The Will of Computer Vision

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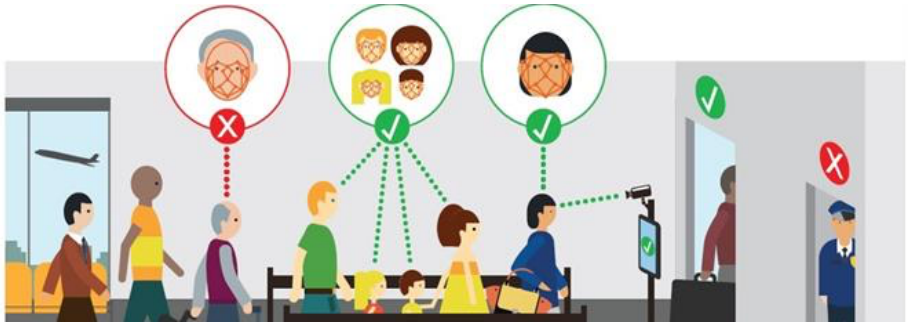
Facial recognition:



Self-driving cars:

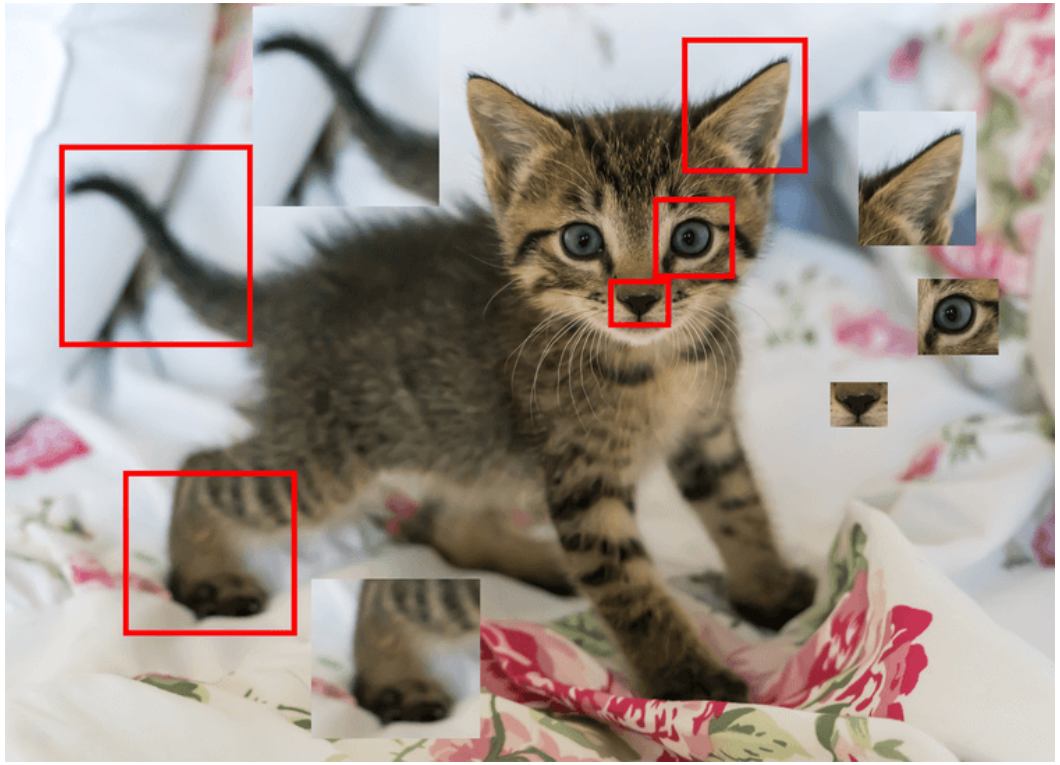
Medical imaging:

Robotic surgery:

https://www.thalesgroup.com/en/markets/digital-identity-and-security/government/biometrics/facial-recognition
https://www.fastcompany.com/90145568/19-artists-draw-their-perfect-self-driving-car
https://blogs.nvidia.com/blog/2020/08/12/lunit-insight-cxr/
https://www.cambridgeindependent.co.uk/business/milestone-as-cmr-surgical-s-versius-robot-is-used-by-nhs-hospitals-for-first-time-9100442/

The Will of Computer Vision was

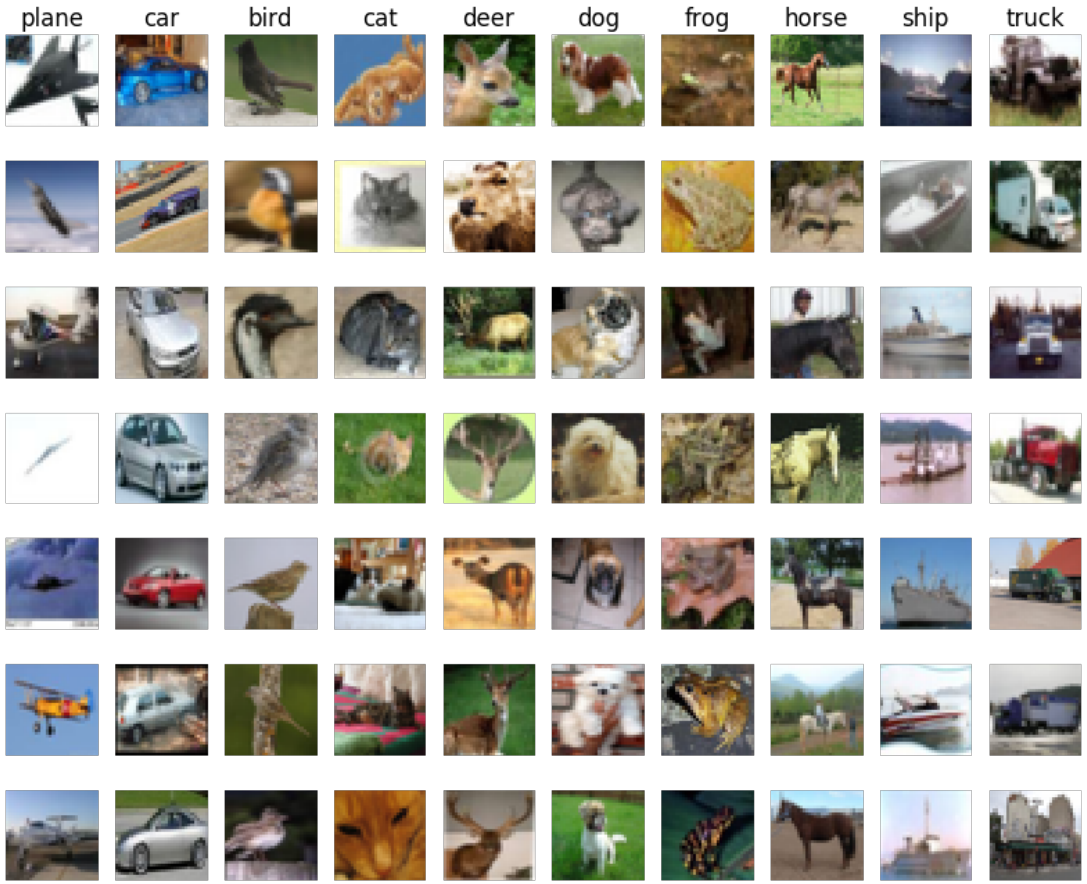
Feature Engineering and Matching



https://techxplore.com/news/2017-03-survival-ai-revolution.html

The Will of Computer Vision was

Large-scale Image Categorization



Categorization vs. Contrast

Categories in the real world are

Non-orthogonal

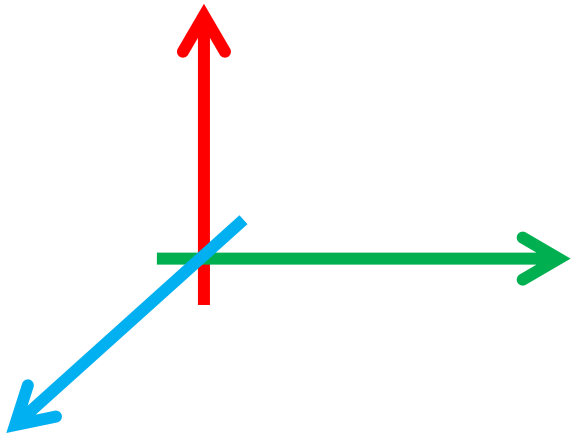
Unbalanced

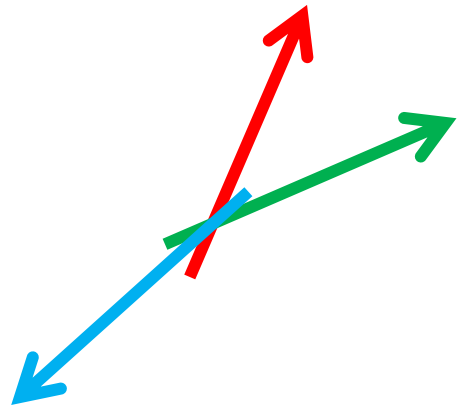
Exponential

(1,0,0)

(0,1,0)

(0,0,1)





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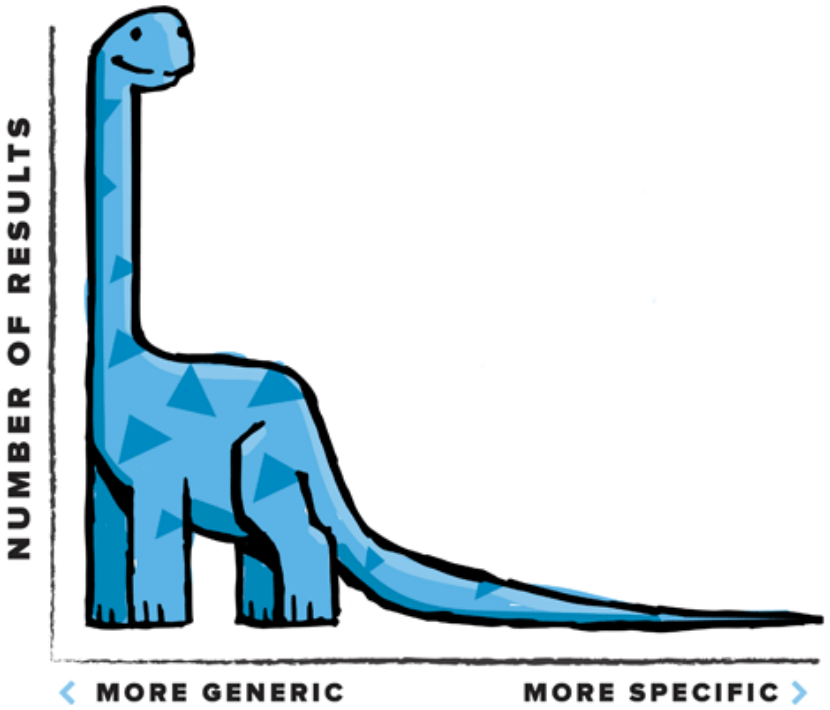

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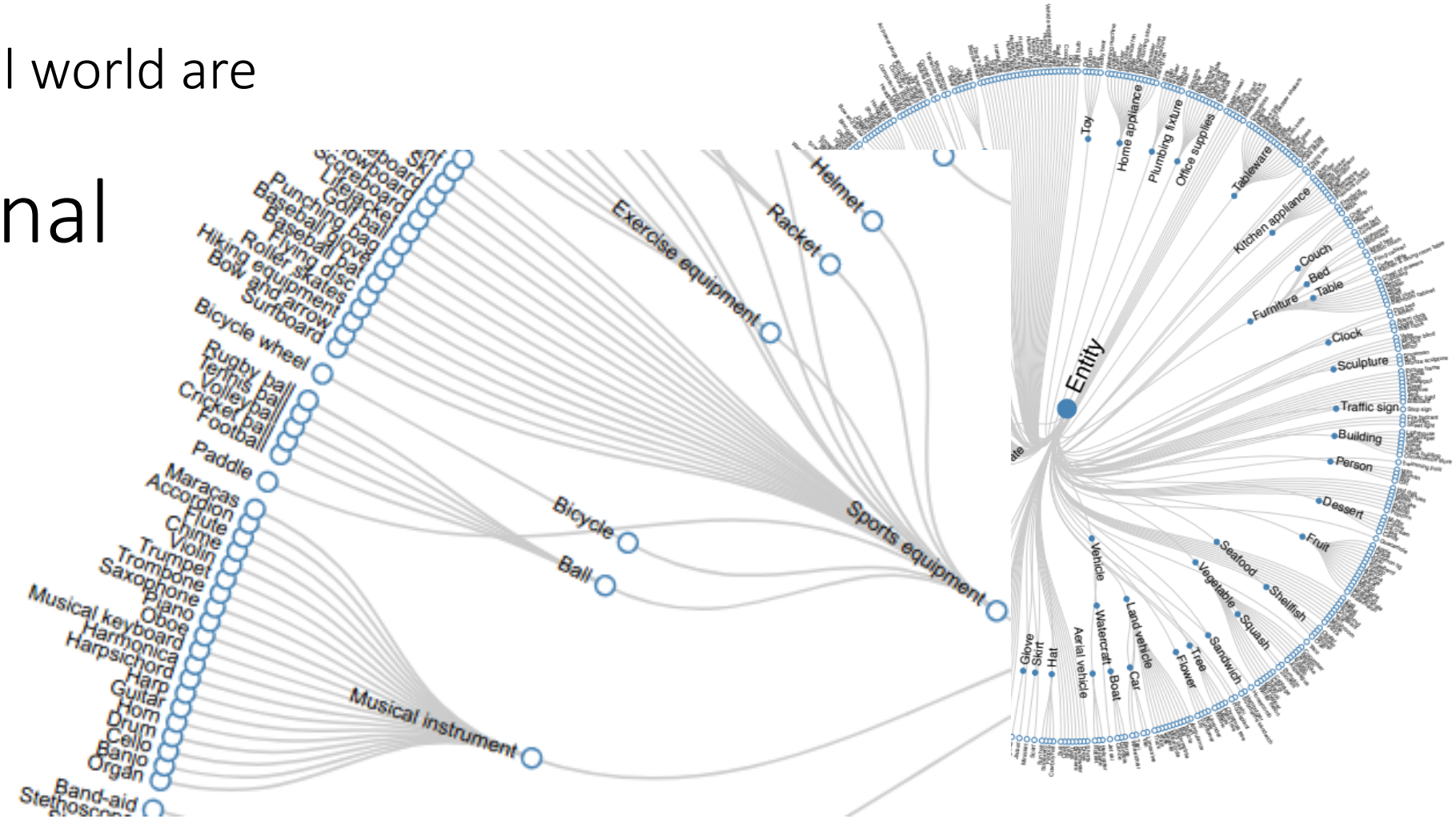

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Large-scale Hidden Context Prediction

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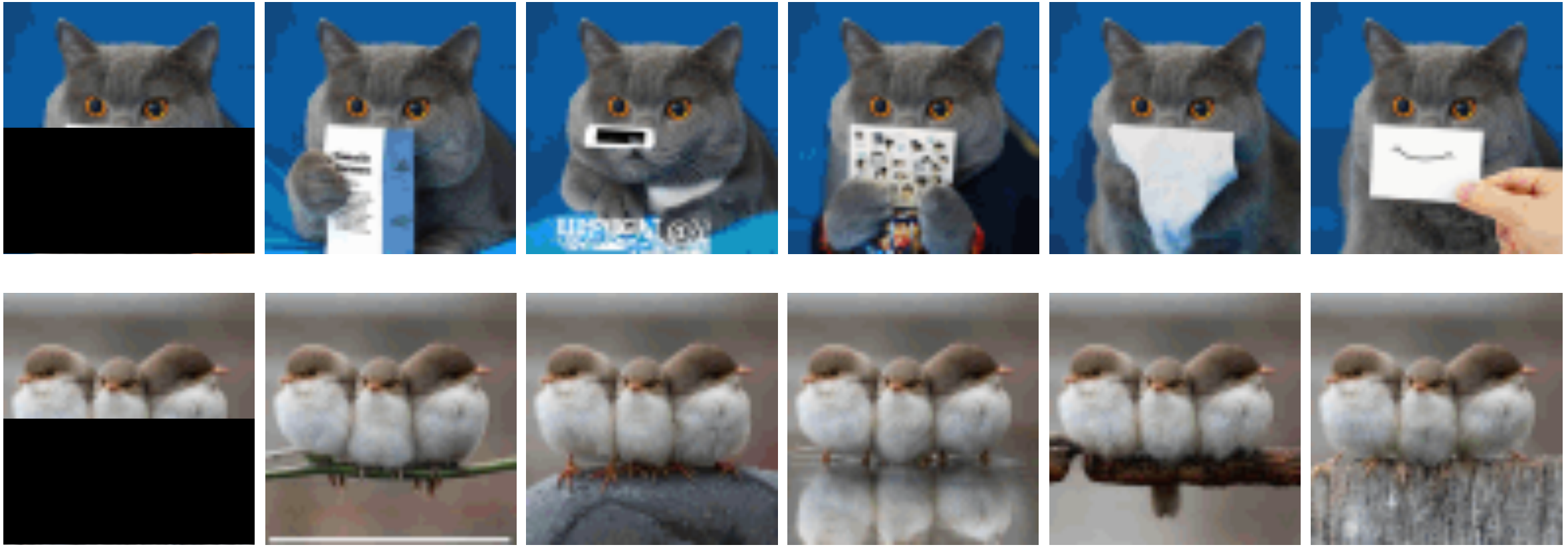
Large-scale Hidden Context Prediction



https://openai.com/blog/image-gpt/

The Will of Computer Vision was

Large-scale Multiple View Discrimination

The Will of Computer Vision was

Large-scale Multiple View Discrimination

Feng, R., Zhou, Z., Gotway, M.B. and Liang, J., 2020. Parts2Whole: Self-supervised Contrastive Learning via Reconstruction. In Domain Adaptation and Representation Transfer, and Distributed and Collaborative Learning (pp. 85-95). Springer, Cham.

WILL: A Novel Pre-training

So Many Pre-trainings: A Survey

	ISIC			ChestX		
	5-shot	20-shot	50-shot	5-shot	20-shot	50-shot
InsDis	43.90 ± 0.55	52.19 ± 0.53	55.76 ± 0.50	25.67 ± 0.42	29.13 ± 0.44	31.77 ± 0.44
MoCo-v1	**44.42 ± 0.55**	**53.79 ± 0.54**	56.81 ± 0.52	25.92 ± 0.45	30.00 ± 0.43	32.74 ± 0.43
PCL-v1	33.21 ± 0.48	38.01 ± 0.44	39.77 ± 0.45	23.33 ± 0.40	25.54 ± 0.43	27.40 ± 0.42
PIRL	43.89 ± 0.54	53.24 ± 0.56	56.89 ± 0.52	25.60 ± 0.41	29.48 ± 0.45	31.44 ± 0.47
PCL-v2	37.47 ± 0.52	44.40 ± 0.52	46.82 ± 0.46	24.87 ± 0.42	28.28 ± 0.42	30.56 ± 0.43
SimCLR-v1	43.99 ± 0.55	53.00 ± 0.54	56.16 ± 0.53	26.36 ± 0.44	30.82 ± 0.43	33.16 ± 0.47
MoCo-v2	42.60 ± 0.55	52.39 ± 0.49	55.68 ± 0.53	25.26 ± 0.44	29.43 ± 0.45	32.20 ± 0.43
SimCLR-v2	43.66 ± 0.58	53.15 ± 0.53	56.83 ± 0.54	26.34 ± 0.44	30.90 ± 0.44	33.23 ± 0.47
SeLa-v2	39.97 ± 0.55	48.43 ± 0.54	51.31 ± 0.52	25.60 ± 0.44	30.43 ± 0.46	32.81 ± 0.44
InfoMin	39.03 ± 0.55	48.21 ± 0.54	51.58 ± 0.51	25.78 ± 0.44	29.48 ± 0.44	31.58 ± 0.44
BYOL	43.09 ± 0.56	53.76 ± 0.55	**58.03 ± 0.52**	26.39 ± 0.43	30.71 ± 0.47	**34.17 ± 0.45**
DeepCluster-v2	40.73 ± 0.59	49.91 ± 0.53	53.65 ± 0.54	26.51 ± 0.45	**31.51 ± 0.45**	**34.17 ± 0.48**
SwAV	39.66 ± 0.54	47.08 ± 0.50	51.10 ± 0.50	**26.54 ± 0.48**	30.91 ± 0.45	33.86 ± 0.46
Supervised	39.38 ± 0.58	48.79 ± 0.53	52.54 ± 0.56	25.22 ± 0.41	29.26 ± 0.44	32.34 ± 0.45

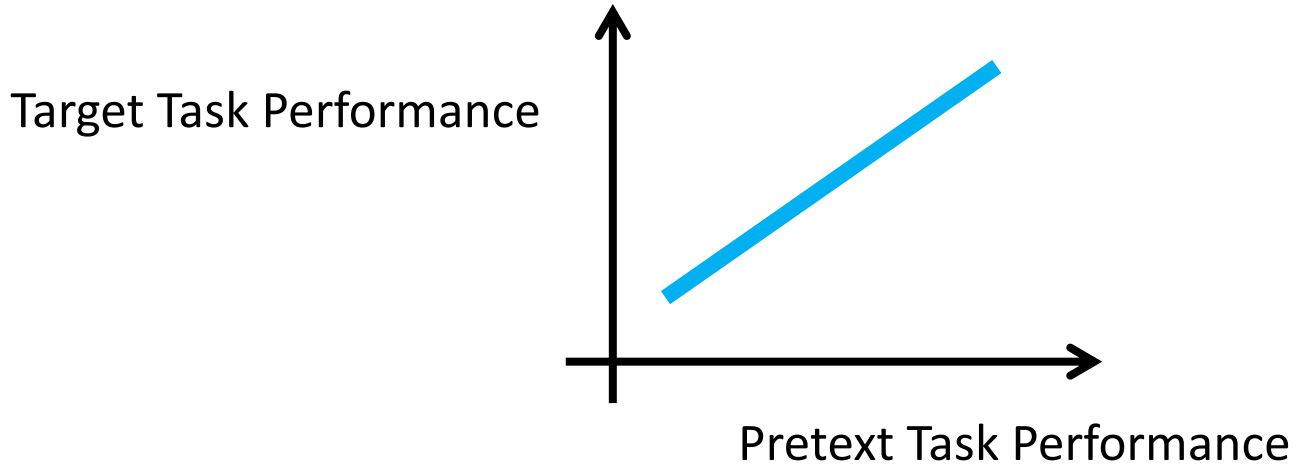
Ericsson, L., Gouk, H. and Hospedales, T.M., 2020. How Well Do Self-Supervised Models Transfer?. arXiv preprint arXiv:2011.13377./

The Will of Computer Vision—Literature

WILL: A Novel Pre-training

So Many Pre-trainings: A Survey

Do Better WILL Transfer?



Kornblith, S., Shlens, J. and Le, Q.V., 2019. Do better imagenet models transfer better?. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (pp. 2661-2671).

“Do not Define Anything”

The choice of augmented views

The choice of model architectures

The choice of pretext tasks

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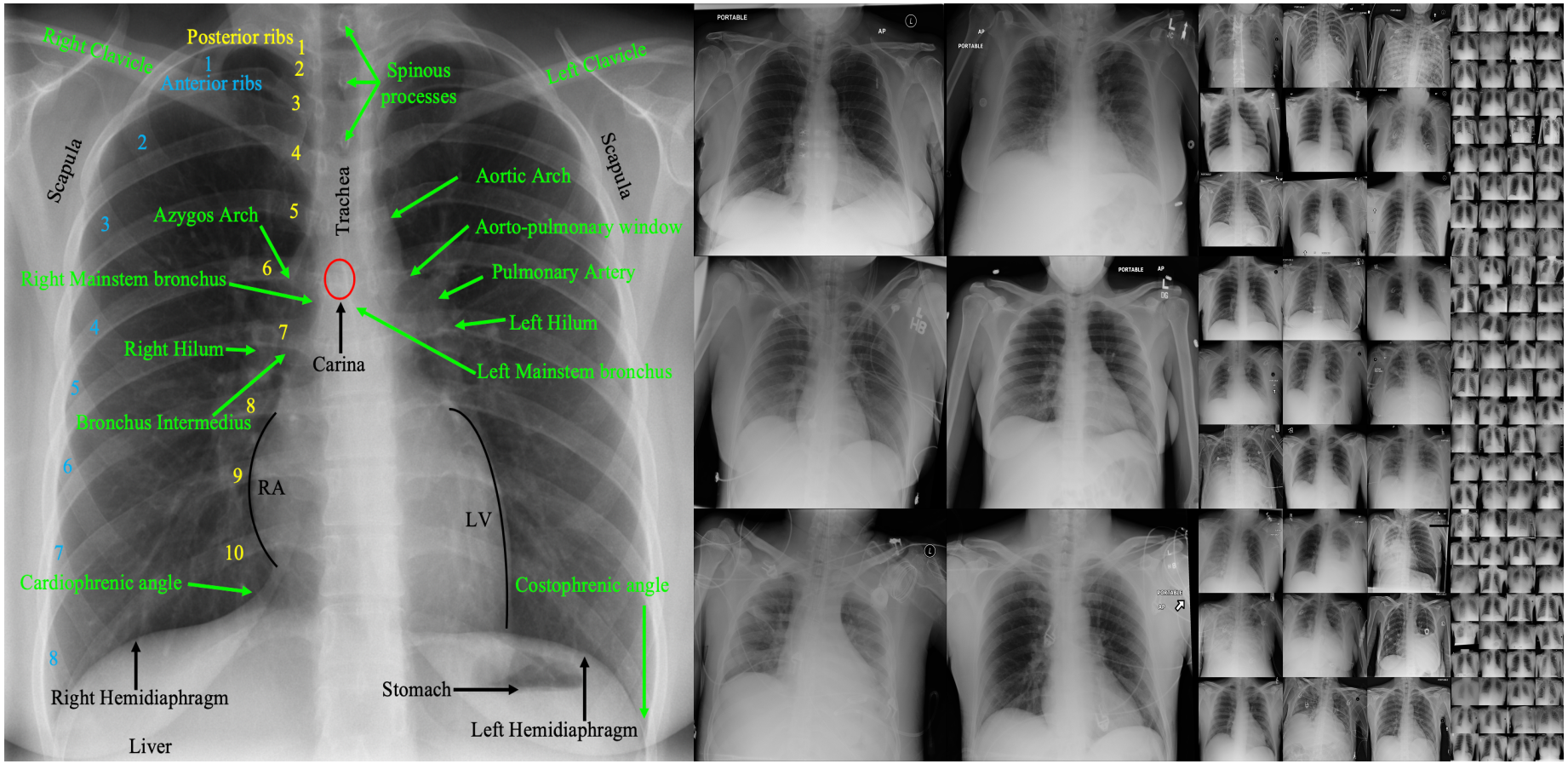
Medical Images Contain Consistent Anatomical Structures



Haghighi, F., Taher, M.R.H., Zhou, Z., Gotway, M.B. and Liang, J., 2020, October. Learning Semantics-enriched Representation via Self-discovery, Self-classification, and Self-restoration. In International Conference on Medical Image Computing and Computer-Assisted Intervention (pp. 137-147). Springer, Cham.

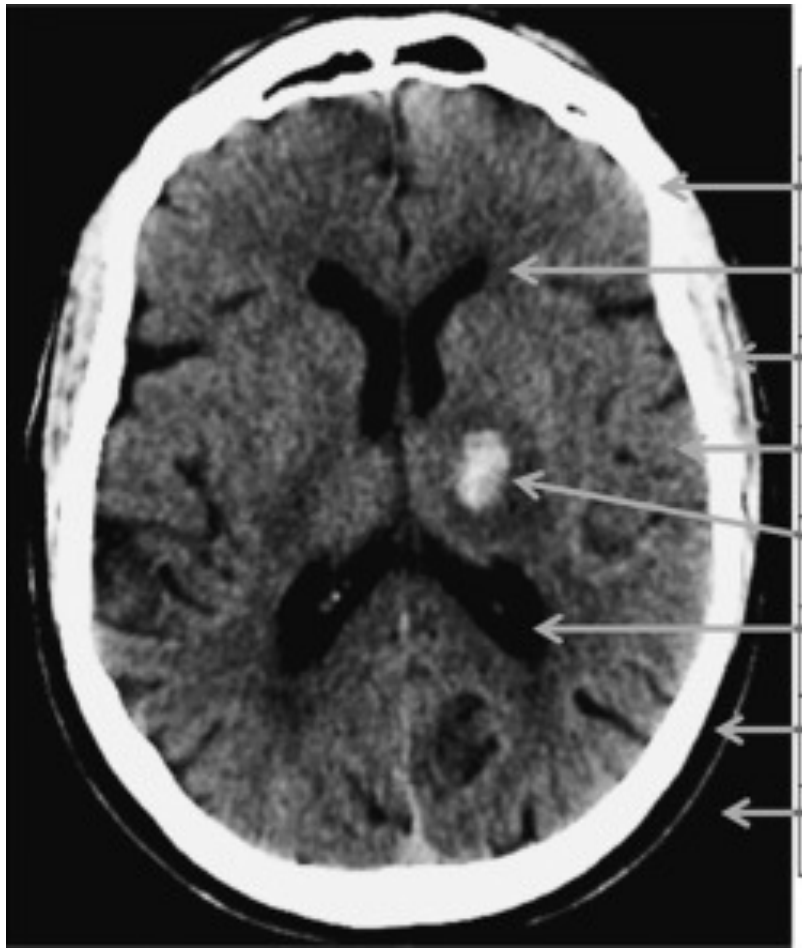
Haghighi, F., Taher, M.R.H., Zhou, Z., Gotway, M.B. and Liang, J., 2021, Transferable Visual Word. IEEE Transactions on Medical Imaging. (coming soon)

Natural Images *Sometimes* Contain Consistent Structures

https://www.biometricupdate.com/202001/facial-recognition-datasets-and-controversies-drive-biometrics-and-digital-id-news-of-the-week

Images are the Language of the Creator

Medical Images Convey Physical Meaning



CT Number Ranges in Hounsfield Units (HU)	
Bone	+1000
White matter	+20 to 30
Muscle	+20 to 40
Gray matter	+30 to 40
Hemorrhage	+65 to +95
CSF (water)	0
Fat	-30 to -70
Air	-1000

https://www.sciencedirect.com/topics/medicine-and-dentistry/hounsfield-scale
Zhou, Z., Sodha, V., Pang, J., Gotway, M.B. and Liang, J., 2020. Models genesis. Medical image analysis, 67, p.101840.

Medical Images are High Dimensional

http://henrybetts.co.uk/an-attempt-at-bullet-time/

The Will of Computer Vision

Pretext tasks and objective functions—

- Identifying the descriptive attributes from the image
- Minimizing the error between computer predictions and human labels
- Predicting some hidden portion of the image
- Distinguishing different views of context and instance
- **Learning characteristics of special image modality**