

## Findings:

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As a part of my source files, I've included a quick Vigenère cipher cracker, a slow Vigenère cipher cracker, and a simple encryption/decryption tool.

The efficiency of the slow Vigenère cipher cracker should resemble  $O(n)$  where the computational weight is a function of the key length. With a key length of seven characters this process is very slow in the constructed python environment, clocking in at around five and a half hours. Otherwise, the cracking process didn't take an unreasonable amount of time. In this solution a python library for constructing unicode Trie structures optimized the word validation process. Additionally, only words with the same length as the provided first word length were dumped into the trie. Finally, every string was converted an integer tuple prior to the cracking process to improve cracking time.

The quick Vigenère cipher cracking implementation exploited the provided problem statements to achieve a consistent decryption time. Given that we knew the first words length, and given each key is shorter than the first word; we can derive keys from comparison between dictionary words and the cipher text. This changes the algorithmic efficiency to a function of the dictionary size in lieu of possible character combinations. This implementation resulted in a decryption to each cipher text in less than a second.

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### Cipher Text 1:

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**Cipher Text:** MSOKKJCSOXOEEKDTOSLGFWCMCHSUSGX

**Plain Text:** CAESARS WIFE MUST BE ABOVE SUSPICION

**Key:** KS    **Dictionary Size:** 15232

**Key Length:** 2

**Word Length:** 6

**Slow Preprocessing:** 0.149009943008    **Quick Preprocessing:** 0.0620830059052

**Slow Decryption:** 0.00571894645691    **Quick Decryption:** 0.00319695472717

**Slow Total:** 0.154891014099    **Quick Total:** 0.0655999183655

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### Cipher Text 2:

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**Cipher Text:** OOPCULNWFRCFQAQJGPNARMEYUODYOUNRGWORQEPVA

RCEPBBSCEQYEARAJUYGWWYACYWBPRNEJBMDTEAEYC

CFJNENSGWAQRTSJTGXNRQRMDGFEEPHSJRGFCFMACCB

**Plain Text:** FORTUNE WHICH HAS A GREAT DEAL OF POWER IN OTHER  
MATTERS BUT ESPECIALLY IN WAR CAN BRING ABOUT GREAT  
CHANGES IN A SITUATION THROUGH VERY SLIGHT FORCES

**Key:** JAY    **Dictionary Size:** 23109

**Key Length:** 3

**Word Length:** 7

**Slow Preprocessing:** 0.162410020828    **Quick Preprocessing:** 0.0620830059052

**Slow Decryption:** 0.142019987106    **Quick Decryption:** 0.00319695472717

**Slow Total:** 0.304531812668    **Quick Total:** 0.0655999183655

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**Cipher Text 3:**

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**Cipher Text:** MTZHZEOQKASVBDOWMWMKMNYIIHVWPEXJA  
**Plain Text:** EXPERIENCE IS THE TEACHER OF ALL THINGS

**Key:** IWKD    **Dictionary Size:** 20197  
**Key Length:** 4  
**Word Length:** 10

<b>Slow Preprocessing:</b>	0.168552875519	<b>Quick Preprocessing:</b>	0.0750939846039
<b>Slow Decryption:</b>	4.70193004608	<b>Quick Decryption:</b>	0.0150651931763
<b>Slow Total:</b>	4.87061715126	<b>Quick Total:</b>	0.0904760360718

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**Cipher Text 4:**

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**Cipher Text:** HUETNMIXVTMQWZTQMMZUNZXNSSBLNSJVSJQDLKR  
**Plain Text:** IMAGINATION IS MORE IMPORTANT THAN KNOWLEDGE

**Key:** ZIENF    **Dictionary Size:** 15407  
**Key Length:** 5  
**Word Length:** 11

<b>Slow Preprocessing:</b>	0.154419183731	<b>Quick Preprocessing:</b>	0.0698618888855
<b>Slow Decryption:</b>	132.933595181	<b>Quick Decryption:</b>	0.0174062252045
<b>Slow Total:</b>	133.088126898	<b>Quick Total:</b>	0.0875811576843

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**Cipher Text 5:**

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**Cipher Text:** LDWMEKPOPSWNOAVBIDHIPCEWAETYRVOAUPSINOVDIEDHCDSELHCCPVHRPOHZUSERSFS  
**Plain Text:** EDUCATION IS WHAT REMAINS AFTER ONE HAS FORGOTTEN WHAT ONE HAS LEARNED IN SCHOOL

**Key:** HACKER    **Dictionary Size:** 24793  
**Key Length:** 6  
**Word Length:** 9

<b>Slow Preprocessing:</b>	0.165453910828	<b>Quick Preprocessing:</b>	0.0684201717377
<b>Slow Decryption:</b>	3201.66024399	<b>Quick Decryption:</b>	0.0107288360596
<b>Slow Total:</b>	3201.82580304	<b>Quick Total:</b>	0.0794751644135

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**Cipher Text 6:**

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**Cipher Text:** VVVLZWWPBWHZDKBTXLDCGOTGTGRWAQWZSDHEMXMLBELUMO  
**Plain Text:** INTELLECTUALS SOLVE PROBLEMS GENIUSES PREVENT THEM

**Key:** NICHOLS    **Dictionary Size:** 7736  
**Key Length:** 7  
**Word Length:** 9

<b>Slow Preprocessing:</b>	~	<b>Quick Preprocessing:</b>	0.0684201717377
<b>Slow Decryption:</b>	~5.6hrs	<b>Quick Decryption:</b>	0.0107288360596
<b>Slow Total:</b>	~5.6hrs	<b>Quick Total:</b>	0.0794751644135