

Marking Medical Images with Natural Language Processing — The end-to-end system concept for training doctor practitioners



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Part 1

Marking Medical Images with
Natural Language Processing

Motivation 1/2

Marking Medical Images challenges

- **Huge** series of images per patient.
- **Huge** set of parameters to rely on
- **Report writing** and further assessment



MEDICAL REPORT					
Name					
Occupation	Address	Age	Date	Location	Zip
Note your idea					
Name					

Motivation 2/2

Marking Medical Images challenges

- Huge series of images per patient.
- Huge set of parameters to rely on
- Report writing and further assessment



**Natural
Language
Processing**

Natural Language Processing Application 1/2



Handle it

Series Description

t1ibetrap2bhdixonoppFIL

- Short description of manually reported series

1. **T1:**

- Refers to a *T1-weighted sequence*, often used to evaluate liver parenchyma and blood vessels. T1-weighted images are valuable for detecting fat, fibrosis, and hemorrhage. Pre- and post-contrast T1 sequences are particularly useful for characterizing liver lesions.

2. **IBE:**

- Likely refers to *In-Phase and Out-of-Phase Imaging*, which is commonly used in liver MRI for detecting fat within the liver parenchyma. This technique allows for differentiation between microscopic fat and iron deposits within liver tissues.

3. **TRAP:**

- Likely stands for *Transverse Relaxation Attenuated Pulse* or similar. It may refer to a sequence type focused on relaxation properties, typically T2 weighted, and can also include techniques used for lesion characterization, helping to identify focal liver lesions, cysts, or masses.

4. **2B:**

- May indicate a *Two-Breath-Hold* technique. This approach helps reduce motion artifacts caused by breathing, especially important in the abdominal area. Some MRI protocols require multiple breath-hold sequences to achieve optimal image clarity.

5. **BH:**

- Stands for *Breath-Hold*, a technique used in MRI imaging to avoid motion artifacts.

Message ChatGPT

LiverHCCSegmentation																									
LiverHccSeg-TCGA-BC-4073	-	-	-	-	+	+	-	-	-	-	+	-	-	-	-	-	-	Y	[nan]		no	0	073Y	182.00	
LiverHccSeg-TCGA-BC-A10Y	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	+	+	Y	Y	['LR-5', 'LR-3', 'LR-5']	no	0	010Y	180.80	
LiverHccSeg-TCGA-BC-A216	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	Y	[nan]	+	Splenic vari	0	003Y	17.93	
LiverHccSeg-TCGA-BC-A3KG	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	Y	Y	['LR-5']	no	0	068Y	F 63.96	
LiverHccSeg-TCGA-BC-A5W4	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	Y	Y	['LR-5']	+	SpeLenomegaLy	0	069Y	M 186.24
LiverHccSeg-TCGA-BC-A69I	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	Y	Y	['LR-5']	no	0	069Y	M 151.05	
LiverHccSeg-TCGA-DD-A4NB	-	-	-	-	+	+	-	-	-	+	-	-	-	-	-	-	-	Y	[nan]	+	SpLenomegaLy	0	-	M 162.00	
LiverHccSeg-TCGA-DD-A4NF	-	-	-	-	+	+	-	-	-	+	-	-	-	-	+	-	-	Y	Y	['LR-5']	no	0	071Y	M 98.72	

Filling the structured data about patients

Natural Language Processing Application 2/2

LiverHCCsegmentation																													
LiverHccSeg-TCGA-BC-4073	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	Y	[nan]	no	0	073Y	M	102.06					
LiverHccSeg-TCGA-BC-A10Y	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	+	+	Y	Y	[LR-5', 'LR-3', 'LR-5']	no	0	076Y	M	90.80	
LiverHccSeg-TCGA-BC-A216	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	[nan]	+	splenic vari	0	063Y	F	117.93	
LiverHccSeg-TCGA-BC-A3KG	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	Y	Y	[LR-5]	no	0	068Y	F	63.96	
LiverHccSeg-TCGA-BC-A5W4	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	Y	Y	[LR-5]	+	SpeLenomegaly	0	069Y	M	106.24
LiverHccSeg-TCGA-BC-A69I	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	Y	Y	[LR-5]	no	0	069Y	M	151.05	
LiverHccSeg-TCGA-DD-A4NB	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Y	[nan]	+	Splenomegaly	0	-	M	162.00	
LiverHccSeg-TCGA-DD-A4NF	-	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	+	-	-	Y	Y	[LR-5]	no	0	071Y	M	90.72	

Report Assessment



Part 2

End-to-End System Concept

Concept

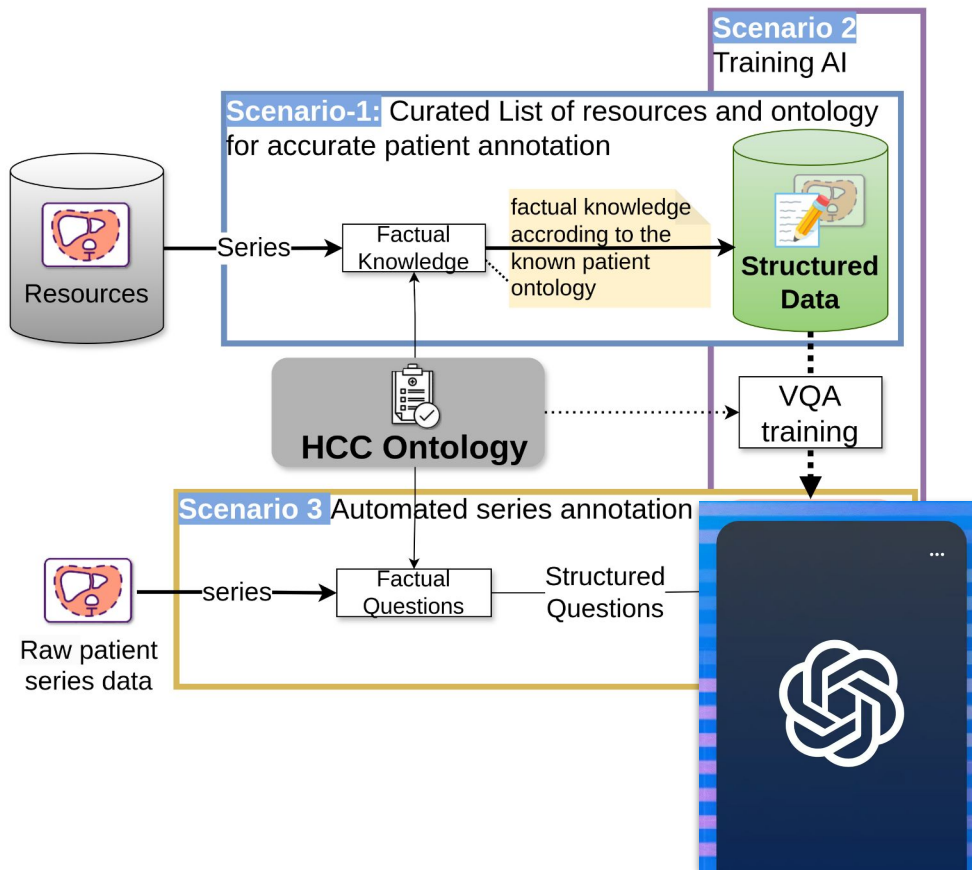
Two components

- **Back-end:** Understanding the reports using GenAI
- **Front-end:** Assessing the reports using the GenAI

Use GenAI as the Framework that could deeply understand patients



Back End



Scenarios:

1. Compose a carefully selected patients and **ontology** for their annotation
2. 🔥 Using This data for fine-tuning GenAI
3. 🤖 Perform automated series annotation

Front End

We follow the concepts with systems that allow viewing volumetric data

[WORK IN PROGRESS]

<https://radiopaedia.org/cases/normal-liver-mri-with-gadolinium-1>



Progress at present

Working on the **Back-end part for accurate patient series annotation** for

- Assessing **GenAI** advances
- Fine-tuning **GenAI** for deep understanding patients..

Output:

<https://docs.google.com/spreadsheets/d/1pg-Bp5nT1O8nsELbBUmvl1Z-DBpsTR8a70hpOb1gJzs/edit?gid=1756283676#gid=1756283676>

		Back-End Features / Parameters																	Front-End													
		Axial DWI	Axial ADC	Axial In Phase (t1rfs)	Axial Opposed Phase (opposed)	Axial T2w (sfse)	Axial Precontrast Fat Suppressed T1w (dynpre)	Mid Arterial T1w	MRCP	Axial Late Dynamic T1w	Anything else	Cerebral T2w	Portal Venous T1w (dynportal)	Localizers	Coronal Late Dynamic T1w	Early Arterial T1w	Axial Transitional/Hepatocyte T1w	Late Arterial T1w	Everything Else	Tumors annotation #1 #2 #3	Liver Segmentation	Tumors Segmentation	MRI LI-RADS	Splenog	PHTN	Ascites	Patient			Medical Reports	Clinical Data	
3	patient_id	I	M	G	H	A	B	C	D	E	F	J	K	L	N	O	P	Q	F	#1	#2	#3						Age	Sex	Weight		
Duke-Liver																																
5	DLDS-0001-cla	+	-	+	+	+	+	+	+	-	+	-	-	-	+	+	-	-	-	-	-	-	-	-	-	-	-	052Y	F	113.4	-	-
6	DLDS-0001-seg	-	-	+	+	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	052Y	F	113.4	-	-	
7	DLDS-0002-cla	-	-	+	+	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	053Y	F	113.4	-	-	
8	DLDS-0002-seg	-	-	+	+	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	053Y	F	113.4	-	-	
9	DLDS-0003-cla	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	-	-	-	-	-	-	077Y	F	52.2	-	-	
10	DLDS-0003-seg	-	-	+	+	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	077Y	F	52.2	-	-	
11	DLDS-0004-cla	+	+	+	+	+	+	+	+	+	+	+	+	+	-	-	+	+	-	-	-	-	-	-	-	-	068Y	F	86.2	-	-	
12	DLDS-0004-seg	-	-	+	+	+	+	+	+	-	-	+	+	+	-	-	-	-	-	-	-	-	-	-	-	-	068Y	F	86.2	-	-	

Summary



How Natural Language Processing may improve Medical Images analysis

- Marking reports
- Enhancing AI (Visual Question Answering)
- Assessing reports of novice practitioners

End-to-End system concepts

- Use GenAI for marking medical images (Back-end)
- Use GenAI for assessing medical reports (Front-end)

Thank you for your attention!

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