Ain Shams University

Faculty of Engineering

Computer Engineering and Software Systems Program

CSE332: Design and Analysis of Algorithm – Spring 2022

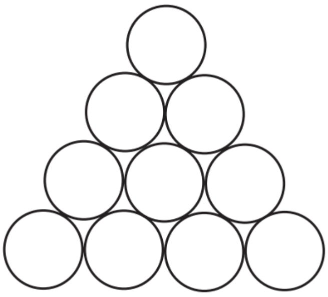
PROJECTREQUIREMENTS

This project is a group project with each group has 4 or 6 students. Each team must do the following Tasks:

Task 1

Inverting a Coin Triangle Consider an equilateral triangle formed by closely packed pennies or other identical coins like the one shown in the figure below. (The centers of the coins are assumed to be at the points of the equilateral triangular lattice.)

Use iterative improvement method to design an algorithm to flip the triangle upside down in the minimum number of moves if on each move you can slide one coin at a time to its new position.



Task 2

Consider the one-dimensional version of peg solitaire played on an array of n cells, where n is even and greater than 2. Initially, all but one cell are occupied by some counters (pegs), one peg per cell. On each move, a peg jumps over its immediate neighbor to the left or to the right to land on an empty cell; after the jump, the jumped-over neighbor is removed from the board.

Using dynamic programming methodology to

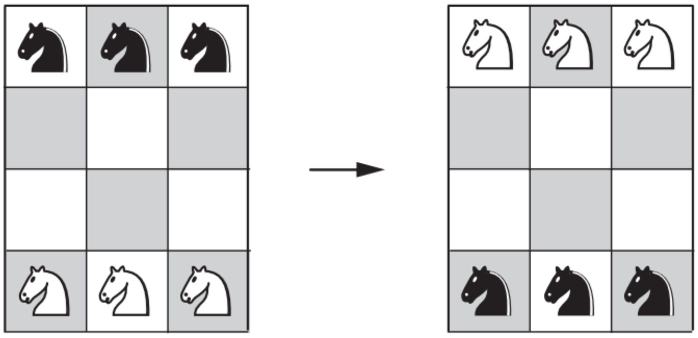
a) write an algorithm that remove all but one peg by a sequence of such moves.

b) Find all the locations of the empty cell in the initial setup for which the puzzle can be solved and the corresponding locations of the single remaining peg.

Task 3

There are six knights on a 3 × 4 chessboard: the three white knights are at the bottom row, and the three black knights are at the top row.

Design a divide and conquer algorithm to exchange the knights to get the position shown on the right of the figure in the minimum number of knight moves, not allowing more than one knight on a square at any time.



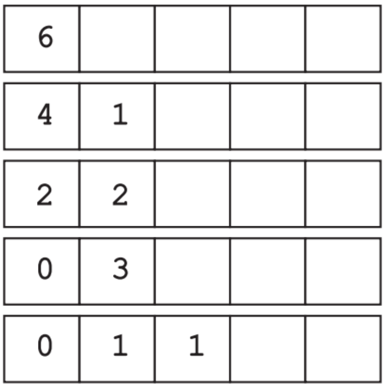
Task 4

A “machine” consists of a row of boxes. To start, one places n pennies in the leftmost box. The machine then redistributes the pennies as follows.

On each iteration, it replaces a pair of pennies in one box with a single penny in the next box to the right. The iterations stop when there is no box with more than one coin. For example, see the figure that shows the work of the machine in distributing six pennies by always selecting a pair of pennies in the leftmost box with at least two coins.

Design an algorithm using greedy method automate the machine, then answer the following questions.

(a) Does the final distribution of pennies depend on the order in which the machine processes the coin pairs?
(b) What is the minimum number of boxes needed to distribute n pennies?
(c) How many iterations does the machine make before stopping?



6				
4	1			
2	2			
0	3			
0	1	1		

Task 5

There is a row of n security switches protecting a military installation entrance. The switches can be manipulated as follows:

(i) The rightmost switch may be turned on or off at will.
(ii) Any other switch may be turned on or off only if the switch to its immediate right is on and all the other switches to its right, if any, are off.
(iii) Only one switch may be toggled at a time.

Design a divide and conquer algorithm to turn off all the switches, which are initially all on, in the minimum number of moves. (Toggling one switch is considered one move.) Also find the minimum number of moves.

Task 6

There are eight disks of different sizes and four pegs. Initially, all the disks are on the first peg in order of size, the largest on the bottom and the smallest on the top.

Use dynamic programming method to transfer all the disks to another peg by a sequence of moves. Only one disk can be moved at a time, and it is forbidden to place a larger disk on top of a smaller one.

Does the dynamic programming method can solve the puzzle in 33 moves? If not then design an algorithm that solves the puzzle in 33 moves.

The report MUST contain each of the following items (items 2 to 8 should be provided for each task separately):

1. Cover page that shows the group names, college name, program name, course code, course name … etc.
2. Detailed assumptions.
3. Problem description.
4. Detailed solution including the pseudo-code and the description of the steps of your solution.
5. Complexity analysis for the algorithm.
6. A comparison between your algorithm and at least one other algorithm that can be used to solve the problem.
7. Sample output of the solution for the different cases of the algorithms with proper description for the output.
8. Conclusion.
9. References that should be clearly cited inside the document.
10. Any additional needed sections.

Project Deliverable

All deliverable must be submitted on the LMS, no deliverable will be accepted by any other means. The following are required to be delivered by the due date:

1. Project code using any programming language. It must be submitted as a zip/rar archive.

2. A presentation (in .pptx format) of the different phases of the project. Each group will do the presentation and project demo via Microsoft-Team after submitting the project.
3. Project document (in .docx format) that contains at least the above mentioned sections.

The following instructions MUST be taken into consideration while doing your project

- Use consistent document format (font sizes, titles, subtitles, captions, paragraph formatting … etc.). Recommended font sizes are: main title 14pt, subtitles 12pt, main text 12pt, and captions 10 pt. Recommended font type is bold "**Calibri**" for titles and subtitles, and regular "Calibri" for all other texts. Recommended spaces before and after paragraphs are 12pt before and 6pt after each paragraph, and 1.5 spacing is highly recommended. Justified paragraphs from both sides are also recommended.
- Figures and tables must be centred in the pages, and they should be numbered separately. Each figure must have a caption that appears below the figure, and each table must have a title above it.
- Pages must be numbered consistently except for the cover page.
- Table of Contents must be included in your document that shows the titles and sub-titles of your report with the corresponding page numbers.
- List of figures and list of tables must be included in your document if you have figures/tables in your document.
- All reports must be written in English, always avoid typos and grammatical errors.
- All submitted files will undergo plagiarism check.
- All project deliverables must be uploaded to the LMS, no hardcopy is accepted, and please do not send your project deliverables by email. No other means of submission will be accepted.
- Presentation, discussion, and demo are required after delivering the project.