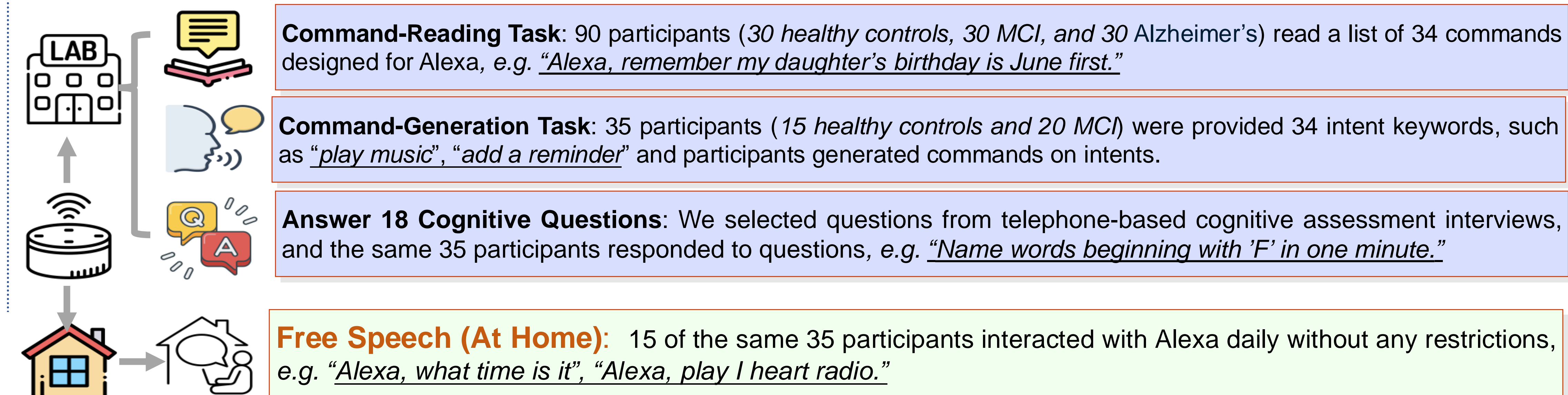


- Mild Cognitive Impairment (MCI) is an intermediate stage between normal cognition and dementia.
- Speech-based diagnosis of MCI is low-cost and non-invasive.
- We employ voice assistant systems (VAS), **Amazon Alexa**, to passively collect speech data from the elderly (Age > 65).
- We propose **Cog-TiPRO**, the LLM-driven framework to study voice commands for long-term monitoring of cognitive decline.

Collect Data via Voice Assistant Systems

Collect speech session data at **three-month intervals over 18 months (2022–2024)** with MoCA clinical test scores.
Two approaches: **In-lab vs. At-home sessions.**



Detect Cognitive Decline via Cog-TiPRO Framework

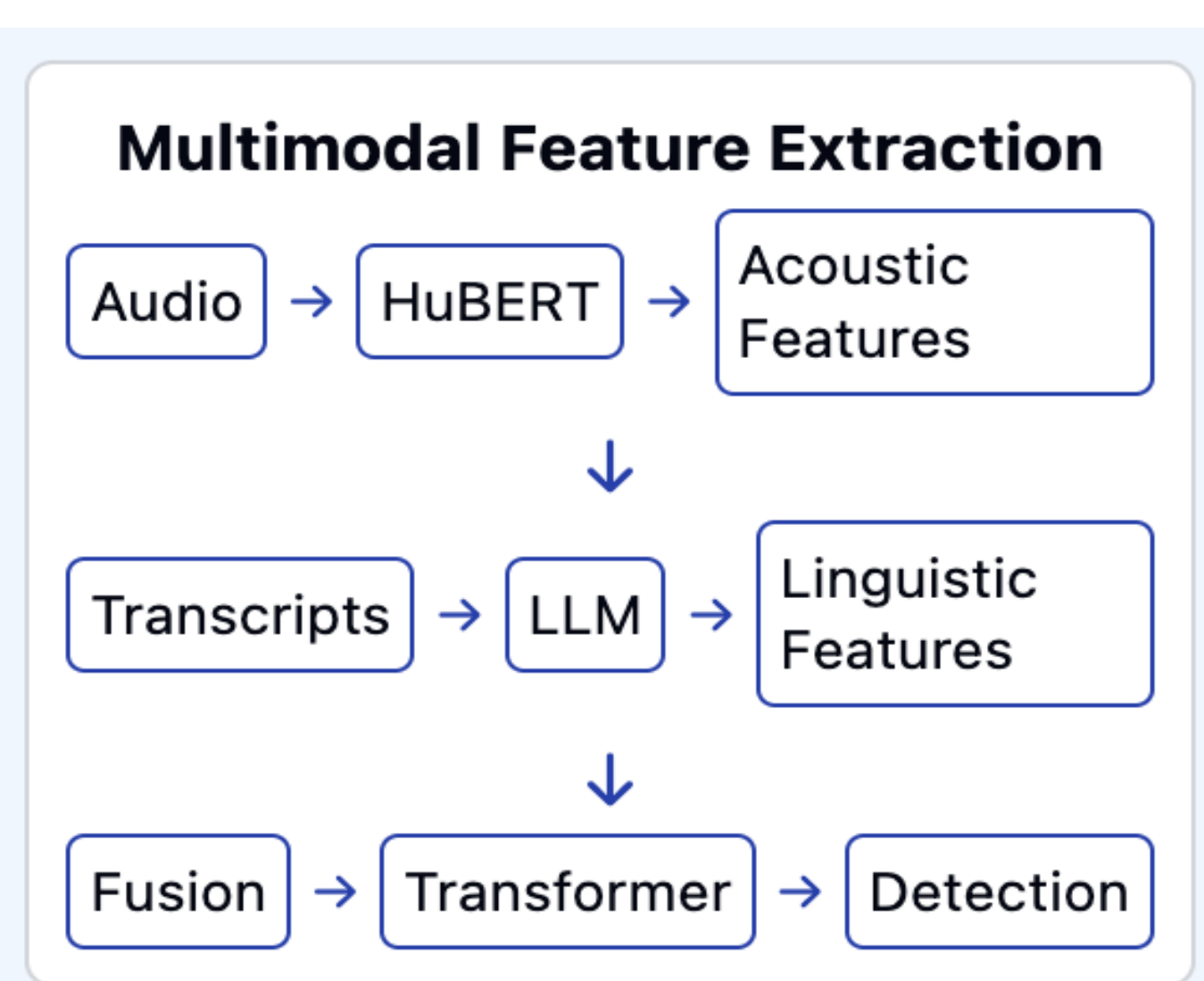
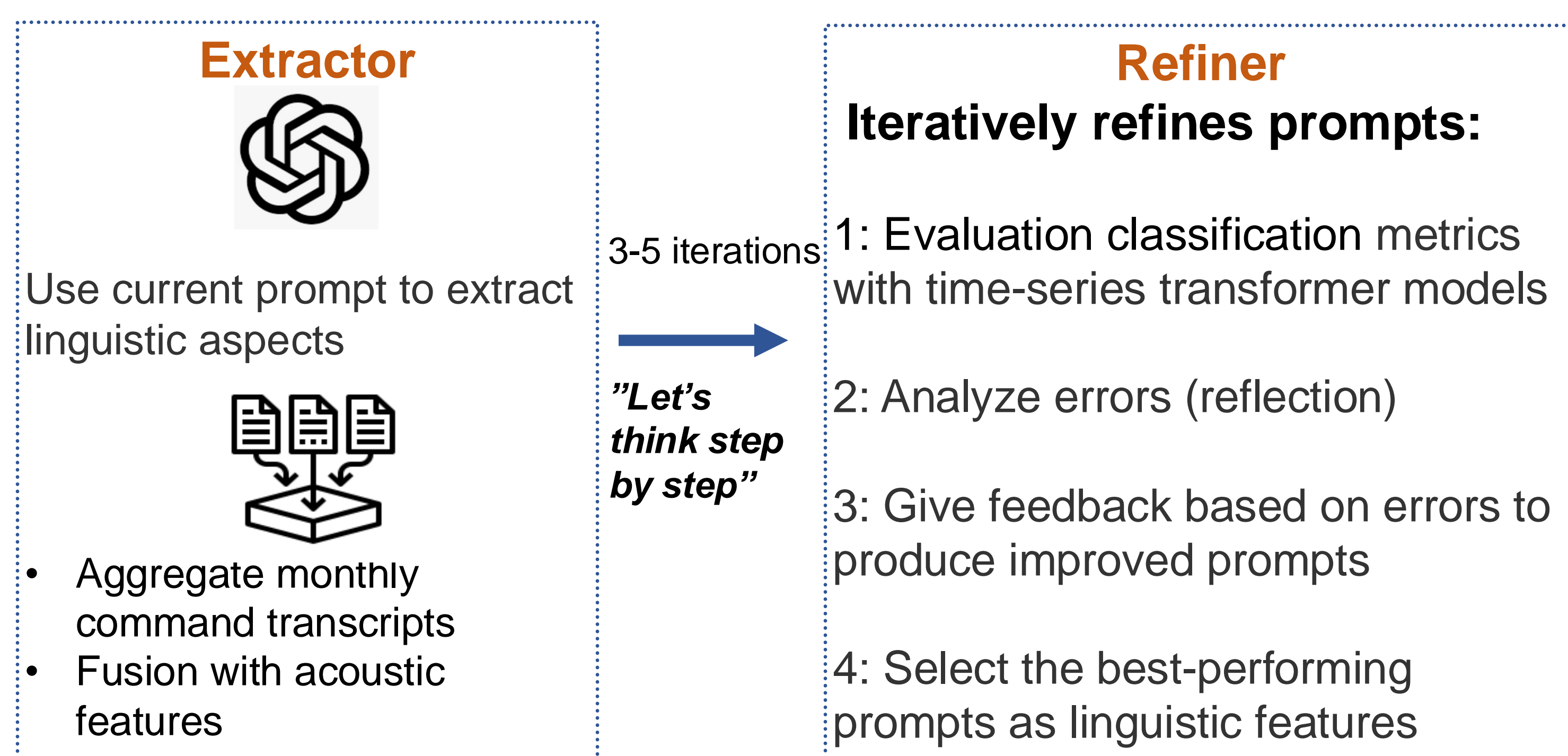
1. Multimodal Feature Extraction

- Speech features using the HuBERT model
- LLM-driven **linguistic aspects (markers & command usage)** from voice command transcripts

2. Time-series Transformer-based Iterative Prompt Refinement to Detect Cognitive Decline (Cog-TiPRO)

- Initial prompt design:

$$P = \{P_{\text{content}}, P_{\text{instruction}}, P_{\text{exemplars}}, P_{\text{output step}}\}$$



3. Temporal Modeling for Next Cognitive Status Detection

- PatchTST and iTransformer models
- Model patterns by using historical data



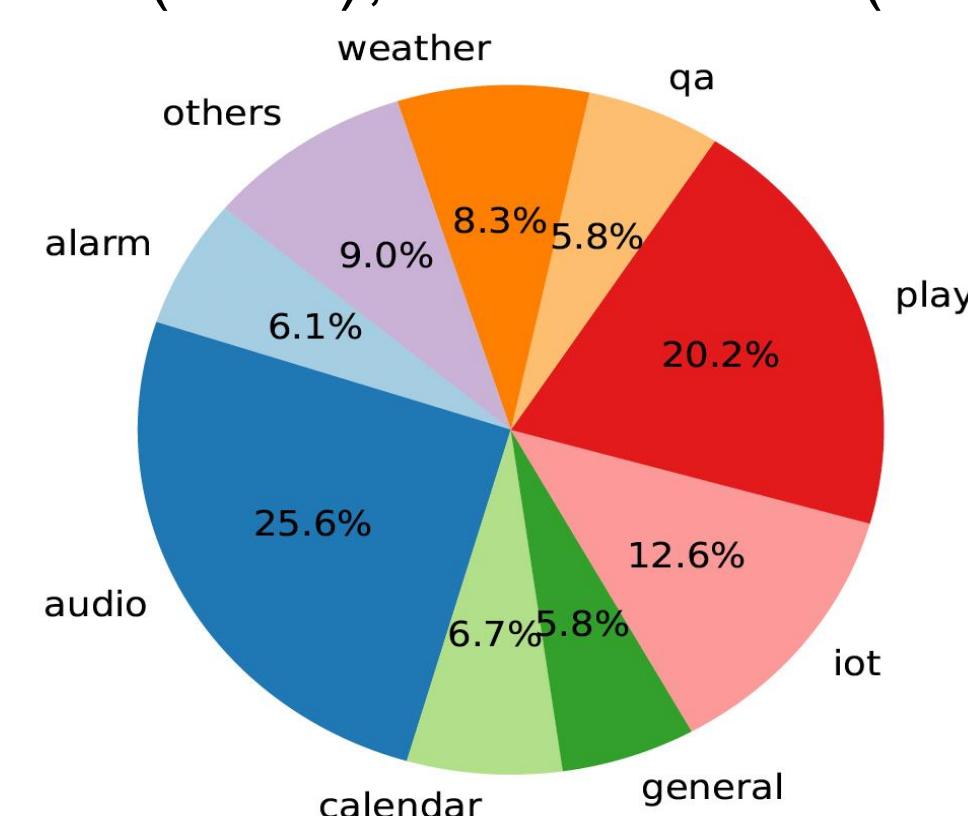
Problem to Solve

Limited understanding of linguistic aspects in voice commands
Use LLMs' summarization and knowledge

Data scarcity and noisy information
Distill MCI-relevant aspects

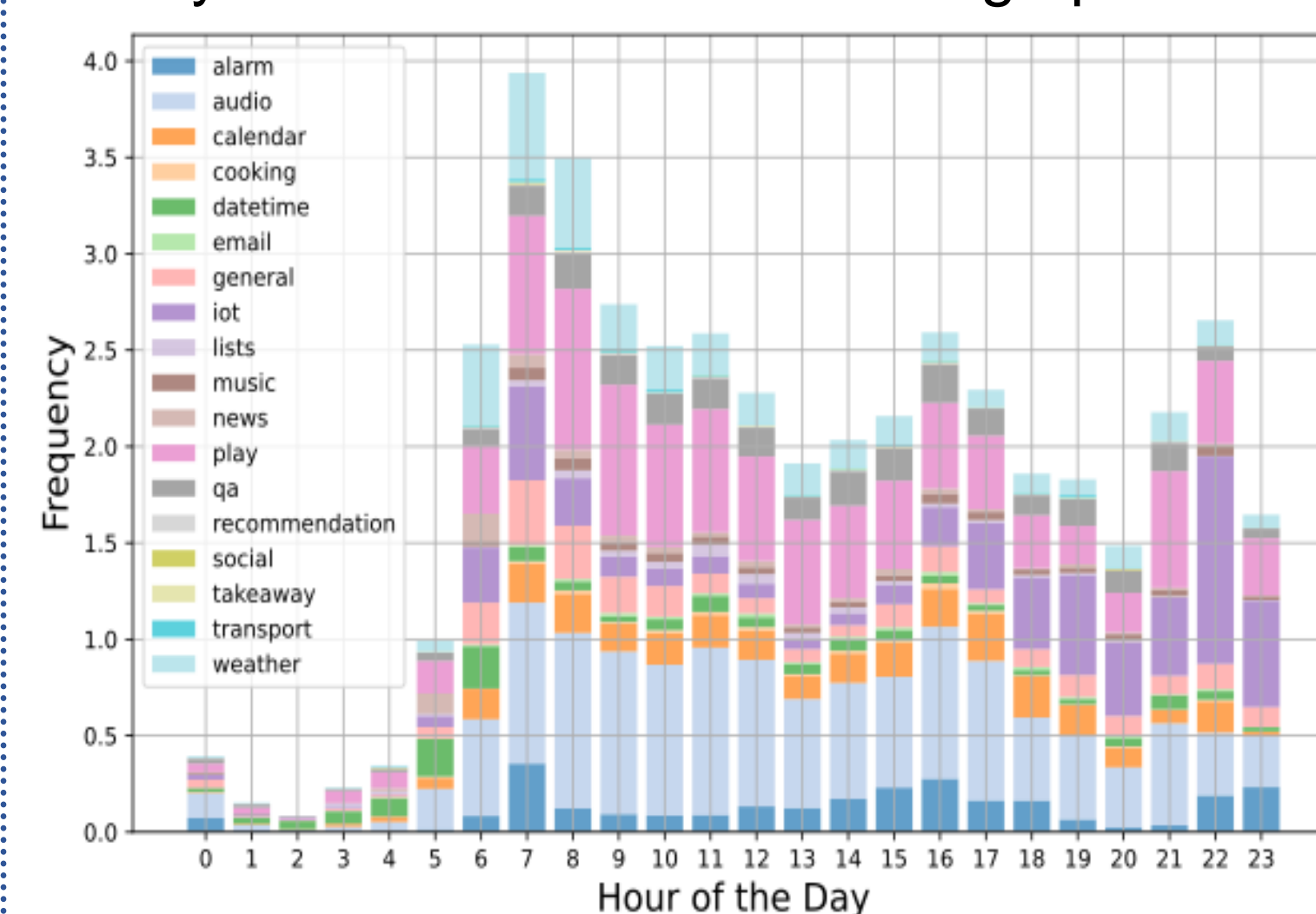
What voice commands do the elderly like to use?

Top-5 domains used (Age > 65):
audio (25.6%), play (20.2%), IoT (12.6%), weather (8.3%), and calendar (6.7%)



When are voice commands used more often?

Hourly distribution of domain usage per week.



Learn more at: <https://cogvox.org/>