

# **UNIX Tools for Musical Research**

## **The Humdrum Toolkit**



### **REFERENCE MANUAL**



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Additional programming was done by Keith  
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manual was written by David Huron.

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## *Preface*

As a music scholar, I have long appreciated the gains in personal productivity that are possible through the judicious use of computer technology. At the same time I've come to recognize that computers are inherently interesting objects, and that there is always the danger of finding the technology more interesting than the musical problems. While musicological problems are often elusive and enigmatic, software programming can offer the quick rewards of linear thinking and the illusion of boundless power. For this reason, I am wary of computer expertise *per se*. My hope is that this manual testifies, not to a compelling interest in computers, but to a more abiding interest in understanding music.

The mindless tasks that often dominate scholarly projects can be powerful deterrents for those contemplating research. Seeing other scholars discouraged by such mindlessness has encouraged me to share my own research tools with the wider scholarly community. The distribution of this software is accompanied, however, by some trepidation. Any set of tools requires the development of a concomitant expertise, and the Humdrum Toolkit is no exception. It is my hope that the investment of time required to learn how to use Humdrum will be more than offset by the subsequent scholarly gains. Regrettably, not all Humdrum users may have this experience.

The Humdrum Toolkit remains a work in progress. As will become evident, the very structure of Humdrum invites users to intervene, augment, re-define, throw-away, and otherwise tinker. Users are encouraged to formulate their own representation schemes and to create their own task-specific software tools — as appropriate. In the case of predefined Humdrum representations, comments, criticisms, and suggests for improvement are most welcome.

A number of individuals have contributed directly or indirectly to the creation of the Humdrum Toolkit. I am deeply indebted to my supporters and collaborators, and take pleasure in voicing my public thanks.

Research assistants Tim Racinsky and Kyle Dawkins have been indispensable in bringing Release 1.0 to completion. Tim Racinsky revised nearly all of my original code and programmed innumerable new tools as well. I have especially valued Tim's cautious skepticism and his relentless pursuit of design inconsistencies and bugs. Kyle Dawkins wrote all of the MIDI-related code and also handled system administration. Through his musical savvy and high energy, Kyle contributed significantly to the excitement of the project.

In addition, several other individuals have contributed by volunteer efforts to this project. Dr. Gregory Sandell kindly agreed to include his library of spectral analyses of instrument tones in this release. Keith Orpen implemented the Damerou-Levenshtein metric used in the program for measuring non-parametric similarity. Keith Mashinter contributed the Kameoka and Kuriyagawa dissonance tool. Jasba Simpson co-authored the implementation of the modified Johnson-Laird syncopation algorithm. Andreas Kornstaedt helped with portability problems. Simon Clift programmed some exploratory routines that helped clarify the feasibility (and infeasibility) of certain tools.

Timothy Prime and Maki Ishizaki volunteered their time to test several of the tools and critique parts of the accompanying documentation. Sandra Serafini put the toolkit through its paces while pursuing her undergraduate thesis on Haydn string quartets. Stephen Bondy

suggested useful modifications to the representation for fretted instruments.

Randall Howard, President of Mortice Kern Systems, provided valuable professional advice on software testing and project organization. In addition, Mortice Kern Systems donated critical development and documentation software that saved a great deal of time. I am also indebted to Dr. Walter Hewlett and Dr. Eleanor Selfridge-Field of the Center for Computer Assisted Research in the Humanities for their professional support and encouragement.

Finally, I would like to thank the Social Sciences and Humanities Research Council of Canada for providing funding to assist in the release of this software to the scholarly community.

David Huron  
1994 August  
Waterloo, Ontario

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# Reference Manual

## Introduction

The Humdrum Toolkit provides a set of inter-related software tools intended to assist in music research. The toolkit is suitable for use in a wide variety of computer-based musical investigations. The toolkit is less well suited to creative (i.e. generative) musical tasks — such as electroacoustic composition.

## Organization of Reference Information

This *Reference Manual* describes all of the individual components included in Release 1.0 of the Humdrum Toolkit. Technical descriptions are given of representation formats, file organizations, command invocations, options, and other information. The *Reference Manual* is divided into seven numbered sections:

Section 1	<i>General Introduction</i>
Section 2	<i>Representation Reference</i>
Section 3	<i>Tandem Interpretation Reference</i>
Section 4	<i>Command Reference</i>
Section 5	<i>Special Files</i>
Section 6	<i>Regular Expressions</i>
Section 7	<i>Developer's Reference</i>

Note that numbers identifying each section are given in parentheses in the upper corner of each manual page.

**Section 1** (*General Introduction*) provides an overview of Humdrum. This section describes the structural and syntactical elements of Humdrum representations. It also describes the means by which essential bibliographic and reference information is encoded in Humdrum electronic documents.

**Section 2** (*Representation Reference*) describes many of the representation schemes currently defined within Humdrum. These schemes include ways of representing period-of-common practice Western music, ways of representing time, pitch, dynamics, tablatures, pitch intervals, functional harmony, embellishment tones, MIDI data, and innumerable other types of music-related information. Note that users are free to define additional or alternative representations that may be better suited to a given application (see Section 7).

**Section 3** (*Tandem Interpretation Reference*) describes special-purpose methods for representing various global musical attributes — such as tuning, temperament, instrumentation, transpositions, languages, Da Capo structures, and other general types of information.

**Section 4** (*Command Reference*) describes the individual commands contained in Release 1.0 of the Humdrum Toolkit. The majority of these commands accept some sort of musically-pertinent input, and transform this input representation into some other musically-pertinent output representation. Other commands manipulate or modify a given input without changing the form

or type of representation.

**Section 5** (*Special Files*) describes special files that are created or required by various Humdrum commands.

**Section 6** (*Regular Expressions*) describes a common syntax by which complex patterns may be defined. Many of the Humdrum commands rely on regular expressions as a means by which the user can specify some sought pattern. The greater the user's familiarity with regular expression syntax, the more powerful the potential effect of various Humdrum commands.

**Section 7** (*Development Reference*) describes how to tailor and augment Humdrum in order to serve specialized research needs. Humdrum defines a format within which an unbounded number of musically-pertinent symbol systems can be defined. Users are thus free to design additional (or alternative) Humdrum representation schemes that are better suited to a given research goal. This section also describes how to write Humdrum compatible software.

## Commands and Representations

Several of the entries in different sections of the *Reference Manual* have similar titles — and this can lead to some initial confusion. For example, one entry in Section 2 of the manual is entitled **\*\*semits**, whereas a separate entry in Section 4 is entitled **semits**. The first entry describes a *representation* format for encoding data pertaining to semitone pitch information. By contrast, the entry in Section 4 (*Command Reference*) describes an executable command named **semits**. The **semits** command is able to translate many other types of data into semitone format.

By way of summary, Section 2 describes a set of “objects” or “nouns,” whereas Section 4 of the manual describes a set of “actions” or “verbs.” In practice, there should be little confusion. The names of Humdrum representations are always designated by two leading asterisks: hence **\*\*solfg** is a data format, whereas **solfg** is the name of a command. In Humdrum, many commands are named according to the type of outputs they produce. So a command named **freq** has a good chance of producing **\*\*freq** as output (although there are some exceptions to this convention).

## Documentation Style

Each of the seven sections of the *Reference Manual* begins with a separate introduction describing how the entries within the section are organized. This introductory information outlines the conventions and abbreviations used in the corresponding section of the documentation. The manual entries themselves include a variety of examples that users may find helpful.

The power of the Humdrum Toolkit lies not in the individual commands, but in how these commands can be made to interact. In order to become a proficient user, frequent browsing through the *Reference Manual* is recommended. Even commands that are quite familiar to a user, will often provide options whose utility becomes evident only with experience.