Specification and schedule

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Formalities

- Preliminary title: Adversarial Domain Adaptation for Screening Mammograms
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Background & Objective

In Sweden, women of age between of 40 and 74 go through regular screening of their breasts every 18-24 months. The screening mainly involves obtaining a mammogram and having radiologists analyze them to detect any sign of breast cancer. This screening is vital and in one study has reduced mortality by 30%. In Sweden and generally world-wide, we have shortage of radiologists for screening in such a scale. Thus, a computer-assisted analysis using machine learning tools is highly relevant not only to reduce the burden on the radiologists but also increase the sensitivity of the analysis.

However, we are facing a big challenge while training a machine learning model, which is the appearance of the mammograms coming from different hospitals. Different hospitals have different imaging equipment and are manually tuned with different settings. So it is hard to learn a single model that can make use of images coming from different places.

In this project we plan to use adversarial domain adaptation to transfer mammograms from different datasets into a standard format, so that mammograms from different sources could be classified and marked by one classifier.

Research Question & Method

Research Question

Our goal is to find a image-level domain adaptation function which could transfer mammograms from different datasets into a standard format by using generative adversarial networks. Also it is necessary to investigate the efficacy of this transfer in improving the results on individual datasets. There are several challenges we will face in the project:

- We need to design an unsupervised neural network, which could accept mammograms from different distributions.
- While designing domain adaptation, how to set the source domain and how to set the target domain.
- After transferring the mammograms through the neural network, how to design a network to mark off where the normal tissue is and where the cancerous tissue is.
- As the provided datasets are all labeled. I also plan to investigate the supervised adversarial domain adaptation approach and compare it with my unsupervised method to measure the performance of this method.

Method

In our problem, as the title suggested, we intend to use adversarial domain adaptation, which has shown very successful in both image-level and representation-level domain adaptation in recent years studies. Generative adversarial network (GAN) will be designed and implemented. This GAN will be pixel-level and unsupervised to fit the mammograms from different sources.

After this has been done the implementation part of the classifier begins. Semantic segmentation method is pretty useful in marking off different tissue.

Once we finish the implementation, we will use mammograms from different sources to train the network and tune the parameters. These datasets will be a combination of some public datasets. Then some of the promising methods, which were found during the literature study, will be implemented and tested as a benchmark.

At last, a combination between our result and the benchmark results together with a final tuning will be carried out.

Expected scientific results

The hypothesis of this thesis is that it is possible to find an adversarial network which is suitable for mammograms from several different distributions and the classifier's accuracy after transfer is still kept at a high level.

This hypothesis will be tested by several individual datasets which do not get involved in training. And also I will run these datasets on some other models. These classified and marked results will then be analyzed and a conclusion is drawn based on these.

Evaluation & News Value

Evaluation

We will define several evaluation metrics, such as, mean intersection-over-union (mIoU), frequency weighted intersection-over-union (fwIoU), pixel accuracy, etc. The result will be quantified by these metrics.

The work's innovation

From the perspective of product application, this work could provide a new tool for auxiliary diagnosis. And for the people or enterprise who is trying to build a auto-mammography diagnosis system, this work could at least help them deal with multi-resources training problem.

From the perspective of academic, there are fewer research about the unsupervised pixel-level adversarial domain adaptation. So if this work's result even beats the state-of-art result, then our work will be pretty meaningful for the academic researcher in adversarial domain adaptation.

Pilot Study

Work relevant to the adversarial domain adaptation and its evaluation could be divided into categories as below.

Transfer Learning
Includes reading of papers and reports relating to transfer learning and know the basic knowledge of transfer learning, what is the advantage and disadvantage of transfer learning.

Domain Adaptation
Including reading of papers and reports relating to transfer learning. What is the difference between the transfer learning and domain adaptation. What is the advantage and disadvantage of domain adaptation.

Feature-level and Pixel-level Domain Adaptation
There are many classification criteria for domain adaption. In this project, I will mainly focus on study the concept of feature-level and pixel-level domain adaptation, making a comparison between them.

Generative Adversarial Networks
As I have already got some basic knowledge about GAN. This time I will mainly focus on pixel-level GAN and study its relevant research.

Adversarial Domain Adaptation
This would be the core part of the pilot study. I will study the relevant research papers and even their implementation. In this part, I will study both the supervised and unsupervised domain adaptation approach.

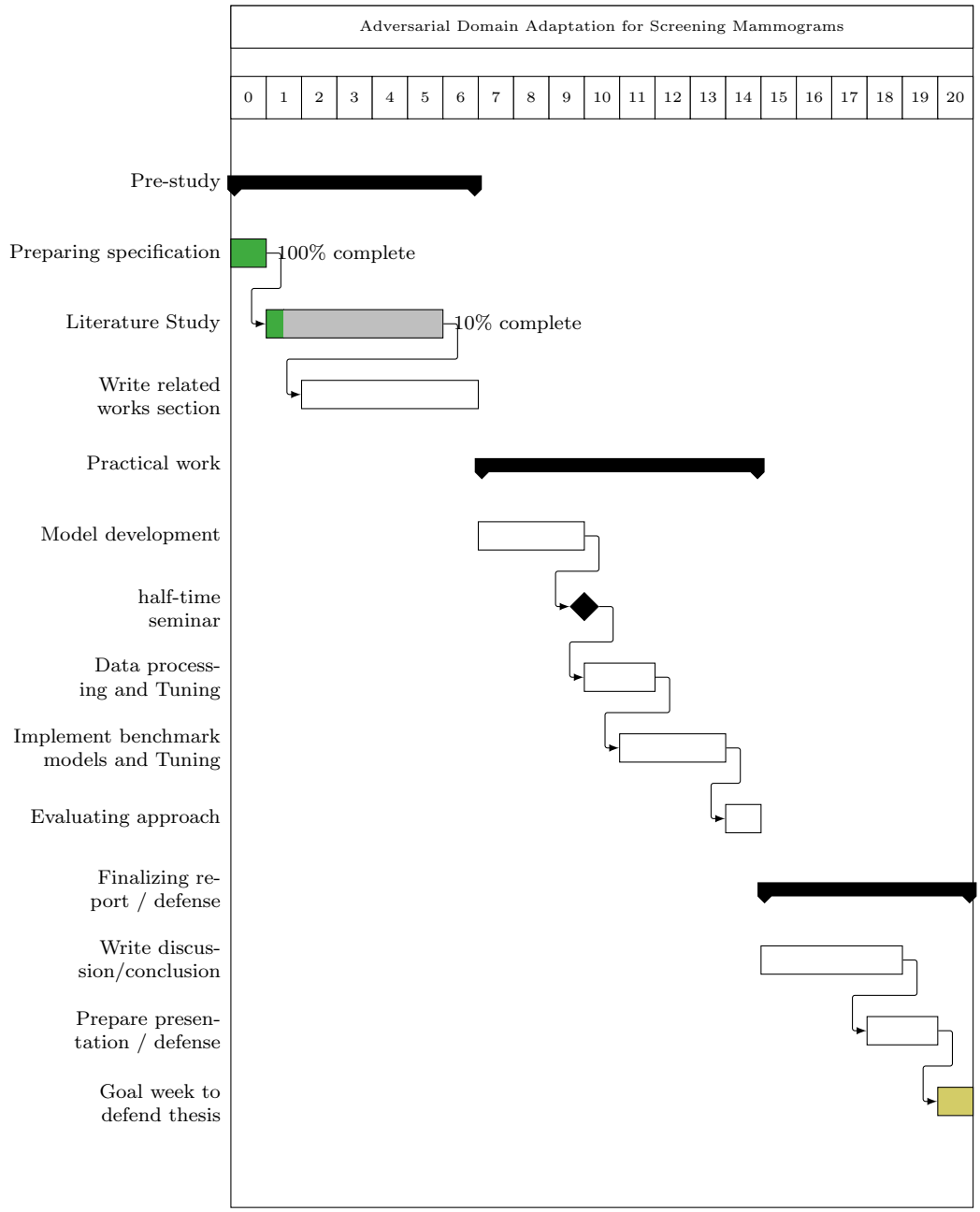
Semantic Segmentation
This part of knowledge is mainly used in marking the transferred mammograms. I will study its relevant knowledge and mainly focus on the state-of-art semantic segmentation algorithms.

Conditions & Schedule

Here is the list of the resources expected to be needed to solve the problem.

- Hardware, a computer equipped with a graphics card
- Software, matlab, deep learning frameworks, such as tensorflow, theano, keras, etc
- Data, mammography datasets, such as CBIS-DDSM, INBREAST, dream pilot dataset, etc
- Perseverance, because it's tough to write a thesis

Schedule


Adversarial Domain Adaptation for Screening Mammograms
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Pre-study
Preparing specification
100% complete
Literature Study
10% complete
Write related works section
Practical work
Model development
half-time seminar
Data processing and Tuning
Implement benchmark models and Tuning
Evaluating approach
Finalizing report / defense
Write discussion/conclusion
Prepare presentation / defense
Goal week to defend thesis