Homage to John Conway

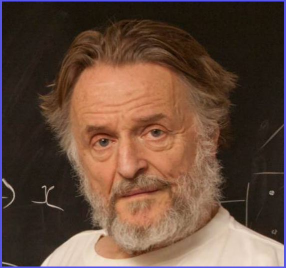


Photo: Princeton University / Denise Applewhite

Theresia Eisenkölbl, Université Lyon 1

John Horton Conway

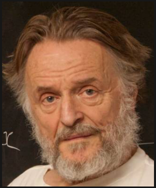


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

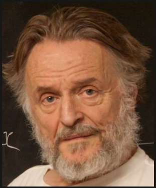


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- $\star$26. 12. 1937

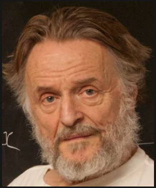


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964

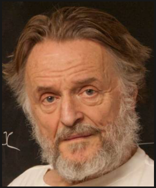


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge

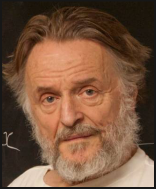


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton

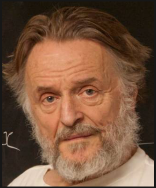


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

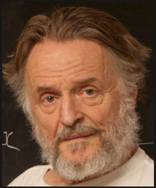


Photo:
Princeton University
Denise Applewhite

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

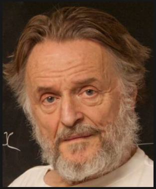


Photo:
Princeton University
Denise Applewhite

Research areas

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

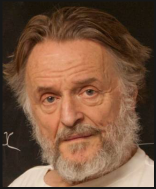


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

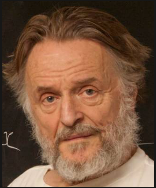


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

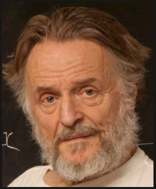


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

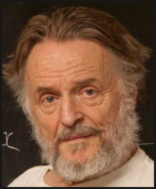


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

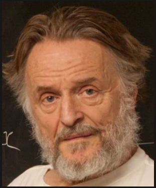


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory
- Monstrous Moonshine
- . . .

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

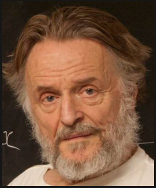


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory
- Monstrous Moonshine
- ...

Books

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

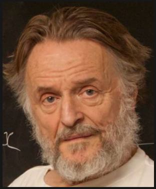


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory
- Monstrous Moonshine
- ...

Books

- *On Numbers and Games (1976)*

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

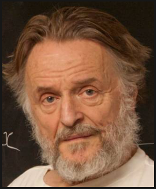


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory
- Monstrous Moonshine
- . . .

Books

- *On Numbers and Games (1976)*
- *(with Berlekamp and Guy)*
  Winning Ways for your Mathematical Plays (1982)

John Horton Conway

Bio

- ⋆26. 12. 1937
- PhD 1964
- Cambridge
- Princeton
- †11. 4. 2020 (Covid-19)

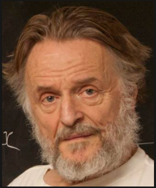


Photo:
Princeton University
Denise Applewhite

Research areas

- Group theory
- Knot theory
- Game theory
- Number theory
- Monstrous Moonshine
- . . .

Books

- *On Numbers and Games (1976)*
- *(with Berlekamp and Guy)*
  Winning Ways for your Mathematical Plays (1982)
- *(with Norton, Wilson and Parker)*
  Atlas of finite groups (1985)

In an interview, John Conway said that after he made his name with his work on the classification of finite simple groups he felt that he was now free to do whatever he liked.

John Horton Conway

In an interview, John Conway said that after he made his name with his work on the classification of finite simple groups he felt that he was now free to do whatever he liked.

His advisor, Harold Davenport, said that when he would give John Conway a problem to solve, „he would return with a very good solution to another problem.“

Summer Camps

Summer Camps

Friday 22nd	Saturday 23rd	Sunday 24th
Breakfast	Breakfast	Breakfast
Anouncements	Anouncements	Anouncements
Mark Levi	**John Conway**	**Don Zagier**
Mathematics by physical reasoning	Topic decided in consultation with participants	Partitions

Summer Camps

Summer Camps

Photo: MoMISS 2012/Katia Sergeeva

Motivation

Motivation

German version of Scientific American

Motivation

German version of
Scientific American

Martin Gardner

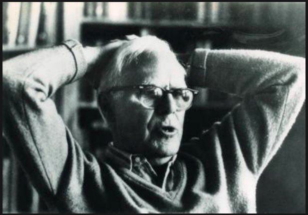


Photo: Wikimedia Commons
Konrad Jacobs

Themes of this talk

Themes of this talk

- Conway group

Themes of this talk

- Conway group
- Conway polynomial

Themes of this talk

- Conway group
- Conway polynomial
- Conway sequence and constant

Themes of this talk

- Conway group
- Conway polynomial
- Conway sequence and constant
- Sprouts and variants

Themes of this talk

- Conway group
- Conway polynomial
- Conway sequence and constant
- Sprouts and variants
- Game of life

Themes of this talk

- Conway group
- Conway polynomial
- Conway sequence and constant
- Sprouts and variants
- Game of life
- Conway circle

Things Named After John Conway

Not logged in

Article | Talk | Read | Edit | View history

WIKIPEDIA
The Free Encyclopedia

Main page
Contents
Current events
Random article
About Wikipedia
Contact us
Donate

Contribute
Help
Community portal
Recent changes
Upload file

Tools
What links here
Related changes
Special pages
Permanent link
Page information
Cite this page
Wikidata item

Print/export
Download as PDF
Printable version

Languages
Add links

List of things named after John Horton Conway

From Wikipedia, the free encyclopedia

This is a list of things named after the English mathematician John Horton Conway (1937–2020).

- Conway algebra – an algebraic structure introduced by Paweł Traczyk and Józef H. Przytycki[1]
- Conway base 13 function – a function used as a counterexample to the converse of the intermediate value theorem[2]
- Conway chained arrow notation – a notation for expressing certain extremely large numbers[3]
- Conway circle – a geometrical construction based on extending the sides of a triangle[4]
- Conway criterion – a criterion for identifying prototiles that admit a periodic tiling[5]
- Conway group – any of the groups Co_0, Co_1, Co_2, or Co_3[6]
- Conway group Co1 – one of the sporadic simple groups discovered by Conway in 1968[6]
- Conway group Co2 – one of the sporadic simple groups discovered by Conway in 1968[6]
- Conway group Co3 – one of the sporadic simple groups discovered by Conway in 1968[6]
- Conway knot – a particular knot in knot theory
- Conway notation (knot theory) – a notation invented by Conway for describing knots in knot theory[7]
- Conway polyhedron notation – notation invented by Conway used to describe polyhedra[8]
- Conway polynomial (finite fields) – an irreducible polynomial used in finite field theory[8]
- Conway puzzle – a packing problem invented by Conway using rectangular blocks[9]
- Conway sphere – a 2-sphere intersecting a given knot in the 3-sphere or 3-ball transversely in four points[7]
- Conway triangle notation – notation which allows trigonometric functions of a triangle to be managed algebraically[8]
- Conway's 99-graph problem – a problem invented by Conway asking if a certain undirected graph exists[10]
- Conway's constant – a constant used in the study of the Look-and-say sequence[11]
- Conway's dead fly problem – does there exist a Danzer set whose points are separated at a bounded distance from each other?
- Conway's Game of Life – a cellular automaton defined on the two-dimensional orthogonal grid of square cells[9]
- Conway's Soldiers – a one-person mathematical game resembling peg solitaire[12]
- Conway's thrackle conjecture – In graph theory, the conjecture that no thrackle has more edges than vertices
- Alexander–Conway polynomial – a knot invariant which assigns a polynomial to each knot type in knot theory[7]

Conway group

The Conway group Co_1 is the quotient of index 2 of the automorphism group of the 24-dimensional Leech lattice.

Conway group

The Conway group Co_1 is the quotient of index 2 of the automorphism group of the 24-dimensional Leech lattice.
The group has 4 157 776 806 543 360 000 elements.

Conway group

The Conway group Co_1 is the quotient of index 2 of the automorphism group of the 24-dimensional Leech lattice.
The group has 4 157 776 806 543 360 000 elements.
It is one of three Conway groups among the 26 sporadic groups in the classifications of finite simple groups.

Conway polynomial: Knots and Links

Conway polynomial: Knots and Links

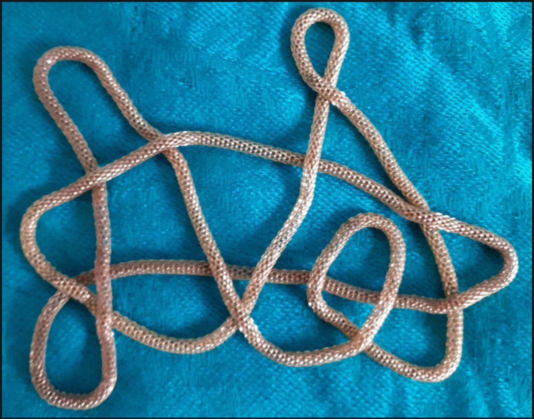
Knot

Conway polynomial: Knots and Links

Knot

Link

Conway polynomial: Knot diagram



Conway polynomial: Definition

Conway polynomial: Definition

The Conway polynomial ∇ (a variant of the Alexander polynomial) is defined by

Conway polynomial: Definition

The Conway polynomial ∇ (a variant of the Alexander polynomial) is defined by

$\nabla\Big($  $\Big) = 1$

Conway polynomial: Definition

The Conway polynomial ∇ (a variant of the Alexander polynomial) is defined by

$$\nabla\Bigg($$  $$\Bigg) = 1$$

$$\nabla\Bigg($$  $$\Bigg) = \nabla\Bigg($$  $$\Bigg) - z \cdot \nabla\Bigg($$  $$\Bigg)$$

The Conway polynomial ∇ (a variant of the Alexander polynomial) is defined by

$\nabla \Big($  $\Big) = 1$

$\nabla \Big($  $\Big) = \nabla \Big($  $\Big) - z \cdot \nabla \Big($  $\Big)$

The Conway polynomial is a knot invariant, i.e., it does not change when the knot is continuously deformed in three dimensions.

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

Conway polynomial: Hopf Link

∇ () $= \nabla$ () $- z \cdot \nabla$ ()

∇ () $= \nabla$ () $- z \cdot \nabla$ ()

$1 \quad = \quad 1 \quad - z \cdot \nabla$ ()

Conway polynomial: Hopf Link

∇ () $= \nabla$ () $- z \cdot \nabla$ ()

∇ () $= \nabla$ () $- z \cdot \nabla$ ()

$1 = 1 - z \cdot \nabla$ ()

$\Rightarrow \nabla$ () $= 0.$

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$,

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$,

$\nabla\Big($  $\Big) = 1$ and $\nabla\Big($  $\Big) = 0$.

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big),$

$\nabla\Big($  $\Big) = 1$ and $\nabla\Big($  $\Big) = 0.$

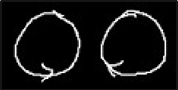
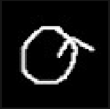
$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

Conway polynomial: Hopf Link

∇ () $= \nabla$ () $- z \cdot \nabla$ (),

∇ () $= 1$ and ∇ () $= 0.$

∇ () $= \nabla$ () $- z \cdot \nabla$ ()

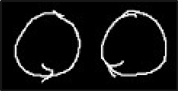
$= \nabla$ () $- z \cdot \nabla$ ()

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big),$

$\nabla\Big($  $\Big) = 1$ and $\nabla\Big($  $\Big) = 0.$

$\nabla\Big($  $\Big) = \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

$= \nabla\Big($  $\Big) - z \cdot \nabla\Big($  $\Big)$

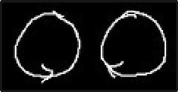
$= 0 - z \cdot 1 = -z.$

Conway polynomial: Hopf Link

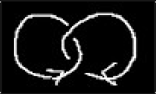
$\nabla\Big($  $\Big) = -z.$

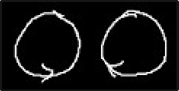
Conway polynomial: Hopf Link

∇ () $= -z.$

∇ () $= 0.$

Conway polynomial: Hopf Link

$\nabla\Big($  $\Big) = -z.$

$\nabla\Big($  $\Big) = 0.$

Two rings linked together cannot be separated in three dimensions without cutting them.

Conway polynomial: Trefoil knot

Exercise

$\nabla \Bigg($  $\Bigg) = ?$

Conway sequence

$$1$$

Conway sequence

$$1$$
$$11$$

Conway sequence

1

11

21

Conway sequence

1

11

21

1211

Conway sequence

1

11

21

1211

111221

Conway sequence

1

11

21

1211

111221

312211

Conway sequence

1

11

21

1211

111221

312211

13112221

Conway sequence

1

11

21

1211

111221

312211

13112221

1113213211

Conway sequence

Conway sequence	Length
1	1
11	2
21	2
1211	4
111221	6
312211	6
13112221	8
1113213211	10
31131211131221	14

Conway sequence: Conway constant

$$\lim_{n\to\infty} \frac{\ell_{n+1}}{\ell_n} = \lambda$$

Conway sequence: Conway constant

$$\lim_{n\to\infty} \frac{\ell_{n+1}}{\ell_n} = \lambda$$

with the Conway constant

$$\lambda = 1.303577269034\ldots,$$

the only positive root of

Conway sequence: Conway constant

$$\begin{aligned} & x^{71}-x^{69}-2x^{68}-x^{67}+2x^{66}+2x^{65}+x^{64}-x^{63}-x^{62}-x^{61}-x^{60}-x^{59} \\ & +2x^{58}+5x^{57}+3x^{56}-2x^{55}-10x^{54}-3x^{53}-2x^{52}+6x^{51}+6x^{50}+x^{49} \\ & +9x^{48}-3x^{47}-7x^{46}-8x^{45}-8x^{44}+10x^{43}+6x^{42}+8x^{41}-5x^{40}-12x^{39} \\ & +7x^{38}-7x^{37}+7x^{36}+x^{35}-3x^{34}+10x^{33}+x^{32}-6x^{31}-2x^{30}-10x^{29} \\ & -3x^{28}+2x^{27}+9x^{26}-3x^{25}+14x^{24}-8x^{23}-7x^{21}+9x^{20}+3x^{19}-4x^{18} \\ & -10x^{17}-7x^{16}+12x^{15}+7x^{14}+2x^{13}-12x^{12}-4x^{11}-2x^{10}+5x^{9}+x^{7} \\ & -7x^{6}+7x^{5}-4x^{4}+12x^{3}-6x^{2}+3x-6. \end{aligned}$$

Conway sequence: Atoms

1

Conway sequence: Atoms

$$1$$
$$11$$

Conway sequence: Atoms

1
11
21

Conway sequence: Atoms

$$1$$
$$11$$
$$21$$
$$12 \mid 11$$

Conway sequence: Atoms

$$1$$
$$11$$
$$21$$
$$12 \mid 11$$
$$111221$$

Conway sequence: Atoms

1

11

21

12 | 11

111221

31 | 22 | 11

Conway sequence: Atoms

1

11

21

12 | 11

111221

31 | 22 | 11

13 | 11 $|_2$ 2221

Conway sequence: Atoms

$$1$$
$$11$$
$$21$$
$$12 \mid 11$$
$$111221$$
$$31 \mid 22 \mid 11$$
$$13 \mid 11 \mid_2 2221$$
$$1113 \mid_2 21 \mid_3 32 \mid 11$$

Conway sequence: Atoms

1

11

21

12 | 11

111221

31 | 22 | 11

$13 | 11 |_2 2221$

$1113 |_2 21 |_3 32 | 11$

$3113 |_3 12 | 11 |_4 13 | 1221$

Conway sequence: Atoms

1

11

21

12 | 11

111221

31 | 22 | 11

$13 \mid 11 \mid_2 2221$

$1113 \mid_2 21 \mid_3 32 \mid 11$

$3113 \mid_3 12 \mid 11 \mid_4 13 \mid 1221$

$13 \mid 2113 \mid_4 1112 \mid_2 3113 \mid 11 \mid 22 \mid 12$

Conway sequence: Atoms

1

11

21

$12 \mid 11$

111221

$31 \mid 22 \mid 11$

$13 \mid 11 \mid_2 2221$

$1113 \mid_2 21 \mid_3 32 \mid 11$

$3113 \mid_3 12 \mid 11 \mid_4 13 \mid 1221$

$13 \mid 2113 \mid_4 1112 \mid_2 3113 \mid 11 \mid 22 \mid 12$

$1113 \mid_2 1221133112 \mid_3 13 \mid 2113 \mid_2 21 \mid_2 22 \mid_2 1112$

Conway sequence: Atoms

11132   13211

311312 | 11131221

1321131112 $|_2$ 3113 | 112212

11131221133112 $|_3$ 1321132122211 2

311321222123211 2 $|_4$ 111312211312112 2

1321131211321112131221 12 $|_5$ 311311222113111221 22

1113122113111221131231121113112221 12 $|_6$ 132113213221133122112 2

Conway sequence: Atoms

$$\boxed{11132}\quad\boxed{13211}$$

$$311312 \,|\, 11131221$$

$$1321131112 \,|_2\, 3113112212$$

$$11131221133112 \,|_3\, 1321132122 1112$$

$$311321222 1232112 \,|_4\, 1113122113121122$$

$$132113121132111213122112 \,|_5\, 311311222113111 22122$$

$$11131221131112211312311211131122 2112 \,|_6\, 1321132132211331221122$$

Conway sequence: Atoms

11132 and 13211 are 2 of 92 atoms. It just remains to show how each atom decays into other atoms. The Conway constant λ is the largest eigenvalue of the transition matrix.

11132 and 13211 are 2 of 92 atoms. It just remains to show how each atom decays into other atoms. The Conway constant λ is the largest eigenvalue of the transition matrix.
λ is the growth constant for any starting string of positive integers with one exception:

11132 and 13211 are 2 of 92 atoms. It just remains to show how each atom decays into other atoms. The Conway constant λ is the largest eigenvalue of the transition matrix.
λ is the growth constant for any starting string of positive integers with one exception:

22

Sprouts: Rules

Example with $n = 3$.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.
- A move consists of connecting two vertices and placing a new vertex on the new edge.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.
- A move consists of connecting two vertices and placing a new vertex on the new edge.
- The new edge may return to the starting vertex.

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.
- A move consists of connecting two vertices and placing a new vertex on the new edge.
- The new edge may return to the starting vertex.
- Edges must not cross.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.
- A move consists of connecting two vertices and placing a new vertex on the new edge.
- The new edge may return to the starting vertex.
- Edges must not cross.
- The maximal degree of each vertex is three.

Sprouts: Rules

Example with $n = 3$.

- Two players alternate.
- Start with $n \in \mathbb{N}$ vertices.
- A move consists of connecting two vertices and placing a new vertex on the new edge.
- The new edge may return to the starting vertex.
- Edges must not cross.
- The maximal degree of each vertex is three.
- A player who does not have a legal move loses.

Sprouts: Does it end?

Does the game always end?

Sprouts: Does it end?

Does the game always end?

Each move uses up two free spots and provides one new spot.

Sprouts: Who wins?

Sprouts: Who wins?

Let A and B be the players and let A be the starting player. The table lists the winner for the given number n of starting vertices.

Vertices	0	1	2	3	4	5	6	7	8	9	10	11

Let A and B be the players and let A be the starting player. The table lists the winner for the given number n of starting vertices.

Vertices	0	1	2	3	4	5	6	7	8	9	10	11
Winner	B	B	B	A	A	A	B	B	B	A	A	A

Sprouts: Who wins?

Let A and B be the players and let A be the starting player. The table lists the winner for the given number n of starting vertices.

Vertices	0	1	2	3	4	5	6	7	8	9	10	11
Winner	B	B	B	A	A	A	B	B	B	A	A	A

True up to $n = 32$.

Sprouts: Who wins?

Let A and B be the players and let A be the starting player. The table lists the winner for the given number n of starting vertices.

Vertices	0	1	2	3	4	5	6	7	8	9	10	11
Winner	B	B	B	A	A	A	B	B	B	A	A	A

True up to $n = 32$. And for $n = 47$.

Sprouts: Who wins?

Let A and B be the players and let A be the starting player. The table lists the winner for the given number n of starting vertices.

Vertices	0	1	2	3	4	5	6	7	8	9	10	11
Winner	B	B	B	A	A	A	B	B	B	A	A	A

True up to $n = 32$. And for $n = 47$.
Open problem.

Brussels Sprouts

Like Sprouts, but instead of vertices, we use crosses that mark four free ends for edges. On a new edge, we place a notch that provides two new free ends, one in each direction from the edge.

Brussels Sprouts: Does it end?

Each move removes two free ends and introduces two free ends, so there are always $4n$ free ends. A face contains at least one free end, so there can be at most $4n$ faces. However, it is not possible to play indefinitely without drawing more than $4n$ faces.

Brussels Sprouts: Who wins?

Brussels Sprouts: Who wins?

Vertices	0	1	2	3	4	5	6	7	8	9	10	11

Brussels Sprouts: Who wins?

Vertices	0	1	2	3	4	5	6	7	8	9	10	11
Winner	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*	*B*	*A*

Game ends when each face contains exactly one free end after m moves. There are $2m$ edges and $n+m$ vertices in the end. Each move removes two free ends and introduces two free ends, so there are always $4n$ free ends and therefore $4n$ faces in the end.

Brussels Sprouts: Who wins?

Euler's formula

$$(n+m) - 2m + 4n = 2.$$

Brussels Sprouts: Who wins?

Euler's formula

$(n+m) - 2m + 4n = 2.$

$$m = 5n - 2.$$

Brussels Sprouts: Who wins?

Euler's formula

$(n + m) - 2m + 4n = 2.$

$$m = 5n - 2.$$

Players win according to the parity of n independently of their chosen moves.

Planted Brussels Sprouts

Like Brussels Sprouts, but we start with a circle that only contains some free ends towards the inner face.

Planted Brussels Sprouts

Like Brussels Sprouts, but we start with a circle that only contains some free ends towards the inner face.

As before, we can determine the number of moves ($n - 1$, easily proved by induction) and the winner does not depend on the choices of the players.

Planted Brussels Sprouts

Like Brussels Sprouts, but we start with a circle that only contains some free ends towards the inner face.

As before, we can determine the number of moves ($n - 1$, easily proved by induction) and the winner does not depend on the choices of the players.

Boring.

Planted Brussels Sprouts

Planted Brussels Sprouts

Caleb Ji, James Propp: *Brussels Sprouts, Noncrossing Trees, and Parking Functions*, arxiv.org/1805.03608.

Planted Brussels Sprouts

Caleb Ji, James Propp: *Brussels Sprouts, Noncrossing Trees, and Parking Functions*, arxiv.org/1805.03608.

Nonetheless, games that are trivial from the point of view of strategy may still pose interesting questions for enumerative combinatorics. ("If you can't beat 'em, count how many ways they can beat you.")

Planted Brussels Sprouts

Caleb Ji, James Propp: *Brussels Sprouts, Noncrossing Trees, and Parking Functions*, arxiv.org/1805.03608.

Nonetheless, games that are trivial from the point of view of strategy may still pose interesting questions for enumerative combinatorics. ("If you can't beat 'em, count how many ways they can beat you.")

We show that the endstates of the game are in natural bijection with noncrossing trees and that the game histories are in natural bijection with both parking functions and factorizations of a cycle of S_n.

Game of Life: Rules

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

- A dead cell with exactly 3 living neighbors will be reborn in the next generation.

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

- A dead cell with exactly 3 living neighbors will be reborn in the next generation.
- A living cell with 2 or 3 living neighbors survives into the next generation.

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

- A dead cell with exactly 3 living neighbors will be reborn in the next generation.
- A living cell with 2 or 3 living neighbors survives into the next generation.
- All other cells will be dead in the next generation.

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

- A dead cell with exactly 3 living neighbors will be reborn in the next generation.
- A living cell with 2 or 3 living neighbors survives into the next generation.
- All other cells will be dead in the next generation.

Is this really a game?

Game of Life: Rules

On an infinite square grid some square cells are „alive“ and the rest are „dead“. The neighbors of a cell are the 8 cells that share at least a point with the cell.

- A dead cell with exactly 3 living neighbors will be reborn in the next generation.
- A living cell with 2 or 3 living neighbors survives into the next generation.
- All other cells will be dead in the next generation.

Is this really a game? „*Zero-player game*“

Balanced rules allow complex behavior: Glider

Balanced rules allow complex behavior: Glider

Conway promised 50$ for someone who could find a configuration that leads to an unbounded number of alive cells. The prize was claimed in 1970 by Bill Gosper for his Gliding Gun that shoots out an endless chain of gliders.

Balanced rules allow complex behavior: Glider

Conway promised 50$ for someone who could find a configuration that leads to an unbounded number of alive cells. The prize was claimed in 1970 by Bill Gosper for his Gliding Gun that shoots out an endless chain of gliders.

Example of changed rules.

Video interviews

Several video interviews with John Conway are available on Numberphile.

Homework: Conway Circle