Aria Javani

9725303

1:

we have two answers $x_1,\ x_2$

$$\begin{cases} x_1 \equiv a \ mod \ m_1 \\ x_1 \equiv b \ mod \ m_2 \end{cases} and \begin{cases} x_2 \equiv a \ mod \ m_1 \\ x_2 \equiv b \ mod \ m_2 \end{cases}$$

$$\begin{cases} x_1 mod \ m_1 = x_2 \ mod \ m_1 \\ x_1 mod \ m_2 = x_1 \ mod \ m_2 \end{cases} \Rightarrow \begin{cases} x_1 - x_2 \equiv m_1 k_1 \\ x_1 - x_2 \equiv m_2 k_2 \end{cases} \Rightarrow k(m_1 m_2) =$$

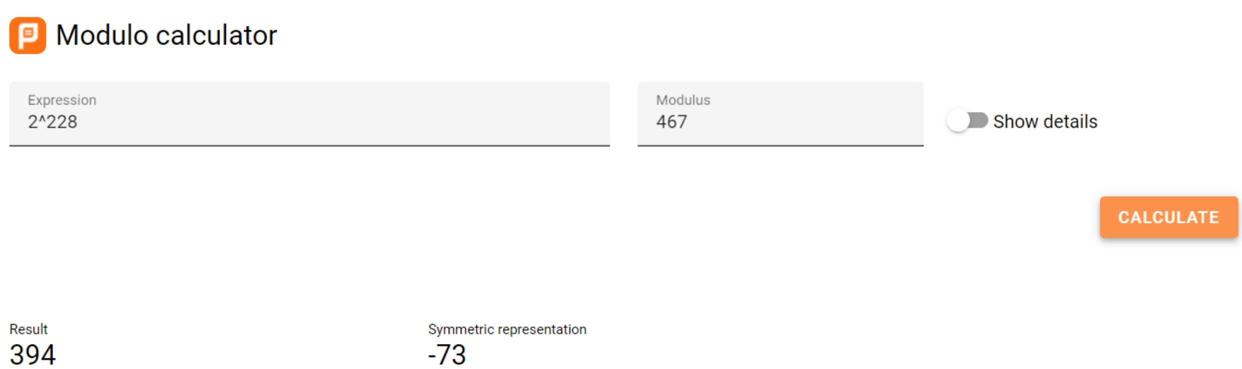
$$x_1 - x_2 \ \Rightarrow \ x_1 \equiv x_2 \ mod \ m_1 m_2$$

2.1:

$p = 467, \alpha = 2, a = 228, b = 57$

$k_{prA} = 228, k_{prB} = 57$

$k_{pubA} = \ \alpha^{228} = 394 \text{ mod } 467$



$k_{pubB} = \ \alpha^{57} = 313 \text{ mod } 467$

Modulo calculator

Expression
2^57

Modulus
467

Show details

CALCULATE

Result
313

Symmetric representation
-154

$$k_{AB} = {k_{pubA}}^{k_{prB}} = {k_{pubB}}^{k_{prA}} = 2^{228\times57} = 2^{12996} = 206 \; mod \; 467$$

Modulo calculator

Expression
2^12996

Modulus
467

Show details

CALCULATE

Result
206

Symmetric representation
206

2.2:

$$p = 467, \alpha = 4, a = 400, b = 134$$

$$k_{prA} = 400 \; , k_{prB} = 134$$

$$k_{pubA} = \; \alpha^{400} = 89 \; mod \; 467$$

Modulo calculator

Expression
4^400

Modulus
467

Show details

CALCULATE

Result
89

Symmetric representation
89

$$k_{pubB} = \alpha^{134} = 51 \; mod \; 467$$

Modulo calculator

Expression
4^134

Modulus
467

Show details

CALCULATE

Result
51

Symmetric representation
51

$$k_{AB} = k_{pubA}{}^{k_{prB}} = k_{pubB}{}^{k_{prA}} = 2^{400 \times 134} = 2^{53600} = 161 \; mod \; 467$$

Modulo calculator

Expression
4^53600

Modulus
467

Show details

CALCULATE

Result
161

Symmetric representation
161

$$p = 467, \alpha = 4, a = 167, b = 134$$

$$k_{prA} = 167 \; , k_{prB} = 134$$

$$k_{pubA} = \alpha^{167} = 89 \; mod \; 467$$

Modulo calculator

Expression
4^167

Modulus
467

Show details

CALCULATE

Result
89

Symmetric representation
89

$$k_{pubB} = \alpha^{134} = 51 \, mod \, 467$$

Modulo calculator

Expression
4^134

Modulus
467

Show details

CALCULATE

Result
51

Symmetric representation
51

$$k_{AB} = {k_{pubA}}^{k_{prB}} = {k_{pubB}}^{k_{prA}} = 2^{167\times134} = 2^{22378} = 161 \, mod \, 467$$

Modulo calculator

Expression
4^22378

Modulus
467

Show details

CALCULATE

Result
161

Symmetric representation
161

2.3 :

Order of our generator is 233 so 167 and 167+233=400 have the same result.

3 :

In this attack the attacker tries to send his own public key to Alice and Bob instead of letting them get each other public key. If he does this successfully in the next step Alice or Bob send their messages encrypted with attacker's key so attacker can read them easily.

4.1 :

a primitive root of p is a number $0 < \alpha < p$ such that all of a powers generate all the number between 0 and p

5 :

$p = 467, g = 2, a = 153 \quad m = 331, k = 197$

$k_{pubA} = 2^{153}\, mod\ 467 = 15 \times 90 \times 8\, mod\ 467 = 10800\, mod\ 467 = 59$

$k_{pubB} = 2^{197}\, mod\ 467 = 19 \times 90 \times 128\, mod\ 467 = 218880\, mod\ 467 = 224$

encrypted message: $m_e = k_{pubA}^{k} m = 59 \times 331\, mod\ 467 = 19529\, mod\ 467 = 382$

Bob sends $\left(m_e, k_{pubB}\right) = (224{,}382)$

Alice decryption : $m = \frac{m_e}{k_{pubB}^{153}} = 331$

6 :

we try to show these problems are equivalent and how to convert each one to other.

in elgemal we find message and in diffie hellman we find the key.

$$m = t.r^{-\log_a b} \; equiation\ for\ attacking\ elgemal$$

next we need to find the common key in diffie helman

$$k_{AB} = \alpha^{k_{prA}k_{prB}} \; by\ knowing\ \alpha^{k_{prA}}, \alpha^{k_{prB}}$$

now suppose we want want to know the elgemal equivalence with diffie helman parameters

$$m = 1.(\alpha^{k_{prB}})^{-\log_\alpha \alpha^{k_{prA}}} = \alpha^{-k_{prA}k_{prB}} = k_{AB}^{-1}$$

next we try to find elgemal message by having a algorithm that find diffie hellman key

$$\alpha^{k_{prA}k_{prB}} = \alpha^{k_{prA}\log_\alpha \alpha^{k_{prB}}} \rightarrow \alpha^{k_{prB}} = k_{pubA}, \alpha^{k_{prA}} = k_{AB}, \alpha = k_{pubB}$$

by doing this exchanges we can put elgemal parameters in out diffie hellman algorithm.

7 :

if we choose 1 then public key is α which allows attacker to find private key effortlessly.

if we choose p-1 then public key is 1 which means our private key is p-1.

8 :

$$a^p \equiv a$$

we've already proven this in homework 3 q7.2 :

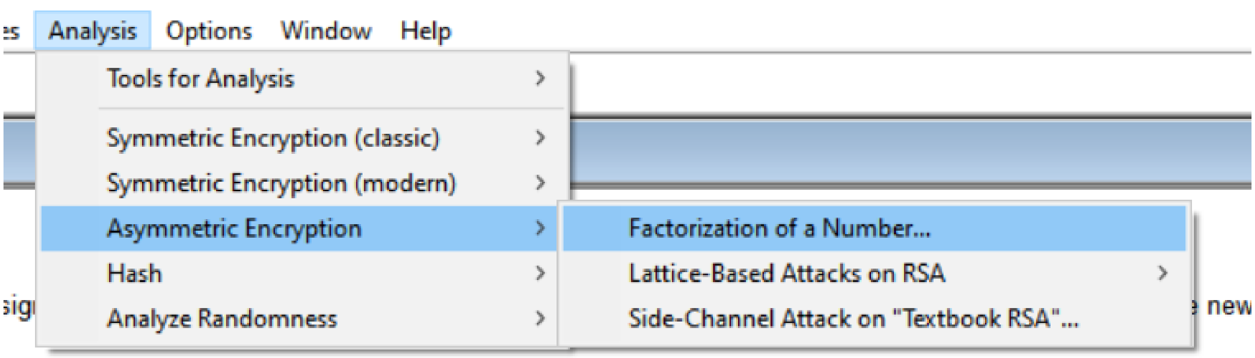
first we assume a set of all possible strings of length p and a different characters possible for each string so the count of string will be a^p . among all of these strings there are exactly a strings consisting of exactly one character. with the rest of them we make a necklace with each string then we consider all the strings with that have a same necklace with subset length of p in one group the reason we choose p as size is because a subset of length T should be chosen with the condition of T dividing length of whole string and since the length of strings is prim number of p we shall use p (also not 1 because it's trivial) as the sub string length. so p divides $a^p - a$ and $a^p = a$

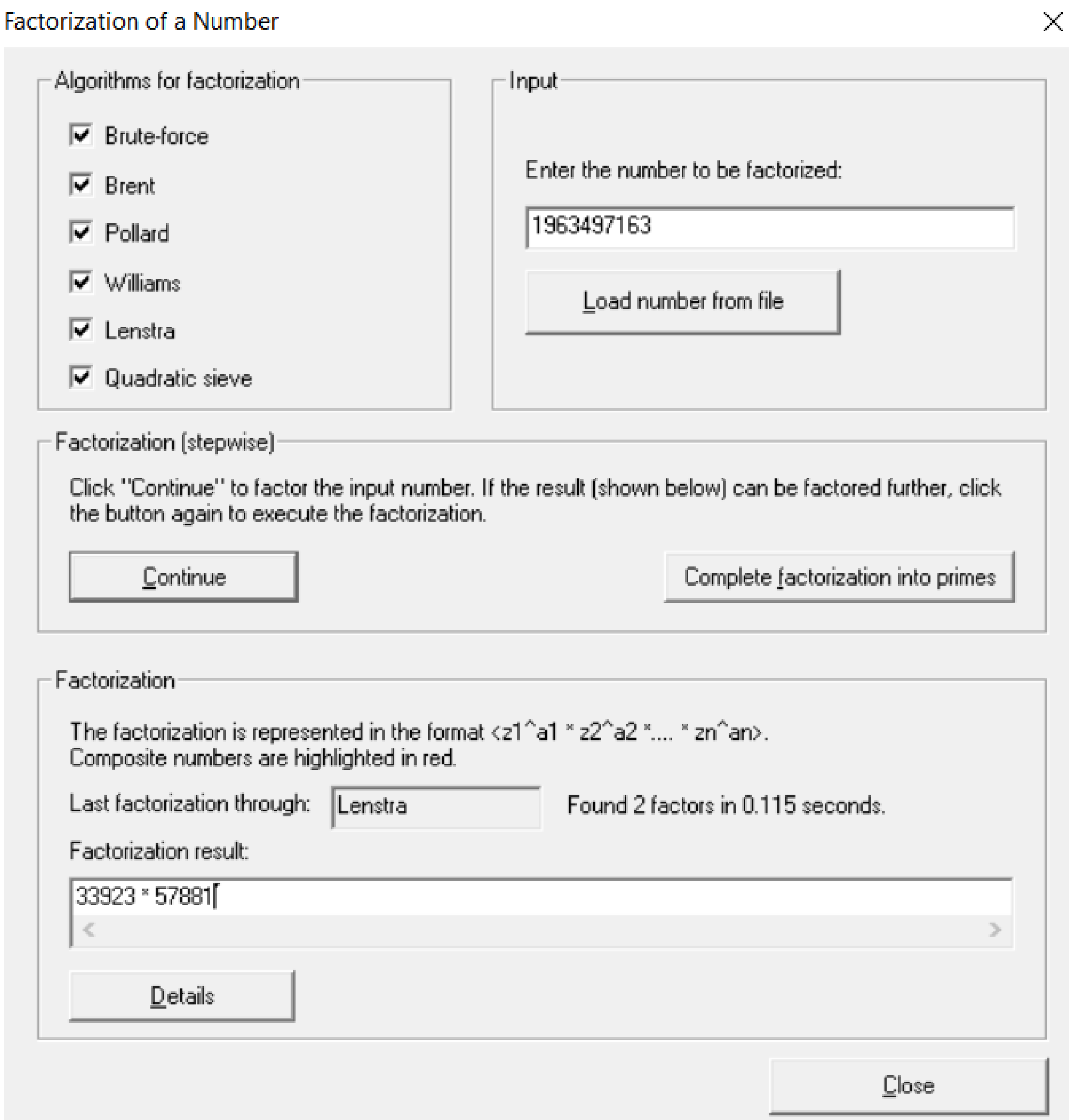
$$(x + y)^p = x^p + y^p$$

$$x + y = a \text{ ,} using\ previous\ theorem: \ a^p \equiv 1, x^p \equiv 1, y^p \equiv 1, 2^p \equiv 1 \ \rightarrow x^p + y^p = a^p = (x + y)^p$$

9 :

1) $1963497163 = 33923 \times 57881$

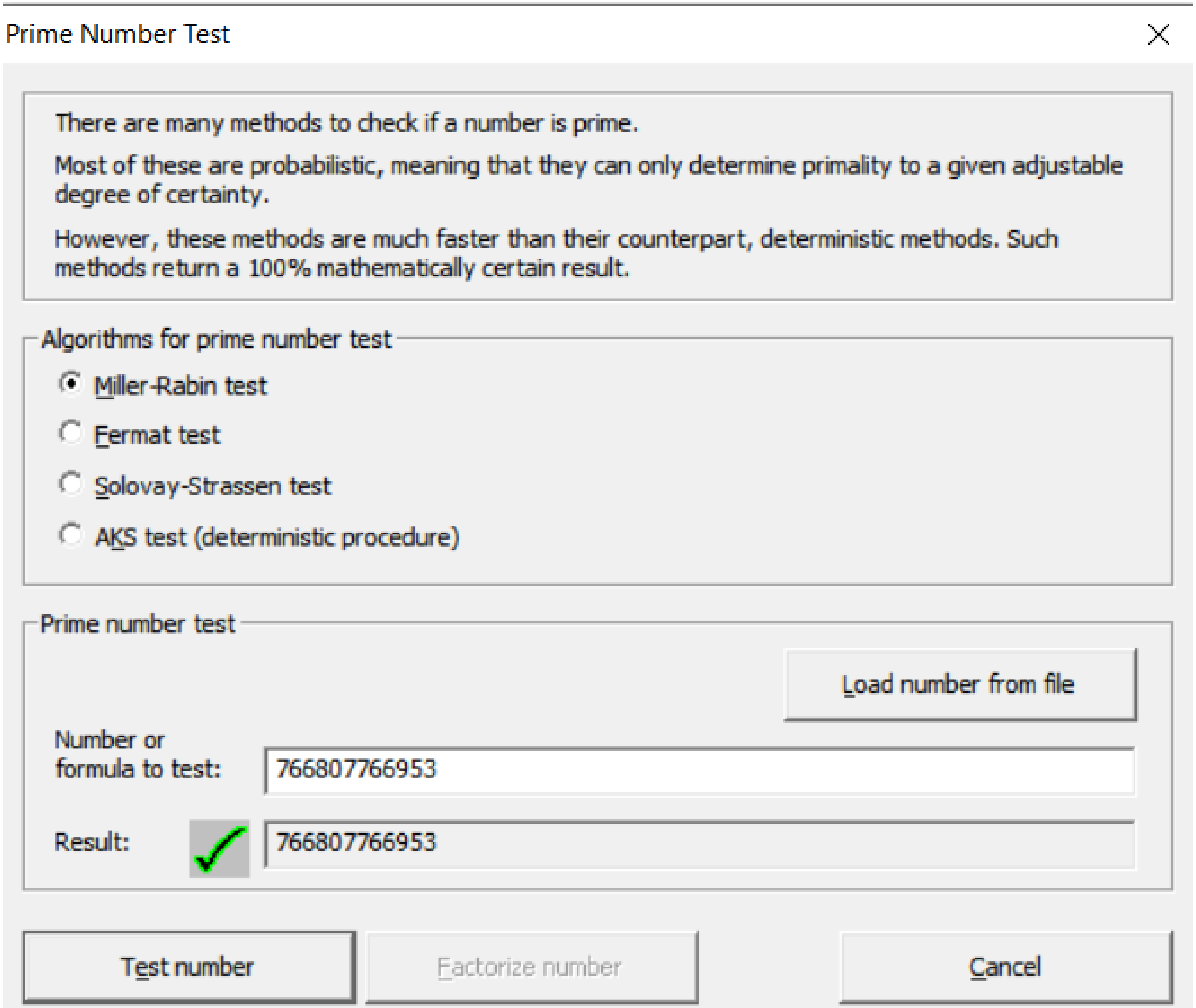


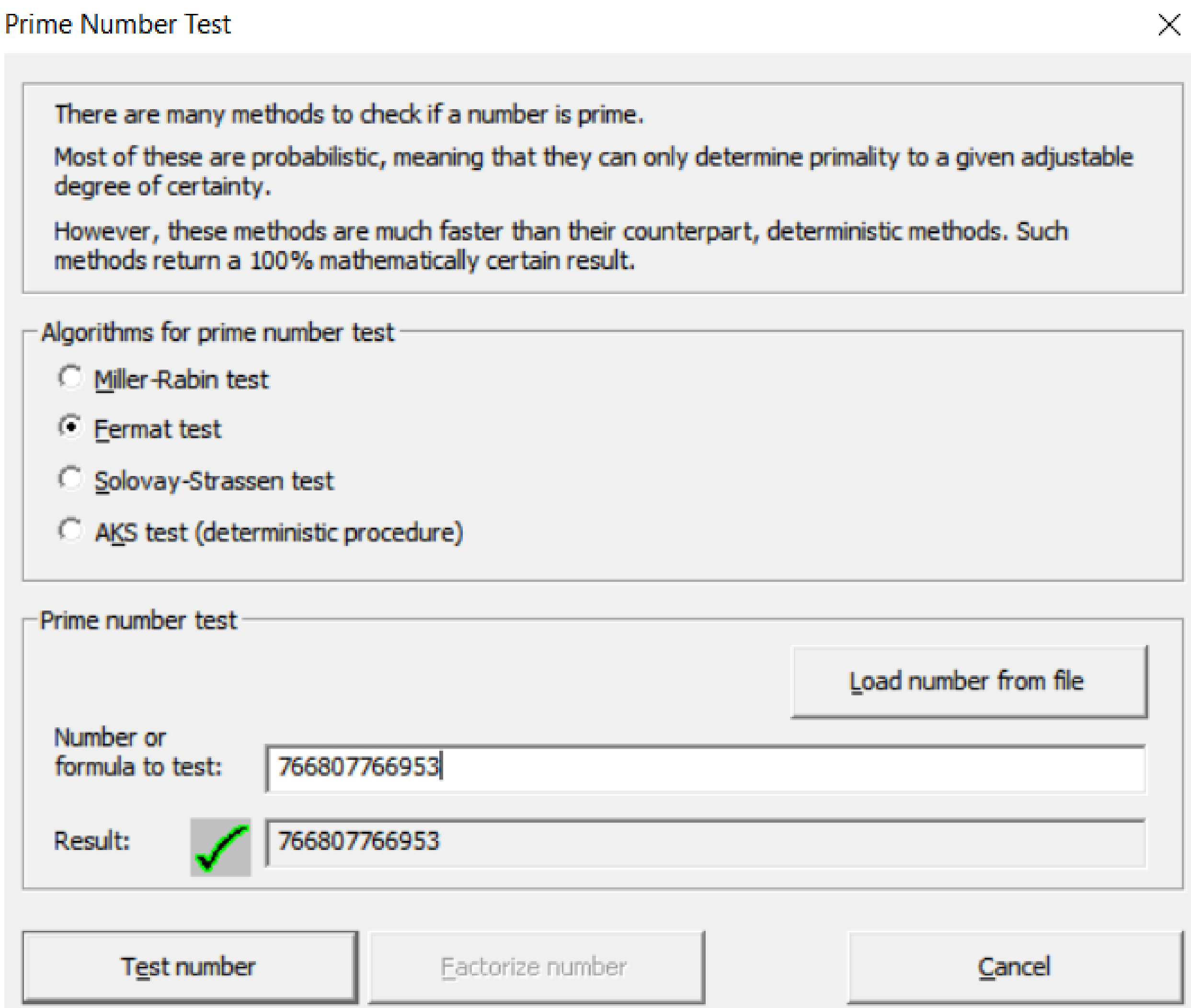


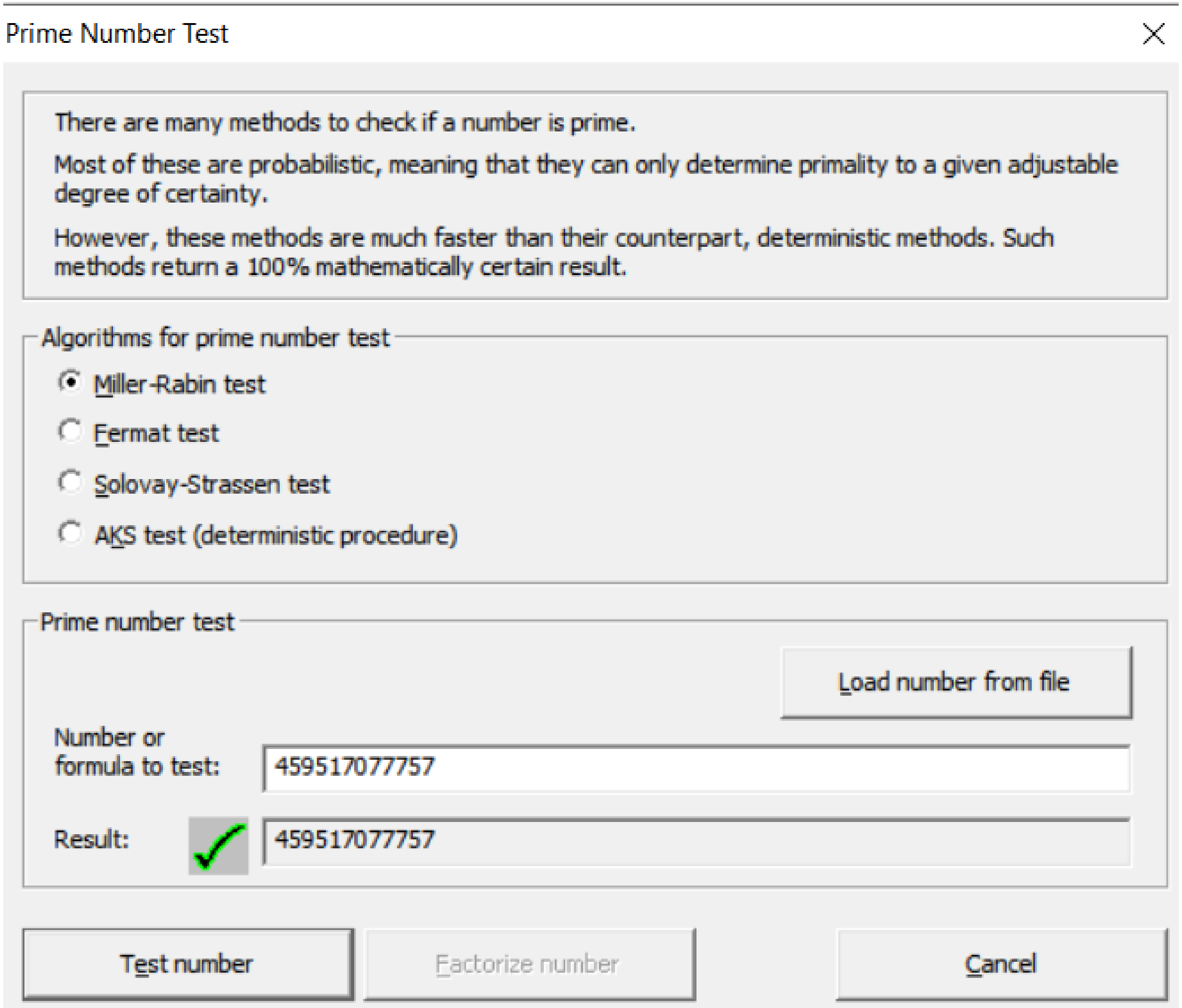
2) prime numbers : 766807766953, 459517077757, 26464987111

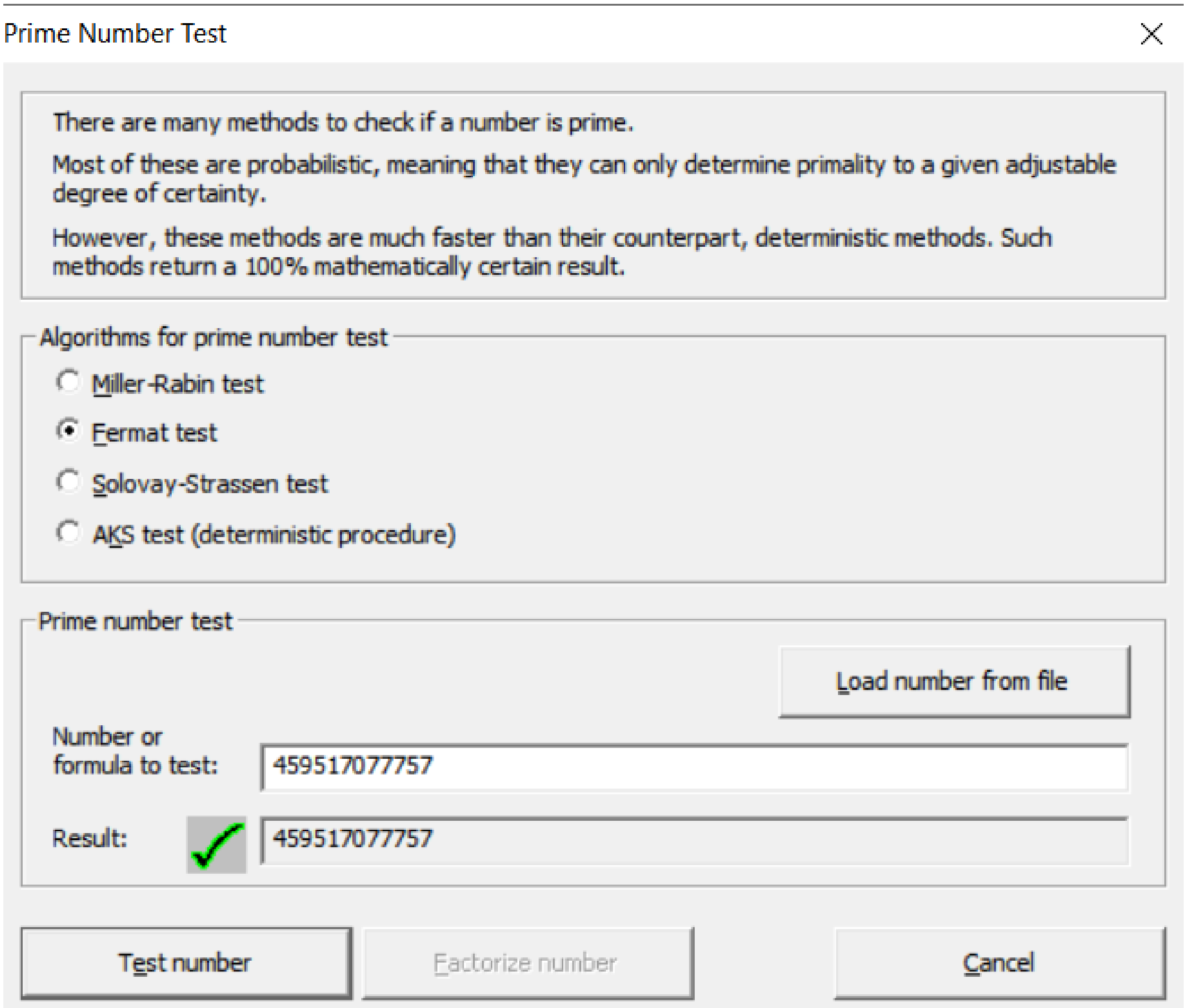
Carmichael numbers : 334153, 314821, 294409

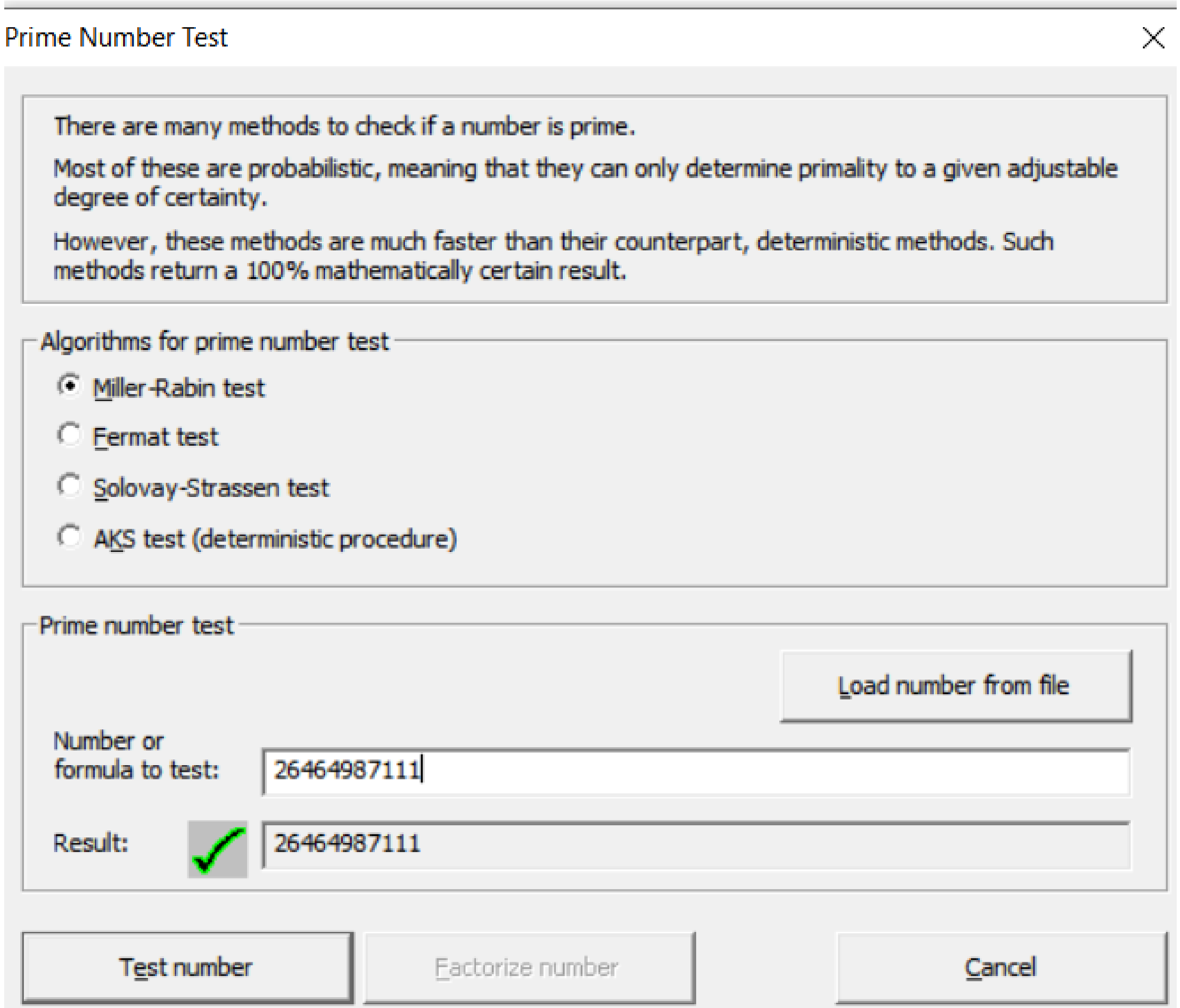
regular composite numbers : 111111111, 222222222, 33333333

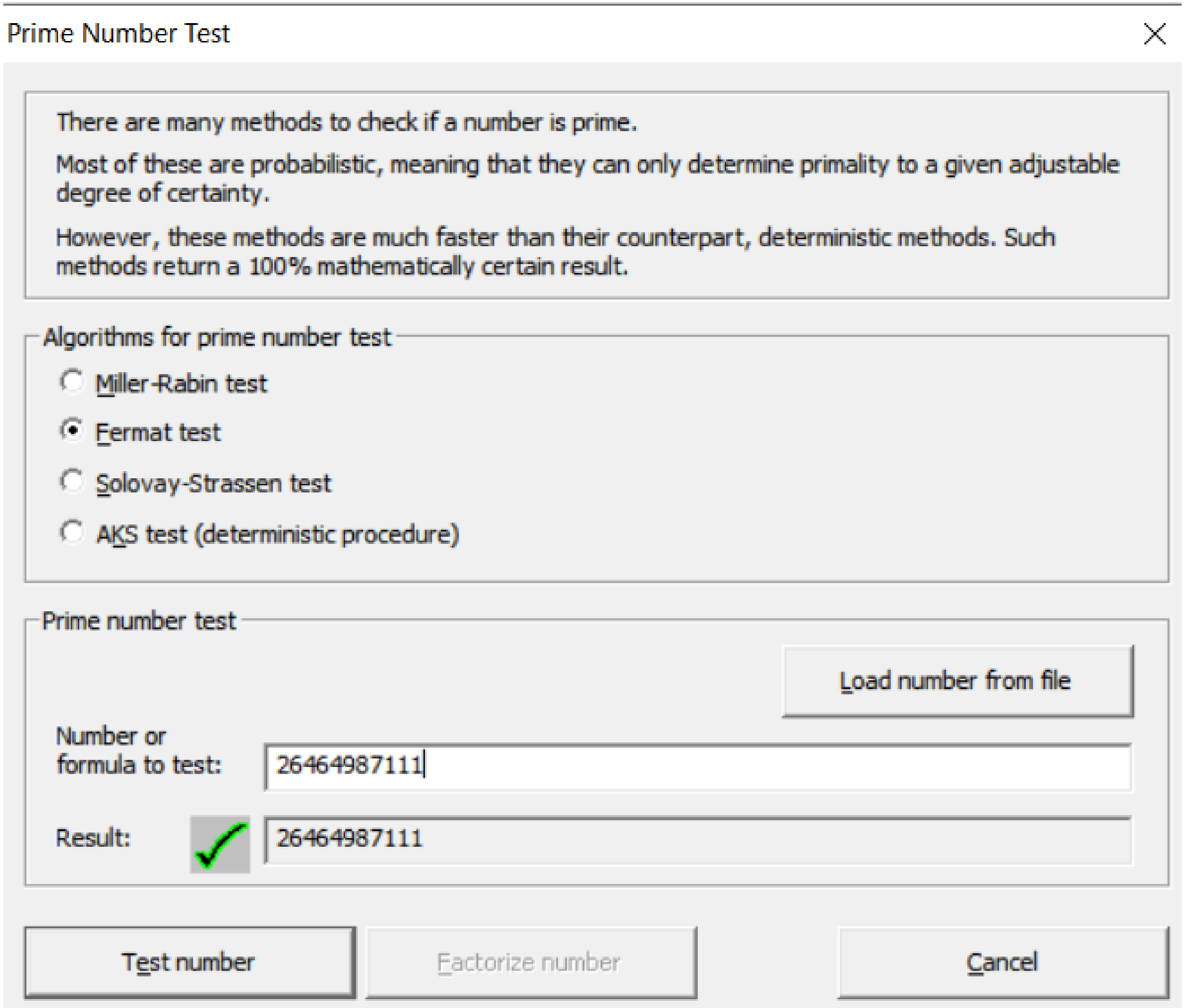

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
766807766953
Result:
766807766953
Test number
Factorize number
Cancel

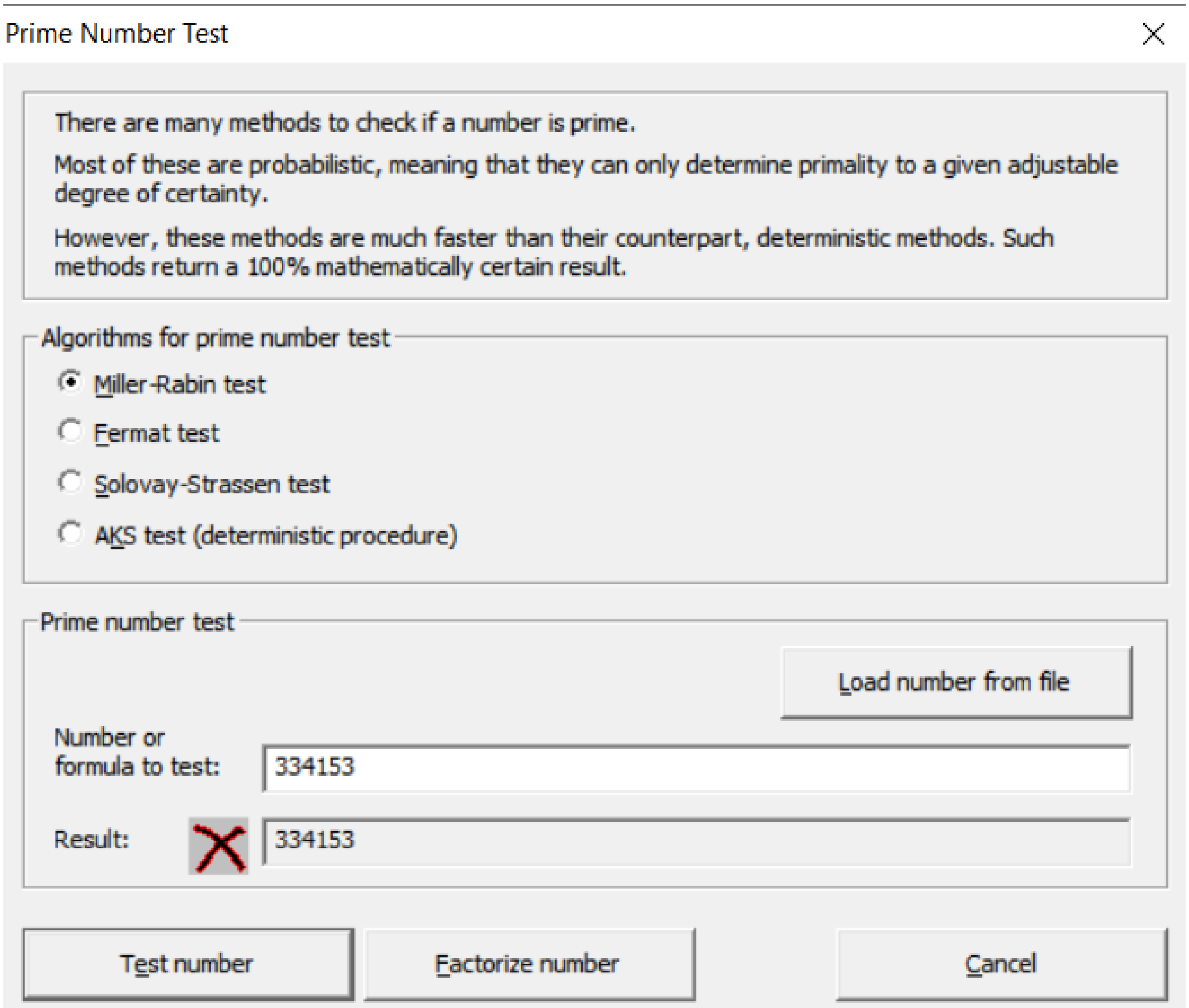

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
766807766953
Result:
766807766953
Test number
Factorize number
Cancel

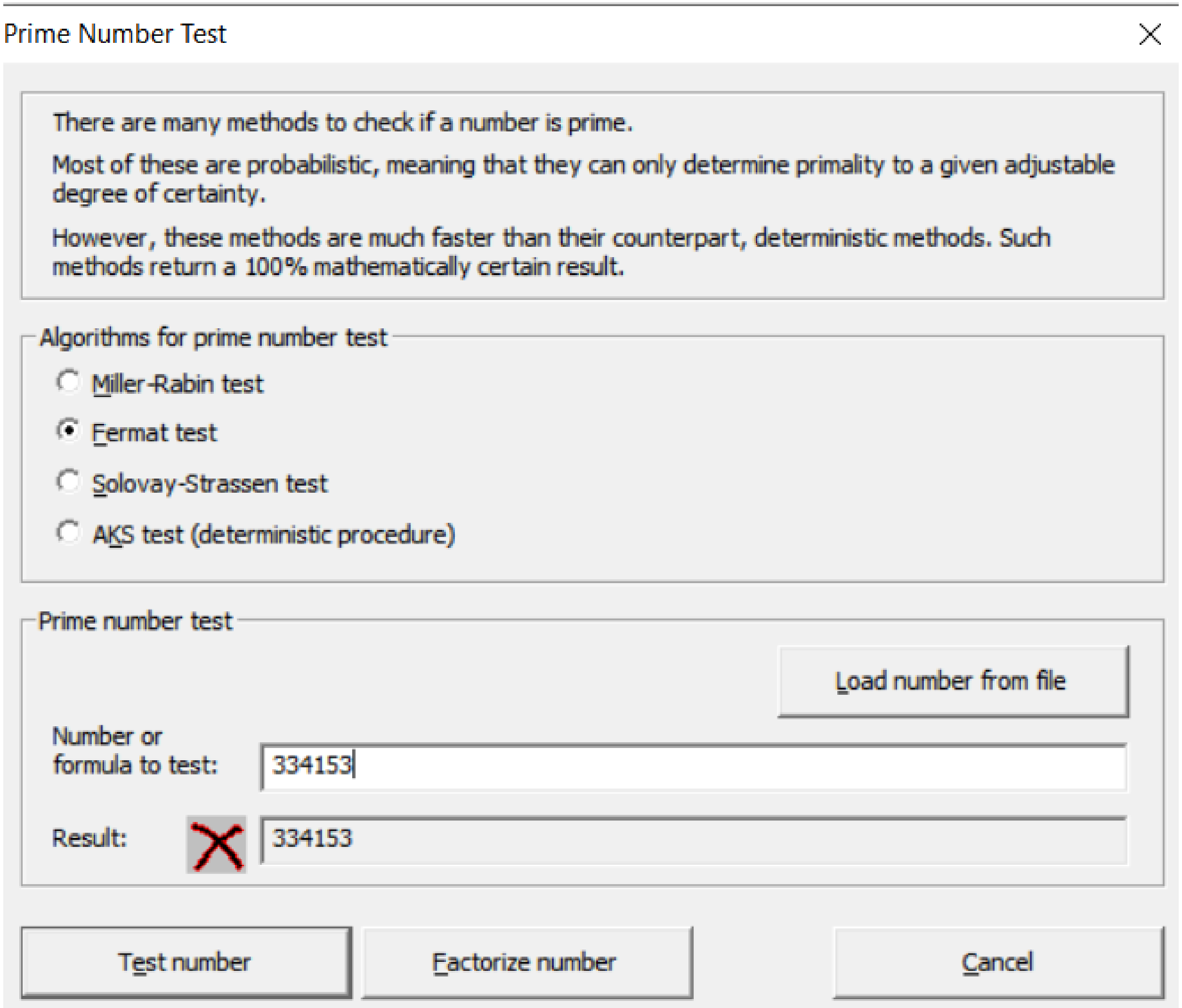

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
459517077757
Result:
459517077757
Test number
Factorize number
Cancel

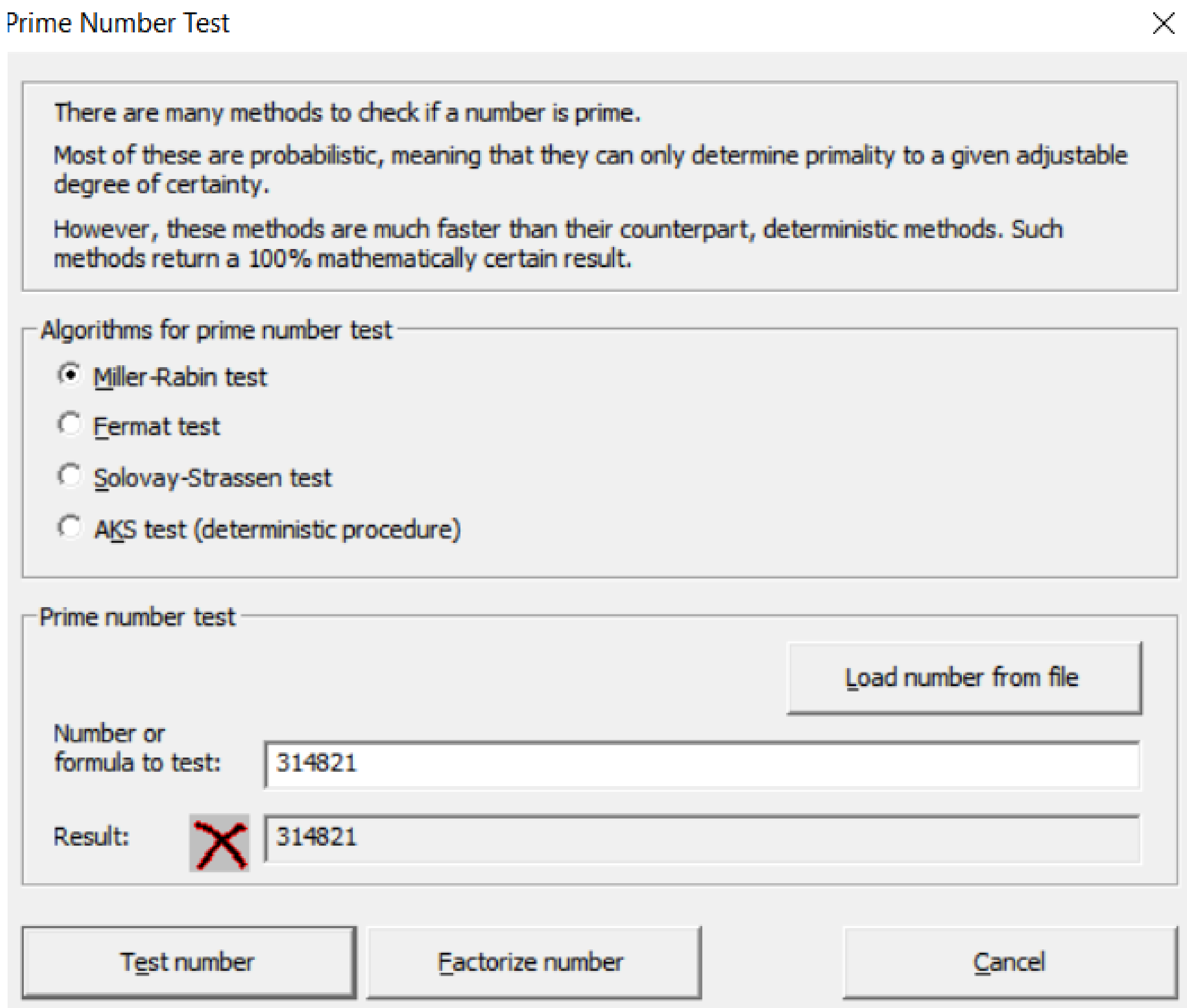

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
459517077757
Result:
459517077757
Test number
Factorize number
Cancel


Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
26464987111
Result:
26464987111
Test number
Factorize number
Cancel

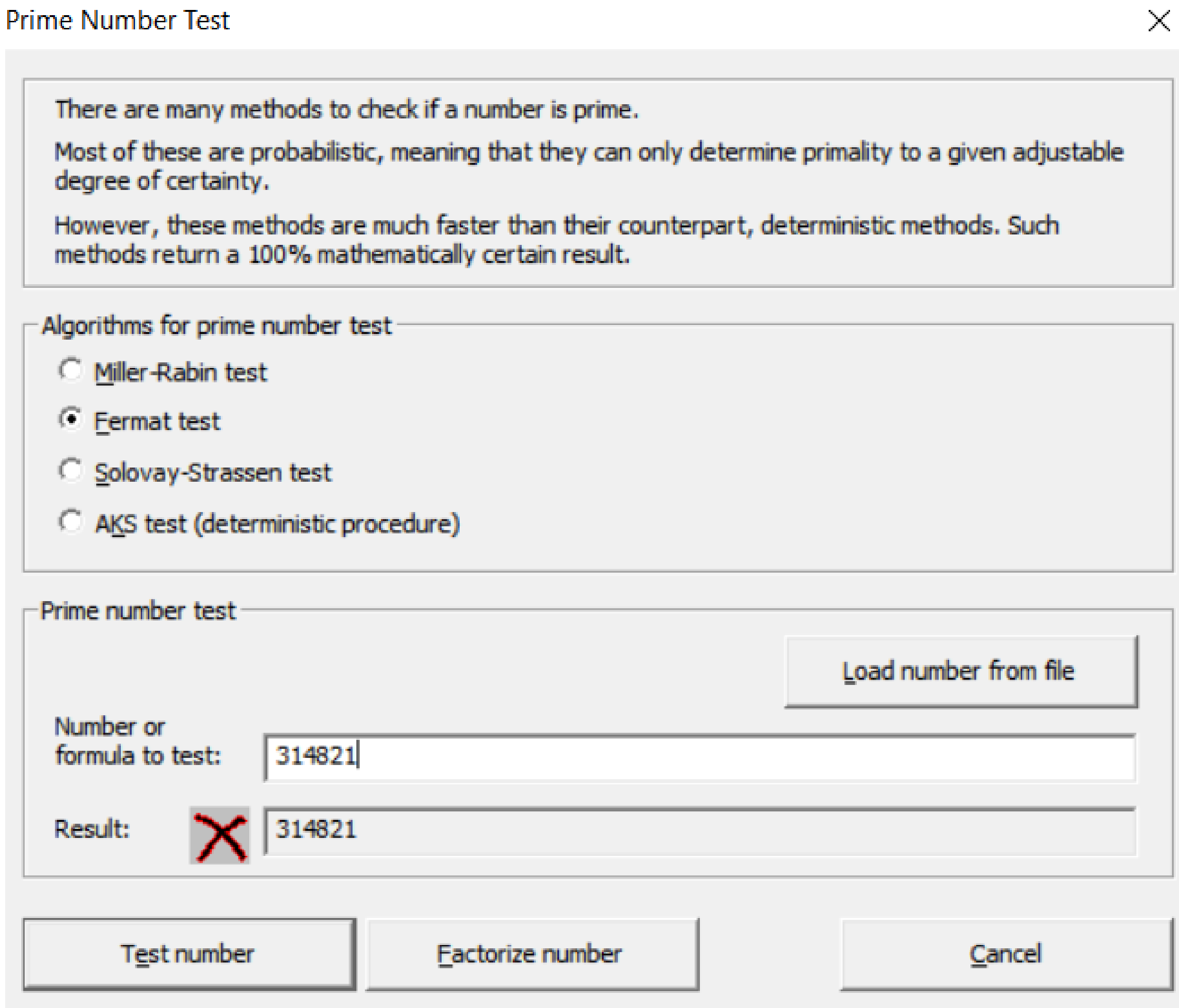

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
26464987111
Result:
26464987111
Test number
Factorize number
Cancel

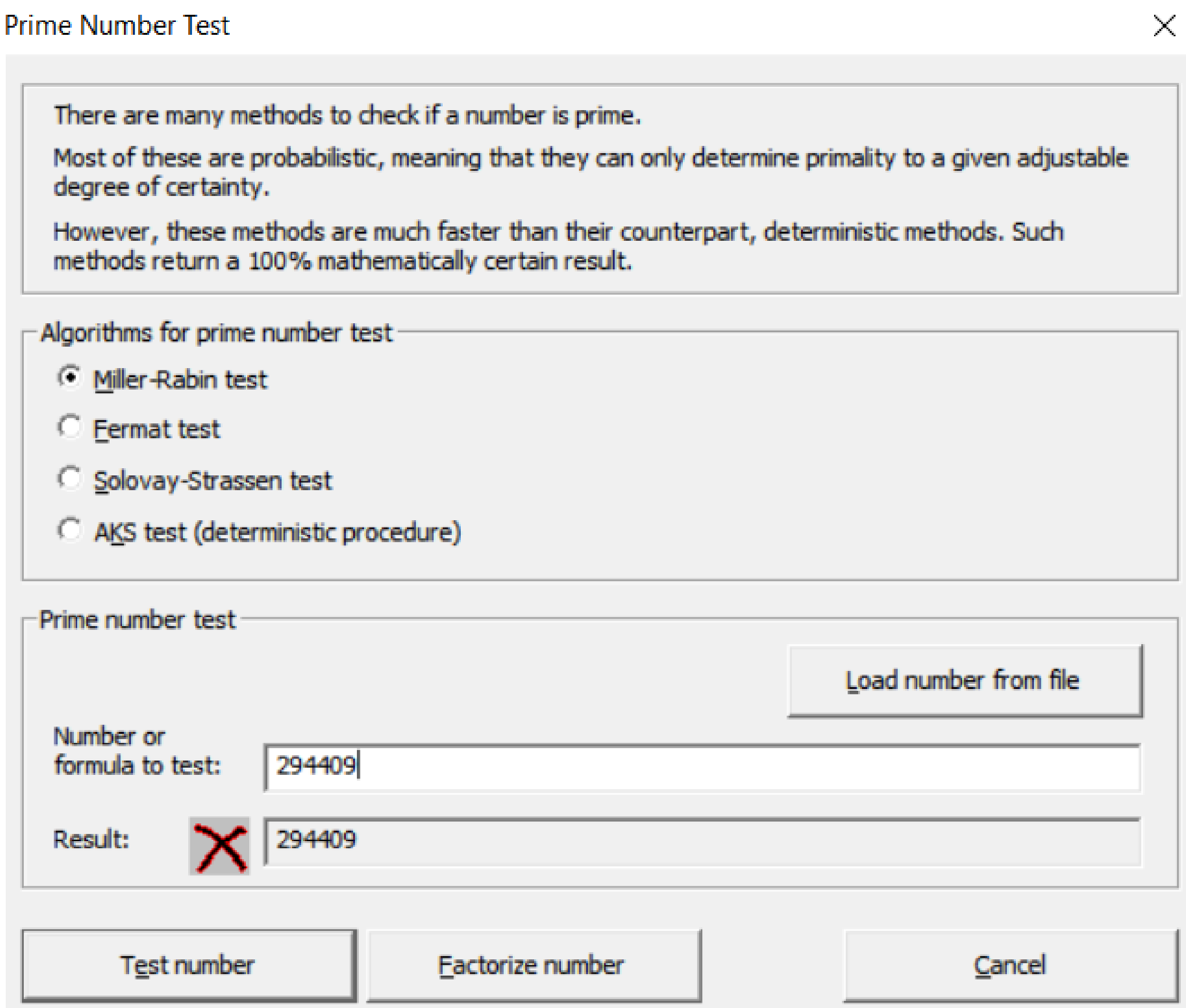

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
334153
Result:
334153
Test number
Factorize number
Cancel

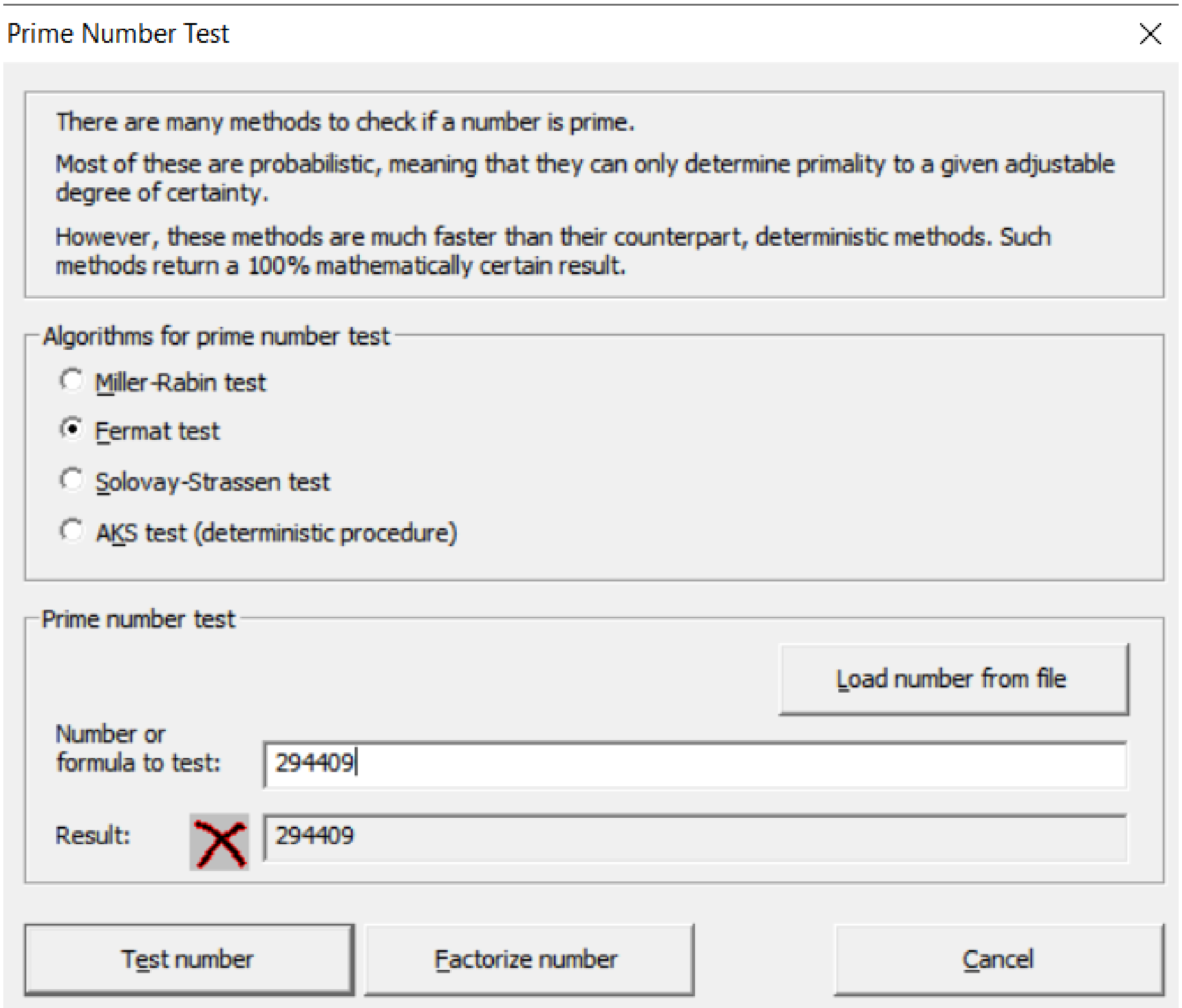

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
334153
Result:
334153
Test number
Factorize number
Cancel

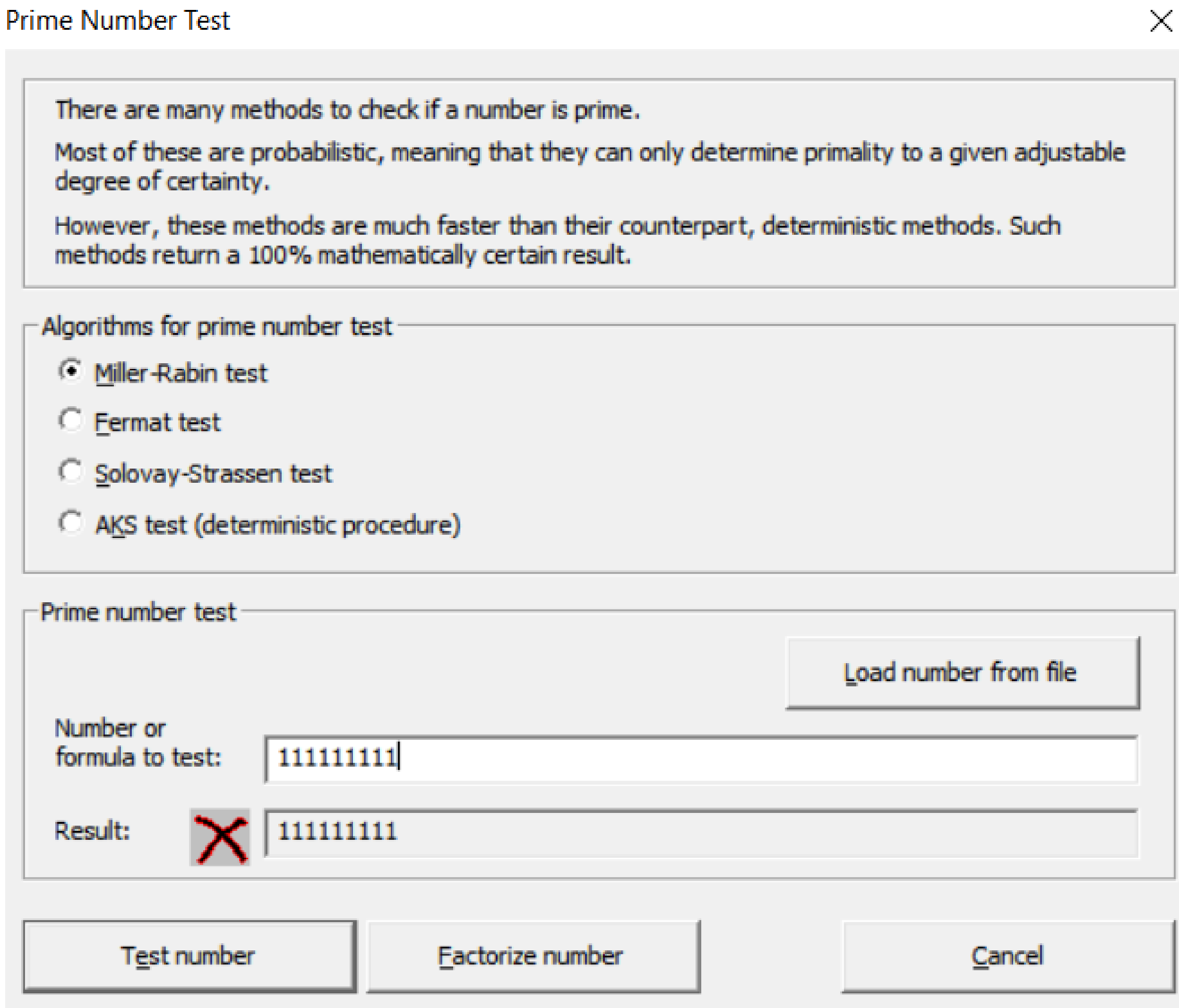


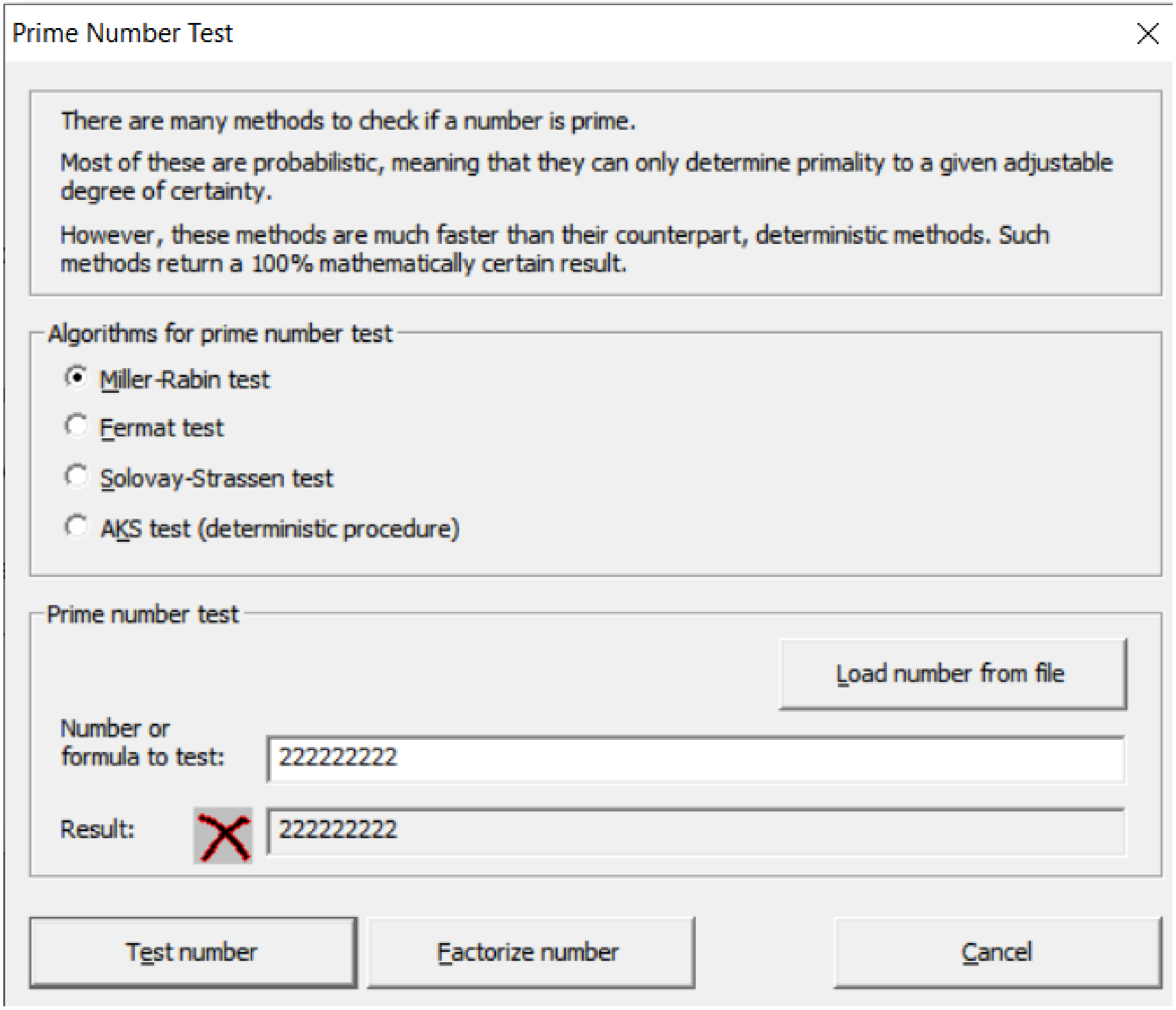
Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
314821
Result:
314821
Test number
Factorize number
Cancel

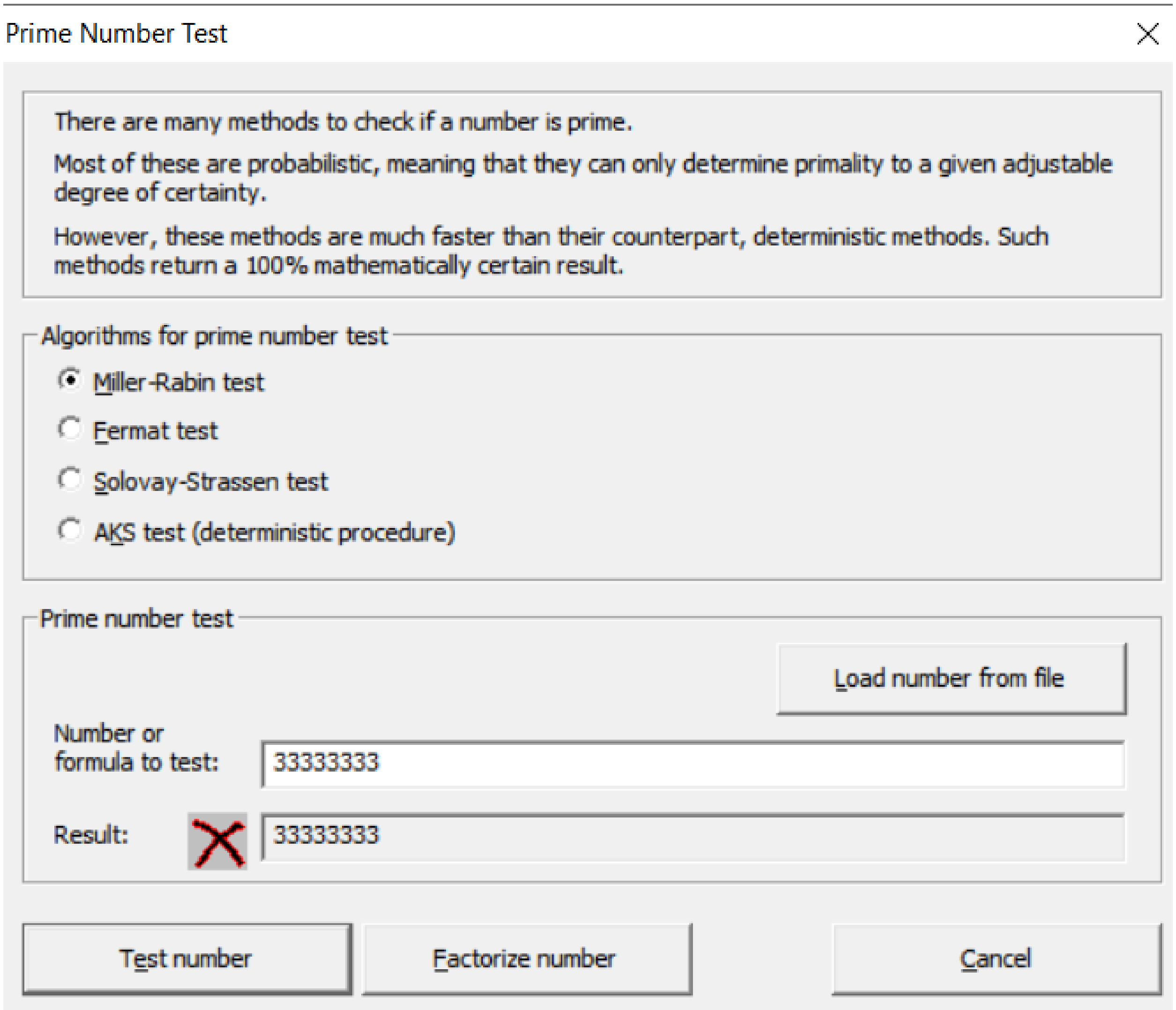

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
314821
Result:
314821
Test number
Factorize number
Cancel


Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
294409
Result:
294409
Test number
Factorize number
Cancel

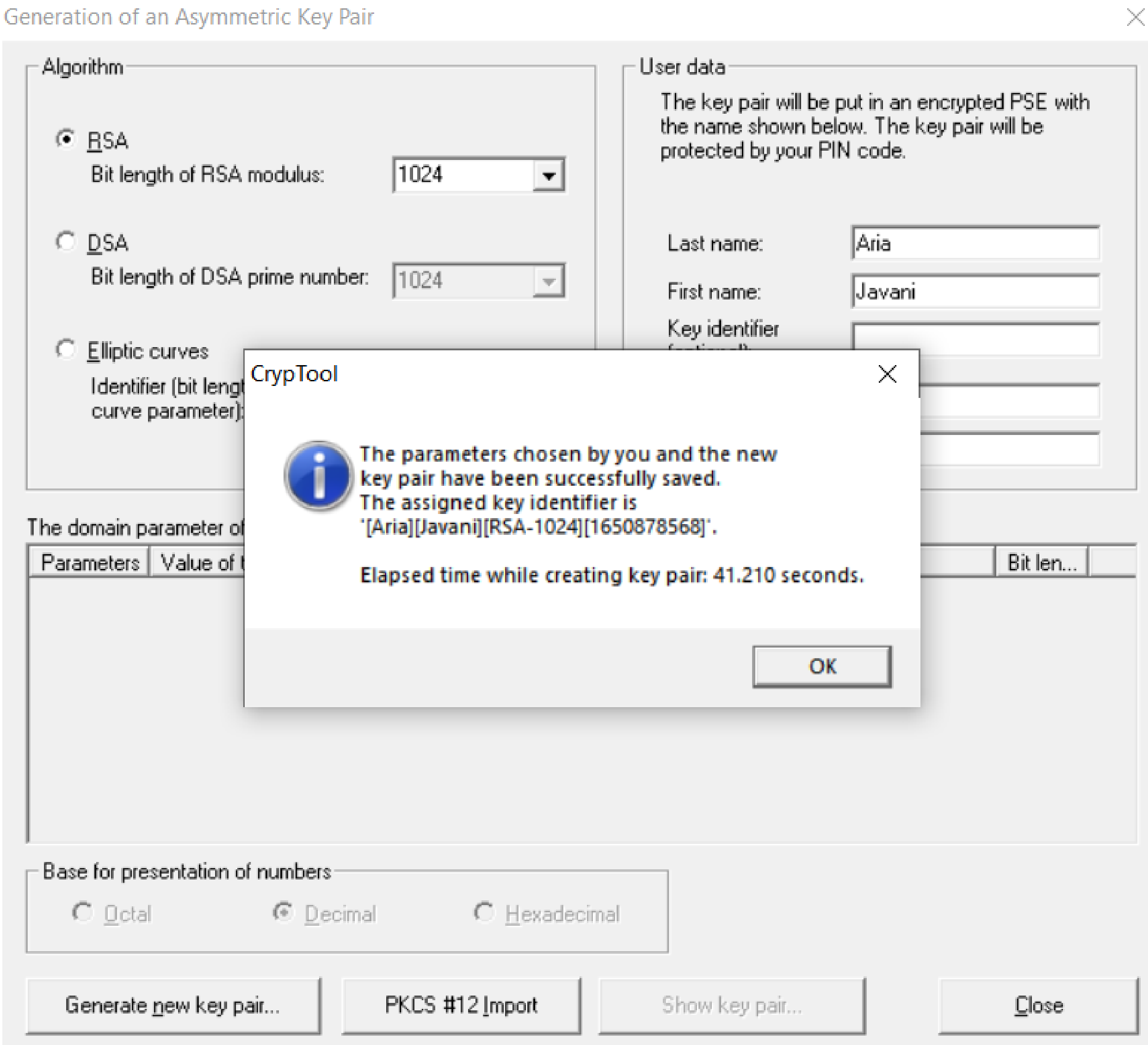

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
294409
Result:
294409
Test number
Factorize number
Cancel


Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
111111111
Result:
111111111
Test number
Factorize number
Cancel


Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
222222222
Result:
222222222
Test number
Factorize number
Cancel

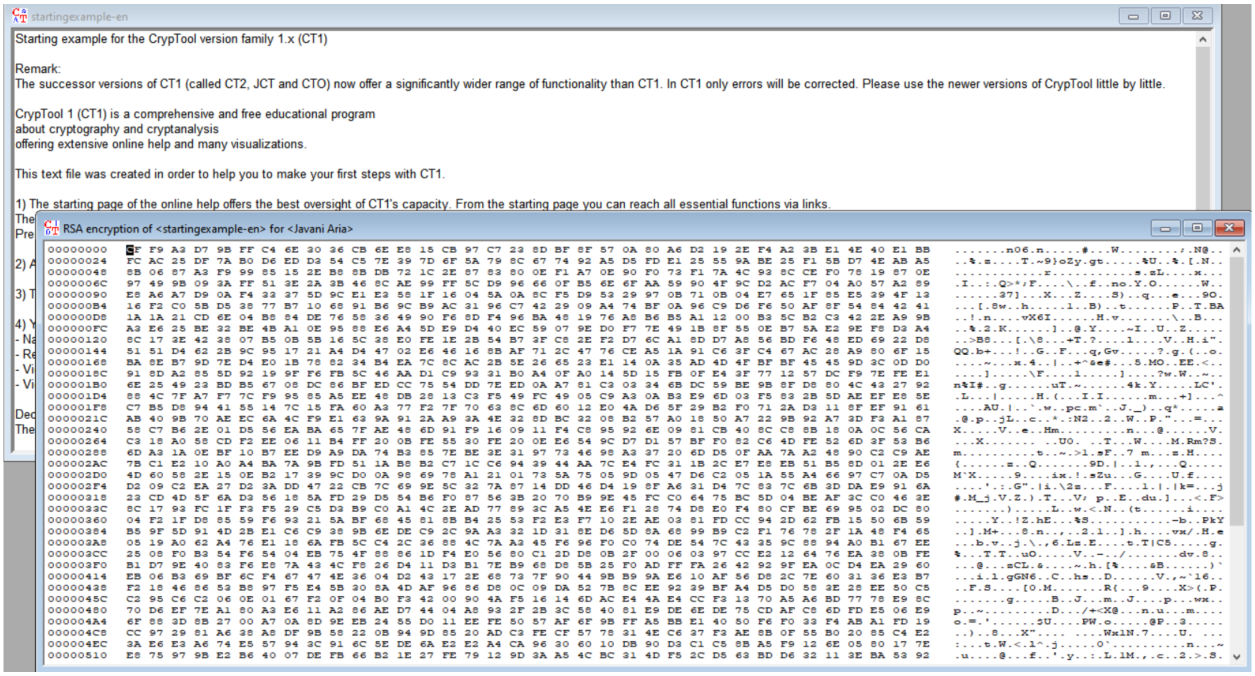

Prime Number Test
There are many methods to check if a number is prime.
Most of these are probabilistic, meaning that they can only determine primality to a given adjustable degree of certainty.
However, these methods are much faster than their counterpart, deterministic methods. Such methods return a 100% mathematically certain result.
Algorithms for prime number test
Miller-Rabin test
Fermat test
Solovay-Strassen test
AKS test (deterministic procedure)
Prime number test
Load number from file
Number or formula to test:
33333333
Result:
33333333
Test number
Factorize number
Cancel

3)

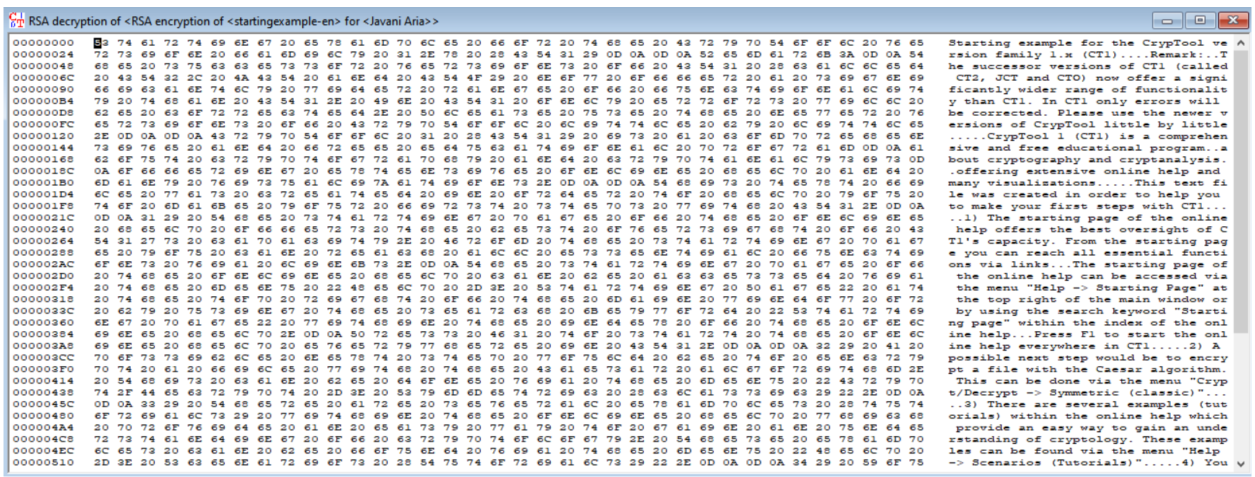


4)

Last name	First name	Key type	Key identifier	Created	Internal ID no.
Aria	Javani	RSA-1024		25.04.2022 02:22:48	1650878568
SideChannelAt...	Bob	RSA-512	PIN=1234	06.07.2006 02:51:34	1152179494

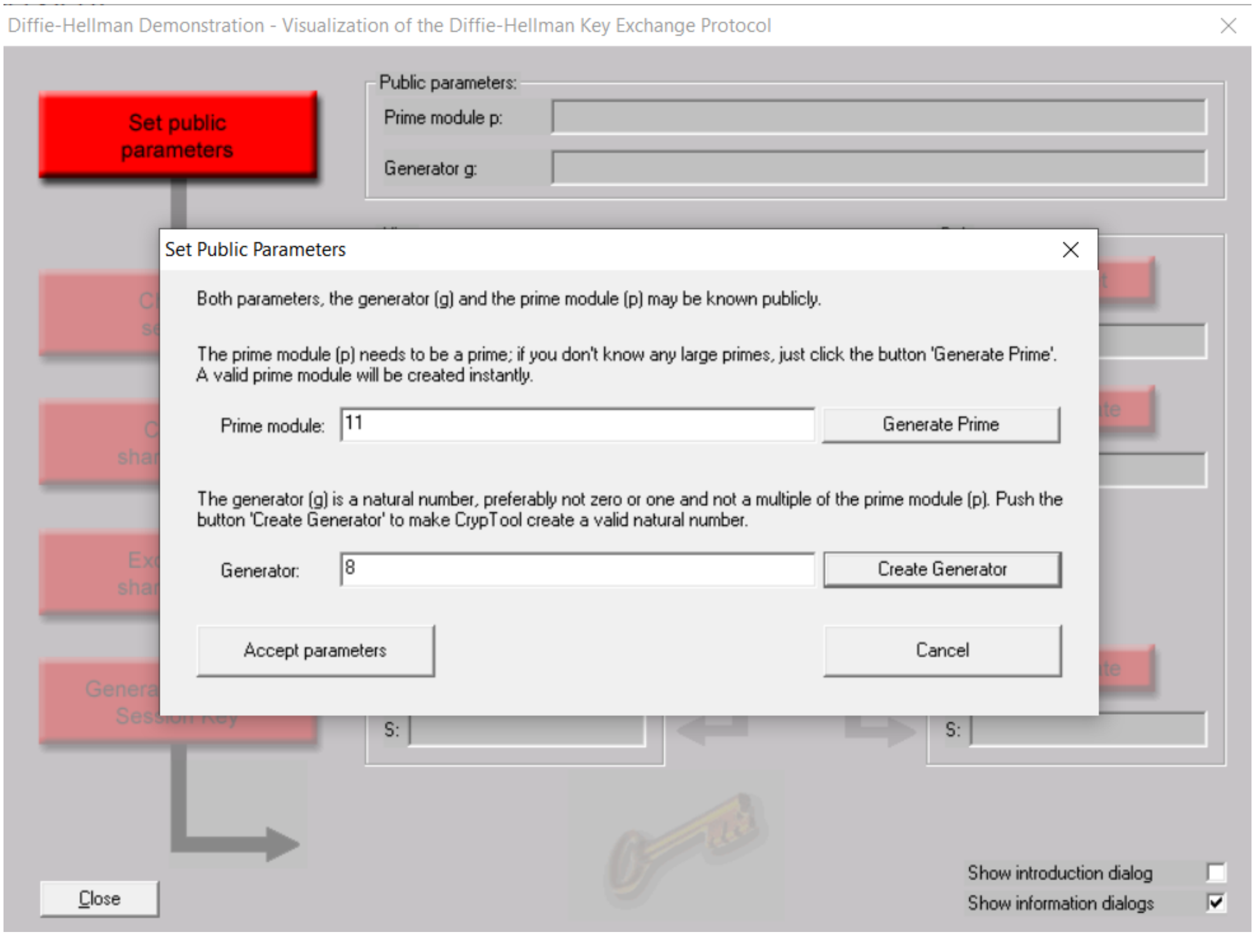


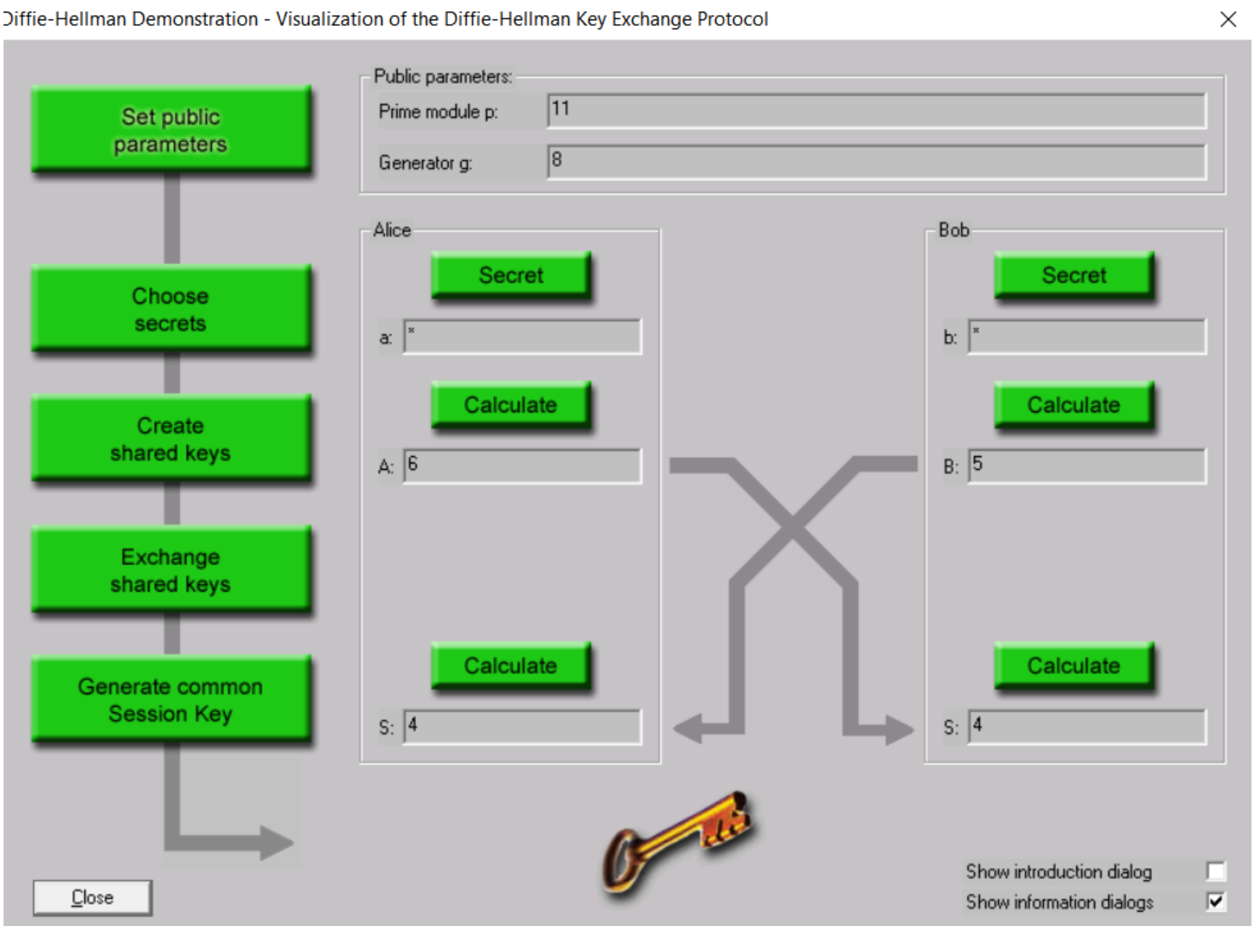
encryption



decryption

5)


Diffie-Hellman Demonstration - Visualization of the Diffie-Hellman Key Exchange Protocol
Set public parameters
Public parameters:
Prime module p:
Generator g:
Set Public Parameters
Both parameters, the generator (g) and the prime module (p) may be known publicly.
The prime module (p) needs to be a prime; if you don't know any large primes, just click the button 'Generate Prime'. A valid prime module will be created instantly.
Prime module:
11
Generate Prime
The generator (g) is a natural number, preferably not zero or one and not a multiple of the prime module (p). Push the button 'Create Generator' to make CrypTool create a valid natural number.
Generator:
8
Create Generator
Accept parameters
Cancel
S:
S:
Show introduction dialog
Show information dialogs
Close


Diffie-Hellman Demonstration - Visualization of the Diffie-Hellman Key Exchange Protocol
Set public parameters
Choose secrets
Create shared keys
Exchange shared keys
Generate common Session Key
Close
Public parameters:
Prime module p:
11
Generator g:
8
Alice
Secret
a:
*
Calculate
A:
6
Calculate
S:
4
Bob
Secret
b:
*
Calculate
B:
5
Calculate
S:
4
Show introduction dialog
Show information dialogs