

Improving on Classification of Architectural Heritage Images with Transfer Learning

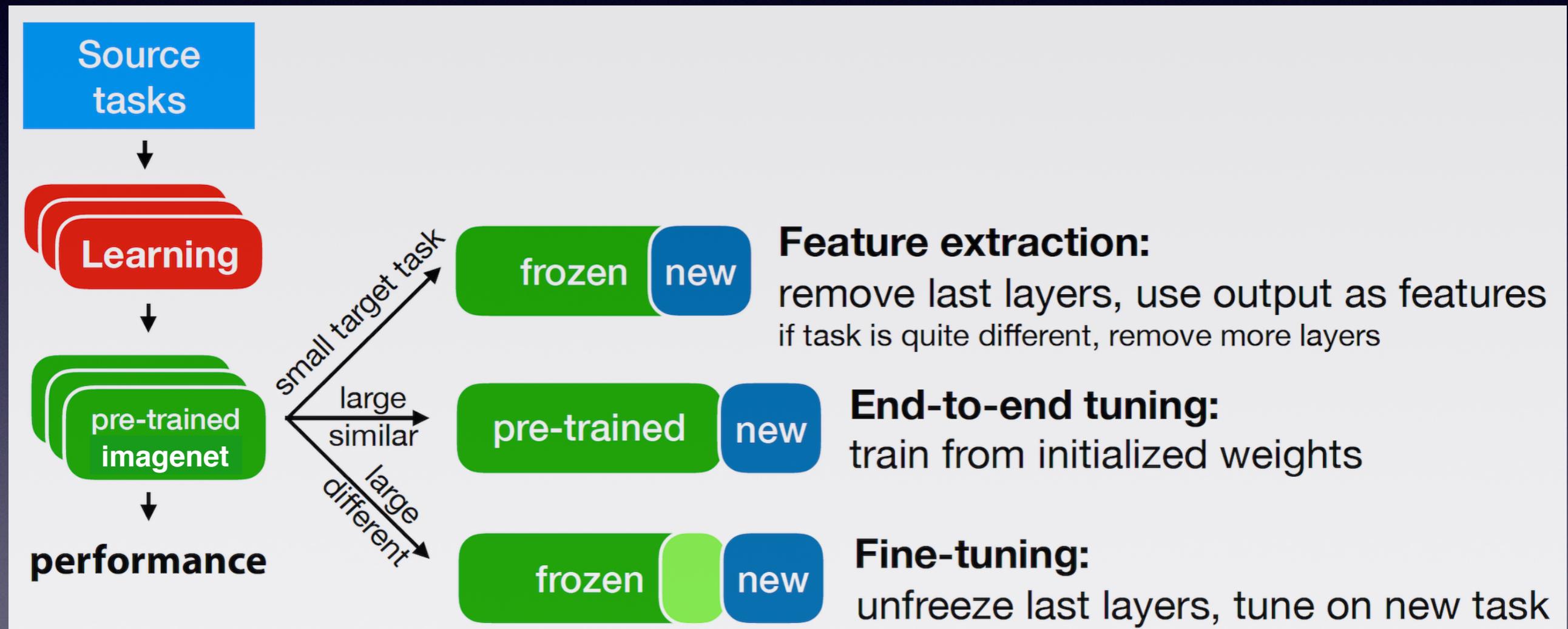
Applied Deep Learning - WS 2019

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The Task
10,235 Training Images
1,404 Test Images
80/20 Train/Validation Split
10 Classes



Transfer Learning in a Nutshell



Hutter F., Vanschoren J.: Learning to Learn -
NeurIPS 2018 Tutorial on Automatic Machine Learning

ImageNet Dataset

- 14,197,122 images
- 21,841 synsets



[Synset: case, display case, showcase, vitrine](#) has bounding box

Definition: a glass container used to store and display items in a shop or museum or home.



[Synset: house](#) has bounding box

Definition: a dwelling that serves as living quarters for one or more families; "he has a house on Cape felt she had to get out of the house".



[Synset: school, schoolhouse](#) has bounding box

Definition: a building where young people receive education; "the school was built in 1932"; "he walked every morning".

Tower

A structure taller than its diameter; can stand alone or be attached to a larger building

Numbers in brackets: (the number of synsets in the subtree).

ImageNet 2011 Fall Release (32326)

- plant, flora, plant life (4486)
- geological formation, formation (11)
- natural object (1112)
- sport, athletics (176)
- artifact, artefact (10504)
 - instrumentality, instrumentation (1)
 - structure, construction (1405)
 - airdock, hangar, repair shed (1)
 - altar (1)
 - arcade, colonnade (1)
 - arch (31)
 - area (344)
 - balcony (4)
 - balcony (2)
 - bascule (0)
 - boarding (2)
 - body (2)
 - bridge, span (17)
 - building, edifice (267)
 - building complex, complex (3)
 - catchment (0)
 - coil, spiral, volute, whorl, helix (1)
 - colonnade (1)
 - column, pillar (2)
 - corner, quoin (0)
 - cross (0)
 - deathtrap (0)
 - defensive structure, defense (0)
 - door (0)
 - entablature (0)

Treemap Visualization

Images of the Synset

ImageNet 2011 Fall Release > Structure, constr

Bell



Clock



Watchtower

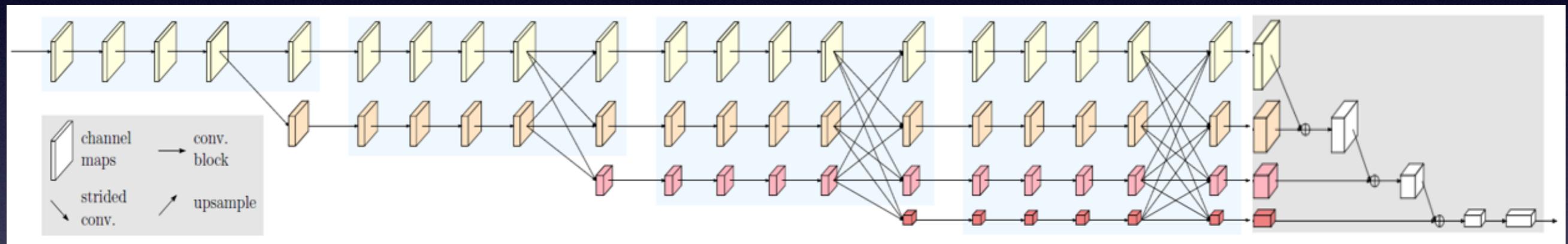


Silo



HRNet

Image Classification



<https://github.com/HRNet/HRNet-Image-Classification>

128.1M Params, pretrained on Imagenet Dataset

Score to Beat

6 out of 10

Baseline: Full Transfer Learning with Resnet

App Demo...

Score to Beat

Results

model	altar	apse	bell tower	column	dome(inner)	dome(outer)	flying buttress	gargoyle	stained glass	vault	performance
baseline	0.906	0.874	0.903	0.953	0.967	0.937	0.805	0.923	0.990	0.925	+/-0
hrnet v1 small	0.9353	0.713	0.8521	0.866	0.922	0.9043	0.8442	0.9437	0.9728	0.9254	-2
resnet 18	0.942	0.6602	0.8629	0.8427	0.9078	0.8762	0.766	0.9536	0.9622	0.9298	-2
resnet 152	0.96	0.8738	0.9193	0.9448	0.9014	0.9356	0.9262	0.9853	0.9547	0.9446	+/-0
hrnet v2 largest	0.9373	0.9091	0.944	0.9458	0.9489	0.936	0.9396	0.9787	0.966	0.9364	+2

Full Trained HRNet wins 6 out of 10

Take Aways

- **Dataset Loading:** Ensure that you have more than 1 worker
- **Batch Sizing:** Find optimal size to utilize GPU to the maximum (without going Out Of Memory)
- **Cuda:** When to use GPU, when to use CPU?
- **Debugging:** Visual Studio Code with Inspection and Debug Console

More Learnings

- Python Dependencies: Windows/Linux/OSX
- HRNet Project Structure: Python Files included at runtime -> breaks Linter
- Flask: Flask-Upload Component is complex (would not use it again)
- Testing: Torchtest is nice but better suited for models from scratch

Thanks!

Resources

- [https://www.researchgate.net/publication/320052364 Classification of Architectural Heritage Images Using Deep Learning Techniques](https://www.researchgate.net/publication/320052364_Classification_of_Architectural_Heritage_Images_Using_Deep_Learning_Techniques) Paper
- https://pytorch.org/tutorials/beginner/transfer_learning_tutorial.html Transfer Learning with Pytorch
- <https://github.com/HRNet/HRNet-Image-Classification> HRNet
- <https://github.com/laszlokiraly/DS-Applied-Deep-Learning> Repository - Transfer Learning & Web App & Docker