Aprendizaje de Máquina e Inteligencia Artificial – Parte I

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Curso Exploratorio de Computación – IIC 1005

Cómo leer el paper de HCI

- … o cómo leer cualquier paper/artículo de investigación

Recomiendo que lean los siguientes recursos para saber cómo leer un paper de investigación:

En qué orden leer el paper (las secciones), acá una guía:
http://www.sagepub.com/bjohnsonstudy/howtoarticle.htm

How to Read an Engineering Research Paper
http://cseweb.ucsd.edu/~wgg/CSE210/howtoread.html

Acá te dan consejos de cómo escribir un buen paper
http://www.csee.umbc.edu/csee/research/cra/etw98/writing-papers.pdf

Un resumen

1. **What are *motivations* for this work?** For a research paper, there is an expectation that a problem has been solved that no one else has published in the literature. This problem intrinsically has two parts. The first is often unstated, what I call the **people problem**. The people problem is the benefits that are desired in the world at large; for example some issue of quality of life, such as saved time or increased safety. The second part is the **technical problem**, which is: *why doesn't the people problem have a trivial solution?* There is also an implication that previous solutions to the problem are inadequate. *What are the previous solutions and why are they inadequate?* Finally, the motivation and statement of the problem are distilled into a **research question** that can be addressed within the confines of this particular paper. Oftentimes, one or more of these elements are not explicitly stated, making your job more difficult.

2. **What is the proposed *solution*?** This is also called the **hypothesis** or **idea**. There should also be an answer to the question *why is it believed that this solution will work, and be better than previous solutions?* There should also be a discussion about *how the solution is achieved (designed and implemented)* or is at least achievable.

3. **What is the work's *evaluation* of the proposed solution?** An idea alone is usually not adequate for publication of a research paper. This is the concrete engagement of the research question. What argument, implementation, and/or experiment makes the case for the value of the ideas? What benefits or problems are identified?

4. **What is your analysis of the identified problem, idea and evaluation?** Is this a good idea? What flaws do you perceive in the work? What are the most interesting points made? What are the most controversial ideas or points made? For work that has practical implications, you also want to ask: *Is this really going to work, who would want it, what it will take to give it to them, and when might it become a reality?*

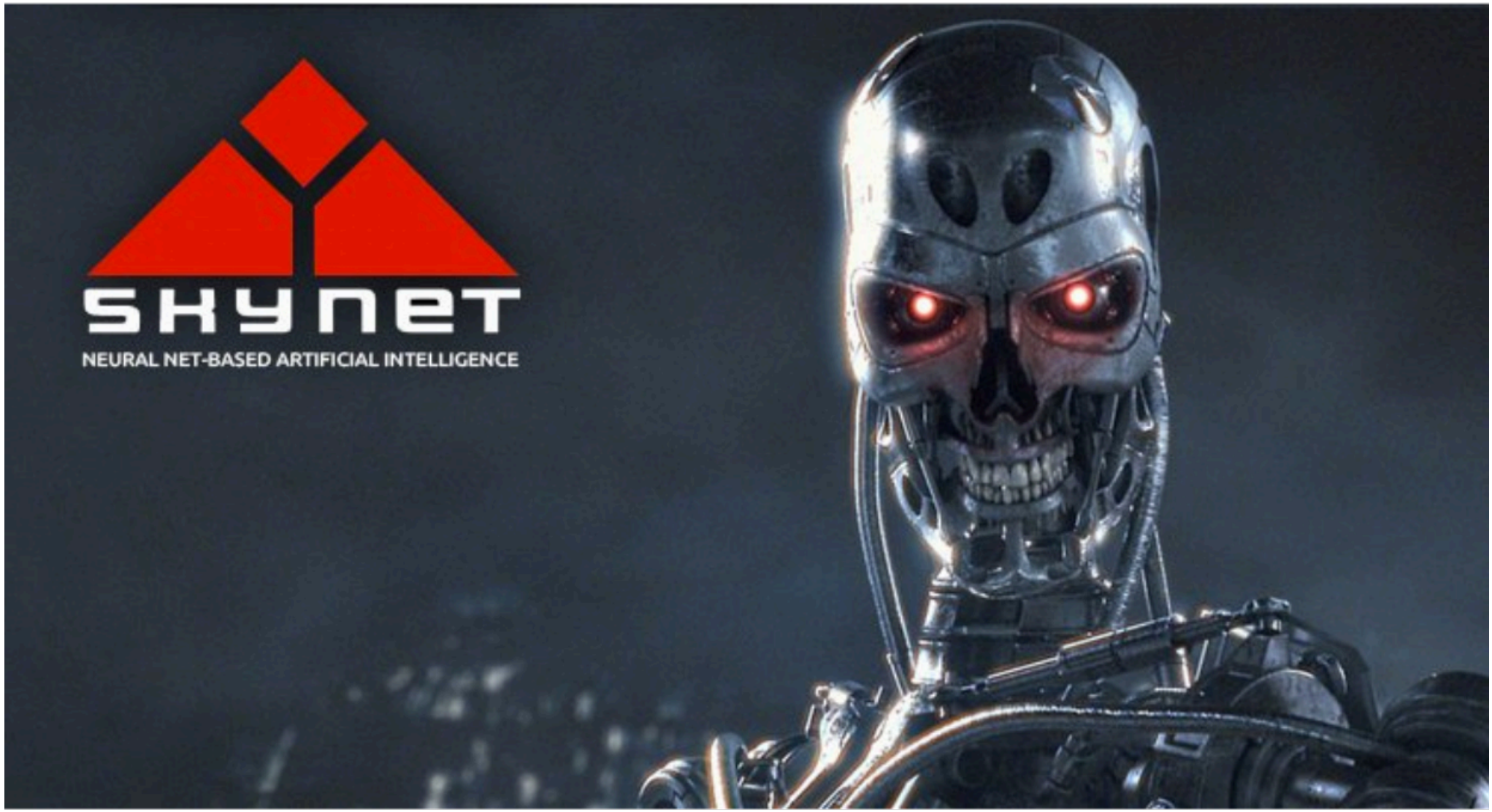
5. **What are the *contributions*?** The contributions in a paper may be many and varied. Beyond the insights on the research question, a few additional possibilities include: ideas, software, experimental techniques, or an area survey.

6. **What are *future directions* for this research?** Not only what future directions do the authors identify, but what ideas did you come up with while reading the paper? Sometimes these may be identified as shortcomings or other critiques in the current work.

7. **What questions are you left with?** What questions would you like to raise in an open discussion of the work? What do you find confusing or difficult to understand? By taking the time to list several, you will be forced to think more deeply about the work.

8. **What is your take-away message from this paper?** Sum up the main implication of the paper from your perspective. This is useful for very quick review and refreshing your memory. It also forces you to try to identify the essence of the work.

Inteligencia Artificial



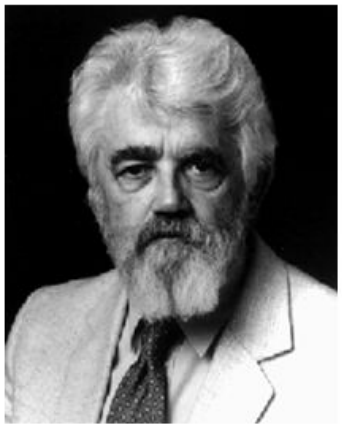
Inteligencia Artificial

- **Objetivo**: Construir máquinas/software que exhiban comportamiento inteligente.

- Algunas aplicaciones comunes: percepción visual, reconocimiento del habla, toma de decisiones, traducción entre lenguajes.

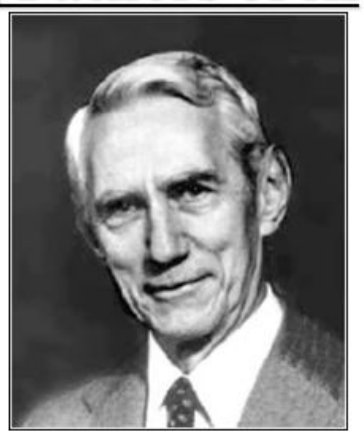
Los Fundadores

1956 Dartmouth Conference: The Founding Fathers of AI

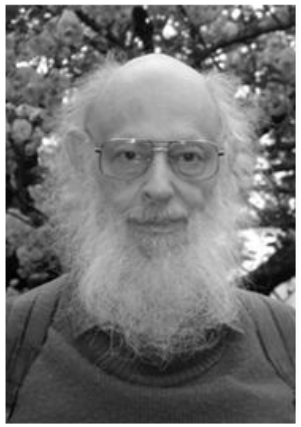


John McCarthy

Marvin Minsky



Claude Shannon



Ray Solomonoff

Alan Newell

Herbert Simon

Arthur Samuel

And three others…

Oliver Selfridge
(Pandemonium theory)

Nathaniel Rochester
(IBM, designed 701)

Trenchard More
(Natural Deduction)

Algunos investigadores destacados actuales

- Fei-Fei Li

(Imagenet, Stanford HAI)

- Michael I. Jordan

(Modelos Gráficos)

- Bengio, Hinton, Le Cun

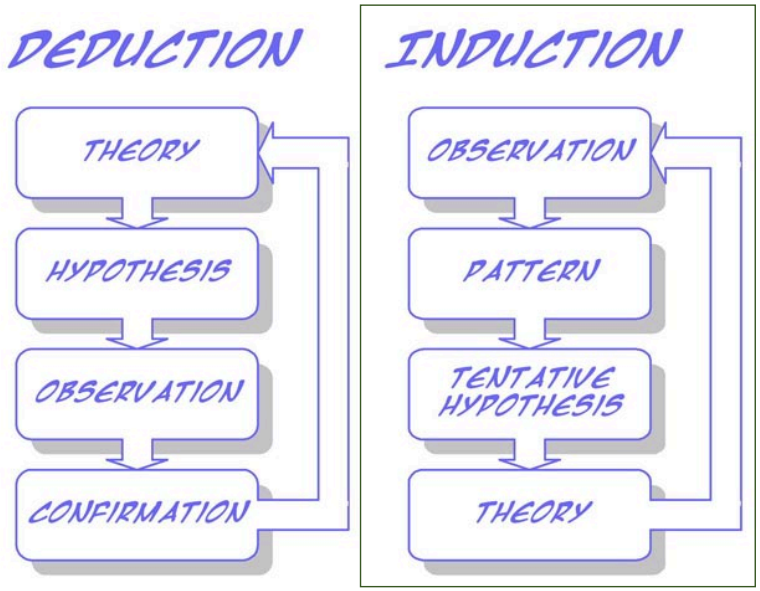
(Turing award 2018)

Inteligencia Artificial

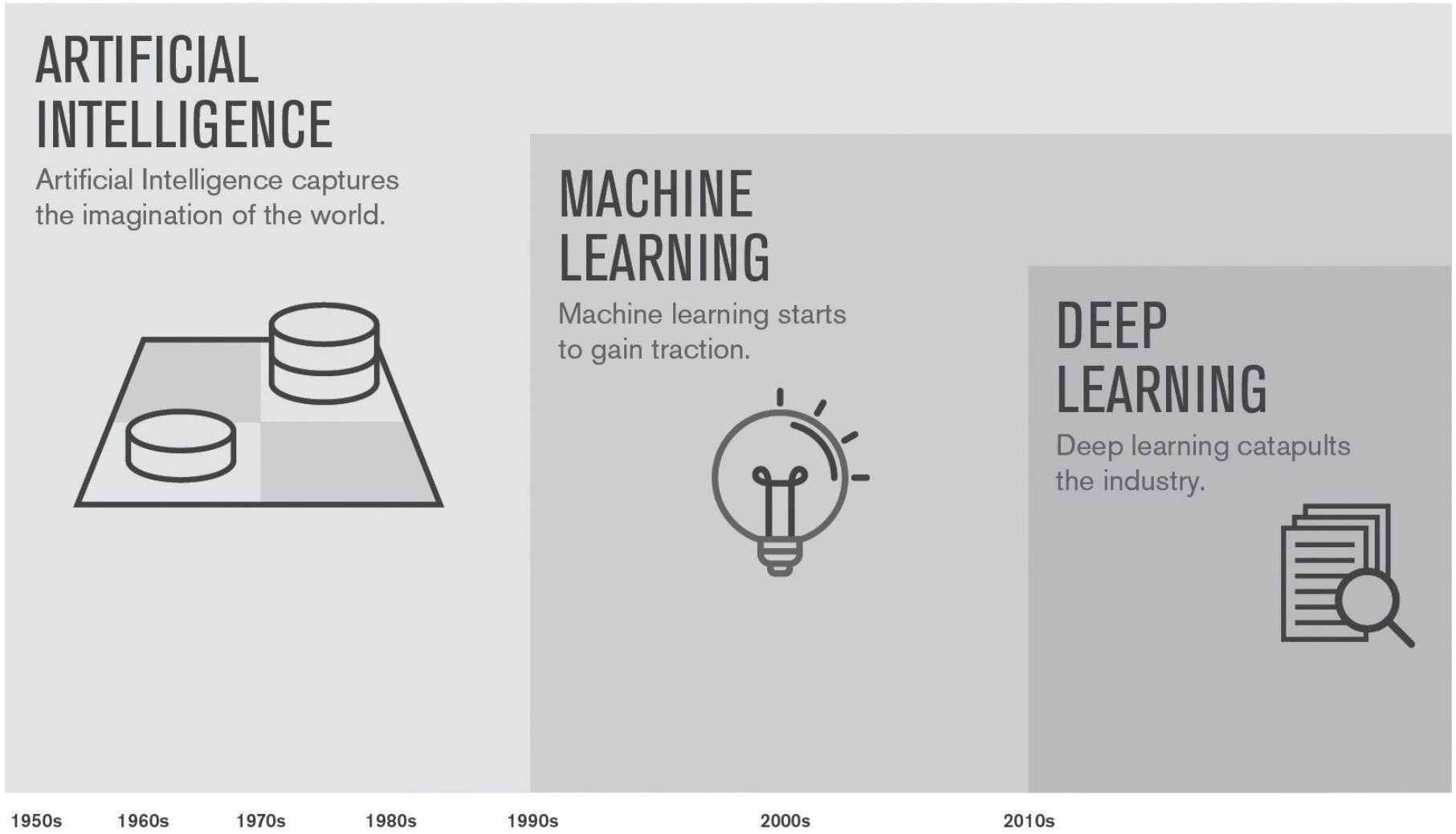
- El dominio de problemas en el área de Inteligencia Artificial incluye:
  - Representar conocimiento
  - Razonamiento
  - Planning
  - Reconocer Patrones
- En esta clase me enfocaré en métodos estadísticos usados para aprendizaje, lo que se conoce como **Machine Learning**, y en el procedimiento de uso de estos algoritmos para encontrar patrones en colecciones de datos (**Data Mining**)

Aprendizaje de Máquina (Machine Learning)

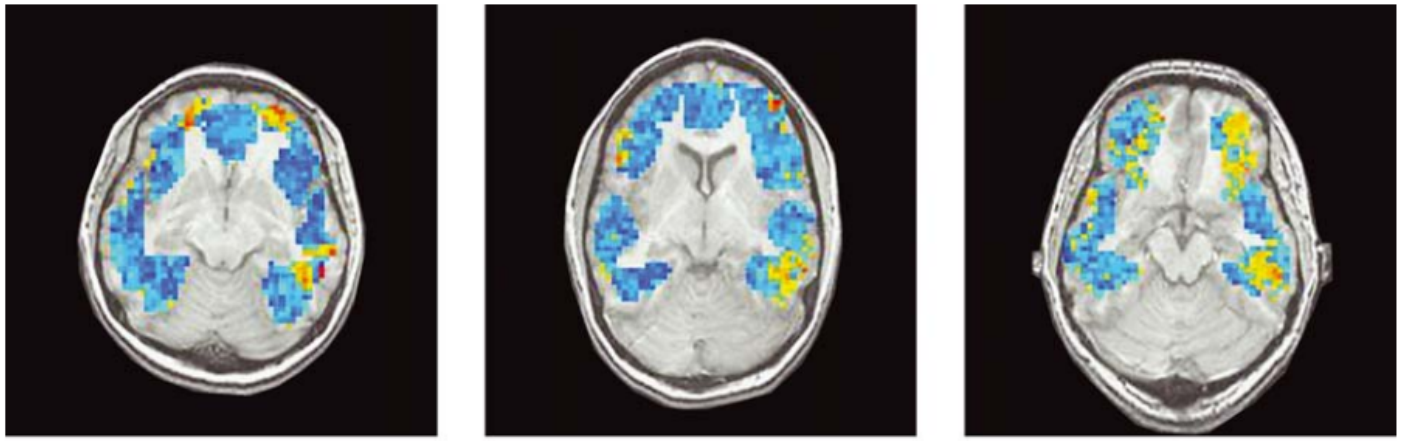
- Estudio de algoritmos computacionales que aprenden y mejoran automáticamente a través de la experiencia.
- Algunos investigadores lo llaman también Aprendizaje Estadístico
- Tareas típicas de Machine Learning
  - Descubrimiento de Patrones
  - Clasificación
  - Clustering
  - Regresión
  - Detección de Anomalías/Outliers
  - Reducción de Dimensionalidad



Relación Histórica IA/ML/DL



Reconocimiento de Estado Mental desde Imágenes fMRI



a. b. c.

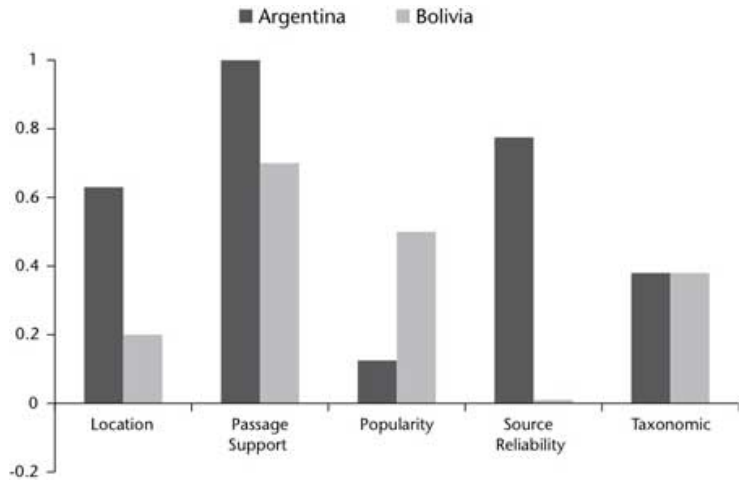
Figure 2. Color plots show locations of voxels that best predict the word semantic category, for three different human subjects. For each voxel, the color indicates the normalized rank error over the test set, for a GNB classifier based on this single voxel. Note the spatial clustering of highly predictive voxels, and the similar regions of predictability across these three subjects. The range of normalized rank errors is [Red ≈ 0.25, Dark Blue ≈ 0.6], with other colors intermediate between these two extremes. Each image corresponds to a single two-dimensional plane through the brain of one subject.

Logros de Machine Learning

- IBM Watson vence a los campeones de Jeopardy. << ... With all of its processing CPU power, Watson can scan two million pages of data in three seconds.>> E. Nyberg, CMU professor
- Implicancias: Aplicaciones en medicina

http://www.aaai.org/Magazine/Watson/watson.php

Chile comparte su frontera mas larga con este país…



Vehículos Autónomos

Generación de música con estilo

- **Deep learning driven jazz generation**
- https://github.com/jisungk/deepjazz
- https://soundcloud.com/deepjazz-ai

Mastering Go

Google AI algorithm masters ancient game of Go

Deep-learning software defeats human professional for first time.

Elizabeth Gibney

27 January 2016

The computer that mastered Go

Nature Video

Imágenes: incluir elementos y estilo

https://github.com/luanfujun/deep-painterly-harmonization

README.md

deep-painterly-harmonization

Code and data for paper "Deep Painterly Harmonization"

Disclaimer

This software is published for academic and non-commercial use only.

Setup

This code is based on torch. It has been tested on Ubuntu 16.04 LTS.

Dependencies:

- Torch (with loadcaffe)
- Matlab or Octave

CUDA backend:

- CUDA
- cudnn

Download VGG-19:

```
sh models/download_models.sh
```

Compile `cuda_utils.cu` (Adjust `PREFIX` and `NVCC_PREFIX` in `makefile` for your machine):

```
make clean && make
```

Usage

To generate all results (in `data/`) using the provided scripts, simply run

```
python gen_all.py
```

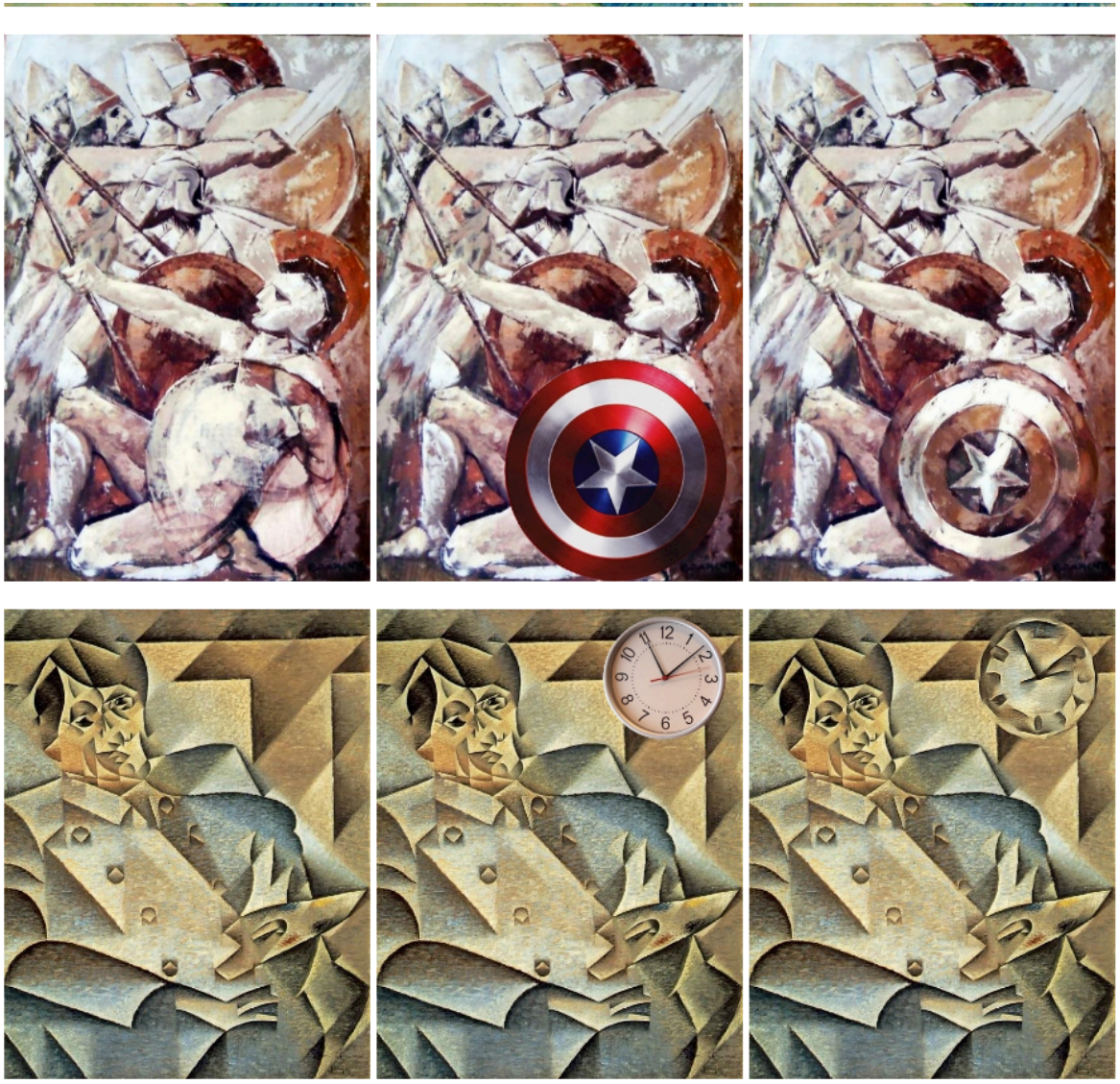
in Python and then

```
run('filt_cnn_artifact.m')
```

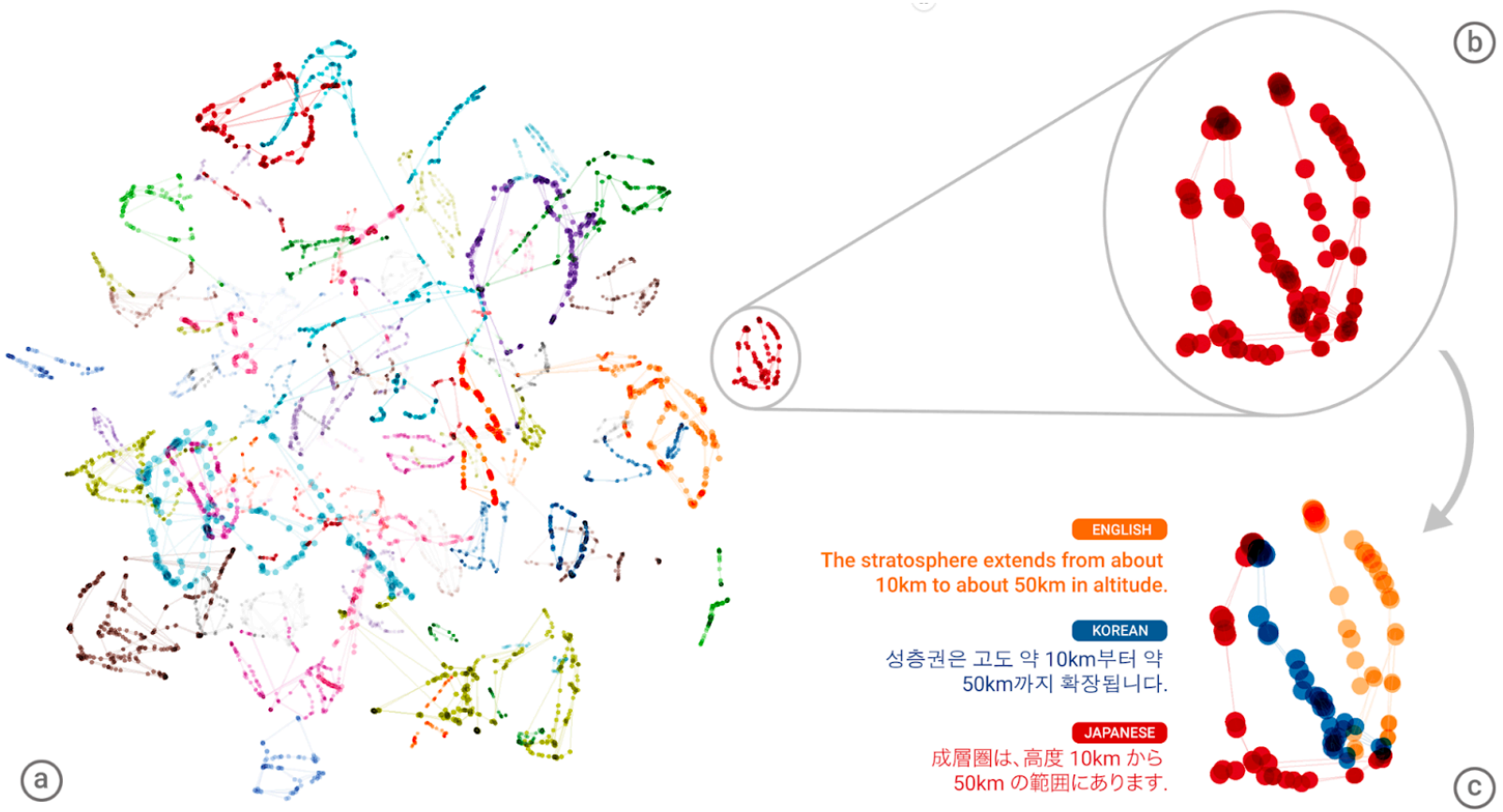
in Matlab or Octave. The final output will be in `results/`.

Note that in the paper we trained a CNN on a dataset of 80,000 paintings collected from wikiart.org, which estimates the stylization level of a given painting and adjust weights accordingly. We will release the pre-trained model in the next update. Users will need to set those weights manually if running on their new paintings for now.

Removed a few images due to copyright issue. Full set here for testing use only.

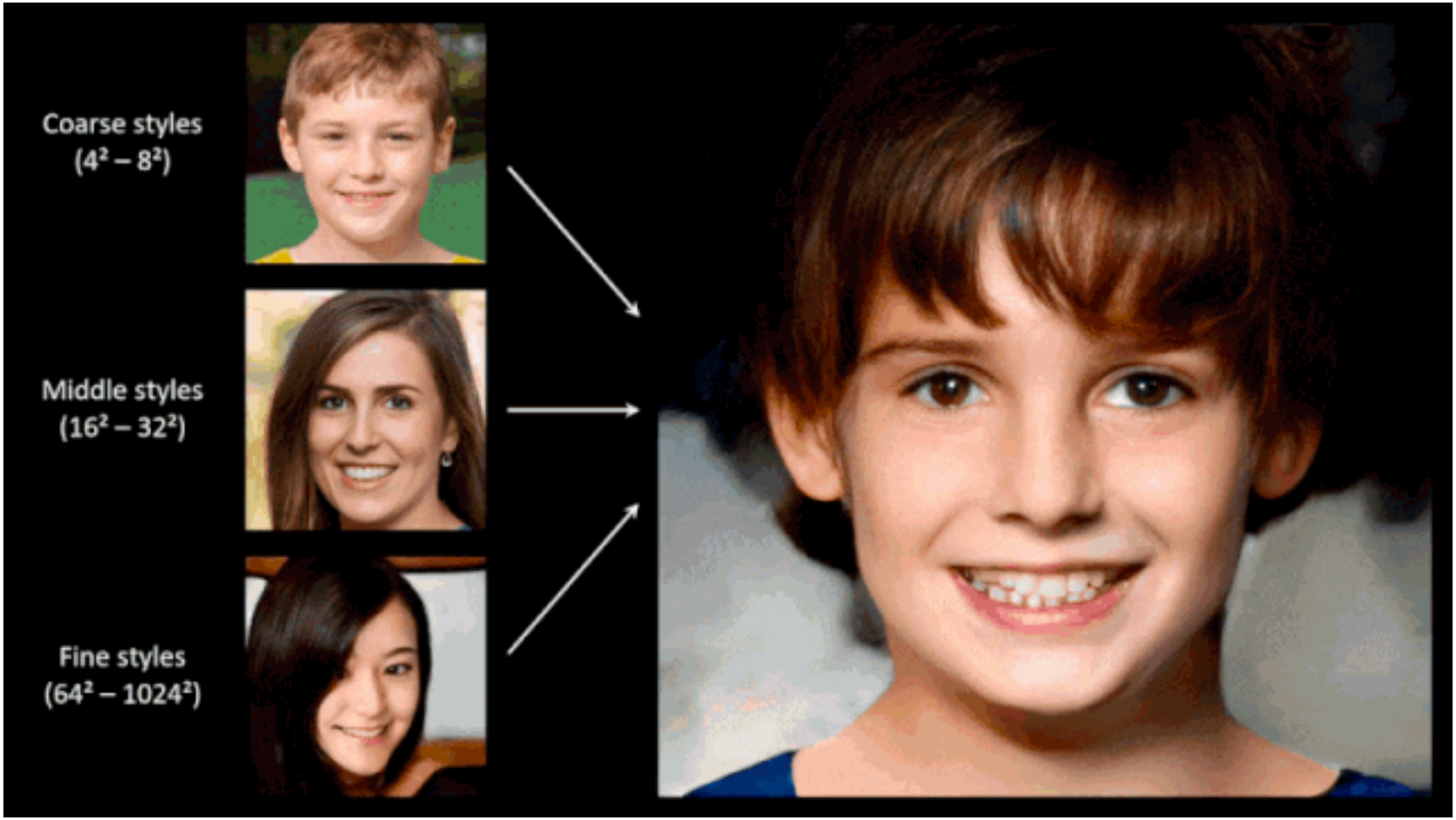


Traducción Automática



https://ai.googleblog.com/2016/11/zero-shot-translation-with-googles.html

Modelos Generativos



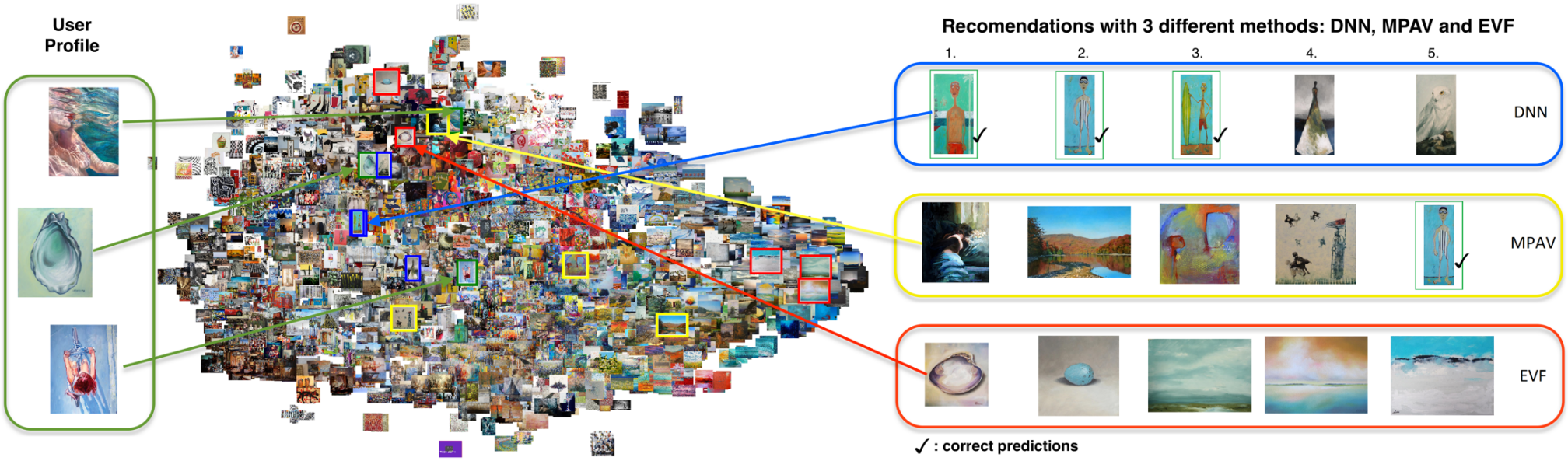
https://medium.com/syncedreview/nvidia-open-sources-hyper-realistic-face-generator-stylegan-f346e1a73826

Modelos Generativos

https://arxiv.org/pdf/1812.04948.pdf

Una imagen vale más que mil palabras

- Trabajo conjunto con Pablo Messina y Vicente Dominguez (DCC UC)



… no les cuento mucho más

- … para dejar algunos ejemplos interesantes al profesor Hans Lobel.

Clasificación Tradicional de algoritmos de ML

- **Aprendizaje Supervisado**: Los algoritmos reciben ejemplos (datos etiquetados) a partir de los cuales aprenden

- **Aprendizaje No Supervisado**: Los algoritmos no reciben ejemplos etiquetados.

- **Aprendizaje Reforzados**: A través de acciones, aprender una “política” que maximize mi ganancia.

Aprendizaje Supervisado

- KNN
- Árboles de Decisión
- Naive Bayes
- Regresión Logística
- Support Vector Machines
- Redes Neuronales

Genéricamente

- Inteligencia de Máquina: **Aprender de los Datos**
- Revisemos de modo conceptual un ejemplo: Construir para un banco un sistema que automáticamente apruebe o niegue crédito

Rechazar o
Aprobar credito??

Applicant information:

age	23 years
gender	male
annual salary	$30,000
years in residence	1 year
years in job	1 year
current debt	$15,000
...	...

Formalización del Problema de Aprendizaje

- Encontrar la fórmula de aprobación *g()* que se aproxime lo más posible a la fórmula ideal *f()*

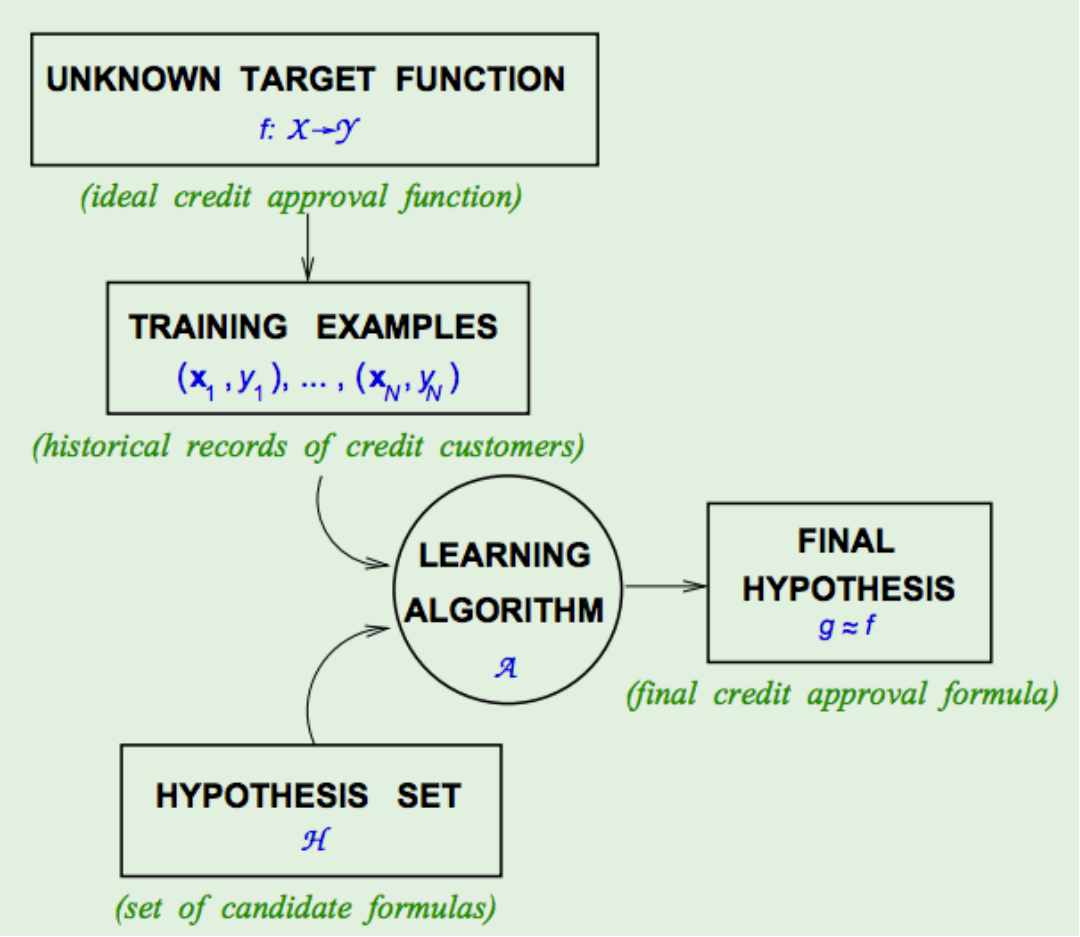
- Input: $\mathbf{x}$ (*customer application*)
- Output: y (*good/bad customer?*)
- Target function: $f : \mathcal{X} \rightarrow \mathcal{Y}$ (*ideal credit approval formula*)
- Data: $(\mathbf{x}_1, y_1), (\mathbf{x}_2, y_2), \cdots, (\mathbf{x}_N, y_N)$ (*historical records*)

$\downarrow \quad \downarrow \quad \downarrow$

- Hypothesis: $g : \mathcal{X} \rightarrow \mathcal{Y}$ (*formula to be used*)

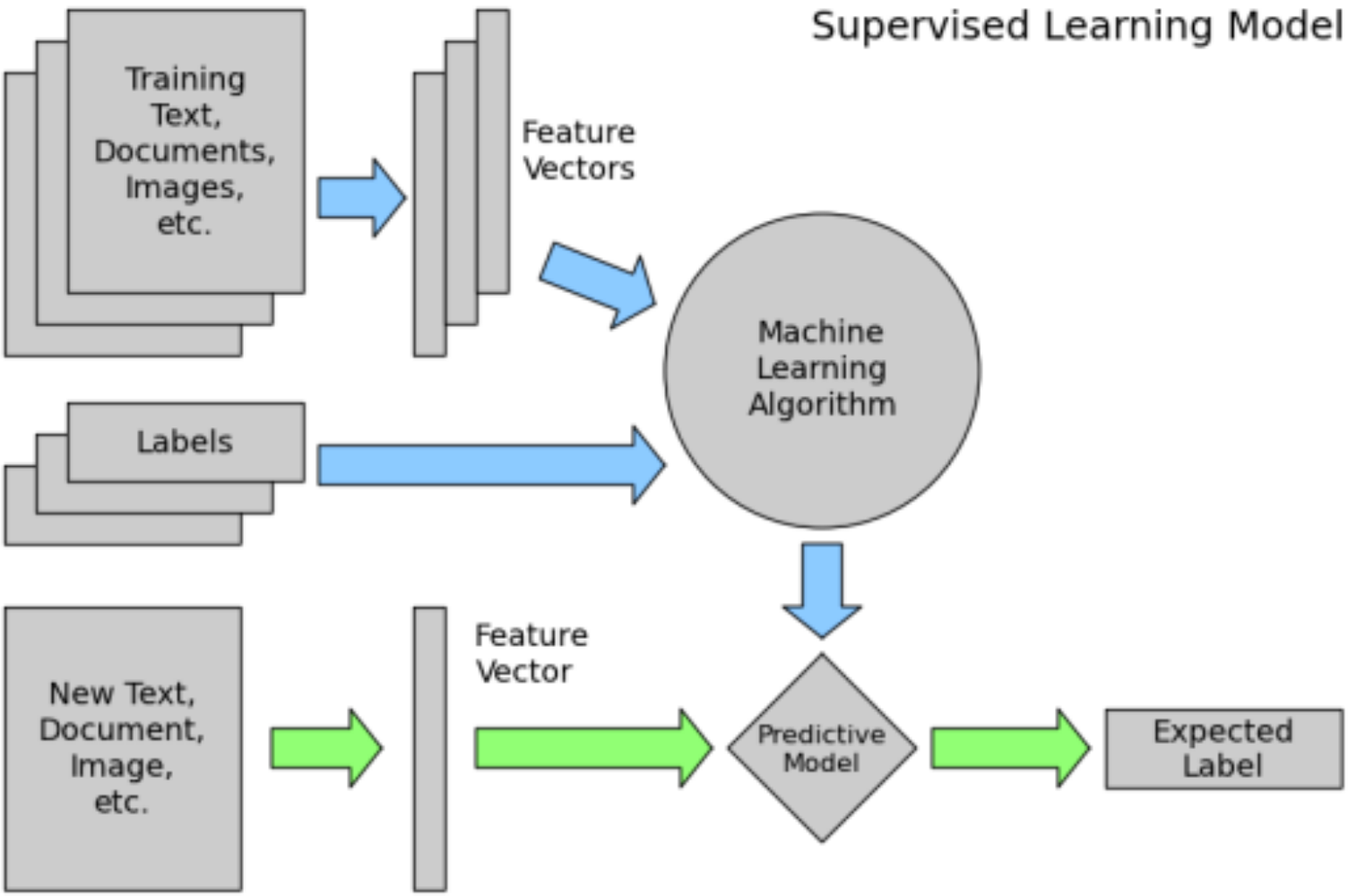
Formalización del Problema de Aprendizaje

- El conjunto de hipótesis H



Pasos para realizar Minería de Datos (supervisado)

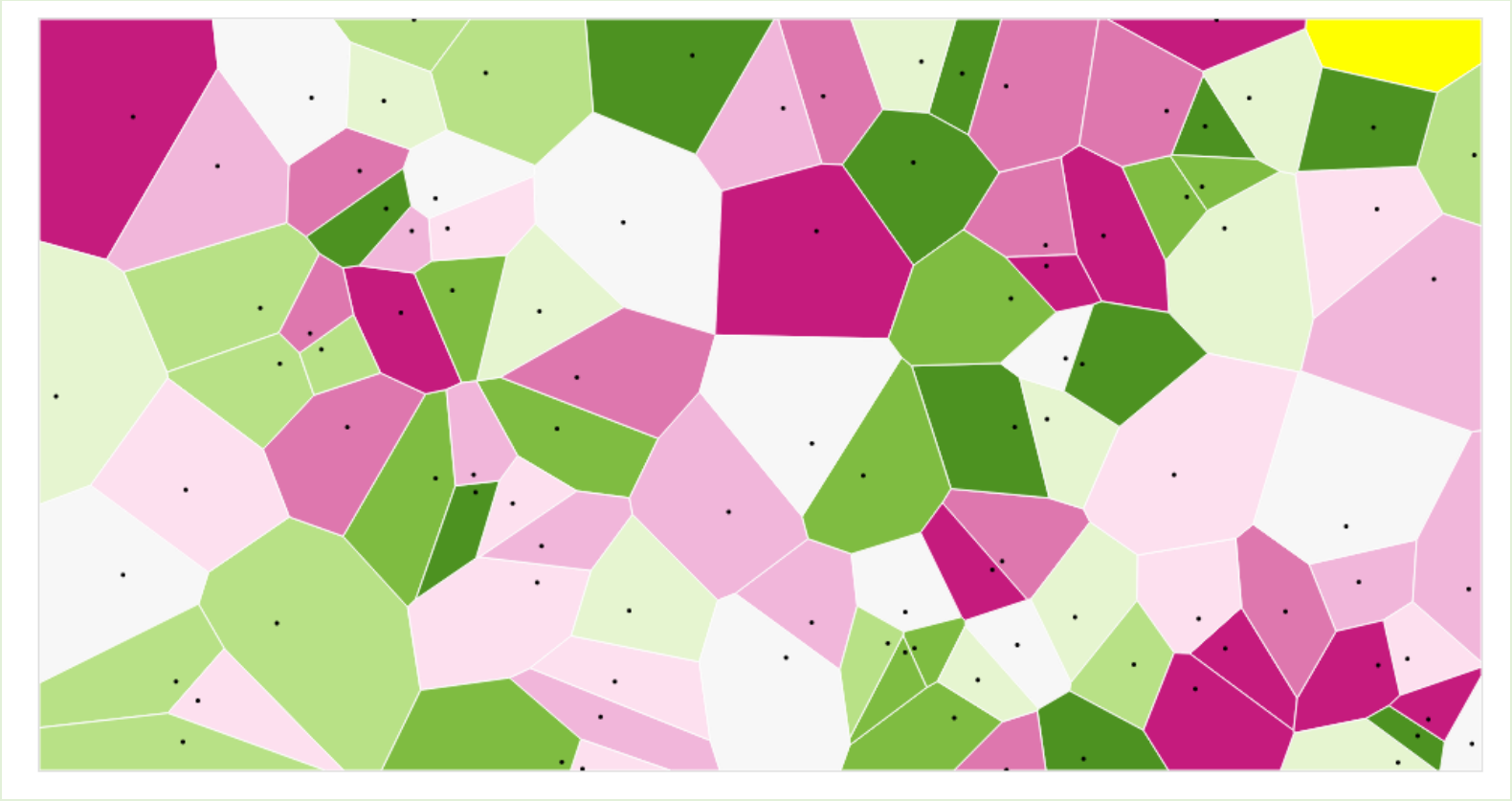
Modelo de Aprendizaje Supervisado (detalle)



K-NN

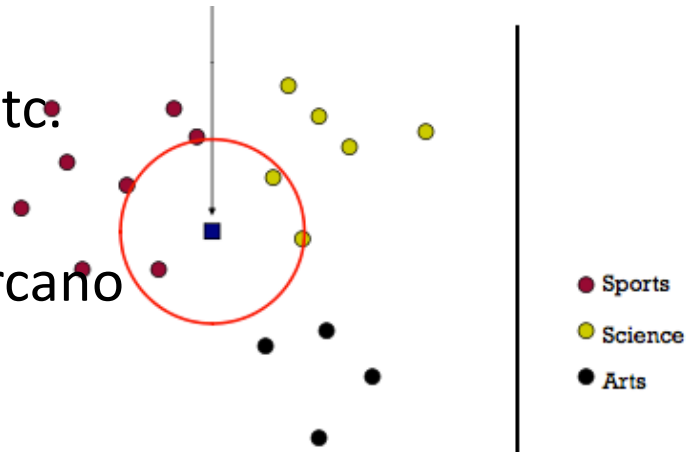
- Significa K-nearest neighbors (K-vecinos más cercanos)
- La intuición de este modelo es clasificar a una instancia en base a la clasificación ya conocida de las instancias más cercanas.

Clasificador KNN - K vecinos mas cercanos

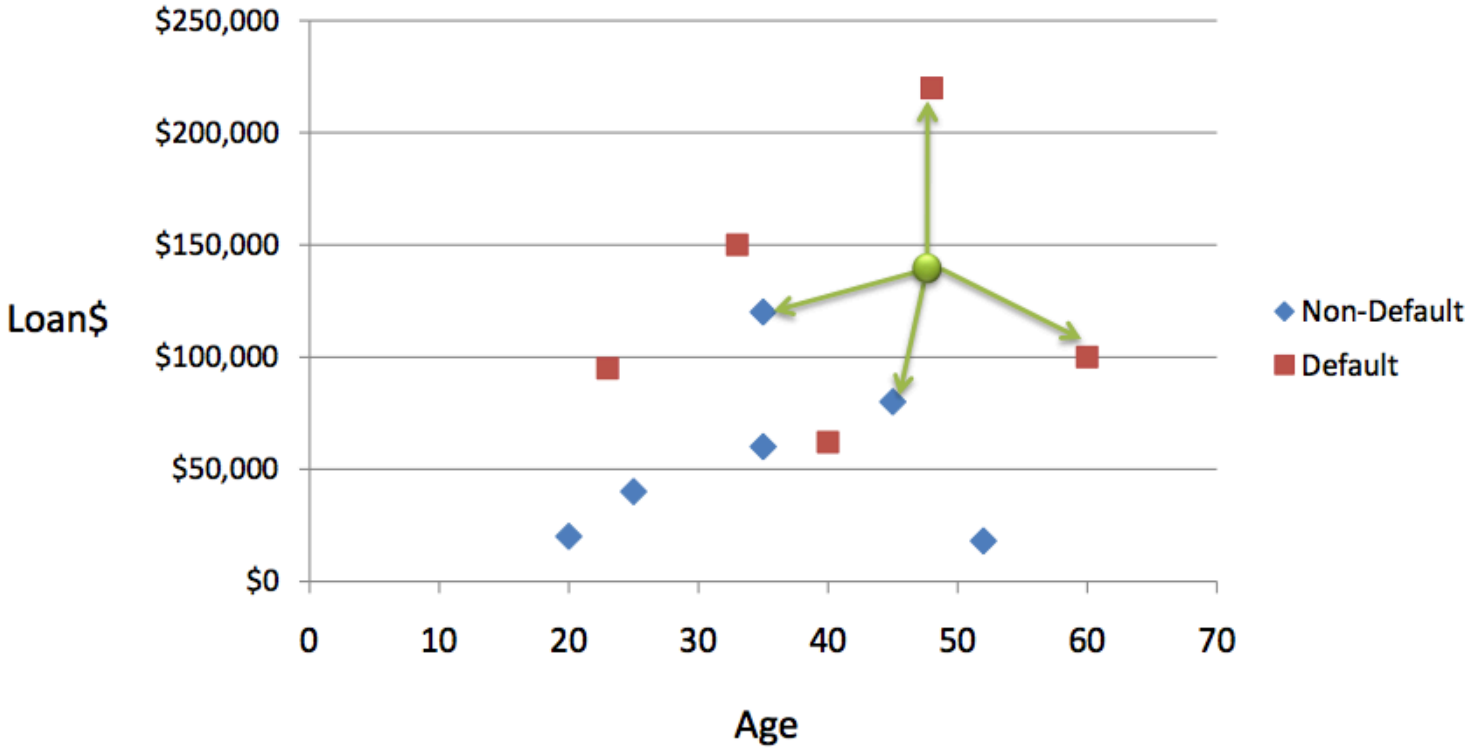


¿Qué parámetros considerar con KNN?

- Una métrica de distancia
  - Euclidiana, Manhattan, Correlación, etc.
- ¿Cuántos vecinos considerar?
  - En 1-NN: solo un vecino => el más cercano
- Una función de peso (opcional)
  - 1/d; 1-d; exp(-d^2), etc.
- ¿Cómo usar los vecinos cercanos para hacer la predicción?
  - El más cercano, votación, el promedio, etc.



Ejemplo: Clasificar el caso siguiente



Usemos 1NN

Age	Loan	Default	Distance
25	$40,000	N	
35	$60,000	N	
45	$80,000	N	
20	$20,000	N	
35	$120,000	N	
52	$18,000	N	
23	$95,000	Y	
40	$62,000	Y	
60	$100,000	Y	
48	$220,000	Y	
33	$150,000	Y	
		↓	
48	**$142,000**	**?**	

Euclidean Distance

$$D = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

Usemos 1NN / 2NN / … KNN

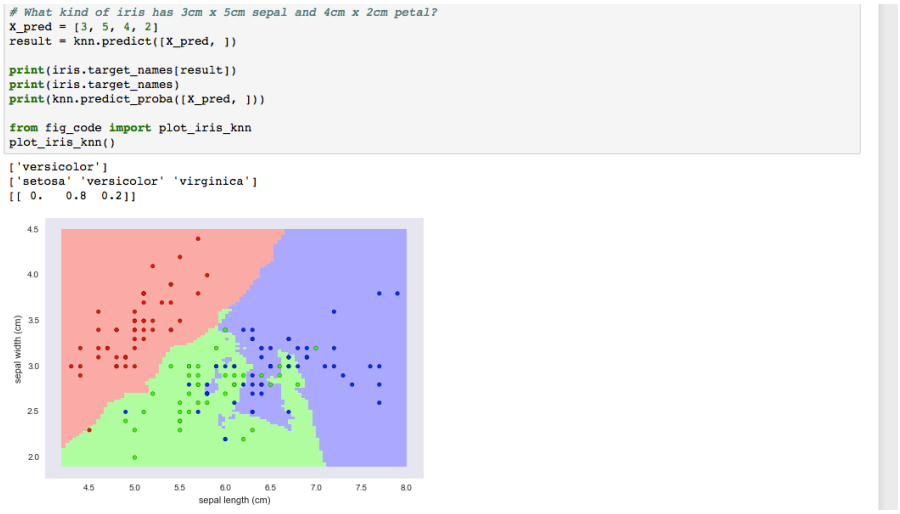
Age	Loan	Default	Distance
25	$40,000	N	102000
35	$60,000	N	82000
45	$80,000	N	62000
20	$20,000	N	122000
35	$120,000	N	22000
52	$18,000	N	124000
23	$95,000	Y	47000
40	$62,000	Y	80000
60	$100,000	Y	42000
48	$220,000	Y	78000
33	$150,000	Y	8000
48	**$142,000**	**?**	

Euclidean Distance

$$D = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

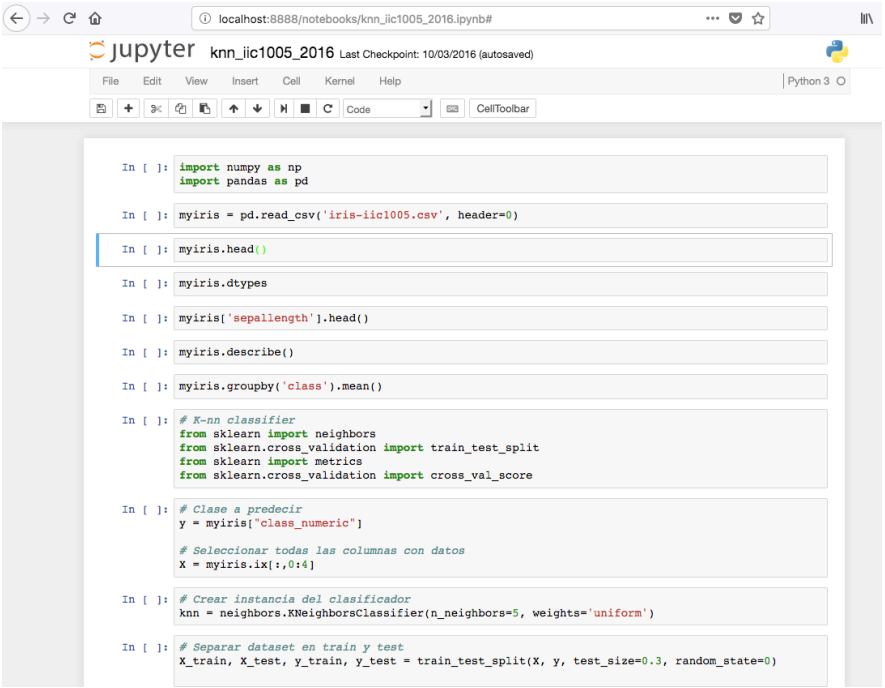
¿Cómo lo hacemos en python?

- Biblioteca sklearn
- Probemos con un jupyter notebook
- strip_knn_iic1005.ipynb (buscar en canvas)



```
# What kind of iris has 3cm x 5cm sepal and 4cm x 2cm petal?
X_pred = [3, 5, 4, 2]
result = knn.predict([X_pred, ])

print(iris.target_names[result])
print(iris.target_names)
print(knn.predict_proba([X_pred, ]))

from fig_code import plot_iris_knn
plot_iris_knn()
```

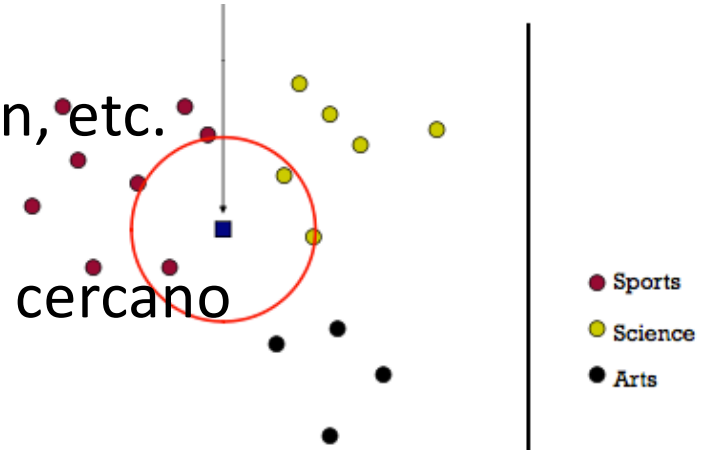
```
['versicolor']
['setosa' 'versicolor' 'virginica']
[[ 0.   0.8  0.2]]
```


```
In [ ]: import numpy as np
        import pandas as pd

In [ ]: myiris = pd.read_csv('iris-iic1005.csv', header=0)

In [ ]: myiris.head()

In [ ]: myiris.dtypes

In [ ]: myiris['sepallength'].head()

In [ ]: myiris.describe()

In [ ]: myiris.groupby('class').mean()

In [ ]: # K-nn classifier
        from sklearn import neighbors
        from sklearn.cross_validation import train_test_split
        from sklearn import metrics
        from sklearn.cross_validation import cross_val_score

In [ ]: # Clase a predecir
        y = myiris["class_numeric"]

        # Seleccionar todas las columnas con datos
        X = myiris.ix[:,0:4]

In [ ]: # Crear instancia del clasificador
        knn = neighbors.KNeighborsClassifier(n_neighbors=5, weights='uniform')

In [ ]: # Separar dataset en train y test
        X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.3, random_state=0)
```

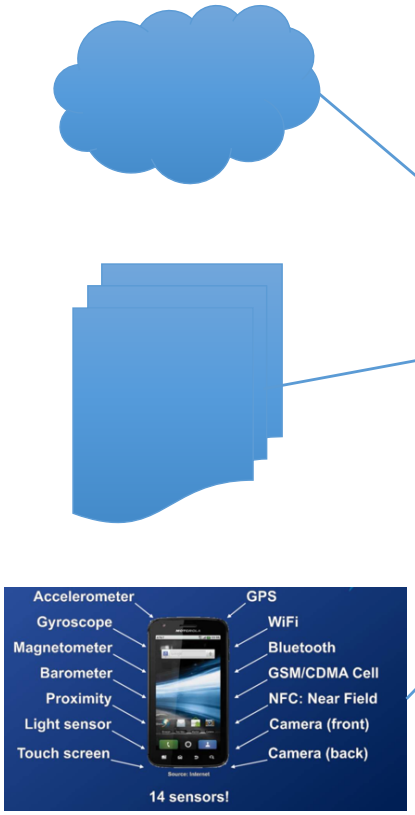
Recapitulando

- Una métrica de distancia
  - Euclidiana, Manhattan, Correlación, etc.
- ¿Cuantos vecinos considerar?
  - En 1-NN: solo un vecino => el más cercano
- Una función de peso (opcional)
  - 1/d; 1-d; exp(-d^2), etc.
- ¿Cómo usar los vecinos cercanos para hacer la predicción?
  - El más cercano, votación, el promedio, etc.



Sin embargo, estamos usando los datos, no un MODELO

Pasos para realizar minería de Datos



Resumen

- Cuáles son las “escuelas de aprendizaje” en Inteligencia Artificial:
  - Aprendizaje deductivo (lógica)
  - Aprendizaje inductivo (learning from data)
- En el modelo inductivo, qué tipos de tareas típicas con encontramos:
  - Predicción
  - Clasificación
  - Clustering
- En cuanto a clasificación, aprendiste: K-NN
- Próxima clase: evaluación y Árboles de Decisión