ELEN E6820:

Speech and Audio Processing and Recognition

Columbia University Dept. of Electrical Engineering
Spring 2002

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Web site:
http://www.ee.columbia.edu/~dpwe/e6820/

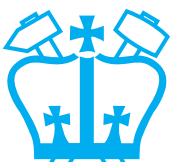
General information

- **Overview:**
  - fundamentals of acoustics & hearing
  - digital audio processing
  - speech recognition
- **Audience:**
  - engineers seeking a foundation for work in speech and audio
- **Course structure:**
  - weekly assignments (25%)
  - midterm exam (25%)
  - final project (50%)
- **Text:**

  Speech and Audio Signal Processing

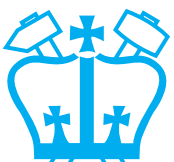
  Ben Gold & Nelson Morgan, Wiley, 2000

  ISBN: 0-471-35154-7



Course outline

- **Fundamentals (4 weeks)**
  - DSP
  - Acoustics
  - Pattern recognition
  - Auditory perception
- **Audio processing (4 weeks)**
  - source and signal modeling
  - music analysis and synthesis
  - psychoacoustic-based audio compression
- **Speech recognition (4 weeks)**
  - acoustic feature vectors
  - modeling temporal structure
  - structure & evaluation of speech recognizers

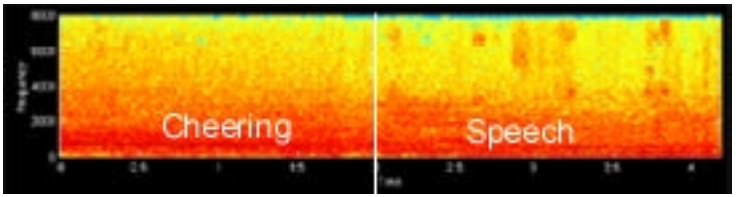


Assignments & Projects

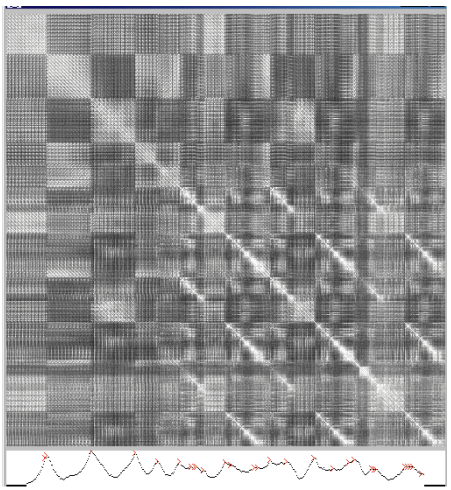
- **Weekly assignments**
  - research papers
  - MATLAB practical
  - written questions
- **Final project**
  - practical investigation into sound processing (MATLAB?)
  - developed in conjunction with professor
  - website/presentation/report

Examples of past projects

- **Detecting sound events in basketball video archive**
  - classifying ‘cheers’ in sport video soundtrack

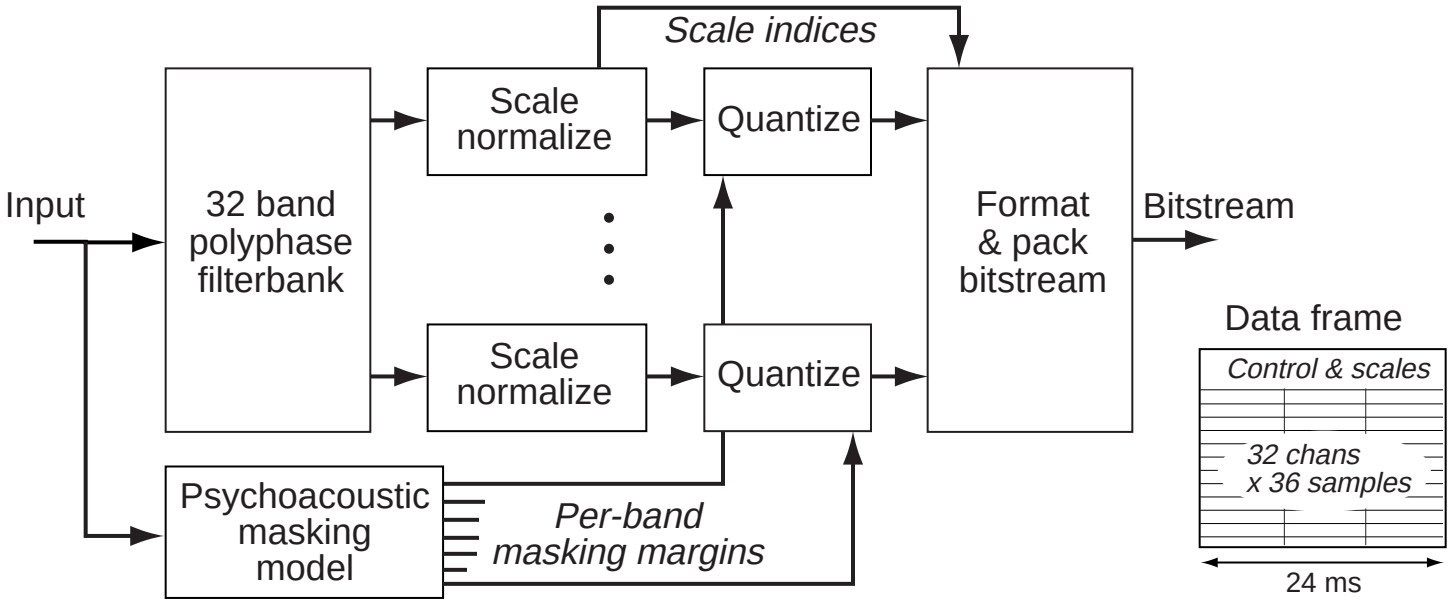


- **The S-Matrix: A novel approach to music segment detection**
  - finding breaks between verse, chorus etc.



Psychoacoustic-based audio compression

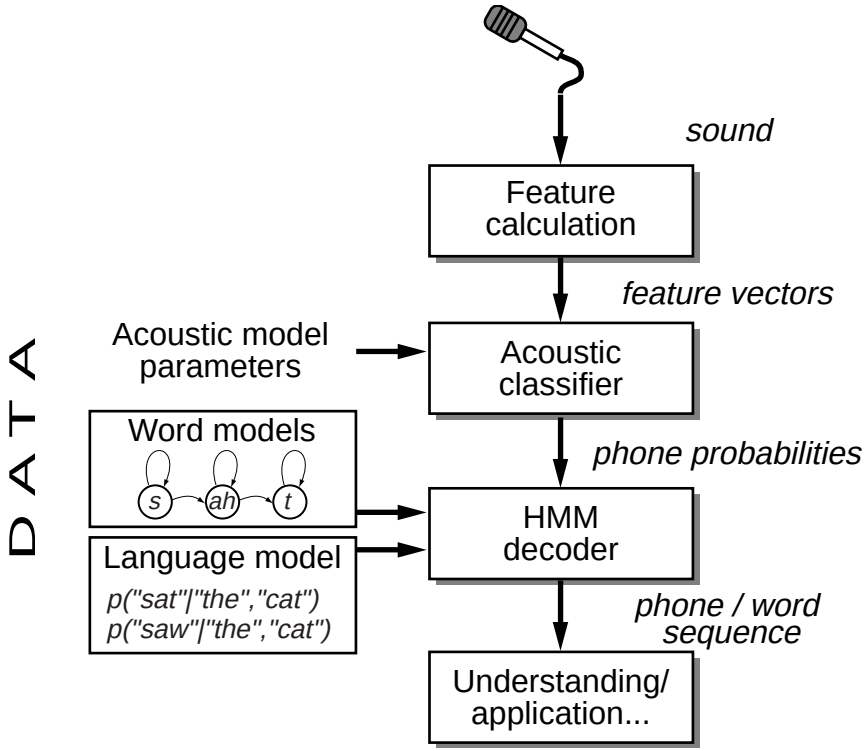
- **Exemplified by MPEG-Audio layer 3 ('MP3')**

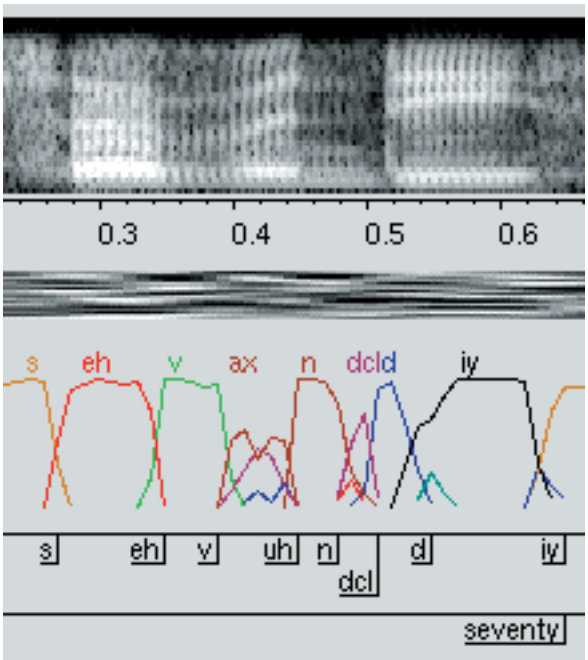


→ **From CD rate (44100 x 2 x 16 = 1.4 Mb/s) to 128 kb/s or less (< 1.5 bits/sample)**

Automatic Speech Recognition (ASR)

- **Standard speech recognition structure:**





- **'State of the art' word-error rates (WERs):**
  - 2% (dictation) - 30% (telephone conversations)