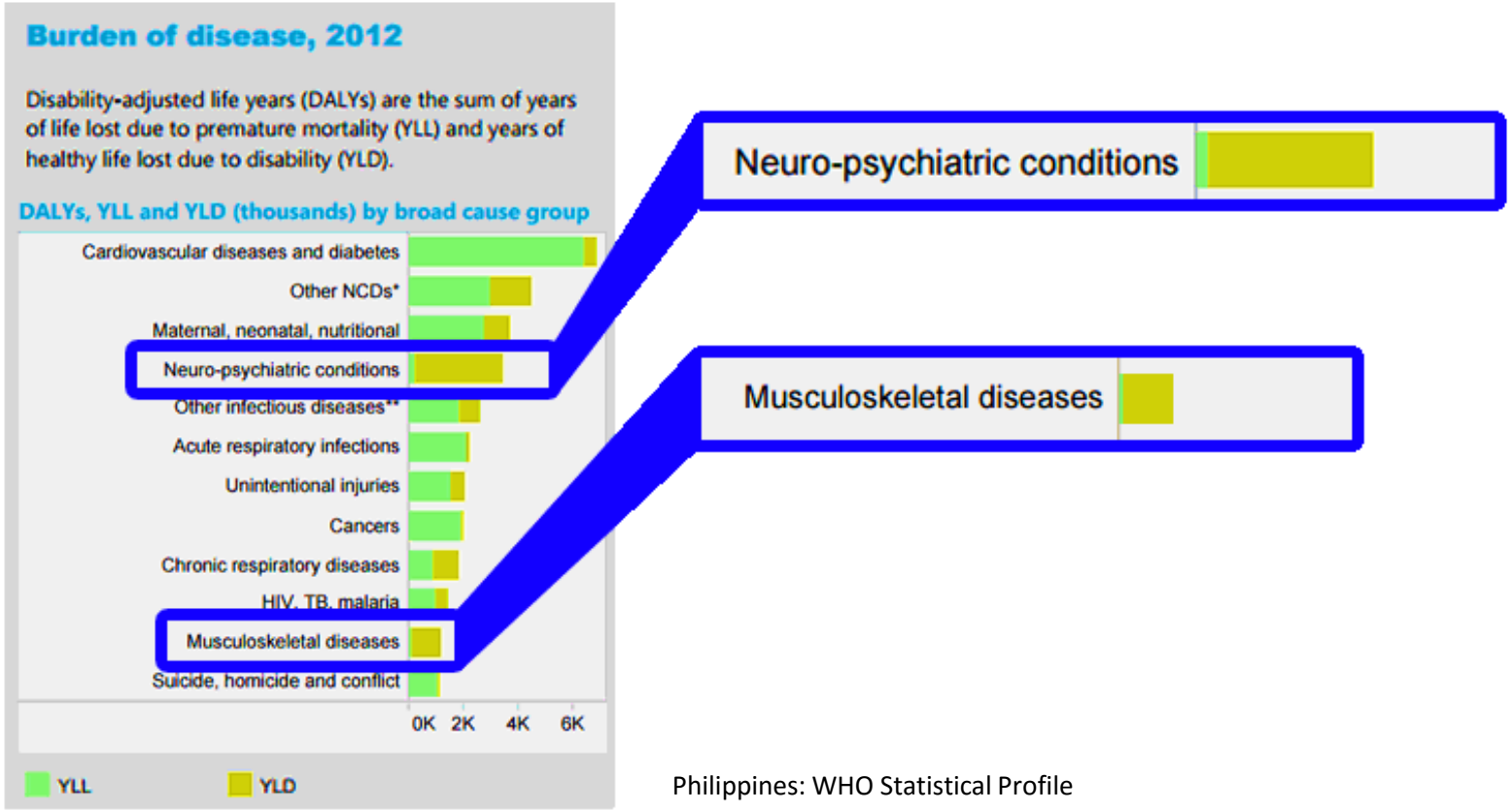
VERTEBRAE SEGMENTATION AND FRACTURE CLASSIFICATION

FROM CT LUMBAR SPINE IMAGES USING TRI-PLANAR 2D PATCHES IN A CONVOLUTIONAL NEURAL NETWORK

Computer Vision and Machine Intelligence Group
Department of Computer Science
University of the Philippines Diliman

Motivation

vertebra segmentation and fracture identification method in spinal imaging



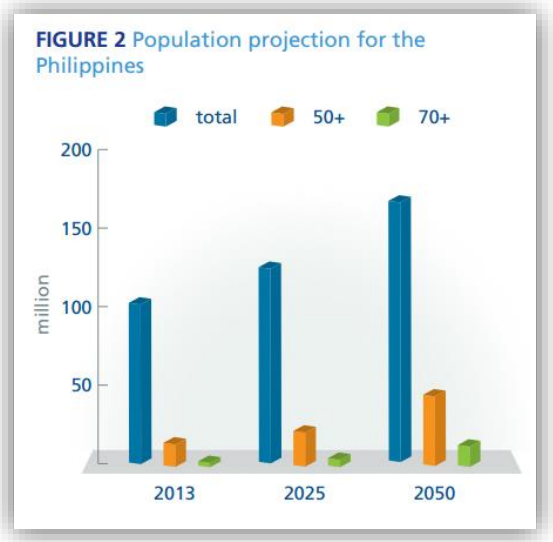
Philippines: WHO Statistical Profile

Motivation

vertebra segmentation and fracture identification method in spinal imaging

In the Philippines, **vertebral fractures** are among the most common fracture cases included in the population of patients suffering from fractures secondary to **osteoporosis**.

The number of Filipinos at high risk of osteoporosis will reach **4 million by 2020** and **10.2 million by 2050.**



State of Osteoporosis in the Philippines
By Asia Pacific Audit Philippines 2013

Vertebrae Segmentation and Fracture Classification from CT Lumbar Spine Images Using Tri-Planar 2D Patches in a Convolutional Neural Network

Project Objectives:

- Make use of the available lumbar data in the present day and create an automated system to segment CT lumbar spine images and classify them according to their fracture types.
- Lessen subjective errors on interpretations of CT lumbar spine images
- Contribute on future modelling of other segmentation and classification techniques on the field of medical image analysis

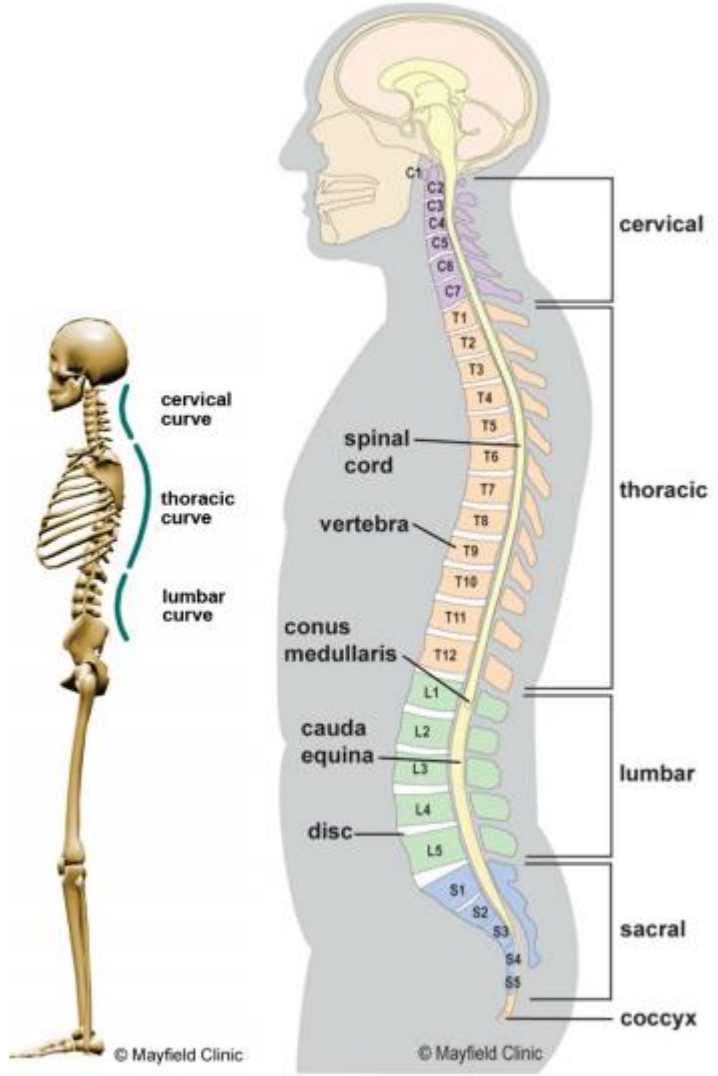
METHODOLOGY
computerized tomography scans

Three-dimensional models of the anatomy, specifically vertebral anatomy, offer a valuable medical tool. Images of vertebrae and the spinal curve, constructed from multiple 2D slices of computed tomography (CT) provide **cross-sectional information** that are not present in 2D scans. CT scans also provide **$360°$ image** of the subject.

CT Scan of the Lumbar Spine
Image from S. Mark Taper Foundation Imaging Center

METHODOLOGY
lumbar spine

- 5 lumbar vertebrae
- Low back
- Largest in size

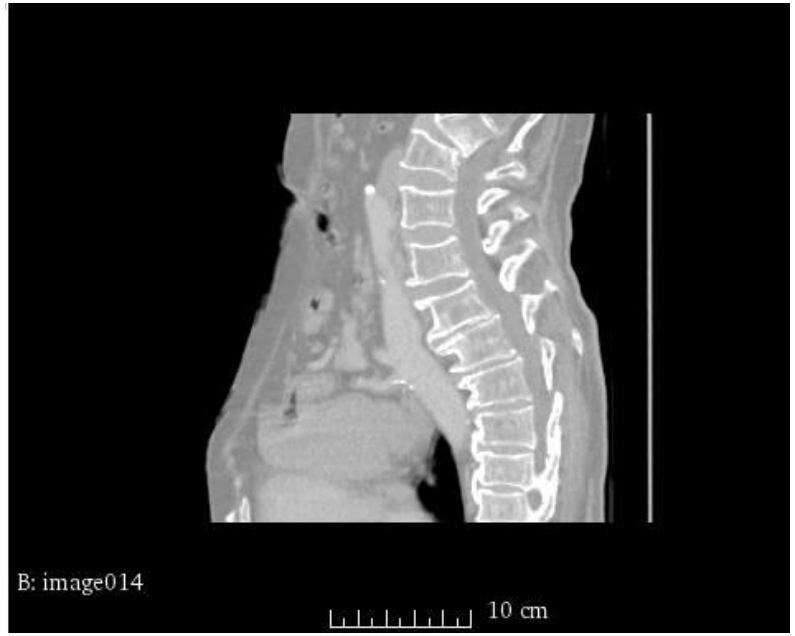


METHODOLOGY

1. Image Preprocessing
2. Feeding of Tri-Planar 2D Patches into the CNN
3. ReLU (Activation Function)
4. Pooling
5. Fracture Classification by Softmax Classifier

METHODOLOGY

Image Preprocessing (SNR)

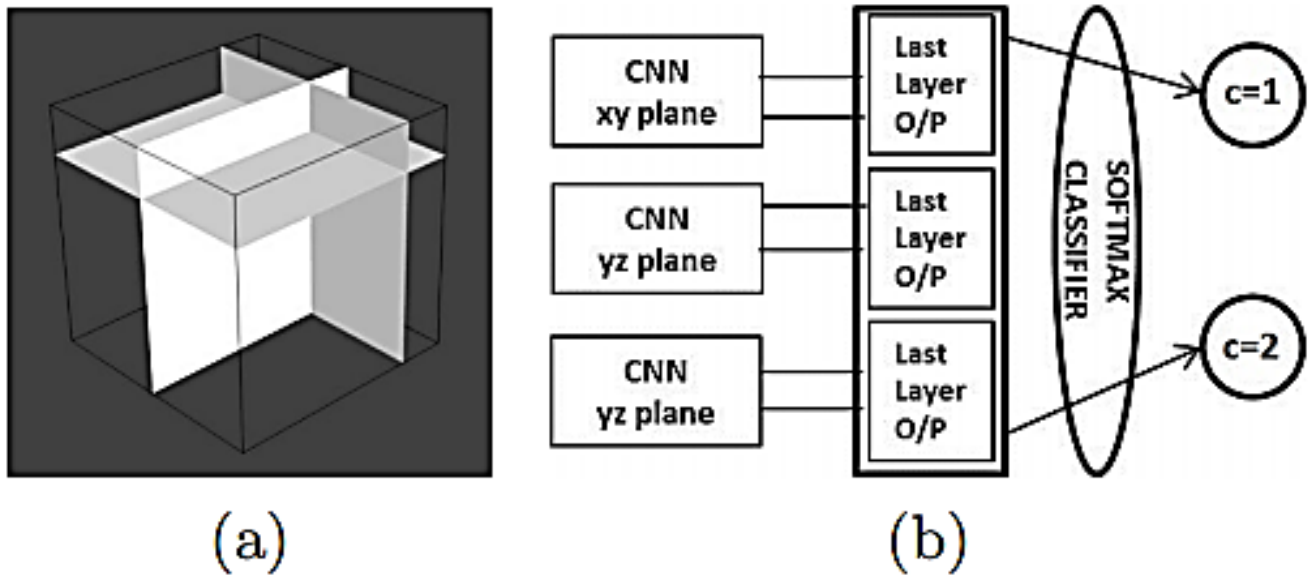


Methods on diffusion filters

METHODOLOGY

Tri-Planar 2D Patches in a Convolutional Neural Network

The three images planes giving rise to tri-planar convolutional neural network (CNN) architecture. The three CNNs are fused in the final layer.

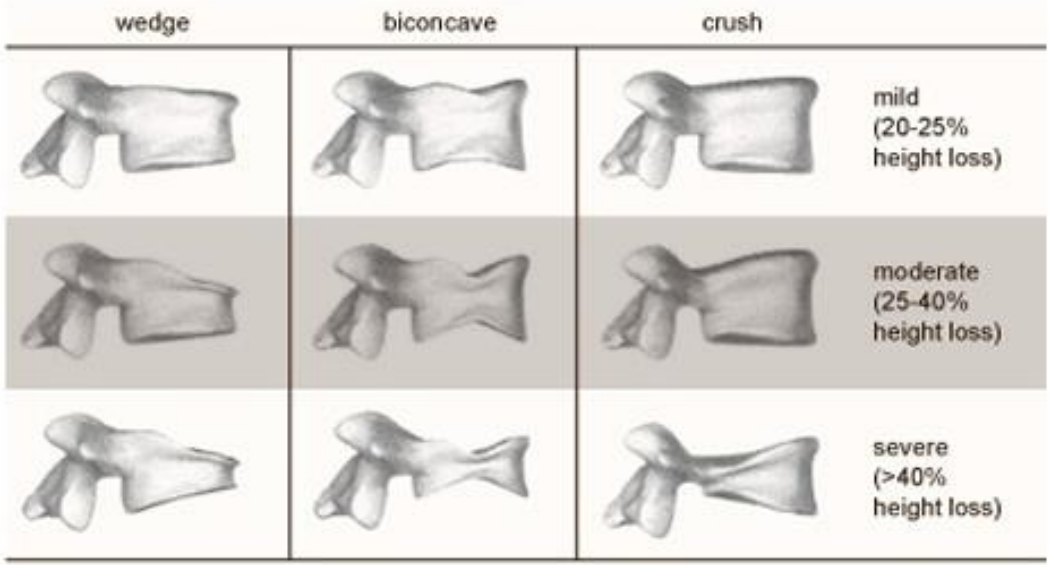


Deep Feature Learning for Knee Cartilage Segmentation Using a Tri-planar Convolutional Neural Network (University of Copenhagen, Denmark)

METHODOLOGY
vertebrae fracture classification

Morphological Cases and Grades of Vertebral Fractures

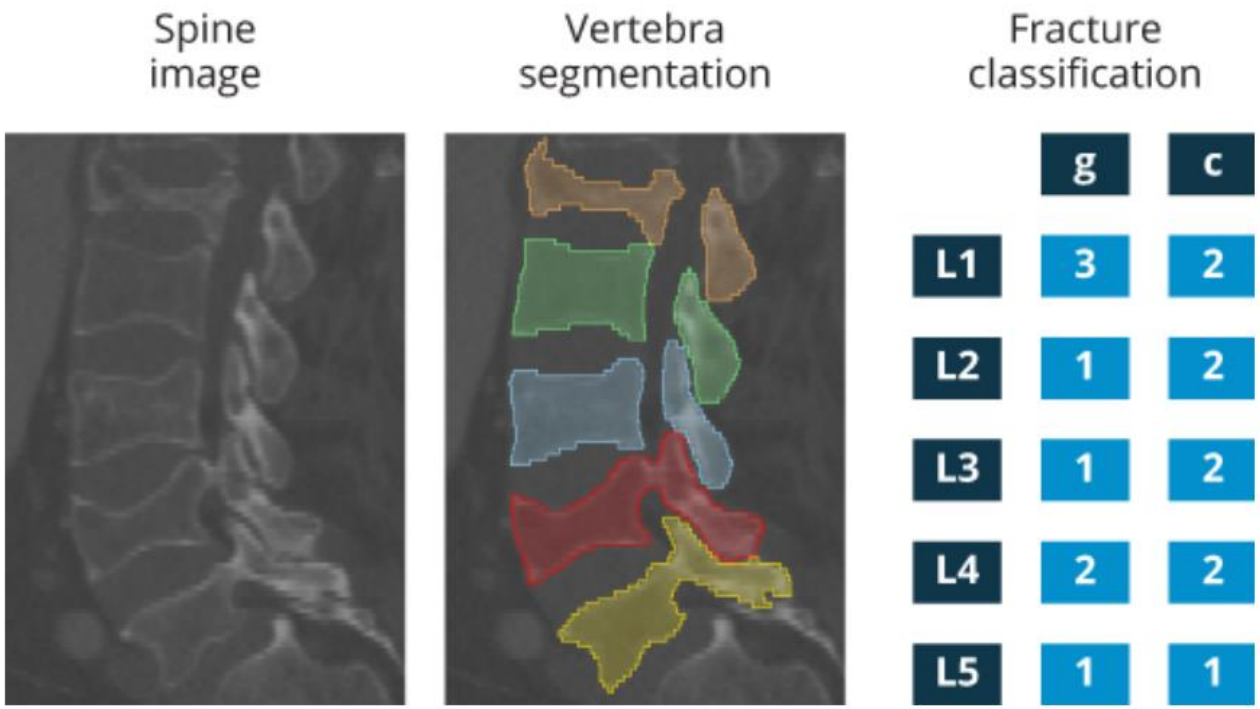
Figure 1: Vertebral fracture variations



Source: Genant HK, Wu CY, van Kuijk C, Nevitt MC, Vertebral fracture assessment using a semiquantitive technique. J Bone Miner Res. 1993; 8:1137-1148

METHODOLOGY

Tri-Planar 2D Patches in a Convolutional Neural Network



CT Scan of the Lumbar Spine
Image from S. Mark Taper Foundation Imaging Center

Values in each row follow vertebral levels in the ascending order from L1 to L5 and sequentially correspond to scores , where g is the grade and c is the case of vertebral fractures.