15th February 2023

Setareh Fatemi

AI_MIGHT AND COMPUTING RESOURCES

Artificial **I**ntelligence methods applied to **M**edical **I**ma**G**es to en**H**ance and personalize BNCT **T**reatment planning

CLINICAL BNCT

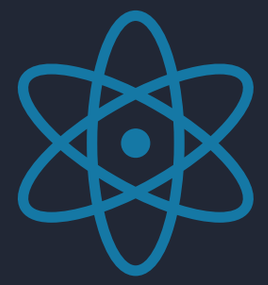
18F-BPA

PET
IMAGING

ROI
INDIVIDUATION

BNCT
CLINICAL
CENTER

BPA

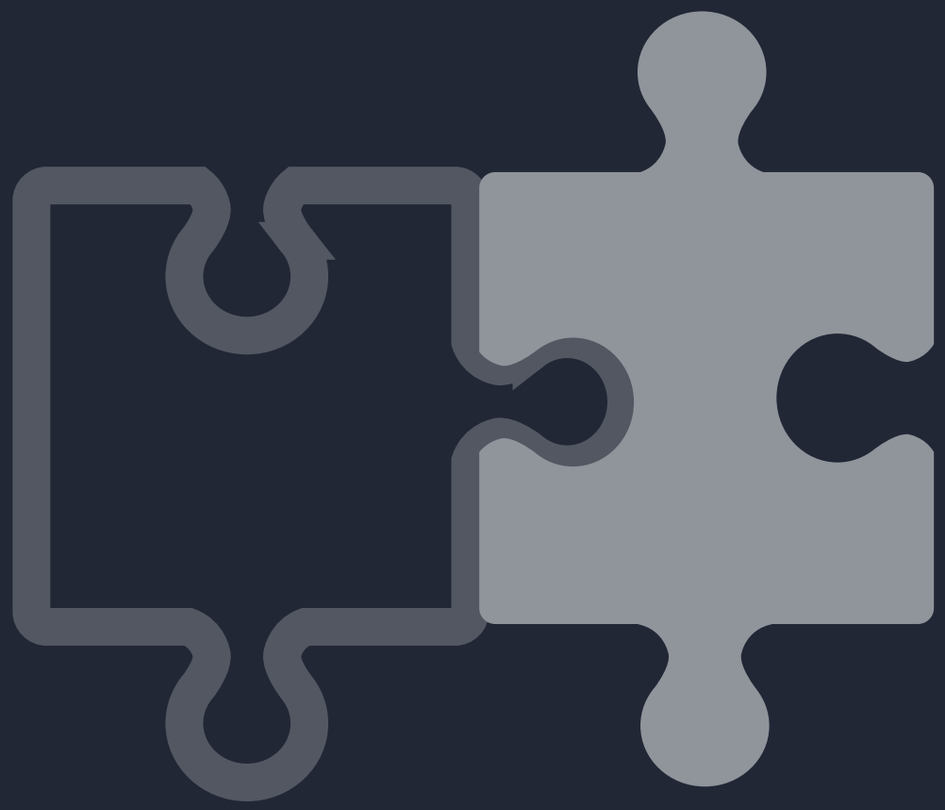


IRRADIATION

TREATMENT PLANNING SYSTEM

Image Registration

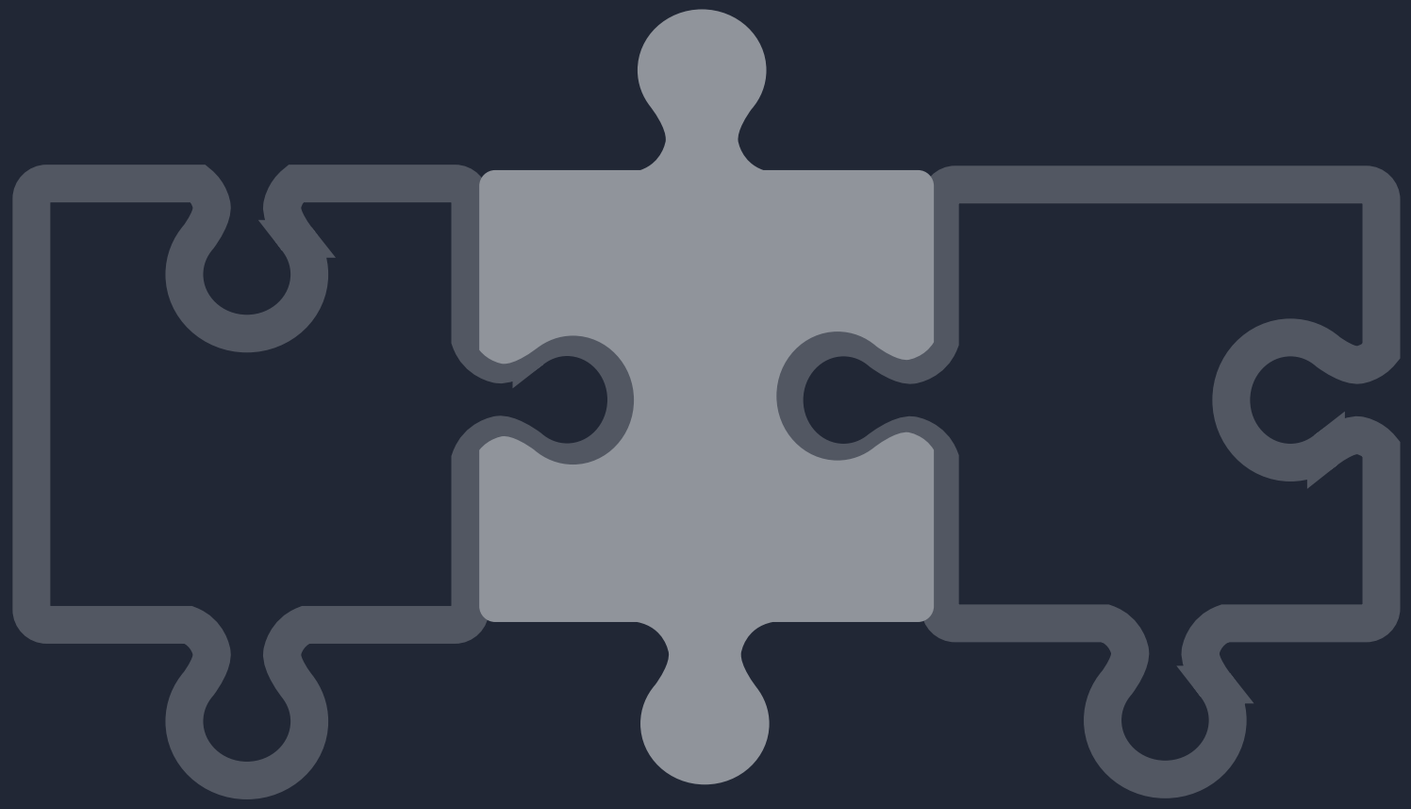
Image
Registration



ROI upload

Image Registration

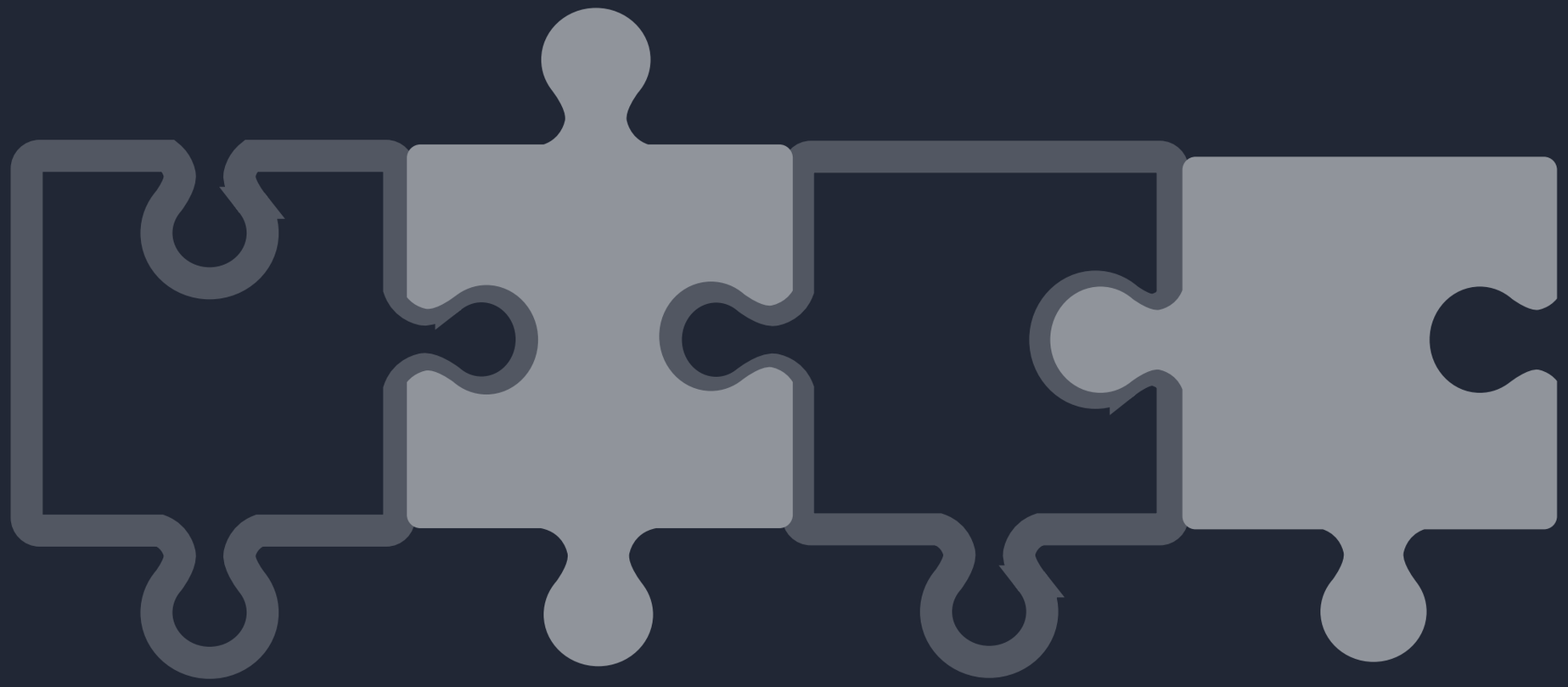
Geometry creation



ROI upload

Image Registration

Geometry creation



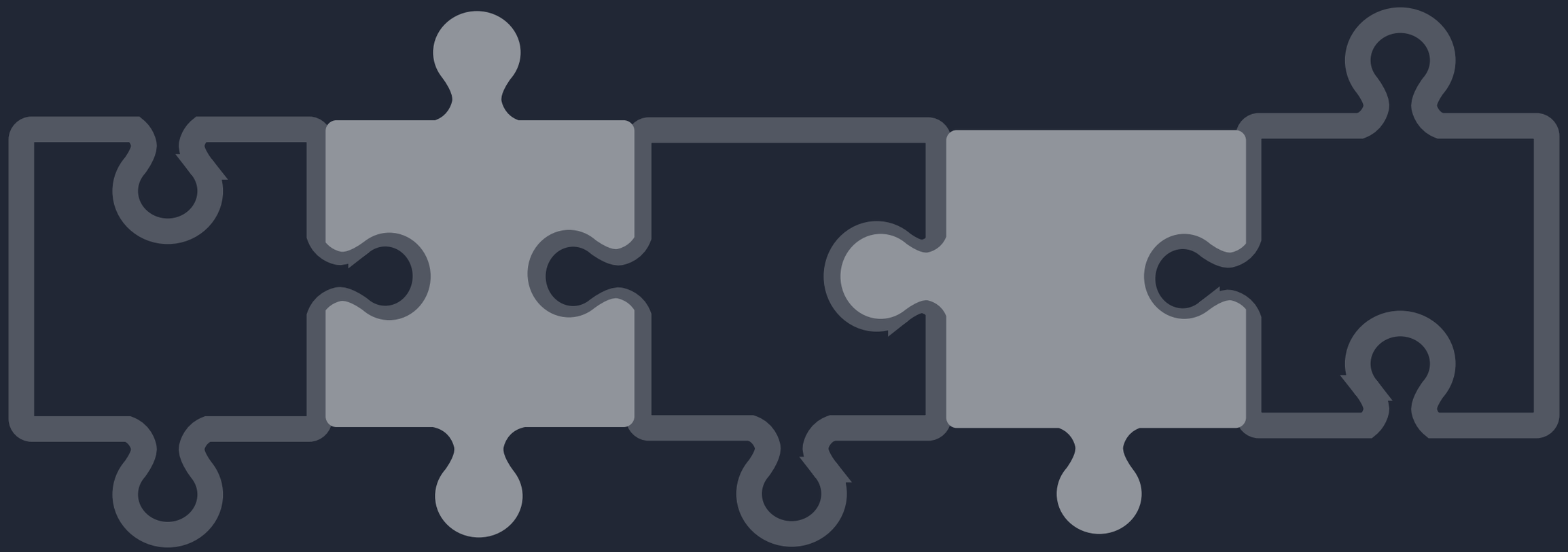
ROI upload

Monte Carlo Simulation

Image Registration

Geometry creation

Dosimetric Information



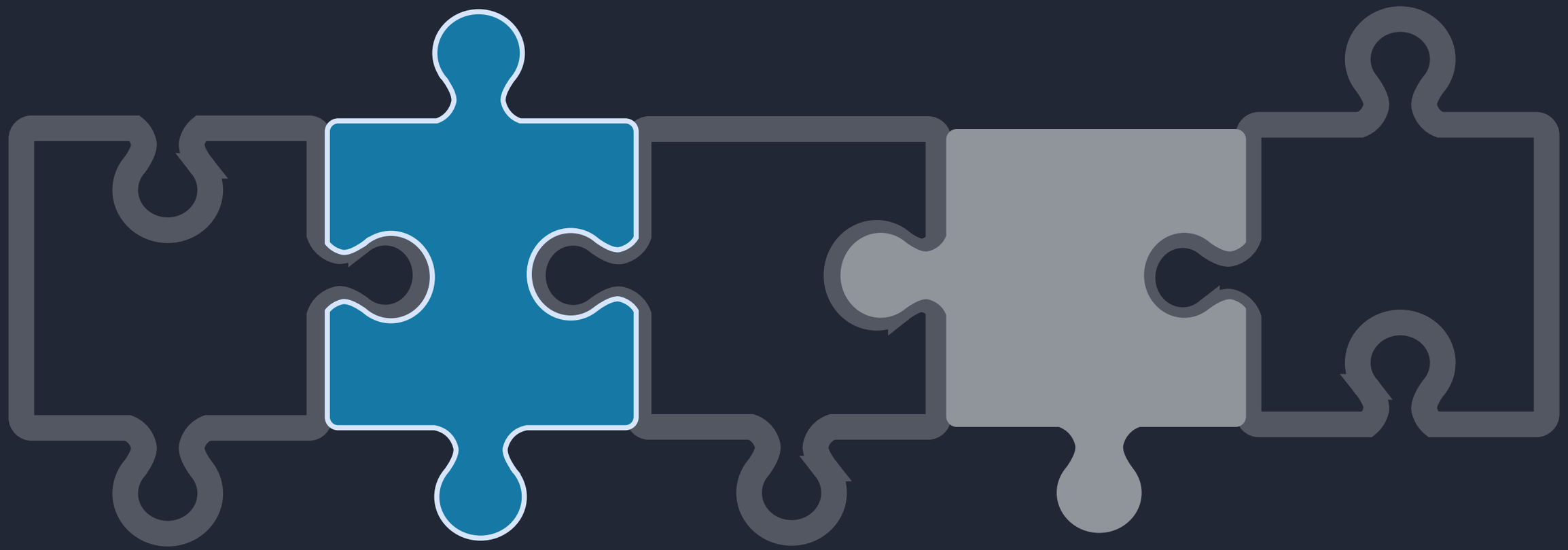
ROI upload

Monte Carlo Simulation

Image Registration

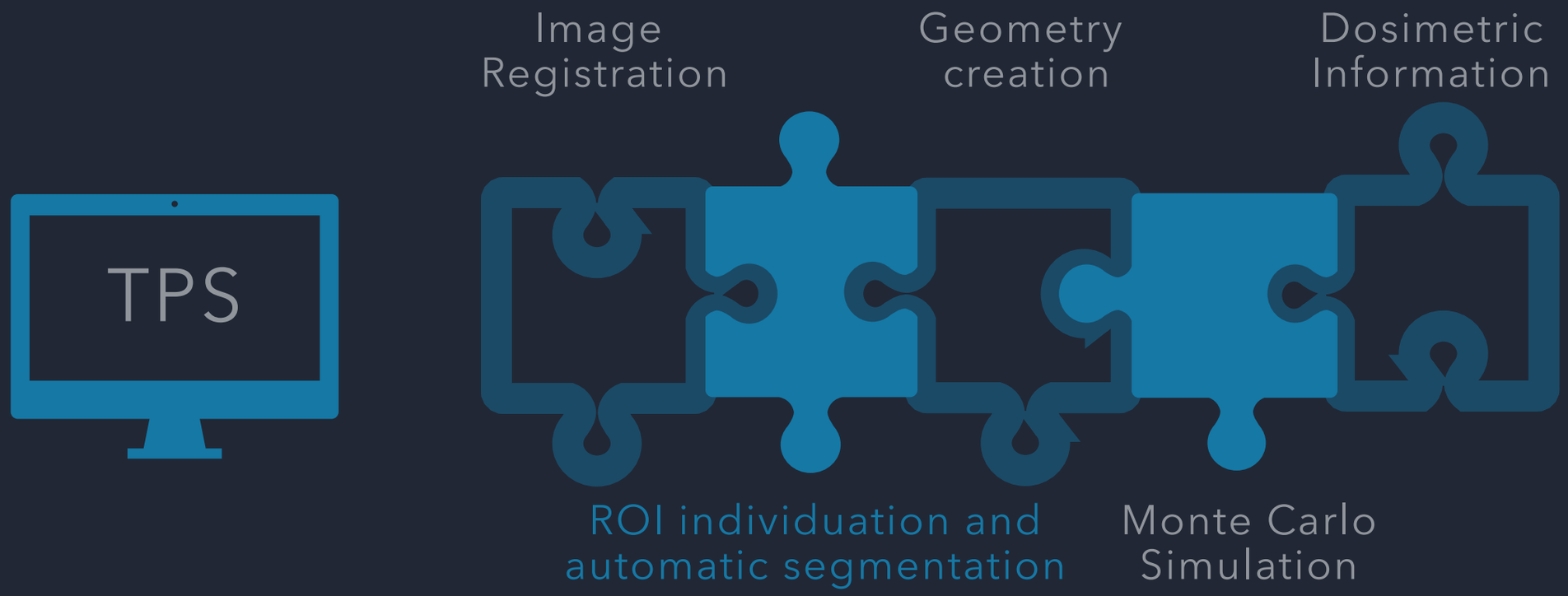
Geometry creation

Dosimetric Information



ROI individuation and automatic segmentation

Monte Carlo Simulation



CLINICAL

Aid physicians in detecting ROIs

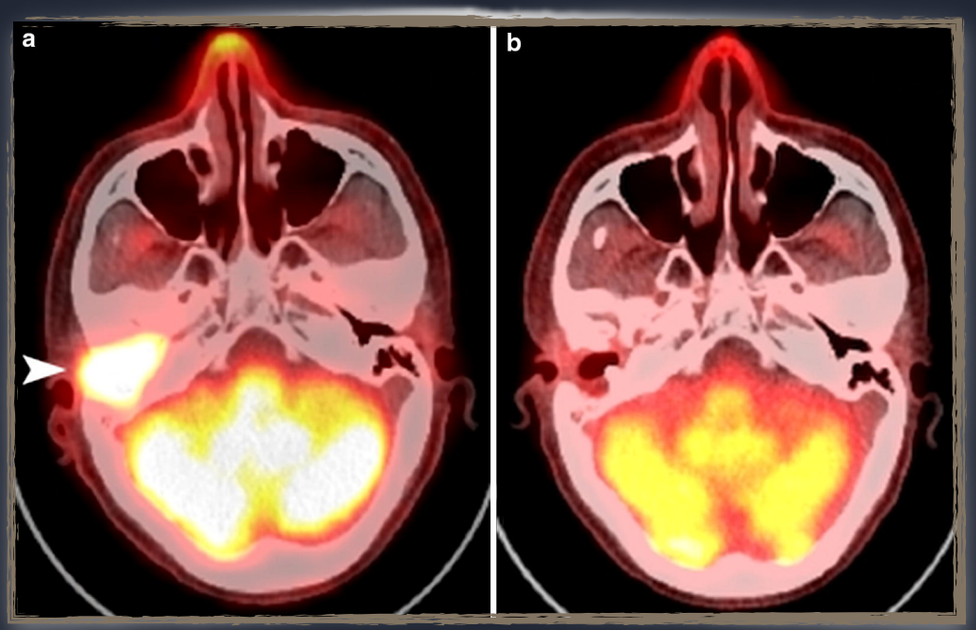
RESEARCH

Speed up database creation to improve TPS

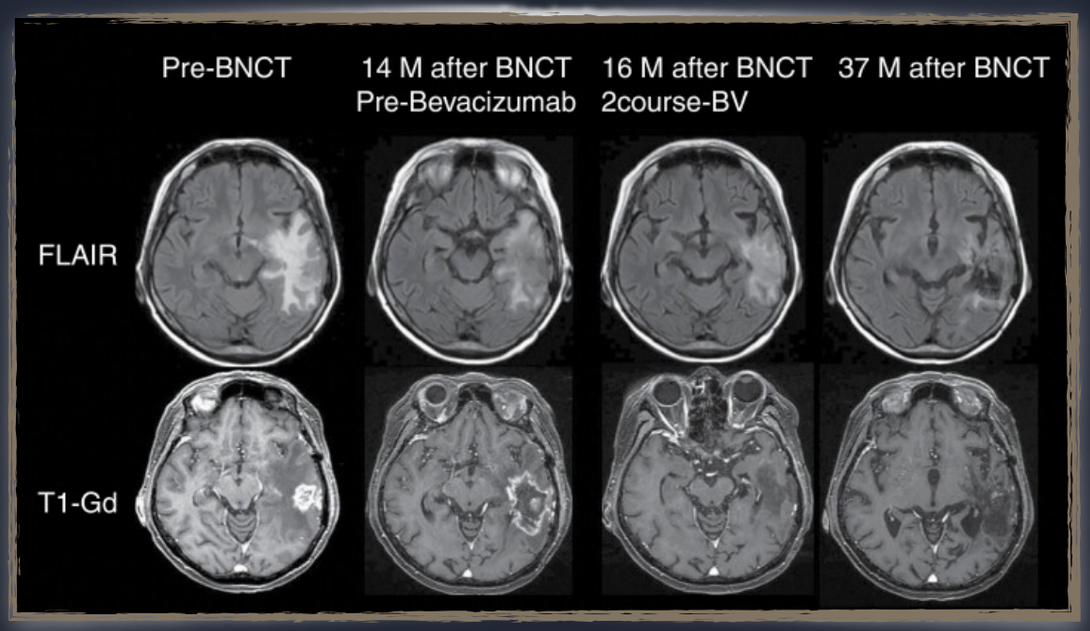
HEAD & NECK CANCER

CT
&
MRI

GLIOBLASTOMA MULTIFORME



Wang LW, Liu YH, Chou FI, Jiang SH. Clinical trials for treating recurrent head and neck cancer with boron neutron capture therapy using the Tsing-Hua Open Pool Reactor. Cancer Commun (Lond). 2018 Jun 19;38(1):37. doi: 10.1186/s40880-018-0295-y. PMID: 29914577; PMCID: PMC6006853.



Kawabata S, Suzuki M, Hirose K, et al. Accelerator-based BNCT for patients with recurrent glioblastoma: a multicenter phase II study. Neurooncol Adv. 2021;3(1):vdab067. Published 2021 May 20. doi:10.1093/noajnl/vdab067

TREATMENT PLANNING SYSTEM

INPUT:
SEGMENTED ROIS

TPS

OUTPUT:
DOSIMETRIC CALCULATION

HEAD & NECK CANCER

BNCT PATIENTS

GLIOBLASTOMA MULTIFORME

MEDICAL IMAGE DATABASE

ROI AUTOMATIC SEGMENTATION

MONTE CARLO SIMULATIONS

HDD/SDD WITH FAST ACCESS

GPU WITH LARGE VRAM

MANY CPUs WITH PARALLELIZATION

THE CANCER IMAGING ARCHIVE

We acquired a special license to use the data since the face of the patients could be reconstructed form the data

H&N data

Here is the full list of the H&N data chosen on TCIA and the checklist of what has already been downloaded:

1. AAMP - 55 patients - MR, RTSTRUCT
2. PET-CT-v2 - ~300 patients - PT, CT, RTSTRUCT, RTPLAN, RTDOSE
3. RadiomicsHN1 - 137 patients - CT, PT, RTSTRUCT, SEG
4. HNSCC - 627 patients - CT, PT, MR, RTSTRUCT, RTDOSE, RTPLAN
5. MRI-DIR - 9 patients - MR, CT, RTSTRUCT
6. OPC-Radiomics - 606 patients - CT. RTSTRUCT
7. QIN - 279 patients - PT, CT, SR, SEG, RWV
8. HNSC - 227 patients - CT, MR, PT, RTSTRUCT, RTDOSE, RTPLAN, Pathology
9. Cetuximab - 111 patients - CT, PT, RTSTRUCT, RTPLAN, RTDOSE
10. HNSCC_3DCT - 31 patients -CT, RTSTRUCT, RTDOSE
11. CPTAC-HNSCC_V9 - 64 patients - CT, MR, SC, Pathology

635 GB

GBM data

Here is the full list of the gbm data chosen on TCIA and the checklist of what has already been downloaded:

1. ACRIN-DSC - 123 patients - MR, CT
2. ACRIN-FMIS - 45 patients - CT, MR, PT
3. IvyGAP - 39 patients - MR, Pathology
4. GLIS-RT - 230 patients - CT, MR, REG, RTSTRUCT
5. TCGA - 262 patients - MR, CT, DX, Pathology
6. CPTAC - 66 patients- CT, CR, SC, MR, Pathology

IMAGE ANALYSIS

HEAD & NECK CANCER

MRI and CT images

GLIOBLASTOMA MULTIFORME

We considered various image parameters to select our images

Image type: CT, MRI, PET, RTSTRUCT etc

Image dimensions

Convolution kernel used

Filter Type

FOV dimensions and FOV shape

Number of slices

Reconstruction method

Slice thickness

Spacing between slices

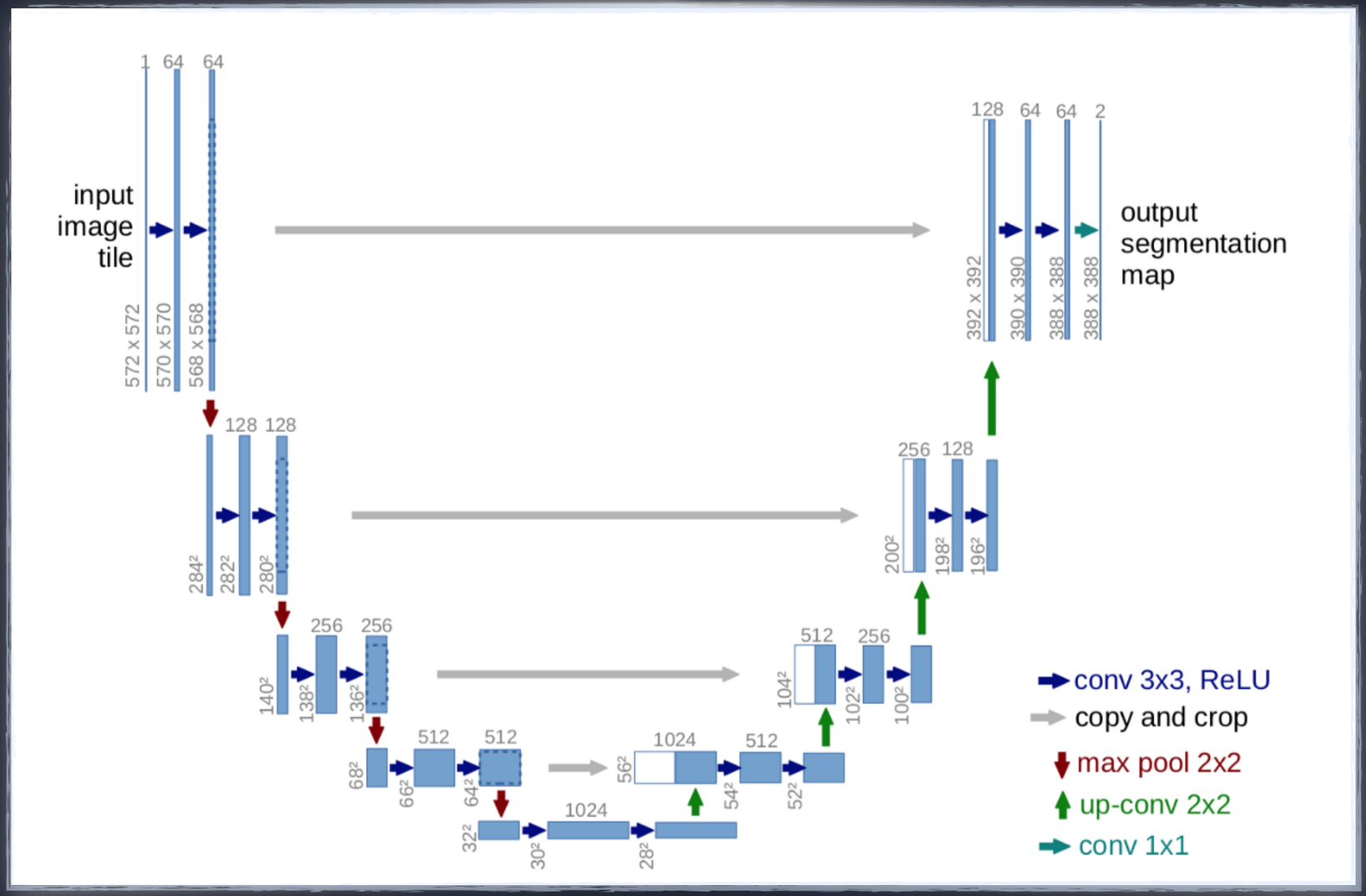
We chose for a first analysis to take into account the CT images with a corresponding RTSTRUCT

IMAGE DATABASE

	H&N	GBM
CT	**1934**	230
MRI	171	$>10^3$

Francesco Morosato - Master Thesis @ UNIPV

DEEP LEARNING



nnUNET

806 GB

COMPUTATIONAL REQUIREMENTS

AVAILABLE FACILITIES

AI_MIGHT @
INFN
UNIT OF PAVIA

RTX 3060
12 GB

EOS @ UNIPV
DEPARTMENT
OF
MATHEMATICS

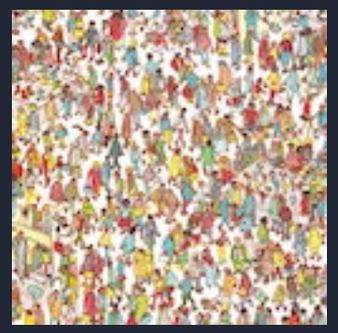
V100
32 GB

RECAS @
INFN
UNIT OF BARI

A**100**
40 GB

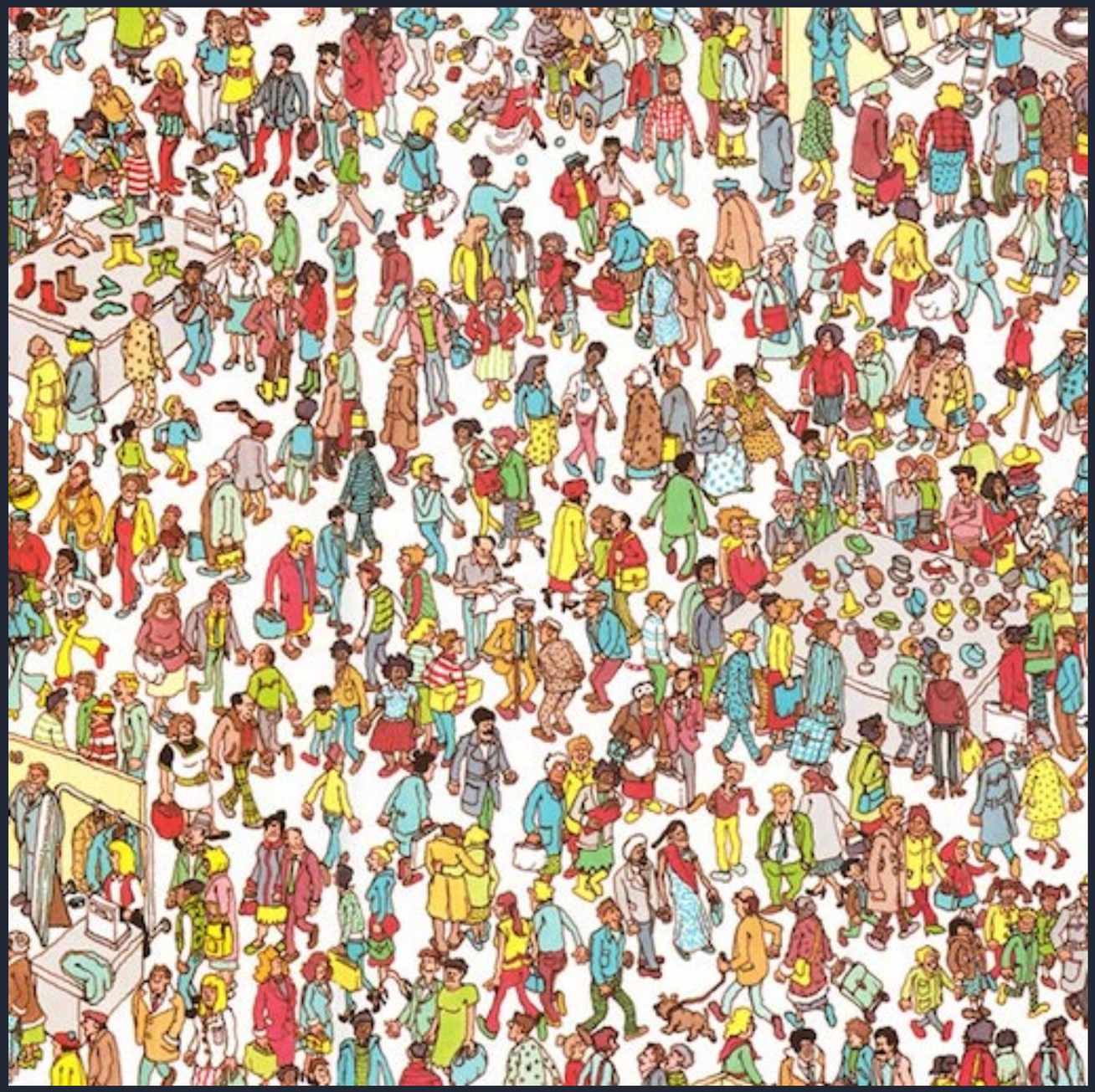
TEST DATA

64x64x64



128x128x128

256x256x256



512X512X512

OTHER PARAMETERS

DEPTH OF STANDARD NET

EPOCHS: 1

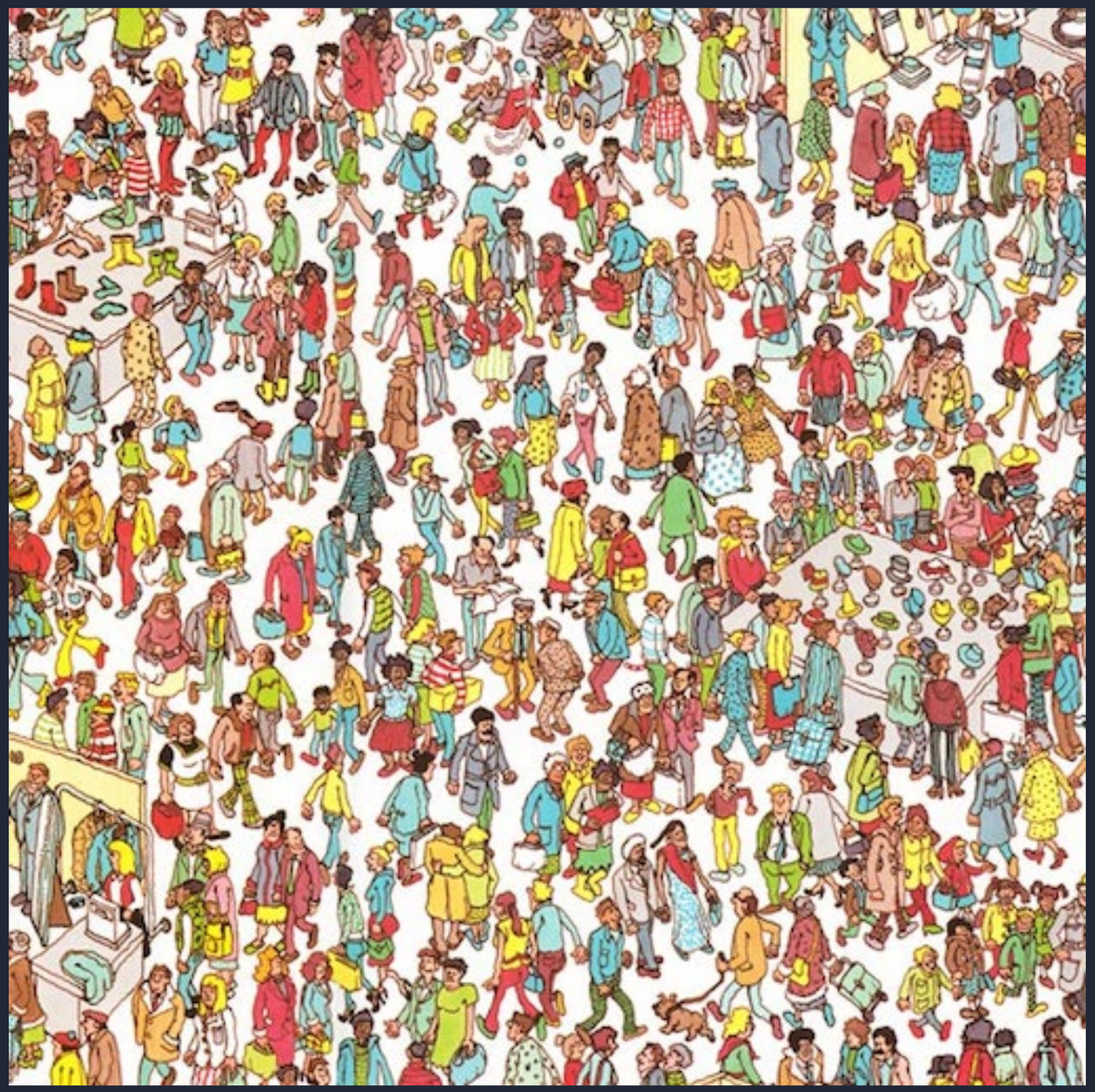
BATCH: 1

OUTPUT:
COMPLETED OR MEMORY FAULT

GB USED

DEPTH: 7

	RTX 3060				V100				A100			
	64	128	256	512	64	128	256	512	64	128	256	512
IMAGE LOAD	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
NN LOAD	✓	✓			✓	✓	✓	✓	✓	✓	✓	✓
FIT	✓	✓			✓	✓			✓	✓		



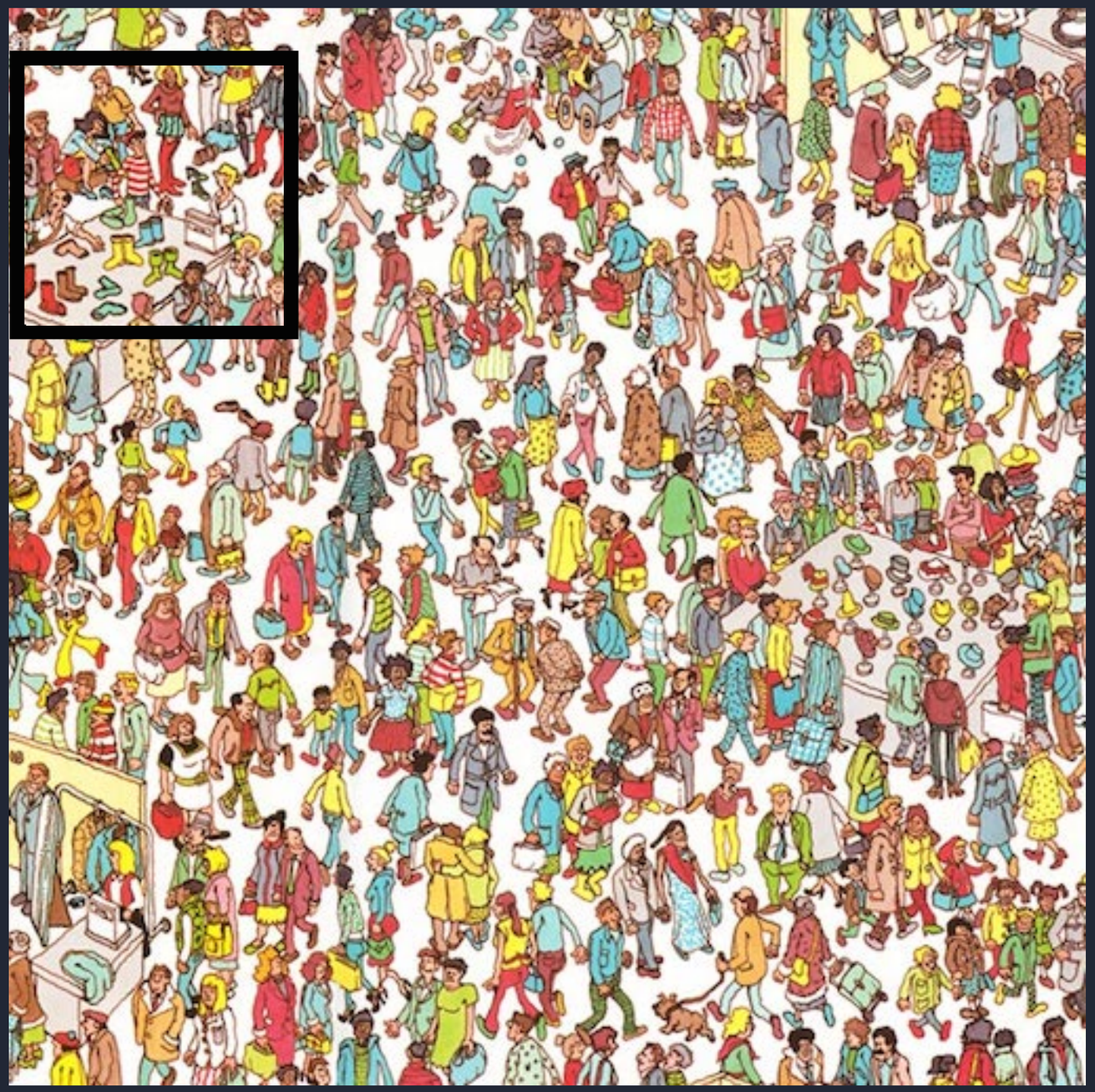
We can use a Boundary Box

We will still have big images

We would prefer to a have a patchless approach

Training on 100 epochs the computational time gets higher

We are now using the resources of recas@ba.infn **that fulfill our needs**



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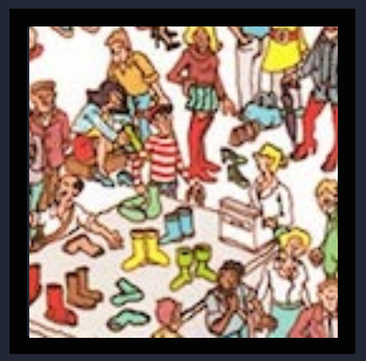

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THANK YOU!