美赛D题特点与切入

《美国数学建模竞赛》

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2016 ICM Problem D：衡量社会信息网络的演变和影响

2016 ICM Problem D Measuring the Evolution and Influence in Society's Information Networks衡量社会信息网络的演变和影响

- Information is spread quickly in today's tech-connected communications network; sometimes it is due to the inherent value of the information itself, and other times it is due to the information finding its way to influential or central network nodes that accelerate its spread through social media. While content has varied -- in the 1800s, news was more about local events (e.g., weddings, storms, deaths) rather than viral videos of cats or social lives of entertainers -- the prevailing premise is that this cultural characteristic to share information (both serious and trivial) has always been there.

- 在今天与技术相连的通信网络中，信息传播迅速;有时是由于信息本身的内在价值，有时是由于信息找到了通过社交媒体加速传播的有影响力或中心网络节点的途径。虽然内容多种多样——在19世纪，新闻更多的是关于当地事件(如婚礼、风暴、死亡)，而不是关于猫的病毒视频或艺人的社交生活——但普遍的前提是，分享信息的文化特征(无论是严谨的还是琐碎的)一直存在。

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- However, the flow of information has never been as easy or wide-ranging as it is today, allowing news of various levels of importance to spread quickly across the globe in our tech connected world. By taking a historical perspective of flow of information relative to inherent value of information, the Institute of Communication Media (ICM) seeks to understand the evolution of the methodology, purpose, and functionality of society's networks.
- 然而，信息的流动从来没有像今天这样容易和广泛，在我们这个科技相连的世界里，各种重要程度的新闻可以迅速传遍全球。通过对信息流动相对于信息固有价值的历史观点，传播媒体研究所(ICM)试图理解社会网络的方法、目的和功能演变。

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- Specifically, your team, as part of ICM's Information Analytics Division, has been assigned to analyze the relationship between speed/flow of information vs inherent value of information based on consideration of 5 periods: in the 1870s, when newspapers were delivered by trains and stories were passed by telegraph; in the 1920s, when radios became a more common household item; in the 1970s, when televisions were in most homes; in the 1990s, when households began connecting to the early internet; in the 2010s, when we can carry a connection to the world on our phones.
- 具体来说，作为ICM信息分析部门的一部分，您的团队被指派分析信息的速度/流量与信息的内在价值之间的关系，这是基于5个时期的考虑:在19世纪70年代，报纸是通过火车传递的，故事是通过电报传递的;20世纪20年代，收音机成为一种更常见的家庭用品;上世纪70年代，大多数家庭都有电视;上世纪90年代，家庭开始接入早期的互联网;在21世纪10年代，我们可以通过手机与世界相连。

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- Your supervisor reminds you to be sure to report the assumptions you make and the data you use to build your models.

Your specific tasks are:

- (a) Develop one or more model(s) that allow(s) you to explore the flow of information and filter or find what qualifies as news.
- 你的主管提醒你一定要报告你做的假设和你用来建立模型的数据。
- 你的具体任务是:
- (a)建立一个或多个模型，让你可以探索资讯的流动，并筛选或找出符合新闻价值的资讯。

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- (b) Validate your model's reliability by using data from the past and the prediction capability of your model to predict the information communication situation for today and compare that with today's reality.
- (c) Use your model to predict the communication networks' relationships and capacities around the year 2050.
- (b)利用过去的数据和模型的预测能力，预测今日的资讯传播情况，并与今日的实际情况作比较，以证实模型的可靠性。
- (c)利用你的模型预测2050年前后通信网络的关系和能力。

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- (d) Use the theories and concepts of information influence on networks to model how public interest and opinion can be changed through information networks in today's connected world.
- (e) Determine how information value, people's initial opinion and bias, form of the message or its source, and the topology or strength of the information network in a region, country, or worldwide could be used to spread information and influence public opinion.
- (d) 利用信息对网络影响的理论和概念，模拟在当今互联世界中，信息网络如何改变公众利益和意见。
- (e) 确定如何利用一个区域、国家或全世界的信息价值、人们最初的意见和偏见、信息的形式或来源以及信息网络的结构或强度来传播信息和影响舆论。

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- Possible Data Sources: As you develop your model and prepare to test it, you will need to assemble a collection of data. Below are just some examples of the types of data you may find useful in this project. Depending on your exact model, some types of data may be very important and others may be entirely irrelevant.
- 可能的数据源:在开发模型并准备对其进行测试时，需要收集数据。下面是一些数据类型的示例，您可能会发现它们在这个项目中很有用。根据您的确切模型，某些类型的数据可能非常重要，而其他类型的数据可能完全不相关。

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- In addition to the sample sources provided below, you might want to consider a few important world events throughout history – if some recent big news events, such as the rumors of country-turned-pop singer Taylor Swift's possible engagement had instead happened in 1860, what percentage of the population would know about it and how quickly; likewise, if an important person was assassinated today, how would that news spread? How might that compare to the news of US President Abraham Lincoln's assassination?
- 除了下面的示例提供来源，您可能想要考虑一些重要的世界事件在历史上——如果最近的一些重大新闻事件，比如乡村歌手泰勒·斯威夫特(Taylor Swift)可能订婚的传言发生在1860年，会有多少人知道这件事，知道的速度有多快；同样，如果一个重要人物今天被暗杀了，这个消息会如何传播？这与美国总统亚伯拉罕•林肯(Abraham Lincoln)遇刺的消息相比，又如何呢？

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- Sample Circulation Data and Media Availability:
- http://media-cmi.com/downloads/Sixty_Years_Daily_Newspaper_Circulation_Trends_050611.pdf
- http://news.bbc.co.uk/2/hi/technology/8552410.stm
- http://www.gov.scot/Publications/2006/01/12104731/6
- http://www.technologyreview.com/news/427787/are-smart-phones-spreading-faster-than-any-technologyin-human-history/
- http://newsroom.fb.com/content/default.aspx?NewsAreaId=22
- http://www.poynter.org/news/mediawire/189819/pew-tv-viewing-habit-grays-as-digital-newsconsumption-tops-print-radio/
- http://www.people-press.org/2012/09/27/section-1-watching-reading-and-listening-to-the-news-3/
- http://theconversation.com/hard-evidence-how-does-false-information-spread-online-25567

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- Historical Perspectives of News and Media:
- https://www.quora.com/How-did-news-get-around-the-world-before-the-invention-of-newspapers-andother-media
- http://2012books.lardbucket.org/books/a-primer-on-communication-studies/s15-media-technology-andcommunica.html
- http://firstmonday.org/article/view/885/794
- Richard Campbell, Christopher R. Martin, and Bettina Fabos, Media & Culture: An Introduction to Mass Communication, 5th ed. (Boston, MA: Bedford St. Martin's, 2007)
- Marshall T. Poe, A History of Communications: Media and Society from the Evolution of Speech to the Internet (New York: Cambridge, 2011)
- Shirley Biagi, Media/Impact: An Introduction to Mass Media (Boston, MA: Wadsworth, 2007)

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- Your ICM submission should consist of a 1 page Summary Sheet and your solution cannot exceed 20 pages for a maximum of 21 pages.
- Note: The appendix and references do not count toward the 20 page limit.
- 你的ICM提交应该包括一个1页的摘要页，你的解决方案不能超过20页，最多21页。
- 注意:附录和参考文献不计入20页的限制。

2017 ICM Problem D:机场安全检查站乘客进出量的优化问题

2017 ICM Problem D: Optimizing the Passenger Throughput at an Airport Security Checkpoint 机场安全检查站乘客进出量的优化问题

Following the terrorist attacks in the US on September 11, 2001, airport security has been significantly enhanced throughout the world. Airports have security checkpoints, where passengers and their baggage are screened for explosives and other dangerous items. The goals of these security measures are to prevent passengers from hijacking or destroying aircraft and to keep all passengers safe during their travel. However, airlines have a vested interest in maintaining a positive flying experience for passengers by minimizing the time they spend waiting in line at a security checkpoint and waiting for their flight. Therefore, there is a tension between desires to maximize security while minimizing inconvenience to passengers.

2001年9月11日美国发生恐怖袭击事件之后，世界各地开始重视机场安全问题。机场有安全检查站可以筛查乘客和他们的行李中有无爆炸物和其他危险项目。这些安全措施的目的是防止乘客劫持或破坏飞机，并保证所有乘客在旅行期间的安全。然而，航空公司有一种既得的利益，就是通过减少乘客在安检点排队等候的时间，为他们保持良好的飞行体验。因此，在使得安全性最大化和使得乘客的不便最小化是矛盾的。

2017 ICM Problem D机场安全检查站乘客进出量的优化问题

- During 2016, the U.S. Transportation Security Agency (TSA) came under sharp criticism for extremely long lines, in particular at Chicago's O'Hare international airport. Following this public attention, the TSA invested in several modifications to their checkpoint equipment and procedures and increased staffing in the more highly congested airports. While these modifications were somewhat successful in reducing waiting times, it is unclear how much cost the TSA incurred to implement the new measures and increase staffing. In addition to the issues at O'Hare, there have also been incidents of unexplained and unpredicted long lines at other airports, including airports that normally have short wait times. This high variance in checkpoint lines can be extremely costly to passengers as they decide between arriving unnecessarily early or potentially missing their scheduled flight. Numerous news articles, including [1,2,3,4,5], describe some of the issues associated with airport security checkpoints
- 在2016年，美国运输安全局（TSA）由于线路极长受到严厉批评，特别是在芝加哥的奥黑尔国际机场。在公众的关注下，运输安全管理局对他们的安检设备和程序进行了几次修改，并在更加拥挤的机场增加了工作人员。虽然这些修改在一定程度上成功地减少了等待时间，但尚不清楚运输安全管理局为实施新措施和增加工作人员付出了多少成本。除了在奥黑尔的问题，在其他机场也有不明原因和不可预测的长龙的事件，包括通常等待时间较短的机场。当乘客在不必要的早到或可能错过他们的定期航班之间做决定时，检查点线路的这种高差异可能让他们付出昂贵的代价。许多新闻文章，包括[1, 2, 3, 4, 5]，描述了一些与机场安全检查站相关的问题。

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- Your Internal Control Management (ICM) team has been contracted by the TSA to review airport security checkpoints and staffing to identify potential bottlenecks that disrupt passenger throughput. They are especially interested in creative solutions that both increase checkpoint throughput and reduce variance in wait time, all while maintaining the same standards of safety and security .
- 您的内部控制管理（ICM）团队已由TSA签订合同审查机场安全检查站和人员配置，以确定潜在扰乱旅客吞吐量的瓶颈。他们对创造性的解决方案特别感兴趣，这些解决方案既增加了检查点吞吐量，又减少了等待时间中的差异，同时又保持了相同的安全性和安全性标准。

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- **Zone A:**
- Passengers randomly arrive at the checkpoint and wait in a queue until a security officer can inspect their identification and boarding documents.
- **Zone B:**
- The passengers then move to a subsequent queue for an open screening line; depending on the anticipated activity level at the airport, more or less lines may be open.
- **区域A：**
- 乘客随机到达检查站，在队列中等待，直到a安全官员可以检查他们的身份证明和登机文件。
- **区域B：**
- 随后，乘客们排到下一个队列，等待开放的安检通道;根据机场的预期活动水平，或多或少会有航班开通。

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- Once the passengers reach the front of this queue, they prepare all of their belongings for X-ray screening. Passengers must remove shoes, belts, jackets, metal objects, electronics, and containers with liquids, placing them in a bin to be X-rayed separately; laptops and some medical equipment also need to be removed from their bags and placed in a separate bin.
- 一旦乘客到达这个队列的前面，他们所有的物品都需要准备X射线筛查。乘客必须脱下鞋子、皮带、夹克衫、金属物品、电子产品和装有液体的容器，将它们分别放入一个箱子里进行x光检查；笔记本电脑和一些医疗设备也需要从他们的包里取出并放在一个单独箱子。

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- All of their belongings, including the bins containing the aforementioned items, are moved by conveyor belt through an X-ray machine, where some items are flagged for additional search or screening by a security officer (Zone D).
- Meanwhile the passengers process through either a millimeter wave scanner or metal detector.
- Passengers that fail this step receive a pat-down inspection by a security officer (Zone D).
- **Zone C:**
- The passengers then proceed to the conveyor belt on the other side of the X-ray scanner to collect their belongings and depart the checkpoint area.
- 他们的所有物品，包括包含上述的箱子物品，由传送带移动通过X射线机，其中一些项目被标记为由安全员进行额外的筛查（D区）。
- 同时，乘客通过毫米波扫描仪或金属探测器进行处理。
- 未能通过此步骤的乘客接受安全检查（D区）。
- **区域C：**
- 乘客随后前往x光扫描仪另一侧的传送带，取走随身物品，离开检查点。

美国机场安全检查点的当前流程如图1所示：

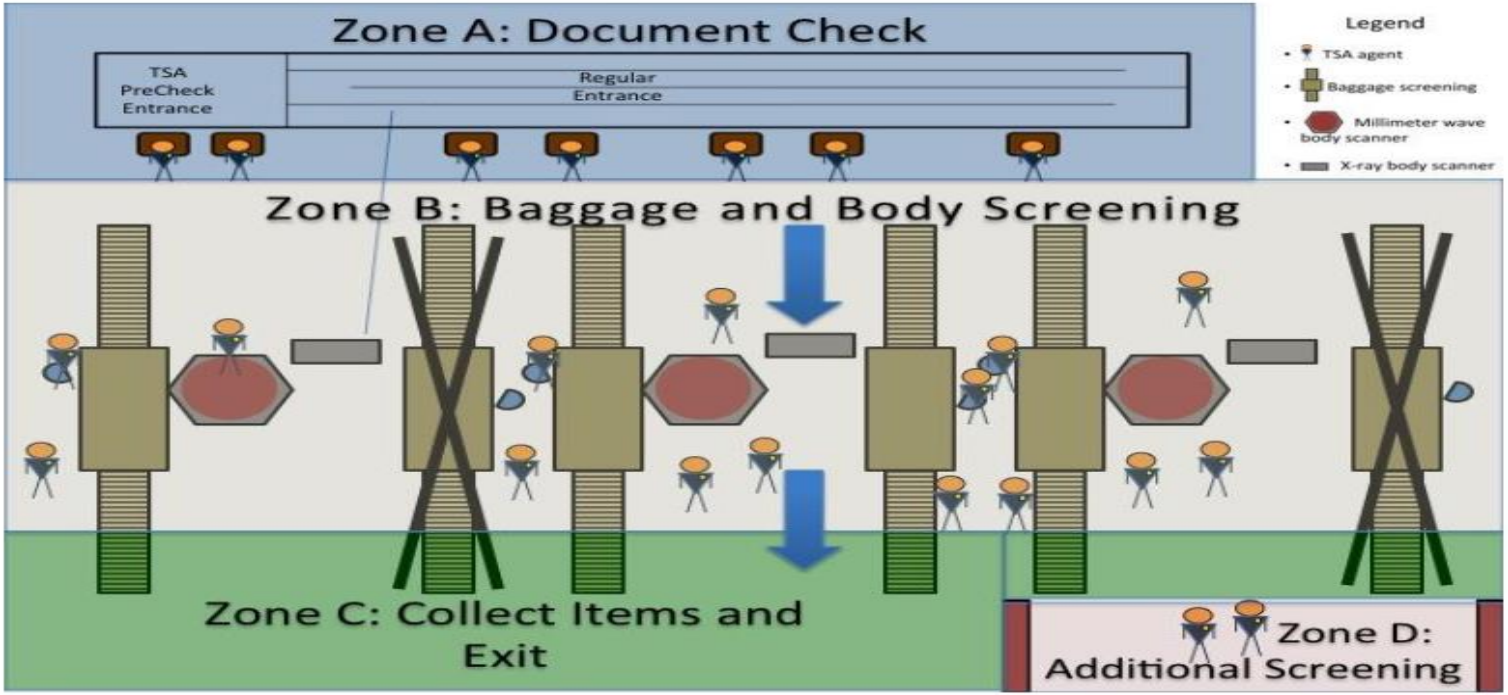

Figure 1: Illustration of the TSA Security Screening Process.

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- Approximately 45% of passengers enroll in a program called Pre-Check for trusted travelers. These passengers pay $85 to receive a background check and enjoy a separate screening process for five years. There is often one Pre-Check lane open for every three regular lanes, despite the fact that more passengers use the Pre-Check process. Pre-Check passengers and their bags go through the same screening process with a few modifications designed to expedite screening. Pre-Check passengers must still remove metal and electronic items for scanning as well as any liquids, but are not required to remove shoes, belts, or light jackets; they also do not need to remove their computers from their bags.
- Data has been collected about how passengers proceed through each step of the security screening process. Click here to view the Excel data.
- 大约45%的乘客参加了一个名为“可信旅客预检查”的项目。这些乘客支付85美元接受背景调查，并享受五年的独立筛查过程。尽管有更多的乘客使用预检查程序，但通常每3条普通车道就有1条预检查通道是开放的。预先检查乘客和他们的行李经过相同的筛选过程，但是还是做了一些修改，以加快筛选。预检人员必须仍然拿走金属和电子物品扫描以及任何液体，但不需拿走除鞋子，皮带或灯夹；他们也不需要从他们的袋子拿走他们电脑。
- 我们收集了关于乘客如何通过每个步骤安全检查过程的数据。点击这里查看Excel数据。

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- Your specific tasks are:
- a. Develop one or more model(s) that allow(s) you to explore the flow of passengers through a security check point and identify bottlenecks. Clearly identify where problem areas exist in the current process.
- b. Develop two or more potential modifications to the current process to improve passenger throughput and reduce variance in wait time. Model these changes to demonstrate how your modifications impact the process.
- 您的任务是：
- a．建立一个或多个模型，使您能够通过安全检查点探索客流，并确定瓶颈。清楚地确定当前流程中存在的问题区域。
- b． 建立两个或多个可能修改的当前过程以改进乘客进出量，减少等待时间的差异。将这些更改模型化，并演示这些修改是如何影响流程的。

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- c. It is well known that different parts of the world have their own cultural norms that shape the local rules of social interaction. Consider how these cultural norms might impact your model. For example, Americans are known for deeply respecting and prioritizing the personal space of others, and there is a social stigma against “cutting” in front of others. Meanwhile, the Swiss are known for their emphasis on collective efficiency, and the Chinese are known for prioritizing individual efficiency. Consider how cultural differences may impact the way in which passenger’s process through checkpoints as a sensitivity analysis. The cultural differences you apply to your sensitivity analysis can be based on real cultural differences, or you can simulate different traveler styles that are not associated with any particular culture (e.g., a slower traveler). How can the security system accommodate these differences in a manner that expedites passenger throughput and reduces variance?
- C. 众所周知，世界各地都有自己的文化规范，这些文化规范形成了当地的社会交往规则。考虑这些文化规范可能如何影响您的模型。例如，美国人以高度尊重和优先考虑他人的个人空间而著称，在社会上不允许“插队”，认为这是一种耻辱。与此同时，瑞士人以强调集体效率而闻名，而中国人则以重视个人效率而闻名。作为敏感性分析，考虑文化差异如何影响乘客通过检查点的过程。适用于您的敏感性分析的文化差异可以基于真实文化差异，或者你可以模拟与任何特定文化（例如，较慢的旅行者）相关联的不同的旅行者风格。保安系统应如何处理这些差异，以加快旅客流量及减少差异?

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- d. Propose policy and procedural recommendations for the security managers based on your model. These policies may be globally applicable, or may be tailored for specific cultures and/or traveler types.
- D. 基于您的模型，为安全管理人员提出政策和程序建议，这些策略可以是全局适用的，也可以是针对特定文化和/或旅行者类型全局适用的。

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- In addition to developing and implementing your model(s) to address this problem, your team should validate your model(s), assess strengths and weaknesses, and propose ideas for improvement (future work).
- 除了开发和实现你的模型来解决这个问题，你的团队应验证您的模型，评估优势和弱点，并提出改进想法（未来工作）的建议。
- *Your ICM submission should consist of a 1 page Summary Sheet and your solution cannot exceed 20 pages for a maximum of 21 pages. Note: The appendix and references do not count toward the 20 page limit.*
- 您的ICM提交应包括1页摘要表和您的解决方案，不能超过20页，最多21页。 注：附录和引用不会计入20页的限制。

2018ICM Problem D: Out of Gas and Driving on E 无加油和电动驱动

2018ICM Problem D: Out of Gas and Driving on (for electric, not empty)无加油和电动驱动（对于电动，不是空的）

- For both environmental and economic reasons, there is global interest in reducing the use of fossil fuels, including gasoline for cars. Whether motivated by the environment or by the economics, consumers are starting to migrate to electric vehicles. Several countries are seeing early signs of the potential for rapid growth in the adoption of electric vehicles. In the US and other countries, the release of the more affordable all-electric Tesla Model 3 has resulted in record numbers of pre-orders and long wait lists To further accelerate the switch to electric vehicles, some countries, including China, have announced that they will ban gasoline and diesel cars in the coming years
- 由于环境和经济的原因，全球都在减少使用化石燃料，包括汽车汽油。无论是受环境或经济动机，消费者开始转向电动汽车。一些国家已经看到了电动汽车快速增长的早期迹象。在美国和其他国家，更为经济实惠的全电式特斯拉3型车型的发布带来了预购订单和长期等待名单的记录。为进一步加快向电动汽车的转型，包括中国在内的一些国家已经宣布将在未来几年内禁止汽油和柴油轿车的).

2018ICM Problem D: Out of Gas and Driving on 无加油和电动驱动

- Eventually, when a ban goes into effect, there needs to be a sufficient number of vehicle charging stations in all the right places so that people can use their vehicles for their daily business, as well as make occasional long-distance trips. The migration from gasoline and diesel cars to electric vehicles, however, is not simple and can't happen overnight. In a fantasy world, we would wake up one day with every gas vehicle replaced by an electric one, and every gas station replaced with a charging station. In reality, there are limited resources, and it will take time for consumers to make the switch. In fact, the location and convenience of charging stations is critical as early adopters and eventually mainstream consumers volunteer to switch (http://www.govtech.com/fs/Building-Out-Electric-Vehicle-Infrastructure-Where-Are-the-Best-Locations-for-Charging-Stations.html).
- 最终禁令生效时，要在所有的地方都有足够数量的车辆充电站，以便人们可以利用车辆进行日常业务，也可以进行偶尔的长途旅行。然而，从汽油车和柴油车到电动车的过渡并不是一帆风顺的，不能一蹴而就。在一个幻想的世界里，我们会有一天醒来，每一辆汽车都换成一辆电动汽车，每一辆加油站都换成一个充电站。实际上资源有限，消费者需要时间进行转换。事实上，充电站的位置和便利对于早期用户和最终的主流用户来说是至关重要的。

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- As nations plan this transition, they need to consider the final network of charging stations (the number of stations, where they will be located, the number of chargers at the stations, and the differences in the needs of rural areas, suburban areas, and urban areas), as well as the growth and evolution of the network of charging stations over time. For example, what should the network look like when electric vehicles represent 10% of all cars, 30% of all cars, 50% of all cars, and 90% of all cars?
- 当国家计划这一转型时，他们需要考虑充电站的最终网络（车站的数量，所在的位置，车站充电器的数量，以及农村，郊区的需求的差异，以及城市地区）以及充电站网络的发展和演变。 例如，当电动汽车占所有汽车的10%，所有汽车的30%，所有汽车的50%以及所有汽车的90%时，网络应该如何？

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- As nations seek to develop policies that promote the migration towards electric vehicles, they will need to design a plan that works best for their individual country. Before they can begin, they would like your team's help in determining the final architecture of the charging network to support the full adoption of all-electric vehicles. Additionally, they would like you to identify the key factors that will be important as they plan their timeline for an eventual ban or dramatic reduction of gasoline and diesel vehicles.
- 随着各国寻求制定政策，促进向电动汽车的转移，它们将需要设计一个最适合本国的计划。在他们开始之前，他们希望您的团队帮助确定充电网络的最终架构，以支持全电动车辆的全面采用。此外，他们正在计划最终禁止或大幅减少汽油和柴油车的时间表，他们希望您确定其计划的关键因素。

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- To help your team manage the scope of this problem, we ask that you focus only on personal passenger vehicles (i.e. cars, vans, and light trucks used for passengers). At the end of your report, you may briefly comment on the relevance of your findings and conclusions on commercial vehicles to include heavy trucks and busses.
- 为了帮助您的团队确定这个问题的范围，我们要求您只关注私家车（即用于乘客的轿车，货车和轻型卡车）。在你的报告结尾，你可以简要地评论你对包括重型卡车和公共汽车在内的商用车的调查结果和结论的相关性。

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- Your tasks are the following:
- **Task 1:** Explore the current and growing network of Tesla charging stations in the United States. Tesla currently offers two types of charging stations: (1) destination charging designed for charging for several hours at a time or even overnight (https://www.tesla.com/destination-charging); and (2) supercharging designed for longer road trips to provide up to 170 miles of range in as little as 30 minutes of charging (https://www.tesla.com/supercharger). These stations are in addition to at-home.
- 你的任务如下：
- 任务1：探索美国当前和日益增长的特斯拉充电站网络。特斯拉目前提供两种类型的充电站：
- （1）目的地充电设计为一次充电几个小时或甚至充电整个晚上；和（2）增压设计用于长途旅行，在短短30分钟的充电时间内提供170英里的行程。这些车站都是在家里以外的地方。

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- charging used by many Tesla owners who have a personal garage or a driveway with power. Is Tesla on track to allow a complete switch to all-electric in the US? If everyone switched to all-electric personal passenger vehicles in the US, how many charging stations would be needed, and how should they be distributed between urban, suburban, and rural areas?
- 许多特斯拉业主拥有个人车库，和私人充电桩。特斯拉能让美国完全转向全电动汽车吗?如果每个人都在美国使用全电动汽车，那么需要多少个充电站?充电站应该如何在城市、郊区和农村地区之间分配?

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- **Task 2:** Select one of the following nations (South Korea, Ireland, or Uruguay).
- **2a.** Determine the optimal number, placement, and distribution of charging stations if your country could migrate all their personal passenger vehicles to all-electric vehicles instantaneously (no transition time required). What are the key factors that shaped the development of your plan?
- 任务2：选择下列国家之一（南韩，爱尔兰或乌拉圭）。
- 2A。确定充电站的最佳数量，布局和分布，如果您的国家可以将所有私家车瞬间转换为全电动汽车（不需要过渡时间）。影响你计划发展的关键因素是什么？

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- **2b.** While these countries have already started installing chargers, you get to start with a clean slate. Present a proposal for evolving the charging network of your chosen country from zero chargers to a full electric-vehicle system. How do you propose the country invest in chargers? Should the country build all city-based chargers first, or all rural chargers, or a mix of both? Will you build the chargers first and hope people buy the cars, or will you build chargers in response to car purchases? What are the key factors that shaped your proposed charging station plan?
- 2B. 虽然这些国家已经开始安装充电器，你还是得从头开始。提出一项建议，将您选择的国家的充电网络从零充电器发展成全电动汽车系统。你建议该国应如何投资充电器？国家应该先建立所有的城市充电器，还是所有的农村充电器，或者两者兼而有之?你会先制造充电器，然后希望人们买你的车吗?或者你会制造充电器来回应人们的购车行为吗？你提出的充电站计划的关键因素是什么?

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- **2c.** Based on your growth plan, what is the timeline you propose for the full evolution to electric vehicles in your country? To get started, you may wish to consider how long it will take for there to be 10% electric vehicles, 30% electric vehicles, 50% electric vehicles, or 100% electric vehicles on your selected country's roads. What are the key factors that shaped your proposed growth plan timeline?
- 2C. 根据你的发展计划，你提出在你的国家电动汽车全面发展的时间是？首先，您可能希望考虑在您选择的国家道路上，10%的电动汽车、30%的电动汽车、50%的电动汽车或100%的电动汽车需要多长时间。什么是影响您提出的电动汽车增长计划时间表的关键因素？

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- **Task 3:** Now consider countries with very different geographies, population density distributions, and wealth distributions, such as Australia, China, Indonesia, Saudi Arabia, and Singapore. Would your proposed plan for growing and evolving the network of chargers still apply to each of these countries? What are the key factors that trigger the selection of different approaches to growing the network? Discuss the feasibility of creating a classification system that would help a nation determine the general growth model they should follow in order for them to successfully migrate away from gasoline and diesel vehicles to all electric cars.
- 任务3：现在考虑一下地理位置、人口密度分布和财富分布非常不同的国家，如澳大利亚、中国、印度尼西亚、沙特阿拉伯和新加坡。你提出的增长和发展收费网络的计划是否仍然适用于这些国家？选择不同增长网络的关键因素是什么？讨论建立一个分类系统，用来帮助一个国家确定他们应该遵循的一般增长模式，以便他们能够成功地从汽油和柴油汽车转向电动汽车。

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- **Task 4:** The technological world continues to change and is impacting transportation options such as car-share and ride-share services, self-driving cars, rapid battery-swap stations for electric cars, and even flying cars and a Hyperloop. Comment on how these technologies might impact your analyses of the increasing use of electric vehicles.
- 任务4：当前世界技术在不断变化，并影响着交通工具的选择，如汽车共享和拼车服务、自动驾驶汽车、电动汽车的快速电池更换站，甚至还有飞行汽车和高铁。请就这些技术如何影响电动汽车使用量发表评论。

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- **Task 5:** Prepare a one-page handout written for the leaders of a wide range of countries who are attending an international energy summit. The handout should identify the key factors the leaders should consider as they return to their home country to develop a national plan to migrate personal transportation towards all-electric cars and set a gas vehicle-ban date.
- 任务5：为出席国际能源峰会的广泛国家的领导人准备一份一页的讲义。讲义应该指出领导人回国后要考虑的关键因素，制定国家计划，将个人交通工具迁移到全电动汽车，并设定禁止使用汽油的日期。

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- Your submission should consist of:
- One-page Summary Sheet,
- One-page handout,
- Your solution of no more than 20 pages, for a maximum of 22 pages with your summary and handout.
- Note: Reference list and any appendices do not count toward the 22-page limit and should appear after your completed solution.
- 您的提交应该包括：
- 一页总结表，
- 一页的讲义，
- 您的解决方案不超过20页，最多22页的摘要和讲义。
- 注意：参考列表和任何附录不计入22页的限制，应在完成的解决方案后出现。

2019 ICM Problem D: Time to leave the Louvre
离开卢浮宫的时间

2019 ICM Problem D: Time to leave the Louvre 离开卢浮宫的时间

- The increasing number of terror attacks in France**[1]** requires a review of the emergency evacuation plans at many popular destinations. Your ICM team is helping to design evacuation plans at the Louvre in Paris, France. In general, the goal of evacuation is to have all occupants leave the building as quickly and safely as possible. Upon notification of a required evacuation, individuals egress to and through an optimal exit in order to empty the building as quickly as possible.
- 法国越来越多的恐怖袭击[1]要求审查许多热门目的地的紧急疏散计划。您的ICM团队正在帮助设计法国巴黎卢浮宫的疏散计划。一般而言，疏散的目标是让所有人尽可能快速安全地离开建筑物。一旦接到需要疏散的通知，每个人都要疏散到一个最佳的出口，以便尽快清空建筑物。

2019 ICM Problem D: Time to leave the Louvre 离开卢浮宫的时间

- The Louvre is one of the world's largest and most visited art museum, receiving more than 8.1 million visitors in 2017[2]. The number of guests in the museum varies throughout the day and year, which provides challenges in planning for regular movement within the museum. The diversity of visitors -- speaking a variety of languages, groups traveling together, and disabled visitors -- makes evacuation in an emergency even more challenging.
- 卢浮宫是世界上规模最大，访问量最大的艺术博物馆之一，2017年接待游客超过810万。博物馆内的客人数量在一天和一年中各不相同，这对规划博物馆内的定期运动提出了挑战。游客的多样性--说多种语言，一起旅行的团体和残疾游客--使紧急情况下的疏散变得更具挑战性。

The Louvre has five floors, two of which are underground.卢浮宫有五层，其中两层是地下的。

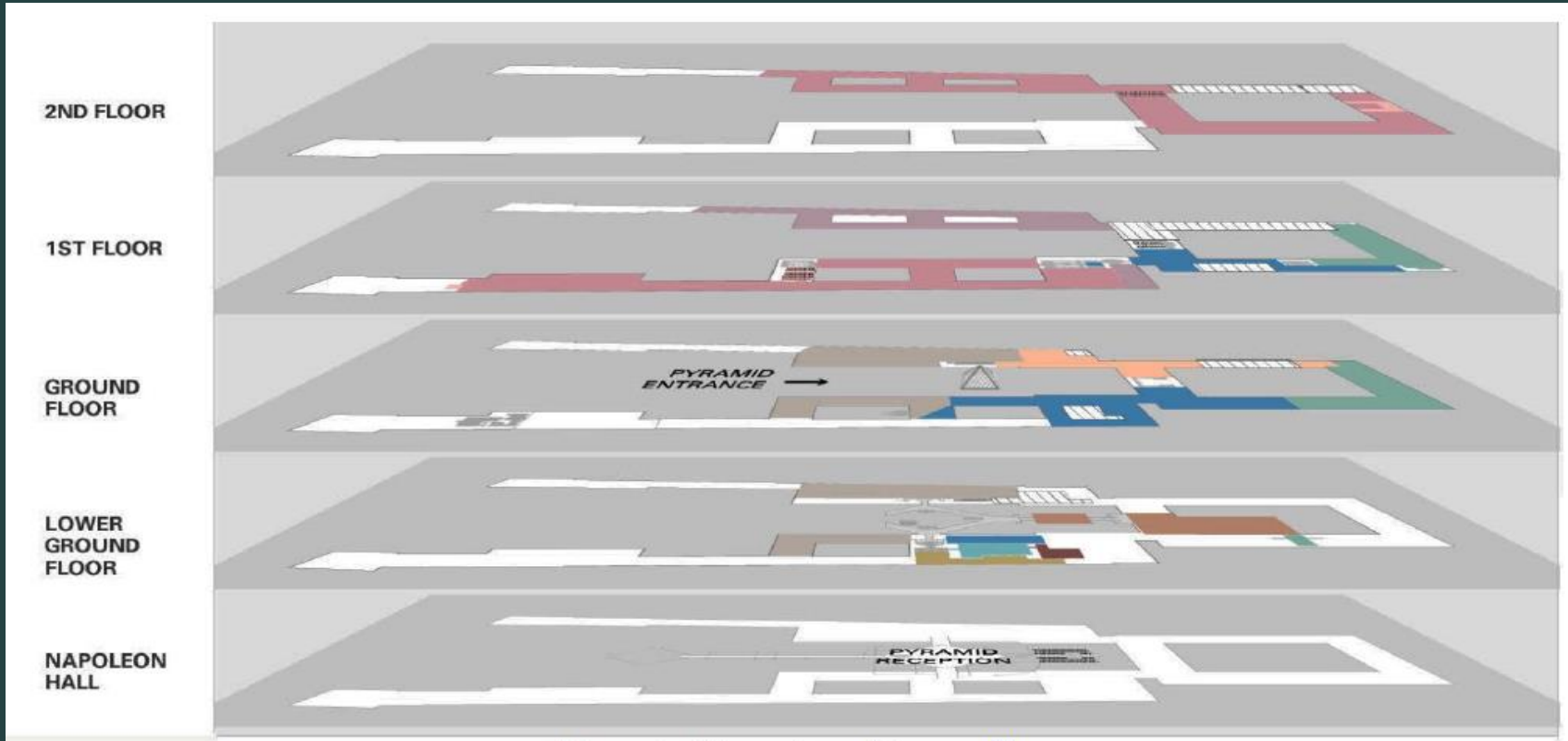

Figure 1: Floor plan of Louvre[3]

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- The 380,000 exhibits located on these five floors cover approximately 72,735 square meters, with building wings as long as 480 meters or 5 city blocks**[3]**. The pyramid entrance is the main and most used public entrance to the museum. However, there are also three other entrances usually reserved for groups and individuals with museum memberships: the Passage Richelieu entrance, the Carrousel du Louvre entrance, and the Portes Des Lions entrance. The Louvre has an online application, "Affluences" (https://www.affluences.com/louvre.php), that provides real-time updates on the estimated waiting time at each of these entrances to help facilitate entry to the museum. Your team might consider how technology, to include apps such as Affluences, or others could be used to facilitate your evacuation plan.
- 位于这五个楼层的380,000个展品占地约72,735平方米，建筑翼长达480米或5个城市街区[3]。金字塔入口是博物馆的主要和最常用的公共入口。然而，还有三个其他入口，通常为拥有博物馆会员资格的团体和个人预留：Passage Richelieu入口，Carrousel du Louvre入口和Portes Des Lions入口。卢浮宫有一个在线申请，"Affluences"（https://www.affluences.com/louvre.php），为帮助进入博物馆的游客，提供实时更新的每个入口的估计等待时间。您的团队要考虑使用什么技术，包括Affluences或其他应用程序，来完成您的疏散计划。

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- Only emergency personnel and museum officials know the actual number of total available exit points (service doors, employee entrances, VIP entrances, emergency exits, and old secret entrances built by the monarchy, etc.). While public awareness of these exit points could provide additional strength to an evacuation plan, their use would simultaneously cause security concerns due to the lower or limited security postures at these exits compared with level of security at the four main entrances. Thus, when creating your model, your team should consider carefully when and how any additional exits might be utilized.
- 只有应急人员和博物馆官员知道实际可用出口点的总数（服务门，员工入口，贵宾入口，紧急出口和君主建造的旧时秘密入口等）。虽然公众知道这些出口点可以为疏散计划提供额外的力量，但与四个主要入口处的安保水平相比，这些出口处的安全系数有限，它们的使用同时会引起安全问题。因此，在建立模型时，您的团队应该仔细考虑何时以及如何使用其他出口。

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- Your supervisor wants your ICM team to develop an emergency evacuation model that allows the museum leaders to explore a range of options to evacuate visitors from the museum, while also allowing emergency personnel to enter the building as quickly as possible. It is important to identify potential bottlenecks that may limit movement towards the exits. The museum emergency planners are especially interested in an adaptable model that can be designed to address a broad set of considerations and various types of potential threats. Each threat has the potential to alter or remove segments of possible routes to safety that may be essential in a single optimized route. Once developed, validate your model(s) and discuss how the Louvre would implement it.
- 您的主管希望您的ICM团队开发紧急疏散模型，允许博物馆领导者探索一系列可能的选择，以便从博物馆撤离访客，同时还允许应急人员尽快进入建筑物。重要的是找出可能限制出口移动的潜在瓶颈。博物馆应急规划人员对适应性模型特别感兴趣，该模型可用于解决各种因素和各种类型的潜在威胁。每种威胁都有可能改变或取消在单一优化路线中必不可少的安全路段。一旦开发完成，验证您的模型，并讨论如何在卢浮宫实施它。

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- Based on the results of your work, propose policy and procedural recommendations for emergency management of the Louvre. Include any applicable crowd management and control procedures that your team believes are necessary for the safety of the visitors. Additionally, discuss how you could adapt and implement your model(s) for other large, crowded structures.
- 根据您的工作成果，提出有关卢浮宫应急管理的政策和程序建议。包括您的团队认为对访客安全所必需的，适用任何人群的管理和控制程序。另外，讨论如何为其他大型拥挤的建筑场所调整和建立模型。

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- Your submission should consist of:
- One-page Summary Sheet,
- Your solution of no more than 20 pages, for a maximum of 21 pages with your summary.
- Judges expect a complete list of references with in-text citations, but may not consider appendices in the judging process.
- Note: Reference list and any appendices do not count toward the 21-page limit and should appear after your completed solution.
- 您的提交应包括：
- 一页摘要表，
- 您的解决方案不超过20页，最多21页与您的摘要。
- 评委希望提供完整的参考文献列表，其中包含文本引文，但可能不会在评审过程中考虑附录。
- 注意：参考列表和任何附录不计入21页限制，应在完成解决方案后显示。

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- Glossary:
- Bottlenecks – places where movement is dramatically slowed or even stopped.
- Emergency personnel – people who help in an emergency, such as guards, fire fighters, medics, ambulance crews, doctors, and police.
- 名词解释：
- 瓶颈 – 运动急剧减慢甚至停止的地方。
- 应急人员 – 在紧急情况下提供帮助的人员，如警卫，消防员，医务人员，救护人员，医生和警察。