Comprendre les données visuelles à grande échelle

ENSIMAG
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9 janvier 2020

Organisation du cours

- **17/10/19** cours 1 - Diane
- **24/10/19** cours 2 - Karteek
- **07/11/19** cours 3 - Karteek
- **14/11/19** cours 4 - Diane
- **28/11/19** cours 5 - Karteek
- **05/12/19** cours 6 - Karteek
- **12/12/19** cours 7 - Diane
- **19/12/19** cours 8 - Diane

Vacances d'hiver

- **09/01/20** cours 9 - Diane + présentation articles 1 & 2 + quizz
- **16/01/20** cours 10 - Diane + présentation articles 3 & 4 + quizz
- **23/01/20** cours 11 - Karteek + présentation articles 5 & 6 + quizz
- **30/01/20** cours 12 - Karteek + présentation articles 7 & 8 + quizz

Attention: la salle change régulièrement

Cours 9: Adaptation à un nouveau domaine

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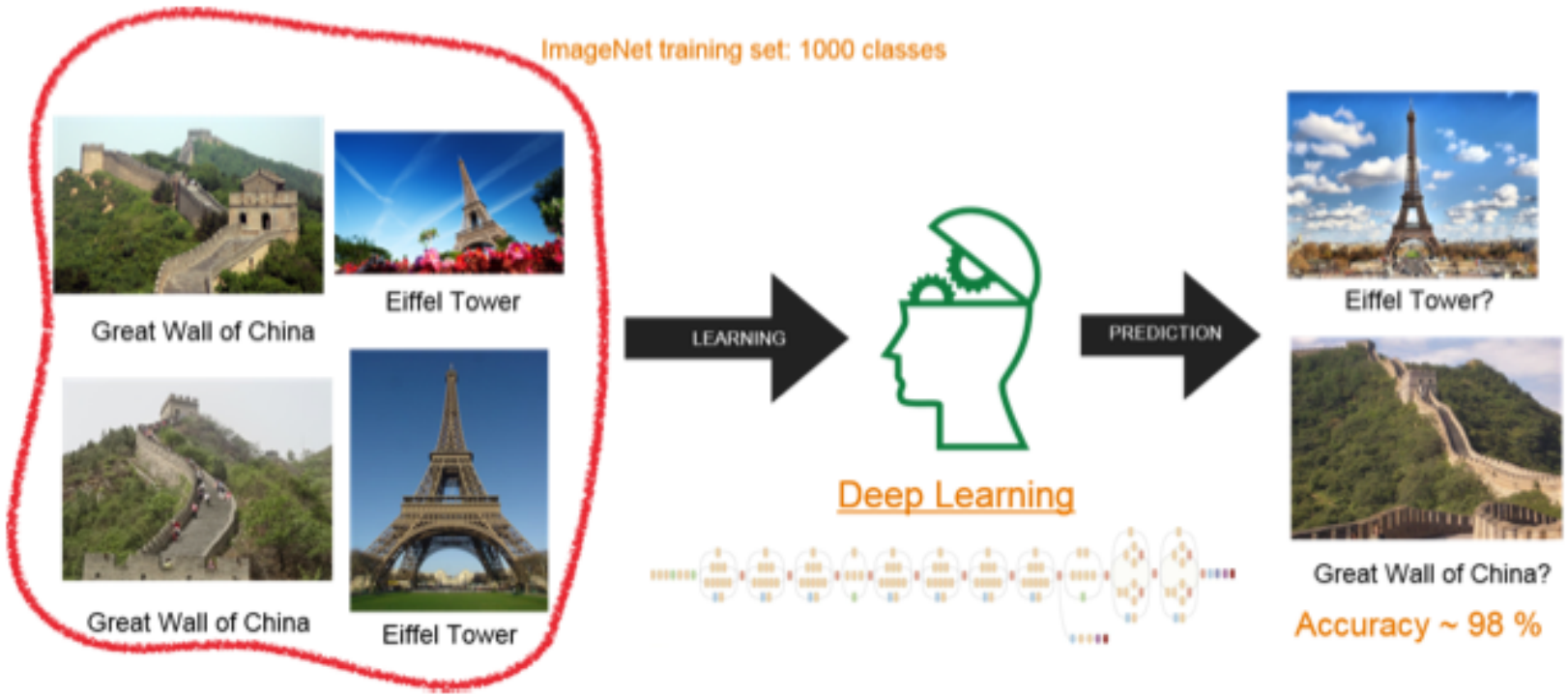
Credit

This lecture reuses slides from

Gabriela Csurka (NAVER LABS Europe)

- Keynote at the TASKCV workshop at ICCV19
  - https://sites.google.com/view/task-cv2019
- For a deeper overview of Domain Adaptation: Full set of slides
  - https://drive.google.com/file/d/11bKFLGvR0Hq_01vN-XnRXwv1_zaMxmKd/view?usp=sharing

Image Classification



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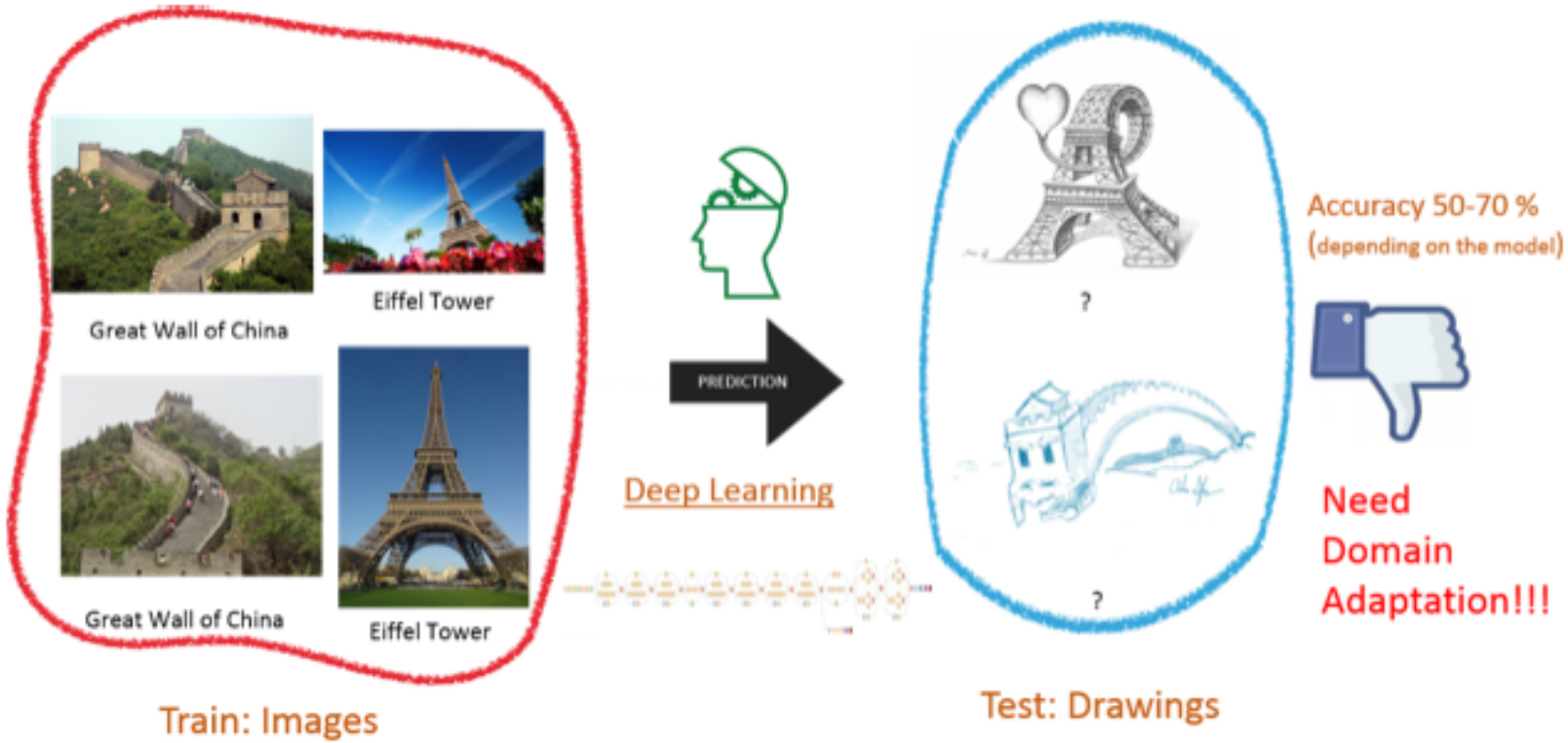
Domain Shift



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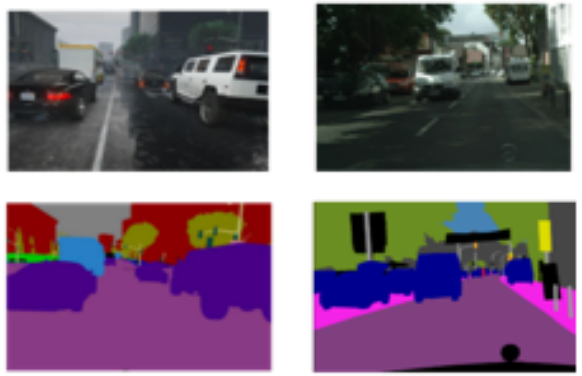
Example scenarios

Recognition

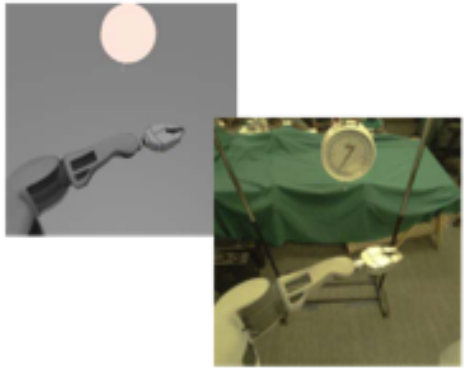
Detection

Segmentation



Re-identification

Control



Visual localization

Still, most of DA literature focuses on classification

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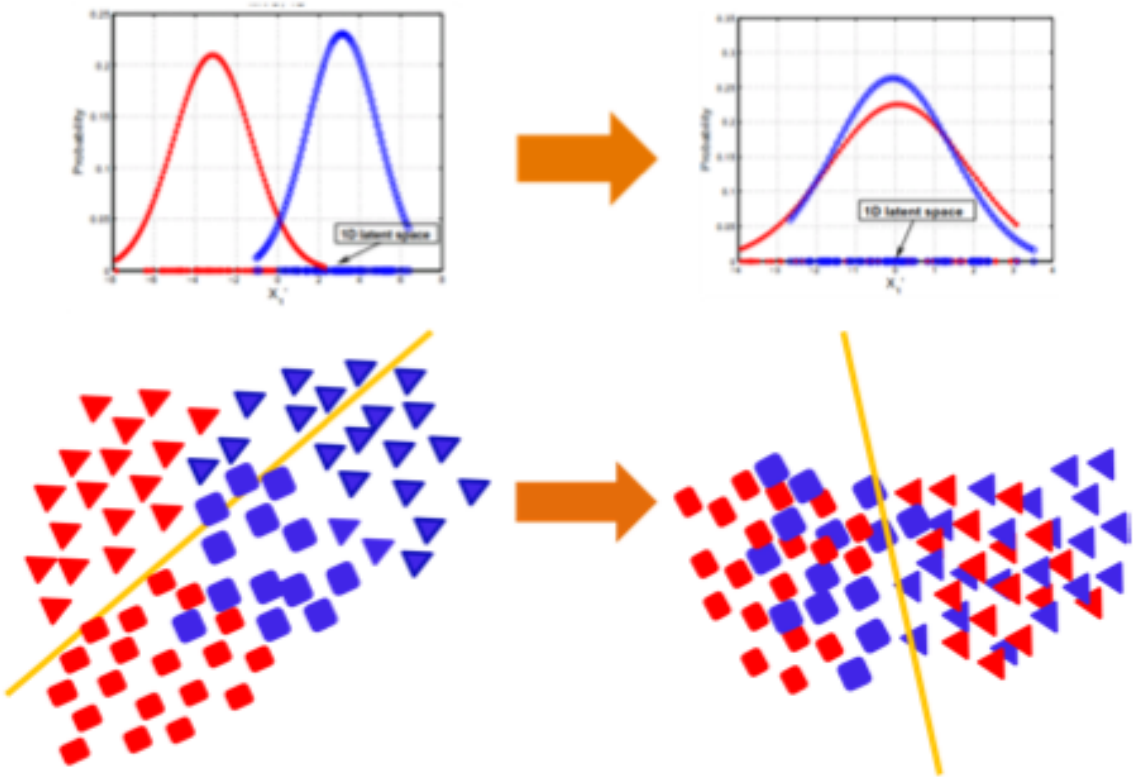
Key idea: solve the distribution mismatch



The distribution mismatch, can be measured for example by the Maximum Mean Discrepancy (MMD), Borgwardt +@BIOINFORMATICS'06

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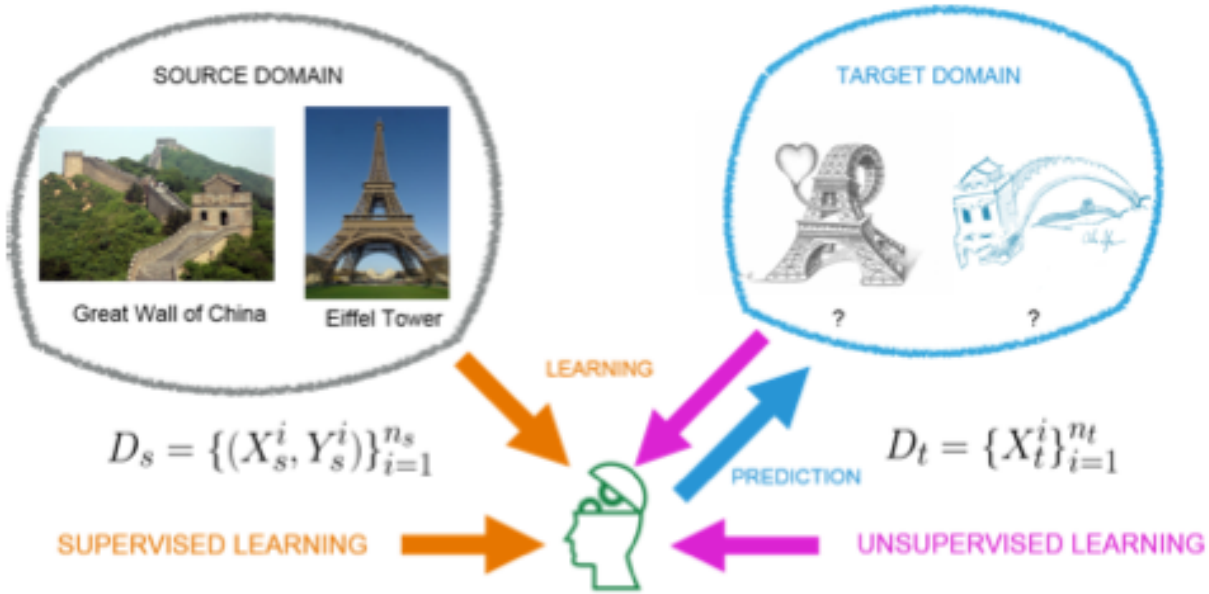
Domain adaptation (DA)

Leveraging labeled data in one or more related domains, referred to as *source domains*, to learn a classifier for data in a *target domain*.



- Unsupervised (US) DA when no label is available in the target domain
- Semi-supervised (SS) DA when a few labels are available in the target domain

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Adaptation à un nouveau domaine

Approches semi-supervisées:

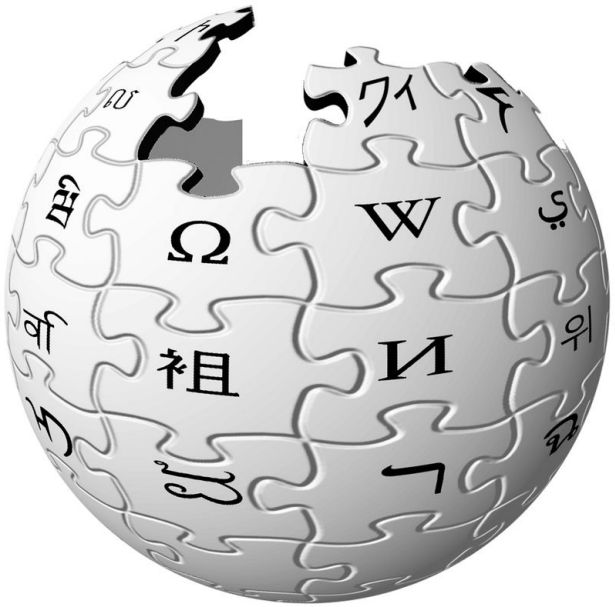
quelques exemples **annotés** sont disponibles dans le domaine cible

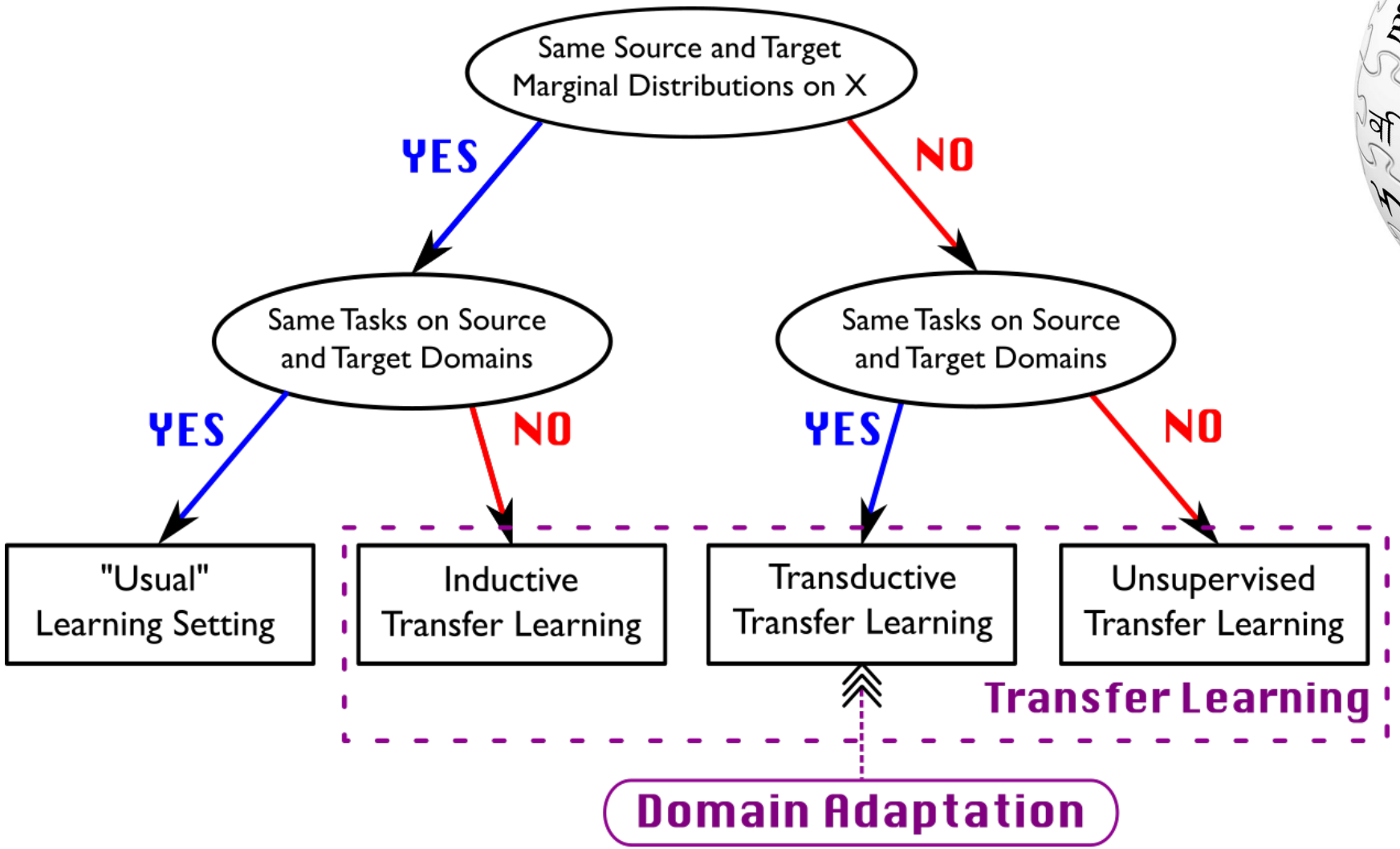
vs

Approches non-supervisées:

des exemples sont disponibles dans le domaine cible, mais **aucun** n'est annoté

Lien avec ”Transfer Learning”





Méthodes d’adaptation semi-supervisées

Quelques exemples de méthodes

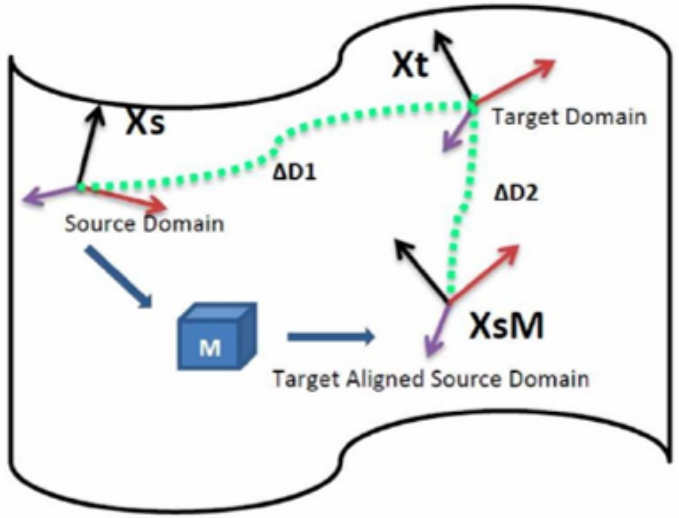
- Pondération des exemples du domaine source
- Ajustement des paramètres du classifieur (eg: SVM)
- *Fine-tuning* du modèle source avec les quelques données annotées de la cible
- Méthodes basées sur l’apprentissage de métriques

Méthodes d’adaptation non-supervisées

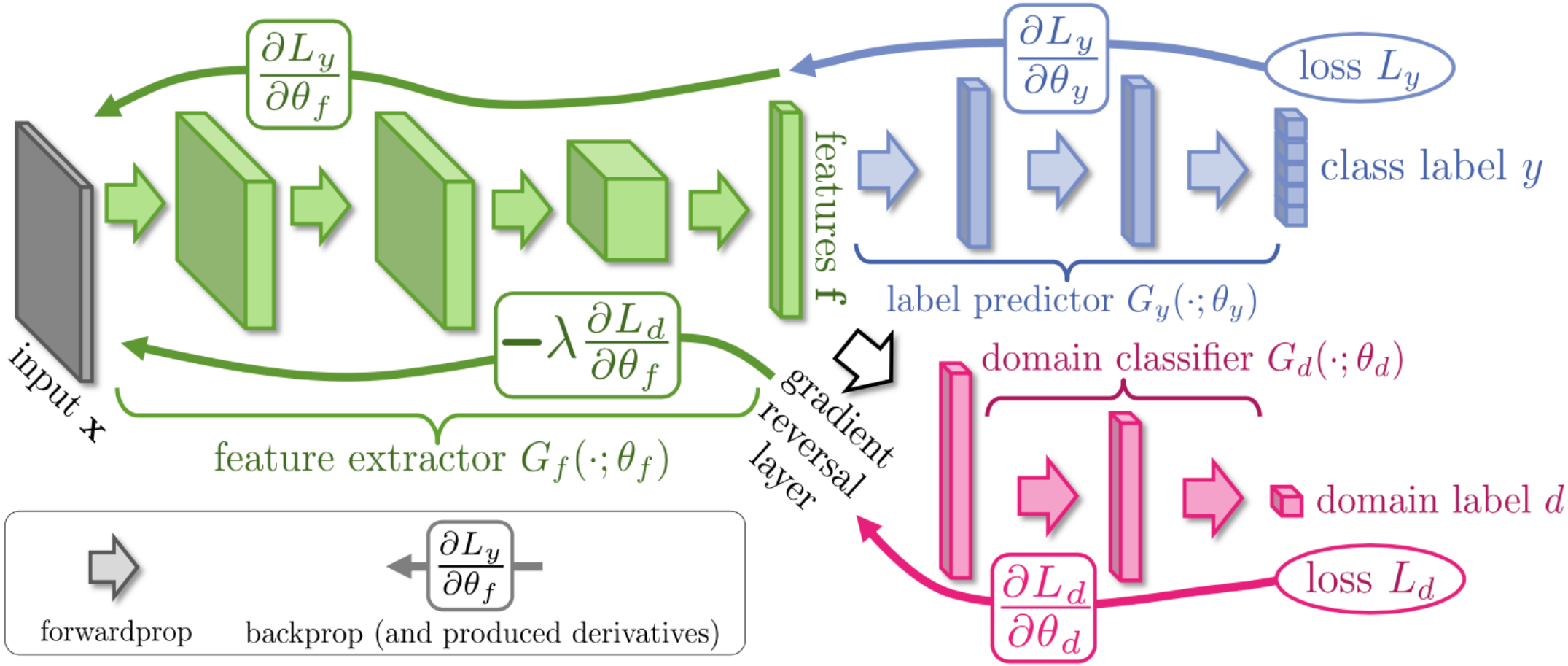
Quelques exemples de méthodes

- Méthodes d’augmentation des descripteurs
- Alignement des espaces des descripteurs
- Apprentissage d’un nouvel espace de représentation
- Transformations locales (ex: optimal transport)

Illustration de l’alignement des espaces



Unsupervised domain adaptation



Domain-Adversarial Training of Neural Networks

Yaroslav Ganin, Evgeniya Ustinova, Hana Ajakan, Pascal Germain, Hugo Larochelle, François Laviolette, Mario March, Victor Lempitsky; ICML 2016

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Domain adaptation with an adversarial loss

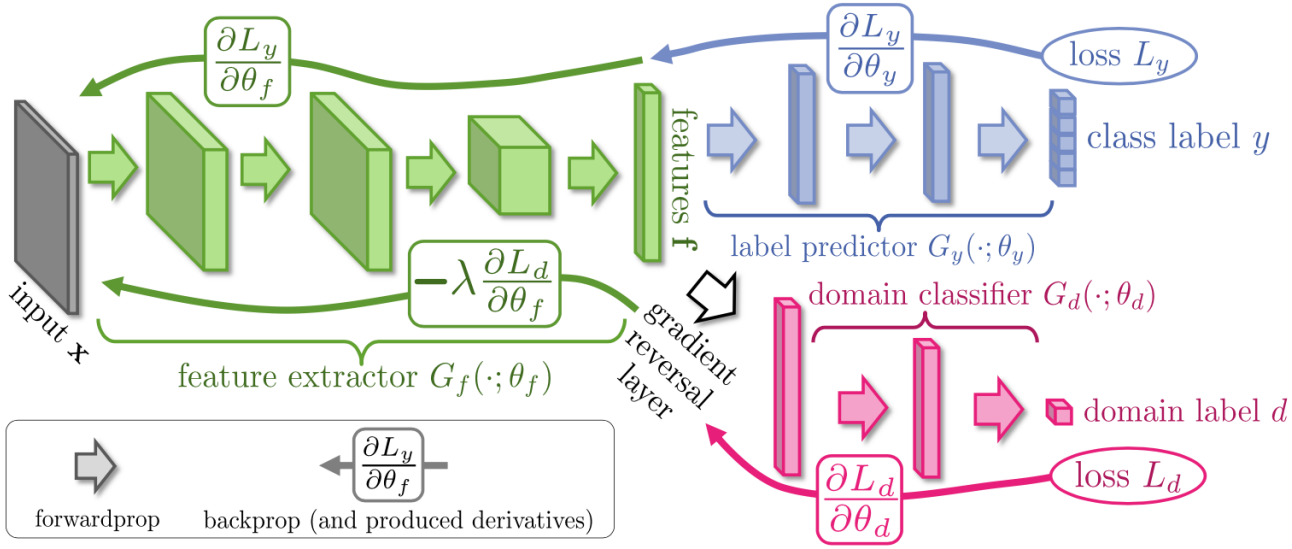
Multi-task training

Task 1: classification task of interest

- Using available labeled data
- Training reduces classification error

Task 2: domain classification

- Using both the source and the target data
- Training to make different domain samples indistinguishable
- Using a standard classification layer and reversing the gradient



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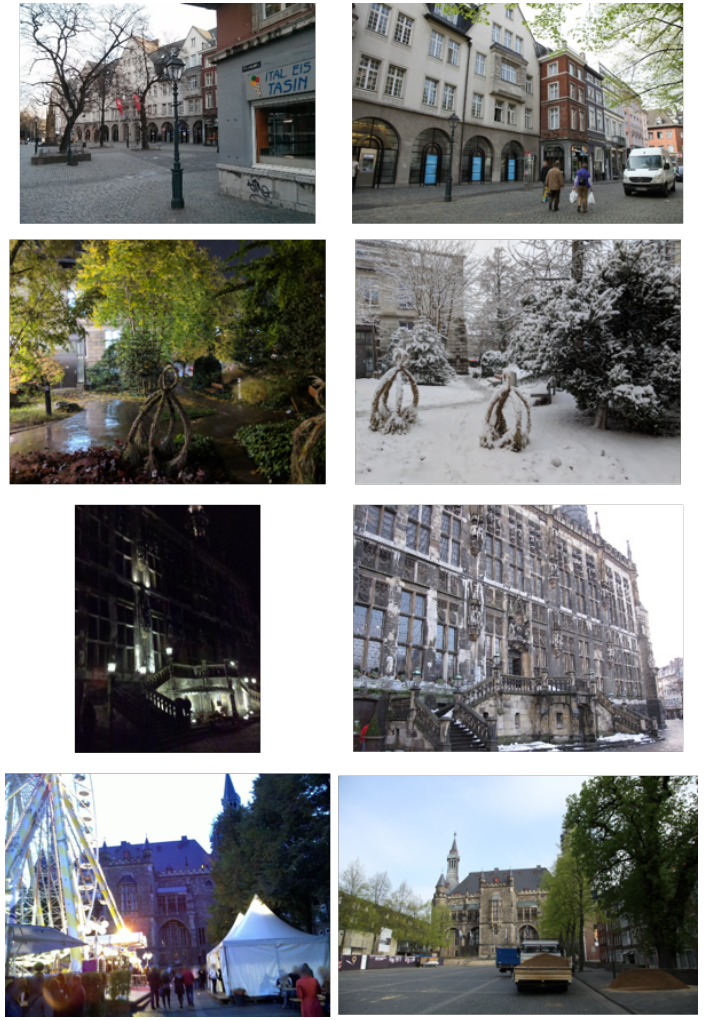
Visual Localization - main challenges

Example application

Domain gap due to:

- strong viewpoint changes
- different sensor's spec
- different weather conditions
- different lighting conditions
- structural changes



The domain shift affects both:

- the global image retrieval
- the local feature matching

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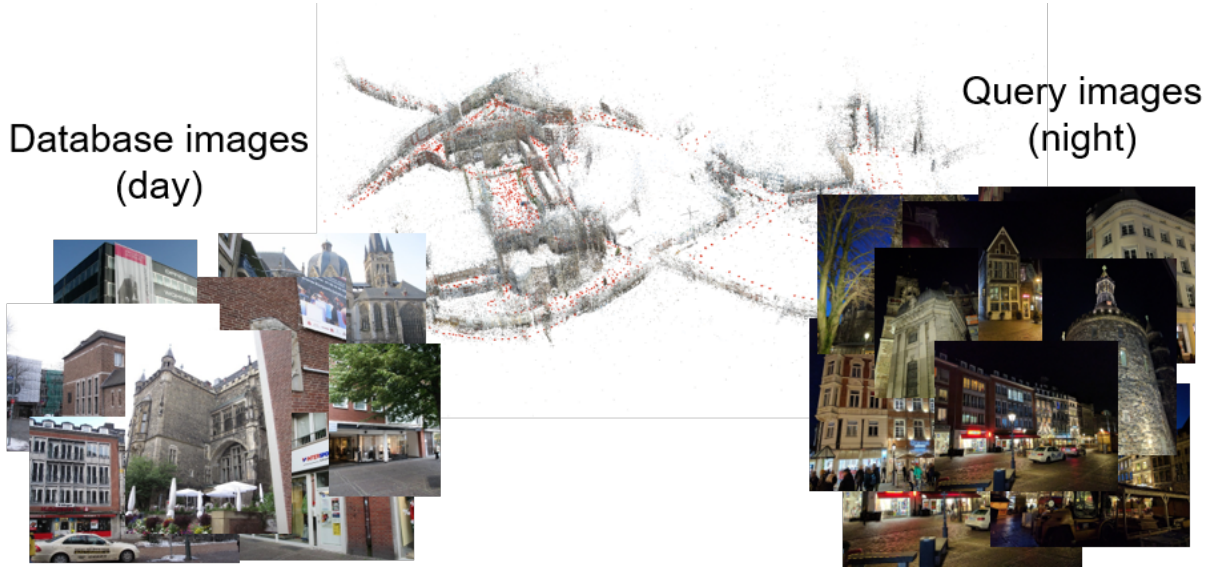
UDA to improve visual localization



Example application

We experimented with:

- Aachen-Day-Night dataset, Torsten+@BMVC'12
- SfM maps and localization done with COLMAP, Schönberger+@CVPR'16
- We tested different configurations varying:
  - the global image representation and the number of top retrieved images
  - the local feature descriptors

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Book on Domain Adaptation

Domain Adaptation in Computer Vision Applications

Editors: **Csurka**, Gabriela (Ed.)

To learn more about DA

- **Introductory part**
  - a comprehensive survey and a deeper look at dataset bias
- **Part I: Shallow Domain Adaptation Methods**
  - GFK, SA, TCA, DME, ATTM, MSDA
- **Part II: Deep Domain Adaptation Methods**
  - deepCoral, DANN, Deep Transfer Across Domains and Tasks
- **Part II: Beyond Image Classification**
  - Segmentation, object and object part detection, re-identification
- **Beyond Domain Adaptation: Unifying Perspectives**
  - domain generalization, multi-domain multi-task learning

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Merci