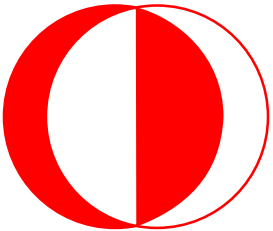
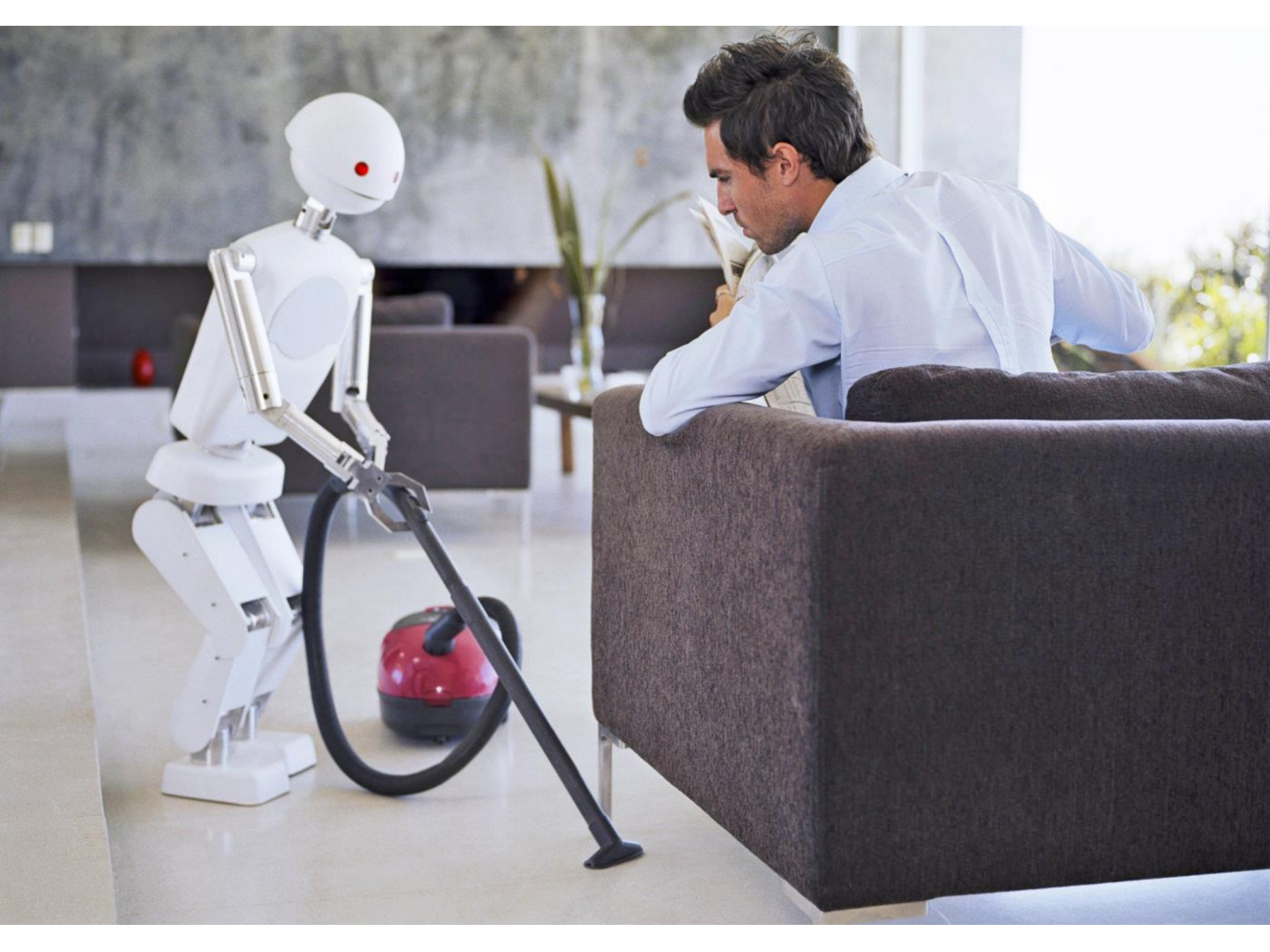


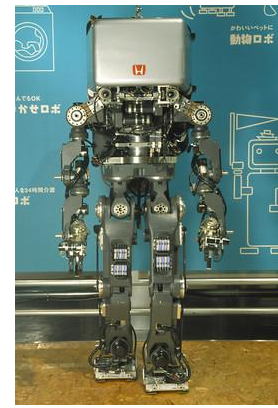
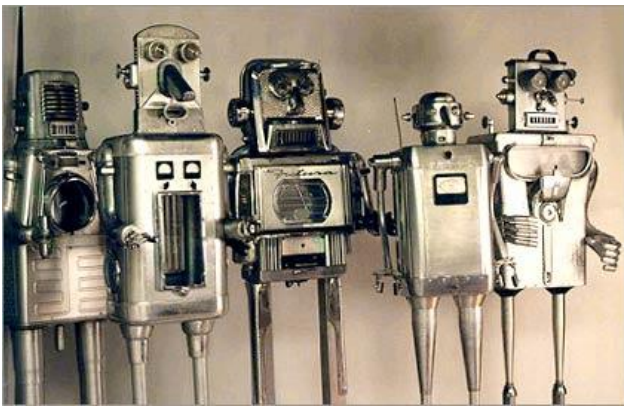
Zekanın Üç Silahşörleri: Algı, Eylem ve Dil

Sinan Kalkan
KOVAN Araştırma Laboratuvarı
Bilgisayar Mühendisliği. ODTÜ

BMO-EMO, 11 Mayıs 2019







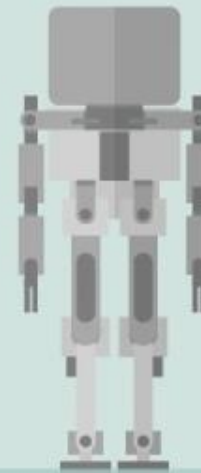
1495
Leonardo Da Vinci

1937/38
„Elektro“
by Westinghouse

1961
„Unimate“
by Devol/Engelberger
@ GM

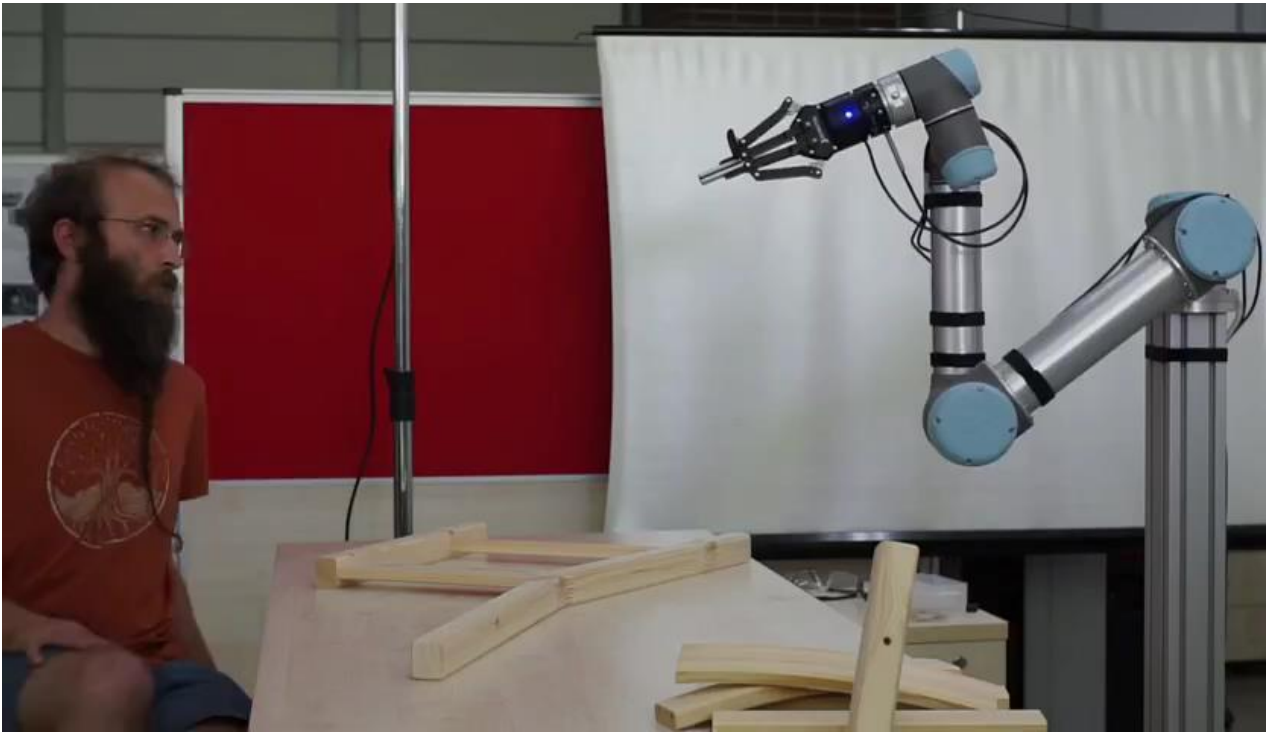
1991
„P1“
by Honda

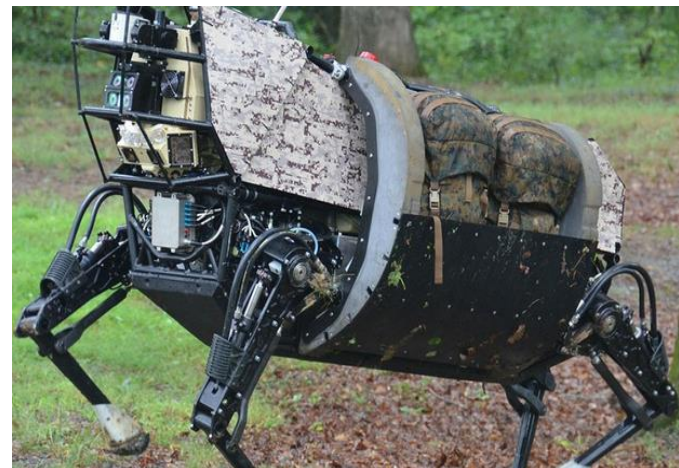
2017
„Panda“
by Franka Emika

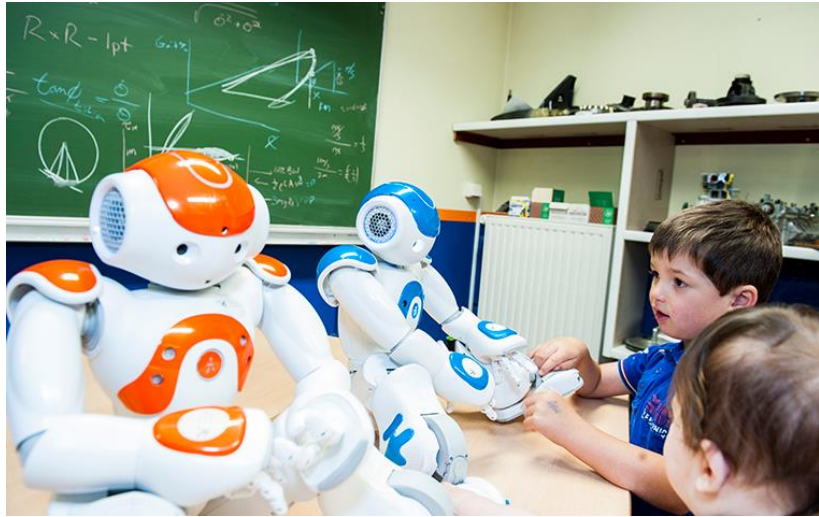


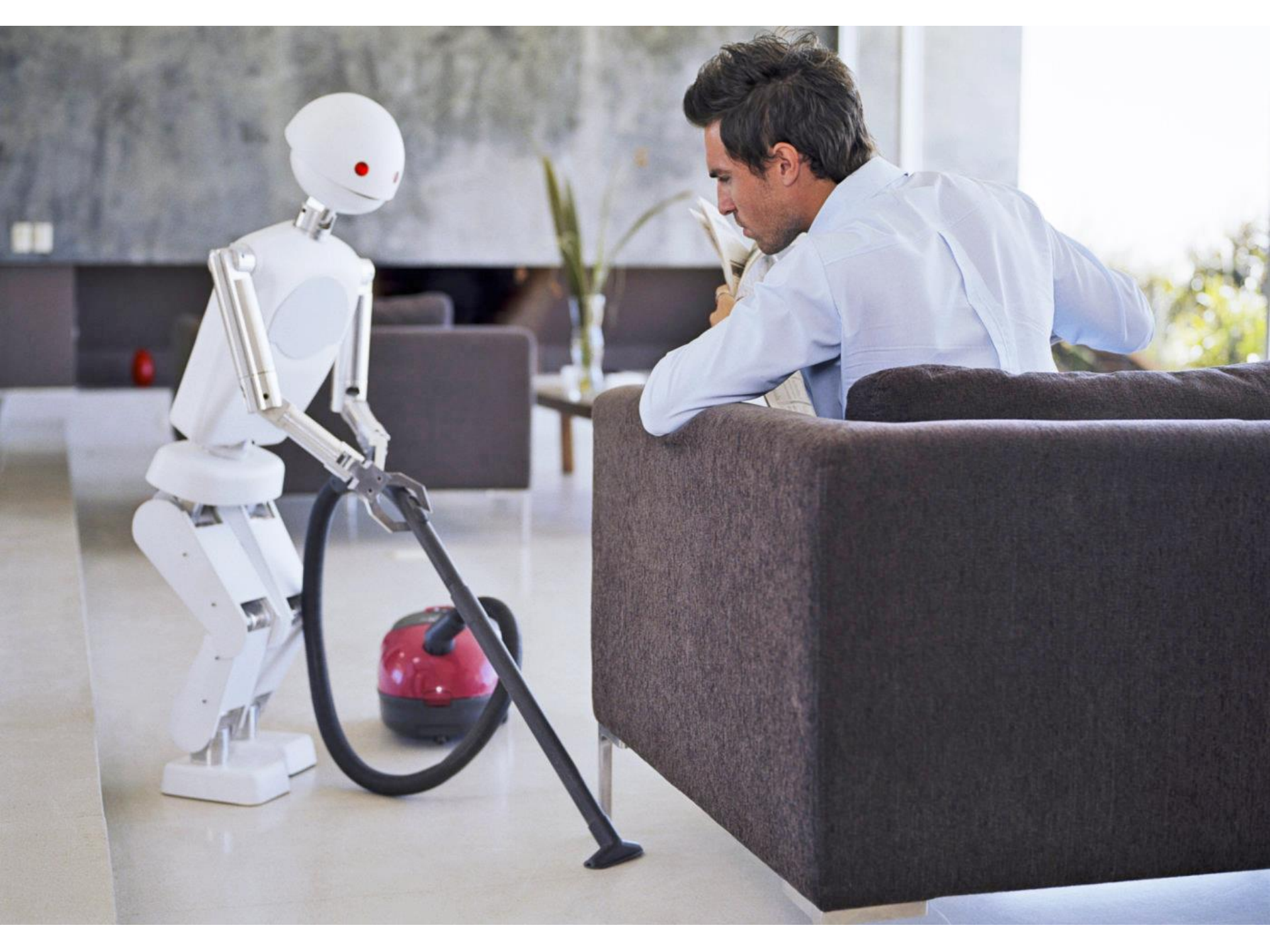












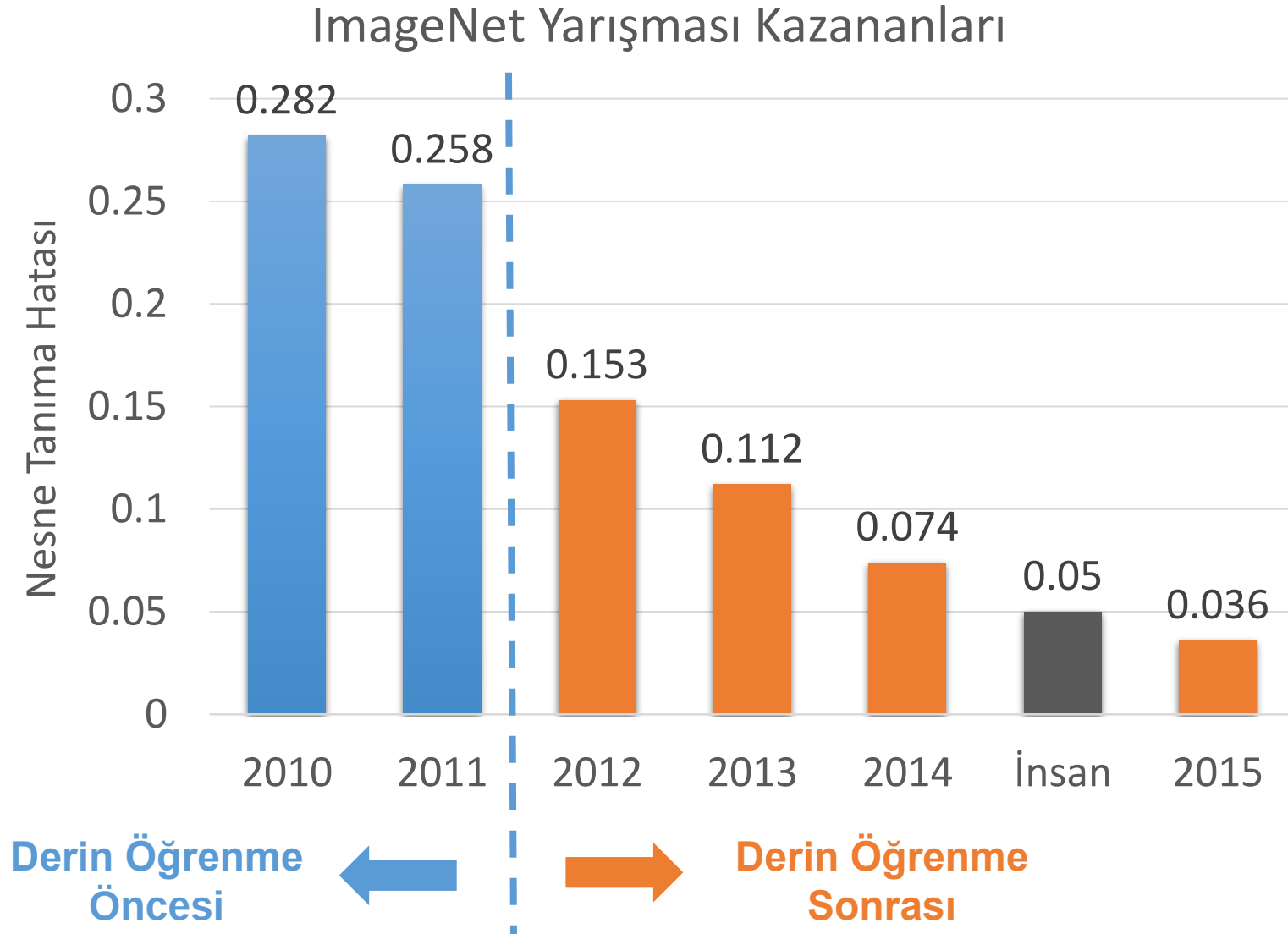
ImageNet Nesne Sınıflandırma Yarışması

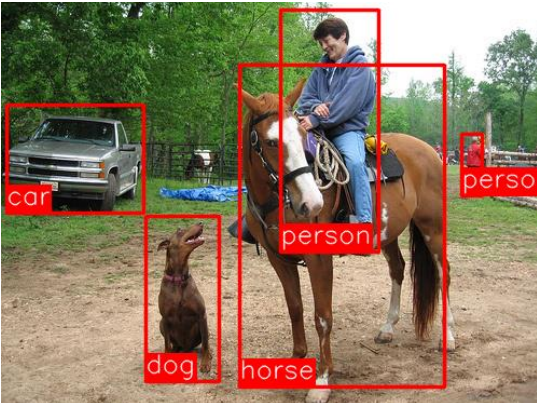
(<http://image-net.org/challenges/LSVRC/>)



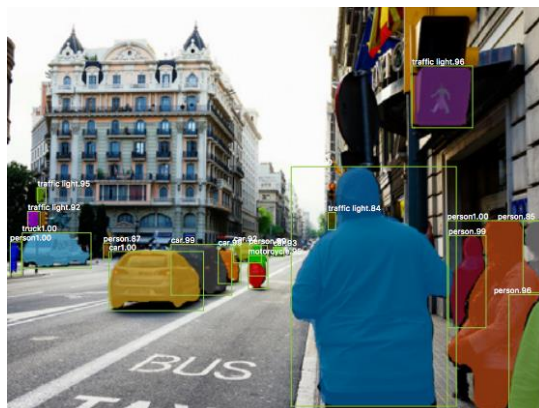
Alex Krizhevsky, Ilya Sutskever, Geoffrey E. Hinton,
ImageNet Classification with Deep Convolutional Neural Networks, NIPS,

Nesne Tanıma





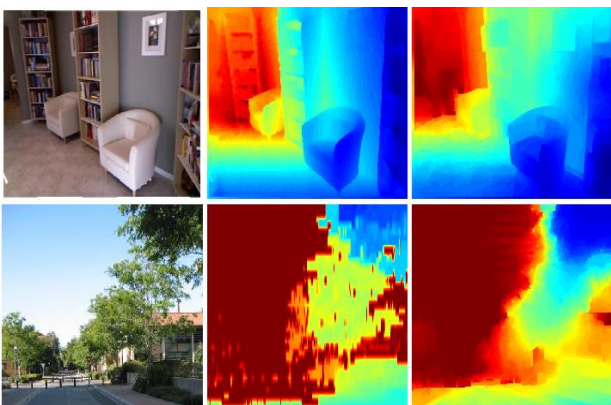
R-CNN (2013)



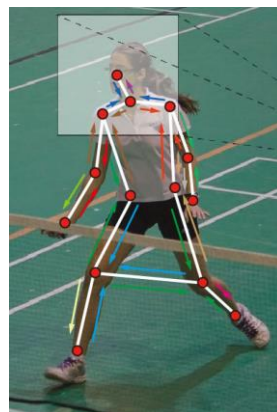
Mask R-CNN (2017)



(Pohlen vd., 2016)



(Hazırbaş vd., 2016)



(Yang vd., 2016)



"construction worker in orange safety vest is working on road."

(Karpathy & Fei-Fei, 2015)



(Gatsy vd., 2015)

Kim gözlük takıyor?

Erkek



Kadın



Task 1

Story

john went to the kitchen
daniel travelled to the kitchen
sandra journeyed to the kitchen
john went to the bedroom
mary went to the bedroom
sandra went back to the bedroom
john journeyed to the garden
daniel went back to the bedroom

Question

where is john

<https://cs224d.stanford.edu/reports/StrohMathur.pdf>



What color are the shoes
on the person's feet ?

Neural Net: brown

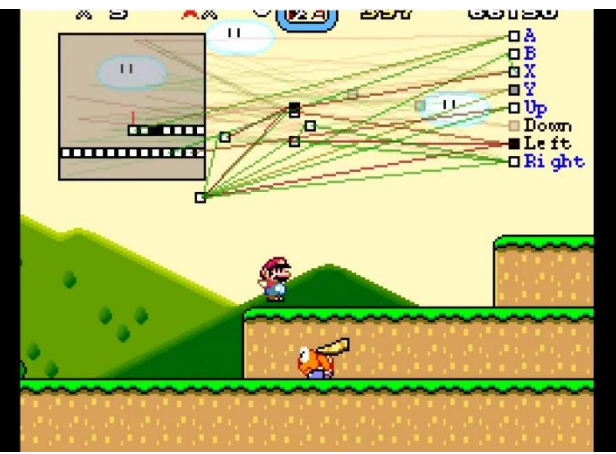
Ground Truth: brown



How many school busses
are there?

Neural Net: 2

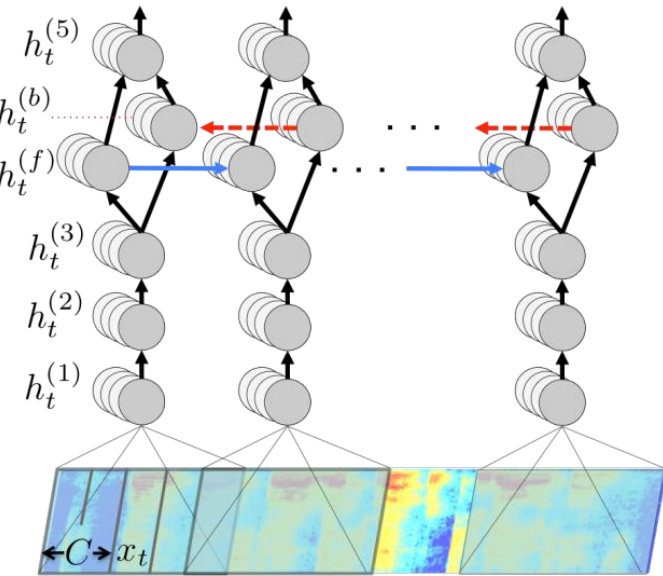
Ground Truth: 2



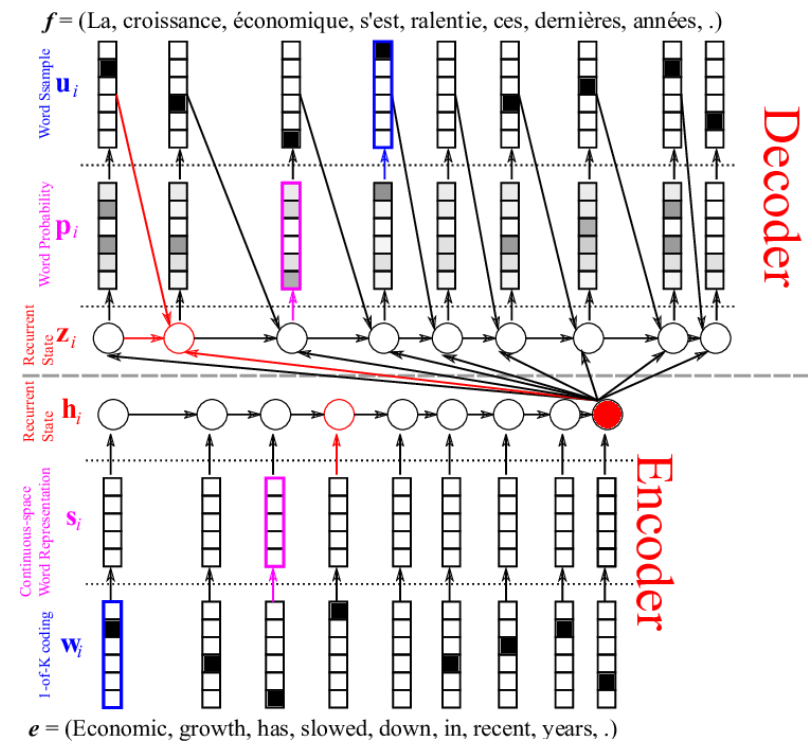
(Seth Bling, 2015)



(Google DeepMind)



(Catanzaro vd., 2015)

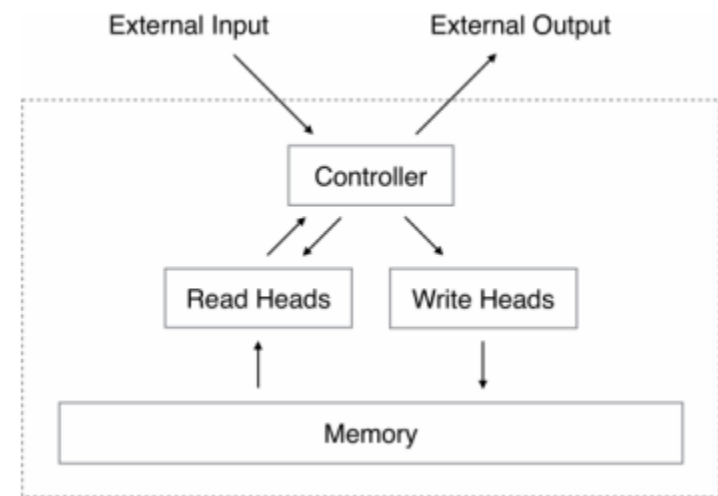


(Cho vd., 2014)



It might
look goofy ...

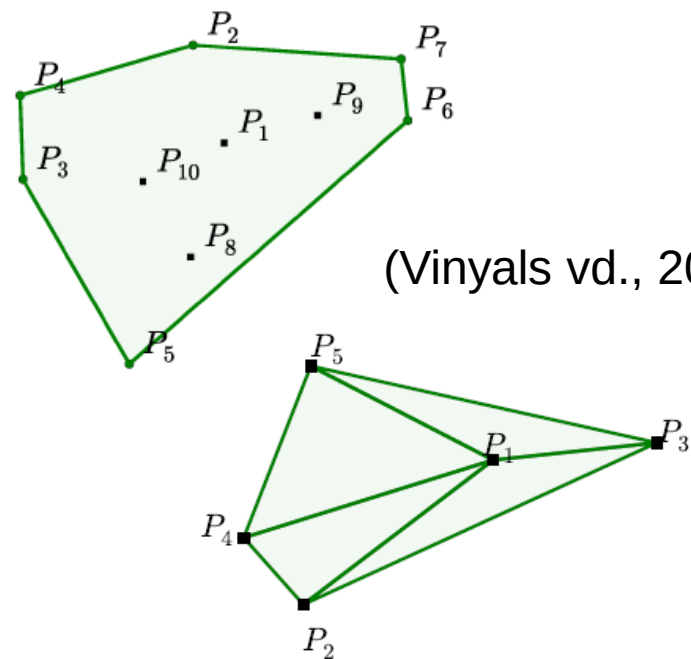
(Google, 2017)



(Graves vd., 2014)



(Levine vd., 2016)



(Vinyals vd., 2015)

Metin Oluşturma

PANDARUS:

Alas, I think he shall be come approached and the day
When little strain would be attain'd into being never fed,
And who is but a chain and subjects of his death,
I should not sleep.

Second Senator:

They are away this miseries, produced upon my soul,
Breaking and strongly should be buried, when I perish
The earth and thoughts of many states.

DUKE VINCENTIO:

Well, your wit is in the care of side and that.

Second Lord:

They would be ruled after this chamber, and
my fair nudes begun out of the fact, to be conveyed,
Whose noble souls I'll have the heart of the wars.

Clown:

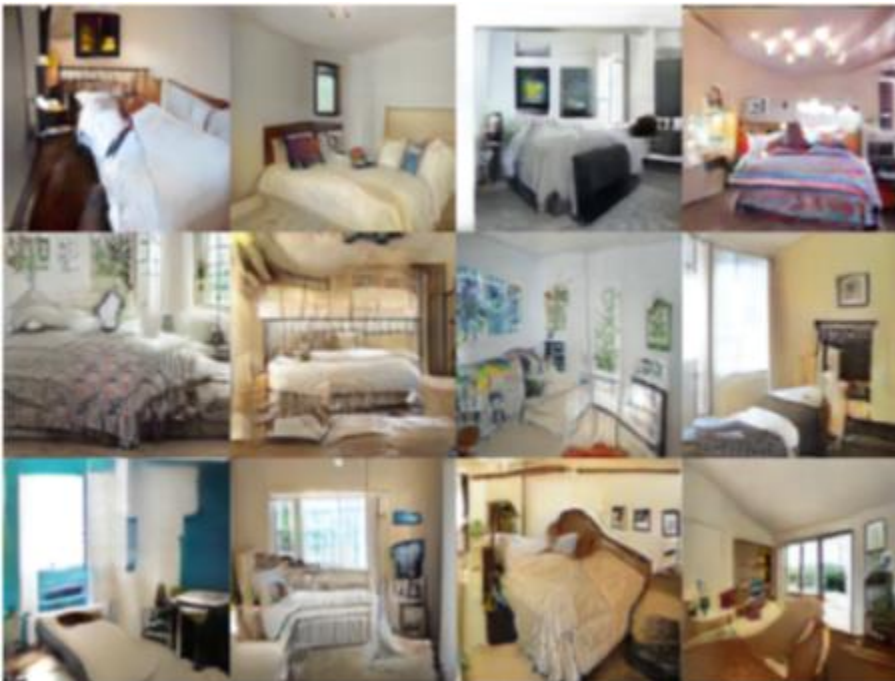
Come, sir, I will make did behold your worship.

VIOLA:

I'll drink it.

Görüntü Oluşturma

Sağdakiler mi gerçek, soldakiler mi?



Xudong Mao, Qing Liy, Haoran Xiez, Raymond Y.K. Laux, and Zhen Wang, Least Squares Generative Adversarial Networks, 2016.

«Pembe boyunlu ve gövdeli, siyah kanatlı bir kuş»

(this small bird has a pink breast and crown, and black primaries and secondaries)

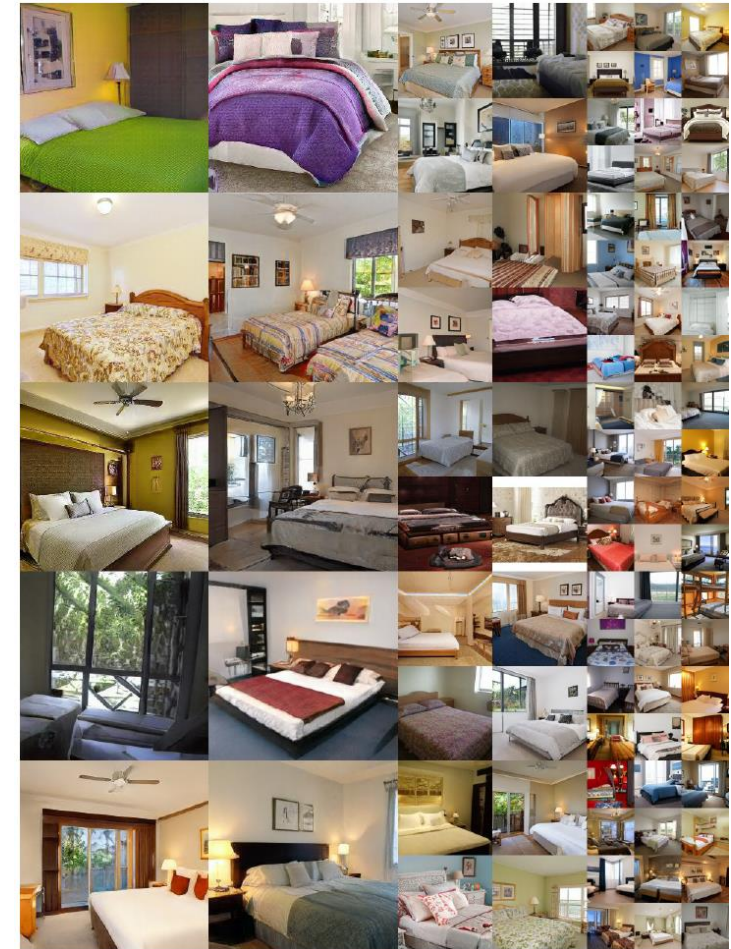


«Mor yapraklı, ortası beyaz çiçek»

(the flower has petals that are bright pinkish purple with white stigma)

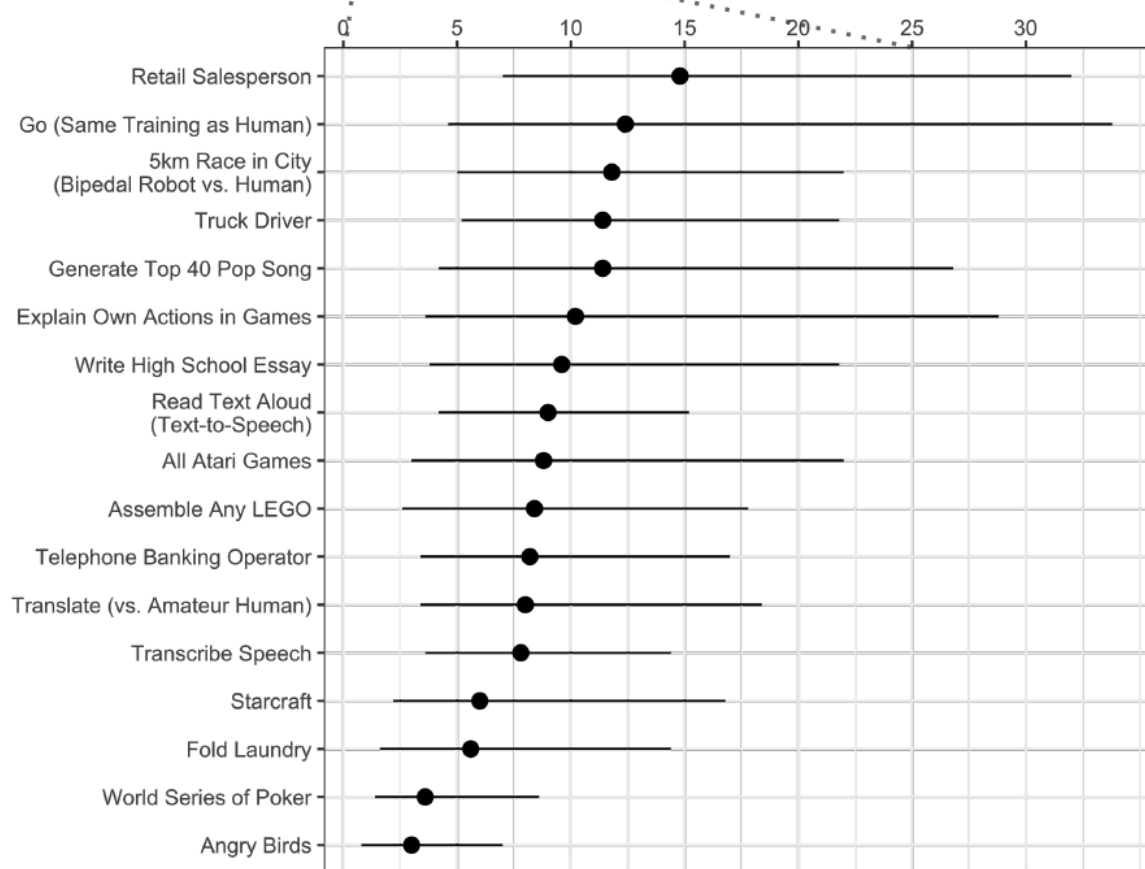
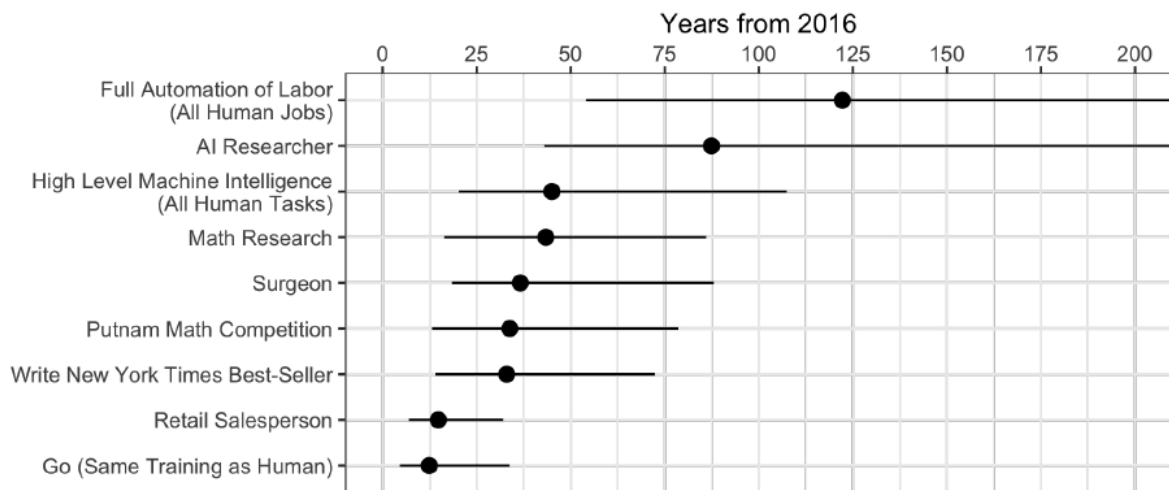






Karras, Laine, Aila, «A Style-Based Generator Architecture for Generative Adversarial Networks», 2018.





Grace, Katja, vd. "When will AI exceed human performance? Evidence from AI experts." *Journal of Artificial Intelligence Research* 62 (2018): 729-754.



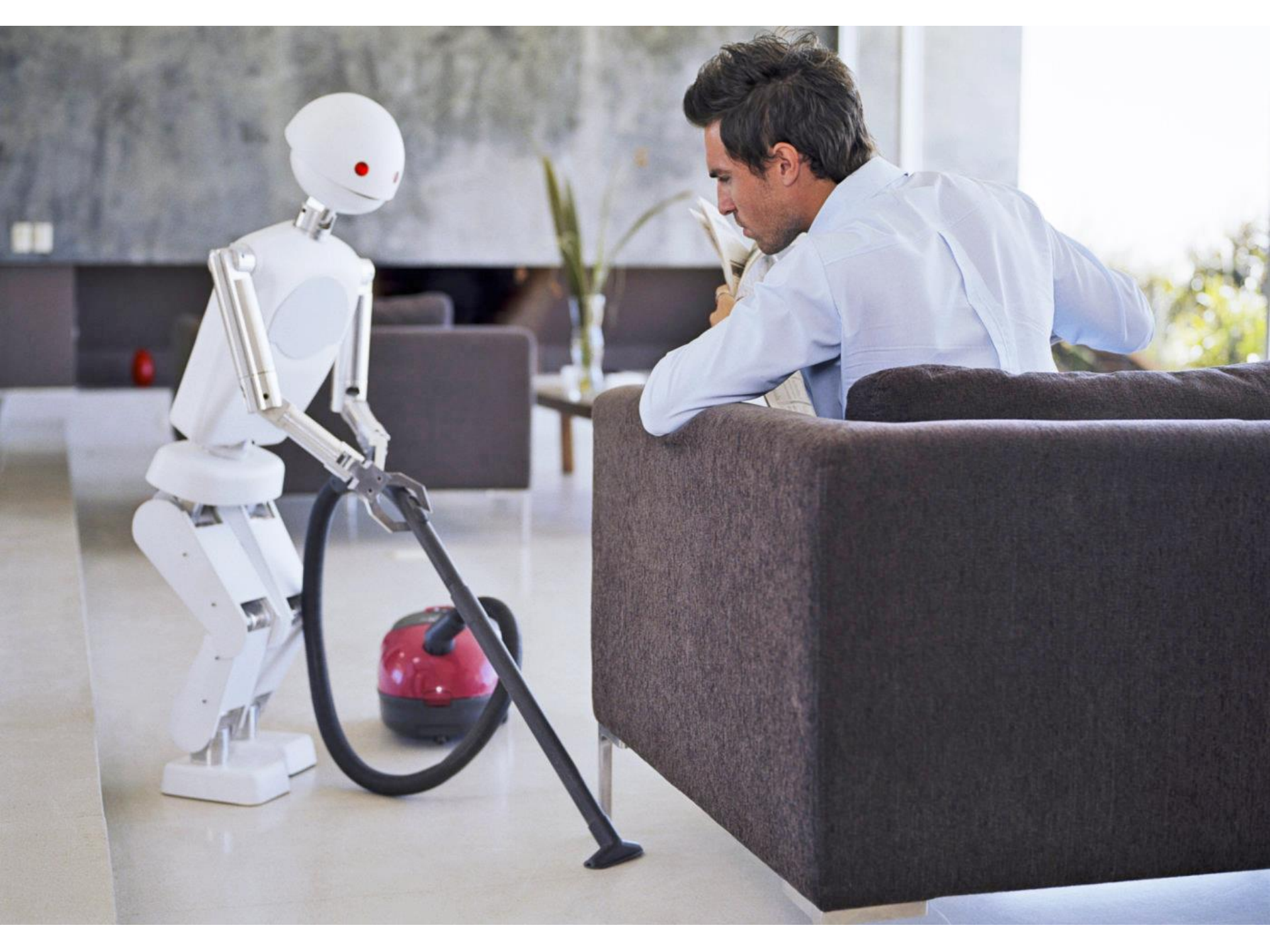
Stephen Hawking:
“yapay zeka insanlığın
sonunu getirebilir”



Elon Musk: “yapay zeka
varlığımız için en önemli
tehdittir”



Bill Gates: “insanlık,
yapay zekanın
tehdidinden korkmalıdır”



Cuando tu novia estudia ingeniería

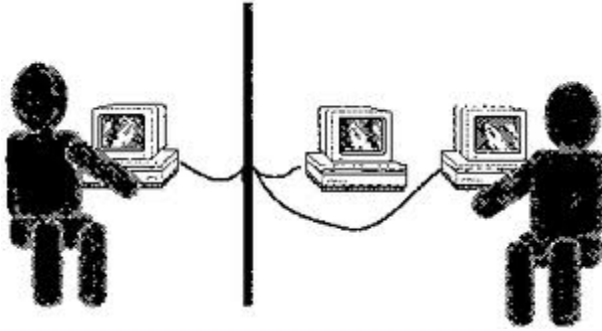
YouTube Simone Elert



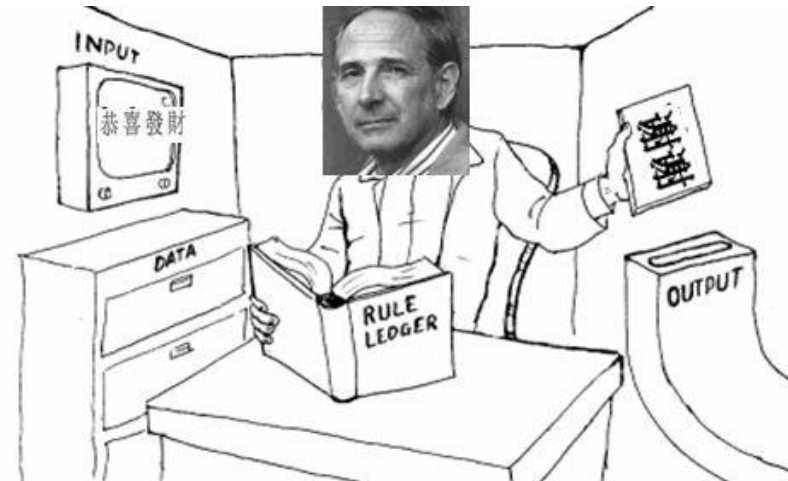
“Zekâ [...] zihnîn öğrenme, öğrenilenden yararlanabilme, yeni durumlara uyabilme ve yeni çözüm yolları bulabilme yeteneğidir. Başka bir deyişle [zekâ], **zihnîn birçok yeteneğinin uyumlu çalışması sonucu ortaya çıkan bir yetenekler birleşimidir.** En geniş anlamıyla, genel zihin gücü olarak da tanımlanabilir. Zihnîn **algılama, bellek, düşünme, usamlama, öğrenme** gibi birçok işlevini içerir.”

-- Wikipedia

Zekâ & Semboller & Anlam



(Turing, 1950)
Turing Testi



(Searle, 1980):
Çince Odası

Tasarlanmış «Çin Odaları»





Semboller

Sembol-Temellendirme Problemi

(İng. Symbol-grounding)
(Harnad, 1990)



**Sensörler,
Motorlar,
Eyleyiciler,**

...



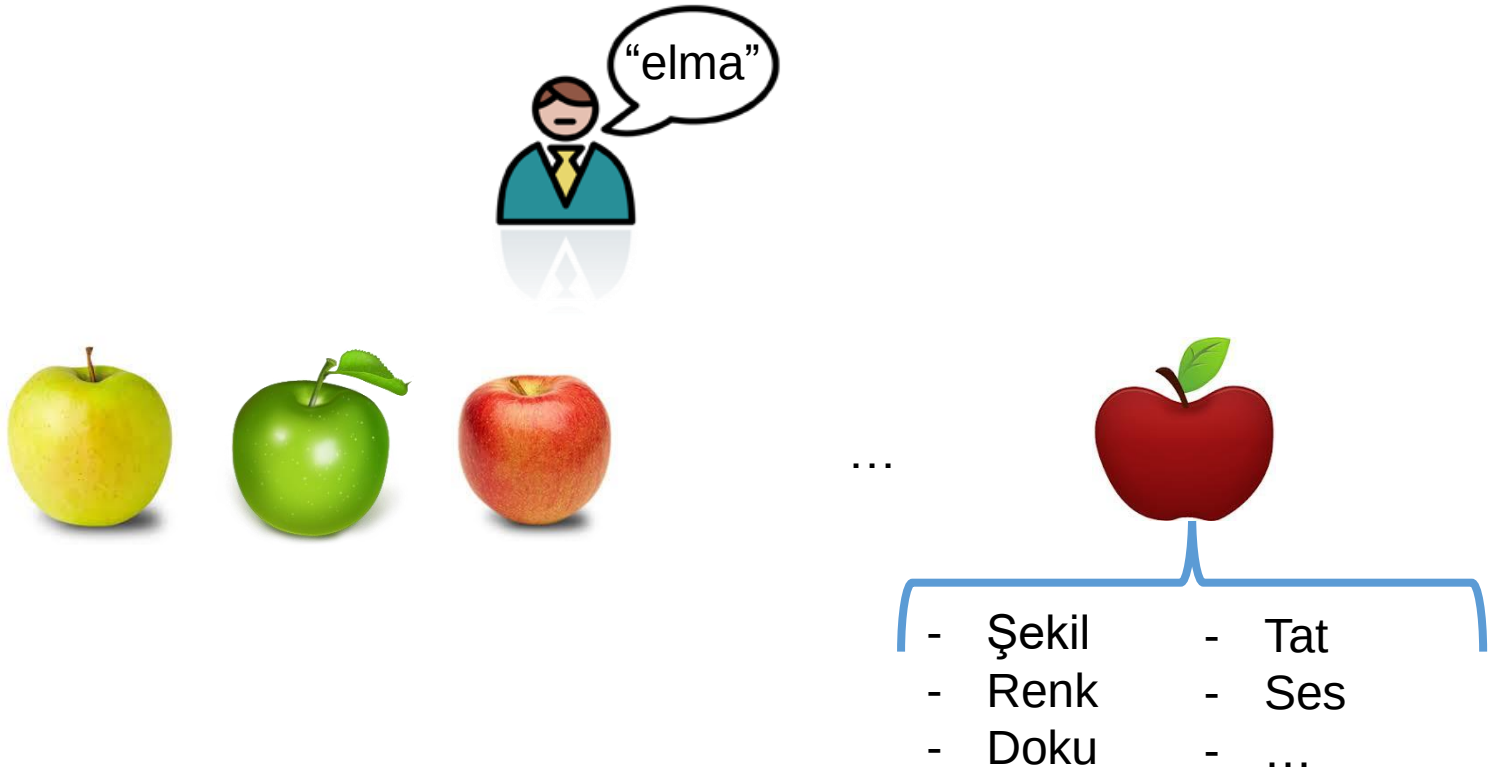
- Anlamlařtırma (kavramlařtırma)
- Baęlam
- Hayat-boyu ğrenme

Önemli Problemler

- Anlamlaştırma (kavramlaştırma)
- Bağlam
- Hayat-boyu öğrenme

Kavramlar

Stephen Harnad:
«To cognize is to categorize»



Sembol Temellendirme & Robotbilim

Bir robot için elma nedir?

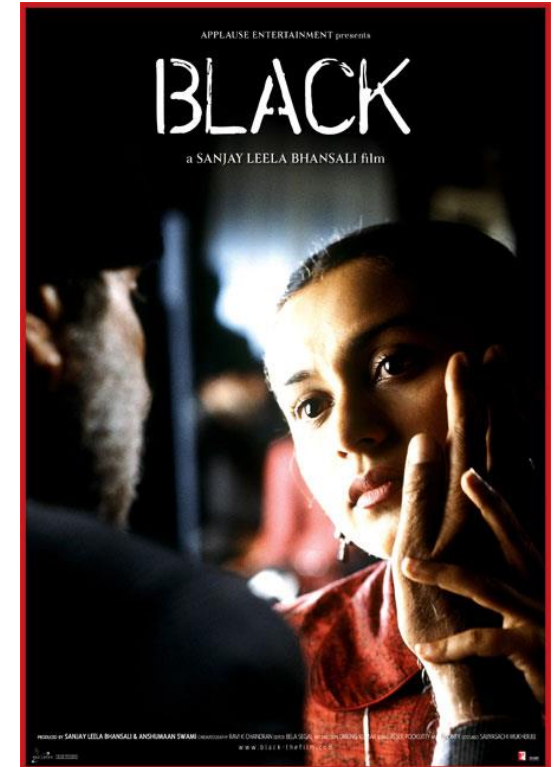


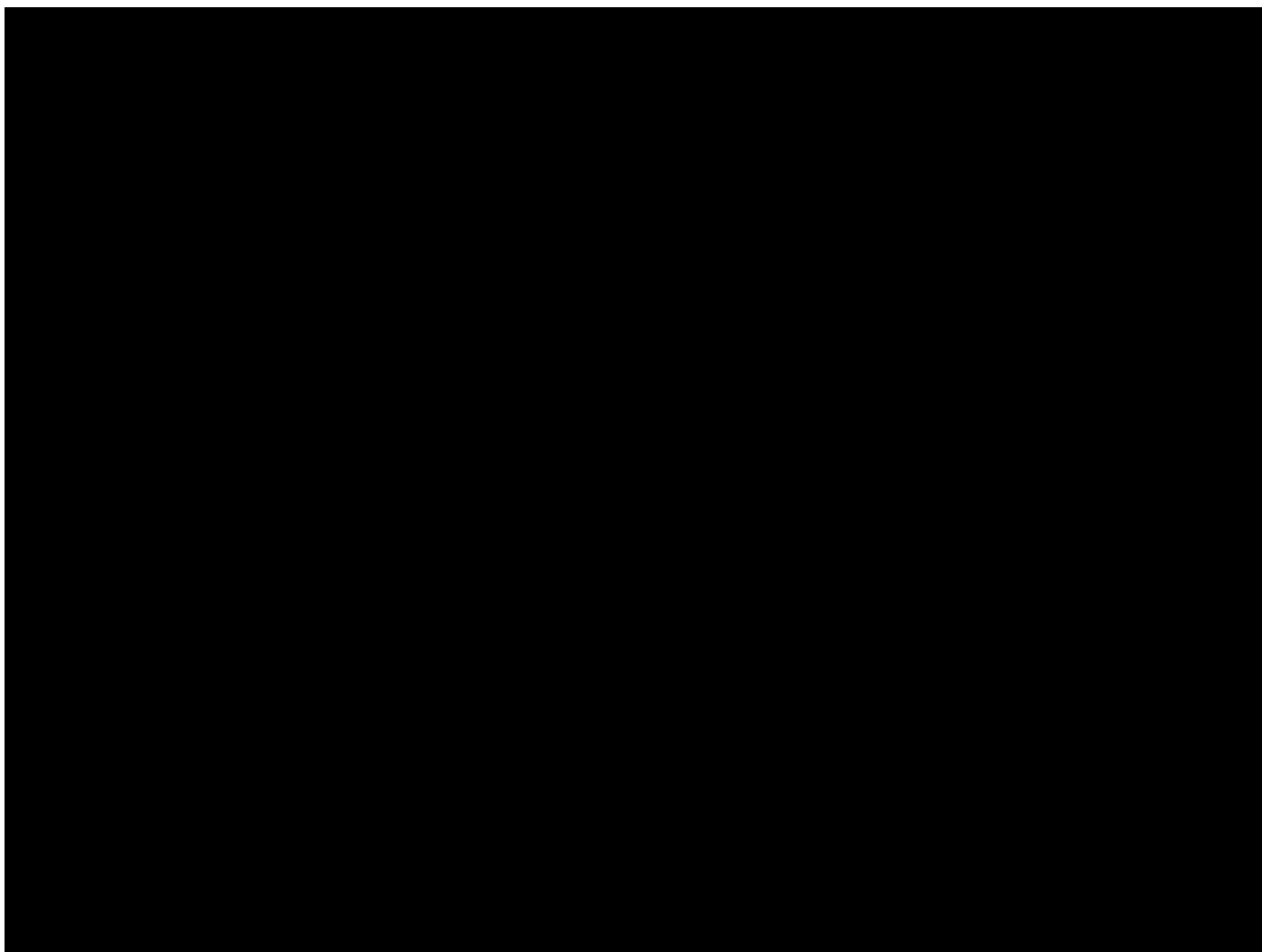
... veya su?



Dilden uzak insan

Kısıtlı algı ve dil durumlarında gelişim,
bilişin önünde engel olabiliyor





Algı-Eylem-Dil, sadece girdi-çıktı yetenekleri değildir.

Önemli Problemler

- Anlamlaştırma (kavramlaştırma)
- Bağlam
- Hayat-boyu öğrenme



Retrieval: Getting Information Out

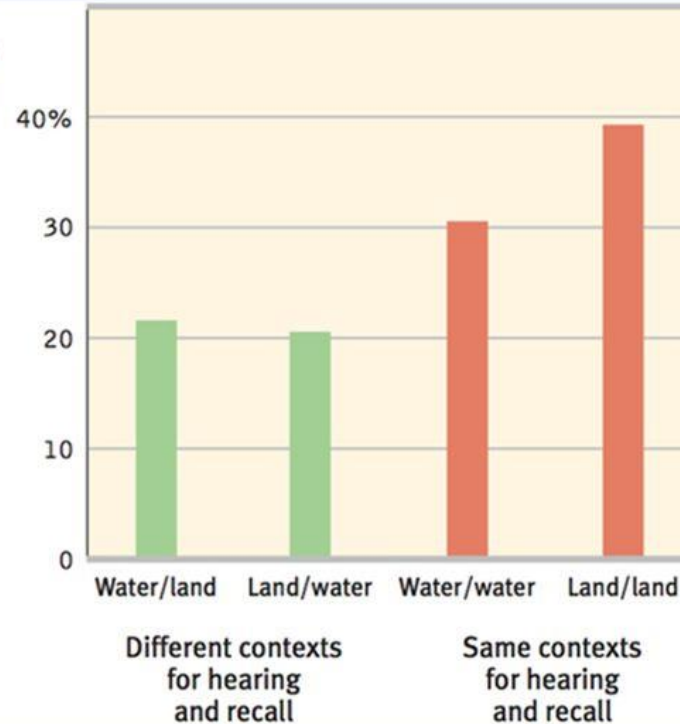
Retrieval Cues:

Context-Dependent Memory

Olga Khoroshunova/Shutterstock



Percentage of words recalled



Godden, D. R., & Baddeley, A. D. (1975). Context-Dependent Memory in 2 Natural Environments - Land and Underwater. *British Journal of Psychology*, 66(3), 325-331.

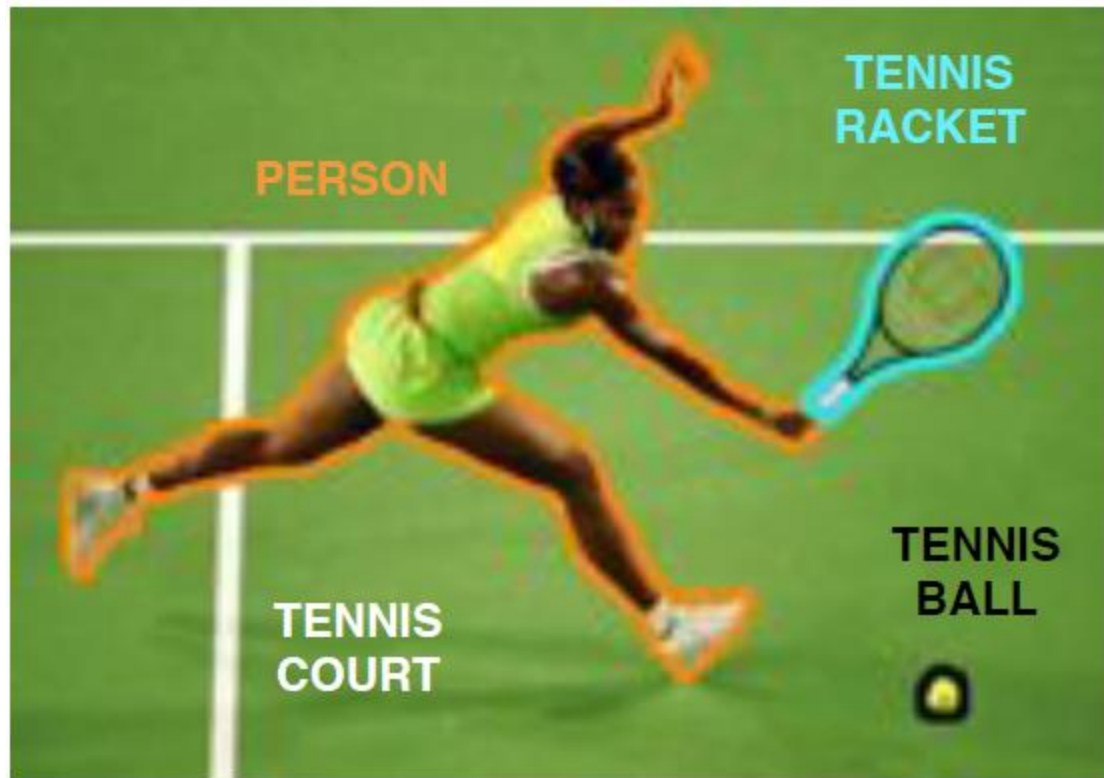
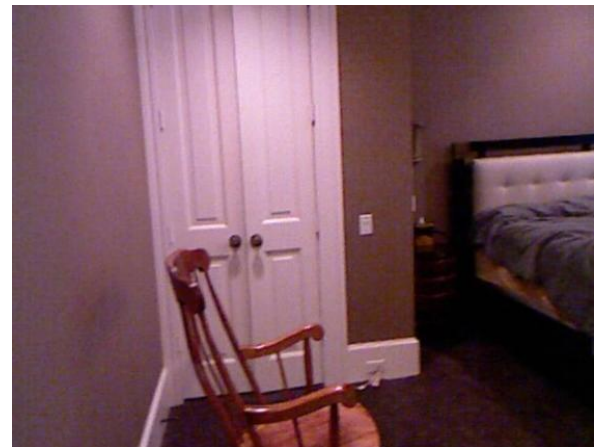
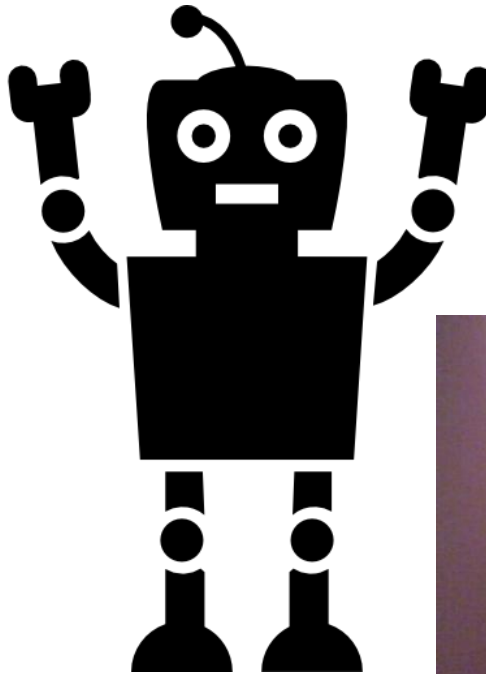
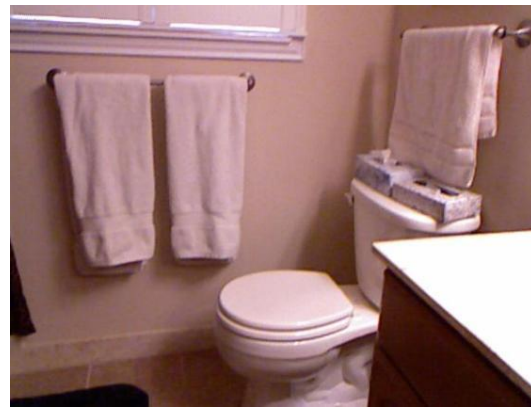


Figure from: Rabinovich, A., & Belongie, S. (2009). Scenes vs. objects: a comparative study of two approaches to context based recognition. CVPR.



Önemli Problemler

- Anlamlaştırma (kavramlaştırma)
- Bağlam
- Hayat-boyu öğrenme



İlgili Çalışmalarımız

Linking Verbs to Affordances

Nilgün Dağ, İlkay Atıl, Kadir Uyanık,
Sinan Kalkan and Erol Şahin

KOVAN Research Lab.
Dept. of Computer Eng.
Middle East Technical University
Ankara, Turkey



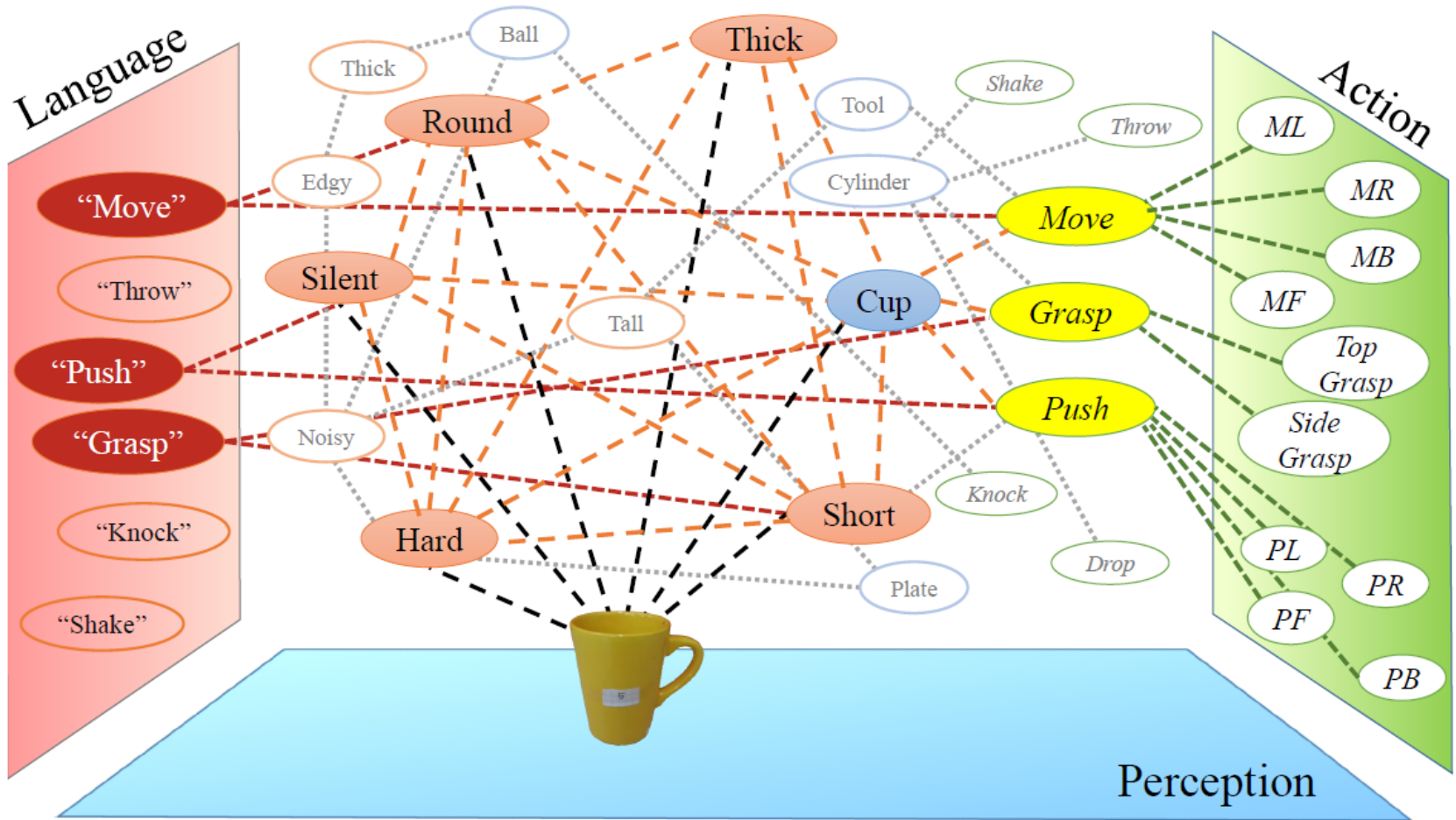
S. Kalkan, N. Dag, O. Yuruten, A. M. Borghi, E. Sahin, "Verb Concepts from Affordances", Interaction Studies Journal, 15(1):1-37, 2014.

O. Yuruten, E. Sahin, S. Kalkan, "The Learning of Adjectives and Nouns from Affordance and Appearance Features", Adaptive Behavior, 21(6):437-451, 2013.

I. Atıl, N. Dag, S. Kalkan, E. Sahin, "Affordances and Emergence of Concepts", 10th International Conference on Epigenetic Robotics, 2010.

N. Dag, I. Atıl, S. Kalkan, E. Sahin, "Learning Affordances for Categorizing Objects and Their Properties", IEEE International Conference on Pattern Recognition (ICPR), pp. 3089-3092, 2010.

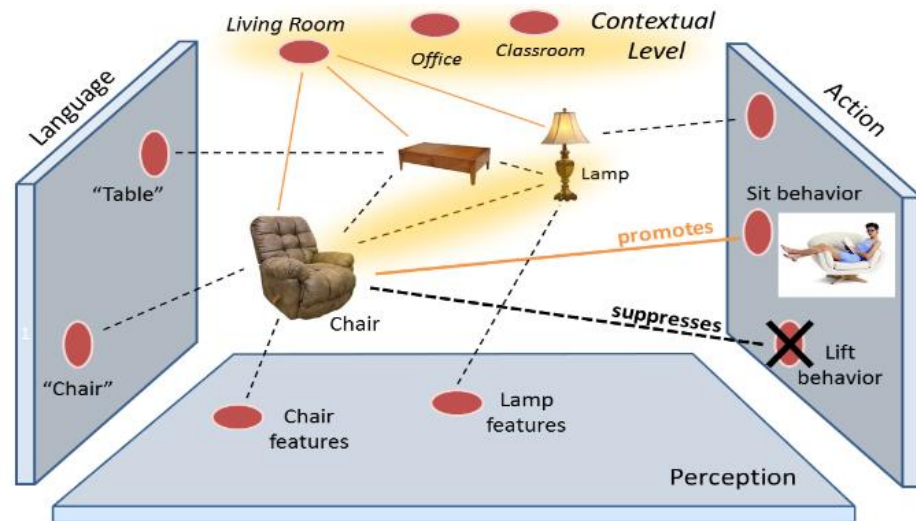
Kavram Ağı ile Algı-Eylem-Dil



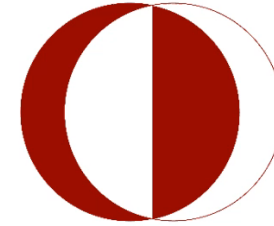


Celikkanat et al., "Learning Context on a Humanoid Robot using Incremental Latent Dirichlet Allocation", IEEE TCDS, 2016.

IEEE TCDS 2019 Outstanding Paper Award



Mustafa Parlar Vakfı Yılın Tezi Ödülü (2018)

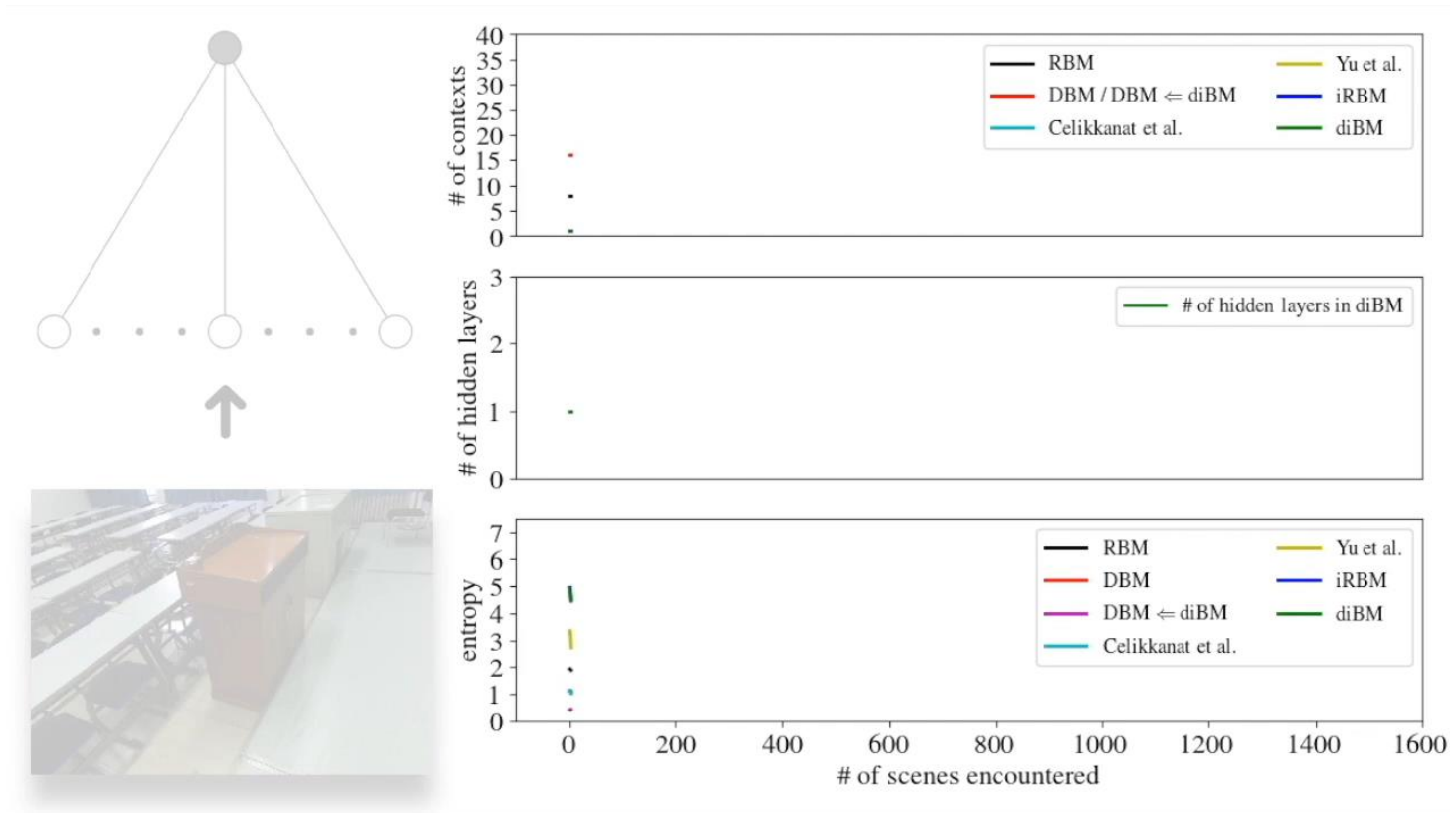


İlker Bozcan, Sinan Kalkan

**Department of Computer Engineering
Middle East Technical University**

I. Bozcan, S. Kalkan, "COSMO: Contextualized Scene Modeling with Boltzmann Machines", Robotics and Autonomous Systems journal, 113:132-148, 2019.

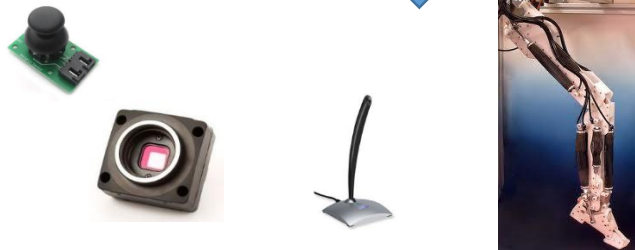
Hayat boyu öğrenme



I. Dogan, H. Celikkanat, S. Kalkan, "A Deep Incremental Boltzmann Machine for Modeling Context in Robots", International Conference on Robotics and Automation (ICRA), 2018.

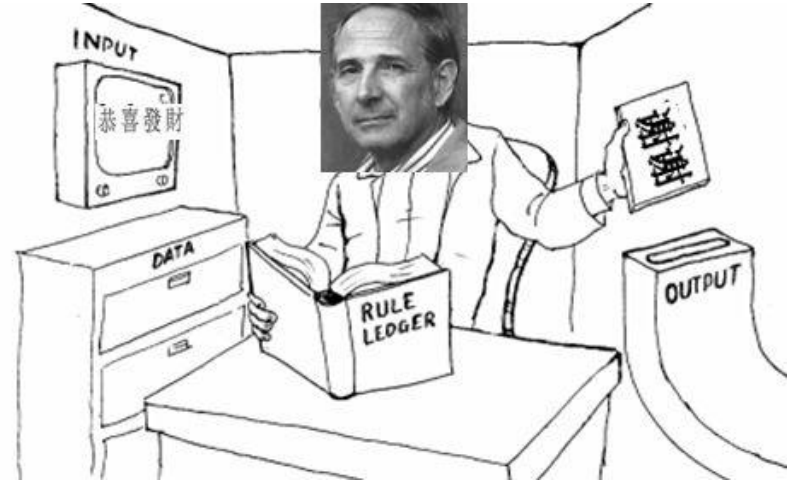


Semboller



**Sensörler,
Motorlar,
Eyleyiciler**

, ...



(Searle, 1980):
Çince Odası



Yapay Zekâ

- “soyut düşünme”
- “anlama”
- “iletişim”
- “mantık yürütme”
- “öğrenme”
- “plan yapma”
- “problem çözme”
- ...



Teşekkürler

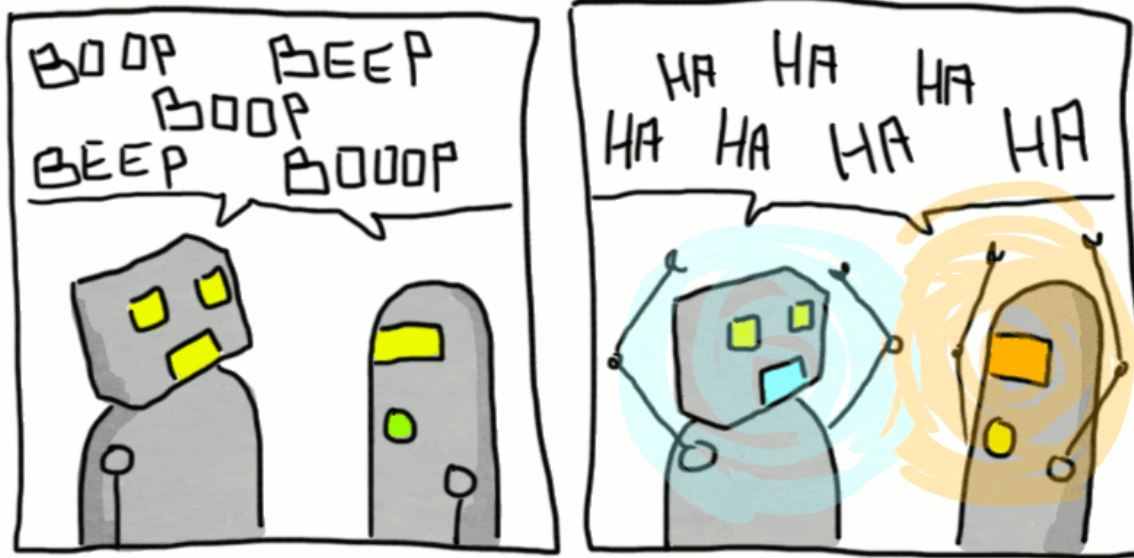


Emergence of communication in RObots through
Sensorimotor and Social Interaction

Bu çalışmalar 109E033, 111E287 ve
215E133 numaralı TÜBİTAK
projeleri tarafından
teklenmiştir.



RobotCub.org



<http://kovan.ceng.metu.edu.tr/~sinan>