

# Indian Knowledge System to Machine Learning.

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## **Content:**

1. What is Machine Learning?
2. The problems of current AI and ML approaches.
3. Solutions to the current problems.
4. Subjectivities and Indian Knowledge Traditions
5. IKS as Data
6. ML for IKS
7. Case Studies
8. Conclusion



# Machine Learning.

- Machine Learning is the sub-field of [Artificial Intelligence](#).
- It helps to build automated systems that can learn by themselves.
- Then, the system enhances their performance by learning from experience without any human intervention.
- This helps the machines make data-directed choices. Whatever the machines learn from past experience using the available data, the machines use it to make predictions.
- For example, you must have used Google Maps for navigation. It tries to show the fastest route with less traffic and congestion. It accomplishes this task by using Machine Learning algorithms.

# ARTIFICIAL INTELLIGENCE VS MACHINE LEARNING VS DEEP LEARNING

## 1 Artificial Intelligence

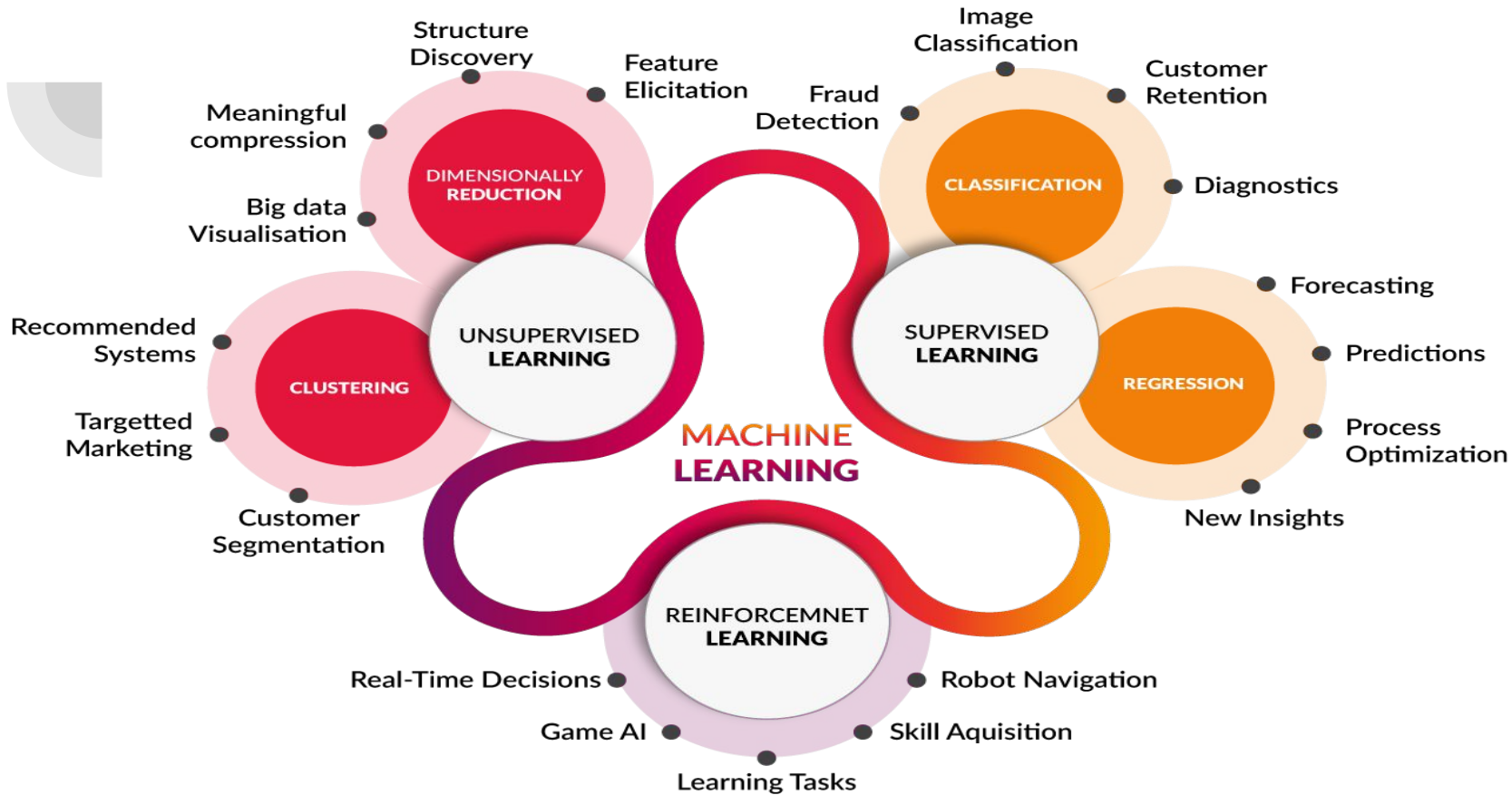
Development of smart systems and machines that can carry out tasks that typically require human intelligence

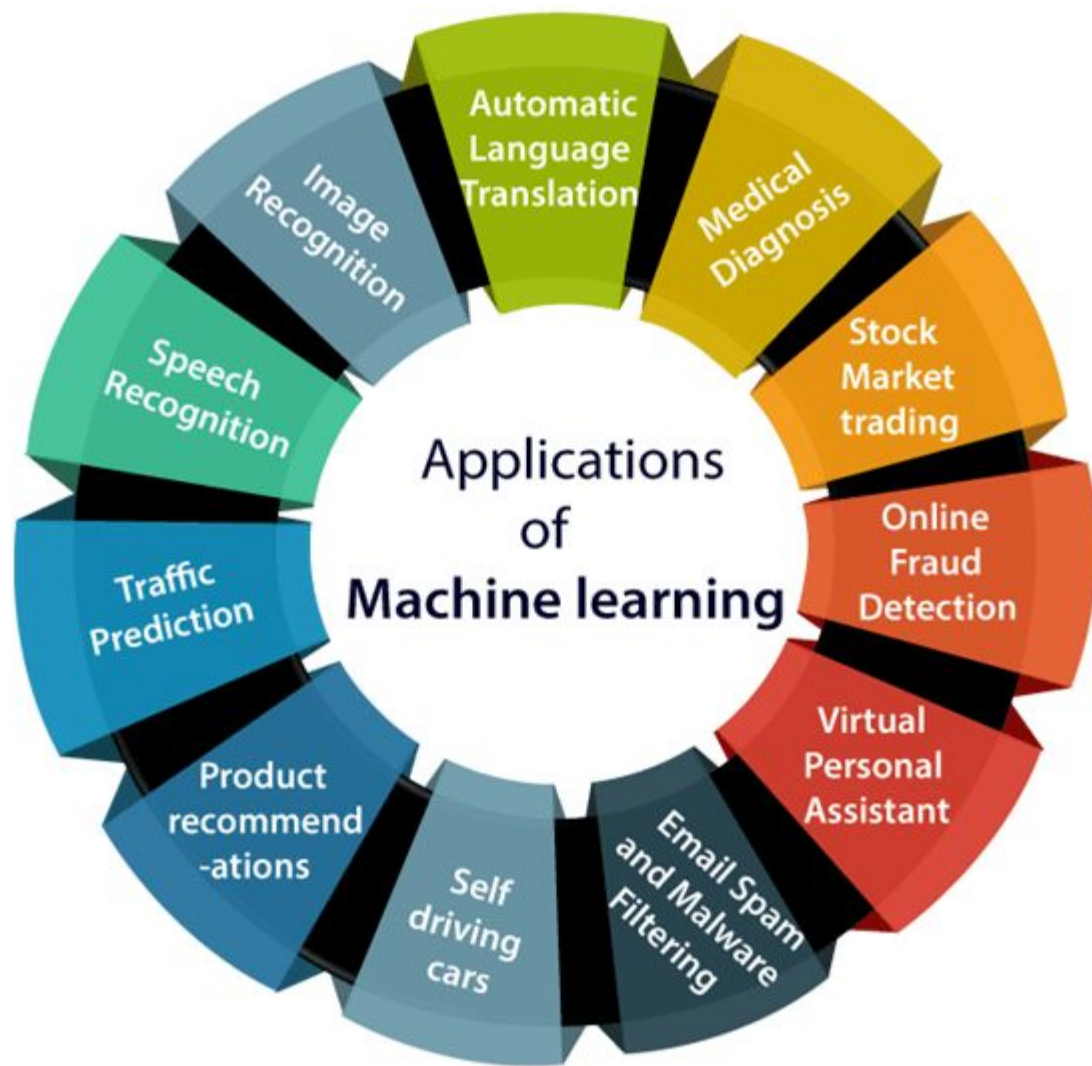
## 2 Machine Learning

Creates algorithms that can learn from data and make decisions based on patterns observed  
Require human intervention when decision is incorrect

## 3 Deep Learning

Uses an artificial neural network to reach accurate conclusions without human intervention







# What is that the machine is learning?

**‘There is no standard’:  
investigation finds AI  
algorithms objectify  
women’s bodies**

<https://www.theguardian.com/technology/2023/feb/08/biased-ai-algorithms-racy-women-bodies#:~:text=Images%20posted%20on%20social,countless%20photos%20featuring%20women's%20bodies.>



## How deep is this problem?

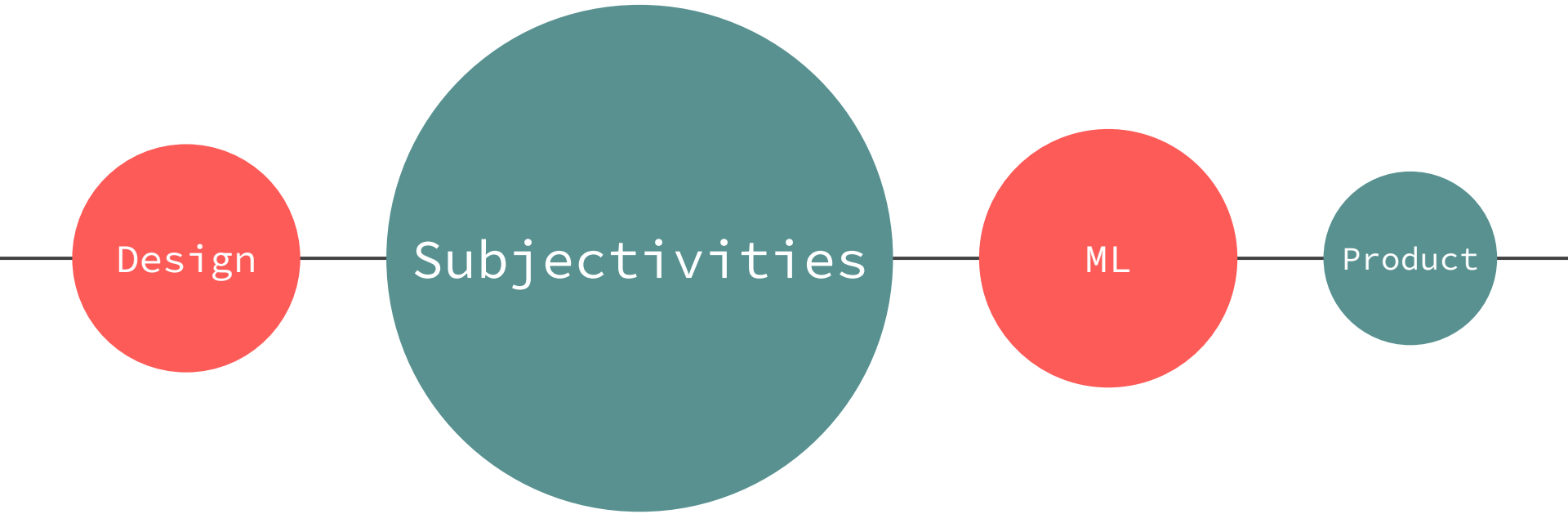
Even medical pictures are affected by the issue. The AI algorithms were tested on images released by the US National Cancer Institute demonstrating how to do a clinical breast examination. Google's AI gave this photo the highest score for raciness, Microsoft's AI was 82% confident that the image was "explicitly sexual in nature", and Amazon classified it as representing "explicit nudity".

Pregnant bellies are also problematic for these AI tools. Google's algorithm scored the photo as "very likely to contain racy content". Microsoft's algorithm was 90% confident that the image was "sexually suggestive in nature".





# How the Machine Learning Works?



# Subjectivities

- What is subjectivity and objectivity?
- An objective perspective is one that is not influenced by emotions, opinions, or personal feelings - it is a perspective based in fact, in things quantifiable and measurable. A **subjective** perspective is one open to greater interpretation based on personal feeling, emotion, aesthetics, etc.





# Is it possible to be objective?

Researchers from the [Perception and Mind Lab](#) opined: They carried out a series of experiments to find out how people detect objects under different conditions. They suggest that the brain's representation of an object includes how someone perceives it — not just how it truly is. They conclude that a person cannot see an object in a way that is entirely separate from their point of view.

<https://www.medicalnewstoday.com/articles/theres-no-such-thing-as-an-objective-view-of-something>



# Can Machines be Objective?

We saw previously that this data should be organized, preprocessed and often labelled very neatly. We also pinpointed the fact that this cannot yet be done by machines, which is why humans are currently “enslaved” into mindless jobs to take care of this step, be it by FigureEight, Amazon Mechanical Turk, Clickworker or Accenture.

<https://medium.com/nerd-for-tech/artifakal-intelligence-2-machines-are-objective-1-2-68668c390282>



# The Dream of Objectivity

When AI is mentioned today it is generally referring to narrow artificial Intelligence (AI). This is when a machine mimics the cognitive functions of “learning” and “problem solving,” but is limited to solving specific types of pre-identified objectives.

<https://medium.datadriveninvestor.com/even-our-machines-are-racist-c89360b4e1a3>



# Why Objectivity is a problem of ML and AI?

Machine Learning is an re-iteration of Human History of identity based discrimination that leads to reproduction of the same.

This has been a central tension since image-generation AI took off last year, as many artists see the tools as unethical—due to being trained on masses of human-made art scraped from the internet—and cudgels to further cut costs and devalue workers.

<https://www.youtube.com/watch?v=GpPA9I79l0k>



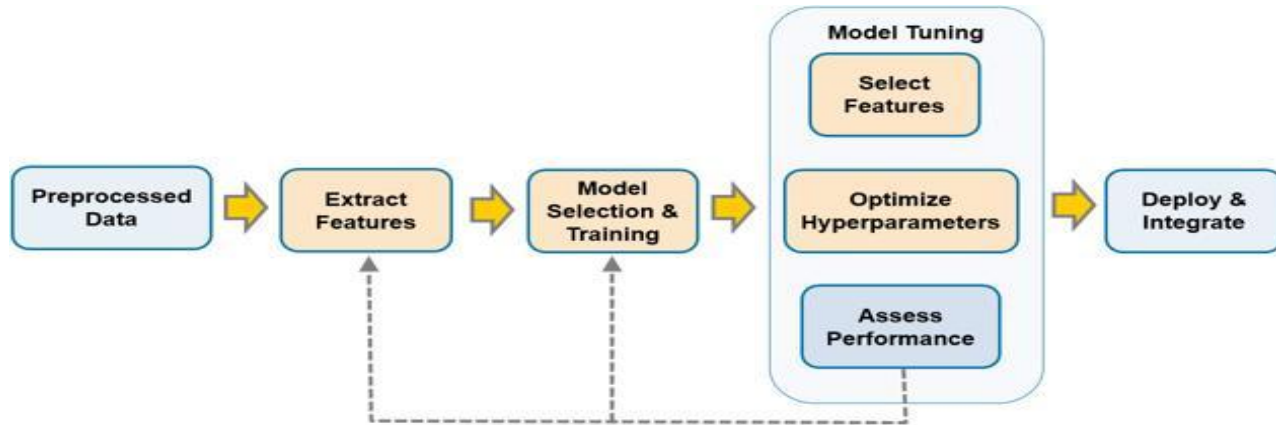
# Is math Objective?

“The technology already exists. It’s only the will we’re lacking.”

"big data increases inequality and threatens democracy."

<https://blogs.scientificamerican.com/roots-of-unity/review-weapons-of-math-destruction/>

# Is it a Problem of Data Optimisation?



Most machine learning problems, once formulated, can be solved as optimization problems.

<https://arxiv.org/pdf/1906.06821.pdf>



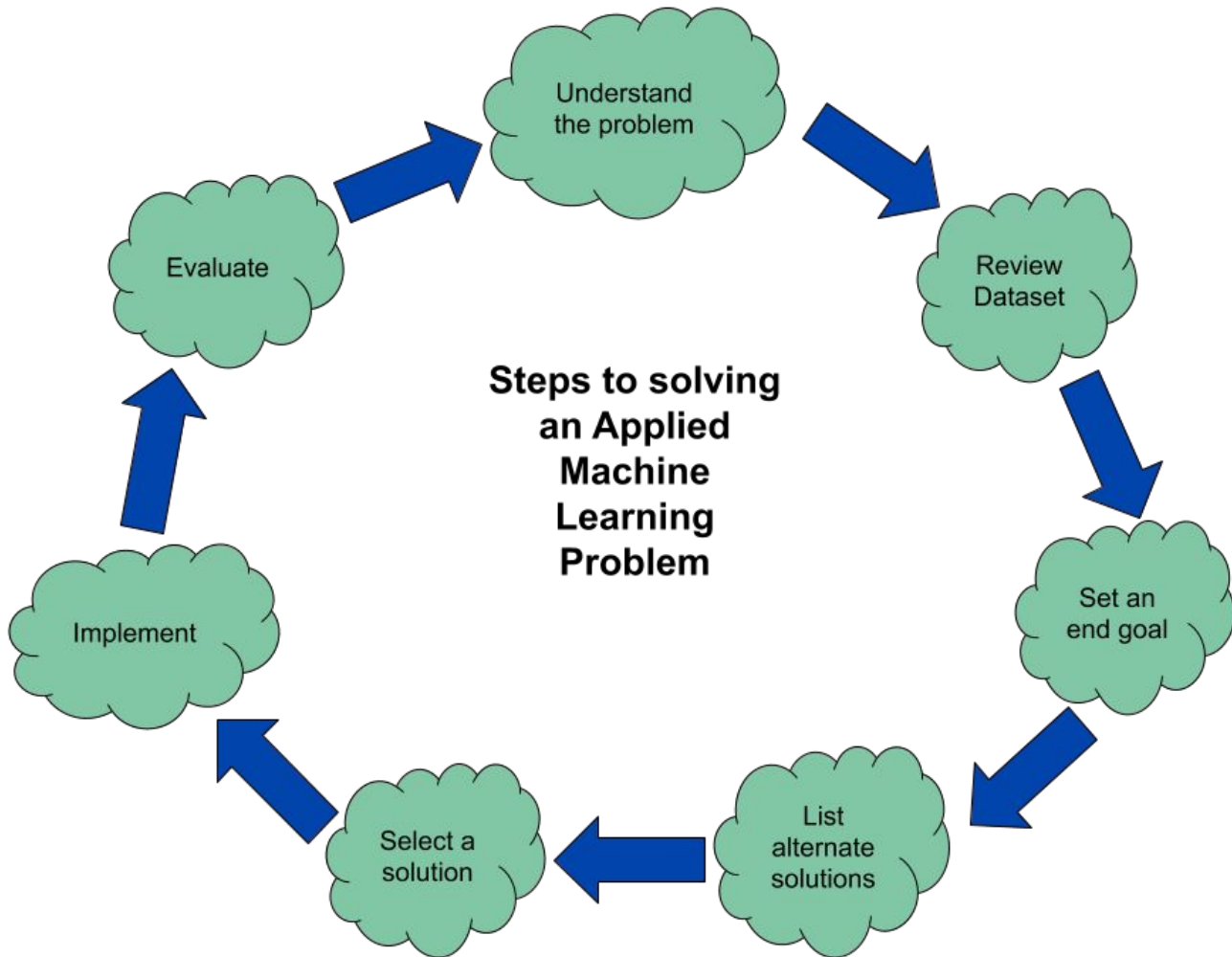


# Subjective Optimisation

One common design for building gesture generators is to apply machine learning algorithms to model the relationship between dialogs and gestures from human conversation data, and the derived model can then generate animations for similar dialogs automatically. The most common design for existing machine learning approaches trains models to fit the training data, but this conventional design is orthogonal to the actual goal of gesture generators, which is to produce natural motions that match well the corresponding dialogue. Although human conversation data collected for training are samples of natural gestures, unless the machine learning model can achieve 100% accuracy on fitting the data while also generalize to novel dialogue, there is no guarantee that the resulting model can generate natural motion.

<https://towardsdatascience.com/one-simple-methodology-to-turn-a-subjective-concept-into-an-objective-metric-14943cf6fb95>

<https://www.youtube.com/watch?v=GpPA9I79l0k>





## **What happens when the data is altogether absent from the source?**

There is no data to fit the training model hence model generated is not inclusive of the knowledge that is absent, because there are no alternate sources to get data.

**Hence the Indian Knowledge  
System to Machine Learning.**

The background is a solid teal color. It features several decorative elements: a large, semi-transparent pie chart in the upper right quadrant; several smaller, semi-transparent pie charts scattered in the upper right and middle right areas; and a semi-transparent bar chart in the bottom right corner with four vertical bars of increasing height.



# Shruti and Smriti

Most of the Indian Knowledge on various issues are stored in a Shruti and Smriti Format. The written text also has limited access to the original systems of knowledge in almost all the fields of study, for instance, politics, economics, decision making and others.

Both these forms of knowledge are non-existent in the digital space. When absent the IKS cannot become the part of data that is used to develop algorithms around decision making for various purposes.



## For instance,

Human judgment is used to classify a representative sample of places into urban or rural. Reliance on several, qualitatively different groups of assessors, as well as on different classification protocols, provides reassurance that the outcome is stable. This sample is in turn used as the training set for a machine learning exercise allowing to classify out-of-sample places as urban or rural. A comparison between the various classification approaches provides further reassurance that the prediction outcome is robust.

[https://www.sciencedirect.com/science/article/pii/S0094119019301068?casa\\_token=dTzRWQb7X4AAAAAA:tuqVxFq1vX1AVL5EOTsEwXges-fXjmNsqlyN4BYjtT19wwraZbA7WCVwmPlvqBRurXMPV47GhXbK](https://www.sciencedirect.com/science/article/pii/S0094119019301068?casa_token=dTzRWQb7X4AAAAAA:tuqVxFq1vX1AVL5EOTsEwXges-fXjmNsqlyN4BYjtT19wwraZbA7WCVwmPlvqBRurXMPV47GhXbK)



# Subjectivities in ML

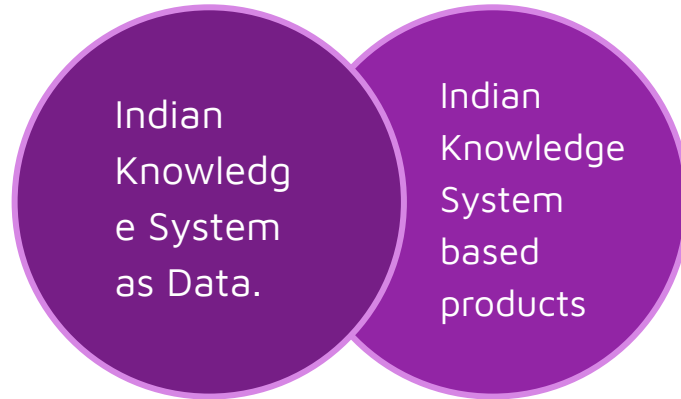
Subjective assessments are increasingly being used to complement more objective approaches across various fields in economics. For example, good-looking ratings by independent parties have been shown to be correlated with occupational sorting, earnings differentials and physical performance (Beller et al., 1994; Hamermesh and Biddle 1994; Postma 2014). Similarly, self-reported happiness has been adopted as a wellbeing indicator on the grounds that everybody has his or her own views on what a good life looks like, and what makes a good life may touch on dimensions for which no reliable indicator is available (Frey and Stutzer 2002; Veenhoven 2004).

[https://www.sciencedirect.com/science/article/pii/S0094119019301068?casa\\_token=dTzRWQb7X4AAAAAA:tugVxFg1vX1AVL5EOTsEwXges-fXjmNsqIyN4BYjtT19wwraZbA7WCVwmPIvqBRurXMPV47GhXbK](https://www.sciencedirect.com/science/article/pii/S0094119019301068?casa_token=dTzRWQb7X4AAAAAA:tugVxFg1vX1AVL5EOTsEwXges-fXjmNsqIyN4BYjtT19wwraZbA7WCVwmPIvqBRurXMPV47GhXbK)



# Broadly

...the application of the Indian Knowledge Traditions in Machine learning can be assessed in two ways:







# What is IKS

At its most elemental level, IKS can be considered the foundation upon which local communities make determinations about local issues. These decisions pertain to various areas of endeavour, including water and other resource use, conservation and management, agriculture, health care issues, as well as providing information and public outreach and education within a **local community**.

**Grounded in a particular culture and geography.**

**The oral tradition**

**IKS tend to be more transparent and openly accessible to communities.**



## Hence,

Machine Learning based solutions for local problems must be based on the decision making processes followed by the local community, not influenced by the global philosophical traditions.

The following machine learning model for earthquake prediction is the North East India.

...originated from the collision between the Indian and the Eurasian Plates. The subduction zone originated in the eastern part of India along the Indo-Myanmar Range...

<https://www.sciencedirect.com/science/article/pii/S1674987120302504>



# The Earthquake Prediction...

...can be understood as a geographically and spatially diverse phenomenon.

1. There cannot be one predictive model for all the earthquakes in India or the world.
2. Each location needs its own predictive system.
3. No two systems can be same due to the difference in demography, land usage, and other social factors.
4. Better solutions need inputs from **DIVERSE** systems.



# **IKS in Decision Making of Hydropower Generation**

IKS along with the scientific processes resulted in the Decision making process for water management.

[49b19b10145ad968035675c74caafe73a409d628](#)



# Decision Making is a Central Problem of ML

...for interpretable reinforcement learning...which involves first training a high-performance neural network decision-making policy using reinforcement learning...

...and then training an interpretable policy to approximate this neural network. However, unlike prior work, we are interested in interpreting the discrepancy between the human policy and the neural network (rather than the neural network itself)...

Thus, we encode this discrepancy into a novel objective, and select an interpretable tip that best minimizes the discrepancy...

<https://hamsabastani.github.io/tips.pdf>



# Economic Decision Making

...if the Sanskrit grammarian Panini came up with nomenclature for compound interest circa 700 BCE, it was Kautilya who understood the relation between interest rates and risk and uncertainty...

...Pareto's Idea of Social Efficiency can be seen in the Ashram system of Hindu Philosophy...

[https://books.google.co.in/books?hl=en&lr=&id=HY6nDwAAQBAJ&oi=fnd&pg=PT5&dq=Satish+Deodhar+iima&ots=7g-Kg\\_biPW&sig=ctH4rrhRahGvvqBvNzcAcN6X3e8&redir\\_esc=y#v=onepage&q=Satish%20Deodhar%20iima&f=false](https://books.google.co.in/books?hl=en&lr=&id=HY6nDwAAQBAJ&oi=fnd&pg=PT5&dq=Satish+Deodhar+iima&ots=7g-Kg_biPW&sig=ctH4rrhRahGvvqBvNzcAcN6X3e8&redir_esc=y#v=onepage&q=Satish%20Deodhar%20iima&f=false)



# Medical Decision Making

This is fueled by the importance of medical care and the generation of data in massive quantities from sources such as medical imaging, biosensors, molecular data, and electronic medical records. The aims of AI in medicine include the **personalization of medical decisions, health practices, and therapies to individual patients.**

This has scope of including IKS in a personalised format. Some of the Ayurveda start-ups are making personalised plans and related stimulations for patients who want an AI based solution with Ayurveda as a part.

<https://www.mdpi.com/2076-3417/11/11/5088>



# Other Applications of IKS in Decision Making algorithms

Architecture.

Metallurgy.

Urban Planning.

Sustainability.

And others...





# ML for Conserving IKS

...Custom built controllers, influenced by the Human Computer Interaction (HCI) community, serve as new interfaces to gather musical gestures from a performing artist. Designs on how to modify a Tabla, Dholak, and Sitar with sensors and electronics are described. Experiments using wearable sensors to capture ancillary gestures of a human performer are also included...

<http://dspace.library.uvic.ca/handle/1828/202>



# To conserve Huaer Folk Song

1. Recurrent Neural Network.
2. Hyper Text Processor.
3. Python Built in Module and Dynamic Webpage Interconnection.

[https://www.researchgate.net/publication/358500307\\_Intangible\\_Cultural\\_Heritage\\_Management\\_Using\\_Machine\\_Learning\\_Model\\_A\\_Case\\_Study\\_of\\_Northwest\\_Folk\\_Song\\_Huaer](https://www.researchgate.net/publication/358500307_Intangible_Cultural_Heritage_Management_Using_Machine_Learning_Model_A_Case_Study_of_Northwest_Folk_Song_Huaer)



# To Conserve the (nature of) Language

...a machine learning tool for distinguishing compound words from non-compound words. This task is modelled as a binary classification problem. Various classification algorithms...such as Naïve Bayes, K-Nearest Neighbor, Decision Tree, Random Forest, Support Vector Machine, Multi-Layer Perceptron, Logistic Regression and Adaboost were used for the classification...

[A Machine Learning Approach for Identifying Compound Words from a Sanskrit Text](#)



# Automatic Visual Inspection System

Imaging technologies for tangible heritage commodities in urban setting, where unmanned vehicles detect the loss of structure in the buildings to report to the authorities.

[https://link.springer.com/chapter/10.1007/978-981-19-0737-1\\_1](https://link.springer.com/chapter/10.1007/978-981-19-0737-1_1)



# Heritage management in India through AI

Digital Restoration of paintings at Ajanta Caves. They are creating a digital repository through high resolution photographs.

<https://www.aninews.in/news/lifestyle/culture/preserving-world-famous-ajanta-cave-paintings-using-ai20210408133912/>



# Scope of AI and ML in Preserving Data

- All in digital archaeology, digitization and on-site documentation
- AI in digital cultural content/object analysis
- AI in content – based classification and retrieval
- AI in archaeometry and data analysis
- AI in natural language processing and CH applications
- AI in semantics and knowledge representation
- AI in museums and cultural tourism
- AI in virtual systems for education and tourism
- Computational archaeology
- Intelligent methods in spatial and temporal analysis
- AI and simulations in archaeology and CH
- Intelligent crowdsourcing approaches

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# SCOPE For IKS in India

1. Decolonising Sanskrit by using AI and NLP. Through Optical Character Recognition, Text Processing, Speech Processing.
2. Data Mining to understand a concept in the Ancient Text.
3. Saint George on a Bike-metadata enrichment.

<https://saintgeorgeonabike.eu>

# **Recognise the role of Popular Culture to understand IKS.**

- Through Gaming.**
- Through Storytelling.**



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# What Stories?

Ramayana.

Mahabharata.

Panchtantra.

Hitopadesha.

Dharamshastra.

STORIES of ITIHAAS (it thus happened).

# THANK YOU

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