

# covid-project

WP3: Digital Tools

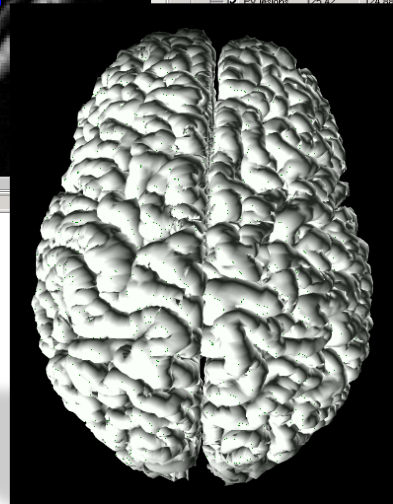
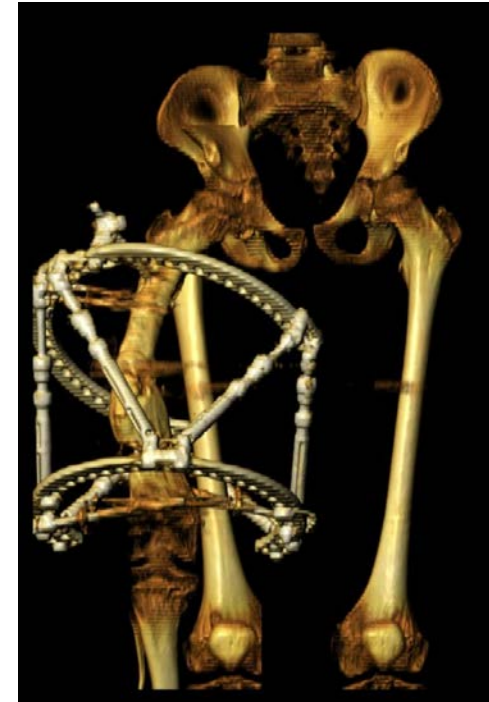
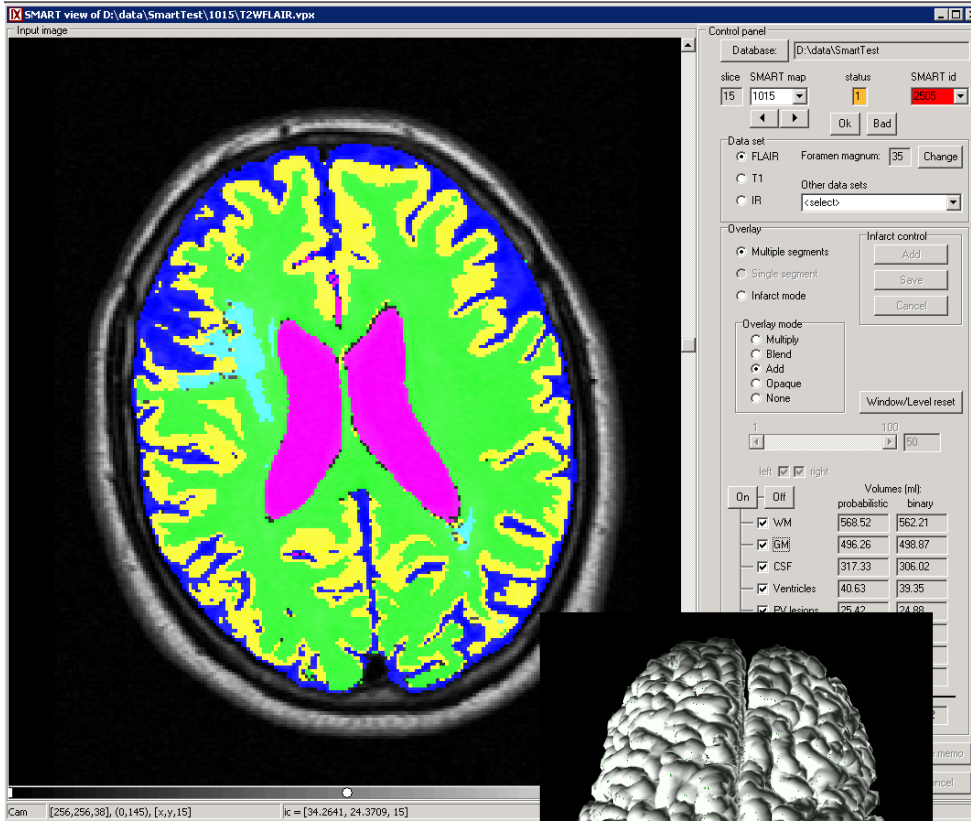
VQuest — e-learning with image manipulation

Seminar Amsterdam

Date: 19.05.2022

Dr. Koen Vincken  
Image Sciences Institute,  
University Medical Center Utrecht

# My background: Image processing



# What is VQuest?



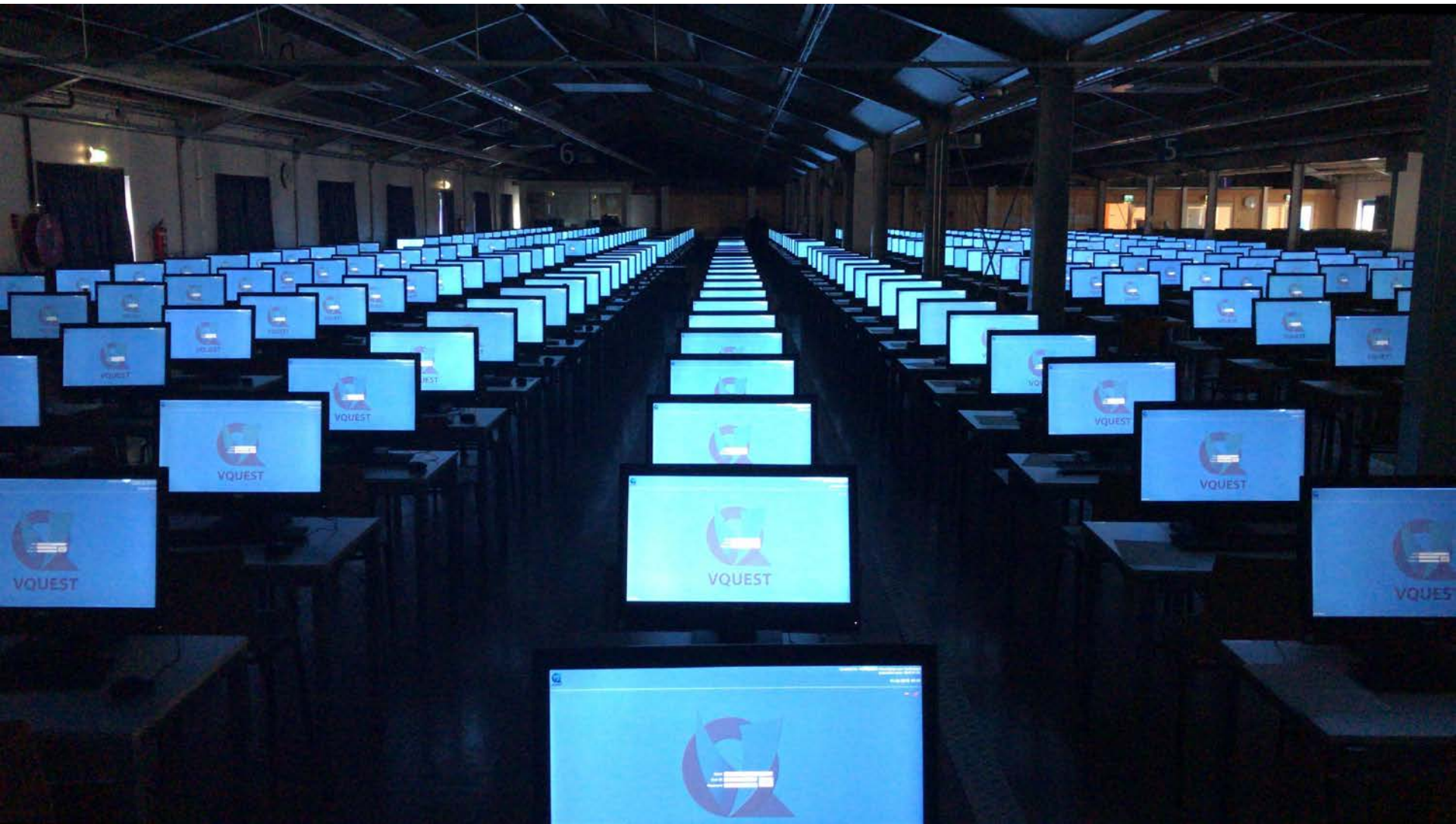
- Volume Quest
  - *volume = volumetric data (i.e. a 3D MRI-scan)*
  - *initiated in 2010 as pilot in UMC Utrecht*
  - *digital assessment for 180 undergraduate students (medicine)*
  - *new: high resolution 3D CT-scan with multiple questions*
- Developed as “educational solution” for large-scale testing, e.g.
  - *bi-annual Dutch Progress Test since 2013 ( $\pm$  350 radiology residents)*
  - *Odisee, Brussel (radiographer)*
  - *University of Münster (Institut für Ausbildung und Studienangelegenheiten der Medizinischen Fakultät)*
  - *European Society for Paediatric Research (EDiPR examination)*
  - *UMC Utrecht, many tests with radiological images*
- Examples...!





# Preparing the Dutch Progress test

Location: TenT (VU medical center, Amsterdam)



# Taking the Dutch Progress test

350 candidates, 180 questions, 60 with 1 or more (2D/3D) images





# Mammography education

by dr. Arancha Fernandez , UMC Utrecht (double monitor set-up)




# Main features of VQuest

- Image manipulation: zooming, panning, contrast enhancement and scrolling (in 3D)
  - *to practice “image interpretation skills”*
- Question types
  - *multiple choice*
  - *multiple alternatives*
  - *long list menu (drop down)*
  - *marker*



# Long list menu (drop down) question type

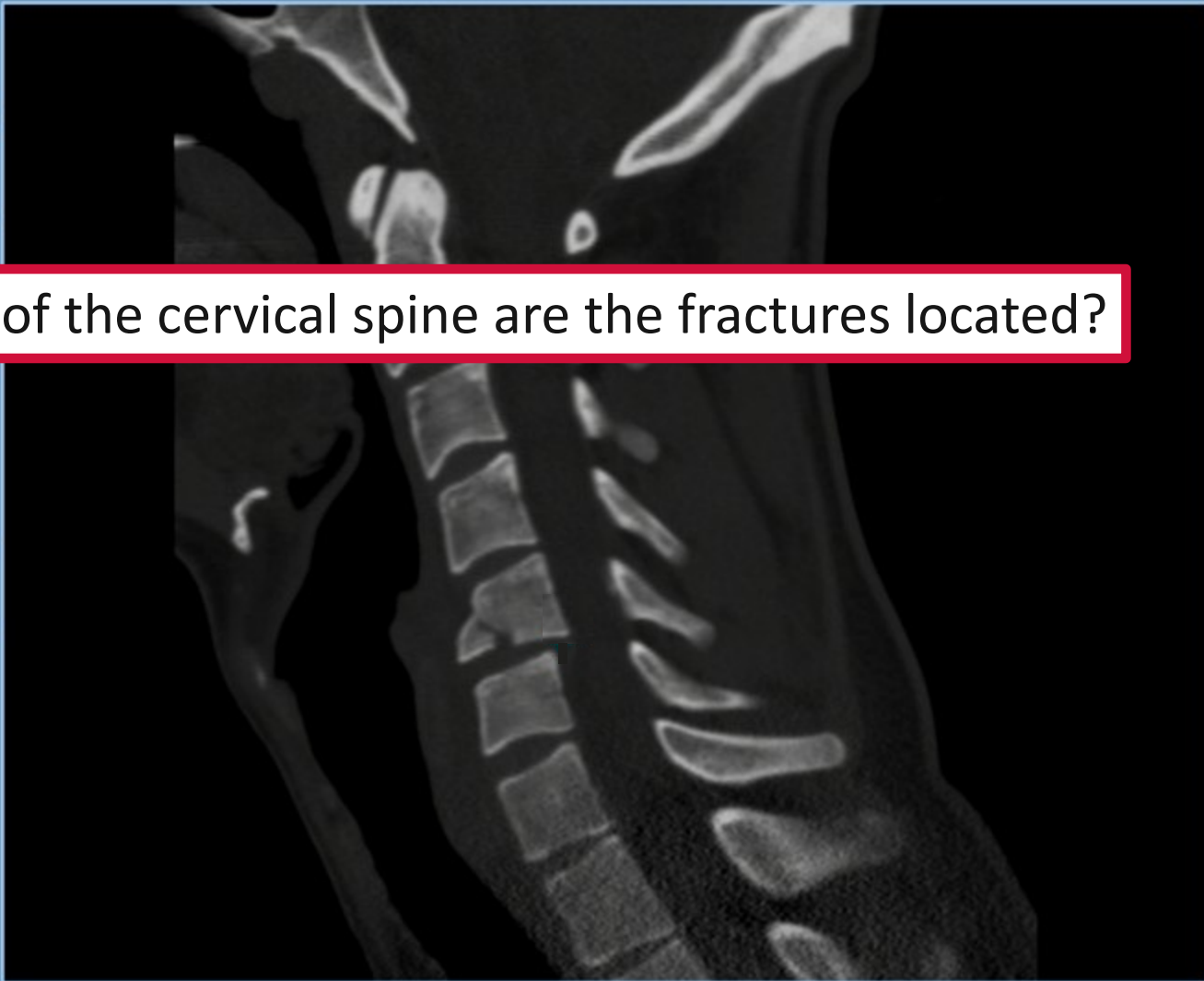
Resident (1000)  
Radiology test example (3 questions)  
0%


Vensterinstellingen   
      

**Question 1** **Emergency Radiology**  
*Male, 36 years. High velocity car accident.*

a. Multiple cervical fractures visible. At which level of the cervical spine are the fractures located?

**At which level of the cervical spine are the fractures located?**








# Long list menu (drop down) question type

Resident (1000)  
Radiology test example (3 vragen)  
0%

Contrast   
Bone



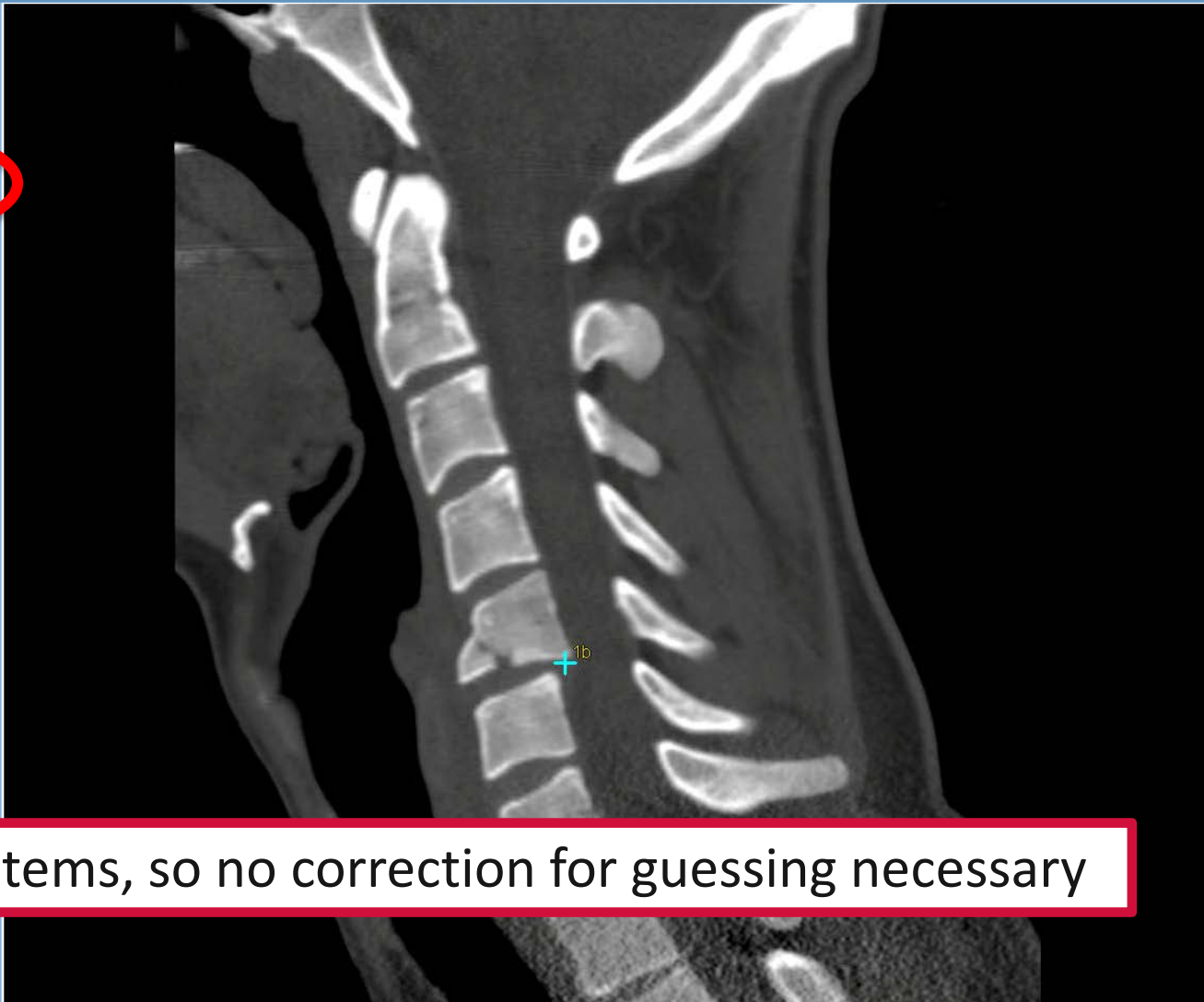
**Vraag 1** **Emergency Radiology**


Male, 36 years. High velocity car accident.

a. Multiple cervical fractures visible. At which level of the cervical spine are the fractures located?

b. There is also a related traumatic injury visible. Where is it located?

- C4-C5 Discus
- C4-C5 Foramen intervertebrale
- C5
- C5 Corpus
- C5 Facetgewricht
- C5 Facetgewricht
- C5 Lamina
- C5 Lamina
- C5 Pedikel
- C5 Pedikel
- C5 Processus articularis inferior
- C5 Processus articularis inferior
- C5 Processus articularis superior
- C5 Processus articularis superior
- C5 Processus spinosus
- C5 Processus spinosus
- C5 Processus transversus
- C5 Processus transversus
- C5-C6 Discus
- C5-C6 Foramen intervertebrale





hundreds of items, so no correction for guessing necessary

# Demo movie: marker and DD question

Student (0001) 16:01

Radiology test example (2 questions) 0%

Window/level Reset

Abdomen A S C

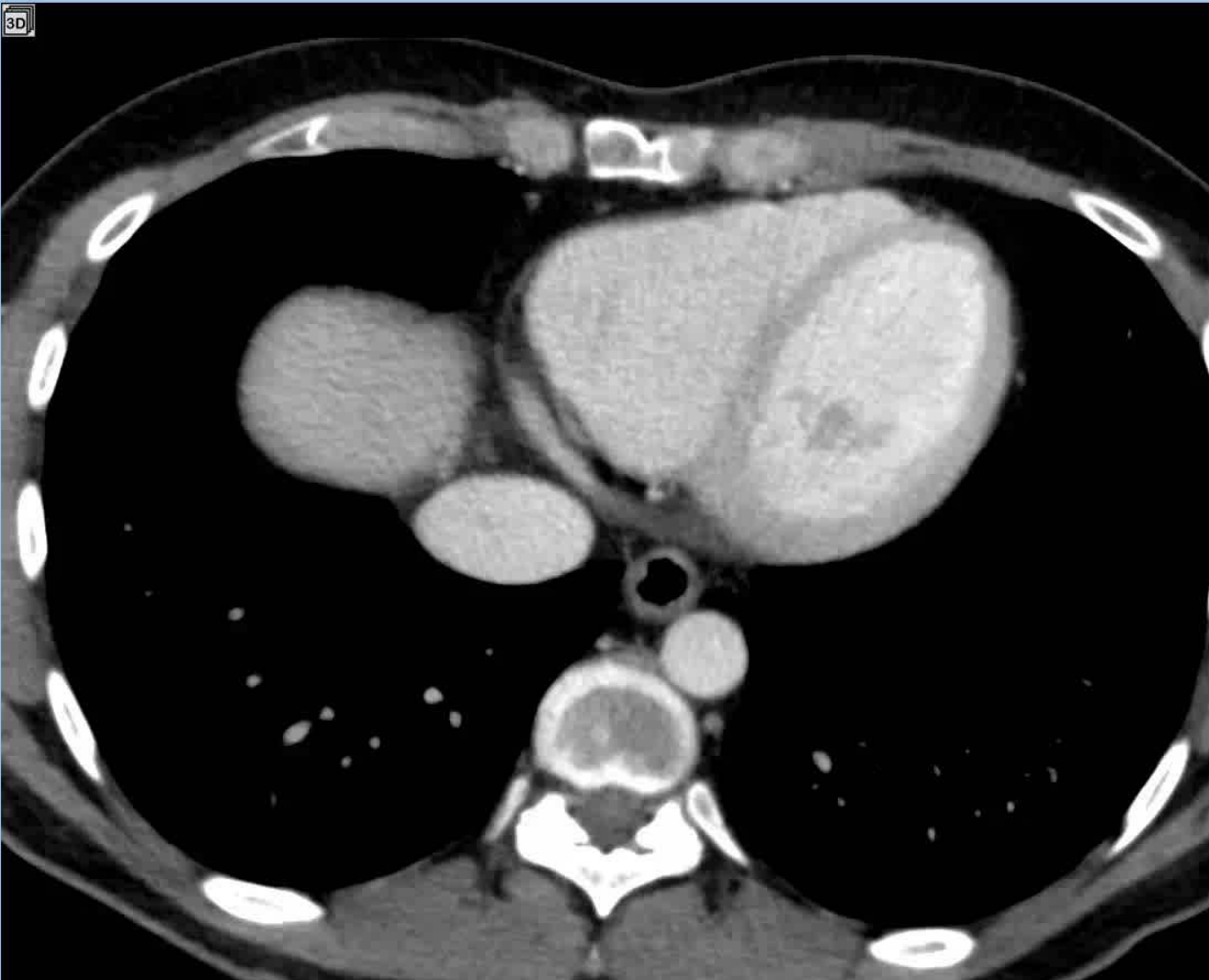
Overview Exit test

**Question 1** Radiological anatomy

Normal CT of the abdomen.

Indicate the head of the pancreas.

Place marker Cancel



A 3D icon is visible in the top left corner of the image area.

Unsure Navigate through unsure only Previous question Next question

# Question with coloured overlay

Test Student (1234)

1%

Vensterinstellingen

Reset

Abdomen

A S C

Overzicht

Toets afsluiten



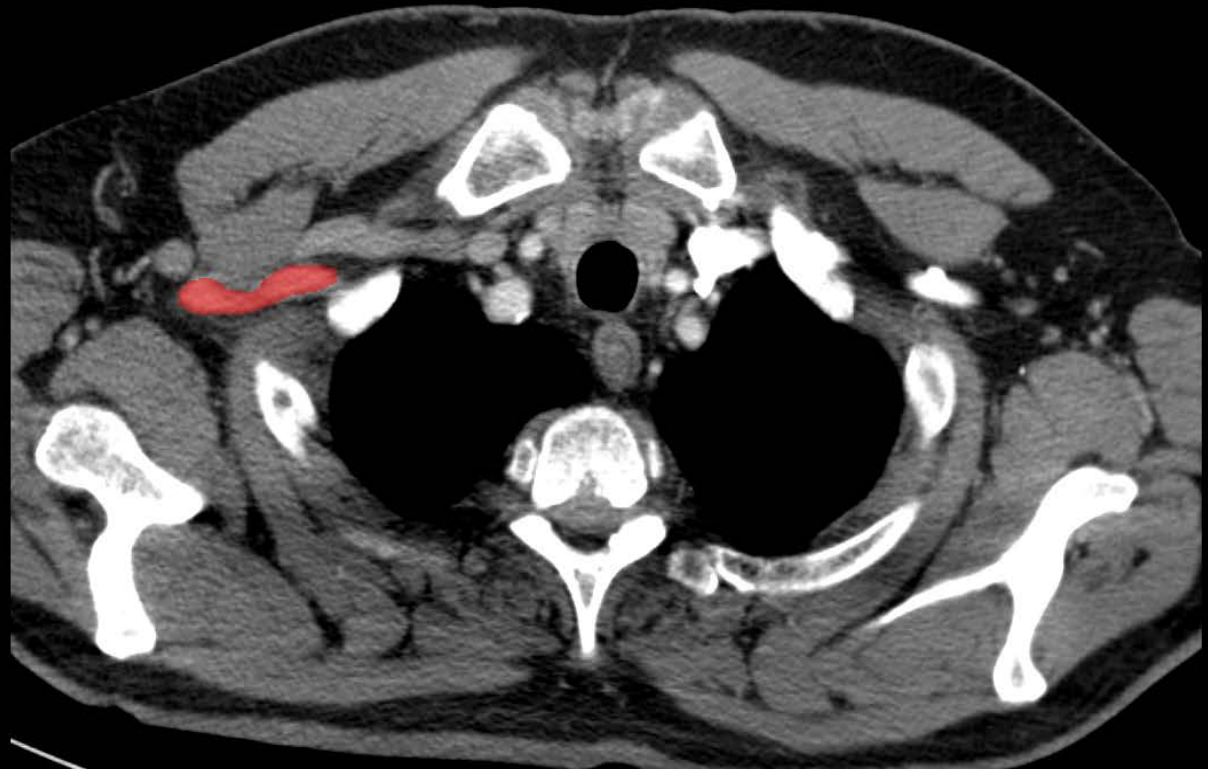
Vraag 46

Thorax anatomie

Welke structuur is rood gemarkeerd? Wees zo specifiek mogelijk. Je hoeft geen links of rechts aan te geven.

Abdominale aorta

What is the name of this structure?



Twijfel

Vorige vraag

Volgende vraag



# Multiple question types combined: testing at different levels of Blooms' taxonomy



Resident (1000)  
Radiology test example (3 questions)  
0%

Vensterinstellingen   
Bone

**Question 1** **Emergency Radiology**  
*Male, 36 years. High velocity car accident.*

a. Multiple cervical fractures visible. At which level of the cervical spine are the fractures located?

b. There is also another related traumatic injury visible. Indicate this injury in the CT-scan.

c. What is the most probable mechanism of injury based on the different injuries?  
 hyperextension  
 hyperflexion  
 compression  
 distraction

d. What is the name of this type of injury?





# Interpretation of marker answers for the teacher: hotspot images

Item analysis

**1. Hand**

You see X-ray of a hand with a fracture.

1a. (Marker) 25%

Indicate the fracture with the marker.

1b. (MC) 75%

Does the X-ray belong to an adult?

Yes  
 No

**2. Saxophone**

Here you see a CT scan of a saxophone.

**3. OS**

Multiple operating systems are in use these days.

Inspect - 1a. (Marker)

Show answer

Show heatmap

W/L: 3401/1493

Inspect - 1a. (Marker)

Show answer

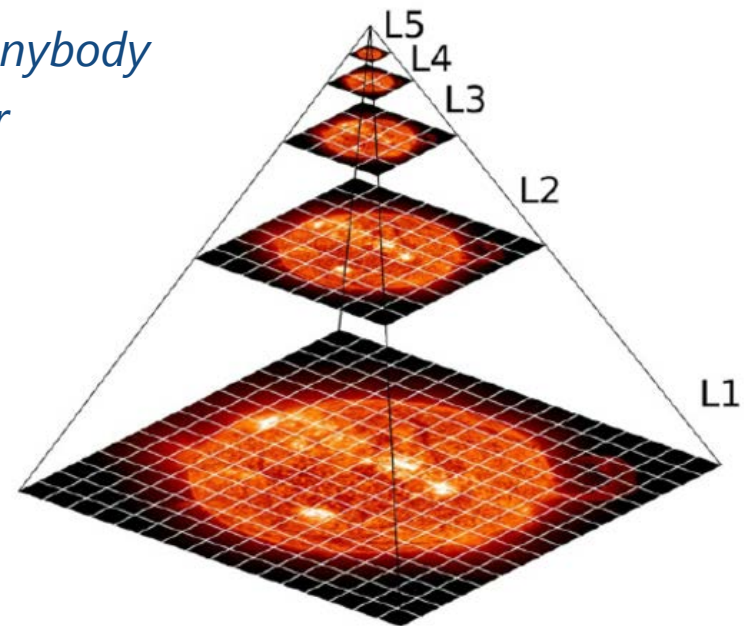
Show heatmap

W/L: 2774/1583



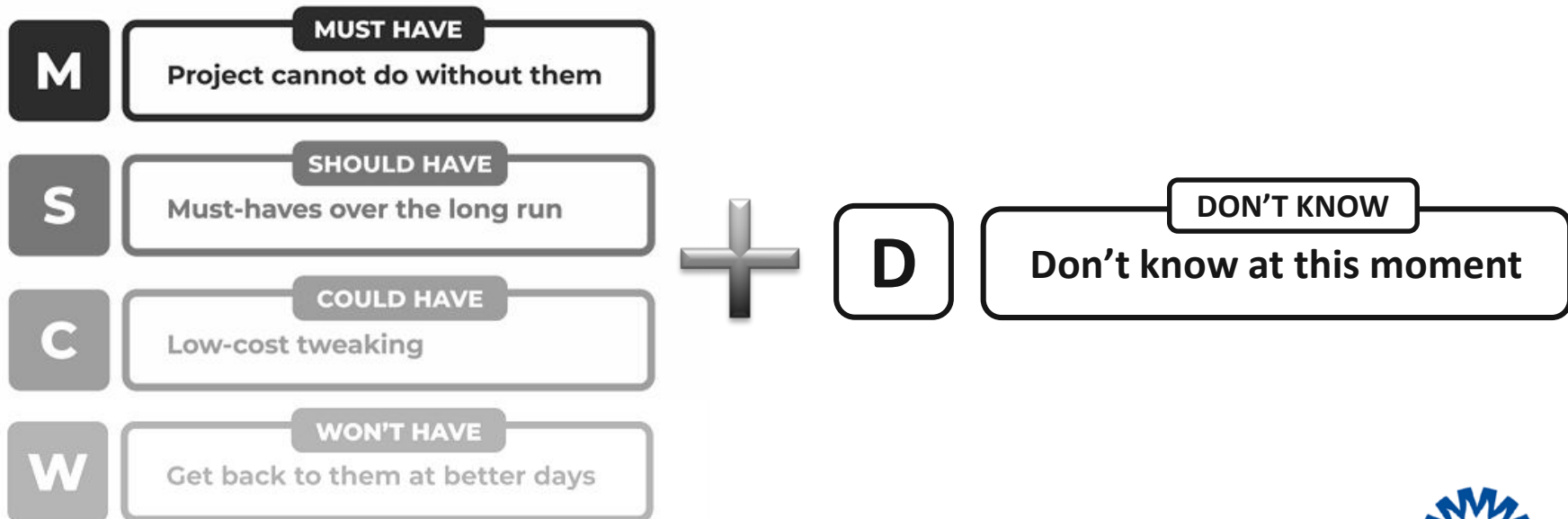
# VQuest: new developments

- From e-testing to e-learning
  - *Feedback, ideal for self study*
  - *Info blocks and hyperlinks to external websites for additional learning material*
  - *Controlled order of questions / adaptive e-learning*
- Online
  - *VQuest available anytime, anywhere, anybody*
  - *no installation necessary, just a browser*
- Whole slide images (WSI)
  - *new viewer to support tiling*
  - *open source to serve community*



# VQuest online with WSI support










- Start of cLovid: kick-off (June 2021)
- Decision on functionalities to be implemented
  - Respondents: 17 teachers, 4 students (N=21)
  - Answering questionnaire according to the well-known “MoSCoW” notation:





# Decision on functionalities to be implemented

## A. General functionalities for teachers and students

	M	S	C	W	D
Fluent zooming and panning of images 	<b>18</b>	2	1	0	0
Zoom overview 	<b>12</b>	4	4	0	1
Zoom tracking 	1	4	<b>11</b>	4	1
Show multiple images simultaneously 	5	<b>9</b>	6	0	0
Z-Stacking 	2	<b>6</b>	<b>6</b>	3	4
Rotating of images 	4	3	<b>7</b>	<b>7</b>	0
Flipping of images 	3	2	<b>9</b>	4	3
Logging of image manipulation 	3	2	<b>9</b>	4	3
Control the availability of specific annotations 	8	<b>9</b>	4	0	0

highest ranking in **bold**

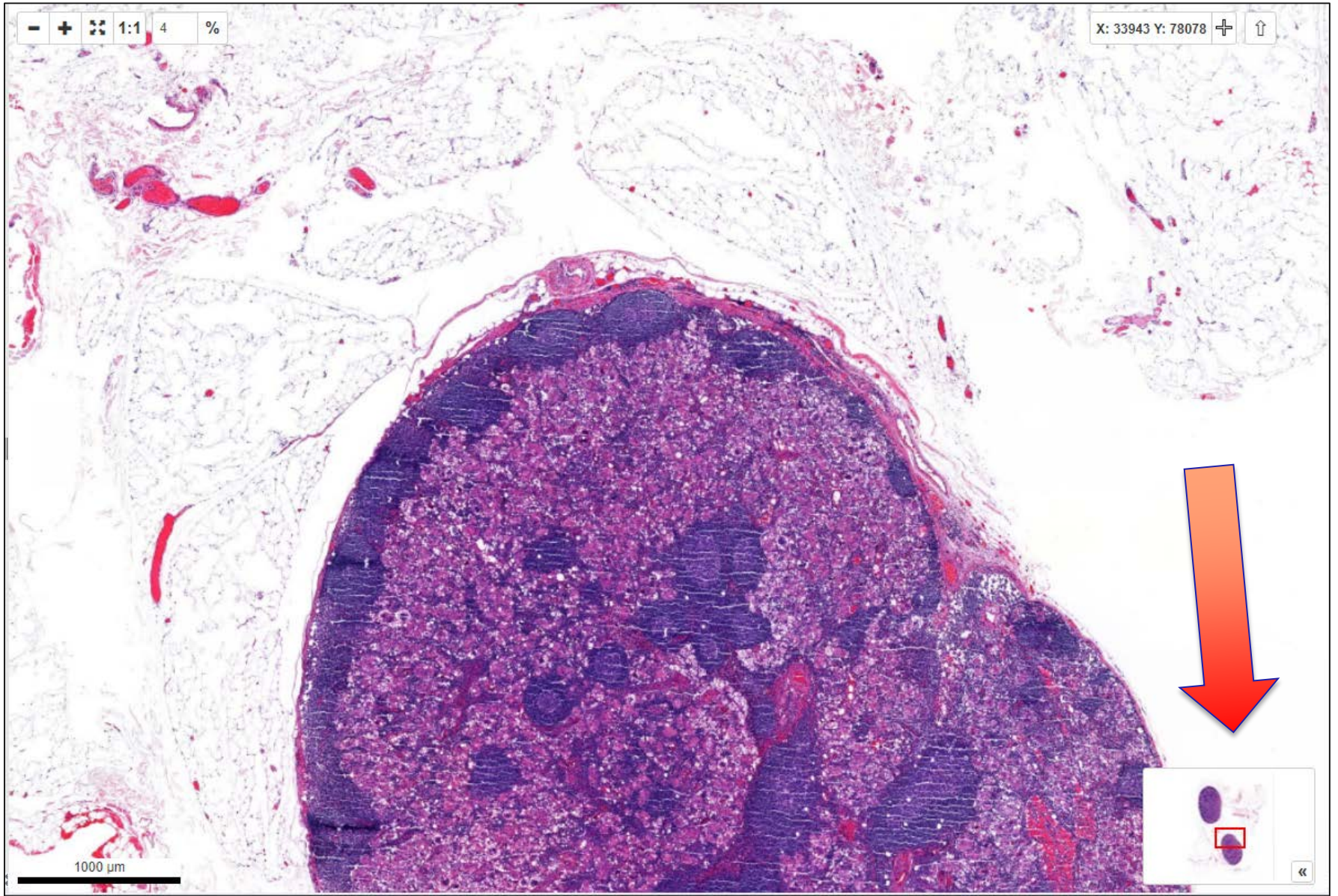


will definitely be implemented



will likely be implemented







# Zoom overview



# Decision on functionalities to be implemented

B. Specific functionalities for teachers

C. Specific functions for students

	M	S	C	W	D
Denote or highlight a specific structure 	<b>17</b>	2	0	0	2
Create Marker questions 	6	<b>12</b>	1	0	1
Create multiple Marker questions 	5	<b>13</b>	0	0	2
Ask the student to identify or describe marked areas 	6	<b>12</b>	0	0	2
Override student choices in the visibility of annotations 	<b>10</b>	4	1	0	3
Option to “make private notes” in images 	7	<b>11</b>	2	0	0



*will definitely be implemented*



*will likely be implemented*





# VQuest online with WSI support

Koen Vincken  
demo cLovid

Reset images Overview Hand in Help

UMC Utrecht, Imaging Division

VQUEST

Question 1/1 Lymph node

Specimen of a lymph node.


The histological specimen of this lymph node is abnormal because:

- The subcapsular sini can not be detected
- The general structure of the lymph node is abnormal
- The lymph follicles show germinal centres
- The lymphocytes show an abnormal cellular struture
- The lymph node is filled with multi-nucleated giant cells

Place a marker in a region where giant cells can be seen.

Place marker

2D



Slide navigation icons: back, forward, search, zoom, refresh.

Slide: 1/1

WW/WC: 246 / 132