Welcome to CVL461: Logistics & Freight Transport

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IIT Delhi

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First of all

Happy New Year!

Introductions

1. Your name and hometown
2. One thing that you like the most about IIT Delhi
3. Reason(s) for signing up for this course
4. Anything interesting about yourself

Outline

Course information

Prerequisites

Course logistics

Student learning expectations

Books

Course information

- ▶ Meeting time: M and Th Slot A 8-9:30 A.M (No entry after 8:07 A.M.!)
- ▶ My office: 322, Block-IV
- ▶ Office hours: TBD
- ▶ Email: pkk@iitd.ac.in. Include "CVL461" in the subject line

What is this course about?

Introduction to mathematical models for analyzing and designing supply chains. Topics include but not limited to

- ▶ Demand modeling and forecasting
- ▶ Inventory management
- ▶ Revenue management and pricing
- ▶ Network flow problems
- ▶ Traveling salesman problem (TSP)
- ▶ Vehicle routing problem (VRP)
- ▶ Facility location problem
- ▶ Other topics

Supply chain

Figure: [1]

[1]Source:TeamViewer
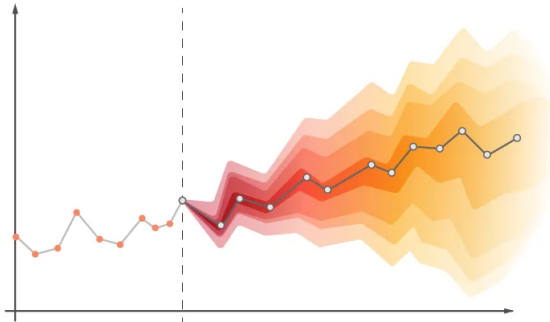
Demand modeling

Based on the historical data, predict demand for future.

Figure: [2]

Inventory management

Given historical demand pattern, decide at what point to reorder a new batch of raw material/products and how much to order.

Figure: Source: https://shipsy.io/blogs/mastering-inventory-expiry-management-techniques-to-boost-cx-and-minimize-waste/

Revenue management and pricing design

Given demand functions, how would you design pricing for series of products?
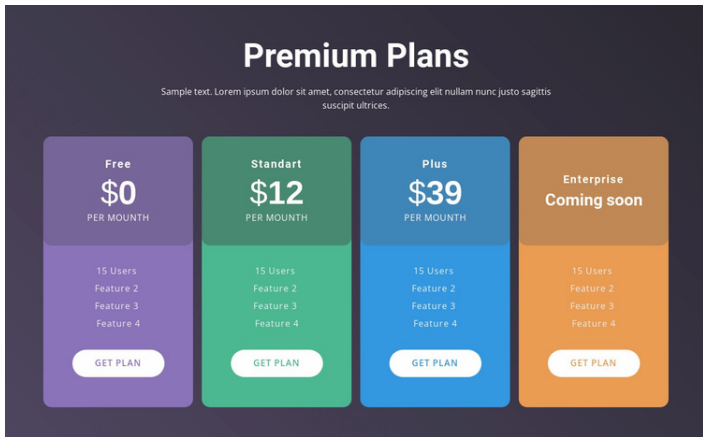

Figure: Source: https://images01.nicepagecdn.com/page/46/09/website-design-preview-460955.jpg

Single flow routing through network

Find the minimum cost route in a network to deliver product from Depot to Warehouse.

Figure: [3]

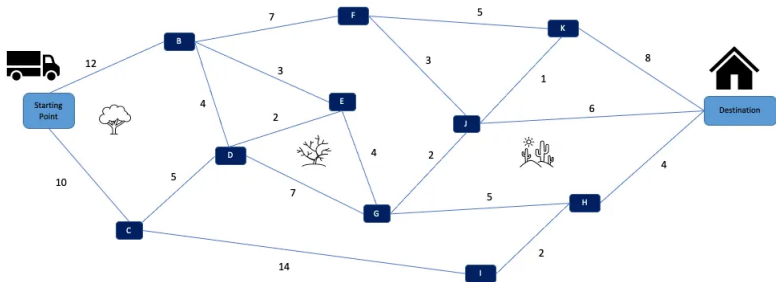# Maximum flow problem

What is the maximum number of bogeys manufactured in Detroit that can be shipped to a warehouse in San Francisco if there is a limit on how many compartments can be shipped across each link of the train network?
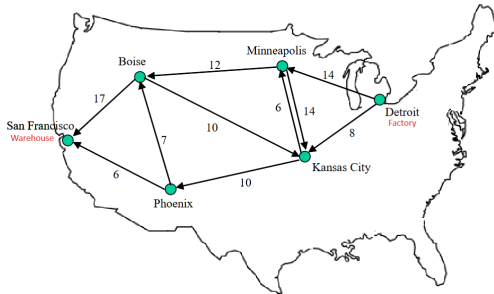

Figure: Golf cart shipping (Source: https://ieda.ust.hk/dfaculty/ajay/courses/ieem101/lecs/graphs/graph-maxflow.pdf)

Traveling salesman Problem (TSP)

Find the minimum cost tour for a truck that leaves a warehouse to deliver products to a set of retailers.

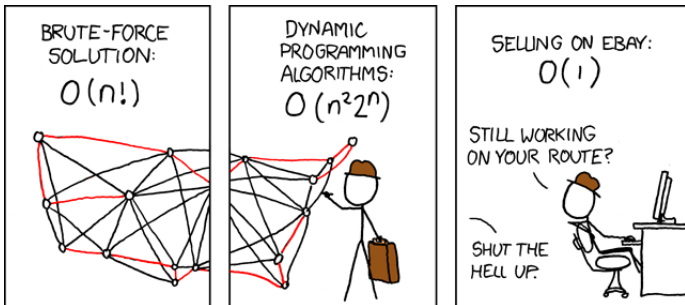Figure: (Source: https://xkcd.com/399/)

Vehicle Routing Problem (VRP)

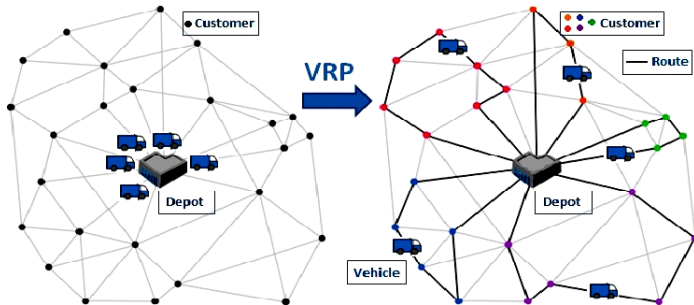What is the optimal set of routes for a fleet of vehicles to traverse in order to deliver to a given set of customers?

Figure: Deopt, Customers, and Vehicle routes (Gupta et al.)

Network design

Given demand patterns and set of candidate facilities, determine the best locations of facilities (distribution centers, plants, etc.) with capacities, production levels for each product, and transportation flows between facilities so that overall production, inventory, construction, and transportation costs are minimized.

Figure: Source:https://www.industryweek.com/supply-chain/supply-chain-technology/article/55139456/supply-chain-management-is-overdue-for-an-upgrade

Outline

Prerequisites

- Calculus
- Linear algebra
- Linear programming Or willingness to learn

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Grading

1. In-class exercises (30%)
2. In-class presentations (15%)
3. Minor exam (25%)
4. Major exam[4] (30%)

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[4]Major exam will be cumulative

In-class exercises

- ▶ I'll ask you to work on some in-class exercises.
- ▶ You are encouraged to discuss these with your peers.
- ▶ Please submit your exercise sheet right after the class ends. They will not be accepted after the class.

In-class presentations

- ▶ Teams of two members.
- ▶ Team members and the papers will be assigned randomly.
- ▶ Each team will have to present the paper in 10 minutes, followed by 5 minutes of Q&A.
- ▶ Everyone in the class is expected to participate in the discussion following each presentation.
- ▶ PPT with revisions using the feedback will be uploaded to the Moodle.

Attendance

- You need to attend at least 75% of classes
- Otherwise you will be awarded one grade less than the actual grade

Auditing the course

To get an NP grade

▶ You need to earn at least 30% (aggregated) of total marks.

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Student learning expectations

- Understanding supply chain and its components
- Modeling freight demand generation and forecasting
- Understanding of both deterministic and stochastic inventory control models
- Understanding revenue management and pricing design
- Solving various network flow models in the supply chain networks
- Understanding traveling salesman (TSP) and vehicle routing problems (VRP)
- Understanding facility location and other design models
- Using off-the-shelf solvers to solve various optimization problems
- Improve presentation skill
- Learning about the recent advances

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Reference books

There is no required textbook for this course. The following are the references:

- ▶ Goetschalckx, Marc. *Supply chain engineering*. New York: Springer, 2011.

- ▶ Ghiani, Gianpaolo, Gilbert Laporte, and Roberto Musmanno. *Introduction to Logistics Systems Management: With Microsoft Excel and Python Examples*. John Wiley & Sons, 2022.

- ▶ Chopra, Sunil, Dharam Vir Kalra, and Gourav Dwivedi . *Supply chain management. Strategy, planning & operation*. Pearson, 2024.

Other material will be shared later.

Thank you!