Miscellaneous applications

① Credit card numbers

Suppose you have some sort of number and you want to be able to detect the kinds of errors which may occur when a person writes it down or types it in.

Suppose these numbers are made of decimal digits and we want only one check digit.

The first choice would be a simple "parity" bit

ie

.
.
.

eg 2 1 3 7

So the sum is always $\equiv 0 \mod 10$

This can detect any 1 error

But this can't detect

So instead

eg 2 1 3 7

So given a number $a_1 \ldots a_{n+1}$ formed this way if you apply the alg to the whole thing but with weight 1 at the right then you will get 0

This can detect any single error
and most swaps of adjacent digits
The only one it can't detect is
$\ldots 0\ 9 \ldots \quad \ldots 9\ 0 \ldots$

So why did we do step 2?

This encoding is called LUHN-10 and is used in credit cards and many other kinds of id or account numbers (eg in your SIN)

Bank cards and credit cards have slightly more structure. The first 6 digits encode the issuing bank/company. The last digit is the Luhn check digit. The middle identifies the account.

Sources:
http://www.ee.unb.ca/tervo/ee4253/luhn.shtml
http://en.wikipedia.org/wiki/Credit_card_number

(2) cell phones and digital TV

Cell phones and digital TV have similar constraints. They want to transmit data that will be interpreted by human perceptual systems using as little bandwidth as possible (the whole move to digital TV was to free up bandwidth)

As a result they don't use error correction or detection, rather they use compression. Specifically lossy compression designed to take into account human visual and auditory perception (so we don't worry about losses in features humans can't perceive, and are most interested in preserving

features that are very salient to us)

Modern cell phones use linear predictive coding which very roughly

Modern cell phones also have

Digital TV uses MPEG-2
When the signal gets excessively degraded you will see it degrade into squares and pieces of it may freeze

This coding uses many tricks including

Sources:
http://en.wikipedia.org/wiki/MPEG-2
http://en.wikipedia.org/wiki/Linear_predictive_coding

③ ECC memory

Does the RAM in your computer have error correction or detection? Probably not unless you specifically got some but your hardware may support it.

Some memory is parity memory which

Other memory is ECC memory. Usually this means

Sometimes (!!!)

Why

Most home computers don't use memory with either error correction or error detection. Why? because modern memory is (in theory) very unlikely to make an error, and in many applications it doesn't much matter anyway (eg might crash but just restart) and it costs more and is slower.

However recent large scale studies of computers in real world situations have shown many more errors occur than theory expected.

So you probably have some correctable errors each month, and perhaps we will see more ECC memory in the future.

Sources:
http://www.cs.toronto.edu/%7Ebianca/papers/sigmetrics09.pdf
http://en.wikipedia.org/wiki/ECC_memory

(4) What should you take next seneste

341 – groups – Imin Chen

343 – applied discrete – me

3811W – topics in classical and moden analysis – Tom Archibald

MACM401/MATH701/819 – Compute algebra – Mike Monagan

440/740 – galois – Imin Chen

445/745 – graph theory – Luis Goddyn

467 – dynamical systems – Weiran Sun

495 – prob and stochastic DEs – David Muraki

821 – combinatorics – me

843 – analytic + diophantine NT – Nils Bruin