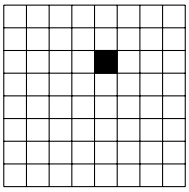
Coursework 4

COMP2721 Algorithms and Data Structures II

1. A *triomino* is an L-shaped tile formed by three adjacent squares of a chess board.

The *trinomino puzzle* problem is to cover any 2^n-by-2^n chessboard with one missing square (anywhere on the board) with triominos. Triominos should cover all the squares except the missing one with no overlaps.



Design a divide-and-conquer algorithm for this problem. Describe your main steps (divide, conquer, combine) informally in plain English and illustrate by a drawings where appropriate.

[0:20 h expected time] [5 marks]

2. Give asymptotic upper bound for $T(n)$ in each of the following recurrences. Assume that $T(n) = n$ for $n \leqslant 2$. Make your bounds as tight as possible, and justify your answers.

   (a) $T(n) = T(n-1) + 1$

   (b) $T(n) = T(n/2) + 1$

   (c) $T(n) = T(\sqrt{n}) + 1$

   (d) $T(n) = 2T(n-1)$

   (e) $T(n) = 2T(n/2)$

   (f) $T(n) = 2T(\sqrt{n})$

   (g) $T(n) = (T(n-1))^2$

   (h) $T(n) = (T(n/2))^2$

   (i) $T(n) = (T(\sqrt{n}))^2$

   (j) $T(n) = 4T(n/2) + n$

   (k) $T(n) = 8T(n/4) + n \log n$

   (l) $T(n) = 27T(n/9) + n^2$

   (m) $T(n) = T(8n/9) + \sqrt{n}$

   (n) $T(n) = 5T(n/25) + \sqrt{n}$

   (o) $T(n) = T(2n/3) + \log n$.

   [1:00 h expected time] [15 marks]

Submission: Work out and present your solution on paper. Stitch together all your sheets and a filled header form and submit via SSO. Indicate date and time of your tutorial, that is, one of the following:

- Tuesday 12–1
- Tuesday 4–5
- Friday 1–2
- Friday 2–3

For a proof of submission, convert your solution into portable document format (via `pdflatex` if you use LaTeX or scan your manuscript) and submit it in Minerva.

Deadline: Monday 27 April 2020, 10am.

Credits: This piece of summative coursework is worth 5% of your grade.