

# COM S 327, Spring 2024

## Programming Project 0

### The Knight's Tour

See this Wikipedia article about the Knight's Tour problem: [http://en.wikipedia.org/wiki/Knight%27s\\_tour](http://en.wikipedia.org/wiki/Knight%27s_tour).

Finding all directed, open tours on a standard,  $8 \times 8$  chessboard is computationally intractable. To find them all on a  $7 \times 7$  board in reasonable time would require a supercomputer. My quick-and-dirty solution finds all  $6 \times 6$  solutions in about 2 hours and all  $5 \times 5$  tours in under a second on a laptop.

Write a C program to find all directed, open Knight's Tours on a  $5 \times 5$  chess board. Assume the spaces of the board are numbered:

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Print all tours as a list of numbers corresponding to the spaces in the order they are visited. For instance, here is one solution:

25, 18, 21, 12, 23, 20, 9, 2, 11, 22, 19, 10, 13, 16, 7, 4, 15, 24, 17, 6, 3, 14, 5, 8, 1

There are 1727 others.

Your output should consist of 1728 lines, each line containing the numbers 1–25, each appearing exactly once, separated by commas (like the line above). This will allow for straightforward, automated checking of your output.

See the syllabus for information about what to turn in and submission format.

#### Extra Challenges (nothing below this line is required)

- Generalize your program to handle boards of arbitrary dimension  $x \times y$ .
- Generalize your program to handle boards on a cylinder.
- Generalize your program to handle boards on a torus.
- Generalize your program to handle arbitrary boards (a graph with rectilinearly connected nodes).
- Find only the subset of tours which are unique under rotation and reflection.
- Print a board with the spaces numbered by the order in which they are visited. For instance, here is the board corresponding with the solution given above:

25	8	21	16	23
20	15	24	7	12
9	4	13	22	17
14	19	2	11	6
3	10	5	18	1

- Generate graphical representations of your tours. For instance, I used METAPOST to generate an image of the tour above and one on a full  $8 \times 8$  board:

