Virtual Coaching Deep Learning Project

A Journey through Data Collection and Annotations

Team Members

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01

Objectives of the project

Objectives

Our aim

To develop an advanced virtual coaching system utilizing deep learning technologies that can accurately evaluate and provide feedback on exercise performance. This system aims to aid both professional athletes and general fitness enthusiasts in improving their form and technique through personalized coaching, ultimately enhancing their overall fitness and reducing the risk of injuries. By achieving this goal, we aim to contribute to the field of AI in sports and fitness, demonstrating the practical application and benefits of deep learning in real-world scenarios.

The goal

To successfully collect, annotate, and analyse exercise data from a diverse group of participants within the academic term. This data will be used to develop a preliminary deep learning model capable of evaluating exercise performance with high accuracy. Specifically, our goal is to:

➢ **Data Collection:**
Target: Gather data from at least 30 participants.
Deadline: By the end of Week 9.

➢ **Data Annotation:**
Target: Annotate all collected videos with metadata (age, weight, height) and detailed exercise scores.
Deadline: By the end of Week 11.

➢ **Scoring System:**
Target: Implement a scoring system for accurate exercise performance feedback.
Deadline: By the end of Week 12.

➢ **Future Goal:**
Develop a mobile application that provides instant live scoring and feedback during exercises to further enhance user experience and training effectiveness.

Resources

Our team is composed of experienced professionals with the necessary skills and expertise to complete the project on time and within budget.

Human resources

Team Members:
    4 Undergraduate Engineers specializing in Computer and Communication Engineering with a minor in AI.

Supervision:

Dr. Walid Gomaa
Eng. Mohamed Hatem (TA)

Collaboration:
    Dr. Islam Ezz El Din (Sports Coach and Expert in Exercise Scoring).

Financial resources

Budget Allocation:

- **Chroma Key Screens:** 600 L.E
- **Professional Tripods:** 900 L.E
- **Miscellaneous Expenses:** 1000L.E
        Total Budget: 2500 L.E

Funding Sources:
        Personal contributions from team members.

Physical resources

Physical Resources
Equipment:
❑ 2 Chroma Key Screens (3*5 meters) for consistent background in videos.
❑ 2 Professional Tripods for stable video recording from multiple angles.
Facilities:
        Top Fitness Gym in Alexandria for data collection sessions.
Software:
❑   Google Drive for data storage and sharing.
❑   Notebook for data analysis and model development.

Project timeline

Data Access and Planning

Equipment preparation

Data Annotation and Initial Analysis

Preparing Scoring Criteria

01 **02** **03** **04** **05** **06** **07** **08**

Gym Negotiation and Equipment Setup

Data Collection Campaign

Collaboration with Expert

Documentation and Future Planning

Data Access Challenges

1- Data Links Provided by Doctor:

MMFIT: Link 🔗
Squat Dataset: Link 🔗

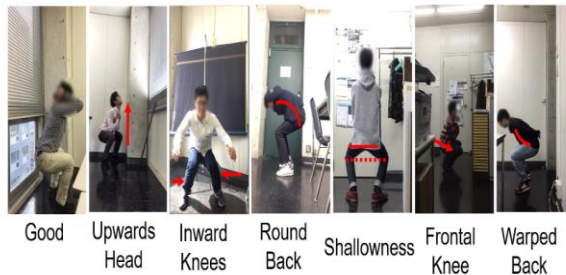## 2- Access Attempts and Challenges:

Week 1: Attempted to access provided datasets, but access was denied.
Week 2: Reported access issue to TA; problem remained unsolved.
Week 3: Communication with Doctor: Informed doctor of access issue; advised to collect data independently.

Squat Dataset

This is a video of the "Single Individual Dataset" used in "Temporal Distance Matrices for Squat Classification" (CVPRW2019).

Good | Upwards Head | Inward Knees | Round Back | Shallowness | Frontal Knee | Warped Back

Exercises

Squats
The body is lowered at the hips from a standing position and then stands back up to complete a repetition. Hands are push in front for balancing.

Push-ups
Legs extended back and balancing the straight body on hands and toes. The arms are flexed to alower and raise the body. Repetitions are counted when the body returns to the starting position.

Dumbbell shoulder presses
From a sitting pisition, the weights are pressed upwards until the arms are straight and the weights touch above the head.

Outcome:

❑ Unable to access provided data, leading to a loss of approximately 3 weeks.
❑ Decision made to proceed with independent data collection efforts.

Gym Selection Process

1-Search and Negotiations:

❖ Conducted intensive search and negotiations with numerous gyms in Alexandria, Egypt.

❖ Sought a gym willing to provide access without fees or formal paperwork.

❖ We arranged to film at the Fencing Club's premises, but they later apologized due to the numerous championships being held.

2- Selected Gym:
Top Fitness Gym, Smouha

❖ Top Fitness Gym located in Alexandria, Smouha.

❖ Chosen for its willingness to support the project without financial or administrative barriers.
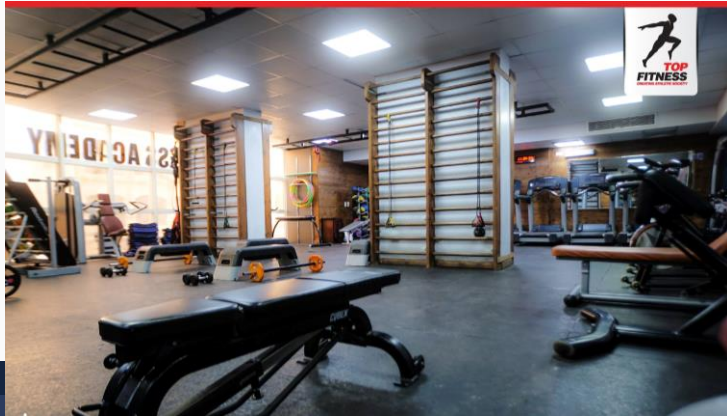
TOPFITNESS
Your Fitness, Your Lifestyle
📞 03-4041025 – 01006555826
📞 03-5928580 – 01558672122

Equipment Overview

Chroma Screens

Dimensions: 3*5 meters

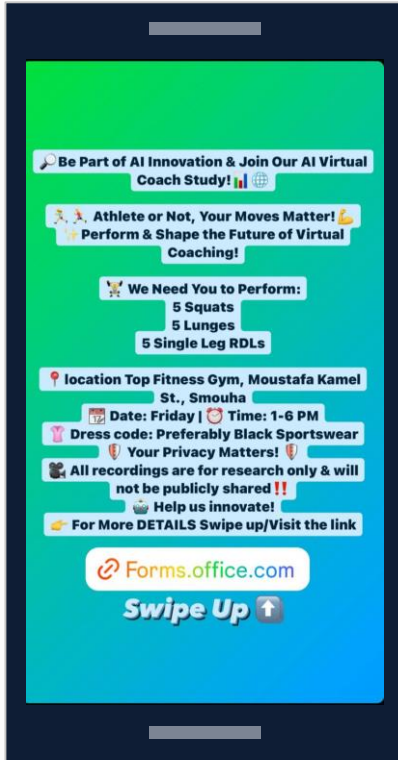**Purpose:** Provide a consistent white background for video recordings.

professional Tripods

Quantity: 2

Purpose: Stable support for frontal and lateral video recording.

Data Collection Campaign

●1- Messaging and Promotion:

- Utilized Social Media posts and QR code to promote data collection campaign.
- Encouraged participation from diverse groups, emphasizing the importance of every individual's contribution.

2- Participant Registration:

- Created a Microsoft Form for participants to register.

- Provided organized data to the gym for ease of access and cost-free entrance.

Phone flyer:
🔍 Be Part of AI Innovation & Join Our AI Virtual Coach Study! 📊🌐
🏃🏋️ Athlete or Not, Your Moves Matter! 💪 ✨ Perform & Shape the Future of Virtual Coaching!
🏆 We Need You to Perform:
5 Squats
5 Lunges
5 Single Leg RDLs
📍 location Top Fitness Gym, Moustafa Kamel St., Smouha
📅 Date: Friday | ⏰ Time: 1-6 PM
👕 Dress code: Preferably Black Sportswear
🛡️ Your Privacy Matters! 🛡️
🎥 All recordings are for research only & will not be publicly shared ‼️
🙌 Help us innovate!
👉 For More DETAILS Swipe up/Visit the link
Forms.office.com
Swipe Up ⬆️

Virtual Coach Project Shoot

Successes and Participation

Wide Range of Participants:

➢ Engaged professional athletes, individuals from various sports teams, and non-athletes.
➢ Age range: 8-54 years old,
➢ demonstrating inclusivity of the campaign

Privacy Assurance

✓ Conducted data collection sessions at the Gym, ensuring convenience and privacy for participants.
✓ Emphasized privacy protection and research-only use of recordings to build trust.

↩ Forwarded

Microsoft Forms
forms.office.com

🔍Be Part of AI Innovation & Join Our AI Virtual Coach Study! 📊🌐

🤸🤾 Athlete or Not, Your Moves Matter! 💪

✨ Perform & Shape the Future of Virtual Coaching!

🏋 We Need You to Perform:
5 Squats
5 Lunges
5 Single Leg RDLs

📍 Location: Top Fitness Gym, Moustafa Kamel St., Smouha
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🎥 All recordings are for research only & will not be publicly shared‼
🙌 Help us innovate!
👉 **For More DETAILS** Swipe up/Visit the link
https://forms.office.com/r/Ezr9RnDHBy

9:30 pm

We are a team of engineering students from Alexandria University specializing in Computer and Communications with a minor in Artificial Intelligence.
We are developing a Virtual Coach system. To achieve this, we require your help!

Project Details: As part of our deep learning course, we are building a Virtual Coach model designed to analyze workout techniques. To train our model effectively, we need to collect video data of individuals performing specific exercises.

Who Can Participate?

- Athletes and non-athletes alike
- Men and women aged between 7 and 50 years

Exercises to be Performed:

- Squats
- Lunges
- Single Leg Romanian Deadlifts (RDL)

Each participant will perform 5 repetitions of each workout.

‼**Data Privacy Assurance:** Please be assured that all video data collected will be used strictly for academic purposes and will not be published or shared outside of the project context.

Participation Details:

- **Venue:** Top Fitness Gym, Moustafa Kamel Street, Smouha
- **Date:** Friday
- **Time:** 1PM to 6PM
- **Dress Code:** Preferably black sportswear

Process: Upon arrival, check-in at the gym's reception where your name will be listed for entry. You will be briefed on the workout routines upon entrance. Participants are required to remove shoes before stepping into the designated shooting area, equipped with frontal and lateral cameras to capture the exercises. ‼No Gym Fees‼
* For Girls: Hair better be tied

Photo showcase

Data Collection Progress and Collaboration

Initial Agreement with Doctor:

o   Target: Collect data for 30 individuals.
o   Exercise Protocol: Each person performs 1 set of 5 repetitions for 3 exercises: Squats, 5 Lunges, and 5 Single Leg RDLs.

Dedicated Filming Days:

o   Allocation: 3 full days dedicated solely to the data collection project.
o   Supervision: Doctor and TA attended one of the filming days, providing guidance and support.

Progress Update:

Filming Intensity:
o   Utilized dedicated time efficiently to film participants performing prescribed exercises.
o   Ensured adherence to exercise protocols and quality of recordings.

Participant Engagement:
Successfully engaged with a diverse range of participants, fulfilling the target set by the doctor.
Collaboration with gym staff facilitated smooth data collection operations.

Enhanced Data Annotation and Collection

Additional Annotations Required

- Doctor's Update: Weight and height annotations needed for each participant.
- Increased Iterations: More than five iterations per exercise set required.
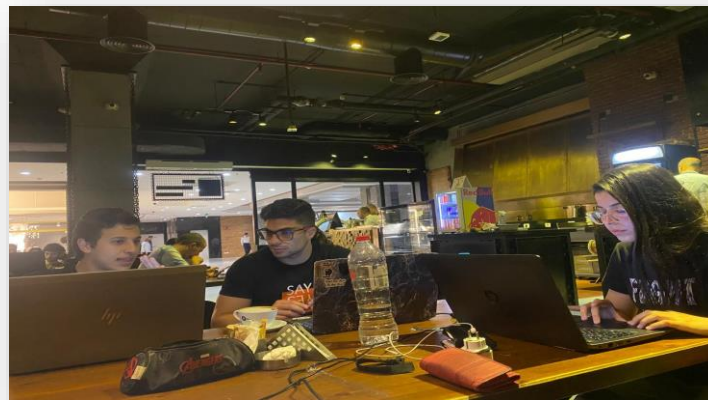
Metadata Collection

✓ Time-consuming task of gathering weight and height data for all participants.
✓ Coordination with participants for accurate metadata retrieval.

Revised Filming Protocol

Updated Exercise Sets:
✓ Revised Protocol: 3 sets for each exercise, with 5 repetitions per set.
✓ Ensured comprehensive data collection to meet updated annotation requirements.

✦ **50 individuals** ✦

Total Participants Filmed

👩 **Females: 14**

🧍 **Males: 36**

Gender Distribution

15-45

Total Exercises Repitition per person

Completion of Metadata Annotations

## 1- Comprehensive Metadata Collection

❑ Annotations Include: Name, Age, Weight, Height for each participant.
❑ Ensured thorough documentation of participant characteristics.

Visual Representation Snip from Excel Spreadsheet ➤

	ID (Primary Key)	Names	Gender	DoB	Age	Height cm	Weight Kg
1							
2	1	Menna Walid	F	20/12/2002	22	162	62
3	2	Mariam Salah	F	22/10/2003	21	167	65
4	3	Ali Ashraf	M	11/08/2015	9	145	49
5	4	Yehia Mohamed	M	20/6/2009	15	171	68
6	5	Sama Samy	F	02/05/2003	21	169	60
7	6	Sama Ahmed	F	02/05/2003	21	169	60
8	7	Saif Sedik	M	03/01/2002	22	174	80
9	8	SaifAllah Mohamed	M	03/01/2002	22	174	80
10	9	Hussein Saeed	M	02/06/2002	21	186	96
11	10	Hussein Hassan	M	02/06/2002	21	186	96
12	11	Omar Hossam	M	26/2/2002	22	176	65
13	12	Omar Mokhtar	M	19/6/1997	27	177	90
14	13	Moaaz Ashraf	M	30/1/2002	22	180	75
15	14	Mohamed Mahmoud	M	25/7/1970	54	178	90
16	15	Mohamed Ahmed	M	25/7/1970	54	178	90
17	16	Abdelrahman Tarek	M	13/8/2004	20	170	78
18	17	Omar Hassan	M	09/06/2000	24	165	66
19	18	Saad Atta	M	31/12/2001	22	176	80
20	19	Aly ElSayed	M	04/04/2011	13	155	43
21	20	Mohamed Alaa	M	03/11/2002	22	177	82
22	21	Omar ElSharkawy	M	12/10/2002	22	179	76
23	22	Mohamed Ossama	M	27/8/2002	22	187	98
24	23	Youssef ElRaggal	M	02/05/2002	22	173	65
25	24	Aisha Mohamed	F	03/12/2014	14	160	52

375 Videos

Data Collected
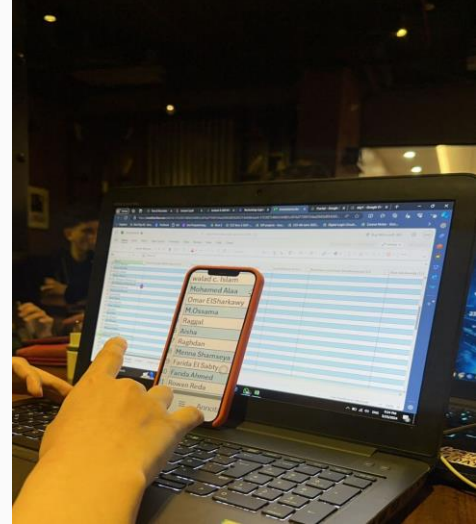
Data Management and Collaboration

Data Storage and Access

Google Drive Account Setup:
- ❑ Established Google Drive account for centralized data storage.
- ❑ Dr.Walid and TA were granted access to facilitate collaboration and data sharing.

Video Processing and Upload

- ❑ Videos processed, cropped, and edited for clarity and consistency.
- ❑ Uploaded to Google Drive in separate files for frontal and lateral views.

Unforeseen Data Loss

Data Deletion Incident:
- ❑ Unfortunately, videos were deleted from the drive, causing data loss and setbacks.
- ❑ Incident addressed and measures taken to prevent recurrence.

Scoring Meeting

Scoring Criteria Discussion:
- ❑ Online meeting scheduled with doctor to
discuss required scoring criteria.
- ❑ Ensured alignment and understanding of scoring standards for accurate evaluation.

Collaboration with Expert for Scoring Criteria

Expert Collaboration for Scoring Criteria

Collaboration with Dr. Islam :
- ❖ **Dr. Islam Ezz El Din,** PHD in sports biomechanics and training, joined project collaboration.
- ❖ Provided expertise in exercise evaluation criteria and scoring, for an enhanced scoring process.

Professional Input for Enhanced Evaluation

Benefit of Collaboration:
- ❖ Incorporating professional expertise ensures accuracy and reliability in exercise assessment.
- ❖ Enhances credibility and effectiveness of virtual coaching system.

Sample Criteria Breakdown

Example Criteria for Lunges:

Stance: 2.5 points
Heels shoulder width apart (0.5 point)
Straight back (0.5 point)
Tight abs (0.5 point)
Chest up (0.5 point)
Head looking forward (0.5 point)

Way down: 4 points
Step forward (0.5 point)
Bend knees slowly 90° (0.5 point)
Back knee is just above the floor (0.5 point)
Swinging arms (0.5 point)
Body weight on the heel of the front foot (0.5 point)
Front foot is parallel with the back foot, not on one line with the back foot (0.5 point)
Balanced position (0.5 point)
Head looking forward (0.5 point)

Way up: 2.5 points
Push with the front foot (0.5 point)
Swin arms (0.5 point)
Head looking forward (0.5 point)
Straight back (0.5 point)
Knees are locked (0.5 point)

Refinement of Scoring Process and Completion Efforts

Scoring Disagreement

- Updates on the sample scoring criteria was required by Dr. Walid Gomaa
- Agreement reached on posting scoring criteria.

Collaborative Scoring Session:

- Contacted Dr. Islam for scoring all 375 videos.
- Successful arrangement of meeting and completion of annotations and scoring.

Annotation Protocol Update

Annotation Protocol Revision:
- ❑ Transitioned from per-person to per-video annotation.
- ❑ Streamlined annotation process for efficiency and consistency.

Commitment to Project Completion

Dedicated Efforts During Exams:
- ❑ Invested 3 full working days during final exams for meetings and scoring sessions.
- ❑ Demonstrated commitment to project success despite academic demands.

Final annotations, Meta Data and Scoring: Excel Spreadsheet

scoring criteria for a single leg Romanian Deadlift (RDL) exercise

Stance (2 points):
- Feet shoulder-width apart: 0.5 points
- Straight back: 0.5 points
- Tight abs: 0.5 points
- Neutral position: 0.5 points

Way Down (5 points):
- Step forward: 0.5 points
- Weight on the heel of the front foot: 0.5 points
- Move torso down: 0.5 points
- Push hips backwards: 0.5 points
- Full back leg extended straight: 0.5 points
- Cross arms and legs movement: 0.5 points
- Supported arm to the side: 0.5 points
- Balance: 0.5 points
- Neutral neck position: 0.5 points
- Support knee bent 15-20°: 0.5 points

Way Up (2 points):
- Neutral neck position: 0.5 points
- Tight abs: 0.5 points
- Slow reverse movement: 0.5 points
- Balance straight back leg: 0.5 points

Breathing (0.5 points):
- Breathing at the stance: 0.5 points

Smooth and Steady Rhythm (0.5 points)
- Smooth and steady rhythm: 0.5 points

scoring criteria for the lunges exercise:

Stance (2.5 points):
- Heels shoulder-width apart: 0.5 points (F)
- Straight back: 0.5 points (L)
- Tight abs: 0.5 points (L)
- Chest up: 0.5 points (L)
- Head looking forward: 0.5 points (F)

Way Down (4 points):
- Step forward: 0.5 points (L)
- Bend knees slowly 90°: 0.5 points (L)
- Back knee is just above the floor: 0.5 points (L)
- Swinging arms: 0.5 points (F)
- Body weight on the heel of the front foot: 0.5 points (L)
- Front foot is parallel with the back foot, not on one line with the back foot: 0.5 points (F)
- Balanced position: 0.5 points (F)
- Head looking forward: 0.5 points (F)

Way Up (2.5 points):
- Push with the front foot: 0.5 points (L)
- Swing arms: 0.5 points (F)
- Head looking forward: 0.5 points (L)
- Straight back: 0.5 points (L)
- Knees are locked: 0.5 points (L)

Breathing (0.5 points): Breath in when lunging: 0.5 points (F)
Rhythm (0.5 points): Smooth and steady rhythm: 0.5 points (L)

scoring criteria for the SQUAT exercise:

Stance (2.5 points):
- Heels shoulder-width apart: 0.5 points (F)
- Feet out 30°: 0.5 points (F)
- Whole feet flat on the floor: 1 point (L)
- Locked knees: 0.5 points (L)

Way Up (5.5 points):
- Bend hips and knees simultaneously: 1 point (L)
- Hips backwards: 1 point (L)
- Knees out: 0.5 points (F)
- Lower back neutral: 1 point (L)
- Head looking forward: 0.5 points (F)
- Chest up: 0.5 points (L)
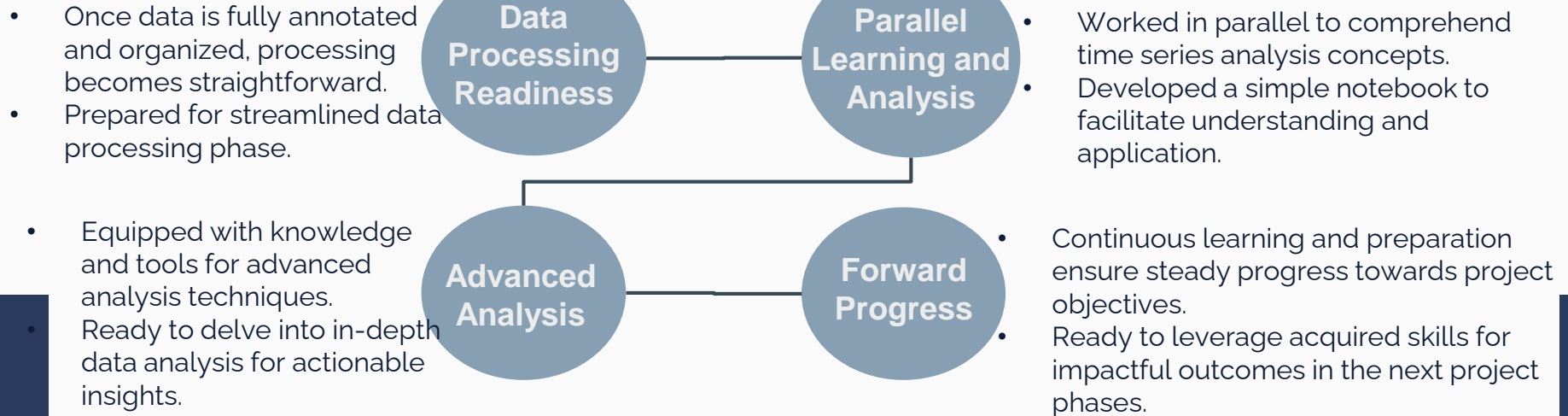- Hips are lower than knee level: 1 point (L)

Breathing (1 point):
- Breath at the stance: 0.5 points (F)
- Hold breathing at the bottom: 0.5 points (F)

Between Reps (1 point):
- Hips and knees are locked: 1 point (L)

Data Processing and Analysis Preparation

- Once data is fully annotated and organized, processing becomes straightforward.
- Prepared for streamlined data processing phase.

Data Processing Readiness

Parallel Learning and Analysis

- Worked in parallel to comprehend time series analysis concepts.
- Developed a simple notebook to facilitate understanding and application.

- Equipped with knowledge and tools for advanced analysis techniques.
- Ready to delve into in-depth data analysis for actionable insights.

Advanced Analysis

Forward Progress

- Continuous learning and preparation ensure steady progress towards project objectives.
- Ready to leverage acquired skills for impactful outcomes in the next project phases.

Ready to proceed to the next phase of data analysis and model development.

Thanks!

Do you have any questions?