VideoLab Manual

VideoLab is a tool for analyzing a series of consecutive images, such as videos. This tool is specifically designed for computer visioners, who needs to closely watch a series of images back and forth and do some basic processing to the images.

This tool supports the process of a series of image organized in a video file, a super ppm file, or a folder. These files can be from your local machine or from a remote server. With this tool, you can open as many image series as you want, browse them conveniently, process them with simple scripts, or convert them to different formats.

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Installation

To deploy VideoLab to your local machine, git clone the repository to your hard drive. You need to install conda (https://conda.io/projects/conda/en/latest/user-guide/install/index.html) and rsync (brew install rsync / sudo apt install rsync). Then, you can follow the commands listed below to establish the conda environment:

- conda create -n your_env_name python=3.8
- conda activate your_env_name
- pip install PyQt5
- pip install numpy
- pip install Pillow
- pip install opencv-python
- pip install opencv-contrib-python
- pip install decord
- pip install pexpect

To deploy VideoLab to Gypsum, you need to do the following steps: ***(UNDER CONSTRUCTION)***

- git clone the repository to Gypsum. Copy the path you save the repository in the server as processor_path,
- run mkdir -p tmp/scripts in the cloned folder
- Download all the third party modules to utils/transformers/thirdparty,
- change configs/serverConfigs/gypsum.json to fit your need. More specifically, type your server address and your user name into field “server” and “username”, respectively. Paste processor_path to the corresponding field. You don’t need to edit template_path and its associated file since it has been adapted to Gypsum already,
- create the environment following what you did on your local machine. Notice: to use the third party module, you may need to install more packages. Please refer to section Advanced Topics.

If you are using other servers, please refer to section Advanced Topics.

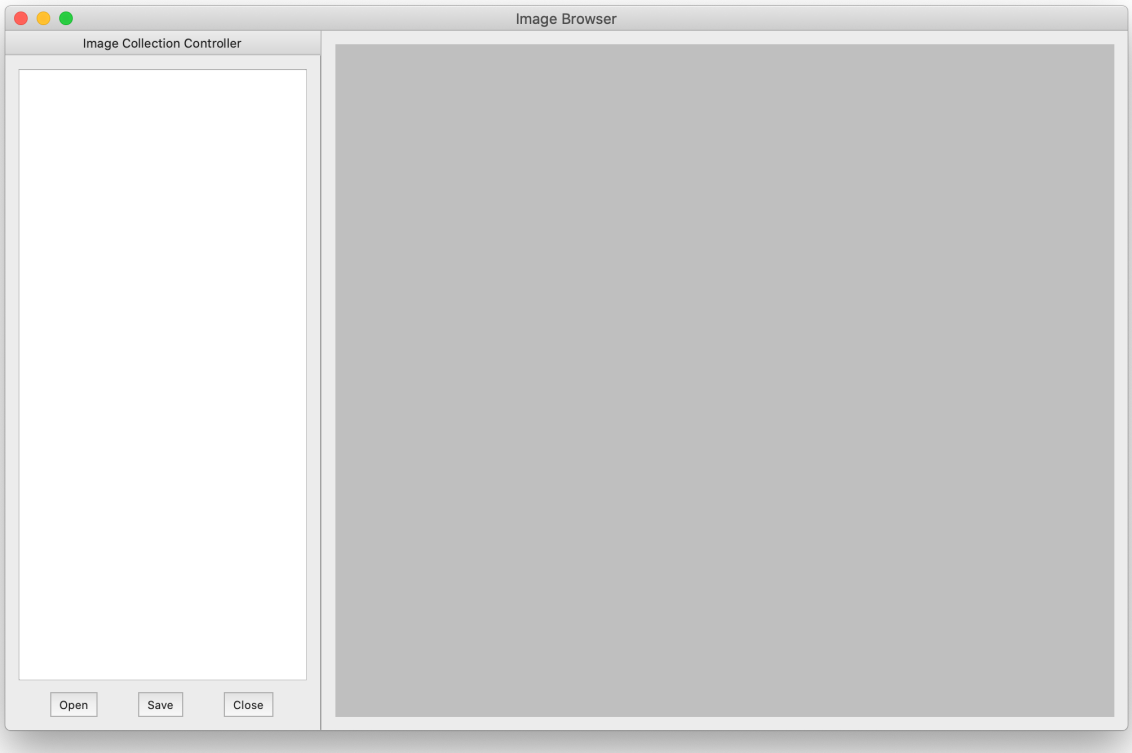
Usage

Launch VideoLab

To launch video lab, you need to open a terminal, activate the conda environment you deployed, and run the launch program:

- conda activate your_env_name
- cd to the root folder of the repository
- python ImageBrowser.py

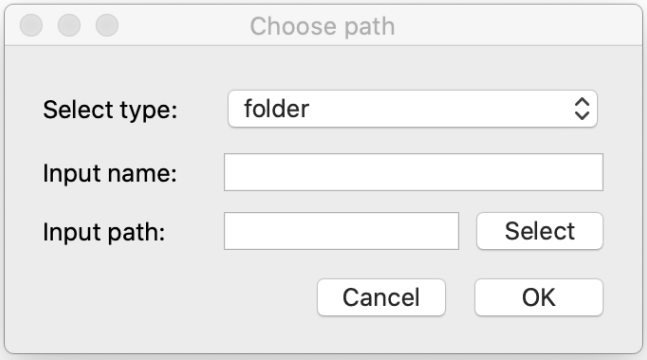
You will see a window like the following image:



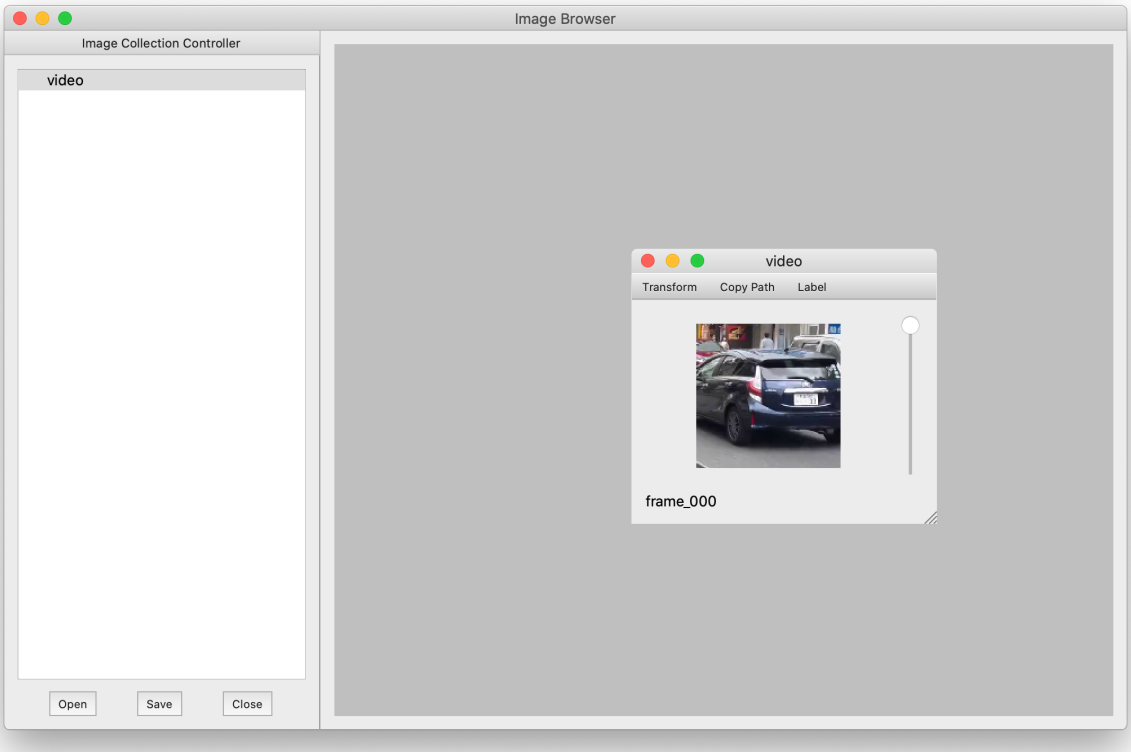
The window has two parts: the left part is a dock widget which shows the image series you have opened. The right part is the area where you browse the image series. You can drag the left part to wherever you like or make it thinner or wider.

Open an image series

To open an image series, click the open button on the left bottom corner of the dock widget. You will see a dialog like this:



Select the format of the image series you want to open, input an unique nickname of the image series, which will be used to refer to the image series you opened, and type in the path of the image series (or use the file dialog to select a path by clicking the “select” button).
Currently, we support three types: folder, video, and ppm. Folder means a folder of images. If you select “folder” as the type, the corresponding path should be a folder which contains at least one image. We support video of mp4 and avi format for now, so the path should be a video file of those two formats. PPM refers to super PPM format, which is a special format we designed for extending the original PPM format. Super PPM format can store and show a series of images in a compact way and it can be opened like a normal PPM file. The corresponding path should be a file of ppm format if we select “ppm” as the type.
You can also input a path from the server to load image series directly from your server. An example of such input path is “sam@gypsum.cs.umass.edu:~/images.mp4”. This input format is of the same as the scp command.
Clicking OK button, the image series will be opened to the dock widget like the following screenshot (VideoLab may ask you for the password of the server when the input path is on the server end). Double click the nickname of the image series, you can see a subwindow is opened for you to display the image series.

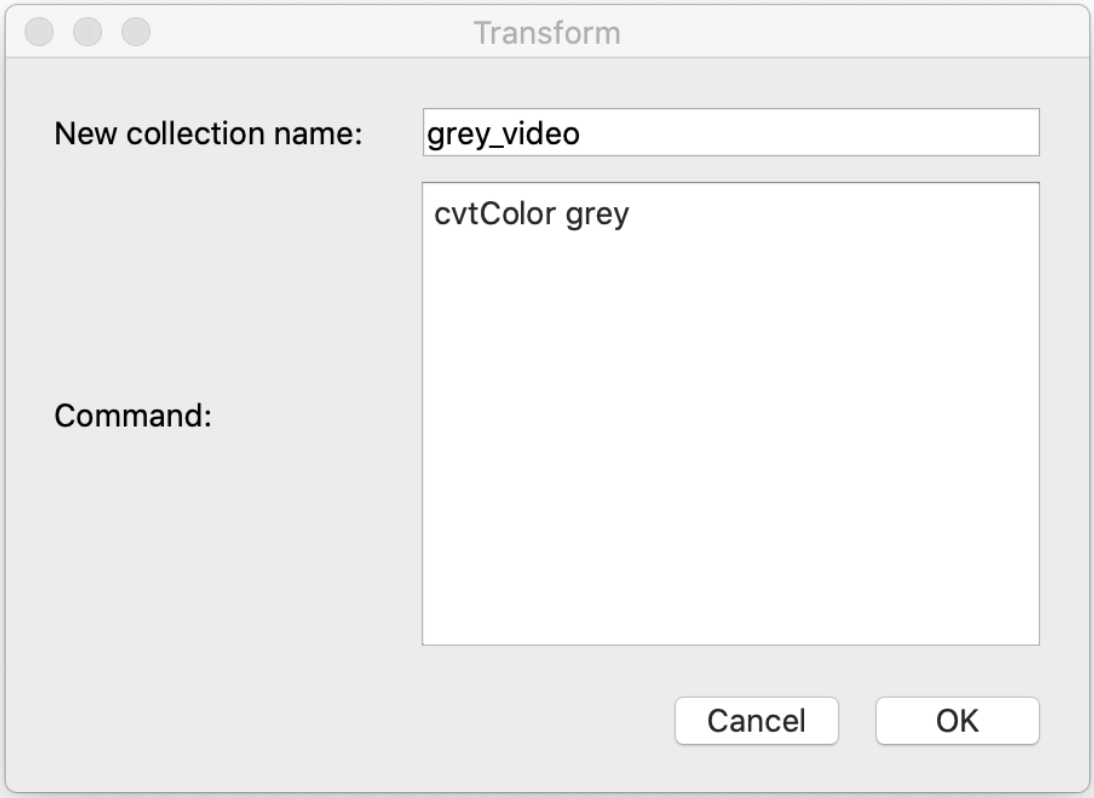


Browse the image series

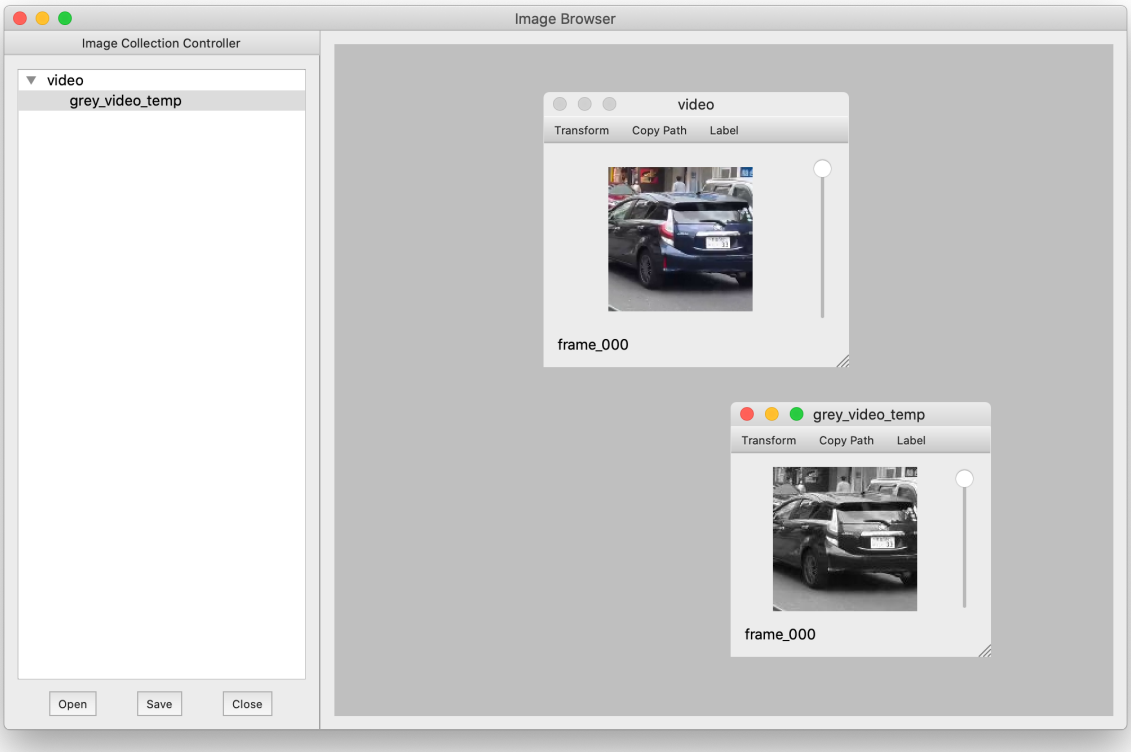
You can drag the slider of the sub to the right of the image to browse forward and backward rapidly. The left bottom corner shows the name of the image. There is a toolbox under the title of the subwindow. “Transform” button will help you process the image series you opened. You can refer to Process images subsection for details. “Copy Path” button will copy the path of the currectly displayed image to your clipboard. “Label” button will pop up a menu, which can help you label some images of interest and browse the labeled subset of images in a separate window and save them to a separate path. Please refer to Label Images subsection for more detail.

Process images

Click “Transform” button on the subwindow, you can see the following dialog:



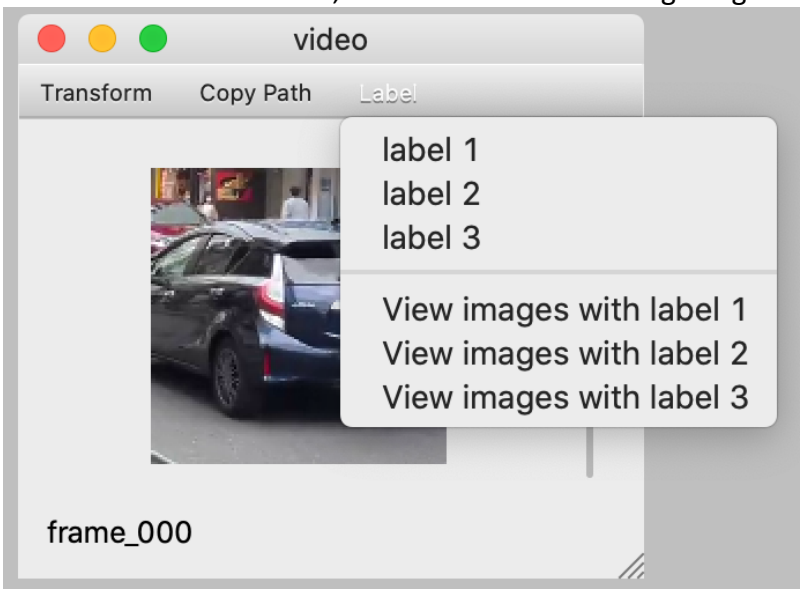
Type in a script for image processing, and the nickname for the new image series which will be generated after processing, and click OK button, VideoLab will run the script to process the image series (if the image series is opened from the server, the processing will run on the server. Otherwise, the processing will run on your local machine) and open the new image series as a sub-series of the original image series:



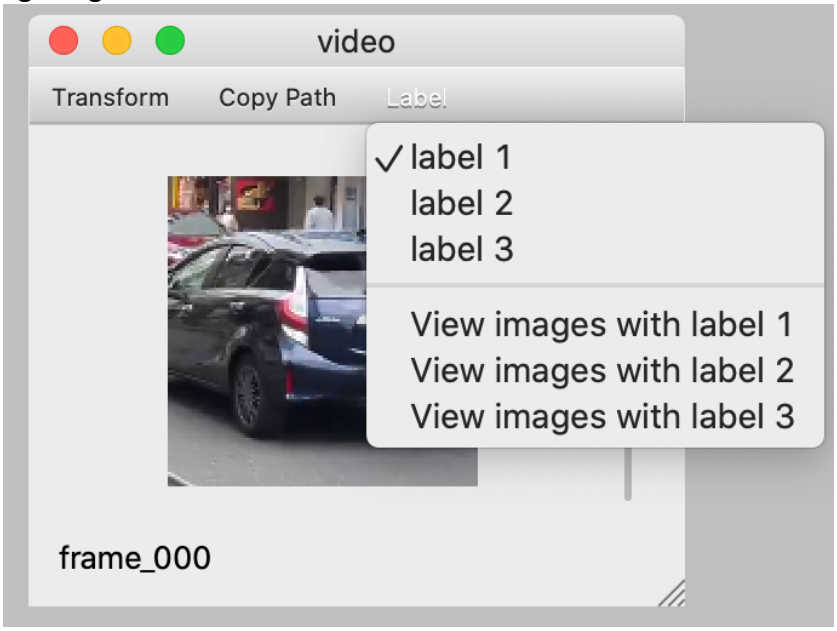
Notice that we added "_temp" to the nickname, meaning this newly generated image series are stored in a temporary folder. You need to save it to avoid losing it after you close VideoLab. Please refer to Save Image Series subsection for more detail.
The grammar of the script VideoLab supports will be described in Scripts section.

Label images

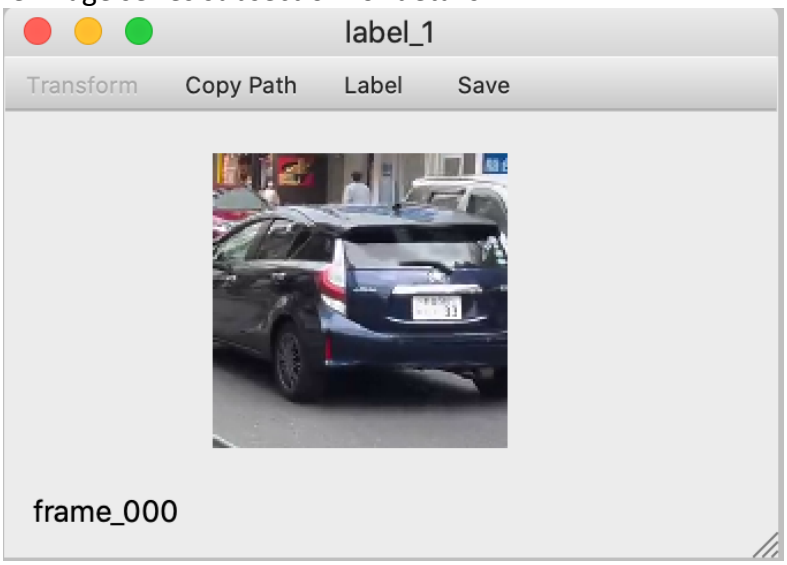
By clicking Label button on the subwindow, a menu like the following image will pop out.



By selecting “label x” in the menu, the currently displayed image will be added to the image subseries of “label x”, and you will see a tick on the item if the current image has been added to the corresponding image subseries:

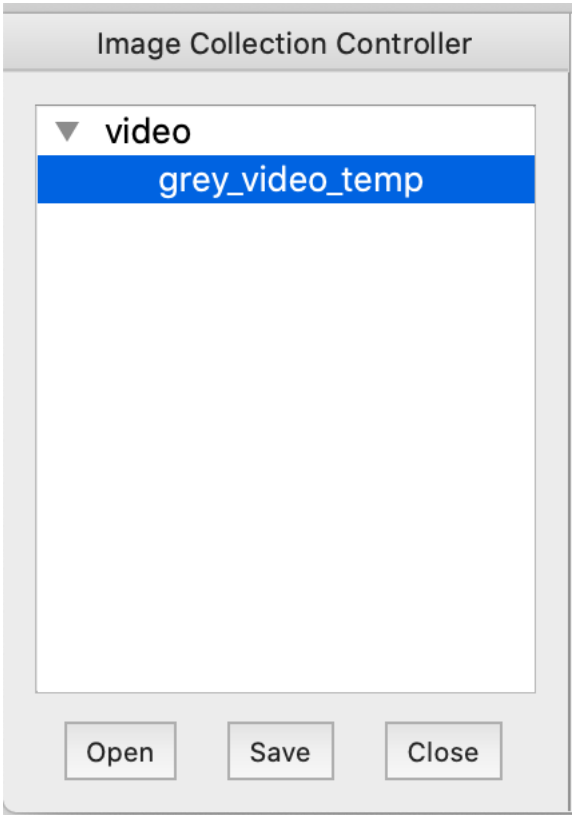


By selecting “View images with label x”, a new subwindow will be opened to show all images with label x. You can save this set of images by clicking “Save” button under the window title. Please refer to Save image series subsection for details.



Save image series

You can save any image series you opened to another path in another format. To do this, you need to select an image series by clicking it in the dock widget, and then click Save button on the bottom of the dock widget.



A dialog will pop up. You should select the format you want to save the selected image series, input the name for it and input the path you want to save it.
Notice that, if the selected type is folder, the input name is the folder name the image series will be saved, and the input path is the path where the newly created folder will be placed. If the selected type is a file like video or ppm, the input name must include the extension, and the input path is the path where the newly created file will be placed.
You can type in a path located in a server to save the image series to the server directly. In this case, you need to type in a path like "sam@gypsum.cs.umass.edu:~/images.mp4", which is the same as the scp command's format. VideoLab may ask you for the password for the server.
By the way, it is a little different to save an image sub series with labels since those subwindows will not be registered to the dock widget. Please refer to Label images subsection.

Close image series

Selecting an image series by clicking its nickname in the dock widget and clicking Close button in the bottom of the widget, you can close the image series you have opened. Notice that, the image series and its associated sub series will all be closed together.

Scripts

To process images in VideoLab, you can just type in a script with some simple commands without the need of writing an individual program. We provide many off-the-shelf commands which should suffice the common use. You can also easily design your own command and extend this powerful tool to suit your need. We will introduce how you can achieve this in section Advanced Topics.

Commands

A script is formed by several lines of commands. VideoLab will parse the script and run it as a pipeline. The basic grammar of each command is like the following format:

command args

For example, in "cvtColor grey", cvtColor is the command part, and grey is the args part. These two parts are separated by a space.

The args part is a string of the format supported by the built-in argparse module in python. VideoLab uses argparse to parse the arguments input by users. Please refer to https://docs.python.org/3/library/argparse.html for the use of argparse. Generally speaking, args can be something like:

--color grey --shape rectangle –workers 2

This is pretty like what we daily use in Linux, so the learning cost is minimized.

Of course, different commands need different arguments. The following table lists all off-the-shelf commands VideoLab currently supports and their associate information. You can also define your own command as I mentioned.

Command	**Arguments**	**Function**
pwcnet		Compute optical flow with PWC-NET
	Example: pwcnet	
	Source: https://github.com/sniklaus/pytorch-pwc	
	Extra packages: pytorch, cupy(pip install cupy-cuda111), flow_viz(pip install flow_viz)	
cvtColor	grey	Convert the image series to greyscale
	Example: cvtColor grey	
raft	see raft github repo	Compute optical flow with RAFT
	Example: raft	
	Source: https://github.com/princeton-vl/RAFT	
	Extra packages: pytorch, scipy	
stabilizedTrack	--bbox x y w h	OpenCV stabilized tracker
	Example: stabilizedTrack --bbox 100 80 100 80 x and y are the index of the left top corner of the bounding box. w and h are the width and the height of the bounding box, respectively.	

Macros

Sometimes, we need to interact with users to make an image processing function work. For example, a tracker needs an initial bounding box selected by the user. If you work only on your local machine, it is fine to implement the interactive logic directly in your own command (see section Advanced Topic for the detail of how to implement your own command). However, if you want your command also work on a server, the interactive logic will no longer function since a server usually does not support GUI. To circumvent this problem, we introduce macros to the VideoLab script.

A macro is a special line of command which will only run on your local machine. The format of a macro is like this:

#define macro_name interact_command

interact_command is a special command which only runs on your local machine. You can use these commands to interact with your user, like letting them select a bounding box from an image. We provide a list of interact command but you also can design your own. Interact command will return a string indicating the user's choice.

The macro above defines a special symbol named macro_name. This symbol is bound with the string returned by interact_command. In the args of ordinary commands, [macro_name] will all be replaced by the string returned by interact_command.

Let's use an example to explain this:

#define bbox selectROI
stabilizedTrack --bbox [bbox]

The first line, a macro, defined a symbol named bbox. selectROI is an interact command which helps users select an initial bounding box and return "x y w h" as a string. Thus, bbox is now bound with the string "x y w h" which describes the bounding box users selected. In the second line, an ordinary command, we will replace [bbox] by the string. Then, VideoLab will remove all macros and run the rest of the script locally or remotely.

Notice that, selectROI only runs on your local machine, [bbox] is replaced by the true parameters. The server can run the ordinary command without disturbing the users. We will discuss about how you can design your own interact command in section Advanced Topics.

Advanced Topics

Create your own command

You can easily design any command you need for VideoLab. Basically, you just need to write a python class derived from utils/transformers/Transform_base, implement the two abstract methods declared in Transform_base, and then register the class to utils/transformers/registeredTransformers.json.

Let's use Transform_cvtColor as an example. This class is defined in utils/transformers/Transform_cvtColor.py. As you see, it has a class variable named command. You need also define this variable in your class and assign it with a string of the command you want to use. Three other methods are also defined. __init__ should not have any argument besides self. The main work for this method is to call the parent's __init__ method and initialize your own code. The other two methods, getArgParser and processImageCollection, are the abstract methods you need to implement.

- getArgParser takes no argument aside from self but outputs a parser from argparse module. In this method, we just use argparse to customize our own parser to parse the args part of the command. If you don't need any argument for your command, just return None.
- processImageCollection takes three arguments, i.e. self, model, args.
  model is of a special type defined in VideoLab. You don't need to know the details of the type. The only thing you need to know is that it has two methods: **model.length()** and **model.get(idx)**. The previous will give you an integer indicating the number images in the image series to be processed. The latter will return a tuple containing the image in **uint8** numpy array and its associated name. The image is of shape **(Height, Width, Channel)**, where channel is of the sequence **RGB**.
  Args is the result parsed by the parser you returned from getArgParser with the args part of the command as the input. Thus you can use something like args.target to get the user's input. Don't forget to examine if the input is valid and raise an exception if needed.
  The final thing you need to pay attention to is that we return images and its associated name as a tuple by **yield**, instead of return. The image should be of the same format as the input. You can change its name if you'd like.

After you implemented your own class, register this class to registeredTransformers.json. The format of the item to add is *"command": [module path, class name]*.

Interact with users

Sometimes we need to interact with users before we process an image series. For example, a tracker may need its user to select an initial bounding box for it. You have two choices to achieve this interactive function.

You can incorporate interactive logics directly to your transformers, i.e. the image processing module. This is the easiest and conveniently way of interacting with users. However, this will limit your transformers to running only on your local machine since a server usually doesn't have GUI.

There is only one thing you need to notice: in transformers, the interactive logics must be run in a sub process. This is because transformers are running in a sub thread, which should not do any UI related work. You can refer to Transform_stabilizedTrack as an example.
Another way to interact with users is to use interact commands and macros. You can design your own interact commands. The steps are pretty similar to the way you create an ordinary command. What you need to do is to create a class derived from utils/interactTools/Interact_base, implement the abstract method interact, and register your class to utils/interactTools/registeredInteractCmds.json. The abstract method only takes one argument, model, besides self. The interface of model is the same as what we introduced in the previous subsection.

Use your own server

VideoLab is designed to be flexible enough to communicate with your server freely. To use your own server, you need to create your own server configuration file, and change configs/serverConfigs/registeredServerConfig.json to point to the configuration file you wrote.
To create your own server configuration file, you can use gypsum.json as a template. You need to change the fileds server, username, processor_path to your corresponding server as described in section Installation. The only field we haven't explored is template_path.
You need to create your own template file and change this field to point to the file. The template file writes all commands you need to run if you want to run a program.
Let's use gypsum_template.txt as an example. On Gypsum we need to apply for a new node for computation instead of running programs on the main node, we input srun to apply for a new node. Then, we activate our deployed conda environment. The third and the fourth lines are special symbols which will be replaced automatically by VideoLab. [GENSCRIPT] will be replaced by a command which generates the script VideoLab will run for image processing. [RUN] will be replaced by a command which run the generated script. Finally, we need to type in exit to release the computing node we are using.
You need to customize your own template file to adapt to your own server. The template file is just like the way you operate your server daily. You only need to add [GENSCRIPT] and [RUN] to the template file.