

Put your *name* and *section number* on your solution and (if more than one sheet) staple. Turn in Section 4 of the NP-completeness homework separately.

You are going to estimate, by hand, the size of the backtrack tree for an uncrossed knight's tour. Go to the bottom of the course website to get your first starting position and offset for counting knight moves. Use your first and last names as listed in csgrades. Use the boards provided to draw your knight tours as Knuth does. You can use the boards with or without the dots in the middle of the squares, whichever is easier.

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

When you pick a knight move, count the number of possible moves. 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.

Do four experiments. It is important that you do this very **carefully**, so that your estimate is valid and that we can check your answers. This process is error prone. You may want to do this with someone else.

1. Write your three values neatly and clearly.
2. Write down your branching factors for each experiment. You do *not* have to write down the branching factors in order. This will be one fewer things to remember as you do the experiments. You can just read the branching factors off of the crossed out values at the end of each experiment. Note that there is an implicit branching factor of 64 for each experiment from picking the start square, which you should include.
3. Write down the product of your branching factors for each experiment.
4. What is your estimate for the number of leaves in the backtrack tree? Round the unit value to the nearest integer.
5. On a scale of 1 to 10 how much fun did you have?

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. Next random number in 1-4: 3. Jump is to C4.

Seven legal moves: E3, D2, A3, A5, B6, D6, E5. Next random number in 1-7: 2. Jump is to D2.

Four legal moves: F1, B1, E4, F3. Next random number in 1-4: 3. Jump is to E4.

Six legal moves: G3, F2, C5, D6, F6, G5. Next random number in 1-6: 4. Jump is to D6.

Six legal moves: F5, B5, B7, C8, E8, F7. Next random number in 1-6: 1. Jump is to F5.

Six legal moves: H4, G3, E3, E7, G7, H6. Next random number in 1-6: 4. Jump is to E7.

Four legal moves: G6, C6, C8, G8. Next random number in 1-4: 2. Jump is to C6.

Six legal moves: D4, B4, A5, A7, B8, D8. Next random number in 1-6: 6. Jump is to D8.

Two legal moves: F7, B7. Next random number in 1-2: 2. Jump is to B7.

Two legal moves: C5, A5. Next random number in 1-2: 1. Jump is to C5.

Four legal moves: D3, B3, A4, A6. Next random number in 1-4: 4. Jump is to A6.

Two legal moves: B4, B8. Next random number in 1-2: 1. Jump is to B4.

Two legal moves: A2, D4. Next random number in 1-2: 1. Jump is to A2.

One legal move: C1. No choice. Jump is to C1.

One legal move: E2. No choice. Jump is to E2.

Three legal moves: G1, F4, G3. Next random number in 1-3: 2. Jump is to F4.

Four legal moves: H3, G2, G6, H5. Next random number in 1-4: 2. Jump is to G2.

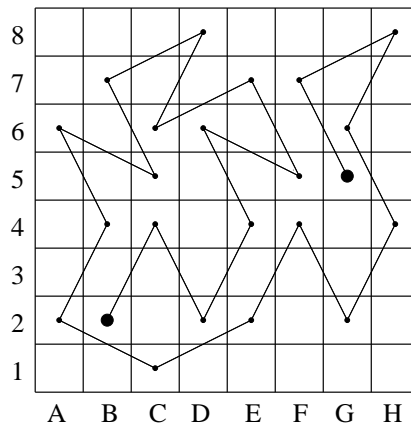
Two legal moves: E1, H4. Next random number in 1-2: 2. Jump is to H4.

One legal move: G6. No choice. Jump is to G6.

Two legal moves: F8, H8. Next random number in 1-2: 2. Jump is to H8.

One legal move: F7. No choice. Jump is to F7.

One legal move: G5. No choice. Jump is to G5.



Ended on G5. Next two random numbers in 1-8: 4,2. New column C. New row 7.

1-2:

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

1-3:

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

1-4:

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

1-5:

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

1-6:

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

1-7:

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

1-8:

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

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