Spatiotemporal Big Data Analytics for Osteoarthritis Detection

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Presentation Outline

About Osteoarthritis Initiative (OAI)

Background Information

Project Description
  Objectives & Source of Data
  Methodologies

Next Steps
Osteoarthritis Initiative (OAI)

- Multi-center, longitudinal, prospective observational study of knee osteoarthritis (OA).

- Develop a public domain research resource.

- Provide database for osteoarthritis including clinical evaluation, biological specimens, and imaging data.
Background Information

What is Osteoarthritis (OA)?
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- Joint disease that mostly affects cartilage
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- Joint disease that mostly affects cartilage
- Causes pain and difficulty in joint motion, and physical disability in older people
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- Joint disease that mostly affects cartilage
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Figure 1: Normal Knee vs Affected Osteoarthritis Knee Image
Objectives:

- Identify clinical biomarkers for early detection of osteoarthritis
- Improve the prevention and intervention strategies of knee osteoarthritis
Osteoarthritis Initiative:

- Baseline - MRI images for entire cohort (n = 4,796 participants)
- 12-month follow-up up to 96-month follow-up
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Figure 2: No sign of osteoarthritis

Figure 3: Severe signs of osteoarthritis
Project Description

Methodologies

- **Method 1**: Image Processing
- **Method 2**: Tensor Decomposition

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**Image Data**

**Feature Extraction & Feature Selection**

**Classification** (Multi-class label)

- No Sign of osteoarthritis
- Some Signs of osteoarthritis
- Severe Signs of osteoarthritis

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Method 1: Image Processing

1. Image Pre-processing
   - Median Filter

2. Image-Segmentation
   - Detection of Cartilage Boundary

3. Thickness Calculation

4. Classification

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Method 2 - Tensor Decomposition

1. Arrange data in a tensor structure

WHAT IS A TENSOR?

A tensor is a multidimensional array
E.g., three-way tensor:

![Diagram of a three-way tensor with modes 1, 2, and 3]
2. Tensor Decomposition
   - Candecomp/Parafac (CP) Decomposition
   - Tucker Decomposition
   - Multi-linear Discriminate Analysis
   - Multi-linear Principal Component Analysis (PCA)
   - Uncorrelated Multi-linear PCA

3. Early Detection & Classification
Next Steps

- Week 2 - Week 4: Theoretically and Experimentally Framework for Method 1 + Analyze Results

- Week 5 - Week 9: Theoretically and Experimentally Framework for Method 2 + Analyze Results + Final Report
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