



LAKE FOREST
COLLEGE

What's so Rational About the Alphabet?

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Lake Forest College – Richter Scholar Program – Summer 2014

Base Conversion

Base 10 to Base 4:

31 (Base 10)
 $31 / 4 = 7 \text{ R } 3$
 $7 / 4 = 1 \text{ R } 3$
 $1 / 4 = 0 \text{ R } 1$
133 (Base 4)

Base 4 to Base 10:

133 (Base 4)
 $(1 \times 4^2) + (3 \times 4^1) + (3 \times 4^0)$
 $16 + 12 + 3$
31 (Base 10)

Random Walks

Depending on the base used in the random walk, each number is assigned a direction that the computer is told to move one unit in when it appears in a rational (which could be "randomly" generated or a specific input).

Example in Base 4:

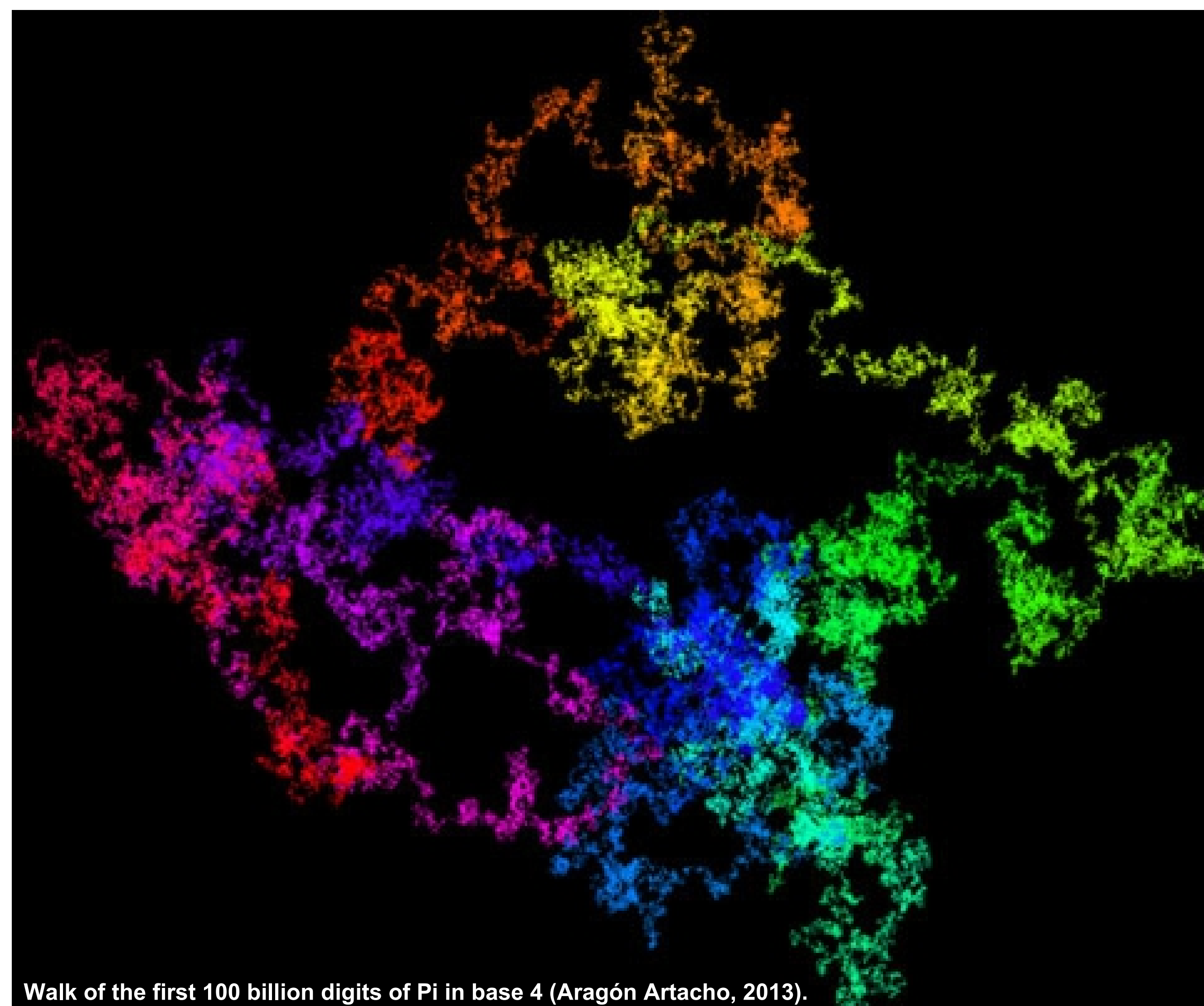
- 0 = move 1 unit 0 radians (right)
- 1 = move 1 unit $\pi/2$ radians (up)
- 2 = move 1 unit π radians (left)
- 3 = move 1 unit $3\pi/2$ radians (down)

419636198 (base 10)
121000302033212 (base 4)

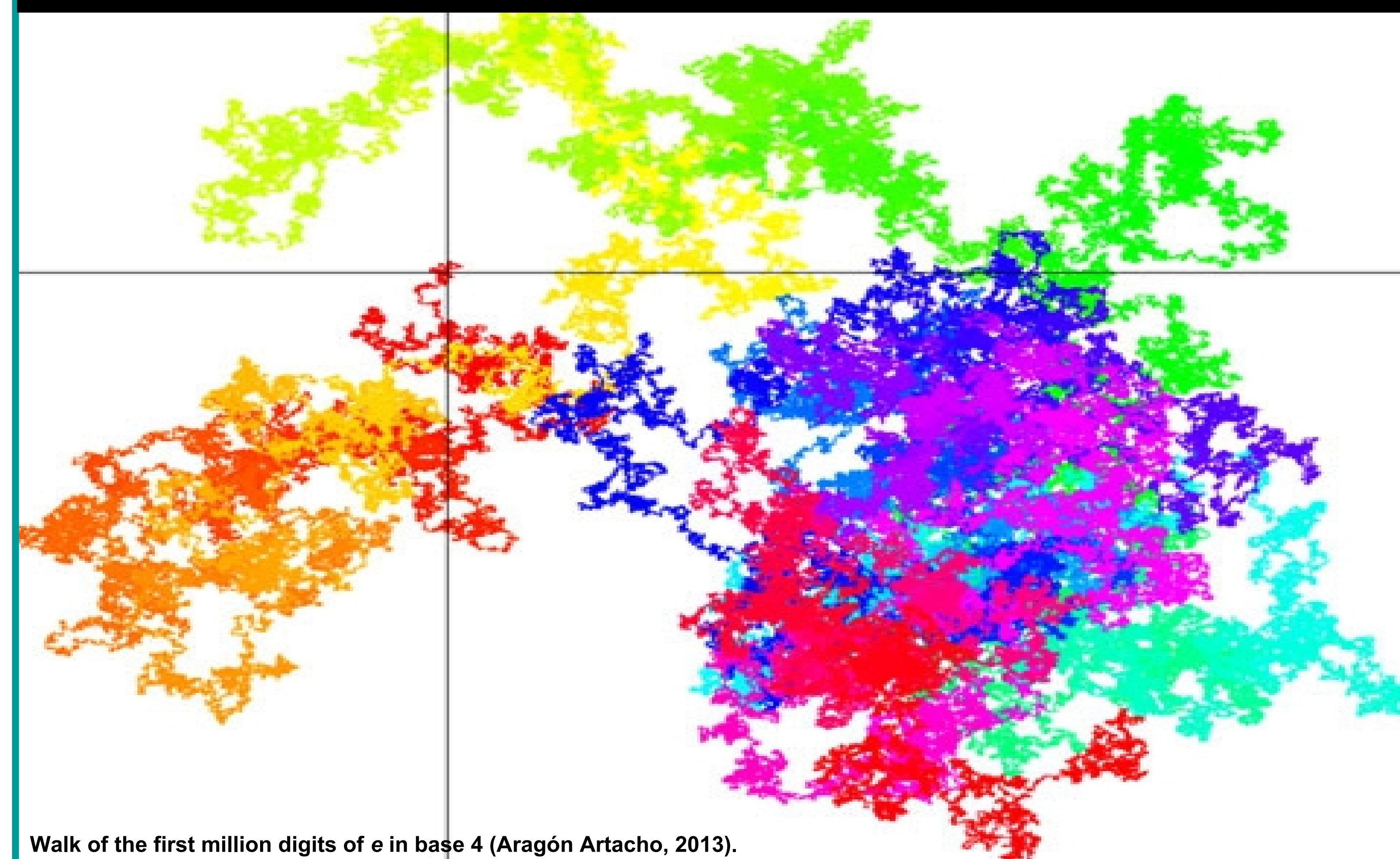
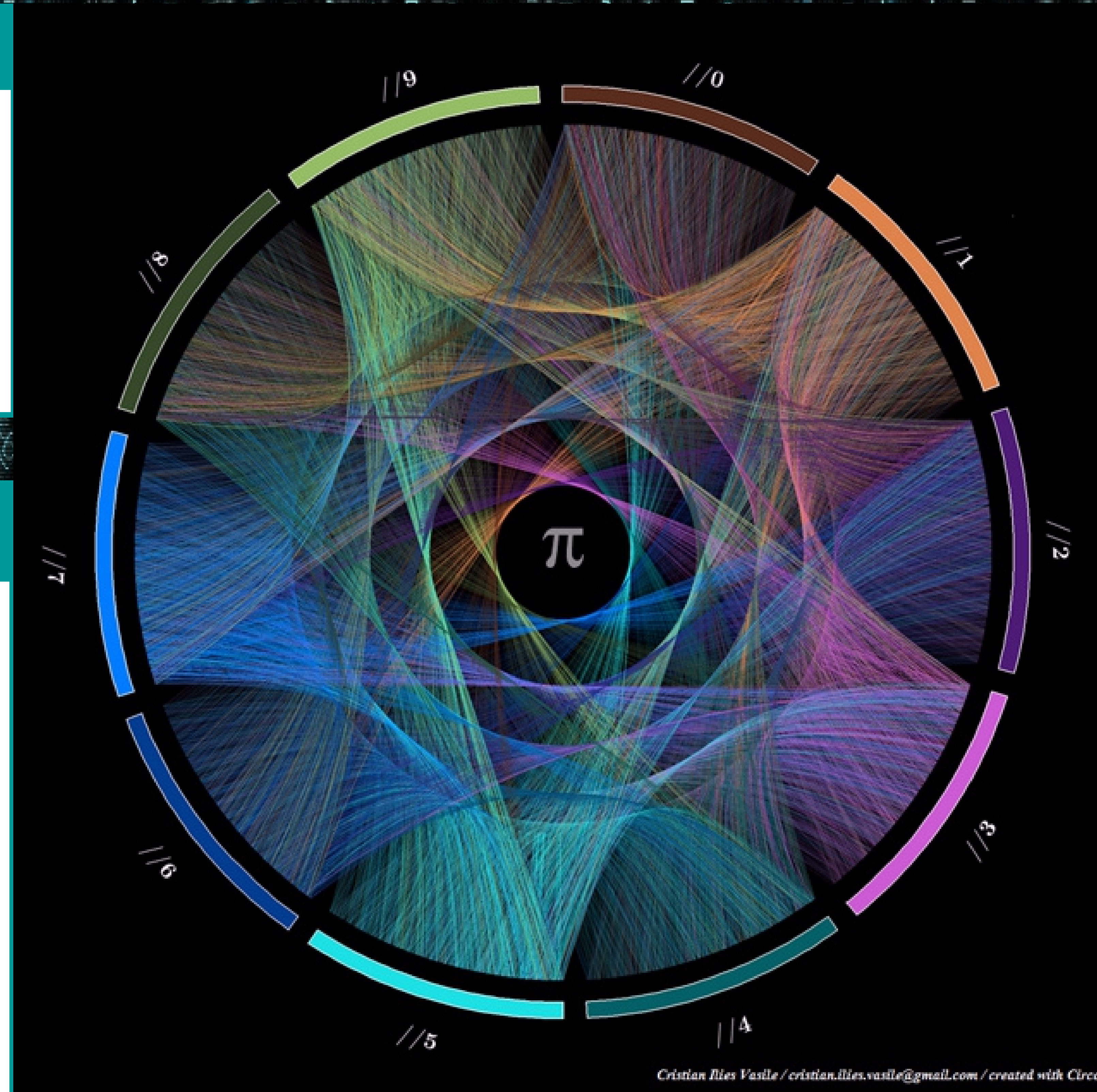
Translates to:

$\uparrow, \leftarrow, \uparrow, \rightarrow, \rightarrow, \rightarrow, \downarrow, \rightarrow, \leftarrow, \rightarrow, \downarrow, \downarrow, \leftarrow, \uparrow, \leftarrow$

The result:



Walk of the first 100 billion digits of Pi in base 4 (Aragón Artacho, 2013).

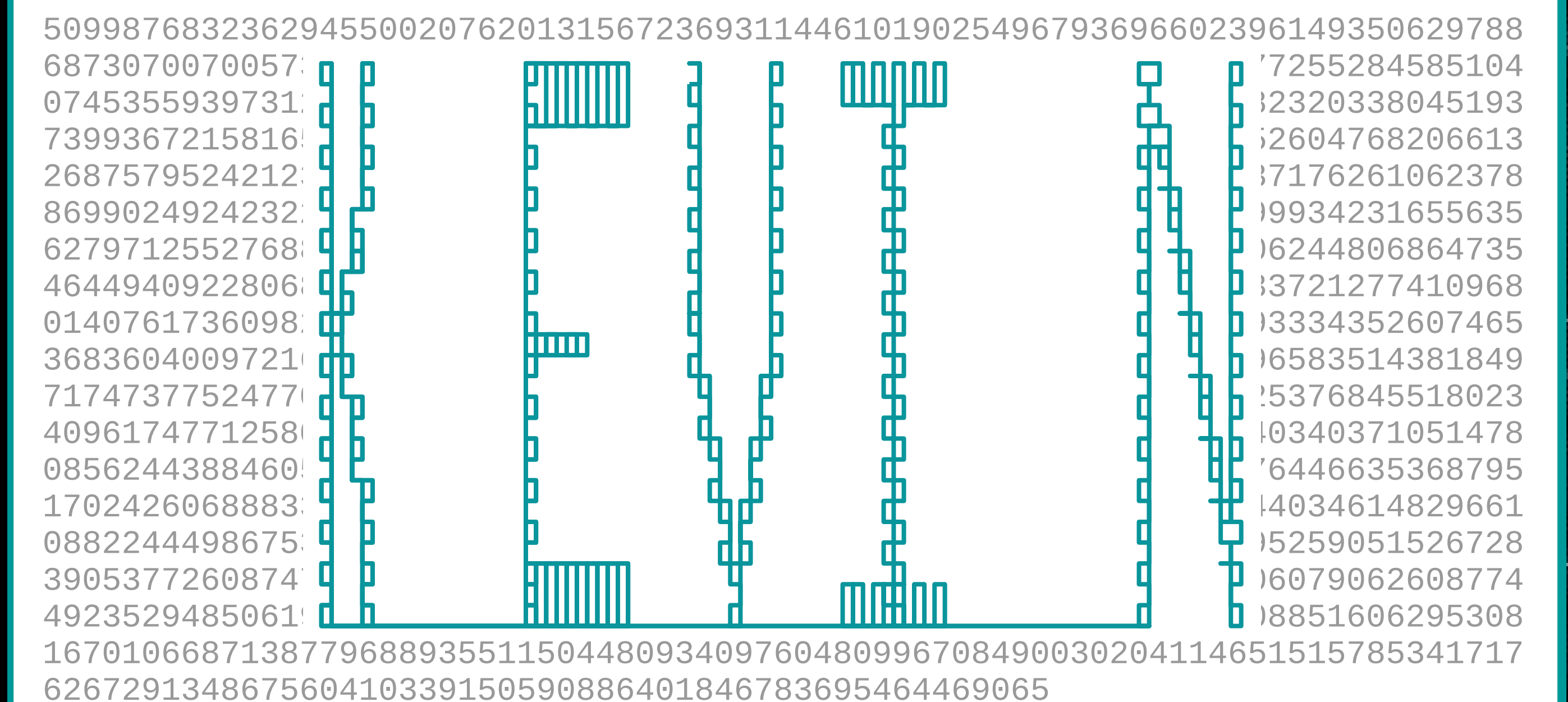


Walk of the first million digits of e in base 4 (Aragón Artacho, 2013).

Walking on Reals

1049012271677499437486619280565448601
6175673584915608761668483808431443584
472528755516292470277595557045371567
9313058783247729772021770818187965906
3736576748798142280132859202786101925
8140957135748704712290267465151312805
9541953997504202061380373822338959713
391954/1612226962694290912940490066273
5492142298807557254685123533957184651
9135301734881431401750453996944547935
3012064383327267097007933052629203035
0920973600450955456136596649325078391
4647728401623856513742952945308961226
8152748875615658076162410788075184599
421938774835

Rational number Q1 (Aragón Artacho, 2013).



References

Aragón Artacho, F. J., Bailey, D. H., Borwein, J. M., & Borwein, P. B. (2013). Walking on real numbers.
http://www.imgbase.info/images/safe-wallpapers/tv_movies/the_matrix/28740_the_matrix_matrix_code.jpg