The relevance of the Chinese Lotto: 25 years outsourcing of cryptanalysis

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1. **NSA NEEDS A NEW SUPERCOMPUTER!**

In November 2010 China had the largest (known) supercomputer. Evidently, NSA might not have been happy with this.

So, we might imagine the following:
NSA director Keith B. Alexander
So, may be Keith B. Alexander went to beg:
Obama’s reaction:
“New” solution:
“New” solution: NSA could outsource the cryptanalysis to, e.g. China!

Quisquater-Desmedt already mentioned “obfuscation” (called covert computation) and presented a primitive solution to prevent outsiders learn the ciphertext, plaintext and key.

Where: Rump Session Crypto 1987 with title:

   Watch for the Chinese Loto and the Chinese Dragon

Published: IEEE Computer 1991 with title:

   Chinese lotto as an exhaustive code-breaking machine

Question: can obfuscation be done, or is this impossible, using the work by Goldreich et al.?
2. Approach

Note: lotto did not exist in China! So, translation was not so trivial. Today it does, so we predicted the existence of lotto in China.
Lottery winner may have hit $80m jackpot

Updated: 2011-07-28 11:17
By Zhang Jiawei (chinadaily.com.cn)

China's lottery may have set a new record with a man expected to win 514 million yuan ($80 million) from two tickets bought in East China's Zhejiang province on Tuesday, beating the previous record win of 359.9 million yuan, claimed by a man in Central China's Henan province in 2009.

The Chutian Metropolis Daily reported Thursday two tickets sold within 34 seconds hit the jackpot. Xianghe county in Shangsi, East China's Zhejiang province, sold 10,000 tickets in an instance.
3. **WHAT ELSE DID WE PREDICT?**

- Outsourcing to China!
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- Outsourcing to China!

- **Serious claims:**
  - our idea to distribute exhaustive search predated Lenstra-Manasse.
  - our idea to use bio-computing predated Adleman’s DNA computing.
4. **CURRENT IMPACT**

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However, we found that many passwords are too short.
If using English (assume 5 bits entropy) only:

<table>
<thead>
<tr>
<th># characters</th>
<th># passwords</th>
<th>1 PC</th>
<th>1 GPU</th>
<th>$2^{60}$/second</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>$2^{30}$</td>
<td>4 min.</td>
<td>1/4 sec.</td>
<td>$2^{-30}$ sec.</td>
</tr>
<tr>
<td>7</td>
<td>$2^{35}$</td>
<td>2 hours</td>
<td>8 sec.</td>
<td>$2^{-25}$ sec.</td>
</tr>
<tr>
<td>8</td>
<td>$2^{40}$</td>
<td>3 days</td>
<td>4 min.</td>
<td>$2^{-20}$ sec.</td>
</tr>
<tr>
<td>9</td>
<td>$2^{45}$</td>
<td>3 months</td>
<td>2 hours</td>
<td>$2^{-15}$ sec.</td>
</tr>
<tr>
<td>10</td>
<td>$2^{50}$</td>
<td>8 years</td>
<td>64 hours</td>
<td>$2^{-10}$ sec.</td>
</tr>
<tr>
<td>11</td>
<td>$2^{55}$</td>
<td>NA</td>
<td>3 months</td>
<td>$2^{-5}$ sec.</td>
</tr>
<tr>
<td>12</td>
<td>$2^{60}$</td>
<td>NA</td>
<td>8 years</td>
<td>1 sec.</td>
</tr>
</tbody>
</table>
Charset of 96 characters (from a keyboard): rounded to $96 = 2^{6.5}$

<table>
<thead>
<tr>
<th># characters</th>
<th>Number of possibilities</th>
<th>1 PC ($2^{22}/sec$)</th>
<th>1 GPU ($2^{32}/sec$)</th>
<th>Rainbow table</th>
<th>Distributed.net boinc, botnets ($2^{40}/sec$)</th>
<th>Big one ($2^{60}/sec$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>$2^{39}$</td>
<td>32 hours</td>
<td>2 min.</td>
<td>YES</td>
<td>1/2 sec</td>
<td>$2^{-21} \text{ sec}$</td>
</tr>
<tr>
<td>7</td>
<td>$2^{45.5}$</td>
<td>6 months</td>
<td>3 hours</td>
<td>YES</td>
<td>1 min.</td>
<td>$2^{-14.5} \text{ sec}$</td>
</tr>
<tr>
<td>8</td>
<td>$2^{52}$</td>
<td>NA</td>
<td>12 days</td>
<td>YES</td>
<td>2 hours</td>
<td>$2^{-8} \text{ sec}$</td>
</tr>
<tr>
<td>9</td>
<td>$2^{58.5}$</td>
<td>NA</td>
<td>3 years</td>
<td>NA</td>
<td>8 days</td>
<td>$2^{-1.5} \text{ sec}$</td>
</tr>
<tr>
<td>10</td>
<td>$2^{65}$</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>2 years</td>
<td>30 sec</td>
</tr>
<tr>
<td>11</td>
<td>$2^{71.5}$</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>1 hour</td>
</tr>
<tr>
<td>12</td>
<td>$2^{78}$</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>NA</td>
<td>100 hours</td>
</tr>
</tbody>
</table>
Official recommendations for passwords:

For Ubuntu 7.10 (October 2007) manual for passwd:

  passwords should consist of 6 to 8 characters including one or more characters from each of the following sets: ...

In FreeBSD 8.1 (July 2010) they recommend:

  The new password should be at least six characters long (which may be overridden using the login.conf(5) “minpasswordlen” setting for a user’s login class) and not purely alphabetic. Its total length must be less than \_PASSWORD\_LEN (currently 128 characters).

Finally, in “Digest Authentication” the hashed value is sent in the clear!
5. **Future Impact**

In 1985 we predicted:
Quisquater and me disagree how long before this will become reality. Quisquater favourite picture: