

Performing with INDRA: A User Manual

Drake Andersen

Version: 0.9.6

Date: February 7, 2023

**For the latest version, visit:
<https://creativeinteraction.org>**

Foreword and Acknowledgements

First and foremost, huge thanks are due to Sam Wolk for his guidance and expertise. I am also grateful to Martha Cargo, Kallie Ciechowski, Jordan Dodson, Rob McClure, Charlotte Mundy, Mike Perdue, Yumi Tamashiro, and Jude Traxler for their involvement and helpful feedback in the earliest performances. Indra would not be possible without the incredible bach objects of Andrea Agostini and Daniele Ghisi. I am also grateful to the programming committee for SEAMUS 2016, where I first presented this work. -DA

Online INDRA Resources

- Visit <https://creativeinteraction.org> for the most up-to-date information
- Contact: indra [at] drakeandersen.com

What's New in this Version

- Fully Apple Silicon-compatible.
- New installation procedure.
- See changelog for details.

Table of Contents

1. Introduction	1
1.1 What is Indra?	1
1.2 System Requirements	2
1.3 Project Parameters	2
1.4 Conceptual Considerations	3
2. Installation	4
3. Building a Collection	5
3.1 Quickstart Tutorial	5
3.1.1 Interface Overview	5
3.1.2 Creating Your First Clip	6
3.1.3 Modifying the Metadata	7
3.1.4 Saving Your Clips as a Collection	7
3.2 Clips	8
3.2.1 Native Clip Creation and Scripting	8
3.2.2 Importing Music XML Files	10
3.2.3 Importing Images	11
3.2.4 Working with Clips	13
3.2.5 Choosing a Clip Format	14
3.3 Metadata	14
3.3.1 Overview of Default Metadata Fields	14
3.3.2 Functional Metadata	15
3.3.3 Working with Metadata Fields	17
3.3.4 Automated Metadata	18
3.3.5 Custom Metadata Fields	20
3.3.6 Visualizing Your Collection	23
3.3.7 Metadata Settings	24
3.4 Tags	25
3.4.1 The Tag System	25
3.4.2 Instrument Tags	27
3.5 Other Considerations for your Collection	27
4. The Conductor	29
4.1 Interface Overview	29
4.2 Preparing for Performance	29
4.2.1 Loading a Collection	30

4.2.2 Instruments and Groups	30
4.2.3 Performance Settings	31
4.3 The Filtering System	32
4.4 Sending Messages to Performers	35
4.4.1 Mode	35
4.4.2 Dynamics	36
4.4.3 Messaging	37
4.5 Advanced Configuration Options	37
5. The Performer	39
5.1 Getting Started	39
5.2 Interface Overview	40
6. Performing with Indra	42
6.1 Building the Collection	42
6.2 Preparing for the First Rehearsal	42
6.3 The Rehearsal Process	43
6.4 The First Performance and Beyond	44
7. Troubleshooting	46
7.1 Common Issues	46
7.2 Known Bugs	47
7.3 Network Troubleshooting Flowchart	47

1. Introduction

1.1 What is Indra?

Indra is a virtual score platform for musical performance. A virtual score is musical notation designed to be presented digitally, rather than on paper. Unlike notation on paper, digital notation can change in real time during a performance. For example, some virtual score compositions develop traditional notation algorithmically, while others use animated graphics.

Indra is a platform, not a composition, meaning that it can be the basis for live performances of many different compositions, as well as many different performances of the same composition. Most importantly, Indra is collaborative and interactive. A composer creates a collection of musical ideas that are passed along to a conductor, who passes them along to the musicians in the ensemble during the performance. Even though many of the ideas originate with the composer, the conductor and musicians shape the form, texture, and feel of each performance.

All of the participants in a performance of Indra run the software on their own devices. All of the devices communicate with one another over a wireless network. A composition, known as a *collection*, is loaded onto the musicians' devices. A collection comprises many individual musical gestures, known as *clips*. Each clip is tagged with metadata that describes its musical qualities, including pitch, register, key, articulation, duration, and so forth. During the performance, the conductor applies filters to select for certain kinds of clips. For example, a conductor might filter for clips in the key of G minor with a short duration. Clips meeting these criteria appear on the musicians' screens immediately.

Indra allows for a great deal of customization within a single collection, from the ability to incorporate graphic notation through image files, to the use of user-definable metadata fields and tags. Composers can import MusicXML files and use music information retrieval to automatically generate metadata. Originally conceived as a digital implementation of Earle Brown's "open form" system, Indra employs a relational database approach to store and access notation and metadata for original works, allowing for flexible and intuitive control over user-defined musical parameters.

Indra is named for a Hindu deity known for his net of jewels that extends infinitely in all directions. In Buddhist philosophy, Indra's net symbolizes the concept of interpenetration through the observation that not only is every other jewel reflected in each individual jewel, but in each reflected jewel are all of the other reflections. This results in a process of infinite reflection and interdependence.

To learn more about virtual scores, check out the February 2010 issue of *Contemporary Music Review* (29/1), which offers a survey of major trends and practitioners. See also Jason Freeman's article in the *Computer Music Journal* titled "Extreme Sight-Reading, Mediated Expression, and Audience Participation: Real-Time Music in Live Performance" *CMJ* 32/3 (Fall 2008): 25-41.

1.2 System Requirements

Indra is distributed as a Max patch and requires Max 8, along with the packages bach, cage, dada, zero, and odot, as well as the object shell and the abstractions da.random and da.coco. Apart from bach, cage, dada, and zero, which are available through the Package Manager, all dependencies are included in the download.

Indra is compatible with Mac and Windows.

System requirements for Max 8 are available on the Cycling '74 site:

<https://cycling74.com/downloads/sys-reqs>

1.3 Project Parameters

There are three main patches for Indra: the composer's patch, the conductor's patch, and the performer's patch. The collection is generated using the composer's patch before the performance. The finished collection is then loaded into the conductor and performers' patches when the work is ready to be rehearsed and performed.

The majority of the information associated with a given composition is stored as a collection in single *.lfile database generated by the composer. (To learn more about *.lfile files, see the bach documentation in Max.)

Images associated with a given collection are stored in the /images directory (folder created upon installation). Image files must remain in the images folder when loading a collection, or they cannot be accessed. Images for multiple collections can be stored in the images folder simultaneously. If you want to store

the images for different collections separately, you can store each collection of images in a separate folder and copy the relevant folder into the project directory when needed (renaming the folder “images” as necessary).

A separate file of performance settings can also optionally be used by the conductor. This settings file (also a *.lill file) is loaded into the conductor’s patch to be used in conjunction with a collection.

1.4 Conceptual Considerations

Indra is designed for musicians who are interested in the indeterminate and improvisatory possibilities of live performance with notation. Although this might appear to be a contradiction, there are numerous precedents for such an approach, from the scores of Anthony Braxton, Earle Brown, John Cage, and Pauline Oliveros to the sign language-based systems of Butch Morris, Walter Thompson, and big band conductors. Even where specific sounds are prescribed by the notation, a spontaneity of form and juxtaposition is retained in each system.

Indra reflects a fundamentally nonlinear conception of composition, meaning that individually sounds and gestures are designed to be rearranged by individuals other than the composer to create musical meaning. The software itself does not currently facilitate maintaining a constant pulse between musicians, though this can be achieved through the use of a click track, traditional conducting technique, or even left to the performers to align themselves.

Indra is optimized for collections that contain many short clips of diverse qualities. It also assumes that ensembles of different instrumentation may play the same composition, and that many clips can be played by many different instruments (as opposed to the traditional division of material by part). However, it can be used in many different ways. Compositions don’t even have to be “new” per se; it could be interesting to have nonlinear performances of existing compositions—even classics from the canon!

You are advised to leave the patch locked and in presentation mode for legibility, consistency of layout, and to avoid unexpected functionality.

2. Installation

The installation procedure is the same for Windows and Mac:

1. Download the latest version of Max from the Cycling '74 website (cycling74.com). Indra is distributed as a Max patch, but you do not need to purchase a license to run Indra.
2. Download the latest version of Indra and unzip the file.
3. Open Max and add the folder or directory where you saved Indra to the File Preferences. You can do this through the main menu by clicking Options → File Preferences. Use the + button to add the folder or directory, making sure the Subfolders box on the right is checked.
4. Download the bach, cage, dada, odot, and zero packages from the Package Manager. (File → Show Package Manager.) All other dependencies are included in the Indra download. **Note that starting in Indra version 0.9.6, you should use the odot package from the Package Manager. If you have a previous version of Indra that came with an odot bundle, delete this version to avoid an error.**
5. Restart Max and open the appropriate patch in the Indra folder: composer, conductor, or performer.

3. Building a Collection

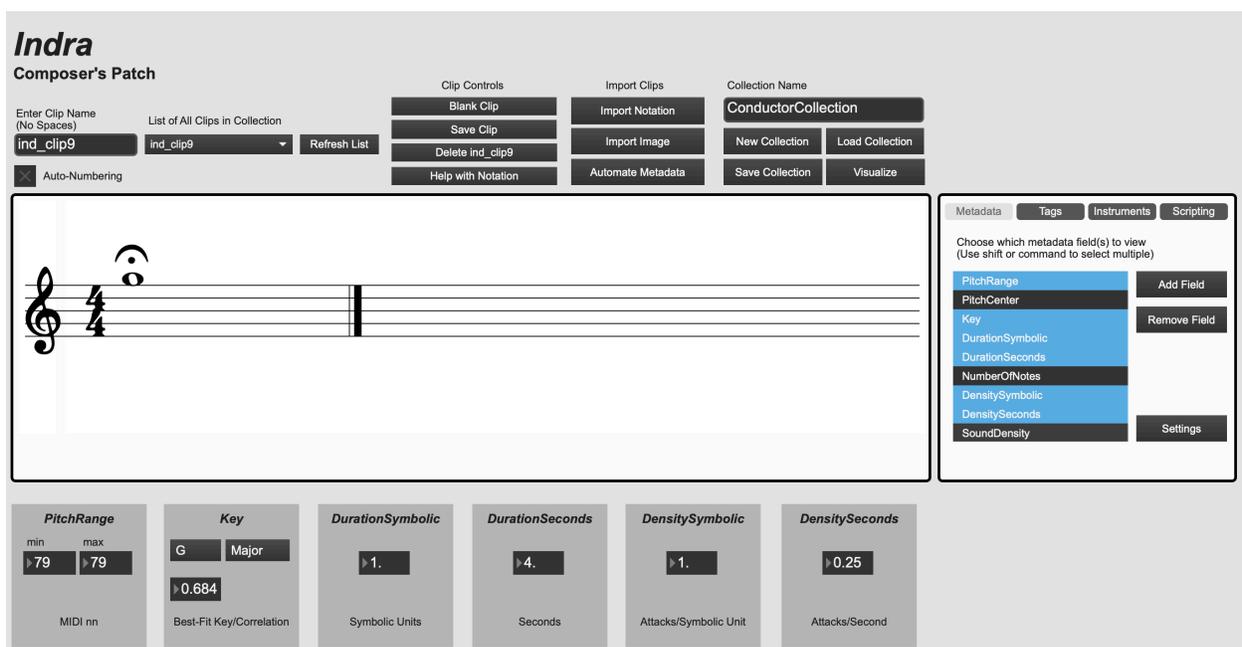
3.1 Quickstart Tutorial

If you have never used Indra before, this section will guide you through creating a clip, modifying its metadata, and saving it as part of a collection using the Composer's Patch. You can also load one of the sample collections that comes with the Indra distribution using the Load Collection (any of the *.lml files in the Indra folder).

3.1.1 Interface Overview

Begin by opening up the Composer's Patch. In the center of the patch (vertically), there are two large white boxes. On the left is the notation display; on the right is a multi-function box with tabs labeled Metadata, Tags, Instruments, and Scripting.

Above the notation display are the clip controls, which allow you to name, load, save, and delete individual clips. Above the multi-function box are collection controls, which allow you to import clips, automatically generate metadata from imported clips, and save, load, and visualize collections. Remember that a "collection" is equivalent to a single composition, containing many musical fragments or "clips."



Below the notation display and multi-function box is the space for the metadata boxes: small gray rectangles for editing metadata, each labeled with a different metadata field. Click on a metadata name in the list in the multi-function box to see the metadata field change below.

3.1.2 Creating Your First Clip

To build a collection, we must create our first clip. Indra is set up to make creating clips easy using the notation display inside the patch. However, as we will see in later sections of this guide, it is also possible (and sometimes preferable) to import preexisting notation as MusicXML files (see section 3.2.2) or images (see section 3.2.3).

Indra uses the bach suite of objects to store and display programmatic notation (that is to say, notation stored as code rather than as an image). For more information on notation in bach, go to Extras → bach.overview and choose “Notation” from the list of topics. What follows will give a brief (and by no means comprehensive) tutorial on editing bach notation using the [bach.score] object.

To create a bar, command+click in the staff. When you create a new bar, its contents are set to a whole rest. To convert a rest to a note, click on the rest (it will turn pink) and command+click again. (For PC, use control instead of command.)

Once you have a note in your bar, you can begin to rhythmically subdivide it, using command+n where n = the number of subdivisions. For example, to turn your whole note into two half notes, select the whole note and hit command+2. To turn each of your half notes into eighth notes, hit command+4.

Once you have composed a rhythm, drag the notes up and down to set the pitches. To turn a note back into a rest, command+click it. To delete a bar, select the bar and command+shift+click.

More options are available by right-clicking on notes, rests, time signatures, clefs, barlines, or the staff itself. Many things can be deleted (or converted to rests) by clicking on them and pressing delete. You can always undo by pressing command+z.

Once you are done with your clip, enter a name (for example, “myClip”) for your clip above (no spaces allowed in clip names), and then click Save Clip. The clip

will now appear in the list of clips above the notation display. If you create multiple clips, you can recall any clip by using this list.

3.1.3 Modifying the Metadata

Once you have a clip, you can tag it with metadata. This allows the conductor to select for it based on its musical qualities during the performance. There are fifteen default metadata fields that come with Indra. As discussed in later sections, you can remove or modify these fields (see section 3.3.7), or even create new custom metadata fields (see section 3.3.5).

The metadata is edited using the gray metadata boxes at the bottom of the patch. The right multi-function box displays the fifteen default metadata fields in a list, beginning with PitchRange. (If you do not see this list, click the Metadata tab so that it turns light gray.) You can select different fields from this list to change which metadata boxes are visible below. Using command+click or shift+click to select multiple fields.

Use command+click to select four metadata fields from the list to view as boxes: PitchRange, PitchCenter, DurationSymbolic, and NumberOfNotes. All four should be visible side-by-side under the notation display. Type in the information requested for each. For PitchRange, type in the lowest and highest pitch value in MIDI note numbers (middle C = 60). For PitchCenter, choose which pitch class (0-11) seems to be the most “centric” and type that number. For DurationSeconds, enter the number of seconds you’d like the performer to take to play the clip. For NumberOfNotes, enter the number of notes.

Once you have entered the metadata values, click Save Clip. The metadata values are now saved with the clip you created earlier. Try creating a few other clips and saving them, along with new metadata. Click Blank Clip to start from scratch.

3.1.4 Saving Your Clips as a Collection

Once you have a handful of clips, you will want to save them as a collection. To do this, simply click Save Collection in the upper-right section of the patch. You will be prompted to name the collection (as with clip names, do not use spaces).

To verify that your data has been saved, you can click New Collection to clear the view in the patch, and then click Load Collection to load your collection. The

collection should be saved in your patch directory with the name you gave it and the *.lill file extension.

3.2 Clips

There are three ways to create clips: (1) creating them in Indra using the notation display (native bach editor); (2) creating them in a notation editing program of your choice (such as Sibelius or Finale) and importing them to Indra as a MusicXML file; or (3) saving them as images and importing them to Indra. A single collection can contain clips created using any or all of these methods if desired.

3.2.1 Native Clip Creation and Scripting

Section 3.1.2 above gives a brief description of how to create a clip using the notation display in Indra. As the notation display is an instantiation of the [bach.score] object, the most comprehensive resource is the bach documentation (Extras → bach.overview or [bach.score] help file). You can also click on Help with Notation inside the patch. This section lays out some of the other tools available for creating and editing clips.

Besides the basic keyboard shortcuts covered in the tutorial (command+click to create a measure or toggle between notes and rests, command+number to subdivide rhythmically, command+z to undo), the most important interface for editing clips is the contextual menu that pops up when you right-click on the notation display. Note that different menus pop up when you click on different parts of the notation display, such as a note or rest, the time signature, the clef, barline, staff, or blank space outside the staff.

Some tasks that can be accomplished using the contextual menus:

- To delete a bar, right-click on the bar and choose delete from the menu.
- To change the enharmonic spelling of a note, right-click on the note and choose Enharmonicity.
- To change the clef or key, right-click on the clef.
- To change the time signature, right-click on the bar. (Clips may contain bars in multiple time signatures.)
- To change the barline style, right-click on the barline.

To hear your clip rendered in MIDI, press the space bar. You can also copy and paste within a clip (or between clips) using the usual `command+c` and `command+v` functions.

There are many additional keyboard shortcuts that can be used to edit your clip. For example, you can add articulations and expressive markings by selecting a note (click it so it turns pink) and holding `option` (Mac) or `alt` (Windows) with specific letters:

- `option+s` = staccato
- `option+a` = accent
- `option+t` = tenuto
- `option+f` = fermata

For more, click `Help with Notation` → `Learn More` → `Notation` → `Articulations` → `Standard articulations list`.

The final tool for editing notation is scripting, which allows you to modify the notation with code instead of by clicking on the screen or using shortcuts. Scripting should be approached carefully and with preparation, as the results of incorrectly typed commands can be unpredictable and result in data loss.

To access the scripting tool, click the `Scripting` tab in the multi-function box. One of the most important scripting functions is being able to select and deselect notes and rests. For example, type `“sel notes”` (no quotes) and click `Enter`. All of the notes in the current clip should be selected (in pink). To deselect, enter `“clearselection”` (one word). The scripting tool also includes `Undo` and `Redo` buttons to undo or repeat changes. The `Next` and `Previous` buttons allow you to step through recently entered commands.

Scripting allows you to enter any message that appears in the `bach` documentation, such as commands that appear in message boxes. Usually these messages require that you first select a given note (often understood by `bach` as a “chord”), and then adding additional notation information to what is known as a “slot.” (See the `bach` documentation and tutorials for more on this.)

For example, to add a “forte” symbol to the first note in your clip, select the first note by typing `“sel chord 1”` and hit `enter`. Then type `“addslot [20 f]”` to add the symbol “f” to slot 20 (which is reserved for dynamics). You can change the shape

of selected notes by typing, for example, “addslot [23 diamond]” or “addslot [23 blacksquare]” (slot 23 is reserved for notehead information).

You can also use scripting to tidy notation automatically. For example, try “sel all” followed by “autobeam” or “autorhythm” (best results with a complex, highly-subdivided rhythm).

Finally, an important consideration to bear in mind while browsing the bach documentation is that some examples use [bach.score] and others use [bach.roll]. While these two objects are very similar, some messages only work on one or the other. (The latter, which displays proportional notation, is not used by Indra.)

3.2.2 Importing Music XML Files

It is possible to import notation into Indra from other software, instead of creating each clip individually using the notation display. One of the advantages of importing a MusicXML file is that it allows you to create many clips in the software of your choice in a single notation file. Indra can parse many clips from a single MusicXML file upon import.

The process involves three steps:

1. Create and correctly format notation in the software of your choice.
2. Export the notation as a MusicXML (*.xml) file.
3. Import the MusicXML file into your collection using the Composer’s Patch.

When you create a notation file containing multiple clips, **each clip must be separated by a single bar of 4/4 time signature containing a whole rest** (and nothing else). Each clip may contain any number of bars with any time signature(s), but Indra recognizes an empty bar of 4/4 as described as a delimiter between clips. If you want a clip to contain a bar of 4/4 within it, create the clip manually using the native tools (or import an image).

Once your notation is formatted correctly, export it as a MusicXML file. If you are given the option, use the uncompressed XML option (*.xml) and **not** the compressed *.mxl format.

Open the Composer’s Patch and click Import Notation. The window that pops up lists the steps to take to import the file:

1. First, click Load MusicXML File and select your file.
2. Your file will appear in a single long staff in the notation display immediately below the Load MusicXML button. Review the appearance and edit as necessary. Make sure that clips are separated by a single 4/4 bar with a whole rest. Note that scripting is also available at right.
3. Your clips will be named automatically once they are parsed. Choose a root name that will identify the clips imported together. For example, if you choose “clip” as your root name, your clips imported from the same file will be named clip1, clip2, clip3, etc. Be sure to choose a unique name so as not to overwrite existing clips. The root name also cannot contain spaces.
4. Click Parse MusicXML file to divide your file into individual clips.
5. Your new clips will appear in the drop-down menu below the Parse button. Select clips from this menu to preview them in the small notation display at the bottom of the screen. Use Delete Clip to remove any clips you don't want to save to the collection. (Note that changes to individual clips made in this screen will **not** be saved.)
6. You can load and parse as many MusicXML files as you would like. The numbering using the same root name will continue automatically until you (1) close the window, (2) hit Clear and Reset, or (3) click Save to Collection. **Be sure to use a unique name for each import or your clips will be overwritten!**
7. You can use the Batch Tagging box to automatically tag all imported clips with tags or instrument tags. Follow the on-screen instructions. This is especially useful if you are importing separate MusicXML files with the clips for each instrument. Tags are applied when you click Save Clips to Collection (not when you click Parse), so be sure to save imports with different tags separately.
8. When you are done, click Save Clips to Collection.

Once this process is complete, you can close the Import Notation window and view your clips in the main patch. You can load new clips via the clip list above the notation display. You can also edit these clips and their metadata as though they had been created natively. Be sure to click Save Collection after you import to preserve your changes.

3.2.3 Importing Images

Using image files for clips in Indra has advantages and disadvantages compared with using programmatic notation. On one hand, using images ensures the consistent appearance of the notation and allows for the use of graphic, colored, nonstandard, or otherwise unsupported notational elements. On the other hand, it

means that all of the metadata information must be entered by hand, since it cannot be derived from the code of the notation as with other clips. You may find that images are preferable for certain applications, but not for others.

Requirements for images in Indra:

- Ideally, all of the images should be 1000 (width) x 250 (height), or slightly less. The size of the display box the performer sees is precisely 1000 x 250. To avoid warping, images are never resized (smaller images remain small and larger images will be cropped).
- Must be one of the following file formats: *.jpg, *.jpeg

To import image files into your collection as clips, click Import Image. Images can be imported singly or in batches. Start by selecting the import mode from the drop-down menu in the bottom left.

Import Single Image:

1. Type a name for your image (no spaces).
2. Drag the image file into the blue box.
3. Repeat as desired.

Import Multiple Images:

1. Choose your naming option (either auto-numbering using a root name, or use the file names of the image files).
2. If you selected auto-numbering, type a root name for your image (no spaces) and set the next number (if other than 1).
3. Drag multiple images, or a folder of images, into the blue box.
4. Repeat as desired.

When you import images, copies of your image files are stored in the /images subfolder in the directory where your patch is saved. This is the folder that the software will use to access the files (not their original location). This folder must be provided to the conductor and performer if your collection contains images.

Once your images are imported, you can preview your images by using the drop-down menu in the middle of the patch. You can also view all of the images imported in the current session by using the chooser at the right, and click Remove Clip to delete any clip you do not want to keep. When you're done, you can close the window and use the clip list in the main patch to view, edit, and apply metadata to these clips.

As with importing notation from MusicXML files (section 3.2.2), you can use the Batch Tagging function when importing images. Batch tagging allows you to automatically assign all imported clips tags and/or instrument tags. Tags are applied as soon as you drag a file or folder into the blue box.

3.2.4 Working with Clips

There is no limit imposed regarding the length of notation-based clips, but the display window in the Performer's Patch—identical to the display window used in the Composer's Patch—comfortably shows up to about twenty notes. For example, four bars of 4/4 with a mixture of quarter notes and eighth notes, or two bars of 4/4 with sixteenth notes and a handful of smaller values.

The presence or absence of accidentals also changes the layout. When you save your clip, longer clips will automatically be condensed so that the entire clip is visible at once. This is exactly what your performer will see. You are advised to split up longer clips that become illegible when condensed, and overall to keep your clips as short as is practical. Using images is also a good alternative for longer clips where you want to have greater control over spacing and layout.

Including dynamics (like *piano* or *forte*) in your clip is possible, but may cause confusion with dynamics sent by the conductor during the performance. See section 3.5 for more on this topic.

All changes to a clip must be saved by clicking Save Clip while that particular clip is loaded in the notation display in the main patch. The Delete Clip button will change its label depending on which clip is currently in view as an extra layer of security to prevent unwanted deletions.

While clip names are necessary to distinguish clips, they don't have much use in an actual performance using Indra. The most important thing is that they are all unique and don't contain any spaces. If you are making several clips manually in succession, you may find it helpful to turn on Auto-Numbering by clicking the check box above the notation display. This allows you to set a consistent format for clip names that will automatically increment each time you save a clip. For example, choosing the root name "clip" and beginning with "1" means that the next clip you save will be clip1, followed by clip2, etc.

Avoid names that are associated with existing functions or meanings in Max, including *null*, *set*, *mode*, *bang*, *clear*, etc. A good way to avoid having to worry

about these is to use the word-plus-number format described above. Also avoid the following reserved names: *Empty*, *NewClip*, *BlankClip*. Best practice is to avoid duplicating the names of other saved elements as well, including metadata fields, tags, or collections.

3.2.5 Choosing a Clip Format

The inclusion of both programmatic (code-based) and image-based notation in Indra allows the user to maximize the advantages and minimize the disadvantages of each format. The central tradeoff is that image-based notation allows for unlimited graphic flexibility, but requires manual entry of metadata (which can be tedious in large collections). Code-based notation is limited to notational elements that are supported by the bach suite, but allows for automated metadata generation.

The bach suite is an incredibly robust platform for notation with support for articulations, expressive markings, dynamics, alternate noteheads, different barlines, irrational rhythmic subdivisions, lyrics, and much more (see section 3.5 for more on including dynamics). One drawback, however, is that it is currently not possible to indicate slurs (ties are supported). This will likely be addressed in a future version of bach. However, for the time being, please consider an alternative, such as the expressive marking “legato” in slot 20, or using an image file for clips that require slurs.

Another limitation for clips is that only one staff is currently supported. This means that clips for instruments that normally read from more than one staff, like the piano, must be restricted to one staff for the time being.

3.3 Metadata

Metadata refers to the information stored with a clip that describes its musical qualities, including pitch content, key, duration, density, and many others.

3.3.1 Overview of Default Metadata Fields

By default, collections in Indra have fifteen active metadata fields, corresponding to commonly-used musical qualities. A brief description of each follows below:

- PitchRange gives the highest and lowest pitches (MIDI note numbers)
- PitchCenter gives the most prevalent or “centric” pitch class (0-11)

- Key gives the key center and mode, along with a correlation coefficient
- DurationSymbolic gives the duration in symbolic (note-based) units
- DurationSeconds gives the duration in seconds
- NumberOfNotes gives the number of notes
- DensitySymbolic gives the number of attacks per symbolic duration unit
- DensitySeconds gives the number of attacks per second
- SoundDensity gives the total duration of notes divided by total duration including rests, ranging from 0 (all rests) to 1 (no rests)
- AllPitches gives a list of all pitches (MIDI note numbers)
- AllPitchClasses gives a list of all pitch classes (0-11)
- DurationType signals whether a clip has a determined or indeterminate duration
- DurationRange gives a range of possible durations for an indeterminate clip (seconds)
- StaccatoDensity gives the number of staccato notes divided by the total number of notes (0-1)
- AccentDensity gives the number of accented notes divided by the total number of notes (0-1)

Although many of these parameters can be represented in different ways, using the definitions given above will ensure consistency and predictability of output within the collection in performance. See section 3.3.5 below for creating custom metadata fields.

Symbolic units are left unspecified by design. Different base units (i.e. quarter note, half note, etc.) may be appropriate in different contexts, but generally the symbolic unit used should be consistent throughout all of the metadata used within a collection. This will be especially important if you also use automated metadata (discussed in section 3.3.4 below).

3.3.2 Functional Metadata

Several of the default metadata fields are also considered **functional metadata**, meaning that they have roles to play in performance that go beyond the default metadata filtering interface used by the conductor. The functional metadata fields are:

- PitchRange
- DurationSymbolic

- DurationSeconds
- DurationType
- DurationRange

The PitchRange field is used to silently filter clips by range in the conductor's patch when the Instrument Range Filter setting is on (Performance Settings). It is also used to silently filter clips by range in the performer's patch if filtering is turned on in Practice Mode.

The four duration-related fields listed above are used together in order to determine how long a clip is displayed to the performer in the performer's patch before advancing to the next clip. A quick summary of how this works: if DurationSeconds metadata is saved, this is always used as the display length for the clip. If not, the software will calculate an appropriate display length based on the current tempo using DurationSymbolic (if available). DurationType and DurationRange allow for indeterminate durations. A detailed explanation is provided in the following paragraphs.

When a clip is loaded in the performer's patch during a performance, first the software checks whether a DurationType has been designated. The options are NoValue, Determined, or Indeterminate. If the type is Indeterminate, the software then checks to see if a DurationRange has been set. If so, it chooses a random value from the range. If the type is Indeterminate but no range has been set, a random value is selected from a range of 6-8 seconds.

If the type is Determined or undefined (i.e. NoValue), the software checks for DurationSeconds. If a value is saved here, this value is always used as the display length. If no value is saved here, the software checks for DurationSymbolic. If there is data saved for DurationSymbolic, an appropriate display length is calculated by taking into account the current tempo, the pulse base (see section 3.3.7), and the base symbolic unit (see section 3.3.4) as defined in the collection. ***If you want your clips' duration to be tempo-sensitive, use DurationSymbolic, not DurationSeconds.***

If the clip does not have DurationSymbolic data but is in the notation format, the symbolic duration (and an appropriate display length as described above) is automatically calculated. If the clip does not have DurationSymbolic data and is in the image format, a random value is selected from a range of 6-8 seconds.

The duration for which a clip is displayed in the Performer’s Patch depends on both the properties described above and the Clip Density range set by the conductor (see section 4.4.1).

3.3.3 Working with Metadata Fields

It is not necessary to use all metadata fields provided by default. In fact, it is likely that only a portion of the default fields will be relevant to a given project. The range of options can therefore be understood as suggestive, rather than prescriptive.

The full list of metadata fields displayed in the multi-function box under the Metadata tab are known as the “active” metadata fields. Active metadata fields can always be accessed, and will be visible to the conductor during the performance. All of the default metadata fields are also active by default.

If you prefer to remove certain fields, click on them and use the Remove Field button. Once a field is removed, it is considered “inactive”: it no longer appears in the list, and will not be visible to the conductor. The active or inactive status of a metadata field affects the entire collection—it cannot be turned on and off per clip.

If you have removed a metadata field and wish to restore it, click Add Field. Use the Restore Metadata chooser to select the field you would like to restore, then click Restore Field. Once you close this window, the field you chose to restore should be visible in the multi-function box metadata list again. (Creating a new custom metadata field will be covered below in section 3.3.5.)

The metadata for a clip can be edited using the gray metadata boxes at the bottom of the screen. Because a collection may contain many active metadata fields, the Composer’s Patch allows users to focus on a subset of the active fields. To choose which fields to view, select fields from the list in the multi-function box. There are two ways of making multiple selections: (1) shift+click to select all items between clicks, or (2) command+click to gather individual fields. To view all of the fields, click the top item in the list, then scroll to the bottom and shift+click on the last item. You may have to scroll down inside the patch to see all rows of the metadata boxes.

To preview how the metadata filtering works, you can load a collection in the conductor patch (see section 4).

3.3.4 Automated Metadata

Notation created using the native notation display or imported from a MusicXML file can have the metadata for its default fields generated automatically. To use the automated metadata function, first create or import the clips, then click Automate Metadata in the main patch.

When the Automated Metadata window pops up, you can view a summary of the process and how the data for each metadata field is generated on the left side of the screen. To begin, select the metadata fields for which you would like to automatically generate data from the chooser titled “Metadata Fields.” Note that only default metadata fields that are currently active are eligible for automatic metadata generation. If you would like to restore a default field that you previously removed, return to the main patch, click Add Field, and follow the instructions in section 3.3.3 to restore the metadata field.

Generating Metadata Automatically

Indra allows you to automatically generate certain kinds of metadata from notation-based clips (images are excluded).

1. First, select the metadata fields you wish to automate. Use shift and/or command to select multiple fields. If a field has been removed, it will not appear here.
2. Select the clip(s) for which you would like to generate metadata, or check the box to generate metadata for all clips. Automatically generated metadata will overwrite any existing metadata.
3. Customize your automatic metadata settings. You can modify how metadata is generated for certain fields.
4. When you're ready, click the button below:

Automatically Generate Metadata

This will overwrite existing metadata and cannot be undone. (Large collections may take several seconds to complete.)

Metadata Fields

- PitchRange
- PitchCenter
- Key
- DurationSymbolic
- DurationSeconds
- NumberOfNotes
- DensitySymbolic
- DensitySeconds
- SoundDensity
- AllPitches
- AllPitchClasses
- DurationType
- StaccatoDensity

Select Specific Clips (<1000)

- clip_a9
- clip_a94
- clip_a123
- clip_a272
- clip_a290
- clip_a311
- clip_a364
- clip_a536

Preview of Selected Clip

This view is for previewing clips only. Changes made here will not be saved.

Settings

Key
Choose Profile to Use: **Krumhansl-Schmuckler**

DurationSymbolic
Choose Base Unit: **Whole Note**

DensitySymbolic
Choose Base Unit: **Quarter Note**

AllPitches
Duplicates On/Off: **Duplicates Off**

AllPitchClasses
Duplicates On/Off: **Duplicates Off**

Define Custom Profile:
Edit Major Profile
Edit Minor Profile

Metadata Explanation

PitchRange = highest and lowest pitches (MIDI note numbers)
PitchCenter = most prevalent pitch class by duration*
Key = best guess at key (by default uses Krumhansl-Schmuckler key profiles)
DurationSymbolic = duration in symbolic (note-based) units
DurationSeconds = duration in seconds (assuming bpm = 60)
NumberOfNotes = number of notes
DensitySymbolic = number of attacks per symbolic duration unit
DensitySeconds = number of attacks per second (assuming bpm = 60)
SoundDensity = total duration of notes divided by total duration (including rests)
AllPitches = list of all pitches
AllPitchClasses = list of all pitch classes
DurationType = if clip contains a fermata, flagged as "indeterminate" (otherwise "determinate")
StaccatoDensity = number of staccato notes divided by total number of notes
AccentDensity = number of accented notes divided by total number of notes

*PitchCenter outputs a single value even if there is a tie; review and change manually if desired

Note: The five dropdown settings are saved with your collection. Any custom key profiles entered manually are not saved with your collection.

Next, select the clips for which you would like to automatically generate metadata. You can select specific clips using the chooser labeled “Select Specific Clips,” or check the box labeled “Select All” to select all clips in the collection. Use command+click or shift+click for multiple selection. You can also preview clips if you are not sure whether you would like to generate metadata for them. Note that automatically generated metadata will overwrite any existing metadata in the selected clips (including previously generated automatic metadata).

Once your clips and metadata fields are selected, customize the settings in the lower part of the screen. These settings can change the data generated, and generally should be kept consistent within a collection. The five dropdown settings are saved with your collection, but any custom key profiles you enter manually **are not** saved, and must be re-entered if you work in multiple sessions.

For most applications, the default values are perfectly workable. For advanced users, a summary of the settings follows:

- Key
 - Choose Profile to Use: Allows you to toggle between the Krumhansl-Schmuckler major/minor profiles, or the alternative profiles proposed by David Temperley in “What’s Key for Key?” (*Music Perception* 17/1, Fall 1999).
 - Define Custom Profile: These buttons allow you to define your own major/minor profiles. This feature is recommended for advanced users only.
- DurationSymbolic and DensitySymbolic
 - Choose Base Unit: This menu allows you to choose the base symbolic unit (i.e. note value) for calculating duration and density. The base unit is assigned a value of 1. So, a measure with four quarter notes with a quarter note as the base unit will have a symbolic duration of 4. The same measure with a whole note as the base unit will have a symbolic duration of 1. This is essentially a matter of personal preference, but users are advised to be consistent.
- AllPitches and AllPitchClasses
 - Duplicates On/Off: This determines whether or not duplicates of the same pitch or pitch class are included when generating a list of all pitches or pitch classes within a clip.

Once you have customized your settings, click the Automatically Generate Metadata button on the left side of the screen. Close the window and review the clips and metadata in the main patch using the notation display and the metadata boxes. Users are advised to carefully check the results of the automatically-generated metadata. The automated metadata is automatically saved with each clip, but you can edit this metadata and save the clip again in the main patch.

A brief aside on duration-related metadata fields: As discussed in section 3.3.2, duration-related metadata fields are functional metadata, meaning that they are used in the performer patch to calculate how long clips are displayed. If you want

your clips to be tempo-responsive (i.e. their display length changes depending on the tempo set by the conductor), leave DurationSeconds at zero (do not automate it), and only use DurationSymbolic. For a more detailed explanation of functional metadata, see section 3.3.2.

3.3.5 Custom Metadata Fields

Indra allows users to create up to fifteen custom metadata fields to supplement or replace the default metadata fields. To create a custom metadata field, open the Metadata tab in the multi-function box and click Add Field. We have already covered how to restore default metadata fields above (section 3.3.3); in this section we will look at the controls on the right in this window, beginning with the chooser labeled “New Custom Metadata.”

First, choose a slot to overwrite with your custom metadata field. If you have not yet created a custom metadata field, you will see a list with options ranging from Metadata1 (the first slot) to Metadata15 (the last slot). You are advised to start with Metadata1, but there is no difference between any of the slots. Each slot can be customized in as many different ways as any other.

If you have previously created a custom metadata field and then removed it, the field may appear in this list under its custom name. You can restore its default name by clicking the Restore Default Names button under the chooser.

Once you have selected a slot, you must choose the settings for this metadata field. The metadata settings should reflect the kind of data the metadata field will be used for. First, type in a name (no spaces; by convention multi-word names are rendered in “camelCase”).

Next, choose the data type. There are six options, described below:

- Integer: a single integer value, appropriate for things like pitches, pitch classes, and counts of elements.
- Float: a single floating-point (decimal) value, for numeric values with decimals like proportions, precise timings, and inversional points of balance.
- MinMaxPair: two integers, stored pair of minimum and maximum values, appropriate for things like a pitch range or a range of durations.
- State: one value amongst several possible, encoded as an integer but defined via human readable state names. Appropriate for qualitative categorization,

such as distinguishing leitmotifs, themes, or types of notation. Note that a single clip can only be assigned a single state for this type of field. If you are interested in qualitative grouping in which a clip can have membership in more than one group, explore the Tags system described below in section 3.4.

- **List:** a list of words and/or numbers. Entirely numeric lists can be treated quantitatively (as with, for instance, a list of all of the pitches in a clip). Lists can also contain non-numeric data, in which case they may be filtered by the conductor through list element matching.
- **Key:** a compound format for use with key-like data, such as modes, scales, and other pitch and pitch class collections. Key metadata is in three parts: (1) an identifier, (2) a type, and (3) a floating-point number indicating the correlation coefficient, roughly equivalent to the strength of fit. The default metadata field Key uses the key data type. In this case, the identifier is the starting note of the scale, the type is whether it is major or minor, and the strength of fit value reflects how closely the clip matches the key.

Each custom metadata field has a unique control that the conductor uses to filter the clips. These controls are described in detail in section 4.3. To summarize, these controls include a strictly numeric range-based slider (rslider), a range-based slider with a notation display (nslider), a one-octave keyboard display (kslider), a list display (chooser/statechooser), and the unique keycontrols which incorporates two list displays (for identifiers and types) and a slider for the strength of fit value. Depending on the type of data you choose for your custom metadata field, you will be presented with different control options.

If you choose rslider as your control option, you will be prompted to set the range of the slider. For example, if you want the control to encompass the entire range of MIDI note numbers, you could set the minimum to 0 and the maximum to 127. All of the metadata values you assign to clips should fall within this range. The other numeric controls have fixed ranges (nslider = 0-127, kslider = 0-11).

The rslider and nslider controls allow the conductor to filter by range, where as long as the value (or range of values, for MinMaxPair) is within the range the composer sets, the clip will be passed through. The kslider allows for multiple selection and uses a matching OR logic: if the metadata value of a clip matches any of the selected kslider values, it is passed through. The list displays also use matching OR logic.

You can also include a label to be displayed in your custom metadata field box. This is usually a brief explanation of the values stored, such as “MIDI nn” or “Pitch Class.”

Finally, the state and key data types require you to specify the options available, since the same options must be common to all clips across the collection. (If you do not want common options across clips, use the list data type, where the stored elements are unique to each clip.) For state, type the possible states as single words (alphanumeric characters only) separated by spaces. For example, for a custom metadata field describing musical function of clips you might include the states “melody countermelody accompaniment rhythmic ostinato beginning ending” (no quotes). Then each clip would be assigned one of these states, allowing the conductor to filter for clips to fulfill particular musical functions during the performance.

For the key data type, you must specify the identifiers and types in the same format (i.e. separated by spaces). For example, a custom metadata field describing the mode of each clip might use the twelve pitch classes as identifiers, and the seven church modes (ionian, dorian, phrygian, lydian, mixolydian, aeolian, locrian) as the types.

When you are done, click Save New Metadata Field to save and activate your new field. When you close the window, it will appear in the active metadata field list. Note that if you are overwriting a previously used slot, saving a new metadata field clears all previous content.

A brief aside on the correlation coefficient for the key data type: The correlation coefficient allows you to indicate how closely each clip fits the given mode, key, or pitch collection. Including this information allows the conductor to distinguish between clips that strongly correspond to a given key, and clips that correspond more weakly.

The value reflects the correlation coefficient produced as a result of the key-finding algorithm used to automatically generate the metadata for the default field Key. A correlation coefficient can range from -1 to 1, where -1 indicates a negative correlation, 0 indicates no correlation, and 1 indicates a positive correlation. The range for the keycontrols slider used by the conductor is always 0-1 (since values below 0 indicate a negative of correlation). By adjusting the slider, the conductor specifies the minimum acceptable correlation.

This value is automatically generated for the Key metadata field if you use the automated metadata function. However, if you choose to create a custom metadata field that uses the key data type, you must decide how to engage with this feature. You can estimate the correlation using values between 0 and 1, calculate it yourself, or ignore this feature by setting the value to 1 across all clips. (Leaving the value at 0 will also work as long as the conductor does not change their slider setting, but setting the value to 1 ensures that even if the conductor adjusts the slider during performance all of the clips matching the identifiers and types specified will still be passed through.)

3.3.6 Visualizing Your Collection

In the upper right corner of the main patch, there is a button labeled Visualize that allows you to review your collection in a customizable visualization. When you open the window, you are presented with a chart-like display and four dimensions which you can assign to different metadata: x-axis, y-axis, size, and color. The first two must be assigned; the latter two are optional.

Visualize Collection

This window allows you to visualize your collection according to its metadata. Use the dropdown menus to select metadata to display. The x-axis and y-axis must be assigned; size and color are optional. This tool is for review only; no changes made in this window affect the content of the collection. Hover over a point to preview the clip in the lower left corner.

Data Types
Currently only numeric metadata is supported. Only metadata fields of type Integer, Float, MinMaxPair, or State can be displayed.

Data Appearance
Some metadata values may appear slightly different in this display, because of how the data is stored. For example, PitchCenter values are shifted by one from the conventional pc range of 0-11, because 0 is considered "no value" rather than pc 0. Likewise, State-type metadata fields are displayed as integers corresponding to the order of menu item (0 = "no value").

Differences that appear here do not affect how the data is stored and/or how the data will appear to the conductor.

Current Selection:
clip21

X Axis: DurationSymbolic
Y Axis: NumberOfNotes
Size: DoNotDisplay
Color: DoNotDisplay

Tag Summary

Tags

- ascending
- dramatic
- mixedmeter

Matching Clips: 5

- clip16
- clip23
- clip1
- clip20
- clip19

Instrument Tags

- Flute
- Violin
- Trumpet
- Piano
- Cello
- Clarinet

Matching Clips: 7

- clip21
- clip26
- clip9
- clip30
- clip14
- clip2
- clip23

Total Number of Clips in Collection: 53

Currently only numeric metadata fields are supported (type Integer, Float, MinMaxPair, or State). Hover over a point to view a preview of the clip in the lower left corner. Some metadata values may appear differently in this display, owing to how the data is stored. For example, PitchCenter values are shifted by one from the conventional pc range of 0-11, because 0 is considered "no value" rather than pc 0. Likewise, State-type metadata fields are displayed as integers corresponding to the order of menu item (0 = "no value").

Across the bottom of the window are several additional functions. On the left you can preview a clip (image or notation) by hovering over that point representing that clip in the chart above. To the right is the Tag Summary, which displays all of the tags and instrument tags currently stored in your collection. If you click on a tag or instrument tag, all of the associated clips are listed in the list to the right.

The visualize window is for review only; no changes made here affect the content of the collection.

3.3.7 Metadata Settings

Just as the range, control, and other settings of custom metadata fields can be selected based on the particular usage envisioned, each of the default metadata fields comes with pre-assigned settings that are optimized for their intended function. However, advanced users may occasionally wish to adjust the settings of metadata fields for a number of reasons. This may be achieved by clicking on Settings in the multi-function box under the Metadata tab.

Generally speaking, users are advised against modifying metadata field settings unless they are absolutely certain of what they are doing. Modifying settings for the default metadata fields can significantly affect the appearance, listing order, automated metadata generation, and operation of the collection in performance. If you want to build a custom metadata field from scratch, return to the main screen and use the "Add Field" button. If you want to remove a field, use the "Remove Field" button on the main screen.

One important feature of Indra controlled through this window is the Pulse Base, located in the lower left corner. If your clip is tempo-sensitive, the pulse base is used in the performer's patch to determine the length each clip is displayed in front of the performer, in coordination with the tempo. For example, if your clip contains four quarter notes and the conductor sets a BPM of 120, with the quarter note as a pulse note it will be assumed that the performer plays it in about two seconds. With the eighth note as the pulse base, it will be assumed that the performer plays it in about four seconds. For more, see section 3.3.2.

To view and/or edit the settings of a particular metadata field, click its name in the Active Metadata Field chooser. Two settings changes that can be made without wider ramifications are the descriptive label (Units Label) and range of the conductor's controls (Min/Max). The label is simply the text that is displayed at

the bottom of the metadata box, while the range affects the conductor's interface only for fields that use the rslider as the control).

Changing the range can give the conductor greater control resolution over your collection, and is advisable if your clips' metadata is distributed across a different range than the one given. For example, the default range of the NumberOfNotes metadata field is 0 to 50. However, if all of your clips have between 1 and 4 notes, then much of the control range is wasted. By changing the range to something closer, like 0 to 5, you ensure a better control resolution.

Optionally, you can auto-set the range by clicking the Auto-Set Range button. This function searches your clip metadata (numeric fields that use rslider only) to find the highest and lowest values, and populates the min and max accordingly. As with all settings changes, you must click Save Changes at the bottom to save any changes.

You can also use the Advanced Metadata Settings window to restore the default name and/or settings for any selected metadata field, or for all fields, using the buttons in the lower left corner.

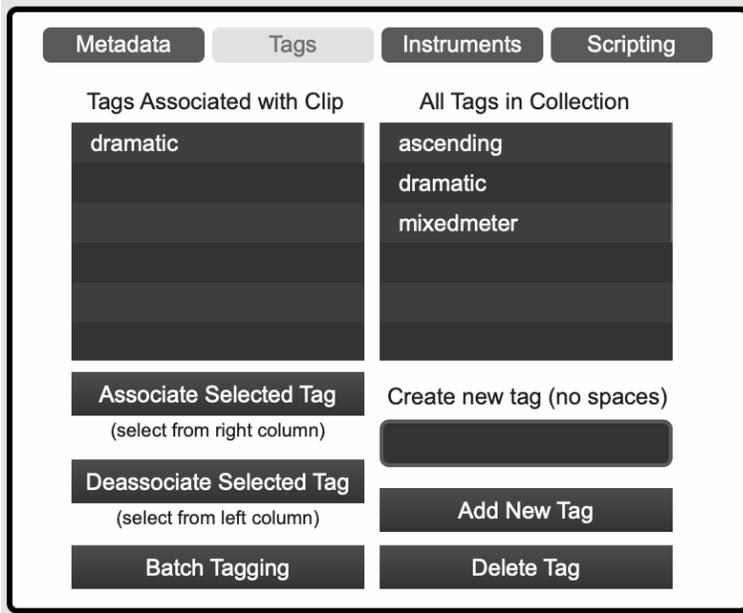
3.4 Tags

The tag system functions in parallel with the metadata system, but independently and with somewhat different functionality. Tags are labels that are stored as part of a collection and can be applied to any clip. Unlike with the state metadata type (discussed in section 3.3.5), a clip can be associated with any number of tags, including none.

In addition to the standard tagging system, Indra also supports a separate tagging system specifically for instrumentation, which allows the conductor to automatically direct clips to specific instruments in performance. Both systems are discussed below.

3.4.1 The Tag System

To edit and view tags, click the Tags tab in the multi-function box. You will see two choosers: on the right, a display of all tags in the collection, and on the left, a list of all the tags associated with the clip currently loaded into the notation display.



If you are just starting out, both of these lists will be empty. Begin by creating a new tag for your collection. Type a name (no spaces) into the text blank in the lower right corner, and then click Add New Tag. The tag will appear in the list above. Create more to add them to the list.

Next, load a clip in the notation display and then click on a tag from the list of tags available on the right. Click Associate Selected Tag. Now the tag should appear in the left and right lists. You can remove a tag from a clip by loading the clip, selecting the associated tag you wish to remove from the list on the left, and clicking Deassociate Selected Tag. To delete a tag from the entire collection (including all associations with existing clips), select a tag from the list on the right and click Delete Tag.

You can associate additional tags with the same clip, or load a different clip to assign tags. Tags are best suited for qualitative categorizations that may overlap, such as emotional or thematic qualities. Just as a single clip may have many tags, many clips can share the same tag. Indra also includes a Batch Tagging feature that allows you to associate multiple tags and/or clips with a single click, instead of associating them one by one. To use this feature, click Batch Tagging. In the window that pops up, use shift+click and/or command+click to select multiple clips and/or multiple tags. When your selection is complete, click the Associate button at the bottom of the screen.

During the performance, the conductor will be able to filter clips by using the metadata system, the tag system, or a combination of both. While filtering by greater numbers of metadata fields simultaneously generally produces narrower fewer results (like an AND query, where all filters must be satisfied), filtering by multiple tags can be done using AND logic (where clips must contain all selected tags) or OR logic (where clips must contain at least one of the selected tags). In this way, the tag system provides a greater degree of flexibility for the conductor.

3.4.2 Instrument Tags

Instrument tags are very similar to regular tags. The main difference comes during the performance. While performing a piece with Indra, the conductor must manually select which metadata and (regular) tags are active or not at any given moment. These settings generate a list of matching clips which are subsequently passed to the instruments. Instrument tags divide up this list so that only clips tagged for a particular instrument are actually sent to that instrument.

Instrument tags can be turned on and off in the Conductor's Patch in the Performance Settings window. Unlike regular tags, instrument tags are invisible: they do not appear in the main list of tags, and work automatically. Automatic operation speeds up the conductor's workflow by allowing the conductor to send instrument-specific clips to multiple instruments in a single operation. It also eliminates the redundant need to select both a recipient and that recipient's tag.

Instrument tags can be accessed by clicking on the Instruments tab in the multi-function box. The appearance and functioning of the Instruments tab in the Composer's Patch is virtually identical to the Tags tab. As with regular tags, a single clip can be tagged with several different instrument tags. Batch Tagging is also available for instrument tags.

3.5 Other Considerations for your Collection

You are advised to choose either `DurationSymbolic` or `DurationSeconds` to determine the display length of clips in your collection (leave the other blank, or remove it from your collection altogether). `DurationSymbolic` is tempo-sensitive (i.e. display length in seconds will change based on tempo). If you include both, `DurationSeconds` takes precedence. If you want your clips to be tempo-responsive, do not fill in `DurationSeconds`—only use `DurationSymbolic`. For more detail, see section 3.3.2.

You may include dynamic levels (such as *piano* or *forte*) in your clips, but be advised that the conductor can assign dynamics during the performance. It is recommended that you use other means, such as articulations, expressive language, or hairpins (without explicit dynamic levels), to indicate the expressive qualities of the music. If, as composer, you do include explicit dynamics in your clips, you must convey to performers how you would like them to interpret notated dynamics as compared with “conducted” dynamics.

4. The Conductor

4.1 Interface Overview

The conductor directs the performance using the Conductor's Patch. When you open the patch, you will notice that the patch is divided into two halves by a horizontal line. Below the line is the space in which the metadata filters are displayed; above the line are the performance controls.



The upper half of the interface can be divided into four distinct sections (from left to right): (1) the control buttons; (2) the recipient multi-function box; (3) the message multi-function box; and (4) the tag list. The control buttons and tag list do not change their appearance. However, the two multi-function boxes each have several tabs: the recipient box contains separate tabs for Instruments, Groups, Assignments, and Config; the message box contains separate tabs for Dynamics, Mode, and Messaging.

4.2 Preparing for Performance

When preparing for a rehearsal or performance, the conductor and performers must all be connected to the same wireless network. The network does not need to be connected to the internet. (In fact, the software functions better if you are not.)

4.2.1 Loading a Collection

The conductor must open the Conductor's Patch on their device. The conductor selects the collection (composition) to be used for performance by clicking the Load Collection button on left side of the screen (in the control buttons column). Collection files are in the *.lill format. Collections that contain images are accompanied by image files which must be saved in a folder called /images in the same directory as the collection file. See section 2 for details on the installation process.

Upon loading a collection, the metadata fields list (lower left) and tag list (upper right) will populate with the collection contents. Just as in the composer's patch, clicking metadata field names from the list generates corresponding boxes in the blank space on screen. This is the metadata filtering system (see section 4.3). The collection loaded by the conductor must be **identical** to the collection distributed to the performers.

Once a collection is loaded, the conductor may review the collection by clicking the Review Collection button on the left side of the patch. This window displays a list of all clips, all metadata fields, all tags, and all instrument tags saved with the collection, as well as the collection settings (these settings are explained in sections 3.3.4 and 3.3.7 above). For the most part, the collection information displayed is for review only and cannot be changed (it can only be modified in the Composer's Patch). The only exception is that the range of certain metadata fields can be adjusted in order to change how the filter operates. Only numeric metadata field that use the rslider control can have their range adjusted. Just as in the Metadata Settings controls in the Composer's Patch (see section 3.3.7), the ranges can also be "auto-set" based on the range of values stored.

The conductor can also view individual clips and visualize the collection in more detail by clicking the Visualize Collection button. The Visualize window is very similar to the display used in the Composer's Patch (see section 3.3.6 for more details).

4.2.2 Instruments and Groups

After loading a collection, the conductor can establish a network connection with the performers. When the conductor opens the Conductor's Patch, the recipient multi-function box is automatically set to the Config tab. The Config tab is used to

build the list of performers who will receive messages from the conductor. To begin, click Start inside the Config patch. Once you click Start, you can instruct the performers (verbally or with a hand signal) to click Announce on their own patches. As performers successfully announce themselves, they will appear in the list. For a more detailed description of configuring the network and troubleshooting suggestions, see sections 4.5 and 5.1.

Once the performers have announced themselves, the conductor can customize how they are named and grouped. To change the names, click More Options. To create or change the groupings, click the Assignments tab. Using groups allows the conductor to send a message to all members of a group without having to select each instrument individually.

In the Assignments tab, the left column lists all of the announced instruments. You can create groups (such as “Winds” or “Ensemble_A”) by typing the name using the text box in the center (no spaces) and clicking Add New Group. The new group name will appear in the list above the text box. To add a performer to a group, click on the performer’s name and the group name in the All Groups column, and click Join Group. To remove a performer from a group, click a performer and a group name in the right column (Selected Group), and click Leave Group. To delete a group (and all associations), click a group name from the center column and click Delete Group.

Once all instruments are announced and groupings have been specified, you can use either the Instruments or Groups tab to select recipients for outgoing messages. The Instruments tab displays all active instruments in a list; the Groups tab displays active instruments and groups in an outline form, allowing the conductor to select recipients by group. Groups and instrument data can be saved from performance to performance (or rehearsal to performance) by using the Save Settings to File button in the Config tab. Settings files are saved in the *.lill format.

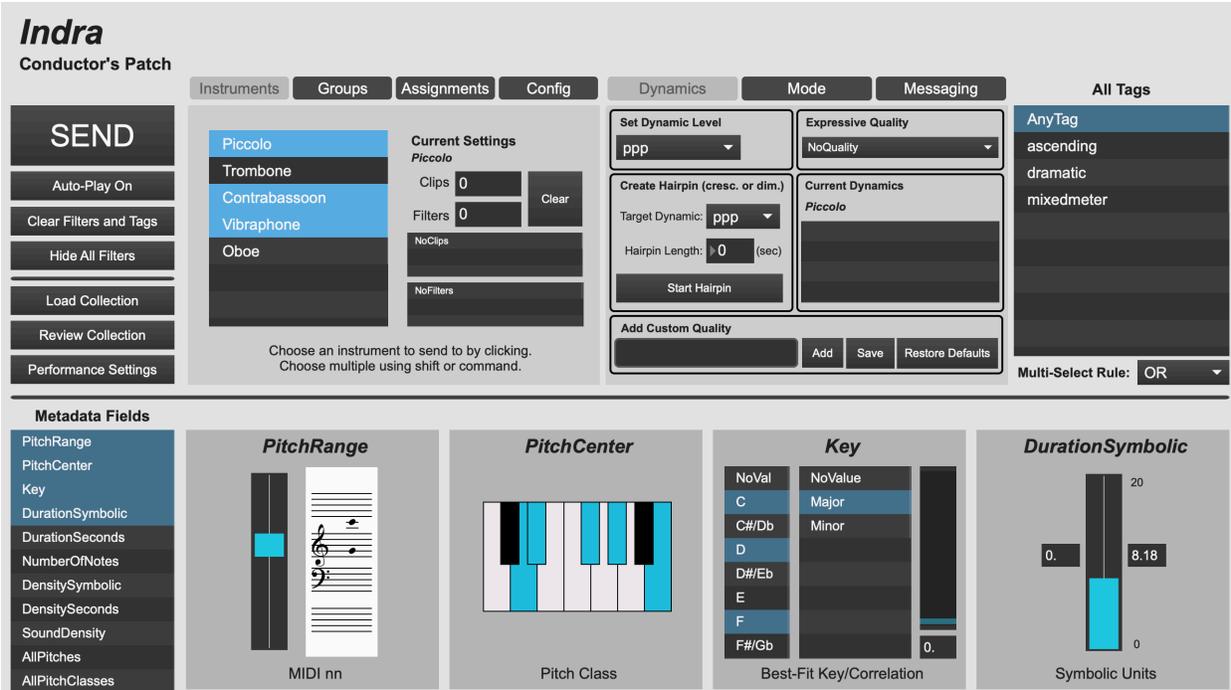
4.2.3 Performance Settings

In addition to the instruments and groupings, there are four performance settings that the conductor may toggle for rehearsal and performance. These settings are saved with the Settings file loaded and/or saved using the Config tab (see section 4.4.2). The performance settings are accessed by clicking the Performance Settings button on the left side of the patch. A description of each follows:

- **Empty Clip Lists:** When filter and tag settings are too restrictive, there may be no clips that match all of the criteria. You can choose how the software resolves this issue. You can choose to automatically clear affected instruments' filters, automatically send a tacet message to affected instruments, or automatically send an improvise message to affected instruments. You can also choose to be prompted each time an empty clip list occurs so that you can choose one of the aforementioned options manually (in real time).
- **Instrument Tags:** Turn this setting on if you plan to use instrument tags; leave it off if you do not. For more on instrument tags, see section 3.4.2.
- **Instrument Range Filter:** The instrument range filter blocks clips whose range falls outside of the range of a particular instrument. The range of a clip is defined by the PitchRange default metadata field (see section 3.3.2), and the range for each instrument is defined by the instrument class chosen by the performer (though it can be modified by the conductor using the More Options window in the Config tab).
- **Automatic Transposition:** The automatic transposition feature transposes notation-based clips for transposing instruments. As above, the transposition for each instrument is defined by the instrument class chosen by the performer, but can be modified manually by the conductor via More Options in the Config tab. Note that image-based notation cannot be transposed.

4.3 The Filtering System

The primary element of the Conductor's Patch is the metadata and tag filtering system. Like the metadata boxes in the Composer's Patch, the metadata filter boxes appear when the corresponding field is selected from the list on the left. Use command/control or shift to select multiple fields simultaneously. Note that this list is only populated after a collection has been loaded.



The image above shows the conductor’s patch with active instruments and a loaded collection containing metadata fields and tags. The basic workflow is as follows: the conductor modifies filter settings using the interface elements in the metadata boxes and the All Tags list, selects recipients, and presses the large SEND button in the upper left corner of the patch. Recipients can be selected before or after modifying filter settings; clicking SEND will send whatever filters are visible on screen. Remember that recipients can be selected individually from the Instruments tab, or by group using the Groups tab.

Every SEND message clears previous filter settings. By default, every SEND message also sends a “play” message to all selected instruments currently not playing, meaning that they will begin to play through the newly filtered clips immediately. If you prefer to change filter settings without sending a “play” message immediately, click the Auto-Play On button so that it reads Auto-Play Off. You can send a manual “play” message later using the Mode tab (see section 4.4.1).

There are six different types of filter interfaces, corresponding to the “control” parameter of each metadata field described in section 3.3.5. Each metadata field has one of the following controls:

- rslider: a strictly numeric range-based slider
 - Values between (and including) minimum and maximum are passed through.
 - Values outside of minimum and maximum are rejected.
 - Range can be modified in Review Collection subpatch.
- nslider: a range-based slider with a notation display
 - Values between (and including) minimum and maximum are passed through.
 - Values outside of minimum and maximum are rejected.
- kslider: a one-octave keyboard display
 - Values matching selection are passed through.
 - Values not matching selection are rejected.
 - Multiple selection is permitted (OR logic).
- chooser/statechooser: a list display permitting multiple item selection
 - Values matching selection are passed through.
 - Values not matching selection are rejected.
 - Multiple selection is permitted (OR logic).
 - Difference is on composer's side: chooser is defined by (potentially) unique contents with each clip; statechooser is defined by selected state amongst several which are consistent from clip to clip.
- keycontrols: a compound control for key-like metadata
 - Contains two multiple-selection list displays (for identifiers and types) and a slider for the strength of fit value.
 - Values matching all three elements of the control are passed through.
 - Values not matching any of the three elements are rejected.
 - Strength of fit slider passes through only values **higher** than slider setting. To effectively bypass strength of fit, leave slider at zero.

Upon sending filter settings, the Current Settings on the right side of the Instruments tab will display the active filters (and the list of clips that match those filters) for the currently selected instrument. To clear all metadata and tag filters for the selected instruments, click the Clear button in the Instruments tab. To clear all metadata and tag filters for all instruments, click the Clear Filters and Tags button in the control buttons column on the left side of the patch. To hide all filters

from the display in the patch, click Hide All Filters. This can be used to avoid the metadata filtering system entirely if you only want to work with tags, for instance.

The conductor filters for tags by using the All Tags list in the upper right. For multiple selection, use command/control or shift. To bypass the filter, select AnyTag. Note that the multiple selection rule can be changed using the dropdown menu below the list: if AND is selected only clips that are associated with all tags selected will be passed through (more restrictive); if OR is selected clips that are associated with any of the tags selected will be passed through (less restrictive).

Overly restrictive filter settings can sometimes exclude all clips in a collection. How the system deals with this situation can be defined by the conductor, and even automated (see section 4.2.3).

4.4 Sending Messages to Performers

In addition to the basic filtering system, there are a number of other messages a conductor may send during a performance, including mode, dynamics, and instant (text) messaging. All messages are sent to performers using the same recipient selection system as the filters and tags (i.e. via the Instruments or Groups tab).

4.4.1 Mode

There are three modes to which a performer can be assigned during a performance: play, tacet, and improvise. Play mode is the usual mode of operation, in which clips are automatically cycled through the performer's display. Tacet clears the notation display and produces a "TACET" message to the performer. Improvise clears to notation display and produces an "IMPROVISE" message to the performer. Conductors who wish to use the improvise message are encouraged to discuss how to interpret this instruction with performers during the rehearsal process.

Mode messages can be accessed in the Mode tab. To change mode, select recipients (using the Instruments or Groups tab) and use one of the buttons in the left column of the Mode tab. Any button with "Immediately" causes a mode change immediately. Any button with "After Current Clip" causes a mode change after the countdown for the currently-displayed clip runs out for each performer. Consequently, the timing of this change will be slightly different for each performer. The Play button is a way of restarting after tacet or improvise; performers must have already been assigned a clip list.

Two secondary mode controls can also be accessed through the Mode tab. The first is Clip Density, which determines the amount of time between clips, in seconds. Use the slider to set the minimum and maximum time between clips; between each pair of clips a random value in this range will be chosen and added to the countdown duration. The second control is Tempo, which sets the local tempo for the performer. The tempo can be different for each performer. Note that there is no common downbeat even if the tempo is set to be the same for all performers; however, in rehearsal the conductor can encourage performers to synchronize their pulse by ear if this effect is desired. For tempo-sensitive clips (see section 3.3.2), changes in tempo affect the display length in the Performer's Patch.

The current mode of the last-selected instrument is displayed under Current Mode. Note that instruments with "after current clip" changes may continue to play for a few seconds even after the mode change is displayed here for the reasons described above.

4.4.2 Dynamics

The Dynamics tab allows the conductor to send dynamics and expression-related messages to performers. As with the Mode tab, performers should be selected first using the Instruments or Groups tabs, and then any changes made in the Dynamics tab are immediately passed through.

There are five distinct boxes for sending, viewing, and customizing different kinds of messages:

- **Set Dynamic Level:** Send a fixed dynamic level from ppp to fff. This dynamic level is displayed to the performer whenever they are in play or improvise mode.
- **Create Hairpin:** Create a timed hairpin from the current dynamic to the target dynamic. Set the target and time first, then click Start Hairpin to begin. Hairpins conclude by switching to the target dynamic as a fixed level.
- **Expressive Quality:** Send expressive text to the performer. This information is displayed alongside the current dynamic in the Performer's Patch.
- **Current Dynamics:** This box lists all of the current dynamic and expressive information for the last-selected instrument. It updates in real time to show the countdown of timed hairpins.

- **Add Custom Quality:** This interface allows you to create custom expressive text. Type in your text (space are OK, but not too long) and click Add. You can save your custom text with the conductor settings file by clicking Save. To restore defaults, click Restore Defaults.

4.4.3 Messaging

The messaging window allows the conductor to send instant text messages to performers through the Indra system. Recipients are selected using the Instruments or Groups tabs, as with all other messaging. Type your message in the box and click Send. A record of past messages is stored in the large central box. If you want to recall a previous message that is cutoff beyond the edge of the box, click on the message in the central box to view it in the lower box.

It is best practice to limit each message to about 50 characters. More than that requires the recipient to scroll, which takes time. You should never send a message of more than 200 characters. Due to formatting limitations, do not send messages that include commas, and do not send messages that comprise **only** a number (integer or float).

4.5 Advanced Configuration Options

In most contexts, it is not necessary to change the default configuration options or workflow. However, Indra contains tools for making these changes when necessary:

- **Changing the UDP Receiving Port:** Indra uses UDP (user datagram protocol) to send messages across the network. UDP requires establishing a receiving port on the network. By default, the conductor's receiving port is set to 7410, which should work fine on most computers. If this port is in use on your device, you can switch ports: in the Config tab, click the Port 7410 box and type a new number (try numbers in the range 7401-7410). Note that if you change the port, you must announce yourself over the network again by clicking Start (and all performers must announce themselves again as well).
- **Customizing Recipient Settings:** In most cases, the performers provide all of the necessary recipient information for a performance. However, in some cases the conductor may wish to customize this information by renaming the recipient, changing the instrument class, or modifying the range or

transposition of an instrument. To make these changes, open the Config tab and click on More Options. **For testing purposes only**, you can also (1) activate and deactivate instruments (equivalent to performers “announcing” themselves during rehearsal or performance), and (2) manually create new recipient entries.

5. The Performer

5.1 Getting Started

When the performer opens the Performer's Patch, they are first greeted by a welcome message, laying out two different modes of operation. If the performer is practicing on their own, they should select Practice Mode in the lower left corner. If they are joining a performance or rehearsal, they should enter their name and instrument (the information that will identify them on the network) and click **Announce** **after** the conductor has announced themselves. (The performer can also modify their UDP receiving port at this point, but this should rarely be necessary; see section 4.5).

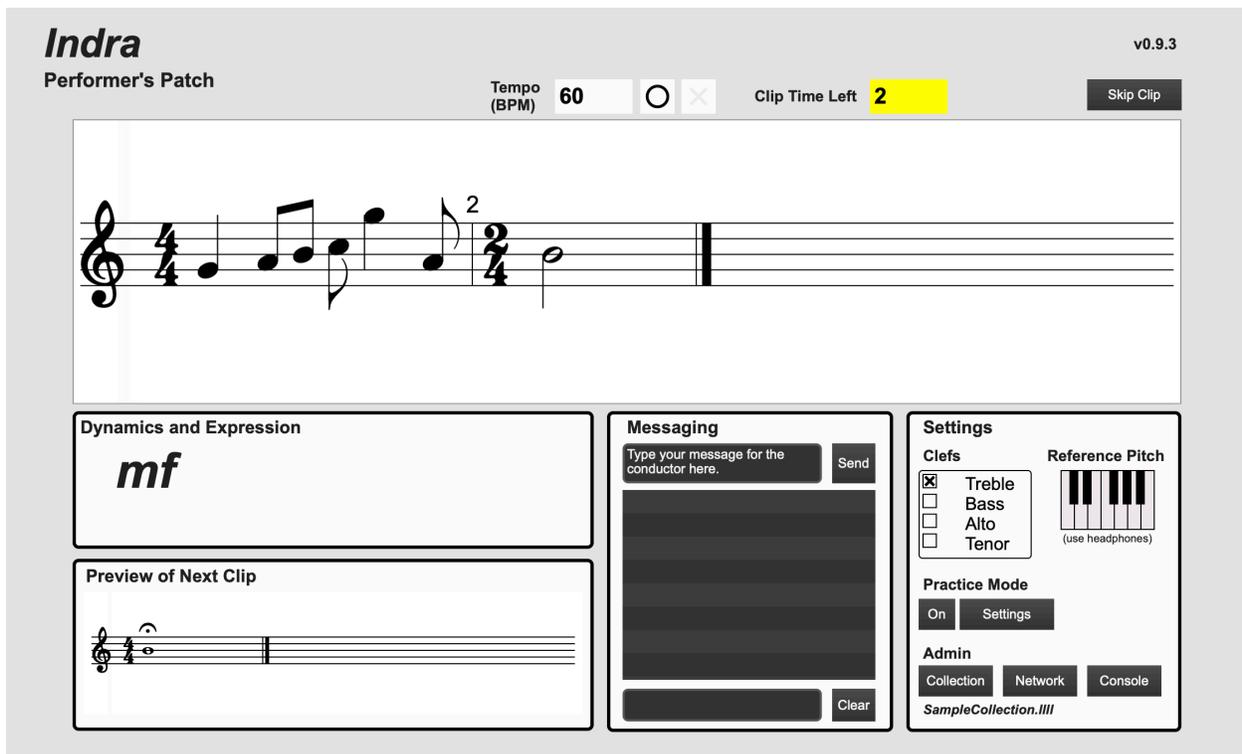
If they are joining the network, after clicking **Announce** they should receive a message indicating that they have successfully joined. This message includes a **Load Collection** button that they should click on to load the appropriate collection for the performance. Once the collection is loaded, the performer is ready to begin.

If the performer is practicing on their own, there are a couple of additional steps. The performer will see a subsequent window labeled Practice Mode with several buttons and options. They should begin by loading the appropriate collection file. Next, the performer should select their transposition, if applicable. The number represents the number of half steps to shift from sounding pitch to written pitch. For example, for trumpet in B-flat written two half steps above sounding pitch, the transposition number should be 2. For piccolo, written one octave above sounding pitch, the transposition should be -12. For non-transposing instruments, enter zero. Image-based clips cannot be transposed.

The performer may wish to filter the clips they see from the collection, given that many of the clips might be intended for other instruments. How the composer structures the collection will largely determine which option the performer chooses here. Clips can be filtered either by range or by instrument tags. The range can be set by choosing an instrument from the instrument list, or by dragging the blue instrument range slider, and clicking **Filter by Range**. If the composer has used instrument tags in the collection, simply select the appropriate tag and click **Filter by Tags**. To bypass filtering altogether, click **No Filter**.

5.2 Interface Overview

Regardless of the selections the performer makes in the windows described above, the interface that appears is identical.



The top half of the screen gives the current notation display. Note that the dimensions of this box are identical to the dimensions of the box in the Composer's Patch, allowing the composer to preview precisely what the performer will see. Just above the notation display is the current tempo and a countdown that indicates how much longer the current clip will be displayed on the screen. The countdown will flash green once when a new clip is loaded, and blink yellow repeatedly when two or fewer seconds remain. The lower half of the screen contains several smaller boxes which display current dynamics and expression, instant messaging, settings, and a preview of the next clip.

The Performer's Patch is designed for a smooth workflow that requires very little intervention from the performer, since they will generally be busy playing! The notation display, dynamics box, and preview box are all read-only. The messaging box allows the performer to send messages to the conductor (see section 4.4.3). The settings box provides the performer with a few different options:

- Clefs: The performer may select which clefs to use for future notation-based clips by checking or unchecking the boxes at left. By clicking on the name of the clef, the performer may switch the currently-displayed clef.
- Reference Pitch: The performer (especially singers) may generate a MIDI reference tone by clicking a key on the piano interface. The performer should use headphones if planning to utilize this feature.
- Practice Mode: These buttons allow the performer to turn practice mode on or off at any time, and also to adjust the filtering and transposition settings described in section 5.1.
- Admin: The Collection button allows the performer to load a new collection. The Network button allows the performer to announce themselves over the network, change their identifying information, or change their receiving port, as described in section 5.1. The Console button can be used for troubleshooting, displaying all incoming messages in the Max console.

Two other controls are available to the performer:

- Tempo Indicator: The toggle box to the right of the BPM display turns a light on and off that flashes (silently) at the current tempo. Note that this is for reference only, and is not linked to a common pulse across the ensemble.
- Skip Clip: The Skip Clip button, located in the upper right corner, allows the performer to skip a clip at any time. If a performer finds themselves using this button often because clips are out of their range or appear intended for other instruments, they should let the conductor know.

6. Performing with Indra

This section of the manual is intended to guide participants through the process of putting together a performance with Indra. See previous sections for references to specific tasks and functions.

6.1 Building the Collection

The first step is for the composer to assemble a collection. This requires a fair amount of planning, especially regarding how flexibly the collection should be designed: Is this collection intended for a particular ensemble, or is the instrumentation flexible? What proportion of the clips are specific to particular instruments, and what proportion can be shared? Will images or notation be used? What metadata fields and/or tags will be used? Which fields and tags will be most helpful in performance? What role will pulse and/or tempo play in the musical language?

Questions like these can be addressed in various ways as described elsewhere in the manual. If the composer and conductor are two separate individuals, they should discuss many of these decisions together. In many cases, understanding the composer's intention helps the conductor lead rehearsals more effectively and efficiently.

6.2 Preparing for the First Rehearsal

In advance of the first rehearsal, the conductor should help ensemble members sort out technical issues: each member should identify the device they will use and have Max downloaded. Each member will also have to follow the instructions for setting up Indra and accessing the appropriate collection file(s), which should be provided by the conductor or composer (see section 2).

Finally, the conductor or composer should indicate to performers how to practice using the software. If they have included instrument tags, they should tell performers to select that option from the filter settings when practicing (see section 5.1). If they have not, they should indicate to performers if and how to set their filter settings (again, for practice mode only). Ideally, performers will arrive at the first rehearsal having successfully installed the software, loaded the collection, and practiced reading from the interface.

The conductor should also ensure that the rehearsal and performance spaces have a wireless network that can be used for the performance. The network does not have to be connected to the internet. If there is no network available, the conductor can use a router without a modem (i.e. without an internet connection) to establish a temporary network.

6.3 The Rehearsal Process

Just before the first rehearsal, the conductor should spend some time with the software and the particular collection to ensure that they have the appropriate settings in place:

1. The conductor should review the Performance Settings and make sure that any instrument-based filtering is in place (whether by range or instrument tag).
2. The conductor should add any custom expressive text using the Dynamics tab.
3. The conductor should review the collection itself to get a sense of what filters, tags, and combinations thereof will be most effective and interesting.
4. For advanced users only: normally instruments will only be logged in the conductor settings file after they first announce themselves (i.e. after the first rehearsal). However, if you use the manual new entry function you can log the instruments manually, and as long as the information provided by the performers in rehearsal matches, you can customize instruments' settings and groupings in advance. Otherwise, this must be done after (or during) the first rehearsal.
5. All of these settings can be saved to the conductor settings file.

At the beginning of the first rehearsal, each performer should be instructed to turn on their device and load the software. The conductor clicks Start in the Config tab, and then signals to the performers that they can each click Announce. Performers receive confirmation that they have joined the network in the form of a pop-up window; the conductor will see the list of performers populate on their screen.

This connection process must take place at the beginning of each rehearsal or performance. The conductor may wish to devise a signal indicating when performers may click Announce, such as a thumbs-up, etc. In order to lead rehearsals effectively, the conductor must be familiar with the networking process, and be prepared to troubleshoot in the moment by offering suggestions, such as changing the UDP port, or starting the announcement process over again. See sections 4.5 and 5.1 for more.

It is best to start making music as soon as possible in the rehearsal process, rather than beginning with a long exposition of information. The conductor is advised to begin without using filters or tags: simply select all of the performers as recipients and click Clear Filters and Tags. This will allow everyone to start getting used to performing with Indra.

Further layers can be introduced slowly. For example, once everyone is comfortable playing together, the conductor can introduce mode changes or dynamic changes. The conductor should be sure to field questions from performers before the introduction of each new layer. Although the conductor will undoubtedly want to experiment with different filter settings and instrumental groupings, they are advised to spend the first rehearsal focusing on the entire group as much as possible so as to get everyone comfortable.

In subsequent rehearsals, the conductor can explore novel ways through the collection, including more intricate filter settings and instrumental groupings. The conductor may also wish to “test” certain patterns or sequences of messages; this kind of “testing” should only be undertaken once the performers are comfortable with the basics. As in the early stages, the conductor should always be prepared to field technical and interpretive questions.

In the final rehearsal before the first performance, the conductor and ensemble should discuss on-stage etiquette related to starting up the software and connecting to the network. This will depend on the size of the ensemble, the general comfort level, the devices being used, the position in the program, and the layout on stage, among other factors. The startup process should be choreographed to the extent possible—signals should be devised for the various stages, such as when performers can announce themselves, or if a performer is having trouble connecting.

6.4 The First Performance and Beyond

The logistics of first performance should be carefully worked out in advance, as described above. The nature of the first performance, however, should be approached creatively. Indra is fundamentally improvisatory and indeterminate, and there are various ways of emphasizing this fact through performance. For example, several conductors could lead successive performances through the same collection. Likewise, the collection used might be linked to another (fully-scored) composition on the program in the spirit of a live remix. Collections may even be

derived from well-known historical works to emphasize the improvisatory creativity of the conductor and ensemble in real time.

These considerations hold for subsequent performances as well. Multiple performances of the same collection—whether conducted by the same individual or not—inevitably result in vastly different musical experiences.

7. Troubleshooting

If you encounter an issue or bug, send it in: [indra \[at\] drakeandersen.com](mailto:indra@drakeandersen.com)

7.1 Common Issues

- **I get an error when I try to load the patch.** If a file cannot be opened because it is from an “unidentified developer,” try right-clicking on the file and clicking “Open” (instead of just double-clicking). If macOS marks any files as “quarantined,” choose the option to allow Mac to try to solve the problem and select “Apply to all.”
- **There are no metadata fields listed in the Conductor’s Patch.** You have to load a collection first, and the active metadata fields for that collection will appear.
- **Images don’t appear after being imported.** Make sure the directory where Indra is saved has been added to the Max File Preferences (Options → File Preferences).
- **I moved Indra to a different folder or subfolder, and now I see error messages and/or the patch doesn’t load correctly.** If you change the folder where Indra is stored—including moving it to a different subfolder—you may have to delete the folder entry in File Preferences and add it again (or uncheck and check the “subfolders” box).
- **The conductor and performers are having trouble connecting over the network.** Try restarting the Announce process and changing the port numbers being used. You may have better luck when the network is not connected to the internet (for the technically minded, this has to do with a static vs. dynamic IP address). See sections 4.5, 5.1, and 7.3.
- **The notation display looks wrong or doesn’t load.** When you first install the bach package, the fonts don’t always load right away. If the notation doesn’t appear correctly (e.g. as orange rectangles with diagonal lines), just close Max and restart it.
- **The notation display doesn’t support certain notation features.** Currently slurs and multiple staves per clip are not supported in the bach objects. See

section 3.2.5 for a summary of current limitations. As an alternative, you can use image files for certain clips.

7.2 Known Bugs

- Instant messages that are just a number (integer or float) are not currently supported (Conductor's and Performer's Patch). Messages must include alphabetical characters. Messages also may not contain commas.
- User may see an error in the console upon loading Composer's or Conductor's Patch related to [dada.cartesian] object. Error may repeat until collection is loaded. This error does not affect functioning.

7.3 Network Troubleshooting Flowchart

This page is intended to guide conductors and performers in resolving network issues during rehearsal or performance. The relevant section (§) of the User Manual is included in parentheses when appropriate.

When You...

...Make Sure You...

- Connect to Wifi/LAN

- Are connected to the same network (§4.2)
(Your network does not have to be connected to the Internet. In fact, you may experience better performance if your router is not connected.)

- Start up Max

- Download and installed the latest version of Max and the latest version of each of the packages (§2)
(You do not need a Max license to run Indra)

- Download and install Indra

- Unzip the ZIP file (§2)
- Added the Indra folder to the Max File Preferences (§2)
(The conductor may ask performers to download Indra directly or provide a specific installation package with a collection as a ZIP file)

- Download the collection to play

- Saved the *.llll file in the Indra folder (§4.2.1 and §5.1)
- Saved all images in the /images subfolder
(The conductor may distribute the collection as part of the Indra installation; if so, performers do not need to download the collection separately)

- From here, the conductor and performers open their patches and connect over the network
- First, the conductor clicks Start in the Config tab
- Then performers can join by entering their information and clicking Announce
- When this doesn't work, you can try the following:

- Change the performers' port number (§4.5 and §5.1)
- Occasionally, performers may have to click Announce twice.

- Test whether messages are reaching the performer by having them turn on Console mode (§5.2). All incoming data will appear in the performer's console.