CrypTool

Cryptography for the masses

An overview of the CrypTool project
... given at the CrypTool conference in Munich, 2019
... from the past (history starting with CT1 as part of the awareness program of one company),
... with statistics and success stories all over the world in the present
... to the future
... plus hints to the talks coming after this presentation

Prof. Bernhard Esslinger

(presentation layout done with some help from Gonzalo; pictures by pixabay)

Cryptography everywhere …

In the digital era, we are all cryptography consumers, whether we know it or not.

Whenever we use the mobile telephone, withdraw money from an ATM, go shopping to an e-commerce site using SSL, or use a messenger, we are using cryptographic services which protect the confidentiality, integrity, and authenticity of our data.

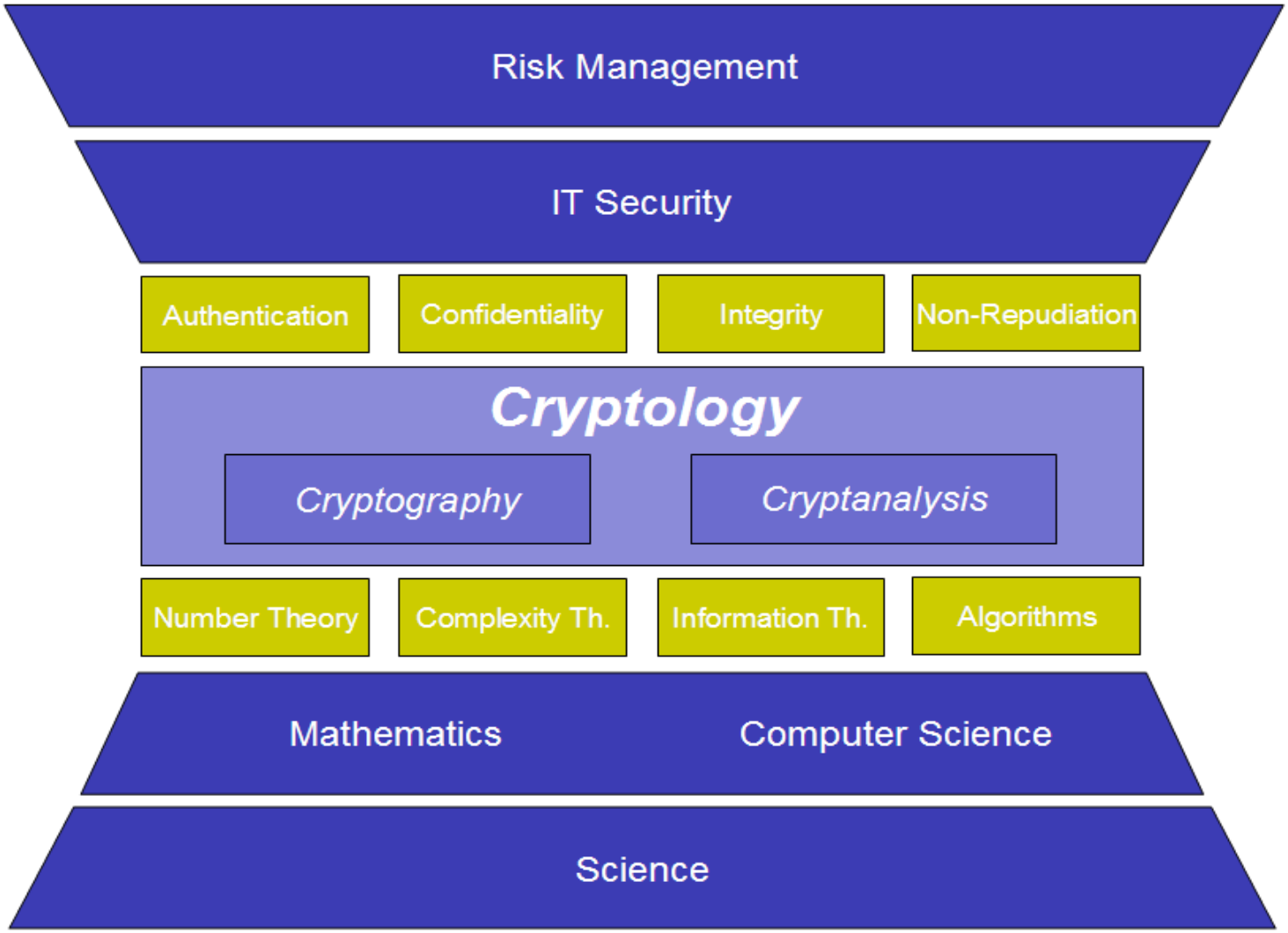
The world as we know it wouldn’t exist without cryptography.

Cryptography challenges education

Around all of us

- perceived as difficult
- lack of understanding
  - curricula
  - teachers need useful tools

Context of Cryptography



www.cryptool.org

CrypTool today: 5 products

CRYPtOOL — version 1.x http://www.cryptool.org/en/cryptool1

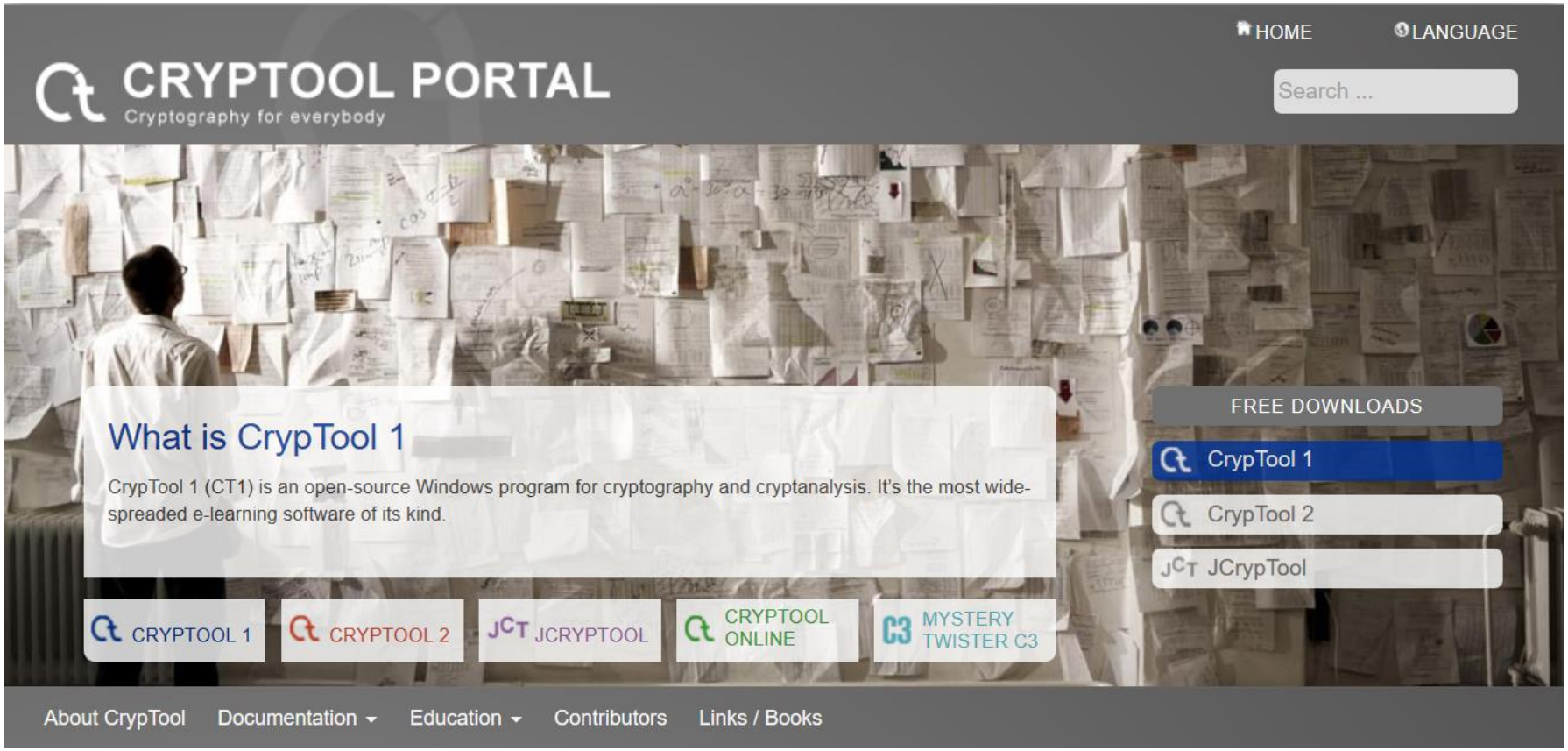
CRYPtOOL 2 — http://www.cryptool.org/en/ct2

JCrypTool — The cryptography e-learning platform. — https://github.com/jcryptool/

CRYPtOOL-ONLINE — http://www.cryptool-online.org

MysteryTwister C3 — THE CRYPTO CHALLENGE CONTEST — http://www.mysterytwisterc3.org/

CrypTool Portal: website today



www.cryptool.org

PORTAL

What is JCrypTool?

JCrypTool (JCT) is an open-source e-learning platform, allowing to experiment comprehensively with cryptography on Linux, MAC OS X, and Windows.

FREE DOWNLOADS

- CrypTool 1
- CrypTool 2
- JCrypTool

CRYPTOOL 1 | CRYPTOOL 2 | JCT JCRYPTOOL | CRYPTOOL ONLINE | C3 MYSTERY TWISTER C3

JCRYPTOOL NEWS

JCRYPTOOL UPDATES TO ECLIPSE 2019-06

JCrypTool weekly builds are based on the latest Eclipse version 2019-06 since July 2019.

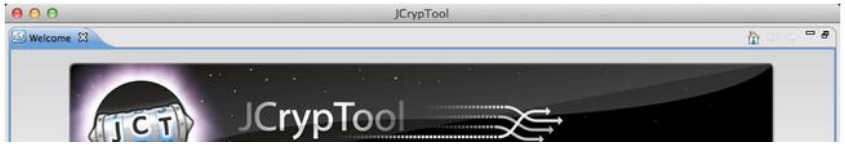
Read more ...

RELEASE CANDIDATE 9 AVAILABLE

Release Candidate 9 is

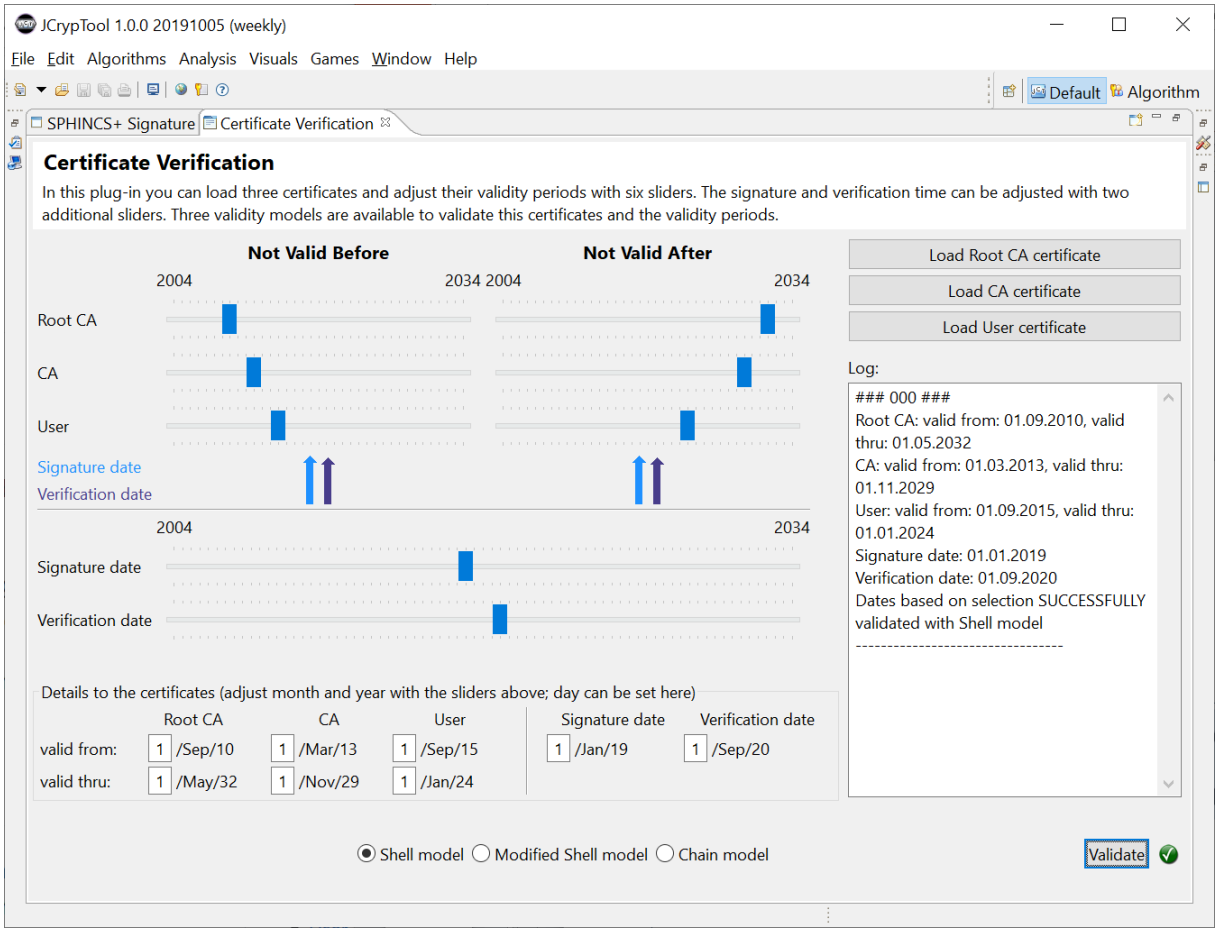
JCrypTool -- The cryptography e-learning platform

JCrypTool enables students, teachers, developers, and anyone else interested in cryptography to apply and analyze cryptographic algorithms in a modern, easy-to-use application. The JCT plaform creates a new way of e-learning by not just encouraging users to learn about cryptography and apply the algorithms themselves, but also to develop their own cryptographic plug-ins and extend the JCrypTool platform in new directions.



JCrypTool: User presentation

https://github.com/jcryptool/core/wiki/jcryptool_user_presentation/jcryptool_presentation_en.pdf



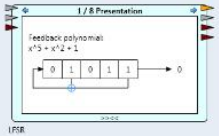
About CrypTool 2

CrypTool 2 is the modern successor of CrypTool 1, the well-known e-learning platform for cryptography and cryptanalysis.

Modern Plug'n'Play Interface / Visual Programming

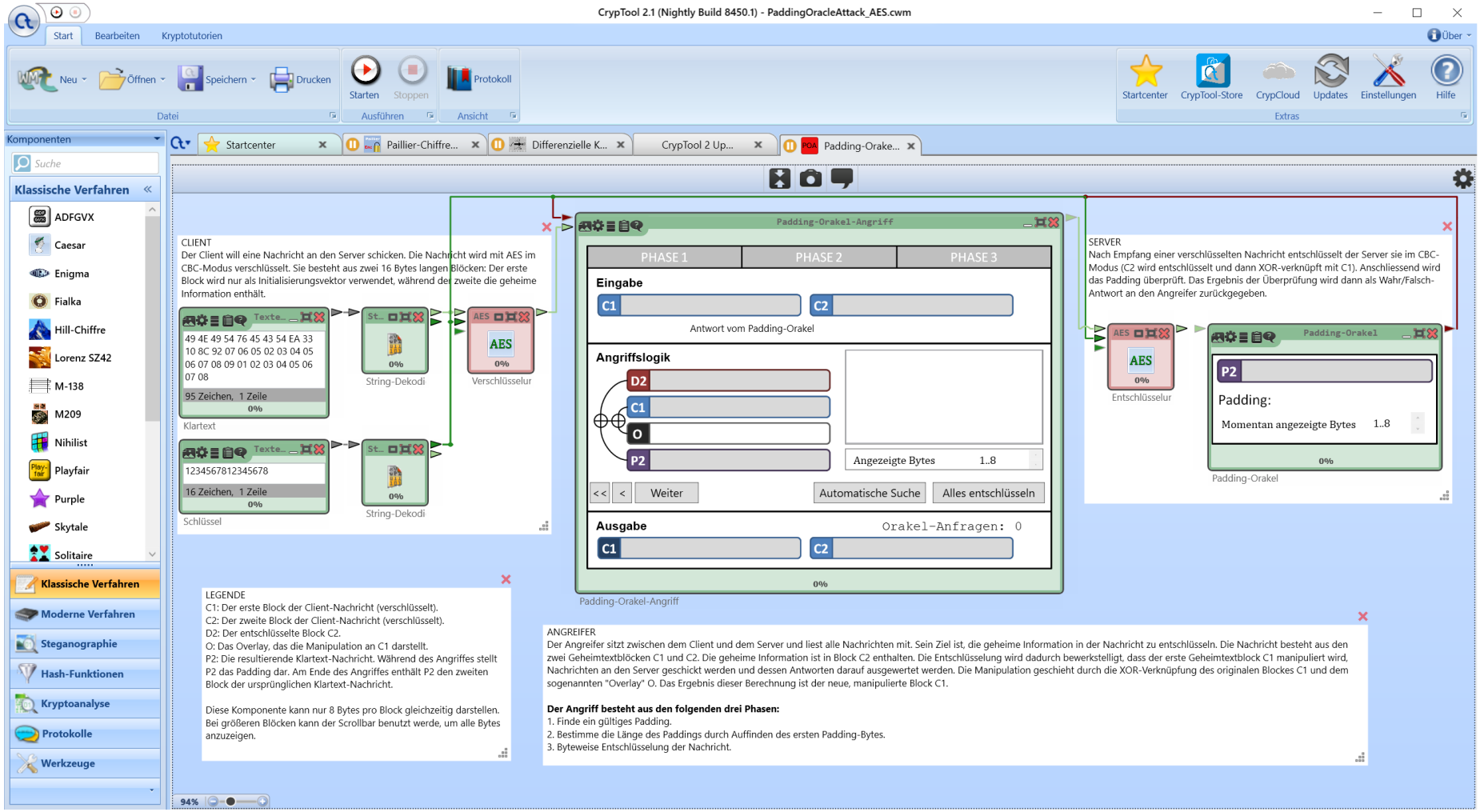
CrypTool 2 provides a graphical user interface for visual programming. So workflows can be visualized and controlled to enable intuitive manipulation and interaction of cryptographic functions.
The vector-oriented GUI is based on the Windows Presentation Foundation (WPF) and gives users the ability to scale the current view at will.

Visualization of Algorithms



The same component used for visual workflow programming can also visualize its inner operation. This makes it handy for the user to comprehend all the details of a cryptographic algorithm while seeing the bigger picture of how this algorithm may be used in a real-life scenario.

CrypTool 2: Sample screen



CrypTool: founded 1998 like …

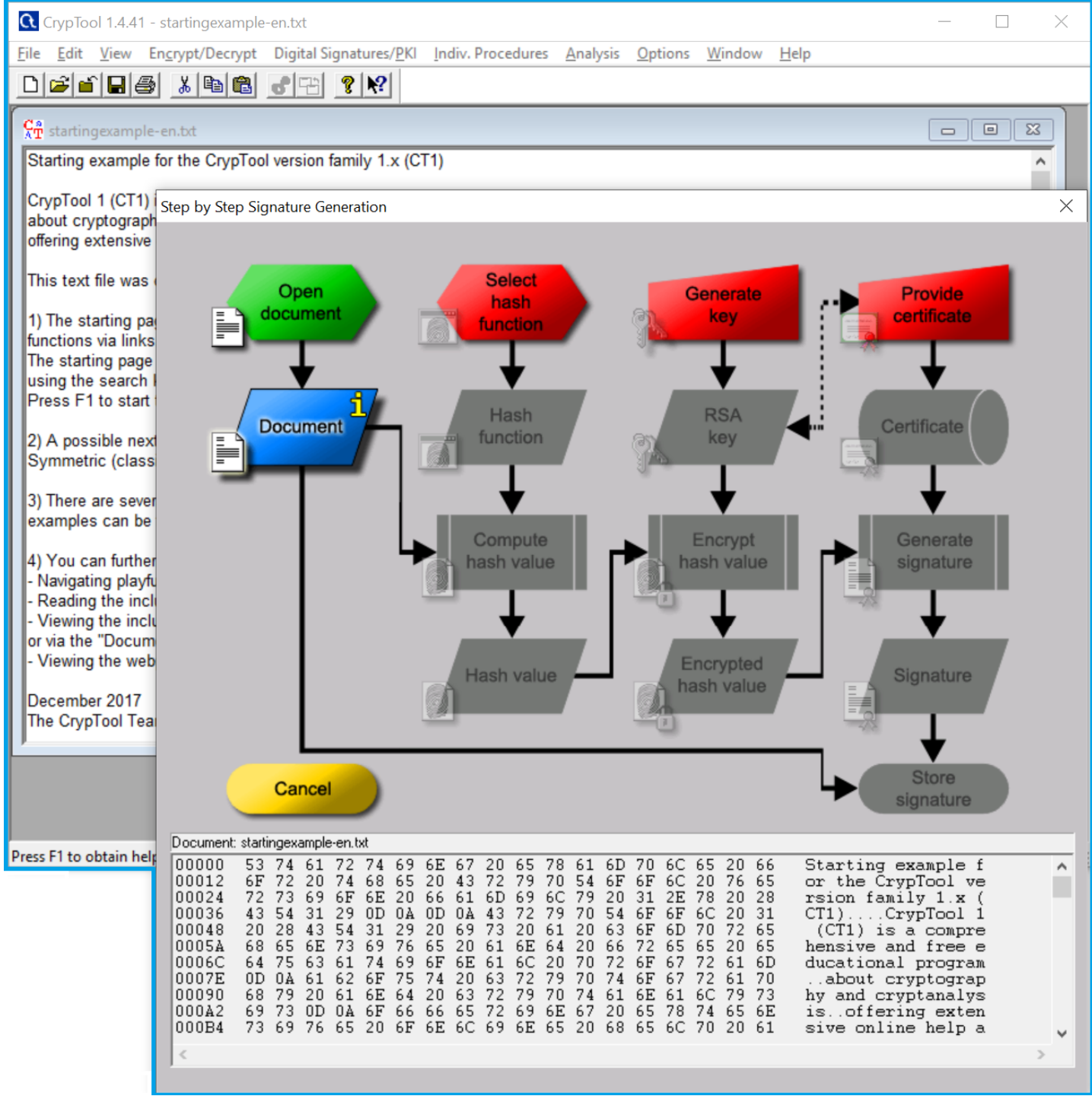
- Attac, Paris
- Google, Menlo Park
- CrypTool, Frankfurt

CrypTool 1: Two warnings

- legal
- worrywarts

besides the warnings:

CT1 still made it

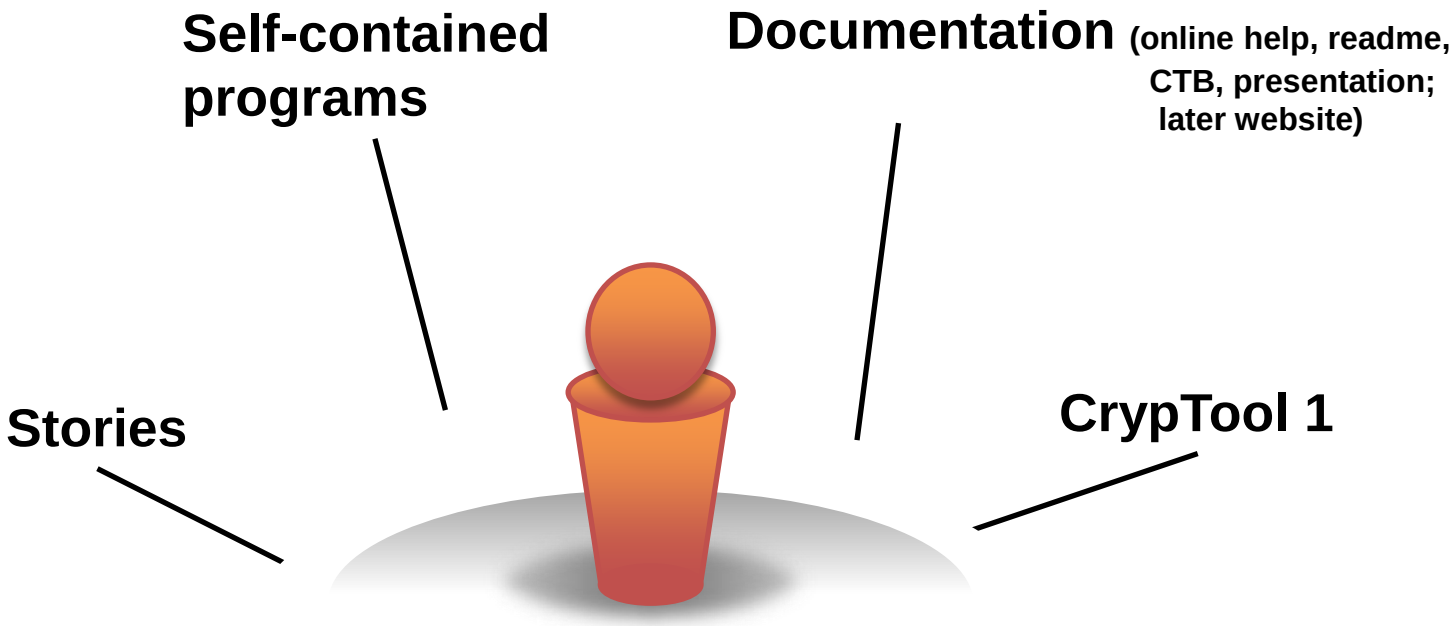


Playful learning

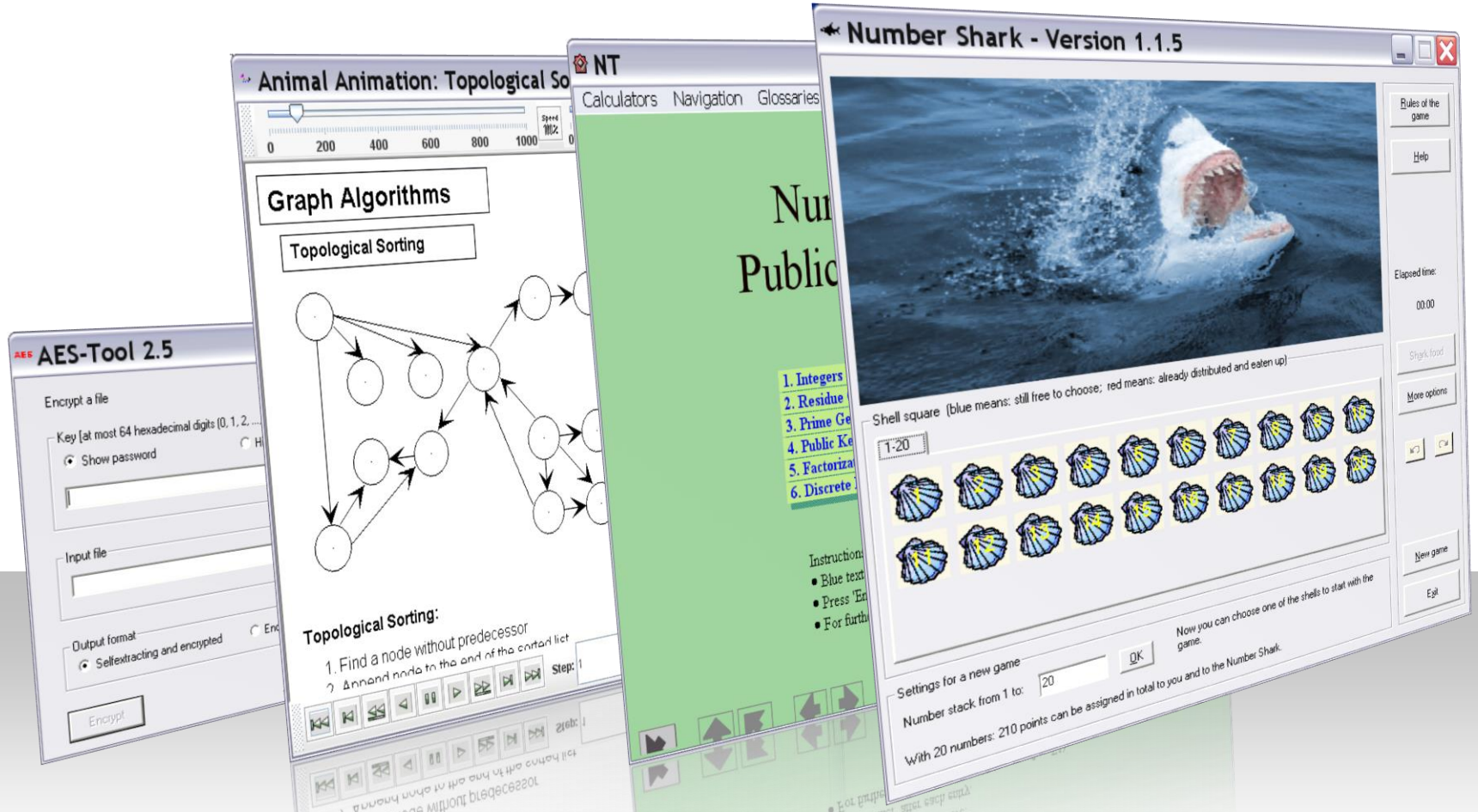
Serious tool

CrypTool can be used to visualize many concepts of cryptology: including digital signatures, symmetric, asymmetric and hybrid encryption, protocols, cryptanalysis, etc.

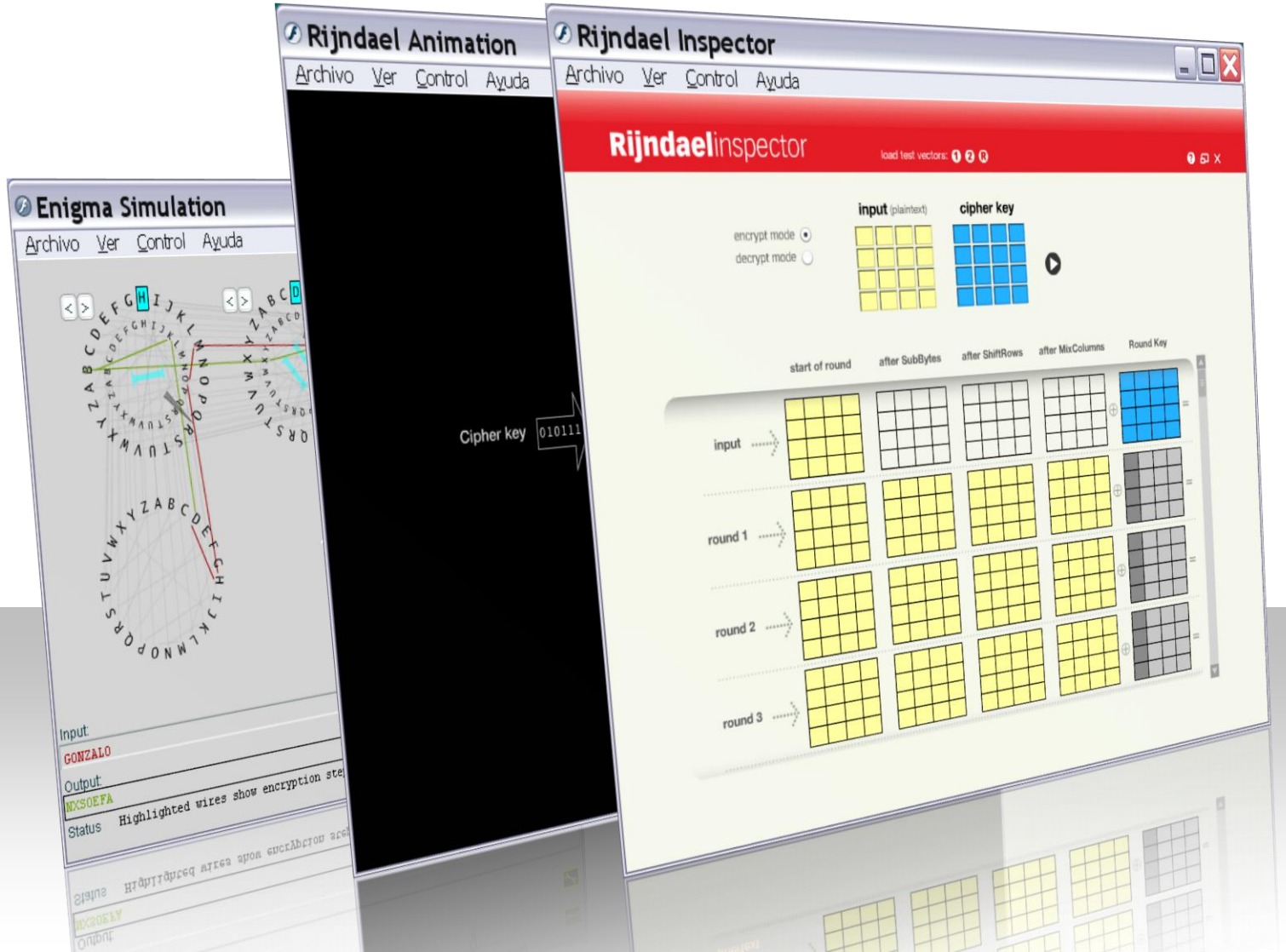
CrypTool 1 package



Self-contained programs



Flash animations



The Dialogue of the Sisters

The Chinese Labyrinth

There are two stories included dealing with number theory and cryptography:

- In "The Dialogue of the Sisters" the title-role sisters use a variant of the RSA algorithm, in order to communicate securely.
- In "The Chinese Labyrinth" Marco Polo has to solve number theoretic problems to become a minister of the Great Khan.

CrypTool website: 2003

CrypTool

Homepage
CT-Uvod
- ©to je CrypTool?
- Online pomoc, dokumentacija i vodici
- Screenshots
- O organizaciji
- Novo u ovoj verziji
- Izdavanje izvornog koda

Prezentacija [PDF]
Download
- Programski paket
- Izvorni kod

PročitajMe-datoteka
Vodič za studente
Linkovi
Kontakt/Imprint

Inicijatori:
- TU Darmstadt
- Deutsche Bank
- Siegen University
- Secude
- FZI

[German]
[English]

TECHNISCHE UNIVERSITÄT DARMSTADT

UNIVERSITÄT SIEGEN — Theorie und Praxis für Karrieren von morgen

Deutsche Bank

CrypTool 1.3.05

eLearning Program za kriptografiju

Hrvatski CrypTool Mirror je preveo i obradio: **Matej Matejiček**, MB 0036375274.
Matej Matejiček je 2001. godine sudjelovao na izradi CrypTool alata, a zaslužan je za implementaciju testova i potrebne dokumentacije na njemačkom koji provjeravaju valjanost pseudoslučajnih generiranih brojeva.
Ove preslika (*mirror*) stranice su rezultat seminarskog rada iz predmeta Operacijski sustavi 2 iz područja Računalne sigurnosti na Fakultetu elektrotehnike i računarstva Sveučilišta u Zagrebu.

Kriptografija je inicijalno vezana uz tajnost pisanih poruke.

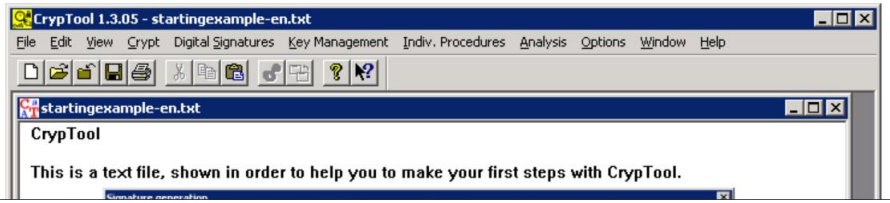
Danas je kriptografija aktivno područje istraživanja sa pregštom primjena u modernom životu (sustav za imobilizaciju u automobilima, mobilni telefoni, SSL veze između pregledavača internet stranica i poslužitelja, ...) -- uglavnom neprimjećena.

Mnogo ljudi su još kao djeca pokušali enkriptirati poruke sa jednostavnim metodama. Ali, većina njih nikad nije dobila neku dublju predodžbu i ideju o modernoj kriptografiji. Sa CrypTool kriptografijom (i kriptoanalizom) se o tome može naučiti i uvježbati na zabavan način.

Open source projekt CrypTool koji je pokrenut od 1998 od strane gospodina Bernhard Esslinger-a, razvija freeware program CrypTool u želji da širi znanje. Ovaj program je korišten na sveučilištima, školama kao i u nacionalnim i internacionalnim kompanijama i agencijama.

Program CrypTool je eLearning alat za Windows operacijski sustav koji je tu da primjeni i analizira kriptografske mehanizme. Sadrži iscrpnu online pomoć sa vodičima/scenarijima i skriptom sa više detaljnih informacija.

Volonteri, pogotovo programeri i studenti koji planiraju pisati njihove teze su uvijek dobrodošli u ovaj svjetski projekt.



CrypTool website: 2008

CRYPtOOL

Acerca de | Características | Medios | Documentación | Descargas

Última versión estable: 1.4.21 Descargar (en inglés) (próximamente en Castellano)

Acerca de

- Introducción a Cryptool
- Cryptool en la Educación
- Crytool para el Conocimiento
- Cobertura en los medios
- Premios
- Colaboradores
- Proyectos Relacionados
- Contacto

Selected Landmark en 2008:

Germany
Land of Ideas

"CrypTool ist einmalig, medial anregend aufgebaut und, soweit ich es uebersehe, ohne Fehler."
-Prof. Dr. Ruediger Grimm, TU Illmenau

Introducción a CrypTool

Cryptool es una aplicación de aprendizaje electrónico gratuita para Windows. Puede utilizarse para aplicar y analizar algoritmos criptográficos. La versión actual de Cryptool se utiliza en todo el mundo. Soporta tanto los métodos actuales de enseñanza en escuelas y universidades como la concienciación de los empleados.

La versión actual ofrece, entre otras cosas, lo siguiente:

- Numerosos algoritmos criptográficos, clásicos y modernos (cifrado y descifrado, generación de clave, contraseñas seguras, autentificación, protocolos seguros, ...)
- Visualización de varios métodos (p.ej. César, Enigma, RSA, Diffie-Hellman, firmas digitales, AES)
- Criptoanálisis de ciertos algoritmos (p.ej. Vigenère, RSA, AES)
- Métodos de medida criptoanalítica (p.ej. entropía, n-grams, autocorrelación)
- Métodos auxiliares (p.ej. tests de primalidad, factorización, codificación en base64)
- Tutorial sobre teoría de números.
- Ayuda detallada on-line.
- Script con más información sobre criptografía.

Desde su uso original para la formación en seguridad de una compañía, Cryptool ha evolucionado en un destacado proyecto de código abierto para temas relacionados con la criptografía.

Desde la primavera de 2008, está funcionando dentro del proyeto Cryptool el Cripto Portal para profesores. Por ahora el portal sólo está disponible en alemán y se espera que actúe como una plataforma para que los profesores puedan compartir material para la enseñanza de la criptografía y temas relacionados.

Actualmente el equipo de Cryptool está trabajando en dos proyectos futuros que se espera que sean los sucesores de la actual versión CrypTool 1.4.x que está escrita en C++. Ambos proyectos de continuación utilizan el último modelo de estándares de programación, pero aún están en un estado alfa/beta:

- Cryptool 2.0 se desarrolla en C# con Visual Studio 2008 (Express Edition) y WPF. La versión alfa (para desarrolladores) se hizo pública en Abril de 2008. Esta versión proporciona una arquitectura completamente desarrollada y una práctica funcionalidad criptográfica combinada con una pionera interfaz gráfica con la funcionalidad de *drag-and-drop*.
- JCrypTool se desarrolla en Java basado en Eclipse RCP. La primera versión (llamada milestone 1) se hizo pública en Agosto de 2007, la publiación de la siguiente versión (llamada milestone2, esperada para desarrolladores y usuarios) se espera para Junio de 2008. JCrypTool es independiente de plataforma y trabaja junto con el FlexiProvider (un potente conjunto de herramientas para la Java Cryptography Architecture JCA) desarrollado por el TU Darmstadt, y con BouncyCastle.

En la hoja de ruta puede encontrar las nuevas características planeadas para ambas futuras versiones, y las fechas esperadas para la publicación de la próxima versión de CrypTool 1.4.x.

Voluntarios, especialmente programadores y estudiantes que planeen escribir sus tesis, son siempre bienvenidos a unirse para el desarrollo de este proyecto world-wide.

Contacto | Imprint | Mapa web

Última modificación de la página: October 28, 2008 - 14:03

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Hosting / CT2 + JCT

- hosting: DA, Duisburg-Essen, Kassel
  → Munich
- the two CT1 successors CT2 + JCT
  - started in 2008,
  - their 1st public version available in 2011

Samples for having to act like professionals

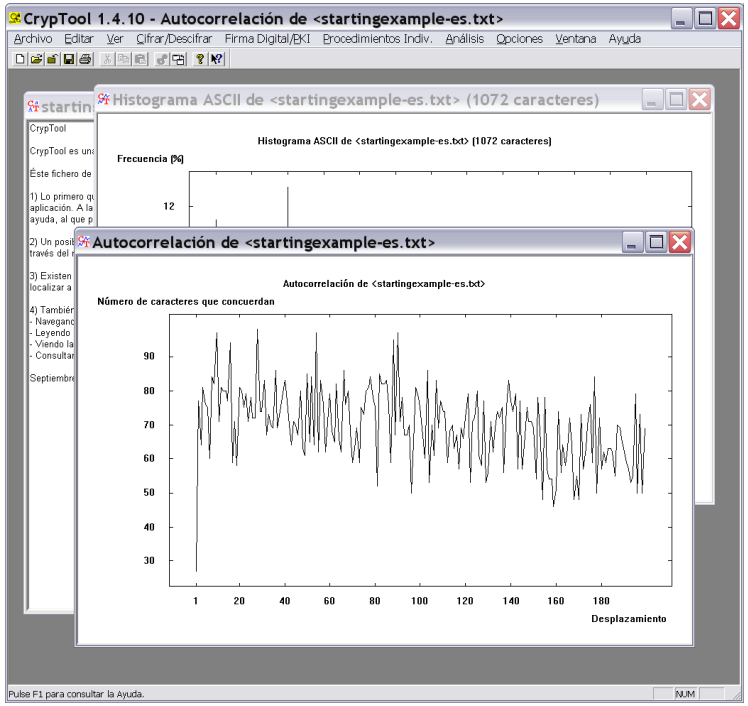
- server certificates
- signed executables
- trade mark for the name „CrypTool“
- General Data Protection Regulation (GDPR)
- update permanently

Working mode with students

- core team of professionals and maintainers
- students: new stuff during their theses
- students: joining our way for a longer time
- current students' theses or projects:
  - SPHINCS+ Hagenberg
  - DCA tutorial Siegen
  - Signatures Passau
  - VIC Bratislava
  - Grover Aachen/Munich
  - PQC Darmstadt (Fraunhofer)
  - Cipher type detection San Jose

Subprojects: CrypTool 1 (CT1)

- today only maintenance
- available in 6 languages
- still high share of all downloads
- specialty:
  F1 for menu items
- last release version
  1.4.41 from Nov 2017



Subprojects: CT2 and JCT

- currently our major versions
- 64 bit

➔ closer look at these: later today

Setup sizes and source loc

	Setup Size	Lines of Code
CT1	ca. 70 MB	ca. 300' in C/C++/Java and Perl ca. 90' in rc files for GUI resources ca. 70' in html and txt for online help
CT2	ca. 170 MB	ca. 600' in C#/C++/Java *metrics vague
JCT	ca. 130 MB	ca. 200' in Java/C/C++

Subprojects: CTO

- cryptography and awareness in the browser
- started 2010
- 2016 last bigger change (new backend with Joomla 3.6, Bootstrap, JS; quicker react times; better responsiveness)
- … more later today

What is CrypTool-Online?

CrypTool-Online (CTO) runs in a browser and provides a variety of encryption and cryptanalysis methods including illustrated examples and tools like password generator and password meter.

FREE DOWNLOADS

- CrypTool 1
- CrypTool 2
- JCrypTool

CRYPTOOL 1 | CRYPTOOL 2 | JCRYPTOOL | CRYPTOOL ONLINE | MYSTERY TWISTER C3

About CrypTool-Online | Ciphers | Codings | Cryptanalysis | Highlights | Documentation

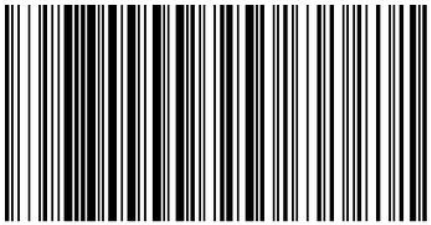
CTO OVERVIEW

CIPHERS

How do classical ciphers work?

CODINGS

Where are codings used and how do they work?



CRYPTANALYSIS

How to obtain the plaintext without knowing the decryption key?

About CrypTool-Online (CTO)

Encrypt directly within your browser

CrypTool-Online provides an exciting insight into the world of cryptology. A variety of ciphers, **coding methods**, and analysis tools are introduced together with illustrated examples. Our emphasis is on making explanations easy to understand in order to further the general interest in cryptography and cryptanalysis. Therefore, you can experiment with the introduced methods in an interactive way directly on the website.

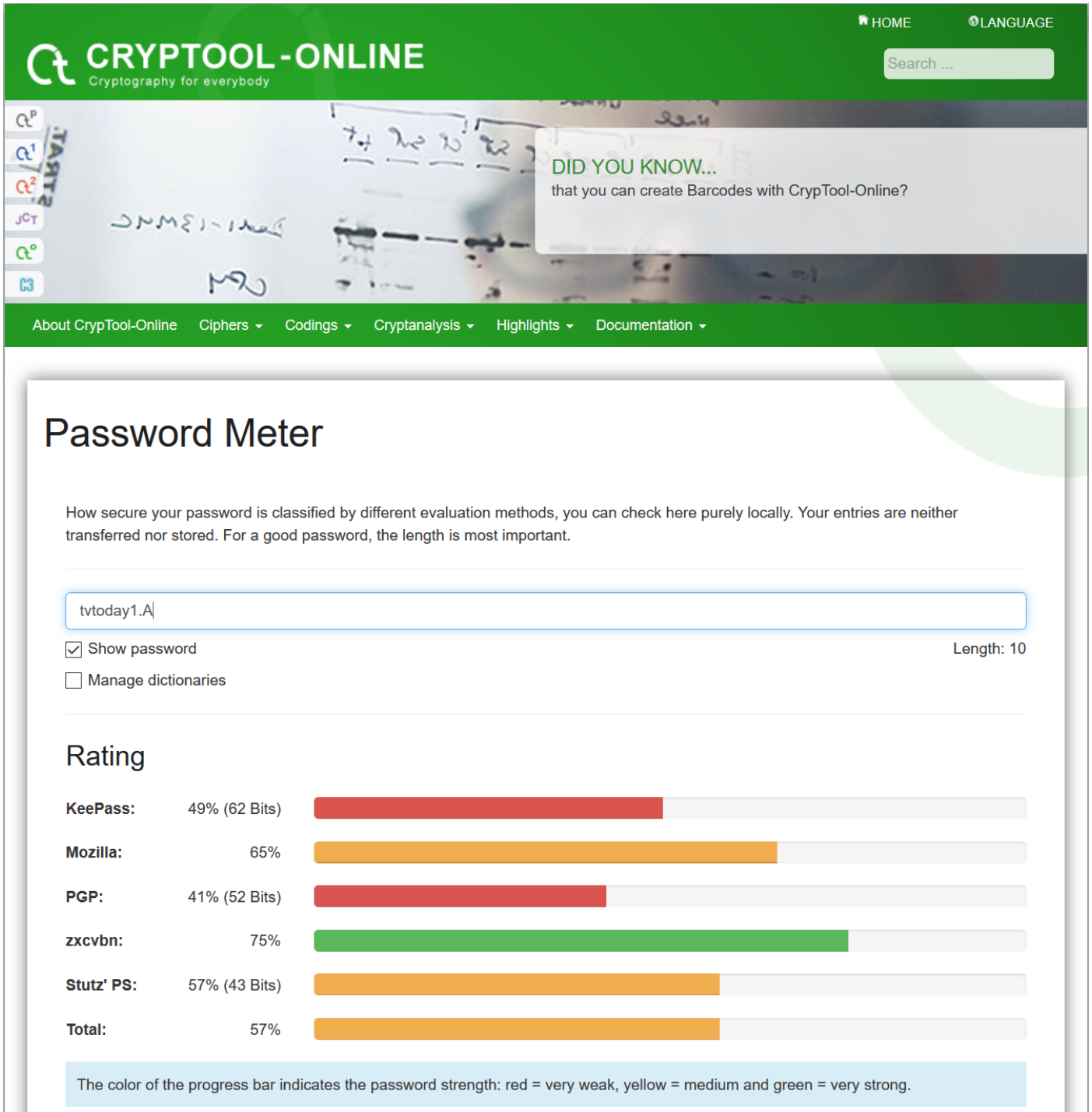
So you can learn the fundamentals of historically relevant ciphers in a little while, and also use the tools under **Ciphers** to encrypt messages yourself. You can also decrypt and **analyze** already encrypted messages and discover weaknesses of different ciphers. Under **Highlights**, you can for instance check the modern cipher AES or let the site generate good passwords for you.

CrypTool-Online is the online version of the e-learning program CrypTool. The so-called download (or offline) versions of CrypTool are also free and suitable for working with longer texts and conducting high performance analyses on encrypted messages.

Developers who like to join and enhance CTO with self-written plugins, find a good guidance in the Wiki. Especially the page How-to-Start leads you step-by-step.

This site works together with the website www.cryptoprograms.com, and partly is a successor of it. The author of cryptograms.com develops the famous Windows analyzer of classic ciphers **CryptoCrack**.

Another example of CTO



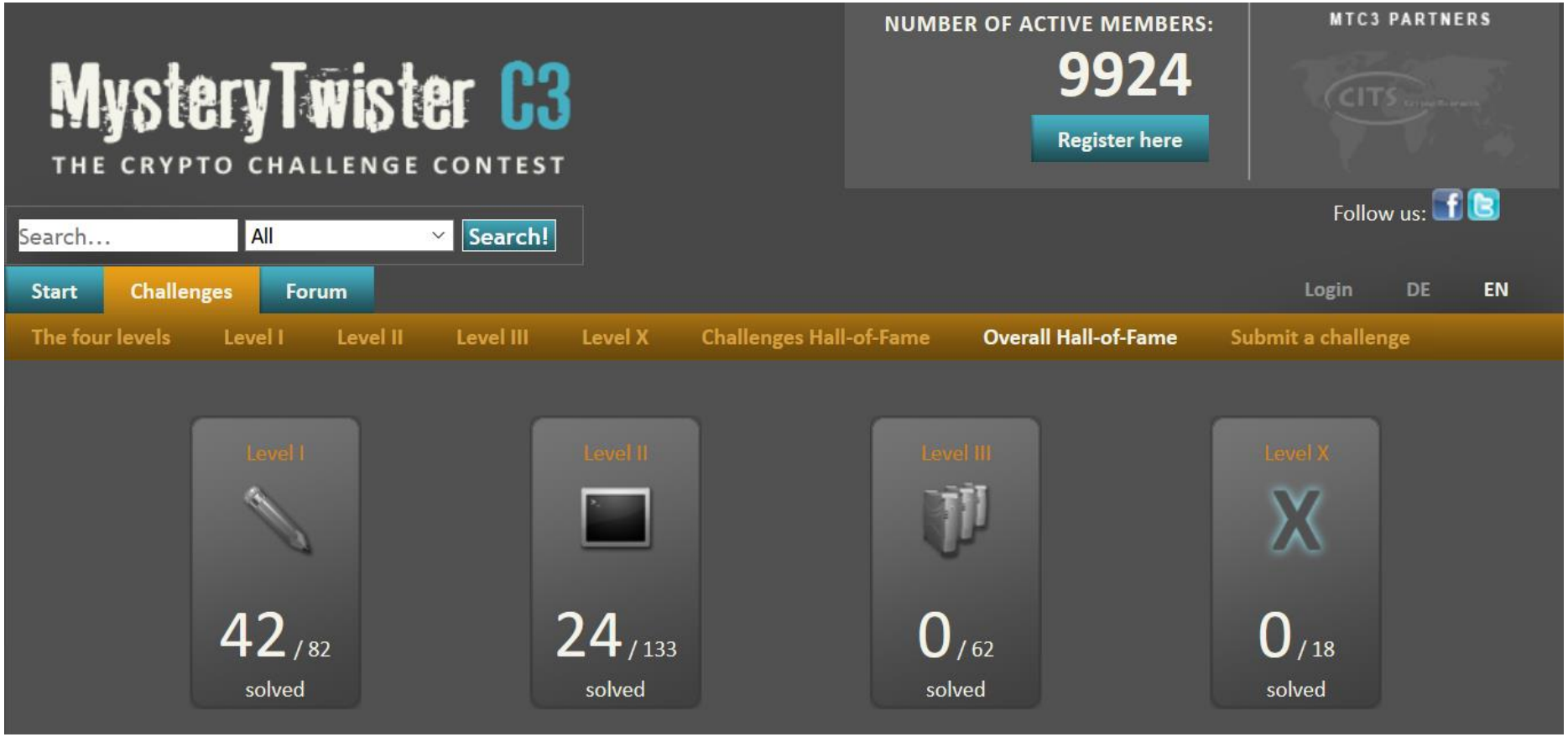
Subprojects: MTC3

- permanent crypto challenge contest
- started in 2010
- since then, more than 25,000 challenges solved

Source of picture: pixabay

… more tomorrow

Subprojects: MTC3



… more tomorrow

Subprojects: MTC3

Sample challenges

Start | Challenges | Forum | Login | DE | EN

The four levels | Level I | Level II | Level III | Level X | Challenges Hall-of-Fame | Overall Hall-of-Fame | Submit a challenge

Level I Challenges (82)

All challenges in Level I, ordered by date posted (the most recent appear first).

Music Code — Part 1

[wolter-01] - 38 users already solved this challenge, 26 are working on it.

A piece of music is given as mp3 file and in music notation. The notes represent a secret message, which was encrypted with two classic methods. In part 1 of this challenge you have to solve the first of these methods. Thereafter, you can set out to solve part 2 (which is in level 2).
Read more...

Click here to get to the corresponding forum topic to share your opinion.
Click here to download the challenge.
Click here to download the additional file of the challenge.

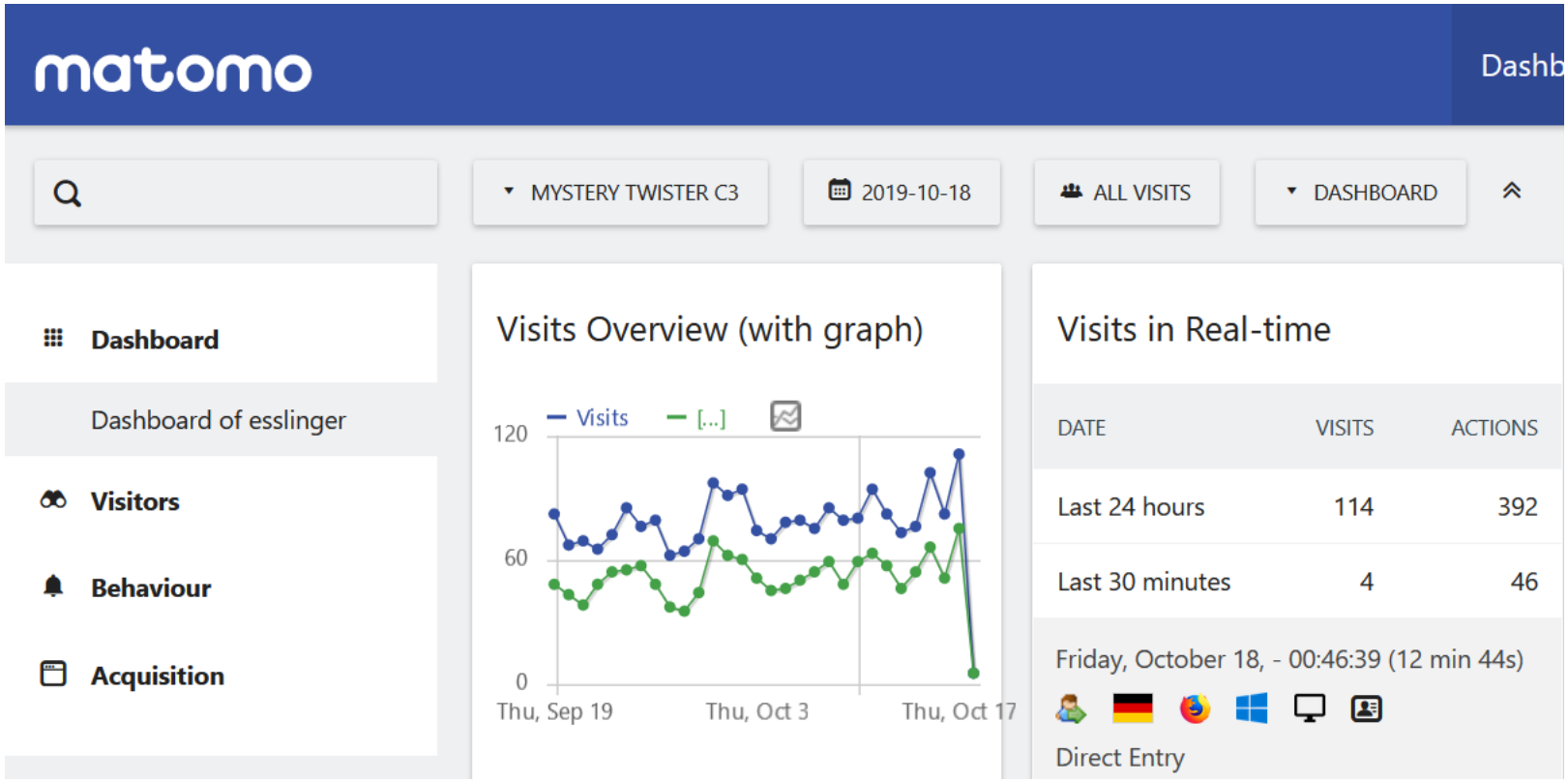
You must be logged in to solve the challenge

Post-Quantum Cryptography: Unbalanced Oil and Vinegar System — Part 1

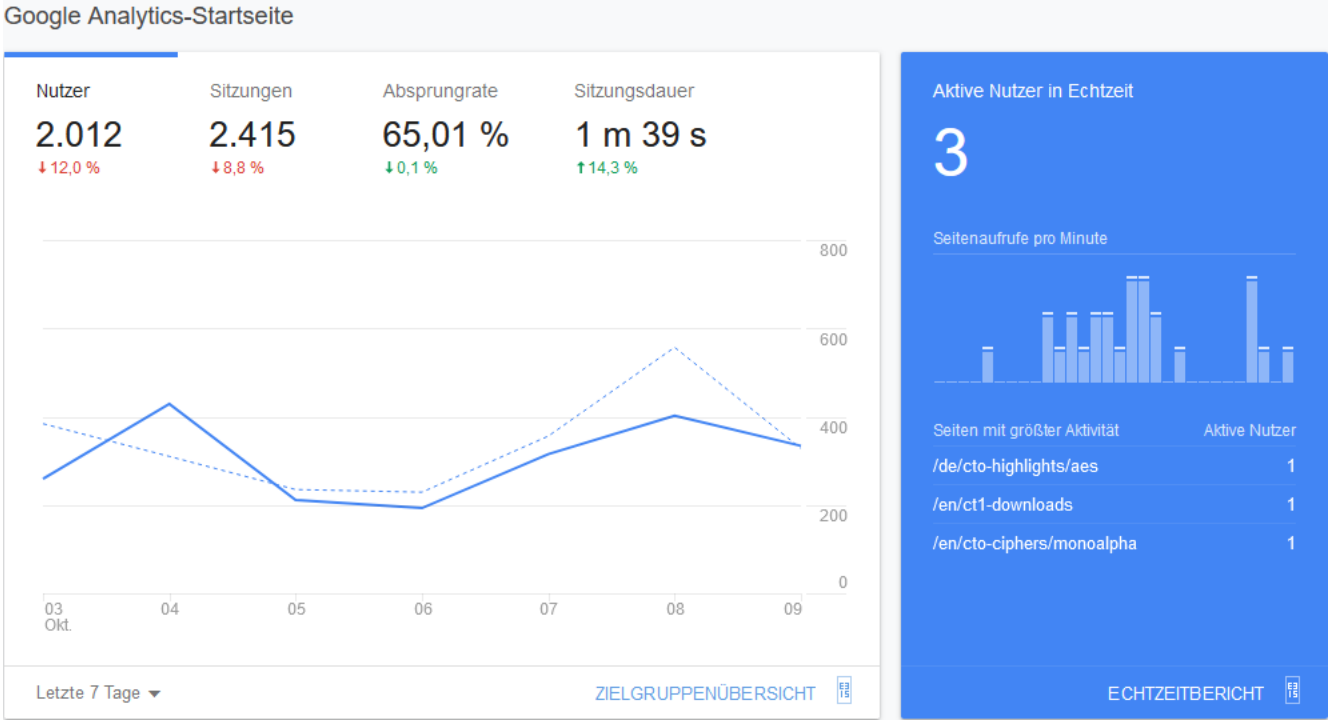
[wolf-01] - 86 users already solved this challenge, 2 are working on it.

Statistics: MTC3

> 70 distinguished users per day



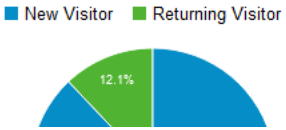
Statistics: CTO and CTP



Oct 10, 2019

Statistics: CTO and CTP

Users	New Users	Sessions	Number of Sessions per User
60,758	60,468	76,842	1.26



	Country	Users	% Users
1.	Germany	19,173	31.46%
2.	United States	9,956	16.34%
3.	India	3,797	6.23%
4.	Switzerland	2,316	3.80%
5.	China	1,970	3.23%
6.	Austria	1,716	2.82%
7.	United Kingdom	1,310	2.15%
8.	Australia	1,297	2.13%
9.	Taiwan	1,211	1.99%
10.	Canada	1,135	1.86%

Architecture: CTO and CTP

To be decided in the near future:

- move to static html

or

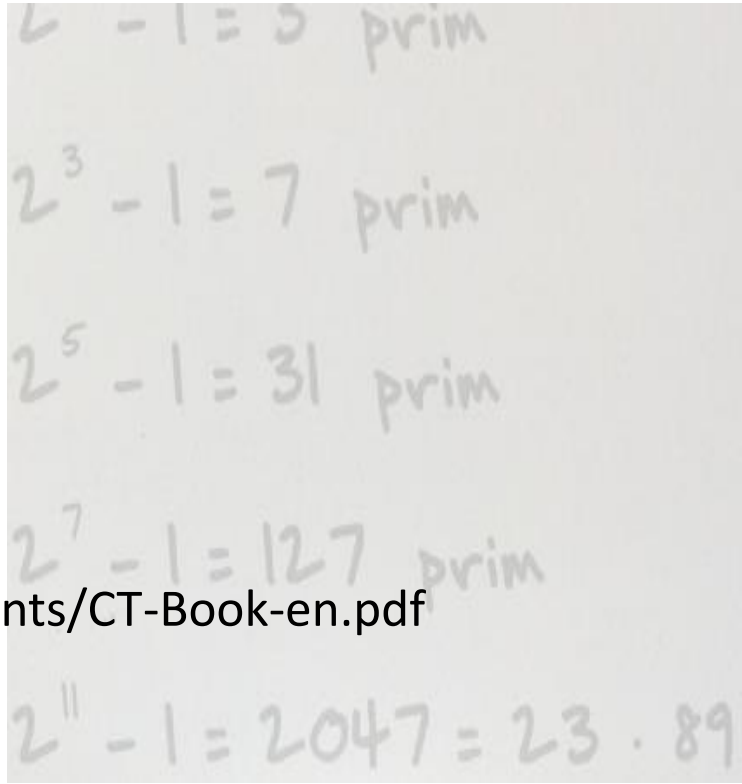
- update to Joomla 4

Source of picture: pixabay

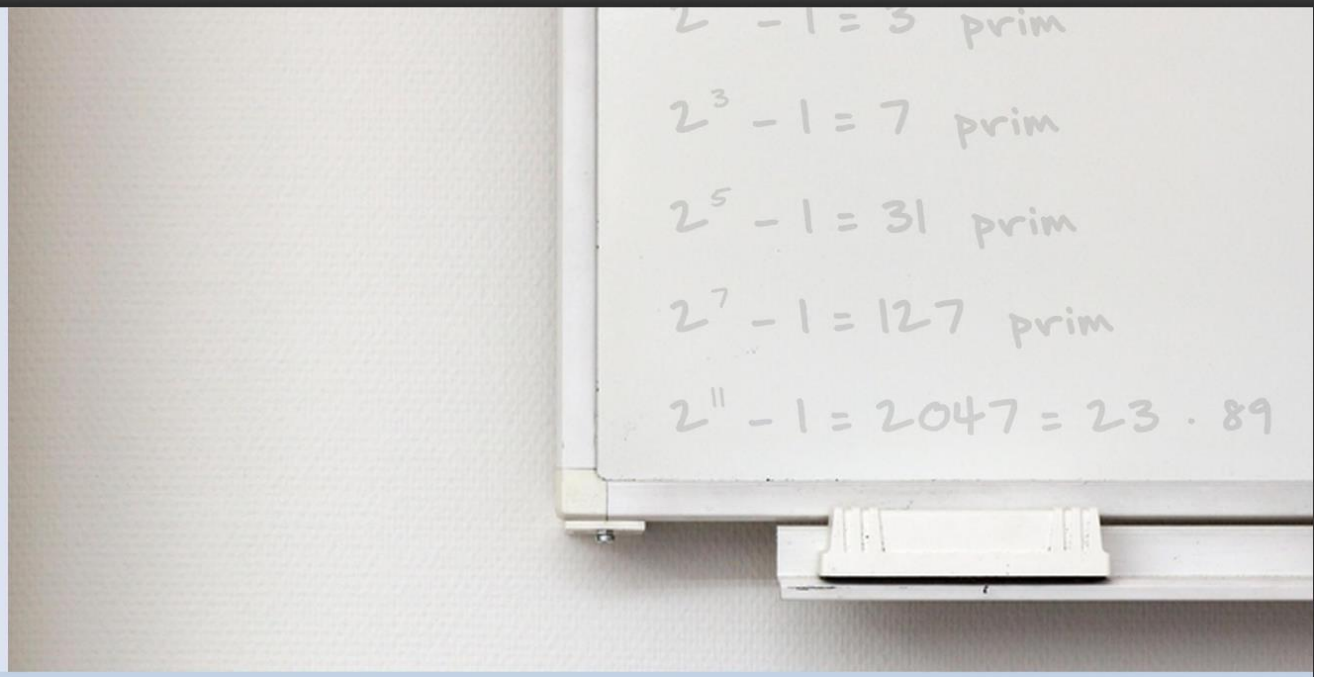
Subprojects: CrypTool Book

- some theory and how to apply crypto with the CT programs and with SageMath
- loc in 2017:
  61,545 LaTeX code (tex)
  825 Sage code (sage)

… more tomorrow



https://www.cryptool.org/images/ctp/documents/CT-Book-en.pdf



The CrypTool Book:
Learning and Experiencing Cryptography with CrypTool and SageMath

Prof. Bernhard Esslinger
and the Development Team
of the Open-Source Software CrypTool

Website: Function volume

CT offers > 400 different crypto functions

- CT1 >= 125
- CT2 >= 245
- JCT >= 125
- CTO >= 45

https://www.cryptool.org/en/ctp-documentation/functionvolume

Cryptological functions in different CrypTool versions

SELECTION

Cryptographic category: No filter applied

Additional search phrase:

☑ CrypTool 1 (CT1) ☑ CrypTool 2 (CT2) ☑ JCrypTool (JCT) ☑ CrypTool Online (CTO)

405 rows found according to the selection criteria.

Function	CT1	CT2	JCT	CTO	CT 1 Path	CT 2 Path	JCT Path	CTO Path
3DES	X	C	A		Encrypt/Decrypt\ Symmetric (modern)\ Triple DES...	[C] Modern Ciphers\ Symmetric\ DES	[A] Block Ciphers\ Block Ciphers\ DESede_CBC (OID: 1.2.840.113549.3.7)	
3DES Brute-Force Attack	X	C\T			Analysis\ Symmetric Encryption (modern)\ Triple DES...	[C] Cryptanalysis\ Specific\ KeySearcher [T] Cryptanalysis\ Modern\ Triple DES Brute-force Analysis		
Achterbahn		C\T				[C] Modern Ciphers\ Symmetric\ Achterbahn [T] Cryptography\ Modern\ Symmetric\ Achterbahn Cipher		
ADFGVX	X	C\T\W	D	X	Encrypt/Decrypt\ Symmetric (classic)\ ADFGVX...	[C] Classic Ciphers\ ADFGVX [T] Cryptanalysis\ Classical\ ADFGVX Cipher dictionary	[D] Algorithms\ Classic\ ADFGVX	Ciphers\ ADFGVX

Where are we today (1)

- overall program downloads (since 2003) > 1 million times
- Alexa rank: between 400,000 and 600,000
- more than 100 bachelor and master theses contributed to it
- developers and users come from all over the world
- mentioned in books, courses, websites, …

Where are we today (2)

➔ CT became the most widespread open-source e-learning program for cryptography and cryptanalysis

- after 21 years ... still an active project with over 1 mio loc being maintained and running
- success has many piles – especially single, dedicated and knowledgeable people …

Can we be satisfied with that?

Yes (many goals achieved) and No

- many chairs not contributing yet
- more researchers using it
- not present in "normal" paper press like “Spiegel” or broadcast television
- weak perception in social media and on smartphones yet
- kind of misuse of our name just noticed – what to do?

Future tasks: 4 core areas

Switch further into the user‘s perspective

Continue to do the „normal“ stuff (homework, support)

Future tasks: 4 core areas

Early design the technical roadmap for CT3

Pass over responsibility to younger people

CrypTool is THE e-Learning program for cryptology

BY:

CrypTool.org
bernhard.esslinger@gmail.com

Contribution samples

University	CT	Plugin
Hagenberg, Eindhoven	JCT	Post-quantum signature series: WOTS, Merkle, SPHINCS
Duisburg-Essen	CT2	Quantum key-exchange protocol BB84
Utrecht	JCT	Elliptic curve calculations over R, F(p), and F(2^m)
Hagen	JCT	Inner states of DES
Frankfurt, Darmstadt	JCT	Kleptography (4 attacks implemented)
Kassel, Belgrade	CT2	Network communication, chat
Bochum	CT2	Keccak for hashing (SHA3), as PRNG, and as stream cipher
Frankfurt	CT2	Padding-oracle attack
Kassel	CT2	Heartbleed attack against a life server
Kassel, Duisburg	CT2	CrypCloud – distributed computing
Bochum	CT2	SAT solver (analyzer works, still problem with port from Unix)
Brno (Freiburg)	CT2	Protocols like oblivious transfer, dining cryptographers
Bratislava	CT2	Fialka, VIC

Some contributing universities

Belgrad, Berlin, Bochum, Bonn, Brisbane, Brno, Darmstadt, Dubai, Duisburg-Essen, Eindhoven, Frankfurt, Hagenberg, Jena, Karlsruhe, Kassel, Klagenfurth, Koblenz, London, Madrid, Mannheim, Osnabrück, San Jose, Siegen, Thessaloniki, Utrecht, Warsaw, …

Abbreviations used

CT	CrypTool
CT1	CrypTool v1 (e-learning program)
CT2	CrypTool v2 (e-learning program)
JCT	JavaCrypTool (e-learning program)
CTO	CrypTool-Online (apply crypto in a browser)
MTC3	MysteryTwister C3 (international cipher contest)
CTP	CrypTool Portal (main website www.cryptool.org)
CTB	CT Book (free and open-source, too)