IE 360 Fall 2019 Final Examination Material

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Nov 23, 2019

Material from Lecture 9 (Topic 7 - Block Layout) until Lecture 16 (Automated Storage and Retrieval Systems) is included in the exam.

1 Topic: Block Layout - Lecture 7

Quantitative/mathematical modeling topics:

- b-matching formulation: Slides 7-9 of Lecture Set 9
- Formulating the QAP (slides 15-16)
- Alternative formulation to QAP as $v*d$ and lower bound (slides 18-19)
- Construction heuristics
  - Greedy heuristic for QAP (slides 20-22)
  - Randomized heuristic for QAP (slides 23-25)
- Improvement heuristics
  - exchange heuristics

Qualitative topics:

- Drawing a Perimter-Specified Adjacency Graph (PSAG)
- Why is solving the PSAG with max total weight hard? Can we convert to block layout easily?
- Assumptions in b-matching problem
- Will b-matching always give a 'clean' layout?
- Will b-matching always have a feasible solution?
- Assumptions in QAP
- Advantages and limitations of exchange heuristics as k changes
- Descent approach used in exchange heuristics

2 Lecture 10/Topic 8: The General Layout Problem

Qualitative topics:

- Need to combine combinatorics and geometrical considerations
- Types of heuristics - ALDEP, CORELAP, CRAFT
- Assumptions of ALDEP, CORELAP and CRAFT

- 2-way vs 3-way vs k-way exchanges: advantages and limitations
- Greedy/steepest descent solutions vs simulated annealing

Quantitative topics:

- General heuristics
  - Iterative steps used in ALDEP, CORELAP and CRAFT: Selection phase and placement phase, metrics used
  - Evaluation of layouts created using ALDEP or CORELAP
  - Evaluating an interchange in CRAFT
  - Drawing layouts once CRAFT has been executed on an existing layout
- Simulated annealing
  - Slide 29 of lecture
  - Know the various terms in the probability function

3 Lecture 11/Topic 9: Integer Programming Formulations for Layout

Quantitative topics:

- Single floor layout: Modeling non-overlap of departments
- Single floor layout: Modeling absolute values
- Multi-floor layout
  - Two-stage integer programs: assigning departments to floors
  - Constraints to relate integer variables with binary variables
  - Absolute value-based objective function formulation

Qualitative topics:

- Assumptions in multi-floor layout
- Is multi-floor layout optimal?

4 Lecture 12/Topic 10: Location Problems - Introduction

Quantitative topics:

- Mathematical formulations of distance metrics
- Median (minsum) objective function
- Center (minmax) objective function
- Covering objective function
- p-median for location problems: Slides 9-12 of lecture
- Location covering: slides 13-14

5 Lecture 13/Topic 11: Rectilinear Location Problems

Quantitative topics:

- Rectilinear 1-median:
  - Formulating the rectilinear distance-based min-sum problem
  - Separability of x- and y- problems
  - Algorithm for solving x-problem: Slides 7-9
  - Computing equations and slopes of contour lines: slide 15
- Rectilinear 1-center:
  - Formulating the rectilinear distance-based min-max problem
  - Writing the absolute-value based formulation and linearizing the absolute values
  - Geometrical intuition - slide 21
  - Final equations - slide 20, slide 23
  - Contours: slide 25

6 Lecture 14/Topic 12: Tchebychev Location Problems

Quantitative topics:

- Converting from Tchebychev coordinates to rectilinear coordinates
- Solving Rectilinear location problems in rectilinear coordinates
- Converting solution back from rectilinear coordinates to Tchebychev coordinates
- Geometric intuition for Tchebychev 1-median problem (similar to rectilinear 1-median problem)

7 Lecture 15/Topic 13: Euclidean Location Problems

Quantitative topics:

- Euclidean 1-median
  - Squared Euclidean median problem - formulation and solution
  - Euclidean 1-median: algorithm summarized on slide 14 - calls on slides 10, 11 and 13 as needed
- Euclidean 1-center
  - Mathematical formulation for Euclidean 1-center
  - Math formulation written as a quadratic program: linear objective and quadratic constraints
  - Converting above math formulation to a quadratic program with quadratic objective and linear constraints

Qualitative topics:

- Need for defining Kuhn's modified gradient and hyperboloid approximation for Euclidean 1-median

8 Lecture 16/Topic 14: Automated Storage and Retrieval Systems

Quantitative topics:

- Computing time for single-command cycle movements of a crane: slides 7-11
- Computing workload for an AS/RS under unit-load or non-unit load systems
- Computing number of cranes required: slides 15, 16