

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 ELMS).

Go to the bottom of the course website to get your starting position and offset. Use your first and last names as listed in ELMS; if your group has more than one person, use the person who is alphabetically first *by last name*. Use the boards provided to draw your knight's tours as Knuth does. You can use the boards with or without the dots in the middle of the squares, whichever is easier. 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 your offset value and count clockwise to find your random jump. The square for your offset value is associated with the random number 1. For example, if your offset value is 4 and your random number is 3, then start down 2 and right 1 from the current knight position and move the knight to the third legal move counting clockwise. (Down 2 and right 1 is the first move, although it may not be a legal move.)

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 every member of your group does every part part of the experiment at some point, so that everybody understands everything; we do not want to have any specialists. If your group has more than one person, make sure to check each other.

1. Write the names of the students in your group in alphabetical order, neatly and clearly, as they appear on ELMS.
2. Write your three values (column, row, and offset) neatly and clearly.
3. Run the appropriate number of experiments. 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.
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, 3.

My start location is B2, and my offset is 3.

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

Seven legal moves: First random number in 1-7: 1. Jump to F2.

Five legal moves: First random number in 1-5: 4. Jump to G4.

Five legal moves: Next random number in 1-5: 5. Jump to H6.

Three legal moves: First random number in 1-3: 1. Jump to F5.

Five legal moves: Next random number in 1-5: 1. Jump to E3.

Two legal moves: First random number in 1-2: 1. Jump to C4.

Five legal moves: Next random number in 1-5: 2. Jump to A5.

Three legal moves: Next random number in 1-3: 3. Jump to C6.

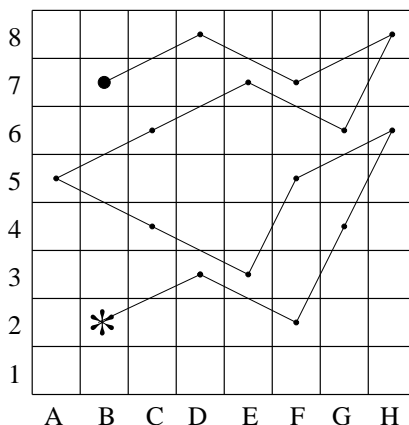
Six legal moves: First random number in 1-6: 6. Jump to E7.

Four legal moves: Next random number in 1-4: 1. Jump to G6.

Three legal moves: Next random number in 1-3: 3. Jump to H8.

One legal move: Jump to F7. One legal move: Jump to D8. One legal move: Jump to B7.

No legal moves: Done.



Ended on B7. First two random numbers in 1-8: 8, 4. New column B. New row 3.

My new start location is B3.

Branching factors: 1, 64, 4, 7, 5, 5, 3, 5, 2, 5, 3, 6, 4, 3, 1, 1, 1

Estimated nodes: 1, 64, 256, 1792, 8960, 44800, 134400, 672000, 1344000, 6720000, 20160000, 120960000, 483840000, 1451520000, 1451520000, 1451520000, 1451520000

1-2:

1 2 2 2 2 2 1 1 2 1 2 1 2 1 2 1 2 1 2 2
1 1 2 1 2 1 2 2 2 1 2 1 2 1 2 2 1 2 2 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:

1 3 3 3 2 3 1 3 3 1 1 2 3 3 3 1 3 3 2 1
2 2 3 3 2 2 1 2 2 1 1 2 3 2 2 3 2 2 1 2
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:

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

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

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

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

1-8:

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

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

8	•	•	•	•	•	•	•	•
7	•	•	•	•	•	•	•	•
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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

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