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FACEBOOK AI



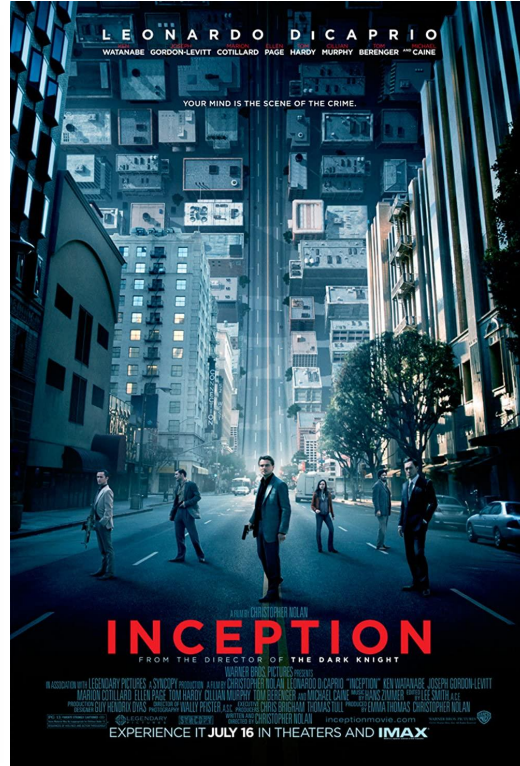
Interpretable Emergent Communication from Scratch

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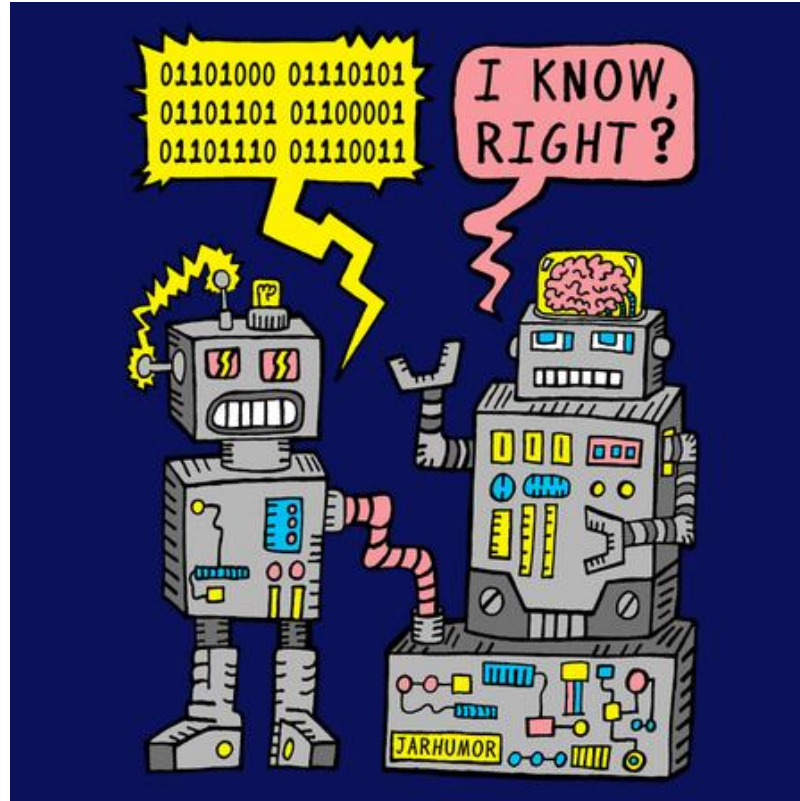
Neural Agents and Their Performance



Agents' Coordination



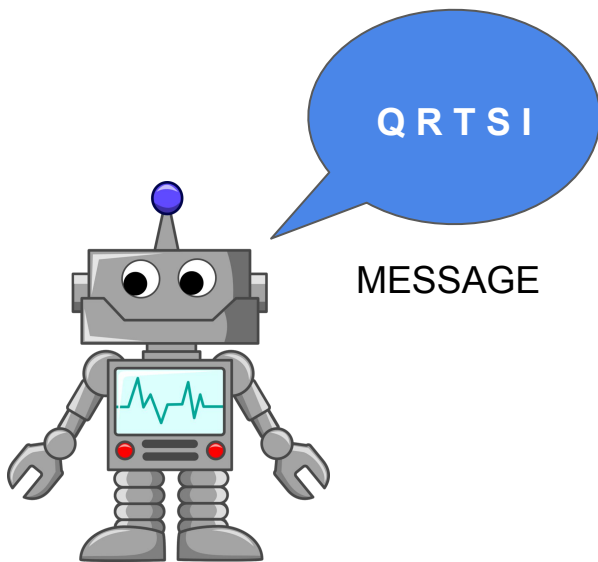
Language-Based Coordination



Discrimination Game

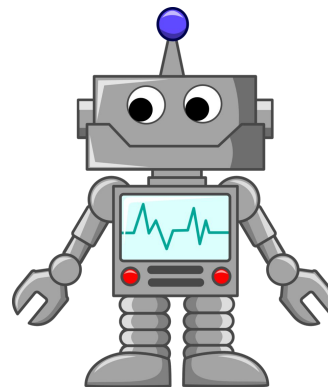


TARGET



SENDER

MESSAGE

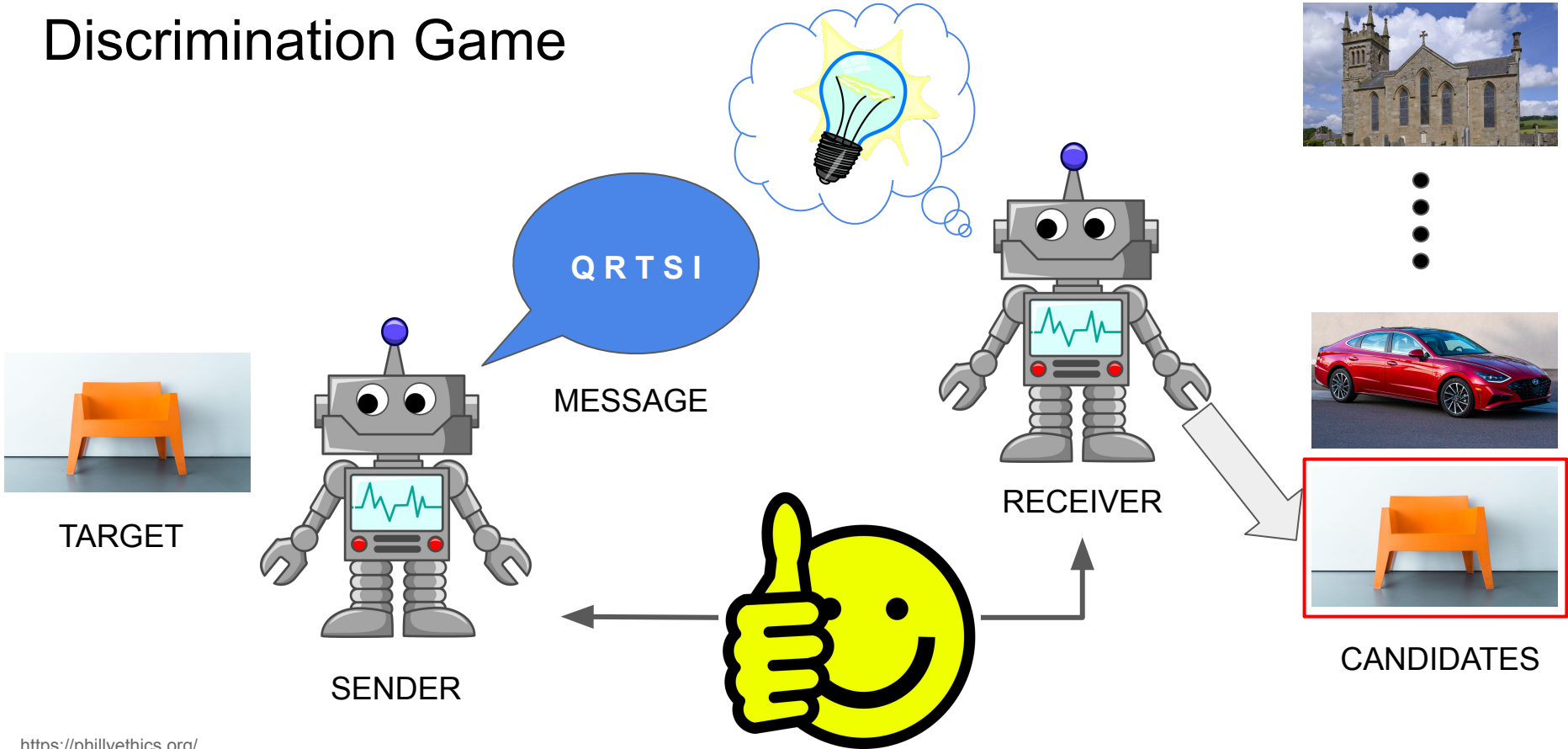


RECEIVER



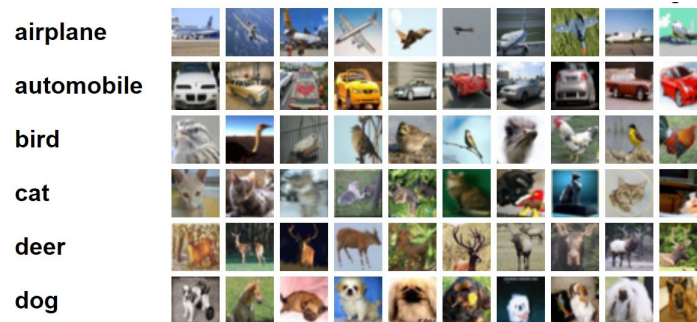
CANDIDATES

Discrimination Game

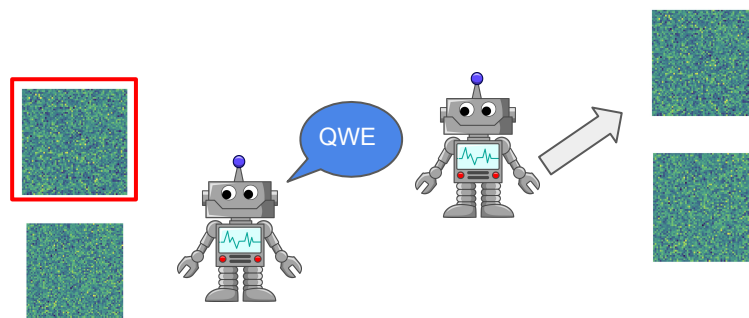


Current Shortcomings

- Limited number of concepts
- Use of shared nets pre-trained

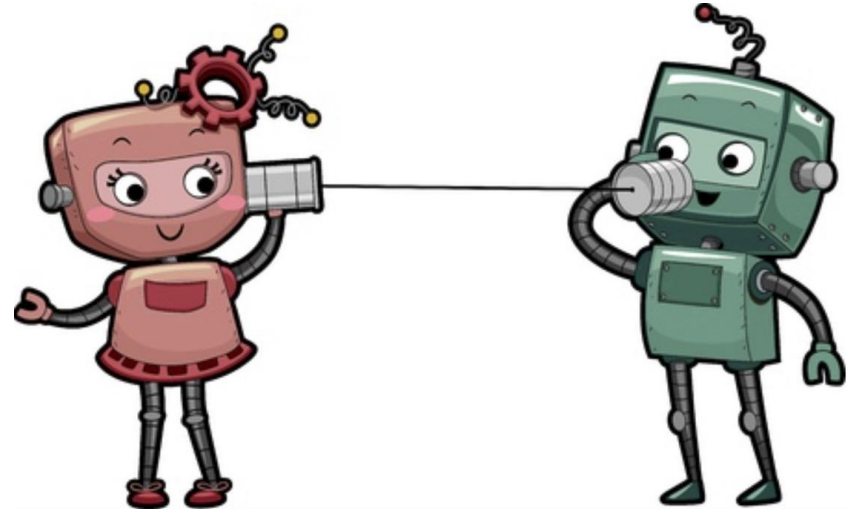


- Evidence language is degenerate

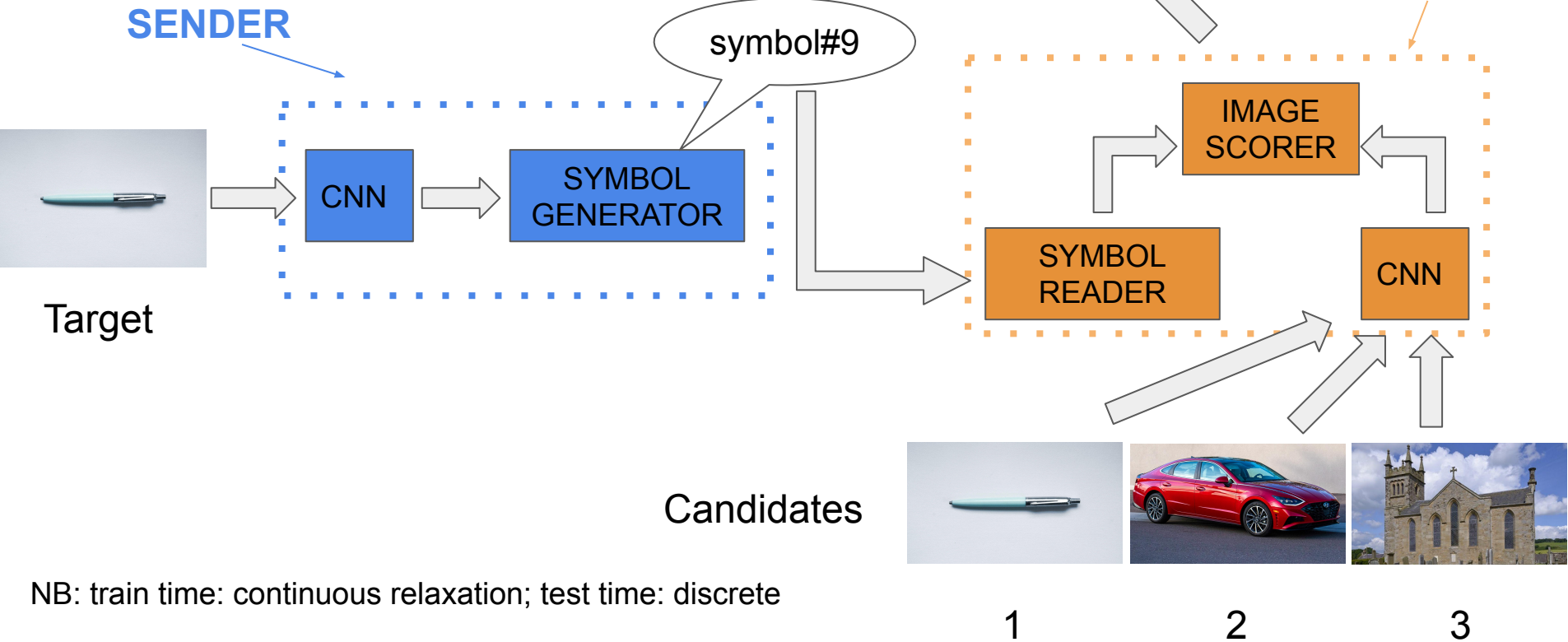


Main Goals

- Develop agents that are able to recognize realistic visual input
- Recognize such input while developing a shared communication and visual system from the ground up
- Foster the emergence of a protocol that describe meaningful semantic concepts



Game Architecture



NB: train time: continuous relaxation; test time: discrete

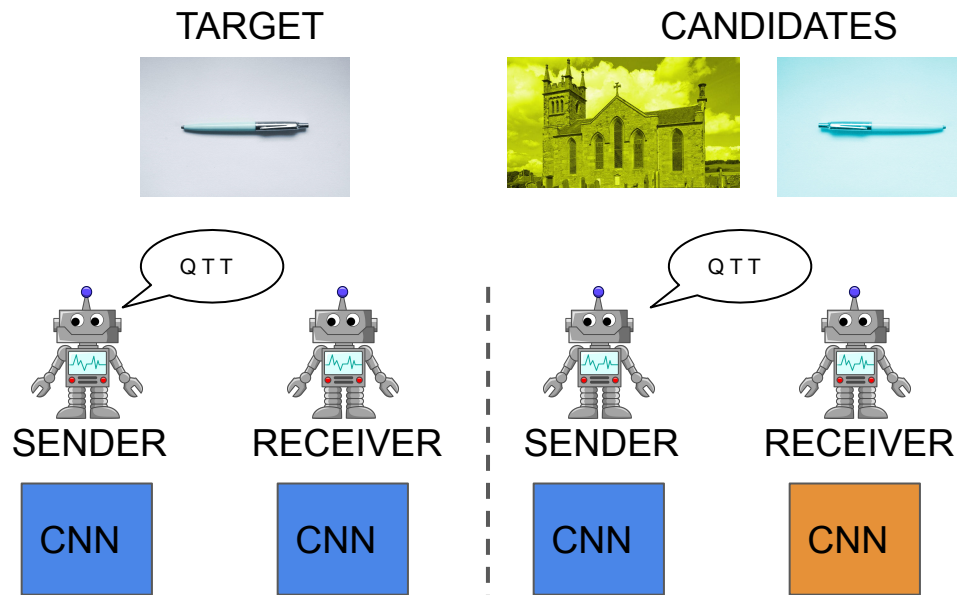
Main Novelty

- Large scale dataset
 - Use of ILSVRC-12



- Image augmentation
 - Helps avoid low-level coordination

- Non-shared visual module
 - Simulate realistic interaction

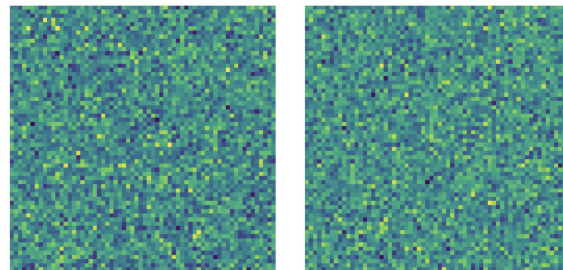


Discrimination Game

	ILSVRC-12 val	Out-of-distribution set
Chance	0.8%	0.8%
Informed Sender (Lazaridou et al. 2017)	31.2%	30.9%
Communication game – shared – augmentations	91.2%	90.8%
Communication game + shared – augmentations	92.8%	92.8%
Communication game – shared + augmentations	81.5%	72.0%
Communication game + shared + augmentations	82.2%	73.7%

Low-level Coordination

Game setup	Gaussian test set
- shared - augmentations	43.4%
+ shared - augmentations	84.7%
- shared + augmentations	0.8%
+ shared + augmentations	0.8%



Language Analysis

	ILSVRC-val			OOD set	
Game Setup	Msg count	nMI		Msg count	nMI
- shared - augmentations	2044	0.50		1921	0.45
+ shared - augmentations	2048	NotSig		2025	NotSig
- shared + augmentations	2042	0.58		1752	0.53
+ shared + augmentations	2046	0.56		1787	0.51



Symbol 1



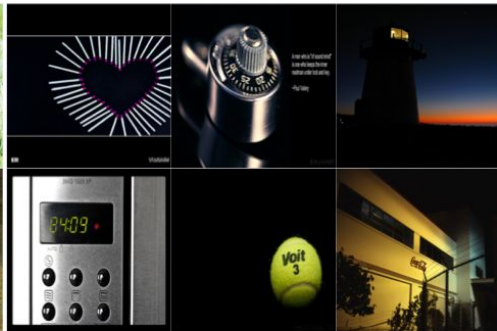
Symbol 2



Symbol 3



Symbol 4

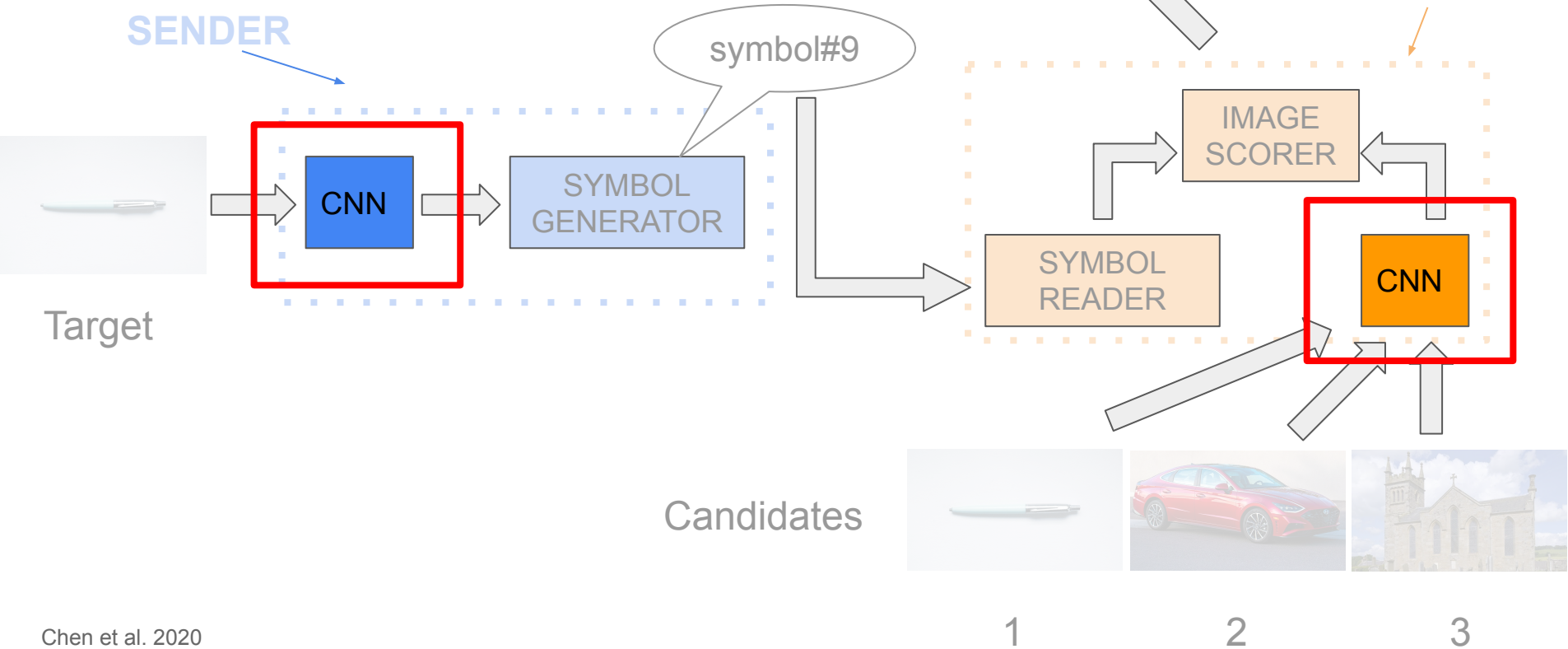


Symbol 5



Symbol 6

Connection to SSL

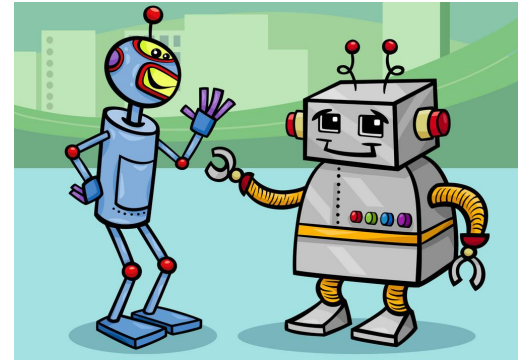


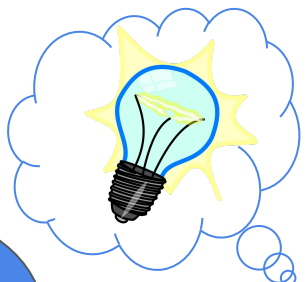
Visual Features Evaluation and Transfer Learning

	ILSVRC-Val	Places205	iNaturalist2018	VOC207
Supervised	76.5%	53.2%	46.7%	87.5%
SimCLR	60.6%	49.0%	31.8%	78.7%
Communication game - shared + augmentations	59.0%	47.9%	30.8%	77.0%
Communication game + shared + augmentation	60.2%	49.1%	31.3%	78.8%

Conclusion

- Deep agents can learn to communicate about a high number of (unseen) object categories
- Agents' communication is interpretable and can be seen as a form of unsupervised image labelling
- Communication helps developing high-quality and reusable visual features from scratch



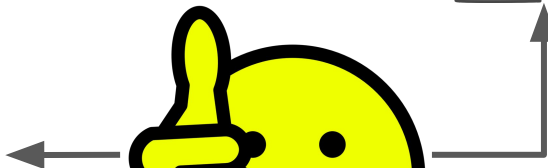
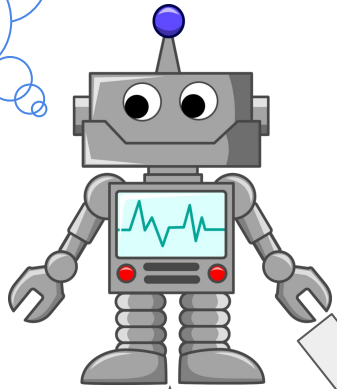
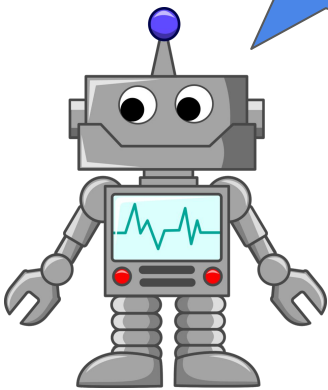


Thanks!

I'm NOT FINISHED YET

Thank You!

Thank You!



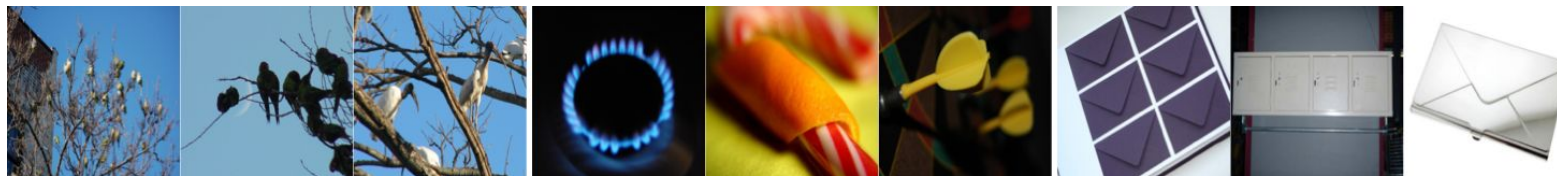


Symbol 1

Symbol 2

Symbol 3

ILSVRC-12



Symbol 1

Symbol 2

Symbol 3

Out of Distribution set

Future Work

- Communication with longer messages
- Contextually realistic distractors in the referential game
- Connection between emergent communication and SSL

