
HotSpotter User Guide

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1 Usage

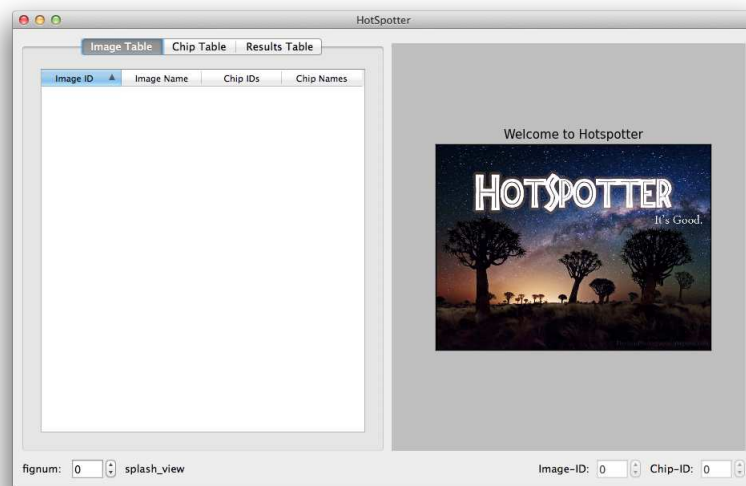
This document presumes that you have downloaded and installed the Windows or Mac version of the HotSpotter software, and describes the basic steps of running the program to identify individual animals. The instructions are primarily focused on the mac version of the software, but adaptation to the windows version is easy. Just know that the control key (`Ctrl`) on windows is equivalent to the command key (`Cmd = ⌘`) on the mac. This guide will use the mac notation.

1.1 Opening the Program

When HotSpotter is first run, the program prompts the user to open a database or create a new one. In each succeeding run, it will start by opening the previous database.

To Open or Create a new Database:

File → Open Database [`⌘+O`]

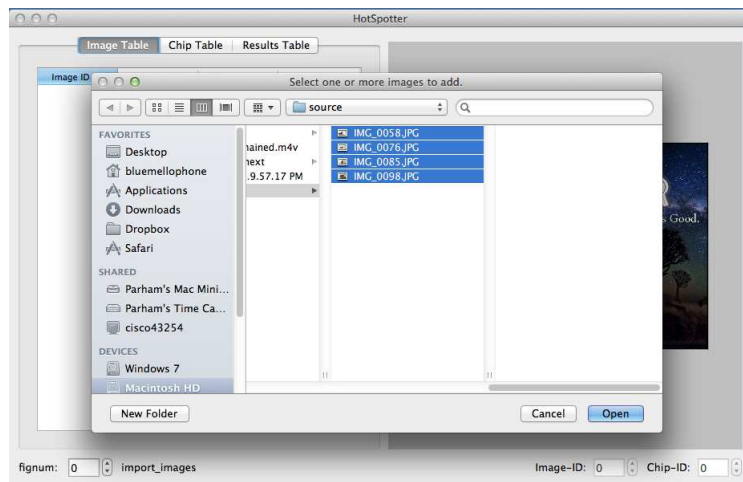


HotSpotter assumes that **empty folders** are given as new databases. HotSpotter can also read StripeSpotter databases by opening the StripeSpotter database's `data` directory.

1.2 Importing images

In order to add one or more images to the database, run

File → Import Images [`⌘+I`]



HotSpotter will copy all selected images into its images directory. These are automatically added to the database and may be seen under “Image View”

1.3 Defining Chips with ROIs and Orientation

Before identifying an animal in an image — or, equivalently, finding other images that show the same animal — a region of interest (ROI) and orientation must be assigned. (The sub-image extracted from an ROI is called a “chip”.) The ROIs must be specified first and this can be done either manually or automatically. The automatic version is not very sophisticated: it simply assigns each image to be its own ROI. This is accomplished by

Convenience → Convert All Images to Chips

This option should be used in the relatively rare case that the animal occupies almost the entire image. The more common case is to specify the ROIs manually. Multiple ROIs are allowed for each image. Each ROI should include most of the body of the animal — anything that might be a distinguishing feature — so users should err on the side of making the ROI too large rather than too small. In order to specify an ROI, the Image Table should be highlighted and then the image should be selected. Then, “ROI mode” must be entered:

Actions → Add ROI [A]

An ROI is selected by clicking two image points in the Plot Widget (on the right of the display) to specify opposite corners of the bounding box.

In the case of an annotation mistake, an ROI can be reselected using

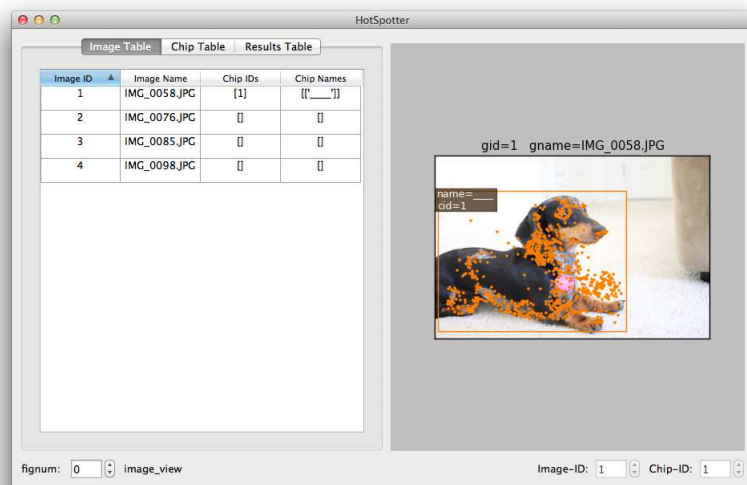
Actions → Reselect ROI [R]

or removed entirely using

Actions → Delete ROI [⌘+Delete]

The default orientation is horizontal, and this is set internally by HotSpotter. This is usually sufficient when taking “normal” — e.g. side-view — pictures of standing animals, such as zebras or giraffes. On the other hand, for overhead pictures of animals like frogs, specification of the orientation is **crucial for accurate recognition**. The orientation is best determined by drawing an axis within the ROI of the animal in a way that can be repeated for each animal. For frog images this is the spine. In order to specify an orientation other than the default (horizontal) orientation, the user must enter orientation mode:

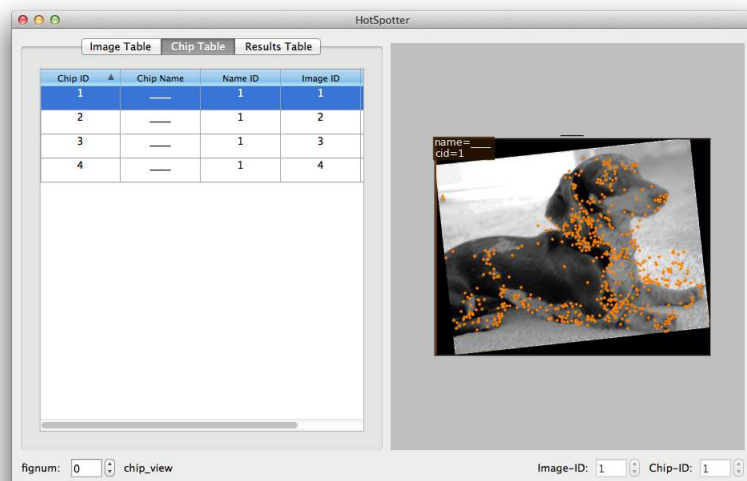
Actions → Reselect Orientation [O]



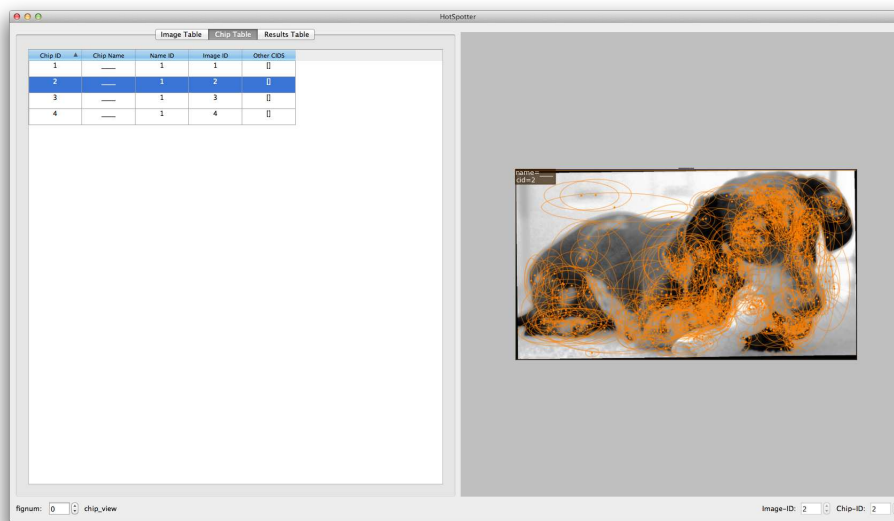
Clicking two points on the Plot Widget defines the orientation axis. Note that the angle does not have to be selected perfectly each time. Pretty close will suffice.

1.4 Chip Properties Display

Within these chips HotSpotter computes its hotspots — elliptical regions centered on points of interest that HotSpotter automatically detects. Intuitively, the hotspots are loosely analogous to a “fingerprint” for the chip. Chips with enough hotspot similarity are matched successfully by HotSpotter. A chip can be seen by clicking on Chip Table and then selecting a chip



The hotspots' points of interest and elliptical regions can be toggled on and off using the menu or hot keys.

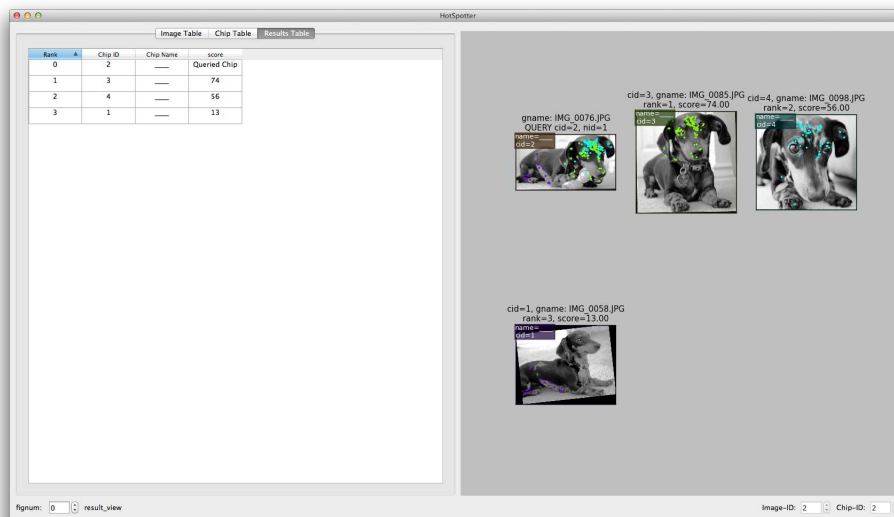


1.5 Running a Query

A Query can be run on the selected chip.

Actions → Query [Q]

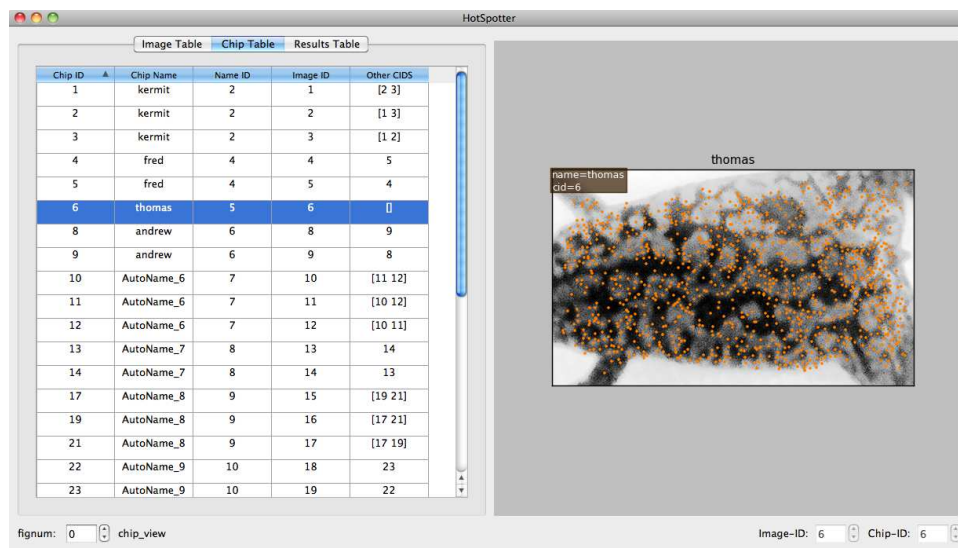
This will quickly find similar chips in the database. The program will automatically rank the chips in order of similarity and will highlight the portions of the image that it identifies as being most similar. Each result will be marked in a different color.



Once the user decides based on a query that two or more chips match, the actual recording of the match occurs only when the chips that match are all given the same name. This requires an understanding of the meaning of the names within HotSpotter, as described next.

1.6 IDs, Names, and Recording Matching Results

In the Chip Table, users will see a Chip ID, a Chip Name, a Name ID, and an Image ID.



The Image ID is the unique numerical index HotSpotter applies to each image. (Back in the Image Table view, users can see the relationship between the Image ID and the image file name.) Similarly, the Chip ID is the unique index HotSpotter applies to each chip. (Remember, there can be more than one ROI/chip per image.) As HotSpotter does its work and chips are successfully matched, users will want to assign names to individual animals and use this same name for all chips in which the animal appears. Initially, before an image is recognized, the “Chip Name” column value will be specified as “____” (four underscores). This denotes an unidentified chip. A user may double-click on a Chip Name to edit it. Whenever two or more chips are deemed to match, users can edit the Chip Name to indicate this. This is as simple as double clicking on the name and assigning it. Use of copying and pasting from one chip name to the other makes this process less prone to typing errors.

2 Additional Tools and Tricks

Here is a brief discussion of a few additional tricks and options for running HotSpotter:

- Actions -> Select Next: selects either the next image that does not already have an ROI or the next chip without an orientation.
- Options -> Toggle Plot Widget: shows the results plot in a separate pane. This is particularly useful for resizing the pane when there are many results.
- Options -> Edit Preferences: change the behavior of HotSpotter. For now, these are not very well documented and should only be used with extreme care or collaboration with the HotSpotter team.
- Convenience -> Convert All Images to Chips: make each image its own ROI and therefore image chip.
- Convenience -> Batch Change Name: change all chip instances of a given name to a new name. This is useful for when the same animal is grouped under two different names.
- Convenience -> Add Metadata Property: record metadata as a series of one or more attribute/value pairs for any user defined metadata. HotSpotter will automatically import existing metadata from StripeSpotter databases.
- Convenience -> Assign Matches Above Threshold: HotSpotter will automatically run each chip in the database as a query and assigns it as a match to any chips whose matching score is above a user-defined threshold.

- Convenience -> View Data Directory: Opens the current database directory.
- Convenience -> View Source Directory: (primarily for developer usage) Opens the HotSpotter source directory.
- Convenience -> View Internal Directory: Opens the current database's .hs_internals directory
- Matching Experiment: (primarily for developer usage) Runs an experiment to see what matches HotSpotter assigns to each chip. Output is written to the database directory.
- Run Name Consistency Experiment: (primarily for developer usage) Runs an experiment to see if HotSpotter agrees with the current labeling. Output is written to the database directory.

3 A Bit of Troubleshooting

In the event that HotSpotter behaves unexpectedly, the first thing to try is a restarting the program. If the error persists, the following will fix common errors:

- **Delete your preference directory.**
HotSpotter keeps a small set of preference files in the user's home directory. These files remember the last database opened as well as other preferences. When updating to new versions these can sometimes cause problems. Deleting the ~/ .hotspotter¹ folder may fix some issues.
- **Re-Import the Images**
If the images you've imported aren't showing up, you can always re-import the images in user_database_dir/images directory.
- **Delete the Computed Directory**
If something looks corrupted or ROIs are being oddly drawn, the user should consider deleting the computed directory. Running the command (Convenience → View Internal Directory) will open user_database_dir/.hs_internals directory. From here the computed directory may be deleted. This will cause the program to recompute all of its data. The user may have to restart HotSpotter.
- **Mac OSX 10.8 Gatekeeper**
For Mac OSX 10.8 Mountain Lion users this app might not run. This error is due to a security feature within Mountain Lion called Gatekeeper. If the app fails to run, please do the following:
 1. Go to System Preferences — Click the Apple icon in the menu bar (top-left of the screen) and select System Preferences in the drop down menu.
 2. Go to Security & Privacy — It is located on the top row, entitled Personal.
 3. Go to the General tab.
 4. Authenticate — Click on the lock at the bottom-left corner of the screen and subsequently input your computer username and password.
 5. In the bottom half of the General tab, there will be the following selection:


```
Allow applications downloaded from:
( ) Mac App Store
(X) Mac App Store and identified developers
( ) Anywhere
```

¹Note that ~ denotes the user's home folder

Select Anywhere and subsequently select Allow From Anywhere in the drop down warning.

6. Close the System Preferences window.
7. Install HotSpotter and run it.
8. To re-enable security after running HotSpotter once, repeat the above changes to your preferences, except click on Mac App Store and identified developers.

- **Email the Developer**

If all else fails users should send an email to `hotspotter.ir@gmail.com`. Please include a detailed description of the error, the output of the (Convenience → Write Logs), and what was being done when it happened.

4 Source Code Dependencies

The remainder of this discussion only applies to downloading and working with the source code instead of the installer packages.

Before executing HotSpotter from the source code users should ensure that their environment is set up correctly. Primarily, this includes Python 2.7.3, Qt, and OpenCV, but it also includes several supporting packages. Users who want to use HotSpotter without modification should download the installer package instead.

4.1 Windows

Install the following dependencies in order. **The software is untested using 64-bit python. It is preferred to use 32-bit builds of each dependency when specified.**

1. Python 2.7 32-bit
 - (a) Download: <http://www.python.org/download/releases/2.7.5/>
 - (b) Install with install packager
2. MinGW (C / C++)
 - (a) Download: <http://sourceforge.net/projects/mingw/files/latest/download?source=files>
 - (b) Install with install packager
 - (c) REQUIRED: C and C++ COMPILER
3. Qt Library 4.8 32-bit
 - (a) Download: <http://qt-project.org/downloads>
 - (b) Install with install packager
4. PyQt4 32-bit
 - (a) Download: <http://www.riverbankcomputing.com/software/pyqt/download>
 - (b) Install with install packager
5. NumPy 32-bit
 - (a) Download: <http://sourceforge.net/projects/numpy/files/NumPy/1.7.1/numpy-1.7.1-win32-superpack-python2.7.exe/download>
 - (b) Install with install packager

6. matplotlib 32-bit

- (a) Download: <http://matplotlib.org/downloads.html>
- (b) Install with install packager

7. PIL 32-bit

- (a) Download: <http://www.pythonware.com/products/pil/>
- (b) Install with install packager

4.2 Mac OSX

Install the following dependencies in order.

1. Qt Library 4.8

- (a) Download: <http://qt-project.org/downloads>
- (b) Install with install packager

2. XQuartz - This dependency is required for FreeType (<http://www.freetype.org/>) and libpng (<http://www.libpng.org/pub/png/libpng.html>)

- (a) Download: <http://xquartz.macosforge.org>
- (b) Install with install packager

3. SIP

- (a) Download:
<http://riverbankcomputing.co.uk/software/sip/download>
- (b) `sudo python configure.py`
- (c) `sudo make`
- (d) `sudo make install`

4. PyQt4

- (a) Download:
<http://www.riverbankcomputing.com/software/pyqt/download>
- (b) `sudo python configure.py`
- (c) `sudo make`
- (d) `sudo make install`

5. NumPy

- (a) Download: <http://sourceforge.net/projects/numpy/files/latest/download?source=files>
- (b) `sudo python setup.py install`

6. matplotlib

- (a) Download: <http://matplotlib.org/downloads.html>
- (b) `sudo python setup.py install`

7. libjpeg

- (a) Download: <http://www.ijg.org/>
- (b) `./configure`

- (c) `sudo make`
- (d) `sudo make install`

8. PIL

- (a) Download: <http://www.pythonware.com/products/pil/>
- (b) `sudo python setup.py install`

5 Source Code

5.1 License

HotSpotter is distributed under the GNU General Public License.

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HotSpotter
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5.2 Download

Download the source code here: <https://github.com/Erotemic/hotspotter>

```
git clone git@github.com:Erotemic/hotspotter.git
```

Users will also need to check out the `tpl` submodule. This can be done separately, or by running the command:

```
python setup.py configure
```

This will also ensure that files have the correct permissions.

Once the source code has been downloaded the program can be run by using the command:

```
python main.py
```

5.3 Contribute

HotSpotter is an open source project. If any tech-savvy users develop a cool feature or a bug-fix and would like to see it incorporated, send an email with the proposed patch to hotspotter.ir@gmail.com for code review.