De-identification of DICOM files

for Data Scientists

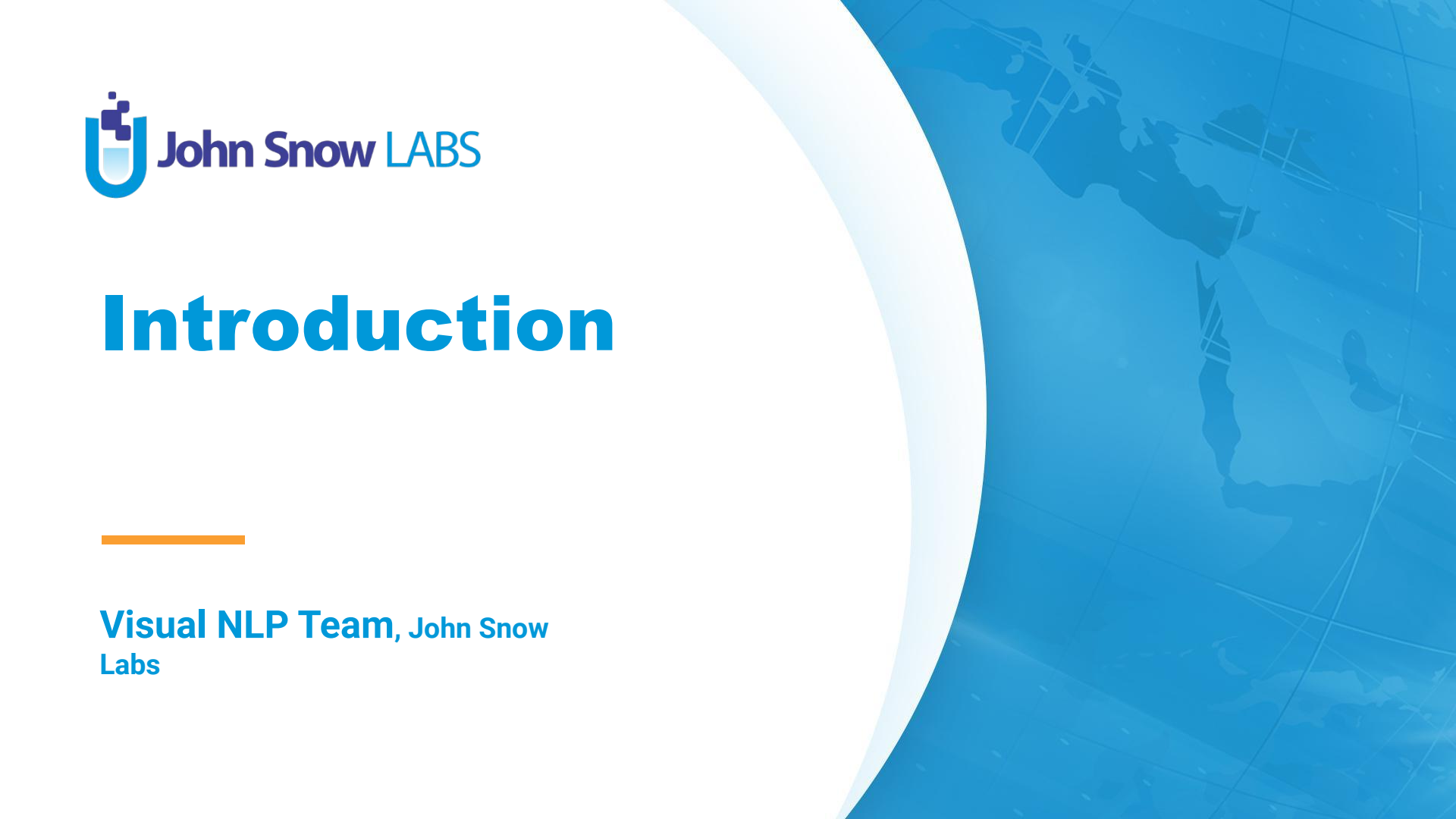
Visual NLP Team, John Snow Labs

Agenda

Main topic	Introduced Concepts
Introduction	Overview of the DICOM file format. Transfer Syntaxes. De-identification Challenges.
De-identification Targets	Burned-in text. Metadata. Overlay Annotation data. Encapsulated Documents.
Visual NLP Primer	Intro to Visual Language Models. Pipelines and Dataframes. Batch Mode vs. Streaming Mode.
Metadata De-identification	Metadata Deidentification Pipelines. User Defined Metadata Removal.
Burned-in Text Removal	Basic Pipelines for Text Removal. Text Detectors. NLP assisted Text Removal. Customized Pipelines. Dealing with big files.
Getting Started	Resources to start de-identifying yourself!

Presenter today

Alberto



Introduction

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The Dicom Format

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- Digital Imaging and Communications in Medicine (DICOM)
- It turned 30 years old last year!
- Metadata is as important as image data.
- First developed for radiology and then cardiology.
- DICOM does not limit its action to images and associated information originating directly from medical devices.
- The standard is reviewed 5 times a year.

Transfer Syntaxes

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1. **Compression**: Uncompressed, JPEG, JPEG Lossless, JPEG 2000, RLE Lossless.
2. **Byte Ordering (Endianness)**: Little Endian or Big Endian.
3. **Photometric Interpretation and Color Spaces**.
4. **Binary Encoding Rules**: Explicit VR (Value Representation) or Implicit VR.

Transfer Syntax UID	Transfer Syntax name
1.2.840.10008.1.2	Implicit VR Endian: Default Transfer Syntax for DICOM
1.2.840.10008.1.2.1	Explicit VR Little Endian
1.2.840.10008.1.2.1.99	Deflated Explicit VR Little Endian
1.2.840.10008.1.2.	Explicit VR Big Endian

Metadata

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DICOM Metadata

PATIENT	STUDY	SERIES	IMAGE
Patient ID	Study ID	Modality	Rows
Patient Name	Study Date/Time	Manufacturer	Columns
Patient BirthDate	Study Description	Model Name/SW Version	Pixel Size
Patient Sex	Institution Name	Patient Position	Photometric Interpretation
Patient Weight	Referring Physician	Body Part Examined	Planar Configuration
...	...	+	Samples per Pixel
		Modality-Specific Attributes	...

- How important is this?: “the image can never be separated from this information”.
- (0008, 0060) -> Two hexa numbers, **(Group, Element).**
- Can also include manufacturer-specific attributes known as private data elements.

Challenges

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- Dealing with multiple Transfer Syntaxes or even different versions of the standard.
- Custom Tags in Metadata.
- Volume of dataset and size of individual files.

De-identification Targets

```
Field: content
                Id: 0
                Path: file:/Users/nmelnik/IdeaProjects/spar
k-ocr/workshop/jupyter/data/dicom/deidentify-medical-2.dcm
                Width: 985 px
                Height: 914 px
                Metadata:
                Dataset.file_meta -------------------------

-----
(0002, 0000) File Meta Information Group Length  UL: 196
(0002, 0001) File Meta Information Version       OB: b'\x00\x01'
(0002, 0002) Media Storage SOP Class UID         UI: 2.25.316618858989
175958452362820380094875916
(0002, 0003) Media Storage SOP Instance UID      UI: 2.25.128345240486
099325554244939980269110548
(0002, 0010) Transfer Syntax UID                 UI: Explicit VR Littl
e Endian
(0002, 0012) Implementation Class UID            UI: 1.3.6.1.4.1.30071
.8
(0002, 0013) Implementation Version Name         SH: 'fo-dicom 4.0.0'
-------------------------------------------------
(0008, 0020) Study Date                       DA: '19990316'
(0008, 0050) Accession Number                 SH: '95555556'
(0008, 0080) Institution Name                 LO: ''
(0008, 1030) Study Description                LO: 'Study Descriptio
n'
(0010, 0010) Patient's Name                   PN: 'Larisa KorsKi'
(0010, 0020) Patient ID                       LO: 'MF-5988888'
(0010, 0030) Patient's Birth Date             DA: '19280802'
(0010, 0040) Patient's Sex                    CS: 'M'
(0010, 1000) Other Patient IDs                LO: 'MF-5988889'
(0010, 1010) Patient's Age                    AS: '075Y'
(0010, 1030) Patient's Weight                 DS: '75.0'
(0020, 000d) Study Instance UID               UI: ''
(0028, 0002) Samples per Pixel                US: 1
(0028, 0004) Photometric Interpretation       CS: 'MONOCHROME2'
(0028, 0008) Number of Frames                 IS: '1'
(0028, 0010) Rows                             US: 985
(0028, 0011) Columns                          US: 914
(0028, 0100) Bits Allocated                   US: 8
(0028, 0101) Bits Stored                      US: 8
(0028, 0102) High Bit                         US: 7
(0028, 0103) Pixel Representation             US: 0
(7fe0, 0010) Pixel Data                       OB: Array of 900290 e
lements
```

```
Field: dicom_cleaned
                Id: 0
                Path: file:/Users/nmelnik/IdeaProjects/spar
k-ocr/workshop/jupyter/data/dicom/deidentify-medical-2.dcm
                Width: 985 px
                Height: 914 px
                Metadata:
                Dataset.file_meta -------------------------

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(0002, 0013) Implementation Version Name         SH: 'fo-dicom 4.0.0'
-------------------------------------------------
(0008, 0020) Study Date                       DA: ''
(0008, 0050) Accession Number                 SH: ''
(0008, 0080) Institution Name                 LO: ''
(0008, 1030) Study Description                LO: 'Study Descriptio
n'
(0010, 0010) Patient's Name                   PN: ''
(0010, 0020) Patient ID                       LO: ''
(0010, 0030) Patient's Birth Date             DA: ''
(0010, 0040) Patient's Sex                    CS: 'M'
(0010, 1000) Other Patient IDs                LO: ''
(0010, 1010) Patient's Age                    AS: ''
(0010, 1030) Patient's Weight                 DS: '75.0'
(0020, 000d) Study Instance UID               UI: ''
(0028, 0002) Samples per Pixel                US: 1
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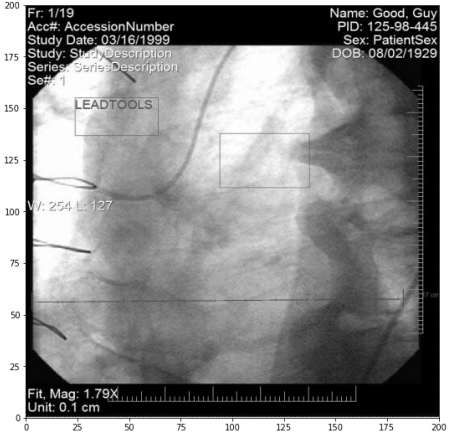

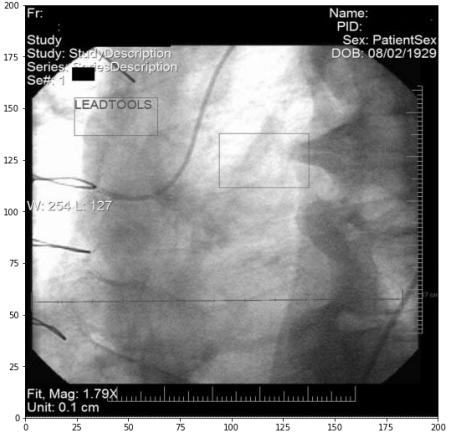

metadata

pixels

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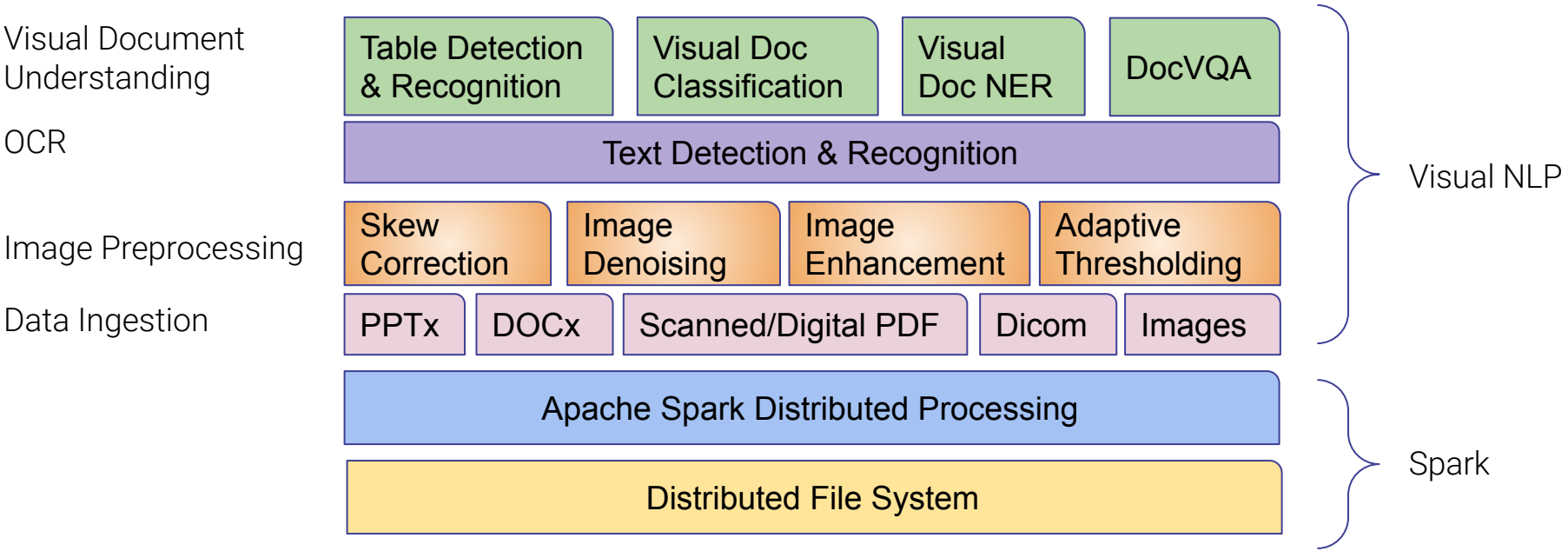
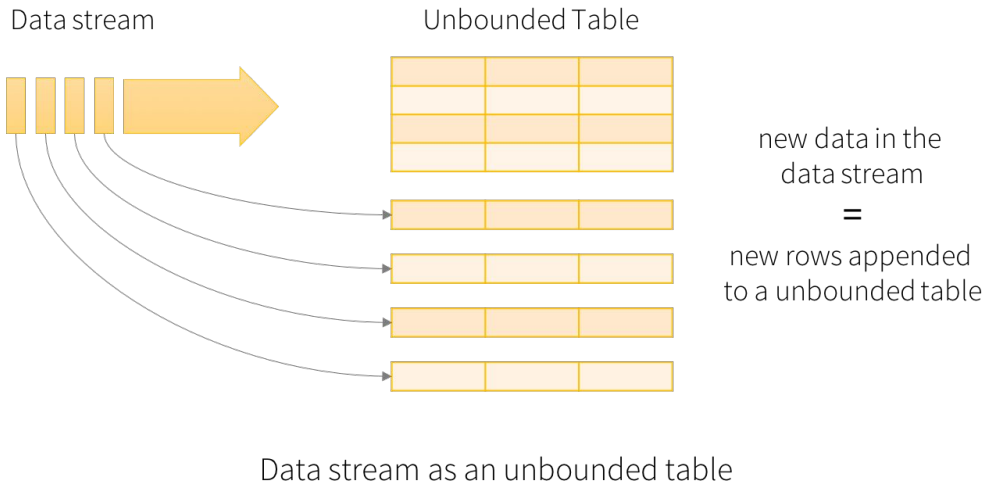
Visual NLP Primer

- Visual NLP is a Visual Document Understanding library built on top of Apache Spark.
- It’s not an API.
- Curated list of features -> only useful things that work.
- Optimized for performance and accuracy.
- Created by industry practitioners.
- Actively developed.
- Security minded.


Visual Document Understanding
OCR
Image Preprocessing
Data Ingestion
Table Detection & Recognition
Visual Doc Classification
Visual Doc NER
DocVQA
Text Detection & Recognition
Skew Correction
Image Denoising
Image Enhancement
Adaptive Thresholding
PPTx
DOCx
Scanned/Digital PDF
Dicom
Images
Apache Spark Distributed Processing
Distributed File System
Visual NLP
Spark

Streaming



- Sources and Sinks.
- Streaming Dataframe.
- Unbounded Table.
- Details: Streaming Query.

Engagement Models

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Software Licensing

- Internal data science team needs to become self-sufficient with NLP and OCR
- Need partner to provide state of the art software in AI, NLP, OCR and LLM
- Want simplicity in architecture, integration, security, and scaling

Professional Services

- Data Science team is small, at capacity, or not familiar with NLP & OCR
- Time-to-market is key, and the team doesn't have enough bandwidth or experience to build a solution
- A partner can help get to market fast and skill up the internal team to become self-sufficient over time
- NLP, OCR is not a core business and it's preferred to outsource it

Managed Services

- NLP & OCR is used across the enterprise, and a robust and trusted solution is needed for scale, reproducibility and speed
- The Data Science team needs to deliver value to the broader organization
- Enterprise projects are a top focus; State-of-the-art models are a priority to not be surpassed by competitors
- Data Science team is growing rapidly and can use domain-specific experts
- Deploying, monitoring, and updating models in production is required

Getting Started

- Check Library Documentation.
- Get your trial license here.
- Check Visual NLP Workshop repo.
- Contact me or Enes: alberto@johnsnowlabs.com, enes@johnsnowlabs.com

Questions and Answers

Contact Us!

Contact us on Slack!

Emails: alberto@johnsnowlabs.com,
enes@johnsnowlabs.com