Multimodal Machine Learning

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Definition

Modality

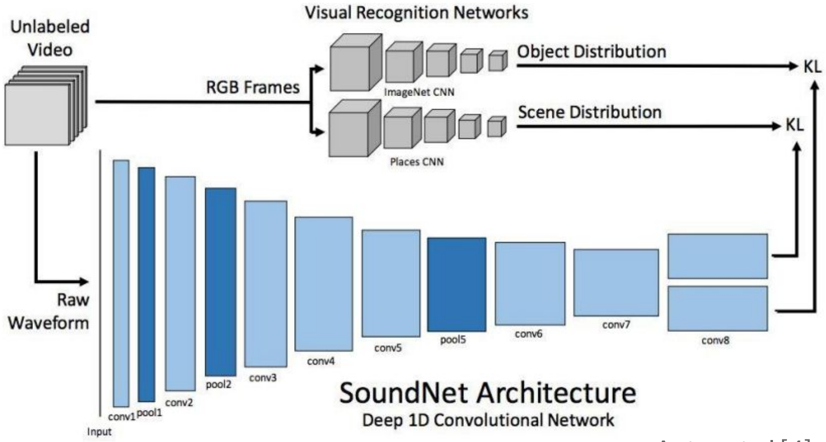
A particular way of doing or experiencing something. It refers to a certain type of information and/or the representation format in which information is stored. [1]

Motivation

- Similar to how humans perceive their environment
- Some information is difficult to acquire unimodally
- Increased robustness

Examples of MMML applications

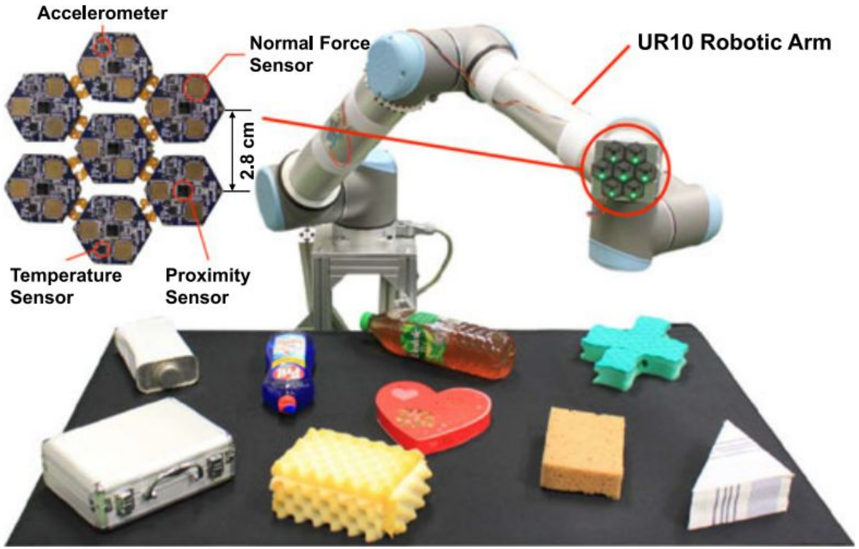
- Natural language processing/ Text-to-speech
- Image tagging or captioning [3]
- SoundNet recognizing objects from sound [4]



Aytar et al [4]

Robot learning to grasp objects, Kaboli et al [2]

- Starts estimating object positions in a grid
- Pressing, sliding, static contact to explore physical properties
- Tries to minimize training for unknown objects



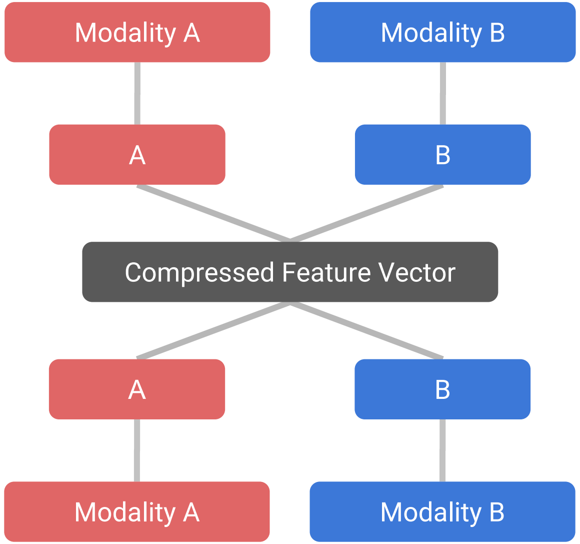
Technical Challenges for MMML [5]

- Representation
- Fusion
- Alignment
- (Translation)
- (Co-Learning)

Representation

Joint representations

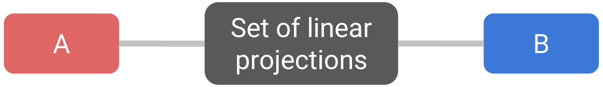
1. Multimodal Tensor Fusion Network
2. **Deep Multimodal autoencoders**
3. Deep Multimodal Boltzmann machines

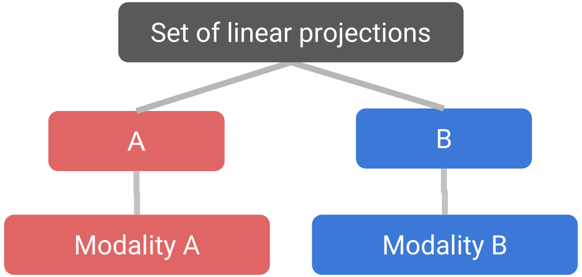


Representation

Coordinated representations

1. Multimodal Vector Space Arithmetic
2. **Deep Canonical Correlation Analysis**
3. Deep Canonically Correlated Autoencoders

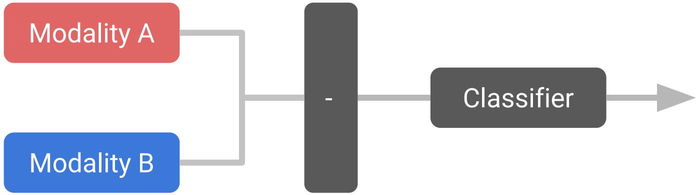




Fusion

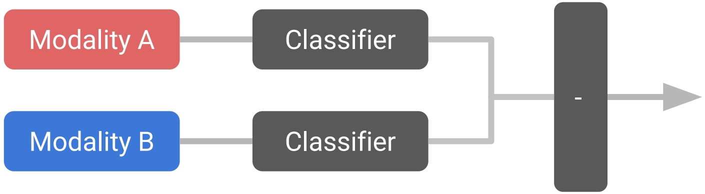
Model-Agnostic Approaches

1. **Early Fusion**
2. **Late Fusion**
3. Hybrid Fusion



Model-Based Approaches

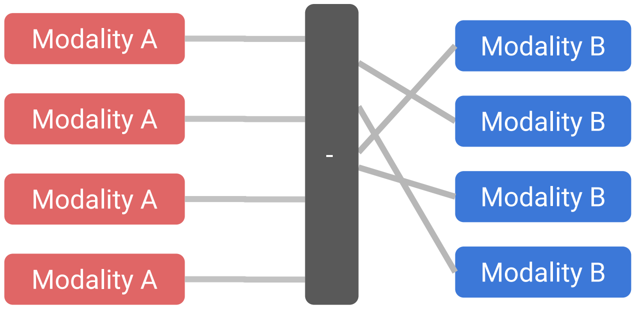
1. Multiple Kernel Learning
2. Deep Neural Network



Alignment

Explicit Alignment
Goal is to find correspondences between elements

Implicit Alignment
Goal is to solve a given problem



The McGurk Effect

The McGurk Effect in MMML

Audio / Visual Setting	Model prediction		
	/ga/	**/ba/**	**/da/**
Visual **/ga/**, Audio **/ga/**	82.6%	2.2%	15.2%
Visual **/ba/**, Audio **/ba/**	4.4%	89.1%	6.5%
Visual **/ga/**, Audio **/ba/**	28.3%	13.0%	58.7%

Sources

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Sources

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Tensor Fusion Network for Multimodal Sentiment Analysis
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Feedback & Questions