MAS115: Week 8 activity

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<h1>Brainteasers</h1>

<p>Here are some fun brainteasers. The solutions can be found on <a
href="http://sam-marsh.staff.shef.ac.uk">Sam Marsh's homepage</a>.</p>

<h2>The problem with hats</h2>

<img src="hats.jpg">

<p>There are 100 prisoners stood in a line, each with either a black or a white hat
on. Each person can see everybody else's hat, but not their own. One by one,
moving down the line, they have to say one word - either black or white. If the colour
they say matches that of their hat, they survive, otherwise they die.</p>
<p>Now, the people were allowed to devise a strategy before being given the hats.
The question is, what's the best strategy to pick? In other words, <strong>how many
people can you save?</strong></p>

<h2>The pigeon-hole principle</h2>

<img src="pigeon.jpg">

<p>The pigeon-hole principle is the following statement.</p>
<p><em>If there are more than n letters to be placed into n pigeon-holes then some
pigeon-hole will contain more than one letter.</em></p>
<p>Here's a statement which looks like some difficult number theory, but just comes
down to the pigeon-hole principle.</p>
<p><em>Let n be any positive integer. Show that there exist two different powers of
n whose difference is divisible by 1000.</em></p>
<p><strong>Can you prove it?</strong></p>

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