2026 MCM Training

Problem B: The Elevator Pitch

Photo Credit: veer.com

In modern high-rise buildings, the elevator system is the vascular system of vertical transportation. Its efficiency directly impacts the quality of life for residents and the productivity of office workers. A common frustration in skyscrapers is the **"long wait"** — standing in the lobby or a hallway, watching the floor indicator stay motionless, or seeing an elevator pass by without stopping.

While traditional elevator control systems respond to calls as they happen, advanced **"Group Control Systems" (GCS)** attempt to optimize the movement of multiple elevators. A critical but often overlooked aspect of this optimization is the Parking Strategy (also known as "Home Landing" or "Idling" strategy). When an elevator has no active calls, where should it go? Should it stay where it last stopped? Should it return to the lobby? Or should it pre-position itself at a predicted high-demand floor?

Inefficient parking leads to:

•Increased Waiting Time (AWT): Elevators are far from where the next call originates.

• Energy Waste: Unnecessary empty trips to a default "home" floor.

• Uneven Wear: Some elevators doing more work than others.

You need to help The Modern Commercial Motor (MCM) company propose a smarter, dynamic parking strategy. To do this, you are required to analyze the operational data of a bank of elevators in a high-rise mixed-use (office/commercial) building over a period of 30 days, understand the traffic patterns, and develop corresponding mathematical models.

Your team is required to develop mathematical models to address the following tasks:

The Crystal Ball Effective dispatching relies on knowing what will happen next. Considering the time-series nature of the data, develop a mathematical model to predict the total passenger flow volume for the next 5-minute time slice. Your model should be able to adapt to different times of the day. You need to

consider: The time-series nature of the data. Is the flow random, or does it follow a strong pattern?

The Pulse of the Building Elevator traffic is not uniform. There are distinct "modes" of operation, such as the Morning Up-Peak,Breakfast Hour, Lunch Hour, Evening Down-Peak, Dinner Hour, and Meeting/Inter-floor traffic. Using your analyzed data, develop a model to automatically classify the current state of the building into these (or other discovered) categories based on real-time data features.

The Strategic Wait Based on your observations of elevator traffic patterns, develop a Dynamic Parking Strategy Model. When an elevator becomes idle (no current calls), your model must decide:

1. Where to park? (Which floor?)
2. How many elevators should be parked at specific key locations?
3. When to move there?

Your goal is to optimize the system's performance. You need to define your own objective functions, such as minimizing average waiting time, minimizing the percentage of "Long Waits", or balancing energy consumption.

Memo to the Management Write a one-page memo to the Building Management and the Elevator Maintenance Company. Explain the logic of your proposed Parking Strategy. Why is it better than simply leaving the elevator where it last stopped or sending everything to the lobby? Explain how your solution saves time or energy.

Files provided

The provided dataset includes detailed logs of 8 elevators over 30 days. The data covers:

- Hall calls (passenger requests from elevator lobbies)
- Car calls (destination selections inside elevator cars)
- Car stops (including stop reasons and directions)
- Car departures
- Load changes (passenger weight entering/exiting)
- Maintenance mode status

A detailed data description is provided in `readme.md`

Glossary

- Hall Call: A request made from the hallway (outside the elevator) to go Up or Down.
- Car Call: A request made from inside the elevator to go to a specific floor.
- Up-Peak: A traffic pattern typically occurring in the morning where most traffic originates at the lobby and goes up.
- Down-Peak: A traffic pattern typically occurring in the evening where most traffic originates at upper floors and goes to the lobby.
- Parking/Home Landing: The floor to which an idle elevator is sent to wait for the next call.
- AWT (Average Waiting Time): The average time a passenger waits from pressing the hall button until the elevator arrives and opens its doors.

Your PDF solution of no more than 25 total pages should include:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution.
- One-page memo.
- References list.
- AI Use Report (If used, does not count toward the 25-page limit).

Note: The contest has a 25-page limit. All aspects of your submission count toward the 25-page limit (Summary Sheet, Table of Contents, Reference List, and any Appendices). You must cite the sources for your ideas, images, and any other materials used in your report.

Use of Large Language Models and Generative AI Tools in COMAP Contests: Please refer to the attachment for the new policy regarding this issue.

Use of Large Language Models and Generative AI Tools in COMAP Contests

This policy is motivated by the rise of large language models (LLMs) and generative AI assisted technologies. The policy aims to provide greater transparency and guidance to teams, advisors, and judges. This policy applies to all aspects of student work, from research and development of models (including code creation) to the written report. Since these emerging technologies are quickly evolving, COMAP will refine this policy as appropriate.

Teams must be open and honest about all their uses of AI tools. The more transparent a team and its submission are, the more likely it is that their work can be fully trusted, appreciated, and correctly used by others. These disclosures aid in understanding the development of intellectual work and in the proper acknowledgement of contributions. Without open and clear citations and references of the role of AI tools, it is more likely that questionable passages and work could be identified as plagiarism and disqualified.

Solving the problems does not require the use of AI tools, although their responsible use is permitted. COMAP recognizes the value of LLMs and generative AI as productivity tools that can help teams in preparing their submission; to generate initial ideas for a structure, for example, or when summarizing, paraphrasing, language polishing etc. There are many tasks in model development where human creativity and teamwork is essential, and where a reliance on AI tools introduces risks. Therefore, we advise caution when using these technologies for tasks such as model selection and building, assisting in the creation of code, interpreting data and results of models, and drawing scientific conclusions.

It is important to note that LLMs and generative AI have limitations and are unable to replace human creativity and critical thinking. COMAP advises teams to be aware of these risks if they choose to use LLMs:

- Objectivity: Previously published content containing racist, sexist, or other biases can arise in LLM-generated text, and some important viewpoints may not be represented.
- Accuracy: LLMs can ‘hallucinate’ i.e. generate false content, especially when used outside of their domain or when dealing with complex or ambiguous topics. They can generate content that is linguistically but not scientifically plausible, they can get facts wrong, and they have been shown to generate citations that don’t exist. Some LLMs are only trained on content published before a particular date and therefore present an incomplete picture.
- Contextual understanding: LLMs cannot apply human understanding to the context of a piece of text, especially when dealing with idiomatic expressions, sarcasm, humor, or metaphorical language. This can lead to errors or misinterpretations in the generated content.
- Training data: LLMs require a large amount of high-quality training data to achieve optimal performance. In some domains or languages, however, such data may not be readily available, thus limiting the usefulness of any output.

Guidance for teams

Teams are required to:

1. **Clearly indicate the use of LLMs or other AI tools in their report**, including which model was used and for what purpose. Please use inline citations and the reference section. Also append the Report on Use of AI (described below) after your 25-page solution.
2. **Verify the accuracy, validity, and appropriateness** of the content and any citations generated by language models and correct any errors or inconsistencies.
3. **Provide citation and references, following guidance provided here.** Double-check citations to ensure they are accurate and are properly referenced.
4. **Be conscious of the potential for plagiarism** since LLMs may reproduce substantial text from other sources. Check the original sources to be sure you are not plagiarizing someone else's work.

COMAP will take appropriate action
when we identify submissions likely prepared with
undisclosed use of such tools.

Citation and Referencing Directions

Think carefully about how to document and reference whatever tools the team may choose to use. A variety of style guides are beginning to incorporate policies for the citation and referencing of AI tools. Use inline citations and list all AI tools used in the reference section of your 25-page solution.

Whether or not a team chooses to use AI tools, the main solution report is still limited to 25 pages. If a team chooses to utilize AI, following the end of your report, add a new section titled Report on Use of AI. This new section has no page limit and will not be counted as part of the 25-page solution.

Examples (this is not exhaustive – adapt these examples to your situation):

Report on Use of AI

Team Control Number: _____
Team Members: _____, _____, _____
AI Tools Used （Example）

AI Tool	Version/Model	Primary Purpose
OpenAI ChatGPT	GPT-4 / GPT-4.5	Brainstorming, debugging
Claude	Claude 3.5 Sonnet	Model discussion, writing
DeepSeek	Latest version	Code generation, verification
GitHub Copilot	IDE-integrated	Code completion

Query/Response Record
ChatGPT Query 1:
Query1: < *insert the exact wording you input into the AI tool*>
Output: < *insert the complete output from the AI tool*>
Purpose: [Brief description of use, e.g., "Understanding advection-dispersion equation formulation"]
Claude Query 1:
Query1: < *insert the exact wording you input into the AI tool*>
Output: < *insert the complete output from the AI tool*>
Purpose: [e.g., "Optimizing decision model mathematics"]
DeepSeek Query 1:
Query1: < *insert the exact wording you input into the AI tool*>
Output: < *insert the complete output from the AI tool*>
Purpose: [e.g., "Generating data preprocessing Python code"]

Human Contribution Declaration
We affirm that:

1. All final modeling decisions, algorithm designs, and interpretations were made by team members.
2. All mathematical derivations were verified by us.
3. All code was reviewed, tested, and understood by us.
4. AI was used only for brainstorming, code snippets, translations, and explanations.
5. The final solution represents our own work and understanding.

(Date: _____)

Appendix: Reference of Common AI Tools (as of 2026)
Language Models:

- **OpenAI**: ChatGPT (GPT-4, GPT-4.5, GPT-5 may be available)
- **Anthropic**: Claude (Claude 3, Claude 3.5 Sonnet)
- **Google**: Gemini (Gemini Pro, Gemini Ultra)
- **Baidu**: ERNIE Bot (ERNIE 4.0)
- **DeepSeek**: DeepSeek latest version
- **Moonshot AI**: Kimi Chat

Code Assistant Tools:

- **GitHub Copilot** (integrated in VS Code and other IDEs)
- **Amazon CodeWhisperer**
- **Tabnine**

- **Replit AI**

Other Tools:

- **Microsoft Copilot** (formerly Bing Chat)
- **Perplexity AI** (research assistance)
- **Wolfram Alpha** (computations and visualizations)

Important Notes:

1. Please truthfully record all AI usage.
2. Queries and outputs may be appropriately summarized, but key information must be retained.
3. It is recommended to record AI usage in real-time during the competition.
4. All content in the final report must undergo manual review and verification by the team.