ChatGPT και Εφαρμογές AI για Ιατρούς

UNIVERSITY OF THE AEGEAN

SCHOOL OF ENGINEERING

DEPARTMENT OF INFORMATION AND COMMUNICATION SYSTEMS ENGINEERING

2nd session – Ζητήματα Ηθικής της Εφαρμογής AI στην Ιατρική και Προστασία Ευαίσθητων Ιατρικών Δεδομένων.

Presenter: Panagiotis Symeonidis

Associate Professor

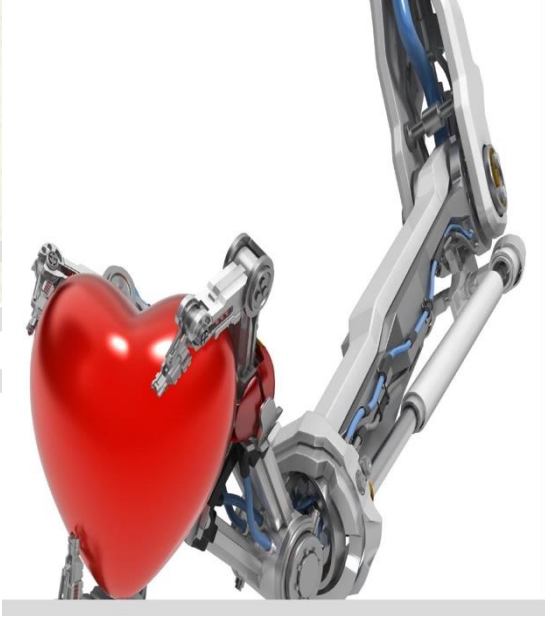
http://panagiotissymeonidis.com

psymeon@aegean.gr

What is AI Ethics in Medicine?

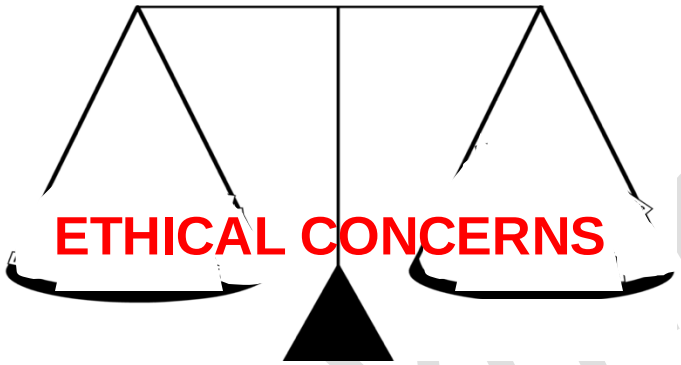
Application and analysis of ethics to contexts in health in which Al is involved

Ethics categories



- **Normative Ethics (Κανονιστική Ηθική)**
- **Meta-ethics (Μετα-ηθική)**
- **Applied Ethics (Εφαρμοσμένη Ηθική)**

How to ensure compliance with the EU AI Act

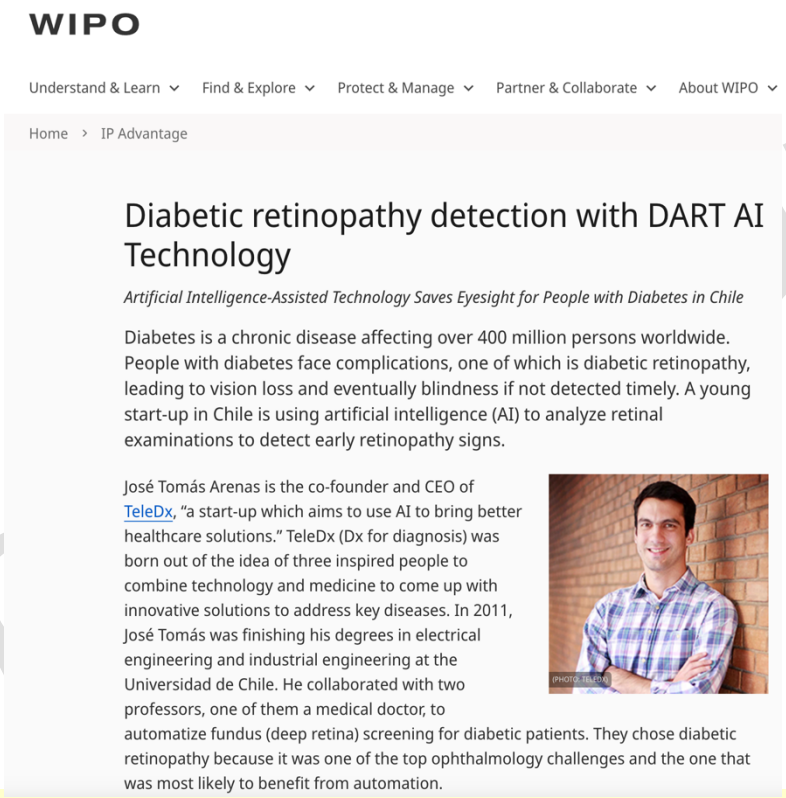


3. Documentation and Transparency:
Maintain comprehensive technical documentation that outlines how the AI system functions, its intended use, and compliance with safety standards.

Transparency in how AI decisions are made is crucial.

Incident with DART AI System in Diabetic Retinopathy Detection

https://www.wipo.int/web/ip-advantage/w/stories/diabetic-retinopathy-detection-with-dart-ai-technology



WIPO

Understand & Learn · Find & Explore · Protect & Manage · Partner & Collaborate · About WIPO

Home › IP Advantage

Diabetic retinopathy detection with DART AI Technology

Artificial Intelligence-Assisted Technology Saves Eyesight for People with Diabetes in Chile

Diabetes is a chronic disease affecting over 400 million persons worldwide. People with diabetes face complications, one of which is diabetic retinopathy, leading to vision loss and eventually blindness if not detected timely. A young start-up in Chile is using artificial intelligence (AI) to analyze retinal examinations to detect early retinopathy signs.

José Tomás Arenas is the co-founder and CEO of TeleDx, "a start-up which aims to use AI to bring better healthcare solutions." TeleDx (Dx for diagnosis) was born out of the idea of three inspired people to combine technology and medicine to come up with innovative solutions to address key diseases. In 2011, José Tomás was finishing his degrees in electrical engineering and industrial engineering at the Universidad de Chile. He collaborated with two professors, one of them a medical doctor, to automatize fundus (deep retina) screening for diabetic patients. They chose diabetic retinopathy because it was one of the top ophthalmology challenges and the one that was most likely to benefit from automation.

A Case of Regulatory Scrutiny under the Medical Device Regulation (MDR)

Overview of DART AI System

❖What is DART?

- An AI-based system developed by TeleDx, a Chilean start-up.

- Designed for early detection of diabetic retinopathy by analyzing retinal images.

- Uses machine learning algorithms trained on ophthalmologist-reviewed data.

❖Objective:

- To provide early detection and reduce the risk of vision loss in diabetic patients.

The Incident

Issue:

- False negatives reported in diagnostic results.

- Missed diagnoses led to delays in treatment for patients at risk of vision loss.

Consequences:

- Patient safety was compromised due to inaccurate detection results.

- Triggered regulatory review under MDR for high-risk AI systems.

Algorithmic techniques for protecting privacy

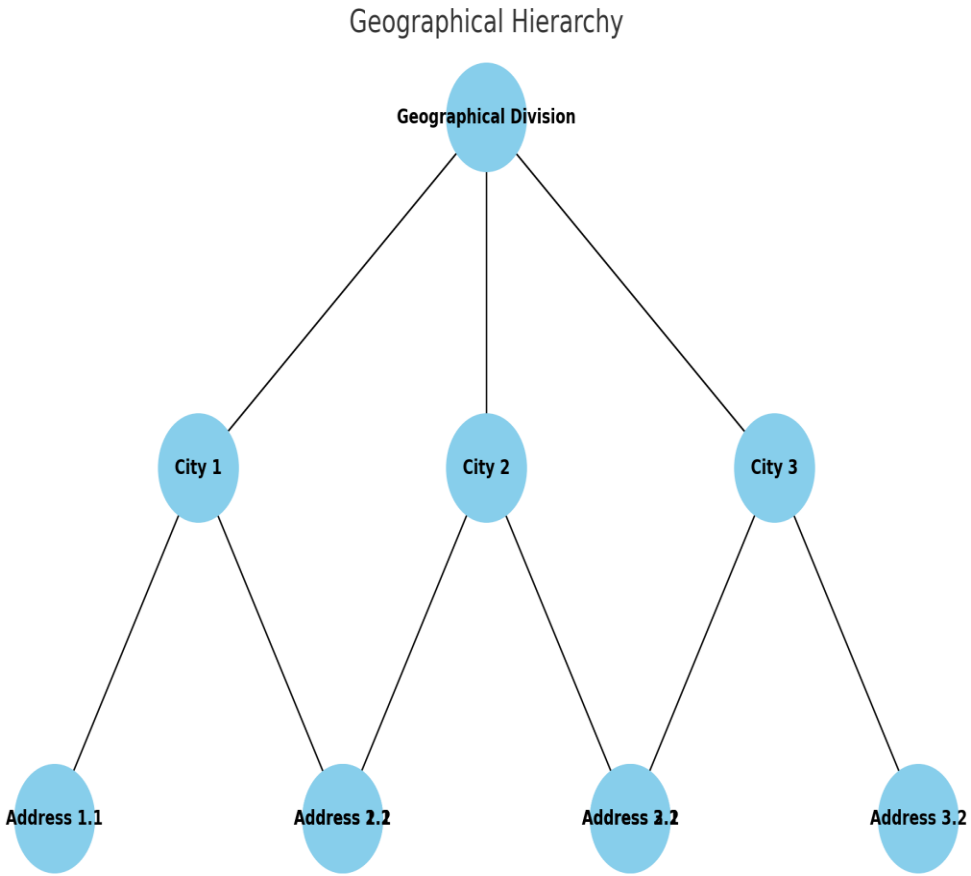
To protect personal data, there are various algorithms such as :

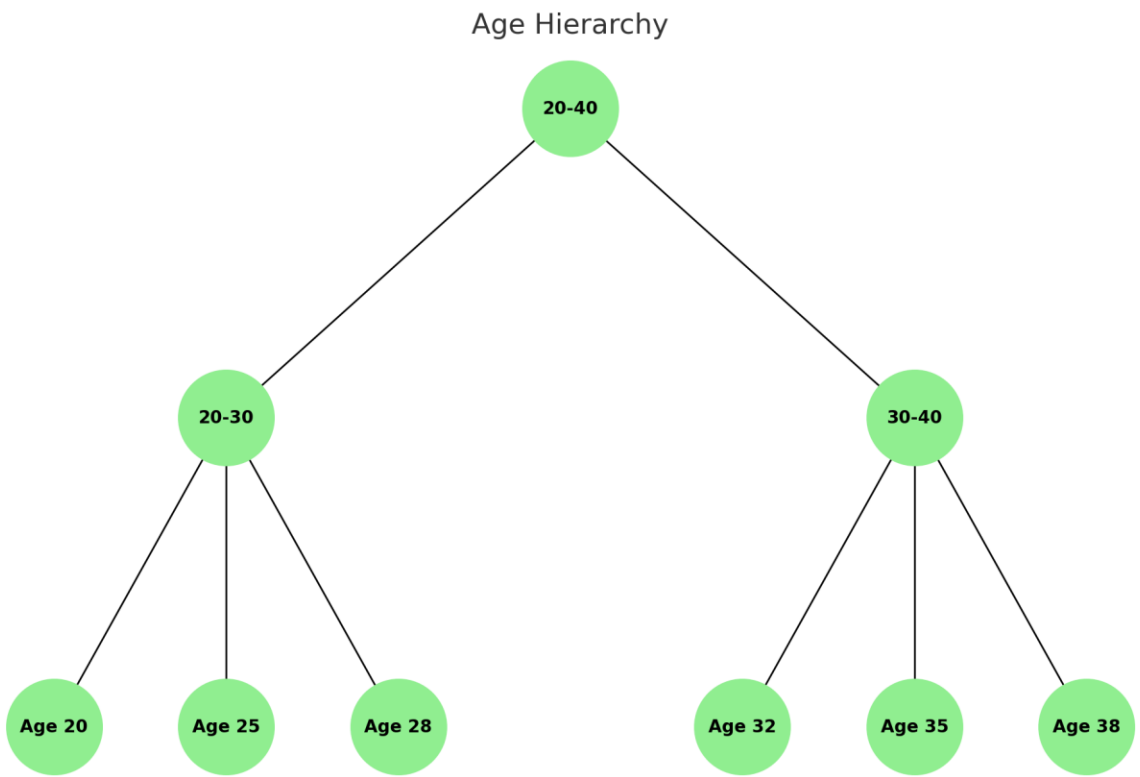
- Generalization (e.g. from house address level conversion at city level)
- Adding “noise”: To user data, a process known as " de-identification "
- Differential privacy: Algorithms based on which modify data while simultaneously providing protection guarantees.
- Encryption : They use encryption tools.

Privacy based on Generalization

Attributes hierarchies example

Name	Gender	City	Age	Disease
Petros Petridis	male	Larissa	26	HIV
Yannis Yannou	male	Volos	29	COVID
Maria Marianou	woman	Kilkis	36	HIV
Christina Christidou	woman	Thessaloniki	37	FLU
Vassilis Vassiliadis	man	Karditsa	38	COVID
George Georgiou	man	Trikala	36	HIV





Anonymization technique based on Generalization

Name	Gender	City	Age	Disease
Petros Petridis	male	Larissa	26	HIV
Yannis Yannou	male	Volos	29	COVID
Maria Marianou	woman	Kilkis	36	HIV
Christina Christidou	woman	Thessaloniki	37	FLU
Vassilis Vassiliadis	man	Karditsa	38	COVID
George Georgiou	man	Trikala	36	HIV

Gender	Geographical Division	Age	Disease
male	Thessaly	20 to 30	HIV
male	Thessaly	20 to 30	COVID
woman	Macedonia	30 to 40	HIV
woman	Macedonia	30 to 40	FLU
man	Thessaly	30 to 40	COVID
man	Thessaly	30 to 40	HIV

Definition Pseudo -identifier :

- Pseudo -identifiers are those data that if properly combined with another public data table can identify a person (Gender, City, Age).

Negative of generalization : They limit the ability of systems to make more accurate predictions (loss of information).

Loss of information

Name	Gender	City	Age	Disease
Petros Petridis	male	Larissa	26	HIV
Yannis Yannou	male	Volos	29	COVID
Maria Marianou	woman	Kilkis	36	HIV
Christina Christidou	woman	Thessaloniki	37	FLU
Vassilis Vassiliadis	man	Karditsa	38	COVID
George Georgiou	man	Trikala	36	HIV

Data generalization => distortion

Definition : The distortion d is defined by the distance from an attribute's initial value to its current value, divided by the total levels of analysis in the hierarchy.

- For the loss of information for a feature A_j concerning rows i we consider $d_{i,j}$. So the distortion D is equal to the sum of the distortions of the individual values of an attribute :

$$D_{current} = \sum_{i,j} d_{i,j}$$

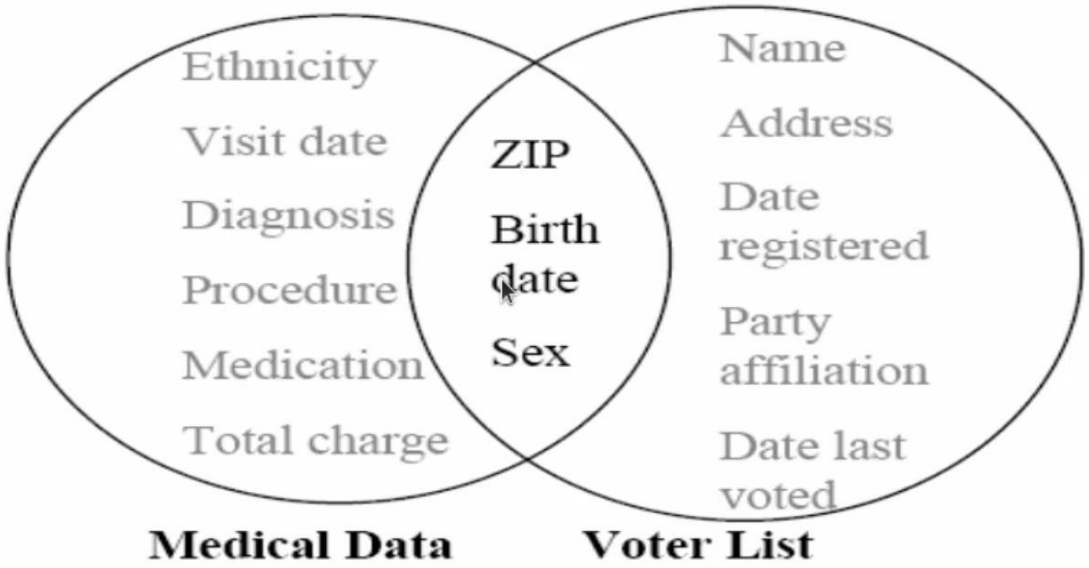
- So the final distortion rate D % is equal to the current distortion $D_{current}$ of the generalized matrix divided by the maximum destortion $D_{maximum}$ that can exist in the fully generalized matrix.

$$\text{D rate } \% = \frac{D_{\text{current}}}{D_{\text{maximum}}} * 100$$

The first Modern Privacy Attack: the case of Massachussetts' Governor

- Sweeney managed to re-identify the medical record of the governor of Massachussetts
  - MA collects and publishes sanitized medical data for state employees (microdata) left circle
  - voter registration list of MA (publicly available data) right circle
- She knew that the governor was present in the medical records

- looking for governor's record
- join the tables:
  - **6 people had his birth date**
  - **3 were men**
  - **1 in his zipcode**



Latanya Sweeney: k-Anonymity: A Model for Protecting Privacy. International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems 10(5): 557-570 (2002)

MAKING DATA ANONYMOUS

Governor: Birth Date = **1950,** ZIP = **300111**

ID	Gender	YoB	ZIP	DIAGNOSIS
1	F	[1960-1956]	300***	Cancer
3	F	[1960-1956]	300***	Gastritis
2	M	[1950-1955]	30011*	Heart Attack
4	M	[1950-1955]	30011*	Heart Attack
5	F	[1960-1956]	300***	Dislocation
6	M	[1950-1955]	30011*	Heart Attack