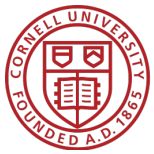
SPOKEN LANGUAGE ACCENT DETECTION

Probabilistic Accent Detection Using Hidden Markov Models

Tre Calhoun
La Vesha Parker
Andrew Vaslas
Nicolas Vera
Cornell University



Cornell University

CONTENTS

PREFACE

All information presented within this document represents our exploration of the HTK software. We make no guarantee of things things things

INTRODUCTION

This is the introduction. This is the introduction. This is the introduction. This is the introduction. This is the introduction. This is the introduction.

REFERENCES

[1] J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices,* **ED-23,** 648 (1976).

[2] R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.

[3] J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.,* **EDL-7**(3). 152 (1986).

PART I

HIDDEN MARKOV MODEL TOOLKIT SOFTWARE SUITE

CHAPTER 1

INSTALLATION OF HTK SOFTWARE

1.1 General Installation information

The website for HTK can be found here. The HTK developers require that you register for a username and password through their site before downloading their software. After registering, visit the downloads page and download the HTK source code (available as a tarball). It is also useful to download the HTKBook as a PDF (available on the downloads page below the software). If you do not wish to download the book, you can view the book online after registering.

1.2 Mac OS X

In order to install HTK for Mac OS X, you first need to make sure that you have Xcode developer tools and X11 installed.

What follows are the installation instructions taken *directly from the README in the root directory of the unziped htk/ directory*, save a bit of formatting. We do not claim this work, and repeat it here only for convenience.

1.2.0.1 Compiling & Installing HTK under UNIX/Linux, OS X or Cygwin

After unpacking the sources, cd to the htk directory.

There are now two ways to install HTK, the ”traditional” and the ”new”. Up to now HTK has always installed its tools as they were built, and installed them to a directory such as ”bin.linux” so that binaries for different architectures can be installed in a home directory say. If you want to install in this way, please add the option ”–enable-trad-htk” when you run configure.

The ”new” method installs by default into /usr/local/bin (equivalent to a configure option of ”–prefix=/usr/local”).

1. decide which of the above methods you wish to use
2. cd to htk, then run ./configure (with appropriate options, run ”./configure –help” if unsure). If you don’t want to build the programs in HLMTools add the –disable-hlmtools option.
3. make all
4. make install

Running ”make install” will install them. This step may need to be done as root, if you are not installing them in your home directory.

Notes for particular Unix variants:
Solaris: if ”make” isn’t installed you may need to add /opt/sfw/bin and /usr/ccs/bin to your path and run ”./configure MAKE=gmake” with any other options you require. Then run ”gmake” instead of ”make”, alternatively you can create a symbolic link called ”make” somewhere it your path to /opt/sfw/bin/gmake

1.3 Windows

Once again, what follows are the installation instructions taken *directly from the README in the root directory of the unziped htk/ directory*, save a bit of formatting. We do not claim this work, and repeat it here only for convenience.

1.3.0.2 Compiling & Installing HTK under Windows

Prerequisites:

- HTK has been verified to compile using Microsoft Visual Studio.
- For testing, you will require a Perl interpreter such as ActivePerl.
- You will need a tool such as 7-zip or winzip (commercial) for unpacking the HTK source code archive.
- It it is helpful if you have some familiarity with using the DOS command line interface, as you will need to interact with it in order to compile, install and run HTK.
- Ensure that your PATH contains:

```
C:\Program Files\Microsoft Visual Studio .NET 2003\Vc7\bin
```

Or if you are using older versions:

```
C:\Program Files\Microsoft Visual Studio\VC98\bin
```

Compilation:

1. Unpack the HTK sources using 7-zip.
2. Open a DOS command window: Click Start, select Run type cmd at the prompt and click OK.
3. cd into the directory in which you unpacked the sources.
4. cd into the htk directory. Type:

```
cd htk
```

5. Create a directory for the library and tools. Type:

```
mkdir bin.win32
```

6. Run VCVARS32 (it should be in your path, see prerequisites above) 7. Build the HTK Library, which provides the common functionality used by the HTK Tools. Enter the following commands:

```
cd HTKLib
nmake /f htk_htklib_nt.mkf all
cd ..
```

8. Build the HTK Tools

```
cd HTKTools
nmake /f htk_htktools_nt.mkf all
cd ..
cd HLMLib
nmake /f htk_hlmlib_nt.mkf all
cd ..
cd HLMTools
nmake /f htk_hlmtools_nt.mkf all
cd ..
```

Installation:

The HTK tools have now been built and are in the bin.win32 directory. You should add this directory to your PATH, so that you can run them easily from the command line in future.

CHAPTER 2

TRAINING CORPUS ACQUISITION

CHAPTER 3

TRAINING CORPUS WITH HTK

> The sheer volumne of answers can often stifle insight...The purpose of computing is insight, not numbers.
>
> —Hamming [2]

3.1 Record or Input Sound Files

Here is some text.

3.2 Labeling the Sound Files

Here are some things you can do for a special section head.

3.3 General Remarks

Here is some normal text. Here is some normal text. Here is some normal text.

CHAPTER 4

CODING THE DATA

4.1 Mel Frequency Cepstral Coefficients

Here we describe what a MFCC is and its usefulness to us.

4.2 Obtaining .mfcc Files

4.2.1 Configuration File

Screenshot of the configuration file along with justification of the various parameters

4.2.2 Command Line Actions

4.2.2.1 The Creation of targetlist.txt

CHAPTER 5

SETTING PARAMETERS FOR THE HIDDEN MARKOV MODEL

Multiple things should happen here:

1. Explain what an HMM is and what it is useful for
2. Explain particularly why it works for what we are doing
3. Describe the input parameters to a hidden markov model
4. Explain why we made any changes to what the original tutorial had/any issues we encountered (i.e. errors being raised when we tried to have too many states due to not having enough training examples for all those states)

I have some sample sections below following the list above:

5.1 What is a Hidden Markov Model?

Here is some sample text.

5.2 HMMs and Accent Detection

Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum

5.3 Input Parameters to HMMs

Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum Lorem ipsum

5.4 Justification for our Modifications

5.5 Summary

This is a summary of this chapter. Here are some references: [1], [4].

REFERENCES

[1] J. S. Kilby, "Invention of the Integrated Circuit," *IEEE Trans. Electron Devices,* **ED-23,** 648 (1976).

[2] R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.

[3] J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.,* **EDL-7**(3). 152 (1986).

[4] A. Berenbaum, B. W. Colbry, D.R. Ditzel, R. D Freeman, and K.J. O'Connor, "A Pipelined 32b Microprocessor with 13 kb of Cache Memory," it Int. Solid State Circuit Conf., Dig. Tech. Pap., p. 34 (1987).

CHAPTER 6

DEFINING THE GRAMMAR OF YOUR NETWORK

CHAPTER 7

TESTING WITH NEW SAMPLES

Corresponds to the Recognition chapter (Moreau ch. 7)

PART II

DATA VISUALIZATION

PART III

ERROR HANDLING AND GENERAL TIPS

APPENDIX A
ERROR HANDLING

This is an appendix with a title.

$$\alpha\beta\Gamma\Delta \tag{A.1}$$

Figure A.1 This is an appendix figure caption.

Table A.1 Appendix table caption

Alpha	Beta	Gamma	Delta
α	β	Γ	Δ

APPENDIX B

SOFTWARE USED

Just list all software used and why we used it

1. Audacity
2. HTK –¿ Maybe even list each of the things we used under HTK & why, i.e. HLab for labeling, HParse for whatever
3. was there anything else?

APPENDIX C

REFERENCES

REFERENCES

[1] Random People, "Hidden Markov Model,"(2014).

[2] R. W. Hamming, *Numerical Methods for Scientists and Engineers*, Chapter N-1, McGraw-Hill, New York, 1962.

[3] J. Lee, K. Mayaram, and C. Hu, "A Theoretical Study of Gate/Drain Offset in LDD MOSFETs" *IEEE Electron Device Lett.,* **EDL-7**(3). 152 (1986).

[4] A. Berenbaum, B. W. Colbry, D.R. Ditzel, R. D Freeman, and K.J. O'Connor, "A Pipelined 32b Microprocessor with 13 kb of Cache Memory," it Int. Solid State Circuit Conf., Dig. Tech. Pap., p. 34 (1987).