National Taiwan University
Department of Electrical Engineering
Algorithms, Fall 2018

Handout #16
November 22, 2018
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Homework #3 (due December 6, 2018 in-class)

1. Exercise 16.1-5 (page 422).
2. Exercise 16.2-2 (page 427).
3. Exercise 16.2-5 (page 428).
4. Exercise 16.3-3 (page 436).
5. Alan decides to follow Mayor Ko's footsteps to bike for 380 kilometers from Taipei to his hometown Kaohsiung to cast his first vote for the city mayor election this Saturday. He needs to take a rest at a 7-11 convenience store to eat a banana and drink water to travel 20 kilometers, and his map gives the distance between each pair of convenience stores on his route (a straight line segment). He wishes to make as few stops at convenience stores as possible along the way. Give an efficient algorithm to determine at which convenience stores he should stop and prove the optimality of your algorithm.
6. Exercise 17.3-7 (page 463)
7. Exercise 17.4-3 (page 471).
8. Problem 17-2 (page 473).
9. A sequence of n operations are performed on a data structure initially in state D_1. The ith operation transforms the data structure from State D_i to state D_{i+1}, $1 \leq i \leq n$. Let

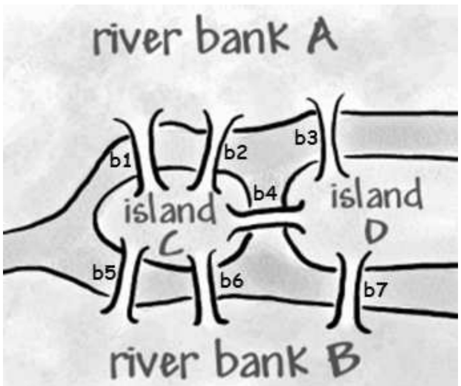
$$c(D_i) = \begin{cases} 2\sqrt{i}, & \text{if } i \text{ is a perfect square (i.e., } 1^2, 2^2, 3^2, \ldots) \\ 2, & \text{otherwise} \end{cases}$$

denote the cost of performing the ith operation, $1 \leq i \leq n$. Use the potential function

$$\Phi(D_i) \quad = \quad i - \left(\left\lfloor \sqrt{i-1} \right\rfloor \right)^2$$

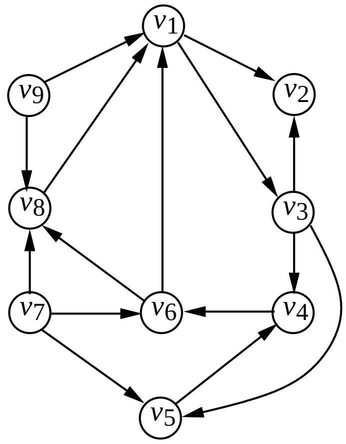
to show that the amortized cost for performing one operation of this sequence is constant.

10. Exercise 22.2-7 (page 602).
11. Exercise 22.4-5 (page 615).
12. Leonhard Euler in 1736 first considered the following mathematical puzzle: The city of Königsberg has seven bridges $b_i, i = 1, ..., 7$, with two river banks A and B and two islands C and D, as shown in the figure below. Euler wondered if it is possible to start at some place in the city, cross every bridge exactly once, and return to the starting place. **Model** this problem as a graph problem.



13. Problem 22-3 (page 623)

14. Find the depth-first spanning forest for the following directed graph. Then find the strongly connected components. Show your work.



15. (DIY Problem) For this problem, you are asked to design a problem *set* related to Chapter(s) 16, 17, and/or 22 and give a sample solution to your problem set. Grading on this problem will be based upon the *quality* of the designed problem as well as the *correctness* of your sample solution.