Data Efficiency and Machine Learning

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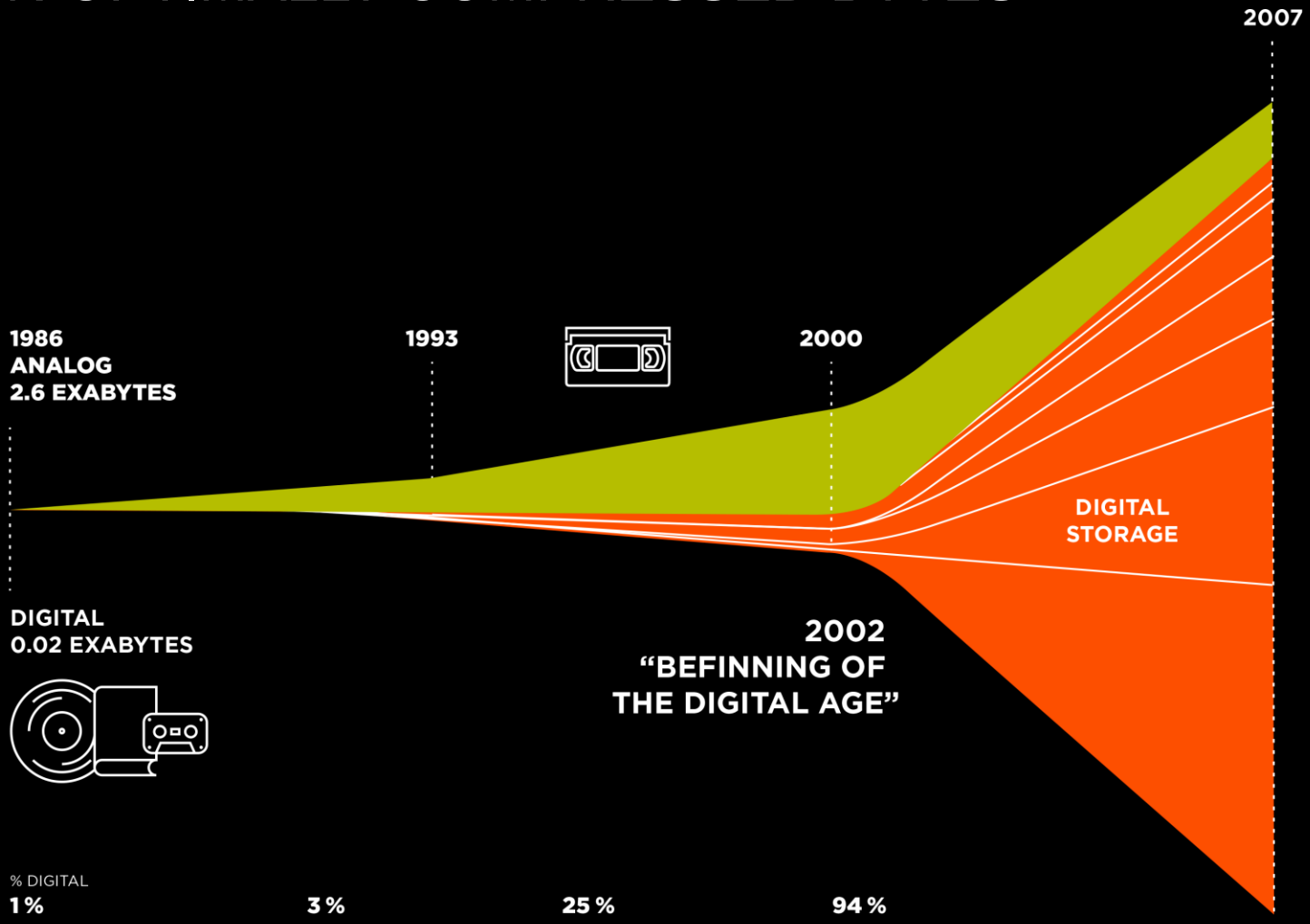
@lawrennd

GLOBAL INFORMATION STORAGE CAPACITY
IN OPTIMALLY COMPRESSED BYTES



ANALOG
19 EXABYTES
- Paper, film, audiotape and vinyl: 6%
- Analog videotapes (VHS, etc): 94%

ANALOG

DIGITAL

- Portable media, flash drives: 2%
- Portable hard disks: 2.4%
- CDs & Minidisks: 6.8%

- Computer Servers and Mainframes: 8.9%

- Digital Tape: 11.8%

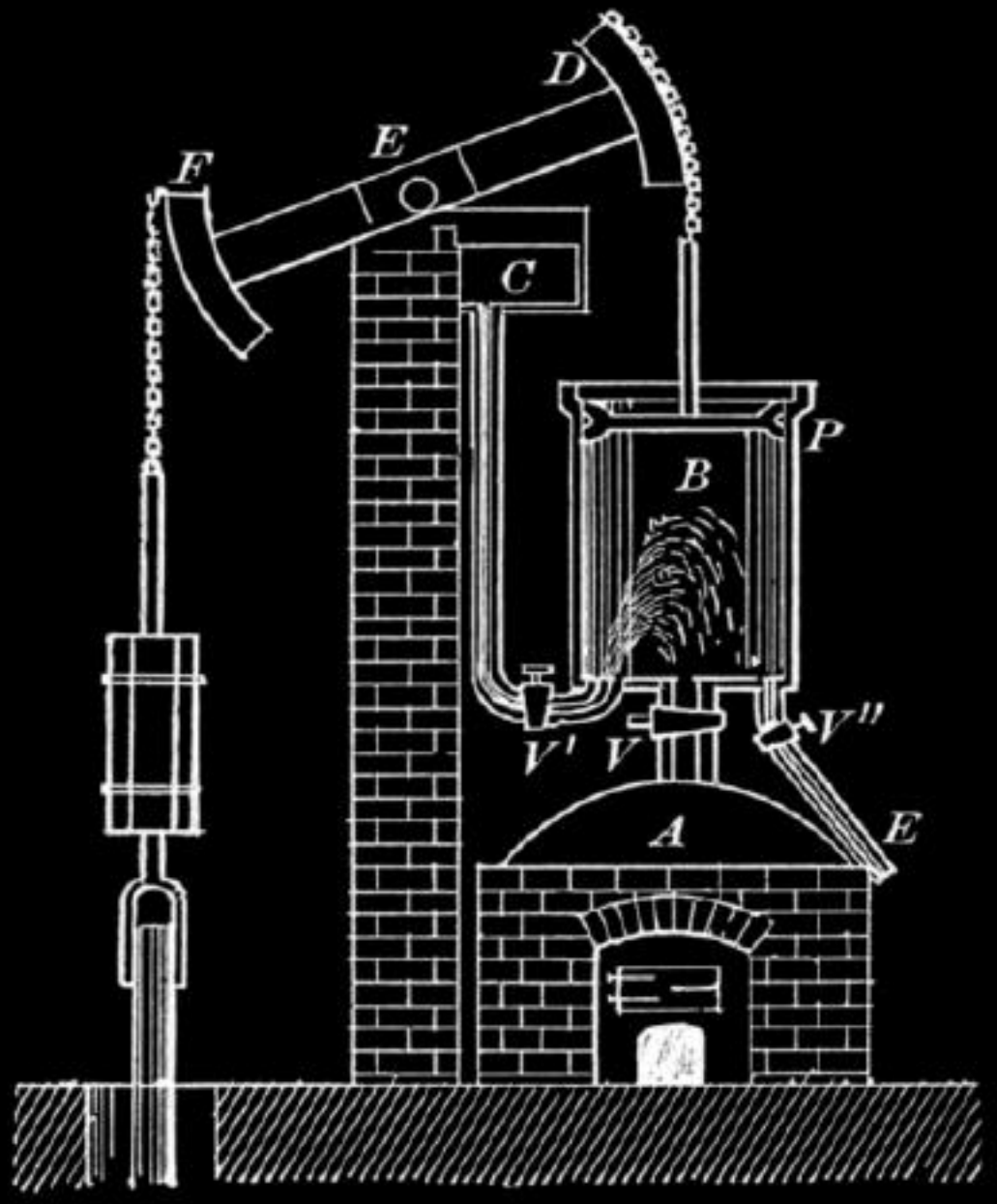
- DVD/Blu-Ray: 22.8%

- PC Hard Disks: 44.5%
  123 Billion Gigabytes

- Others: < 1% (incl. Chip Cards, Memory Cards, Floppy Disks, Mobile Phones, PDAs, Cameras/Camcorders, Video Games)

DIGITAL
280 EXABYTES

Source: Hilbert, M., & López, P. (2011). The World's Technological Capacity to Store, Communicate, andCompute Information. Science, 332 (6025), 60-65. martinhilbert.net/worldinfocapacity.html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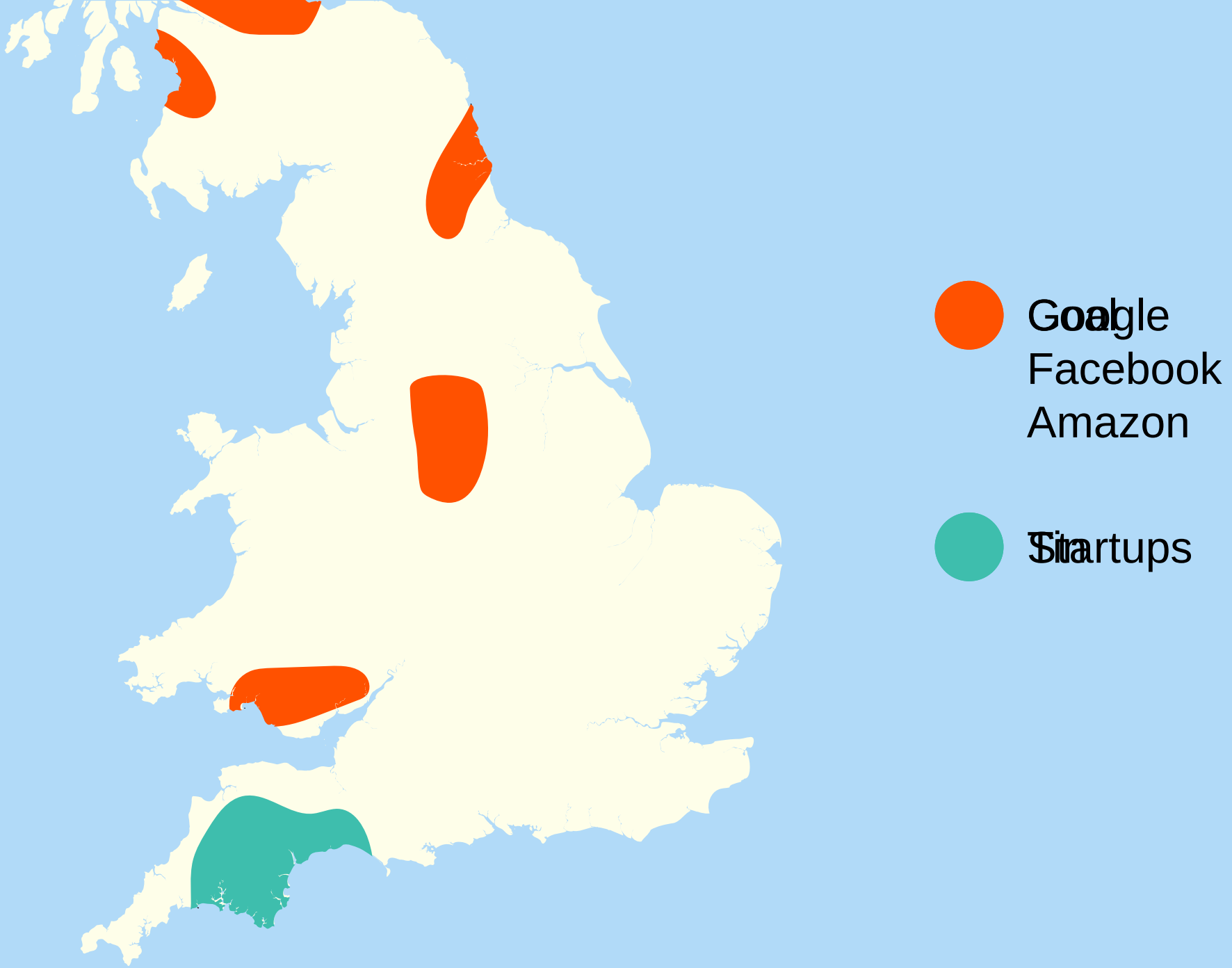
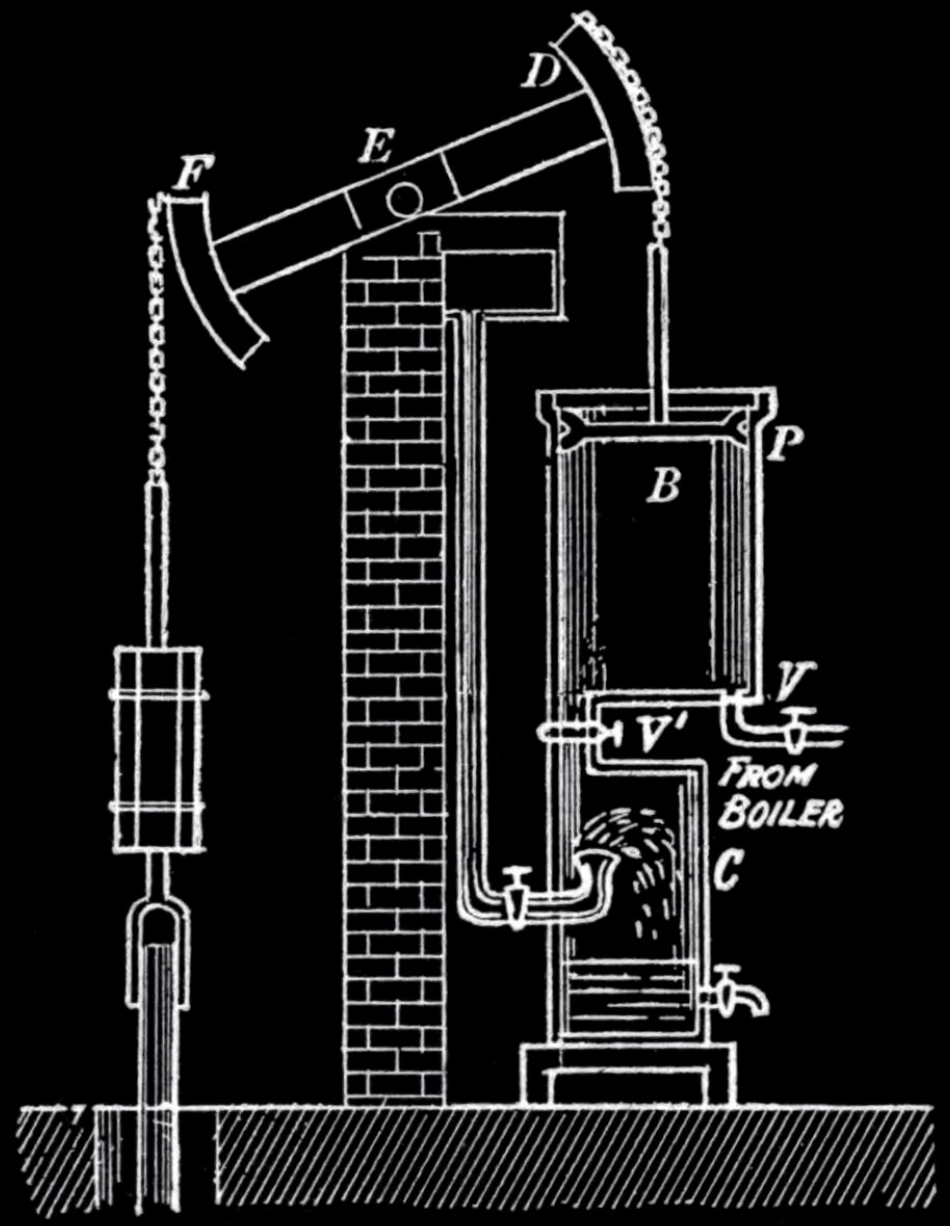

Google
Facebook
Amazon
Startups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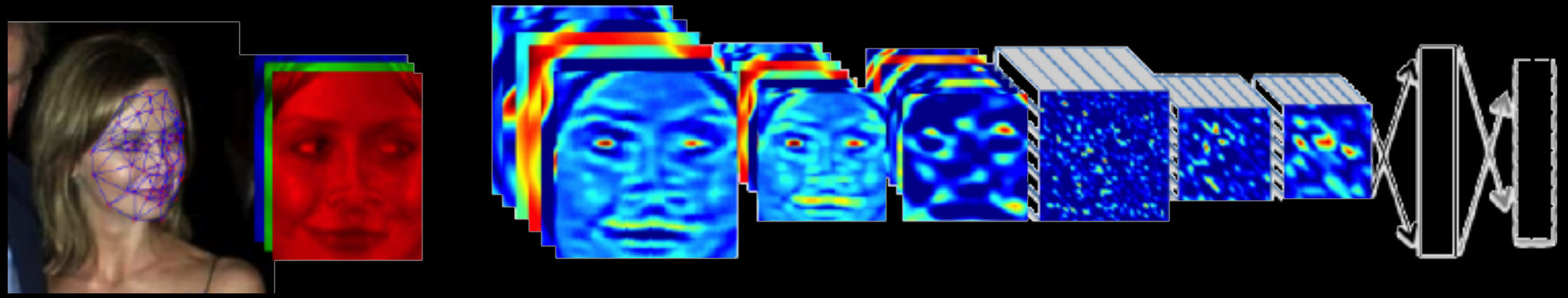
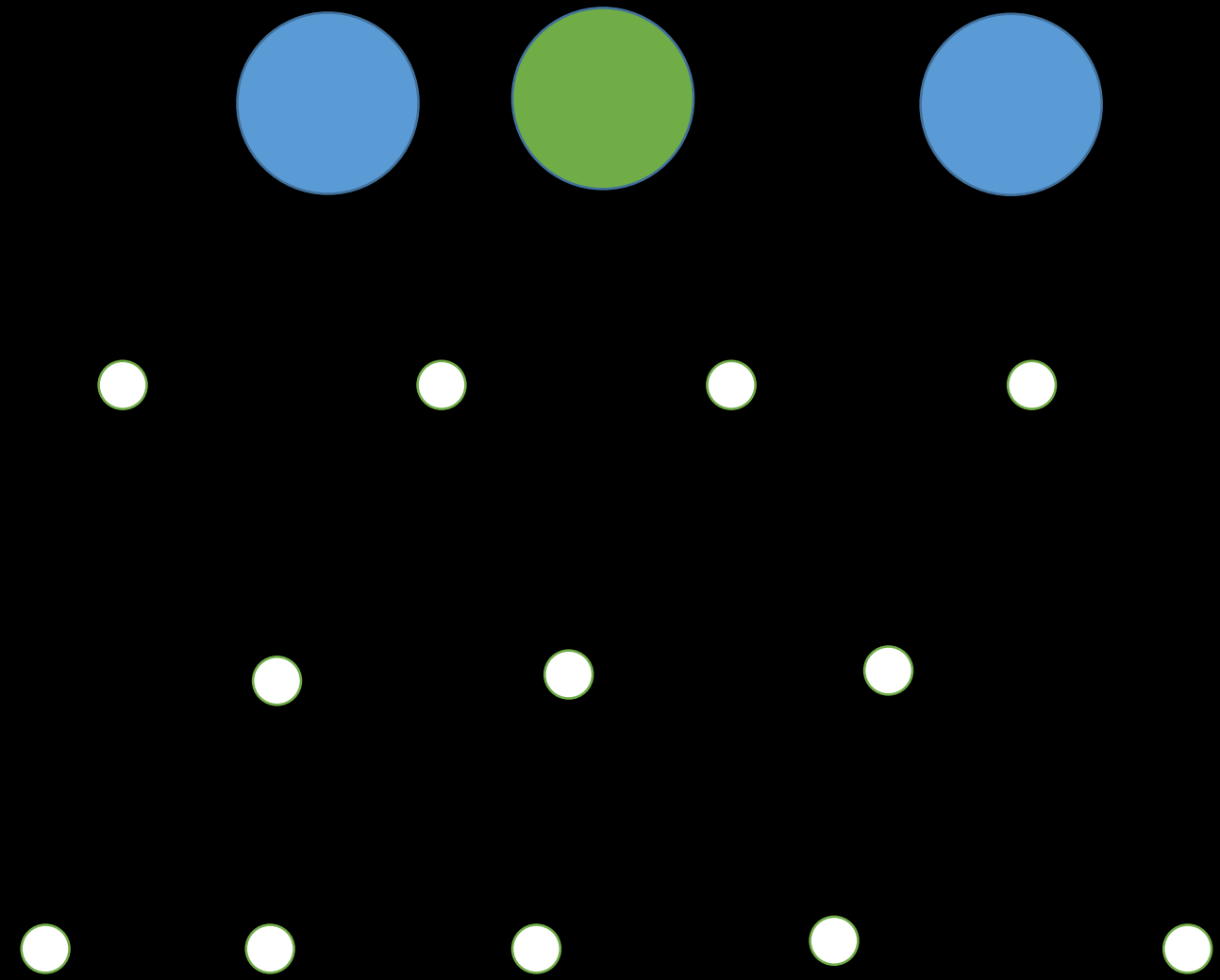
BOILER
C

Outline of the DeepFace architecture. A front-end of a single convolution-pooling-convolution filtering on the rectified input, followed by three locally-connected layers and two fully-connected layers. Color illustrates feature maps produced at each layer. The net includes more than 120 million parameters, where more than 95% come from the local and fully connected layers.

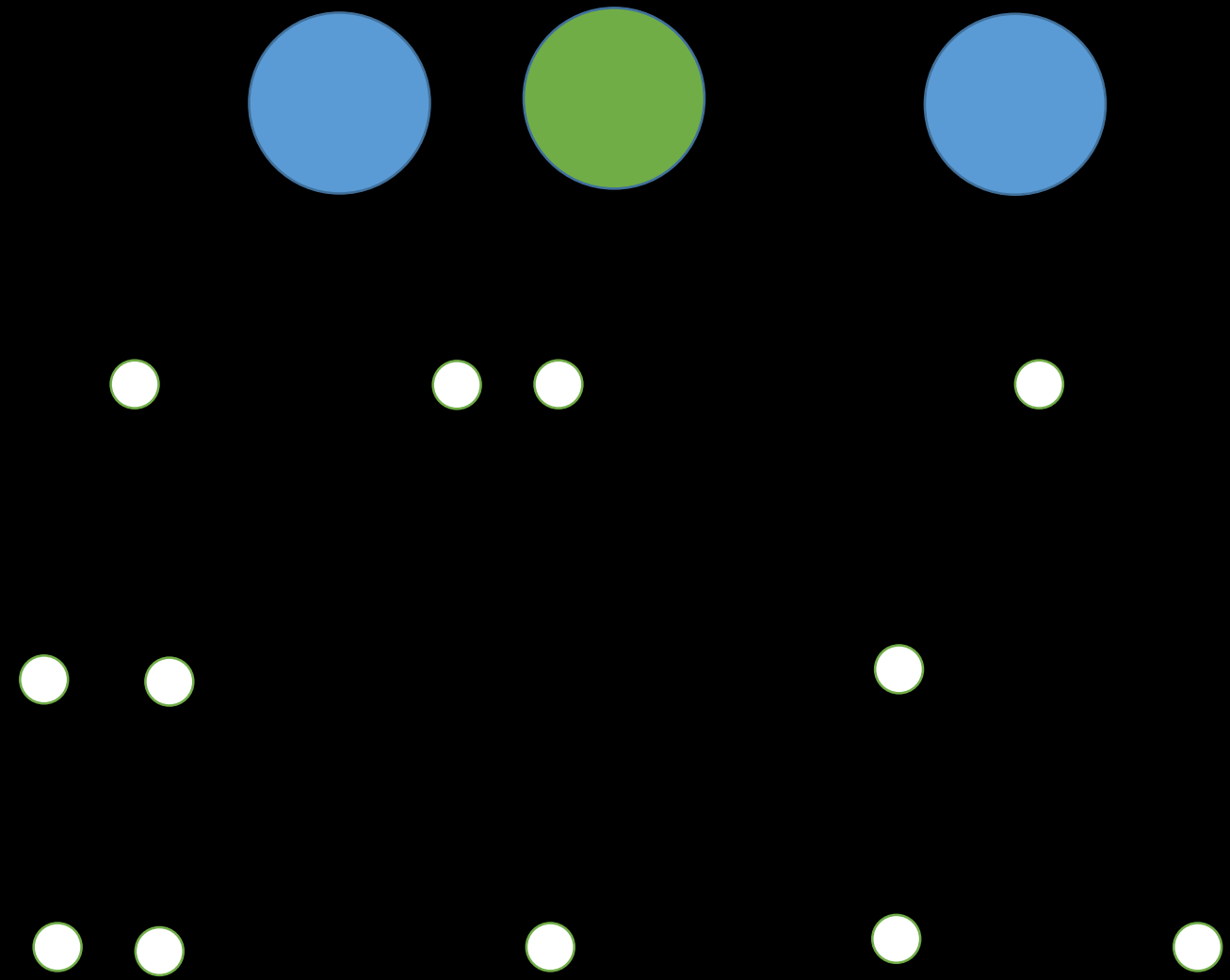


Source: DeepFace



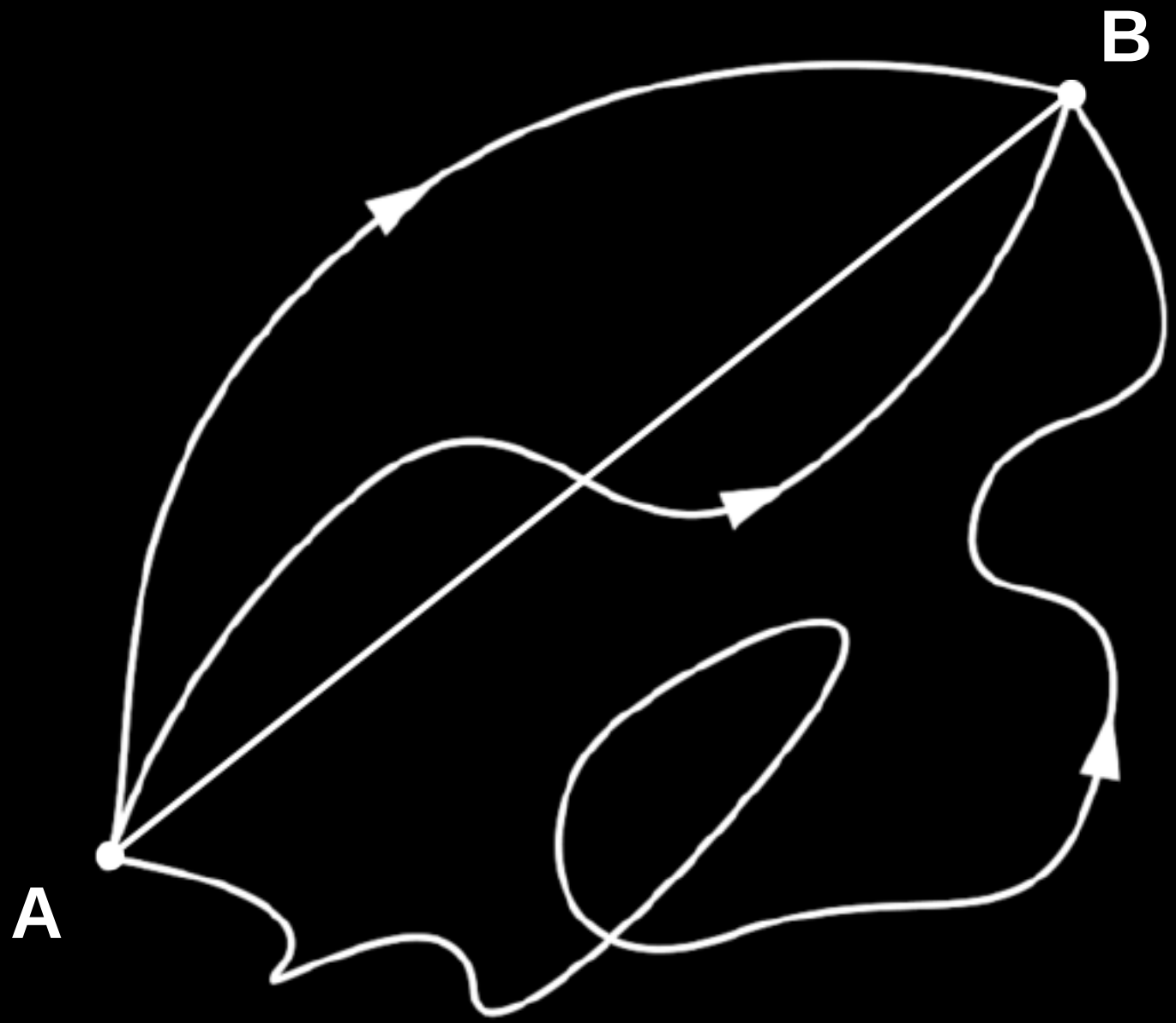
Yes

No



Yes

No


B
A

other, we say that its choice is an effect without a cause. It is then, says Leibnitz, the blind chance of the Epicureans. The contrary opinion is an illusion of the mind, which, losing sight of the evasive reasons of the choice of the will in indifferent things, believes that choice is determined of itself and without motives.

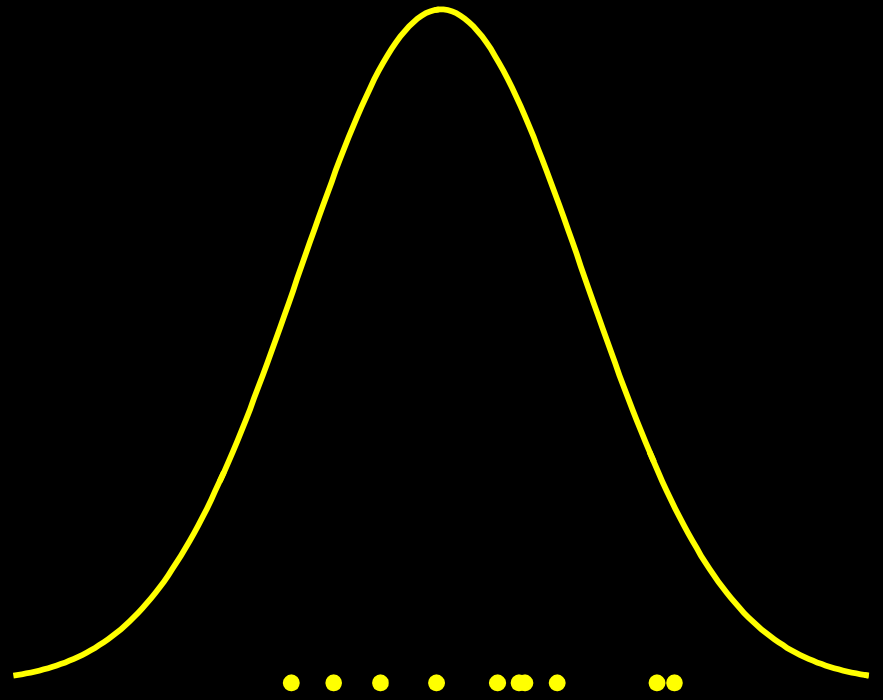
We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow. Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it—an intelligence sufficiently vast to submit these data to analysis—it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes. The human mind offers, in the perfection which it has been able to give to astronomy, a feeble idea of this intelligence. Its discoveries in mechanics and geometry, added to that of universal gravity, have enabled it to comprehend in the same analytical expressions the past and future states of the system of the world. Applying the same method to some other objects of its

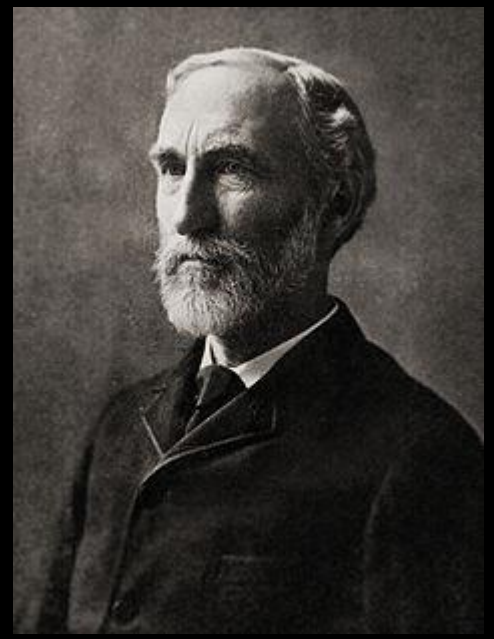
height: "The day will come when, by study pursued through several ages, the things now concealed will appear with evidence; and posterity will be astonished that truths so clear had escaped us." Clairaut then undertook to submit to analysis the perturbations which the comet had experienced by the action of the two great planets, Jupiter and Saturn; after immense calculations he fixed its next passage at the perihelion toward the beginning of April, 1759, which was actually verified by observation. The regularity which astronomy shows us in the movements of the comets doubtless exists also in all phenomena.

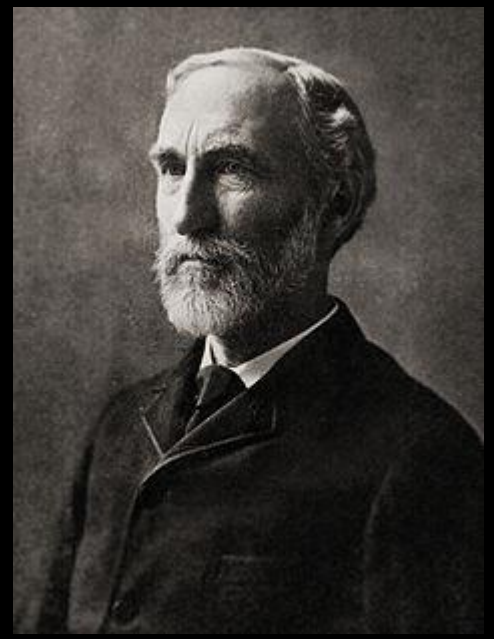
The curve described by a simple molecule of air or vapor is regulated in a manner just as certain as the planetary orbits; the only difference between them is that which comes from our ignorance.

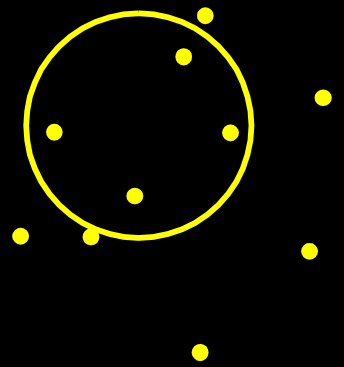
Probability is relative, in part to this ignorance, in part to our knowledge. We know that of three or a greater number of events a single one ought to occur; but nothing induces us to believe that one of them will occur rather than the others. In this state of indecision it is impossible for us to announce their occurrence with certainty. It is, however, probable that one of these events, chosen at will, will not occur because we see several cases equally possible which exclude its occurrence, while only a single one favors it.

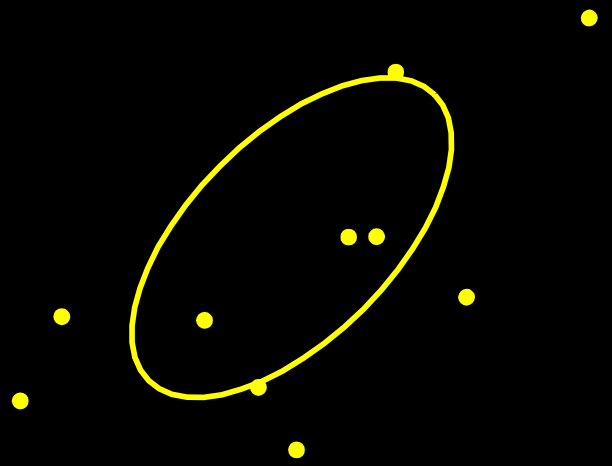
The theory of chance consists in reducing all the

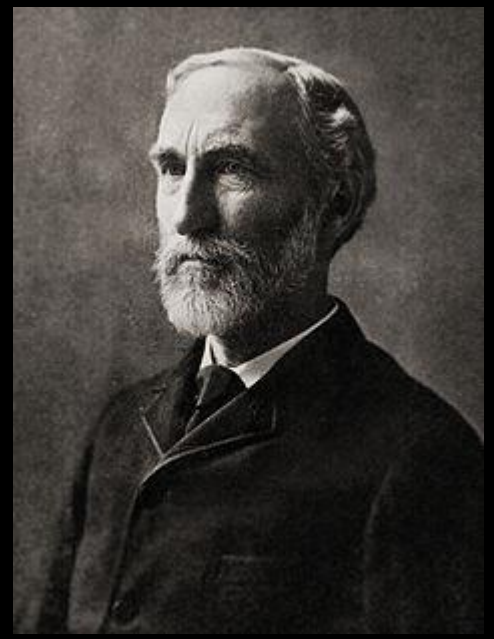












"My greatest concern was what to call it. I thought of calling it ‘information’, but the word was overly used, so I decided to call it ‘uncertainty’. When I discussed it with John von Neumann, he had a better idea. Von Neumann told me, ‘You should call it entropy, for two reasons. In the first place your uncertainty function has been used in statistical mechanics under that name, so it already has a name. In the second place, and more important, nobody knows what entropy really is, so in a debate you will always have the advantage.“

(HT Alex Matthews)

Gibbs vs Boltzmann Entropies*

E. T. Jaynes
Department of Physics, Washington University, St. Louis, Missouri
(Received 27 March 1964; in final form, 5 November 1964)

The status of the Gibbs and Boltzmann expressions for entropy has been a matter of some confusion in the literature. We show that: (1) the Gibbs H function yields the correct entropy as defined in phenomenological thermodynamics; (2) the Boltzmann H yields an "entropy" that is in error by a nonnegligible amount whenever interparticle forces affect thermodynamic properties; (3) Boltzmann's other interpretation of entropy, $S=k \log W$, is consistent with the Gibbs H, and derivable from it; (4) the Boltzmann H theorem does not constitute a demonstration of the second law for dilute gases; (5) the dynamical invariance of the Gibbs H gives a simple proof of the second law for arbitrary interparticle forces; (6) the second law is a special case of a general requirement for any macroscopic process to be experimentally reproducible. Finally, the "anthropomorphic" nature of entropy, on both the statistical and phenomenological levels, is stressed.

Take precisely stated prior data or testable information about a probability distribution function. Consider the set of all trial probability distributions that would encode the prior data. Of those, the one with maximal information entropy is the proper distribution, according to this principle.

maximum entropy

principle of indifference

Thank you

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http://inverseprobability.com
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