

You are going to estimate, by hand, the size of the backtrack tree for an uncrossed knight's tour. You may have groups of size one, two, or three. Just one student in each group should hand in the assignment (on Gradescope).

Go to the bottom of the course website to get your starting position. Use your first and last names as listed in Gradescope; if your group has more than one person, use the person who is alphabetically first. Use the boards provided to draw your knight's tours as done in the example (and as Knuth does). You can use the boards with or without the dots in the middle of the squares, whichever is easier. Draw the boards. For your start position put an asterisk or a star, so that it is obvious where each tour starts. You must draw the boards; do not hand in a screen shot.

8								
7		8		1				
6	7				2			
5			●					
4	6				3			
3		5		4				
2								
1								
	A	B	C	D	E	F	G	H

Use the knight's tour program on the website. To pick a knight move see how many possible moves there are. Go to the list in the back of this page to find the first unused random number for that value. Cross it off. When you count, start from the upper right (1 o'clock). Moving clockwise, the first legal move is number 1, the second legal move is number 2, etc.

To start your next experiment, find the next two numbers in the 1-8 list (and cross them off). Consider where your knight landed at the end of the last experiment. Add the first number to the column value, moving *right* exactly that number of squares, circling around (back to the left) if you need to. Add the second number to the row value, moving *up* exactly that number of squares, circling around (back to the bottom) if you need to. (In both cases, 8 will bring you back to where you started.) This is the starting position for your next experiment. It will be random.

If your group has size one, do four experiments. If your group has size two, do six experiments. If your group has size three, do eight experiments. It is important that you do this very **carefully**, so that your estimate is valid and that we can check your answers. Make sure that everyone knows how to everything; we do not want specialists.

1. Write the names of the students in your group in alphabetical order, neatly and clearly, as they appear on Gradescope.
2. Write your two values neatly and clearly.
3. Run the appropriate number of experiments. Draw the boards.
4. Write down your branching factors for each experiment. Note that there is an implicit branching factor of 64 for each experiment from picking the start square, which you should include.
5. For each experiment, calculate the expected number of nodes for each level, from the data of your experiment. (NOTE: The root has 1 node, and the next level has 64 nodes.)

6. Average your experiments for each level to calculate the expected number of nodes for each level. If an experiment does not reach some level, average in 0 for that experiment. Round each value to the nearest integer.
7. On a scale of 1 to 10 how much fun did you have? *Each individual in the group should answer separately.*

EXAMPLE:

I type Clyde Kruskal and get back: B, 2.

My start location is B2.

Four legal moves (C4, D3, D1, A4). Next random number in 1-4: 3. Jump to D1.

Three legal moves (E3, F2, C3). Next random number in 1-3: 2. Jump to F2.

Five legal moves: Next random number in 1-5: 1. Jump to G4.

Five legal moves. Next random number in 1-5: 4. Jump to E5.

Seven legal moves. Next random number in 1-7: 4. Jump to D3.

Three legal moves. Next random number in 1-3: 2. Jump to B4.

Five legal moves. Next random number in 1-5: 2. Jump to D5.

Four legal moves. Next random number in 1-4: 2. Jump to F6.

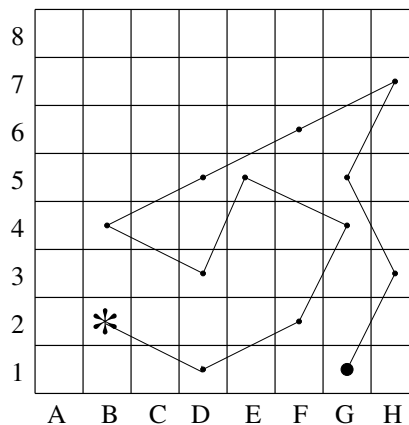
Five legal moves. Next random number in 1-5: 2. Jump to H7.

Two legal moves: Next random number in 1-2: 1. Jump to G5.

One legal move. Jump to H3.

One legal move. Jump to G1.

No legal moves: Done.



Ended on G1. Next two random numbers in 1-8: 6, 3. New column E. New row 4.

Branching factors: 1, 64, 4, 3, 5, 5, 7, 3, 5, 4, 5, 2, 1, 1

Estimated nodes: 1, 64, 256, 768, 3840, 19200, 134400, 403200, 2016000, 8064000, 40320000, 80640000, 80640000, 80640000

1-2:

1 2 2 2 2 1 1 2 2 2 2 1 2 1 2 1 2 1 2 2
1 2 2 1 1 1 2 1 1 2 2 2 1 1 2 1 1 1 1 1
2 1 2 2 1 1 2 2 1 2 1 1 1 1 1 2 1 2 2 1
2 1 2 1 2 1 2 2 1 1 1 1 1 2 1 1 2 1 2 2
1 2 2 2 1 2 1 1 2 1 2 1 1 1 1 1 2 1 2 2

1-3:

2 2 3 1 2 1 1 2 2 1 3 1 2 3 2 1 2 3 2 2
2 1 2 2 2 2 3 3 3 3 1 1 1 1 3 3 3 3 1 3
3 3 1 1 2 1 1 1 2 2 1 2 1 3 1 2 3 1 3 3
3 1 1 3 2 1 2 3 3 1 3 3 3 1 2 3 3 1 1 1

1-4:

3 2 1 2 3 1 4 3 4 4 3 1 1 4 1 4 2 2 1 3
4 4 1 2 2 2 1 3 3 3 3 2 3 1 2 3 1 2 3 1
3 4 3 2 3 1 2 2 4 3 2 2 1 2 2 4 4 1 1 1
3 2 4 2 4 3 1 2 1 3 4 4 3 4 1 2 1 2 3 1

1-5:

1 4 2 2 2 2 3 2 3 5 5 4 5 3 3 2 4 5 3 4
2 3 2 2 2 4 1 3 3 2 5 5 1 2 5 1 2 2 3 4
1 4 4 2 4 4 2 2 3 1 5 5 4 4 5 2 5 1 1 5

1-6:

1 5 3 5 1 4 2 1 6 5 5 2 6 1 4 2 6 5 1 1
3 2 1 5 5 4 3 5 3 5 2 5 2 5 5 6 5 4 2 4
2 4 6 4 4 1 4 4 4 4 5 2 4 2 5 5 1 6 4 3

1-7:

4 1 4 7 1 3 5 5 2 6 6 4 2 3 5 7 7 2 7 1
5 1 4 2 7 3 2 3 7 7 3 6 3 5 4 7 6 4 6 7

1-8:

6 3 7 7 4 8 1 7 4 7 3 7 5 4 3 3 2 5 8 5
7 4 6 1 2 7 5 8 1 5 5 5 3 8 6 7 8 5 6 5

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7	•	•	•	•	•	•	•	•
6	•	•	•	•	•	•	•	•
5	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•
1	•	•	•	•	•	•	•	•
	A	B	C	D	E	F	G	H

8	•	•	•	•	•	•	•	•
7	•	•	•	•	•	•	•	•
6	•	•	•	•	•	•	•	•
5	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•
1	•	•	•	•	•	•	•	•
	A	B	C	D	E	F	G	H

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5	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•
1	•	•	•	•	•	•	•	•
	A	B	C	D	E	F	G	H

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5	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•
1	•	•	•	•	•	•	•	•
	A	B	C	D	E	F	G	H