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Project Report

HUMAN SKELETAL SYSTEM

1. Introduction

1.1 Purpose

The purpose of this project is to study and organize the bones in the human body by applying various data structures and algorithms. The project will serve as a learning tool for understanding the number and specific sequence of bones in an adult human being and the application of computational techniques to biological data.

1.2 Document Conventions

- All headings and subheadings follow a hierarchical numbering system.
- Code snippets for algorithms are included in monospace font.
- Diagrams are provided where necessary.

1.3 Project Scope

1.3.1 Scope Definition

This project covers:

- Identifying and organizing the bones in the adult human body.
- Applying algorithms (insertion, merge, heap, quick sort) and data structures (array, stack, queue, tree, hash) to the data.

1.3.2 Core Features

- Implementation of sorting algorithms for ordering bones.
- Data structure operations to manage bone information.

1.3.3 Subsequent Releases

Future versions may include:

- Enhanced visualization of the skeletal system.
- Integration with 3D modeling tools.

1.3.4 Alignment with User and Business Goals

The project aligns with educational and research objectives, making data analysis for biological systems more accessible and structured.

1.4 References

1. Gray's Anatomy: The Anatomical Basis of Clinical Practice.
2. Introduction to Algorithms (Fourth Edition).
3. Human Anatomy and Physiology (Marieb).

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2. Overall Description

2.1 Product Perspective

2.1.1 Product Context

The project integrates anatomy and computational techniques to enhance understanding of skeletal organization.

2.1.2 Product Origin

This is an educational project aimed at bridging biology and computer science.

2.1.3 Product Relationship to Existing Systems

Relates to anatomy educational software and algorithm simulation tools.

2.1.4 Product Ecosystem

It fits into learning management systems and standalone computational tools for anatomy.

2.2 User Classes and Characteristics

2.2.1 Tech Enthusiasts

Interested in data structures and algorithms.

2.2.2 Casual Shoppers

Biology students aiming for a structured study guide.

2.2.3 Favored User Class

Educators and researchers in interdisciplinary fields.

2.2.4 Alignment with User Needs

Provides practical examples of algorithms and their application to real-world data.

2.3 Operating Environment

2.3.1 Hardware Platform

Minimum: Laptop/Desktop with modern processor and 4 GB RAM.

2.3.2 Operating Systems and Versions

Windows 10+, macOS 10.14+, Linux (Ubuntu 18.04+).

2.4 Design and Implementation Constraints

2.4.2 Database Technology

SQLite for managing bone-related data.

2.4.4 Third-Party Integrations

No external libraries beyond Python’s standard library.

2.4.5 User Interface Design

Simple command-line interface for interaction.

2.5 Assumptions and Dependencies

2.5.1 Assumptions

- User has basic knowledge of biology and programming.
- Python 3.8+ is pre-installed.

2.5.2 Dependencies

- Python standard libraries for data processing.

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3. System Features

- Detailed list of all 206 bones in the adult human body.
- Sequence management using sorting algorithms.
- Operations on bones using arrays, stacks, queues, and trees.

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4. Number and Sequence of Bones

The adult human skeleton consists of 206 bones, organized as follows:

4.1 Axial Skeleton

- **Skull**: 22 bones
  - Cranial bones: 8 (e.g., frontal, parietal, occipital)
  - Facial bones: 14 (e.g., maxilla, mandible, zygomatic)
- **Hyoid Bone**: 1 bone
- **Vertebral Column**: 26 bones
  - Cervical: 7
  - Thoracic: 12
  - Lumbar: 5
  - Sacrum: 1 (fused)
  - Coccyx: 1 (fused)
- **Thoracic Cage**: 25 bones
  - Ribs: 24
  - Sternum: 1

4.2 Appendicular Skeleton

- **Pectoral Girdle**: 4 bones
  - Clavicles: 2
  - Scapulae: 2
- **Upper Limbs**: 60 bones
  - Humerus: 2
  - Radius: 2
  - Ulna: 2
  - Carpals: 16
  - Metacarpals: 10
  - Phalanges: 28
- **Pelvic Girdle**: 2 bones
  - Hip bones (coxal bones): 2
- **Lower Limbs**: 60 bones
  - Femur: 2
  - Tibia: 2
  - Fibula: 2
  - Patella: 2
  - Tarsals: 14

- Metatarsals: 10
- Phalanges: 28

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5. External Interface Requirements

5.1 User Interfaces

5.1.1 Design Standards and Guidelines

Follows a modular programming approach.

5.1.2 Screen Layout and Resolution

Text-based outputs for easy readability.

5.1.3 Standard Interface Elements

Command-line input and output.

5.2 Software Interfaces

5.2.4 Non-Functional Requirements

- Code readability and maintainability.
- Efficient algorithms with optimal time complexity.

5.3 Hardware Interfaces

5.3.1 Supported Device Types

PCs and laptops.

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6. Quality Attributes

6.1 Performance

Efficient sorting and data structure manipulation within O(n log n) complexity.

6.2 Reliability

Correctly manages and organizes all 206 bones.

6.3 Usability

Intuitive interface for non-expert users.

6.4 Security

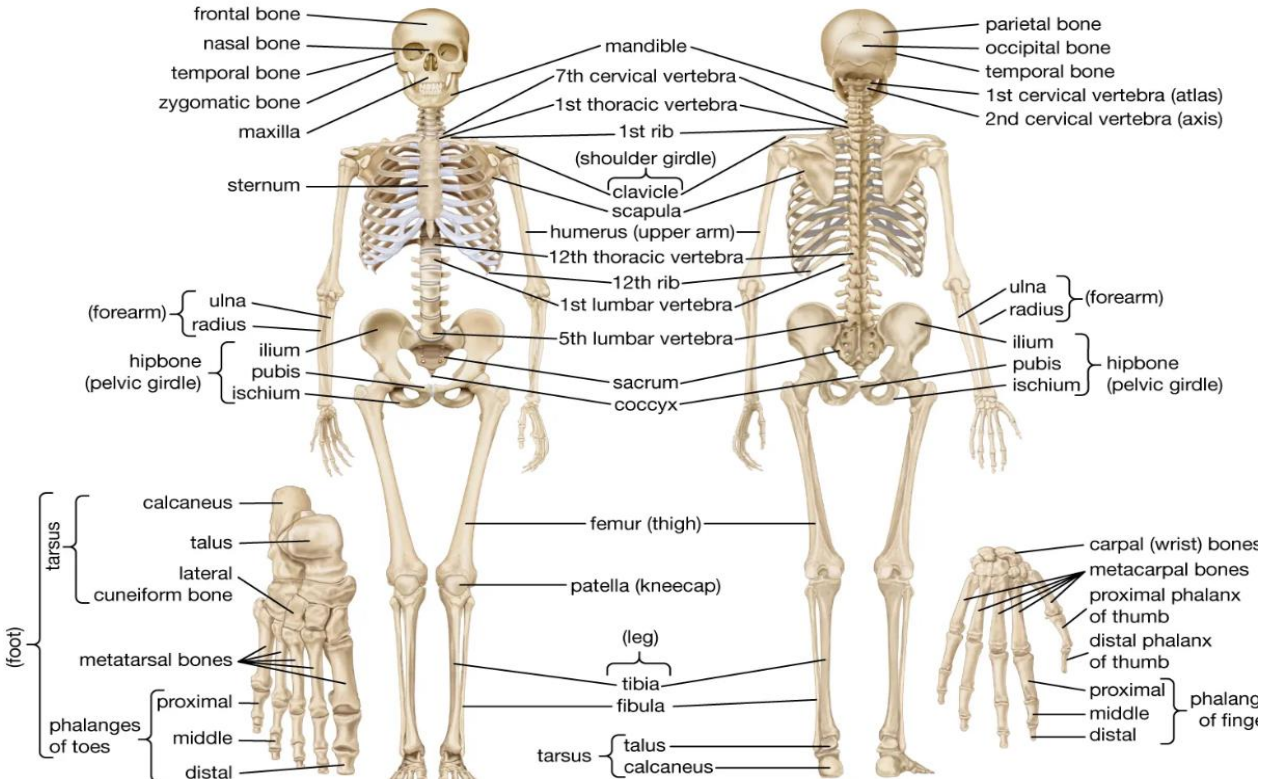
No sensitive data is processed.

6.5 Maintainability

Code is modular and well-documented.

Appendix B: Analysis Model

- **Data Representation**: Each bone is stored as an object containing its name, location, and properties.
- **Sorting Algorithms**: Applied to organize bones alphabetically or by position.
- **Data Structures**:
    - **Array**: Stores bone names.
    - **Stack**: Allows reverse sequencing of bones.
    - **Queue**: Simulates a lineup of bones for processing.
    - **Tree**: Represents hierarchical relationships (e.g., skull -> cranial bones).
    - **Hash Table**: Fast retrieval of bone information.


frontal bone
nasal bone
temporal bone
zygomatic bone
maxilla
sternum
(forearm)
ulna
radius
hipbone
(pelvic girdle)
ilium
pubis
ischium
(foot)
tarsus
calcaneus
talus
lateral cuneiform bone
metatarsal bones
phalanges of toes
proximal
middle
distal
mandible
7th cervical vertebra
1st thoracic vertebra
1st rib
(shoulder girdle)
clavicle
scapula
humerus (upper arm)
12th thoracic vertebra
12th rib
1st lumbar vertebra
5th lumbar vertebra
sacrum
coccyx
femur (thigh)
patella (kneecap)
(leg)
tibia
fibula
tarsus
talus
calcaneus
parietal bone
occipital bone
temporal bone
1st cervical vertebra (atlas)
2nd cervical vertebra (axis)
ulna
radius
(forearm)
ilium
pubis
ischium
hipbone
(pelvic girdle)
carpal (wrist) bones
metacarpal bones
proximal phalanx of thumb
distal phalanx of thumb
proximal
middle
distal
phalang
of finge