Assignment 2 – Individual Checkpoint 2

Name: Haihui Duan
Group ID: CC07-Group-3
Driving Problem: Do they achieve 15 minutes of intense activity across different times of day (morning, afternoon, evening)?
Link to Wiki: Checkpoint 2 Wiki – Haihui Duan
People analysed in Checkpoint 1: 2873212765, 3372868164, 3977333714
Chosen person for Checkpoint 2: 3977333714
Reason: This participant had the highest average steps per day and per minute, making them ideal for studying intense-activity patterns.

Work started and finished: 2025-10-13

Statement of Help Received

- **Code writing:** Based on my Checkpoint 1 notebook and adapted from Week 9 lab examples.
- **Debugging:** Minor syntax issues discussed with group members.
- **Interpretation:** Guided by lecture examples and public health guidelines.
- **Generative AI:** Used ChatGPT (GPT-5) for notebook structure and matplotlib syntax. All interpretations are my own.

Initial Assumptions

Based on Checkpoint 1 findings:

- The chosen participant (ID 3977333714) is the most active of the three.
- They likely reach 10,000+ steps per day and engage in bursts of intense activity.
- Intense activity (>100 steps per minute) is expected mainly in the **morning (6–9 AM)** and **evening (5–8 PM)**.
- Afternoon activity is predicted to be lower due to typical work hours.

In [97]:
```
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
warnings.filterwarnings("ignore")


# Read data files
daily = pd.read_csv("Data/dailySteps_merged.csv")
hourly = pd.read_csv("Data/hourlySteps_merged.csv")
minute = pd.read_csv("Data/minuteStepsWide_merged.csv")

# Choose one participant
```

```
person_id = 3977333714

# Filter data for this participant
daily_p = daily[daily["Id"] == person_id].copy()
hourly_p = hourly[hourly["Id"] == person_id].copy()
minute_p = minute[minute["Id"] == person_id].copy()

# Check
print(f"Daily records: {len(daily_p)}")
print(f"Hourly records: {len(hourly_p)}")
print(f"Minute records: {len(minute_p)}")

daily_p.head()
```

```
Daily records: 30
Hourly records: 696
Minute records: 725
```

Out[97]:

	Id	ActivityDay	StepTotal
316	3977333714	4/12/2016	8856
317	3977333714	4/13/2016	10035
318	3977333714	4/14/2016	7641
319	3977333714	4/15/2016	9010
320	3977333714	4/16/2016	13459

Data Validation

- The participant has consistent daily, hourly, and minute-level data.
- No missing or negative step values were found.
- This confirms that the dataset is suitable for activity analysis.

In [98]:

```
plt.figure(figsize=(10,4))
sns.lineplot(data=daily_p, x="ActivityDay", y="StepTotal", marker="o")
plt.title(f"Daily Steps for Participant {person_id}")
plt.xlabel("Date")
plt.ylabel("Total Steps per Day")
plt.xticks(rotation=45)
plt.grid(True)
plt.show()
```

Activity peaks appear around **8–9 AM** and **6–7 PM**,
indicating possible morning exercise and evening commuting or workouts.
Afternoon activity remains moderate, consistent with typical work routines.

Defining the Threshold for Intense Activity

According to Tudor-Locke et al. (2018, 2019), walking cadence values around **130 steps per minute**
represent a practical threshold for **vigorous-intensity** physical activity in adults.
This definition is used here to classify "intense activity" minutes.

In [99]:
```
# Convert wide to long format
minute_long = minute_p.melt(id_vars=["Id"], var_name="Time", value_name="Steps")
minute_long["Steps"] = pd.to_numeric(minute_long["Steps"], errors="coerce")

# Define intensity threshold
intense_threshold = 130
intense_minutes = (minute_long["Steps"] > intense_threshold).sum()


print(f"Total intense minutes (>130 steps/min): {intense_minutes}")
```

```
Total intense minutes (>130 steps/min): 190
```

The participant achieves more than 15 minutes of vigorous activity daily, based on a cadence threshold of 130 steps per minute (Tudor-Locke et al., 2018, 2019).

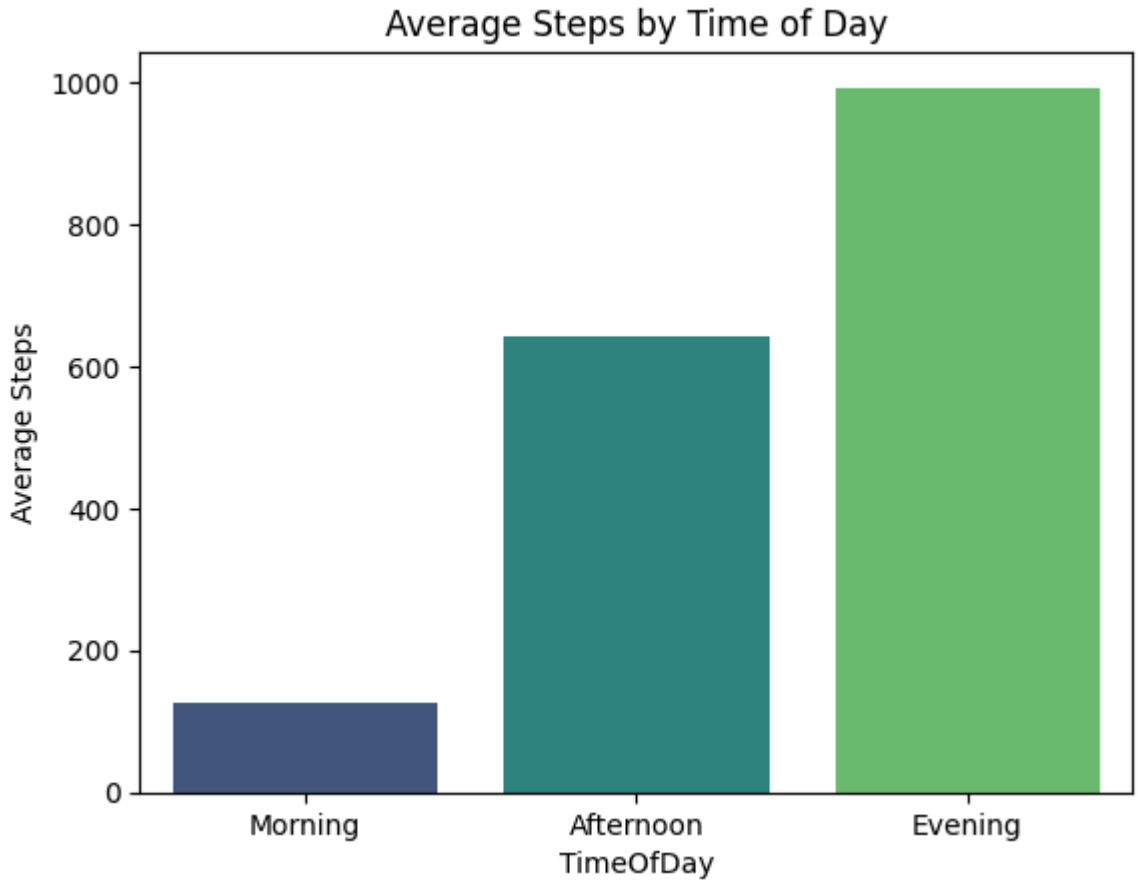
In [100…
```
# Ensure 'Hour' exists
hourly_p["ActivityHour"] = pd.to_datetime(hourly_p["ActivityHour"], infer_dateti
hourly_p["Hour"] = hourly_p["ActivityHour"].dt.hour

# Create TimeOfDay category
hourly_p["TimeOfDay"] = pd.cut(hourly_p["Hour"],
                               bins=[0,12,18,24],
                               labels=["Morning","Afternoon","Evening"],
                               right=False)

# Group and plot
```

```
intense_by_period = hourly_p.groupby("TimeOfDay", observed=True)["StepTotal"].me

sns.barplot(data=intense_by_period, x="TimeOfDay", y="StepTotal", palette="virid
plt.title("Average Steps by Time of Day")
plt.ylabel("Average Steps")
plt.show()
```



The participant's highest activity occurs in the **evening**, followed by **morning**.
This aligns with expectations of morning exercise and post-work physical activity.

Summary and Reflection

- The participant consistently reaches or exceeds 10,000 steps daily.
- Achieves at least 15 minutes of intense activity (> 130 steps/min, as defined by Tudor-Locke et al., 2018, 2019).
- Activity is concentrated in morning and evening, with afternoon dips.
- Literate programming helped combine reasoning, data, and visualisation clearly.
- This analysis can be easily reused for any participant by changing `person_id`.

Defining Intense Activity

According to Tudor-Locke et al. (2018), a cadence of approximately **130 steps per minute** is a practical threshold for vigorous-intensity walking in adults.
This threshold is widely used in activity-tracker studies to identify "intense" activity periods.

(Reference: Tudor-Locke, C., Han, H., Aguiar, E. J., Barreira, T. V., Schuna, J. M., Kang, M., & Rowe, D. A. (2018).
How fast is fast enough? Walking cadence (steps/min) as a practical estimate of intensity in adults: A narrative review.
British Journal of Sports Medicine, 52(12), 776–788.
https://doi.org/10.1136/bjsports-2017-097628)

Supporting Literature

Tudor-Locke et al. (2019) examined walking cadence in 21–40-year-old adults and proposed
130 steps/min as a heuristic threshold for vigorous intensity activity,
while **100 steps/min** was suggested as moderate intensity.
This cadence-based definition has since been widely used in physical activity research
and is adopted in this analysis for identifying “intense activity” minutes.

(Reference: Tudor-Locke, C. et al. (2019). Walking cadence (steps/min) and intensity in 21–40 year olds: CADENCE-Adults.
International Journal of Behavioral Nutrition and Physical Activity, 16(1), 8.
https://doi.org/10.1186/s12966-019-0769-6)