

Discovery, Inside and Out

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Valparaiso Symposium on Undergraduate
Research and Creative Expression
May 14, 2020

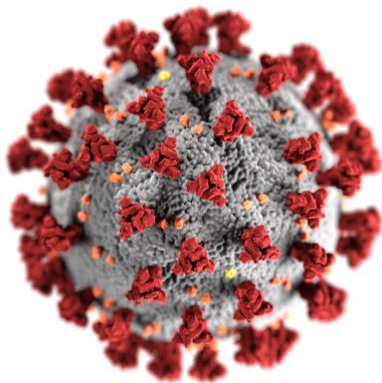











Image credit: <https://phil.cdc.gov/details.aspx?pid=23312>


Discovery in the World

 **AMA**  Join / Renew   

7 medications to watch in global race to discover COVID-19 treatment

APR 21, 2020

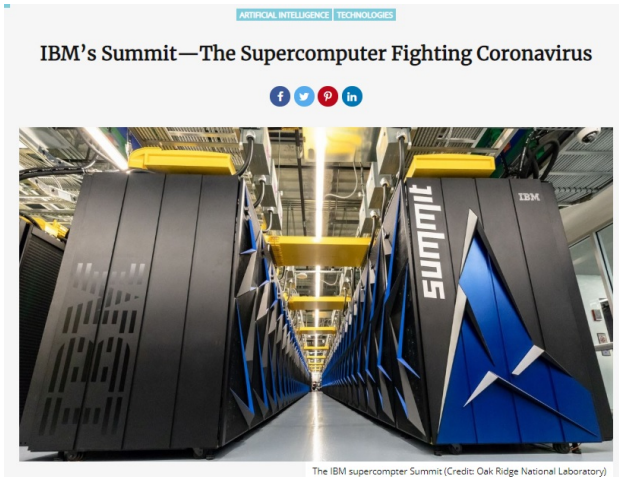
   



Andis Robeznieks
Senior News Writer
American Medical Association
[@AndisRobeznieks](#)
[Full Bio](#)

No therapies have yet to conclusively show effectiveness against COVID-19, but researchers around the globe are working furiously to identify drugs that could prevent illness or provide treatment, as evidenced by a recent [literature review](#) that identified 1,315 scientific articles devoted to that topic.

Discovery in the World



Discovery in the World

🕒 MAY 8, 2020

Societal behavior during, and after, the pandemic

by Jason Maderer, Carnegie Mellon University



Credit: CC0 Public Domain

"Humans are so fascinating, and that's why I study them."

Discovery in the World

Can't I *please* just visit one friend?

CODE ▾

Visualizing social distancing networks in the era of COVID-19

Goodreau SM, Pollock ED, Birnbaum JK, Hamilton DT, Morris M, on behalf of the UW Network Modeling Group

4/3/2020

1 The situation

COVID-19 is raging around the world, and you and your family have been asked (OK, told) to stay home and practice social distancing.

For the most part you are doing so, because you are good people.

But, you wonder—or perhaps, more likely, your kids wonder—**is there really so much harm in meeting up with just one friend?**

After all, there are all kinds of interactions still happening—between health care workers and patients, people in the food services industries and their customers, and so on. Why does one more matter?

This is a question we've heard a lot from our own friends and relatives.





To be clear, when we talk about “meeting up” here, we mean doing so in a way that doesn't carefully follow all the rules about social distancing. That is, you interact directly or at a distance of less than 6 feet, and/or you share various items between you without rigorous handwashing and disinfecting.

For many of the people asking the question, it seems particularly low-risk to meet up with a friend if neither one has an elderly person in their household, or someone else with a compromised immune system, given how concentrated the mortality is within those populations.

As network epidemiologists, this is our effort to explain why these connections matter more than they may seem.

Discovery in the World

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Editors' Choice: COVID-19 Roundup

by *the Editors* - March 17, 2020

The COVID-19 pandemic has prompted a range of reflections and resources related to digital humanities, especially on digital pedagogy, labor, data visualization, and online collections. We have collected some of them here, and we hope it serves as a useful resource for our readers.

Discovery in the World

12 AMAZING VIRTUAL CHOIRS TO COME OUT OF COVID-19

Tori Cook · Apr 06, 2020

[Learn more: choir management, member management, humor and inspiration](#)

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Community choruses are working to find new methods of bringing their choristers together during this pandemic. As we discuss opportunities to [build community](#), one common theme emerges — the concept of a virtual choir.

Virtual choirs are already starting to pop up everywhere — in our Facebook feeds, on YouTube, and almost hourly in our online choir forums.

They have, perhaps surprisingly, become somewhat of a controversial subject amongst choral leaders.

On one hand, virtual choirs are pretty cool and they are a great way to make music "together" in isolation.

Discovery in the World

A French chocolatier designed coronavirus-themed Easter eggs

Thomas Patte Mar 7, 2020, 4:15 PM



French chocolatier Jean-François Pré with his viral chocolates. DAMIEN MEYER/IFRIG/Getty

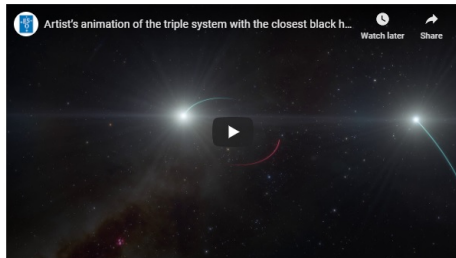
Discovery in the World

Astronomers say they've found the closest black hole to Earth

Don't worry, it's actually 1,000 light-years away

By [Loren Grush](#) | [@lorengrush](#) | May 6, 2020, 10:12am EDT

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Astronomers have discovered what they think is a new black hole, and if they're right, it's not that far away from Earth. At a mere 1,000 light-years away, the small black hole would be our cosmic neighbor — the closest one to our planet ever found.

Personal Discovery



Personal Discovery

- I've discovered just how much nature there is to explore and appreciate even though we are in the middle of a giant city.
- I'm better at baking than I thought, and I'm only getting better while this goes on.



Personal Discovery

- I am excited that I may be able to attend more conferences than I ever thought I would because they are going virtual.
- I've come to realize just how much I appreciate my office, my campus, and my face-to-face colleagues and students.



Personal Discovery



- I got to teach my 4 year old to read! Watching someone learn to read is AWESOME.
- I've realized anew how much I really do enjoy my kids, and also how Beautiful the inquiring mind is.

SOURCE



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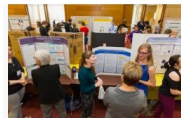
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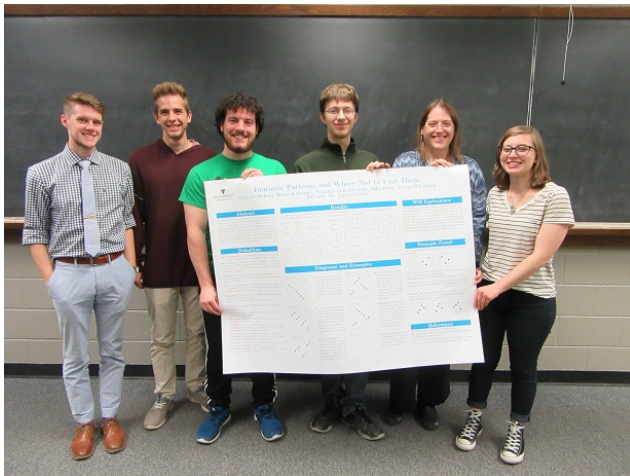
Undergraduate Research



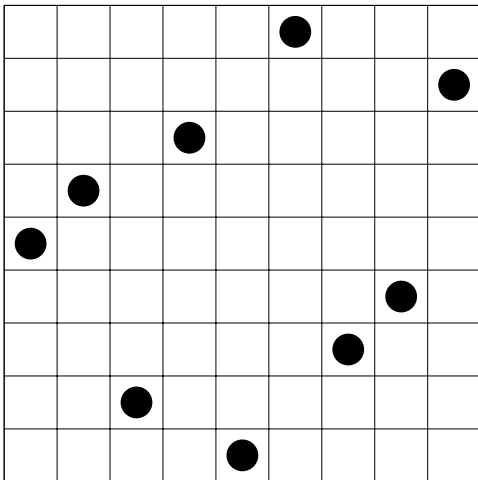
Undergraduate Research



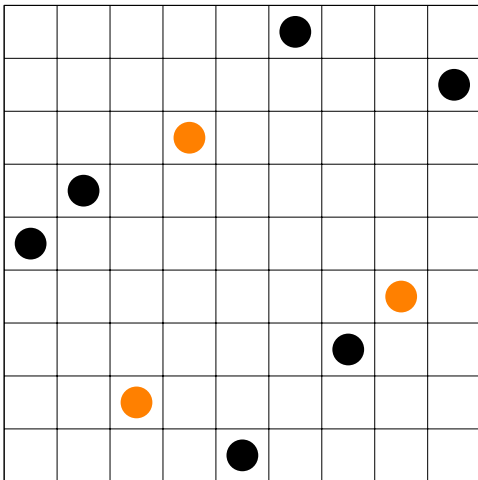
Discovery in the Discipline



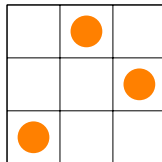
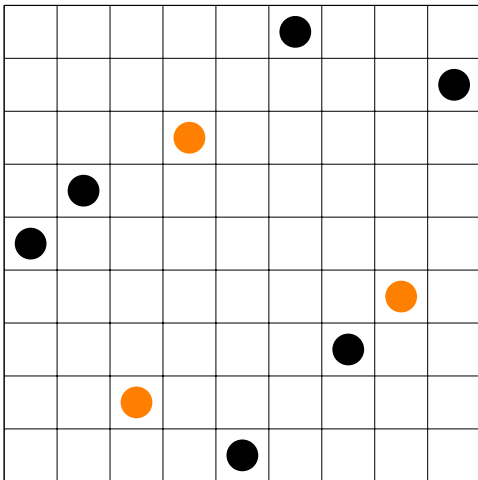
Discovery in the Discipline: Permutations



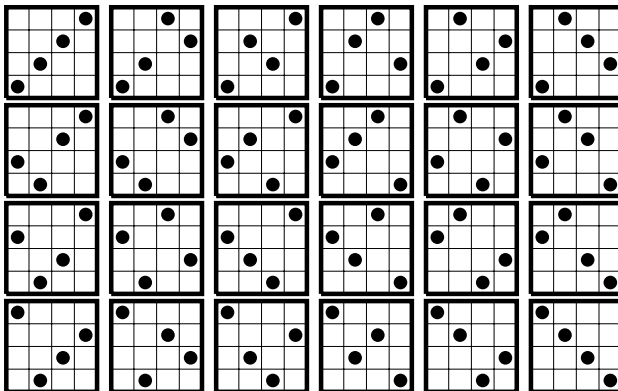
Discovery in the Discipline: Permutations



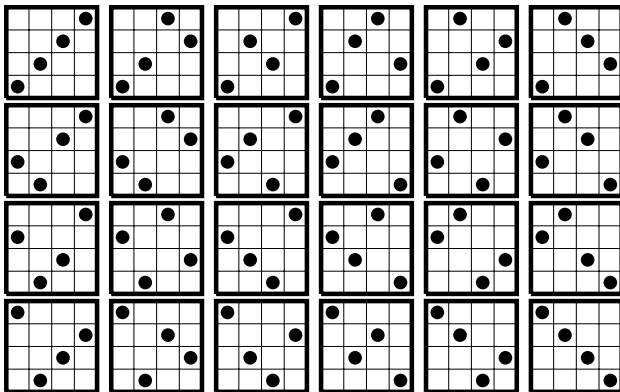
Discovery in the Discipline: Permutations





Discovery in the Discipline: Permutations

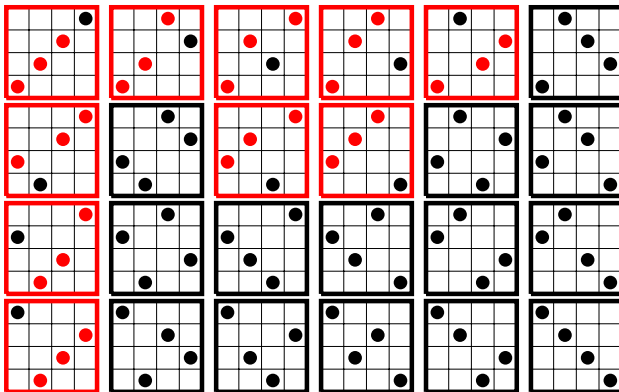


Discovery in the Discipline: Permutations



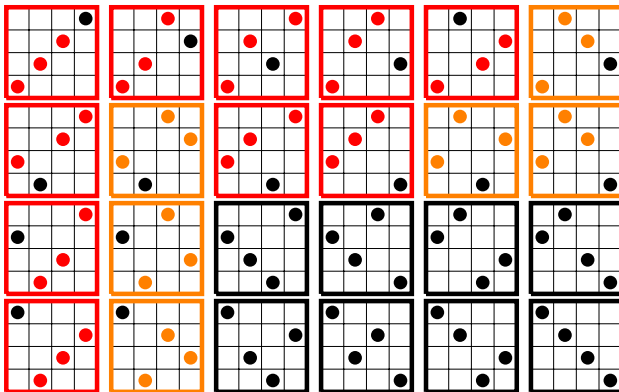
Which permutations have no  or  ?

Discovery in the Discipline: Permutations





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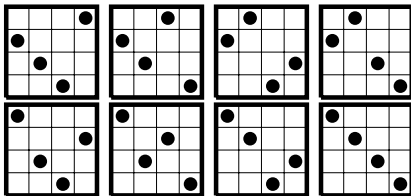
Discovery in the Discipline: Permutations





Which permutations have no or ?

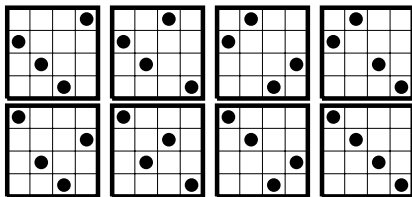
Discovery in the Discipline: Permutations

Permutations that have no  or 





Discovery in the Discipline: Permutations

Permutations that have no  or 





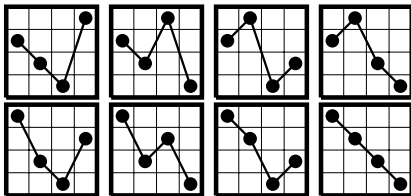
Theorem (Simeon and Schmidt, 1985)

There are 2^{n-1} permutations



of size n with no  or .

Discovery in the Discipline: Permutations



Permutations that have no  or 

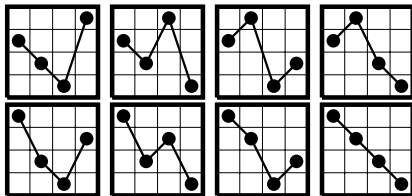


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Discovery in the Discipline: Permutations

Permutations that have no  or 



Theorem (Simeon and Schmidt, 1985)

There are 2^{n-1} permutations

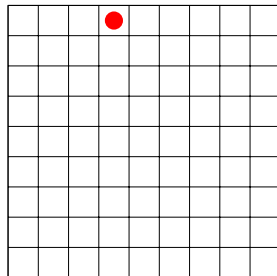
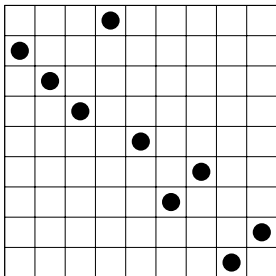
of size n with no  or .

How many expected...

- ascents? descents?
- peaks? valleys?

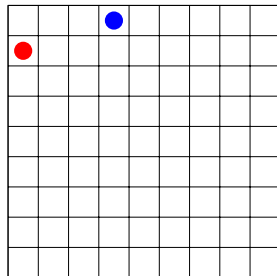
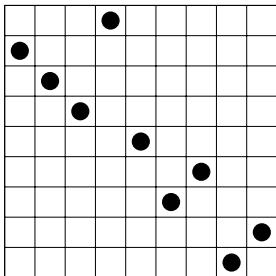
Discovery in the Discipline: Permutations

Shifting perspective...



Discovery in the Discipline: Permutations

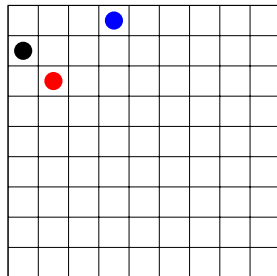
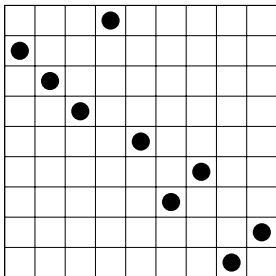
Shifting perspective...



L

Discovery in the Discipline: Permutations

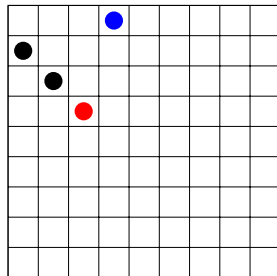
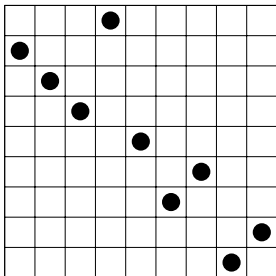
Shifting perspective...



LL

Discovery in the Discipline: Permutations

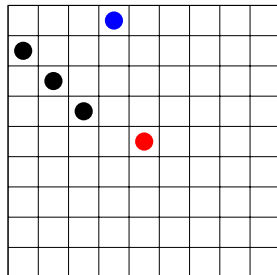
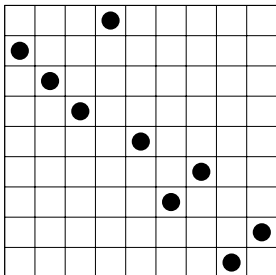
Shifting perspective...



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Discovery in the Discipline: Permutations

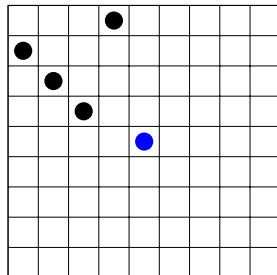
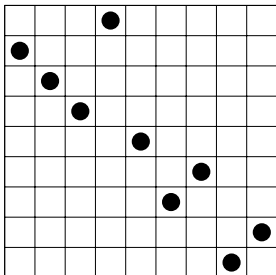
Shifting perspective...



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Discovery in the Discipline: Permutations

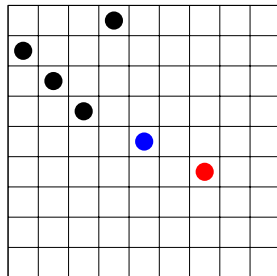
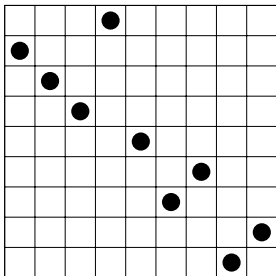
Shifting perspective...



LLLR

Discovery in the Discipline: Permutations

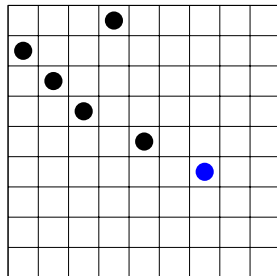
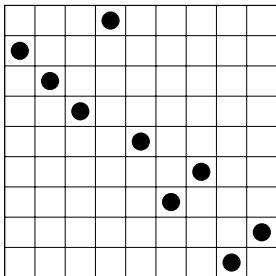
Shifting perspective...



LLLRR

Discovery in the Discipline: Permutations

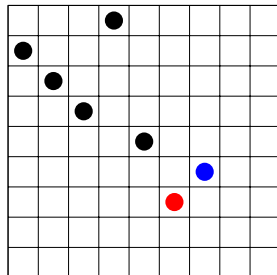
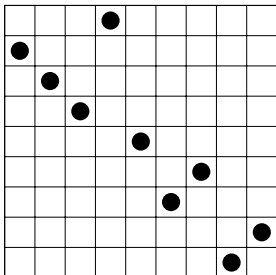
Shifting perspective...



LLLRR

Discovery in the Discipline: Permutations

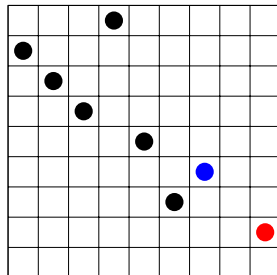
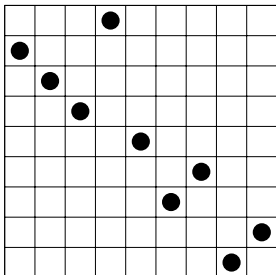
Shifting perspective...



LLLRRL

Discovery in the Discipline: Permutations

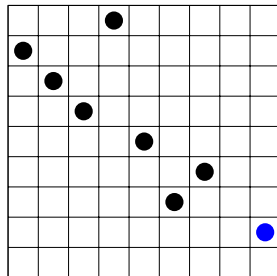
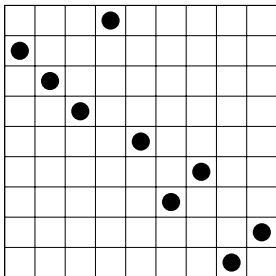
Shifting perspective...



LLLRRRLR

Discovery in the Discipline: Permutations

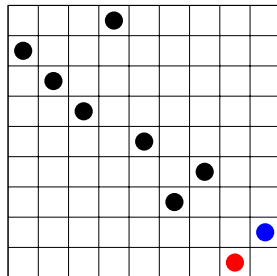
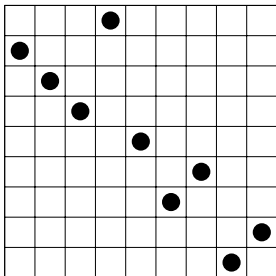
Shifting perspective...



LLLRRLR



Discovery in the Discipline: Permutations

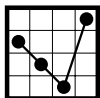
Shifting perspective...



LLLRRRLR**L**

Discovery in the Discipline: Permutations

Permutations that have no  or 



LLL



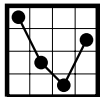
LLR



LRL



LRR



RLL



RLR





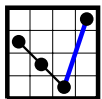
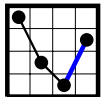
RRL



RRR

Discovery in the Discipline: Permutations



Permutations that have no  or 

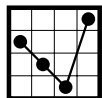
L^{LL}L^{LR}L^{RL}L^{RR}RL^LRL^RR^{RL}

RRR

- Number of ascents: (count initial L plus RLs)

Discovery in the Discipline: Permutations

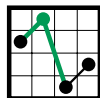
Permutations that have no  or 



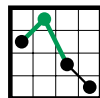
LLL



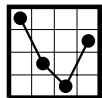
L LR



LR L



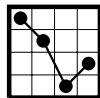
LR R



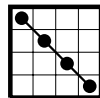
RLL



R LR



RRL



RRR

- Number of ascents: (count initial L plus RLs)
- Number of peaks: (count LR_s)

Results

Number of permutations of size n
with the given statistic equal to k

Patterns	Ascents	Descents	Peaks	Valleys
123,132	$\binom{n}{2k}$	$\binom{n}{2(n-k-1)}$	$\binom{n}{2k+1}$	$2 \binom{n-1}{2k}$
132,213	$\binom{n-1}{k}$	$\binom{n-1}{k}$	$\binom{n}{2k+1}$	$\binom{n}{2k+1}$
132,321	1, $k = n-1$ $\binom{n}{2}$, $k = n-2$	1, $k = 0$ $\binom{n}{2}$, $k = 1$	n , $k = 0$ $\binom{n-1}{2}$, $k = 1$	2, $k = 0$ $\binom{n}{2} - 1$, $k = 1$
213,231	$\binom{n-1}{k}$	$\binom{n-1}{k}$	$\binom{n}{2k+1}$	$\binom{n}{2k+1}$
213,312	$\binom{n-1}{k}$	$\binom{n-1}{k}$	2, $k = 0$ $2^{n-1} - 2$, $k = 1$	trivial

Discovery in the Discipline



Journal of Integer Sequences, Vol. 22 (2019),
Article 19.2.6

Distributions of Statistics Over Pattern-Avoiding Permutations

Michael Bukata, Ryan Kulwicki, Nicholas Lewandowski, Lara Pudwell,
Jacob Roth, and Teresa Wheeland

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Abstract

We consider the distribution of ascents, descents, peaks, valleys, double ascents, and double descents over permutations avoiding a set of patterns. Many of these statistics have already been studied over sets of permutations avoiding a single pattern of length 3. However, the distribution of peaks over 321-avoiding permutations is new, and we relate it to statistics on Dyck paths. We also obtain new interpretations of a number of well-known combinatorial sequences by studying these statistics over permutations avoiding two patterns of length 3.

Discovery in the Discipline



Advances in Applied Mathematics

Volume 105, April 2019, Pages 130-167



Counting consecutive pattern matches in $\mathcal{S}_n(132)$ and $\mathcal{S}_n(123)$

Ran Pan , Dun Qiu , Jeffrey Rammell

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<https://doi.org/10.1016/j.aam.2019.01.005>

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Abstract

In this paper, we study the distribution of consecutive patterns in the set of 123-avoiding permutations and the set of 132-avoiding permutations, that is, in $\mathcal{S}_n(123)$ and $\mathcal{S}_n(132)$. We first study the distribution of consecutive pattern γ -matches in $\mathcal{S}_n(123)$ and $\mathcal{S}_n(132)$ for each length 3 consecutive pattern γ . Then we extend our methods to study the joint distributions of multiple consecutive patterns. Some more general cases are discussed in this paper as well.

Discovery in the Discipline

Crossings over permutations avoiding some pairs of three length-patterns

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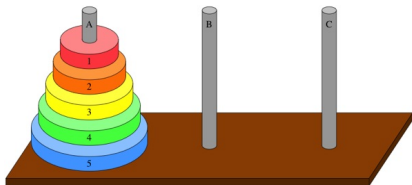
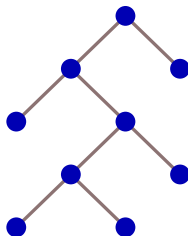
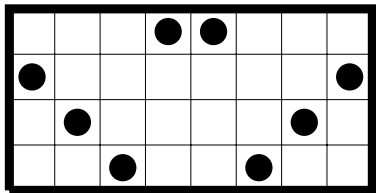
Abstract

In this paper, we compute the distributions of the statistic number of crossings over permutations avoiding one of the pairs $\{321, 231\}$, $\{123, 132\}$ and $\{123, 213\}$. The obtained results are new combinatorial interpretations of two known triangles in terms of restricted permutations statistic. For some pairs of three length-patterns, we find relationships between the polynomial distributions of the crossings over permutations that avoid the pairs containing the pattern 231 on the first hand and the pattern 312 on the other hand.

Keywords: restricted permutation statistic, crossing, generating function, combinatorial interpretations.

2010 Mathematics Subject Classification: 05A19, 05A15 and 05A10.

So many stories...



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Why Research?

Benefits of (Undergraduate) Research:

- Enhances student learning through mentoring relationships with faculty
- Increases retention and graduation in academic programs
- Increases enrollment in graduate education and provides effective career preparation
- Develops critical thinking, creativity, problem solving, and intellectual independence
- Develops an understanding of research methodology
- Promotes an innovation-oriented culture

from the Council on Undergraduate Research:

<https://www.cur.org/who/organization/mission/>

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Why Research?

Research is formalized
curiosity. It is poking and
prying with a purpose.

– Zora Neale Hurston



Personal Discovery

"Most importantly, I learned that math is collaborative. When doing research, math becomes a collaborative field where mathematicians are constantly pitching ideas to each other in hopes that together they can reach their goal."

"There is something so satisfying and rewarding about solving problems in a research setting. The results you come up with are novel; no one has ever done it before. Once you find a pattern and prove why it works, you have proven something that all mathematicians can use forever."

"I thoroughly enjoyed unleashing a new sense of self-motivation from the experience."

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Toward Lifelong Discovery, Inside and Out

What discoveries have you made...

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Thanks for listening!