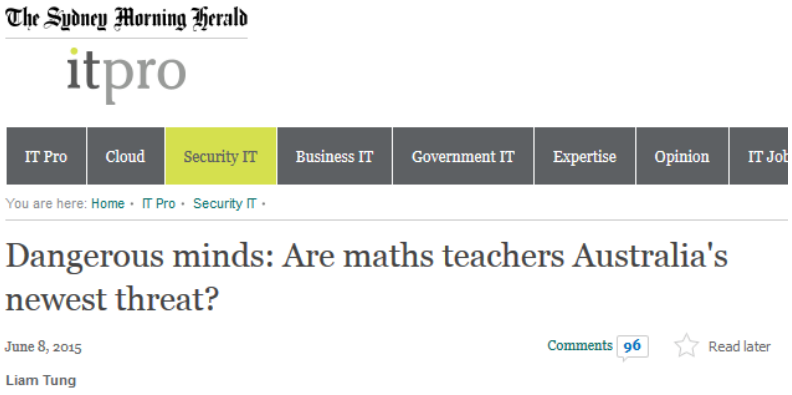
Your calculator as a weapon

Daniel V Mathews

Daniel.Mathews@monash.edu

Recent controversy



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Australia's Act of Intellectual Terrorism: DTCA 2012

— Kevin B Korb

In October 2012 the Australian parliament passed the Defence Trade Controls Act. The stated purposes of the act are unobjectionable: implementing the prior Australia-United States Defense Trade Cooperation Treaty, simplifying defence-related trade between Australia, the US and the UK, and tightening the regulation of intangible transfers of military goods, reflecting the growth of the internet in communications. Unfortunately, these good intentions have led the Australian government to adopt an extraordinarily broad definition of military goods and to impose an impossibly harsh regulatory regime on activities concerning them, to the point that what is today ordinary academic research into, for example, Bayesian

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Response to Australia's Defence Trade Controls Act

July 6, 2015

We are deeply concerned about Australia's Defence Trade Controls Act (DTCA). The act prohibits the "intangible supply" of encryption technologies, and hence subjects many ordinary teaching and research activities to unclear, potentially severe, export controls. As an international organization of cryptographic researchers and educators, we are concerned that the DTCA criminalizes the very essence of our association: to advance the theory and practice of cryptography in the service of public welfare.

We affirm that the public welfare of Australians — and society in general — is best served by open research and education in cryptography and cybersecurity. Open, international scientific collaboration is responsible for the encryption technologies that are now vital to individuals, businesses, and world governments alike. The current legislation cuts off Australia from the international cryptographic research community and jeopardizes the supply of qualified workforce in Australia's growing cybersecurity sector.

We call on Australia to amend their export control laws to include clear exemptions for scientific research and for education.

IACR Member Signatories (219): add your signature!

- Christian Cachin, President of the IACR, IBM Research - Zurich, Switzerland
- Nigel Smart, Vice President IACR, University of Bristol, United Kingdom
- Gregory Rose, Cryptography Consultant, Australian citizen and IACR treasurer, United States

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Academics like Kevin Korb are nervous that "overly broad" definitions in the DSGL could land them in court for teaching cryptography... and a number of other fields.

Plan

I'll try to:

- Show you some of these laws and try to make some sense of them
- Explain some related ideas from mathematics and cryptography
- Present a facetious-but-not-that-facetious argument that your calculator could be regarded as a dual-use military-civilian item ("weapon")
- Raise some broader issues

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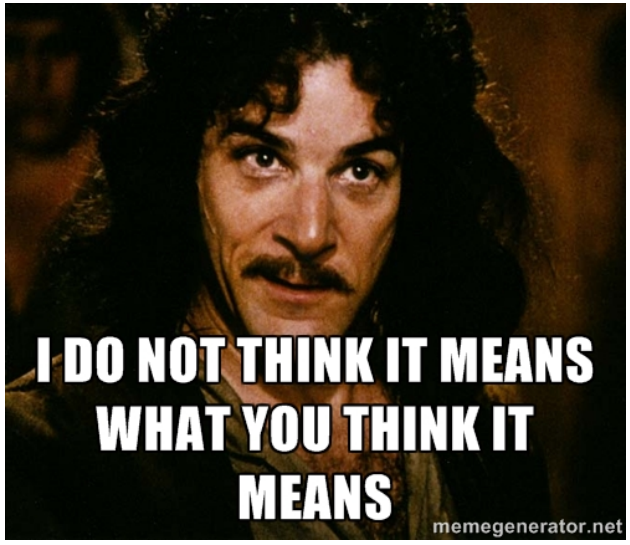

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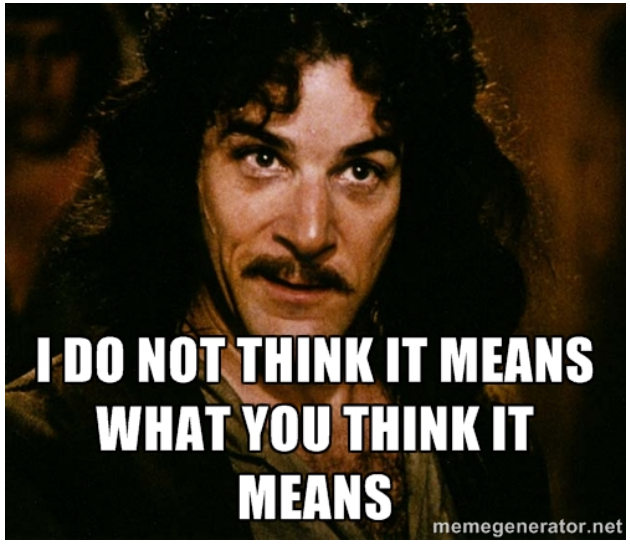

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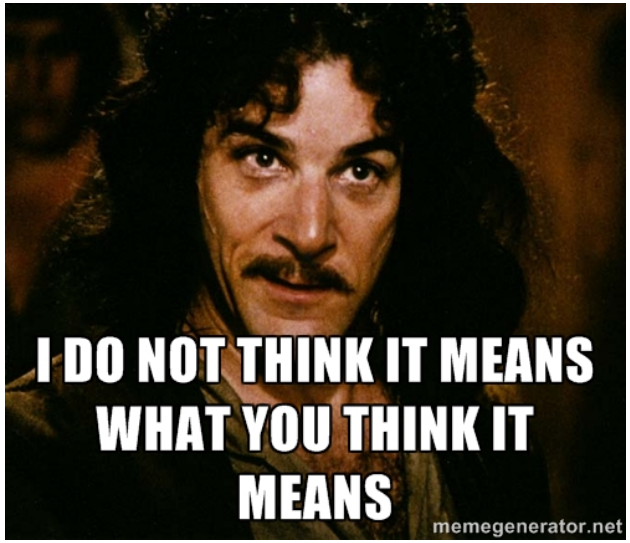

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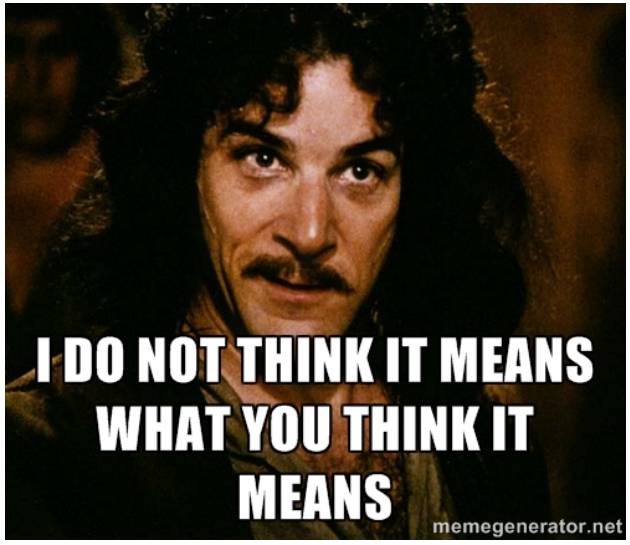

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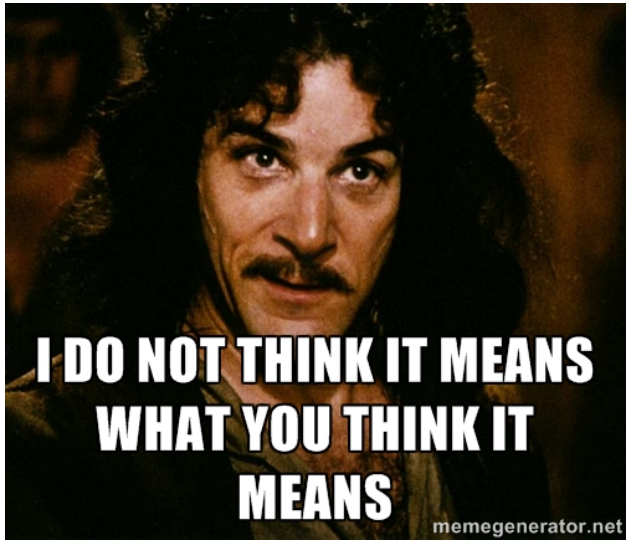

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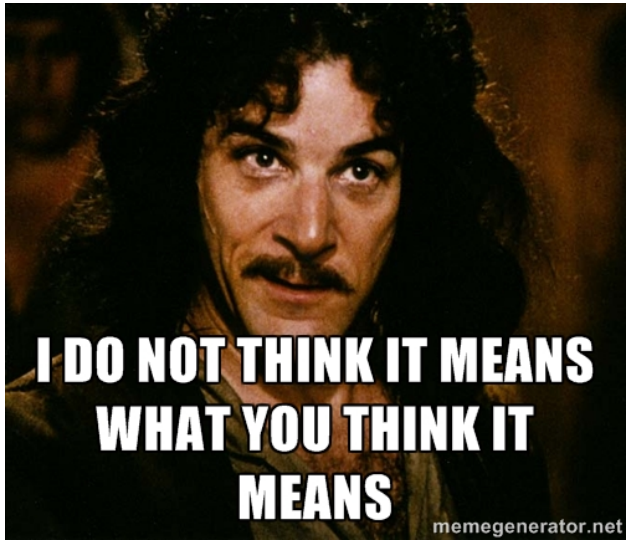

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Most controversial provision: section 10

- *Offence — supply of DSGL technology*

DTCA section 10

to supply DSGL technology. There is a process for becoming a registered broker.

Division 1—Primary offences

10 Offence—supply of DSGL technology

(1) A person (the ***supplier***) commits an offence if:

(a) the supplier supplies DSGL technology to another person; and

(b) either:

(i) the supply is from a place in Australia to a place outside Australia; or

(ii) if the supply is the provision of access to DSGL technology—at the time of the provision of access, the supplier is in Australia and the other person is outside Australia; and

(c) either:

(i) the supplier does not hold a permit under section 11 authorising the supply ~~of the DSGL technology~~; or

(ii) the supply ~~of the DSGL technology~~ contravenes a condition of a permit that the supplier holds under section 11; and

(d) there is no notice in force under subsection 14(1) in relation to the supplier and the supply.

Penalty: Imprisonment for 10 years or 2,500 penalty units, or both.

Exceptions

(1A) Subsection (1) does not apply if:

(a) the supply is not the provision of access to DSGL technology; and

(b) the supply is made orally; and

(c) the supply is neither for a military end-use nor for use in a Weapons of Mass Destruction program.

Note: A defendant bears an evidential burden in relation to the matter in subsection (1A): see subsection 13.3(3) of the *Criminal Code*.

(2) Subsection (1) does not apply if:

(a) the supply is of DSGL technology in relation to original goods; and

(b) the supply is by an Australian Community member or by a member of the United States Community; and

(c) the supply is to an Australian Community member or a member of the United States Community; and

(d) the supply is for an activity referred to in Article 3(1)(a), (b), (c) or (d) of the Defense Trade Cooperation Treaty; and

(e) at the time of the supply, the original goods are listed in Part 1 of the Defense Trade Cooperation Munitions List; and

(f) at the time of the supply, the original goods are not listed in Part 2 of the Defense Trade Cooperation Munitions List.

Note: A defendant bears an evidential burden in relation to the matter in subsection (2): see subsection 13.3(3) of the *Criminal Code*.

(3) Subsection (1) does not apply if:

(a) the DSGL technology is supplied by or to a person who is a member of the Australian Defence Force, an APS employee, an employee of ASIO, an employee of ASIS, a member or special member of the Australian Federal Police or a member of the police force of a State or Territory; and

(b) the supply occurs ~~he or she supplies the DSGL technology~~ in the course of his or her duties as such a person.

Note: A defendant bears an evidential burden in relation to the matter in subsection (3): see subsection 13.3(3) of the *Criminal Code*.

(3A) Subsection (1) does not apply if:

(a) the supply is of DSGL technology within the scope of Part 2 of the Defence and Strategic Goods List; and

(b) the supply is preparatory to the publication of the DSGL technology to the public or to a section of the public; and

(c) there is neither a notice in force under subsection 14B(1), nor a notice in force under subsection 14C(1), in relation to the supplier and the DSGL technology.

Note: A defendant bears an evidential burden in relation to the matter in subsection (3A): see subsection 13.3(3) of the *Criminal Code*.

(4) Subsection (1) does not apply in the circumstances prescribed by the regulations for the purposes of this subsection.

Note: A defendant bears an evidential burden in relation to the matter in subsection (4): see subsection 13.3(3) of the *Criminal Code*.

~~*Geographical jurisdiction*~~

~~(5) Section 15.2 of the *Criminal Code* (extended geographical jurisdiction—category B) applies to an offence against subsection (1).~~

Definition

(6) In this section:

place includes:

(a) a vehicle, vessel or aircraft; and

(b) an area of water; and

(c) a fixed or floating structure or installation of any kind.

11 Permits for purposes of section 10

(1) A person may apply to the Minister for a permit under this section to supply DSGL technology ~~to another person~~.

Note: Section 66 sets out application requirements.

(2) Without limiting subsection (1), an application by a person under that subsection may do one or more of the following:

(a) cover 2 or more supplies by the person;

(b) cover one or more supplies by the person for a period described in the application;

(c) cover one or more supplies by the person for a project described in the application.

DTCA section 10

A summary of the offence:

- The “supply" of “DSGL technology" overseas without a permit is an offence.
- (But military technology may flow freely US $\leftrightarrow$ Australia.)
- Exemptions for “supplies" which are “oral" or “preparatory to publication" to (a section of) the public.
- Maximum penalty: 10 years imprisonment or $\$450,000$ fine

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Existing Gaps – Intangible Supply

- A permit is required if an Australian physically exports a controlled virus. However, if they email instructions on how to produce or enhance that virus, no permit is currently required.
- The Australian Government has no visibility or control over the electronic export of this information, including whether it is potentially destined for a biological weapons program.

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“Supply":

- Need not be for payment.
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DSGL is essentially in two parts:

- Part 1: *Munitions list*
- Part 2: *Dual-use list*

Contents

DSGL

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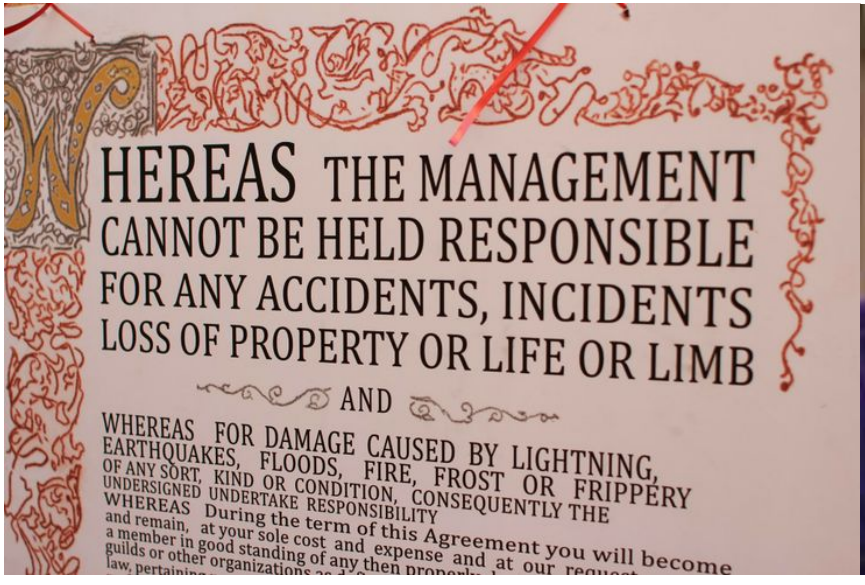
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UNDERSIGNED UNDERTAKE RESPONSIBILITY
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Category 5 — Telecommunications and “information security"

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      1. Factorisation of integers in excess of 512 bits (e.g., RSA);
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  - US/Australian military, intelligence, police.

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Applied cryptography question:

- How strong are the specifications in the DSGL?

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- Is this the right way to be thinking about cryptography? (Human rights, privacy, freedom of information...)

Applied cryptography question:

- How strong are the specifications in the DSGL? WEAK!

Questions

Preceding provisions are premised on the idea that

sufficiently strong cryptography is a dual-use civilian-military technology.

Political/moral/legal/policy questions:

- Is this idea right?
- Even if it has dual uses, is it appropriate to regulate via a permit regime with heavy criminal sanctions?
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Mathematics/computer science questions:

- What do the technical words even mean?

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A group does not care if its operation is addition, multiplication, or anything else!

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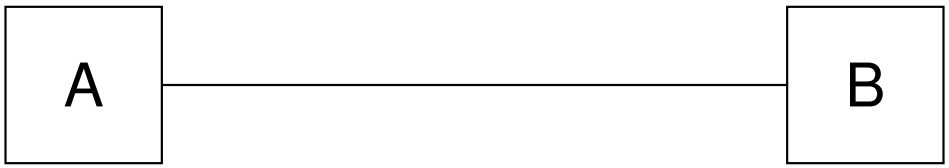
Question

Despite such public conditions, can A and B establish a shared secret?

Diffie-Hellman key exchange



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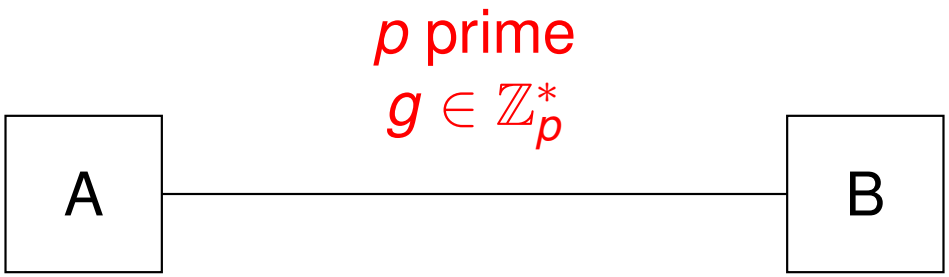

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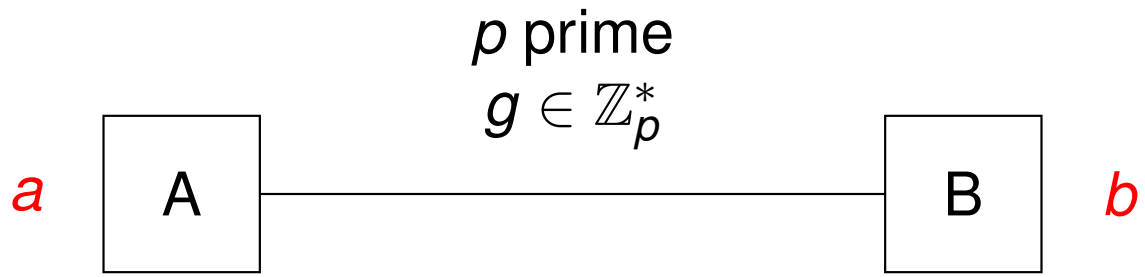

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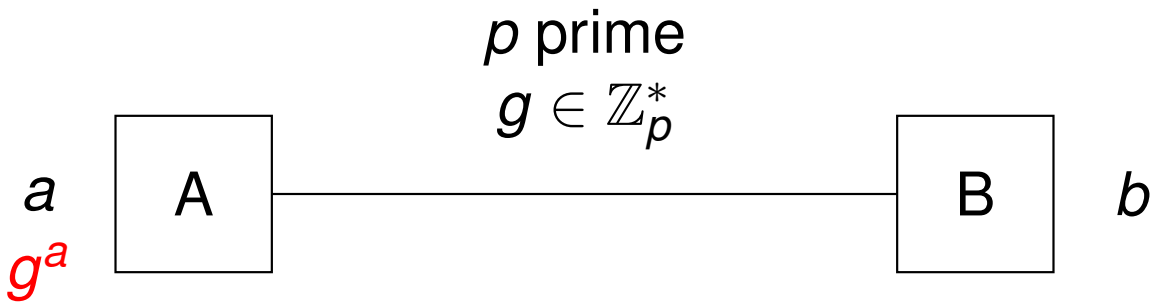

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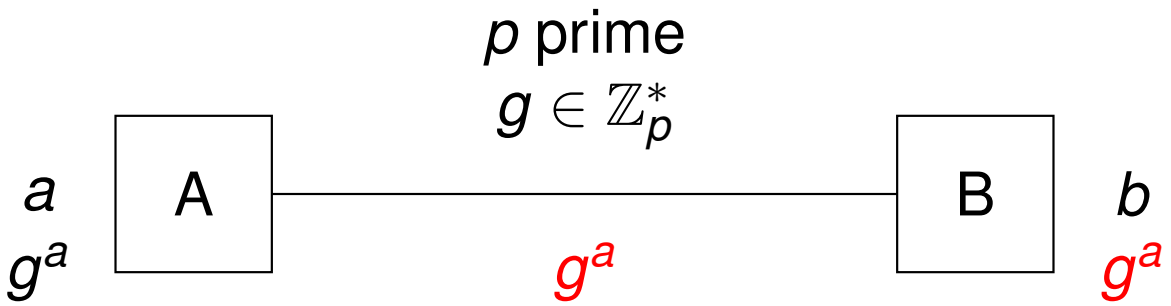

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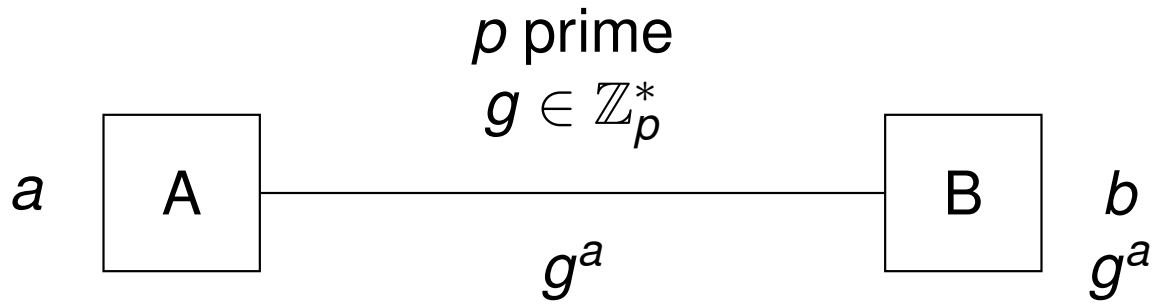

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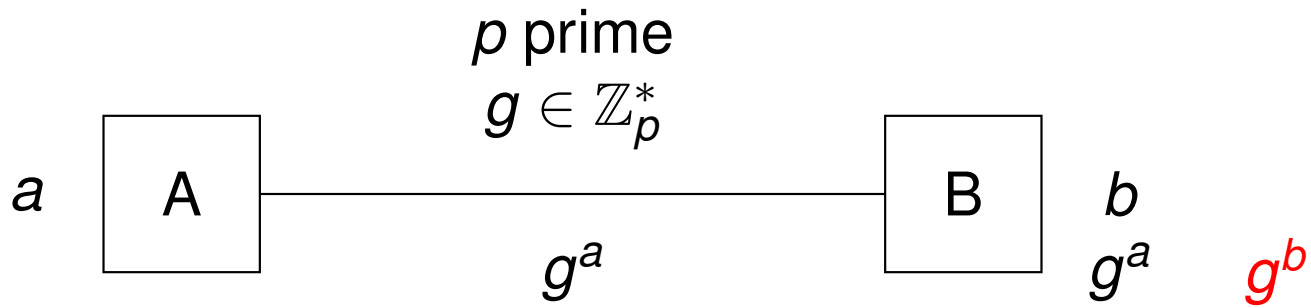

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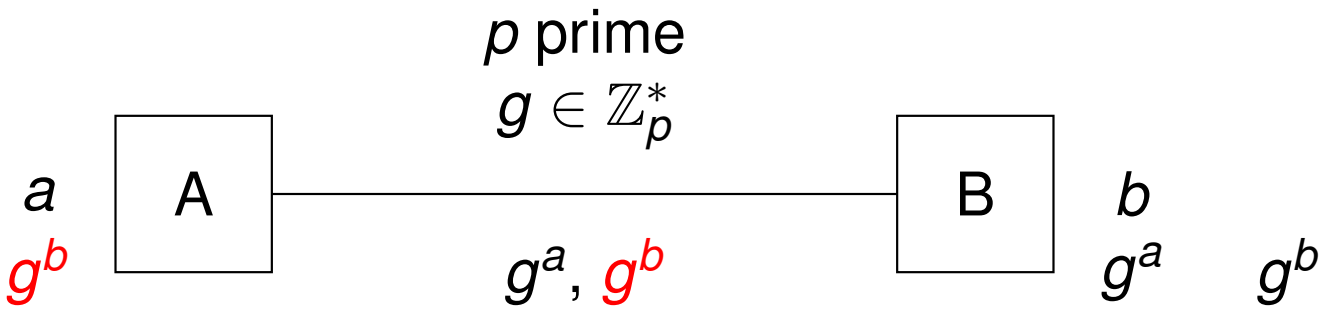

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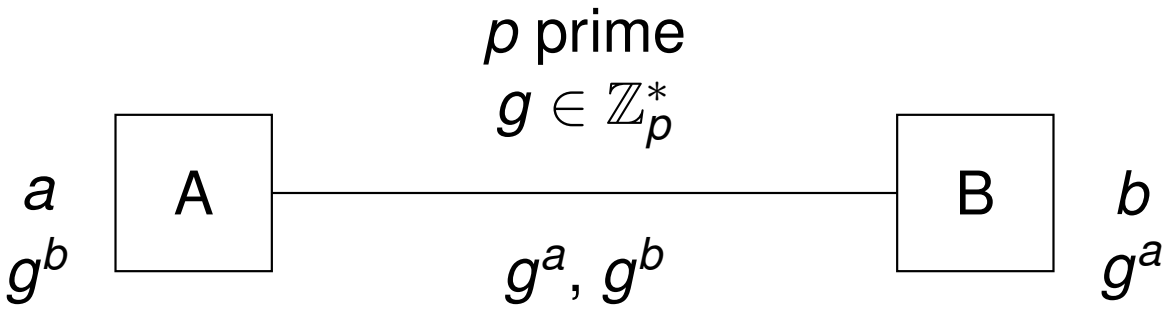

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   - These calculations are “easy" (exponentiation mod p).
   - Now p, g, g^a, g^b are publicly known but a is known only to A and b is known only to B.

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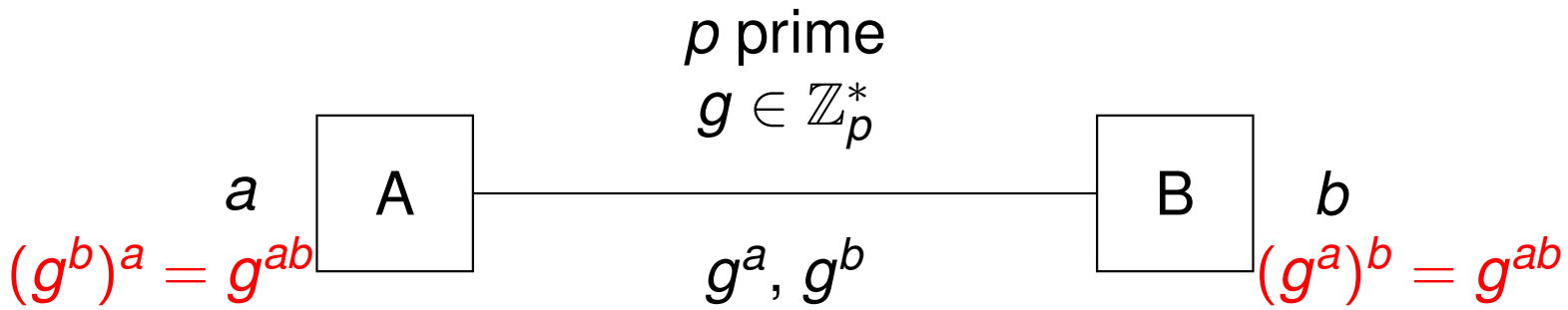

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   B calculates $g^b \pmod p$ and sends it to A.
   - These calculations are “easy" (exponentiation mod p).
   - Now p, g, g^a, g^b are publicly known but a is known only to A and b is known only to B.
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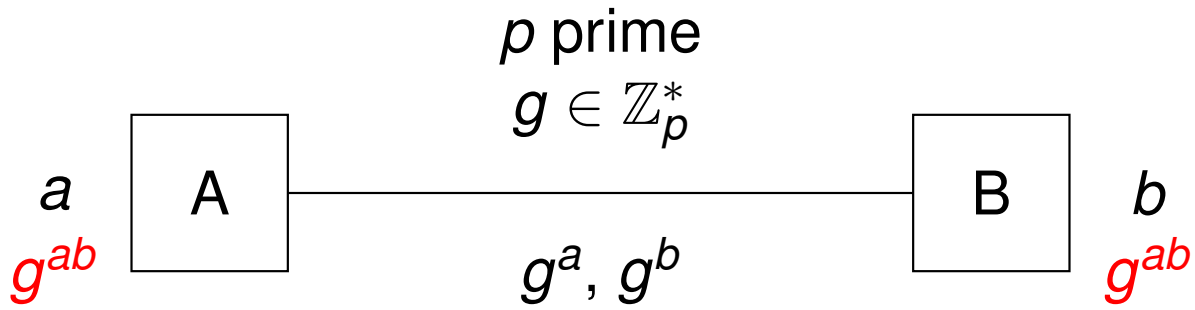
Diffie-Hellman key exchange



1. A and B agree on a large prime p, and a $g \in \mathbb{Z}_p^*$.
   - Both p and g are publicly known.
2. A and B choose secret numbers a, b at random.
3. A calculates $g^a \pmod p$ and sends it to B.
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4. A calculates $(g^b)^a = g^{ab} \bmod p$.
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   - The number $g^{ab} \pmod p$ is A and B’s *shared secret*.

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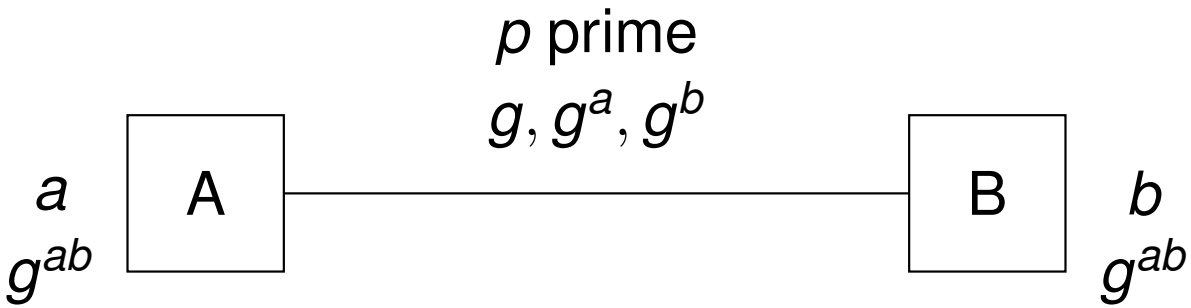

Security of the key exchange:

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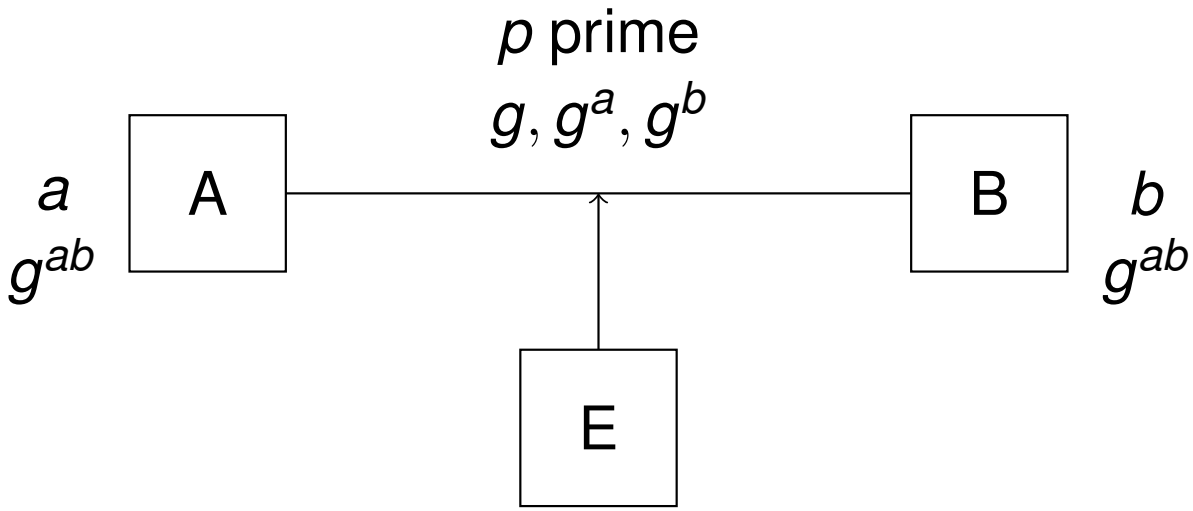

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- An eavesdropper Eve must compute shared secret g^{ab} from knowledge of g^a, g^b, p, g only, in order to listen in.

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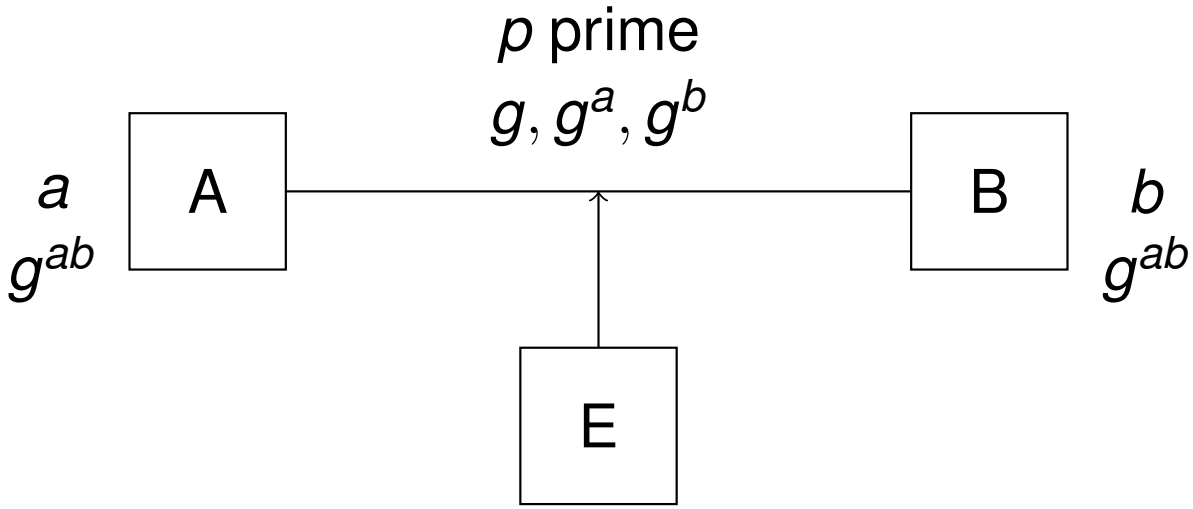

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- Finding a or b from g^a, g^b would allow Eve to compute g^{ab}, but this requires finding *discrete logarithms* modulo p.
  - $a = \log_g g^a$, $b = \log_g g^b$

Back to the DSGL

“Cryptography"... based on... An “asymmetric algorithm" where the security of the algorithm is based on any of the following:...

3. Discrete logarithms in a group other than mentioned in 5A002.a.1.b.2 in excess of 112 bits [sic]

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- Has *infinitely many* elements — far more than 2^{112}!
- Discrete logarithm is just *division*.
  - E.g. $\log_3 18 = 6$.

The BAD algorithm

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(Are there any *good* ones? Not that I know of.)

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Dan's Basic Algorithm using Division (BAD)

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To encrypt a message:

1. Convert the message to a number m.
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WORST. ALGORITHM. EVER.

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- Laws should be written & implemented by people who understand them.
- Technical knowledge is important in debates on these topics.
- Even if badly written laws are unlikely to be used in bad ways, they *could* be so used.
- We shouldn't have badly written laws in the first place!

History

How did we get here?

- 1990s “crypto wars" over US encryption policy
- US Export controls (ITAR)
- International arms control: Wassenaar Arrangement
- Australian DSGL
- 2007 Australia-US Defence Trade Cooperation Treaty

Conclusion

Finally...

Don’t stop doing mathematics!

THANKS FOR LISTENING.