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Use Open-Source Tool to Simplify & Automate Video/Image Labeling Process

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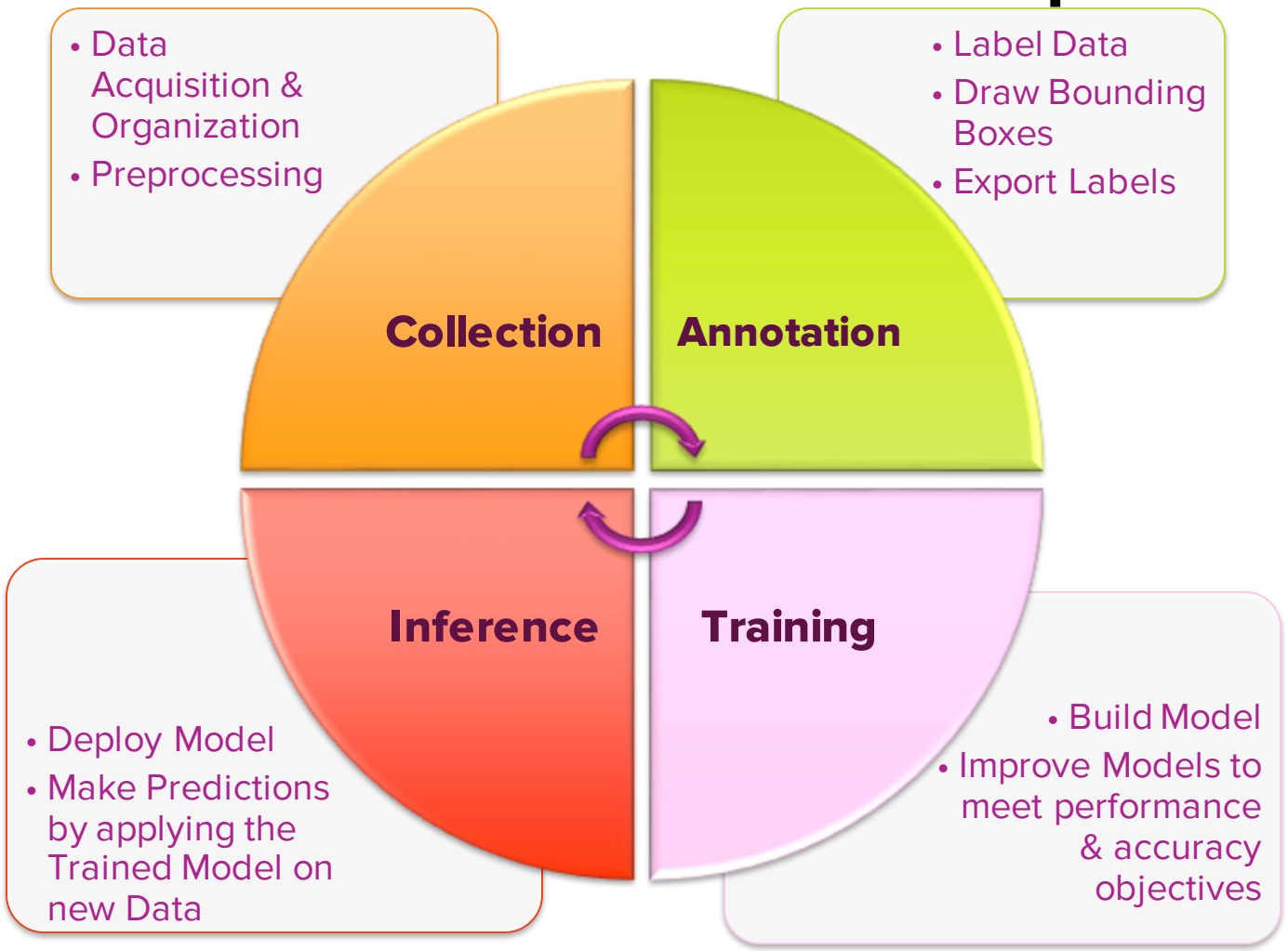
Overview

- Introduction
- Project Setup
- Annotation Specifications
- Annotation Best Practices
- Perform Annotations
- Conclusion

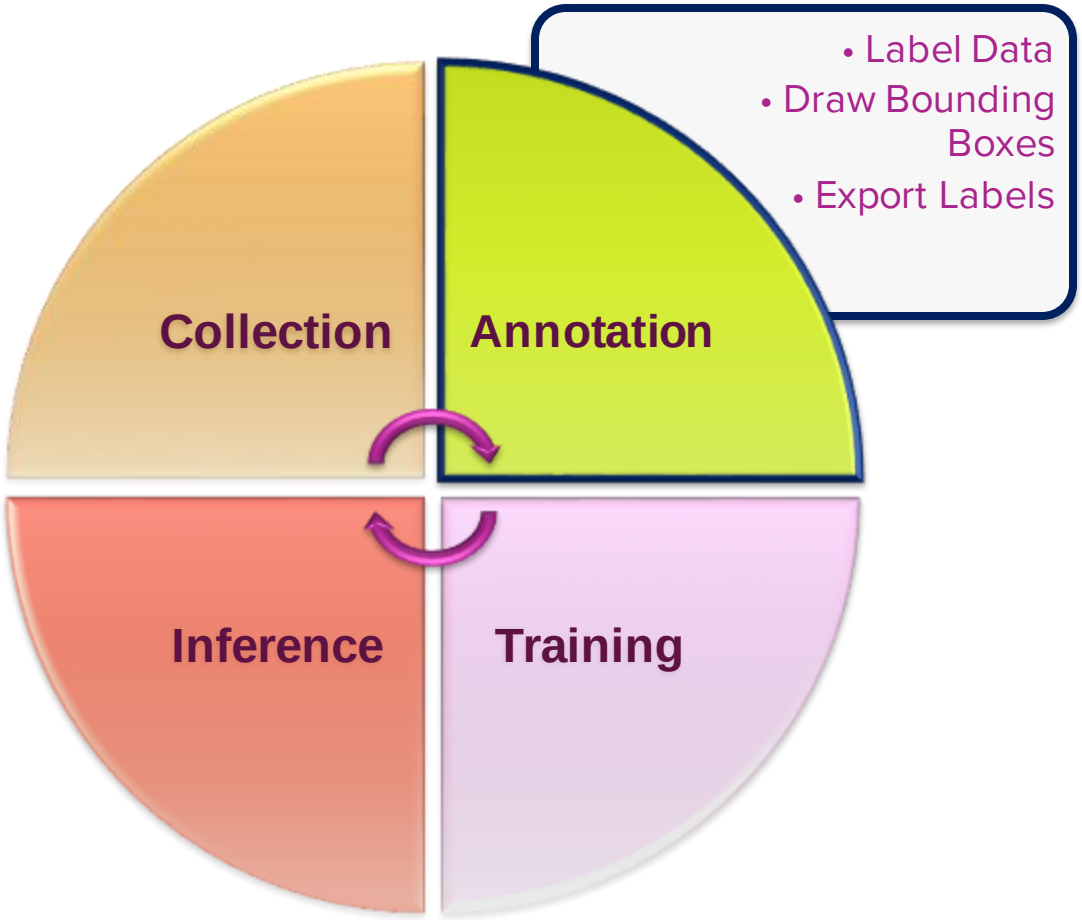
Introduction

AI/ML Solution Development



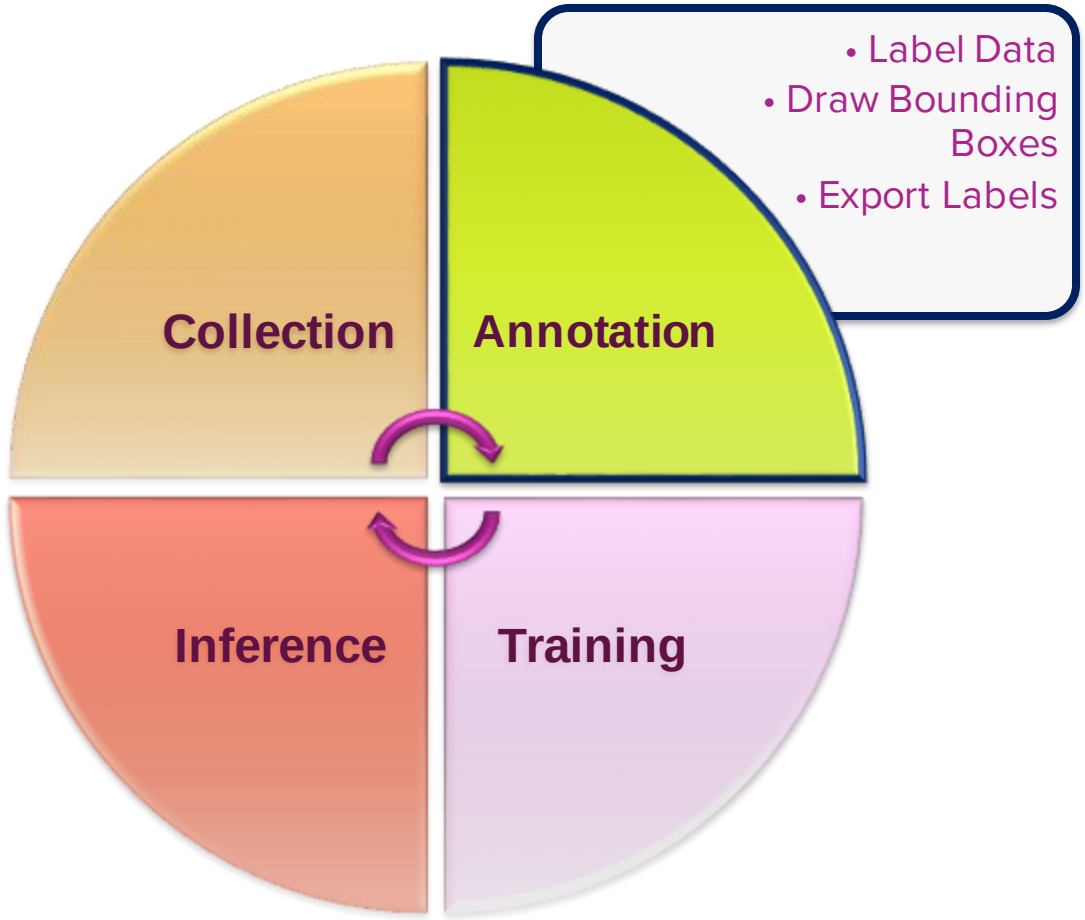
Data Annotation / Labeling

- Establish ground truth
- Draw bounding boxes around object
- Simplest step
- Challenges
  - Manual vs Automation
  - Time consuming
  - Expensive
  - Difficult to Scale



Data Annotation / Labeling

- Commercial Tools
  - Labelbox
  - Dataloop
  - RectLabel
- Open-Source Tools
  - Bbox
  - LabelImg
  - VGG Image Annotator (VIA)



OpenVINO OpenCV

Computer Vision Annotation Tool
https://github.com/opencv/cvat

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Project Setup

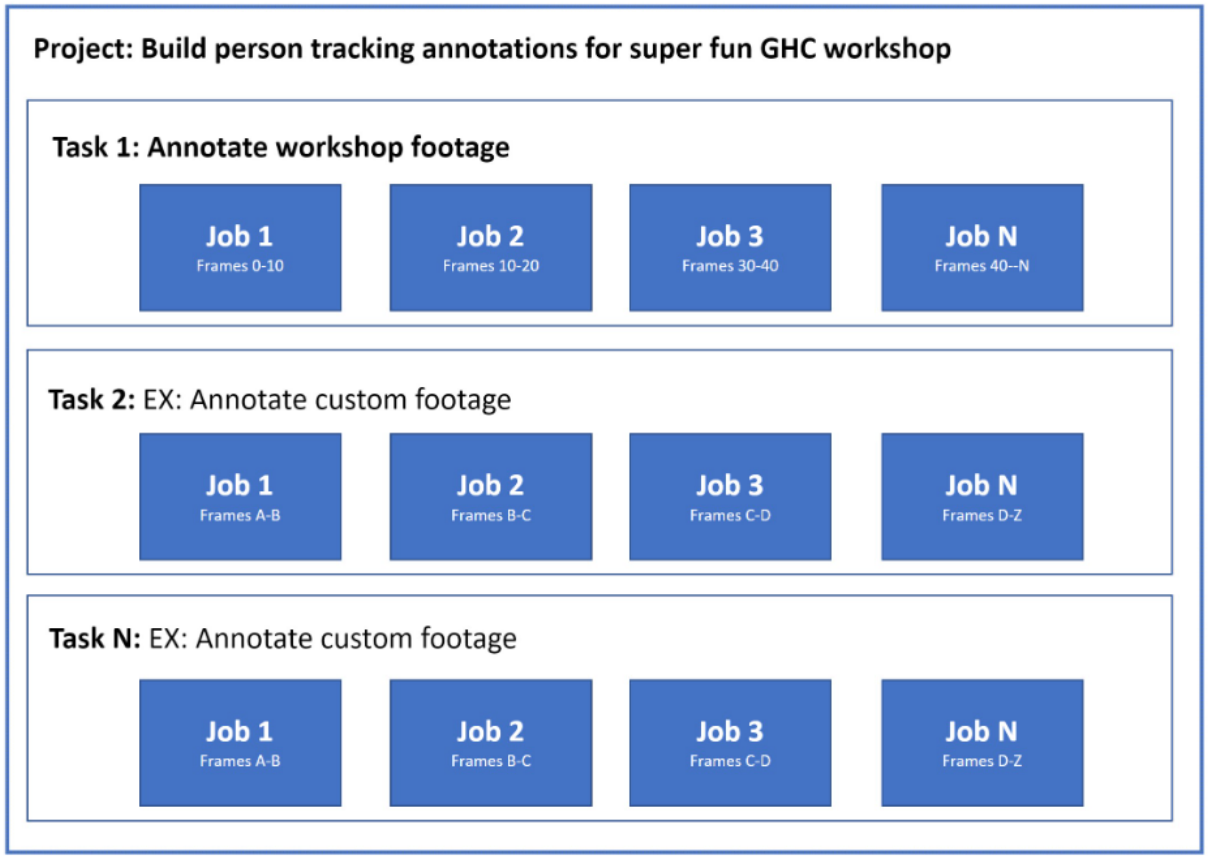
https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/annotationSteps.md

https://github.com/sicoyle/ghc-data-annotation-workshop

https://app.cvat.ai/auth/login

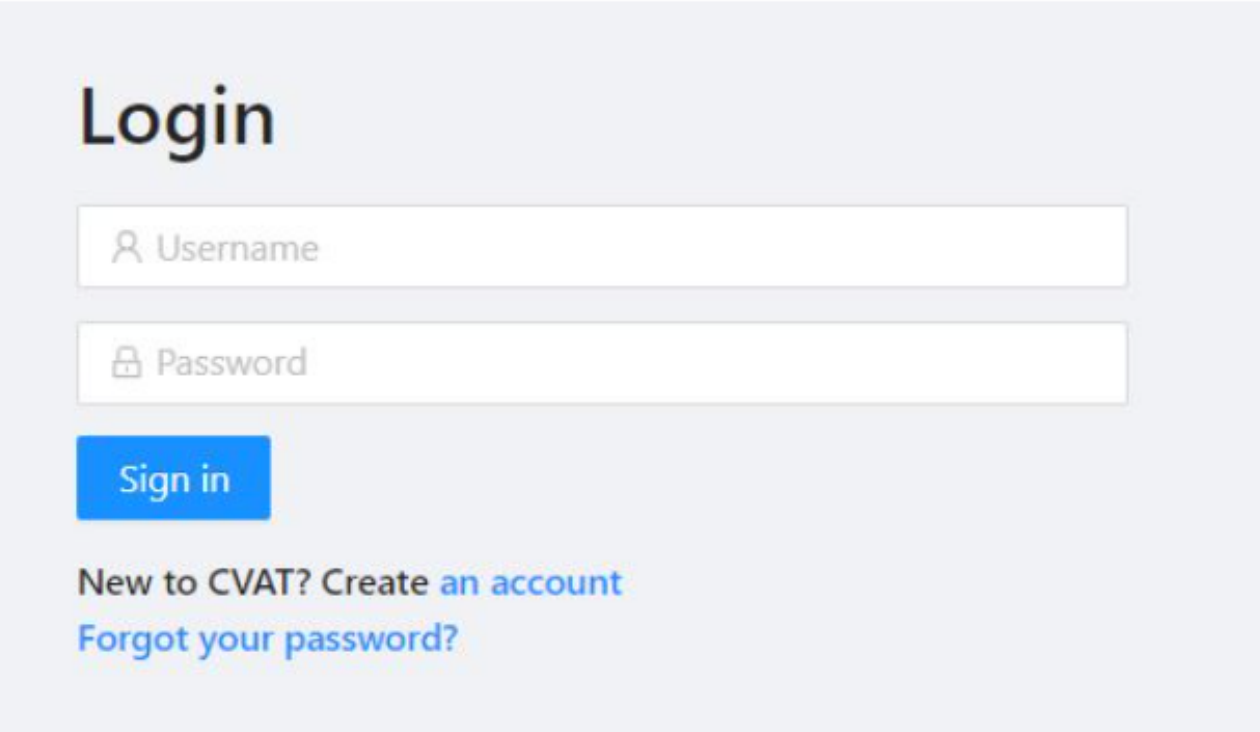
Background information

CVAT projects have a hierarchy incorporating tasks and jobs. Annotation projects may have many annotation tasks and jobs. Tasks are where you upload video footage and specify the associated project and labels. Tasks represent the progress for annotation footage and details of the task. They also allow you to upload existing annotations and export annotations. Tasks may have multiple jobs. Jobs allow you to split up tasks by frame to divvy up the annotations among a team.



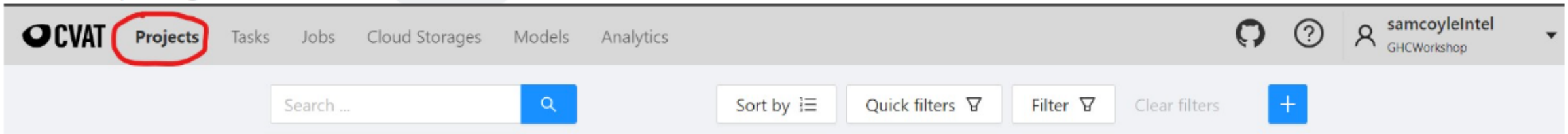
Steps to follow to create an annotation project

1. Create an account and login at **https://app.cvat.ai/auth/login**



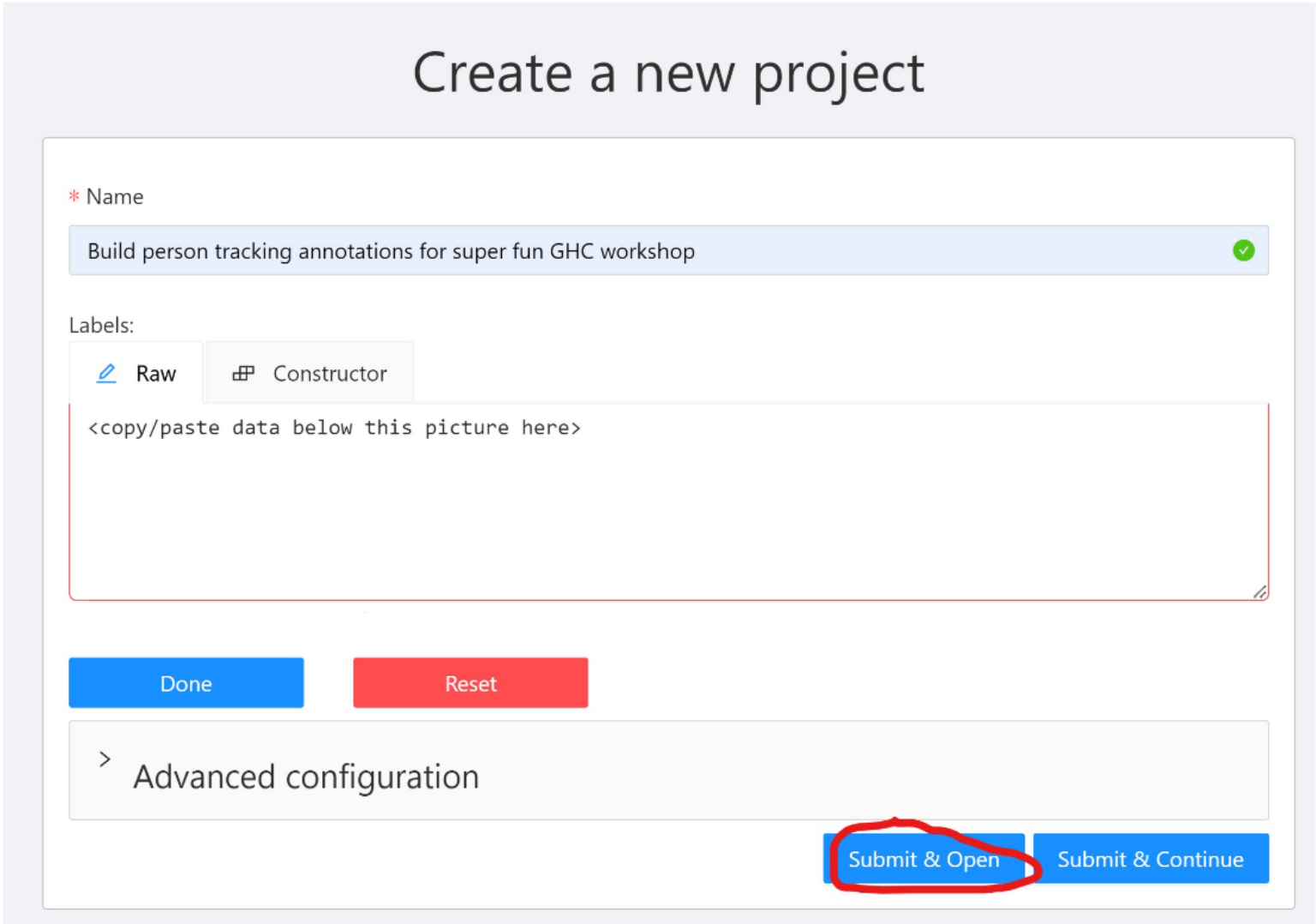
> While creating a new account, a valid email address is required. Tool requires email confirmation by clicking on the link sent to this email address

2. Use the top navigation bar to click `Projects`.



3. Click the blue `+` sign and then `Create a new project`.

4. Copy the details from the image below to fill out the project to be created and select `Submit & Open`. For the raw label data, copy/paste the data snipped below the picture. These data represent the labels & their attributes.



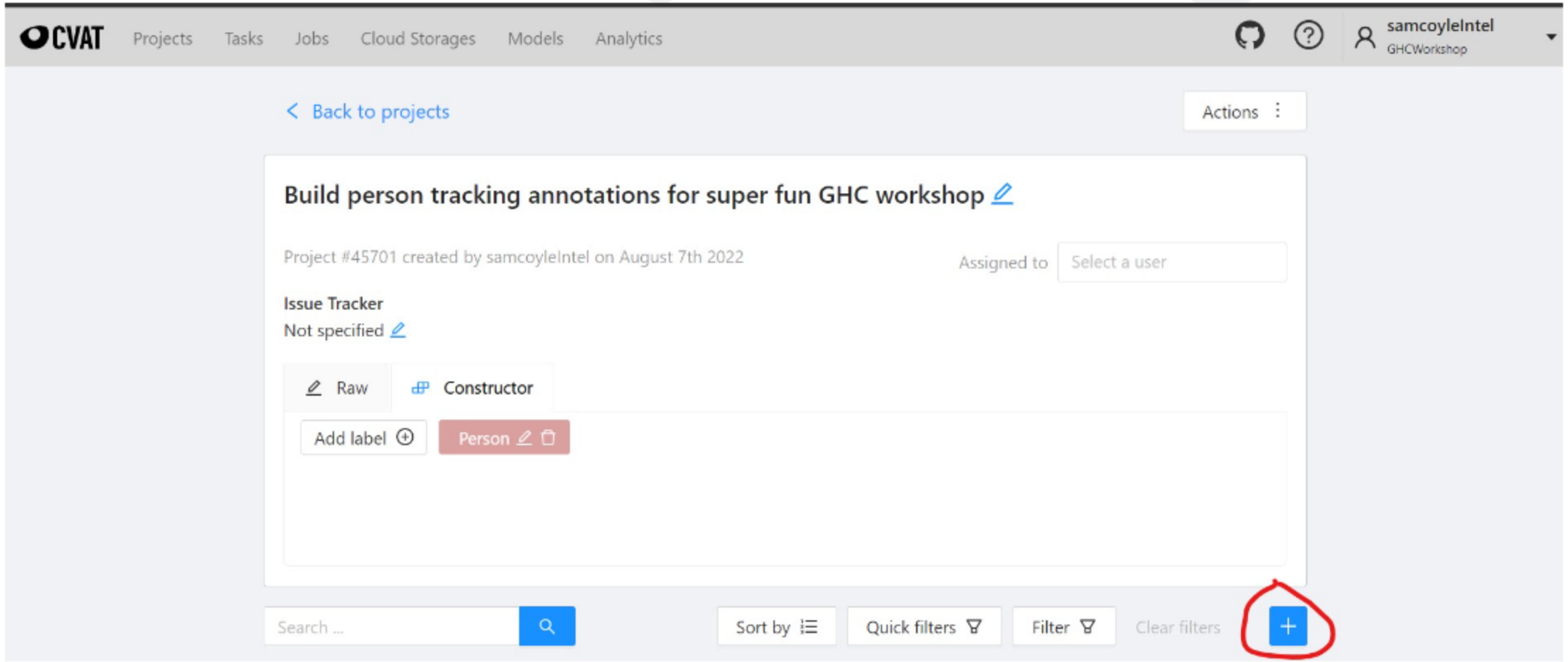
Raw Label data to copy/paste into the CVAT UI:


```
[
  {
    "name": "Person",
    "id": 1199059,
    "color": "#c06060",
    "attributes": [
      {
        "id": 1198651,
        "name": "Identity",
        "input_type": "number",
        "mutable": false,
        "values": [
          "1",
          "1000",
          "1"
        ]
      },
      {
        "id": 1198650,
        "name": "Occlusion",
        "input_type": "number",
        "mutable": false,
        "values": [
          "0",
          "2",
          "1"
        ]
      }
    ]
  }
]
```


https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/annotationSteps.md

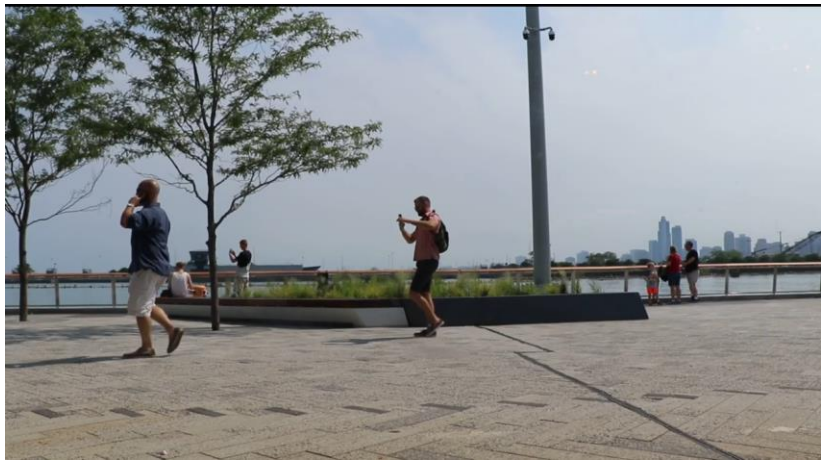
> Note: For more information on the labels used for the workshop, please refer to the Annotation Specifications Doc.

5. Click on your newly created project and click on the blue `+` sign at the bottom right of it to create a new `task` for it.

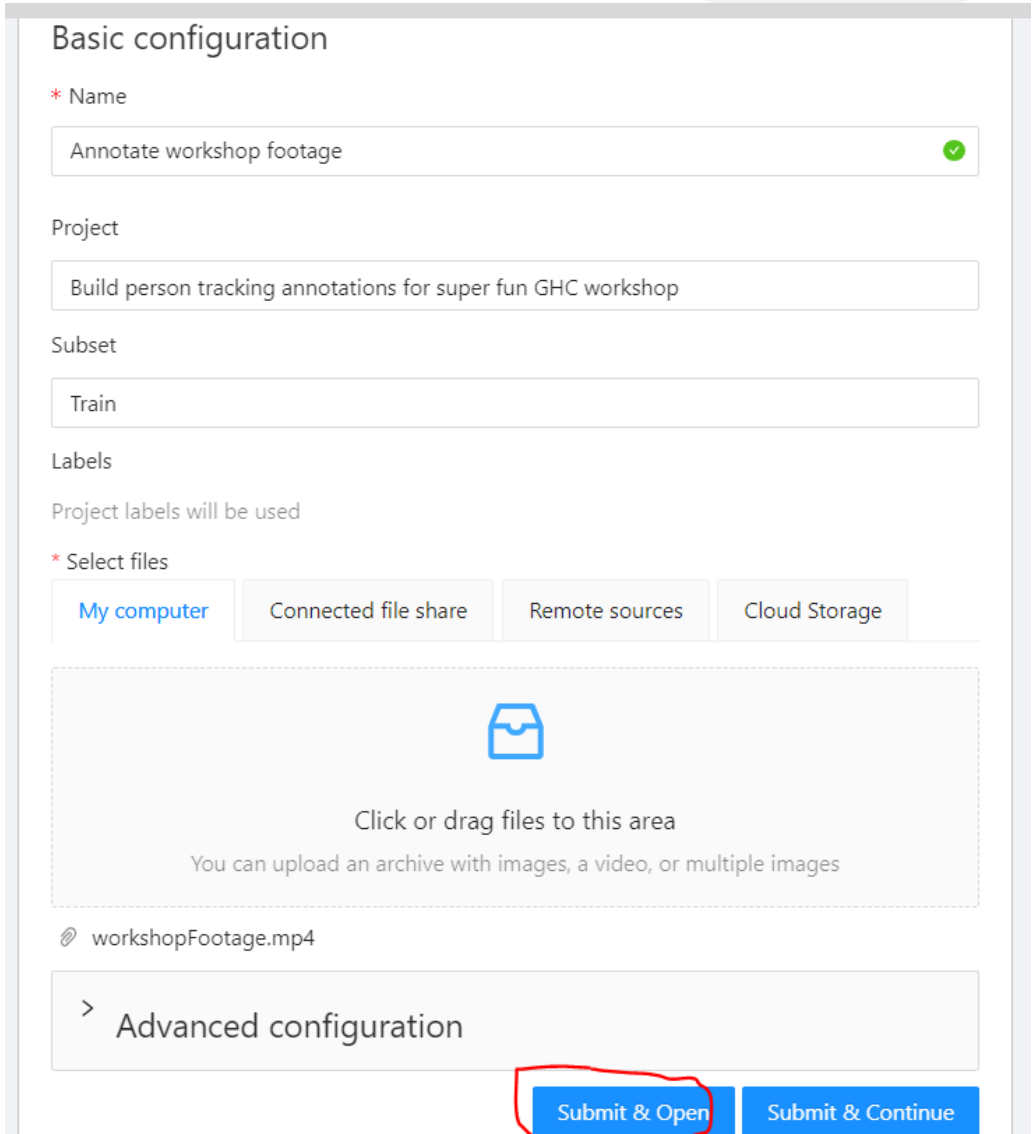


6. Create your task copying the details below and click `Submit & Open` on your task:

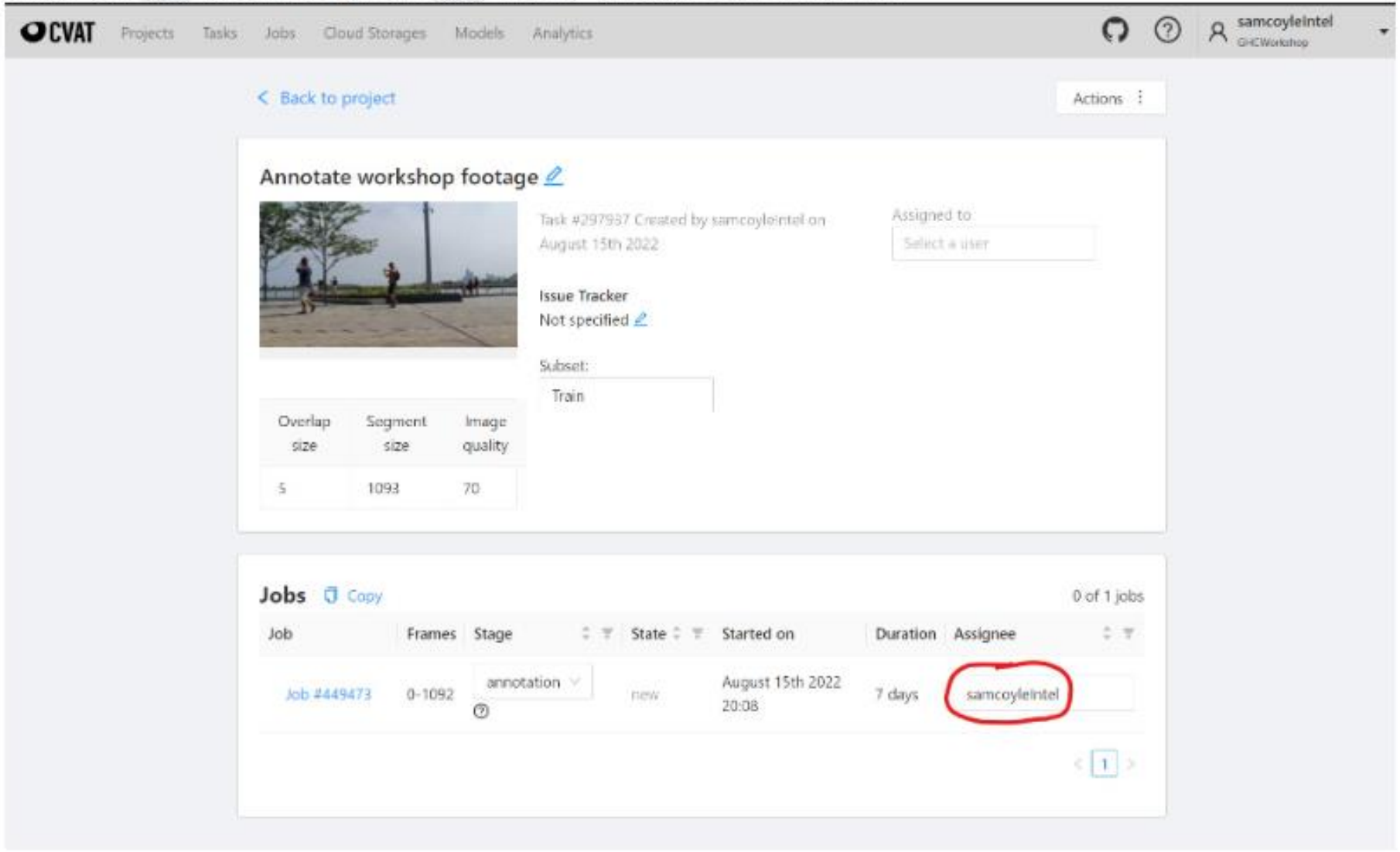
https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/assets/video/workshopFootage.mp4



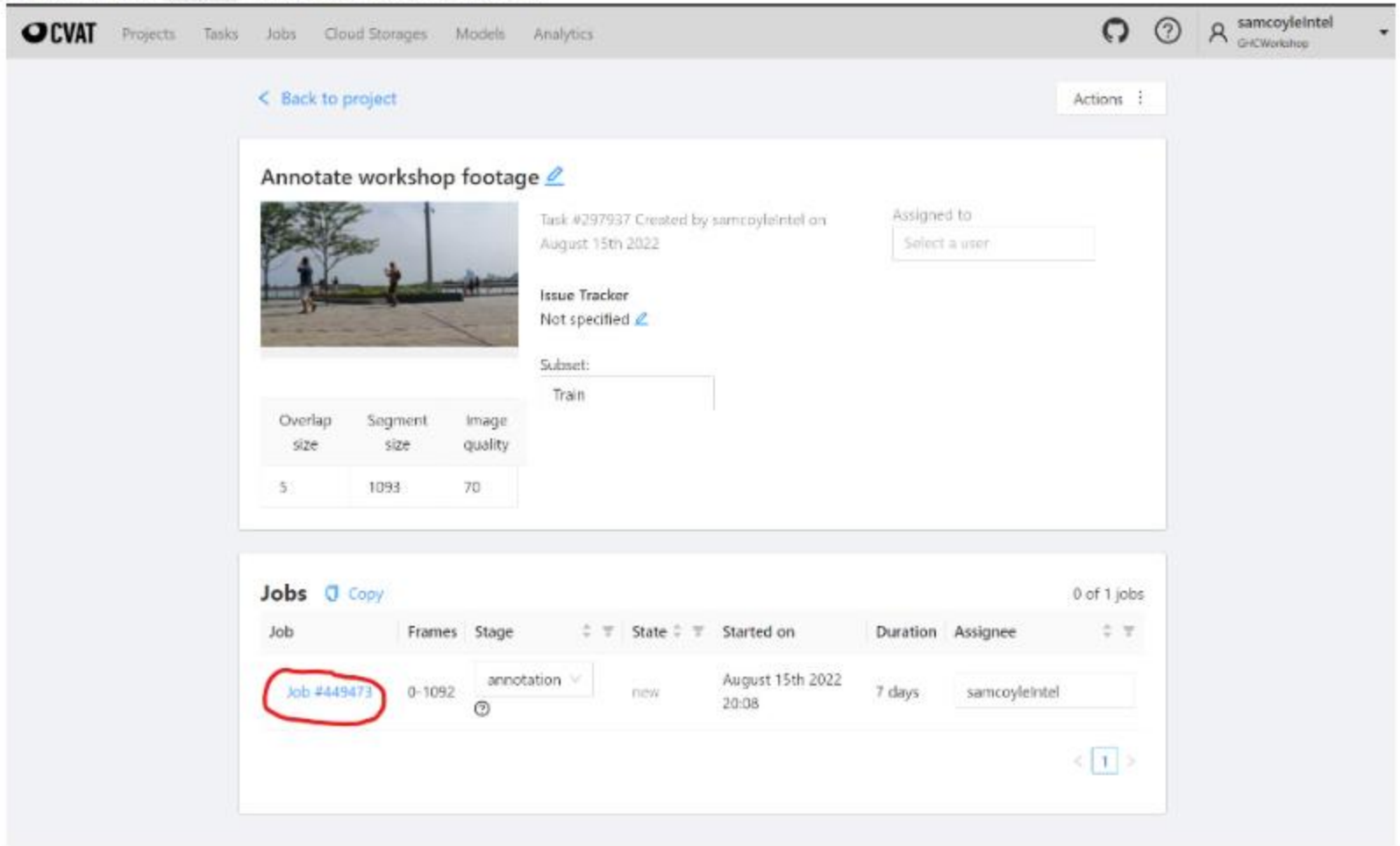
Note: It may take a few seconds-minutes to upload the video footage pending the network bandwidth.



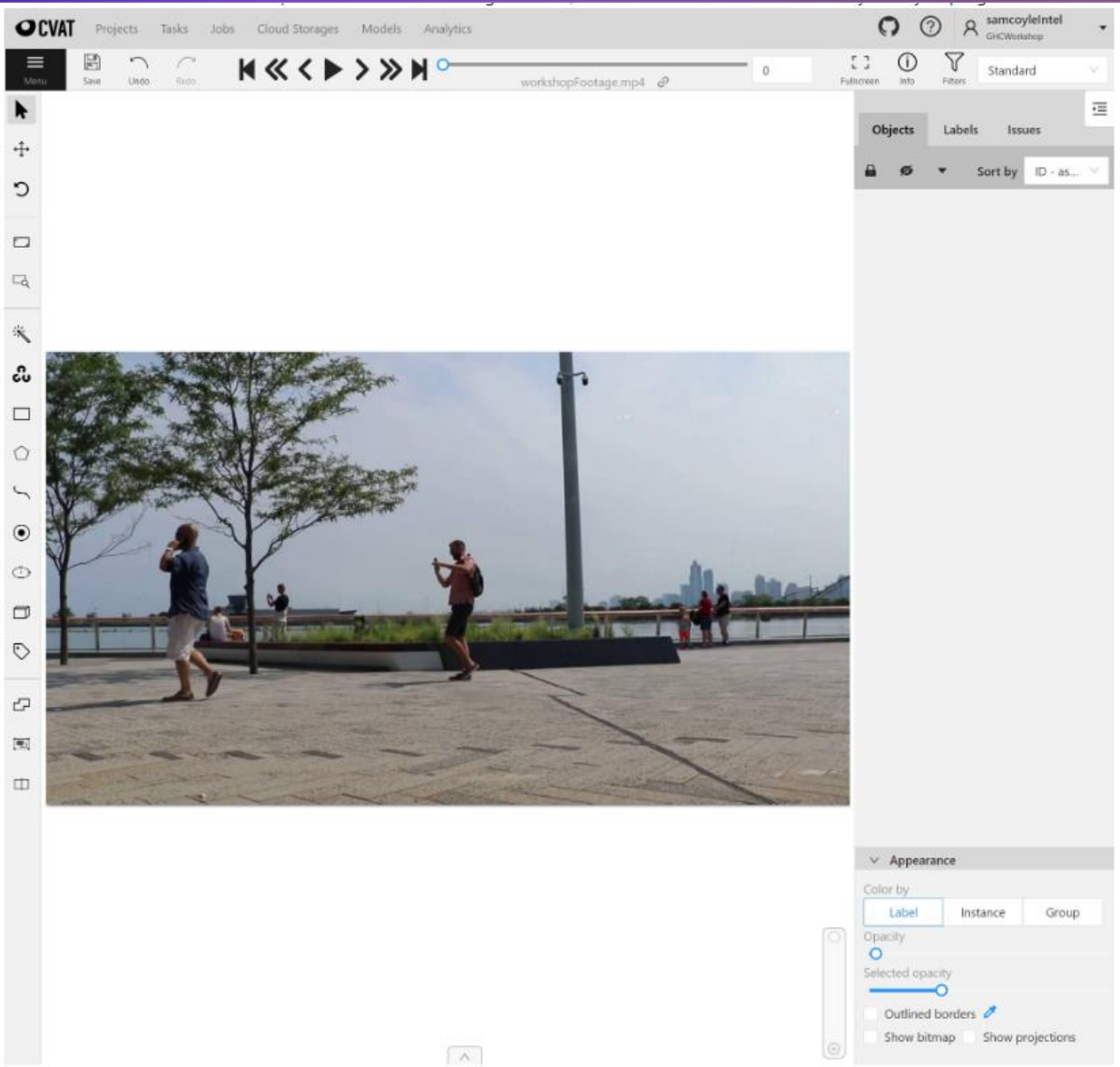
7. Under the `job` details, assign the `job` to your username as seen below.



8. Click on the `job #` that was created above.



This will take you to a screen where you can start data annotations. This is where you will use the supporting documents to perform your data annotations. Feel free to ask questions as needed during this time, and collaborate with those around you as you progress.


CVAT
Projects
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Analytics
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Objects
Labels
Issues
Sort by
ID - as...
Appearance
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Label
Instance
Group
Opacity
Selected opacity
Outlined borders
Show bitmap
Show projections

Annotation Specifications

https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/annotationSpecifications.md

Data annotation specifications

Specifications to guide annotations for a person tracking project

The information below is meant to guide discussion and provide pointers and considerations that a professional annotation team would have for a person detection annotation project.

General Comments

- Only visible parts of people should be annotated.
- Don't include bags, purses, baby carriages, shopping carts, etc. into a bounding box.
- Individuals should have the same identity if he/she/it/they appear/disappear several times throughout a video.
- Don't annotate small or really blurry people.

Annotation Format

`CVAT` supports multiple annotation formats that may be found https://opencv.github.io/cvat/docs/manual/advanced/formats/

- Annotation Format is to be chosen by the annotator. One example is `CVAT` XML file schema/metadata.

More information on the XML annotation format specifically may be found https://opencv.github.io/cvat/docs/manual/advanced/xml_format/
The link describes the tags that are present in the XML, what they mean, and demonstrates an annotation example using annotation boxes, polygons, etc.

https://opencv.github.io/cvat/docs/manual/advanced/xml_format/

Person Tracking

The annotation file should contain the following information per frame (from either manual or interpolated annotations):

Annotation	Annotation Type	Encoded by
Person (location)	Rectangular bounding box (x1, y1, x2, y2)	x1: horizontal coordinate of the top left corner y1: vertical coordinate of the top left corner x2: horizontal coordinate of the bottom right corner y2: vertical coordinate of the bottom right corner
Identity	Number	Number indicating the person's identity (maintained over time).
Occlusion	Number	Value: • Person is not occluded (0) • Person is partially occluded (<= 50%) (1) • Person is heavily occluded (>50%) (2)

Annotation Best Practices

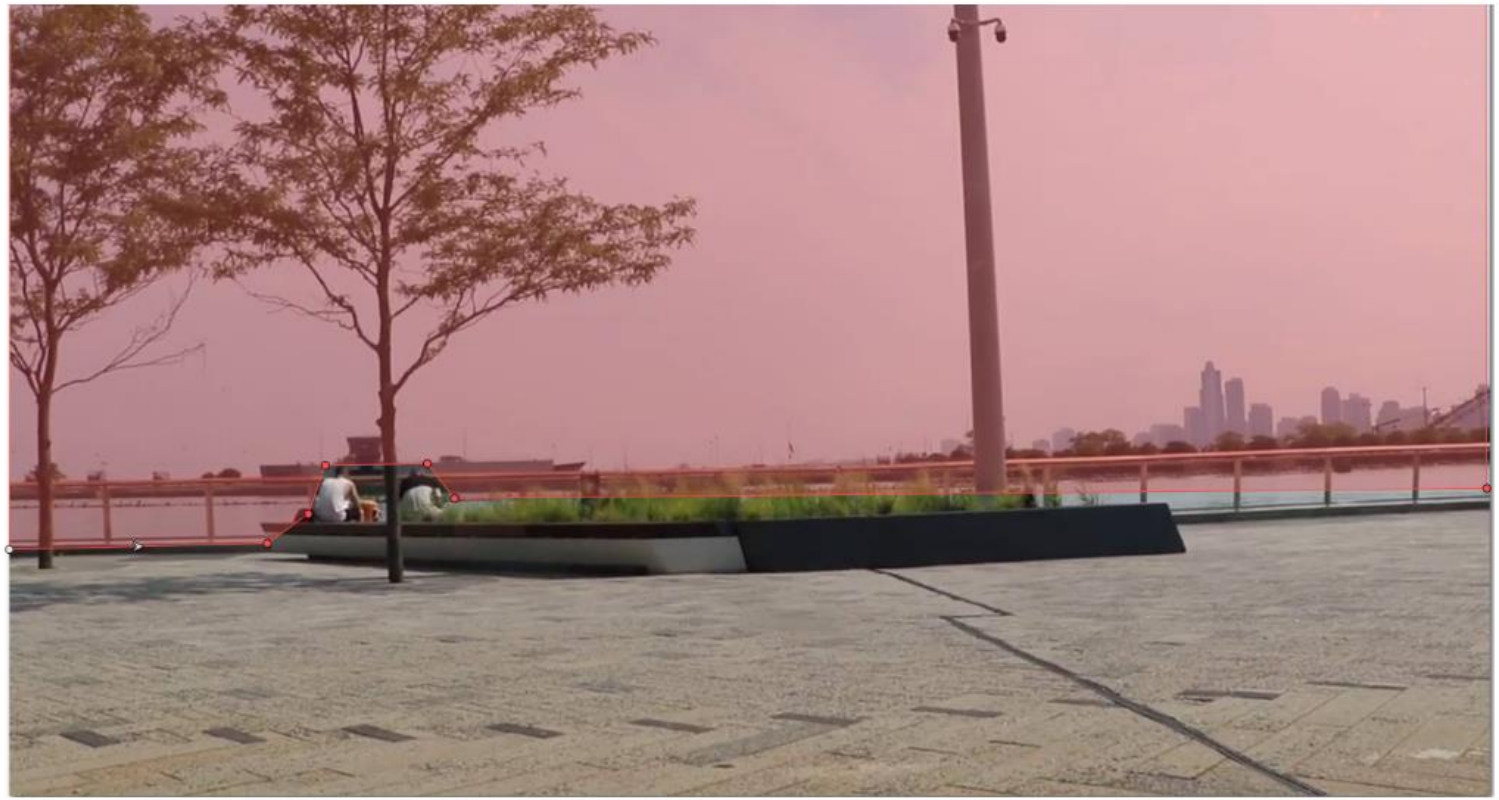
https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/annotationBestPractices.md

Data Annotation Best Practices

1. How big do people have to be to require annotating?

All people should be annotated. However, `ignore regions` may be defined for regions of the image where people are too small. `Ignore regions/zones` are common to have depending on your footage use case.

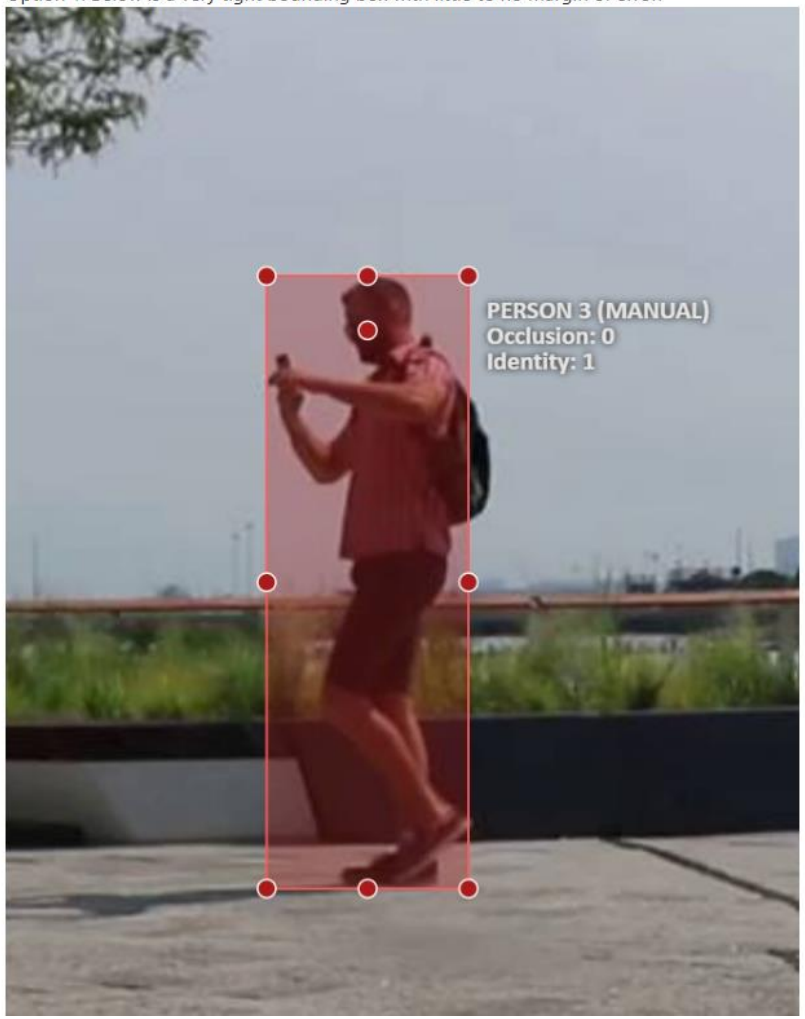
For example, in the image below, the red region can be described as our `ignore region`. This region will be excluded from annotations. In the case that ships pass by in the water with passengers on deck, then we do not want them counted towards our data annotations.



2. How precise should annotations be?

Annotations may be made with very tight bounding boxes, with 1-5% margin, or with >5% margin of boundaries.

Option 1: Below is a very tight bounding box with little to no margin of error:



Option 2: Below is a looser bounding box with a 1-5% margin of error:

Option 3: Below is the loosest bounding box with a >5% margin of error:

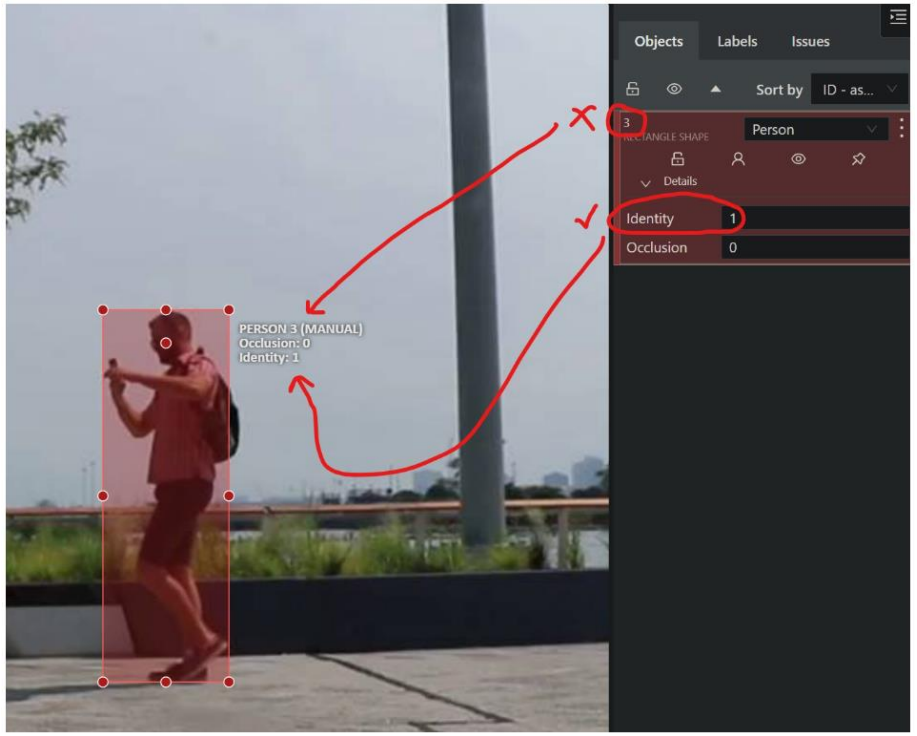
For the purposes of this workshop, Option 2 is suitable for our use case. Please utilize Option 2 for reference when performing your data annotations.

3. What is the `Identity` attribute?

Annotation	Annotation Type	Encoded by
Identity	Number	Number indicating the person's identify (maintained over time).

`Identity` is not personally identifiable information in the way one might initially think. It does **not** mean name, DOB, address, etc. `Identity` in this sense refers to a means to track the same person across different frames.

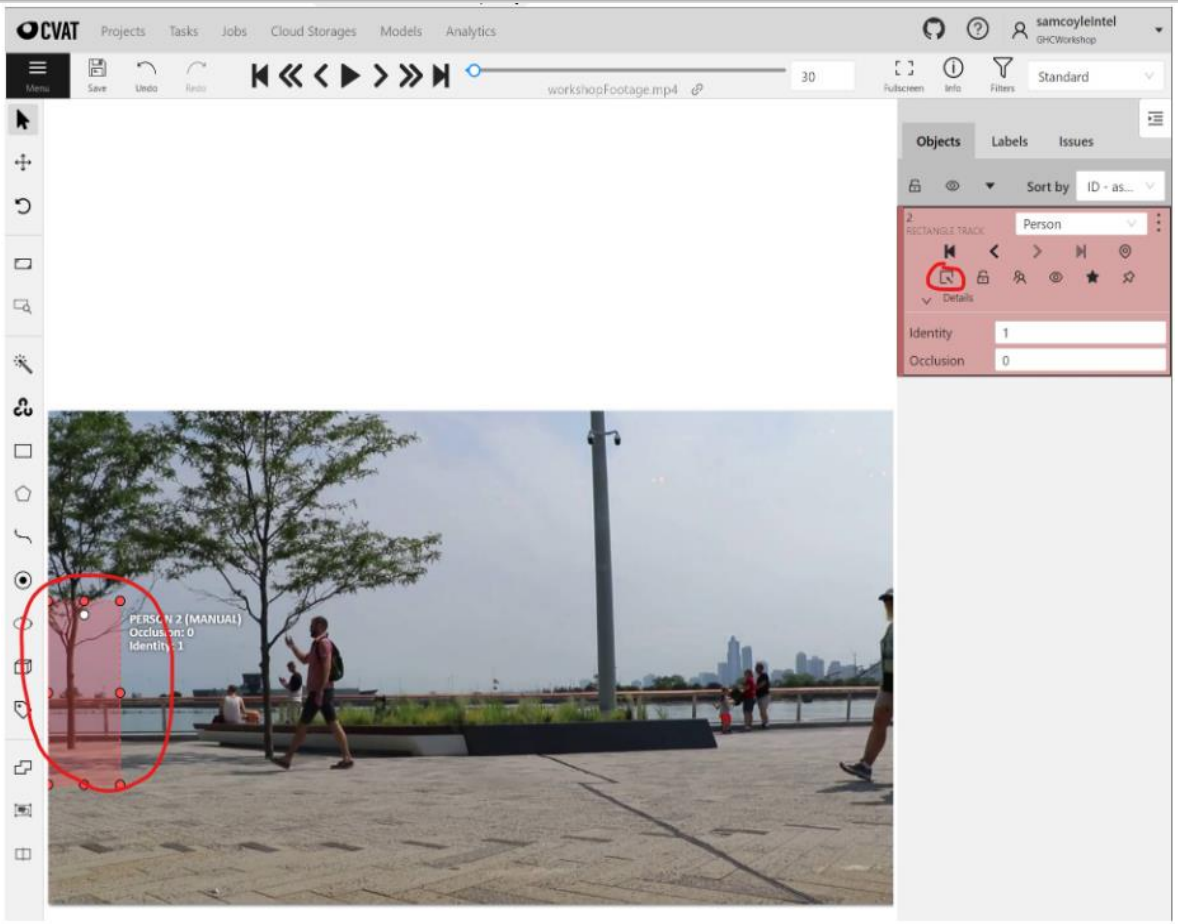
`CVAT` creates automatic `IDs` which cannot be changed. For example, the image below has the automatic `ID` of `PERSON 3`. However, we refer to the person with the `Identity` label of `1`. This is the `Identity` with which we will refer to this person throughout the duration of the video. For these purposes, you may disregard the automatic `IDs` given to each of your annotations. In other words, please disregard the numbers by the red `X` in the image.



4. How to annotate partial people?

For cases where people are present only partially in the frame, annotate the parts of the person that you can. Be sure to mark the `Occlusion` field accordingly.

5. How to annotate people who left the frame? For cases where someone walked to where they are no longer visible, mark the person as outside the frame by clicking on the `Switch Outside Property` field circled in the image below.



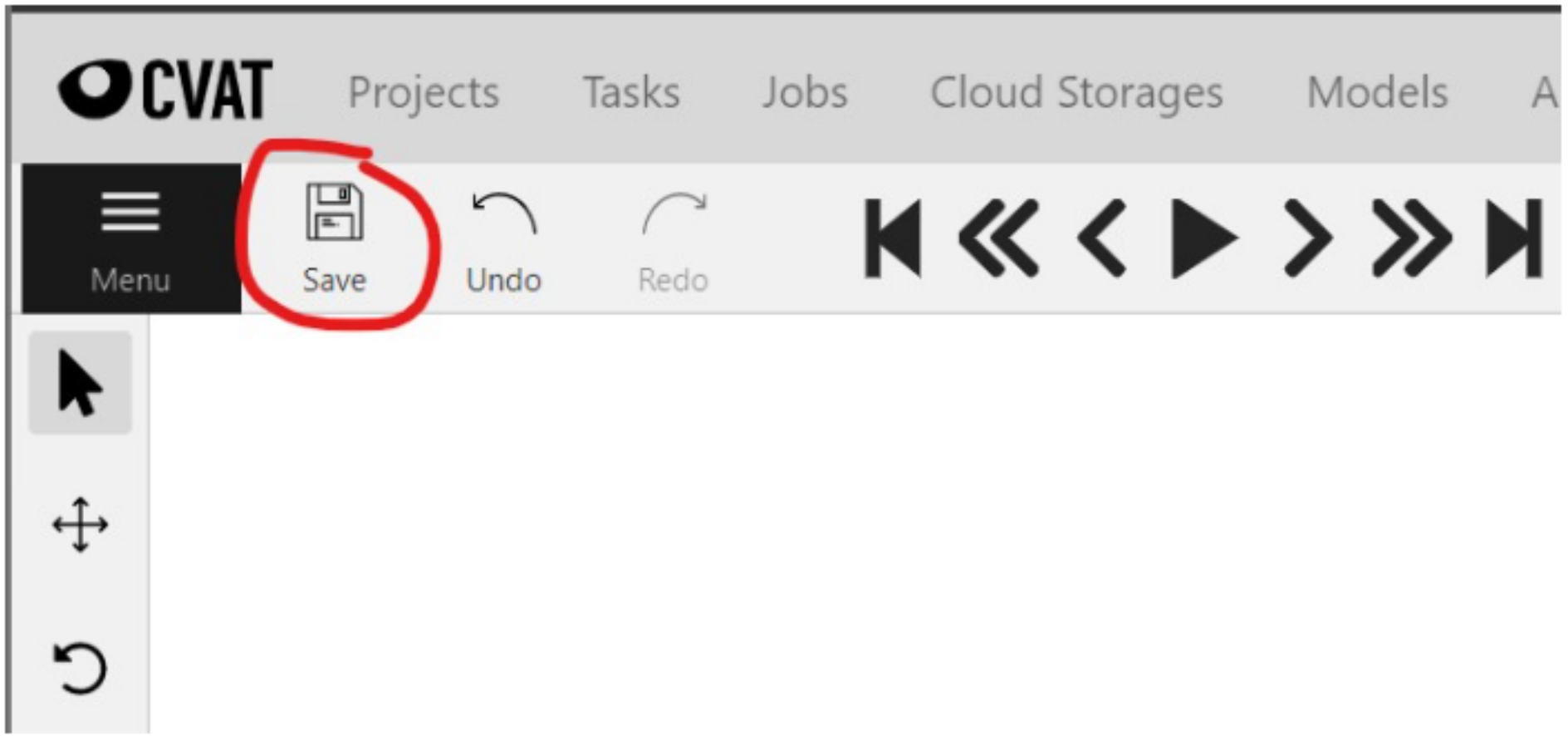
In the example above, the person who was being tracked by `Identity = 1` has now walked outside the frame. By switching the `Outside Property` circled under the `Objects` tab on the right, CVAT understands that the person is no longer visible within the frame. This field will ensure that the data annotations properly account for people as they walk outside the frame.

6. If annotating every 10 frames, then how to account for the frame count not being evenly divisible by 10?

The workshop footage contains `1093` frames. Being that it is a video and people are being tracked, then it is acceptable to annotate every 10 frames. This is because CVAT knows to interpolate the frames between that are unannotated to automatically annotate them for us. If annotating every 10 frames, you will end up on frame `1090`. Go ahead and annotate the last frame numbered `1093`.

7. When to save annotation progress?

Click `Save` after each frame has been annotated.



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Perform Annotations

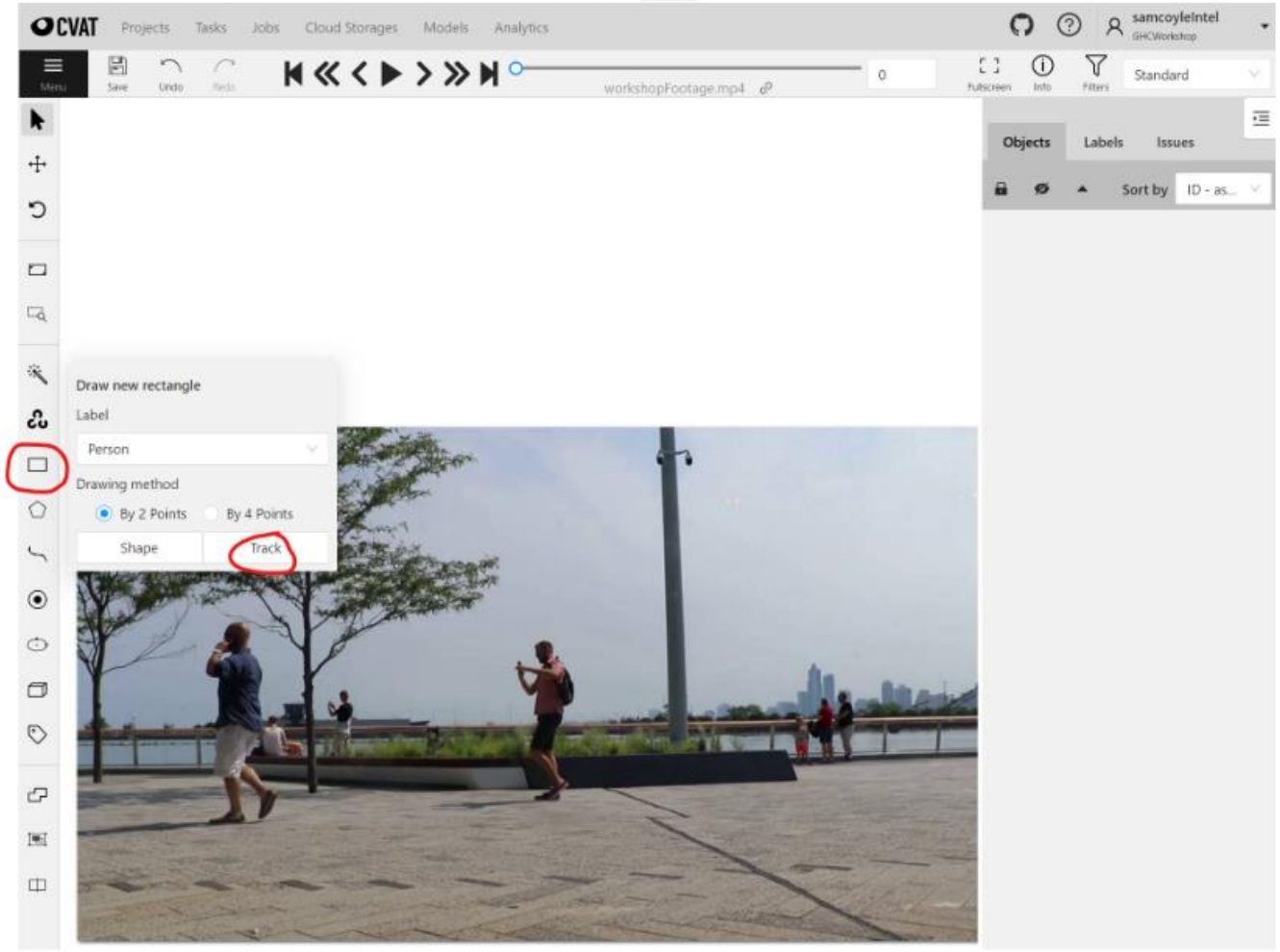
https://github.com/sicoyle/ghc-data-annotation-workshop/blob/main/annotationSteps.md

https://github.com/sicoyle/ghc-data-annotation-workshop

https://app.cvat.ai/auth/login

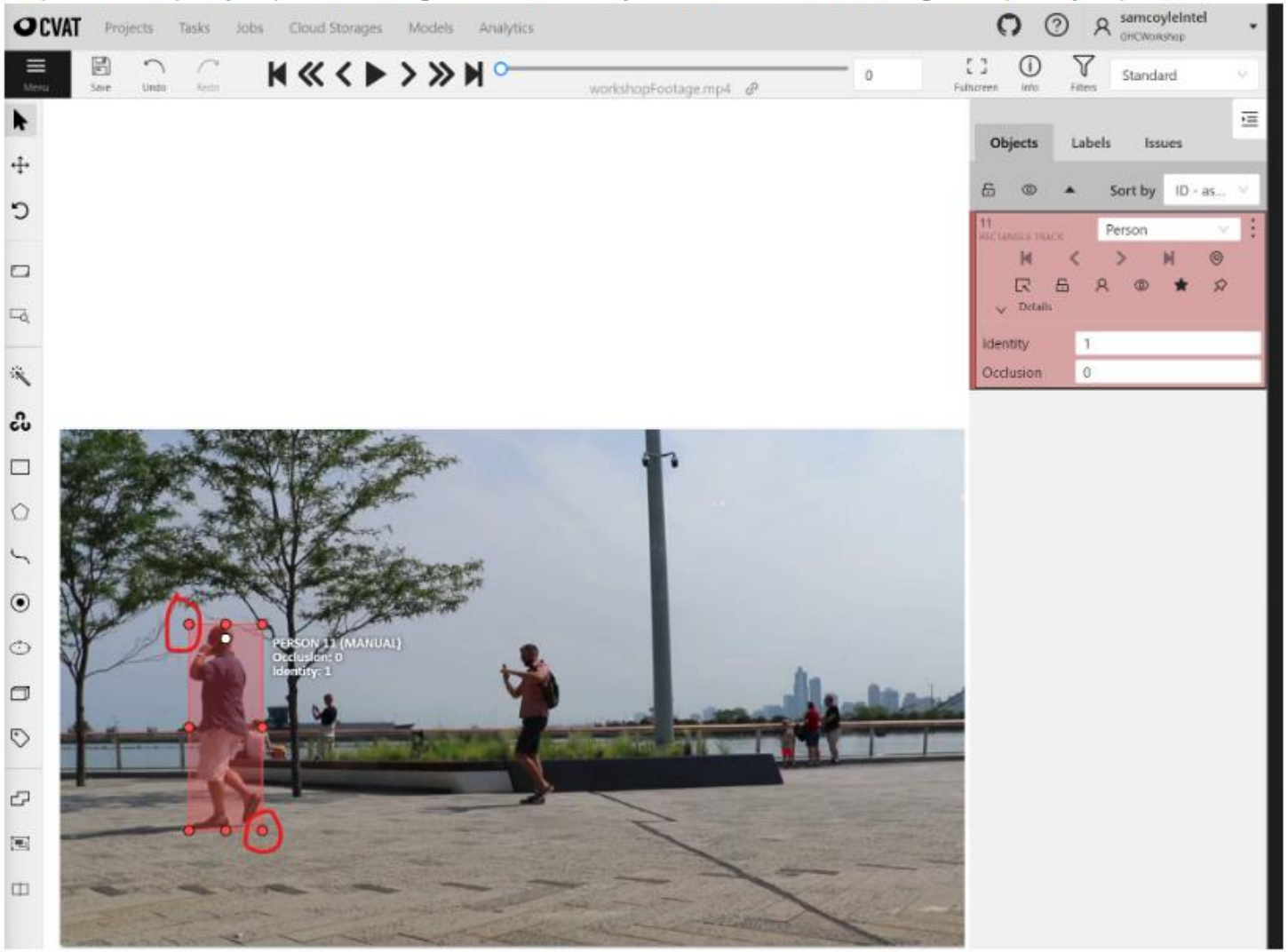
Steps to follow to perform data annotations

1. Hover over the rectangle shape on the left navigation bar, and select `Track`.

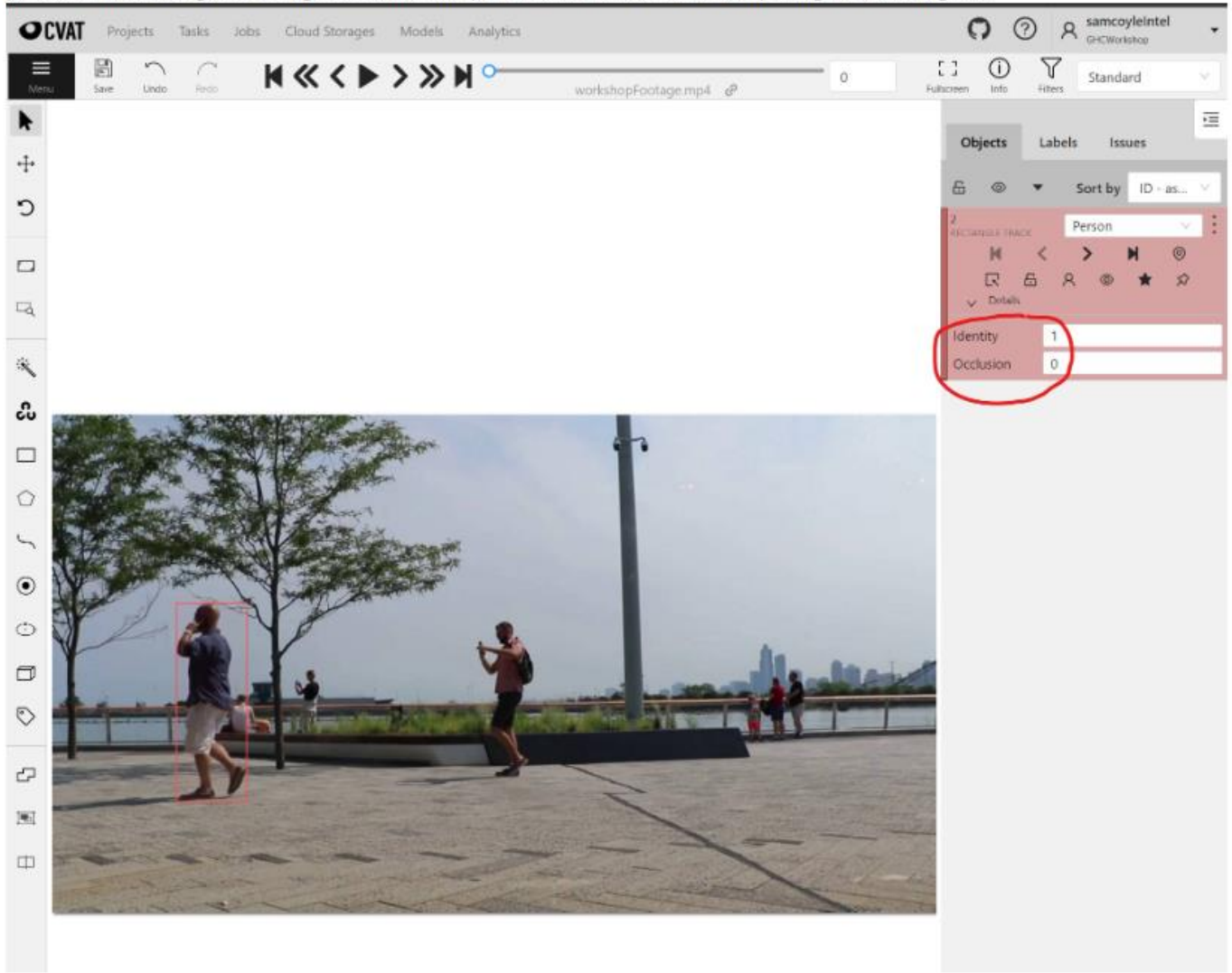


> Note: We are annotating a video file. This means we will want to track people as they move across the frame throughout the video.

2. Place your cursor at the top left of the person and click. This should create the start of your bounding box. Now go to the bottom right of the person to complete your person bounding box, and click when you have included the bottom-rightmost part of your person.



3. In the right most part of the CVAT UI, under the `Objects` tab, you will leave `Identity` as `1`, and `Occlusion` as `0` as this is the first person we are creating a bounding box around. This person also has no occlusions impacting the bounding box.

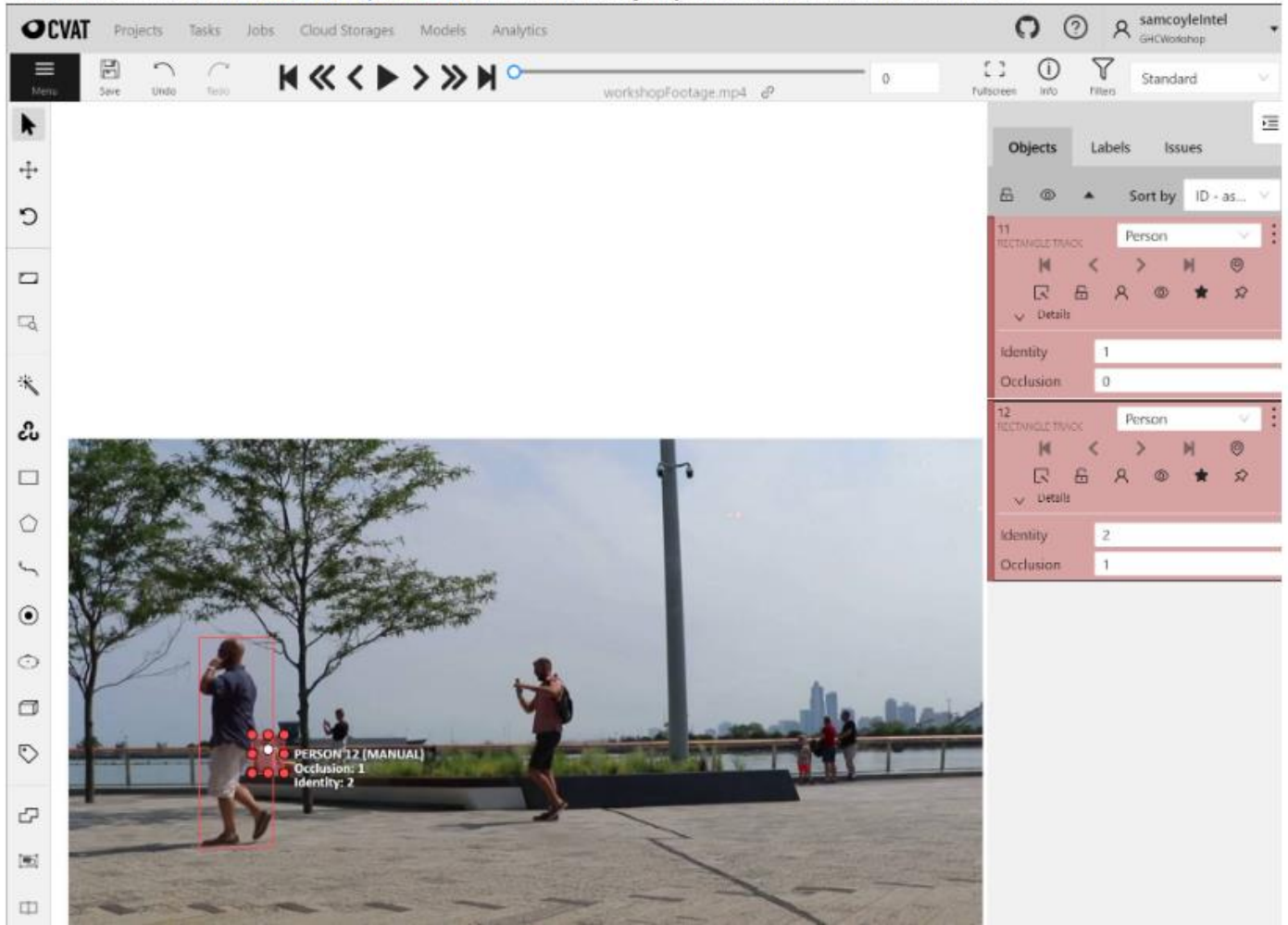


4. Once you have completed annotations for one person, then move onto the next person in the frame.
5. Repeat steps 1-3 for each person going left to right in the frame.

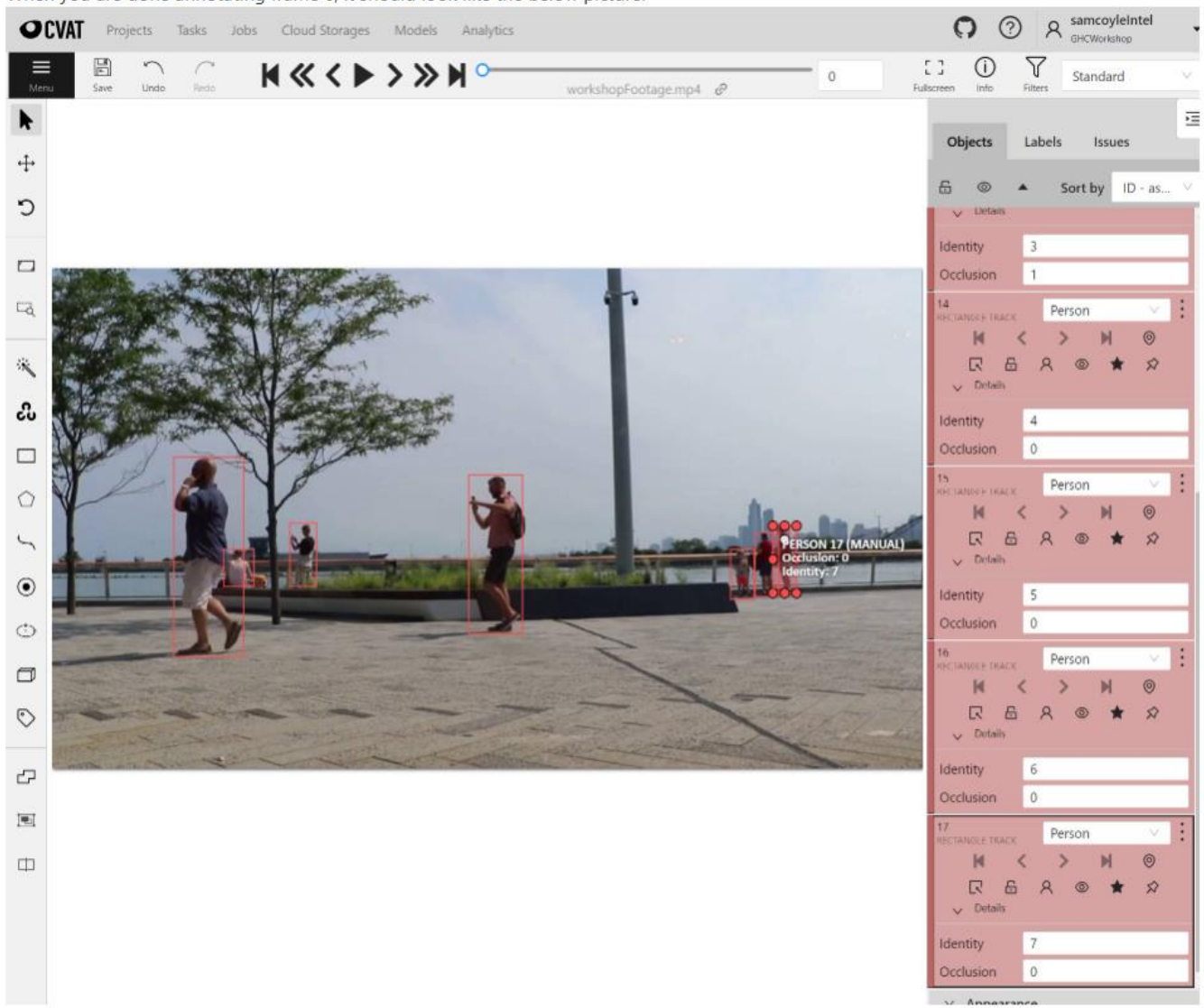
Note: Since Person 2 is seated and we only see ~50% of their body, we will mark their `occlusion` field as 1.

Also make sure to increment the number in `Identity` field for each new person. Refer to the point 3 in Annotation Best Practices for more details on this `Identity` field

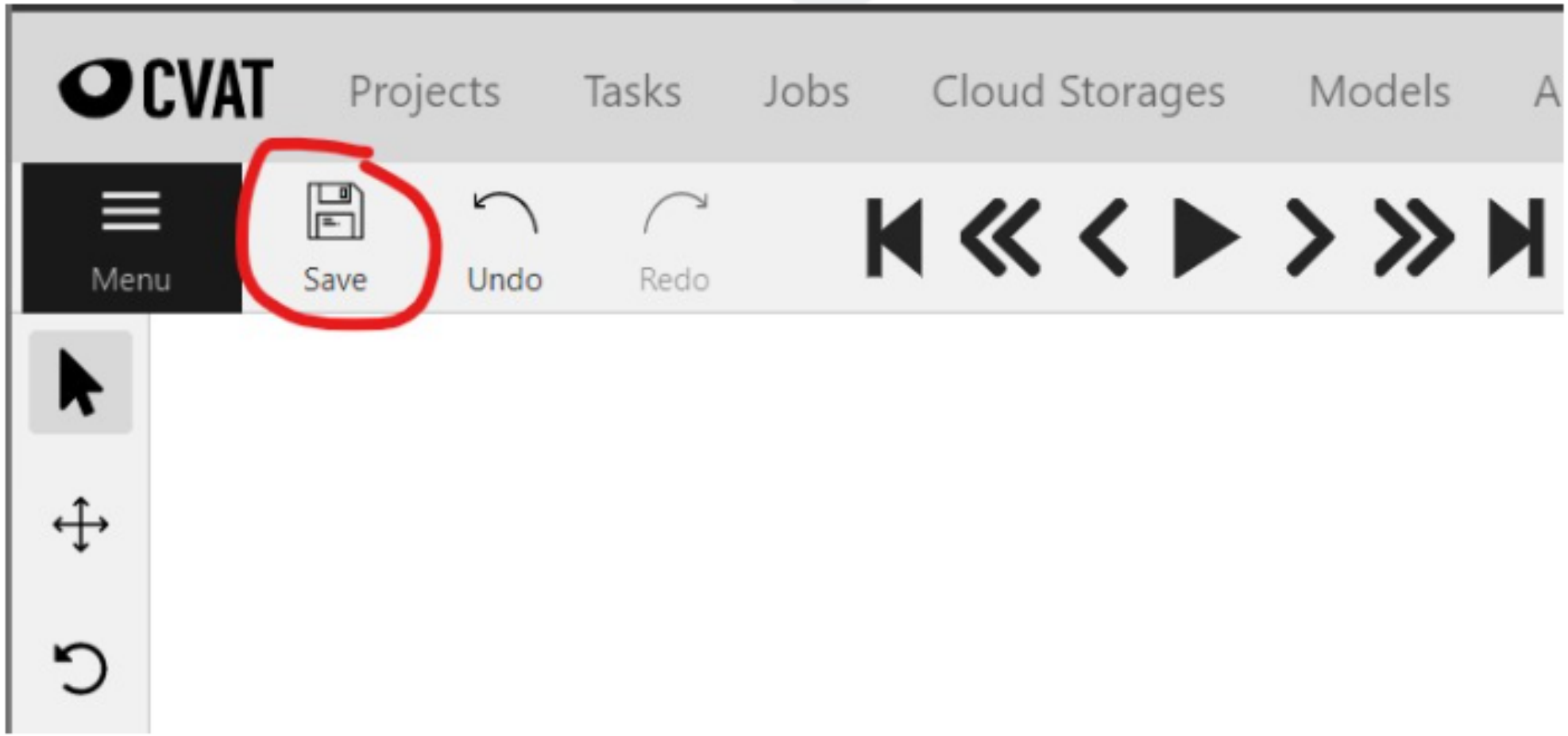
Remember to refer to the Annotation Specifications as needed to adjust your annotations based on occlusions.



When you are done annotating frame 0, it should look like the below picture.

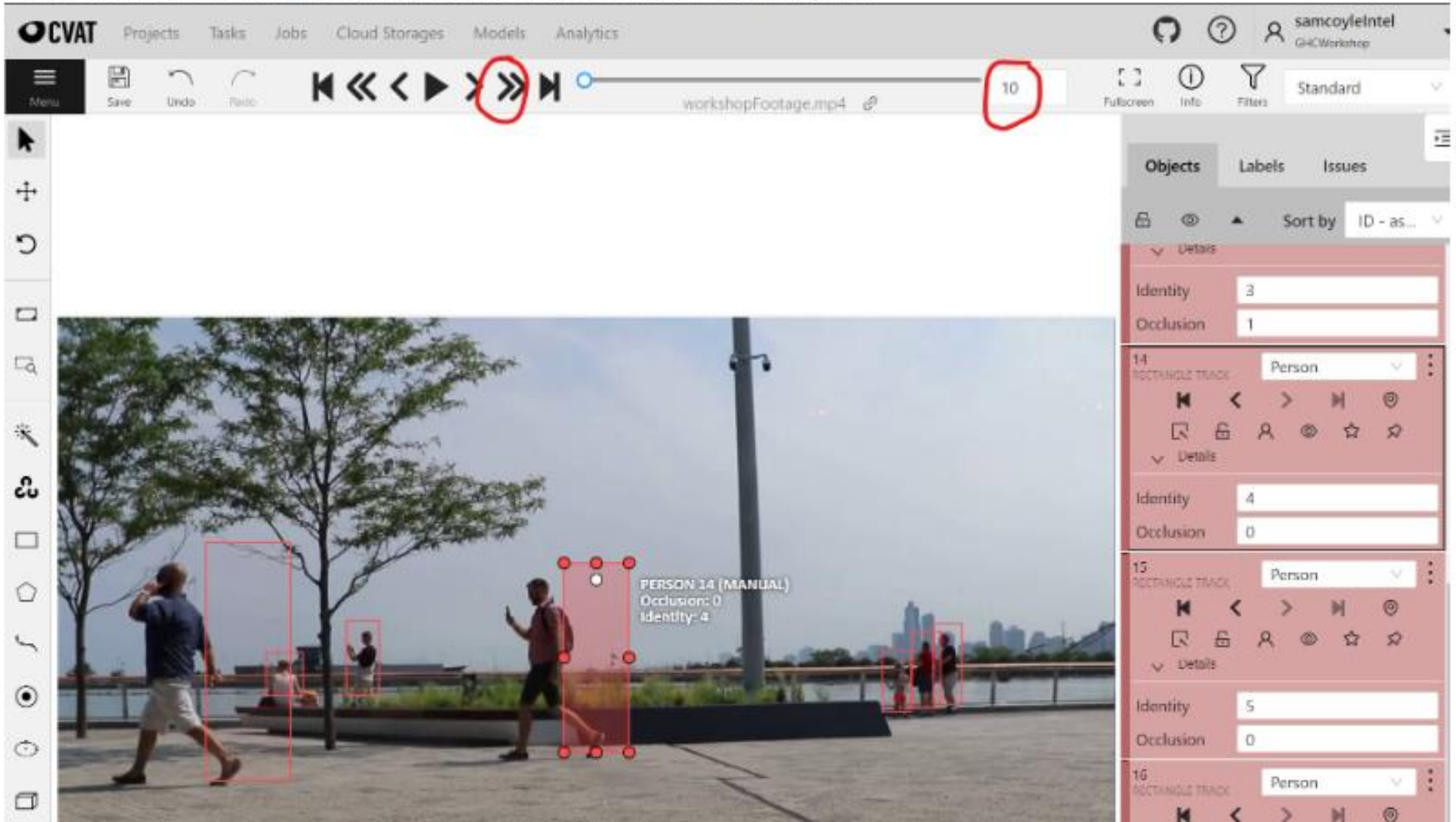


6. Now that all people in the frame are annotated, click `Save` to save the current annotations.

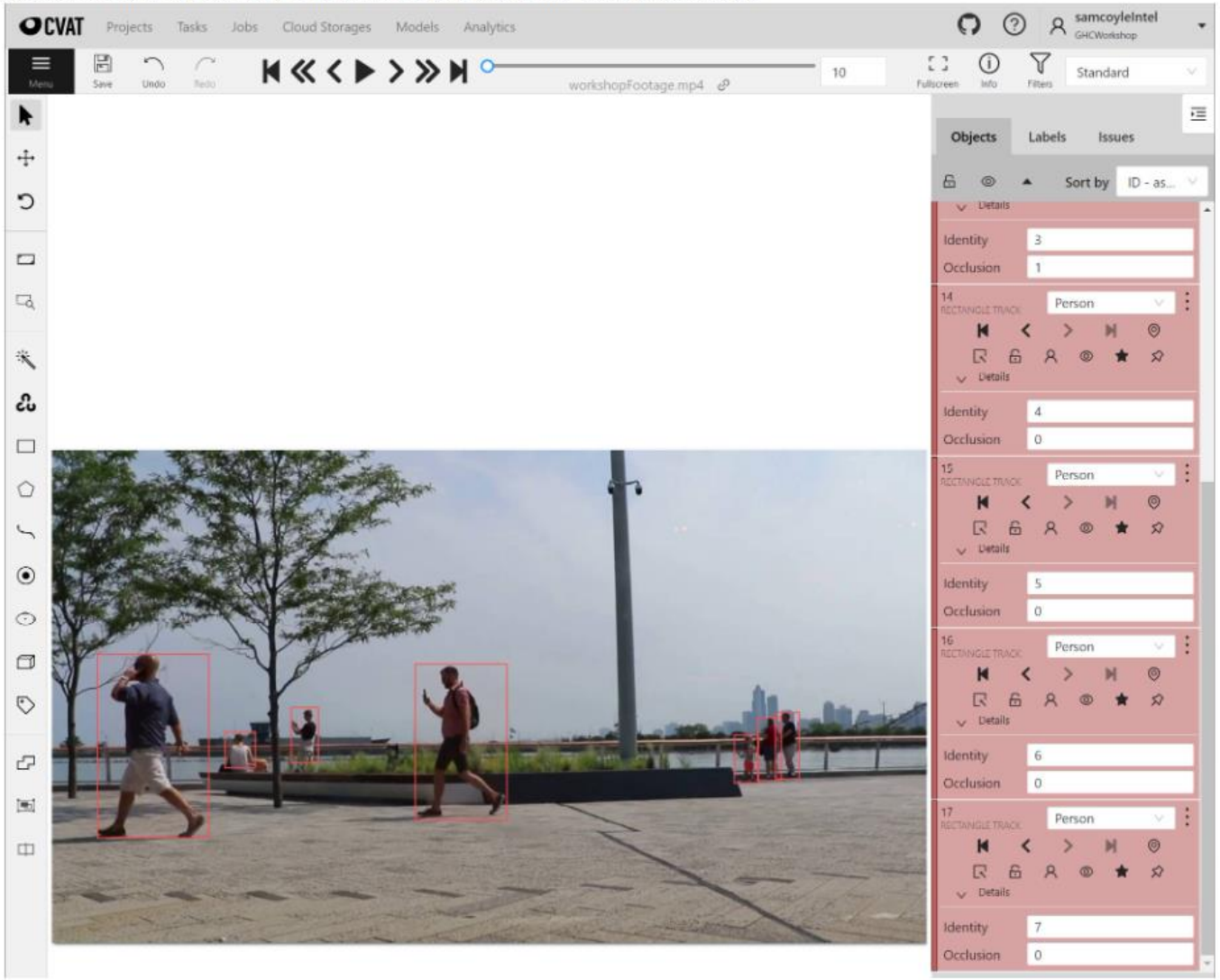


7. The track bar (marked in red below) can be used to scroll through the frames one after the other.

Click on the double right arrow to increment the frame count by 10.

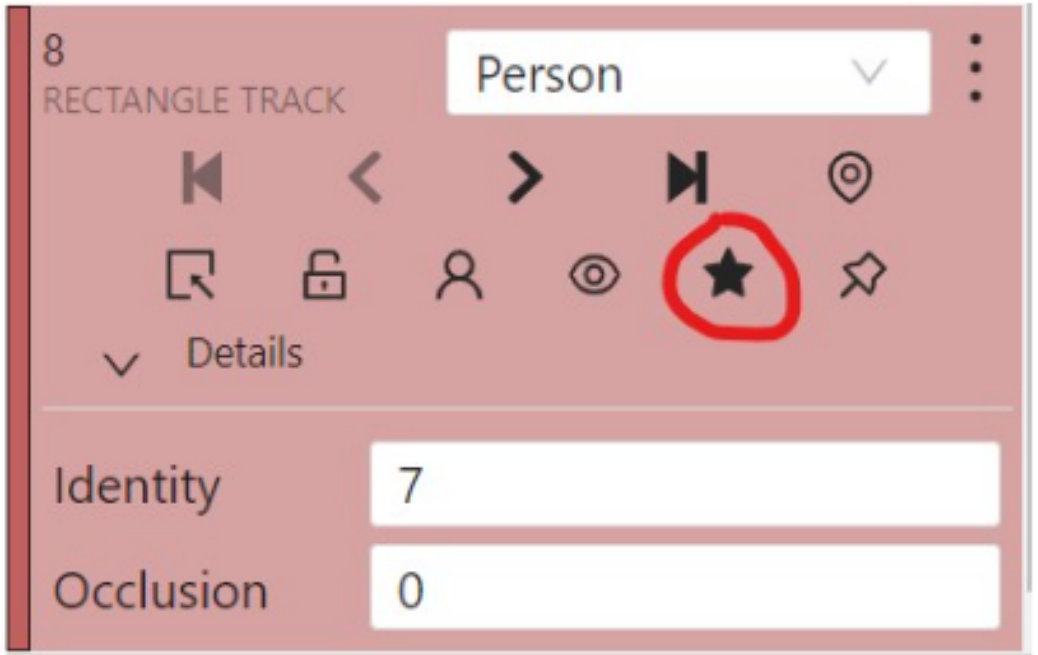


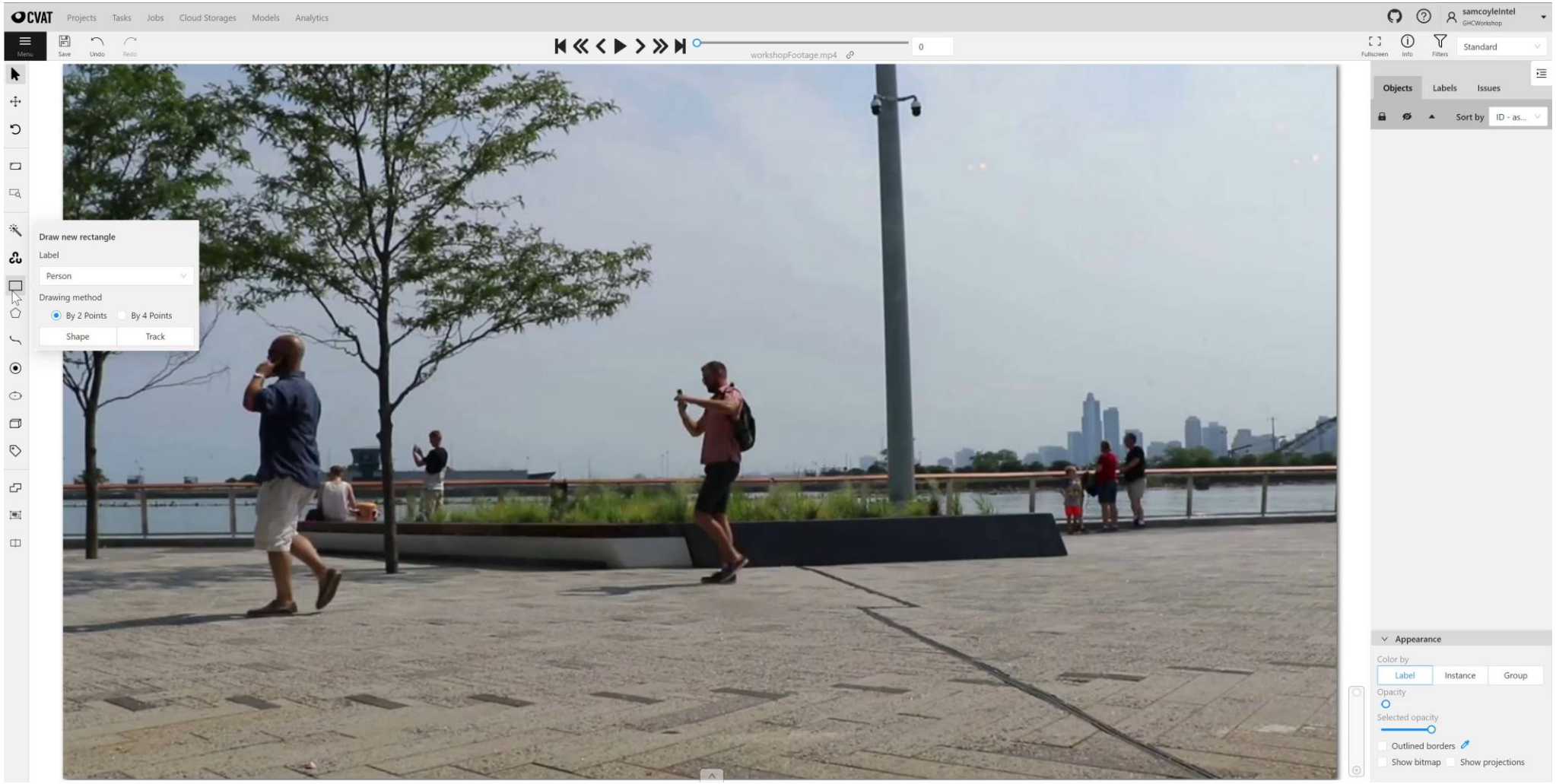
8. Adjust the bounding boxes for the frame so that they look similar to the picture below.



9. Continue steps 1-7 for every 10 frames of the video annotated each person in the frame.

Note: You will see that the initial bounding boxes are no longer properly placed. The bounding boxes size and placement will need to be adjusted since this is a different frame, and people have moved. Also, by annotating every 10 frames, we are leveraging CVAT's interpolation feature. The interpolation feature allows annotators to annotate key frames, and then the frames between them will be interpolated automatically. Each frame annotated is automatically denoted as a key frame with the star shown below.




CVAT
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Objects
Labels
Issues
Sort by
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Draw new rectangle
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Person
Drawing method
By 2 Points
By 4 Points
Shape
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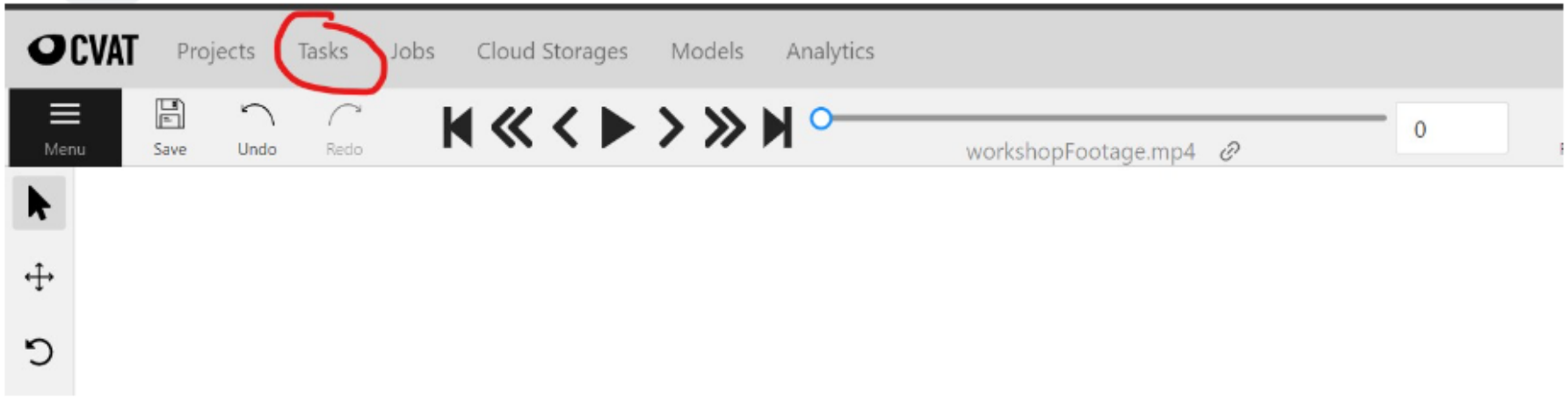
Appearance
Color by
Label
Instance
Group
Opacity
Selected opacity
Outlined borders
Show bitmap
Show projections

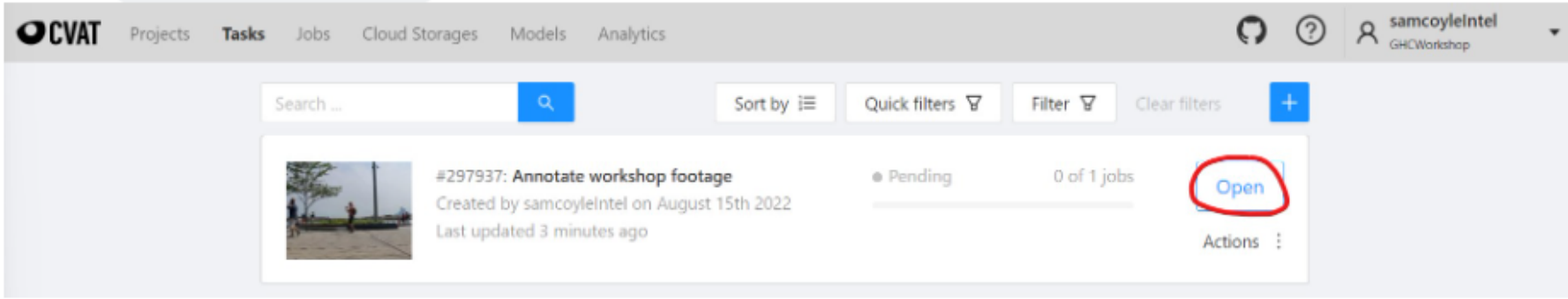
Steps to follow once frames have been annotated

The following steps are meant to demonstrate to workshop attendees that data annotations go beyond a one-person effort. Data annotation efforts may be reviewed by other team members, and even exported upon completion.

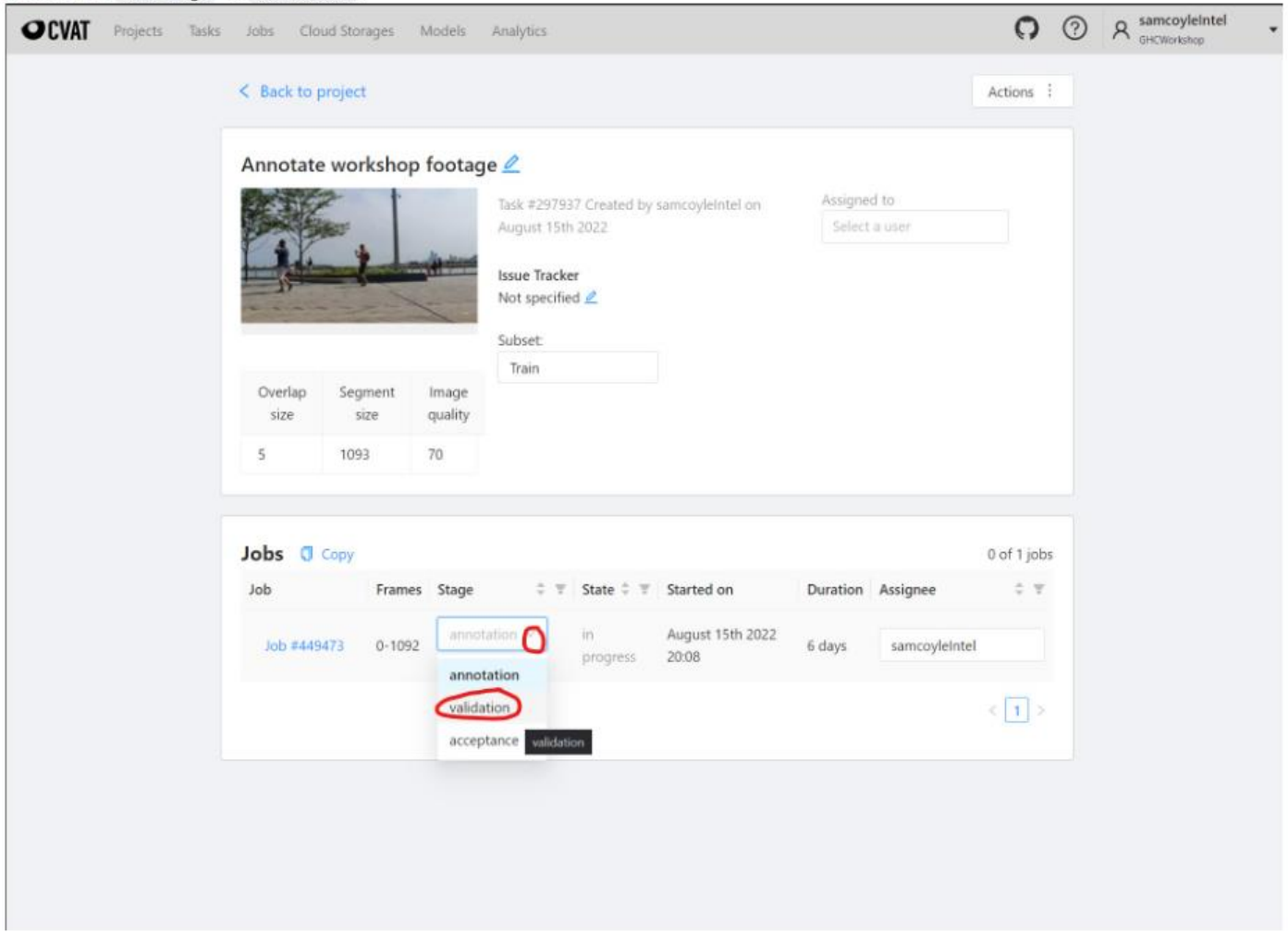
1. Click `Tasks`.



2. Open the `Annotate workshop footage` task.

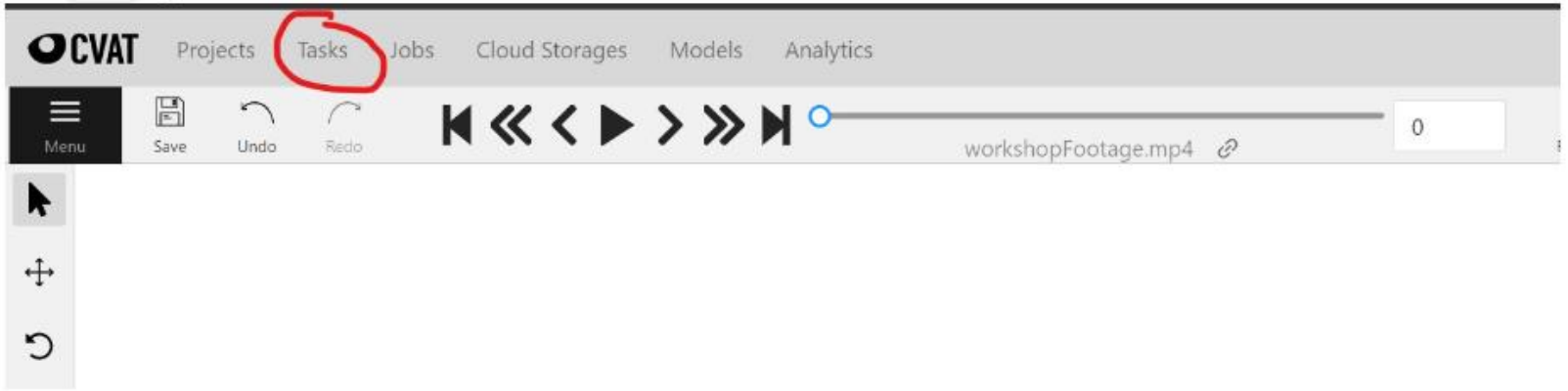


3. Update the `Job Stage` to `validation`.

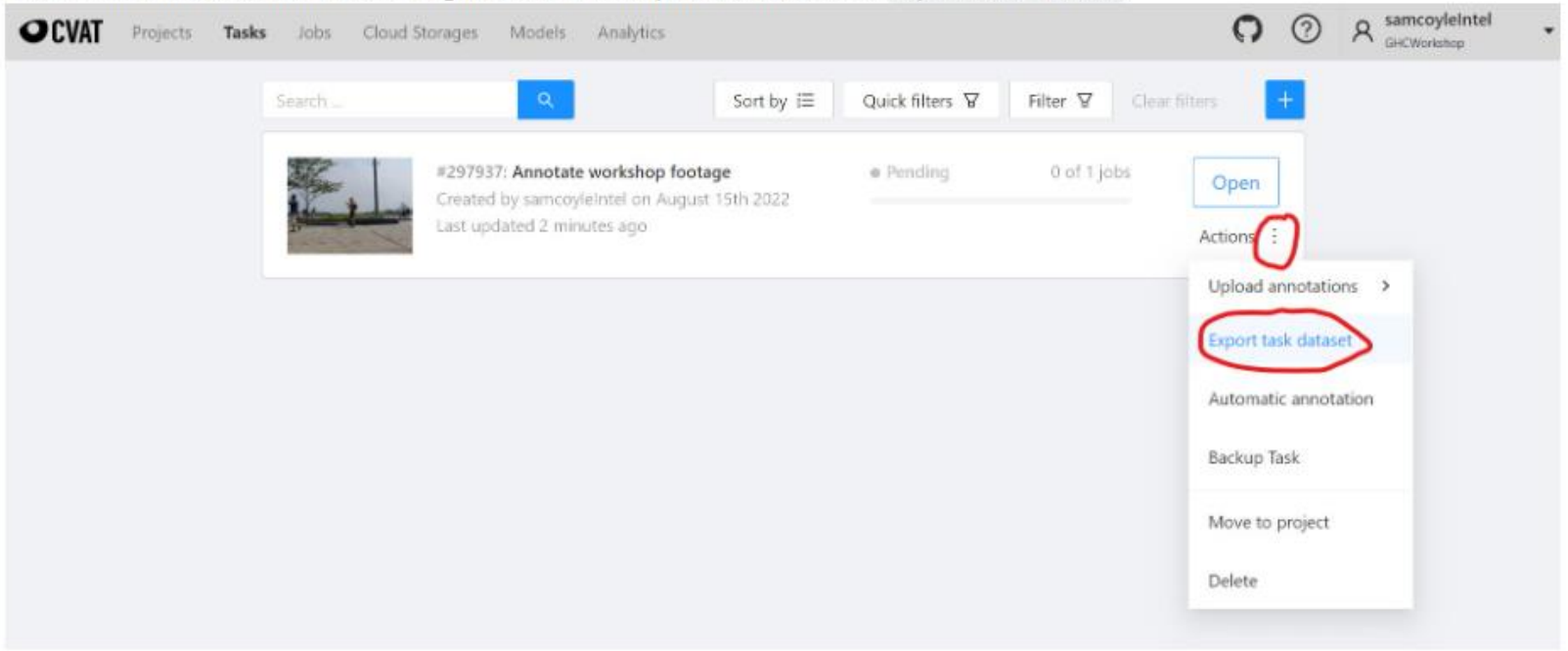


Note: This is an important step when participating in data annotations within a team environment. Updating the stage from `annotation` to `validation` signals to others that the current annotations are ready for others to review. Once they have been reviewed and adjusted as necessary, then the annotations may be marked `accepted`.

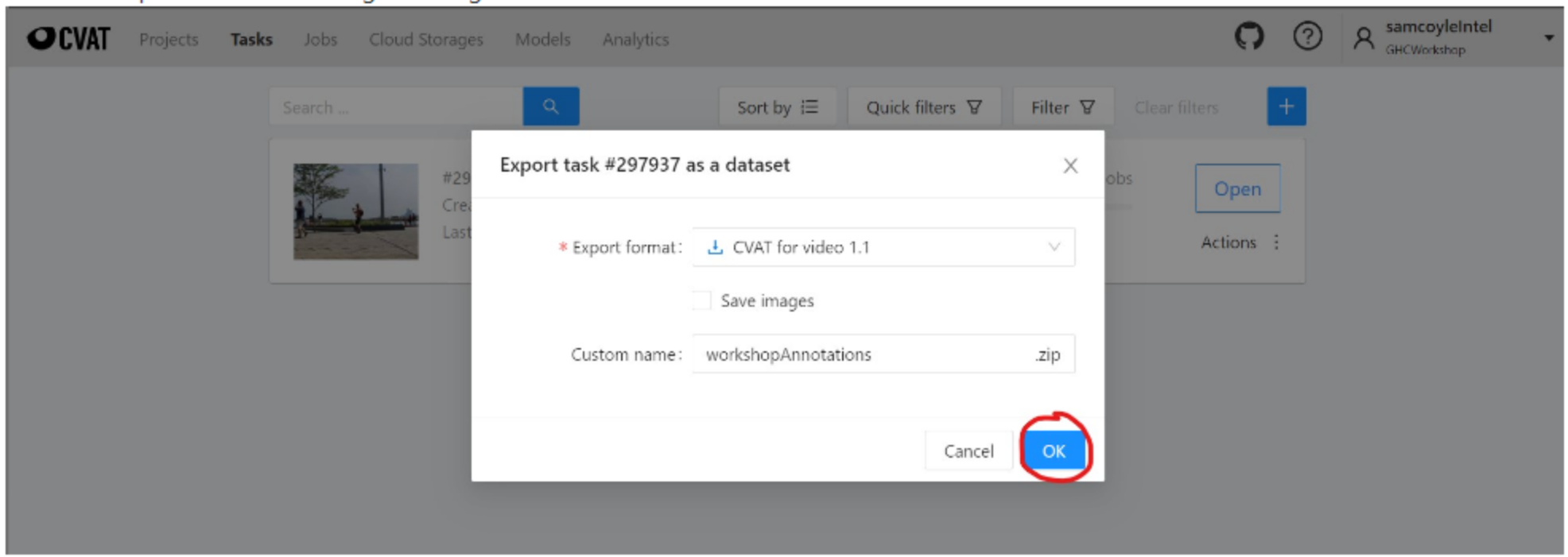
4. Click `Tasks` again.



5. Click on the three dots at the bottom right of the workshop task, and select to `Export task dataset`.



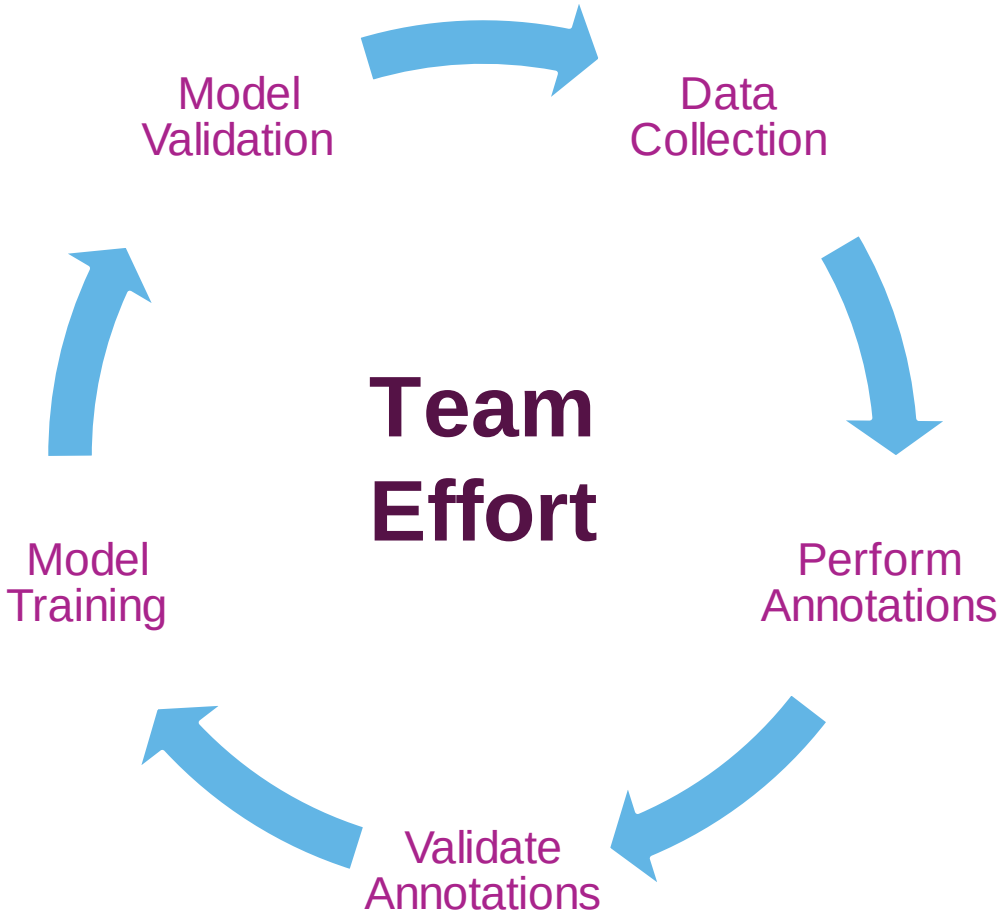
6. Fill in the export details following the image below.



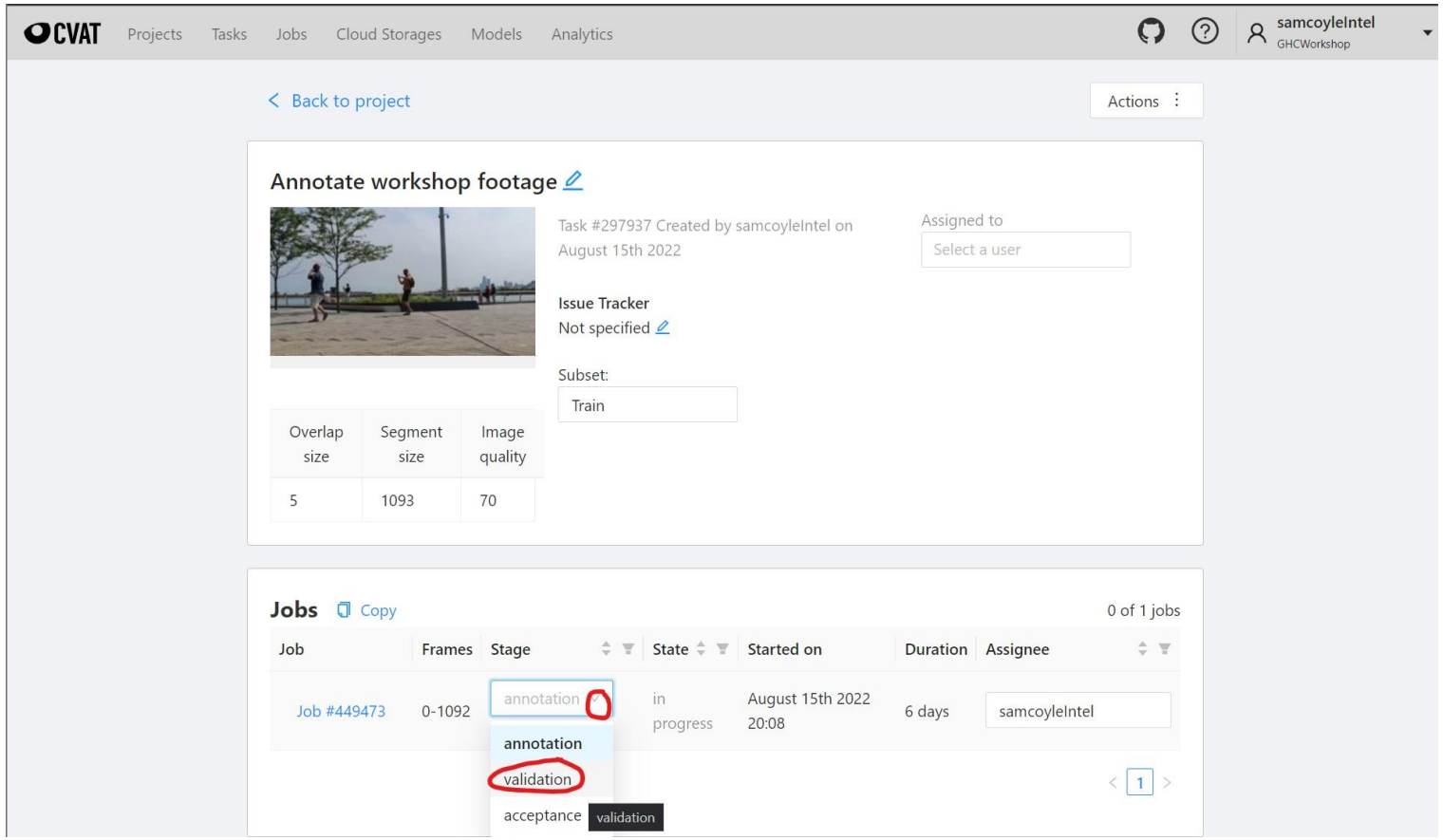
> Note: You will now see the annotations downloaded to a zip folder in the Downloads folder. The zip folder contains an annotations XML formatted file that encodes the annotated data. Different formats may be selected pending the format needed to train the specified model of choice. More information may be found in the section on Annotation Format. The file contains tags corresponding to the project pieces created for this workshop (ie `<task>`, `<labels>`, `<track>`, `<box>`). Those tags correspond to the task, label, and track ID, bounding box of the people annotated, etc. This exported data is what would be used to train a model.

Conclusion

Annotation Workflow

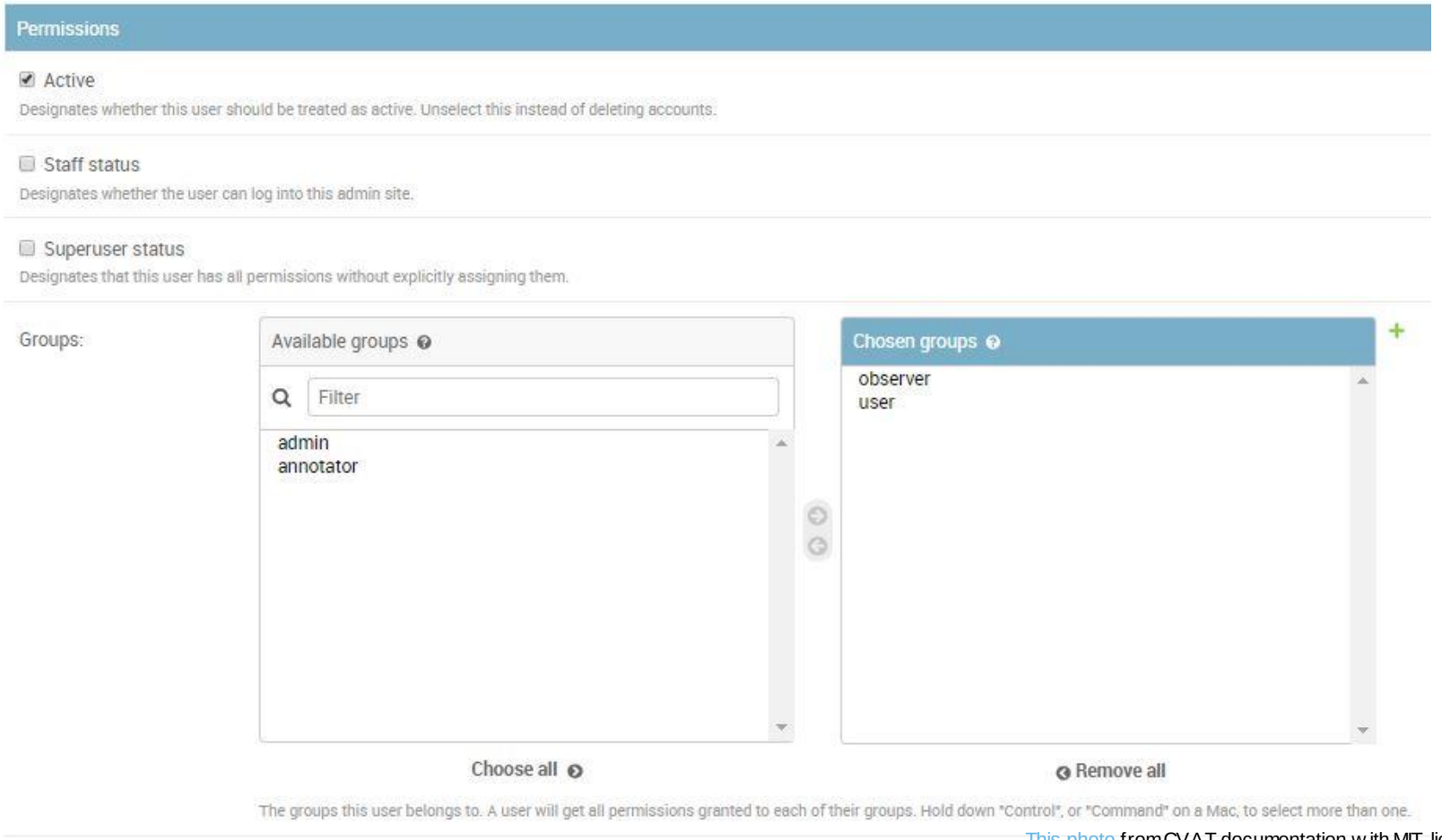


CVAT for Teams



CVAT Roles

- Local installation
- Simple setup
- Open-Source solution
- Better support professional data annotation teams



Thank You

Samantha Coyle
Software Engineer

Neethu Elizabeth Simon
Senior Software Engineer

ANITA B.ORG 2022 GRACE HOPPER CELEBRATION | NEXT IS NOW

Use Open-Source Tool to Simplify & Automate Video/Image Labeling Process

Samantha Coyle

Neethu Elizabeth Simon

Overview

- Introduction – 5 min (N)
- Project Setup – 10 min (S)
- Annotation Specifications – 2 min (N)
- Annotation Best Practices – 3 min (S)
- Perform Annotations – 30 min (S & N slides 42-45)
- Conclusion – 5 min (S)
- QA / wiggle room – 5 min

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Thank You