

GSA COURSE BOARD

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2026

Boat US
Group Mbr
GA 81715 S
DSC GIN:
033801947



Commodore's Report

Tory Gibb

It is great to finally be out on the water. It would be even better if the weather could decide to stop putting the rain that we all need on Wednesday evenings. However, a bad day messing around in boats beats a good day doing almost anything else.

Our next big event is the Sock Burning this coming Saturday at Bowley's Marina. This is another great opportunity to socialize with fellow club members and even meet some new folks who might be interested in our activities.

We lost another sailor, Kirk Culbertson, last month. He raced in Glenmar with his father George for many years. He was one of the founders of the Downtown Sailing Center and the success of that organization is a tribute to his vision and hard work. The Downtown Sailing Center is holding a celebration of his life on May 31, starting at 2:00 PM followed by a gathering at the Little Havana restaurant.

A memorial service will be held for Bob Greenfield on June 10 at 10:00 AM at Emmanuel Episcopal Church, 811 Cathedral Street.
<https://www.legacy.com/us/obituaries/baltimoresun/name/robert-greenfield-obituary?id=61295553>

General membership meeting fourth Tuesday of the month, May 26 at Middle River Yacht Club. Doors open at 6:30.
Tory Gibb

Portsmouth Fleet Captain Bill Lammeree

Hello Everyone,

Here it is..... Finally, the time we have been waiting half a year for..... The start of the sailing and racing season.

If you purchased a trailer/boat parking permit at Rocky Point Park, you can now put your boat there. We have about 8 people ready to race on Thursday evenings. The Portsmouth Fleet races every Thursday evening, from 6pm until almost dark. That gives us time to get in 2 to 3 races, depending on the wind strength and course length.

I always like to invite everyone to come down to the park on Thursday evenings, to watch the racing. We start about 6 or 6:30, and race just off the point at the far end of Rocky Point Park. Just enter the park and keep going straight to the end of the road, and you will see us in the parking lot on the right, at the end of the road. We launch right there, and race just off the dock. The park has also made some nice improvements recently, which makes it even nicer to come down and watch some racing.

During April we had the Portsmouth Fleet Winter Dinner. That was a few months later than usual, but there were a lot of extenuating circumstances causing delays. Susan Davis hosted, and we had a nice time. About a month later, on May 9th, we had the annual Waffle Brunch, hosted by Sam Jackson. Belgian Waffles with fruit toppings and whipped cream, as well as other breakfast casseroles, which other people brought. Lots of good food and conversation.

Sam Jackson is our full-time race committee, along with a changing list of other volunteers, to help Sam with the RC chores of setting the marks and scoring the races. We use a power boat provided by BCSC, for the Race Committee. This year, the boat has received some upgrades which should make it very nice for Sam to operate. Primarily, the boat has been refitted with a brand new 50hp, 4 stroke engine. This replaces the older 2 cycle engine, which I think was about 25 hp. So, I'm sure Sam is looking forward to trying out the repowered race committee boat.

'Hope to see you at Rocky Point Park for the Thursday night small boat racing. If you arrive after 5pm, the entrance kiosk is closed and entry to the park will be free. Bring a chair and plan to sit close to the water to watch the racing. The wind is predominately from the South, which means we will be moving downwind with spinnakers, preparing to take down the 'chutes and gybe at the leeward mark, not too far from shore.

The first practice races are on Thursday, May 21st and 28th. The first series race is Thursday, June 4th.

Again, if you are interested in helping, please feel free to contact me.

Regards,
Bill Lammeree
Cap't. - Portsmouth Fleet 443-690-4104

Robert (Bob) Greenfield

May 29, 1925 - April 10, 2026

At 100 years of age, long time Emmanuel parishioner Bob Greenfield died peacefully in his sleep on Friday, April 10, 2026. His niece shared with us that he had a good day on Thursday, and enjoyed ice cream for dessert before turning in for the night. A memorial service for him will be held at Emmanuel on Wednesday, June 10 at 11am.

<https://www.legacy.com/us/obituaries/baltimoresun/name/robert-greenfield-obituary?id=61295553>

Robert Greenfield Obituary

Robert E. Greenfield, 100, passed away peacefully on April 10, 2026, at Roland Park Place in Baltimore. Bob was born in [Chicago, IL](#) on May 29, 1925, to Horace and Elizabeth (Bell) Greenfield. With his parents he moved to various places before settling in the [Rochester, NY](#) area. He graduated from the Harley School in 1943, served in the European theater of WWII, and then attended the University of Rochester, graduating in 1950. He also served in Japan in the Korean War after which he attended the University of Michigan where he received a degree in Library Science in 1952. After accepting a position with the Enoch Pratt Free Library, he came to Baltimore in July of that year. He served as a Young Adult Librarian and branch manager until 1961. After a short fling in the world of business, he accepted a position as a branch manager with the Baltimore County Public Library with which he served until his retirement in 1980. Following that he served as a Parish Administrator at Emmanuel Episcopal Church and as Executive Secretary of the Maryland Library Association, retiring once again in 1989. Since his retirement he traveled extensively, including several bicycle trips in Europe, Bermuda and Nova Scotia.

Bob lived in Bolton Hill and then Middle River before moving to Charles Village in 1980. While always interested in music his big interest (and reason for staying in Maryland) was sailing. He owned and skippered nine different sailboats, the last of which he donated to the Downtown Sailing Association. He also raced and cruised extensively during his periods of ownership and stayed active with the DSC and the Baltimore City Yachting Association. He was also a life member of the Glenmar Sailing Association for which he served as Commodore for three terms.

Volunteer activities included Meals on Wheels of Central Maryland, Citizen Review Board for Children and as a layreader and chaliceist at Emmanuel Church. His cultural interests included the Baltimore Symphony and Opera, Everyman Theatre, and both the Walters and Baltimore Museums of Art. For the past several years he had been an active member of the Renaissance Institute of the College of Notre Dame.

Bob was predeceased by his parents, his brother Bruce Greenfield, his sister Margery Greenfield and his niece Elizabeth Greenfield. He is survived by his nephew Mark Greenfield and nieces Jane Nierstedt and Mara Kelley and eight great nieces and nephews.

A memorial service will be held on Wednesday, June 10th at 11 am at Emmanuel Episcopal Church, 811 Cathedral Street, Baltimore. In lieu of flowers donations may be made to Emmanuel Episcopal Church and the Renaissance Institute.

George Kirkpatrick "Kirk" Culbertson

September 18, 1955 to April 21, 2026

The Downtown Sailing Center has lost a dear friend. On April 21, 2026, George "Kirk" Culbertson, who was affectionately referred to as "Captain Kirk," passed away. It is not an overstatement to say that, without Captain Kirk, there would not have been a Downtown Sailing Center.

In 1993, the DSC was founded as a non-profit community sailing center by a group of sailors who had all been members of a private sailing club in Baltimore. A leader and a motivator by nature, Kirk organized a founding board, raised seed money, and was instrumental in getting the DSC off the ground and on the water.

As a CPA, the end of tax season corresponded nicely with the beginning of the sailing season. So, Kirk just started to recruit folks from all walks of life to introduce them to the joy of sailing. Ultimately, when the limited budget could afford it, Kirk became the DSC's first Executive Director for an initial annual salary of \$10,000. As the sole employee, Kirk did everything from handle bookkeeping, marketing, scheduling as well as teaching folks how to sail well enough so they, in turn, could become sailing instructors.

As the organization grew, Kirk brought local and national attention to the DSC's progress and programming through his involvement in U.S. Sailing. This attention led to various awards and commendations from U.S. Sailing and the State of Maryland for the DSC and himself including:

- Best New Community Sailing Program, 1998
- Best Community Sailing Program, 2003
- USSA Community Sailing Director of the Year, 2004
- Mayor and City Council recognition resolutions, 2005
- Fox 45 MLK Champion of Courage, 2005
- 100 Black Women Award for Community Service, 2005

And, Kirk truly had a knack for capitalizing on an idea or opportunity when it presented itself. One example was when Steve Gross joined the DSC. Steve had never been on a boat in his life, but came down one afternoon to investigate. Kirk took him sailing, ultimately gave him lessons, and turned Steve into a true believer and eventually President of the DSC. One day, Steve, who had a brother with spina bifida, suggested to Kirk that the DSC should make sailing accessible so anyone, regardless of physical ability, could sail. Steve had the idea, but Kirk made it a reality. The two of them became a dynamic duo, leaving no stone unturned to make the DSC a national model for accessible sailing.

Kirk devoted more than 12 years of his life to the DSC. These were critically formative years, and Kirk wanted to make sure that the DSC was on solid footing, and could continue to move forward without him, before he stepped down in 2005. When he ultimately handed over the helm, it was difficult to imagine the DSC without Captain Kirk as a daily fixture to keep things running smoothly. So much of what we now take for granted at the DSC – Accessible Sailing, Thursday Night Racing, the "Ya Gotta Regatta", the Sailing Instructor Training Program (now known as the Young Mariners Institute), the Juniors Sailing Camp and the Cruising Education Program – all came about under the leadership of Captain Kirk.

As news of his passing was received by many of the DSC sailors from decades ago, the reaction was the same: "Captain Kirk made such a tremendous and positive impact on so many."

To our beloved Captain Kirk, as you embark on your next journey, remember to take the second star to the right, and straight on 'til morning. God Speed!

Over the years, Kirk also made generous donations to the DSC. In lieu of flowers, he asked for donations to be made on his behalf to the DSC. Celebration of Life is being planned and details will be forthcoming.

**Member at Large
Marisa Conner**

Mark Your Calendars:



**Glenmar Annual Sock-Burning and Nautical Tag Sale / Swap Meet
With Bowleys Point Yacht Club**

This year, Glenmar's 2026 Annual Sock Burning Party will be held in collaboration with the Bowleys Point Yacht Club on Saturday afternoon, **May 16, at Bowley's Marina, from 1:30 PM - 4:00 PM.**

Burn your socks at this event to welcome in the new season! We will also donate socks to a shelter, so please bring a package of new socks as well to donate. (Socks are one of the most needed items in homeless shelters.)

Bowleys Point Yacht Club and Glenmar will provide soda, beer, and wine, and burgers and hot dogs. Please bring a side dish or dessert to share. We will gather at the gazebos by the swimming pool.

Entertainment provided by the Ryzing Son Duo.

Bring those no longer needed marine parts and gear to sell, swap, or give away!

We will also have a brief remembrance of those members who have crossed the bar in recent years.

Please RSVP to Marisa Conner at conner.marisa@gmail.com

Come by Boat or land yacht.

Per Bowley's Management: [If you arrive via land yacht,] buzz the intercom at the gate, and the office will open the gate. Parking is an issue this time of year. The parking lot just inside the gate to the right should be open. Gravel lot next to the Chandlery building (Cinder block building – Clubhouse) The boats in land storage in this location are scheduled to launch on the 14th , so it should be empty.

Sailing: A Way of Life

How does sitting in a law class teach you how to sail?

Have your buddy tap you on the shoulder and say, "Let's cut this class and go sailing."

I had no idea how to sail, but the weather looked great, so off we went to my buddy's home on the Magothy River.

Sailing a Sunfish in a straight line was one thing – staying dry while turning was another challenge entirely. But after that day, I was hooked. I introduced sailing to the girl I was dating, Linda, and she quickly caught the bug too.

Not long after, Linda told me she was heading off for a semester at Chapman College's World Campus Afloat aboard the S.S. Ryndam. She traveled to South America, Africa, and Europe. With my first mate gone for several months, I decided to surprise her by building a 13½-foot sailboat.

When she returned in late spring, she loved it.

That summer was unforgettable. We both knew something special was happening between us. Then one day, while I was up on a ladder painting window frames, Linda looked up and said, "Are we getting married or what?"



Paisano Crew in Training

I climbed down and said, "First, we need to get you an engagement ring - and talk to your parents."

We were married on September 18, 1970, and spent our honeymoon sailing the Chesapeake Bay aboard a newly acquired 24-foot Columbia Charger - found, of course, by Linda in the newspaper. We traded the small wooden boat (and trailer) for something bigger and more comfortable. Before long, we had two daughters, and space started to feel tight.



S2 9.2 *Paisano*

After six years, we moved up to a Catalina 27, and then three years later, Linda found a brand-new 30-foot S2 at Maryland Marina. We sailed that boat for six wonderful years.

One night, after picking up a crab pot in the dark and having to swim under the boat to cut it free, I came home frustrated. Linda agreed: if I could find a full-keel boat with a protected prop and shaft, she'd consider another upgrade.

That spring, we bought a 1968 Morgan aft-cockpit centerboard sailboat. We spent 23 incredible years aboard her.



Morgan 40 *Paisano*

Eventually, we noticed how much boat design had evolved - wider beams, walkout transoms, and more modern layouts. Linda liked the Beneteau 423, and we gave it a try. It was a good boat, but something never quite felt right. After three years, we moved on and found our current boat, a Hunter 460.



Linda Gathwright

For the past 20 years, she has been everything we could have hoped for - she sails well, handles beautifully, rafts and entertains with ease, and keeps her crew comfortable and safe. When our daughters first saw the Hunter, they looked around in amazement and asked, "Why didn't we have this boat when we were growing up?" It was a fair question - and one that still makes me smile. Like most things in life, it took time to get there.

Unfortunately, life brought challenges beyond the water. Linda - my Admiral, first mate, and the love of my life - was diagnosed with Alzheimer's disease. Still, sailing gave us a lifetime of incredible memories with family and friends.

Linda passed away on June 19, 2025.

What remains are the memories - of the places we've been, the people we've shared them with, and the life we built together on the water.



I hope to see you all out on the Bay.

Clement Gathwright
S/V *Paisano*



Beneteau 423 *Paisano*



Cap'n Clem



Hunter 460 *Paisano*



Glenmar Cruise Raft-up, Circa 1980.
How many of these boats can you identify? How many of these boats do you remember?



Ez Fleet Captain Report

Michael Johns

Our first two races as an Ez Fleet are in the books. The first race was compromised by a fickle breeze and persistent rain but the RC was up to the task and they rewarded the 7 boats that started in week 1 with a short race. Week 2 brought more wind and no rain and 9 boats showed up. Hopefully the rest of our boats, including the newest members of our fleet, David Coleman of Flying Circus and Vance Hobbs of Sizzle will be out soon. It will be exciting, and demanding, having as many as 15 boats on the starting line.

Our scorer, Tom Calvert has also been up to the task using NextSailor and Ez to determine the results. Jordan, David and I have reported observed wind speed and course each week to Tom, smooth sailing so far. We are all learning what the Velocity Prediction Program (Ez) expects of our boats in different wind speeds and courses. It's interesting and revealing.

Looking ahead our Black Cat Pursuit Start Race is set for Friday July 10th.

We'll cap off this exciting new season with our AARP Series which begins on Wed Sept 23rd (my birthday) and concludes on Oct 28th.

It's shaping up to be a great year for Glenmar Ez Fleet Members.

Go Glenmar!



May 16, 2026: Save the Date!

**Bowleys Point Yacht Club
and
Glenmar Sailing Association**

*Invite you to the
2026 Annual Sock-Burning and Swap Meet*

MEMBERS AND NON-MEMBERS WELCOME!!!

**Saturday Afternoon, May 16, 2025
1:30 PM - 4:00 PM**

**Bowley's Marina
1700 Bowleys Quarters Rd**

**Bowleys Point Yacht Club and Glenmar Sailing Association
will provide soda, beer, and wine, and burgers and hot dogs
Please bring a side dish or dessert to share**

Entertainment: Duo Ryzing Son

**Burn your socks at this event to welcome in the new season!
We will donate socks to a shelter, so please also bring a package of new socks to donate.
(Socks are one of the most needed items in homeless shelters)**

***Bring those no longer needed marine parts and gear
to sell, swap, or give away!***

**Please RSVP to
Marisa Conner at conner.marisa@gmail.com (GSA)
or
Russell King at rking842000@gmail.com (BPLYC)**

GSA Nighthawk Series - 04/29/2026 - 09/09/2026

Race: 1

Ez (EZ PHRF 5 Winds)

[View Fleet Results](#) [CSV Export](#)

Start Time: 2026-04-29 18:50:00 Distance: 1.78nm Wind Speed: 5kts Course Config: Mostly Reaching - 5 Winds - VLight

Pos	Sail	Boat	Skipper	Rating	Fin. Order	Finish	Elapsed	Corrected	Sec/Mile Behind	Points
1	51128	Liquid Limit ii (S2 9.1)	david kozera	261	1	19:24:14	00:34:14	00:26:29	0	1
2	73051	Still a Gorilla (S2 9.1)	Tom Calvert (GSA)	269.4	2	19:24:48	00:34:48	00:26:49	11.2	2
3	USA 1339	Three Sheets (J/24)	Tim Myers	338.4	5	19:28:37	00:38:37	00:28:35	70.8	3
4	85	Split Decision (C&C 99)	Jordan Tacchetti	224.7	4	19:25:22	00:35:22	00:28:42	74.7	4
5	586	Kokomo Express (Goman Express 35 S.D.)	Eric Linder	191.3	3	19:25:06	00:35:06	00:29:26	99.4	5
6	63027	Shira Simcha (C&C / 27)	Sheldon Langsam	355.5	6	19:30:02	00:40:02	00:29:29	101.1	6
7	83267	Dream Scape (Catalina 30 MkII WK TMBS)	Robert Smith	363.2 467.1	7	19:34:14	00:44:14	00:30:23	131.5	7
DNC	63066	Something Wicked	Michael Johns							15
DNC	108	Blonde Stranger	Daniel Miller							15
DNC	53309	Deliberate	Bill Fannon							15
DNC	13	Tipsy Turtle	Glenn Dorris							15
DNC	246	LaBrAt II	paul scott(zapf)							15
DNC	63018	Expresswave	Ronald Link							15
DNC	43279 / 43279	Flying Circus	David Coleman							15



Treasury Report

Tom Calvert

GLENMAR SAILING ASSOCIATION, INC				
Category Description	2025 Proposed Budget	2025 YTD Actual 11/2025	2026 Proposed Budget	2026 YTD Actual
INCOME				
Income - General				
Courseboard Subscriptions	\$0.00			
Season's End Party	\$1,050.00	\$1,080.00	\$1,080.00	1095
Donations - Kids Fund	\$45.00	\$65.00	\$50.00	0
Donations - General Fund	\$70.00	\$220.00	\$200.00	240
Dues - Associate & Jr's	\$0.00			
Dues - Initiations (New Members)	\$240.00	\$130.00	\$130.00	355
Dues - Renewals (Present Members)	\$4,975.00	\$4,435.00	\$4,330.00	4125
Printed Roster Subscriptions	\$0.00			
Interest & Dividends	\$998.00	\$910.84	\$1,000.00	199.47
Misc. sundries	\$0.00			20
TOTAL Income - General	\$7,378.00	\$6,840.84	\$6,790.00	6034.47
Income - PHRF Racing				
PHRF Racing Dues	\$1,800.00	\$1,644.00	\$1,400.00	1215
N. Bay Regatta & Party				
Racing-CBYRA Sanctioned				
TOTAL Income - PHRF Racing	\$1,800.00	\$1,644.00	\$1,400.00	1215
Income - Portsmouth Racing				
Small Boat Regatta (Thistle Districts)	\$0.00	\$675.00	\$0.00	
Portsmouth Fleet Racing Dues	\$240.00	\$200.00	\$240.00	
TOTAL Income - Portsmouth Racing	\$240.00	\$875.00	\$240.00	
TOTAL INCOME	\$9,418.00	\$9,359.84	\$8,430.00	7249.47

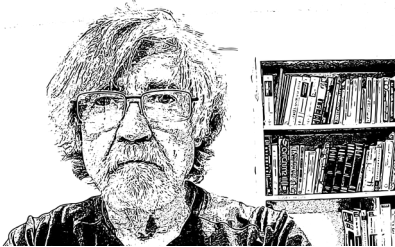
GLENMAR SAILING ASSOCIATION, INC				
<i>Category Description</i>	2025 Proposed Budget	2025 YTD Actual 11/2025	2026 Proposed Budget	2026 YTD Actual
EXPENSES				
Cruising				
Awards	\$150.00	\$0.00	\$100.00	
Cruise events	\$50.00	\$88.77	\$100.00	
Family cruise	\$100.00	\$0.00	\$100.00	
Winter meetings				
TOTAL Cruising	\$300.00	\$88.77	\$300.00	
Gen. Expenses - Social events				
Season's End Party	\$5,000.00	\$4,561.37	\$4,200.00	5004.64
Corn roast	\$200.00	\$0.00	\$200.00	
Entertainment for Meetings				
Meeting Cookout		\$0.00		
Meeting room (MRYC)	\$250.00	\$250.00	\$250.00	250
Printing Banquet Program		\$56.71	\$60.00	
TOTAL Gen. Expenses - Social events	\$5,450.00	\$4,868.08	\$4,710.00	5254.64

General Operating Expenses				
Bank charges			\$0.00	
Board Appreciation	\$300.00	\$0.00	\$0.00	
Dues US Sailing	\$250.00	\$250.00	\$250.00	260
Courseboard	\$0.00	\$0.00	\$0.00	
PayPal Fees		\$0.00	\$0.00	
Dues CBYCA	\$250.00	\$0.00	\$250.00	
Officer Flags				
Honors-Perpetuals				
Insurance	\$0.00	\$0.00	\$0.00	
Membership Drive - T Shirts			\$0.00	
Membership Renewal		\$52.68	\$50.00	6.35
PO Box	\$102.00	\$102.00	\$102.00	106
Office supplies			\$0.00	39.18
Postage	\$40.00	\$73.00	\$40.00	78
Rosters				
Storage	\$839.52	\$603.72	\$90.00	90
Burgees				
Web site				
TOTAL General Operating Expenses	\$1,781.52	\$1,081.40	\$782.00	579.53

<i>Category Description</i>	2025 Proposed Budget	2025 YTD Actual 11/2025	2026 Proposed Budget	2026 YTD Actual
PHRF racing				
Dues to CBYRA	\$250.00	\$250.00	\$250.00	250
Equipment	\$200.00	\$0.00	\$0.00	67.71
Print & Postage		\$14.60	\$0.00	
Promotion - Green Book		\$0.00		
EZ Certificates		\$995.00	\$0.00	200
Racing Committee		\$0.00	\$0.00	
Repairs&supplies	\$50.00	\$76.90	\$75.00	36.2
Social	\$200.00	\$529.66	\$500.00	114
Two New Racing Marks	\$0.00	\$0.00	\$0.00	
Race Seminar		\$0.00	\$0.00	
Trophies - GSA & CBYRA	\$900.00	\$1,040.96	\$500.00	1011.89
Yellow Book	\$0.00	\$0.00	\$0.00	
TOTAL PHRF racing	\$1,600.00	\$2,907.12	\$1,325.00	1679.8
Portsmouth Racing				
Committee		\$0.00	\$0.00	
Regatta (Thistle Districts)		\$1,012.37	\$0.00	
Repairs & supplies	\$200.00	\$0.00	\$460.00	
Social	\$100.00	\$0.00	\$100.00	
Trophies	\$200.00	\$95.03	\$100.00	
TOTAL Small Boat Racing	\$500.00	\$1,107.40	\$660.00	
TOTAL EXPENSES	\$9,631.52	\$10,052.77	\$7,777.00	7513.97
OVERALL SURPLUS or (DEFICIT)	-\$213.52	-\$692.93	\$653.00	263.03
Wells Fargo Checking Acct. Balance \$5438.36 (3/31)				
T.Rowe Price Bond Fund Balance \$11,346.10 (3/31)				
T. Rowe Price Money Market Fund Balance \$9,716.80 (3/31)				

Musings May 2026

narlin



Suppose aliens invade the earth and threaten to obliterate it in a year's time unless human beings can find the Ramsey number for red five and blue five. We could marshal the world's best minds and fastest computers, and within a year we could probably calculate the value. If the aliens demanded the Ramsey number for red six and blue six, however, we would have no choice but to launch a preemptive attack. - Paul Erdős

My topic this month, and very often, is combinatorics, which is simply the study of counting. What I like about combinatorics, and discrete mathematics in general, is that it primarily concerns integers. Paul Erdős might be the best known combinatorist. He was a Hungarian mathematician who died in 1996 after publishing about 1525 mathematical papers, a number that exceeds everyone except perhaps Leonhard Euler. I have mentioned before that if all of Euler's discoveries were named after him, nearly every theorem would be named Euler's theorem. More about Paul at the end.

So, I will try to tell you what a Ramsey number is. Most probably, I will fail, but here goes anyway. As part of the explaining, I first need to define a "graph". A graph in 2-dimensions, is one or more dots placed on a piece of paper, such that the dots do not touch one another. That's it. No other rules. For a mathematician, some dot(s) on plain paper constitute a graph, one dot, or two dots, or "n" dots on a page. If they do not touch, then we have a graph. If I connect the dots, the connecting line is called an "edge". (I like to do easy maths.) Also, then the dots, which are of course still just dots, are called **vertices**. Every discipline (especially sailors) like to use jargon. It helps to maintain an exclusive club. A **complete graph** is one where every dot is connected to every other dot with a line.

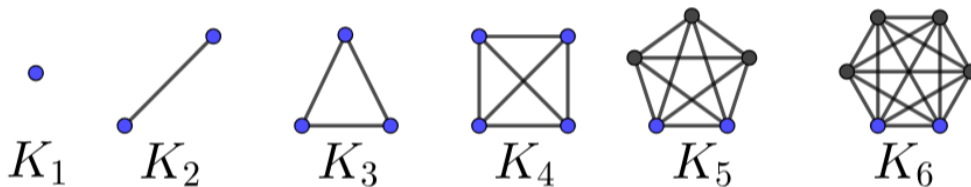


Figure 1: The figure shows the first 6 complete graphs. The subscript number indicates the number of dots. In the figure, K is just the traditional symbol. In German maths, we use vollständiger graph. Although komplett is a word, meaning complete, and Germans might say "komplettes Frühstück, mathematicians don't use it. I guess you have to be in the club!

So some wag comes along and decides to use two colors (red and blue) for the edges. He didn't get to draw the dots so they all remain black. Now we can color any edge red or blue. In fact, we decide that every edge must be either red or blue. Here is a picture of K_3 showing all the ways to color the triangle.

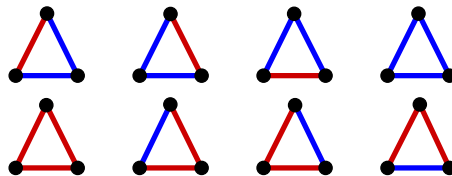


Figure 2: K_3 , colored red and blue. Eight ways to edge-color a triangle using red and blue. After rotation, the first 3 and the last 3 are alike. Thus there are really just 4 different colorings.

One of the interesting(?) things about the K_3 triangles is that they all have at least one vertex (dot) which is connected to either two blue or two red edges. Now we get fancy. We will call any two connected dots a **clique**. In particular, two connected dots make a 2-clique. It's exactly like they are friends. But within the 8 triangles shown, there are two special triangles; one is all blue and the other is all red. In those instances, we have a 3-clique. That is 3 dots are all friends. An n-clique is a group of friends such that everyone has an edge to everyone else – i.e. a complete graph. Isn't maths cool!

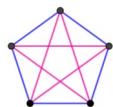
So two dots sharing an edge is a 2-clique. Three dots that form either a blue triangle or a red triangle is a 3-clique. Four dots with the same color edge would make a 4-clique, but I have looked on ahead and that will get way too hard, so for now (possibly forever) we will stop with a 3-clique. A 3-clique is a complete graph.

Finally, we come to a hard question. ==>
And the answer to the question is named a **Ramsey Number**.

What is the smallest (least number of dots) complete graph that must always contain an n-clique?

So we are asked for the least number of dots such that always “n” of them are friends, and to be friends means that the “n” of them are all connected with a single color, either red or blue. I will ignore n=1. It is trivial, but hard to think about because there is no edge. Now what about n=2. Well if we have 2 dots, then I can color its single edge red and I have a 2-clique. Of course I could color its edge blue and still have a 2-clique. Clearly, any number of dots greater than 2 would also work, so 2 is the least number. It is the **Ramsey Number** to assure a 2-clique. I am ignoring the exclusive club notation because for this purpose it's not worth the trouble to explain.

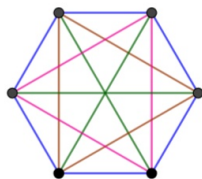
So what about an n of 3. That does not mean 3 dots in the complete graph. It means “*What is the least number of dots for a complete graph that must always contain a 3-clique?*” Well, what about a triangle? It certainly can contain a 3-clique, but we colored 8 triangles and 6 of them did not have a 3-clique. So K_3 is not the Ramsey Number for n=3. What about K_4 ? I can easily show by counter example that K_4 doesn't have to have a red or blue triangle in it. Just make a square of the 4 dots and color the sides red and the top and bottom blue. The diagonals can be either color. Done, 4 dots, 6 edges, and no red or blue triangle. Well, what about 5 dots? In the complete graph we must connect all the dots to all the other dots. But can we do that with red and blue and not make a triangle? Sure.



Make a pentagon (5 dots). Color the outside blue and internally connect the dots with red. No 3-clique. (Crossing edges with no dot do not constitute a triangle.)

I can win with 6 dots. With six dots and a complete graph, there will always be a red or blue triangle. But how many edges exist in a K_6 complete graph? The answer is 15. Here is a simple combinatoric formula.

$$\text{Number of edges} = \frac{\text{dots}(\text{dots} - 1)}{2}$$



Here is the K_6 . Count the edges if you want. I have colored them into 6 blue, 3 green, 3 red, 3 brown because they are already getting tough to count. No matter how hard you may try, and using only 2 colors, there will always be a 3-clique (monochromatic triangle) of either red or blue.

Before going any further, it rather makes sense to ask “How many ways are there to color the edges of an n-complete graph (i.e. K_n) with two colors”? If the dots were labeled, (I didn't label 'em.) then the combinatoric answer is merely 2 raised to the power of the number of edges, which would quickly be a big number. For instance, $2^{15} = 32768$. Which sort of accounts for my not showing you all the ways to color K_6 . But you may foresee that some of the colorings are really just rotational duplicates (isomorphs) and shouldn't be counted. I don't have a non-club-exclusive word for removing those duplicates, but in the club it is called “up to isomorphism.” When we calculate that way, the number of colorings is divided by n! (Sort of! But mostly no!). In fact the counting method works really well for n=1 and 2 and 3. It fails at n=4 and all thereafter.

The question I am trying to answer is “How many ways are there to color the edges of an n -complete graph (i.e. K_n) with two colors?” Below is what I am currently counting. I am not showing any formulas because I don’t understand them. I can write a program, but cannot explain how it works.

For a graph of 3 vertices (that’s a triangle), there were only 4 different edge 2-colorings up to isomorphism (figure 2).

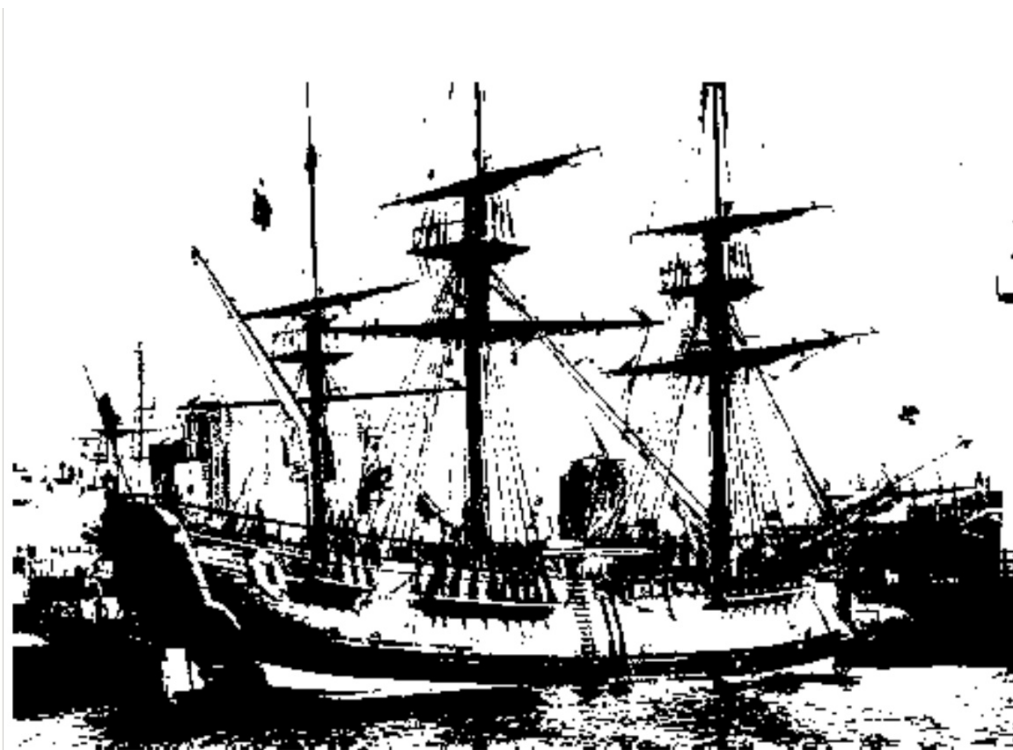
For a graph of 4 vertices (that’s a square), there are only 11 different edge 2-colorings up to isomorphism. I described a counter example as proof that 4 vertices cannot be a Ramsey number.

For a graph of 5 vertices (a pentagon), there are 34 different edge 2-colorings up to isomorphism. I drew a counter example in the margin to show that a complete graph on 5 dots can be drawn using 2 edge colors with no monochromatic triangles between dots.

For a graph of 6 vertices (a hexagon), there are 156 different edge 2-colorings up to isomorphism and I made no attempt to draw them. It is possible, albeit lengthy, to understand why there must always be a monochromatic triangle in each and every one of the 156 different colorings. Further, that remains true for all graphs with more than 6 dots. Ergo, the Ramsey Number which guarantees a 3-clique is 6.

Here is the **big deal**. What is the Ramsey Number that guarantees a “complete graph” 4-clique? The answer is 18. It takes 18 dots on a page with all of them connected to all of the others in order to assure that no matter how you color the edges with red and blue that you will absolutely, always create a monochromatic 4-clique. You cannot color it without creating that square+X. **Paul Erdős** proved that.

And a Bonus. The Ramsey Number that guarantees a 5-clique is unknown.



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