



Ingeniería Biomédica en Radiología

Juan F. Orejuela Z.



 **FUNDACIÓN VALLE DEL LILI**
Excelencia en Salud al servicio de la comunidad



Certificados por nuestro con la reducción de emisiones de gases de efectos invernadero.



Certificación internacional en cuidados paliativos Newpalex, otorgada por New Health Foundation



Institución Acreditada con EXCELENCIA por Icontec Internacional y reconocimiento especial por la excelente gestión desde 2012.

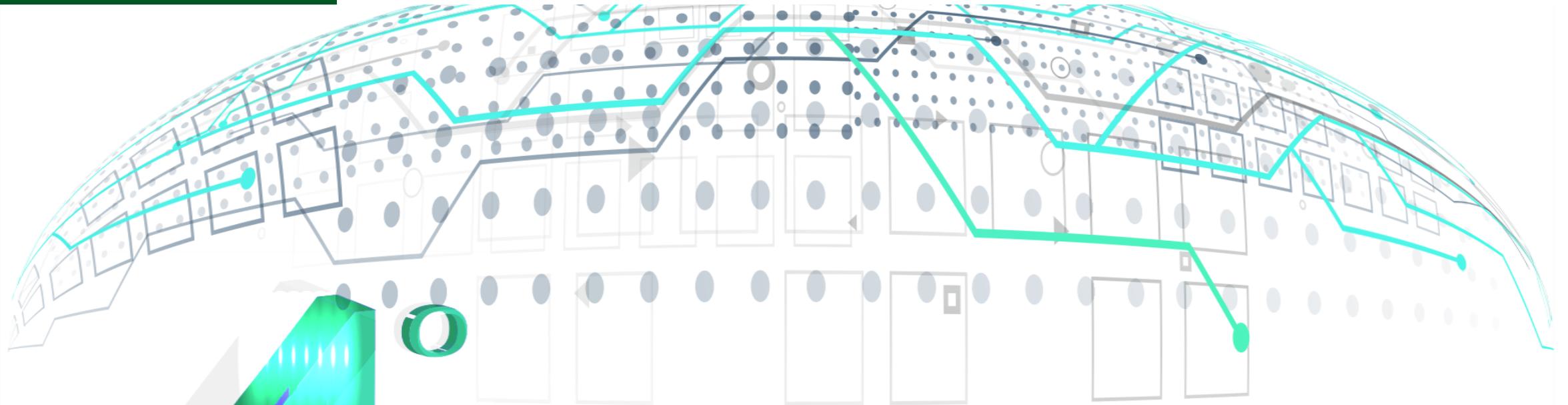


Ingeniería Biomédica en Radiología



1

Introducción



4

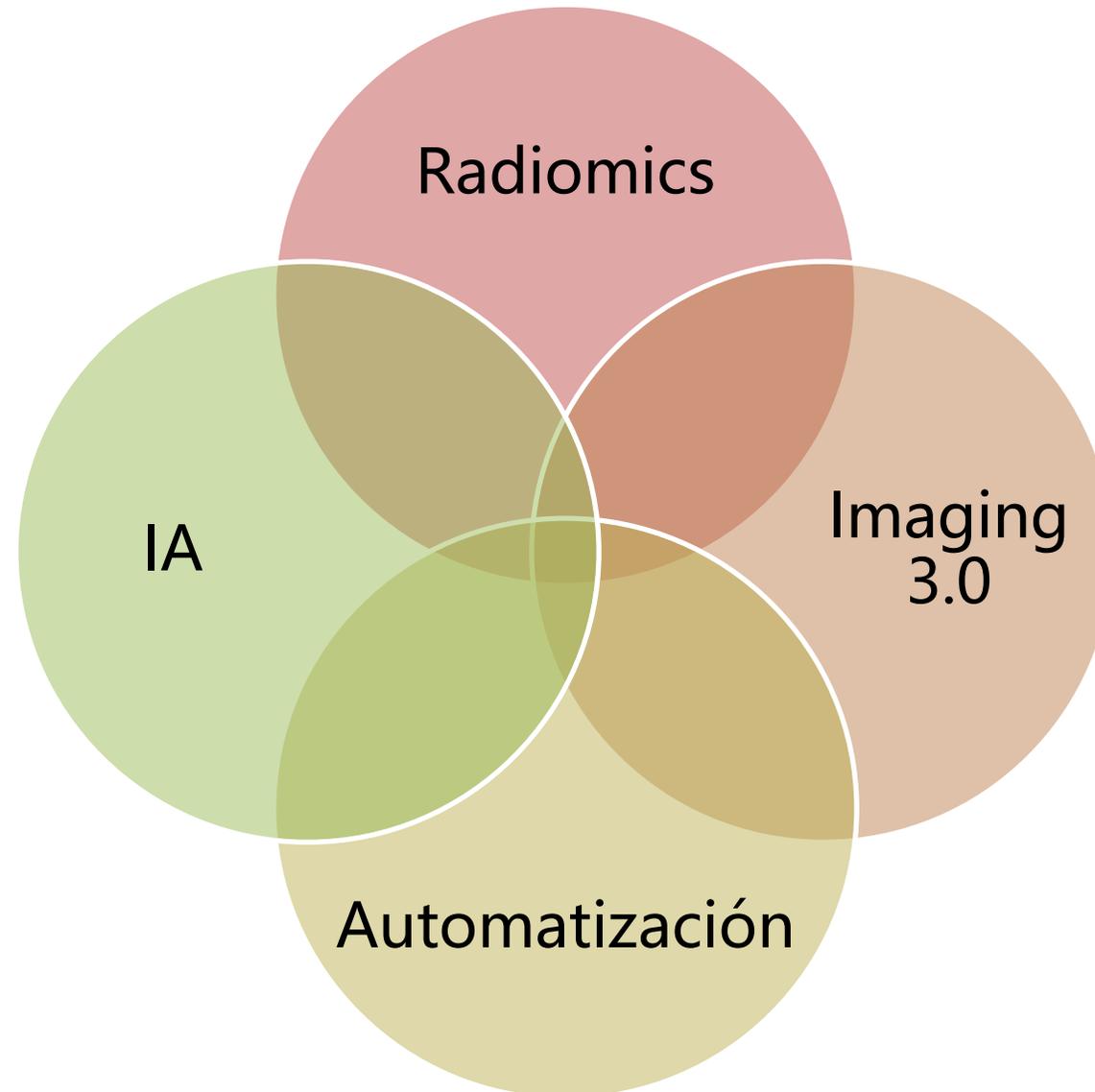
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Día de la
INVESTIGACIÓN

Retos de la investigación
e innovación en los
hospitales universitarios.



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Auditorio principal
Carlos Ardilla Lülle



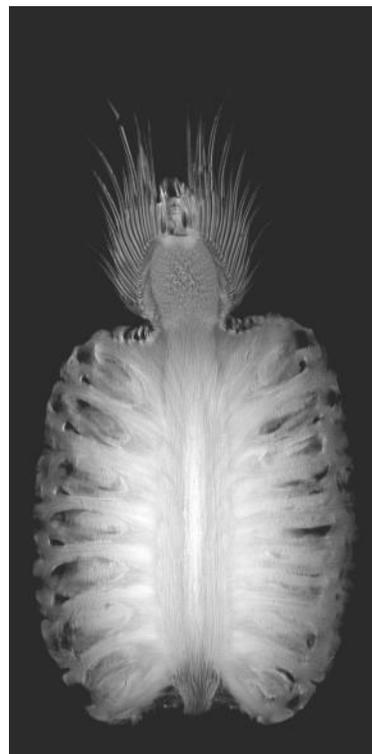
Radiomics



¿Radiomics?



Lo que todos ven



Lo que el radiólogo ve

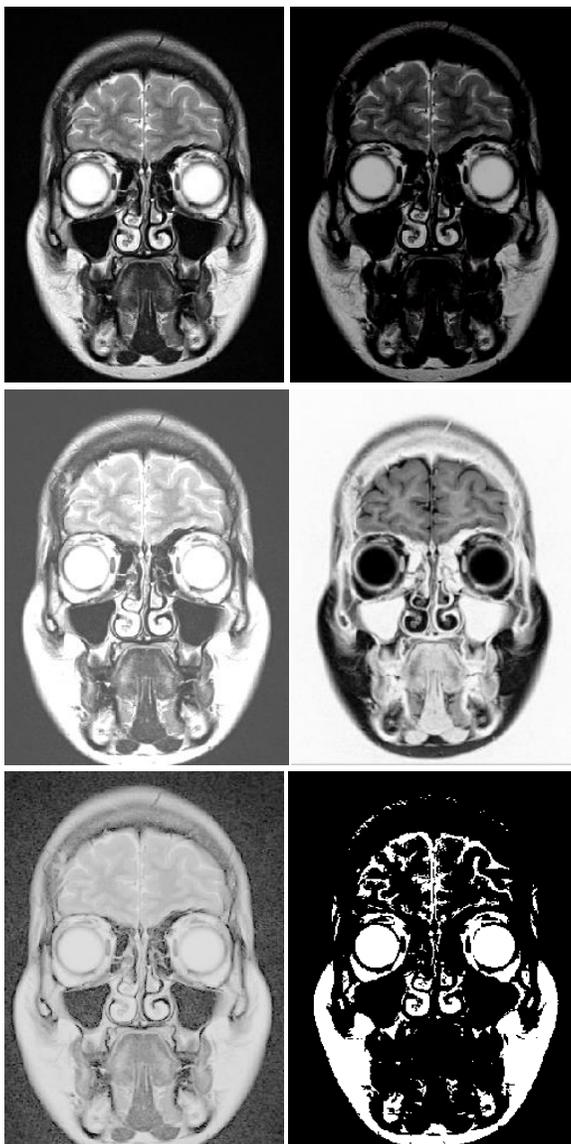


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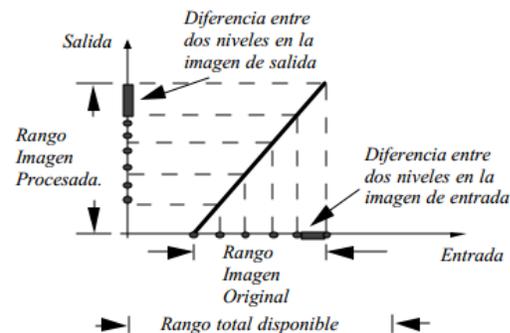
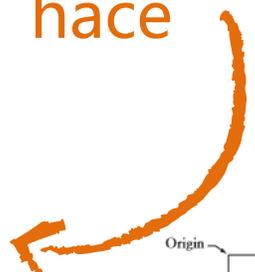
Lo que un ingeniero ve



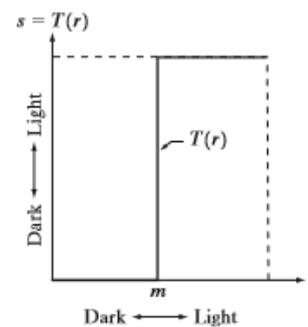
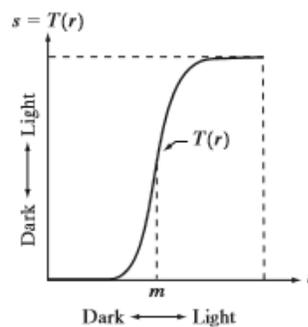
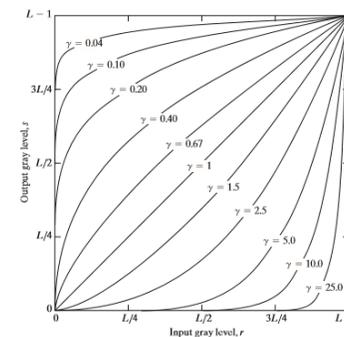
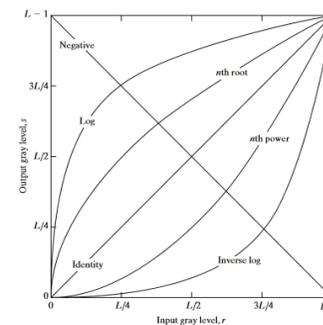
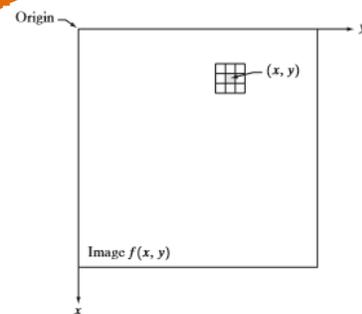
¿Radiomics?

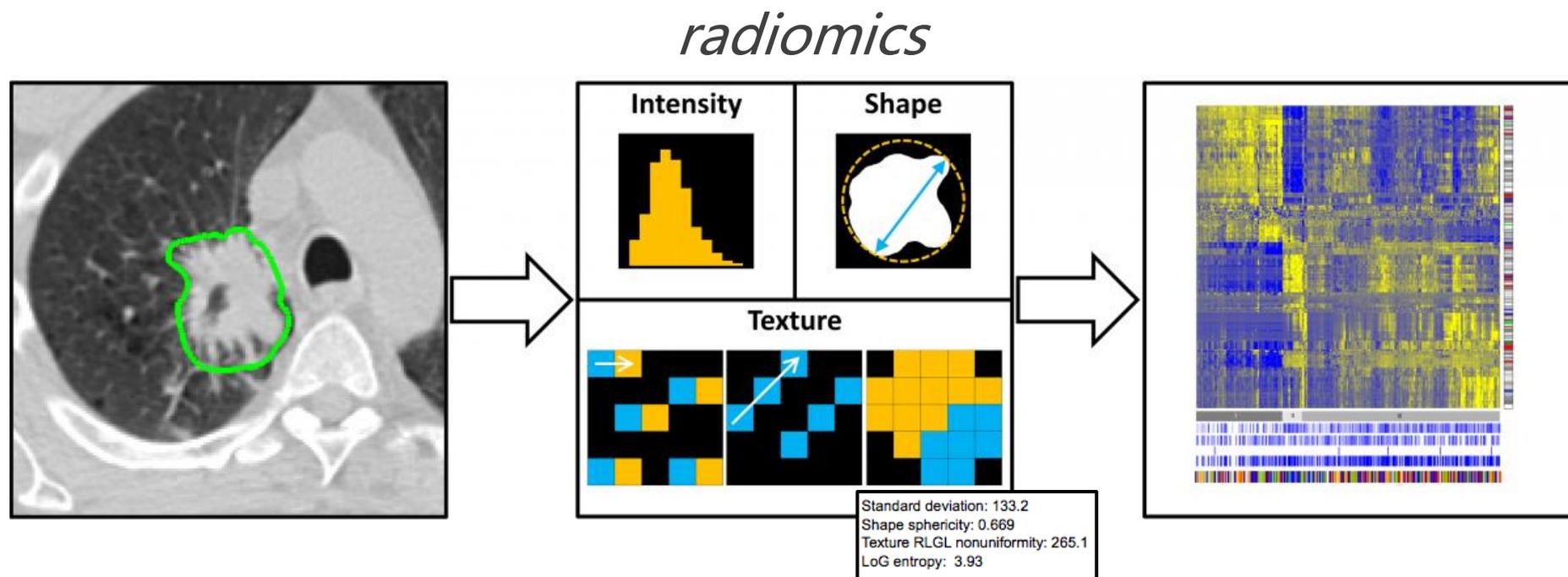


Lo que el radiólogo hace



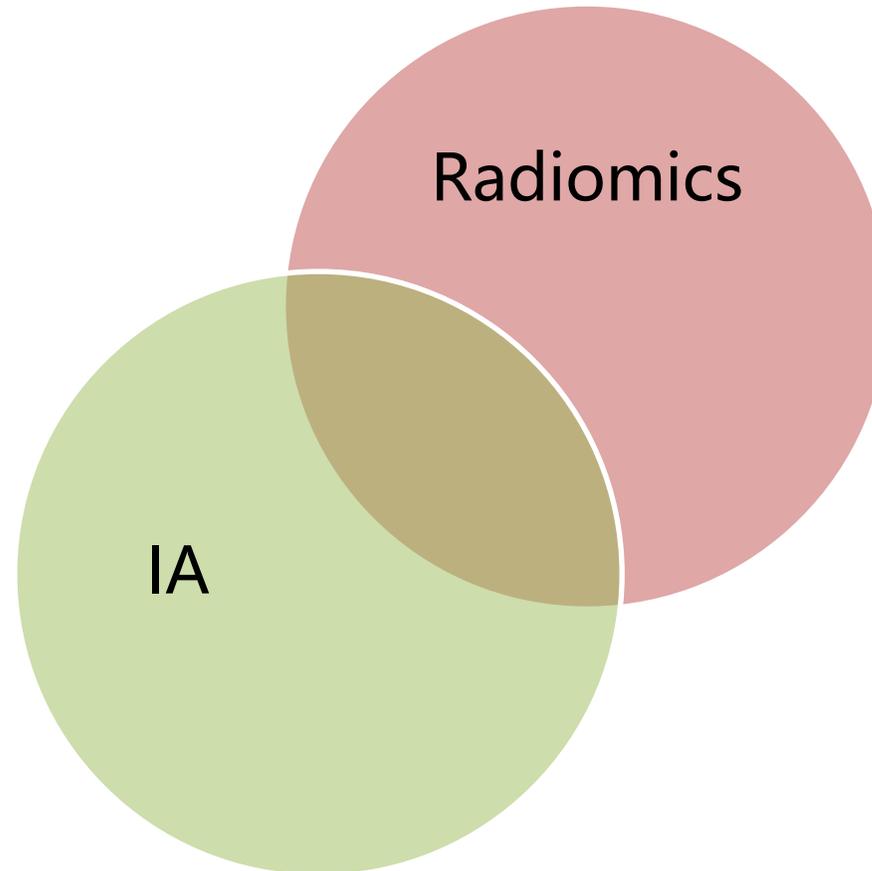
Lo que el ingeniero hace

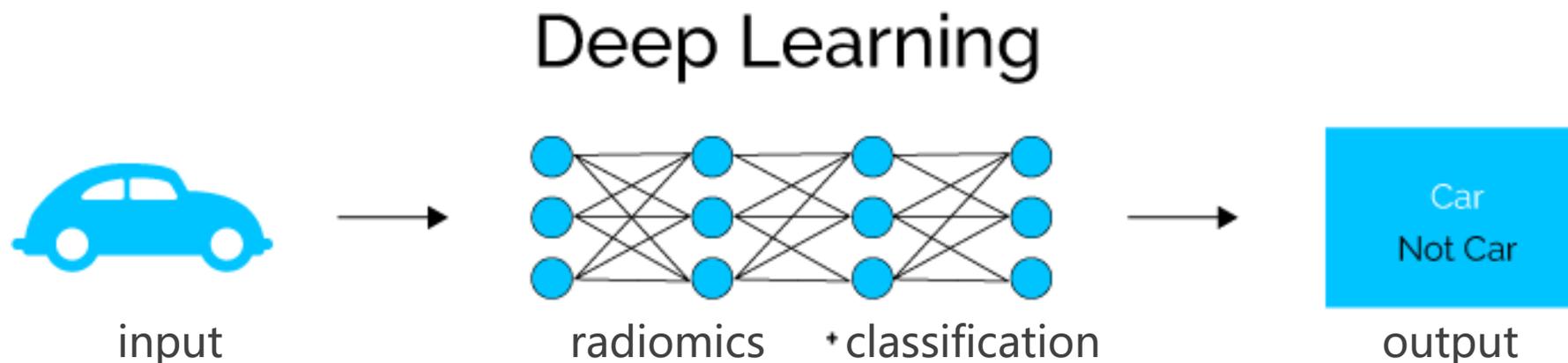
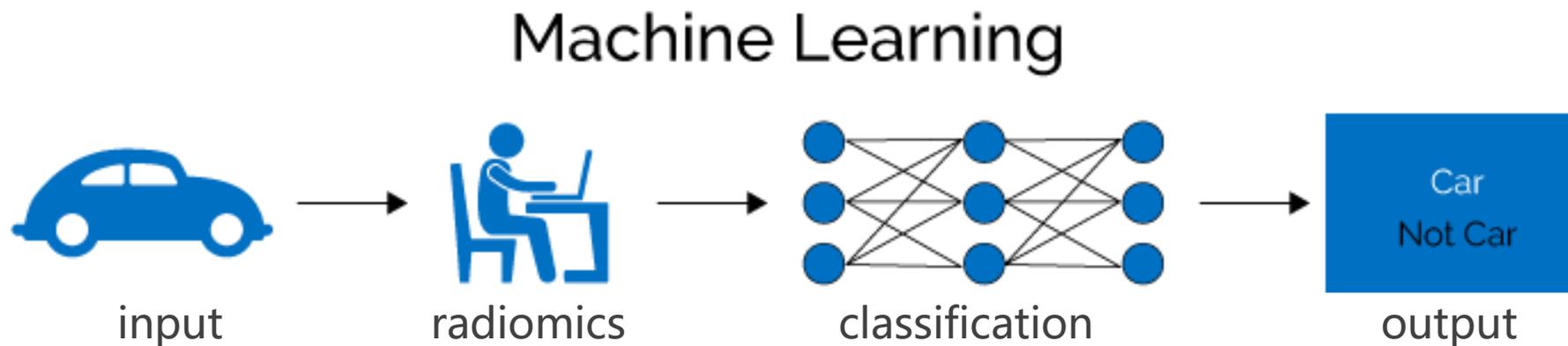




- Obtener grandes cantidades de información de la imagen.
 - Cuantificar información visible.
 - Identificar información no visible.

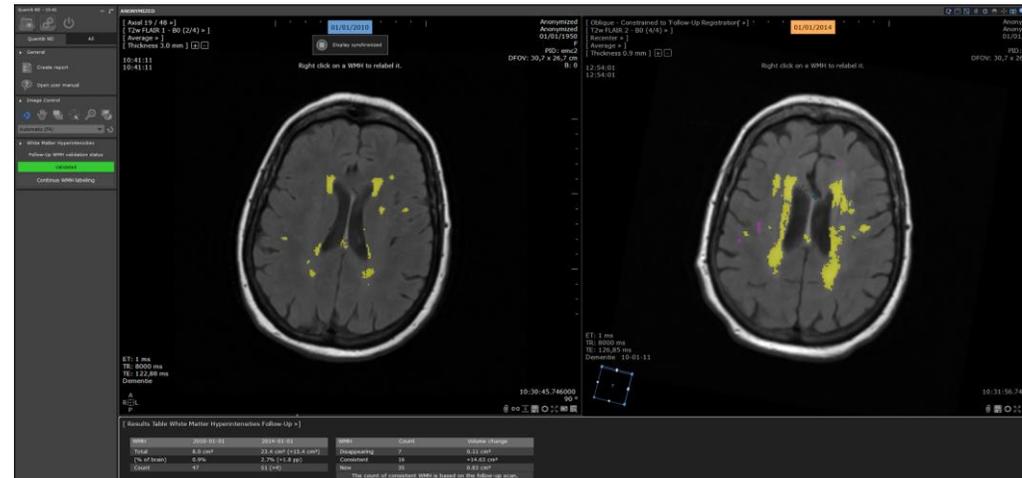
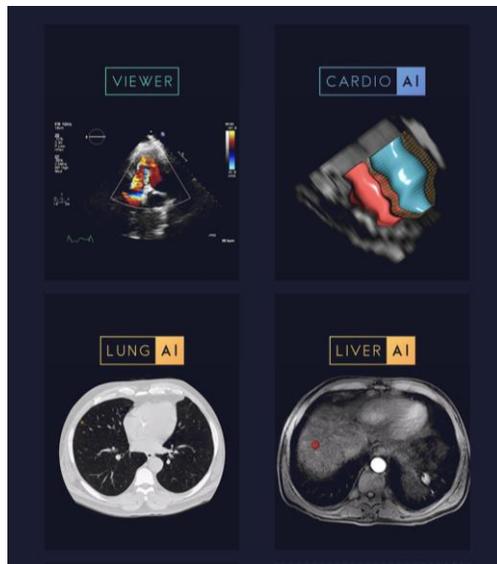
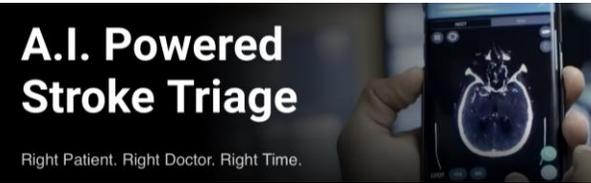
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- Caracterización (Diagnóstico), Clasificación (Diagnóstico diferencial), predicción (Pronóstico – Sobrevida), etc.

IA en Radiología

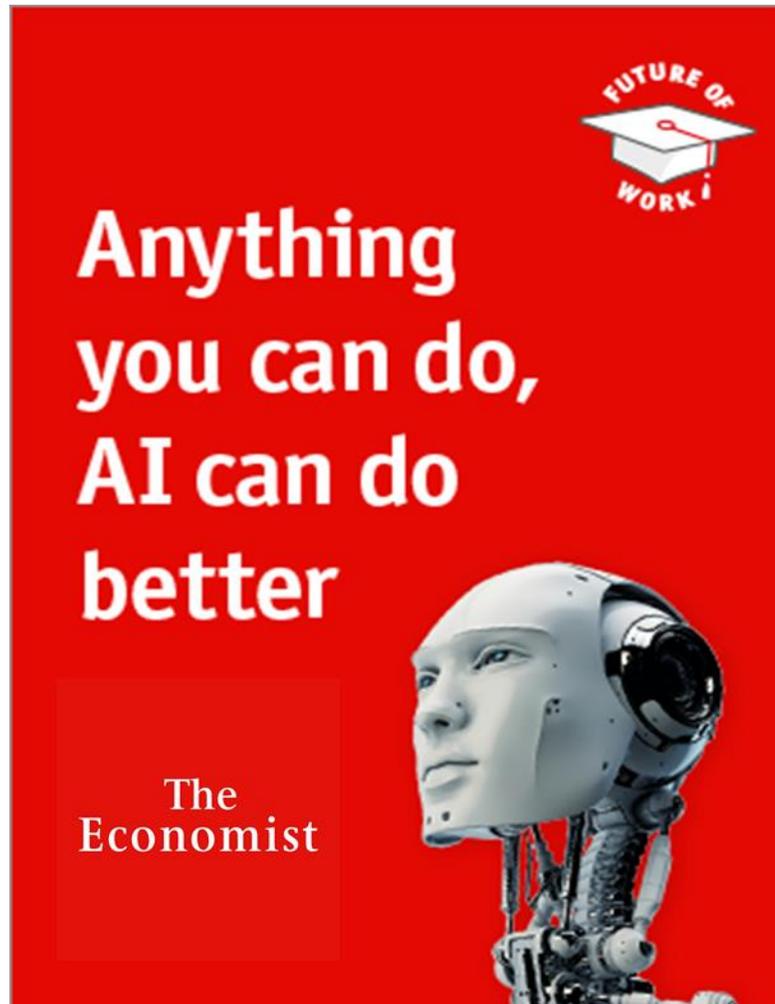


¿IA en

NDACIÓN
LE DEL LILI
al servicio de la comunidad

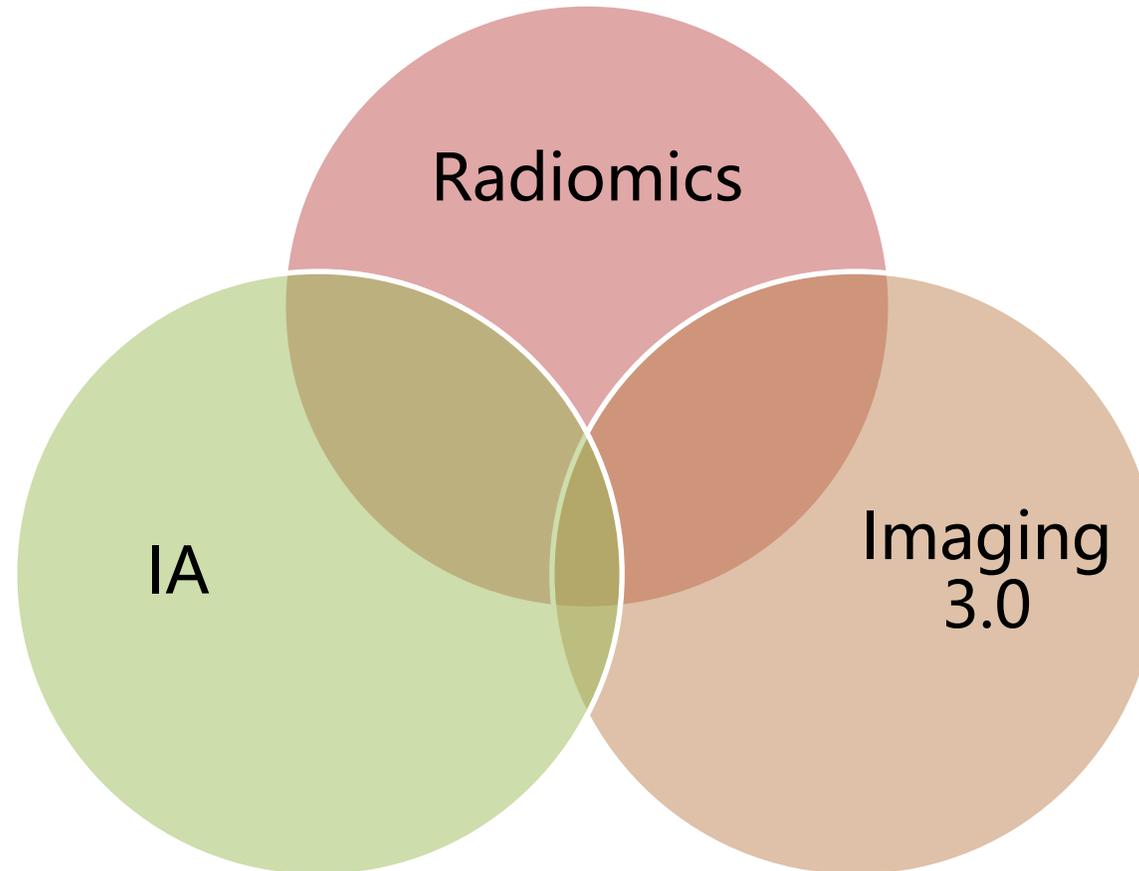


¿IA en Radiología?



¿La Inteligencia Artificial va a reemplazar al Radiólogo?

¿La cocina automática
va a reemplazar a los
padres?



IMAGING 2.0



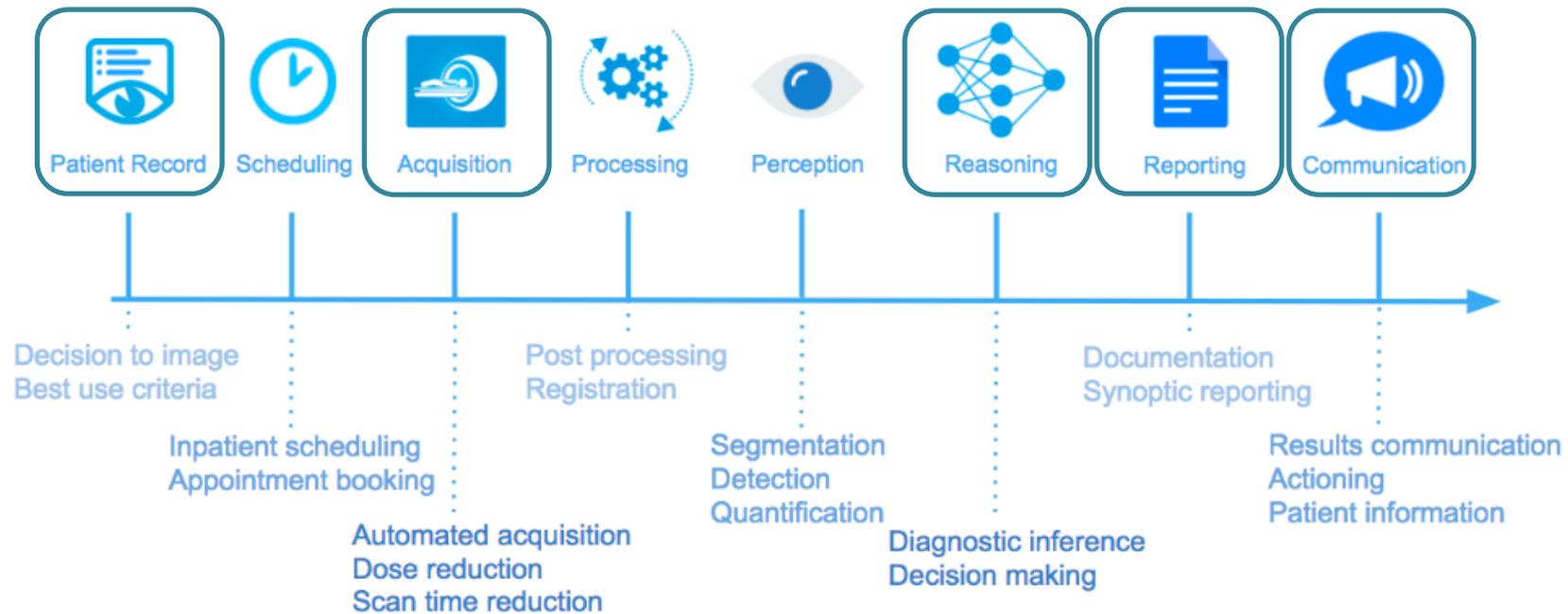
Basada en volumen

IMAGING 3.0



Basada en valor

Imaging 3.0

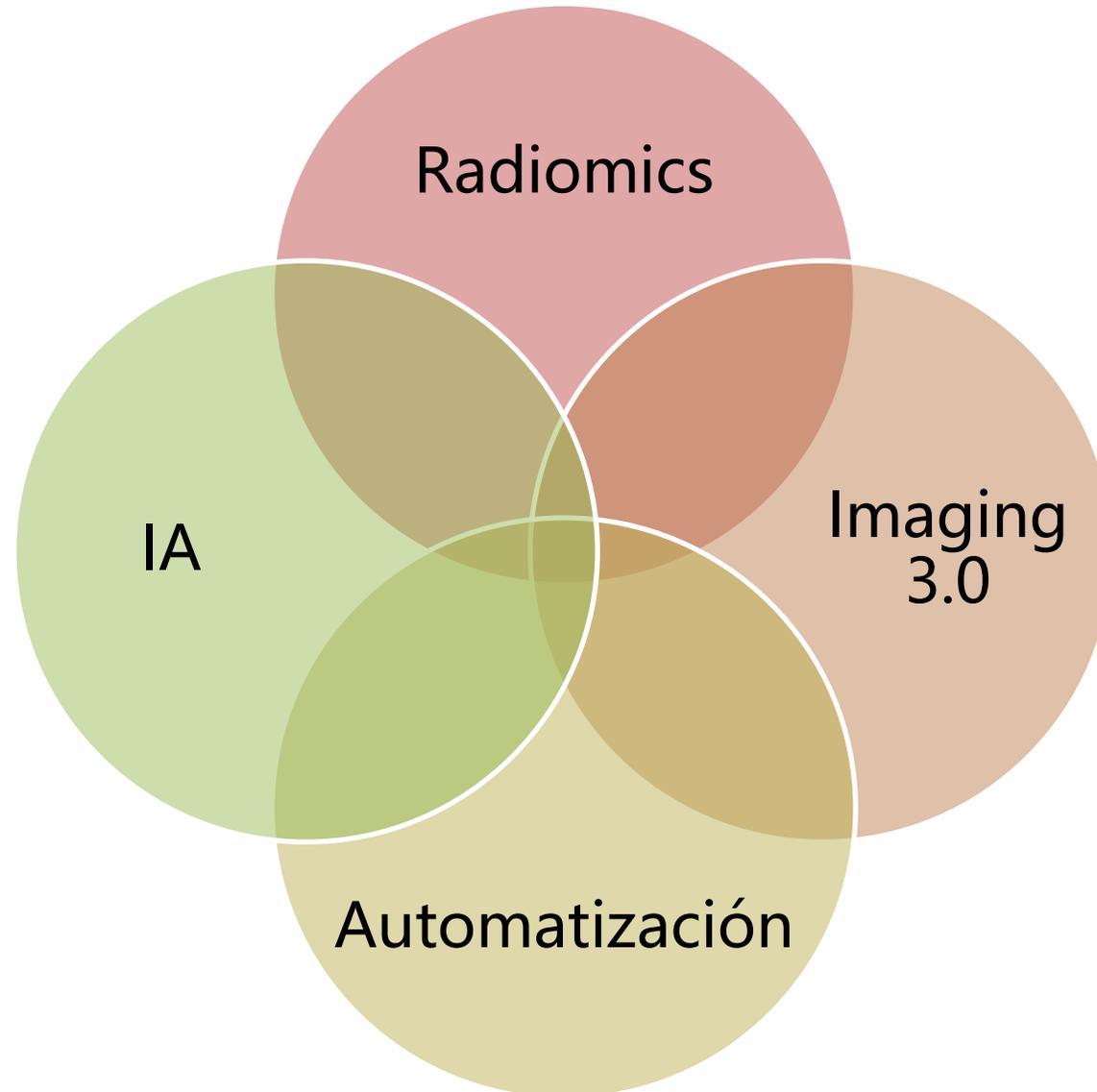


Simplified schematic of the diagnostic radiology workflow, with examples of where AI systems can be implemented. Image copyright @drhughharvey.

- Procesos administrativos, operativos, asistenciales y clínicos.

¿IA en Radiología?!





```
single_subject_analysis()
{
# REQUEST FOR ANALYSIS
process=`Scocoa standard-dropdown --title "Imagine Single-Subject $version" --text "Select analysis:" --items "Voxel-based
morphometry" "functional MRI" "Diffusion MRI" "Utils"`
option=`echo "$process" | head -n 1`; process=`echo "$process" | tail -n -1`
if [ "$option" == 2 ]; then exit 65; fi

### VOXEL BASED MORPHOMETRY ANALYSIS SINGLE SUBJECT VERSION
if [ "$process" == 0 ]; then
# REQUEST FOR VBM SUBPROCESS
subprocess=`Scocoa standard-dropdown --title "Imagine Single-Subject $version" --text "Select process:" --items "Recon-
all (step by step)" "Recon-all (all steps)" "QDEC process" "Stats tables"`
option=`echo "$subprocess" | head -n 1`; subprocess=`echo "$subprocess" | tail -n -1`
if [ "$option" == 2 ]; then exit 65; fi
##
-----

if [ "$subprocess" == 1 ]; then reconall_all_single_subject_analysis; fi
if [ "$subprocess" == 2 ]; then qdec_single_subject_analysis; fi
if [ "$subprocess" == 3 ]; then statstable_single_subject_analysis; fi
fi

### DIFFUSION MRI ANALYSIS SINGLE SUBJECT VERSION
if [ "$process" == 2 ]; then
dif
fi

### UTILS ANALYSIS
if [ "$process" == 3 ]; then
# REQUEST FOR UTILS SUBPROCESS
subprocess=`Scocoa standard-dropdown --title "Imagine Single-Subject $version" --text "Select process:" --items "File
conversion (mgz to nii)"`
option=`echo "$subprocess" | head -n 1`; subprocess=`echo "$subprocess" | tail -n -1`
if [ "$option" == 2 ]; then exit 65; fi
##
-----

if [ "$subprocess" == 0 ]; then fileconversion_mgznii_single_subject_analysis; fi
fi
}

multi_subject_analysis()
{
Scocoa ok-msgbox --title "Imagine Multi-Subject version - $version" --text "Ups..." --informative-text "Multi-Subject version
is under development. Sorry about that." --icon "x" --no-newline
}

# DEFINICIÓN DE VARIABLES
CD_APP="/Applications/CocoaDialog.app"
cocoa="$CD_APP/Contents/MacOS/CocoaDialog"
version="v1.0"

# INICIANDO APLICACIÓN
Scocoa bubble --debug --title "Imagine Single-Subject version - $version" --text "Inicializando aplicación..." --text-color
"ffffff" --background-top "000000" --background-bottom "000000" --icon "atom" \ &
rv=`Scocoa msgbox --no-newline --float --icon "atom" --text "Select your type of analysis:" --informative-text "If it's not
obvious, select Single-Subject Analysis for processing a dataset from one subject, \
or Multi-Subject Analysis for processing datasets from multiple subjects." --button1 "Single-Subject Analysis" --button2
"Multi-Subject Analysis" #--button3 "Group Analysis"`

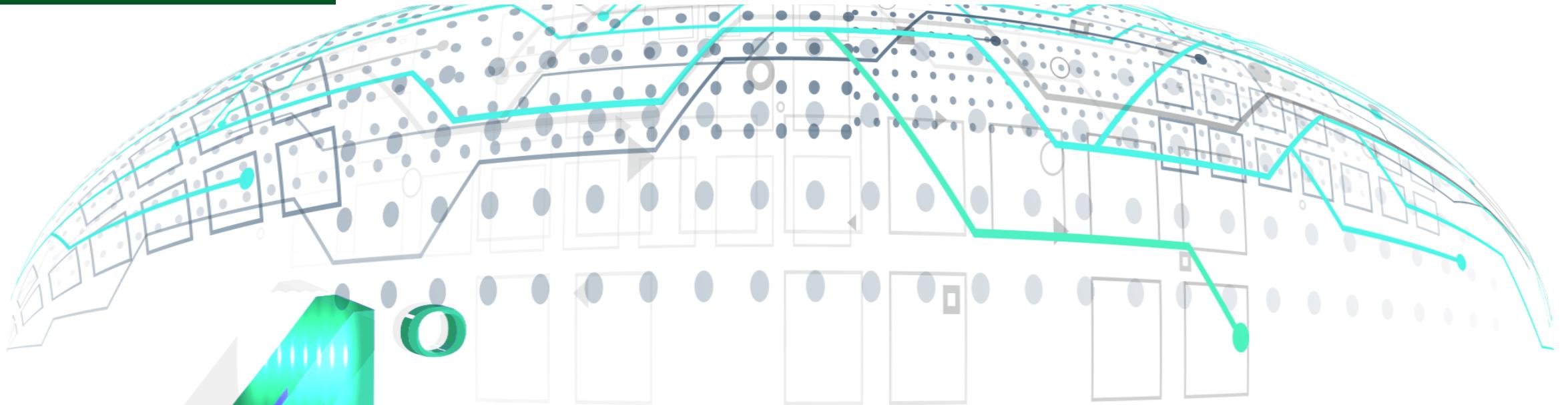
if [ "$rv" == "1" ]; then single_subject_analysis
elif [ "$rv" == "2" ]; then multi_subject_analysis
elif [ "$rv" == "3" ]; then higher_level_analysis; fi
```

- Reducción de fuentes de errores.
- Optimización de recursos.
- Procesamiento paralelo.
- Estandarización de procesos.
- ¿La automatización reemplaza al IB?



2

Nuestra experiencia



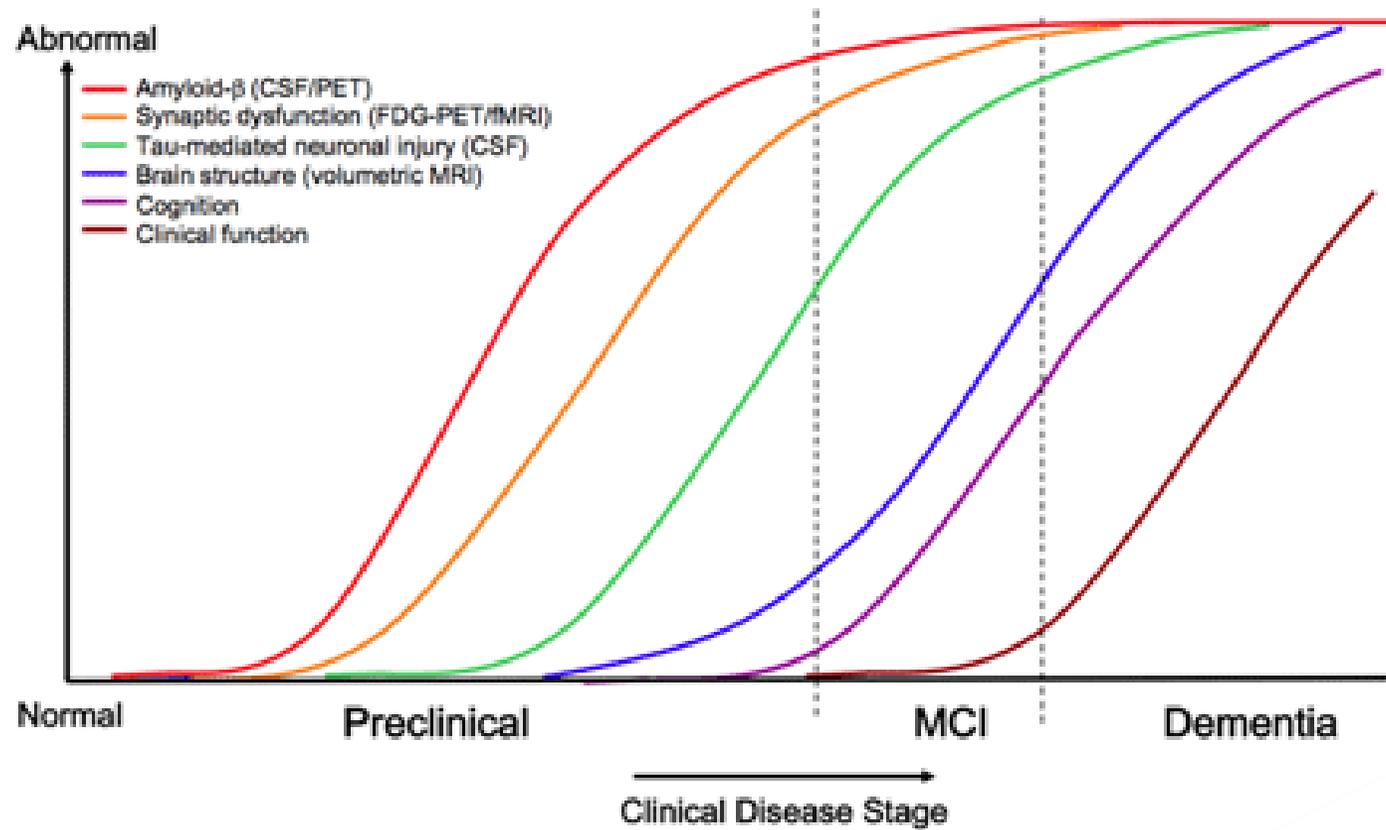
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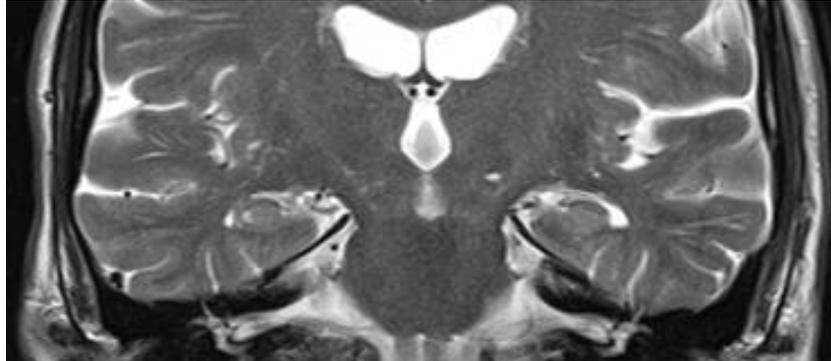
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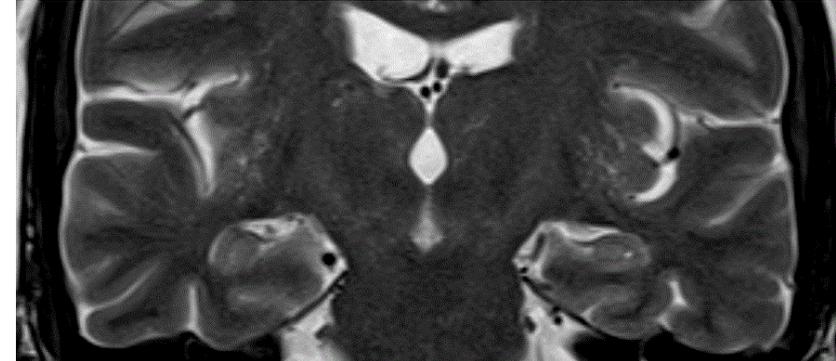


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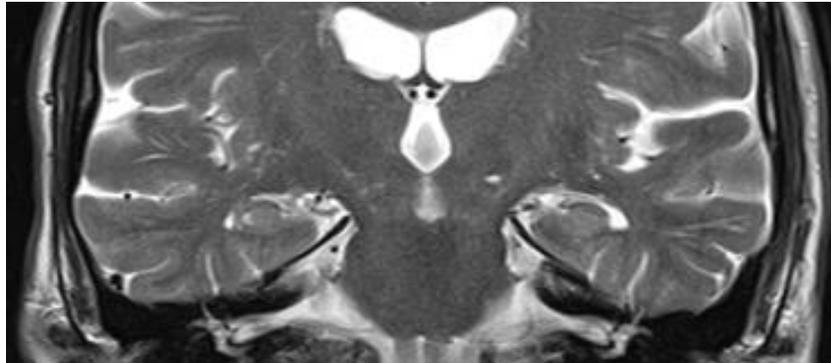
ENVEJECIMIENTO NORMAL



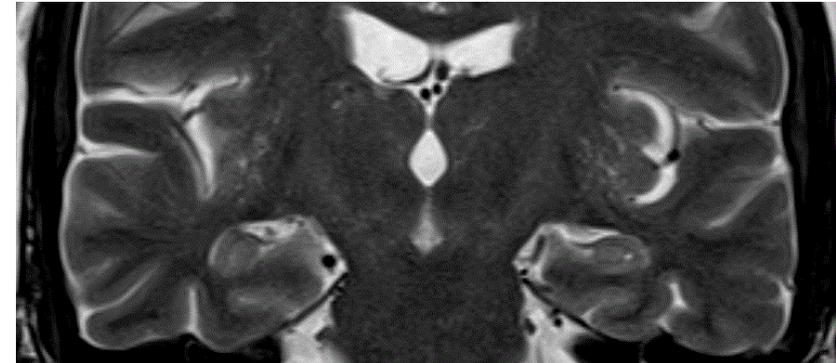
DEFICIT COGNITIVO LEVE

- Volumen del hipocampo. (Precisión diagnóstica 75.0 % en EA).

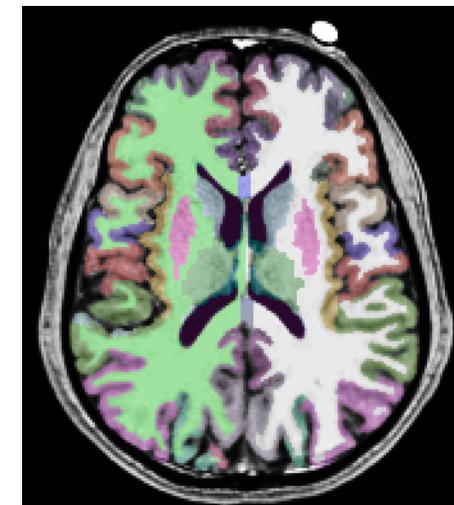
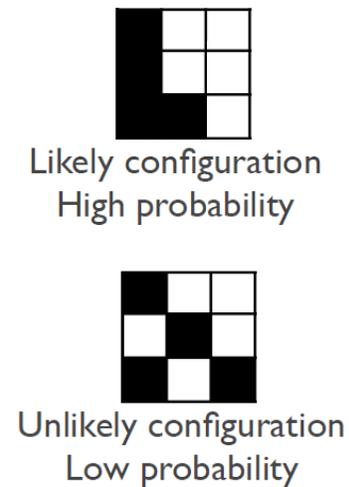
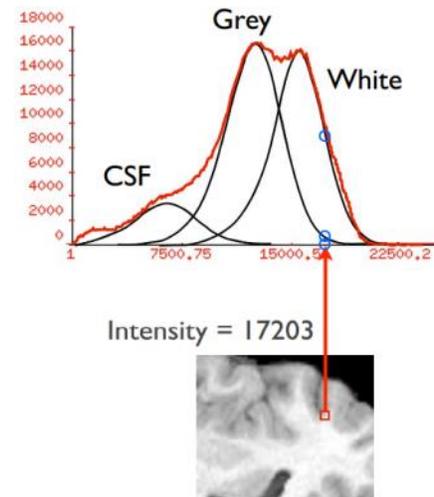
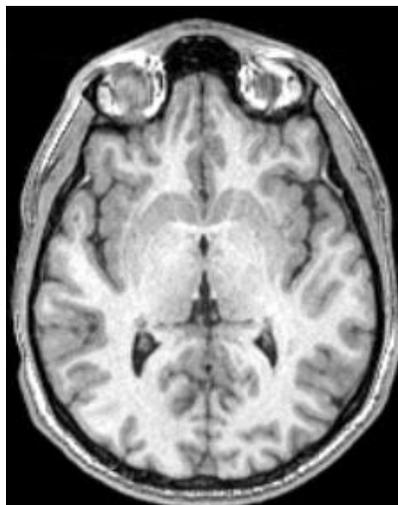




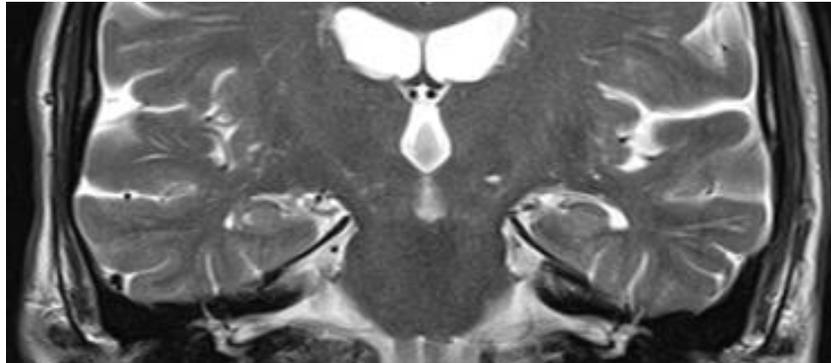
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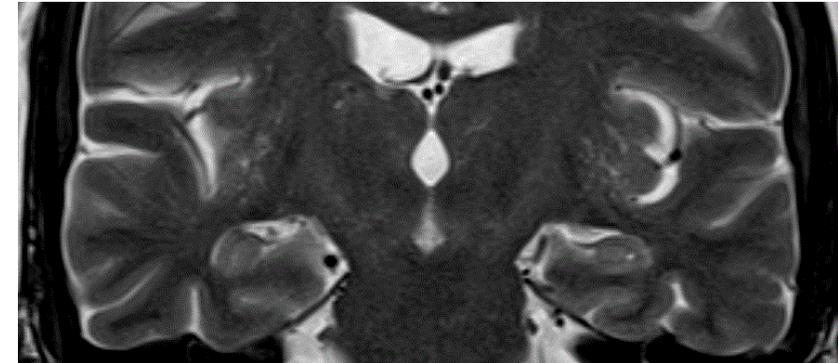
DEFICIT COGNITIVO LEVE



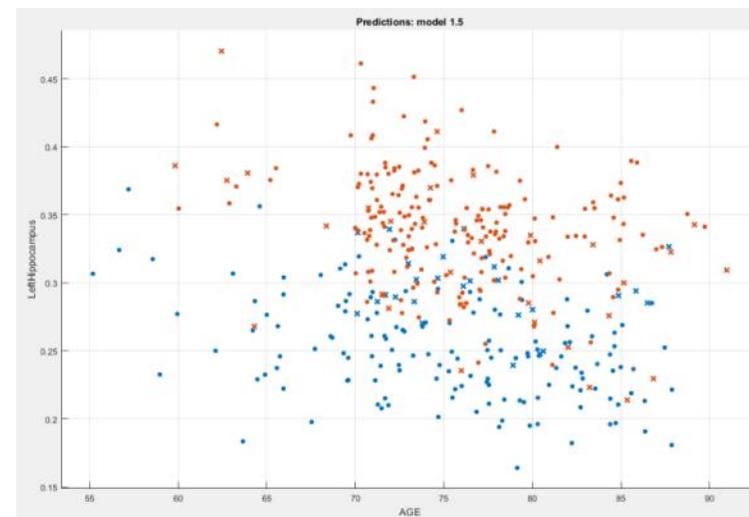
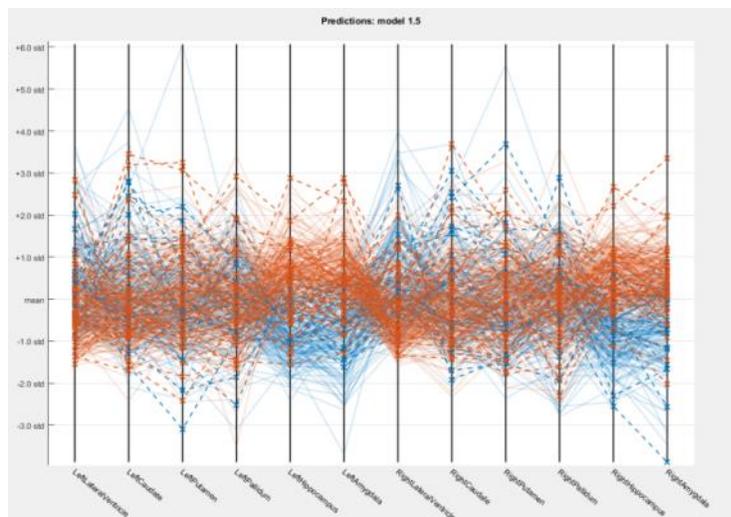
- Más de 200 regiones de interés (Atlas Desikan-Killiany, Destrieux).
- No diferencias estadísticamente significativas a nivel subcortical y cortical.



ENVEJECIMIENTO NORMAL

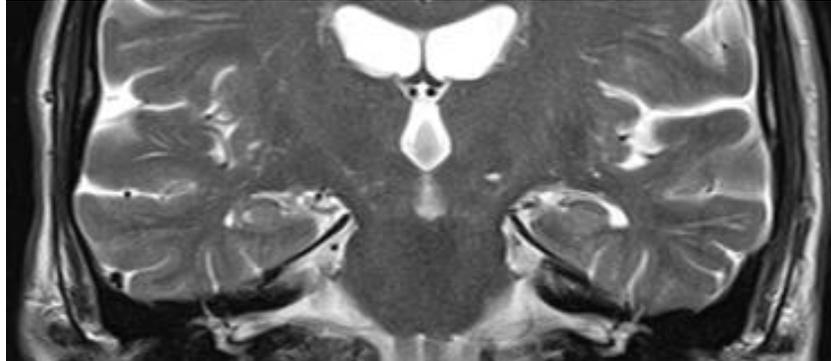


DEFICIT COGNITIVO LEVE

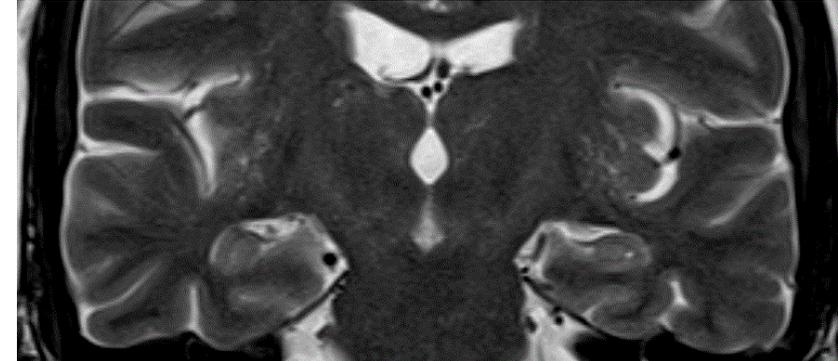


- SVM Lineal. Velocidad de predicción 6300 obs/s.
- Entrenamiento 6.7 s.

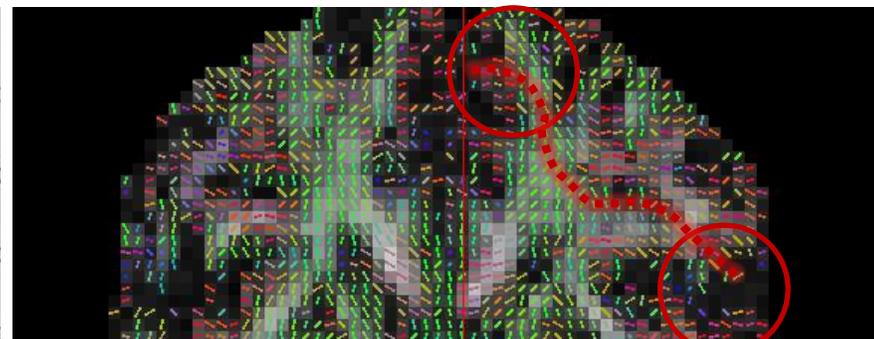
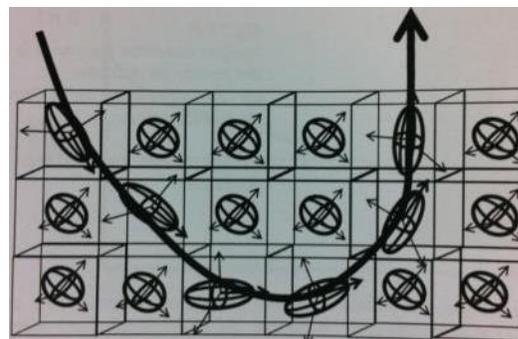
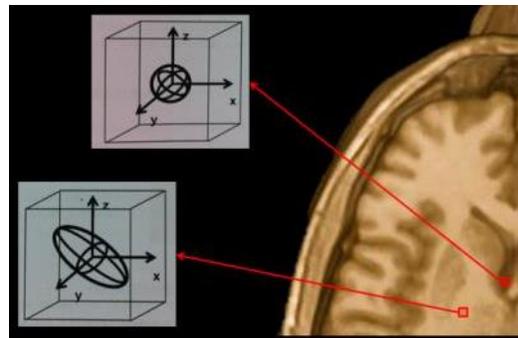
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ENVEJECIMIENTO NORMAL



DEFICIT COGNITIVO LEVE

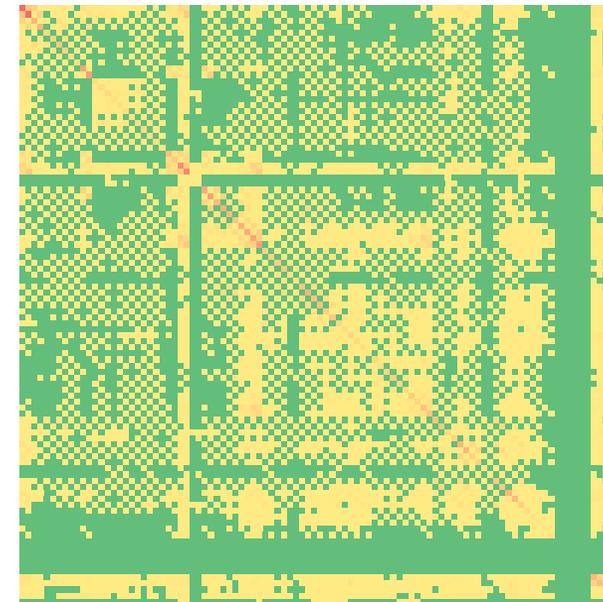
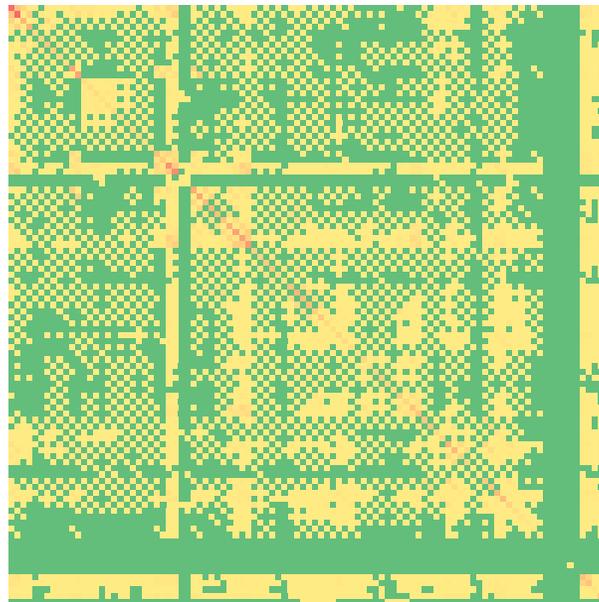


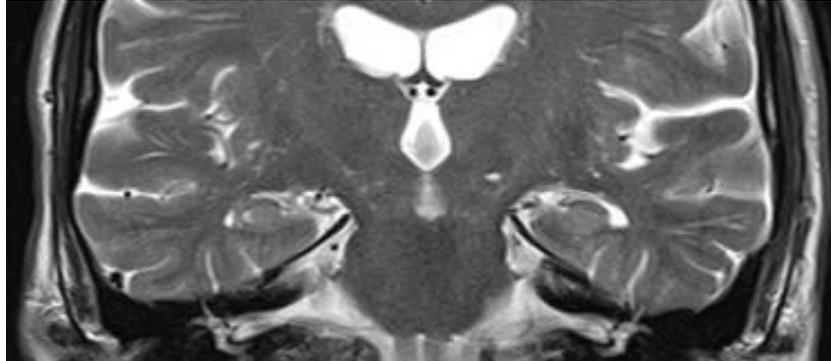


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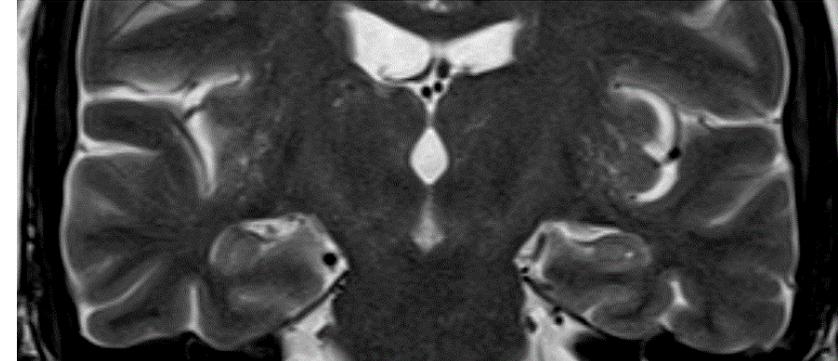


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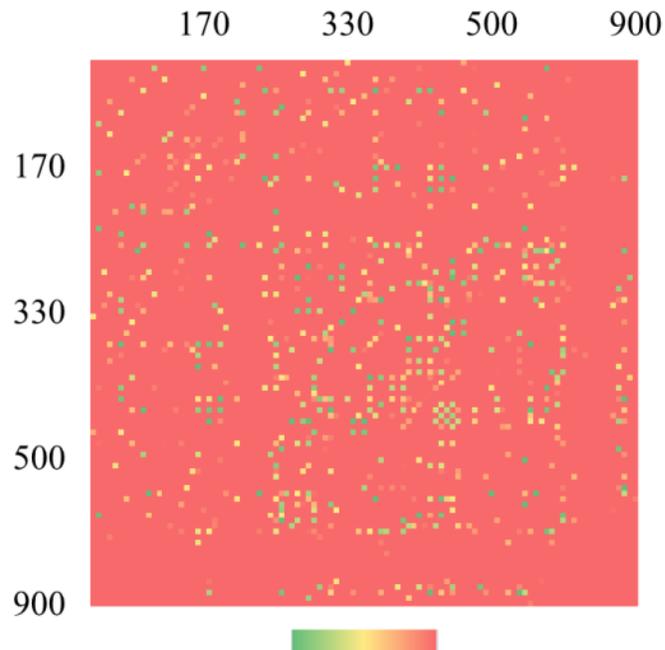




ENVEJECIMIENTO NORMAL



DEFICIT COGNITIVO LEVE



- 26 parejas de regiones de interés.
- Conexiones intrahemisféricas (76.9%), de proyección (15.4%), e interhemisféricas (7.7%).
- Lóbulos temporal y occipital (40.7%), frontal (25.9%) y parietal (22.2%).
- Precúneo (9.62%), giro lingual y giro temporal superior (7.69%)

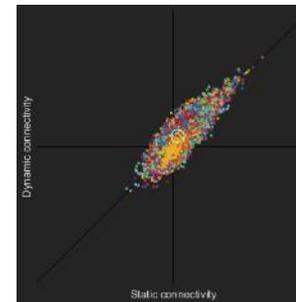
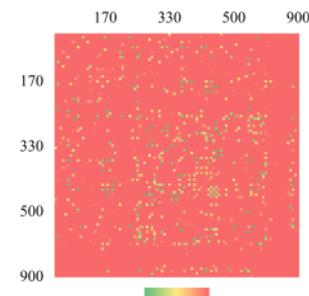
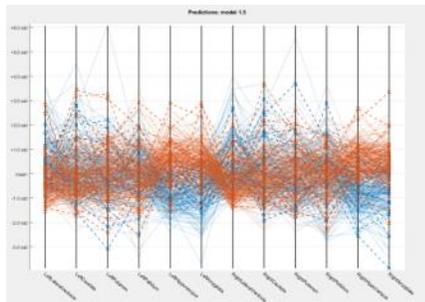
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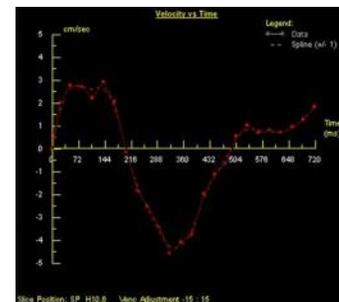
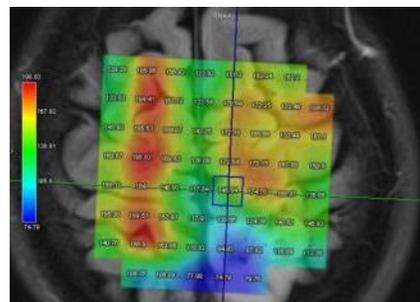


DEFICIT COGNITIVO LEVE



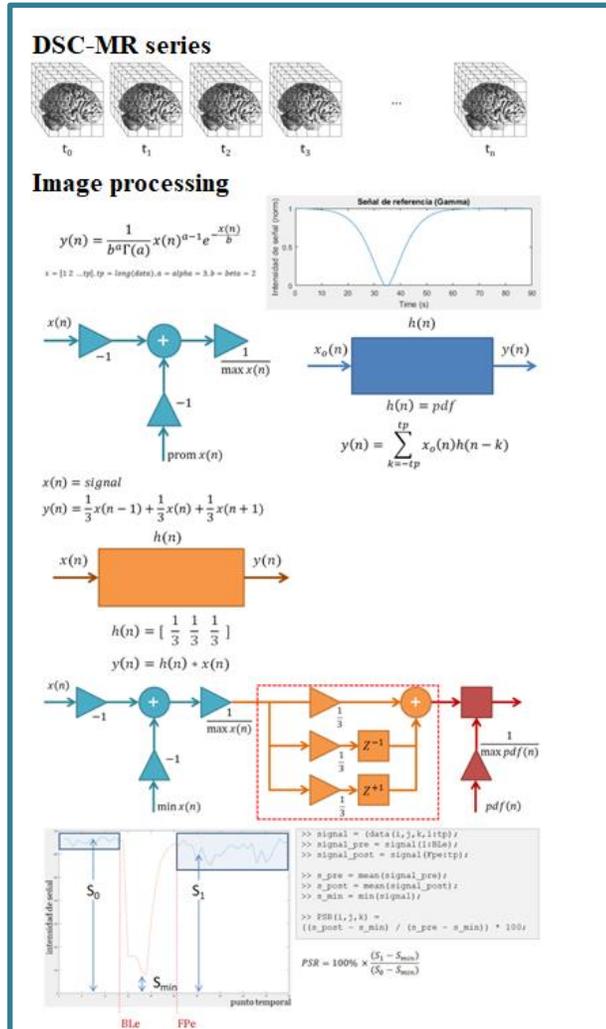
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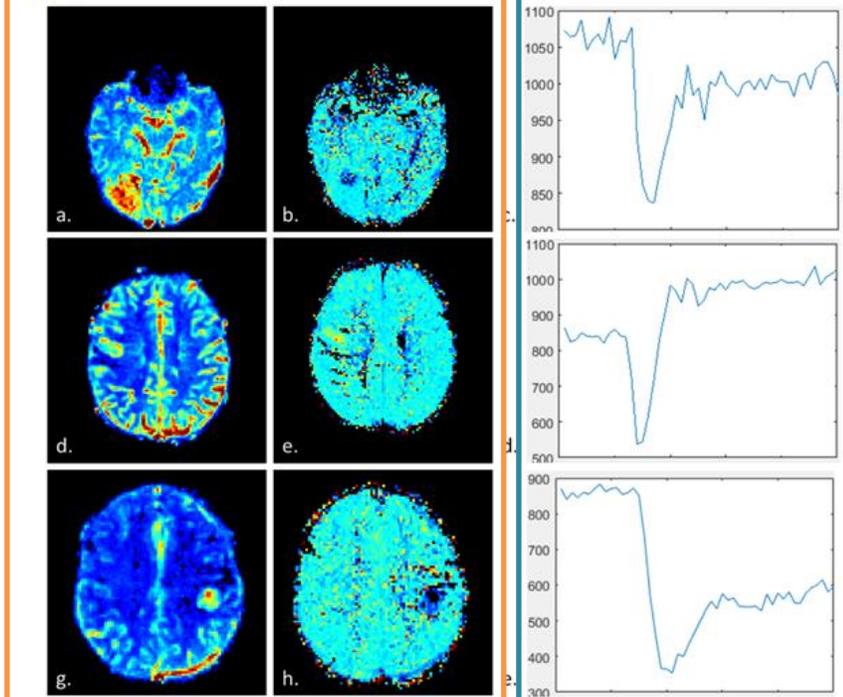


Development and evaluation of a Matlab-based toolbox for calculation of the percentage of signal recovery (PSR) from dynamic susceptibility contrast MR perfusion sequences (DSC-MR) for classification of high-grade intra-axial brain lesions.

J Orejuela-Zapata, M Arango-Granados, J Núñez-Bonilla, A Granados-Sánchez



Results

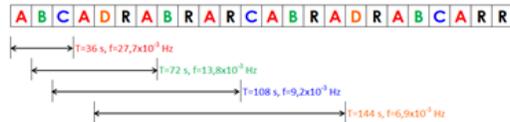


- ✓ El rCBV en glioblastoma fue 2.96 ± 0.96 , linfoma 2.30 ± 0.30 , y metástasis 2.36 ± 1.59 . No diferencias estadísticamente significativas ($p = 0.633$).
- ✓ El PSR en glioblastoma fue 95.36 ± 39.86 , linfoma 193.24 ± 97.91 , y metástasis 57.43 ± 23.99 . Diferencias estadísticamente significativas ($p = 0.015$).
- ✓ La precisión diagnóstica fue del 41,67% según el protocolo de MR actualmente utilizado, y del 91,67% con el análisis de PSR.

Desarrollo y aplicación de paradigmas multitarea en estudios de resonancia magnética funcional.

J Orejuela-Zapata, S Rodríguez-Takeuchi, A Granados-Sánchez

Diseño experimental

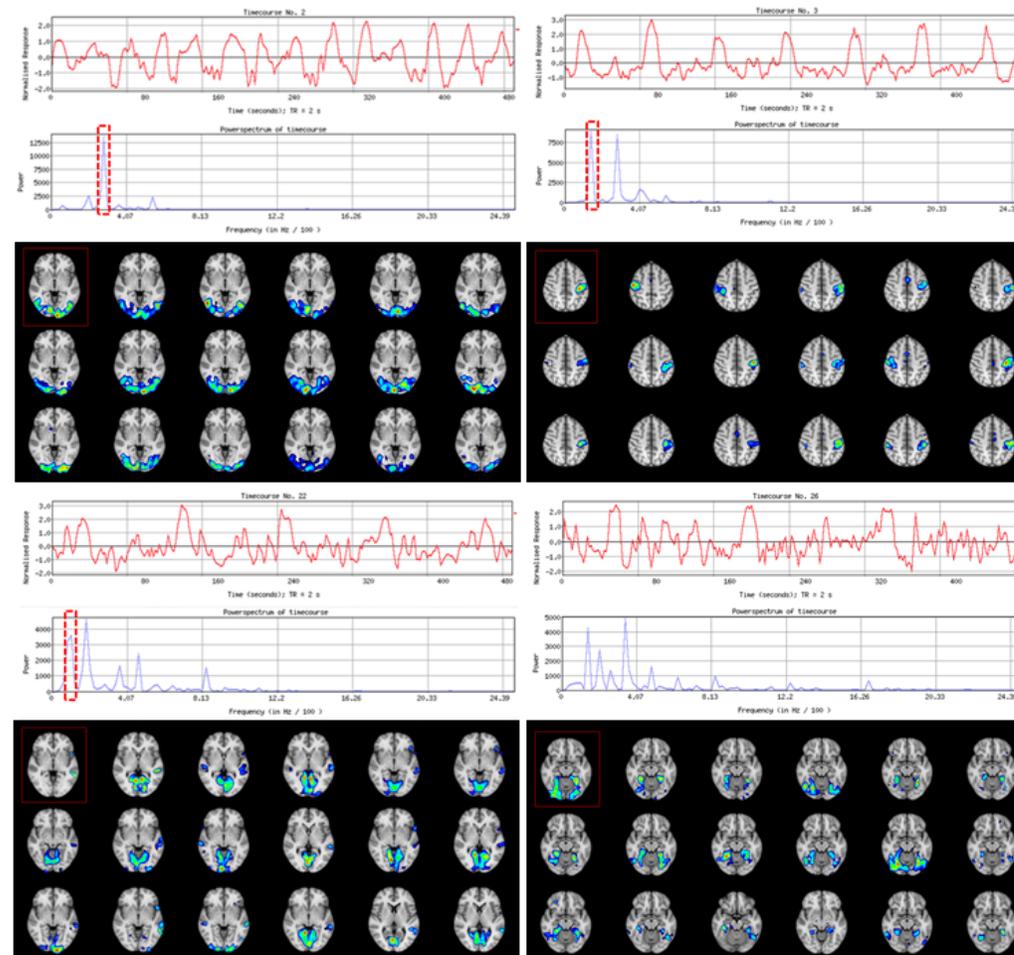


Análisis de componentes independientes aplicando transformadas de Fourier para descomponer señales hemodinámicas cerebrales a partir de información temporal y espacial.

Comparación entre método estándar actual (S1) y método propuesto (S2)

- ✓ Tiempo de adquisición ↓↓ 39,82 %
S1 = 28 min, S2 = 16 min
- ✓ Tiempo de procesamiento ↓↓ 68,56 %
S1 = 42 min, S2 = 13 min
- ✓ Tiempo total / estudio ↓↓ 57,39 %
S1 = 75 min, S2 = 32 min
- ✓ Número imágenes
Almacenamiento ↓↓ 54,3 %
- ✓ Activaciones consistentes entre diferentes sujetos control y en comparación con los estudios funcionales tradicionales.

Results





Gracias



Began ~~at~~ $2\frac{1}{4}$ " from bottom surface of
beam to magnet Dewar surface

1:45 AM. FANTASTIC SUCCESS!
First Human Image
Complete in Amazing Detail
Showing Heart
Lungs
Vertebra
Musculature

Image taken at Makoff
nipple level

