

*測試環境 windows 10 的 cmd

1. 實作演算法介紹：

KMP 是一個以 failure function 為輔助的演算法，當遇到重複的字串時可以依據 failure function 所計算出來的數值決定要往前移幾格，而非直接移到第一位重頭開始計算，如此一來當字串大量重複時可以節省許多時間。

2. 測試資料與結果並說明：

Pattern：

aAaaaaaAAaaaaaAAaa

Text：

aaasdaAsaaaaaaaaAAAAaAAAAAAAAAAaaaaaAAAAaAAAAAAAAAAAAaAAaa
AAAAAAaAAAAaAAAAadaxaaafadaAAaAaaAAAAaAaAAAAAAAAAAAAa
sdadax

測試資料只有一行，而測試結果為第 8~60、88~106 個字都有找到相同的字串。

3. Brute-Force 與 KMP 的執行時間：

以防萬一我測了兩次 KMP 與 Brute-Force 同樣的測資。

KMP:

453.151000/349.051000

Brute-Force:

485.026000/400.835000

因字串大量重複，故可以發現 KMP 執行的速度比 Brute-Force 快。

4. 其他：

其實影響時間的也包括輸出，我測試了另一份檔案比較大的資料(測試資料放在最下面)，結果發現有輸出的 KMP 執行時間是 108524.012000ms / 110664.765000ms，而 Brute-Force 執行時間則是 108865.660000ms / 109921.322000ms，但沒有輸出的 KMP 執行時間是 515.184000ms / 515.640000ms / 530.055000ms，Brute-Force 執行時間則是 545.079000ms / 526.586000ms / 543.754000ms。有輸出的第一次測試說明 Brute-Force 比 KMP 快，但有輸出的第二次測試則說明 KMP 比較快，表示主要影響的是當時 CPU 的運轉狀態，以及輸出所花的時間。而沒有輸出的 KMP 三次測試都比 Brute-Force 快，雖然 CPU 的運轉狀態也需要列入考量，但我想因為輸出太花時間，導致 CPU 的運轉狀態變成了很重要的因素，才會導致如此情形發生吧。

*第四點提到的測資 Pattern 與 Text 皆為相同的檔案，內容如下：

CABBBAAABACCCCCBABAC

CACACCBAABBCBCCCABBCCB

ACCAABCAACAABBACCCCCCCC

BBAAABAAABCCBABAAAACACACABA

CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAACAAACCCCCAACACAB
ABACBAAAAACCCCCABAABCACAACACBBAA
CCCAABCCCBABBBCAACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBBACACAAACBBBAABCAACACBABBC
BABBBABACABABAACAAABACCB
ACABAAABBCABBBBACBACCACBBBBAABCAABAABCCCAAACBA
BAAABBBACABACCBBACCBCCCBABACBBCABACBCABAACAACACBCBB
CBBBABABCACCABAAAACACBABCBAACCAAACABAACACBABABCABBAABBCBC
ABBCACCABAABCABABCBAACAABB
BBBBBCACBABACABCCBCCACBBACCABCBAABBBABCBBCCBCABCAABBCABCACBACBB
CBABABACBAA
CCBBBBBCACBBCBACBBBABACAAACBCABBACACABAACBBBABCBCAACCACCAABAB
CABBCABACAAAAACBABBBBBBCBCC
ABCCABABBBBCBAABBCBBABABCBBACBACCCACABCBBBABBBACABCAAABBABC
ACCAACACABAACCBBCBAAA
CBCABACBACABACBCCBCCCCABBABCABBCBCBBBCAB
AACAAACCCCCABBCABACABABACACABA
BABBAABBCBCCABBBACCABAABAABCBCBCBBBABBBABCABBAB
BBABBBBACBCCCCBBAAABABBBBCBCCCCACBCCCCBBAACCBBCBBABB
CAACBCAABBCABBBAAABBBBACAAAAABBAACAACABCAABCCCBABBB
BBBABCBACCCBACAAACCCAABBBBCBACCAABBAACCBBA
ABABBBBCACACAAAABACCBBCBCCABABBBBCBAACBBCCCCACCBACBA
ABBBBCABBBBBBACAABBBBBBBBABBBBCBCCACACBBABCCBBBBBACCCAABCCA
AA
BACCBABCABABCCCBAAACA
AAACBBCABABCAACACAABBABBACBBBC
BCABCBCABBAABAABBBABCBCACACAABAACAABCABBAAABACA
CCBABA
ABACBCC
BBAC
ACBCCABBAACBA
BCABBCACBBCBAAC
ABCBBBBCBCCAACCAABCBBAA
ACBBACB
CBCBBAAABCAA
AACAC

ACBABCBB
BCCBCA
CCABAACB
BAABBBABAAC
CCCABA
CABACCAABCBB
BCBAACCACCCBCACABB
ABCCBCCAACAACBBCCCCABB
CBBABACCACACBCCAAAACBBBCAACCCABAA
ABCCACCBACCCB
BCBBCCCABBACCCCBBCBAABBBBBABCBABAAABBCCCCABC
ABBABBCCAABAACBBACCBBCCAACCCCAACBAACCACABCAACBCCABBBA
BABBCAACBBBBBAABBBBABBBCCABAACCBACBBCAABCAABCCCCABBBCBAACCA
BBAAACCCBABBBACCBBCBBCAACBCBBCBBAACACAAACACBBCABCCBAACBCACBACAB
A
BCBBACAAAACCCCCAABAACCCBACABACAABBBBBBAABCCCBACBCACABACABCCBAB
BBBBAA
CBCBBABCBACACABBBACABCBBCBAAACACBAABCAA
CACBBAAACBACCCCBBAACCBBCBCCC
BABACCBBAACCCABBCCABAC
AABCCAABABBCBB
ACABCABBBAAABACCCCCBABAC
CACACCBAAABBCBCCCABBCCB
ACCAABCAACAABBACCCCCCCC
BBAAABAAABCCBABAAAACACACABA
CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAAACAAACCCCCCAACACAB
ABACBAAAAACCCCCABAABCACAACACBBAA
CCCAABCCBCBABBCAACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBACACAAACBBBAABCAACACBABBC
BABBABBBACABABAACAAABACCB
ACABAAABBACABBBBCACBACCACBBBBABCAABAABCCCAAACBA
BAAABBBACABBACCBACCBCCCBABACBBCABACBCABAACAACACBCBB
CBBBABABCACCABAAAACBABCBCACCCAAACABAACACBABABCABBAABBCBC
ABBCACCABAABCABABCBAACAABB
BBBBBCACBABACBCCBCCACBBACCABCBAABBBABCBCCBCABCAABBCABCACBACBB
CBABABACBAA

CCBBBBBCACBBCBACBBBABACAAACBCABBACACABAACBBBABCBACAACCACCAABAB
CABBCABACAAAAACBABBBBBBCBCC
ABCCABABBBBCBCAABBCBBABABCBBACBACCCACABCBBBABBBACABCAAABBABC
ACCAACACABAACCBBCBAAA
CBCABACBACABACBCCBCCCCABBABCABBBCBCCBBBCAB
AACAAACCCCCABBCABACABABACACABA
BABBAABBCBCCABBBACCABAABAABCBCBCACBBBABBBABCABBAB
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BBBABCBACCCBACAAACCCAABBBBCBACAACCAABBAACCBBA
ABABBBBCACACAAAABACCBBCBCCABABBBBCBAACBBCCCCACCBACBA
ABBBBCABBBBBBACAABBBBBBBABABBCBCCACACBCCABBCBBBBAACCCAABCCA
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BACCBABCABABCCCBAACA
AAACBBCABABCAACACAABBABBACBBBC
BCABCBCABBABAABBBABCBACACAABAACAABCABBAAABACA
CCBABA
ABACBCC
BBAC
ACBCCABBAACBA
BCABBACBBCBAAC
ABCBBBBCBCCAACCAABCBA
ACBBACB
CBCBBAAABCAA
AACAC
ACBABCBB
BCCBCA
CCABAACB
BAABBBABAAC
CCCABA
CABACCAABCBB
BCBAACCAACCCBCACABB
ABCCBCCAACAACBBCCCCABB
CBBABACCACACBCCAAAACBBBCAACCCABAA
ABCCACCBACCCB
BCBBCCCABBACCCABCBCAABBBBBABCBABAAABBCCCCABC
ABBABBCCAABAACBBACCBBCCAACCCCAACBAACCACABCAACBCCABBBA
BABBCAACBBBBAABBBABBBCCABAACCBACBBCAABCAABCCCCABBBBCBAACCA

BBAAACCCBABBACCBBCBBAACBCBBCBBAACACAAACACBBCABCCBAACBCACBACAB
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BCBBACAAAACCCCCAABAACCCBACABACAABABBBBAABCCCBACBCACABACABCCBAB
BBBBA
CBCBBABCBACACABBBACABCBBCBAAACACBAABCAA
CACBBAAACBACCCCBBAACCBBCBCCC
BABACCBBAACCCABBCCABAC
AABCCAABABBCBB
ACAB
CABBBAABACCCCCBABAC
CACACBBAABBCBCCCBABCCB
ACCAABCAACAABBACCCCCCCC
BBAAABAAABCCBABAAAACACACABA
CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAAACAAACCCCCAACACAB
ABACBAAAAACCCCCABAABCACAACACBBAA
CCCAABCCBCBABBCAACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBACACAAACBBBAABCAACACBABBC
BABBBABACABABAACAAABACCB
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BAAABBBACABBACCBBACCBCCCBABACBBCABACBCABAACAACACBCBB
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CCBBBBBCACBBCBACBBBABACAAACBCABBACACABAACBBBABCBCAACCACCAABAB
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ABCCABABBBBCBAABBCBBABABCBBACBACCCACABCBBBABBBACABCAAABBABC
ACCAACACABAACCBBCBAAA
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BABBAABBCBCCABBBACCABAABAABCBCBACBBBABBCABBAB
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ABBBBCBABBBBACAABBBBBBBBABBBBCBCCACACBB CABBCBBBBAACCAABCCA

AA

BACCBABCABABCCCBAACA

AAACBBCABABCAACACAABBABBACBBBC

BCABCBCABBABAABBBABCBCACACAABAACAABCABBAAABACA

CCBABA

ABACBCC

BBAC

ACBCCABBAACBA

BCABBACBBCBAAC

ABCBBBBBCCCAACCAABCBB

ACBBACB

CBCBBAAABCAA

AACAC

ACBABCBB

BCCBCA

CCABAACB

BAABBBABAAC

CCCABA

CABACCAABCBB

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CACACBAAABBCBCCABBCB

ACCAABCAACAABBACCCCCC

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CCBABA
ABACBCC
BBAC
ACBCCABBAACBA
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ACBBACB
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AACAC

ACBABCBB
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BAABBBABAAC
CCCABA
CABACCAABCBB
BCBAACCACCCBCACABB
ABCCBCCAACAACBBCCCCABB
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BABACCBBAACCCABBCCABAC
AABCCAABABBCBB
ACAB
CABBBAABACCCCBABAC
CACACCBAAABBCBCCABBCB
ACCAABCAACAABBACCCCCCCC
BBAAABAAABCCBABAAAACACACABA
CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAACAAACCCCCCAACACAB
ABACBAAAAACCCCCABAABCACAACACBBAA
CCCAABCCCBABBBCAACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBACACAAACBBBAABCAACACBABBC
BABBBABACABABAACAAABACCB
ACABAAABBACABBBBCACBACCACBBBBAABCAABAABCCCAAACBA
BAAABBBACABBACCBACCBCCCBABACBBCABACBCABAACAACACBCBB
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CBABABACBAA
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BAABBBABAAC
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BABBCAACBBBBBAABBBBCABBBCCABAACCBACBBCAABCAABCCCCABBBBCBAACCA
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CACBBAAACBACCCCBBAACCAABBCBCCC
BABACCBBAACCCABBCABAC
AABCCAABABBCBB
ACABCABBBAAABACCCCBABAC
CACACBBAABBCBCCCABBCB
ACCAABCAACAABBACCCCCC
BBAAABAAABCCBABAAAACACACABA
CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAAACAAACCCCCAACACAB
ABACBAAAAACCCCCABAABCACAACACBBAA
CCCAABCCBCBABBCAACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBAACAAACBBBAABCAACACBABBC
BABBABBBACABABAACAAABACCB
ACABAAABBACABBBBCACBACCACB BBBBABCAABAABCCCAAACBA
BAAABBBACABACCBACCBCCCBABACBBCABACBCABAACAACACBCBB
CBBBABABCACCABAAAACACBABCBACCCAAACABAACACBABABCABBAABBCBC
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CBABABACBAA
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ABCCABABBBBCBAABBCBBABABCBBACBACCCACABCBBBABBBACABCAAABBABC
ACCAACACABAACCBBCBAAA
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AA
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AAACBBCABABCAACACAABBABBACBBBC
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CCBABA
ABACBCC
BBAC
ACBCCABBAACBA
BCABBACBBCBAAC
ABCBBBBCBCCAACCAABCBBBA
ACBBACB
CBCBBAAABCAA
AACAC
ACBABCBB
BCCBCA
CCABAACB
BAABBBABAAC
CCCABA
CABACCAABCBBBC
BCBAACCACCCCBACABB
ABCCBCCAACAACBBCCCCABB
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BABBCAACBBBBAABBBBABBCCABAACCBACBBCAABCAABCCCCABBBBCBAACCA
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BCBBACAAAACCCCAABAACCCBACABACAABABBBBAABCCCBACBCACABACABCCBAB
BBBBAA
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CACBBAAACBACCCCBBAACCBBCBCCC
BABACCBBAACCCABBCCABAC
AABCCAABABBCBB
ACAB
CABBBAAABACCCCBABAC
CACACCBAAABBCBCCABBBCCB
ACCAABCAACAABBACCCCCCCC

BBAAABAAABCCBABAAAACACACABA
CBCABBABBCBAAAACBABCCBBACBCC
BABABCBABCBAACAAACCCCCAACACAB
ABACBAAAAACACCCABAAABCACAACACBBAA
CCCAABCCCBABBBACABBCABCACABCABC
ACCAABAAAABCBBBCAABABAABAABBACBBCBCCC
CACABBBBACABBACACAAACBBBAABCAACACBABBC
BABBBABACABABAACAAABACCB
ACABAAABBACABBBBCACBACCACBBBBAABCAABAABCCCAAACBA
BAAABBBACABBACCBBACCBCCCBABACBBCABACBCABAACAACACBCBB
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ACCAACACABAACCBBCBAAA
CBCABACBACABACBCCBCCCCABBABCABBCBCBBBCAB
AACAAACCCCABBCABACABABACACABA
BABBAABBCBCCABBBACCABAABAABCBCBCACBBBABBCABBAB
BBABBBBACBCCCCBBAAABABBBBCBCCBBBCACBCCBCBBAACCBBCBBAB
CAACBCAABBCABBBAAABBBBACAAAAABBAACAACABCAABCCCABBBB
BBBABCACCCBACAAACCCAABBBBCBACAACCAABBAACCBBA
ABABBBBCACACAAAABACCBBCBCCABABBBBCBAACBBCCCCACBCACBA
ABBBBCABBBBBBACAABBBBBBBABABBCBCCACACBBACBBCCBBBBBACCCAABCCA
AA
BACCBABCABABCCCBAACA
AAACBBCABABCAACACAABBABBACBBBC
BCABCBCABBABAABBBABCBCACACAABAACAABCABBAAABACA
CCBABA
ABACBCC
BBAC
ACBCCABBAACBA
BCABBCACBBCBAAC
ABCBBBBCBCCAACCAABCBBAA
ACBBACB
CBCBBAAABCAA

AACAC
ACBABCBB
BCCBCA
CCABAACB
BAABBBABAAC
CCCABA
CABACCAABCBB
BCBAACCACCCBCACABB
ABCCBCCAACAACBBCCCCABB
CBBABACCACACBCCAAAACBBBCAACCCABAA
ABCCACCBACCCB
BCBBCCCABBACCCABCBCAABBBBBABCBABAAABBCCCCABC
ABBABBCCAABAACBBACCBBCCAACCCCAACBAACCACABCAACBCCABBBA
BABBCAACBBBBAAABBCABBBCCABAACCBACBBCAABCAABCCCCABBBBCBAACCA
BBAAACCCBABBACCBBCBBAACBCBBCBBAACACAAACACBBCABCCBAACBCACBACAB
A
BCBBACAAAACCCCAABAACCCBACABACAABBBBBBAABCCCBACBCACABACABCCBAB
BBBBAA
CBCBBABCBCACACABBBACABCBBCBAAACACBAABCAA
CACBBAAACBACCCCBBAACCAABBBBCBCCC
BABACCBBAACCCABBCCABAC
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