

## Newsletter No. 47

September 2005
In our June 2002 issue we mentioned the movie $A$ Beautiful Mind about the mathematician John Nash. There have been a few other movies touching on mathematics and at least one play. Proof is not a movie yet, although John Madden is to direct a film version starring Gwyneth Paltrow, it's a Tony and Pulitzer winning play by David Auburn and has been showing in London and Boston, to name just a couple of places. Three of the four main characters are mathematicians, one of them John Nash, but the story is fiction and takes a different path from A Beautiful Mind. The plot centres round attempts to prove things like theorems but also others like authorship and emotional issues. In particular the play asks if proof-checking can ever be an act of love since it can be destructive, attempting to demolish someone else's creation. What if you love the creator? Is it better to trust their judgement or to seek the truth and resolve any doubts? There is a musical play on a related subject, Wiles' proof, called Fermat's Last Tango. Apparently it features songs like 'There's a Big Fat Hole in your Proof' and 'Math Widow'. The play is available on VHS video tape and DVD from the Clay Institute.

There is also the CBS TV series, some of which you may have seen here, called Numb3rs. It concerns a mathematician who helps his brother, an FBI agent, solve crimes. One of the stories was about someone getting ready to announce a proof of the Riemann hypothesis when his daughter was kidnapped. Serious maths questions are woven into the plots.

But the all-time best mathematical cartoon must surely be the Walt Disney "Donald Duck in Mathmagic Land". If you haven't seen it you've missed a treat and it's a treat that your students might well enjoy too. How about something for the last couple of weeks of term 4 ?

Moving away from maths, the Charles Babbage Institute at the University of Minnesota has a list of movies featuring computers called, 'Hollywood and Computers'. I'm not sure how complete it is but there are 42 movies on their list.

This being Issue 47 of our newsletter reminds me, apropos of nothing in particular, that 47 is the quintessential prime number and there's even a society to look at and promote its uniqueness. It's called The 47 Society and you can find it at http://www.47.net/47society/ By the way, did you know that $47+2=49$ and $47 \times 2=94$ ? Not only that but 47 is called by some a self-conscious number because $4+7=11,7+11=18,11+18=29$ and $18+29=47$. There are three smaller self-conscious numbers. Can you find them? (Answer below).

One more thing while I'm about it and that is the monthly problems that we have. I'd just like to remind you that each month we offer a prize of $\$ 50$ in book vouchers for the person who sends in the best answer to our Problem of the month. This is an open problem and can be tackled by anyone, staff or students who is not related to one of this web site's workers. Now I have to say that if you send in an answer, your chances of winning are very high. We rarely get as many as 10 solutions sent in. If you have a bright child, student, fellow teacher or if you think that you can crack it yourself, then send in your attempt at this month's problem. If you are working with prospective teachers let them know about the problem, it might help them to buy that book that they always wanted.

But that's not the only problem we have. There is also a monthly junior problem for anyone up to Year 8. If you have a student or two in your class who you think might be able to do the problem or might be challenged by it, or a grandchild who likes books, then tell them what it is and how to send the answer in. We're eagerly looking to give away a $\$ 20$ book voucher to the winner. So go straight to the monthly problems and worry about the rest of the newsletter later.

Whereas a classroom is a place of social interaction, the space in front of a TV screen is a private preserve.

Neil Postman

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27-30 September. 2005: NZAMT Conference to be held at Christ's College, Christchurch. For more details check the website www.nzamt9.org.nz/.

## Weird object

Some of us here enjoy the Antique's Road Show. From time to time they have a weird object that is hard to believe has any use at all but turns out to be surprisingly useful. We thought that we'd try one on you this month.

What is this? I'm afraid that there are no prizes but we'd be interested in your ideas.
You would do well to read the object very carefully for clues. Hopefully there is enough information there plus all the unwitting hints that we've given you in the past, to be able to pull off a miraculous feat of detective work.


## Top Gear

Getting back to the media, you've all probably heard of the TV programme Top Gear. I have to say that it's more of a hit with the ladies in my family than the males but even so we all enjoy it. Maybe the sex appeal of the hosts makes all the difference. Wouldn't you just love to pick up little Richard and carry him home?

Anyway it has occurred to us that we should test drive a few theorems or pieces off of the Number Framework. Or perhaps you could send in the most stupid piece of maths that you've ever seen.

Something else I've talked about is having a Cool Board. What maths would you put on your Cool board? Why is it cool? Because Jeremy says so?

## Games

In this piece, Alice and Blair are playing special types of games. In these games both players have complete information - they know all the moves that have been made and all the moves that could be made. They also play as well as they can. The question is is there a strategy for either player that will enable them to win the game?

Let's start off with Noughts and Crosses with Alice playing noughts. Where should Alice play in order to be sure of winning? Failing that, can she play so as not to lose?

If we are going to analyse this game, the first thing to notice is that Alice essentially has only three different squares to put her nought. This is because any two squares on the board below that have the same number are essentially the same. You can see this by turning the board round through $90^{\circ}$, clockwise or anti-clockwise, or though $180^{\circ}$.

| 1 | 2 | 1 |
| :---: | :---: | :---: |
| 2 | 3 | 2 |
| 1 | 2 | 1 |

So Alice essentially has three moves to experiment with. Suppose she puts a nought in a cell numbered ' 1 '. Using symmetry again, this leaves Blair with 5 options (see the picture below).

| O | 1 | 2 |
| :---: | :---: | :---: |
| 1 | 3 | 4 |
| 2 | 4 | 5 |

If Blair moves anywhere except the centre position he is doomed. In all but option 4, Alice can win by using three corner squares to force Blair into a double threat. (One of these is shown below.) With option 4 Blair still isn't safe - Alice uses two corner squares and the centre square. Blair will then have to block the double threat from Alice's three noughts.


If Blair takes the centre square as his first option, then he can force a draw. In fact he can get the same result by playing carefully to either of Alice's other two possible opening moves.

So, if two players are playing well, then they have to draw Noughts and Crosses. But what if we only use noughts, and all noughts are the same? So the game now is just Noughts, with both players playing identical noughts, and a player winning if that player puts the third of three noughts in a row. Is this a forced draw?

Think about it for a moment. Isn't it clear though that Alice must win? She goes straight to the centre square. With a nought there, Blair can only put a nought next to Alice's first one. Then Alice can make three noughts in a row on her second turn.

What if we move to a four by four board like the one below? Does Alice have a winning strategy now?


Alice can in fact win now by playing in one of the centre four squares or a corner square. Look at a centre square play. In the picture below we have put a dash in a square where Blair can't play without losing. Blair has a move on a non-dashed square but his move creates another dash. This leaves Alice with one move before the board is covered with noughts and dashes. Blair then has no move.


The next question is what if we play Noughts on a five by five board? Does Alice still win? Why don't you try it out? Then what about a six by six board, and so on?

You might like to know that adults play these kinds of games for research. They are called Combinatorial Games. Books have been written about them and there is still a great deal to learn.

## Solution to August's problem

Last month we asked this. What is the smallest whole number that when you change any one of its digits to any other, the result is not prime? For example, the number is not 27 since you can replace the 2 by 3 giving 37 which is prime. Similarly, the number is not 54 since you can replace the 4 by 9 giving 59 which is prime

A little trial and error will tell you that you are looking for a consecutive batch of ten whole numbers, beginning with one that has last digit 0 , in which (i) no primes occur or (ii) just one prime occurs.

If condition (i) applies, then changing the last digit does not produce a prime and changing any of the others won't, if the last digit is even for example. If condition (ii) applies, then changing the last digit of that prime changes it to a non-prime. Changing any of the other digits may or may not give a prime and that needs investigation.

There is only one prime in the nineties, 97 , but changing the 9 to a 4 gives the prime 47 . There is only one prime in the one-twenties, 127, but changing the 2 to 0 gives 107 which is prime. There is only one prime in the one-forties, 149, but changing the 4 to an 0 gives 109 which is prime. There is only one prime in the one-eighties, 181, but changing the 8 to a 0 gives 101 which is prime.

The first batch of ten we are looking for without a prime is in the 200s, i.e. 200 to 209. Look at 200. Changing the last 0 to any other digit does not give a prime. Changing any of the other digits leaves a number ending in 0 which is even and not prime.

Hence, the answer to the problem is 200.
We had no answers to this question. Don't let this happen again.

## This Month's Problem

The surface area and volume of a certain cube have the same number of digits. If the length of the side of the cube is a whole number and all its digits are the same (there must be at least two digits) find that length.

We will give a petrol voucher to one of the correct entries to the problem. Please send your solutions to derek@nzmaths.co.nz and remember to include a postal address so we can send the voucher if you are the winner.

## Last Month's Junior Problem

In order to get a few more entries this month, we'll move away from the Post Office. This month we'll give a $\$ 20$ voucher for a solution by a student up to Year 8 to the next problem.

Twenty rectangular tiles are laid out in the 4 by 5 array shown below.

|  |  |  |  |  |
| :--- | :--- | :--- | :--- | :--- |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Now 8 of the tiles are red and the rest are blue. What percentage of the tiles are blue?
The solution (of 60\%) that we liked best was sent in by Andrew Simpkin, Room 3, One Tree Point School, Ruakaka. Congratulations Andrew.

## This Month's Junior Problem

Alice and Blair took two 1 litre containers and filled them with a mixture of water and orange juice. In the first container the ratio of water to juice was 2 to 1 and in the other container the ratio was 3 to 1 . They then put the combined mixture into a 2 litre container. What was the ratio of water to juice in the mixture in the 2 litre container?

To put a claim in for the $\$ 20$ book voucher, send your solution to Derek at derek@nzmaths.co.nz. It would help to have your school address, and teacher's name added to the message. Let's have a bumper entry this month.

## Afterthought

The three smallest self-conscious numbers are 14, 19 and 28.

