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Ormiston Pairs

ANDY EDWARDS

Once students understand what a prime number is and how to resolve composites into their prime factors, an ocean of number theory lies before them. It is an enchanting place, infinitely wide and stretching to the farthest horizon as well as being infinitely deep.

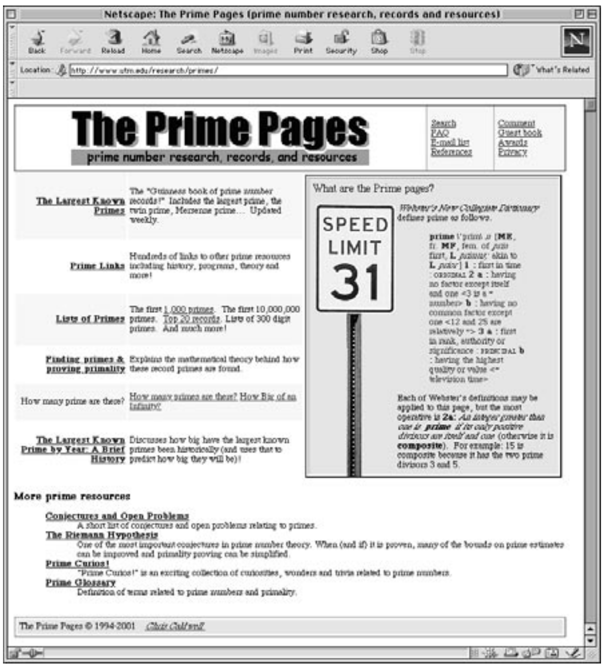
However, most of our educational efforts concentrate on teaching our charges how to swim — or at least stay afloat — in it. Later we take our most proficient swimmers and focus on teaching them to navigate the major shipping lanes, even though we know how seldom these skills will be useful to them. This is sad, when, for many students, an intrinsic interest lies in just surfing in the ocean of number theory, or sailing off to the coast of some unknown island. They know that there are places they can be the first to visit — and they want to be the first to visit them.

When I mentioned to a class that the prime numbers get scarcer as we travel out along the number line, enough interest was created for me to find a little investigation so that they could make a few discoveries of their very own. A quick visit to the small primes Internet site (at http://www.utm.edu/research/primes) swiftly produced a list of the first 10 000 primes (and later, the first 10 008!) Before their very eyes the students saw that the first 1000 integers contained 168 primes, whereas there were only 106 between 10 000 and 11 000 and only 81 between 100 000 and 101 000, supporting the earlier claim.

I defined a type of prime pair — Ormiston Pairs for want of a better name — and gave everyone a piece of paper closely printed with about 600 primes. We went hunting.

An Ormiston Pair consists of two successive prime numbers, P_n and P_{n+1}, whose digits are the same but in different orders (obviously!). The primes 137 and 173 satisfy the second condition but not the first, as 139, 149, 151, 157, 163 and 167 intervene between them on the prime list. They are not successive and so are not an Ormiston Pair.

The hunt had not been going on for very long before someone suggested that only the last two digits really mattered. Not quite true, but a pretty



List of five and six-digit Ormiston Pairs

(34613, 34631)	Jack Townsend
(85313, 85331)	Helen Masters
(35617, 35671)	JT
(88379, 88397)	Kerry-Lee Crouch
(35879, 35897)	JT
(90379, 90397)	Nigel Pinto
(37379, 37397)	HM
(90679, 90697)	NP
(37813, 37831)	HM
(93113, 93131)	NP
(40013, 40031)	Kai Gorman
(94379, 94397)	Chris Male
(40213, 40231)	KG
(97213, 97231)	CM
(45613, 45631)	David Sweatman
(123379, 123397)	Ian Jackson
(48091, 48109)	Daniel Kilkeary
(124213, 124231)	IJ
(49279, 49297)	DK
(126613, 126631)	Rick Lord
(51613, 51631)	Melinda Howells
(131713, 131731)	RL
(55313, 55331)	Suraya Saleh
(140779, 140797)	KG
(56179, 56197)	SS
(145091, 145109)	KG
(56713, 56731)	SS
(147179, 147197)	KG
(63079, 63097)	Qing Jin Chan
(163679, 163697)	NP
(63179, 63197)	QJC
(164513, 164531)	NP
(65479, 65497)	James Stopa
(215279, 215297)	JS
(66413, 66431)	JS
(216379, 216397)	JS
(74779, 74797)	KG
(293413, 293431)	KG
(75913, 75931)	Tim Smith
(392113, 392131)	KG
(76213, 76231)	TS
(393779, 393797)	KG
(76579, 76597)	TS
(399079, 399097)	Kris Peterman
(76679, 76697)	TS
(400579, 400597)	KP

handy rule of thumb, especially when combined with the next observation. Someone else said that unless both tens and units digits were odd, you could not get two prime numbers by reversing them.

Within a few minutes, we had a list of terminal pairs 'worth checking'. In order of worthiness these were …13 & …31; …79 & …97; then …37 & …73; …17 & …71; …39 & …93; then …19 & …91. This last one was not considered very likely as the space between the successive primes would have to be 72, but it was conceded that this was possible and it did lead to the inspired comment that …091 & …109 offered good potential and only needed to be checked once per thousand.

The hunt proceeded much more quickly after these observations and produced confirmation that the first two Ormiston Pairs were [1913, 1931] and, surprisingly, [19013, 19031]. It also produced, thanks to the students cited, the accompanying non-exhaustive list of five- and six-digit Ormiston Pairs.

There are plenty more openings for research about this class of numbers with or without computer assistance. They can be devised to suit all levels from about grade six onwards. Here are a few examples:

Helen Masters' first pair uses only three distinct digits. Is it possible to find a pair that uses only two? If so, what is the smallest such pair?

Do Ormiston Triples exist? (e.g. …019, …091, …109) What is the smallest Ormiston Triple — if it exists?

Does the number of Ormiston Pairs per thousand increase, decrease or remain stable as the numbers get higher?

By the way, just in case you are wondering what the use of all this is, you are right to wonder. It is not 'useful': just interesting. As teachers of the oldest subject in the civilised world, we have a duty to be as interesting as that subject makes it possible to be. Sometimes, that duty can be a joy both to our students and to ourselves.

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Editorial note: What interesting things are you doing in your classroom? Why not submit your classroom discoveries to the *AMT*?