# 1. Introduction to Robot Hearing

1. Why do robots need to hear?
2. Human-robot interaction
3. Auditory scene analysis
4. Audio signal processing in brief
5. Audio processing in the ear
6. Audio processing in the midbrain
7. **Audio processing in the brain**

# Auditory Cortex

The auditory cortex is largely understood today, there are two main hypotheses:

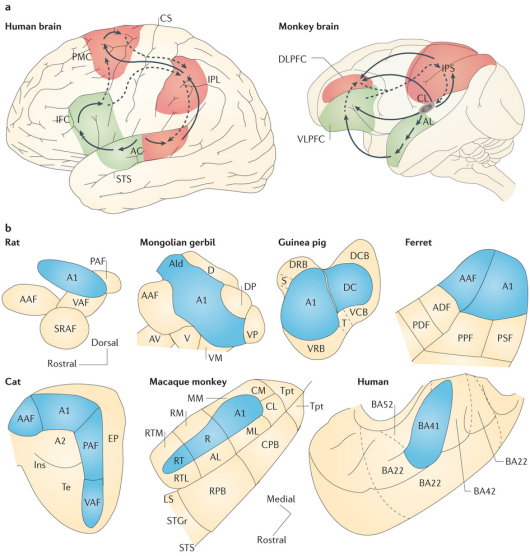
- There are two pathways, with a division of labor between spatial and non-spatial processing
- Dynamically organized processing networks are likely to support auditory perception.

The first hypothesis is supported by functional imaging (humans) and single-neuron physiological studies (non-human animals)

# Auditory Streams in the Cortex

- Dorsal stream (red) analyze space and motion.
- Ventral stream (green) involved in auditory-object perception.
- Core regions (blue) of the auditory cortex for different species.

# Auditory Areas

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# Session Summary

- Division of labor: where and what pathways
- Dorsal and ventral streams
- The auditory cortex varies from species to species

# Week Summary (I)

- It is necessary to augment physical interactions between robots and their environment with cognitive interactions between robots and people.
- Human-robot interaction (HRI) is more general and more difficult than human-computer interaction
- HRI goes well beyond speech processing/recognition, it needs auditory scene analysis
- Binaural hearing allows rich interactions based on acoustic wave processing and understanding

# Week Summary (II)

- All animals (fish, frogs, reptiles, owls, bats, cats, monkeys, humans) have two ears...
- The anatomy/physiology of the ear is well understood... more than just a *microphone*.
- The midbrain plays a crucial role in spatial hearing, a simple physiological model for ITD/ILD processing is available.
- The auditory cortex processes in parallel two flow of information: where and what
- Biological models for the analysis of complex auditory information are not yet available.