Canon

CANON MEDICAL SYSTEMS DO BRASIL

CELEBRATING SCIENCE AND INNOVATION
35 YEARS LIKA
1986-2021
Laboratório de Imunopatologia Keizo Asami

VIRTUS IMPAVIDA
UNIVERSIDADE
FEDERAL
DE PERNAMBUCO

DCM Uploader: um sistema de informação para garantia de confidencialidade, integridade e disponibilidade no tráfego de imagens médicas baseadas no padrão DICOM

Resultados da Sprint 05b

25/04/2023

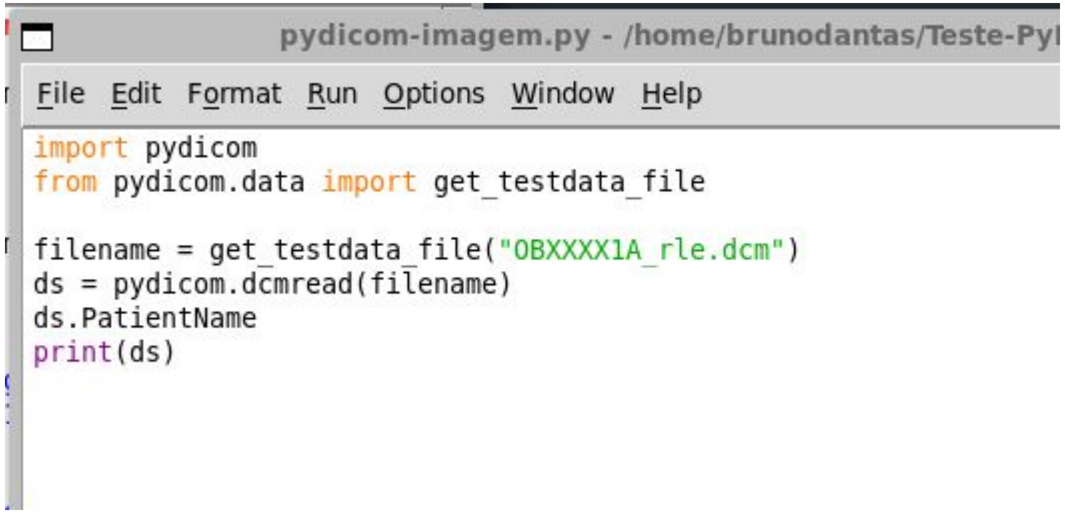
Contexto da Sprint 5b

- Investigar implementação da comunicação site to site
  - Pydicom
  - Orthanc
  - Dcm4chee
- Estruturar arquitetura
  - 2 MVP

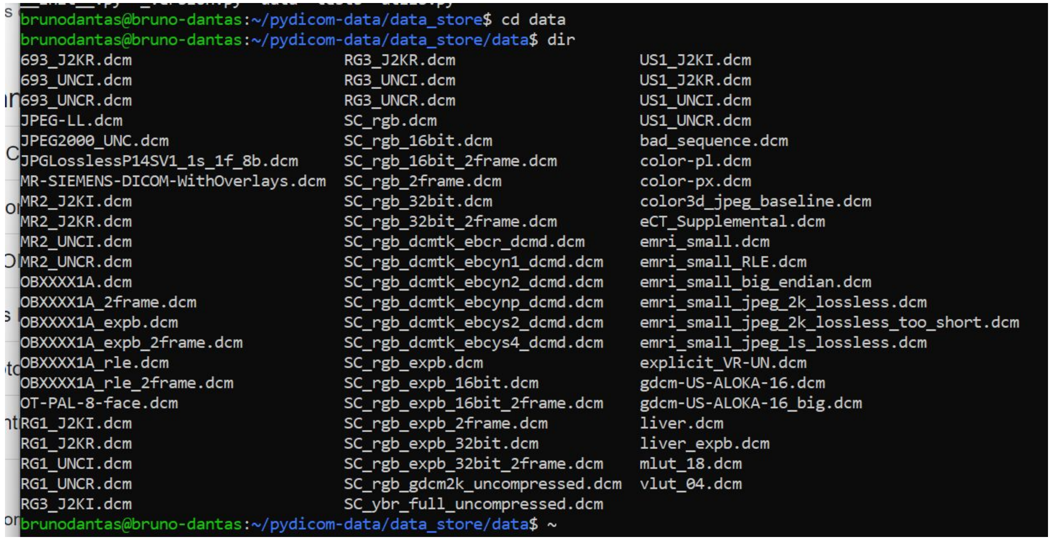
Contexto da Sprint 5b

1. Pydicom
2. Dcm4chee
3. Orthanc

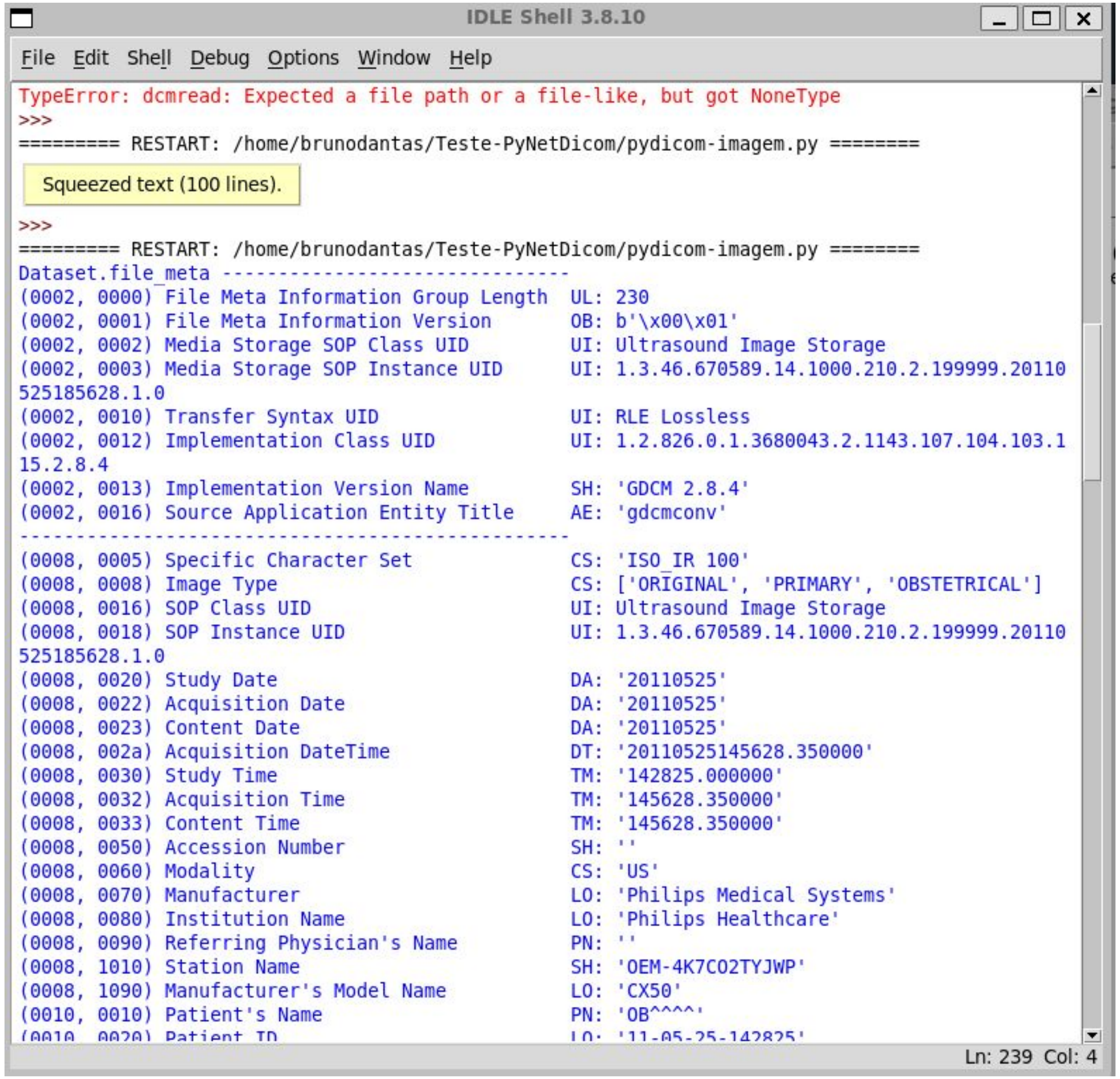
Resultados - **Pydicom/Pynetdicom** 1/6


pydicom-imagem.py - /home/brunodantas/Teste-Py
File Edit Format Run Options Window Help

```python
import pydicom
from pydicom.data import get_testdata_file

filename = get_testdata_file("OBXXXX1A_rle.dcm")
ds = pydicom.dcmread(filename)
ds.PatientName
print(ds)
```



```
brunodantas@bruno-dantas:~/pydicom-data/data_store$ cd data
brunodantas@bruno-dantas:~/pydicom-data/data_store/data$ dir
693_J2KR.dcm                       RG3_J2KR.dcm                    US1_J2KI.dcm
693_UNCI.dcm                       RG3_UNCI.dcm                    US1_J2KR.dcm
693_UNCR.dcm                       RG3_UNCR.dcm                    US1_UNCI.dcm
JPEG-LL.dcm                        SC_rgb.dcm                      US1_UNCR.dcm
JPEG2000_UNC.dcm                   SC_rgb_16bit.dcm                bad_sequence.dcm
JPGLosslessP14SV1_1s_1f_8b.dcm     SC_rgb_16bit_2frame.dcm         color-pl.dcm
MR-SIEMENS-DICOM-WithOverlays.dcm  SC_rgb_2frame.dcm               color-px.dcm
MR2_J2KI.dcm                       SC_rgb_32bit.dcm                color3d_jpeg_baseline.dcm
MR2_J2KR.dcm                       SC_rgb_32bit_2frame.dcm         eCT_Supplemental.dcm
MR2_UNCI.dcm                       SC_rgb_dcmtk_ebcr_dcmd.dcm      emri_small.dcm
MR2_UNCR.dcm                       SC_rgb_dcmtk_ebcyn1_dcmd.dcm    emri_small_RLE.dcm
OBXXXX1A.dcm                       SC_rgb_dcmtk_ebcyn2_dcmd.dcm    emri_small_big_endian.dcm
OBXXXX1A_2frame.dcm                SC_rgb_dcmtk_ebcynp_dcmd.dcm    emri_small_jpeg_2k_lossless.dcm
OBXXXX1A_expb.dcm                  SC_rgb_dcmtk_ebcys2_dcmd.dcm    emri_small_jpeg_2k_lossless_too_short.dcm
OBXXXX1A_expb_2frame.dcm           SC_rgb_dcmtk_ebcys4_dcmd.dcm    emri_small_jpeg_ls_lossless.dcm
OBXXXX1A_rle.dcm                   SC_rgb_expb.dcm                 explicit_VR-UN.dcm
OBXXXX1A_rle_2frame.dcm            SC_rgb_expb_16bit.dcm           gdcm-US-ALOKA-16.dcm
OT-PAL-8-face.dcm                  SC_rgb_expb_16bit_2frame.dcm    gdcm-US-ALOKA-16_big.dcm
RG1_J2KI.dcm                       SC_rgb_expb_2frame.dcm          liver.dcm
RG1_J2KR.dcm                       SC_rgb_expb_32bit.dcm           liver_expb.dcm
RG1_UNCI.dcm                       SC_rgb_expb_32bit_2frame.dcm    mlut_18.dcm
RG1_UNCR.dcm                       SC_rgb_gdcm2k_uncompressed.dcm  vlut_04.dcm
RG3_J2KI.dcm                       SC_ybr_full_uncompressed.dcm
brunodantas@bruno-dantas:~/pydicom-data/data_store/data$ ~
```


IDLE Shell 3.8.10
File Edit Shell Debug Options Window Help
Squeezed text (100 lines).
Ln: 239 Col: 4

```
TypeError: dcmread: Expected a file path or a file-like, but got NoneType
>>>
========= RESTART: /home/brunodantas/Teste-PyNetDicom/pydicom-imagem.py ========
Squeezed text (100 lines).
>>>
========= RESTART: /home/brunodantas/Teste-PyNetDicom/pydicom-imagem.py ========
Dataset.file_meta -------------------------------
(0002, 0000) File Meta Information Group Length  UL: 230
(0002, 0001) File Meta Information Version       OB: b'\x00\x01'
(0002, 0002) Media Storage SOP Class UID         UI: Ultrasound Image Storage
(0002, 0003) Media Storage SOP Instance UID      UI: 1.3.46.670589.14.1000.210.2.199999.20110
525185628.1.0
(0002, 0010) Transfer Syntax UID                 UI: RLE Lossless
(0002, 0012) Implementation Class UID            UI: 1.2.826.0.1.3680043.2.1143.107.104.103.1
15.2.8.4
(0002, 0013) Implementation Version Name         SH: 'GDCM 2.8.4'
(0002, 0016) Source Application Entity Title     AE: 'gdcmconv'
-------------------------------------------------
(0008, 0005) Specific Character Set              CS: 'ISO_IR 100'
(0008, 0008) Image Type                          CS: ['ORIGINAL', 'PRIMARY', 'OBSTETRICAL']
(0008, 0016) SOP Class UID                       UI: Ultrasound Image Storage
(0008, 0018) SOP Instance UID                    UI: 1.3.46.670589.14.1000.210.2.199999.20110
525185628.1.0
(0008, 0020) Study Date                          DA: '20110525'
(0008, 0022) Acquisition Date                    DA: '20110525'
(0008, 0023) Content Date                        DA: '20110525'
(0008, 002a) Acquisition DateTime                DT: '20110525145628.350000'
(0008, 0030) Study Time                          TM: '142825.000000'
(0008, 0032) Acquisition Time                    TM: '145628.350000'
(0008, 0033) Content Time                        TM: '145628.350000'
(0008, 0050) Accession Number                    SH: ''
(0008, 0060) Modality                            CS: 'US'
(0008, 0070) Manufacturer                        LO: 'Philips Medical Systems'
(0008, 0080) Institution Name                    LO: 'Philips Healthcare'
(0008, 0090) Referring Physician's Name          PN: ''
(0008, 1010) Station Name                        SH: 'OEM-4K7CO2TYJWP'
(0008, 1090) Manufacturer's Model Name           LO: 'CX50'
(0010, 0010) Patient's Name                      PN: 'OB^^^^'
(0010, 0020) Patient ID                          LO: '11-05-25-142825'
```

Resultados - **Pydicom/Pynetdicom** 2/6

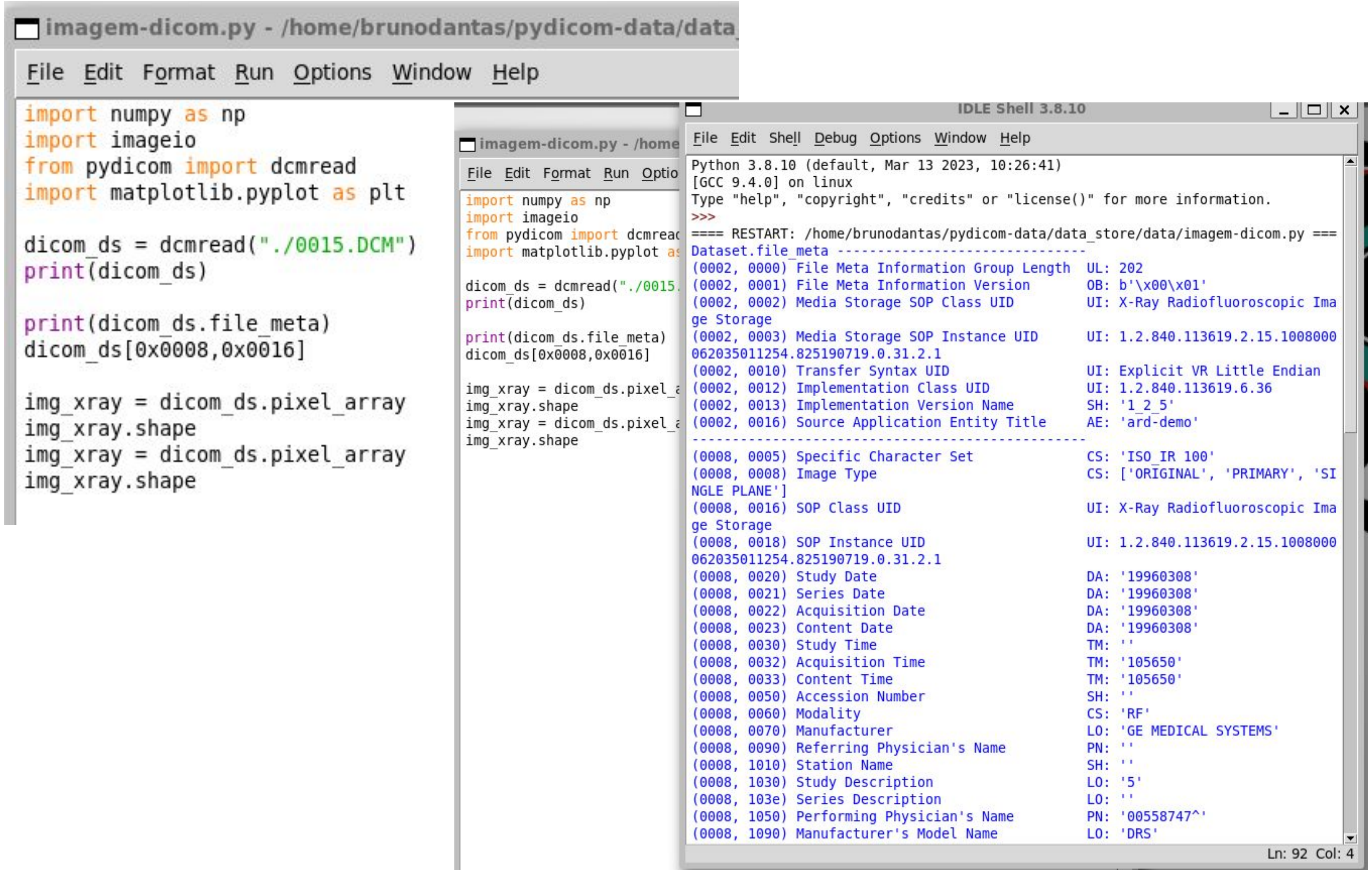


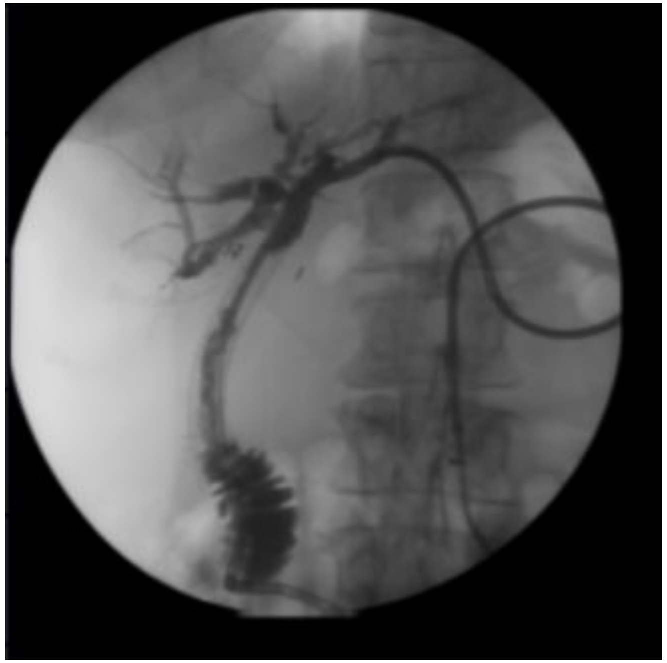
imagem-dicom.py - /home/brunodantas/pydicom-data/data
File Edit Format Run Options Window Help

```python
import numpy as np
import imageio
from pydicom import dcmread
import matplotlib.pyplot as plt

dicom_ds = dcmread("./0015.DCM")
print(dicom_ds)

print(dicom_ds.file_meta)
dicom_ds[0x0008,0x0016]

img_xray = dicom_ds.pixel_array
img_xray.shape
img_xray = dicom_ds.pixel_array
img_xray.shape
```

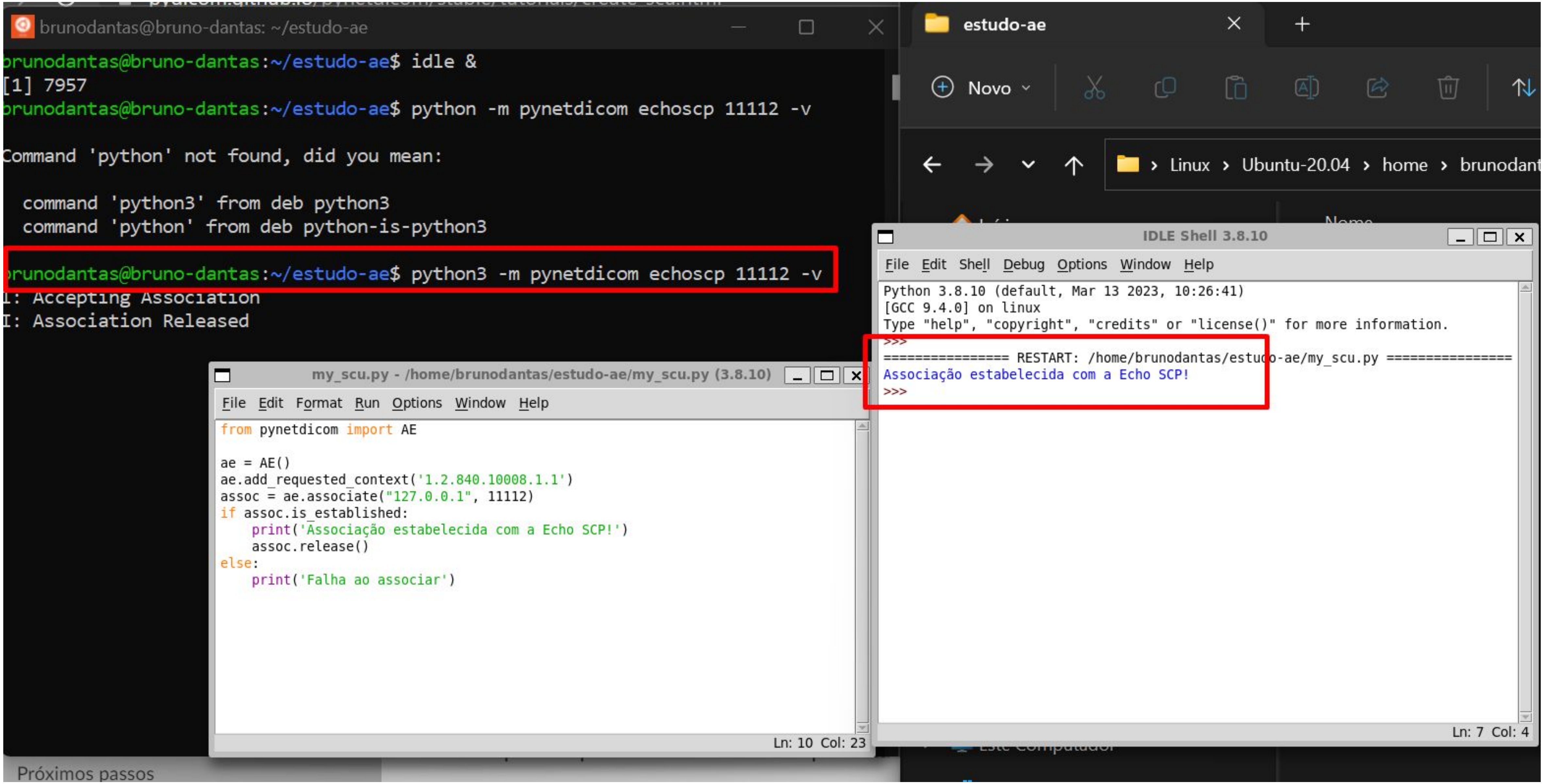
imagem-dicom.py - /home
File Edit Format Run Optio

```
import numpy as np
import imageio
from pydicom import dcmread
import matplotlib.pyplot as

dicom_ds = dcmread("./0015.
print(dicom_ds)

print(dicom_ds.file_meta)
dicom_ds[0x0008,0x0016]

img_xray = dicom_ds.pixel_a
img_xray.shape
img_xray = dicom_ds.pixel_a
img_xray.shape
```

```
Python 3.8.10 (default, Mar 13 2023, 10:26:41)
[GCC 9.4.0] on linux
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: /home/brunodantas/pydicom-data/data_store/data/imagem-dicom.py ===
Dataset.file_meta -------------------------------
(0002, 0000) File Meta Information Group Length  UL: 202
(0002, 0001) File Meta Information Version       OB: b'\x00\x01'
(0002, 0002) Media Storage SOP Class UID         UI: X-Ray Radiofluoroscopic Ima
ge Storage
(0002, 0003) Media Storage SOP Instance UID      UI: 1.2.840.113619.2.15.1008000
062035011254.825190719.0.31.2.1
(0002, 0010) Transfer Syntax UID                 UI: Explicit VR Little Endian
(0002, 0012) Implementation Class UID            UI: 1.2.840.113619.6.36
(0002, 0013) Implementation Version Name         SH: '1_2_5'
(0002, 0016) Source Application Entity Title     AE: 'ard-demo'
-------------------------------------------------
(0008, 0005) Specific Character Set              CS: 'ISO_IR 100'
(0008, 0008) Image Type                          CS: ['ORIGINAL', 'PRIMARY', 'SI
NGLE PLANE']
(0008, 0016) SOP Class UID                       UI: X-Ray Radiofluoroscopic Ima
ge Storage
(0008, 0018) SOP Instance UID                    UI: 1.2.840.113619.2.15.1008000
062035011254.825190719.0.31.2.1
(0008, 0020) Study Date                          DA: '19960308'
(0008, 0021) Series Date                         DA: '19960308'
(0008, 0022) Acquisition Date                    DA: '19960308'
(0008, 0023) Content Date                        DA: '19960308'
(0008, 0030) Study Time                          TM: ''
(0008, 0032) Acquisition Time                    TM: '105650'
(0008, 0033) Content Time                        TM: '105650'
(0008, 0050) Accession Number                    SH: ''
(0008, 0060) Modality                            CS: 'RF'
(0008, 0070) Manufacturer                        LO: 'GE MEDICAL SYSTEMS'
(0008, 0090) Referring Physician's Name          PN: ''
(0008, 1010) Station Name                        SH: ''
(0008, 1030) Study Description                   LO: '5'
(0008, 103e) Series Description                  LO: ''
(0008, 1050) Performing Physician's Name         PN: '00558747^'
(0008, 1090) Manufacturer's Model Name           LO: 'DRS'
```



Resultados - **Pydicom/Pynetdicom** 3/6



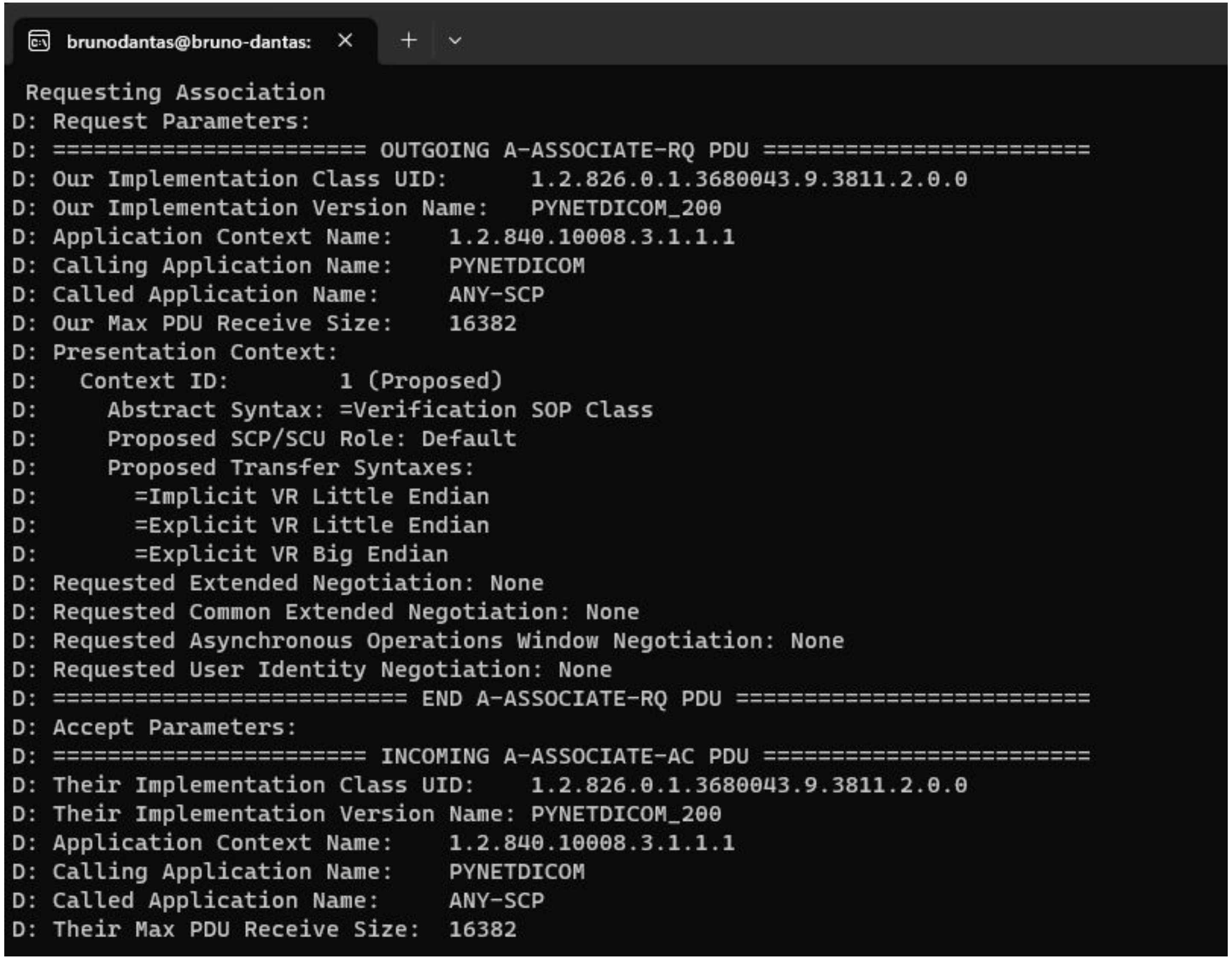
brunodantas@bruno-dantas: ~/estudo-ae
estudo-ae
Novo
Linux › Ubuntu-20.04 › home › brunodant
my_scu.py - /home/brunodantas/estudo-ae/my_scu.py (3.8.10)
File Edit Format Run Options Window Help
Ln: 10 Col: 23
IDLE Shell 3.8.10
File Edit Shell Debug Options Window Help
Ln: 7 Col: 4
Próximos passos

```
brunodantas@bruno-dantas:~/estudo-ae$ idle &
[1] 7957
brunodantas@bruno-dantas:~/estudo-ae$ python -m pynetdicom echoscp 11112 -v

Command 'python' not found, did you mean:

  command 'python3' from deb python3
  command 'python' from deb python-is-python3

brunodantas@bruno-dantas:~/estudo-ae$ python3 -m pynetdicom echoscp 11112 -v
I: Accepting Association
I: Association Released
```

```python
from pynetdicom import AE

ae = AE()
ae.add_requested_context('1.2.840.10008.1.1')
assoc = ae.associate("127.0.0.1", 11112)
if assoc.is_established:
    print('Associação estabelecida com a Echo SCP!')
    assoc.release()
else:
    print('Falha ao associar')
```

```
Python 3.8.10 (default, Mar 13 2023, 10:26:41)
[GCC 9.4.0] on linux
Type "help", "copyright", "credits" or "license()" for more information.
>>>
================ RESTART: /home/brunodantas/estudo-ae/my_scu.py ================
Associação estabelecida com a Echo SCP!
>>>
```

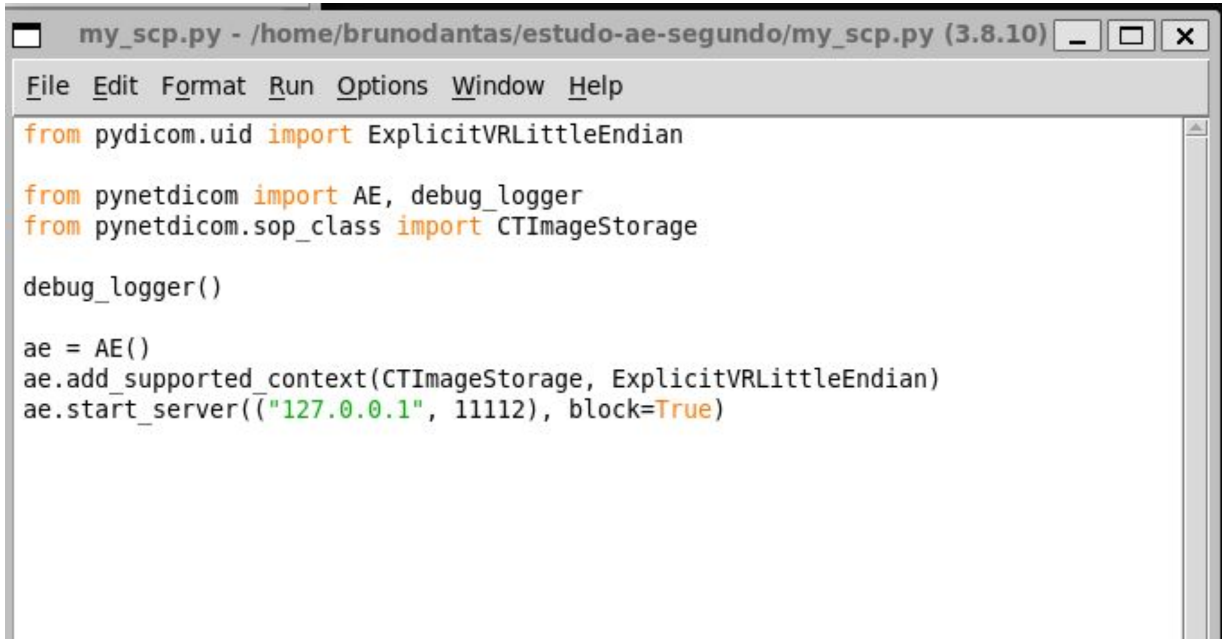
Resultados - **Pydicom/Pynetdicom** 4/6



```
 Requesting Association
D: Request Parameters:
D: ======================= OUTGOING A-ASSOCIATE-RQ PDU ========================
D: Our Implementation Class UID:      1.2.826.0.1.3680043.9.3811.2.0.0
D: Our Implementation Version Name:   PYNETDICOM_200
D: Application Context Name:    1.2.840.10008.3.1.1.1
D: Calling Application Name:    PYNETDICOM
D: Called Application Name:     ANY-SCP
D: Our Max PDU Receive Size:    16382
D: Presentation Context:
D:   Context ID:        1 (Proposed)
D:     Abstract Syntax: =Verification SOP Class
D:     Proposed SCP/SCU Role: Default
D:     Proposed Transfer Syntaxes:
D:       =Implicit VR Little Endian
D:       =Explicit VR Little Endian
D:       =Explicit VR Big Endian
D: Requested Extended Negotiation: None
D: Requested Common Extended Negotiation: None
D: Requested Asynchronous Operations Window Negotiation: None
D: Requested User Identity Negotiation: None
D: ========================== END A-ASSOCIATE-RQ PDU ==========================
D: Accept Parameters:
D: ======================= INCOMING A-ASSOCIATE-AC PDU ========================
D: Their Implementation Class UID:    1.2.826.0.1.3680043.9.3811.2.0.0
D: Their Implementation Version Name: PYNETDICOM_200
D: Application Context Name:    1.2.840.10008.3.1.1.1
D: Calling Application Name:    PYNETDICOM
D: Called Application Name:     ANY-SCP
D: Their Max PDU Receive Size:  16382
```

Resultados - **Pydicom/Pynetdicom** 5/6

-



my_scp.py - /home/brunodantas/estudo-ae-segundo/my_scp.py (3.8.10)
File Edit Format Run Options Window Help

```
from pydicom.uid import ExplicitVRLittleEndian

from pynetdicom import AE, debug_logger
from pynetdicom.sop_class import CTImageStorage

debug_logger()

ae = AE()
ae.add_supported_context(CTImageStorage, ExplicitVRLittleEndian)
ae.start_server(("127.0.0.1", 11112), block=True)
```

Resultados - **Pydicom/Pynetdicom** 6/6

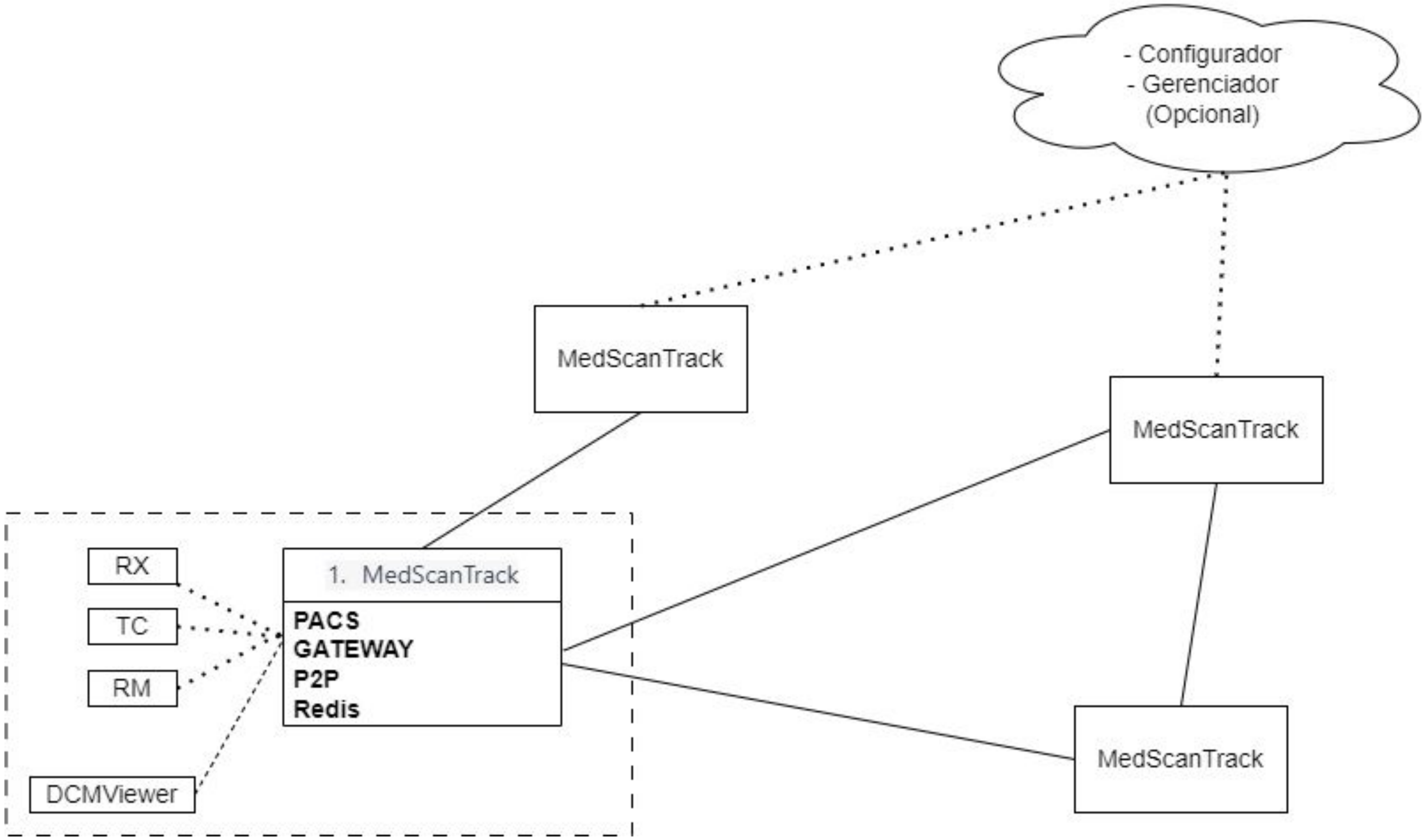
Supported Service Classes

- Application Event Logging Service Class
- Basic Worklist Management Service Class
- Color Palette Query/Retrieve Service Class
- Defined Procedure Protocol Query/Retrieve Service Class
- Display System Management Service Class
- Hanging Protocol Query/Retrieve Service Class
- Implant Template Query/Retrieve Service Class
- Instance Availability Notification Service Class
- Media Creation Management Service Class
- Modality Performed Procedure Step Managemen

Contexto da Sprint 5b

1. Pydicom
2. Dcm4chee
3. Orthanc

Resultados - **DCM4chee** 1/5 (Sprint 5b)



Resultados - **DCM4chee** 2/5 (Sprint 5b)

POC

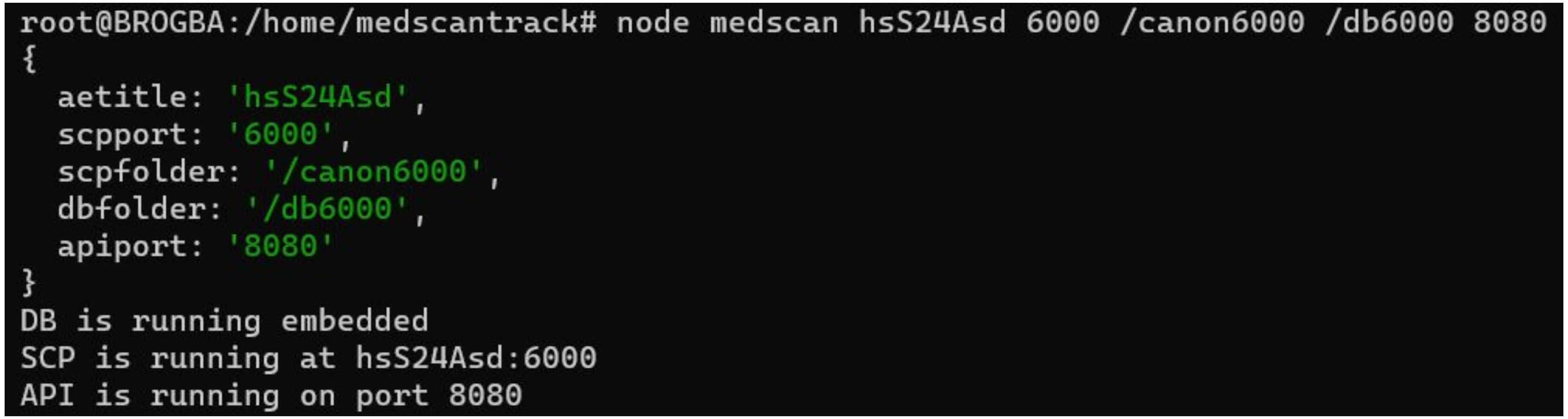
REDE => AE TITLE = Chave aleatória ou hash de uma senha

- **ID único**
- **Restrição SCP**
- **Chave privada**
- **API key**
- **AE Title Dicom: 16 caracteres -> 10^24 combinações**

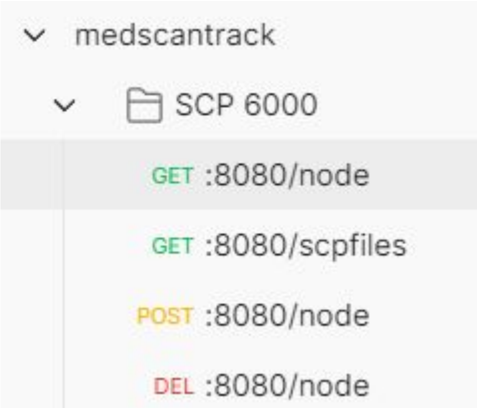
dcm4chee

- **STORESCP**
- **STORESCU (mais rápido que rsync e SSH)**

Resultados - **DCM4chee** 3/5 (Sprint 5b)



```
root@BROGBA:/home/medscantrack# node medscan hsS24Asd 6000 /canon6000 /db6000 8080
{
  aetitle: 'hsS24Asd',
  scpport: '6000',
  scpfolder: '/canon6000',
  dbfolder: '/db6000',
  apiport: '8080'
}
DB is running embedded
SCP is running at hsS24Asd:6000
API is running on port 8080
```



medscantrack

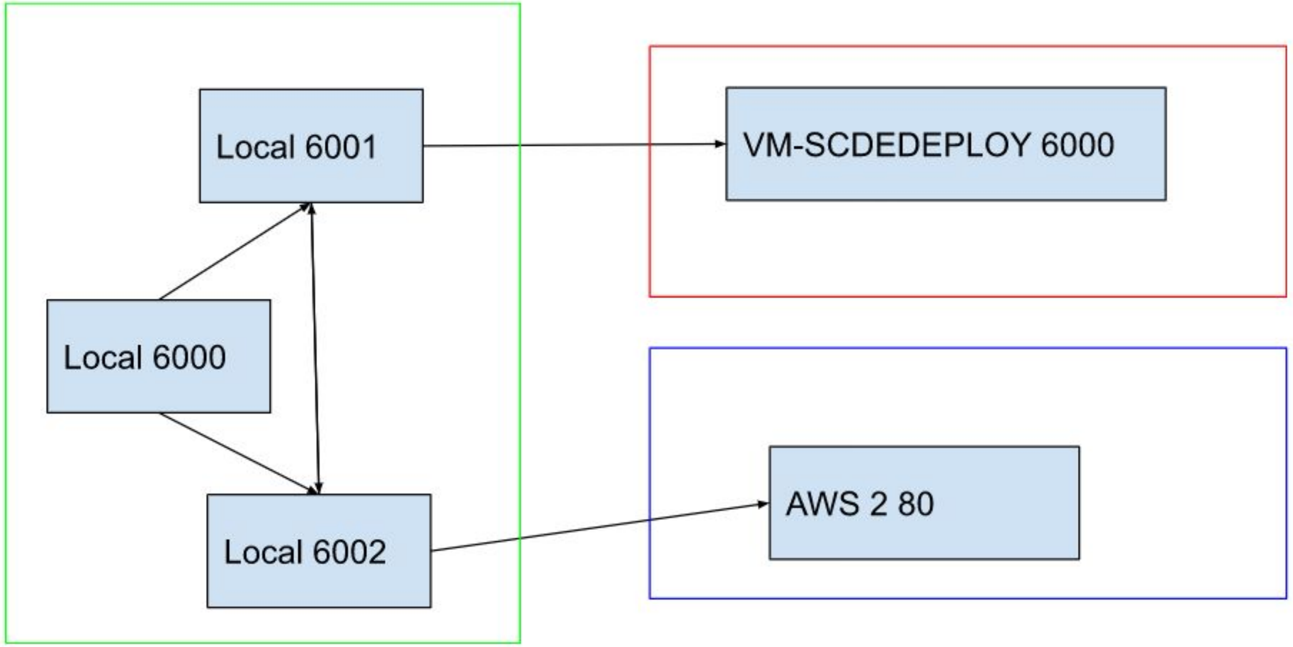
SCP 6000

GET :8080/node

GET :8080/scpfiles

POST :8080/node

DEL :8080/node

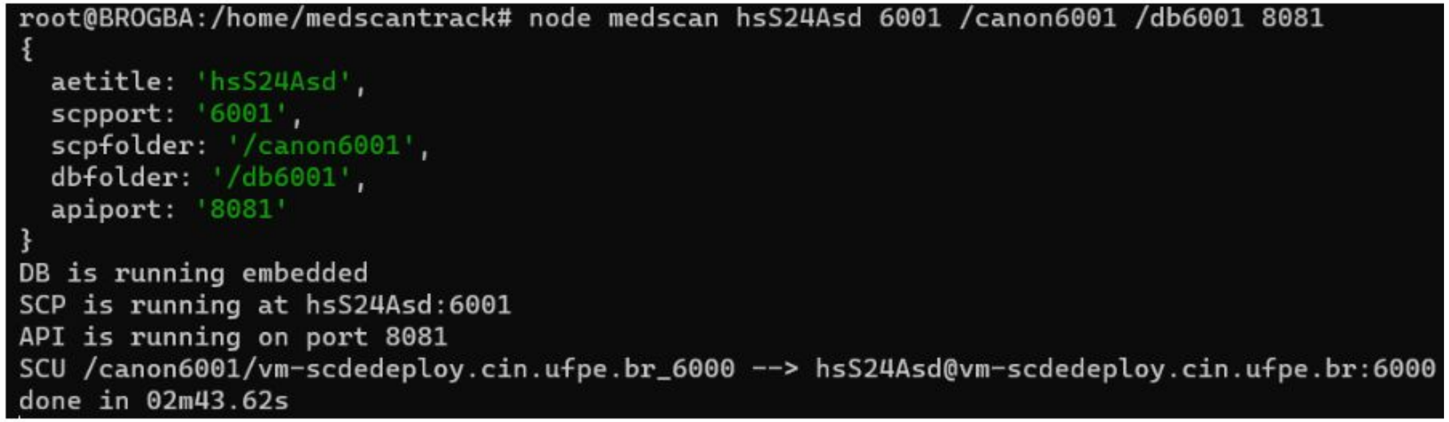


Resultados - **DCM4chee** 4/5 (Sprint 5b)

Teste com dataset 1 - 660 MB

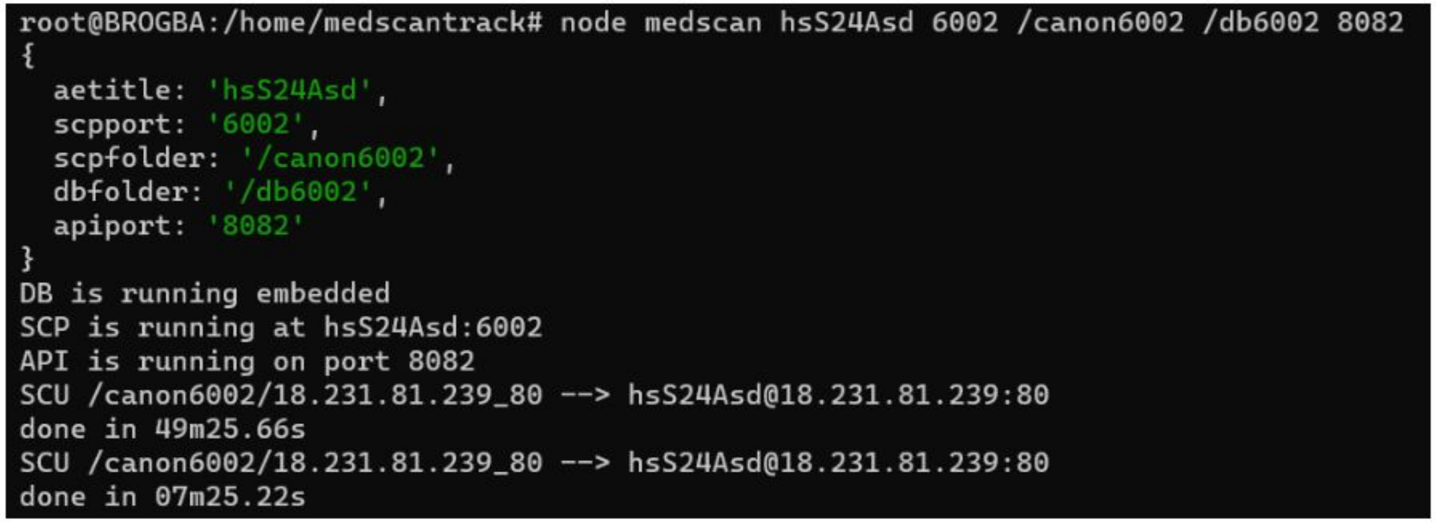
LOCAL - LOCAL: < 3 s

LOCAL - VM-CIN: < 3 min



```
root@BROGBA:/home/medscantrack# node medscan hsS24Asd 6001 /canon6001 /db6001 8081
{
  aetitle: 'hsS24Asd',
  scpport: '6001',
  scpfolder: '/canon6001',
  dbfolder: '/db6001',
  apiport: '8081'
}
DB is running embedded
SCP is running at hsS24Asd:6001
API is running on port 8081
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000 --> hsS24Asd@vm-scdedeploy.cin.ufpe.br:6000
done in 02m43.62s
```

LOCAL - AWS: 49 min / 7 min



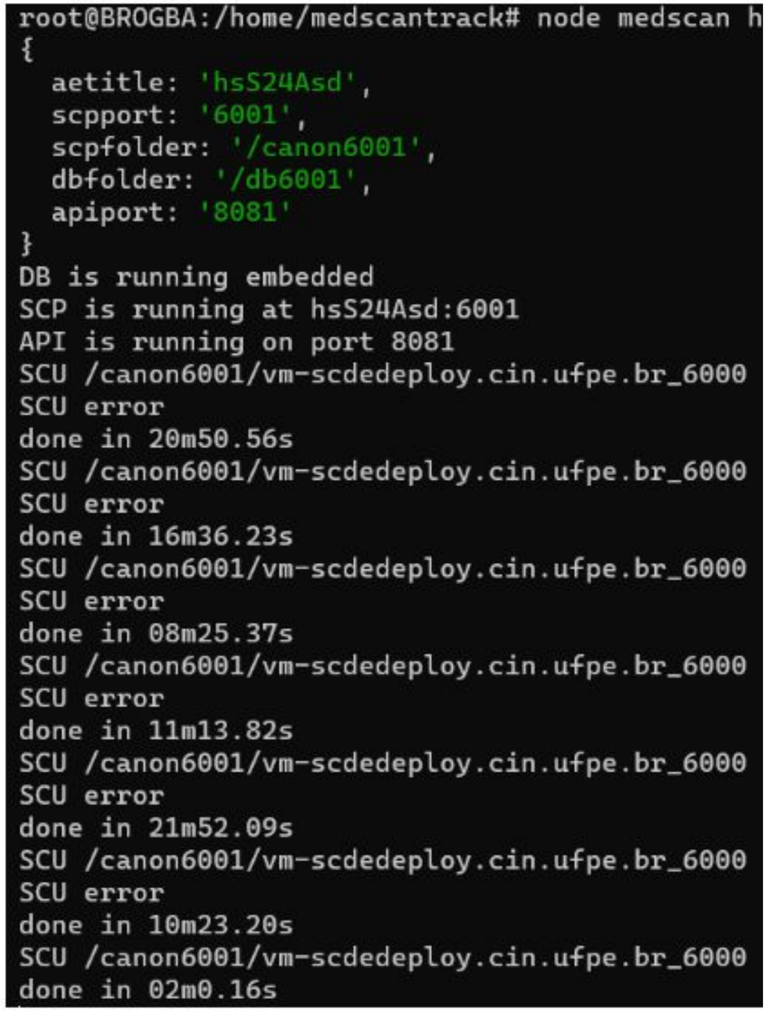
```
root@BROGBA:/home/medscantrack# node medscan hsS24Asd 6002 /canon6002 /db6002 8082
{
  aetitle: 'hsS24Asd',
  scpport: '6002',
  scpfolder: '/canon6002',
  dbfolder: '/db6002',
  apiport: '8082'
}
DB is running embedded
SCP is running at hsS24Asd:6002
API is running on port 8082
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
done in 49m25.66s
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
done in 07m25.22s
```

Resultados - **DCM4chee** 5/5 (Sprint 5b)

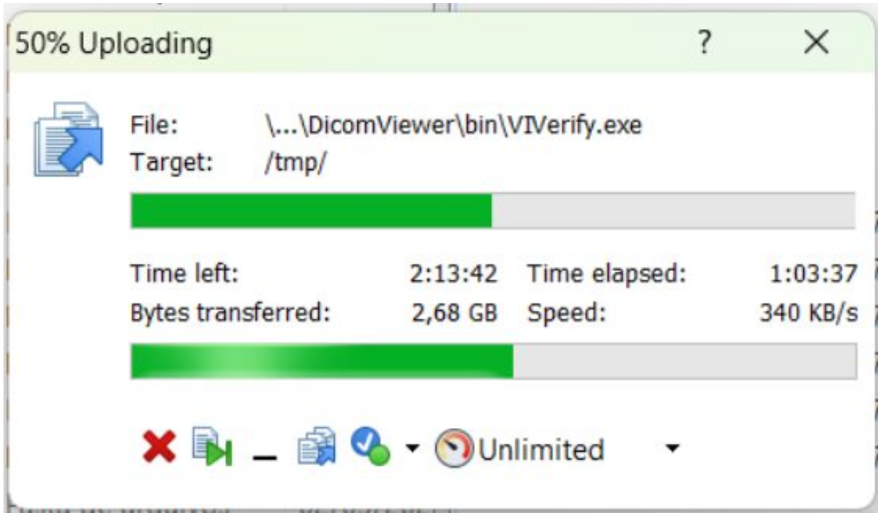
Teste com dataset 2 - 5,29 GB

LOCAL - LOCAL: < 30 s

LOCAL - VM-CIN: 1h30



```
root@BROGBA:/home/medscantrack# node medscan h
{
  aetitle: 'hsS24Asd',
  scpport: '6001',
  scpfolder: '/canon6001',
  dbfolder: '/db6001',
  apiport: '8081'
}
DB is running embedded
SCP is running at hsS24Asd:6001
API is running on port 8081
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 20m50.56s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 16m36.23s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 08m25.37s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 11m13.82s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 21m52.09s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
SCU error
done in 10m23.20s
SCU /canon6001/vm-scdedeploy.cin.ufpe.br_6000
done in 02m0.16s
```



50% Uploading

File: \...\DicomViewer\bin\VIVerify.exe

Target: /tmp/

Time left: 2:13:42

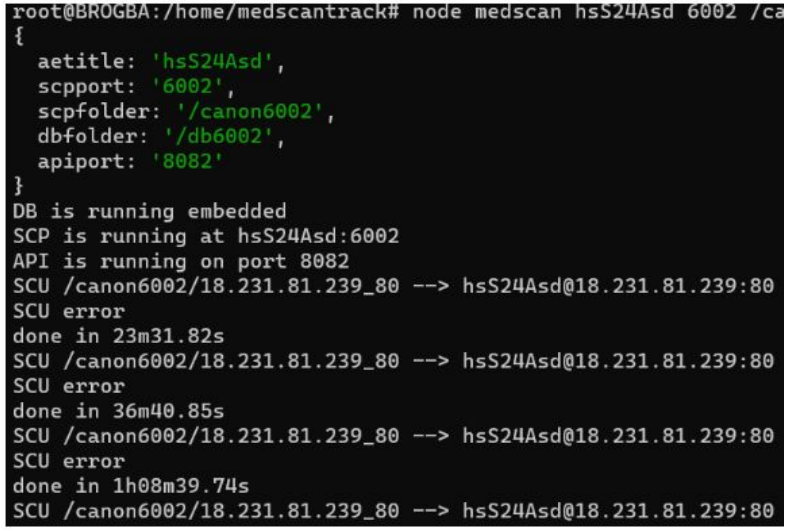
Time elapsed: 1:03:37

Bytes transferred: 2,68 GB

Speed: 340 KB/s

*** Mais rápido que SSH**

LOCAL - AWS: 2h08



```
root@BROGBA:/home/medscantrack# node medscan hsS24Asd 6002 /ca
{
  aetitle: 'hsS24Asd',
  scpport: '6002',
  scpfolder: '/canon6002',
  dbfolder: '/db6002',
  apiport: '8082'
}
DB is running embedded
SCP is running at hsS24Asd:6002
API is running on port 8082
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
SCU error
done in 23m31.82s
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
SCU error
done in 36m40.85s
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
SCU error
done in 1h08m39.74s
SCU /canon6002/18.231.81.239_80 --> hsS24Asd@18.231.81.239:80
```

Proximos passos

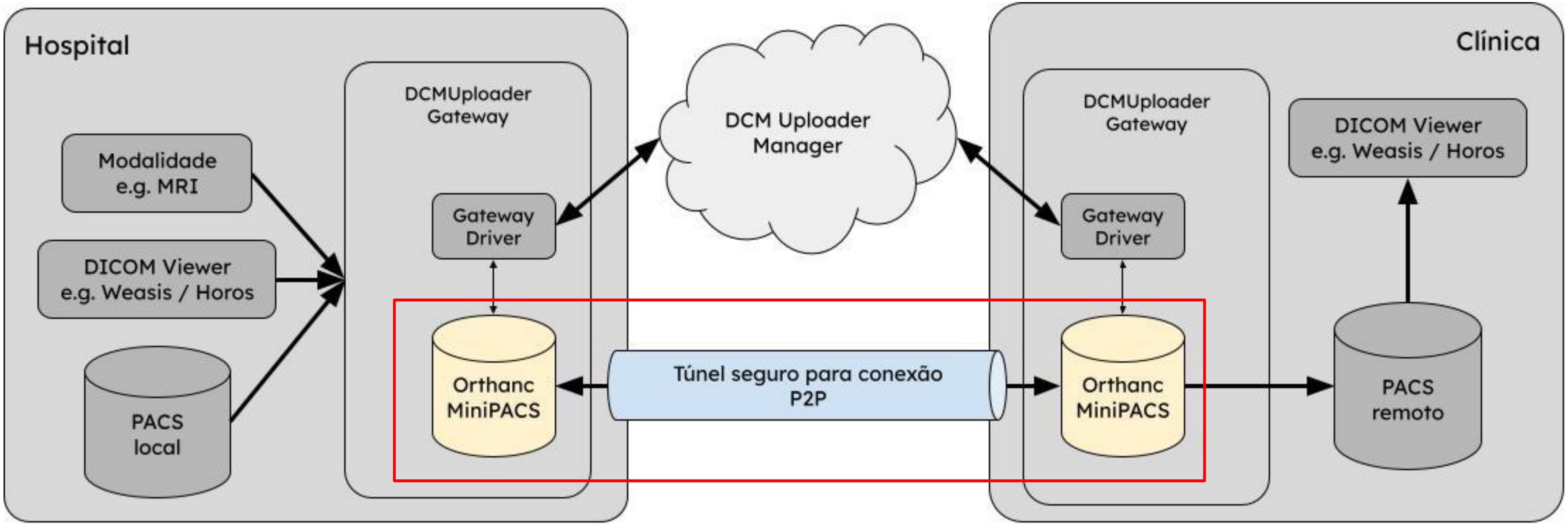
- validação
- gerenciador

Contexto da Sprint 5b

1. Pydicom
2. Dcm4chee
3. Orthanc

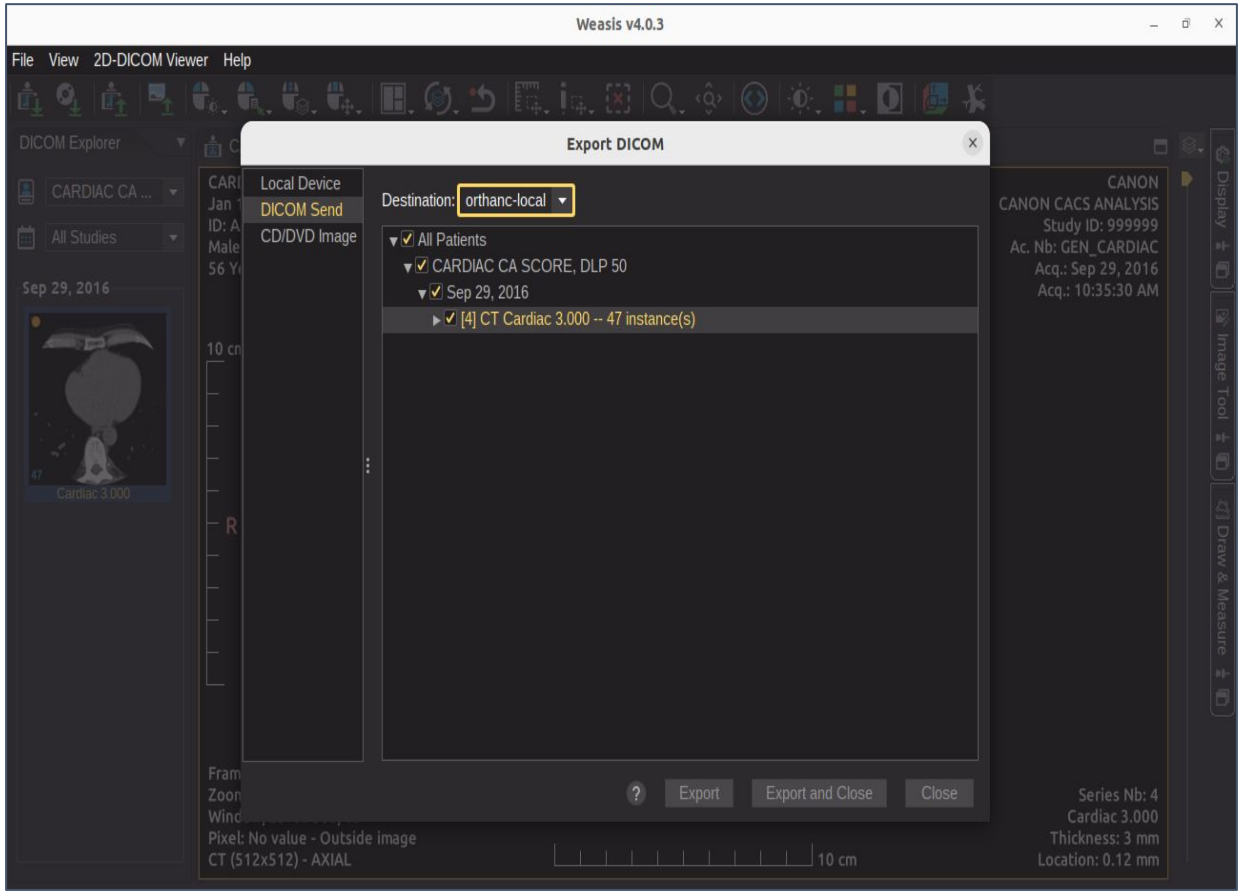
Resultados - **Orthanc** 1/4

- Ngrok / Localtunnel



Resultados - **Orthanc** 2/4

- Orthanc Foo (https://drive.google.com/drive/folders/1Dcfx6riwHWYnROytSp5QjLTm7



Export DICOM

- Local Device
- DICOM Send
- CD/DVD Image

Destination: orthanc-local

- ☑ All Patients
  - ☑ CARDIAC CA SCORE, DLP 50
    - ☑ Sep 29, 2016
      - ☑ [4] CT Cardiac 3.000 -- 47 instance(s)

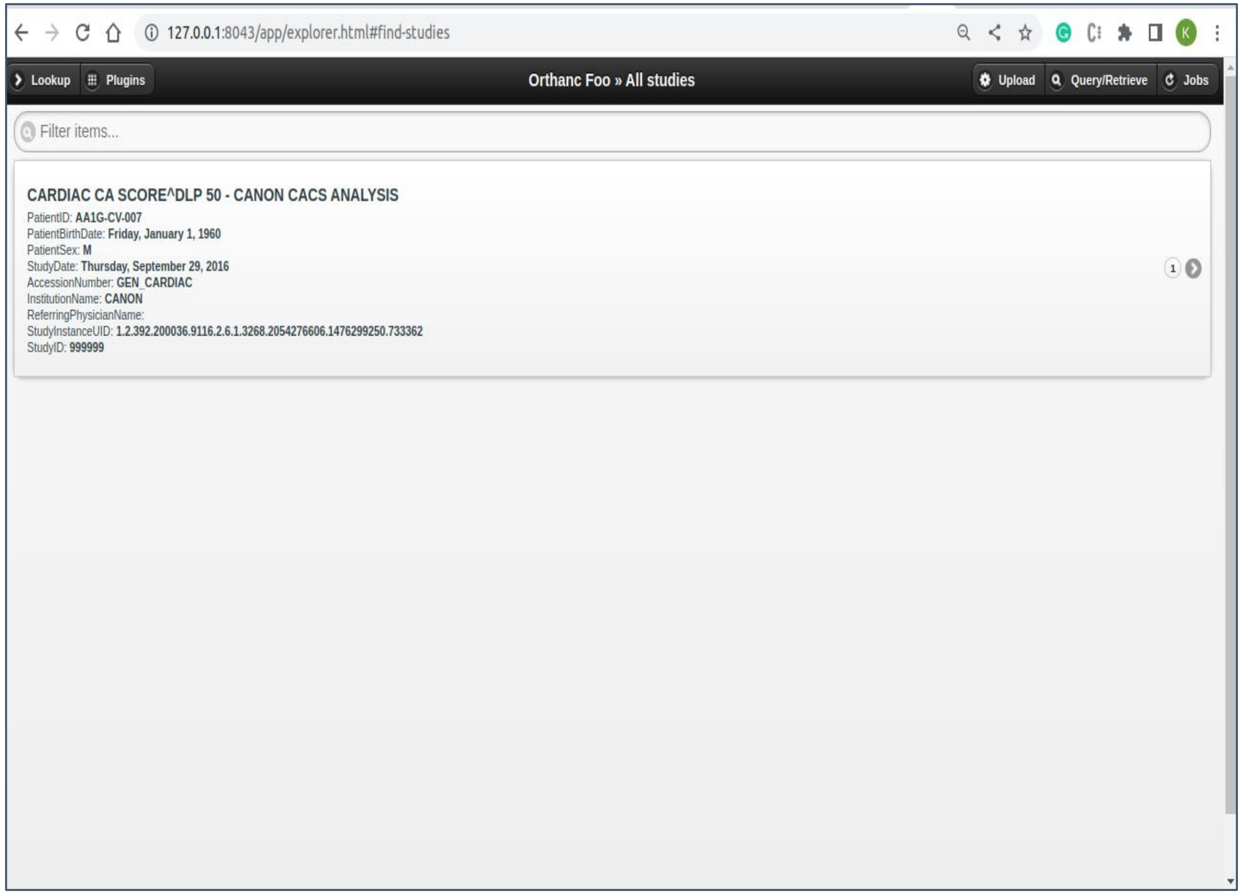
? | Export | Export and Close | Close

CANON
CANON CACS ANALYSIS
Study ID: 999999
Ac. Nb: GEN_CARDIAC
Acq.: Sep 29, 2016
Acq.: 10:35:30 AM

Pixel: No value - Outside image
CT (512x512) - AXIAL

10 cm

Series Nb: 4
Cardiac 3.000
Thickness: 3 mm
Location: 0.12 mm



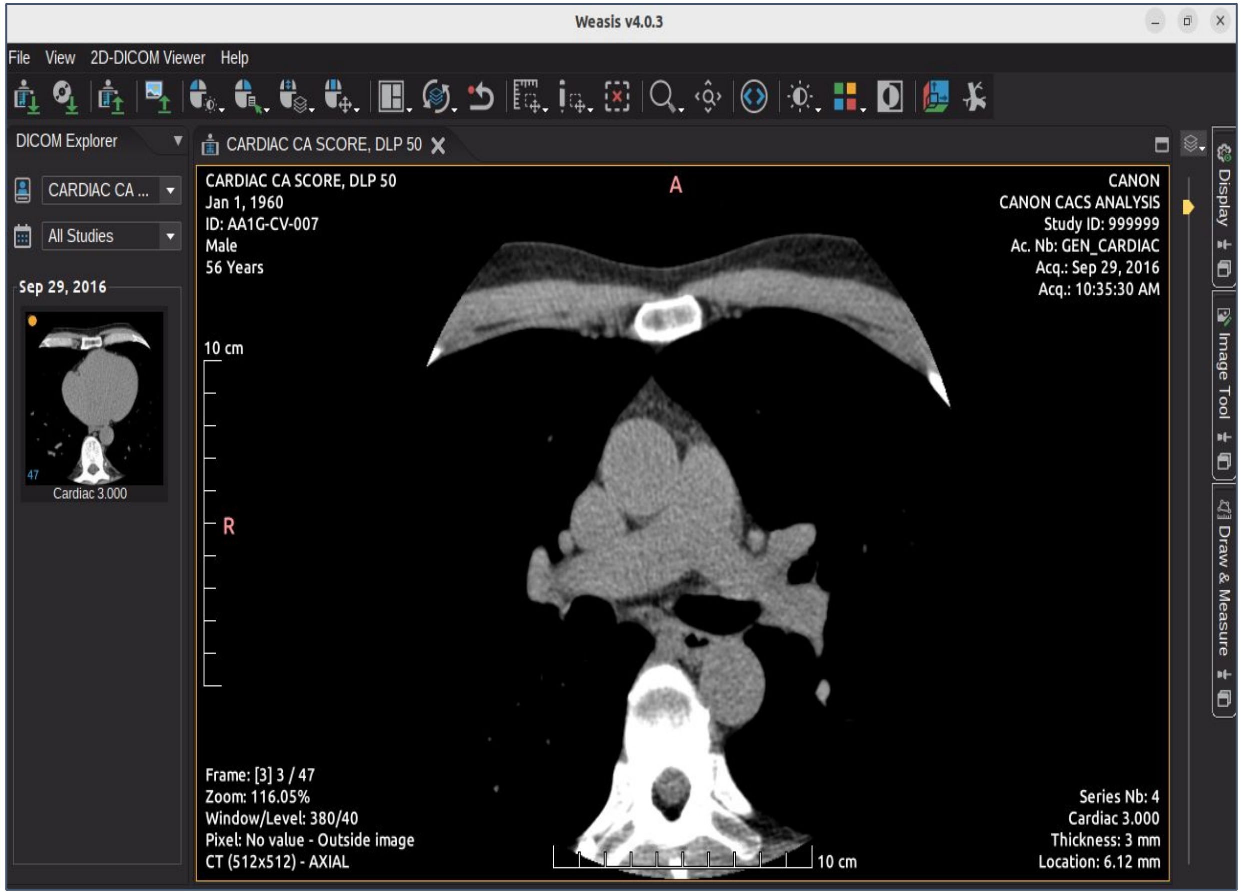
Orthanc Foo » All studies

CARDIAC CA SCORE^DLP 50 - CANON CACS ANALYSIS

PatientID: **AA1G-CV-007**
PatientBirthDate: **Friday, January 1, 1960**
PatientSex: **M**
StudyDate: **Thursday, September 29, 2016**
AccessionNumber: **GEN_CARDIAC**
InstitutionName: **CANON**
ReferringPhysicianName:
StudyInstanceUID: **1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.733362**
StudyID: **999999**

Resultados - **Orthanc** 3/4

- Orthanc Bar (https://drive.google.com/drive/folders/1Dcfx6riwHWYnROytSp5QjLTm7

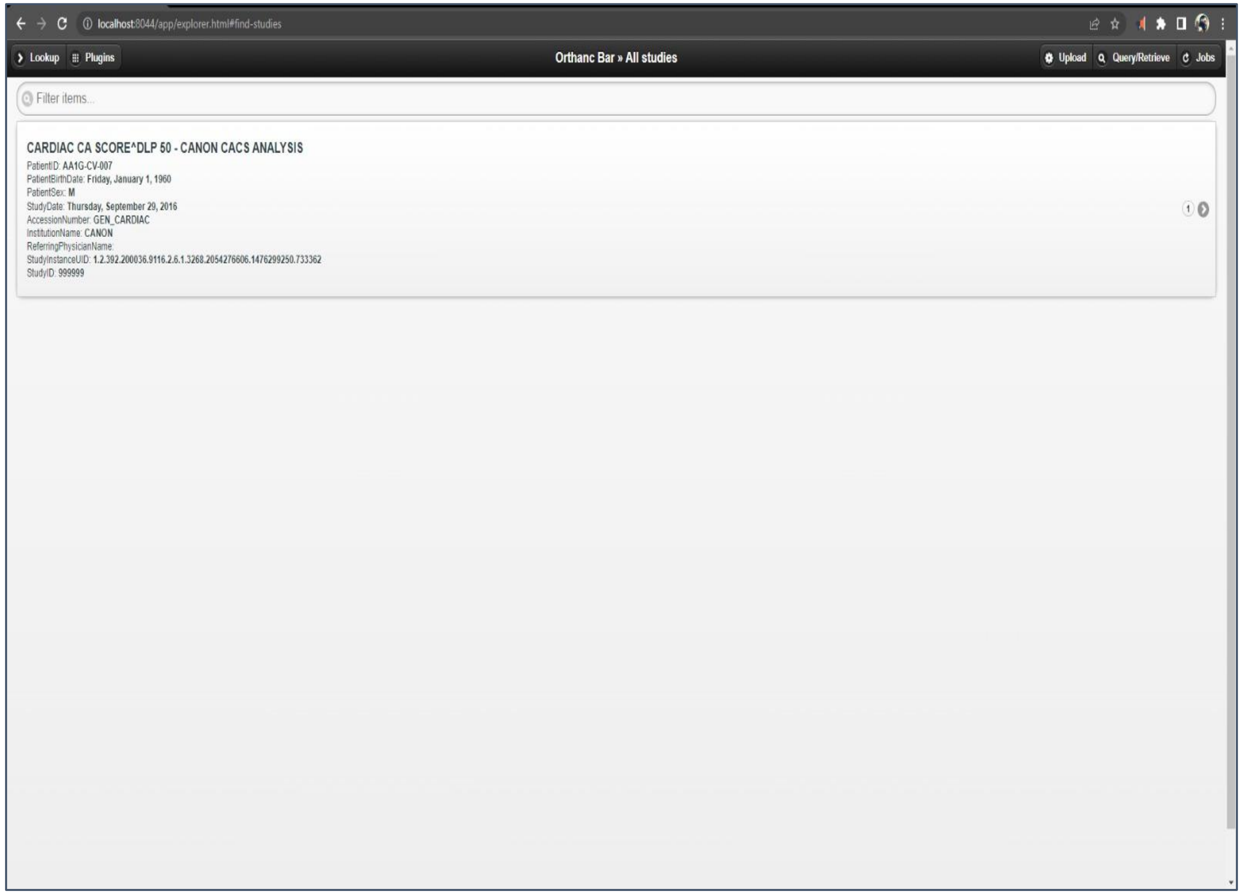


CARDIAC CA SCORE, DLP 50
Jan 1, 1960
ID: AA1G-CV-007
Male
56 Years

CANON
CANON CACS ANALYSIS
Study ID: 999999
Ac. Nb: GEN_CARDIAC
Acq.: Sep 29, 2016
Acq.: 10:35:30 AM

Frame: [3] 3 / 47
Zoom: 116.05%
Window/Level: 380/40
Pixel: No value - Outside image
CT (512x512) - AXIAL

Series Nb: 4
Cardiac 3.000
Thickness: 3 mm
Location: 6.12 mm


localhost:8044/app/explorer.html#find-studies
Lookup
Plugins
Orthanc Bar » All studies
Upload
Query/Retrieve
Jobs
Filter items...
1

CARDIAC CA SCORE^DLP 50 - CANON CACS ANALYSIS
PatientID: AA1G-CV-007
PatientBirthDate: Friday, January 1, 1960
PatientSex: M
StudyDate: Thursday, September 29, 2016
AccessionNumber: GEN_CARDIAC
InstitutionName: CANON
ReferringPhysicianName:
StudyInstanceUID: 1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.733362
StudyID: 999999

Resultados - **Orthanc** 4/4

- Testes concorrentes
  - Estudos pequeno
  - Estudos médio
  - Estudos grande

- Estudo de 5GB *

Próximos passos

- Focar nos diferentes tipos de testes em ambas as soluções
- Comparar os resultados de ambas as soluções
- Melhorar robustez da comunicação em situações adversas
- Simplificar configuração da solução

Canon

CANON MEDICAL SYSTEMS DO BRASIL

CELEBRATING SCIENCE AND INNOVATION
35 YEARS LIKA
1986-2021
Laboratório de Imunopatologia Keizo Asami

VIRTUS IMPAVIDA

UNIVERSIDADE
FEDERAL
DE PERNAMBUCO

DCM Uploader: um sistema de informação para garantia de confidencialidade, integridade e disponibilidade no tráfego de imagens médicas baseadas no padrão DICOM

Resultados da Sprint 05a

18/04/2023

Contexto da Sprint 05

- Analisar diferentes ferramentas de comunicação DICOM
  - Pydicom
  - DCM4che
  - Orthanc
- Elaborar requisitos do sistema
- Propor arquitetura

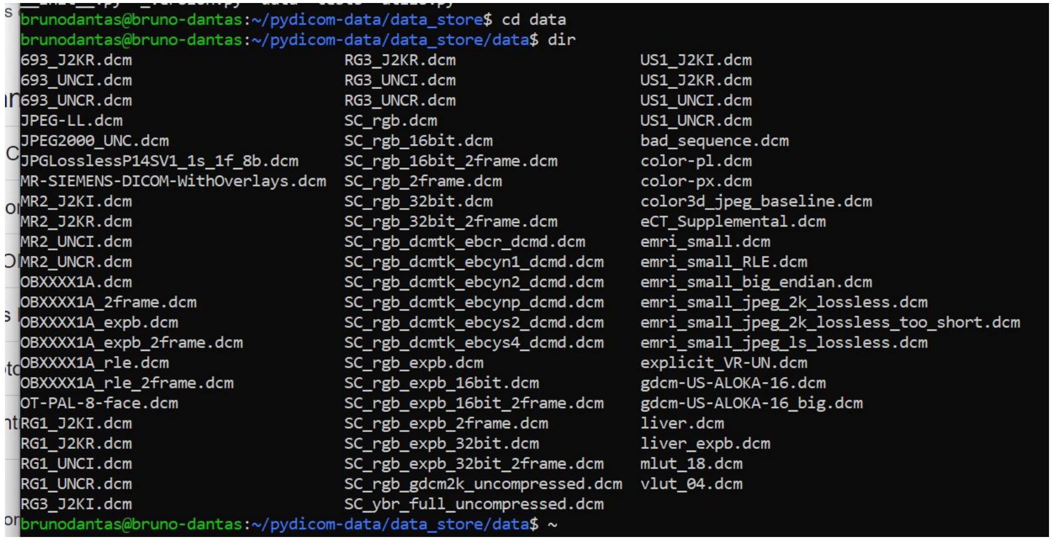
Resultados - Pydicom

- Pydicom

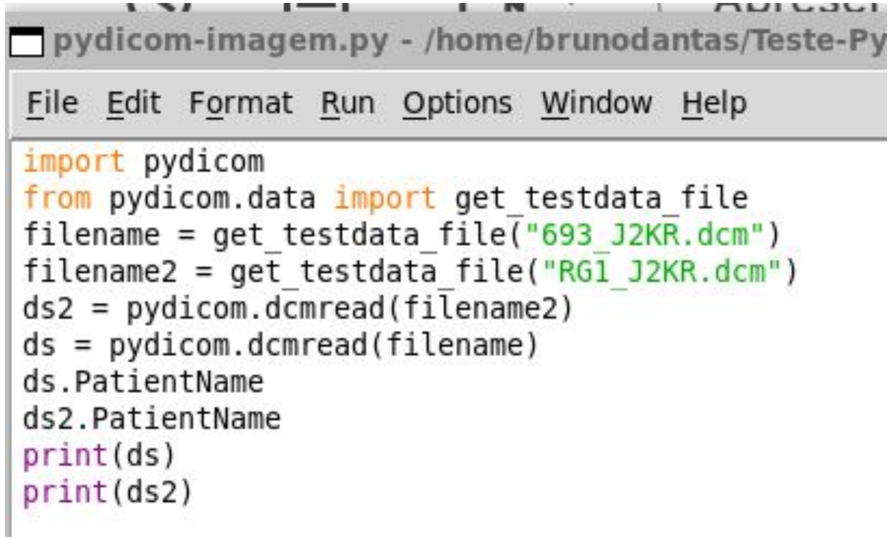
Documentação:

- Github: https://github.com/pydicom/pydicom
- Biblioteca: https://pydicom.github.io/pydicom/stable/
- Versão do Pydicom: 2.3.1

Resultados - Pydicom

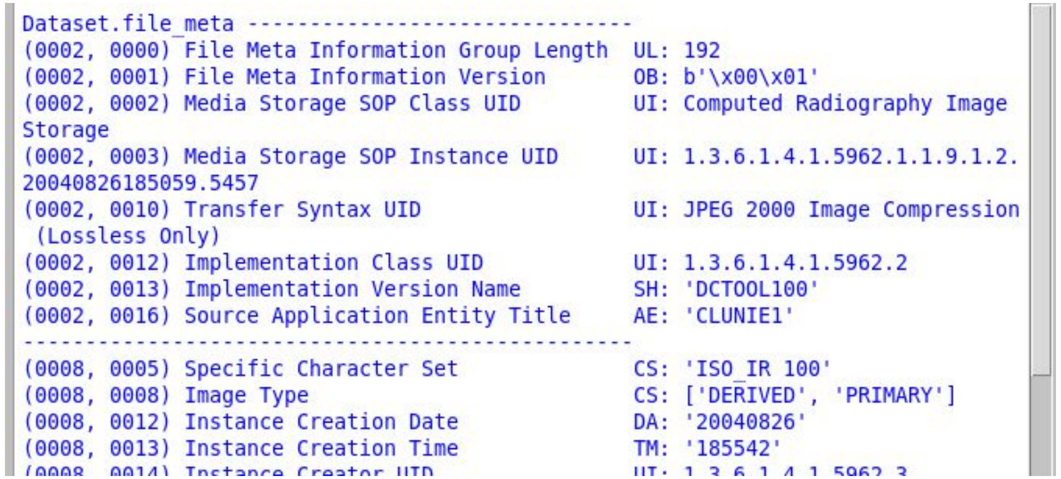


```
brunodantas@bruno-dantas:~/pydicom-data/data_store$ cd data
brunodantas@bruno-dantas:~/pydicom-data/data_store/data$ dir
693_J2KR.dcm                        RG3_J2KR.dcm                     US1_J2KI.dcm
693_UNCI.dcm                        RG3_UNCI.dcm                     US1_J2KR.dcm
693_UNCR.dcm                        RG3_UNCR.dcm                     US1_UNCI.dcm
JPEG-LL.dcm                         SC_rgb.dcm                       US1_UNCR.dcm
JPEG2000_UNC.dcm                    SC_rgb_16bit.dcm                 bad_sequence.dcm
JPGLosslessP14SV1_1s_1f_8b.dcm      SC_rgb_16bit_2frame.dcm          color-pl.dcm
MR-SIEMENS-DICOM-WithOverlays.dcm   SC_rgb_2frame.dcm                color-px.dcm
MR2_J2KI.dcm                        SC_rgb_32bit.dcm                 color3d_jpeg_baseline.dcm
MR2_J2KR.dcm                        SC_rgb_32bit_2frame.dcm          eCT_Supplemental.dcm
MR2_UNCI.dcm                        SC_rgb_dcmtk_ebcr_dcmd.dcm       emri_small.dcm
MR2_UNCR.dcm                        SC_rgb_dcmtk_ebcyn1_dcmd.dcm     emri_small_RLE.dcm
OBXXXX1A.dcm                        SC_rgb_dcmtk_ebcyn2_dcmd.dcm     emri_small_big_endian.dcm
OBXXXX1A_2frame.dcm                 SC_rgb_dcmtk_ebcynp_dcmd.dcm     emri_small_jpeg_2k_lossless.dcm
OBXXXX1A_expb.dcm                   SC_rgb_dcmtk_ebcys2_dcmd.dcm     emri_small_jpeg_2k_lossless_too_short.dcm
OBXXXX1A_expb_2frame.dcm            SC_rgb_dcmtk_ebcys4_dcmd.dcm     emri_small_jpeg_ls_lossless.dcm
OBXXXX1A_rle.dcm                    SC_rgb_expb.dcm                  explicit_VR-UN.dcm
OBXXXX1A_rle_2frame.dcm             SC_rgb_expb_16bit.dcm            gdcm-US-ALOKA-16.dcm
OT-PAL-8-face.dcm                   SC_rgb_expb_16bit_2frame.dcm     gdcm-US-ALOKA-16_big.dcm
RG1_J2KI.dcm                        SC_rgb_expb_2frame.dcm           liver.dcm
RG1_J2KR.dcm                        SC_rgb_expb_32bit.dcm            liver_expb.dcm
RG1_UNCI.dcm                        SC_rgb_expb_32bit_2frame.dcm     mlut_18.dcm
RG1_UNCR.dcm                        SC_rgb_gdcm2k_uncompressed.dcm   vlut_04.dcm
RG3_J2KI.dcm                        SC_ybr_full_uncompressed.dcm
brunodantas@bruno-dantas:~/pydicom-data/data_store/data$ ~
```

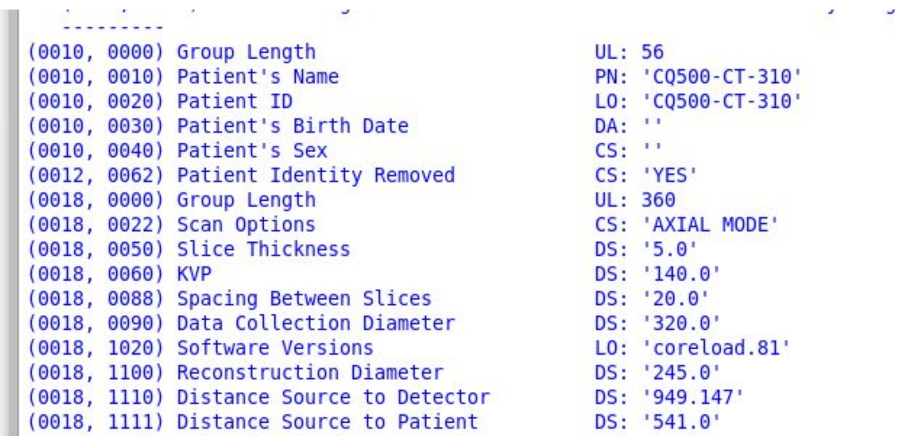


pydicom-imagem.py - /home/brunodantas/Teste-Py
File Edit Format Run Options Window Help

```
import pydicom
from pydicom.data import get_testdata_file
filename = get_testdata_file("693_J2KR.dcm")
filename2 = get_testdata_file("RG1_J2KR.dcm")
ds2 = pydicom.dcmread(filename2)
ds = pydicom.dcmread(filename)
ds.PatientName
ds2.PatientName
print(ds)
print(ds2)
```



```
Dataset.file_meta -------------------------------
(0002, 0000) File Meta Information Group Length  UL: 192
(0002, 0001) File Meta Information Version       OB: b'\x00\x01'
(0002, 0002) Media Storage SOP Class UID         UI: Computed Radiography Image
Storage
(0002, 0003) Media Storage SOP Instance UID      UI: 1.3.6.1.4.1.5962.1.1.9.1.2.
20040826185059.5457
(0002, 0010) Transfer Syntax UID                 UI: JPEG 2000 Image Compression
 (Lossless Only)
(0002, 0012) Implementation Class UID            UI: 1.3.6.1.4.1.5962.2
(0002, 0013) Implementation Version Name         SH: 'DCTOOL100'
(0002, 0016) Source Application Entity Title     AE: 'CLUNIE1'
-------------------------------------------------
(0008, 0005) Specific Character Set              CS: 'ISO_IR 100'
(0008, 0008) Image Type                          CS: ['DERIVED', 'PRIMARY']
(0008, 0012) Instance Creation Date              DA: '20040826'
(0008, 0013) Instance Creation Time              TM: '185542'
(0008, 0014) Instance Creator UID                UI: 1.3.6.1.4.1.5962.3
```



```
 --------
(0010, 0000) Group Length                        UL: 56
(0010, 0010) Patient's Name                      PN: 'CQ500-CT-310'
(0010, 0020) Patient ID                          LO: 'CQ500-CT-310'
(0010, 0030) Patient's Birth Date                DA: ''
(0010, 0040) Patient's Sex                       CS: ''
(0012, 0062) Patient Identity Removed            CS: 'YES'
(0018, 0000) Group Length                        UL: 360
(0018, 0022) Scan Options                        CS: 'AXIAL MODE'
(0018, 0050) Slice Thickness                     DS: '5.0'
(0018, 0060) KVP                                 DS: '140.0'
(0018, 0088) Spacing Between Slices              DS: '20.0'
(0018, 0090) Data Collection Diameter            DS: '320.0'
(0018, 1020) Software Versions                   LO: 'coreload.81'
(0018, 1100) Reconstruction Diameter             DS: '245.0'
(0018, 1110) Distance Source to Detector         DS: '949.147'
(0018, 1111) Distance Source to Patient          DS: '541.0'
```

Resultados - Pydicom

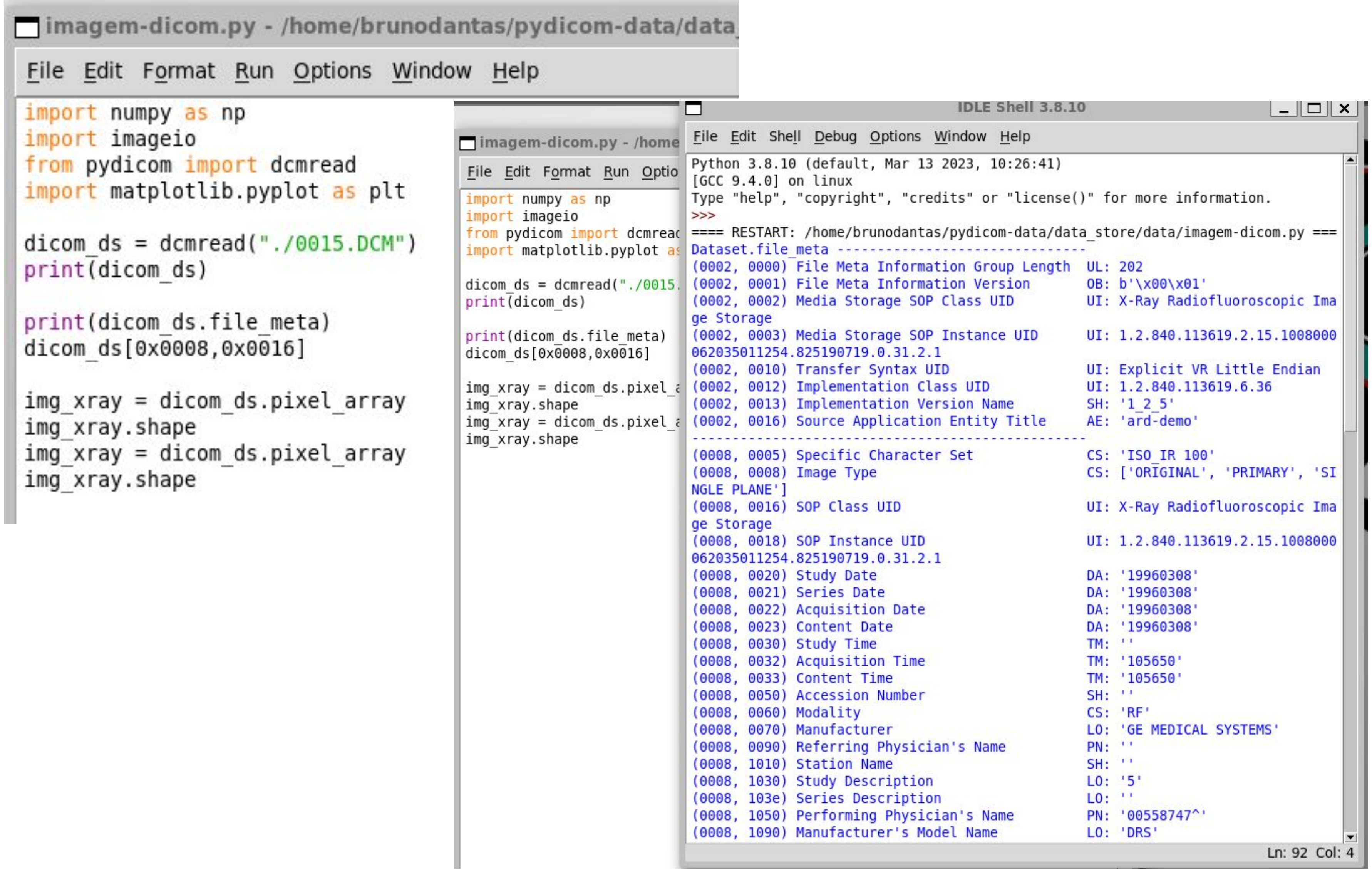


imagem-dicom.py - /home/brunodantas/pydicom-data/data
File Edit Format Run Options Window Help

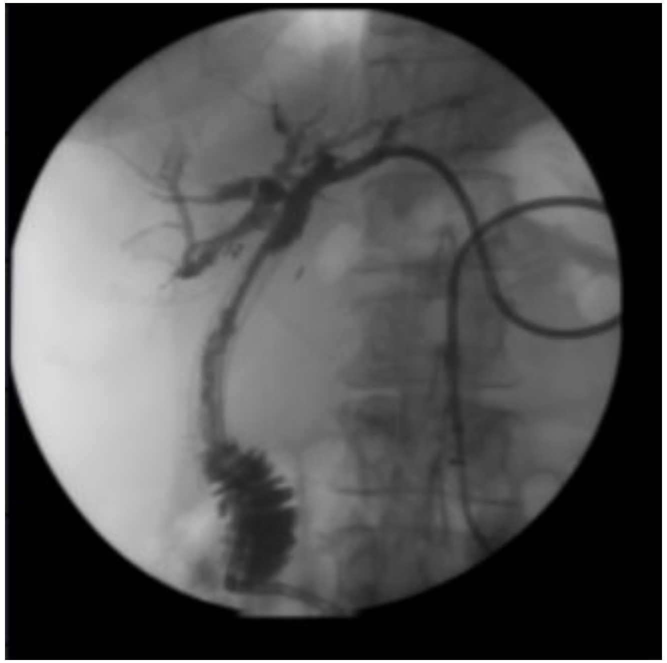
```
import numpy as np
import imageio
from pydicom import dcmread
import matplotlib.pyplot as plt

dicom_ds = dcmread("./0015.DCM")
print(dicom_ds)

print(dicom_ds.file_meta)
dicom_ds[0x0008,0x0016]

img_xray = dicom_ds.pixel_array
img_xray.shape
img_xray = dicom_ds.pixel_array
img_xray.shape
```

imagem-dicom.py - /home

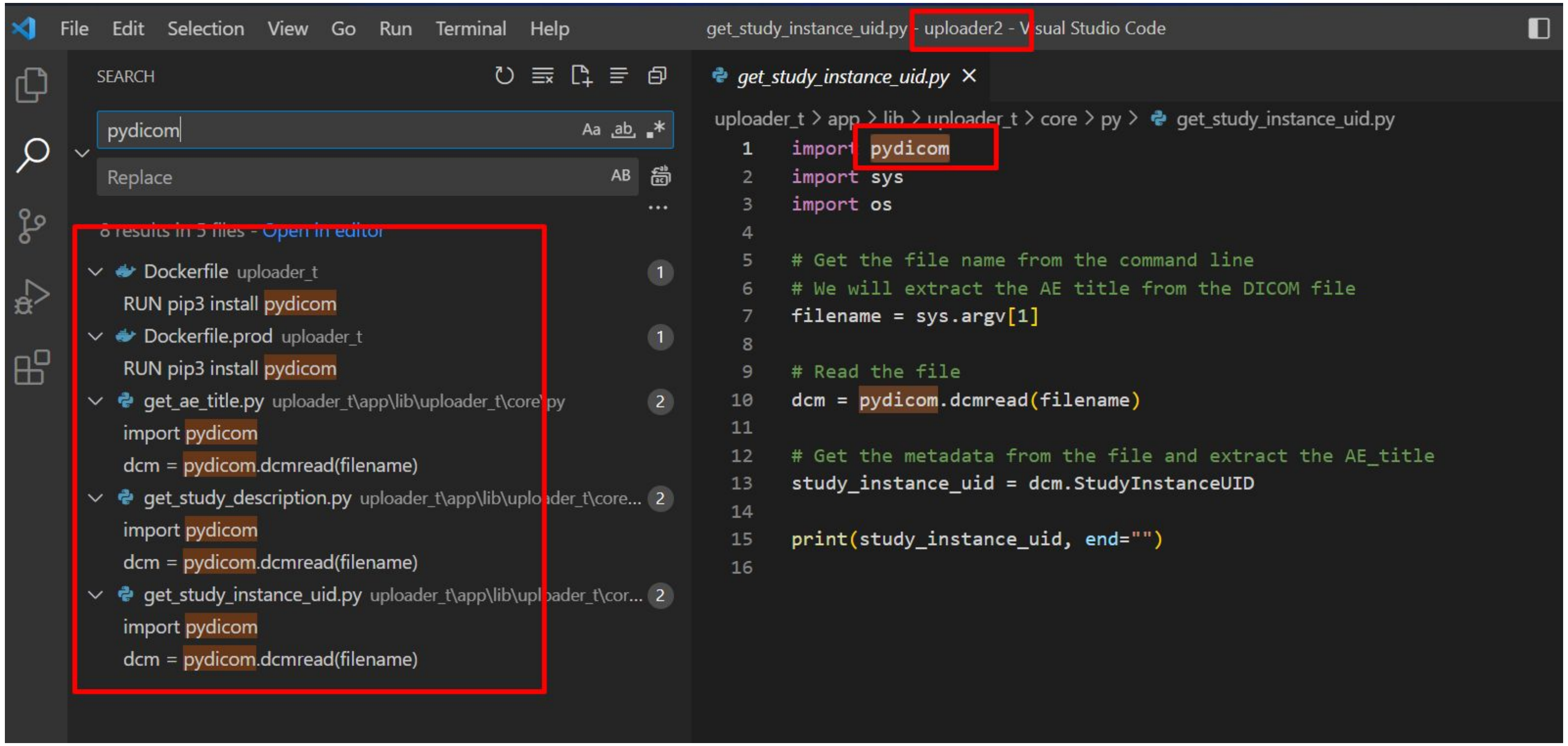
File Edit Format Run Optio

```
import numpy as np
import imageio
from pydicom import dcmreac
import matplotlib.pyplot as

dicom_ds = dcmread("./0015.
print(dicom_ds)

print(dicom_ds.file_meta)
dicom_ds[0x0008,0x0016]

img_xray = dicom_ds.pixel_a
img_xray.shape
img_xray = dicom_ds.pixel_a
img_xray.shape
```

```
Python 3.8.10 (default, Mar 13 2023, 10:26:41)
[GCC 9.4.0] on linux
Type "help", "copyright", "credits" or "license()" for more information.
>>>
==== RESTART: /home/brunodantas/pydicom-data/data_store/data/imagem-dicom.py ===
Dataset.file_meta -------------------------------
(0002, 0000) File Meta Information Group Length  UL: 202
(0002, 0001) File Meta Information Version       OB: b'\x00\x01'
(0002, 0002) Media Storage SOP Class UID         UI: X-Ray Radiofluoroscopic Ima
ge Storage
(0002, 0003) Media Storage SOP Instance UID      UI: 1.2.840.113619.2.15.1008000
062035011254.825190719.0.31.2.1
(0002, 0010) Transfer Syntax UID                 UI: Explicit VR Little Endian
(0002, 0012) Implementation Class UID            UI: 1.2.840.113619.6.36
(0002, 0013) Implementation Version Name         SH: '1_2_5'
(0002, 0016) Source Application Entity Title     AE: 'ard-demo'
-------------------------------------------------
(0008, 0005) Specific Character Set              CS: 'ISO_IR 100'
(0008, 0008) Image Type                          CS: ['ORIGINAL', 'PRIMARY', 'SI
NGLE PLANE']
(0008, 0016) SOP Class UID                       UI: X-Ray Radiofluoroscopic Ima
ge Storage
(0008, 0018) SOP Instance UID                    UI: 1.2.840.113619.2.15.1008000
062035011254.825190719.0.31.2.1
(0008, 0020) Study Date                          DA: '19960308'
(0008, 0021) Series Date                         DA: '19960308'
(0008, 0022) Acquisition Date                    DA: '19960308'
(0008, 0023) Content Date                        DA: '19960308'
(0008, 0030) Study Time                          TM: ''
(0008, 0032) Acquisition Time                    TM: '105650'
(0008, 0033) Content Time                        TM: '105650'
(0008, 0050) Accession Number                    SH: ''
(0008, 0060) Modality                            CS: 'RF'
(0008, 0070) Manufacturer                        LO: 'GE MEDICAL SYSTEMS'
(0008, 0090) Referring Physician's Name          PN: ''
(0008, 1010) Station Name                        SH: ''
(0008, 1030) Study Description                   LO: '5'
(0008, 103e) Series Description                  LO: ''
(0008, 1050) Performing Physician's Name         PN: '00558747^'
(0008, 1090) Manufacturer's Model Name           LO: 'DRS'
```



Resultados - Pydicom


File
Edit
Selection
View
Go
Run
Terminal
Help
get_study_instance_uid.py - uploader2 - V sual Studio Code
SEARCH
Aa
ab
.*
Replace
AB
get_study_instance_uid.py
uploader_t > app > lib > uploader_t > core > py > get_study_instance_uid.py

pydicom

8 results in 5 files - Open in editor

- Dockerfile uploader_t — 1
  - RUN pip3 install pydicom
- Dockerfile.prod uploader_t — 1
  - RUN pip3 install pydicom
- get_ae_title.py uploader_t\app\lib\uploader_t\core\py — 2
  - import pydicom
  - dcm = pydicom.dcmread(filename)
- get_study_description.py uploader_t\app\lib\uploader_t\core... — 2
  - import pydicom
  - dcm = pydicom.dcmread(filename)
- get_study_instance_uid.py uploader_t\app\lib\uploader_t\cor... — 2
  - import pydicom
  - dcm = pydicom.dcmread(filename)

```python
import pydicom
import sys
import os

# Get the file name from the command line
# We will extract the AE title from the DICOM file
filename = sys.argv[1]

# Read the file
dcm = pydicom.dcmread(filename)

# Get the metadata from the file and extract the AE_title
study_instance_uid = dcm.StudyInstanceUID

print(study_instance_uid, end="")

```

Resultados - Pydicom

- Pynetdicom

SCP - Service Class Providers

Mover, Armazenar, Encontra…

SCU - Service Class Users

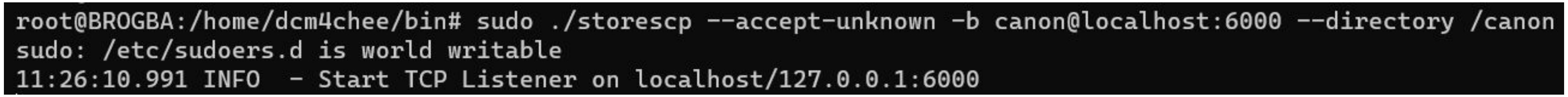
pynetdicom3 **DICOM Upper Layer Protocol for TCP/IP**

Resultados - dcm4chee

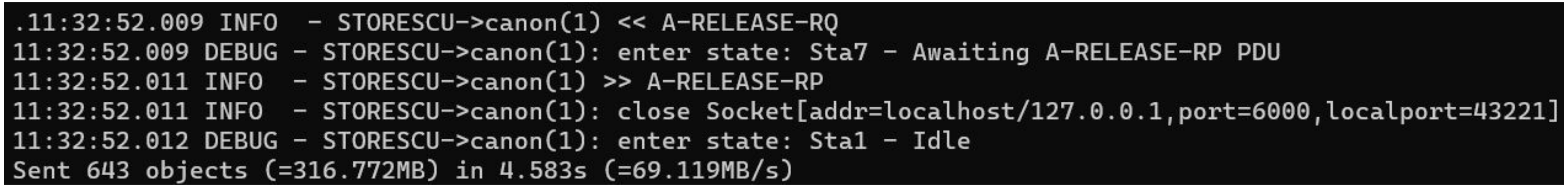
- dcm4chee
  - Popular framework dicom em java
  - Todas as funcionalidades de um PACS e mais…
  - autenticação, conversão, compressão, criptografia, priorização, redirecionamento, armazenamento, REST, utilities

Resultados - dcm4chee

- storescp [options] -b [<aet>[@<ip>]:]<port>
- storescu [options] -c <aet>@<host>:<port> [<file>..][<directory>..]

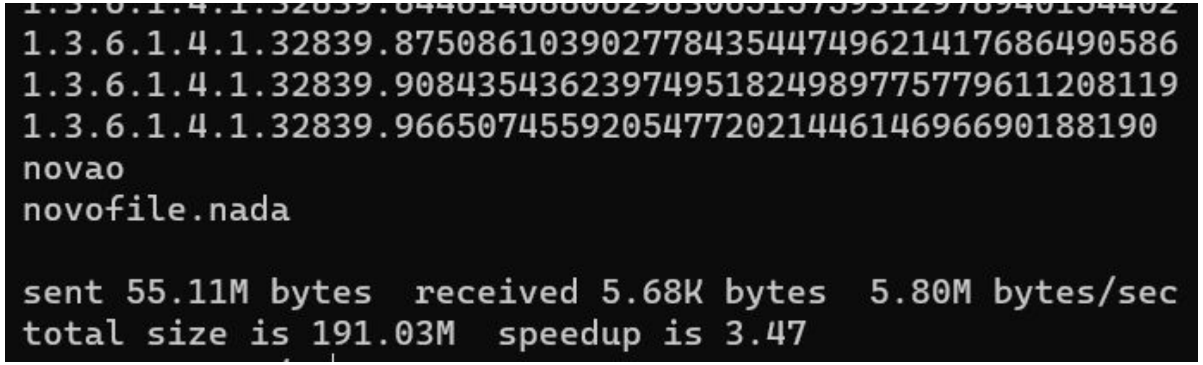


```
root@BROGBA:/home/dcm4chee/bin# sudo ./storescp --accept-unknown -b canon@localhost:6000 --directory /canon
sudo: /etc/sudoers.d is world writable
11:26:10.991 INFO  - Start TCP Listener on localhost/127.0.0.1:6000
```



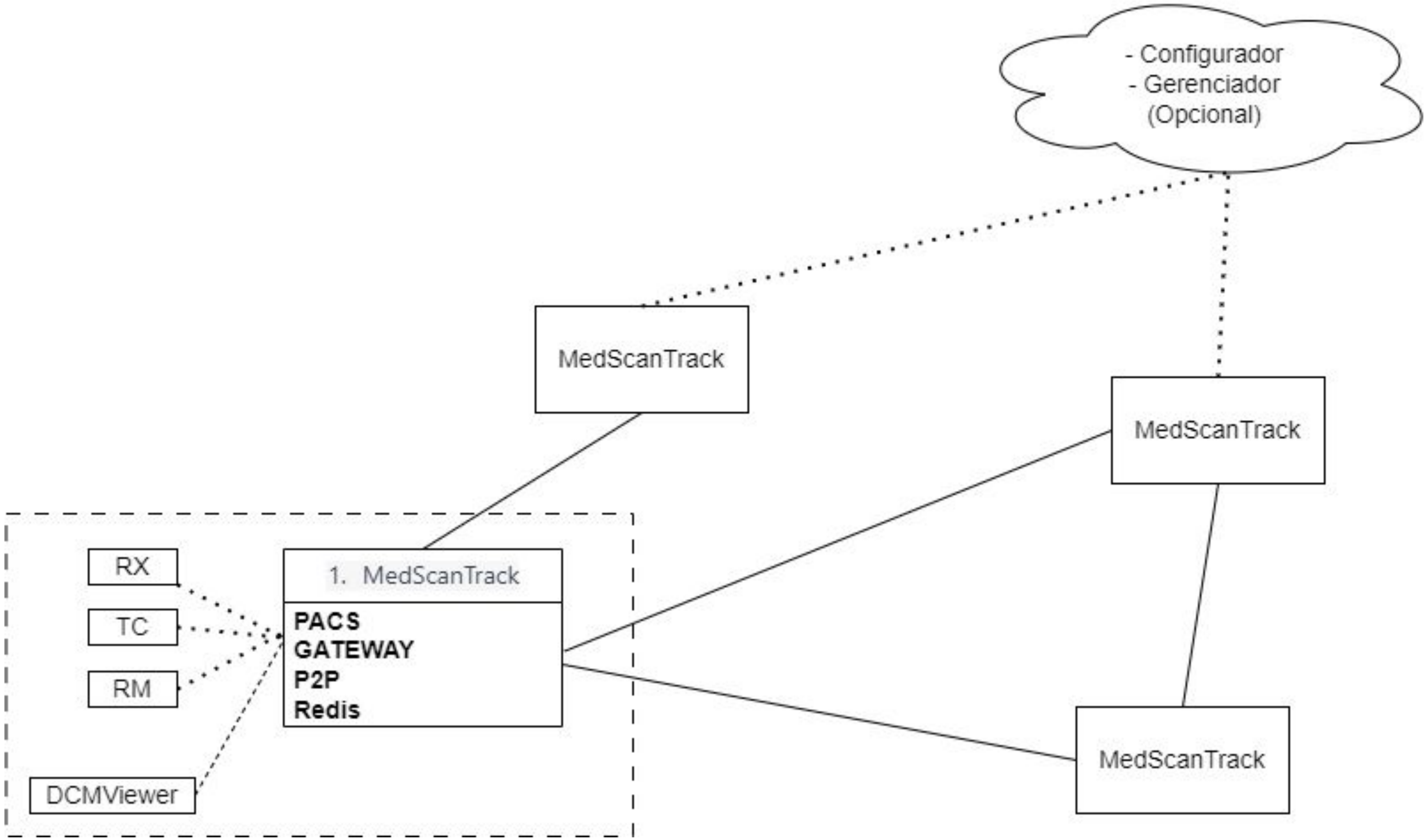
```
.11:32:52.009 INFO  - STORESCU->canon(1) << A-RELEASE-RQ
11:32:52.009 DEBUG - STORESCU->canon(1): enter state: Sta7 - Awaiting A-RELEASE-RP PDU
11:32:52.011 INFO  - STORESCU->canon(1) >> A-RELEASE-RP
11:32:52.011 INFO  - STORESCU->canon(1): close Socket[addr=localhost/127.0.0.1,port=6000,localport=43221]
11:32:52.012 DEBUG - STORESCU->canon(1): enter state: Sta1 - Idle
Sent 643 objects (=316.772MB) in 4.583s (=69.119MB/s)
```

rsync -avhze 'ssh -c aes256-gcm@openssh.com' --compress-level=9 /canon/ /canon2/



```
1.3.6.1.4.1.32839.8440146880029830051575312978940154402
1.3.6.1.4.1.32839.87508610390277843544749621417686490586
1.3.6.1.4.1.32839.90843543623974951824989775779611208119
1.3.6.1.4.1.32839.9665074559205477202144614696690188190
novao
novofile.nada

sent 55.11M bytes  received 5.68K bytes  5.80M bytes/sec
total size is 191.03M  speedup is 3.47
```

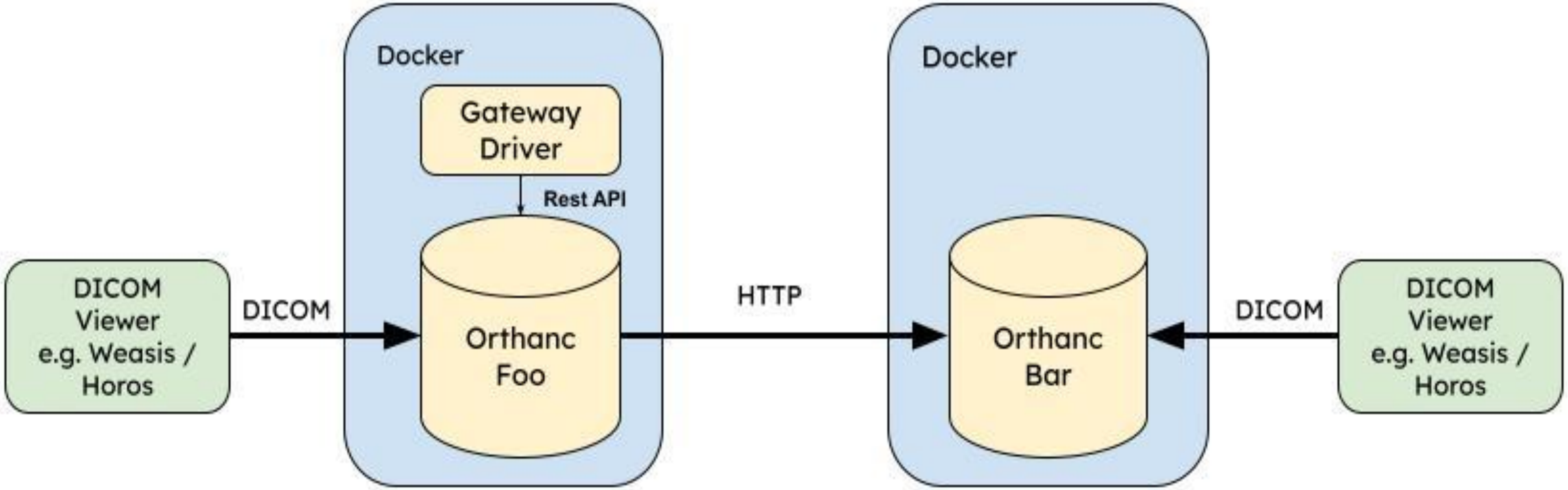
Resultados - dcm4chee



Resultados - **Orthanc**

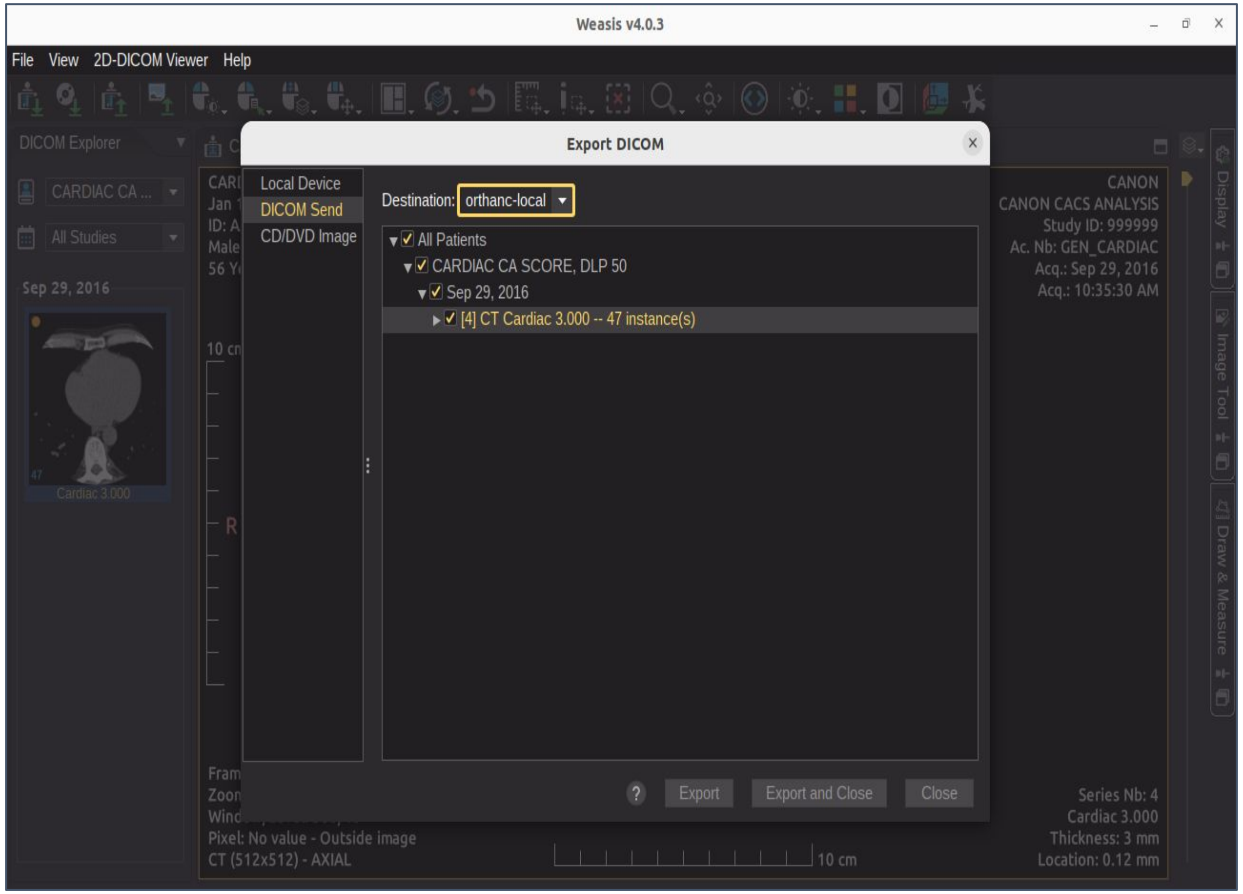
- Resultados em 3 ambientes
  - Local
  - VM CIn
  - AWS

Resultados - **Orthanc**



Resultados - **Orthanc**

- Local



Export DICOM

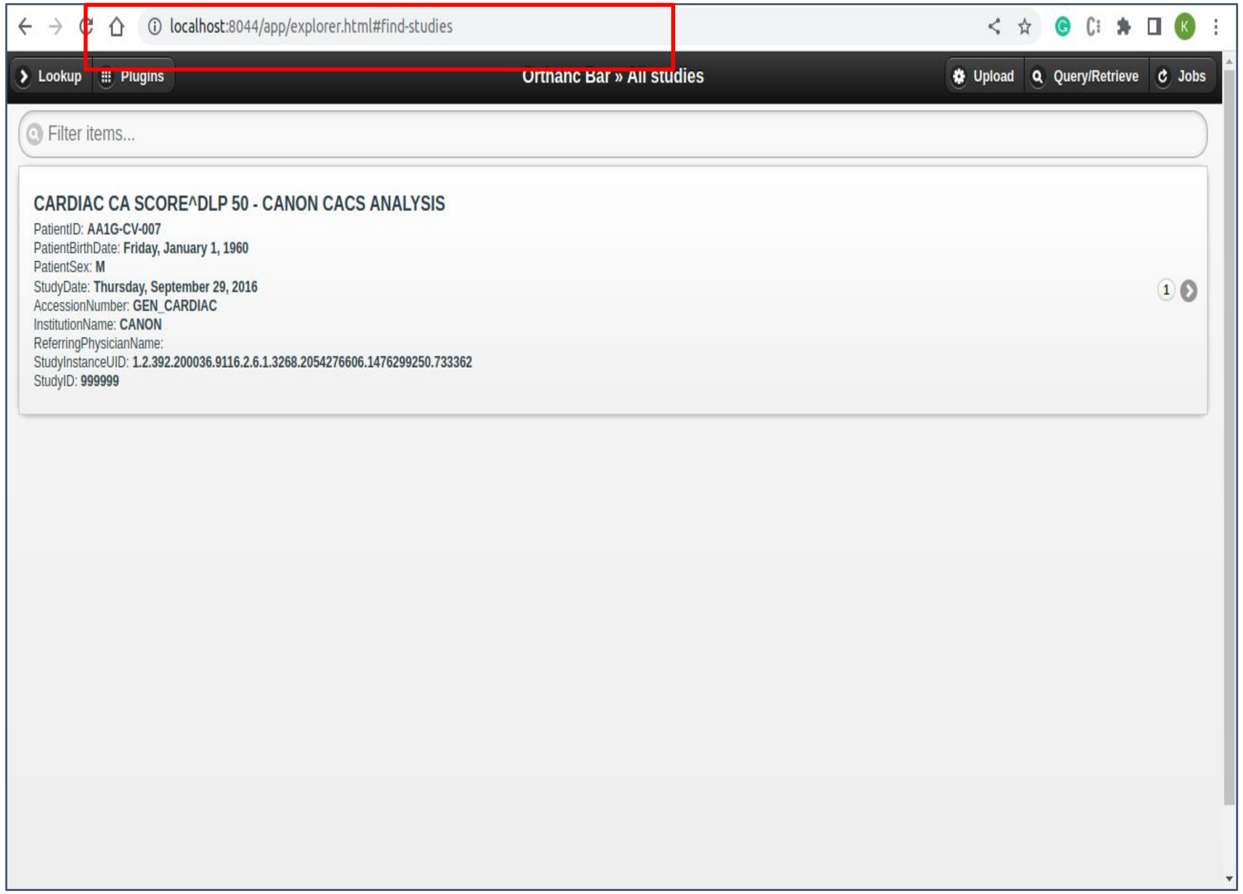
Destination: orthanc-local

- ☑ All Patients
  - ☑ CARDIAC CA SCORE, DLP 50
    - ☑ Sep 29, 2016
      - ☑ [4] CT Cardiac 3.000 -- 47 instance(s)

CANON
CANON CACS ANALYSIS
Study ID: 999999
Ac. Nb: GEN_CARDIAC
Acq.: Sep 29, 2016
Acq.: 10:35:30 AM

Pixel: No value - Outside image
CT (512x512) - AXIAL

Series Nb: 4
Cardiac 3.000
Thickness: 3 mm
Location: 0.12 mm



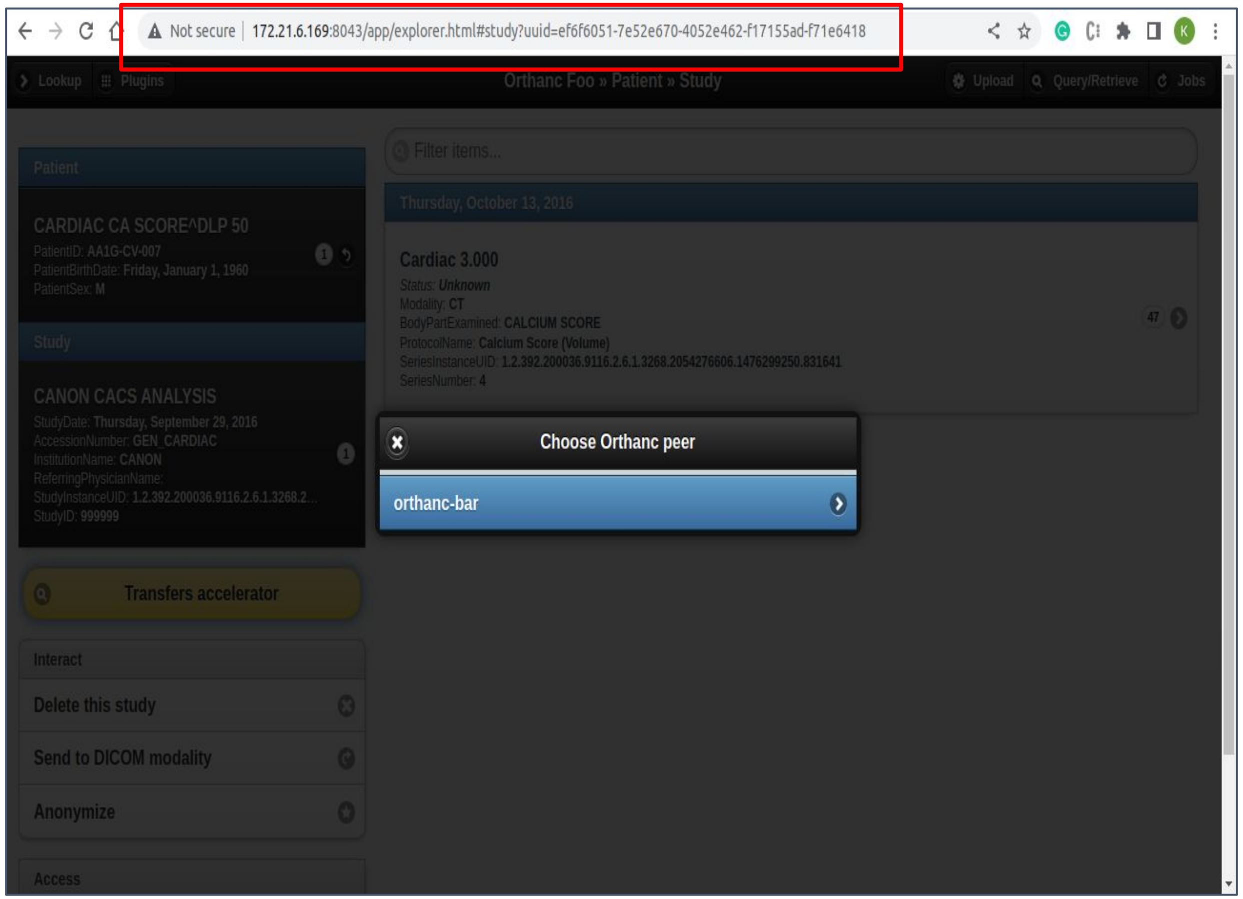
localhost:8044/app/explorer.html#find-studies
Lookup
Plugins
Orthanc Bar » All studies
Upload
Query/Retrieve
Jobs
Filter items...
1

CARDIAC CA SCORE^DLP 50 - CANON CACS ANALYSIS

PatientID: AA1G-CV-007
PatientBirthDate: Friday, January 1, 1960
PatientSex: M
StudyDate: Thursday, September 29, 2016
AccessionNumber: GEN_CARDIAC
InstitutionName: CANON
ReferringPhysicianName:
StudyInstanceUID: 1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.733362
StudyID: 999999

Resultados - **Orthanc**

- VM Cln



Not secure | 172.21.6.169:8043/app/explorer.html#study?uuid=ef6f6051-7e52e670-4052e462-f17155ad-f71e6418
Lookup
Plugins
Upload
Query/Retrieve
Jobs
Filter items...
Transfers accelerator

Orthanc Foo » Patient » Study

Patient

CARDIAC CA SCORE^DLP 50
PatientID: AA1G-CV-007
PatientBirthDate: Friday, January 1, 1960
PatientSex: M

Study

CANON CACS ANALYSIS
StudyDate: Thursday, September 29, 2016
AccessionNumber: GEN_CARDIAC
InstitutionName: CANON
ReferringPhysicianName:
StudyInstanceUID: 1.2.392.200036.9116.2.6.1.3268.2...
StudyID: 999999

Thursday, October 13, 2016

Cardiac 3.000
Status: Unknown
Modality: CT
BodyPartExamined: CALCIUM SCORE
ProtocolName: Calcium Score (Volume)
SeriesInstanceUID: 1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.831641
SeriesNumber: 4

Choose Orthanc peer

orthanc-bar

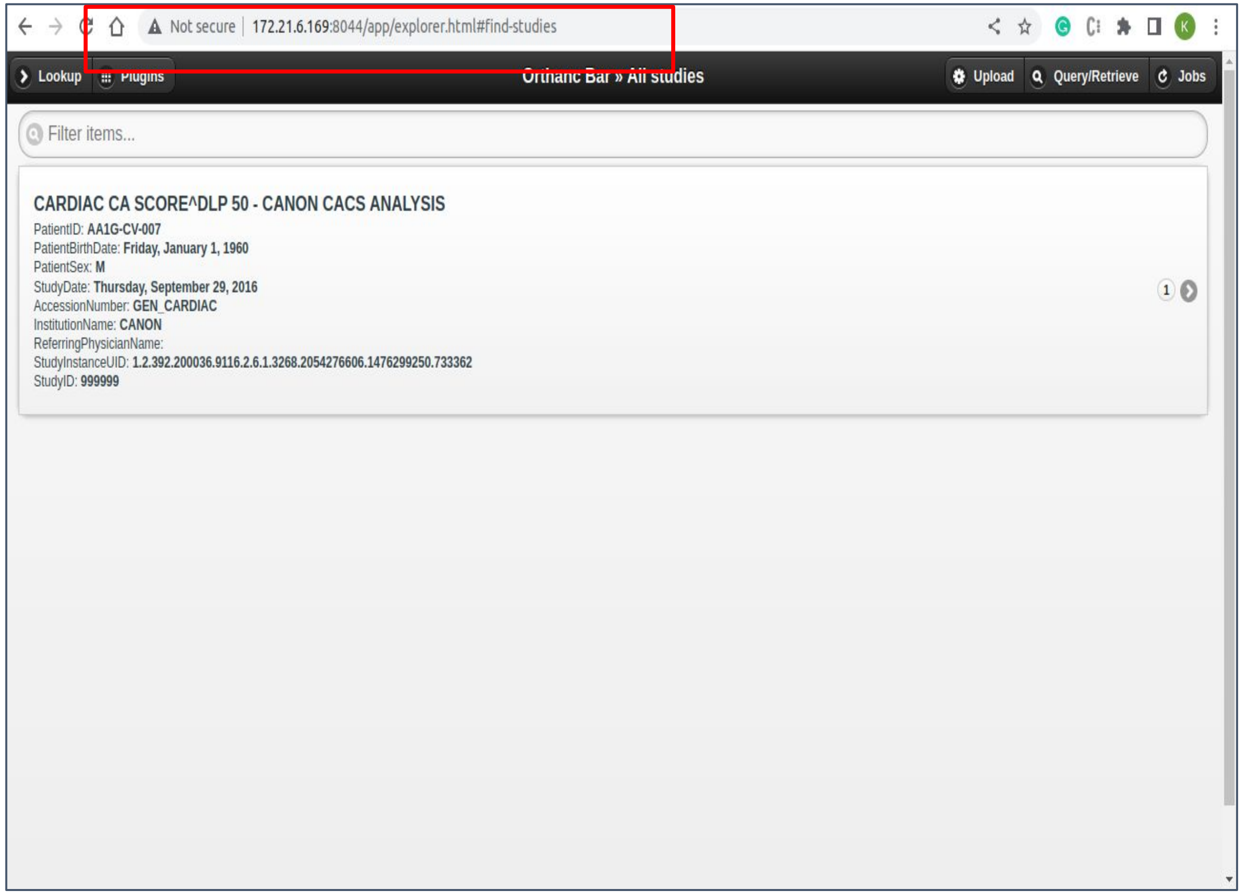
Interact

Delete this study

Send to DICOM modality

Anonymize

Access



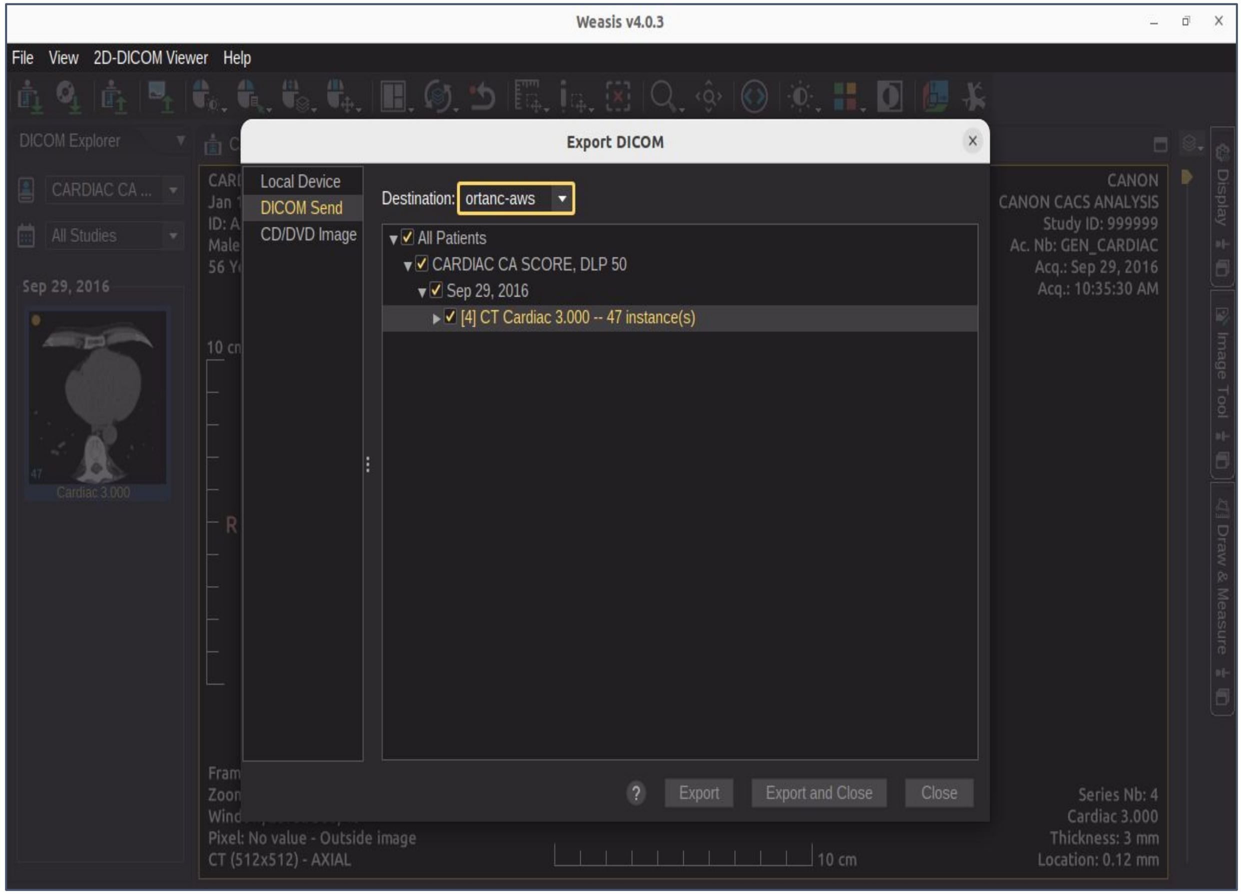
Not secure | 172.21.6.169:8044/app/explorer.html#find-studies
Lookup
Plugins
Upload
Query/Retrieve
Jobs
Filter items...

Orthanc Bar » All studies

CARDIAC CA SCORE^DLP 50 - CANON CACS ANALYSIS
PatientID: AA1G-CV-007
PatientBirthDate: Friday, January 1, 1960
PatientSex: M
StudyDate: Thursday, September 29, 2016
AccessionNumber: GEN_CARDIAC
InstitutionName: CANON
ReferringPhysicianName:
StudyInstanceUID: 1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.733362
StudyID: 999999

Resultados - **Orthanc**

- AWS



Weasis v4.0.3

File View 2D-DICOM Viewer Help

Export DICOM

Local Device
DICOM Send
CD/DVD Image

Destination: ortanc-aws

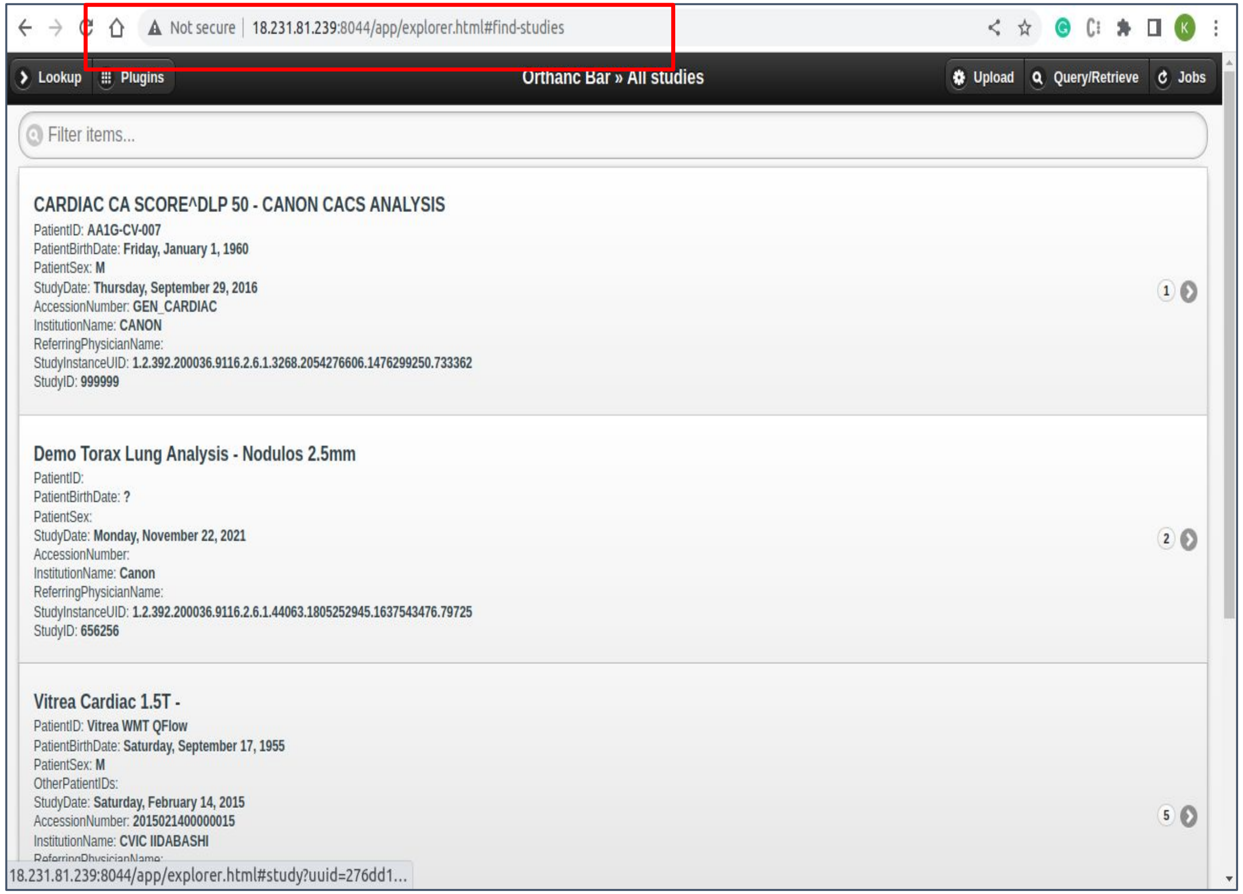
▼ ☑ All Patients
▼ ☑ CARDIAC CA SCORE, DLP 50
▼ ☑ Sep 29, 2016
▶ ☑ [4] CT Cardiac 3.000 -- 47 instance(s)

? Export Export and Close Close

CANON
CANON CACS ANALYSIS
Study ID: 999999
Ac. Nb: GEN_CARDIAC
Acq.: Sep 29, 2016
Acq.: 10:35:30 AM

Pixel: No value - Outside image
CT (512x512) - AXIAL

Series Nb: 4
Cardiac 3.000
Thickness: 3 mm
Location: 0.12 mm



Not secure | 18.231.81.239:8044/app/explorer.html#find-studies

Lookup Plugins Orthanc Bar » All studies Upload Query/Retrieve Jobs

Filter items...

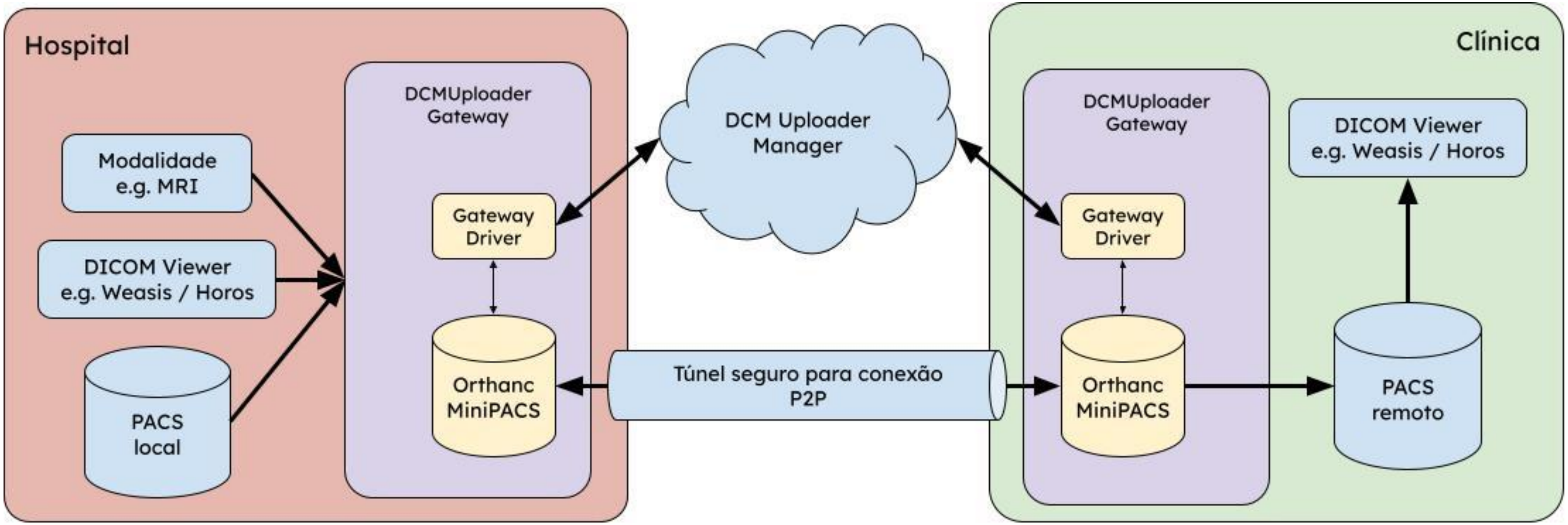
CARDIAC CA SCORE^DLP 50 - CANON CACS ANALYSIS
PatientID: **AA1G-CV-007**
PatientBirthDate: **Friday, January 1, 1960**
PatientSex: **M**
StudyDate: **Thursday, September 29, 2016**
AccessionNumber: **GEN_CARDIAC**
InstitutionName: **CANON**
ReferringPhysicianName:
StudyInstanceUID: **1.2.392.200036.9116.2.6.1.3268.2054276606.1476299250.733362**
StudyID: **999999**
1

Demo Torax Lung Analysis - Nodulos 2.5mm
PatientID:
PatientBirthDate: **?**
PatientSex:
StudyDate: **Monday, November 22, 2021**
AccessionNumber:
InstitutionName: **Canon**
ReferringPhysicianName:
StudyInstanceUID: **1.2.392.200036.9116.2.6.1.44063.1805252945.1637543476.79725**
StudyID: **656256**
2

Vitrea Cardiac 1.5T -
PatientID: **Vitrea WMT QFlow**
PatientBirthDate: **Saturday, September 17, 1955**
PatientSex: **M**
OtherPatientIDs:
StudyDate: **Saturday, February 14, 2015**
AccessionNumber: **2015021400000015**
InstitutionName: **CVIC IIDABASHI**
ReferringPhysicianName:
5

18.231.81.239:8044/app/explorer.html#study?uuid=276dd1...

Resultados - **Orthanc**



Próximos passos

- Investigar implementação da comunicação site to site
- Estruturar arquitetura