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The Next Generation of Medical AI

Deep learning based medical image standardization

2022 Korea-UK AI/ML workshop

Sejong University

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Our Team

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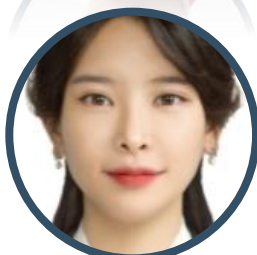
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- Professor at Dept of Bio and Brain Engineering (KAIST)
- IEEE Fellow
- IEEE Senior Member

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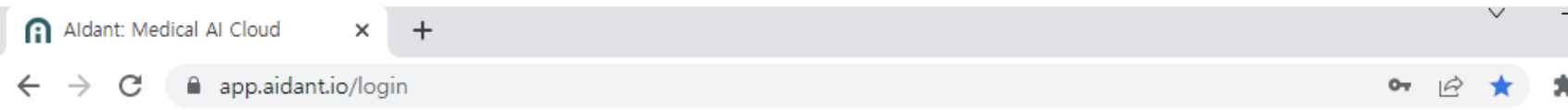
Download 2000 high quality synthetic chest x-ray images at below site.

app.aidant.io/login

MEDICAL AI CLOUD
AIdant

Synthetic Chest X-ray Images

Original Data
We trained a generative adversarial network with high-quality medical image data collected in a large domestic hospital. In the case of chest X-ray images, for example, about 100,000 images of normal and abnormal images each were used for training the model. The training process was conducted in a legitimate way through the Institutional Review Board (IRB) for research ethics.

Visual Turing Test
We conducted a Visual Turing Test with five specialists in thoracic radiology to verify the quality of the synthetic chest X-ray images. We prepared 100 pieces of real and synthetic images each, randomly mixed them, and then asked whether the presented image was real or synthetic one. The test results averaged about 60% accuracy, which shows that the synthetic image is very difficult to distinguish from the real image.

Synthetic Chest X-ray Images
Our synthetic chest X-ray images are provided as an 8-bit PNG file and have a size of 1024 x 1024 in pixel. To preserve the characteristics of the original data, the histogram equalization was not applied, and a minimal pre-processing was applied (clip the brightness of the top 1% on the original data). The original data is divided into normal and abnormal based on the diagnosis code, and the synthesized images learned based on this are also provided as normal and abnormal groups, respectively.

Sample Details
Samples of synthetic chest X-ray image data are provided in units of 1,000 each for normal and abnormal.

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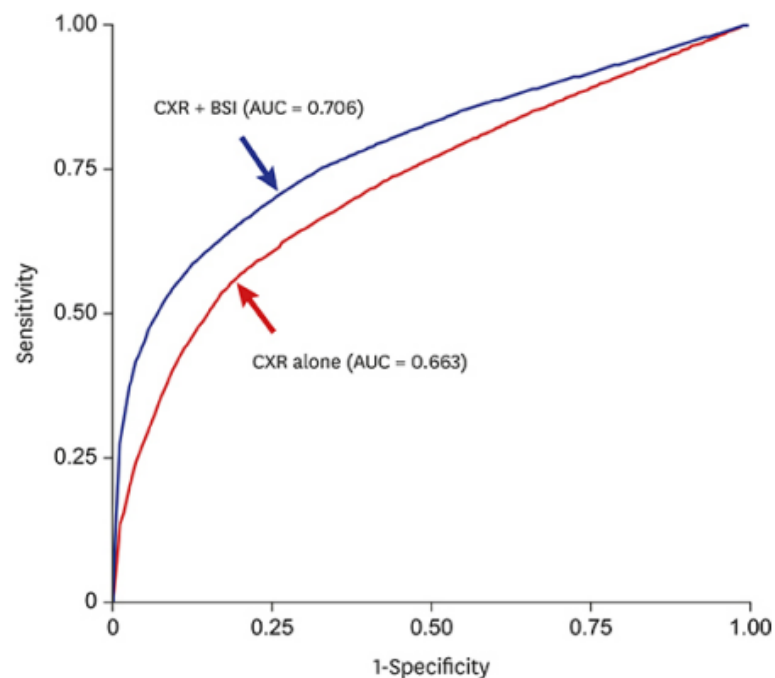# AI model as a good supporter

Fig. 1. The mean ROC curves for per-regional detection of subtle lung lesions on CXR without and with BSI by ten readers.
AUC = area under the ROC curve, ROC = receiver operating characteristic, CXR = standard chest radiographs, BSI = bone suppression image.
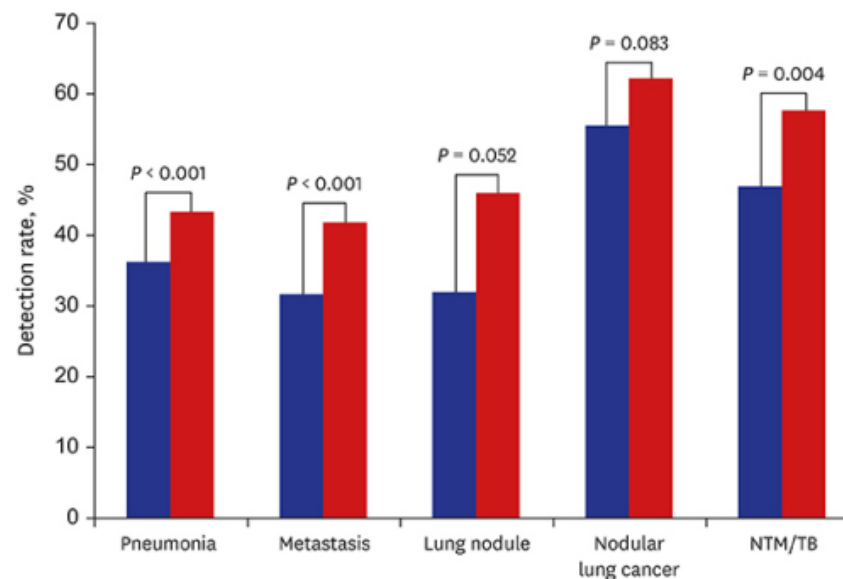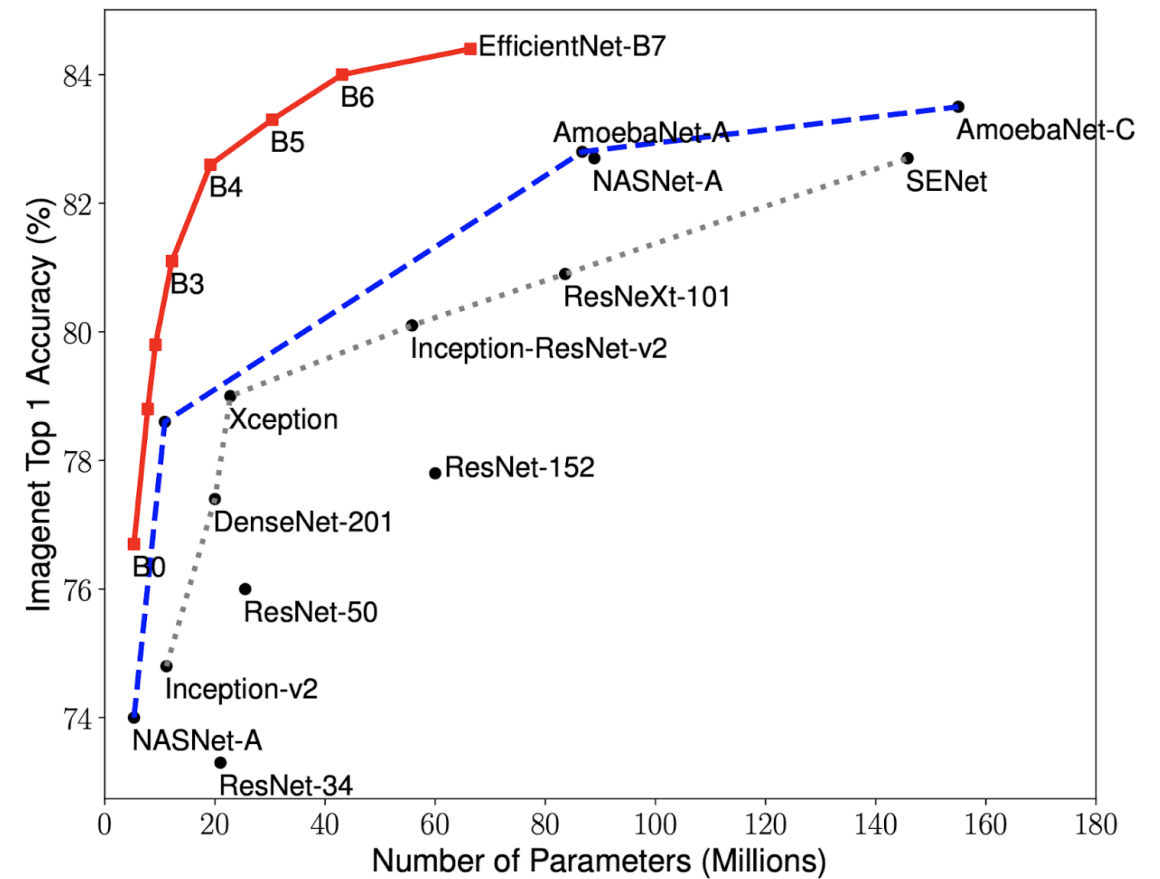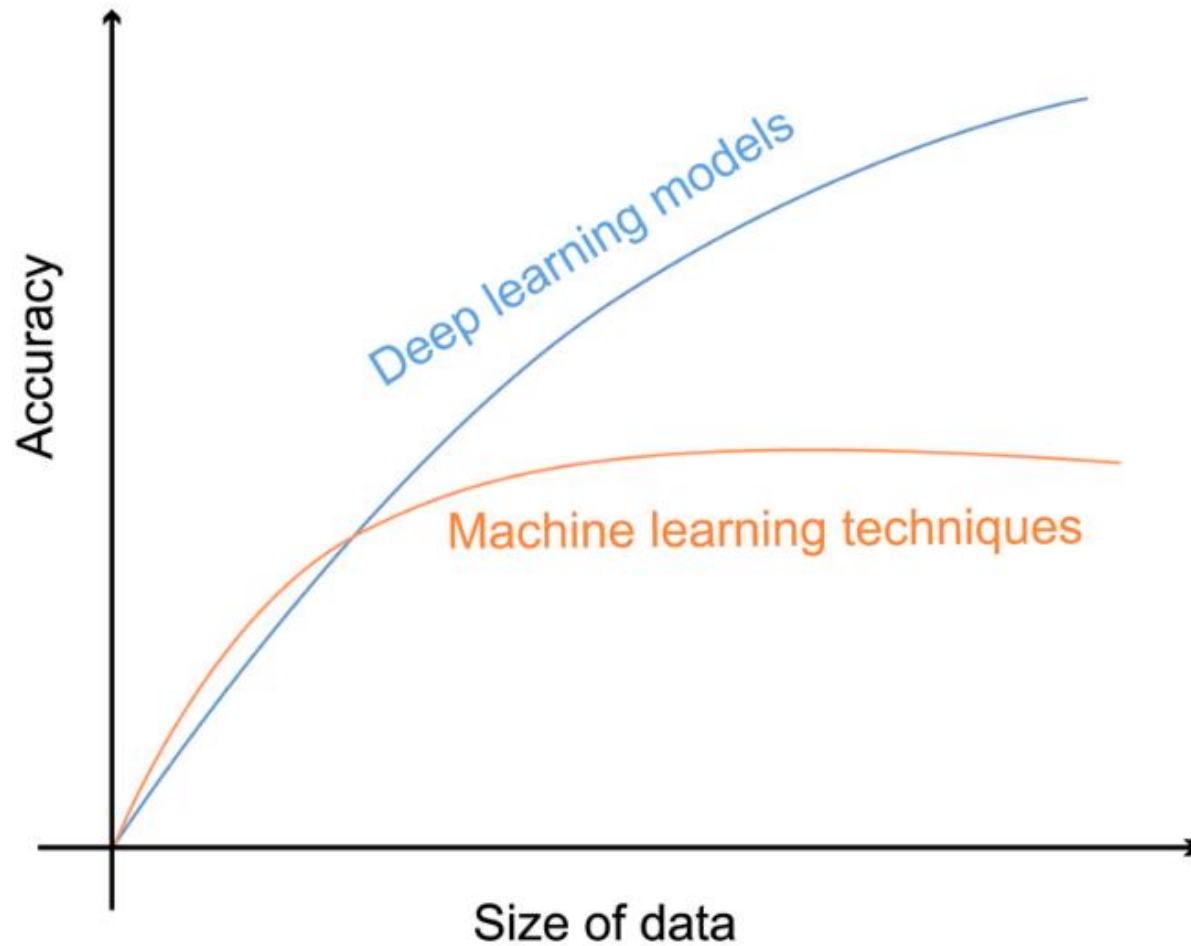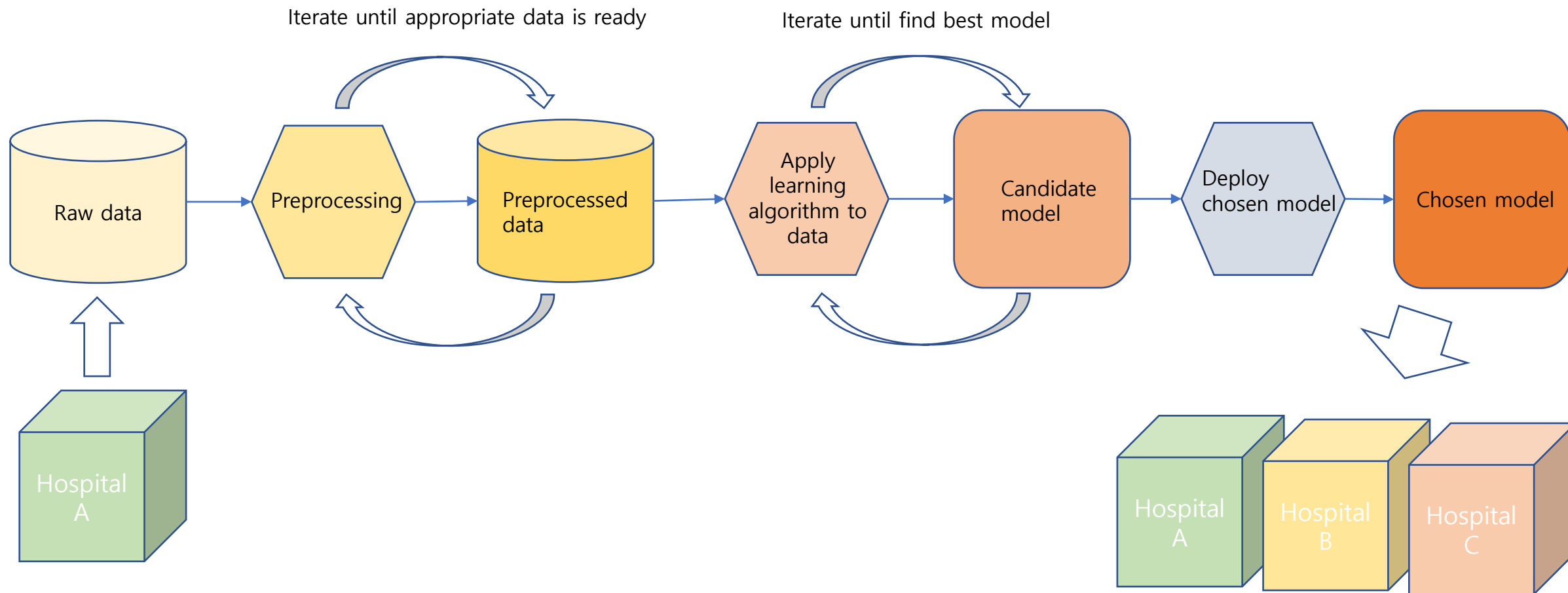

Fig. 2. The per-regional detection rate for five lung diseases on CXR without or with BSI.
CXR = standard chest radiographs, BSI = bone suppression image, NTM/TB = non-tuberculous mycobacterial infection or pulmonary tuberculosis.

AI needs large amount of learnable data/parameters

Standard protocol of data analysis

Standard protocol usually has generalization issue

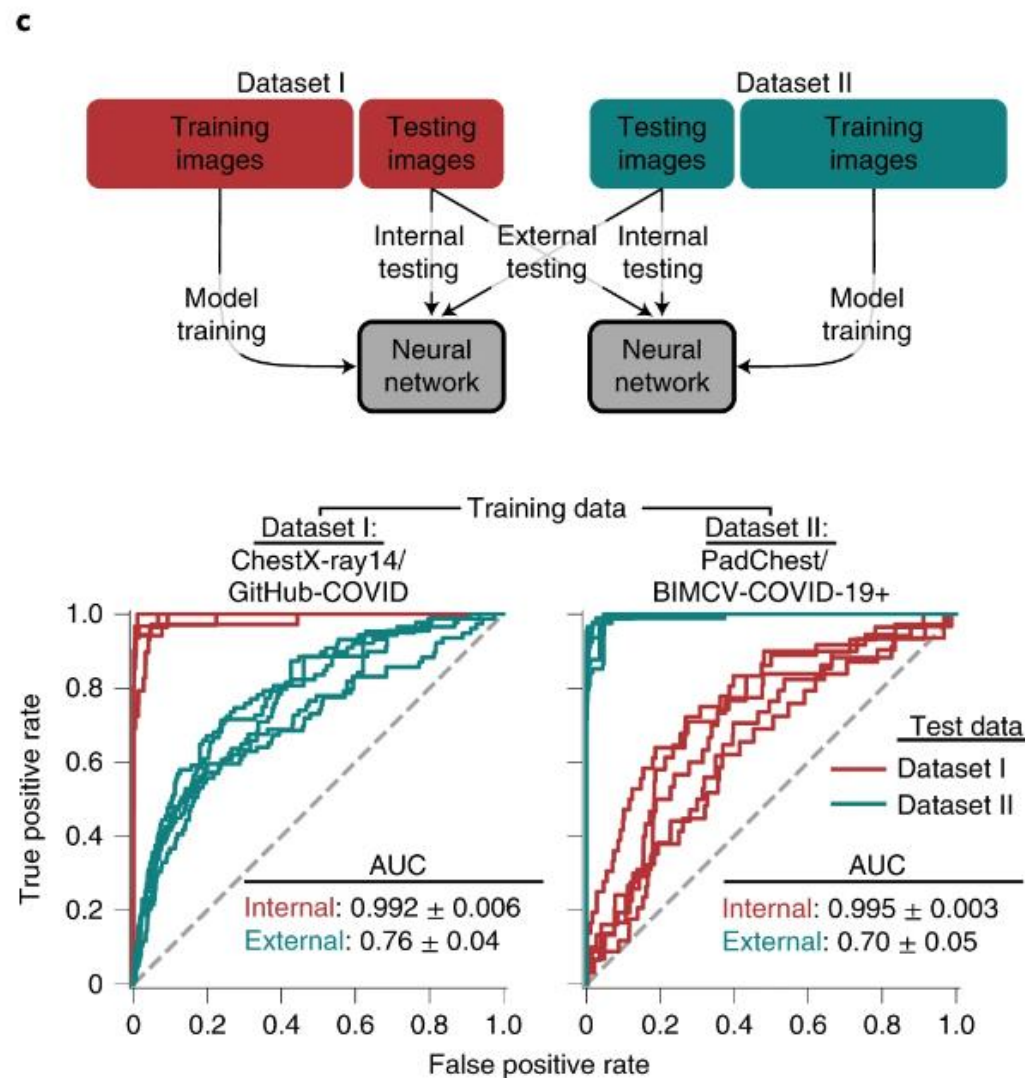https://pubmed.ncbi.nlm.nih.gov/33085623
Measuring Domain Shift for Deep Learning in Histopathology
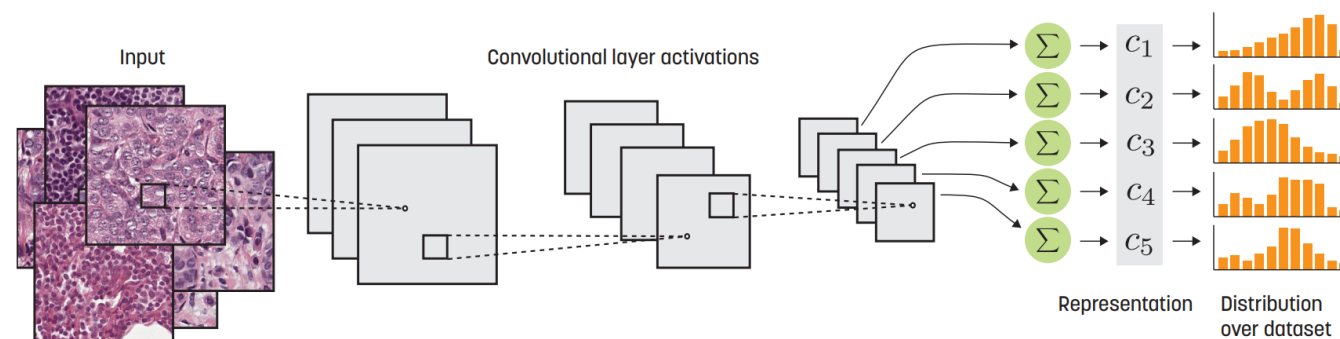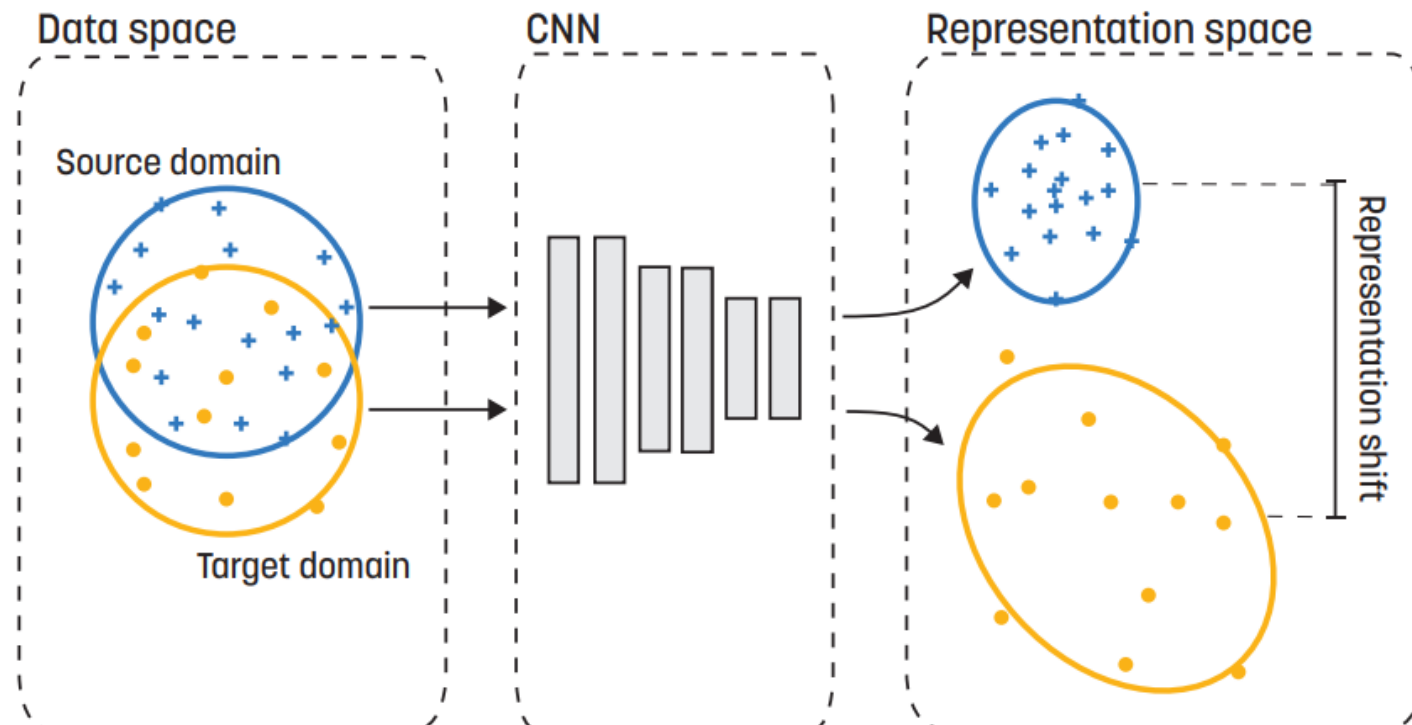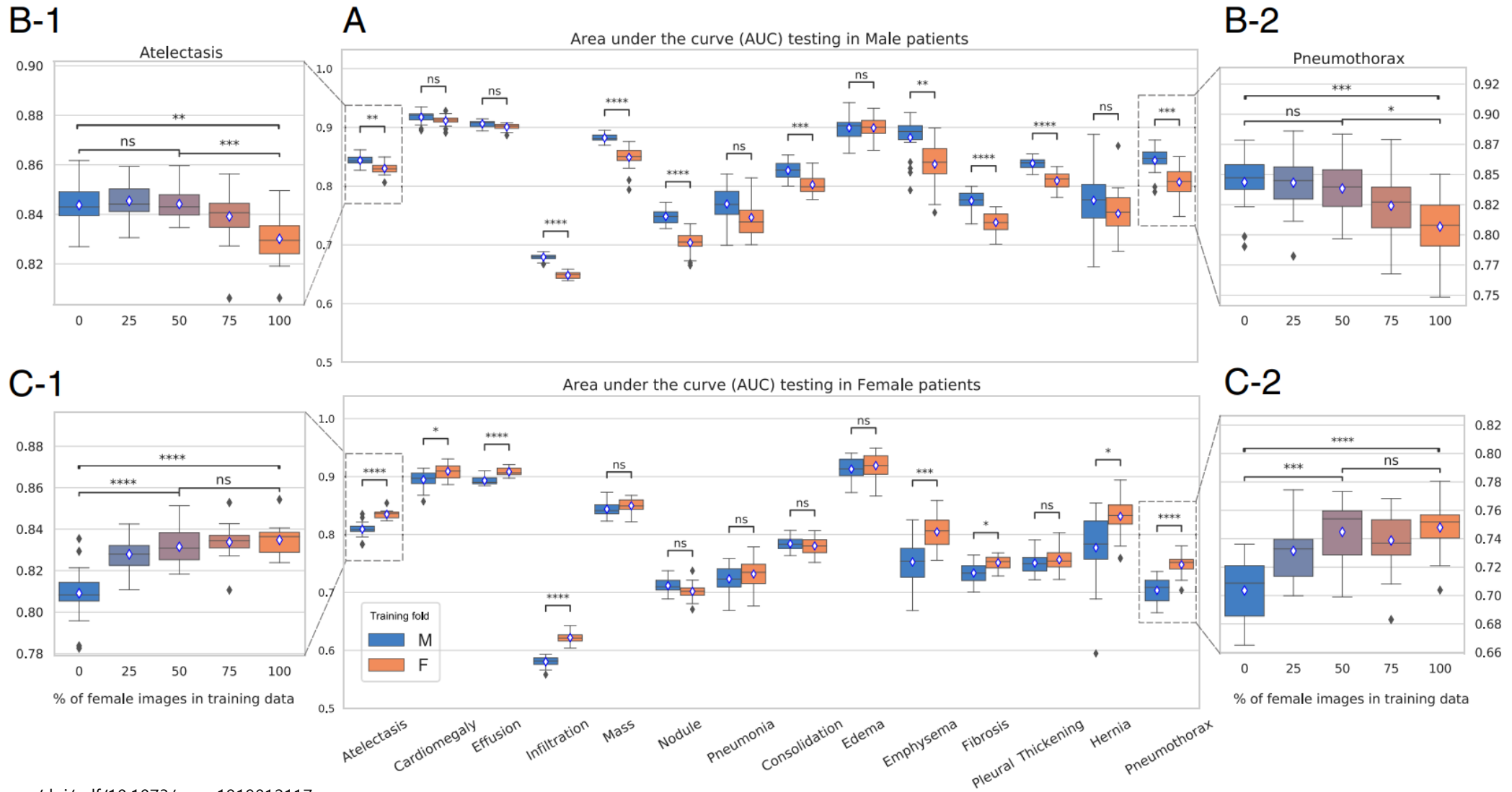
Domain discrepancies resulted in useless model

Standard protocol of data analysis should be adaptable
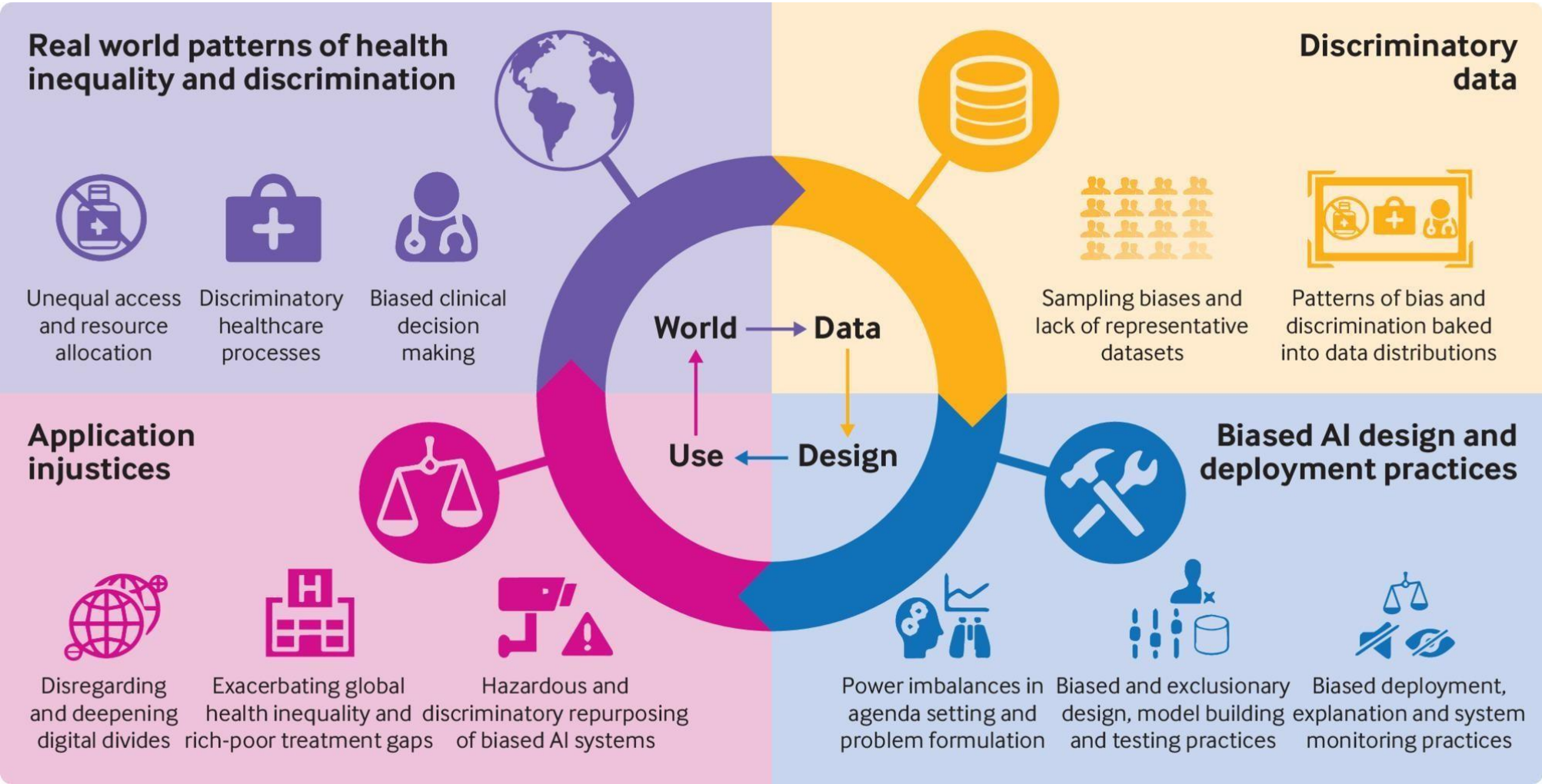
Medical image acquisition from different CT vendor

% Share of Installations: Whole Body CT including NM

2012 to 2020

Source: U.S. FDA / Colorado Department of Public Health and Environment
Prepared by: Stuart Kusta, Principle Analyst at Prerequisite Market Intelligence

Pie chart (2012 to 2020):
- Canon 10%
- Siemens 28%
- Philips 8%
- Hitachi 0%
- GE 54%

Bar chart legend: GE, Canon, Hitachi, Philips, Siemens (2012–2020)

https://medicalimagingmarketcom.wordpress.com/2021/05/11/oem-market-share-computed-tomography-united-states/
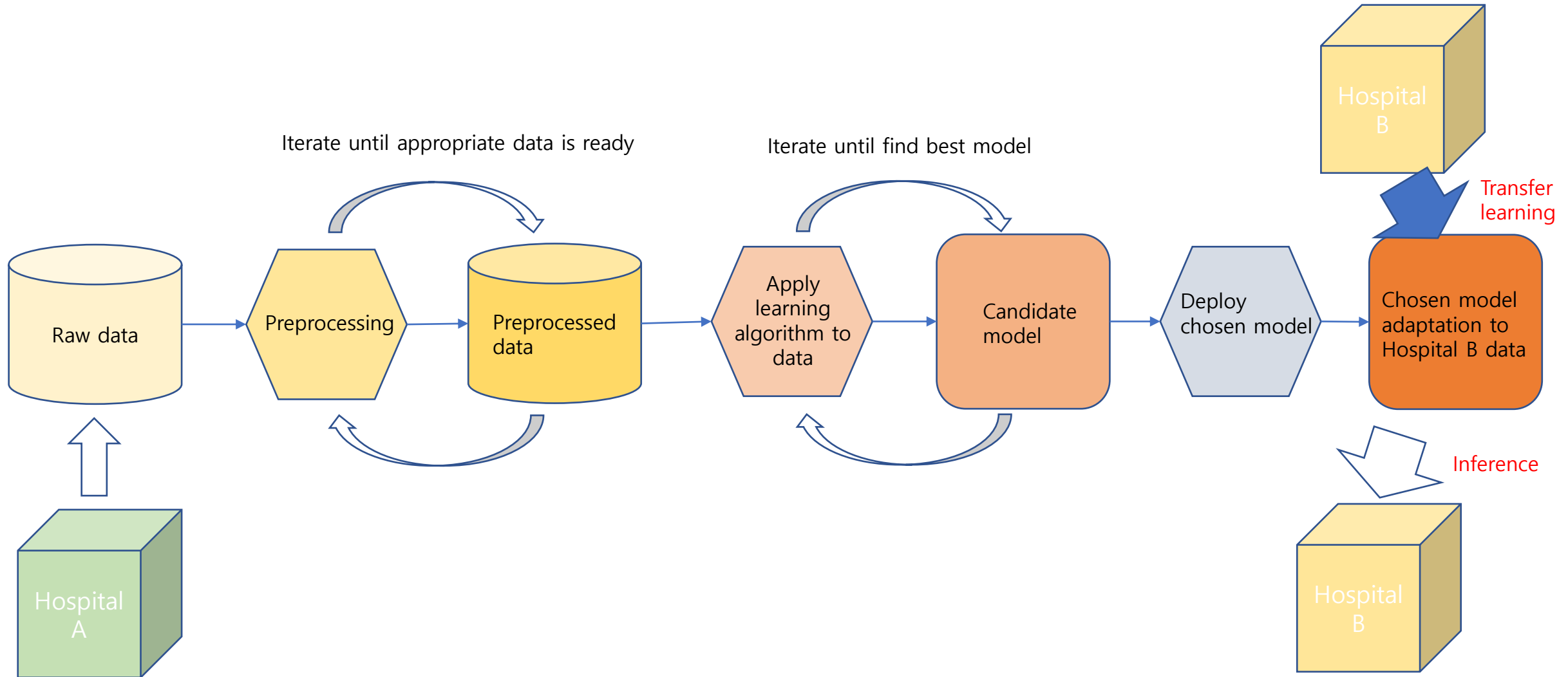
Medical image acquisition from different patient charac.

AI should know specific domain or should be generalized
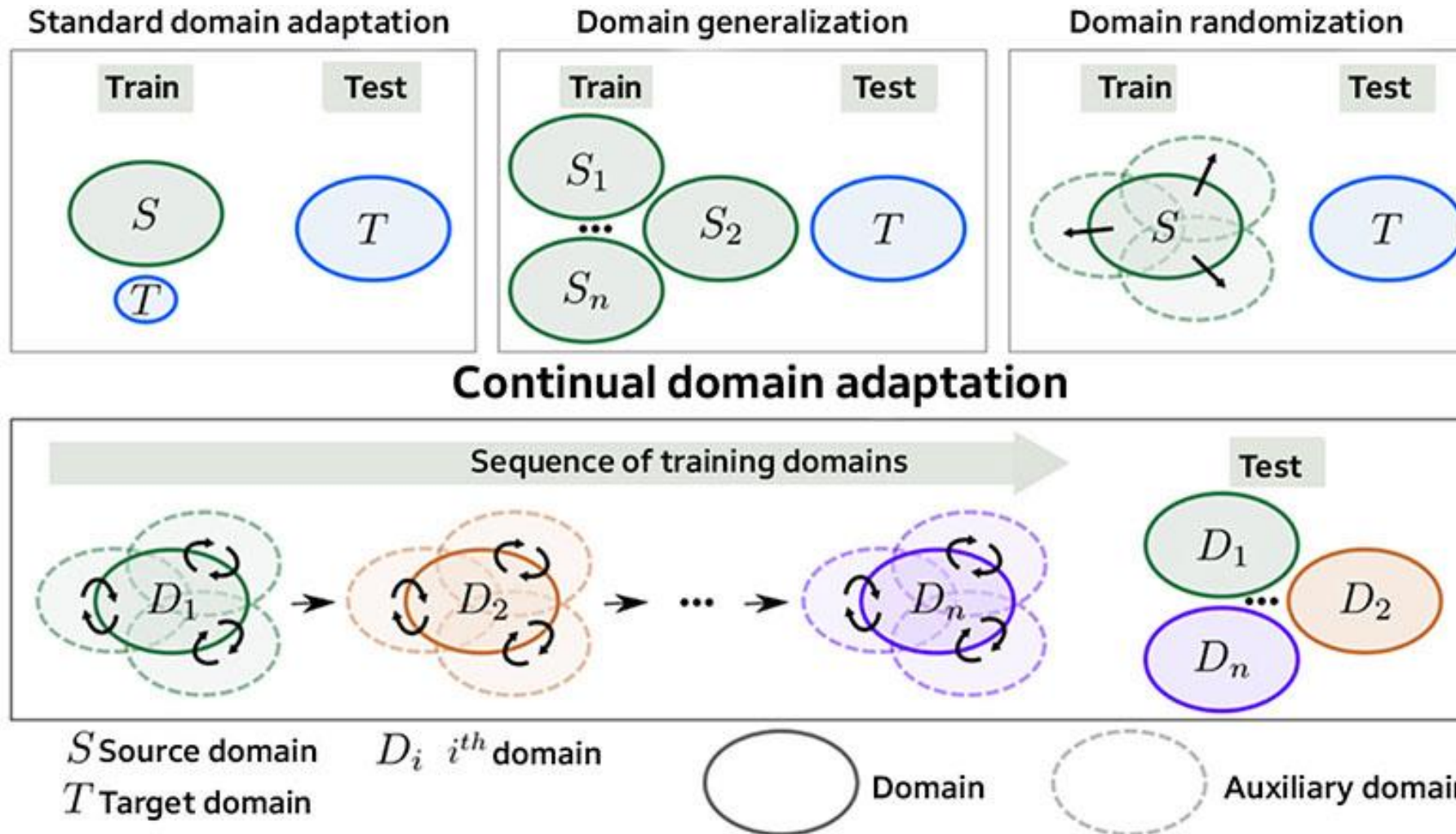
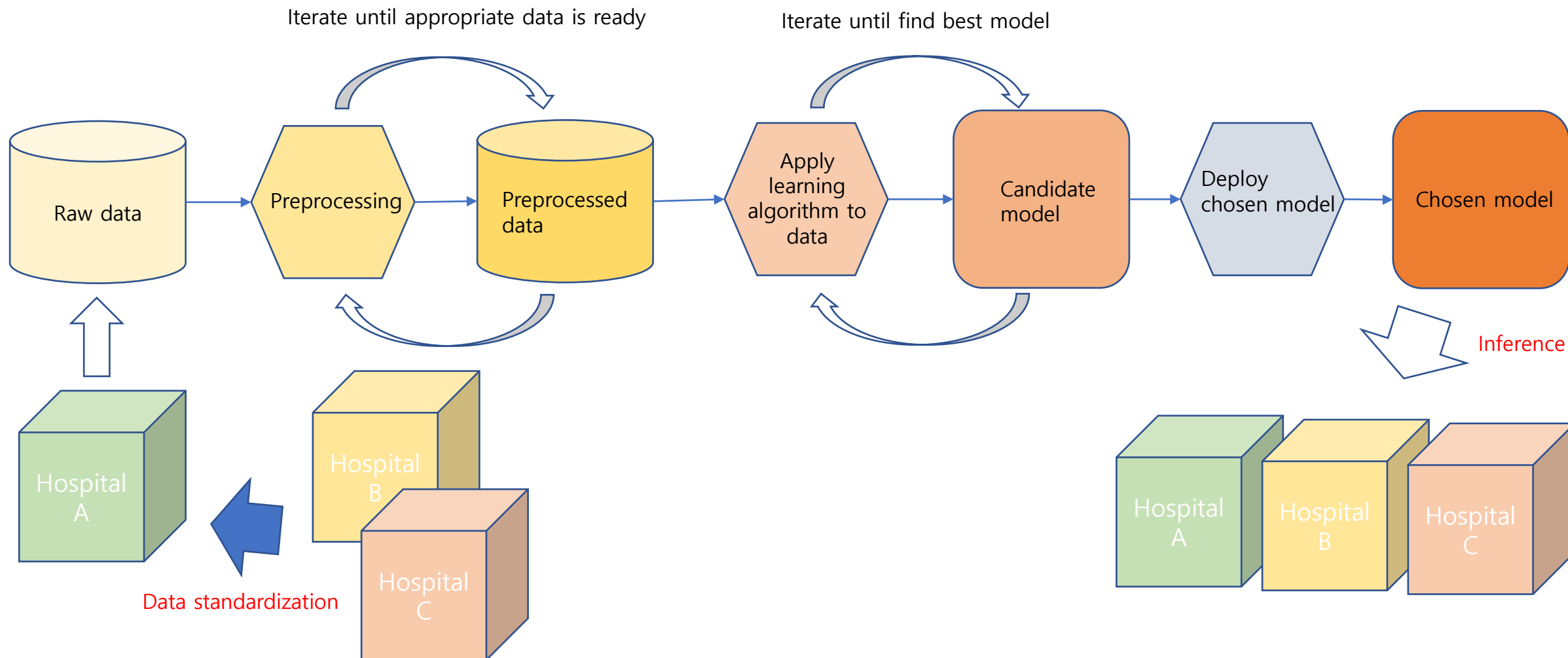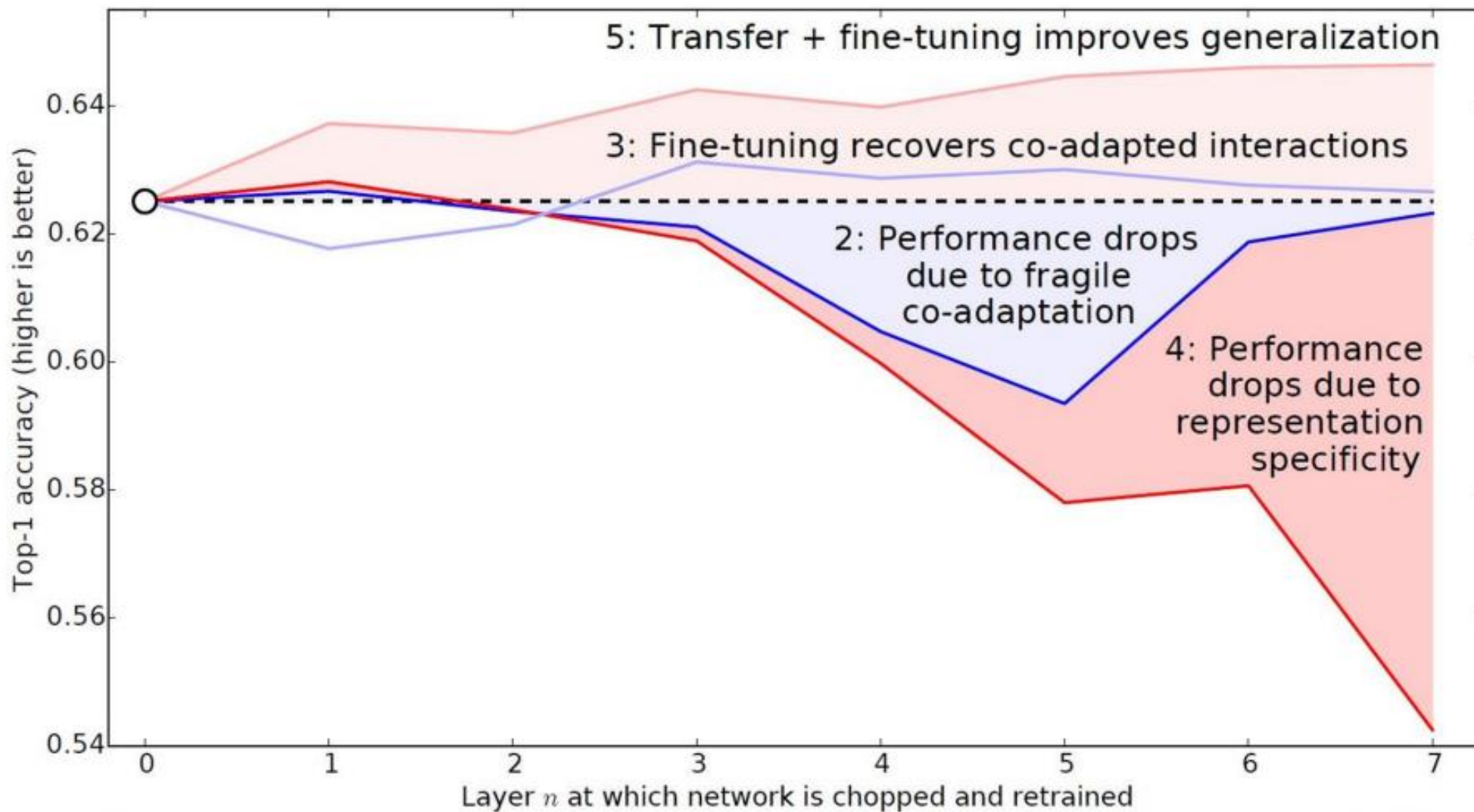# Many efforts for domain generalization/adaptation
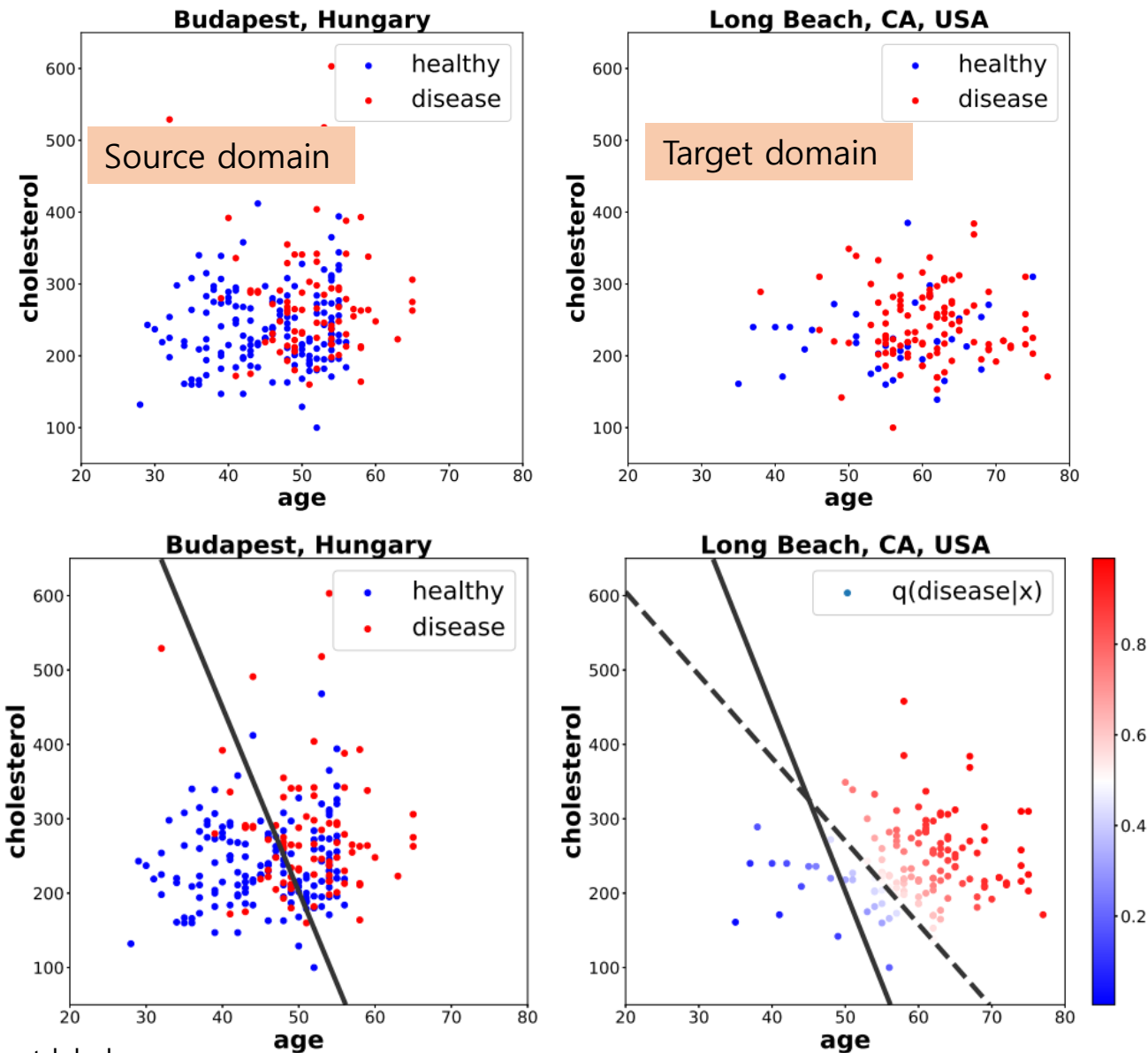

https://arxiv.org/pdf/2103.03097.pdf

Model adaptation

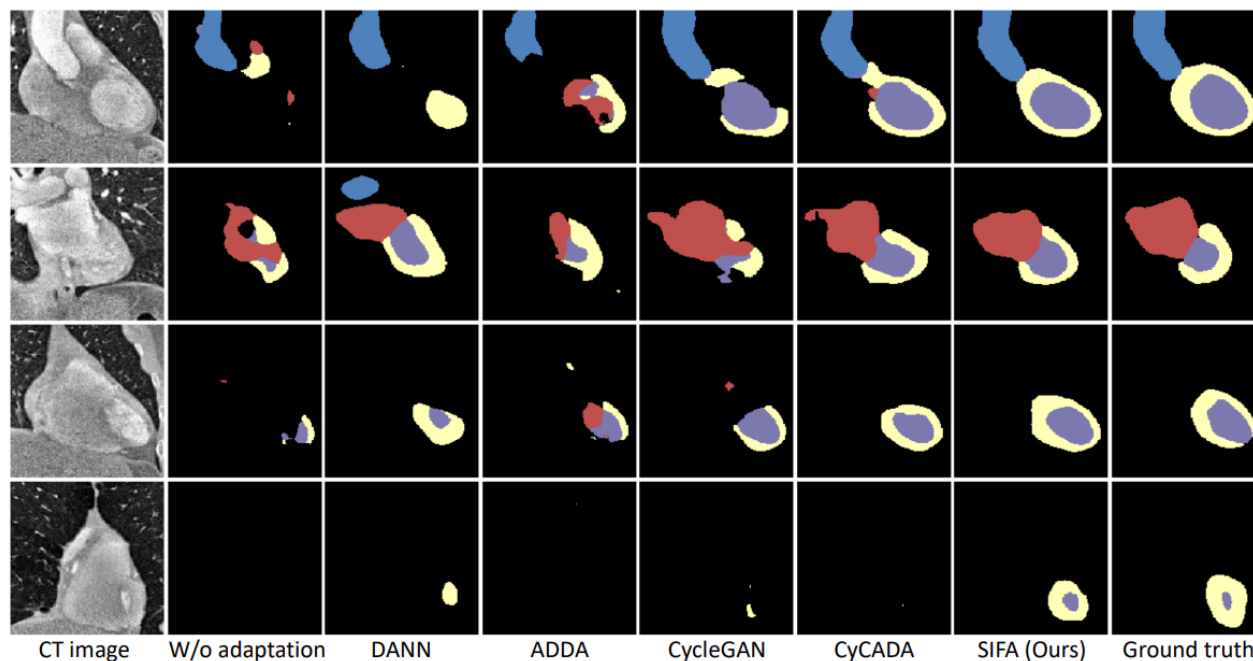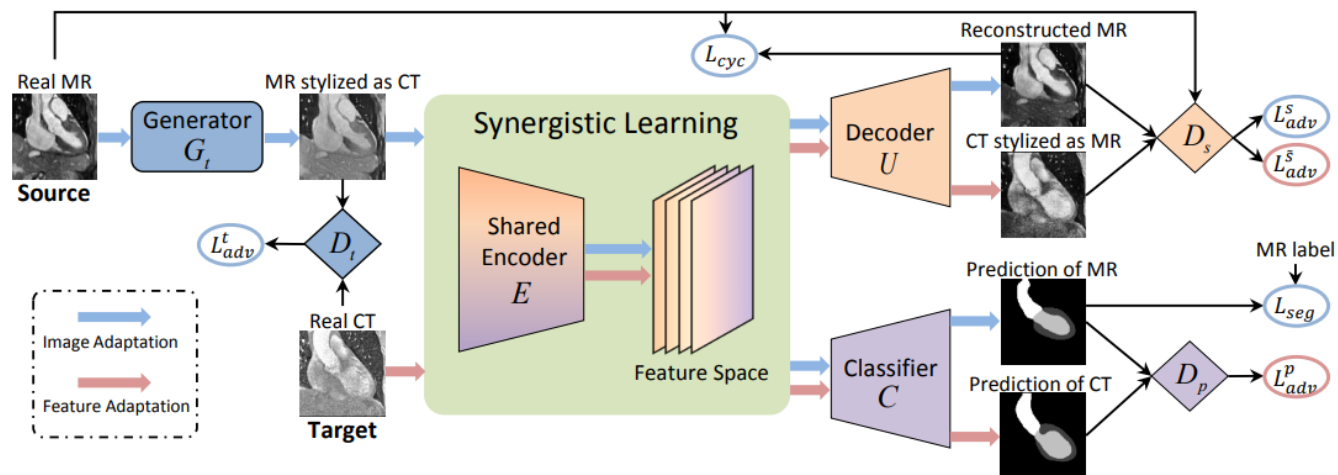# Data adaptation
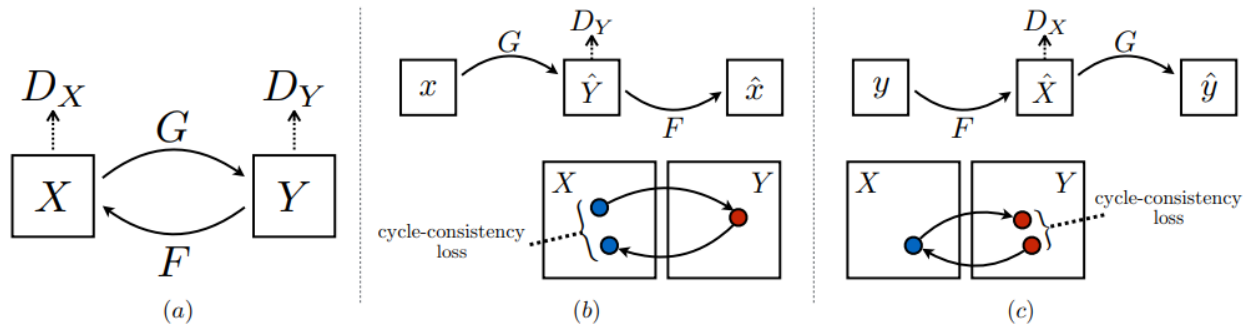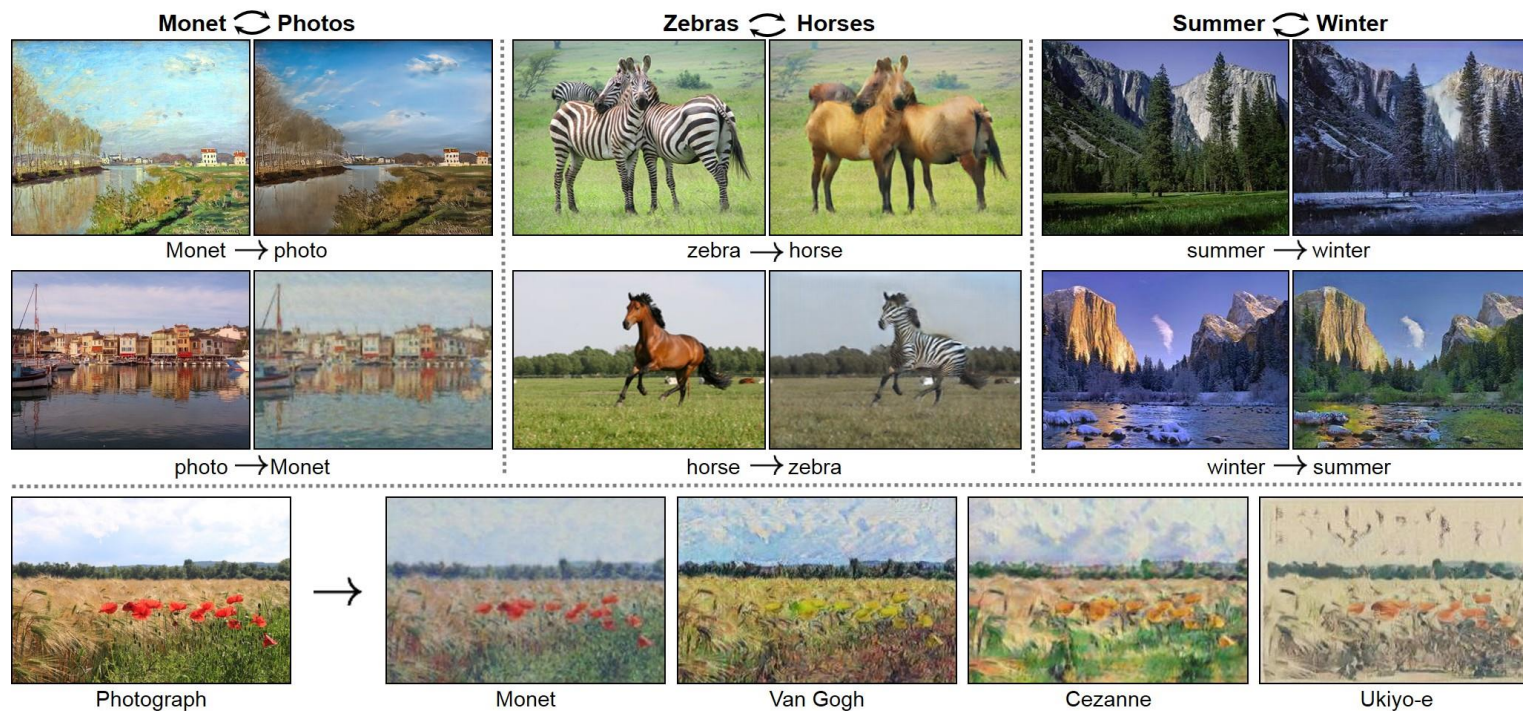
A research example of model adaptation

https://arxiv.org/pdf/1802.03601.pdf Deep Visual Domain Adaptation: A Survey, Neurocomputing 2018
J. Yosinski, J. Clune, Y. Bengio, and H. Lipson. How transferable are features in deep neural networks? In Advances in neural information processing systems, pages 3320–3328, 2014.

A research example of model adaptation

Source domain

Target domain

https://arxiv.org/pdf/1901.05335.pdf
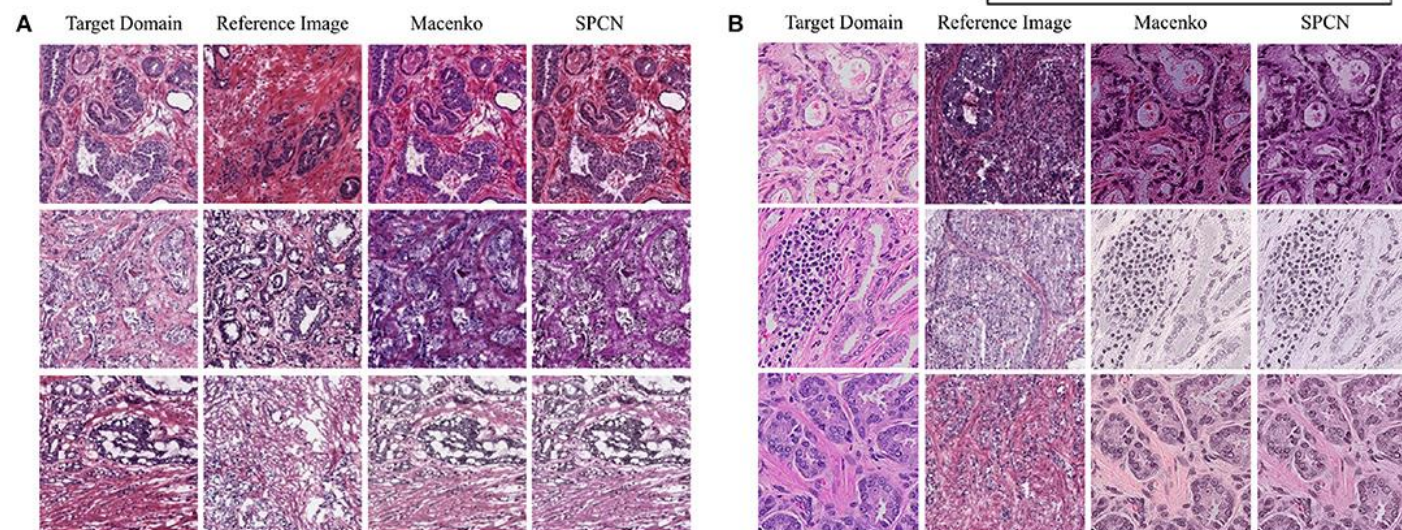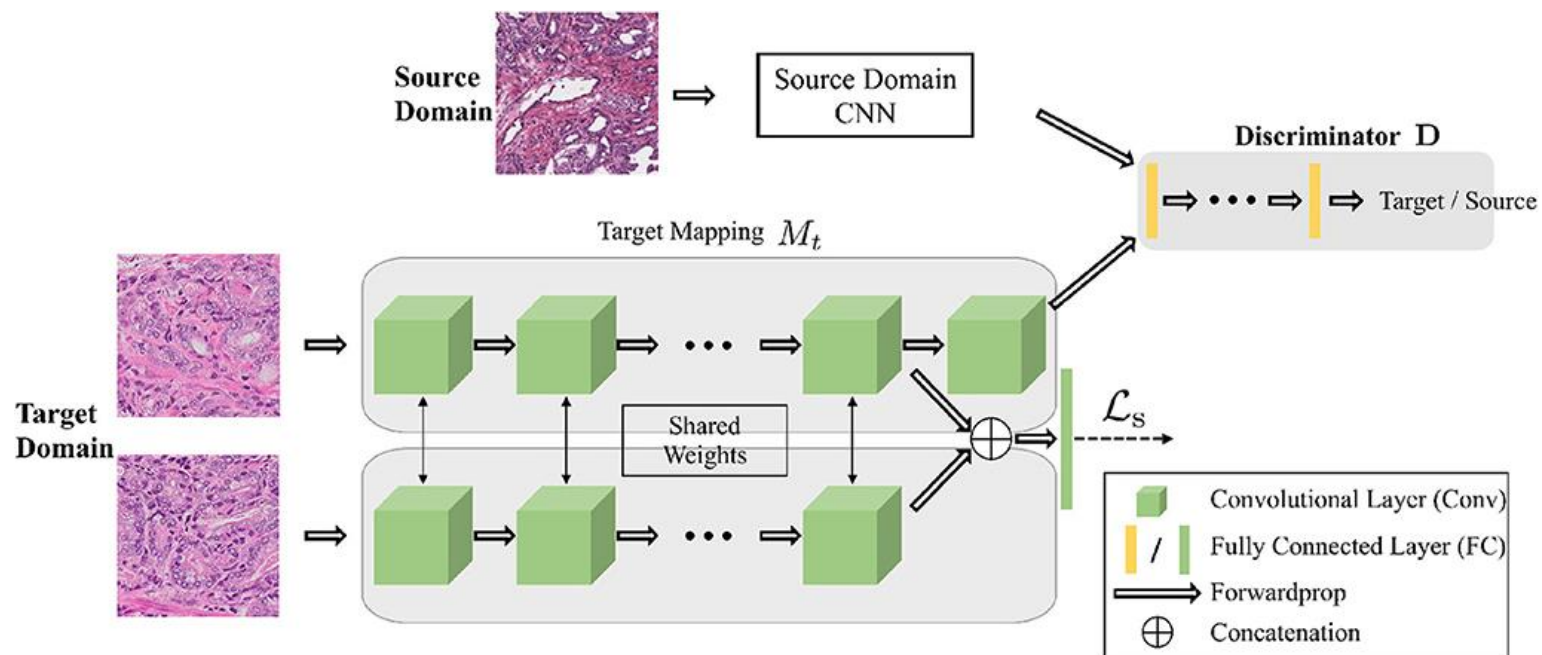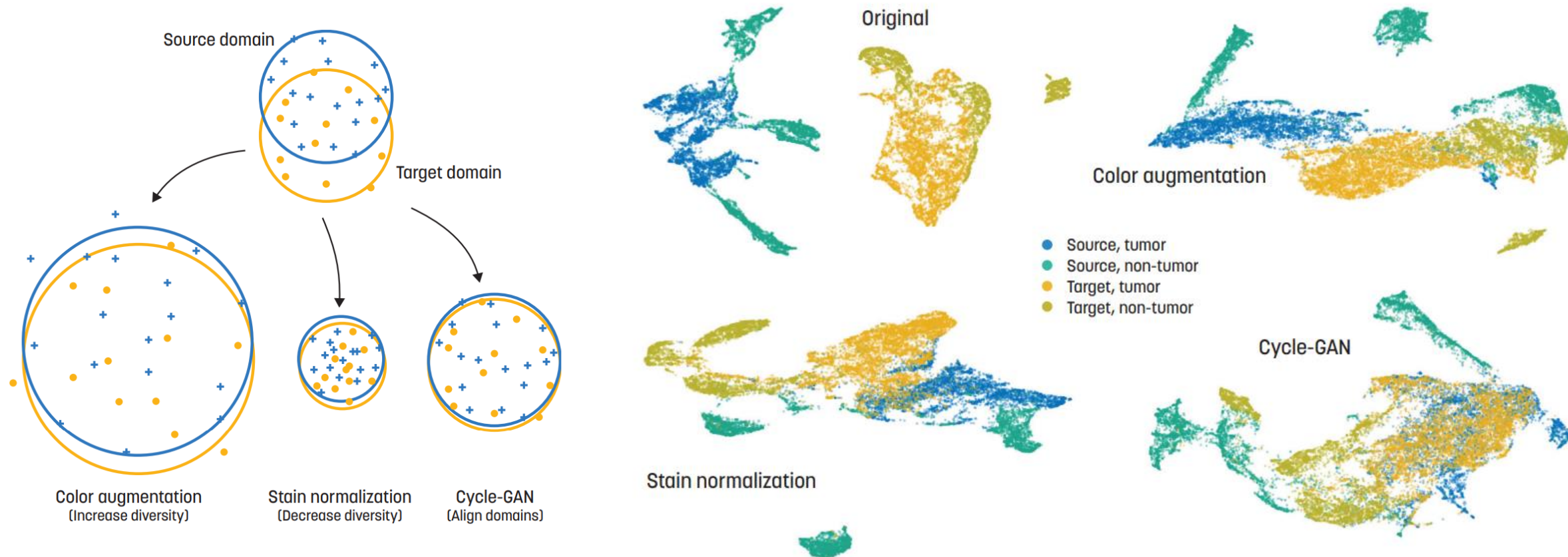A review of domain adaptation without target labels

Data adaptation

A research example of data adaptation

A research example of data adaptation

A research example of data adaptation

Thank you

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