



INSTRUCTIONS FOR USE

Slide Score v1.2

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1 Introduction

This Instructions for Use is applicable for the medical software Slide Score v1.2 For newest version, go to: <https://www.slidescore.com/docs/index.html>.

1.1 Product description

Slide Score is a web viewer for high resolution scans of microscopy images in particular histopathology slides. It makes it easy to upload images, setup a scoring sheet (set of questions) and invite pathologists to score the images.

1.2 Intended use

Slide Score is a web-based histopathology image management platform to help pathologists view, share and gather data from microscopy slides - whole slide images in research settings..

1.3 Identification of the target population

Slide Score can be used for different kinds of patient population (newborns, children, elderly population), which depends on the need, whenever pathology is needed.

1.4 Warnings

- ✓ Healthcare professionals should review Slide Score annotated images and reports concurrently with original images before making a final determination on a case. Slide Score is an adjunct tool and does not replace the role of the Healthcare professional or his/her clinical judgement.
- ✓ Healthcare professionals should review original images for all suspected pathologies

1.5 Contraindications

- ✓ There are no known contraindications for the Slide Score software, although care should be taken when considering using the product according to the warnings and limitations below.

1.6 Limitations

- ✓ Healthcare professionals should review Slide Score annotated images and reports concurrently with original images before making a final determination on a case. Slide Score is an adjunct tool and does not replace the role of the Healthcare professional or his/her clinical judgement.

- ✓ Healthcare professionals should review original images for all suspected pathologies

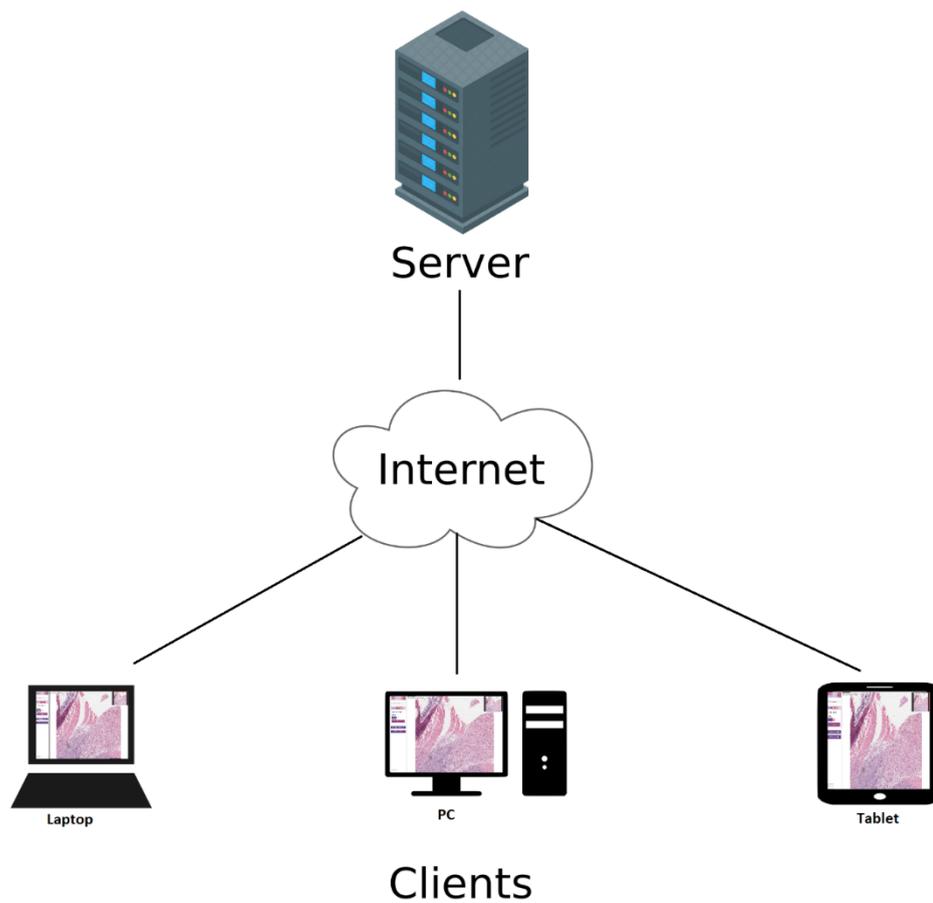
1.7 Measures that users must take for proper use of software

- ✓ Users need to respect this instruction for use.
- ✓ Slide Score shall only be used according to this Instructions for Use.
- ✓ In case a wrong image is sent for analysis, any output should be disregarded
- ✓ In the event of interruption of the network communication, the procedure must be repeated.

2 What is Slide Score and how to use it

Slide Score is a web-based histopathology image management platform to help pathologists view, share and gather data from microscopy slides - whole slide images in research settings. As a result, pathologists are able to enhance their performance while enjoying a greater user experience scoring slides.

Slide Score provides a streamlined interface that replaces the error-prone gathering and assessment of pathological variables on paper or in spreadsheet applications.



Read this instruction before use. For the newest version, go to:
<https://www.slidescore.com/docs/index.html>.

3 General safety Instructions

- ✓ This Instructions for Use (IFU) deals with the specifications, operation and maintenance of Slide Score Medical software. Slide Score is by no means responsible for any problem/accident arising from a user ignoring the instructions for use and maintenance described in this IFU.
- ✓ This IFU contains a description of all the functions available, so read this IFU carefully and familiarize yourself thoroughly with its contents before operating the software. If any technical problem should arise, please contact Slide Score B.V. (<https://www.slidescore.com/Home/Contact>)

4 Software Installation

Installation Steps:

Install operating system

Open ports 80 and 443 in the firewall (if applicable)

Execute provided installation script

Verify that the service is running, if not check output of journalctl or contents of logs/log.txt

Install HTTPS certificate (if applicable)

Adjust application settings (appsettings.json)

- if you use an internal SMTP server, provide its settings in Email.SmtpServer, Account and Password. Also change the FromAddress to a mailbox you control.
- if the MX record of your domain is not accessible from Slide Score server - for example because it's in an DMZ - add your domain to Email.WhiteListEmailDomains
- set the email addresses of site administrators (;-separated) in Admin
- if you want to store images on another volume, make a symbolic link called images in the slidescore directory that points there. This location must be read-write
- add any extra folders from which you wish to include whole slide images to AllowedFolders (read-only)
- if you want to use cBioPortal integration, set AllowEmbeddingFrom to domains of your cbiportal servers (;-separated)
- To help planning the deployment: These are folders that can contain user-uploaded files: UploadTempStore, RootImagesFolder, ThumbnailsFolder. UploadTempStore needs <20 GB space, RootImagesFolder stores all the slides and attachments, ThumbnailsFolder needs about 300 KB per image

4.1 Hardware requirements

The hardware requirements are:

- Minimum specifications:
 - 2 vCPUs
 - 8GB RAM
- Recommended specifications for institutions:
 - 16 cores

- 64GB RAM
- OS and database on SSD
- 1Gb Network
- ☐ For each concurrent user
 - 1 core
 - 300 IO operations/s on slide storage

4.2 Software requirements

Slide Score is deployed behind Apache reverse proxy that forwards requests to the .NET Core server (Kestrel). Slide Score uses an in-process Sqlite3 as a database.

Operating systems

We recommend Linux systems for optimal performance.

Following operating systems are supported:

- Ubuntu 18.04 or 20.04
- RHEL/CentOS 8

Additional software

Main software packages required (Debian): aspnetcore-runtime-5.0, sqlite3, libtiff, cairo, libxml2

Networking

- open incoming port 443 for HTTPS
- (optional) outgoing SMTP connection for sending emails
 - o otherwise Slide Score will use Amazon Simple Email Service API over HTTPS

5 Product features and Functional description of Slide Score

5.1 Getting started

Register as a new user and login

When you first open Slide Score you will be greeted with a login form:

Log in

Use your Slide Score account to log in.

Or register as a new user

1

Email

Password

Remember me?

Log in

[Forgot your password?](#)

If you don't have an account yet, click the link **1** to open registration screen:

Register

Create a new account.

Email

1

Password

2

Confirm password

3

Register



Instruction for Use - Slide Score

You can enter your email in **1** - your colleagues will give access to the studies to this email so make sure it's the right one. Please enter password with at least one non-alphanumeric character ('!', ',', '+', '-', '(', '<', ...), digit ('0'-9') and uppercase letter ('A'-Z') each. For example 'password1' is not an acceptable password but 'W!2_>e9TE' is. Please enter your password in **2** and a second time to **3** for confirmation. When done click the "Register" button.

You will get an email with a confirmation link

Slide Score

to me ▾

Please confirm your account by clicking this link: [link](#)

Please click the link, you will be taken directly to the home screen.

If your account has access to sensitive data you might want to set-up [two-factor authentication](#).

Score your first slide

In Slide Score slides are organized into studies - sets of images that logically belong together and need to be scored with the same criteria. You can learn more about how to organize them in the [Administration section](#).



All studies

Synchronized viewing...

1	Slides	TMA's	Score!
TMA_Demo HE	0	1	
WSS_Demo HE	5	0	

2

Search 

Search studies and samples:

Stainings: 

HE

The [home screen](#) shows the list of studies **1** with their "Score!" buttons **2**. Clicking this button will take you directly to the next slide that you need to score from that study. The header shows the currently logged in user and a link to log out **3**. You should always log out when not using Slide Score.

Click the "Score!" button **2** for "WSS_Demo" study now.

Using the slide viewer

That opens the whole slide viewer of Slide Score:

Log out

Scoring

Staining intensity 2

0
1
2
3

No tissue
No tumor
Too few cells

Staining H-Score 3

% of cells with intensity 0+:

<25
25-49
50-74
>75

% of cells with intensity 1+:

<25
25-49
50-74
>75

% of cells with intensity 2+:

<25
25-49
50-74
>75

% of cells with intensity 3+:

<25
25-49
50-74
>75

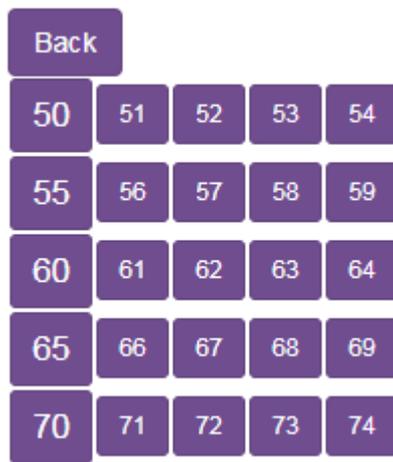
No tissue
No tumor
Too few cells

Submit

On the right you see the actual slide 1, you can zoom in and out with your mouse wheel, click and drag the view with a mouse or use cursor keys to move around.

There is a scoring panel with two questions and a submit button on the left side. You can indicate the intensity of the staining by clicking 0, 1, 2 or 3 on the "Staining intensity" question 2. You can also use the buttons "No Tumor", "No tissue" or "Too few cells" if it's not possible to answer this question for one of these reasons. Second question asks for H-Score - percentage share of cells with particular intensity 3 (of course it doesn't make much sense to talk about the intensity of staining on an H&E slide, but it's an example). You can indicate an intensity by first clicking a button with a range that includes the actual percentage and then clicking a button with the number. For example if we want to indicate that 60 % of cells are of intensity 0+, we would click the button labeled "50-74". This will open the range 50 - 74 with 5 numbers per row:

Instruction for Use - Slide Score



Now we can click the button "60" and that answers this part of the question. Once we fill in 3 percentages the 4th percentage in H-Score will be added to sum up to 100.

When all the questions are answered

Staining intensity



Staining H-Score

% of cells with intensity 0+:



% of cells with intensity 1+:



% of cells with intensity 2+:



% of cells with intensity 3+:



we can review them again, clicking the button with an answer **1** will open the question again and

we can indicate a different answer. We can submit the answers by clicking the Submit button **2**.

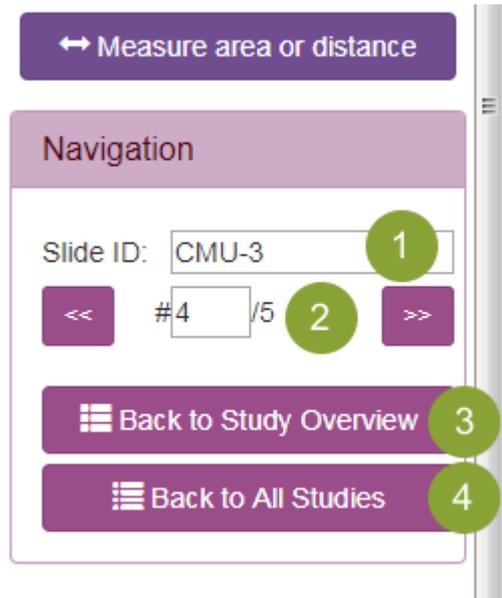
Doing that takes us to the next slide in the study that we haven't scored until there are no more slides. Congratulations on scoring your first slide!

Navigating between slides

You can use the Navigation panel to move to a different slide:



Instruction for Use - Slide Score



The first field ¹ shows the name of the slide. You can type in the exact name of another slide and press Enter to show that instead. If you don't know the exact slide name you can move to the previous and next slide in the study using the buttons at ². The text box displays the position of the currently displayed slide in the study, you can change it and press Enter to jump directly to a slide at a different position. In the example above we are viewing the 4th slide out of 5 in this study.

You can use the last two buttons to go to overview of this study ³ or the home page with all studies ⁴

Score your first TMA

What is a TMA?

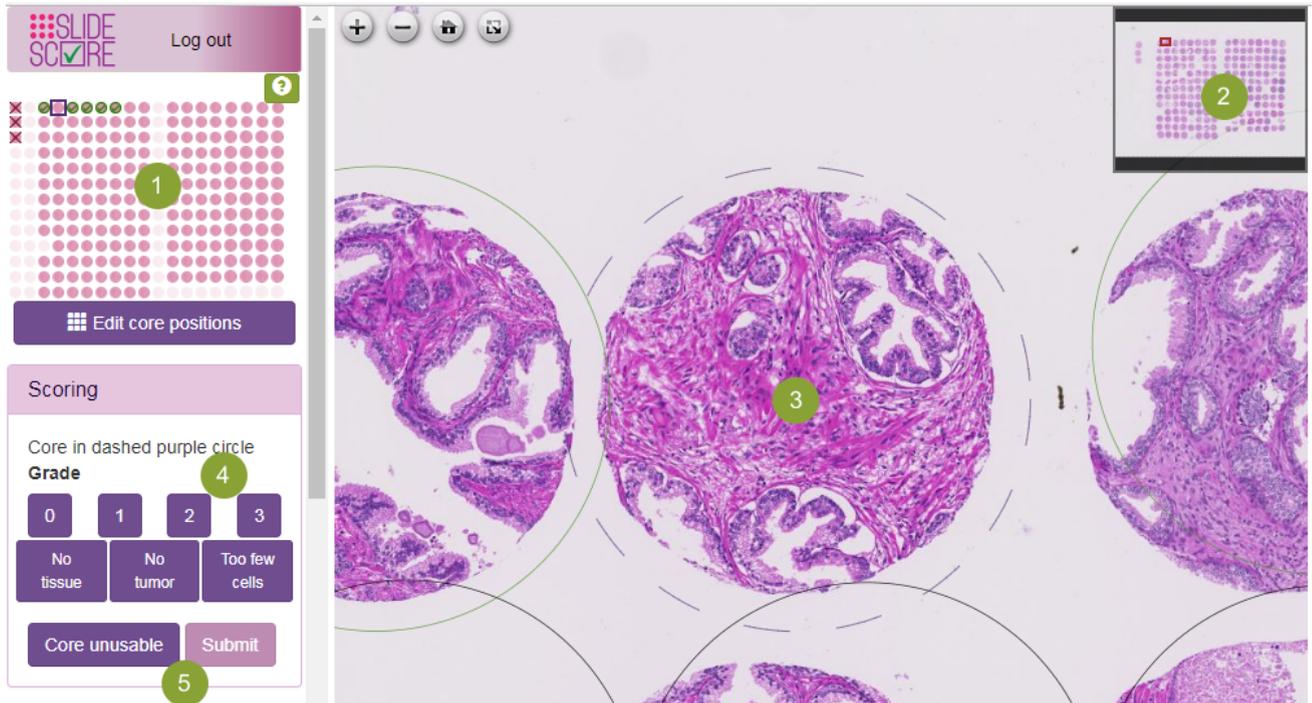
TMA (Tissue MicroArray) is a rectangular grid of hundreds of **cores** - circular tissue samples around 1mm in diameter - on a slide. These cores are so small that things often go wrong and the tissue gets folded or the core gets washed away and the core becomes unusable or missing. That's why there are 3 or 4 cores from the same sample, the **duplicates**.

TMA map defines which core belongs to which sample. **Controls** - cores for checking the staining or the orientation - are also indicated on this map.

TMA allows staining lots of samples with fewer antibodies and saves tissue. Slide Score allows you to score them quickly.

TMA Overview

To see a TMA in Slide Score click on the "Score!" button - the one with a checkmark - next to the "TMA Demo" study like we did for the whole slide study [in the previous section](#). Your browser will then show something like this



The TMA map is shown in upper left corner (1), you can compare it with the actual slide on the overview of the slide on the right (2).

You can click a core on the TMA map to select it, that will also move the view to the selected core and zoom in on it.

The selected core is marked with a dashed circle (3). If you haven't scored the core yet and you aren't happy with the position, you can click anywhere on the slide to move the center of the core there. Hopefully, it's already been done (see [how to place the grid](#)).

You can also click another core to select it and move the view on it.

Filling in the scoring sheet at (4) is done the same way as for whole slides. There is an extra button (5) which you can click to indicate that this core can't be scored because there is a problem with it (it's just not there or the tissue is folded, out of focus or obscured).

The green question mark button next to the TMA map (1) shows the legend and some keyboard shortcuts

Instruction for Use - Slide Score

X

	Not a core
	Control core
	Unusable core
	Scored core
	Selected core
	Duplicate (1 sample)

Hold Ctrl to see current scores
 Single click to move center of current core
 Press 'p' to go back to the previous core
 Press 'n' to go to next unscored core
 Press 'm' to go to next core without position
 Press 'Ctrl+F' to search for core

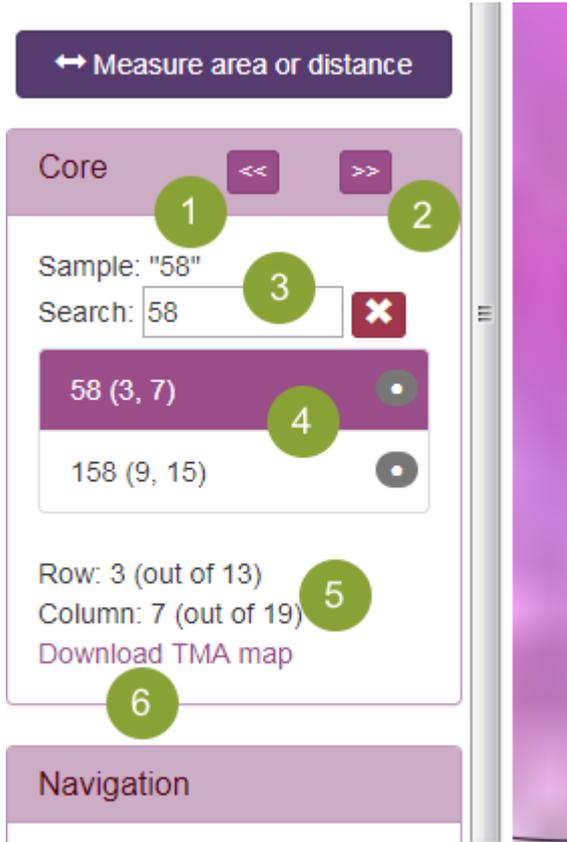
Most important is that the pink circles are cores and they get a green checkmark when you score them. Circles with a red cross are controls which you can't score.

TMA Core Navigation

[Watch this as a video](#)

You can change the selected core by clicking the TMA map, clicking the core on the slide, or by using the TMA Core Navigation panel

Instruction for Use - Slide Score



The back button **1** appears once you have moved between cores at least once. Clicking it will take you to the previously selected core.

The forward button **2** selects the next core that you haven't scored yet.

You can see the sample identifier of the currently selected core **3** and the search box under the navigation buttons. If you type (a part of) a sample identifier into the search box, Slide Score will display a list of all cores that have a sample identifier containing what you've typed. For example, here we typed "58" and both cores 58 and 158 show up in the search results **4**. The search results contain the sample identifier of the core along with its coordinates (in the format: row, column), and an indication whether it has been placed (a dot) or scored (a checkmark). You can click one of the cores to select it and zoom in on it.

Coordinates of the current core **5** are also displayed, above the link to download the original TMA map **6** that you can use to check the map. Note that this link appears only if your study manager has uploaded it.

5.2 Advanced

Using study overview

Study overview is the default page when you log in to Slide Score.

All studies Synchronized viewing... 6

	Slides	TMA's	Admin
+ Collaborations DCIS Breast HE CD68 2			
BASIS Breast HE	560	0	5
Colon trios Unpublished COAD Colon HE	0	138	

Search studies and samples: 3

HE x 4

Organs: Breast Colon Endometrium

Diseases: COAD DCIS

Stainings: CD68 HE P53

You can see all the studies that you have access to here arranged in folders. Folders can be opened by clicking the "+" button 1 to display the studies contained within.

Slide Score shows the staining(s), disease(s) and organ(s) within the study as "tags" next to a study (or folder) 2. You can click a tag to quickly show only studies with the same tag.

You can do more filtering on the right side. Use the search box 3 to search study name, image names and TMA sample IDs for a value. You can combine this with searching by tags - all tags are displayed below the search box. You can return to the default view by clicking the red cross button 4 or pressing Escape.

You can see the number of whole slides and TMA's to the right of the tags.

Each study has up to 4 quick access buttons 5:

- Start Scoring - takes you directly to the first image or TMA core that you haven't scored yet in this study

Instruction for Use - Slide Score

-  Download Results - download the file containing all answers submitted so far (see [the Get results section](#) for more).
-  Reimport - re-import this study based on configuration files. This button only shows up for [server administrators](#)
-  Edit Study - opens the [administration screen](#) for this study

It's possible to view up to 8 slides or TMA cores at the same time with Synchronized Viewing 6. This is described in the [section on Synchronized Viewing](#)

Clicking the study name takes you to the overview of that study.

Using study view

Study view lists the slides contained in this study with their thumbnails, labels and an indication whether you've already scored them.

TMA_Demo

Results
Download Results
Edit Study
Open In QuPath 1

Start Scoring! 2
Search slides and samples: 3

Thumbnail	Label	Name	Scored?	QuPath
		HE_Hamamatsu	17%	Open in QuPath

Back to Study List 4

You can use the buttons next to the study name 1 to view/download results or edit the study in the [administration screen](#) (these buttons only show up if you have the right to do that). If you have [QuPath integration](#) enabled you will also see a button to download a QuPath project containing all the images in the study.

"Start Scoring!" button 2 will take you directly to the first image or TMA core that you haven't scored yet.

Search slide names or TMA core identifiers using the search box 3.

Slides can have a thumbnail and a label (these can be switched off in the [administration screen](#)), name, whether it's scored (or a percentage of the TMA cores that have been scored) and a button to open the image in QuPath if you have [QuPath integration](#) enabled.

To go back to overview of all studies click 4

Get results

If the administrator of the study [gave you the right to download results](#) you can download the slides' scores at any time by going to the [study overview](#) and clicking the download button with an arrow pointing down.

Another option is to open the [study view](#) by clicking its name and click "Download Results". This page also has a "Results" button - this will show the scores in your web browser. Note that only the first 1000 answers are shown, you have to download the file for the rest.

Results for TMA studies don't include cores that were marked as not available.

Results are arranged one answer per line, each line contains the image that was scored, by whom, which question was answered, details of a TMA core if it is a TMA and the value of the answer.

For whole slide studies with questions other than annotation and free text there is another way to view the results: "Results Comparison". You can see how many people answered each possible answer for each whole slide, the consensus and how your scores compare with others. It is useful for assessing concordance for each slide. You can access it from the Results view.

✔ Results List

Select a question Specimen type ▼

Thumbnail	Label	#	Name	Your Answer	Majority Opinion	Agreement	Biopsy	Resection
Search...	Search...	Search...	Search...	Search...	Search...	Search...	Search...	Search...
		1	1808	Biopsy	Biopsy	1.00	1	0
		2	CMU-1- Small- Region	Resection	Resection	1.00	0	1

☰ Back to Study List

You can click the header of a column to sort the list by that column or type into the text field under the header to filter it.

Two-factor authentication

Data in Slide Score can be quite sensitive. If you want to secure your account from hackers you can enable the so-called two-factor authentication - to login you will need a one time code from a special app on your smartphone next to your email and password. Hackers will have a much harder time stealing your account!

2 step verification needs some basic setup. You will need to download an authenticator app that will receive the code and configure it to work with Slide Score.

To start login to Slide Score and click your username in the upper right corner. This will open your account settings. On the right select "Two-factor authentication". You may need to reenter your

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password to confirm your identity. Then click the "Add authenticator app" and follow the steps outlined there.

Manage your account

Change your account settings

Profile	Two-factor authentication
Password	Authenticator app
Two-factor authentication	<input type="button" value="Add authenticator app"/>

You can set it up on multiple devices so that you always have access.

If you lose your phone and are worried that someone might access your account you need to reset the authenticator key. That option will be enabled in the "Two-factor authentication" menu once you configure your authenticator app.

Tips when scoring

Keyboard control

Using a mouse for extended periods can cause RSI (repeated strain injuries). We understand that scoring slides can be addictive but you should always take breaks.

To help avoid the risk of RSI, Slide Score supports a lot of keyboard controls.

When viewing a slide:

- Arrow keys (or W, A, S and D) pan the slide. You can hold them to move around rapidly.
- Holding shift while pressing left and right arrow keys results in finer movements.
- Holding shift while pressing up and down arrow keys zooms in and out a small amount, respectively.
- Q and E zooms in and out a larger amount, respectively.
- X (or number 0) zooms out so that the whole slide fits the screen.
- Number keys 1-5 (in the alphanumeric part of your keyboard not numpad) zoom in to a predefined level.

If you press one of these keys and nothing happens it could be that the slide viewer is not receiving keyboard input. Click the slide or pan it with the mouse to fix that.

Predefined magnification levels

You can set a magnification level using either a keyboard shortcut (as described above) or a button in the top part of the viewer that resembles an objective with a color band indicating the level. These levels are similar to common microscopes, from small magnification to large: red, orange, green, blue and white.

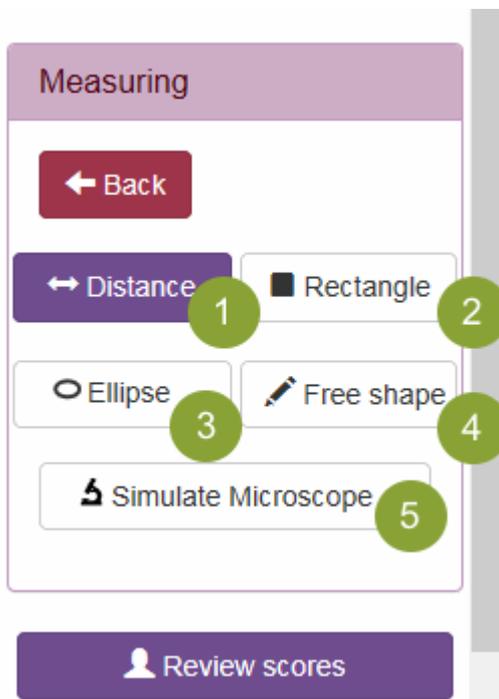


The magnification levels don't exactly correspond to any magnification that you would see using a microscope because viewing a slide digitally is just such a different experience. But the ratios between them are the same as between these objectives: 10x, 40x, 100x, 400x and 1000x.

These well-defined magnification levels can be handy when using the synchronous view of slides that have different sizes. For example, if there were originally only H&Es stainings and later some IHC slides were made it can happen that they have slightly different scanned area. If you set up synchronous viewing with them they would have slightly different zoom levels by default. You can uncheck "Keep synchronized" and press 1 on each slide to view them at the same zoom level.

Measure and microscope

Slide Score viewer includes tools for measuring the distance between two points and the area of an ellipse, rectangle or a hand drawn shape. To use them click "Measure distance and area" just under the scoring panel.



As long as you have this panel opened, holding the mouse button when moving the mouse will draw a shape instead of panning the view. Note that the shape will only be visible as long as you hold the mouse button, when you release it, it disappears. To close this panel click the "Back" button.

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You can select the type of shape by clicking the buttons in this panel:

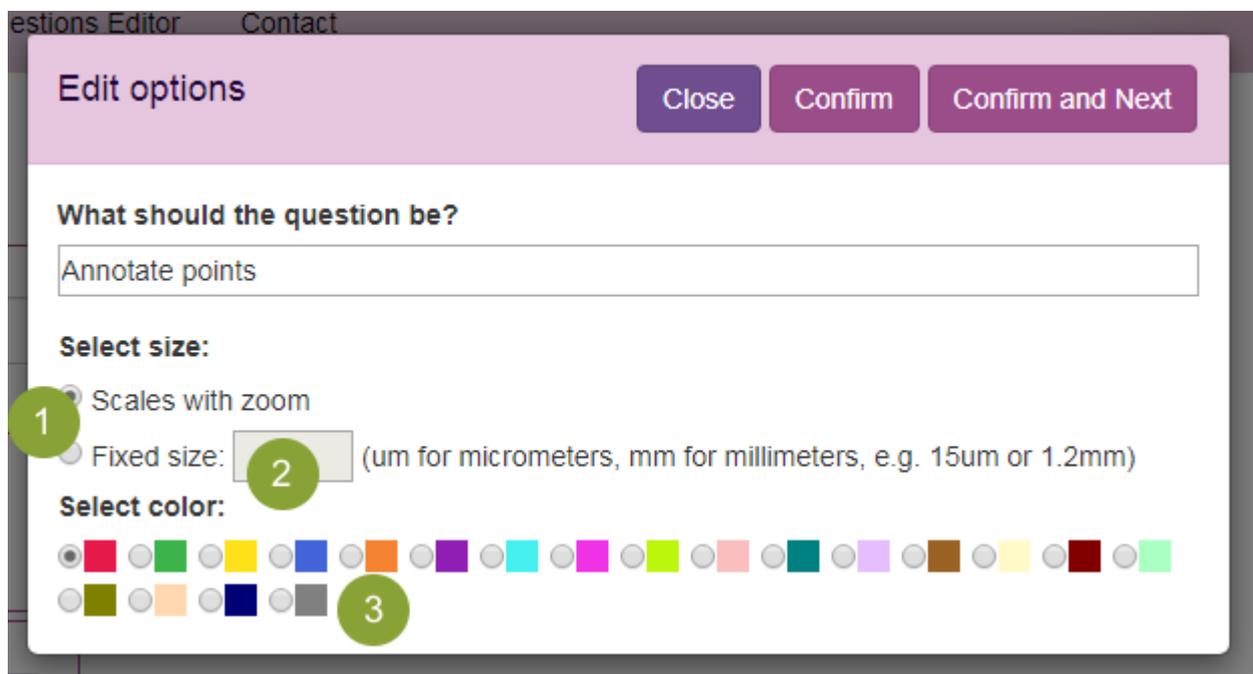
- "Distance" ¹ draws a line with a little balloon showing the length of the line in micro- or millimeters.
- "Rectangle" ² draws a rectangle and shows its area.
- "Ellipse" ³ draws an ellipse.
- "Free shape" ⁴ allows you to draw any shape with your mouse and displays its area.

The last button "Simulate Microscope" ⁵ works a bit differently. When you click it the whole view darkens with the exception of a circle with area 0.2mm^2 (a similar area you would see when looking at the slide with a microscope at 40x). You can drag this circle around - as if you're looking at the slide with a microscope. This is useful for following scoring methodology written for microscopes - for example the CAP protocol for mitotic score requires you to count mitosis in 10 fields of view at 40x. You can drag outside the circle to pan the view. Press the same button again or press Ctrl+M to hide the field of view.

Note: Field of view at particular magnification shouldn't really be seen as a standard area, different oculars can introduce differences on the order of 2x. It's better to use the actual area in mm^2 . See this paper for more <https://journals.sagepub.com/doi/full/10.1177/0300985815593349>.

Annotation

The last two question types in the scoring sheet editor are for marking cells or circles of predefined size (Annotate Points) or annotating interesting areas (Annotate shapes).



"Annotate points" can be configured ¹ in two modes:

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- "Scales with zoom" - This allows raters to indicate points on the slide with a circle that gets smaller as you zoom in on the slide so that it's always visible but doesn't get in the way
- "Fixed size" - Using this option you can create a question for indicating individuals cells or nuclei (if you set the size **2** to "5um" - 5 micrometers) or areas for DNA extraction or TMA cores (setting the size to for example 1.2mm). Circles indicated with this question will always keep the actual size - so if you set it to 5um they will not be visible when looking at the whole slide until you zoom in.

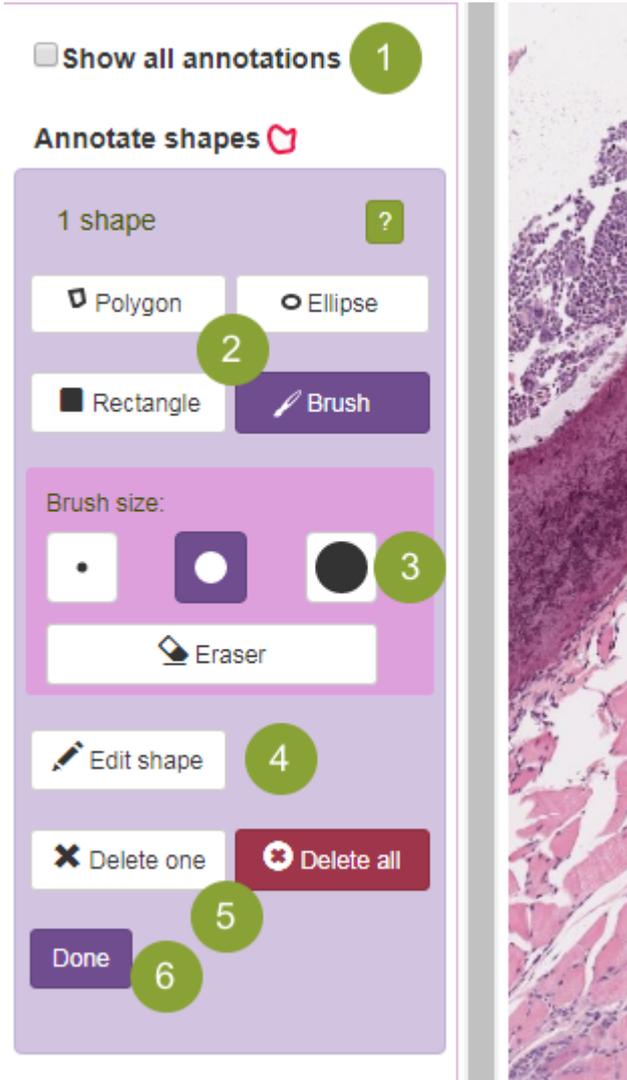
You can select one of the colors **3** for outline of the annotation circles.

"Annotate shapes" can also be configured with one of the colors.

Using Annotation tools

Annotation questions appear initially collapsed just with a button "Add annotations". Clicking it will change the function of the mouse on the slide viewer. For "Annotate points" questions clicking the slide will add a point at that location - note that if the question is configured as fixed size (and with very small size) you may not see it without zooming in. You can hold the mouse button to drag the point around and right click it to remove it. Note that you have to Submit your annotations to save them.

"Annotate shapes" questions are a bit more sophisticated, clicking the "x shapes" button will quickly flash green circles around existing shapes (to make them easier to find) and open the panel with annotation tools:



Even before you open the panel if there is more than 1 question with annotations, the "Show all annotations" ¹ checkbox will show up. Checking it will display all annotations from all questions in a "read-only" mode - you will not be able to change them.

When you're satisfied with your annotations you click the Done button ⁶ to close the panel and regain normal function of the mouse for panning the slide.

The annotation tool panel itself is dominated by the buttons for tool selection ² "Rectangle" and "Ellipse" work similarly as the [measurement tools](#) but they don't disappear after you release the mouse button. You can drag them around with your mouse. Right clicking the shape will delete it. Note that shapes can overlap.

Using "Polygon"

Polygon is useful for annotating irregular areas - lesions, tissues and so on. To create a polygon click the slide to create a start point and then click again to create a straight connecting line or drag to draw a precise outline. If you click the start point, or drag to it, the polygon will complete. You can

Instruction for Use - Slide Score

cancel it by pressing the escape key or right clicking with your mouse. Pressing the delete key will remove the last point on the polygon.

Editing shapes

If you make a small mistake you can correct it by clicking the Edit Shape button ⁴ and clicking the shape you want to correct. This will create small black draggable rectangles around the edges that you can drag to adjust the shape. Note that with polygons the number of draggable rectangles depends on your zoom so if you need more control you can zoom in. Rectangles drag the neighboring points on the polygon with them so you can make large scale changes when you zoom out. For finer changes it's best to use the "Brush" tool:

Once you have made some shapes you can use the "Delete one" or "Delete all" buttons ⁵ to remove them. Delete one will turn your cursor into a crosshair and if you click a shape with it it will be deleted. Note that there is no undo, yet.

Using "Brush"

"Brush" will change your mouse cursor into a small circular brush (you can configure its size with ³) that you can use to fill the shape you want to annotate by dragging the mouse. It works best on a tablet with a stylus, but it's possible to precisely annotate areas with a mouse, too. If you drag while holding the right mouse button it will erase instead of fill, you can also switch to erasing by pressing the Eraser button.

If you touch another shape (Polygon, Ellipse or Rectangle) while dragging with the brush (or Eraser) it will merge the shape with the brush area. You can use this to make small effective changes to the shapes.

Note that if you use Apple Pencil ® on Apple iPad ® you can drag the slide with your fingers and brush with the pencil without switching tools - on a regular computer it's best to move around using the keyboard.

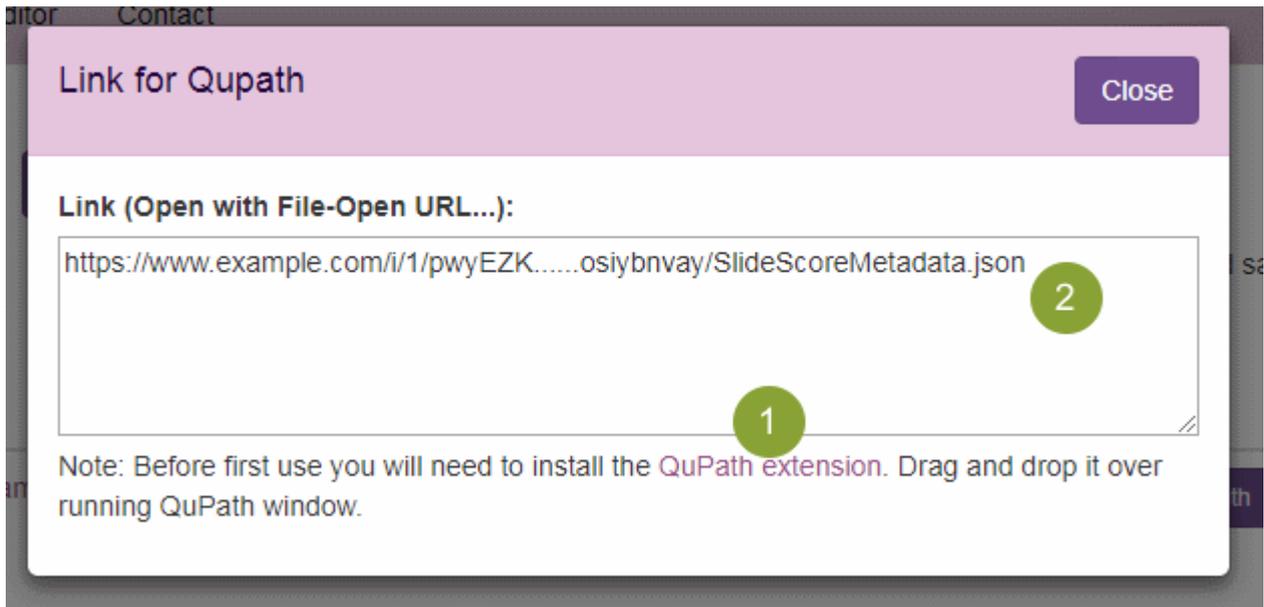
QuPath Integration

[QuPath](#) is a great open-source image analysis tool with user-friendly interface.

Slides hosted in Slide Score can be opened in QuPath directly using a plugin.

To use QuPath with Slide Score:

1. Click your username in upper right corner to open your settings page
2. Make sure "QuPath Integration" is checked
3. Click "Open in QuPath" button next to an image
4. A dialog opens with a link to the image.



1. Click the 1 link to download the plugin
2. Start your QuPath
3. Drag the plugin on QuPath and follow instructions

Once this setup is done follow these steps to open a slide in QuPath:

1. Click "Open in QuPath" button next to an image
2. Copy the URL 2
3. In QuPath click the File menu and Open URL... command
4. Paste the URL to open the image!

You can also open the whole study in QuPath:

1. Go to study view
2. Click "Open in QuPath" next to the study name, this will download a QuPath project file (with .qpproj extension) containing all the study images. Save this file to an empty folder
3. Double click the QuPath project file to open it

When you open the project for the first time it will take some time before thumbnails of all the slides are available.

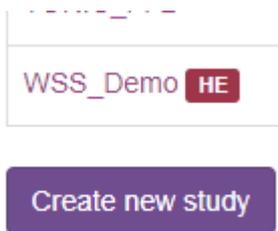
Following new developments

We work hard on making Slide Score the best platform for digital pathology. When we add a new feature we write about it on the ["What's new" page](#)

5.3 Administration

Creating a new study

To create a new study scroll to the bottom of the overview of studies and click the Create new study button



This will open a dialog for selecting a new name. Please, give this new study a unique name using only alphanumeric characters and underscore and click the Confirm button. Note that you can't change this name later, but you can show different "label" instead of it in some places.

Slide Score will then create the new study for you, give you the Edit right (more on rights in the [Users section below](#)) and show the study overview page:

New_study properties

Unpublished
Note: there is no undo so click carefully!

Overview Study Settings Slides Scoring Sheet Users **1** Save!

Slides **2**

Storage **3**
0.00 GB

Q&A **4**
0 questions, 0 answers

Users **5**
1 users

Progress **6**
Not yet published
Publish Delete

The "Overview" tab shows at-a-glance overview of the study

- Number and type of slides **2**, hover over a slide with your mouse to see its name,
- How much disk space they take up **3**,

Instruction for Use - Slide Score

- You can quickly see how much progress is there on scoring by looking at number of questions and number of answers (across all images, users and questions) there is already **4** ,
- How many people can see this study and what can they do with it **5** , hover over a user icon with your mouse to see their email and rights. Their rights are also indicated by the icon - pencil means Edit, arrow down (download) means they can get results, checkmark means they can score slides and eye is for users who can only view slides,
- When was the study published (if at all) and buttons to view or delete it. Studies that haven't been published yet are only visible to users who can Edit them. So, if you assign a pathologist to score it, they won't see the study in their overview until you click the "Publish" button in the Progress section **6** . Always remember to publish the study when you're done setting it up and before sending out emails.

As you can see it's mostly empty now because the study has just been created. All the details can be configured on the tabs **1** .

- The "Overview" tab is active now,
- ["Study Settings"](#) is used to arrange studies in folders, restrict privacy-sensitive information and so on,
- You can upload and manages slides and TMAs on ["Slides"](#),
- If you want the slides to get scored, you will have to set up your ["Scoring sheet"](#),
- Configuring who can see this study and what can they do with it is done on the ["Users"](#) tab. You can also send emails to study participants from there.

Note that all changes are immediately saved.

Study settings

To help with organizing your studies you can arrange them in folders or tag them with disease or organ, you can also change how Slide Score behaves for this study on the "Study Settings" page:

Study Setup

Unique name

Name that will identify the study. Please use only A-Z, 0-9 and _

Basics 1

Label

Name that will be displayed to users

Folder

Group different stainings or scoring sheets from the same study together

Privacy 2

- Show slide labels in study overview
- Show thumbnails of slides in study overview
- Show TMA sample IDs
- Allow creating anonymous sharing links
- Replace slide names with anonymous ordinal numbers for raters and viewers**
 - ... with a randomized unique order of slides for each rater and viewer
- Pathologists can see each others' scores

Scoring 3

- Score all duplicate TMA cores from a sample at the same time
- Pathologists can compare their scores to majority opinion
- Pathologists cannot overwrite their scores
- Pathologists cannot see study overview and switch back and forth between slides
Only using "Start scoring" link is allowed

Categories 4

Organ

e.g. Breast;Skin

What organ(s) does the study investigate separated by semicolon (;)

Disease

e.g. Melanoma;DCIS

What disease(s) does the study investigate separated by semicolon (;)

Stainings

e.g. HE;PD-L1

List stainings contained in this study separated by semicolon (;)

External system ID

e.g. E-111

External system number

Study name can't be changed once a study is created, but you can use the "Label" on the "Basics" panel 1 to display a different name with any characters you want. You can put the study in a study folder, by setting the "Folder" field. If you set it to the same value for two studies they will be shown together in that folder. That's useful if you have multiple stainings that you want to score for different things from the same project. This field will suggest existing folders to make it easier to use the same value.

The Privacy section 2 can be used to limit what viewers and raters see. Note that in this and the following section if you change a setting from default it will be shown in bold. You can hide labels (they can contain patient, sample or study identifiers that you don't want to show) or thumbnails, hide sample identifiers from whole slide names or from TMA cores. Additionally, you can enable unique shuffling of the slides for each rater. Score review - raters can copy other rater's score - can be disabled by unchecking the last option.

The Scoring section 3 can be used to further configure how pathologists score slides. Switch to scoring all TMA cores from the same sample at the same time instead of scoring core by core. Note that this might bias the scores. It's possible to enable comparison between rater's own answers and the majority opinion from everyone else. This can be used to give everyone a personalized feedback page - they can see whether they are biased compared to others, see [this example](#). The last two

Instruction for Use - Slide Score

settings can be used to further simplify Slide Score user interface, disallowing overwriting of answers and even moving backwards in a study.

Categories (or tags) ⁴ are labels you can attach to your study which make it easier to find. You can tag it with organ, disease or stainings. You can use multiple values if you separate them by a semicolon (;). These fields also suggest existing values - please use those suggestions and stick to the same format (it should be "CD8" not "CD-8") to make things easier to find. You can also include a tag with an identifier from an external system (e.g. biobank).

Slides

We can configure slides that belong to this study on this page. A slide can be a part of more than one study at a time.

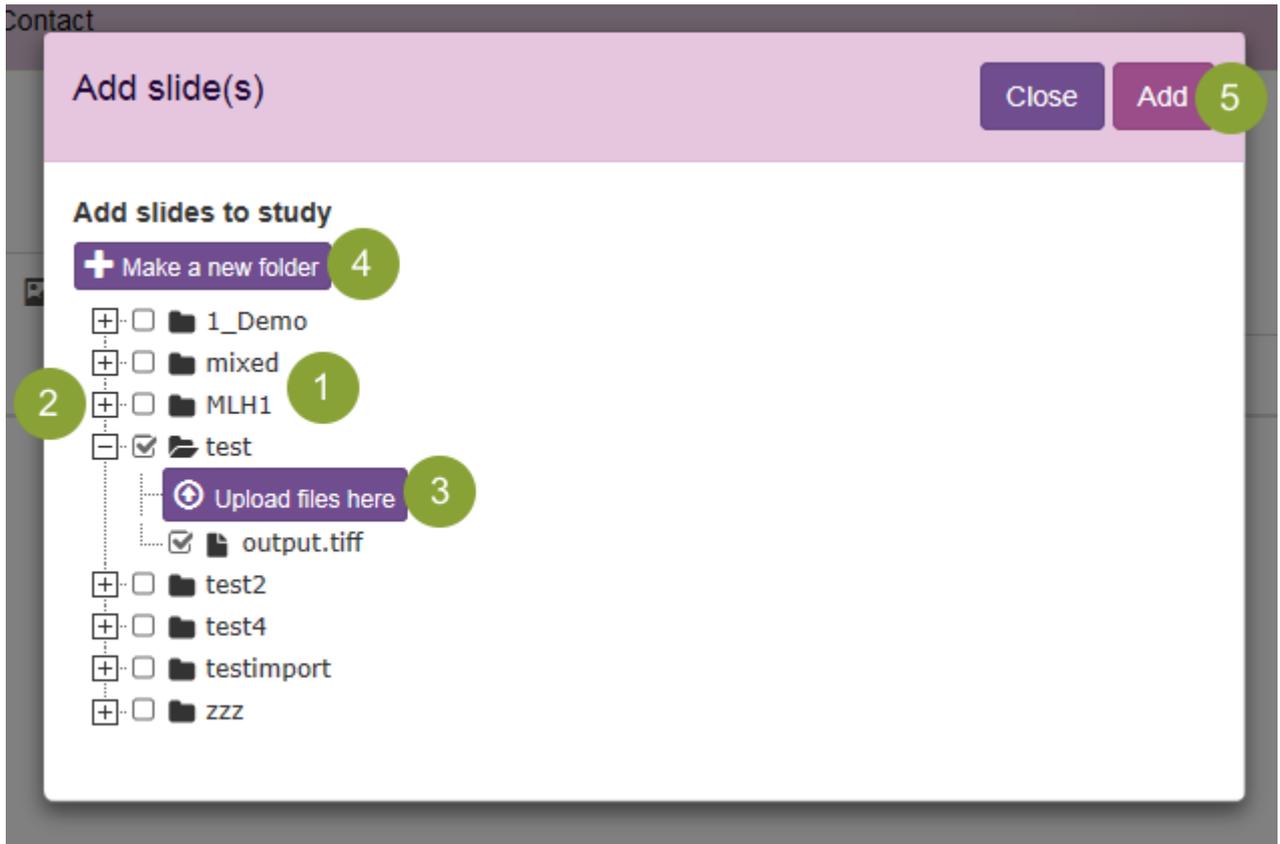
The slide tab can look like this:

Search Slides	Score progress	Rotation	TMA?	Map	Cores placed	Delete
1808	0/1	0°	<input type="checkbox"/>			
<u>60032_B-cat</u>	0/1	0°	<input checked="" type="checkbox"/>	test	0/3	

For each slide it displays:

- Thumbnail, if you hover with your mouse over it an enlarged thumbnail appears in lower right ¹,
- Name, you can click it to view the slide. You can search slides by name using the search box ²,
- Score progress - how many people have scored the slide / number of people who can score,
- How much should it be rotated - this is useful for TMAs (so that the map and the slide look similar) and whole slides (if you want to use Synchronized viewing you should rotate the slides so that they have the same orientation),
- Whether it's a TMA and if it is:
- Which TMA map to use (see [next section](#) for more)
- How many cores have been placed out of all the cores that need to be placed. You should place all the cores before you invite pathologists to score the study, so that they are more efficient, see [how to place the TMA grid](#)
- Button to remove a slide from this study. If the slide has already been scored you will get a warning. Note that this doesn't delete the slide from disk, it just removes the association with this study.

And there is a button to add more slides to the study ³. We will use this button to add a few slides, click it now.



You can see all the folders with slides on the server here ¹. Select which slides (or folders) to add to the study by checking the check box next to their name. Selecting a folder will add all slides within that folder to the study. If a slide is already part of this study it will be ignored.

If you click the '+' left of the folder name ² you can see the slides inside it, with their check boxes and an "Upload files here" button ³. Click the "Upload files here" button to select slides from your computer - you can select multiple by holding Ctrl or Shift when clicking - to upload them to the server.

You can click the "Make a new folder" button ⁴ to create a new folder and upload some new files there. When you're done click the "Add" button ⁵ to include all the checked slides and folders in the study.

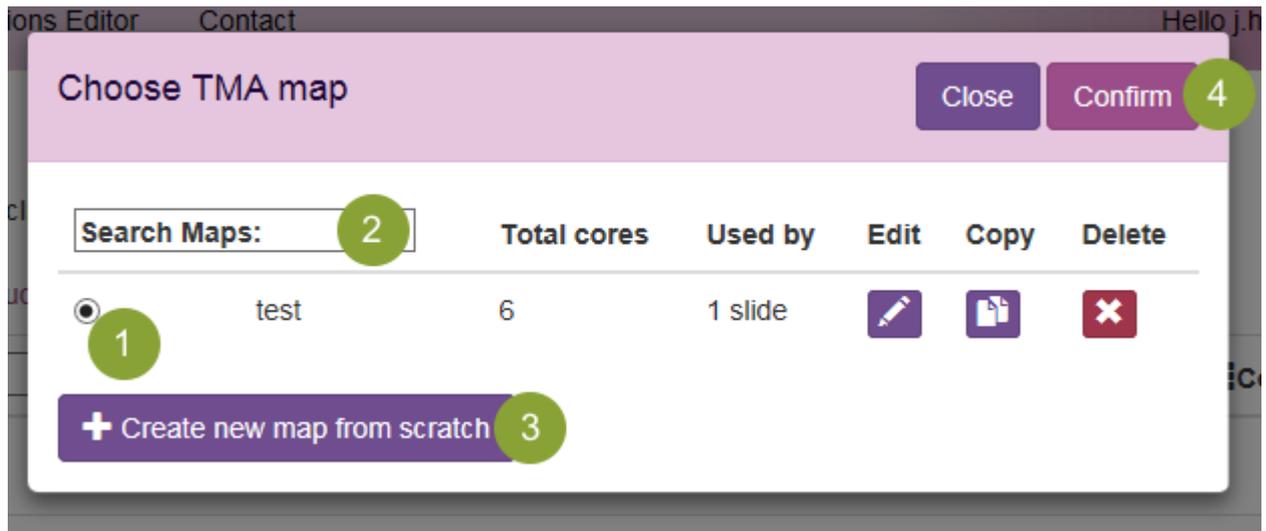
TMA maps

To mark a slide as TMA first check the check box on the [Slides](#) tab. This will display the TMA map name and an edit button.

TMA? Map

test Edit

This will open the overview of TMA maps that you have access to.



Each TMA map has a few columns:

- Select button **1**, click it to assign this map to the TMA slide where we clicked Edit,
- Name, you can search for TMA map by its name using the search box **2**,
- Total number of cores that this map defines,
- How many slides already use this map. If this map is already used you will get a warning when changing or deleting it - scores and TMA cores positions can't be kept if you change it,
- And buttons to Edit it, Copy it (so that you can edit it without losing scores) and Delete it.

You can also create a new map **3**. When done click the Confirm button **4**.

Try clicking the Create a new map from scratch button, it opens a new dialog:

Questions Editor Contact Hello I hudecek

Edit a new TMA map Close Add **6**

Name: **1**

Control labels: **2**

Note: Please specify which sample IDs should be considered control, separated by a colon (.). For example "Control, cntrl, liver"

Empty labels: **3**

Note: Please specify which sample IDs should be considered as empty positions, separated by a colon (.). For example "empty, NA, 0"

Map

```
ctrl ctrl ctrl 1 1 1
2 2 2 3 3 3| 3 4
nil nil nil 4 4 4
```

Error! Every row has to have the same number of columns. First row has 6 columns, but row 2 has 7 **5**

Note: Please specify sample IDs (and control or empty labels) separated by TABS. It's easiest to arrange the map in Excel and paste it here. Please don't include header rows and columns

A TMA map has an identifying name **1** and a grid of core/sample identifiers **4**. To make orientation easier you can mark some cores as controls - these slides won't be scored - or mark some positions as empty. Please list the control **2** and empty **3** identifiers in the corresponding fields separated by commas (,).

The example map **4** has 3 rows, however there is a mistake - row number 2 has a different number of columns than row number 1. Slide Score points it out **5**, to correct it make sure that the map is rectangular with the same number of columns in each row. Easiest way to do this is to edit it in an Excel sheet and paste it in this window.

When done click the "Add" button **6**. This will add the TMA map to the list in the previous dialog so that you can select it to use it for the current slide.

Placing TMA grid

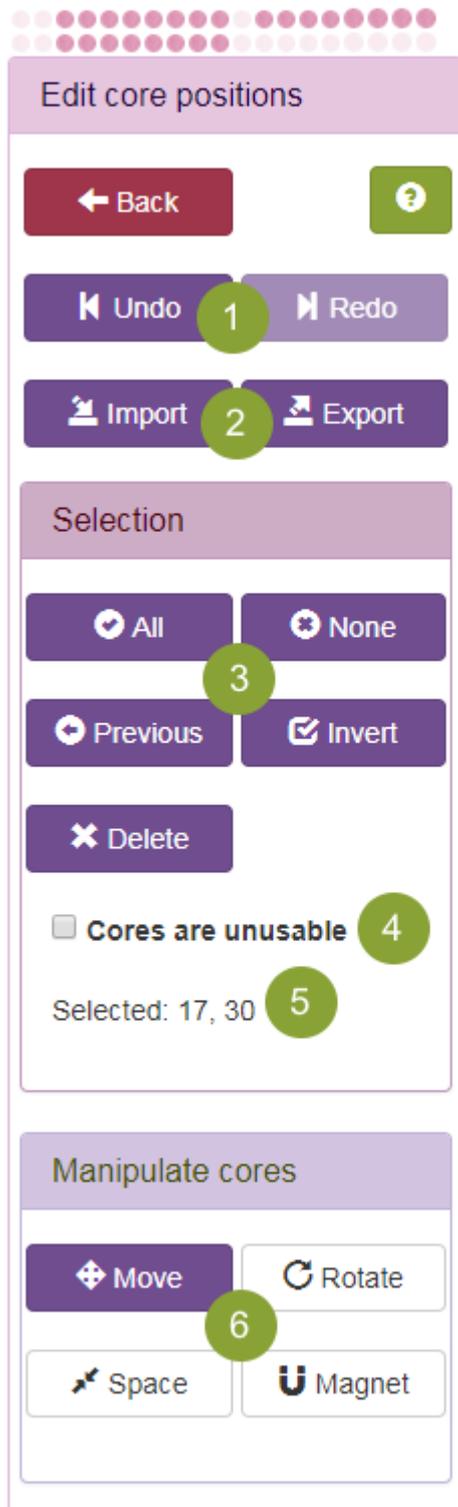
While it's possible to place TMA cores one-by-one it's a lot more efficient to use the "Edit Core Positions" panel to handle all the cores at once. Let's try it.

Instruction for Use - Slide Score

Open the first slide in the "TMA Demo" study and click the "Edit Core Positions" button just below the TMA map. This puts the viewer into a special mode:

- Clicking a core in the viewer doesn't select it, you can still select it by clicking on the map or by clicking and holding the mouse button while moving the mouse to create a selection rectangle.
- Clicking a core and holding the mouse button while moving it will select the core and move it. You can use it to quickly adjust the position of single cores.
- Clicking a core while holding Ctrl adds it to the selection (or removes it if it was already selected)
- Clicking a core while holding Shift adds the whole row of cores to the selection (or removes it if it was already selected)
- Clicking a core while holding Ctrl and Shift add the whole column of cores to the selection (or removes it if it was already selected)

Let's look at the panel in detail:



You can read explanations and review keyboard shortcuts by clicking the question mark button - it will show a dialog that describes how to use this panel in detail.

The red "Back" button saves any pending changes, closes the panel and returns the viewer to normal mode where clicking a core selects it etc.

Undo and Redo buttons **1** can be used to revert the last change.

Instruction for Use - Slide Score

You can use Import and Export buttons ² to place a regular grid on the slide, import grid from another TMA or from JSON description or export a JSON description of the current grid.

The Selection sub-panel contains buttons ³ to

- Select All cores,
- None - select no cores at all,
- Invert - cores which were selected become unselected and vice versa,
- Previous - selects the previously selected set of cores,
- Delete - removes all selected cores from the slide and you will have to place them again.

Clicking the checkbox "Cores are unusable" ⁴ will remove selected cores from scoring.

You can see what are the sample identifiers of the currently selected cores at ⁵.

The Manipulate cores sub-panel contains buttons ⁶ that switch what happens when you drag selected cores: Move, Rotate, Space (adjust spacing between them) and Magnet (twist the whole grid to simulate shifts of part of TMA). It's best to experiment with these buttons (you can always use the Undo button) and see how they work.

You will be most efficient if you learn their keyboard shortcuts (M, R, S and U respectively) or drag modifiers - if you activate the Move button and click and hold the mouse button while moving the mouse, the cores will move with your mouse. If you hold Ctrl while doing that they will rotate instead, Alt adjusts the spacing and Shift twists the whole grid like the Magnet function.

Step by step guide to placing the grid

1. Open the Edit Core Positions panel
2. If there are already cores placed on the grid select all (press Ctrl+A or the All button) and delete them (press the Delete button on keyboard or in the Selection subpanel)
3. Press Import,
4. Press Import from Map. This places a regularly spaced grid shaped like the TMA map on the slide. If you have a perfect TMA you're done, but usually the cores don't align exactly.
5. Press All (or Ctrl+A),
6. Move the grid so that its center is in the center of the cores on the slide,
7. Rotate (holding ctrl while dragging) so that the grid has a similar inclination to the grid of cores on the slide,
8. Adjust the spacing (holding ctrl while dragging) so that the cores fit. You may have to adjust both horizontal and vertical spacing. If you can't get them to fit try to be off by the same distance in both extremes (i.e. in the first row and last row)
9. Use the Magnet function (holding shift while dragging) to drag the cores in corners into place
10. You might need to select None (press Esc) and select a group of misbehaving cores by drawing the selection rectangle around them and adjusting them.

Don't forget about the Undo button!

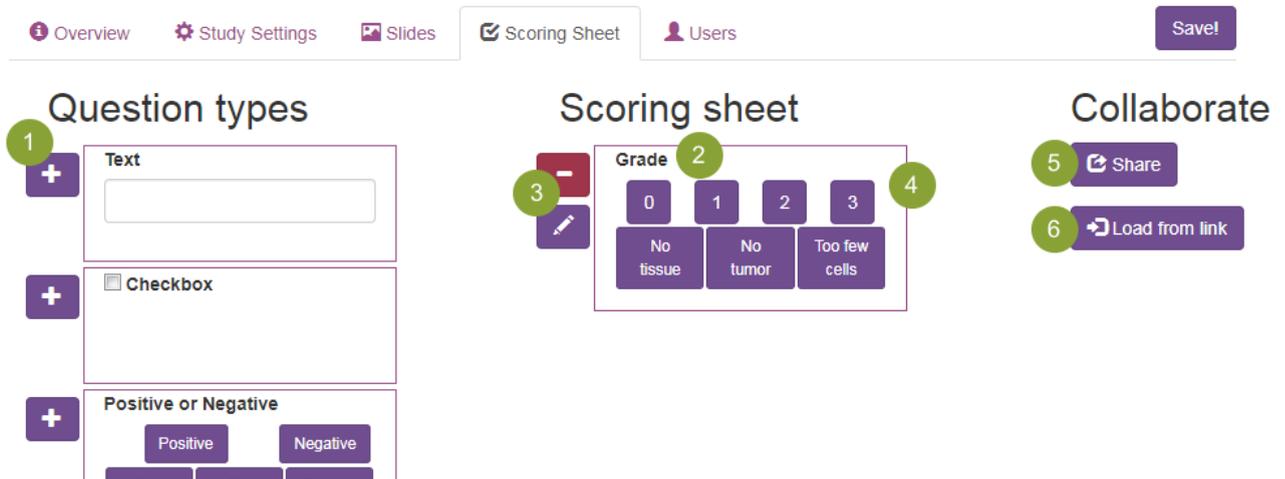
Scoring sheet

This page is used to configure the questions that pathologists need to answer for each slide/TMA core.

Instruction for Use - Slide Score

This editor is [accessible to everyone](#) so that people can collaboratively design the scoring sheet.

Let's look at how it works:



The left column contains [question types](#) (free text, yes or no checkbox, percentage input, ...) and the central column contains actual questions on your scoring sheet. You can add a question of a particular type to your scoring sheet by clicking the '+' button ¹ which creates a new question ². You can change it by clicking the title of the question ² or the pencil button ³, you can remove it by clicking the red '-' button. If you have multiple questions you can reorder them by dragging them in the right place, it's best to start dragging them by the empty area ⁴ (not the buttons or title).

If you click the button "Share" ⁵ a new dialog will open with a link that includes details of the scoring sheet. Send this link to anyone who needs to provide input or comments on the scoring sheet and ask them to send you their sharing link back. You can then click the "Import from URL" button ⁶ and paste their link into the dialog to load their questions. Note that changing the scoring sheet in that link doesn't actually change anything, they always have to share the link with you.

Clicking the title of a question ² or pencil button ³ opens the question settings dialog:

Its contents depend on the question type, but all questions have a title **1**. Please use a descriptive and short title: use "Tumor Percentage" or "Tumor (%)" instead of "Please score Tumor percentage". Also make sure all pathologists have a clear idea what methodology to use to answer your questions.

Questions with the "No tumor", "No tissue" and "Too few cells" buttons have a yes or no checkbox whether these buttons should be shown **2**. For some questions you can configure options - one option per line **3**.

When you're done you can either press Enter or click Confirm **4** to close the dialog. Or press Ctrl+Enter or click Confirm and Next **5** to close this question and open the next one in your scoring sheet. It's fastest to add all questions at first, edit the first one and move through every question with Ctrl+Enter.

Question types

- Free text

Text without any restrictions or checks. Best suited for remarks or comments

- Check box

Yes/no checkbox, ideal when you need a binary answer. You can also add multiple checkboxes to create a question where multiple answers can be selected.

- Positive or Negative



Instruction for Use - Slide Score

Slides are often scored for positive staining, this question type fits this purpose.

- Intensity

0, 1, 2 and 3 values usually used for intensity of staining

- Percentage

For collecting numbers 0-100. White buttons with a range open a table of values within that range when clicked with numbers divisible by 5 in slightly larger font size.

- Dropdown

Customizable list of options. Only one option can be selected. It's useful for the first option to be "Unknown" as it is the default.

- Customizable

Customizable set of up to 4 buttons. Only one option can be selected. Note that possibilities should be short to fit within the buttons. You don't have to include "Unknown" in this case, it gets added automatically.

- H-Score

H-Score (histo score) describes the percentages of cells with particular intensity of staining. It's basically four Percentage type questions grouped together. As soon as the pathologist fills in three values the fourth one is calculated to sum up to 100.

- Annotate points

Allows pathologists to indicate a set of points (for example cells) on the slide. You can configure the color of the circle that marks the point. The results for this question are a set of coordinates in image pixels.

Users

It's important to share your slides with the right people and no one else. That is done on the Users page:

The screenshot shows the 'Users' tab in a navigation menu. Below the menu is a table with columns for 'Search Users', 'Score Progress', and 'User can'. The 'User can' column has sub-columns for 'Score', 'Export scores', 'Edit', and 'Remove'. There are two rows of users in the table. Below the table are two buttons: 'Add' and 'Send an email to everyone'. Numbered callouts 1-6 point to specific elements: 1 points to the search input, 2 to the first user row, 3 to the 'Export scores' icon, 4 to the 'Remove' icon, 5 to the 'Add' button, and 6 to the 'Send an email to everyone' button.

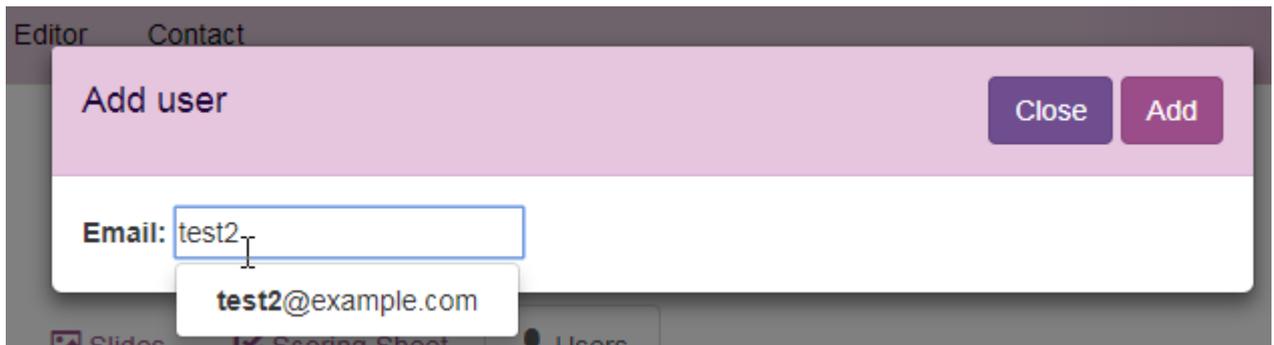
Search Users	Score Progress	User can			
		Score	Export scores	Edit	Remove
test@example.com	0/0				
test2@example.com	0/0				

Add Send an email to everyone

Instruction for Use - Slide Score

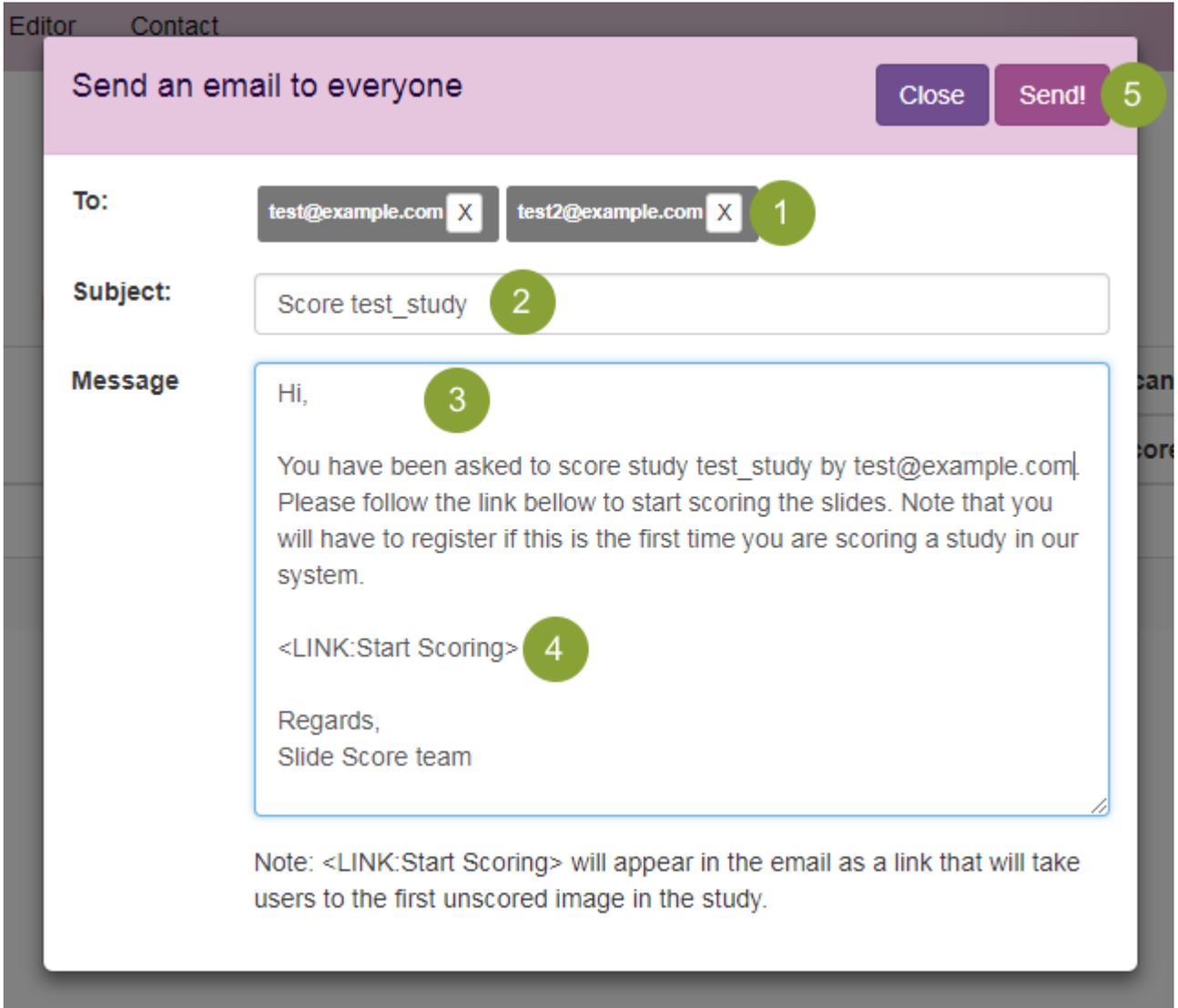
You can search users ¹ by (part of) their email address ². For each user you see an indication how many slides have they completely scored and what can they do in this study - you can control that by checking the check boxes ³. Here user "test" can score slides and edit the study (i.e. they can access this screen) and user "test2" can score slides and download the results. If no box is checked the user can only view slides. Use the remove button ⁴ to remove all rights to this study from the user.

You can add new users to this study with the Add button ⁵. That opens a dialog:



You can type in part of the user's email address and accept a suggestion or type in a completely new email address.

And lastly it's possible to send an email to all users in the study directly from Slide Score ⁶. You can compose the email in a separate dialog:



Editor Contact

Send an email to everyone Close Send! 5

To: test@example.com X test2@example.com X 1

Subject: Score test_study 2

Message

Hi, 3

You have been asked to score study test_study by test@example.com|. Please follow the link bellow to start scoring the slides. Note that you will have to register if this is the first time you are scoring a study in our system.

<LINK:Start Scoring> 4

Regards,
Slide Score team

Note: <LINK:Start Scoring> will appear in the email as a link that will take users to the first unscored image in the study.

Here you can edit the email before sending. You can remove recipients by clicking on the cross button 1, by default all users in the study are included. You can use a better Subject 2 and improve the body of the email 3. Note that "" will be replaced by a link to the "Score!" button of this study - pathologists can click and it will take them directly to the first slide, score a couple of slides and stop. They can return to this email in a couple of days and click the link again to continue where they left off.

Confirm sending the email with the Send button 5

Editing an existing study

If a study has already been published and users are looking at it some care has to be taken to avoid disruption and loss of data.

- Removing a slide, user or question will delete all answers associated,
- Changing a TMA map - either the grid or the controls and empty fields - will result in deleting all cores' positions and answers on all slides that use this map.

Instruction for Use - Slide Score

- Changing which TMA map a slide is using will delete all cores' positions and answers for this slide,

On the other hand:

- Reordering questions can be done safely,
- Rotating slides even TMAs will not cause data loss,
- Changing user rights will not affect their scores - you can see scores from a user which no longer has the right to score,
- Changing study settings will not have any effect on the scores or TMA cores' positions.

5.4 API

Overview

Slide Score API allows programmatically uploading slides, creating studies and downloading results.

You can for example:

- write a script that [uploads slides](#) to the server, [configures them](#) so that each rater sees a unique set, [sends the raters an email](#) with a unique link to let them score it, [checks if they have finished scoring](#) and downloads the scores.
- create integration with your lab management system.
- train your deep learning image analysis model on pixel data requested from Slide Score, push the results back for review by pathologists and use that to improve the model further

It can only be enabled by site administrators.

This API is based on common tasks that need to be done. A next version of API based on GraphQL with more control for all important entities is on the roadmap.

Note that this documentation assumes some programming knowledge and is a work in progress.

Examples

You can either write a script that sends the HTTP requests directly or make use of C# or Python SDKs. If you use C# have a look at [an example client in C#](#) that includes SlideScoreClient.cs class that will help you make the API calls.

For Python install the SDK module with `pip install slidescore-sdk`, initiate the client class:

```
from slidescore import *
client = APIClient(url, apitoken)
```

The client object has methods that directly correspond to the API calls.

Creating Token

Before you can access the API you need an access token.

Login as Site Administrator and go to the [Create Token](#) page.

Fill in the name and expiration date of the token. Check below what methods you need to call and give the token only the rights that are needed only for the necessary studies.

Can upload

API token can upload slides and configuration files

Can create upload folders

API token can create folders on the server to create new studies

Can upload scores

API token can upload results and annotations to studies. This is useful for image analysis workflows - models can push their results to Slide Score.



Instruction for Use - Slide Score

Can download configuration files for studies

API token can request the current configuration of studies in the form of [configuration files](#). This is useful if you want to synchronize an external database with Slide Score configuration.

Can read raw tiles from slides and their metadata

API token can read image tiles. The API has 3 ways to access the pixels GetScreenshot (the most high level call - request a region and level of detail), GetTile (DeepZoom-like request), GetRawTile (request that's forwarded to the slide libraries - OpenSlide and others. You need to check the image metadata first - levels in the slide and so on).

With this right image analysis algorithm can request (and cache) the pixels of slides.

Can upload only in folders

This is a restriction.

Semicolon-separated list of folders on the server to which the token can upload. If you leave it empty API token can upload slides in any folder. If you set it, API token won't be allowed to upload to any other folders.

Can read (get scores, images) only these studies

This is a restriction.

Semicolon-separated list of studies which the token can read - download scores (with Can get scores of any study), images, ... If you leave it empty API token can read any study. If you set it API token won't be allowed to read any other studies.

Can modify (upload images, delete, reimport) only these studies

This is a restriction.

Semicolon-separated list of studies which the token can modify - add slides, reimport, ... If you leave it empty API token can modify any study. If you set it, API token won't be allowed to modify any other studies.

Can create studies

Unused at the moment

Can reimport studies

API token can (after uploading configuration files and slides) re-import a study.

This will read configuration files and apply changes to the study. Note that it can overwrite changes made manually in the administration interface - you can use GetConfigFiles to create up-to-date config files and change only those.

You always need to run reimport after you upload the slide(s) using the API otherwise they won't show up.

Can delete owned studies

Unused at the moment

Can get scores of owned studies

API token can retrieve (unless Can read blocks it) scores of studies that the token has created.

Can get scores of any study



Instruction for Use - Slide Score

API token can retrieve (unless Can read blocks it) scores of any study.

Can get study configuration

API token can retrieve (unless Can read blocks it) configuration files of any study and can send emails on behalf of the Slide Score server.

Can download

API token can download actual files containing the image data in original format (unless Can read blocks it)

Can delete

API token can delete slides from a study (unless Can modify blocks it)

Authentication

This API token needs to be supplied for all API calls in the Authorization HTTP Header like this:

```
Authorization: Bearer hblJlYWRPbmx5U...3RlZGllcyI6IiIsIkNhbk1
```

When you no longer need it you can give it up by calling POST /Admin/GiveupToken with the token as POST parameter.

Get results

GET Api/Scores

Required rights: Can read the study, Can get scores of owned studies or at least Can get scores of any study if it was created by the API token

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study which you want to download scores from
question	string	no	Optional, return only answers to this question
email	string	no	Optional, return only answers by this user
imageid	string	no	Optional, return only answers for this image
caseid	string	no	Optional, return only answers for this case

Returns tab separated file with all the scores from the study. The format is the same as when downloading results manually.



Instruction for Use - Slide Score

GET Api/GetStudiesUpdated

Required rights: Can read, Can get scores of owned studies or at least Can get scores of any study if it was created by the API token

Parameters:

Name	Type	Required	Explanation
since	string	yes	ISO 8601 date and time string with timezone

Returns JSON object with an array of integer IDs in StudyIDs - IDs of studies that had results submitted since the given date You can use this method if you are periodically checking for new results.

Get images

GET Api/Images

Required rights: Can read

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study which you want to list images from

Returns

JSON array of images with their ID and Name. Useful for creating reports with links to view the slide. You can construct an URL like <https://server/Image/Details?imageId=1&studyId=2> that will open image with ID=1 in study with ID=2. For TMAs you can use additional GET parameters to select single or few cores:

- tmaRow and tmaCol for row and column (0-based) respectively
- tmaSample searches for TMA core with this Sample ID. If it is unique it selects and zooms in otherwise it shows up in the "Search" panel
- tmaId internal TMA core ID

Upload

Uploading a file has 3 steps:

1. POST RequestUpload
2. Upload using Tus.io
3. POST FinishUpload

POST RequestUpload

Required rights: Can upload



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Parameters:

Name	Type	Required	Explanation
filename	string	yes	Filename (without path) to use for the file on the server - this can be used to rename slides
folder	string	no	Folder on the server (under the images root) to which the file should be uploaded. Note that you can only upload to the root folder, its subfolders and their subfolders, if empty studyId has to be set and it will determine the folder
studyId	int	no	if folder is not set it will be set to name of this study

Returns

JSON object with token attribute. This is the upload token you will need for uploading.

Upload using Tus.io

You can use any of [Tus.io's clients](#) to perform the upload. Add uploadtoken that you've received from previous step and API token (as apitoken) as metadata. You will receive fileid that you will need in the next step

POST FinishUpload

Required rights: Can upload

Parameters:

Name	Type	Required	Explanation
token	string	yes	upload token from RequestUpload
id	string	yes	fileid from Tus.io

Returns

JSON string containing "OK"

When Tus is done uploading you have to commit the upload using this method.

Uploading Results

It's possible to upload scoring results to Slide Score - this is useful if you have some legacy slides that you want to review or you are moving all the data to a single repository - Slide Score. This is



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also very useful for Active learning - training image analysis models with manual corrections with quick turn-around.

POST Api/UploadResults

Required rights: Upload scores

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study where results should be imported
results	string	yes	The results should have the same format as when you download them from Slide Score

This is the format of results expected:

```
ImageID(tab)Name(tab)By(tab)(optionally: TMA Row(tab)TMA Col(tab)TMA  
Sample(tab))Question(tab)Answer
```

ASAP interoperability

Slide Score supports exchanging annotations with [ASAP](#). Since both programs use slightly different ways to organize the annotations you might want to specify how to map colors in ASAP to questions in Slide Score.

GET Api/ExportASAPAnnotations

Required rights: Can get scores

Parameters:

Name	Type	Required	Explanation
imageId	int	yes	Image for which annotations should be exported
user	string	yes	User whose annotations/answers should be exported
question	string	no	Which question to export if there are multiple annotation-type questions. Can be empty to export all

Returns

Single XML file containing annotations for image `imageId` created by user `user` for the question (it has to be of type `AnnoShapes` or `AnnoPoints`). This XML file can be loaded straight to ASAP.

POST Api/UploadASAPAnnotations



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Required rights: Upload scores

Parameters:

Name	Type	Required	Explanation
imageid	int	yes	Image for which annotations should be imported
user	string	yes	User under whose account these annotations/answers should be imported
asapAnnotation	string	yes	Contents of the ASAP XML file
questionsMap	string	no	Defines mapping between colors used in the annotation file and questions defined in the study in Slide Score, see below

questionsMap: Each mapping is on a new line and consists of color hex code, semicolon (;) and the name of the question. Example mapping file:

```
#f0f0f0;Lymphocytes  
#ff0000;Tumor area
```

If you don't specify questionsMap each new color of annotations will be imported into a new question called "Imported annotation #".

Returns

JSON object with attribute Success (true for successful import) and Log containing log of the the import detailing generated questions and more.

Screenshots

GET Api/GetScreenshot

Required rights: Can get scores, Can get pixels

Parameters:

string withAnnotationForUser, int x, int y, int width, int height, int level, string scoreIDs

Name	Type	Required	Explanation
------	------	----------	-------------

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imageID	int	yes	Image to screenshot
x	int	no	screenshot top-left corner coordinate in pixels in most detailed level, if x, y, width and height are 0 the whole image is imaged
y	int	no	screenshot top-left corner coordinate in pixels in most detailed level, if x, y, width and height are 0 the whole image is imaged
width	int	no	screenshot width in pixels in most detailed level, if x, y, width and height are 0 the whole image is imaged
height	int	no	screenshot height in pixels in most detailed level, if x, y, width and height are 0 the whole image is imaged
withAnnotationForUser	string	no	If the study has annotation-type questions you can include particular user's answers-annotations in the screenshot
scoreIDs	string	no	If the study has annotation-type questions you can include only particular question IDs (comma-separated) to only select some annotations to include. If you leave it empty all annotations by <code>withAnnotationForUser</code> will be added. Cannot be specified in combination with <code>question</code>
question	string	no	If the study has annotation-type questions you can include one particular annotation-type question to include. If you leave it empty all annotations by <code>withAnnotationForUser</code> will be added. Cannot be specified in combination with <code>scoreIDs</code>
level	int	yes	DeepZoom level - binary exponent of the larger dimension of the resulting image - 11 for an image with larger dimensions between 1024 and 2048 pixels, 12 for 2048 - 4096 and so on

Returns

JPEG file with the screenshot. Note that this method can be slow and won't work for more than ~50 megapixel images. Please, request smaller ones and stitch them together.

Note that x, y, width and height all refer to the level with the highest detail so if you are requesting lower detail levels you need to multiply them by a factor of $2^{(\text{difference in levels})}$. For example if the



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image is 87140x87140 pixels, the highest-detail level is 17. If we request level 12, we are looking at a 5 times zoomed out image. One pixel in level 12 equals $2^5=32$ pixels in level 17. If we need a 100x100 image we need to request width and height equal to $32*100=3200$.

Error codes: 401 for invalid token, token that doesn't have enough rights, 404 if image doesn't exist, 400 if both scoreIDs and question are specified

Sending emails

POST Api/SendEmail

Required rights: Can get configuration files

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study that email is related to
to	string	yes	Semicolon (;) separated list of email addresses to send it to, they have to be configured as users of the study
subject	string	yes	Email Subject line
body	string	yes	Text of the email to send. In plain text. It can contain token <code><LINK:Start Scoring></code> which will be replaced with a link to start scoring the study

It will send an email to all addresses listed in `to`. The From address will be `info@slidescore.com`.

Returns

Empty JSON object if successful.

Study configuration

Studies are set up by uploading configuration files to the root folder and image files into a subfolder. If the subfolder has the same name as the study all image files there are automatically uploaded. Otherwise you need to reference them with an `study.<studyname>.images` file (see [Slides](#) for more).

Users

Users are configured in a file `study.<studyname>.emails`. This file contains one user of the study per line.



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By default they get only CanScore right. You can specify `viewonly` or additional rights (`cangetresults`, `canscore`, `canedit`) separated by comma if you want to change that. Note that you can't remove rights from a user this way, they are only added. To remove user's rights, use the administration interface.

For example:

```
email@example.com
email2@example.com;viewonly
email3@example.com;canscore,canedit,cangetresults
```

Slides

By default all slides in a folder that has the same name as the study are imported. Additionally, this folder can contain `*.images` file that references images, one image per line. You can also specify TMA map, rotation to use with the image and potential new name, like this:

```
../otherfolder/1.svs
../otherfolder/2.svs;study.example.map;90
../otherfolder/011938r082.tif;;Nice Image
```

Note that TMA map, rotation or new name can be left out or empty and they will be ignored.

TMA Maps

You can import a TMA Map in two ways - either reference it in an `.images` file in study's folder or create a map file with the name `study.<studyname>.map<additional identifier>` in the root folder. The map file can be divided into a header and the actual map.

Header contains properties and their values separated by a colon (:). Header properties can be:

- `tmas` comma-separated list of slides that this map applies to
- `controls` comma-separated list of TMA core IDs in the map that should be considered controls and not scored
- `ignore` comma-separated list of TMA core IDs in the map that should be ignored - they will show up as empty space
- `rotate` specifies the clockwise rotation that should be applied to all slides listed in `tmas` in multiples of 90. Note that you can't change the rotation for a slide individually you need to create a new map for each rotation
- `origmap` path to the original TMA map - usually an Excel file - that users can download from the slide viewer for cross-checking
- `force` if you set this to true everytime this study is [reimported](#) all scores and positions belonging to cores from this map will be deleted. If you don't set it to true the map is used only on the first import and you can't change anything afterwards. Use carefully!

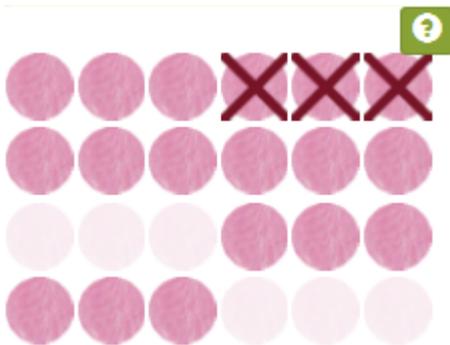
The header is terminated by an empty line. The map starts under it. Each line in a map is a row of TMA core IDs, columns are separated by TAB character. If a line doesn't have the same number of columns as the longest row it will be padded by empty cores.

Here is an example of a simple map:

```
tmas: 1.svs
controls: ctrl
ignore: 0, empty
force: true

1 1 1 ctrl ctrl ctrl
2 2 2 3 3 3
0 0 0 4 4 4
5 5 5 empty empty empty
```

The imported map applies to 1.svs and looks like this



Study Settings

Study settings are configured in the study.<studyname>.config file.

It contains properties of the study, in the format property name: value (or value1,value2)

Recognized properties:

```
allowchangingscores
allowresultscomparisonforeveryone
allowsharingslidesanonymously
artid
disallownavigation
disallowrewritingscores
disease
folder
friendlyname
hideslidenames
organ
scoretmacoresatonce
```



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```
showduplicates
showlabels
showotherpeoplescores
showslidenames
showthumbnails
showtmasampleids
stainings
```

Questions

The questions that form study's scoring sheet are listed in `study.<studyname>.scores`. The format is a bit complicated, it's best to create the scoring sheet in the [Question editor](#), click the Share button and copy the value of the `f` URL parameter to the questions file. In principle it has one line per question - name of the question followed by a semicolon (;), question type (FreeText, DropDown, Percentage, Checkbox, ...), followed by another semicolon and optionally other configuration for the question (options for a DropDown for example).

Importing

After uploading all important files call the POST `Api/Reimport` method to create the study based on the config files and return a log of how did it go.

POST `Api/Reimport`

Required rights: Can reimport studies

Parameters:

Name	Type	Required	Explanation
<code>studyName</code>	string	yes	Name of the study to (re-)import
<code>ignoreImageErrors</code>	true or false	no	If true the import process doesn't stop after encountering problems with a slide but try to import all slides

Returns

String with log of the import process

If you need to change an existing study you can upload modified config files and run `Reimport` again.

Note that nothing gets removed, only added. Furthermore, if you've removed an image or users using the administration interface it will be added again if it is in the config files.



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Note that you can't delete files on the server, only overwrite them.

Synchronizing

All users with CanEdit right can enter the administration interface and make changes to the study. Often it's needed to rotate some images, adjust a TMA map or reorder questions. However, when you call Reimport next time these changes can be overwritten. To prevent this from happening use GET Api/GetConfig method with study ID as a parameter. It will return the complete configuration of a study as an object graph (for details see the [API client](#)).

Download slide

GET Api/DownloadSlide

Required rights: Can read, Can download

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study which you want to download image from
imageId	int	yes	Which image to download

Returns

The slide file. Note that it can be very large (>10GB). It currently only works for slides that are all contained in a single file (i.e. not .mrxs)

Delete slide

POST Api/DeleteSlide

Required rights: Can modify, Can delete

Parameters:

Name	Type	Required	Explanation
studyId	int	yes	Study from which you want to delete the image

imageId	int	yes	Which image to delete
---------	-----	-----	-----------------------

Returns

Empty result on success.

Clone a study

You can easily clone a study as it is by requesting the configuration files of an existing study using `Get Api/GetConfigFiles` method with study ID as a parameter. This will return a JSON object with content of all the configuration files. Note that they are dynamically generated from the database - these are not necessarily the same files that were used to create the study.

Getting pixel data

Slide Score can act as a platform for storing the slides and serving them for other applications. The API has 2 methods how to request the tiles that make up pathology slides:

1. Accessing the Deep Zoom tiles using `GetImageMetadata`, `GetTileServer` and requests to `/i/` endpoint. This is the high-performance method. It serves tiles in different levels, each level being twice as detailed as the previous one. It increases complexity of the client code as each slide can have different number of levels and tile size and they need to be stitched together to create the image.
2. [GetScreenshot](#) for low volume of requests, if you need the slide with annotation or just a low resolution image.

Deep Zoom tiles

Deep Zoom is a technology for displaying high resolution images in the browser. Slide Score uses it to display slides to the users. It is possible for your script to use the same interface. As it's highly optimised for speed, it should be the fastest method of accessing the slides remotely.

When using Deep Zoom a large image is requested in parts - tiles. These tiles need to be stitched together to create the whole image. To support zooming in and out of image Deep Zoom defines levels. The last level has all the detail that is actually in the image. The level above it is twice smaller (its width and height are both half so you could say it's 4 times smaller). And so on and on until level 0 which is 1x1 pixel. So, if you have an image that's 4096x4096 pixels it would have 12 levels (as 2^{12} is 4096), level 12 would be 4096x4096, level 11 would be 2048x2048 and so on.

Now back to the tiles. Remember that we can't request the whole level as it might be too large. The pixels are requested in tiles. For example the image from the last paragraph might have tiles with size 256x256 pixels. In that case level 12 would have $4096/256=16$ rows and columns of tiles. Level 11 would have 8 and so on.

When using this method you need to first request access to the `/i/` endpoint by calling `GetTileServer` - this will return two tokens for authentication: one needs to be supplied in a cookie and another in the URL. This replaces the standard API authentication for the `/i/` endpoint. You will also need to



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request image dimensions, tile size and levels by calling GetImageMetadata. Then you can start requesting the JPEG encoded tiles using the /i/ endpoint.

GET Api/GetImageMetadata

Required rights: Can get pixels

Parameters:

Name	Type	Required	Explanation
imageId	int	yes	ID of the image to access

Returns

JSON object with success flag and SlideMetadata object:

```
long Level0TileWidth
long Level0TileHeight
int OSDTileSize
double MppX
double MppY
double ObjectivePower
string BackgroundColor
int LevelCount
long Level0Width
long Level0Height
double[] Downsamples
```

OSDTileSize holds the size of tiles (256px in the example above)

Level0Width and Level0Height is the width and height of the largest most detailed level (note that in Deep Zoom the most detailed level is the last one not level 0). You will need to calculate the number of levels from the larger of width and height.

GET Api/GetTileServer

Required rights: Can get pixels

Parameters:

Name	Type	Required	Explanation
imageId	int	yes	ID of the image to access

Returns

JSON object with cookiePart and urIPart to be used in the calls to /i/ endpoint.



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Calling the /i/ endpoint

You can request the JPEG encoded tiles at URL

```
/i/<imageID>/<urlPart>/i_files/<level>/<column>_<row>.jpeg
```

replace urlPart with the respective authentication token from GetTileServer, imageID with the ID of the requested image, level, column and row with the coordinates of the tile. You also need to include a cookie with name "t" and value of the cookiePart token from GetTileServer.

For example

```
/i/53926/318yu2xYJBUK6IKpsb/i_files/9/0_0.jpeg
```

To request the tile from the upper left corner of the image with ID 53926. It's from a level 9 which has size at most 512x512.

6 Maintenance

Maintenance of Slide Score will be performed according to the implemented software maintenance service agreement with Slide Score.

In case of any irregularities during the use of Slide Score, please contact Slide Score B.V. support using the contact details given on the last page of this document.

7 Troubleshooting

Please troubleshoot any issues according to the table below. If your problem is not solved, please contact Slide Score B.V. support.

Troubleshooting table for error messages

7.1 Installation

OBSERVATION	POTENTIAL CAUSE	ACTION
slidescore process is not starting	journalctl shows slidescore triggered FailFast	Check the message that was included at termination of the process. Check that the user running the process has read permissions for all files under the installation directory, execute permission on all directories, write permission for logs, thumbnails, images, keys, db, tus and attachments.
-	journalctl shows memory access error	Check that all native dependencies (libopenslide libISyntaxAdapter, libSkiaSharp) can load (see output of ldd command)

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Uploading files doesn't work (error 400)	web application firewall (WAF, for example mod_security) rules block legitimate traffic	If mod_security is active disable the following rules: 932140 941160 949110 980130 981242
Email addresses on our domain are not accepted	Email address validation checks whether the domain has MX record, on intranet that is often not the case	Add your domain to Email:WhiteListedDomains setting in the appsettings.json configuration file
MRXS slides contain heavy artifacts (all black and white or "mosaic effect")	old version of Pixman (v0.38)	Compile v0.40+ from sources, "install -c" it to a suitable location and add line Environment=LD_PRELOAD=<path to libpixman.so> to the slidescore.service systemd definition file
After successful login, the login page is shown again	authentication cookie is not set	Verify that the application uses HTTPS (authentication cookie has a Secure flag set)

7.2 Usage

OBSERVATION	POTENTIAL CAUSE	ACTION
study administrator unable to upload slides	no directories where upload is allowed	Study administrators can only upload slides to directories which contain slides from studies where they are administrators. Site administrator should add the first slide to the study so that study administrator can upload slides to the same directory
button Review for reviewing scores doesn't appear for user	user doesn't have Get results permission	Site or study administrator should give the user Get results permission
User cannot access a study	incorrect user identifier/email specified in the Users tab	Verify that the correct user identifier/email is specified in the Users tab of the study

Troubleshooting table for error messages.

OBSERVATION	POTENTIAL CAUSE	ACTION
"File unrecognized" when uploading a slide file	This slide format is not recognized	Convert slide to one of the recognized formats, for example BigTIFF

8 Symbols

Symbol	Description
	Medical software manufacturer Indicates the Medical software manufacturer, as defined in EU Directives 90/385/EEC, 93/42/EEC and 98/79/EC.
Slide Score v1.2	Name and version of the medical software.
	Company logo.
	Mark of conformity according to the European Medical Device Directive 93/42/EEC.
	Follow Instructions for use.

9 Regulations

Medical software Slide Score is classified as a class I medical device according to MDD 93/42/EEC:2007/47 as amended.



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