shield your honour. She blushed when he gave her a white orchid. The beetle droned in the hot June sun.

Source : <https://replicate.com/openai/whisper/examples>



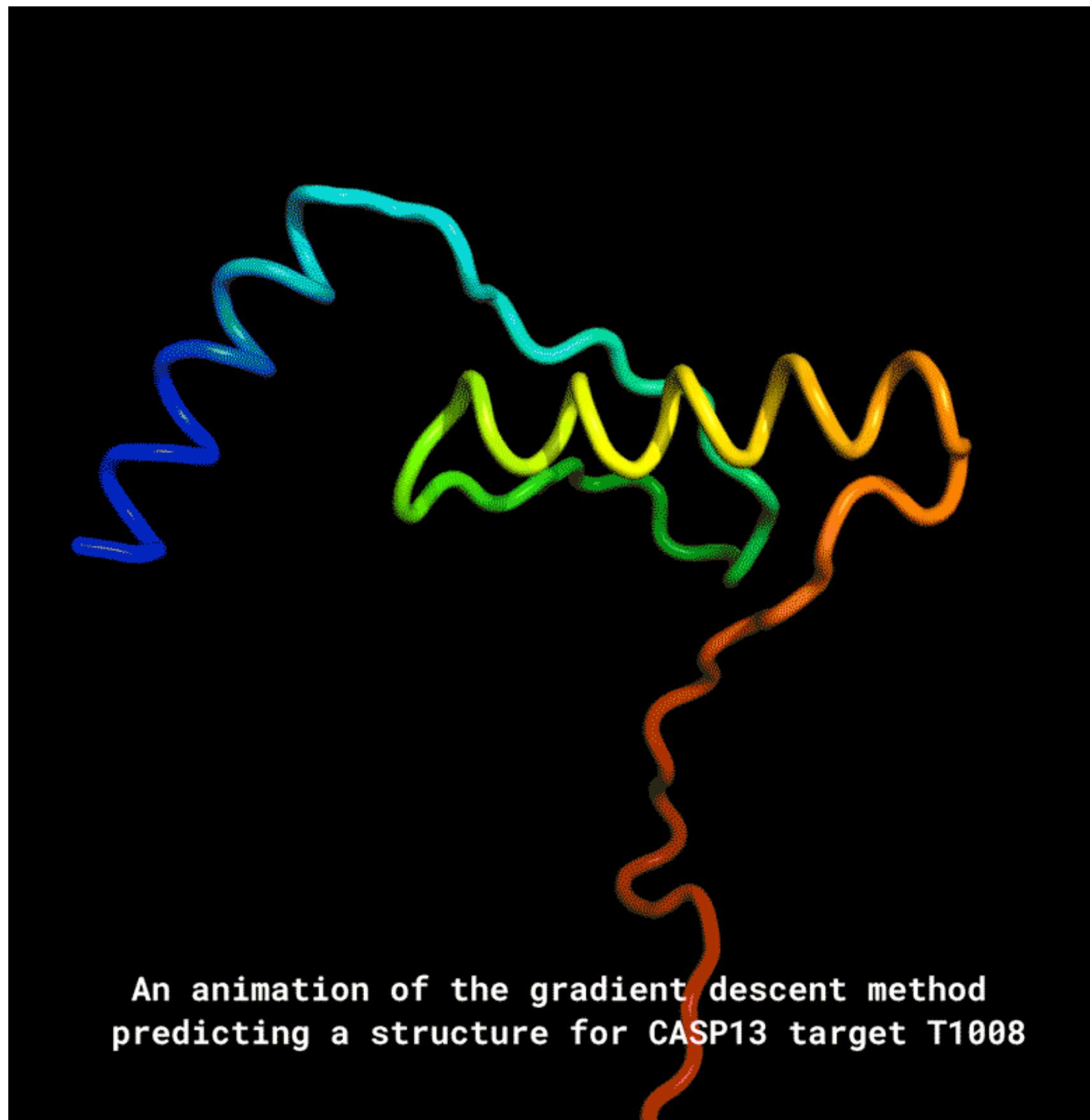
Source : <https://github.com/amrrs/subtitle-embedded-video-generator>

Recent ML Advancements : Video

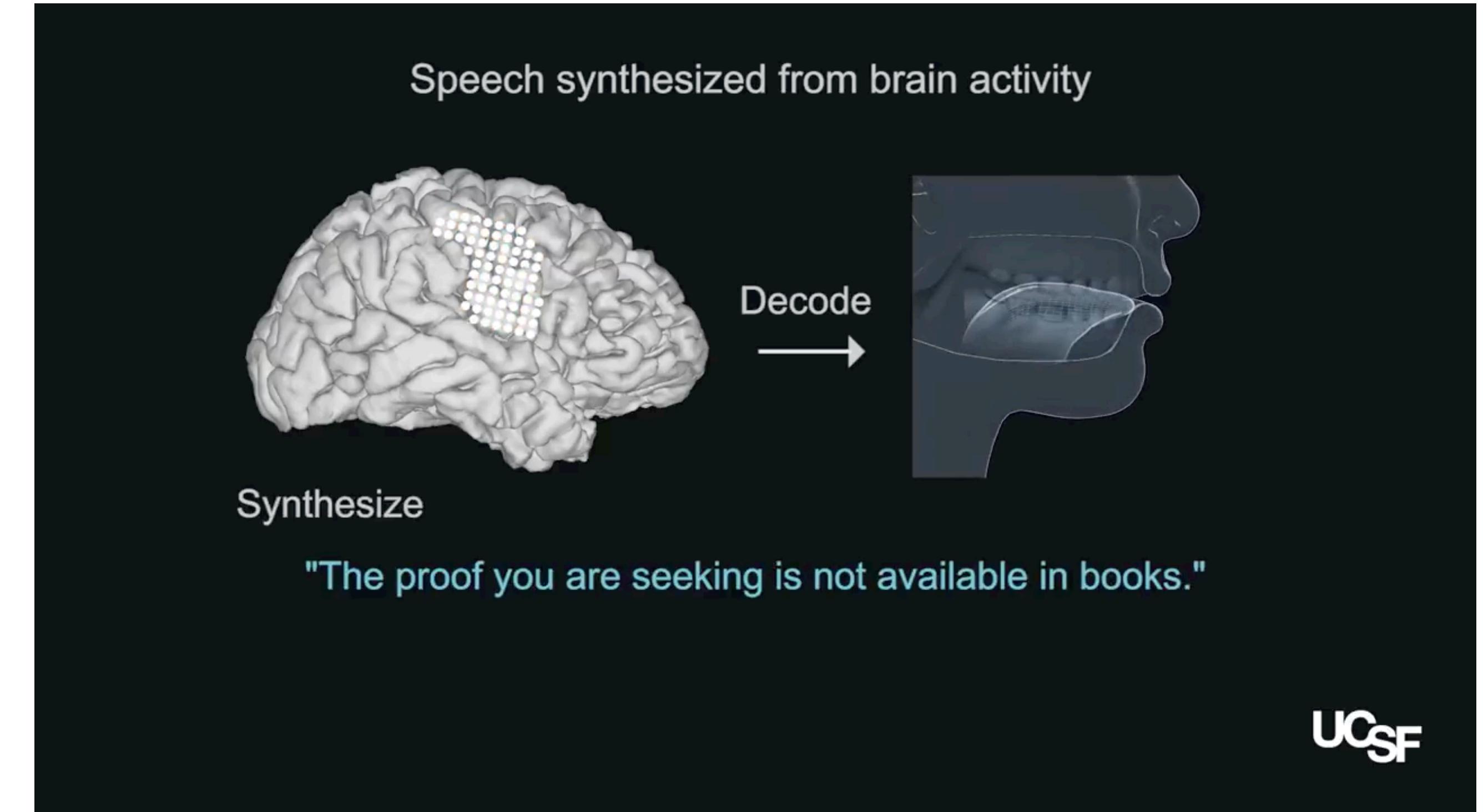


Recent ML Advancements : Other Fields

AlphaFold



Brain recordings to speech synthesis



Source : <https://www.ucsf.edu/news/2019/04/414296/synthetic-speech-generated-brain-recordings>

Source : <https://www.deepmind.com/blog/alphafold-using-ai-for-scientific-discovery-2020>

JA

Why are these important to you?

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- All these advancements affect the market

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Rapid Transit in 1877 - First Horse Car run in Manchester, N.H.

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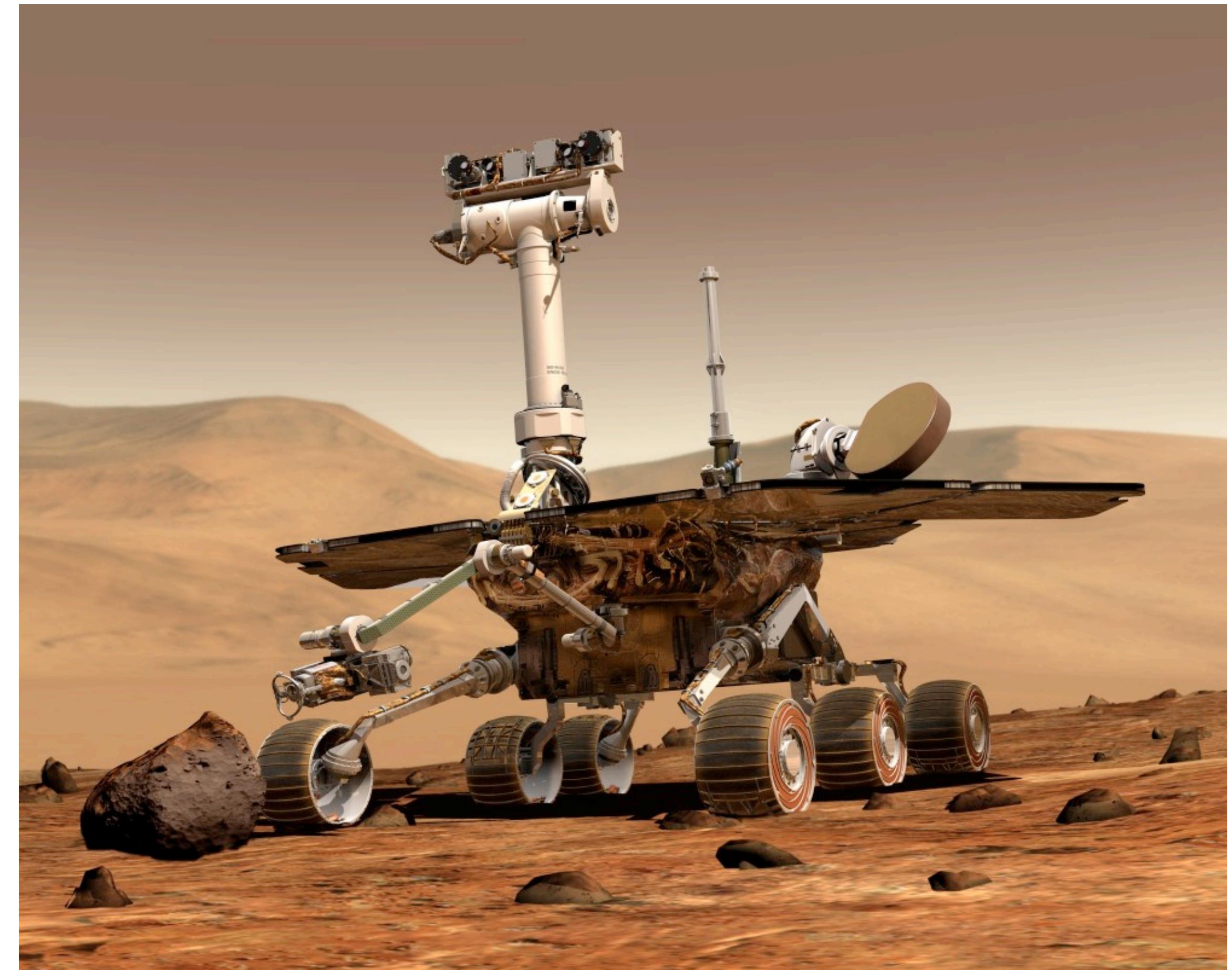
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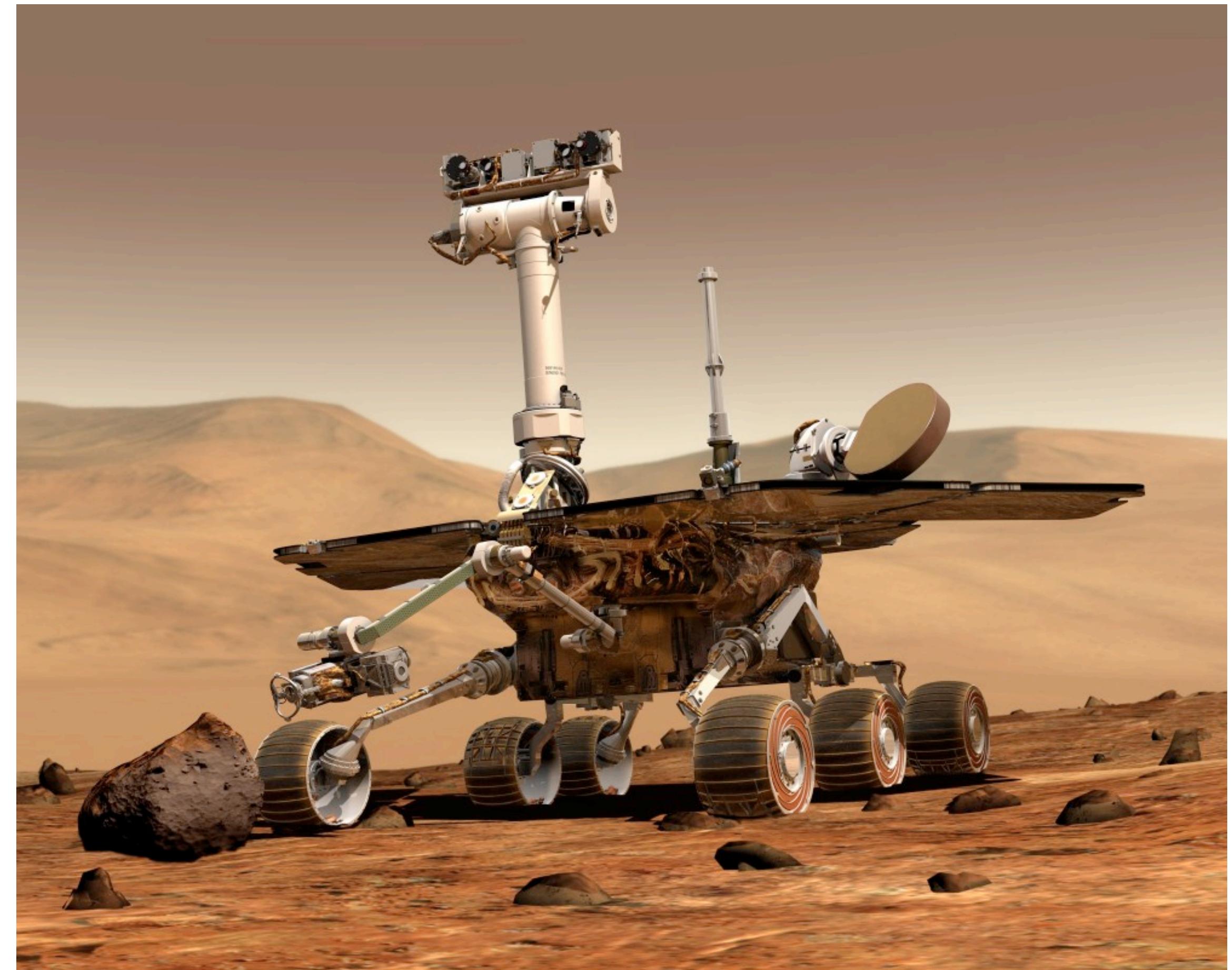
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- They affect the jobs available
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- The academic curriculum is getting outdated
- And, most importantly
- To maintain your curiosity
- And use it in a beneficial direction



Practical

- Scripting language
- Object Oriented Programming
- Python
- Machine Learning libraries
- Deep Learning libraries
- Jupyter Notebooks for EDA
- Kaggle competitions
- Research projects

Theory

- Maths
 - Linear Algebra
 - Optimization Theory
- Probability
- Random Variables
- Moments
- Signal Processing
- Machine Learning Algorithms
- Research papers

Signals and Processing them

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 - To produce more signals
- How do we represent them?
 - Using bits and bytes

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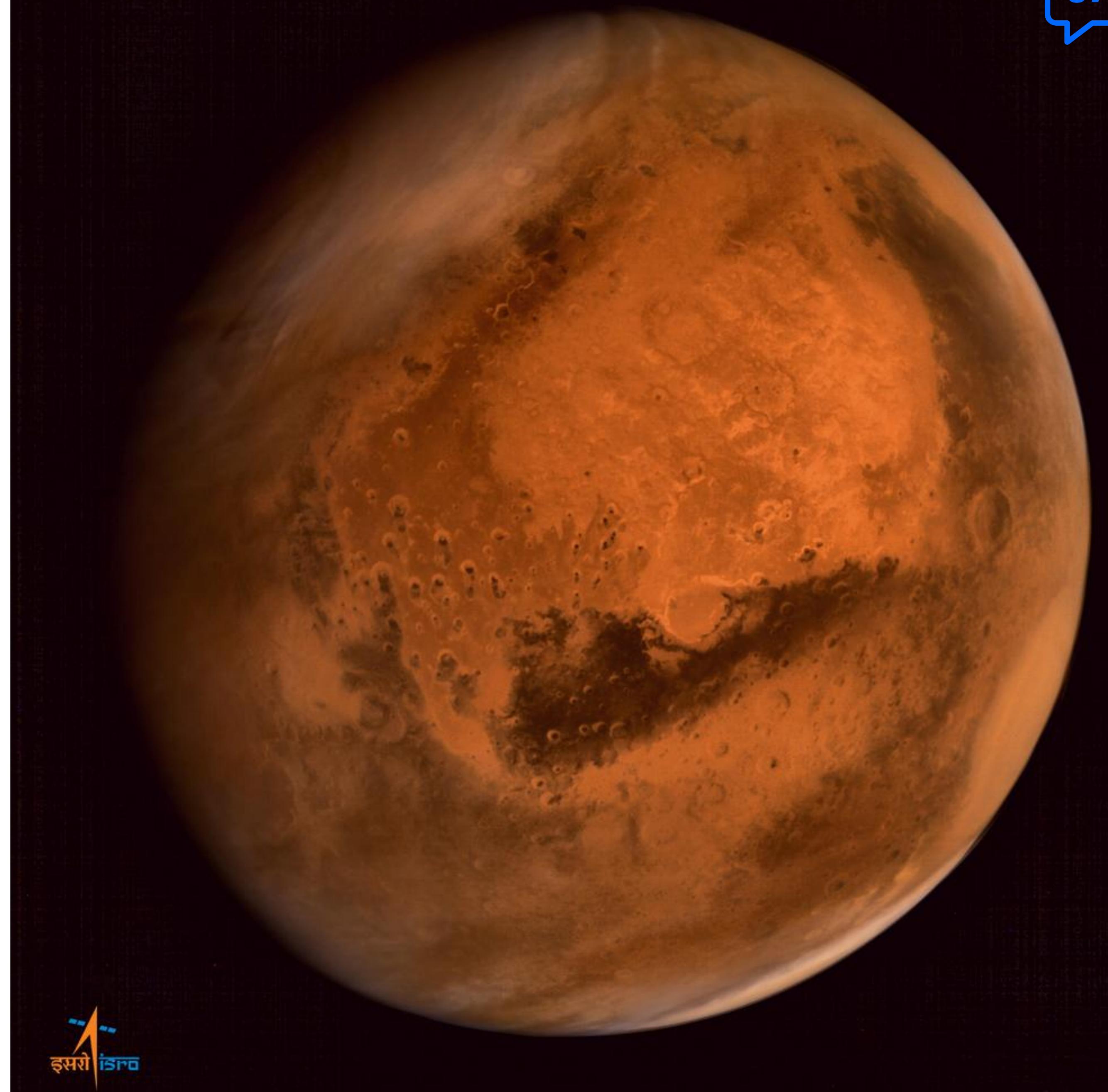
Signal Processing

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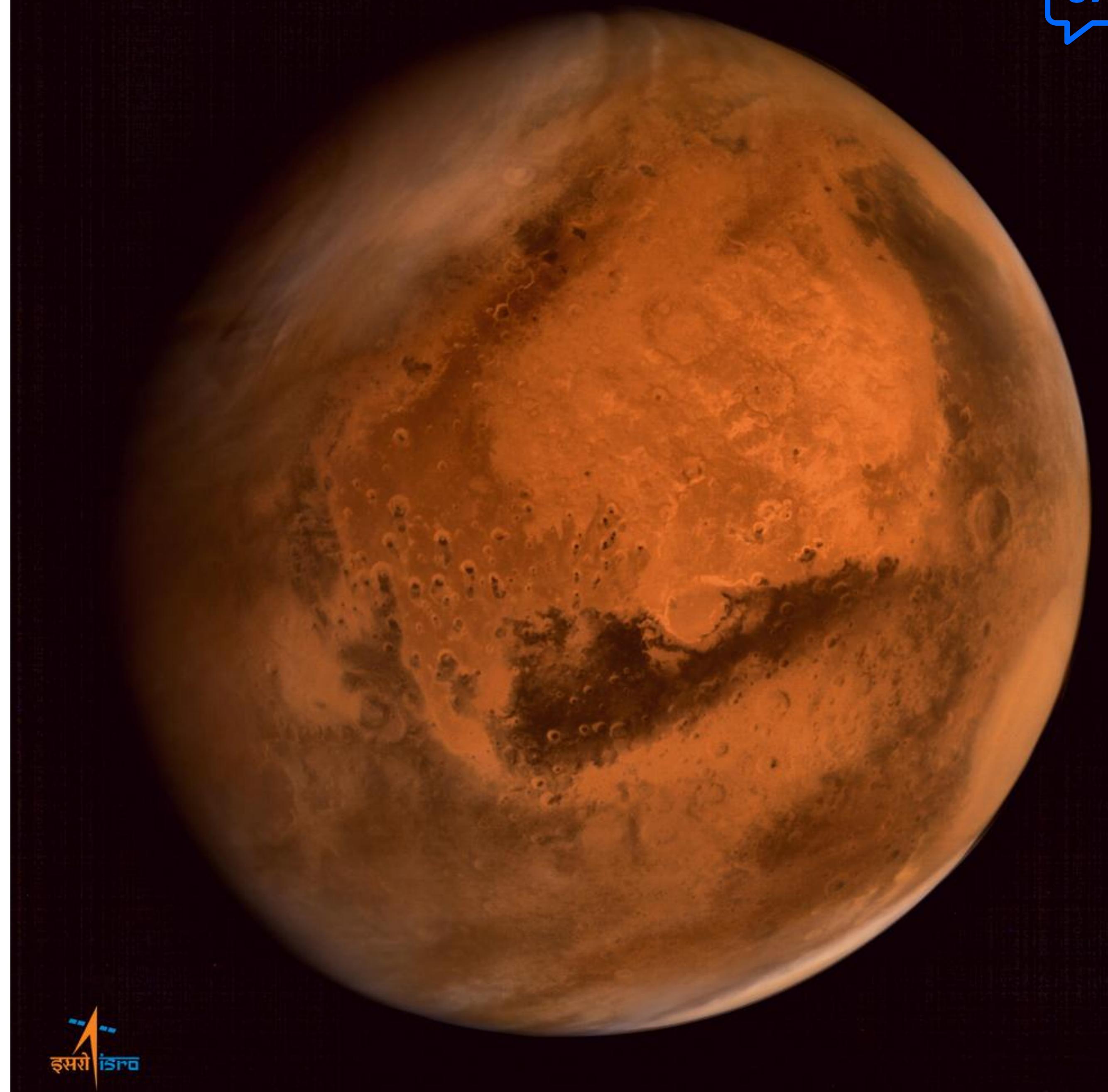
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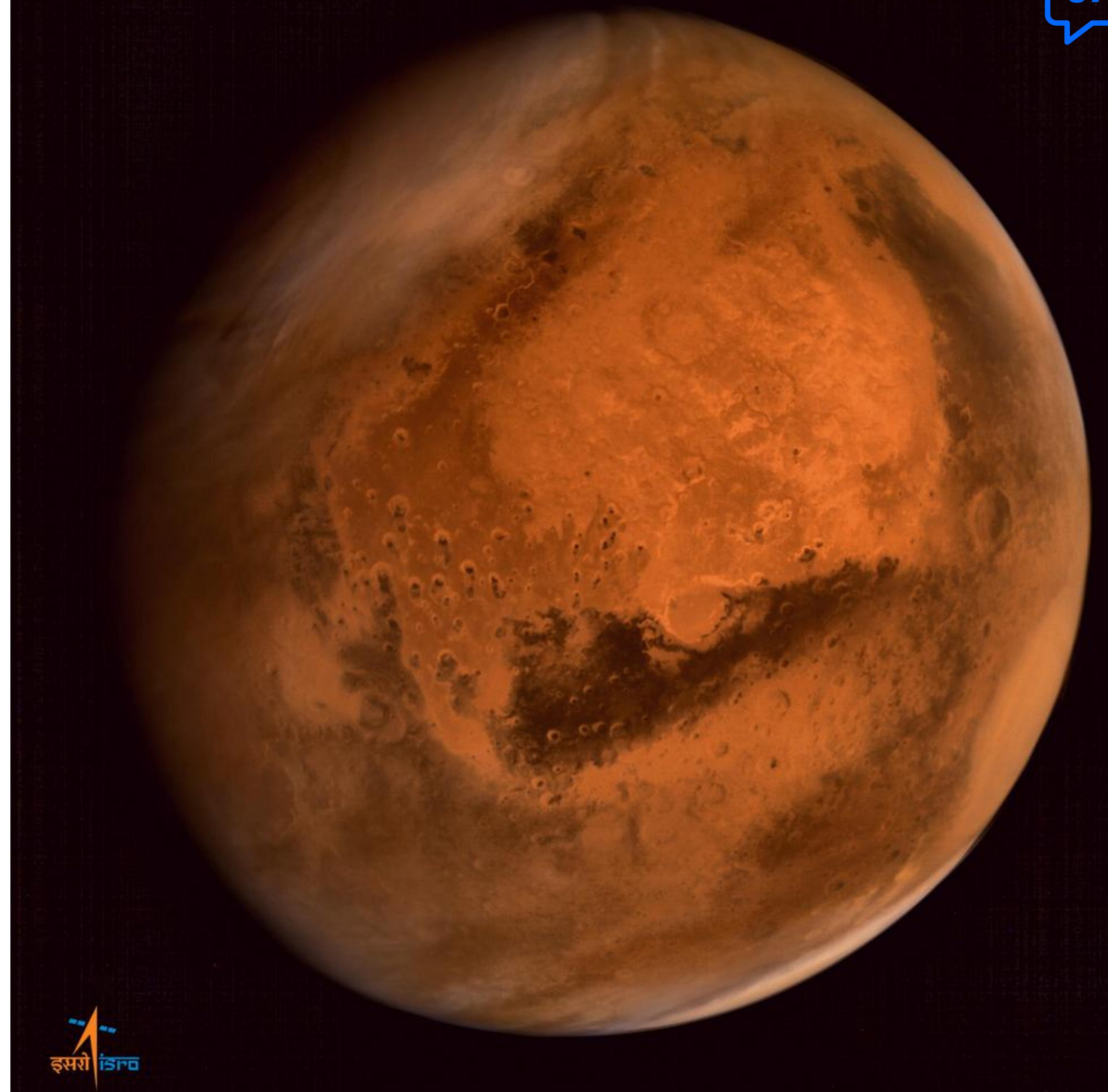
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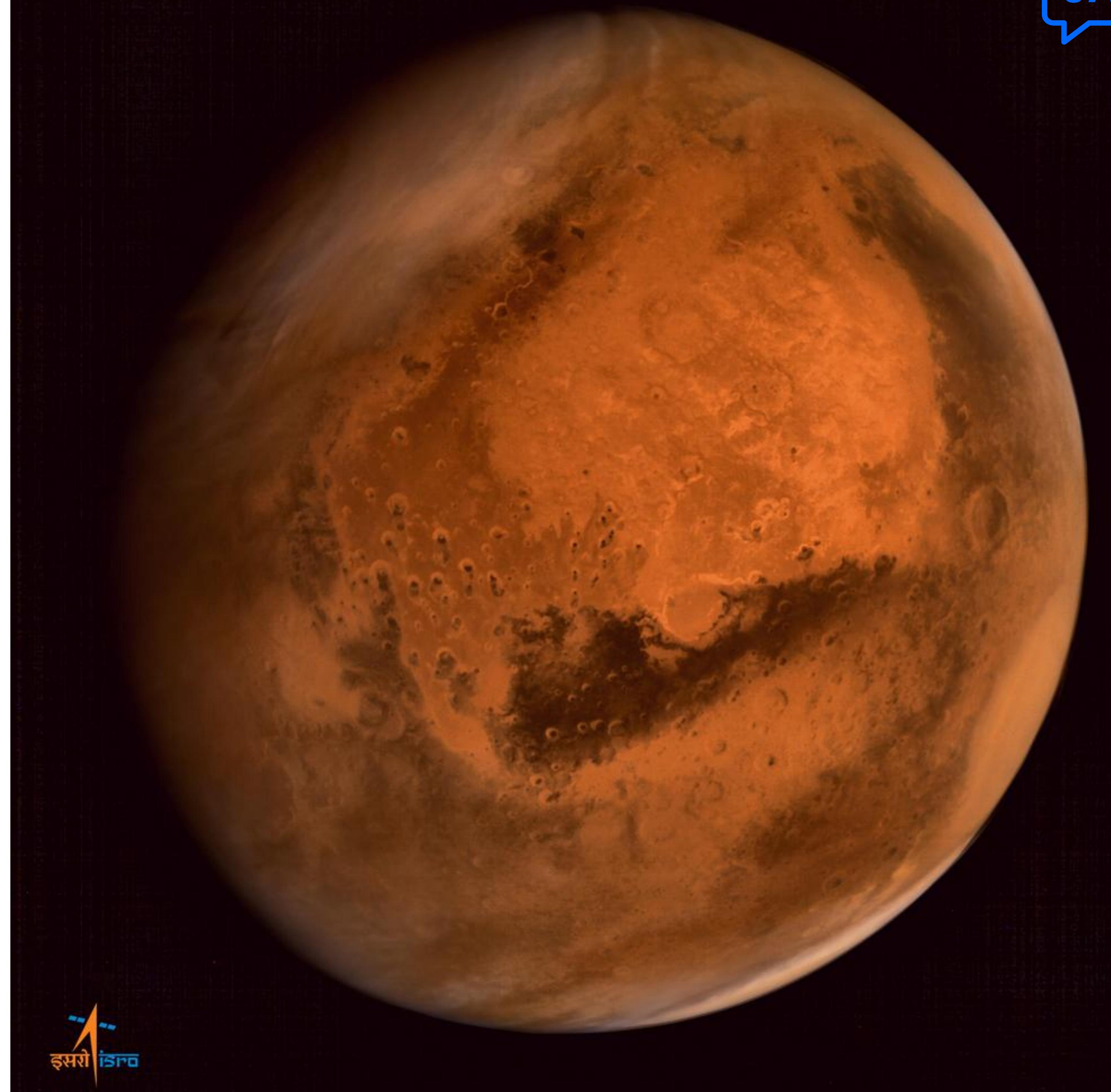
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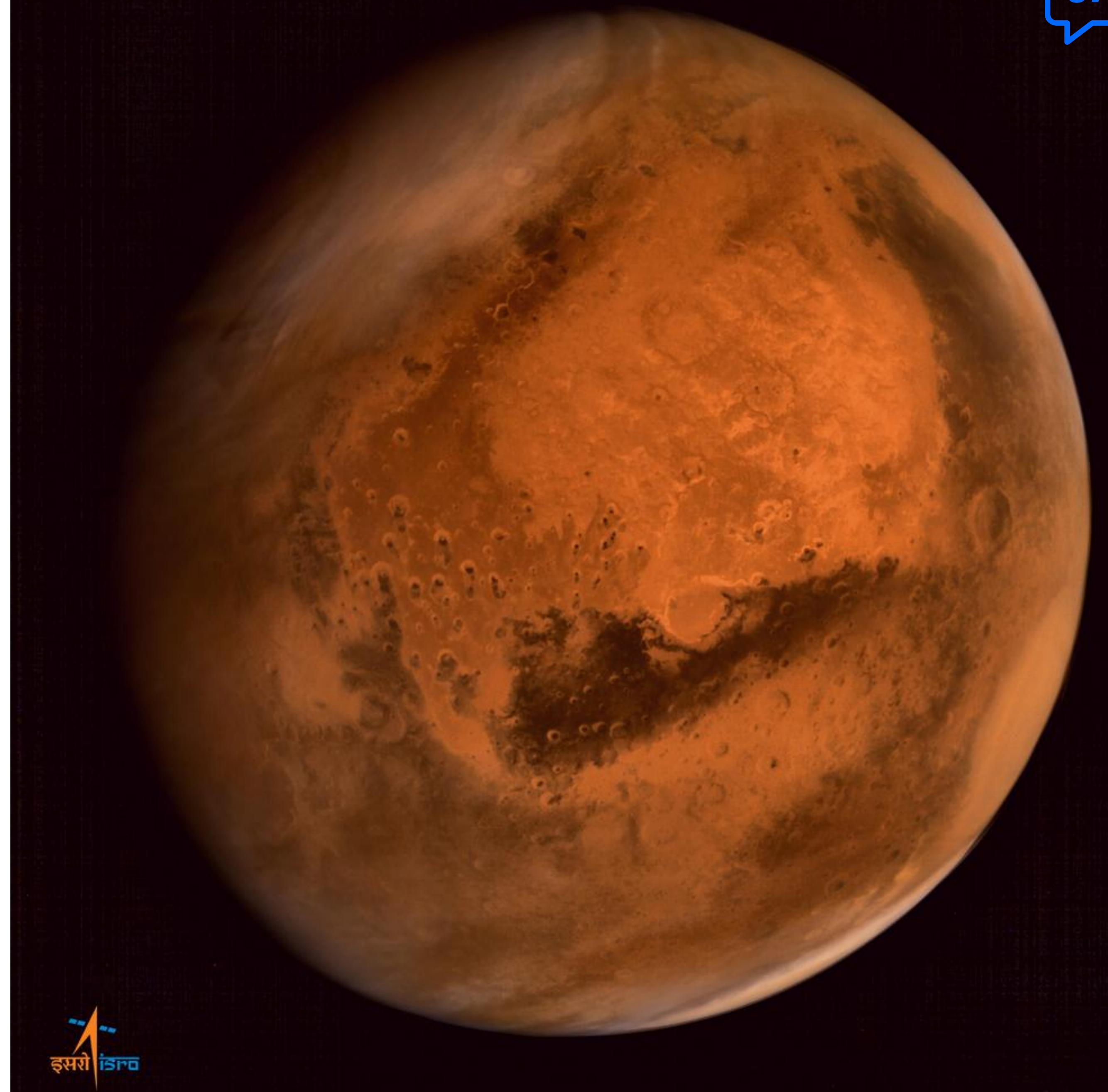
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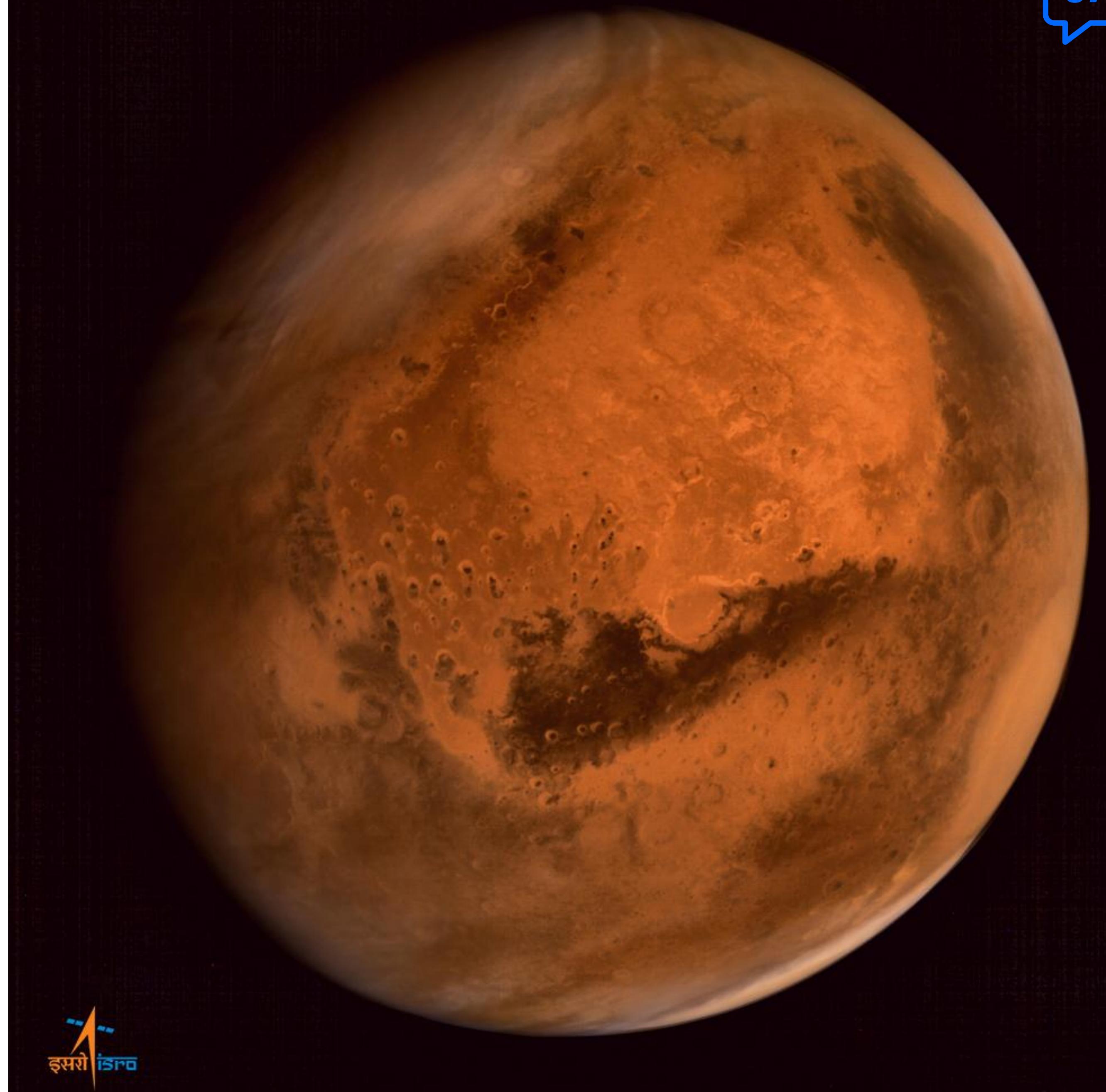
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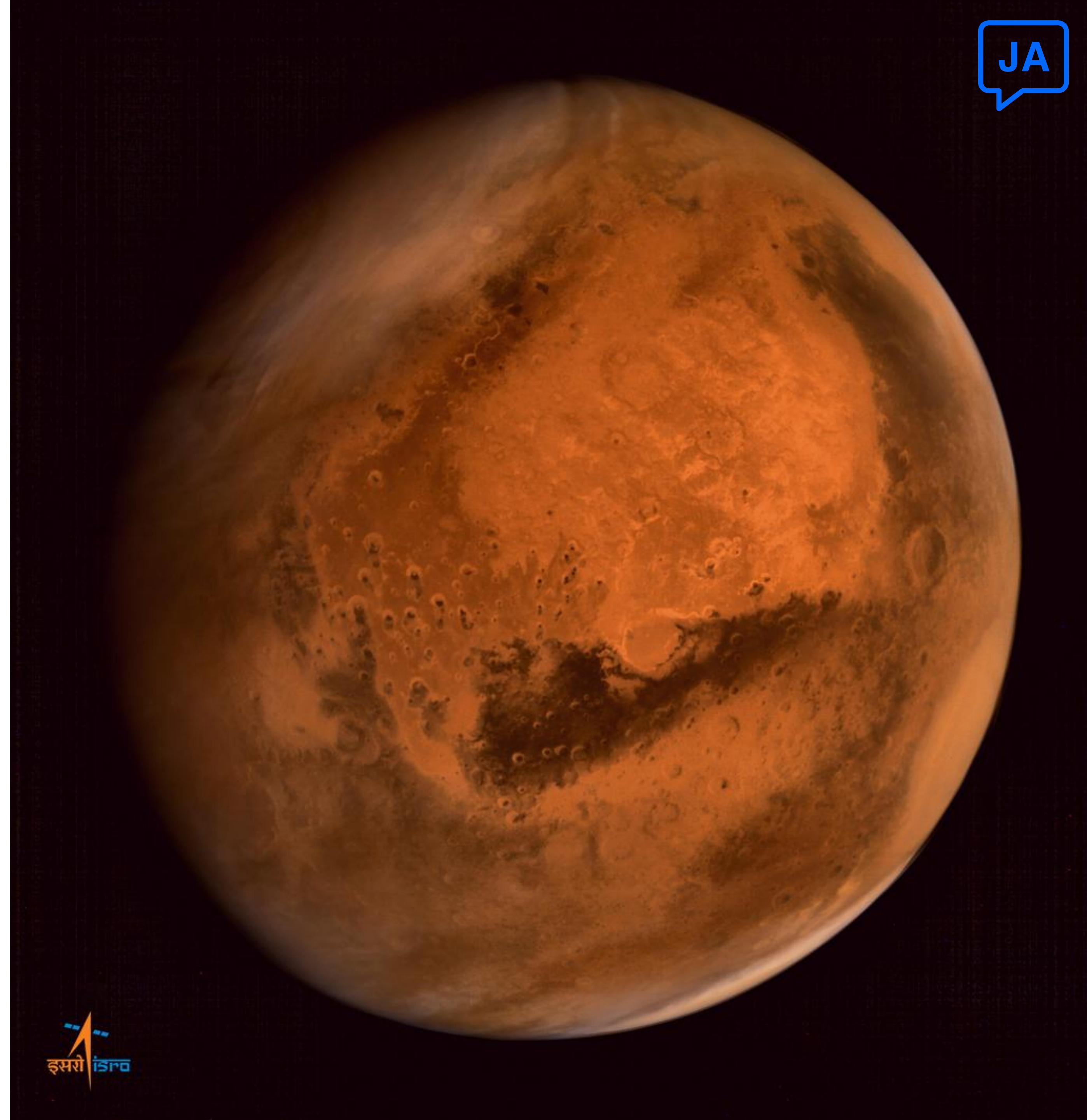
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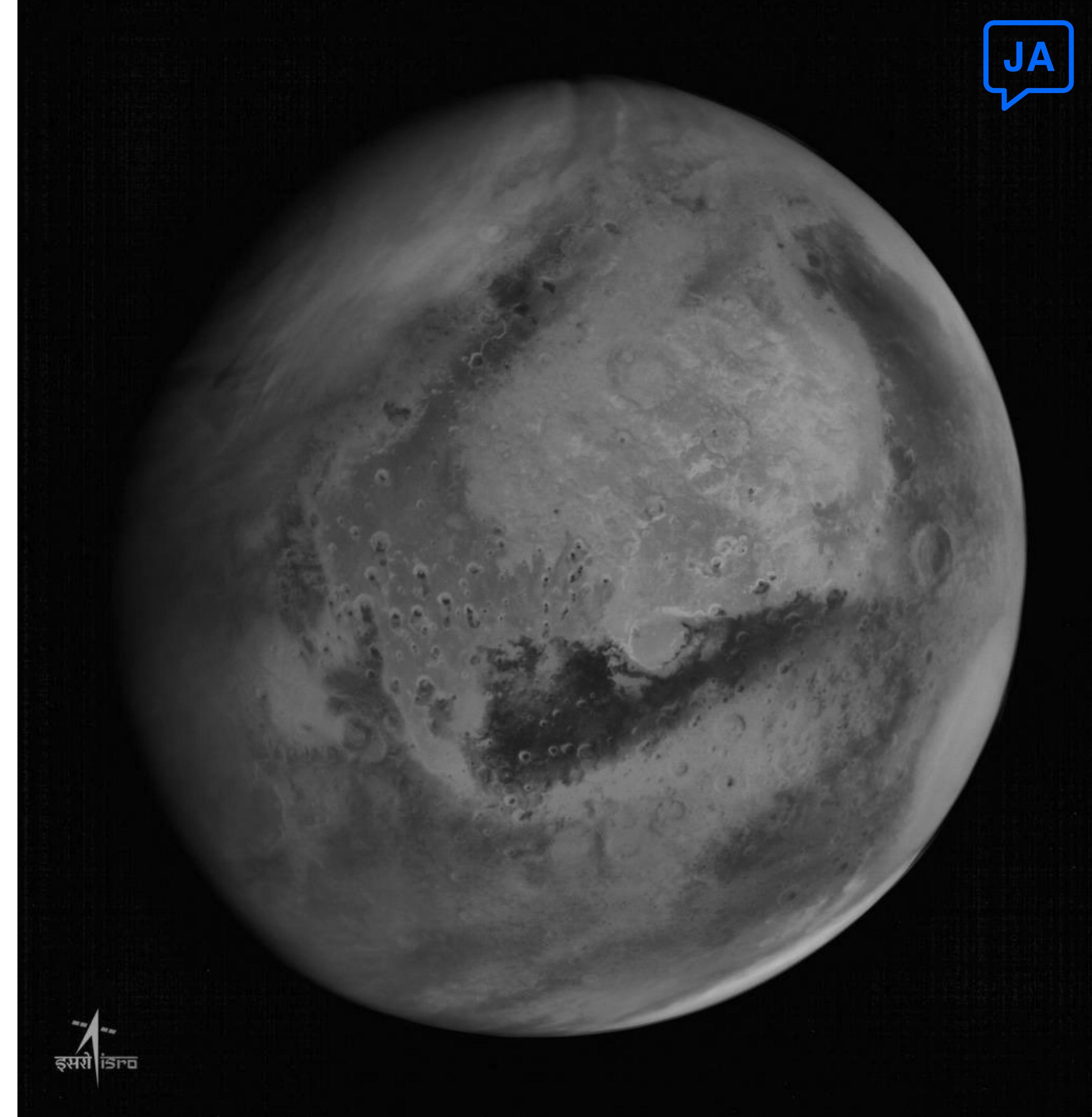
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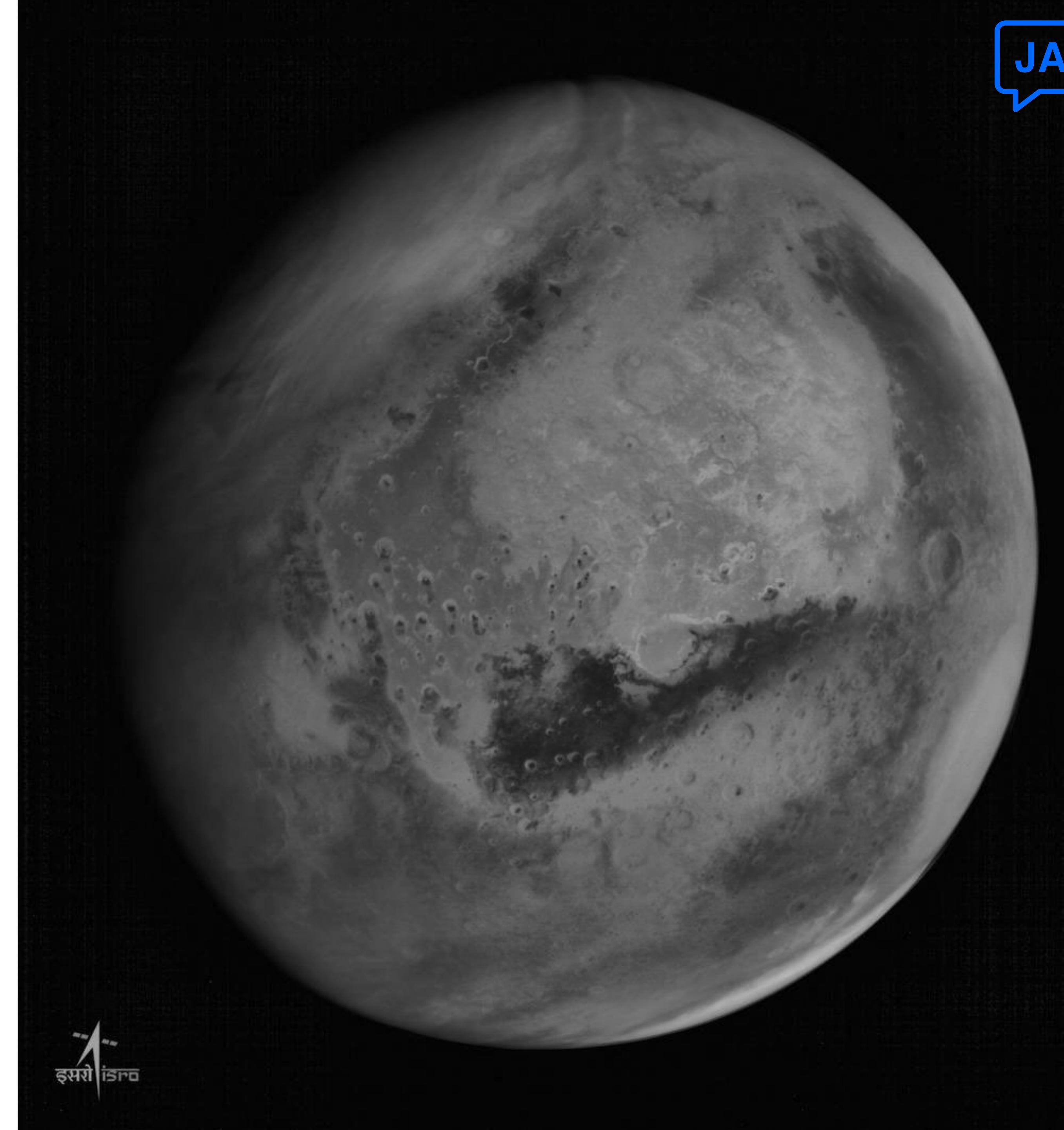
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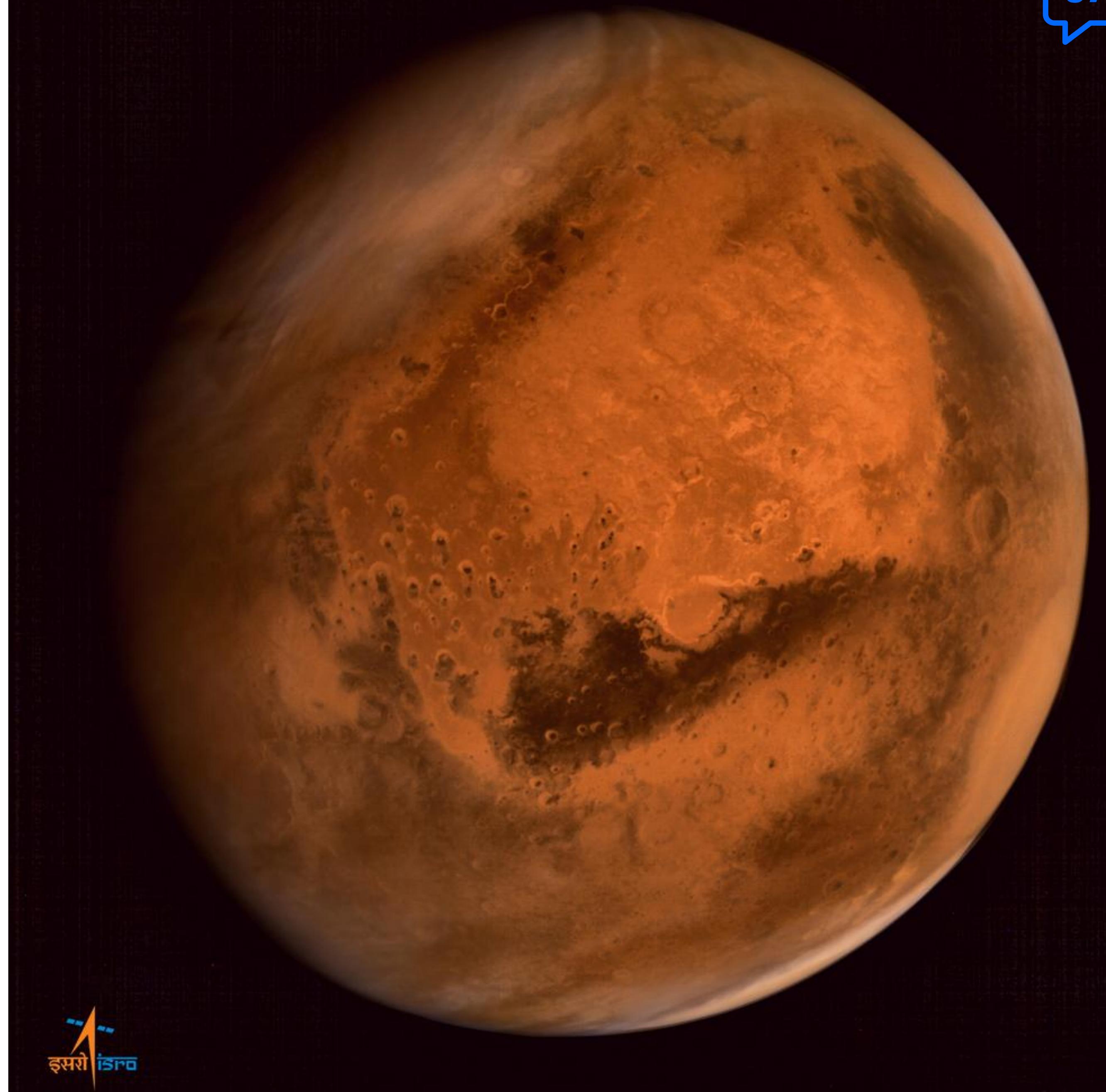
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JA

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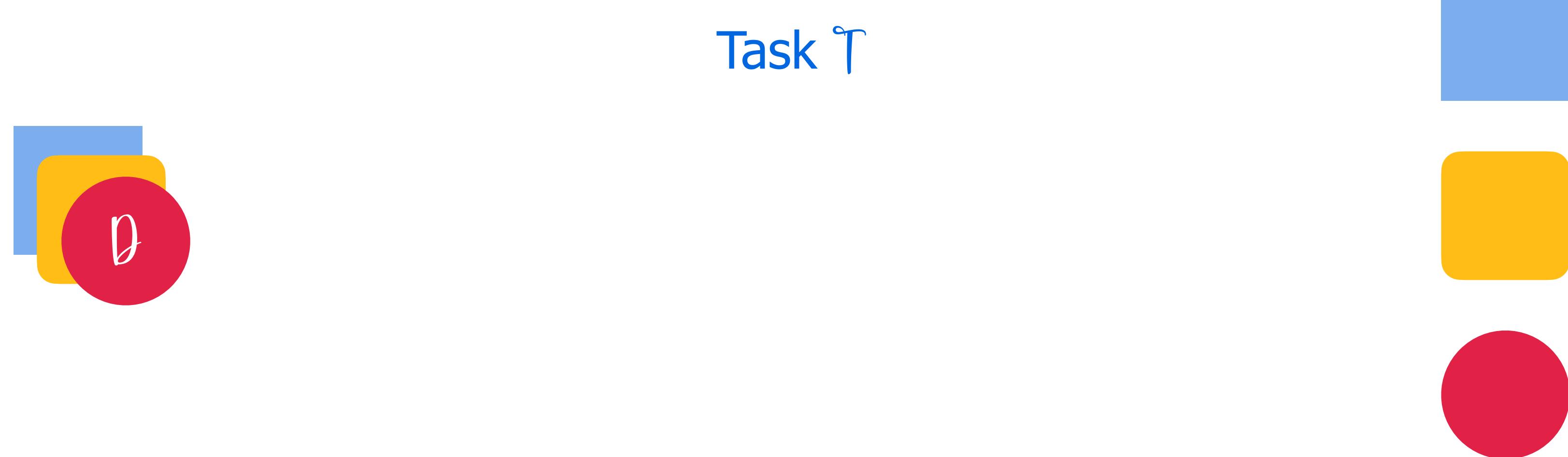
Signal Processing

- Data D



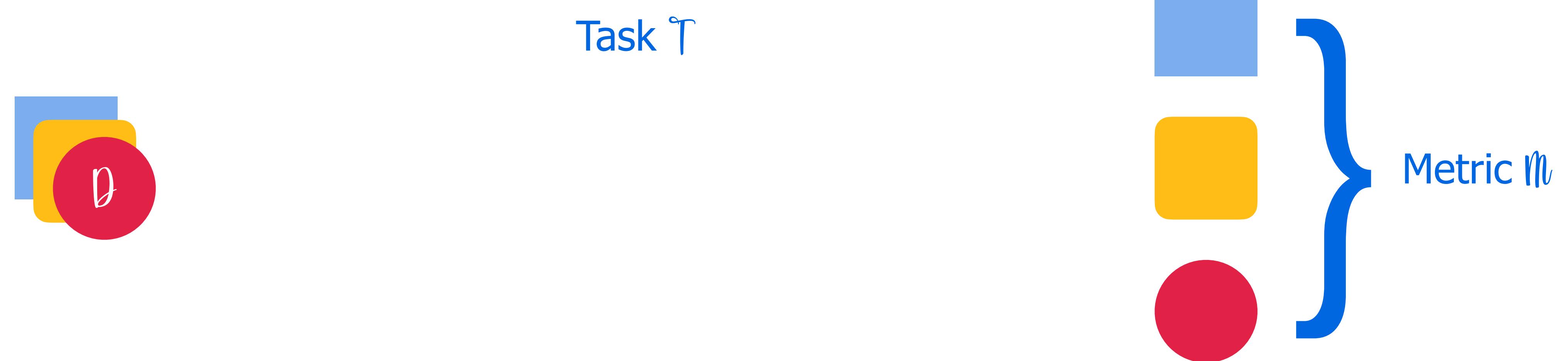
Signal Processing

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- Task T



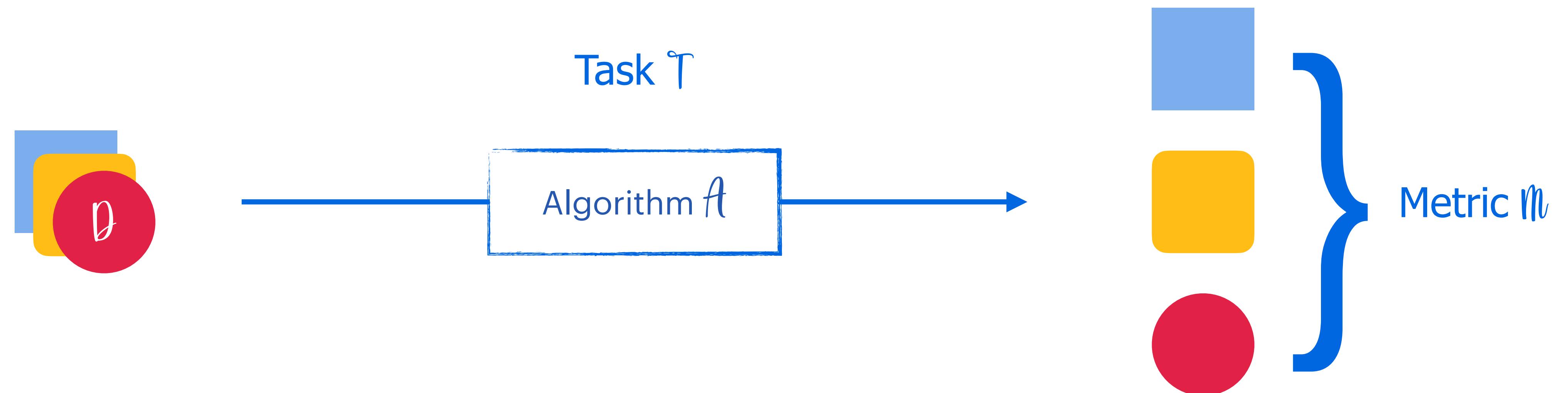
Signal Processing

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- Task T
- Metric M



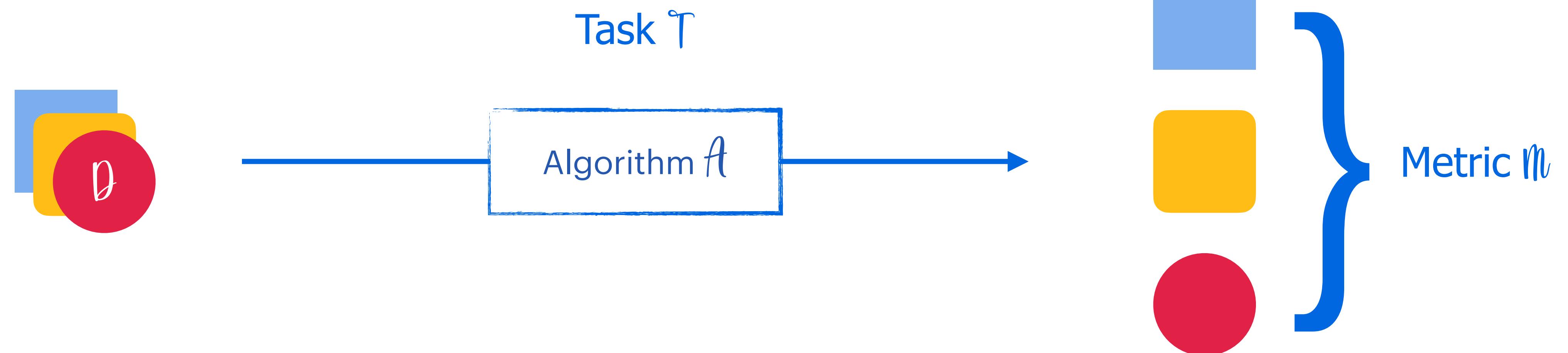
Signal Processing

- Data D
- Task T
- Metric M
- Algorithm \mathcal{A}



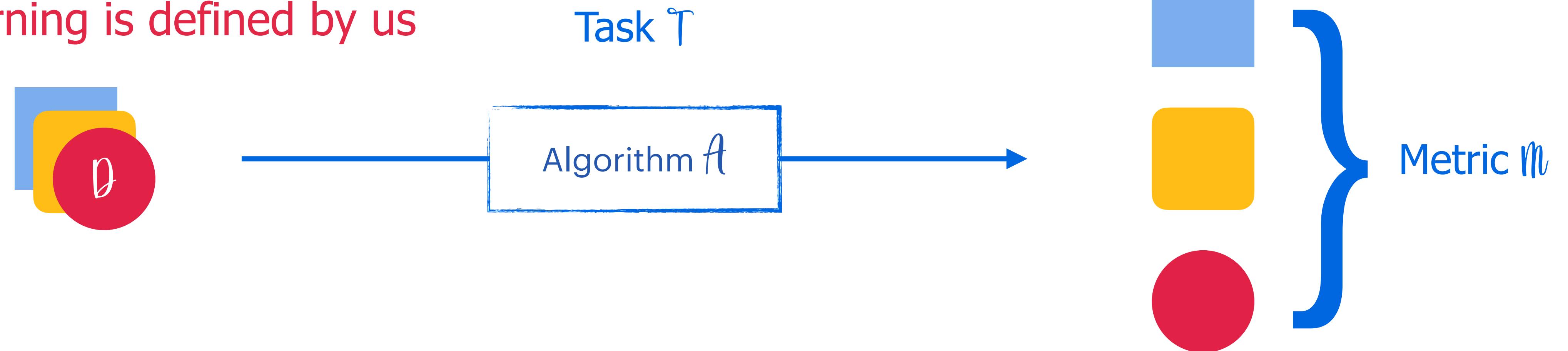
Signal Processing

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- Metric M
- Algorithm f
- Specified by us



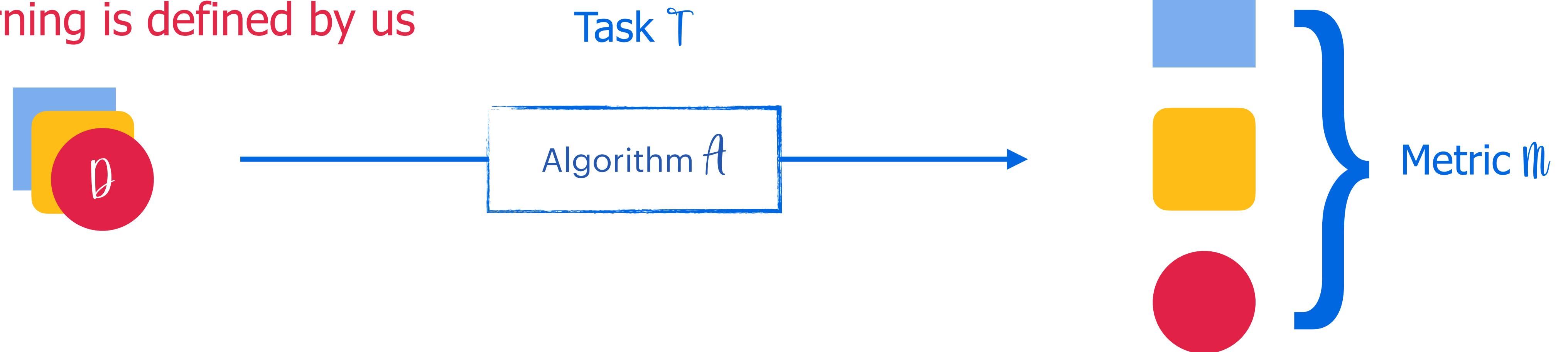
Signal Processing

- Data D
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- Metric M
- Algorithm f
 - Learnt by Machine
 - The learning is defined by us



Machine Learning

- Data D
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Machine Learning for Signal Processing

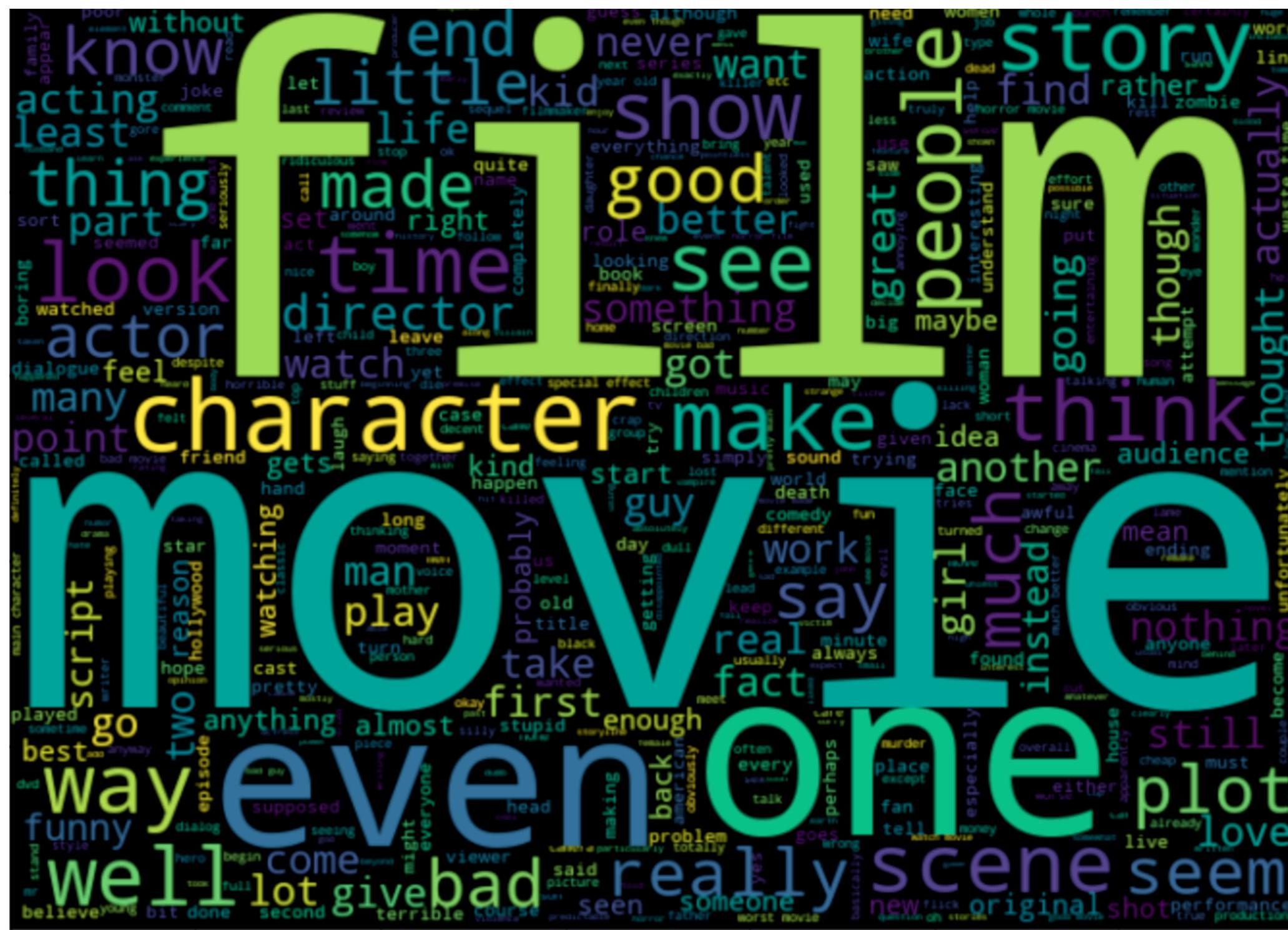
Machine Learning for Signal Processing

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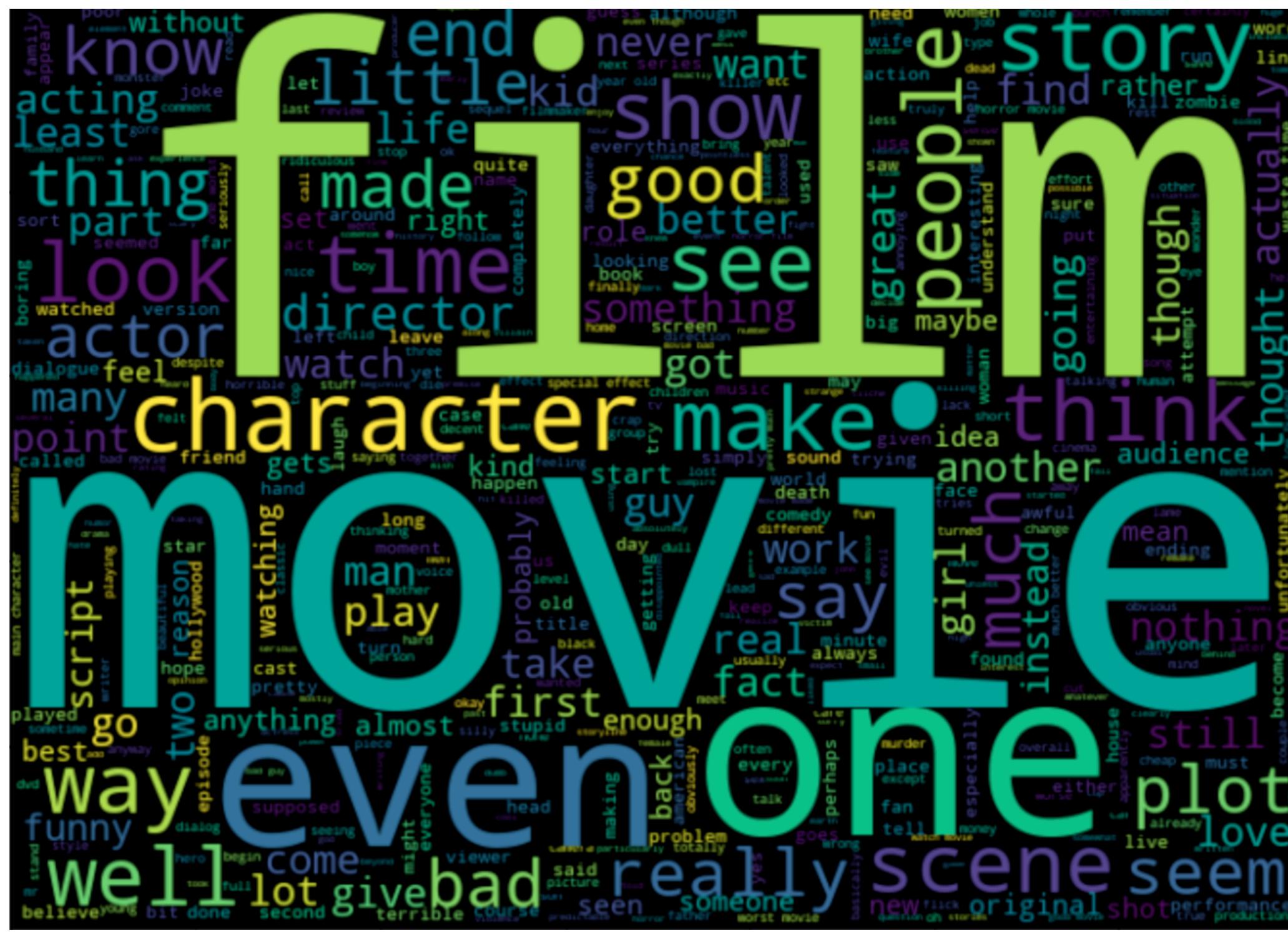
Text



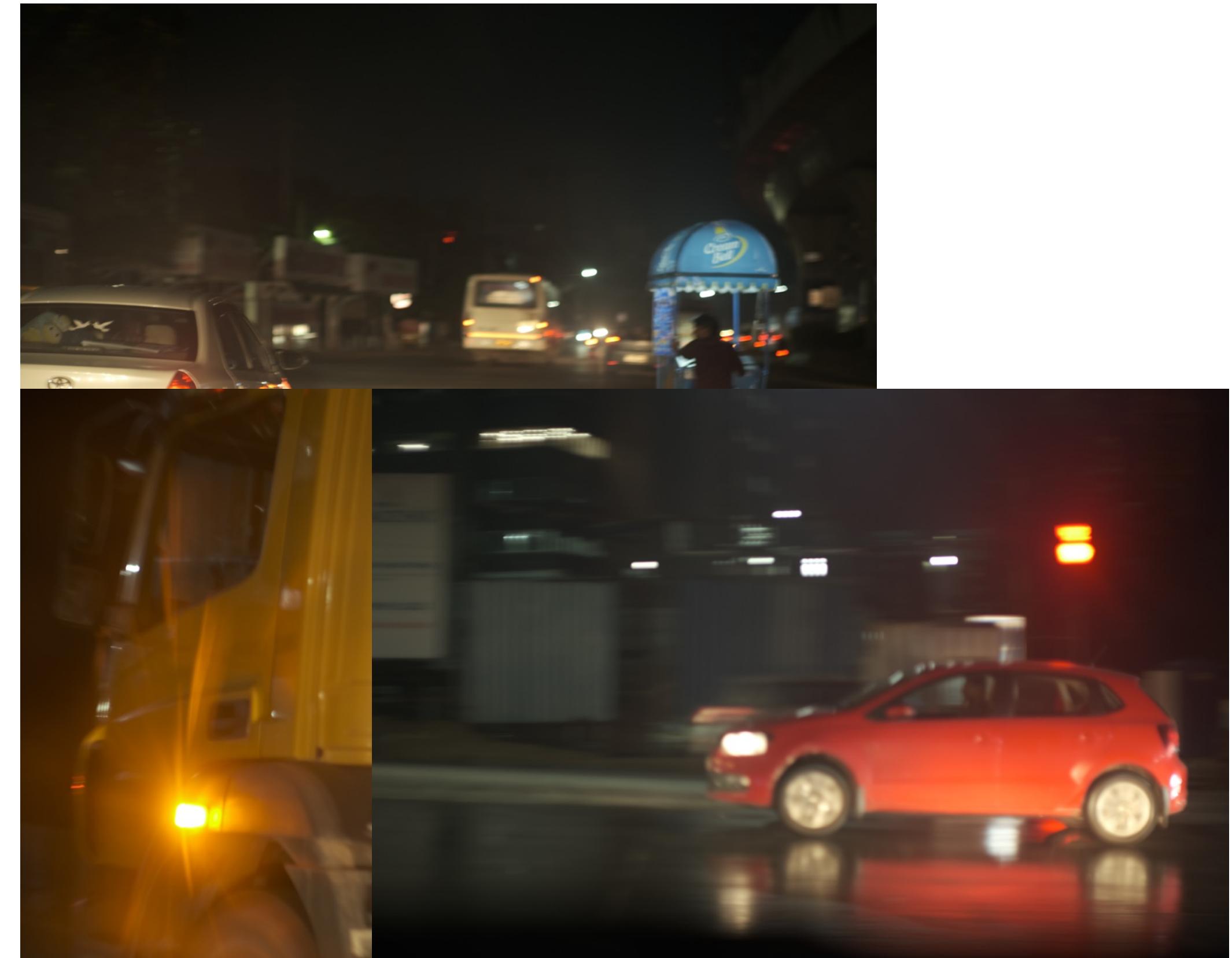
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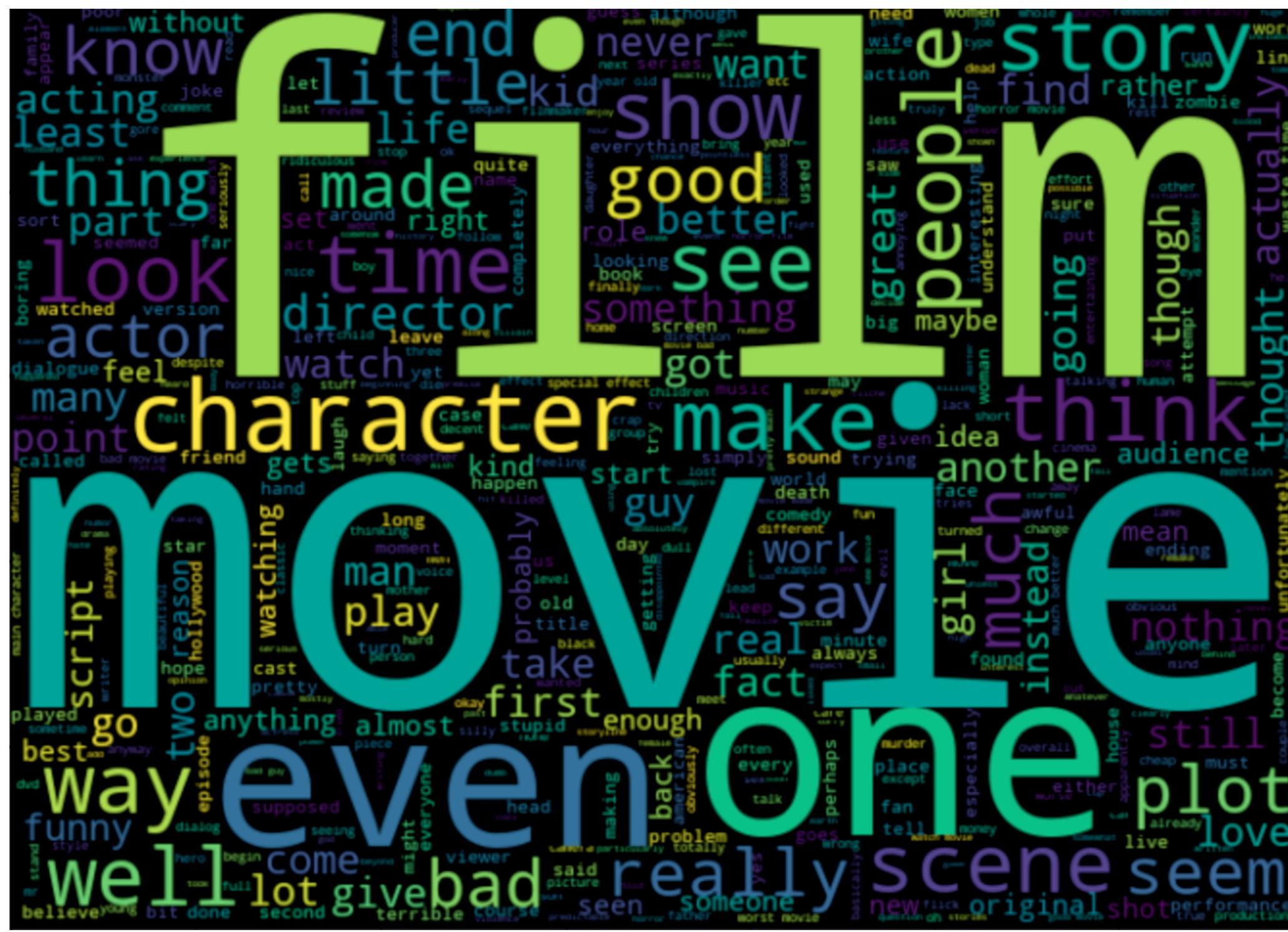
Image



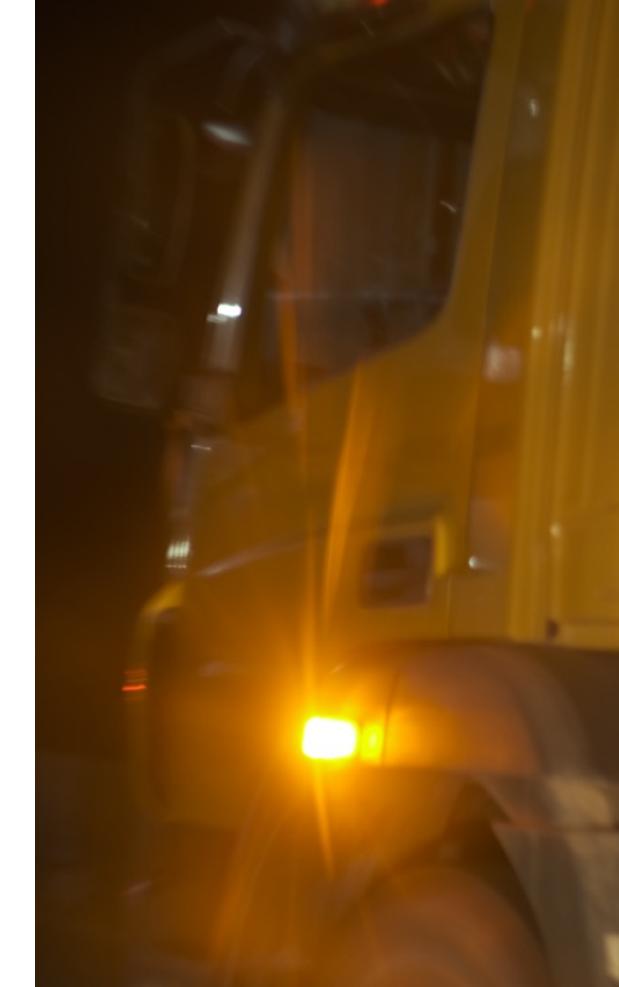
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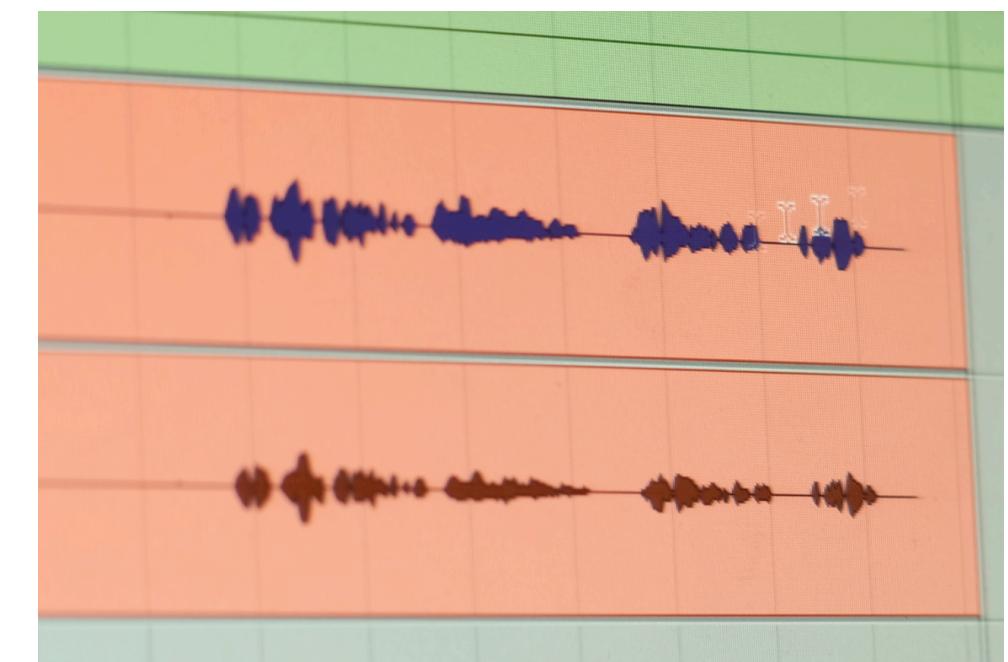
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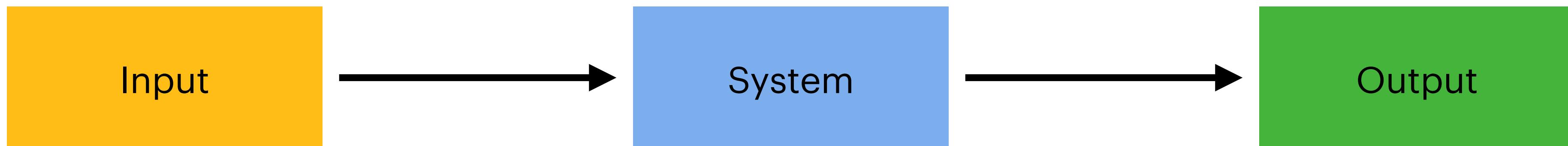
Image



Audio & Speech



Systems for Signal Processing



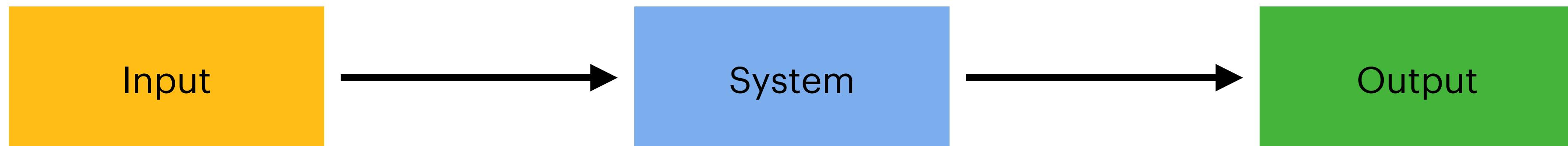
Systems for Signal Processing

- Systems are objects that process signals



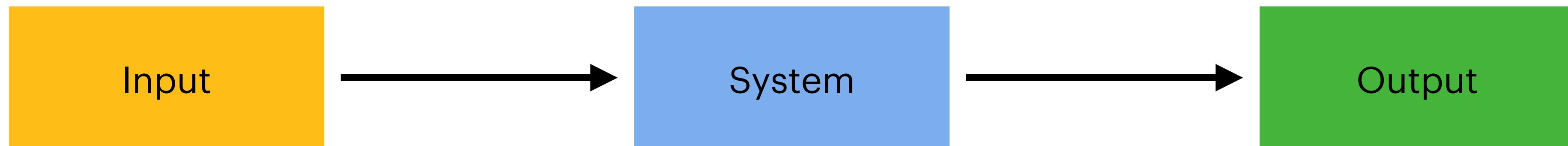
Systems for Signal Processing

- Systems are objects that process signals
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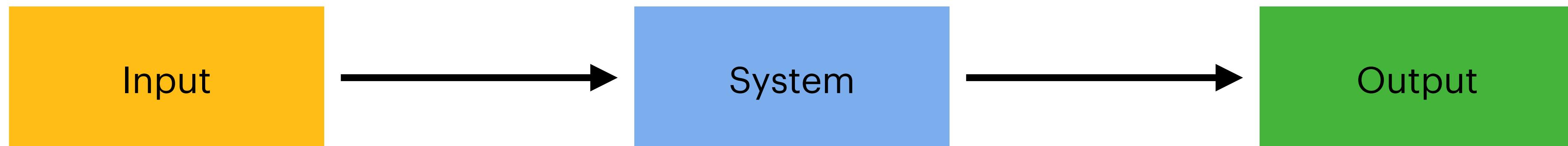
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- Modern systems exist in our computers



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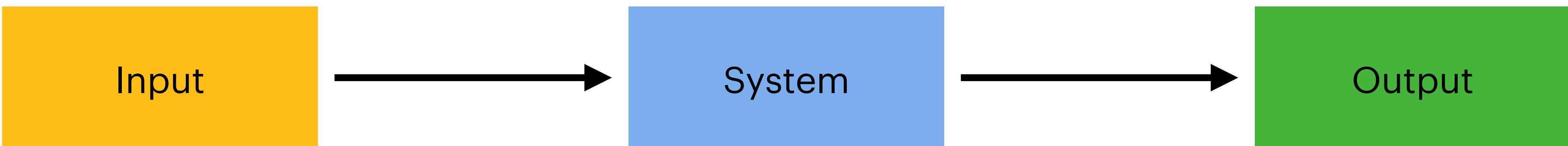
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 - We can represent them analytically using mathematical expressions



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 - Some systems are nothing but signals which act upon other signals.



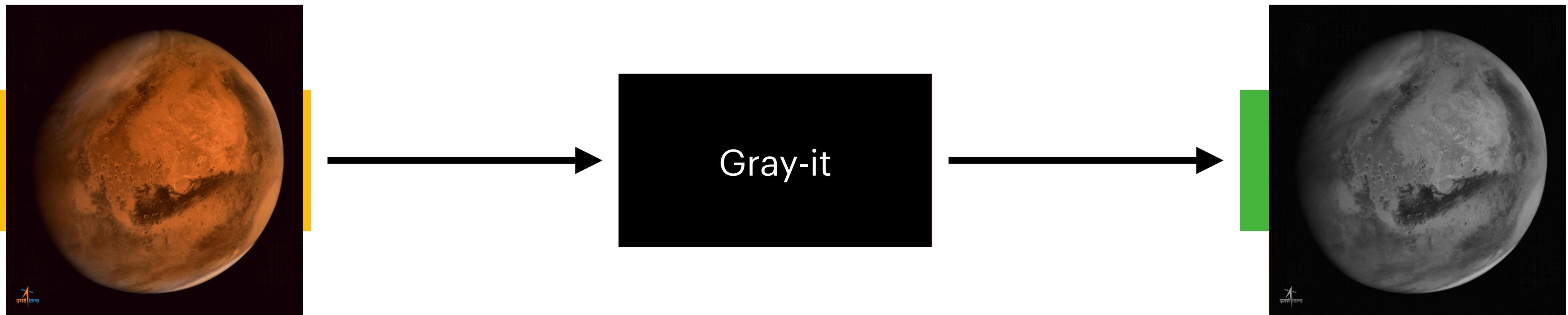
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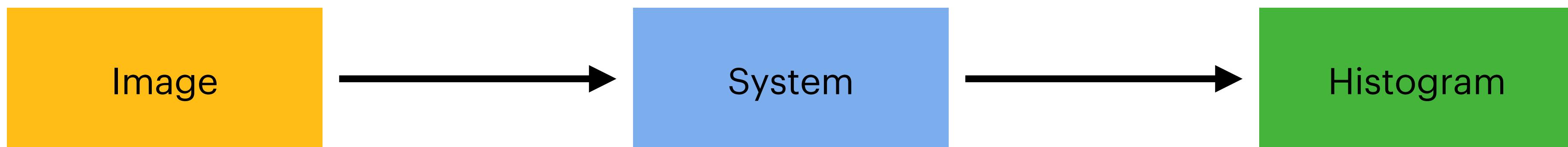


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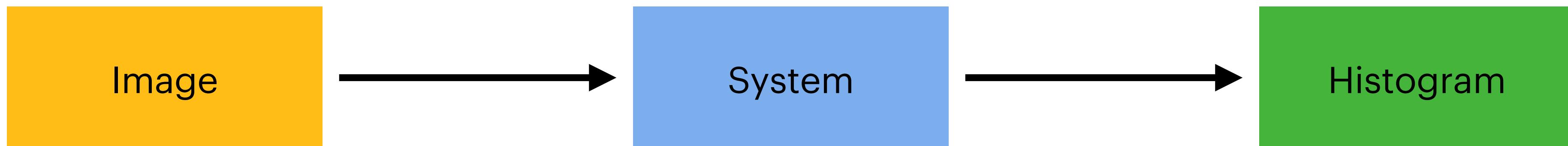


One Image System : Histogram



One Image System : Histogram

- Histogram gives us information about an image.



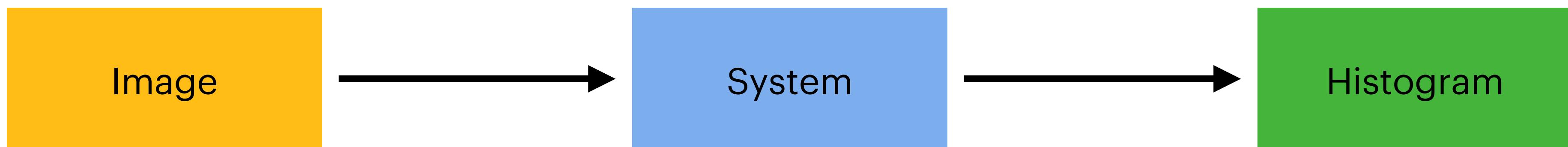
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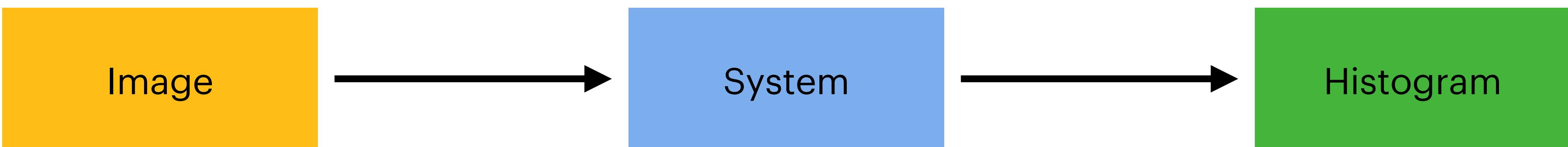
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 - Intensity values



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Histogram : Image

- What is an image?
 - Visual representation of anything
- Why do we need them?
- How do we store?



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- How do we store?
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Histogram : Image

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- Why do we need them?
- How do we store?
 - Analog - Photos
 - Digital



Histogram : Digital Image

Histogram : Digital Image

- Digital Formats

Histogram : Digital Image

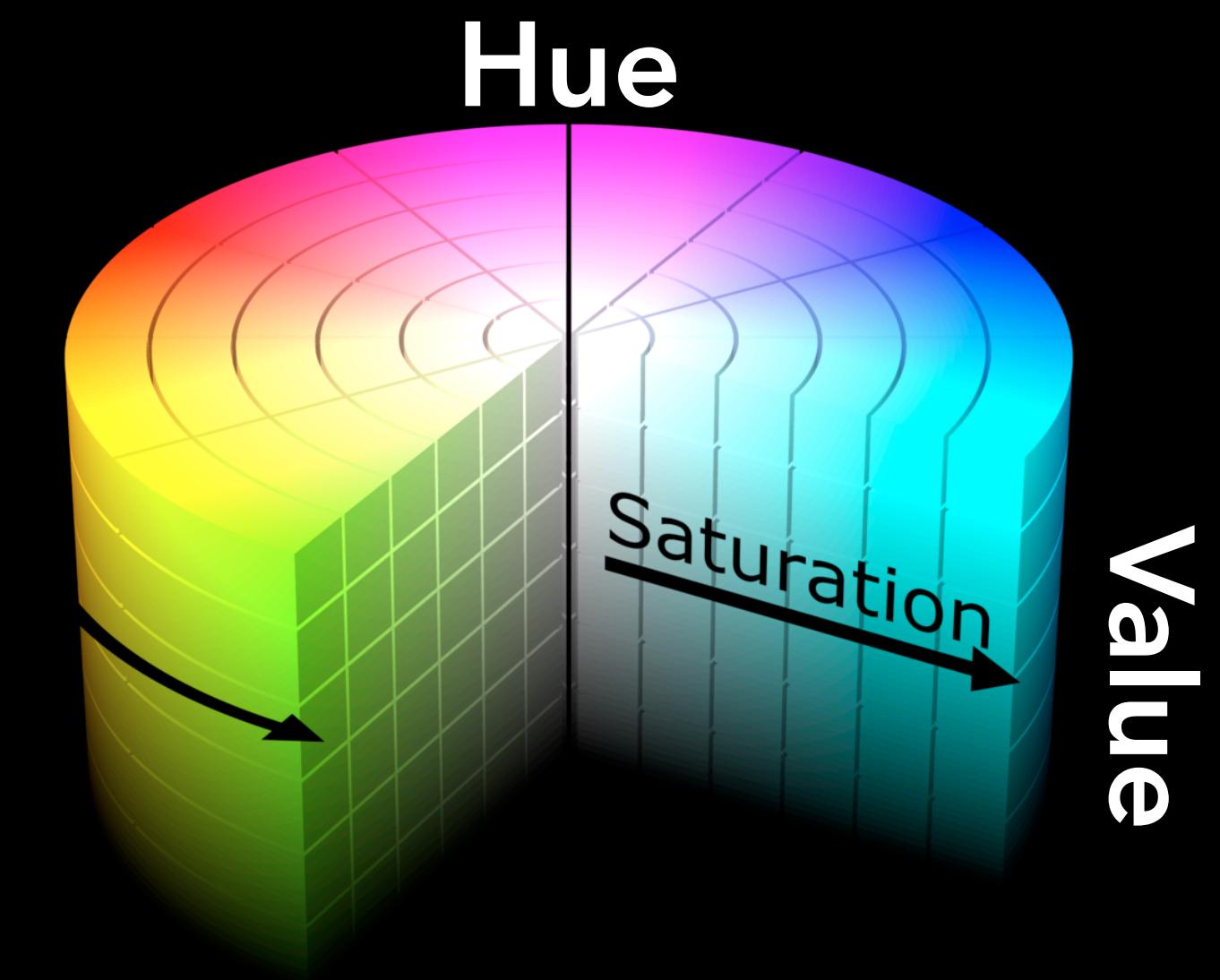
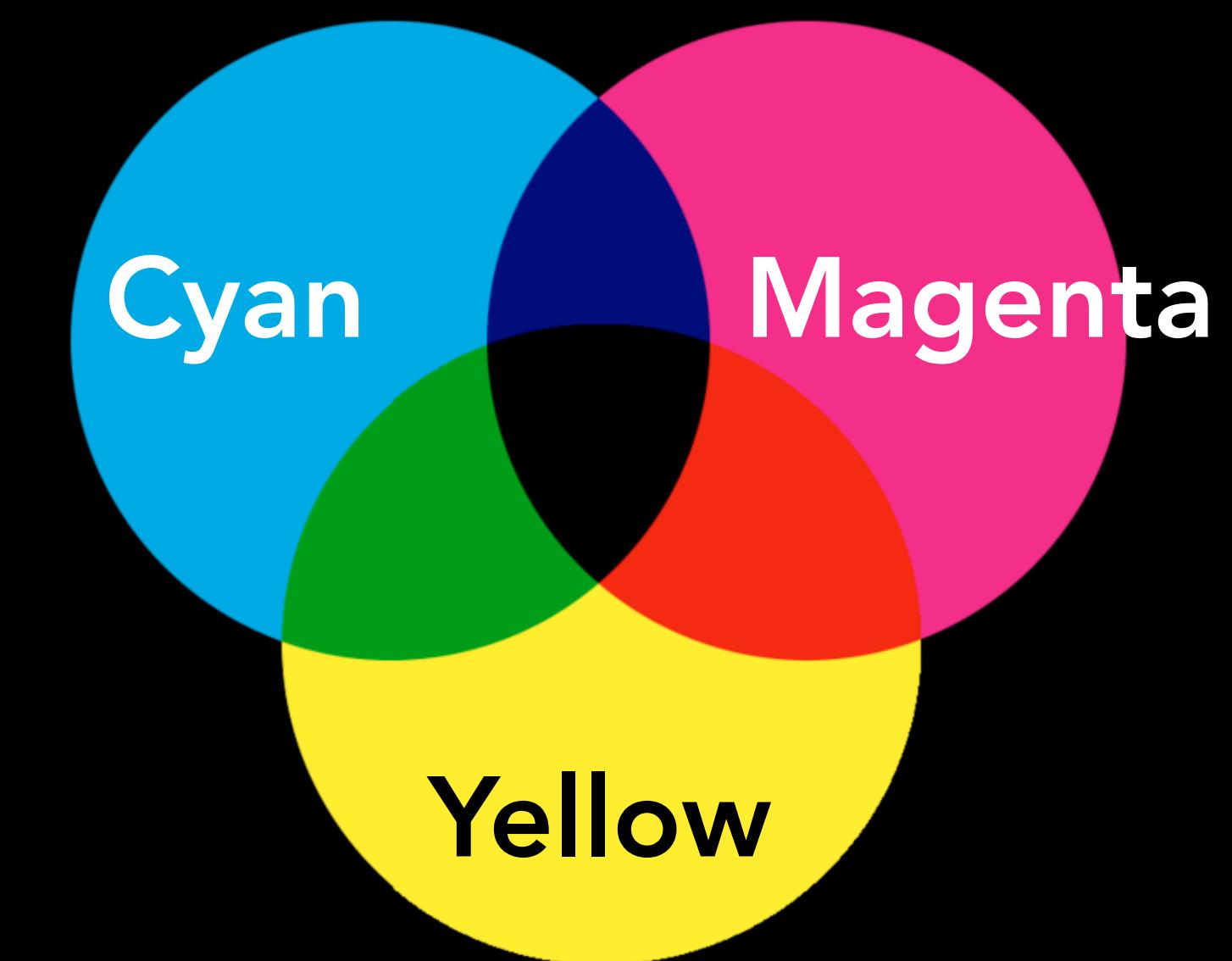
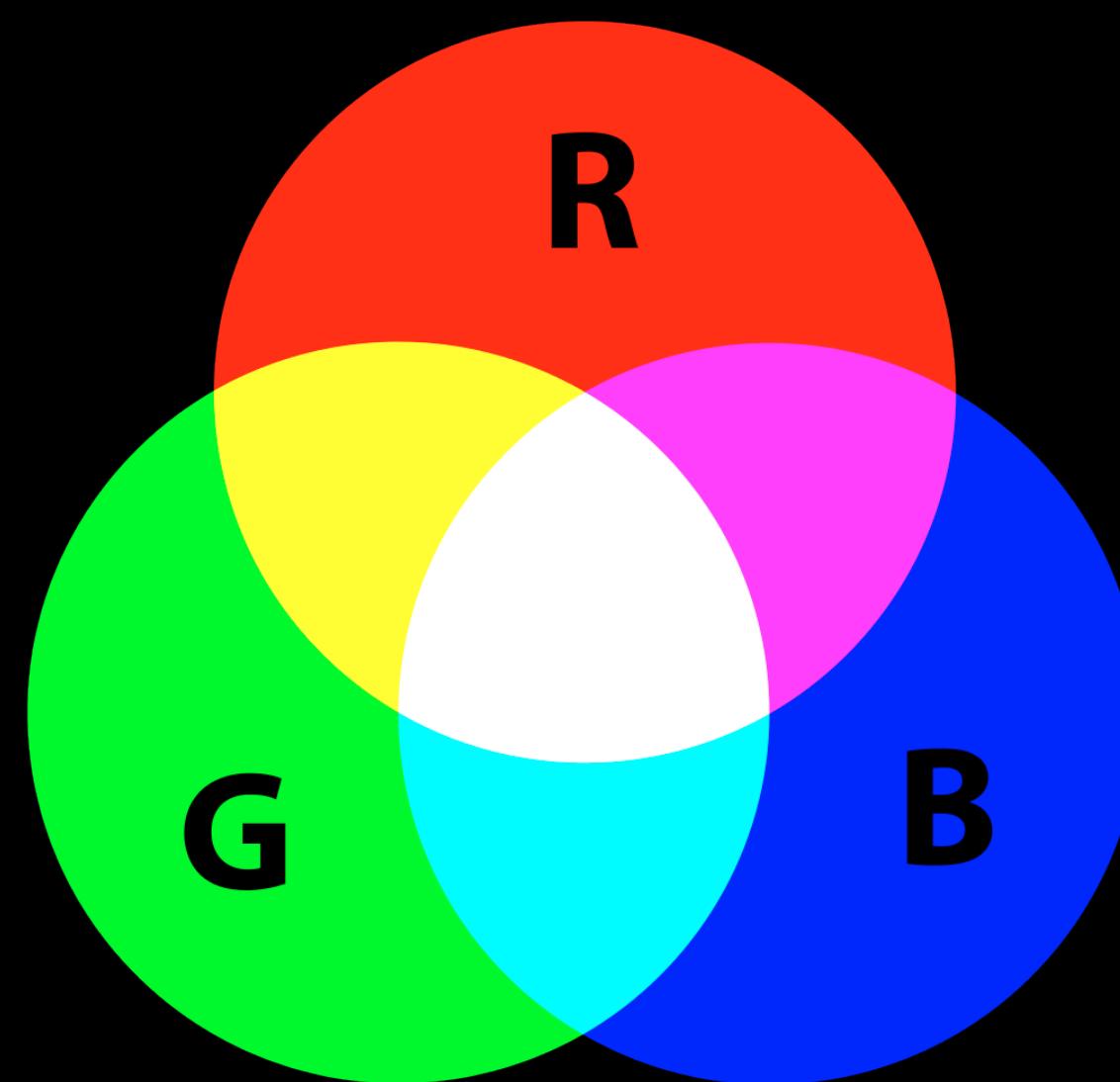
- Digital Formats
- File Formats : JPEG, PNG, TIFF, PDF, EPS

Histogram : Digital Image

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JA

Digital conversion

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- Things in real world -> human world

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 - Distance between Anantapur & your house - 150 km (~ 1-2km)
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 - Distance between Main gate & Main building - 100 m (~ 10-20m)

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 - Distance between In and Out gate - 10 m (~ 1-2m)
 - Distance between our eyes - 3 cm (~ 1-2mm)

Digital conversion

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- Ex : Distance
 - Distance between Anantapur & your house - 150 km (~ 1-2km)
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 - Distance between Main gate & Main building - 100 m (~ 10-20m)
 - Distance between In and Out gate - 10 m (~ 1-2m)
 - Distance between our eyes - 3 cm (~ 1-2mm)
 - Distance between two atoms ~ nm (~ 10-20pm)

JA

Digital conversion - Resolution

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 - Distance between Anantapur & your house - 150 km (~ 1-2km)
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 - 150 km + 1.2 km + 78 m (= 151.278 km)

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 - 150 km + 1.2 km + 78 m + 94 cm (= 151.27894 km)

Digital conversion - Resolution

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 - 150 km + 1 km + 0.2 km (= 151.2 km)
 - 150 km + 1.2 km + 78 m (= 151.278 km)
 - 150 km + 1.2 km + 78 m + 94 cm (= 151.27894 km)
 - 150 km + 1.2 km + 78 m + 94 cm + 98.72083 mm

Digital conversion - Images

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- Therefore while storing/capturing image, we need to think about :
 - The file format : JPG, PNG, TIFF
 - The color space : RGB, CMYK, HSV
 - The bit-depth : 8-bit, 10-bit, 12-bit, 14-bit

Histogram : Digital Image



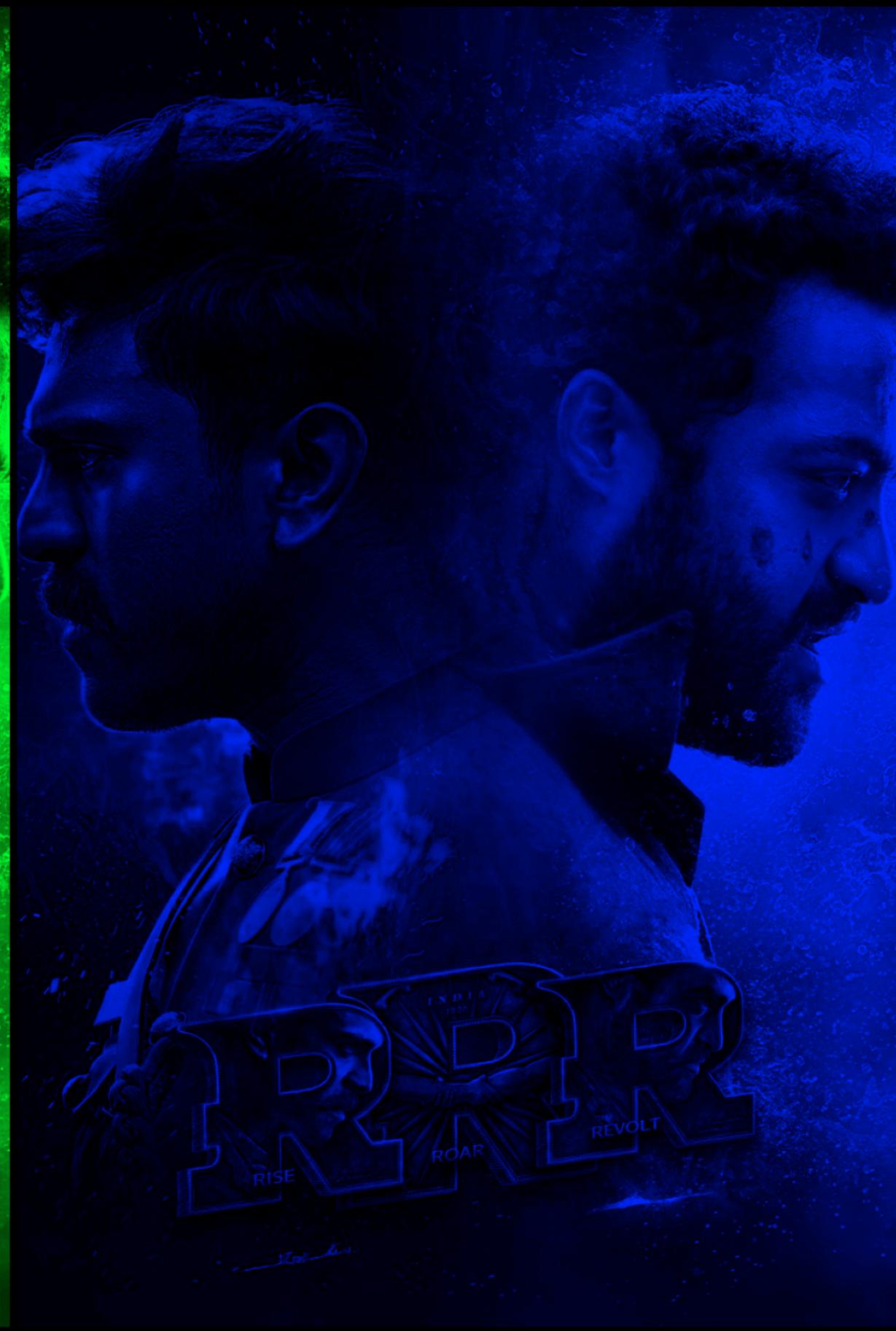
Histogram : Digital Image



Red



Green



Blue

Histogram : Digital Image



Histogram : Digital Image



Histogram : Digital Image



Histogram : Digital Image



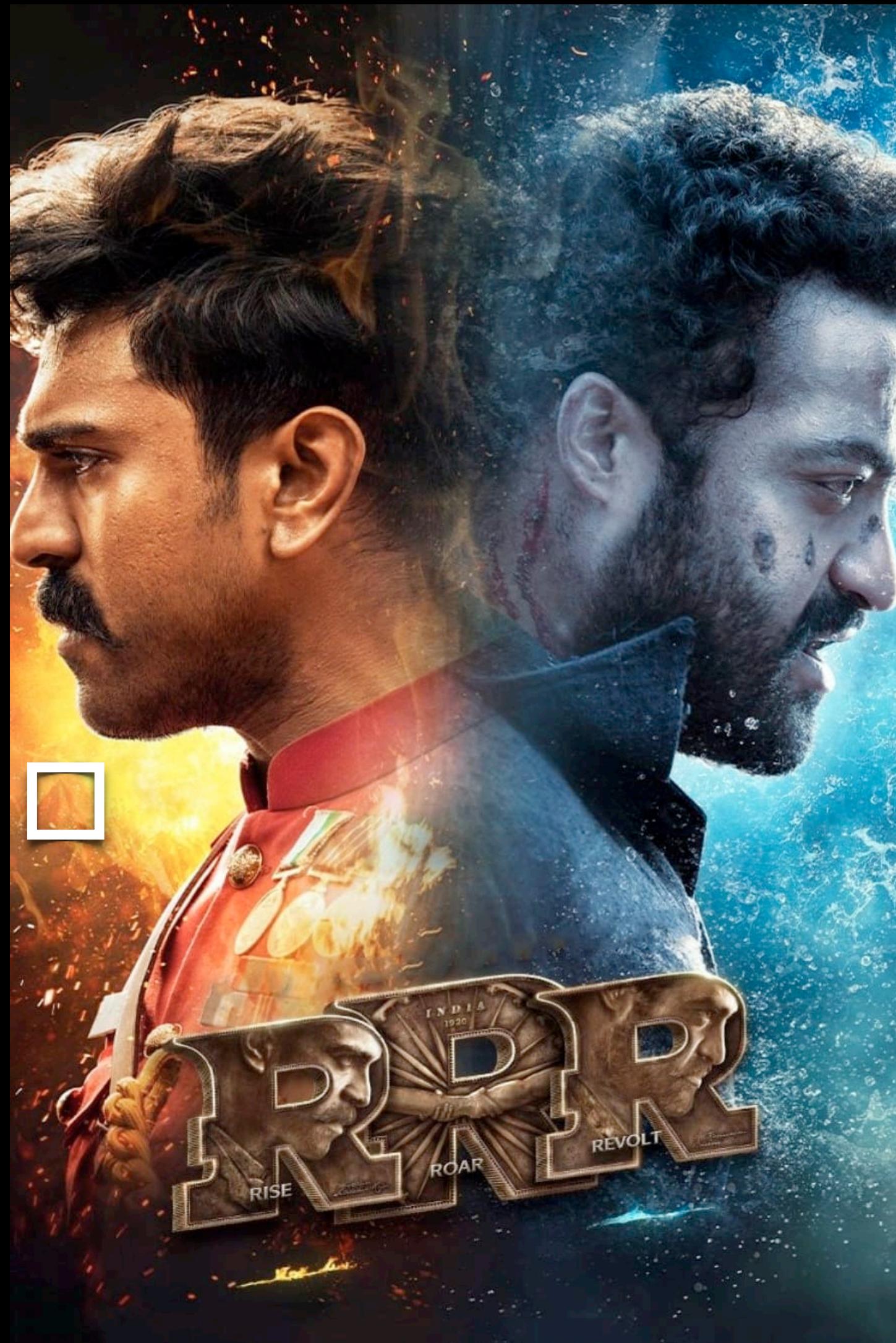
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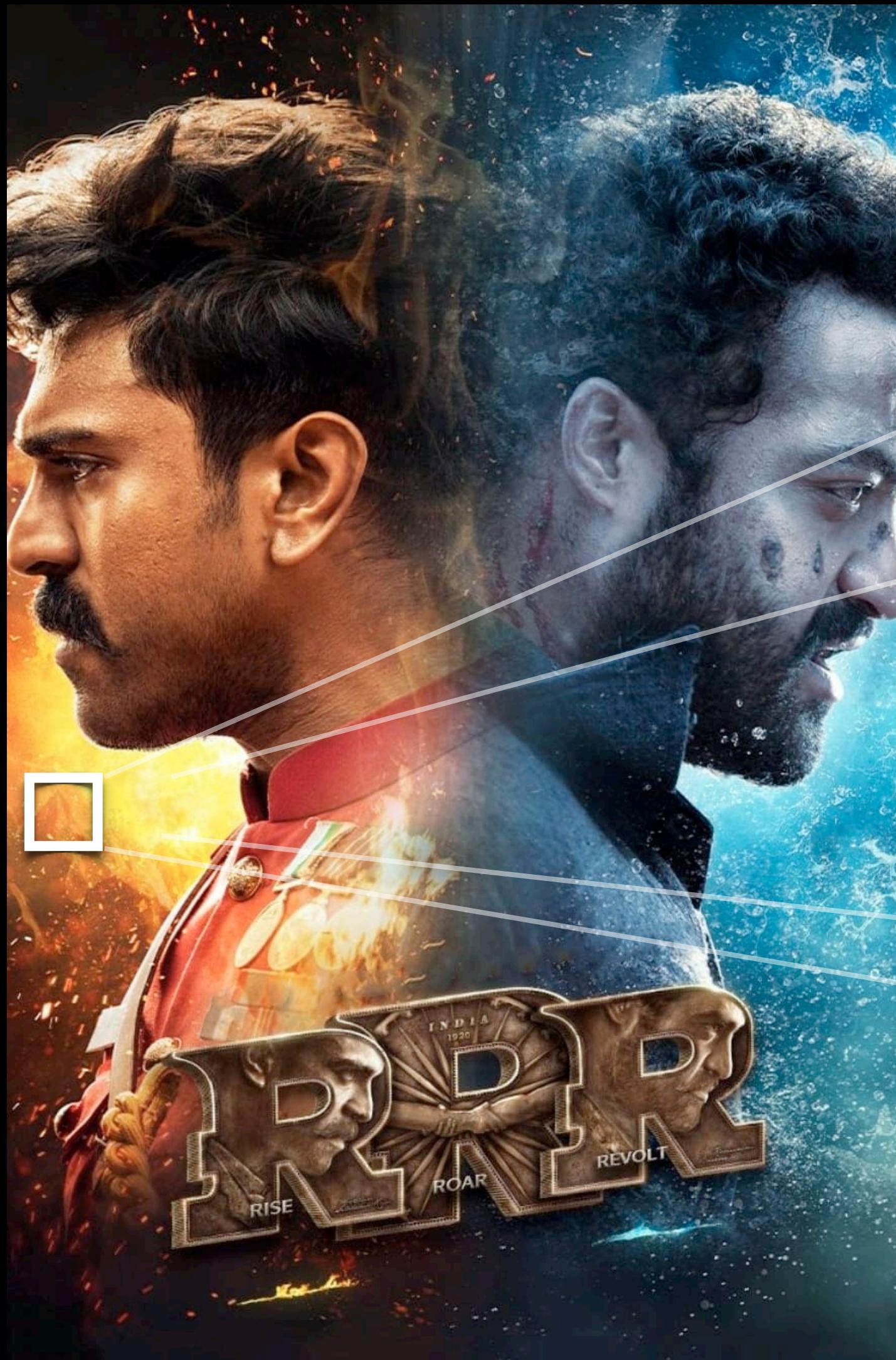
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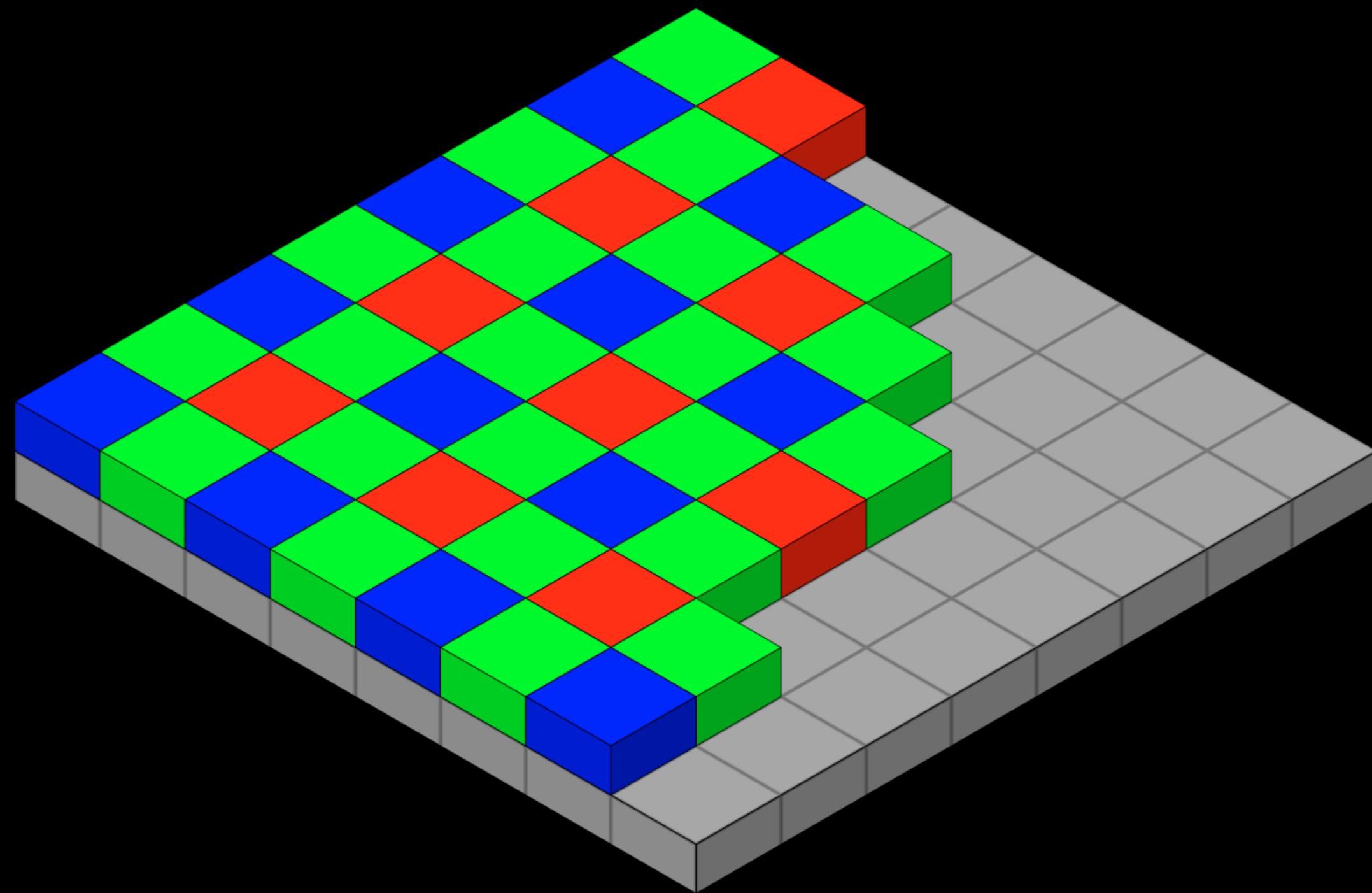


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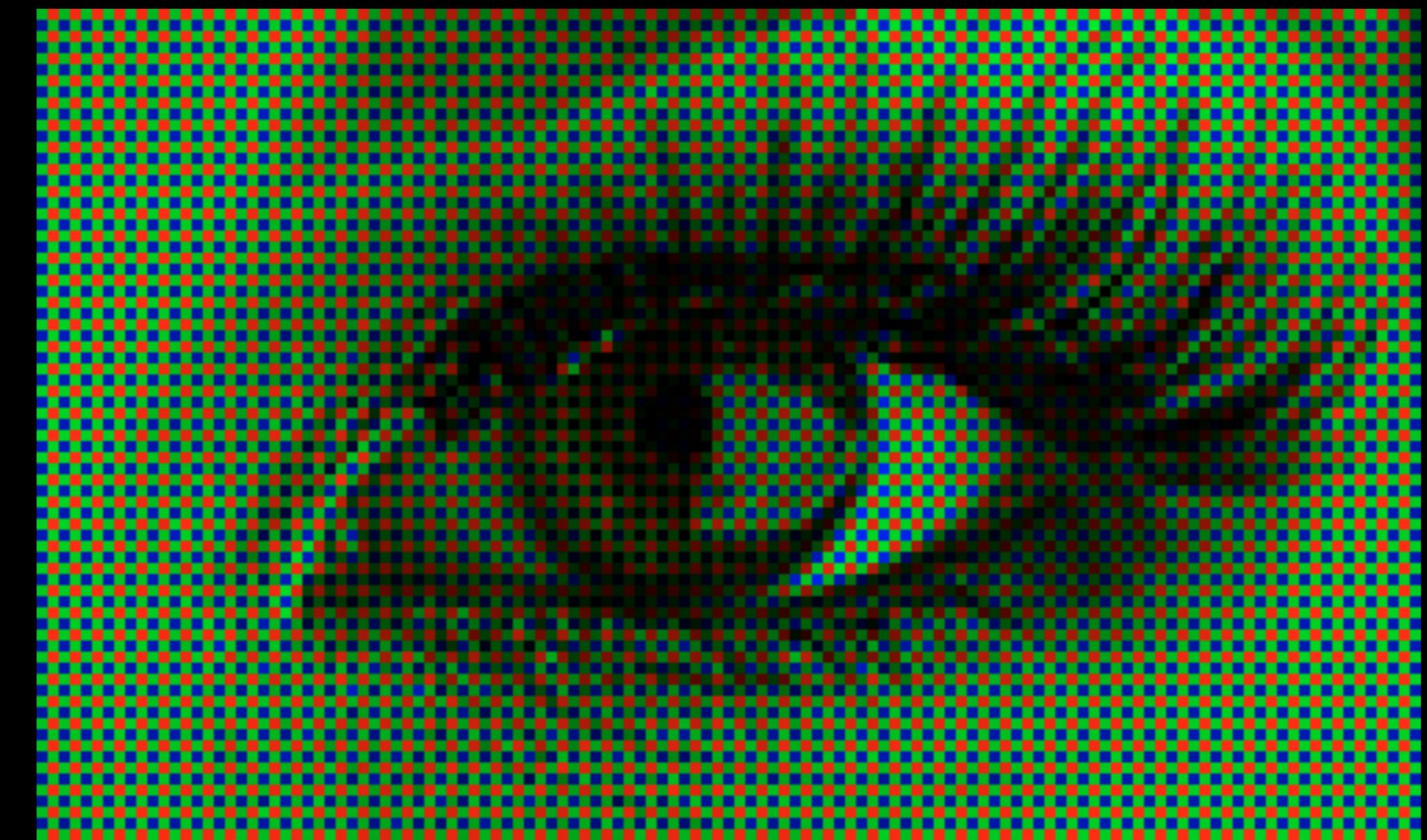


255	255	255	255	255	255	251	248	247	251	252	254
255	255	255	255	253	250	248	248	252	254	255	255
253	253	252	250	250	249	248	248	254	255	255	255
255	253	250	248	248	248	246	246	254	255	255	255
255	254	249	246	247	248	246	245	250	252	254	254
255	252	246	243	246	249	250	249	250	251	253	253
253	247	242	240	245	251	253	253	251	252	254	254
250	244	238	240	246	253	255	255	252	255	255	255
241	240	241	243	248	251	254	254	255	255	255	255
241	242	240	244	247	250	252	252	254	255	255	255
242	242	241	243	245	248	240	249	251	252	252	252
247	250	253	254	252	249	247	246	247	248	249	249
245	247	250	251	250	248	247	247	250	250	251	251
242	244	245	248	249	250	248	247	252	252	252	252
245	244	244	246	246	248	249	249	248	252	253	253
249	246	244	245	245	248	250	250	248	252	250	251
250	245	242	243	247	251	252	250	249	250	249	249
244	240	236	239	246	253	254	253	250	250	249	249
240	234	232	235	245	254	255	255	250	249	250	250
227	229	232	238	244	249	251	250	250	249	248	248
227	228	230	235	242	246	247	246	247	245	244	244
227	227	229	233	239	243	243	242	243	241	241	241
133	135	138	137	137	137	136	138	140	147	151	155
130	132	134	134	135	135	135	138	141	149	153	157
124	125	128	129	131	133	136	141	151	155	158	158
124	123	122	123	126	130	134	139	149	153	155	158
122	119	118	118	121	127	130	135	145	149	149	154
117	112	109	109	117	124	129	133	140	144	149	149
105	100	96	99	108	120	126	131	134	141	145	145
93	87	86	89	101	114	123	129	135	140	140	140
76	77	79	86	95	104	112	117	124	129	132	132
69	70	73	80	88	95	103	108	117	121	126	126
66	66	69	74	81	89	95	100	110	113	117	117

Histogram : Digital Image Sensor

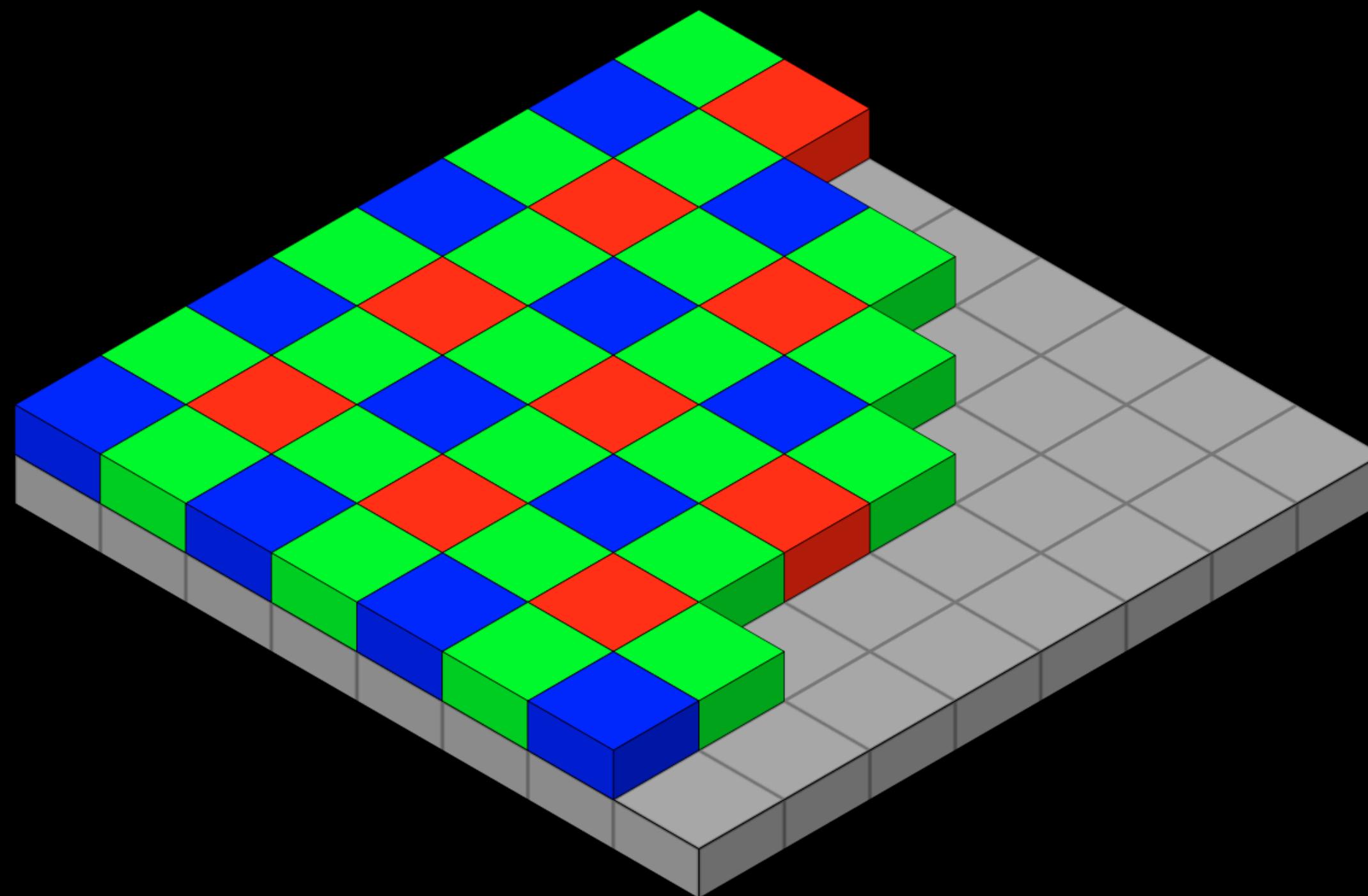


Bayer Sensor

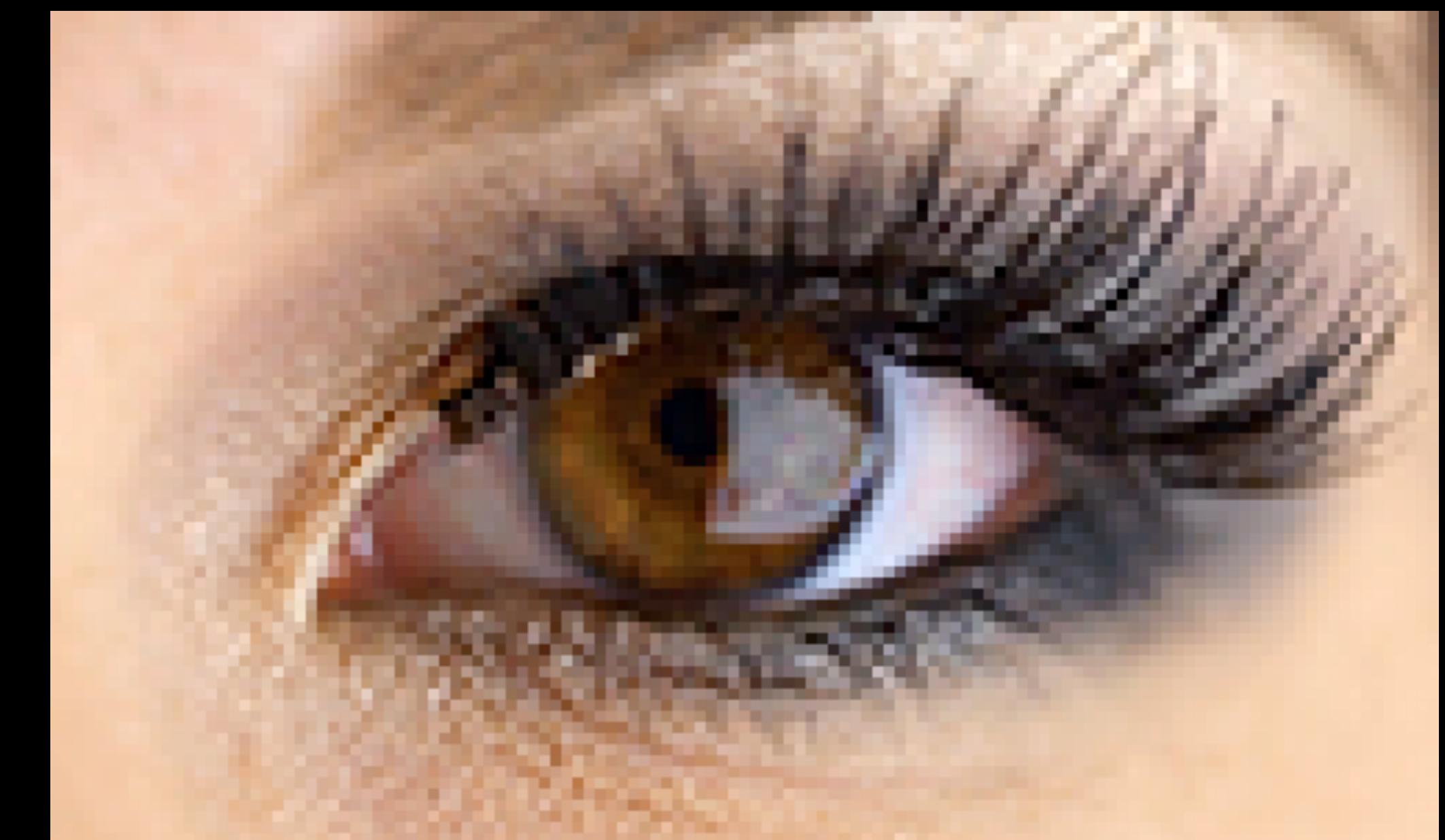


Source : <https://www.red.com/red-101/bayer-sensor-strategy>

Histogram : Digital Image Sensor



Bayer Sensor



Source : <https://www.red.com/red-101/bayer-sensor-strategy>

Histogram : Images and Matrices

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 - Visual representation of anything

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Width

255	255	255	255	255	251	248	247	251	252	254
255	255	255	255	253	250	248	248	252	254	255
253	253	253	250	253	254	252	249	247	246	247
255	255	255	250	251	250	248	247	247	250	251
255	255	255	247	247	250	251	250	248	247	249
255	255	255	242	244	133	135	138	137	137	136
255	255	255	245	244	130	132	134	134	135	135
253	253	253	249	246	124	125	128	129	131	133
250	250	250	250	245	124	123	122	123	126	130
241	241	241	244	240	122	119	118	118	121	127
241	241	241	240	234	117	112	109	109	117	124
242	242	242	227	229	105	100	96	99	108	120
			227	228	93	87	86	89	101	114
			227	227	76	77	79	86	95	104
					69	70	73	80	88	95
					66	66	69	74	81	89
					95	104	112	117	124	129
					103	108	117	117	121	126
					100	100	110	113	117	117

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	255	255	255	255	255	251	248	247	251	252	254
	255	255	255	255	253	250	248	248	252	254	255
	253	253	247	250	253	254	252	249	247	246	247
	255	255	245	247	250	251	250	248	247	247	248
	255	255	242	244	250	251	250	248	247	247	249
	253	253	245	244	249	246	248	247	247	250	251
	250	250	249	246	249	246	248	247	247	250	251
	241	241	244	240	244	240	242	241	241	241	155
	241	241	240	234	240	234	242	239	239	239	155
	242	242	227	229	227	228	227	227	227	227	155
Height ↓	227	227	105	100	96	99	108	120	126	131	134
Channels ↓	227	227	117	112	109	109	117	124	129	133	140
	227	227	122	119	118	118	121	127	130	135	145
	227	227	117	112	109	109	117	124	129	133	144
	227	227	105	100	96	99	108	120	126	131	141
	227	227	93	87	86	89	101	114	123	129	135
	227	227	76	77	79	86	95	104	112	117	124
	227	227	69	70	73	80	88	95	103	108	117
	227	227	66	66	69	74	81	89	95	100	110
	227	227	66	66	69	74	81	89	95	100	113
	227	227	66	66	69	74	81	89	95	100	117

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 - $[H, W, C]$ - Ex : $(1920, 1080, 3)$



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255	255	255	255	255	251	248	247	251	252	254
255	255	255	255	253	250	248	248	252	254	255
253	253	247	250	253	254	252	249	247	246	247
255	255	245	247	250	251	250	248	247	247	249
255	255	242	244	250	251	250	248	247	247	251
253	253	245	244	249	246	249	246	247	250	251
250	250	249	246	249	246	250	245	244	244	245
241	241	244	240	244	240	242	234	234	234	235
241	241	240	234	227	229	227	228	227	227	227
242	242	227	229	227	228	93	87	86	89	101
						76	77	79	86	95
						69	70	73	80	88
						66	66	69	74	81

Height ↓

Channels ↓

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255	255	255	255	253	250	248	248	252	254	255
253	255	247	250	253	254	252	249	247	246	247
255	255	245	247	250	251	250	248	247	247	249
255	255	245	244	133	135	138	137	137	136	138
253	255	245	244	130	132	134	134	135	135	138
250	253	249	246	124	125	128	129	131	133	136
241	250	249	246	124	123	122	123	126	130	134
241	241	244	240	122	119	118	118	121	127	130
242	241	240	234	122	119	118	118	121	127	130
242	242	227	229	117	112	109	109	117	124	129
242	242	227	228	105	100	96	99	108	120	126
242	242	227	227	93	87	86	89	101	114	123
69	76	77	79	86	95	104	112	117	124	129
69	70	73	80	88	95	103	108	117	121	126
66	66	69	74	81	89	95	100	110	113	117

Height ↓

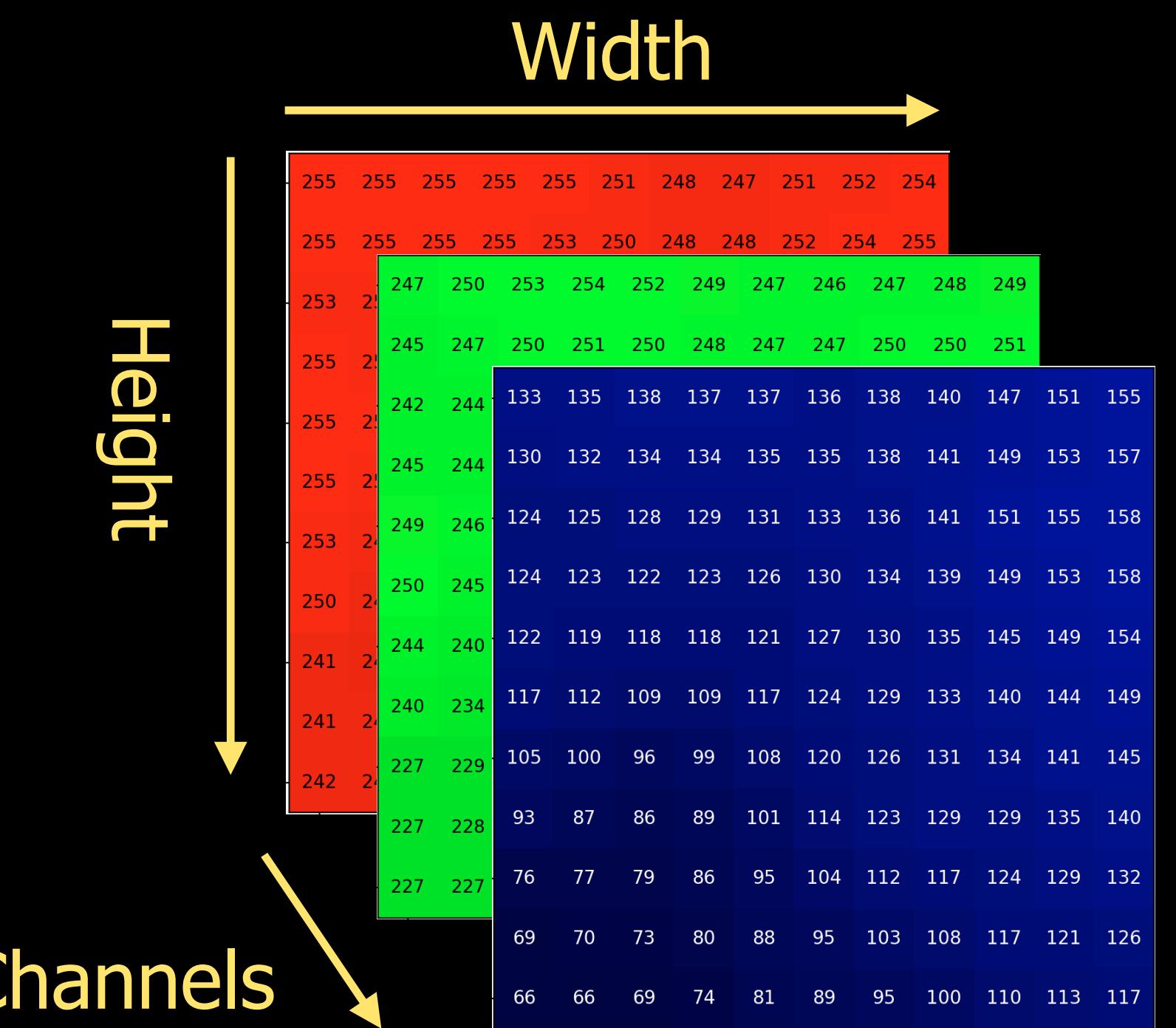
Channels ↓

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 - $[H, W, C]$ - Ex : $(1920, 1080, 3)$
- Image processing \approx Matrix Transformations

Therefore, to process any image/signal, we need :

- Matrix operations - Theory
- Computer programming - Practical



Histogram : Grayscale Images



=



3 channels

[892, 1338, 3]



1 channel = mean of 3 channels

Histogram : Grayscale Images

- Image with single Channel



=



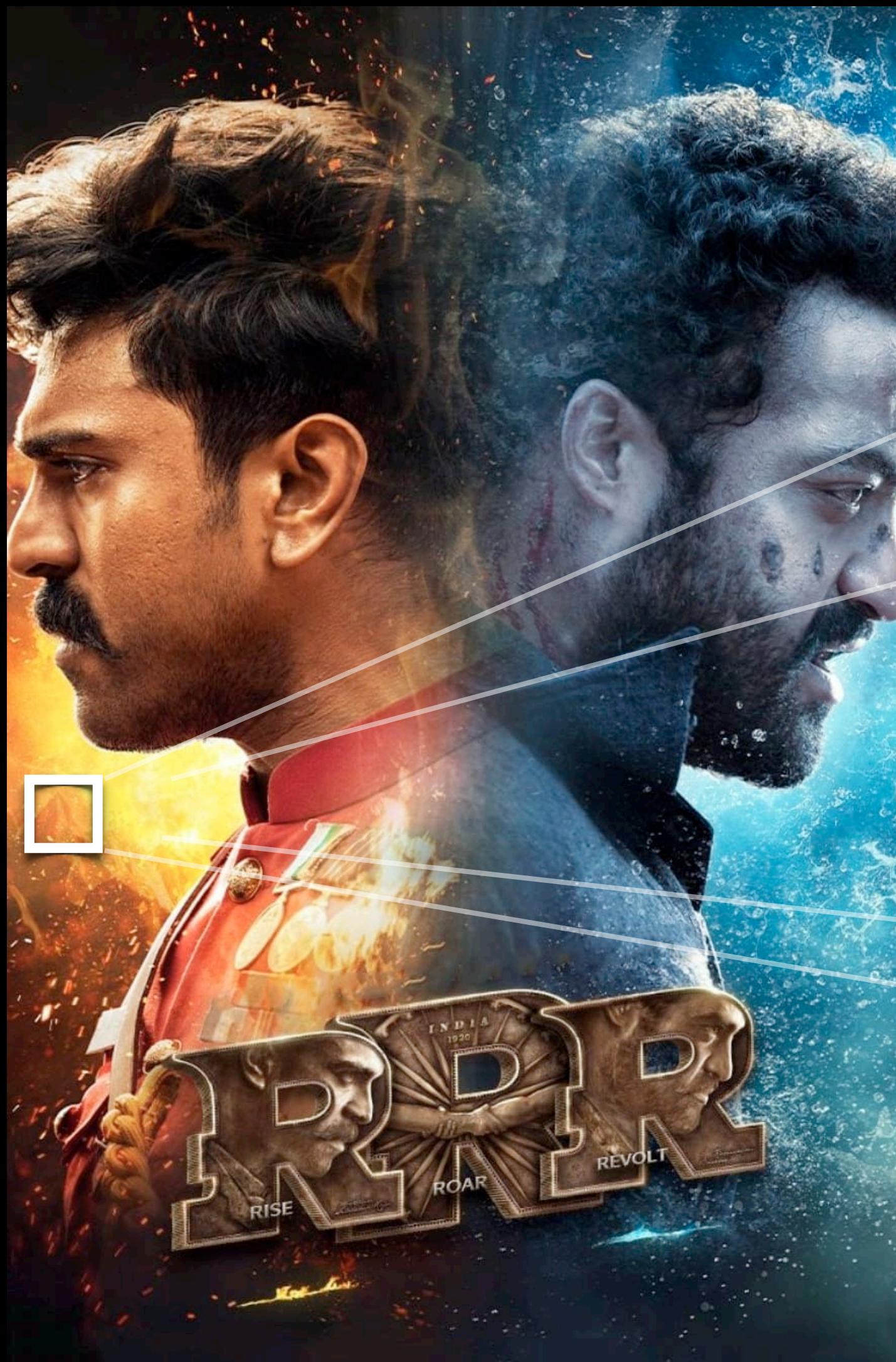
[892, 1338, 3]

3 channels



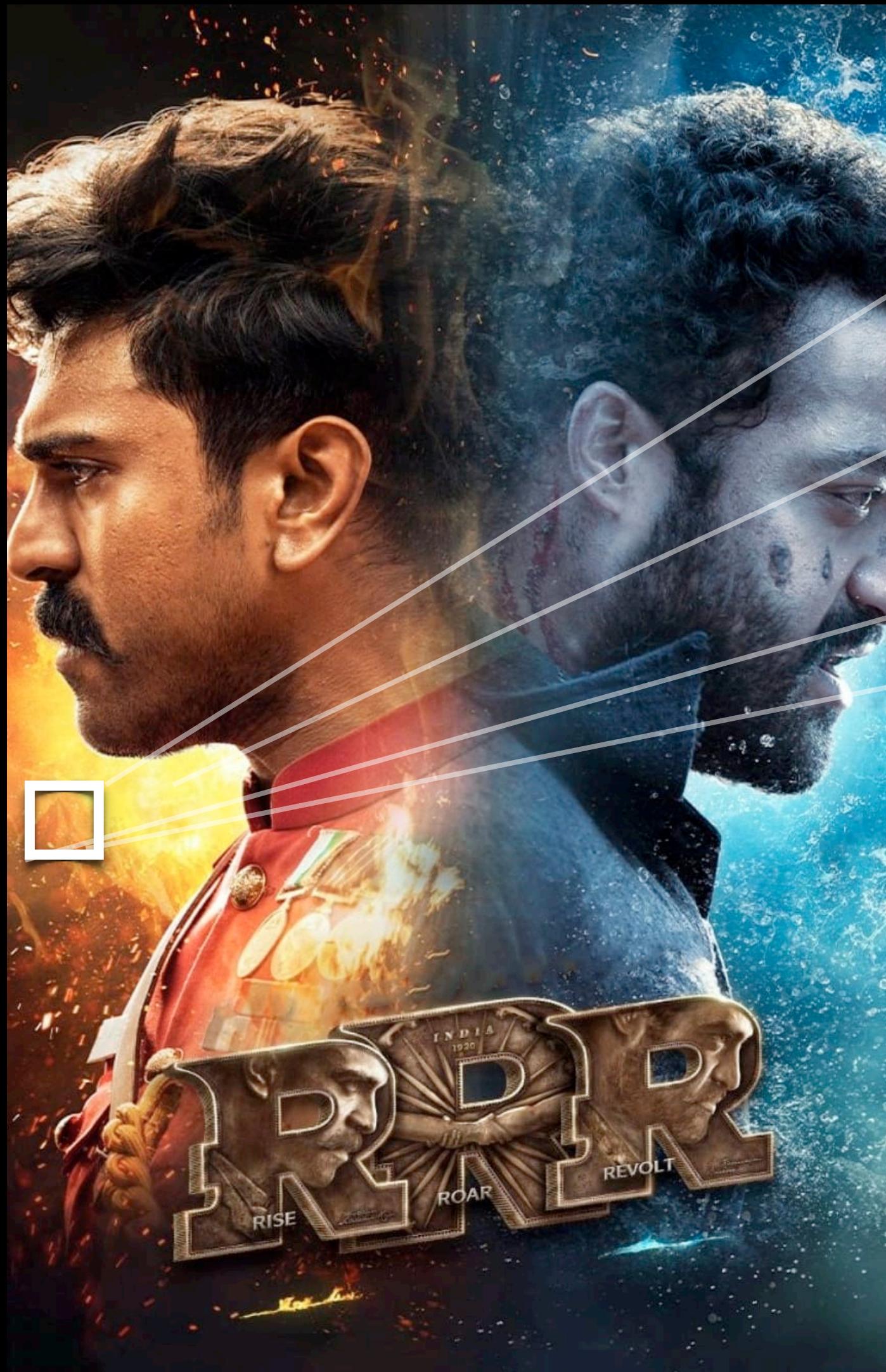
1 channel = mean of 3 channels

Histogram : Digital Image



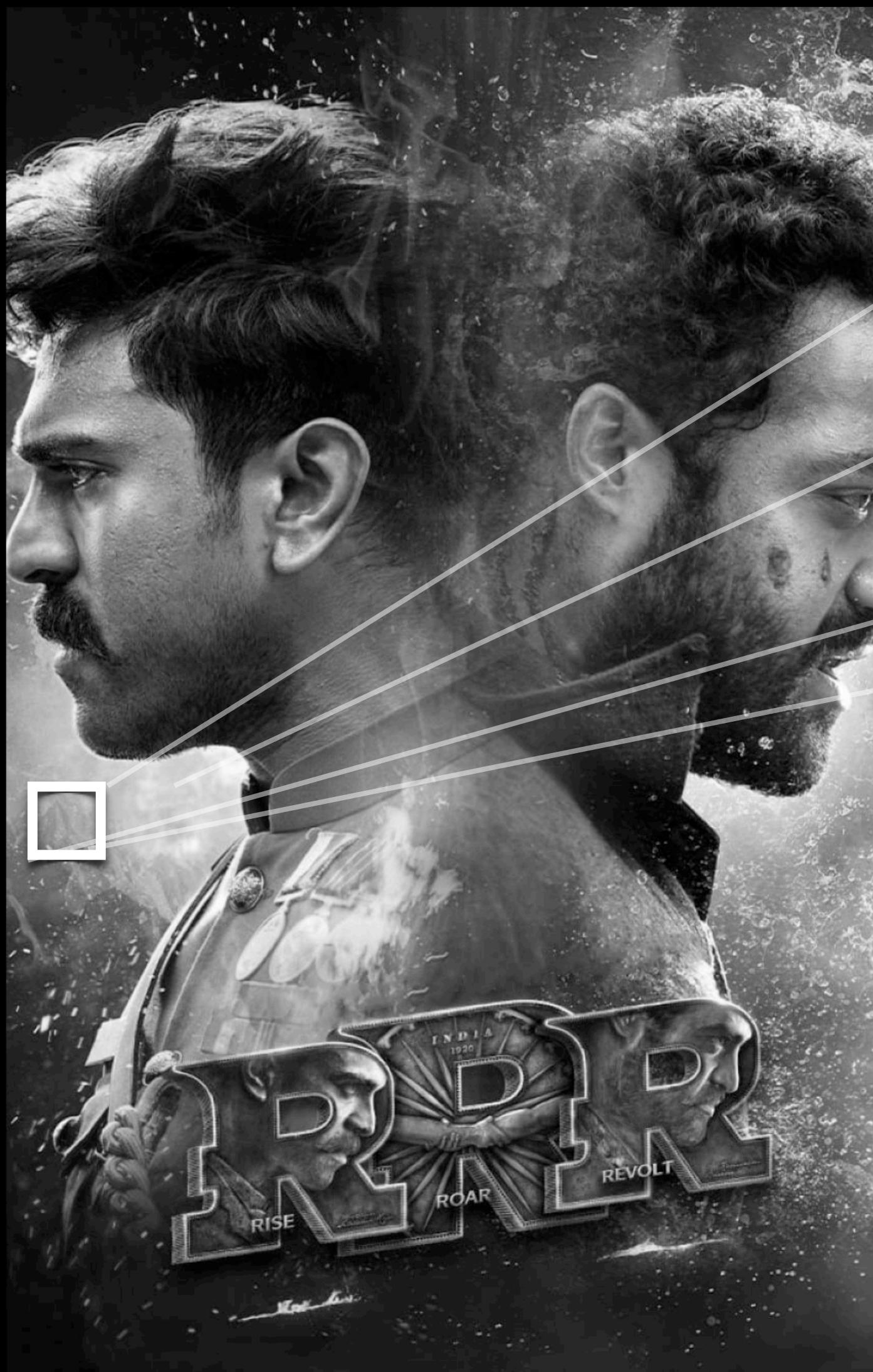
255	255	255	255	255	255	251	248	247	251	252	254
255	255	255	255	253	250	248	248	252	254	255	255
253	253	252	250	250	249	248	248	254	255	255	255
255	253	250	248	248	248	246	246	254	255	255	255
255	254	249	246	247	248	246	245	250	252	254	254
255	252	246	243	246	249	250	249	250	251	253	253
253	247	242	240	245	251	253	253	251	252	254	254
250	244	238	240	246	253	255	255	252	255	255	255
241	240	241	243	248	251	254	254	255	255	255	255
241	242	240	244	247	250	252	252	254	255	255	255
242	242	241	243	245	248	240	249	251	252	252	252
247	250	253	254	252	249	247	246	247	248	249	249
245	247	250	251	250	248	247	247	250	250	251	251
242	244	245	248	249	250	248	247	252	252	252	252
245	244	244	246	246	248	249	249	248	252	253	253
249	246	244	245	245	248	250	250	248	252	250	251
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244	240	236	239	246	253	254	253	250	250	249	249
240	234	232	235	245	254	255	255	250	249	250	250
227	229	232	238	244	249	251	250	250	249	248	248
227	228	230	235	242	246	247	246	247	245	244	244
227	227	229	233	239	243	243	242	243	241	241	241
133	135	138	137	137	137	136	138	140	147	151	155
130	132	134	134	135	135	135	138	141	149	153	157
124	125	128	129	131	133	136	141	151	155	158	158
124	123	122	123	126	130	134	139	149	153	158	158
122	119	118	118	121	127	130	135	145	149	154	154
117	112	109	109	117	124	129	133	140	144	149	149
105	100	96	99	108	120	126	131	134	141	145	145
93	87	86	89	101	114	123	129	135	140	140	140
76	77	79	86	95	104	112	117	124	129	132	132
69	70	73	80	88	95	103	108	117	121	126	126
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Histogram : Digital Image



255	255	255	255	255	255	251	248	247	251	252	254
255	255	255	255	253	250	248	248	252	254	255	255
253	253	252	250	250	249	248	248	254	255	255	255
255	253	250	248	248	248	246	246	254	255	255	255
255	254	249	246	247	248	246	245	250	252	254	254
255	252	246	243	246	249	250	249	250	251	253	253
253	247	242	240	245	251	253	253	251	252	254	254
250	244	238	240	246	253	255	255	252	255	255	255
241	240	241	243	248	251	254	254	255	255	255	255
241	242	240	244	247	250	252	252	254	255	255	255
242	242	241	243	245	248	249	249	251	252	252	252
247	250	253	254	252	249	247	246	247	248	249	249
245	247	250	251	250	248	247	247	250	250	251	251
242	244	245	248	249	250	248	247	252	252	252	252
245	244	244	246	248	249	249	248	252	253	253	253
249	246	244	245	248	250	250	248	252	250	251	251
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244	240	236	239	246	253	254	253	250	250	249	249
240	234	232	235	245	254	255	255	250	249	250	250
227	229	232	238	244	249	251	250	250	249	248	227
227	228	230	235	242	246	247	246	247	245	244	227
227	227	229	233	239	243	243	242	243	241	241	227
133	135	138	137	137	136	138	140	147	151	155	155
130	132	134	134	135	135	138	141	149	153	157	157
124	125	128	129	131	133	136	141	151	155	158	158
124	123	122	123	126	130	134	139	149	153	158	158
122	119	118	118	121	127	130	135	145	149	154	154
117	112	109	109	117	124	129	133	140	144	149	149
105	100	96	99	108	120	126	131	134	141	145	145
93	87	86	89	101	114	123	129	129	135	140	140
76	77	79	86	95	104	112	117	124	129	132	132
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66	66	69	74	81	89	95	100	110	113	117	117

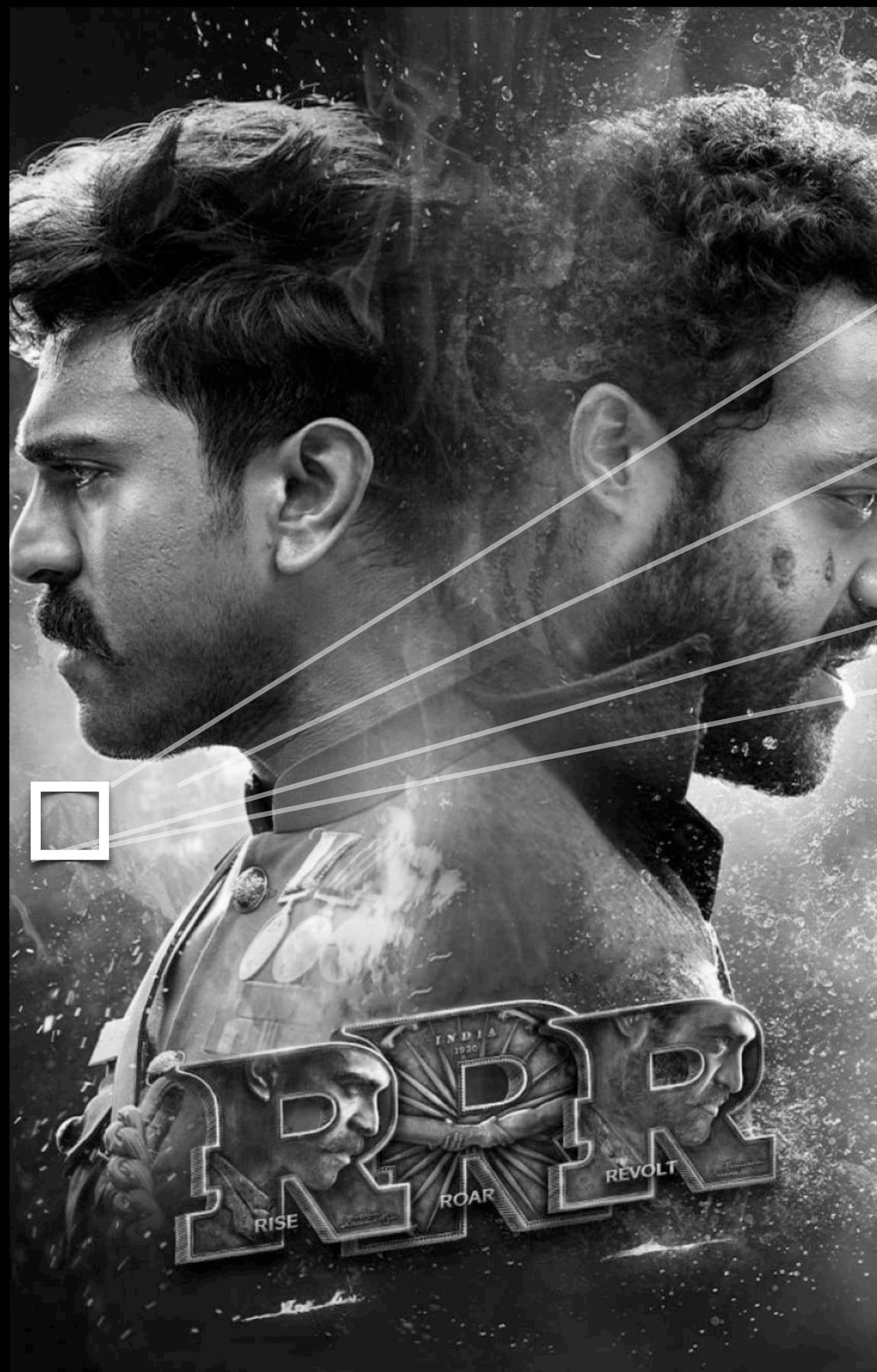
Histogram : Digital Image



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255	255	255	255	253	250	248	248	248	252	254	255	245	247	250	251	250	248	247	247	250	250	251	130	132	134	134	135	135	138	141	149	153	157
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242	242	241	243	245	248	249	249	251	252	252	252	227	227	229	233	239	243	243	242	243	241	241	66	66	69	74	81	89	95	100	110	113	117

211.0	213.0	215.0	215.0	214.0	212.0	211.0	211.0	211.0	215.0	217.0	219.0	
210.0	211.0	213.0	213.0	212.0	211.0	211.0	212.0	212.0	217.0	219.0	221.0	
206.0	207.0	208.0	209.0	210.0	210.0	210.0	212.0	212.0	219.0	220.0	221.0	
208.0	206.0	205.0	205.0	207.0	209.0	209.0	211.0	218.0	220.0	222.0		
208.0	206.0	203.0	203.0	205.0	208.0	208.0	209.0	215.0	217.0	219.0		
207.0	203.0	199.0	198.0	203.0	208.0	210.0	210.0	213.0	215.0	217.0		
200.0	195.0	191.0	192.0	199.0	208.0	211.0	212.0	211.0	214.0	216.0		
194.0	188.0	185.0	188.0	197.0	207.0	211.0	213.0	210.0	213.0	215.0		
181.0	182.0	184.0	189.0	195.0	201.0	205.0	207.0	209.0	211.0	211.0		
179.0	180.0	181.0	186.0	192.0	197.0	200.0	202.0	206.0	207.0	208.0		
				179.0	183.0	188.0	193.0	195.0	197.0	201.0	202.0	203.0

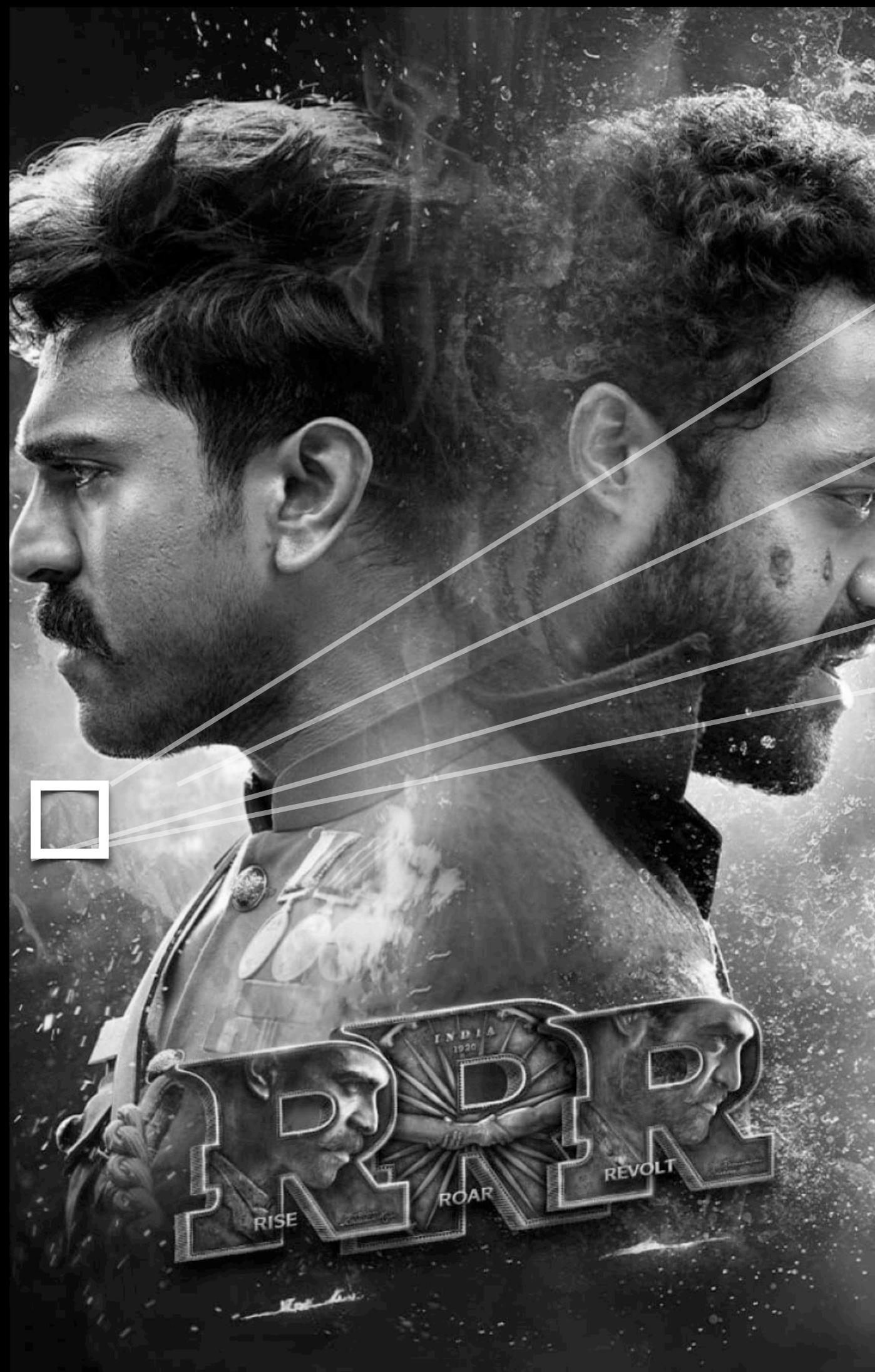
Histogram : Digital Image



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250	244	238	240	246	253	255	255	252	255	255	255
241	240	241	243	248	251	254	254	255	255	255	255
241	242	240	244	247	250	252	252	254	255	255	255
242	242	241	243	245	248	249	249	251	252	252	252

211.0	213.0	215.0	215.0	214.0	212.0	211.0	211.0	215.0	217.0	219.0
210.0	211.0	213.0	213.0	212.0	211.0	211.0	212.0	217.0	219.0	221.0
206.0	207.0	208.0	209.0	210.0	210.0	210.0	212.0	219.0	220.0	221.0
208.0	206.0	205.0	205.0	207.0	209.0	209.0	211.0	218.0	220.0	222.0
208.0	206.0	203.0	203.0	205.0	208.0	208.0	209.0	215.0	217.0	219.0
207.0	203.0	199.0	198.0	203.0	208.0	210.0	210.0	213.0	215.0	217.0
200.0	195.0	191.0	192.0	199.0	208.0	211.0	212.0	211.0	214.0	216.0
194.0	188.0	185.0	188.0	197.0	207.0	211.0	213.0	210.0	213.0	215.0
181.0	182.0	184.0	189.0	195.0	201.0	205.0	207.0	209.0	211.0	211.0
179.0	180.0	181.0	186.0	192.0	197.0	200.0	202.0	206.0	207.0	208.0

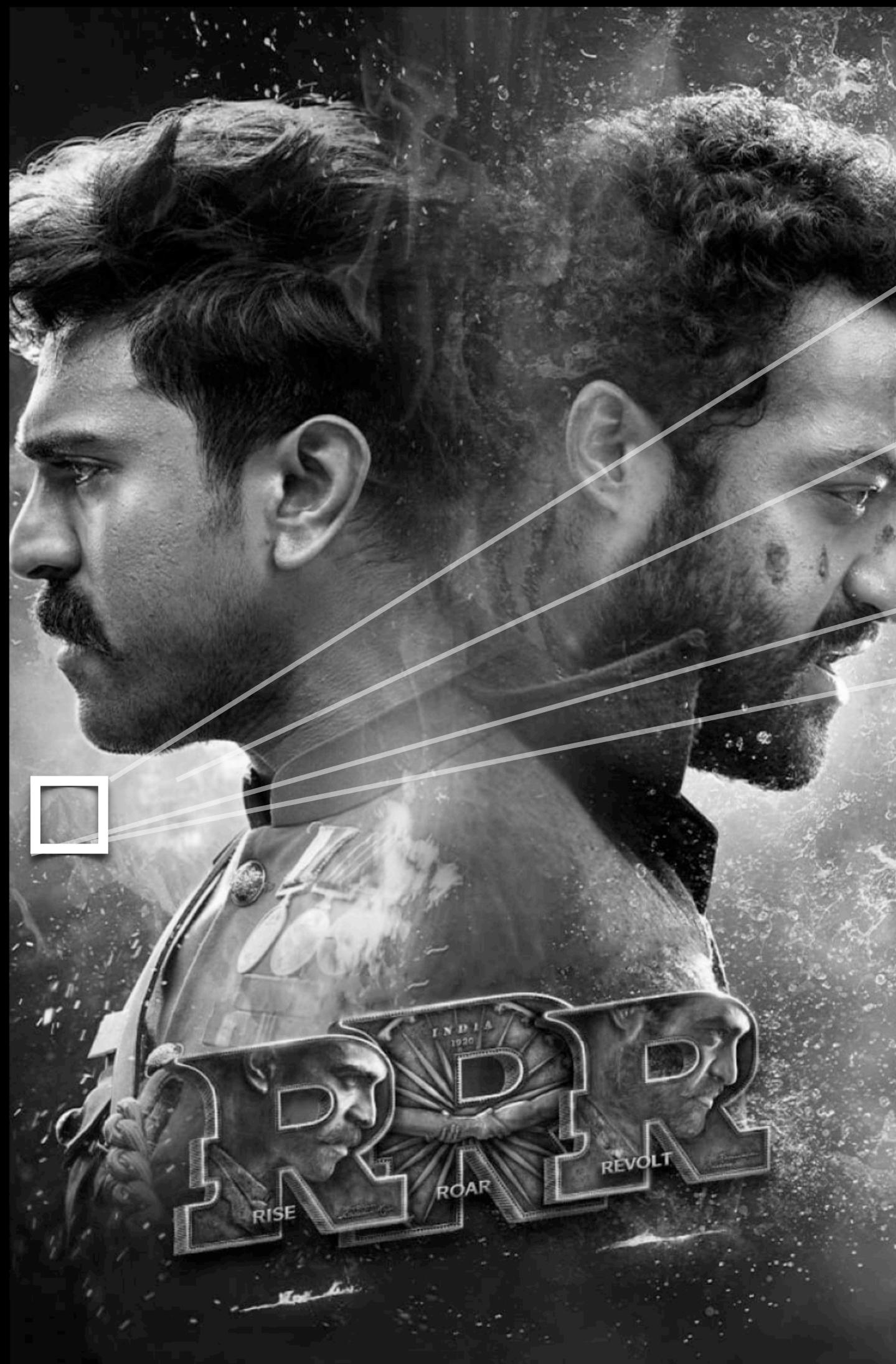
Histogram : Digital Image



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255	255	255	255	253	250	248	248	252	254	255	245	247	250	251	250	248	247	247	250	250	251	130	132	134	134	135	135	138	141	149	153	157
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241	242	240	244	247	250	252	252	254	255	255	227	228	230	235	242	246	247	246	247	245	244	69	70	73	80	88	95	103	108	117	121	126
242	242	241	243	245	248	249	249	251	252	252	227	227	229	233	239	243	243	242	243	241	241	66	66	69	74	81	89	95	100	110	113	117

211.0	213.0	215.0	215.0	214.0	212.0	211.0	211.0	215.0	217.0	219.0
210.0	211.0	213.0	213.0	212.0	211.0	211.0	212.0	217.0	219.0	221.0
206.0	207.0	208.0	209.0	210.0	210.0	210.0	212.0	219.0	220.0	221.0
208.0	206.0	205.0	205.0	207.0	209.0	209.0	211.0	218.0	220.0	222.0
208.0	206.0	203.0	203.0	205.0	208.0	208.0	209.0	215.0	217.0	219.0
207.0	203.0	199.0	198.0	203.0	208.0	210.0	210.0	213.0	215.0	217.0
200.0	195.0	191.0	192.0	199.0	208.0	211.0	212.0	211.0	214.0	216.0
194.0	188.0	185.0	188.0	197.0	207.0	211.0	213.0	210.0	213.0	215.0
181.0	182.0	184.0	189.0	195.0	201.0	205.0	207.0	209.0	211.0	211.0
174.0	180.0	181.0	186.0	192.0	197.0	200.0	202.0	206.0	207.0	208.0
		179.0	183.0	188.0	193.0	195.0	197.0	201.0	202.0	203.0

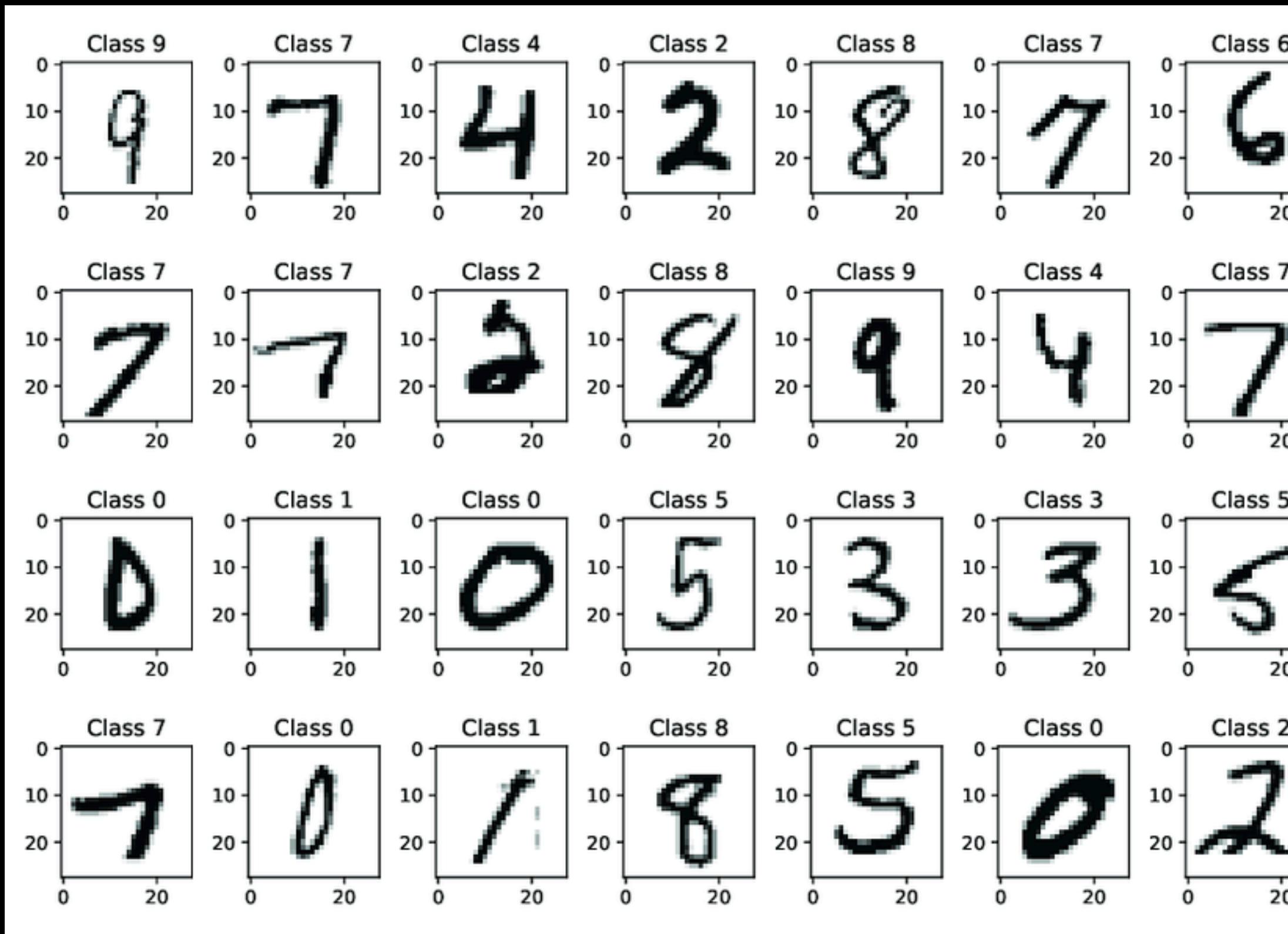
Histogram : Digital Image



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255	253	250	248	248	248	246	246	254	255	255
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255	252	246	243	246	249	250	249	250	251	253
253	247	242	240	245	251	253	253	251	252	254
250	244	238	240	246	253	255	255	252	255	255
241	240	241	243	248	251	254	254	255	255	255
241	242	240	244	247	250	252	252	254	255	255
242	242	241	243	245	248	249	249	251	252	252

211.0	213.0	215.0	215.0	214.0	212.0	211.0	211.0	215.0	217.0	219.0
210.0	211.0	213.0	213.0	212.0	211.0	211.0	212.0	217.0	219.0	221.0
206.0	207.0	208.0	209.0	210.0	210.0	210.0	212.0	219.0	220.0	221.0
208.0	206.0	205.0	205.0	207.0	209.0	209.0	211.0	218.0	220.0	222.0
208.0	206.0	203.0	203.0	205.0	208.0	208.0	209.0	215.0	217.0	219.0
207.0	203.0	199.0	198.0	203.0	208.0	210.0	210.0	213.0	215.0	217.0
200.0	195.0	191.0	192.0	199.0	208.0	211.0	212.0	211.0	214.0	216.0
194.0	188.0	185.0	188.0	197.0	207.0	211.0	213.0	210.0	213.0	215.0
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179.0	180.0	181.0	186.0	192.0	197.0	200.0	202.0	206.0	207.0	208.0
		179.0	183.0	188.0	193.0	195.0	197.0	201.0	202.0	203.0

Histogram : Grayscale Images



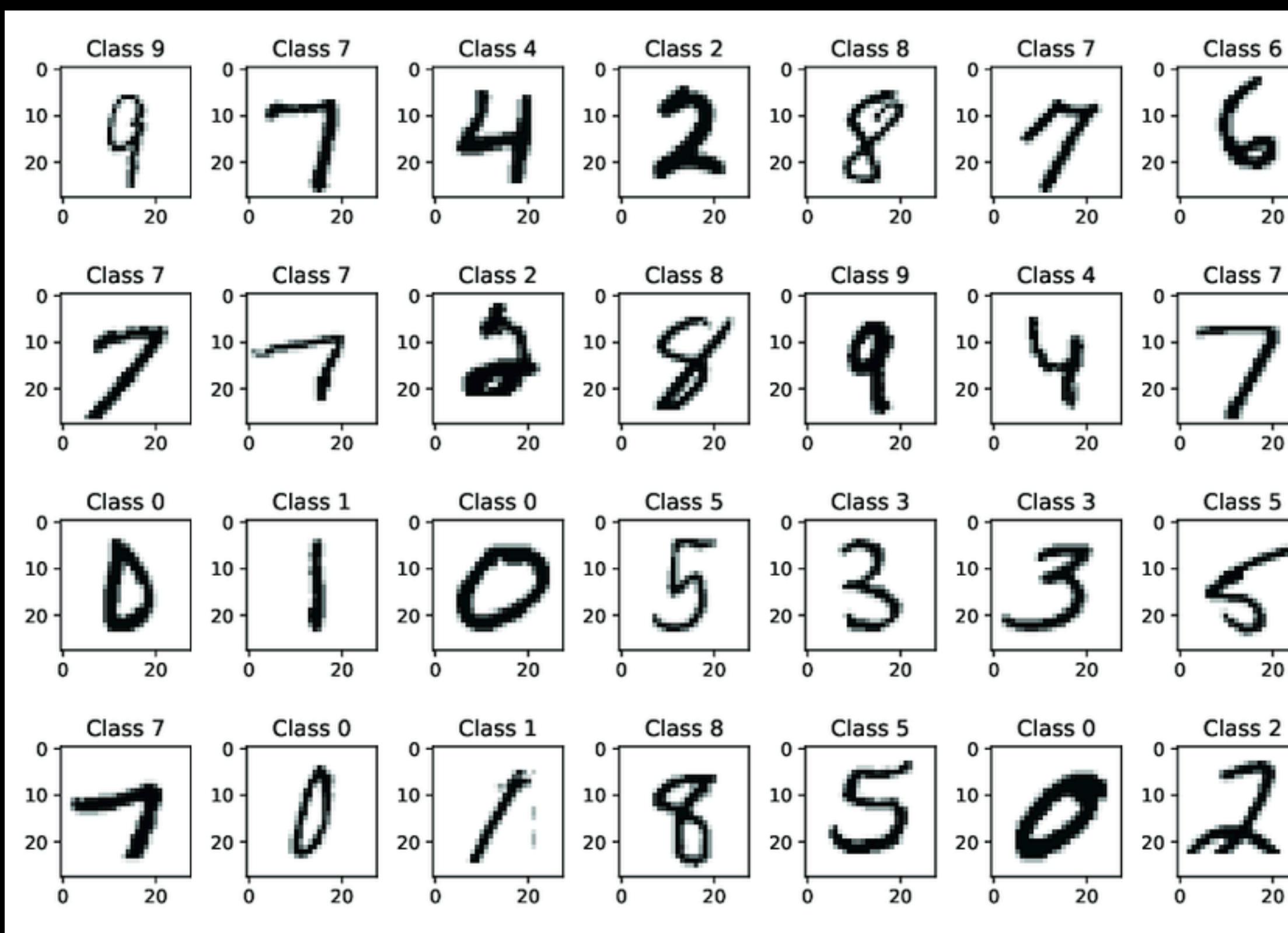
MNIST Data

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1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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7	0	0	0	0	0	5	92	36	36	140	154	154	154	224	253	253	253	253	253	253	253	253	253	253	253	253	253	170	0
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11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
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27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

MNIST Data

Histogram : Grayscale Images

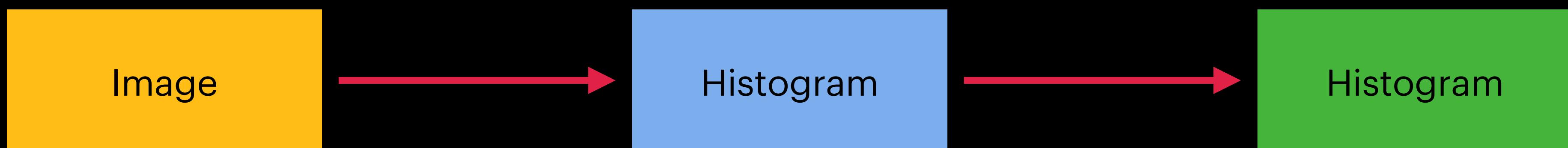
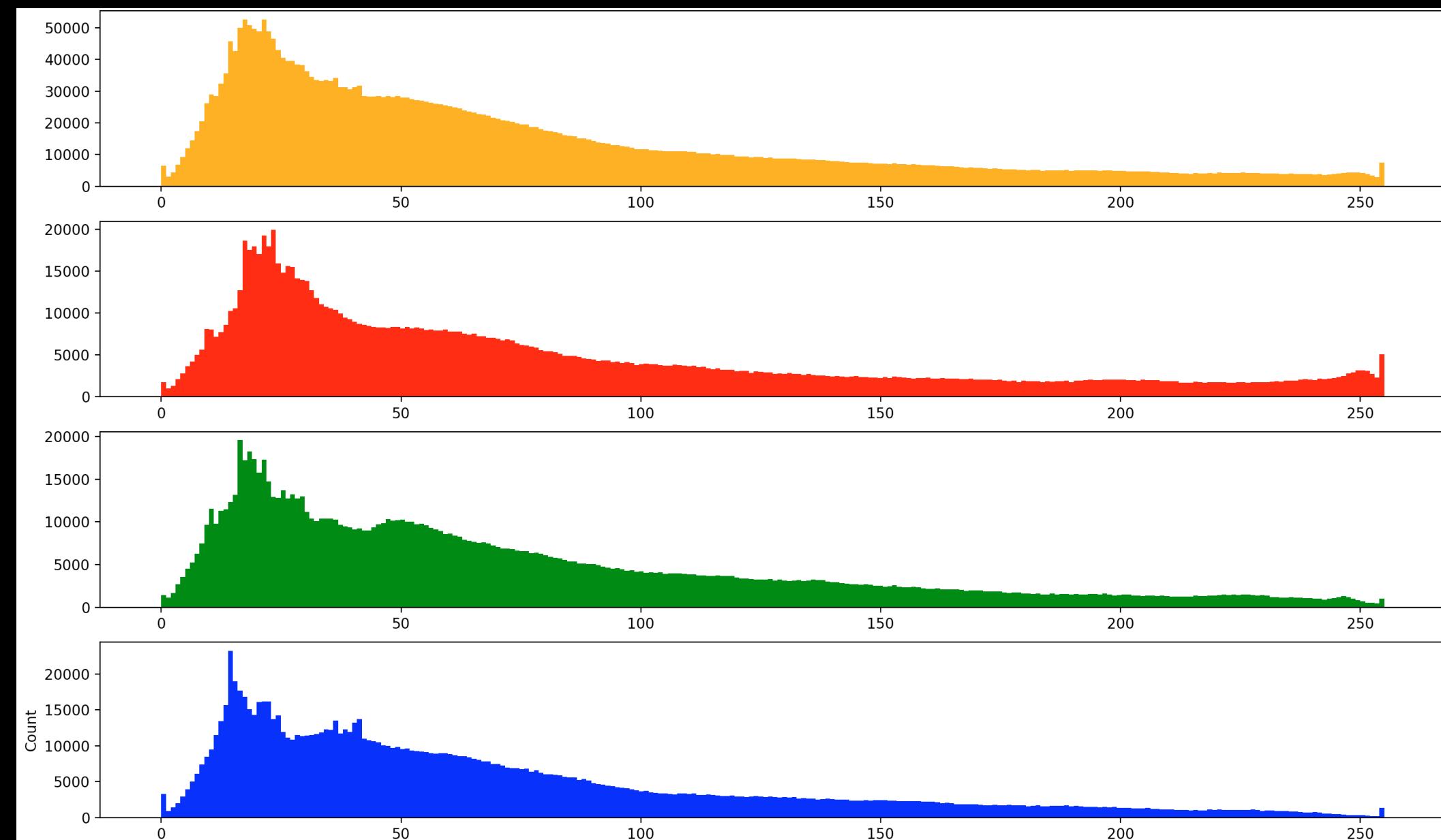
- Image with single Channel



MNIST Data

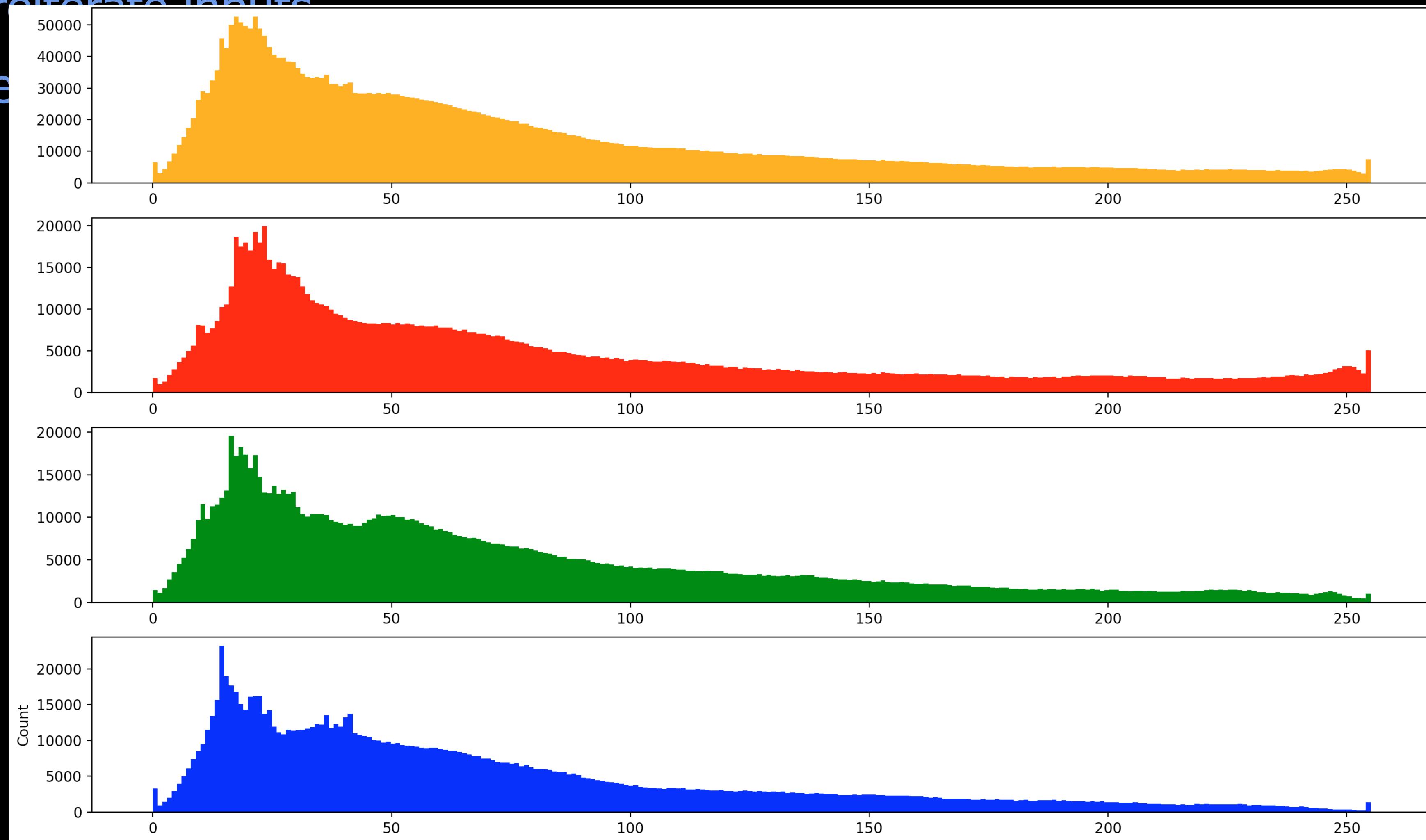
Histogram : Let's Define Goals

- Always reiterate inputs
- And where we need to reach from here



Histogram : Let's Define Goals

- Always reiterate inputs
- And when





Thank you
Be Hungry & Active