NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

CC0002 Navigating the Digital World

Module 5:

Principles of Data Ethics in the Digital World

Presented by Assoc Prof Andres Carlos Luco

ETHICS

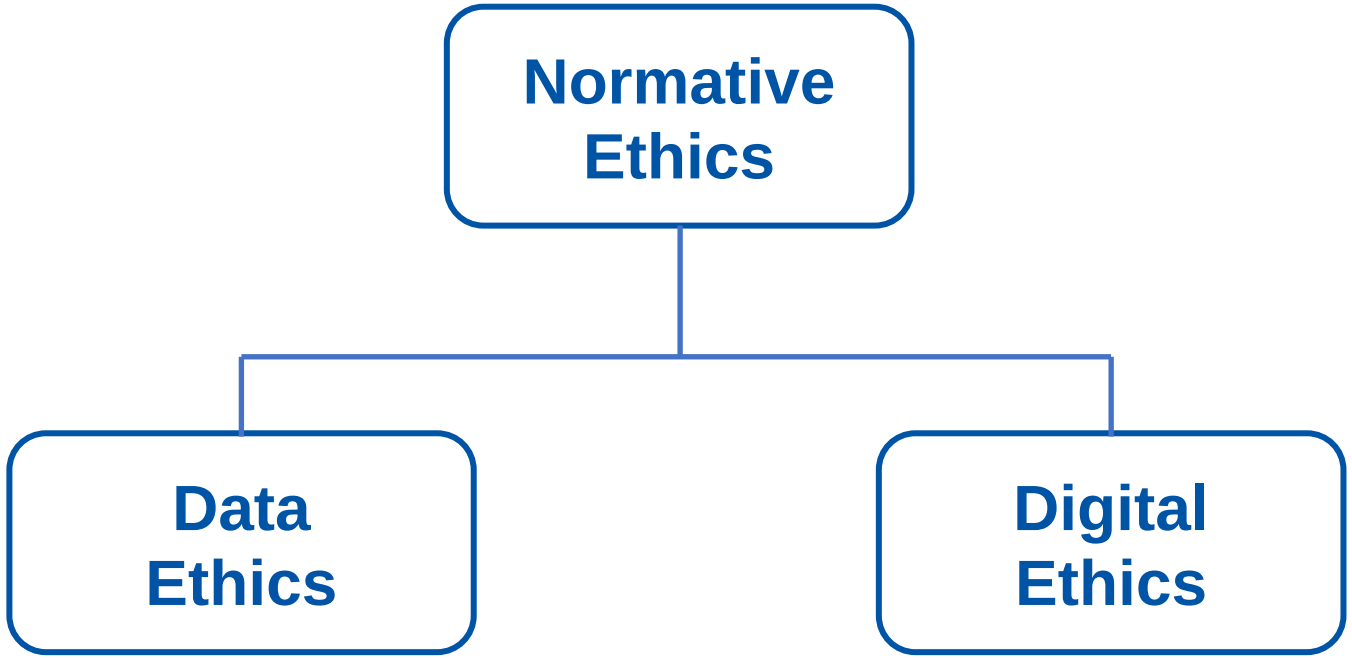
Ethics

- **Ethics** is the study of morality. Morality is a subject that pertains to right and wrong action (Oxford English Dictionary):
  - In all human societies on the ethnographic record, people make distinctions between right and wrong (Brown, 1991).
  - I take it that you have your own views about what is right and wrong.
  - In the branch of ethics called **normative ethics**, we try to arrive at *well-founded* views about morality.

Brown, D. E. (1991). *Human universals*. Temple University Press.

Ethics

- In this module, we'll delve into normative ethics as it relates to using, applying, and developing digital and online tools.



Why Do We Need Data and Digital Ethics?

- There is an international consensus that ethics is vital to the development, application, and use of digital and online technologies (Vallor, 2021).
  - Technology shapes the way people live.
  - While digital and online technologies offer remarkable benefits (e.g., knowledge, communication, efficiency, personalisation), they also pose risks of significant harms to privacy, security, autonomy, fairness, transparency, etc.
  - Lawmakers are often unable to keep up with the speed of technological advancement. Hence, not only expert technologists, but also ordinary users, must learn to develop and use technologies in ways that avoids harms while getting the most from the benefits.

Vallor, S. (n.d.). *An introduction to data ethics* (p. 2). Markkula Center for Applied Ethics at Santa Clara University.

MORAL THEORIES

Moral Theories

- In normative ethics, **moral theories** are developed to achieve two aims (Timmons, 2019):
  - **Theoretical aim:** To explain what features of actions make them morally right or wrong
  - **Practical aim:** To offer practical guidance in making morally correct decisions

Timmons, M. (2019). *Disputed moral issues: A reader*. Oxford University Press.

Moral Theories

- These three moral theories are among the most influential in normative ethics (Timmons, 2019):

    1) **Utilitarianism (Jeremy Bentham, John Stuart Mill, Peter Singer, etc.):** An action is morally right when it would likely produce at least as much well-being (welfare) as would any other action one might perform instead. Otherwise, the action is wrong.

        - The classical utilitarians, such as Bentham and Mill, took well-being to consist of pleasure and the absence of pain.

        - Peter Singer, a contemporary utilitarian, takes well-being to consist of the satisfaction of one's preferences/desires.

Timmons, M. (2019). *Disputed moral issues: A reader*. Oxford University Press.

Moral Theories

- These three moral theories are among the most influential in normative ethics (Timmons, 2019): **(continued)**

    2) **Virtue ethics (Confucius, Aristotle, etc.):** An action is morally right when it is what a virtuous person would do in the circumstances. Otherwise, the action is wrong.

        - Commonly recognised virtues include honesty, courage, justice, temperance, beneficence, humility, loyalty, and gratitude.

        - A truly virtuous person is one who has *all* the virtues. A virtuous person may only be a hypothetical ideal that we can strive to be.

Timmons, M. (2019). *Disputed moral issues: A reader*. Oxford University Press.

Moral Theories

- These three moral theories are among the most influential in normative ethics (Timmons, 2019): **(continued)**

    3) **Immanuel Kant's deontological ethics:** An action is morally right when it treats persons (including oneself) as ends in themselves and not merely as a means. Otherwise, the action is wrong.

        - Kant's theory says that all persons are unconditionally valuable insofar as they are *rational* and *autonomous*.

        - It also says that we should respect the value of persons, and not use them in a way that disrespects their value.

Timmons, M. (2019). *Disputed moral issues: A reader*. Oxford University Press.

PRINCIPLES OF DATA ETHICS

Principles of Data Ethics

- Moral theories are meant to provide very general explanations and guidance concerning what we morally ought to do.
- While moral theories have the advantage of comprehensiveness, it can be difficult to deduce what they would prescribe in a particular context.
- Several professional associations and private firms have formulated more specific *principles* to guide actions with respect to data and information technology.
    - Links to these sets of principles are provided in the Notes section below.

Principles of Data Ethics

- The following principles are sampled from the Singapore Computer Society's professional Code of Conduct:

  Integrity

  SCS members will act at all times with integrity. They will:

  - not lay claim to a level of competence that they do not possess
  - act with complete discretion when entrusted with confidential information
  - be impartial when giving advice and will disclose any relevant personal interests
  - give credit for work done by others where credit is due

Singapore Computer Society. (n.d.). *Code of Conduct*. https://www.scs.org.sg/membership/code-of-conduct

Principles of Data Ethics

- The following principles are sampled from the Singapore Computer Society's professional Code of Conduct:

Professionalism

SCS members will act with professionalism to enhance the prestige of the profession and the Society. They will:

- uphold and improve the professional standards of the Society through participation in their formulation, establishment and enforcement
- not seek personal advantage to the detriment of the Society
- not speak on behalf of the Society without proper authority
- not slander the professional reputation of any other person
- use their special knowledge and skill for the advancement of human welfare

Singapore Computer Society. (n.d.). *Code of Conduct*. https://www.scs.org.sg/membership/code-of-conduct

Principles of Data Ethics

EXERCISE 1:

- Can any of the principles in the Singapore Computer Society (SCS) Code of Conduct be supported by utilitarianism? Describe one such principle and explain how utilitarianism supports it.
- Can any of the principles in the SCS Code of Conduct be supported by virtue ethics? Describe one such principle and explain how virtue ethics supports it.
- Can any of the principles in the SCS Code of Conduct be supported by Kant's deontological ethics? Describe one such principle and explain how Kant's ethics supports it.

Principles of Data Ethics

QUESTION 1:

The Singapore Computer Society is “the leading infocomm and digital media society for industry professionals, leaders, students, and tech enthusiasts” (Singapore Computer Society)

Most of you are not and will never be members of the SCS. Nor do most of you consider yourselves industry professionals/leaders/students/enthusiasts in information communication and digital media.

Do you think people should follow the SCS principles, even if they are not members of the SCS and do not fit the profile of someone who could be a member?

CYBERBULLYING

Cyberbullying

Cyberbullying is the use of the internet or digital devices to inflict psychological harm on a person or group (Quinn, 2019; Media Literacy Council 2018).

Quinn, M. J. (2019). *Ethics for the information age* (8th ed.). Pearson.

Cyberbullying

- Examples of cyberbullying (Quinn, 2019):
  - Repeatedly texting or emailing hurtful messages to another person.
  - Spreading derogatory lies about another person.
  - Tricking someone into revealing highly personal information.
  - “Outing” or revealing someone’s secrets online.
  - Posting embarrassing photographs or videos of other people without their consent.
  - Impersonating someone else online in order to damage that person’s reputation.
  - Threatening or creating significant fear in another person.

Quinn, M. J. (2019). *Ethics for the information age* (8th ed.). Pearson.

Prevalence of Cyberbullying

- According to the 2020 Child Online Safety Index (Cosi) report, which includes data on 145,000 children across 30 countries, **45%** of 8- to 12-year-olds experienced cyberbullying, either as the bullies or as the victims.
- Within Singapore, **40%** of 8- to 12-year-olds and **52%** of 13- to 19-year-olds were exposed to cyberbullying.

Cyberbullying

- Effects of cyberbullying:
  - Depression and anxiety
  - Low self-esteem
  - Difficulty sleeping
  - Headaches, stomachaches
  - Suicidal thoughts
  - Suicide attempts
  - Eating disorders

American SPCC. (n.d.). *Effects of cyberbullying*. https://americanspcc.org/impact-of-cyberbullying/

Cyberbullying

QUESTION 2

What’s wrong with cyberbullying?

Cyberbullying

- What you can do if ***you*** are cyberbullied:
  - Don’t blame yourself.
  - Don’t retaliate.
  - Save the evidence: Take screenshots of texts.
  - Talk to someone you trust.
  - Block the bully.
  - Report the bully.
  - Keep social media passwords private.
  - Restrict others’ access to your social media pages.
  - Change your social media accounts: If you are harassed, delete the account and create a new one.

Media Literacy Council. (2018). *Cyber-bullying*. https://www.betterinternet.sg/Resources/Resources-Listing/Youth---cyber-bullying

Cyberbullying

- How to know if ***someone you care about*** is being cyberbullied:
  - Changes in mood or personality.
  - Work or school performance declines.
  - Lack of desire to do things they normally enjoy.
  - Upset after using phone or going online.
  - Secretive about what they are doing online.
  - Unusual online behaviour: Not using phone/computer at all; using phone/computer all the time; receiving lots of notifications.
  - Deleting social media accounts.

Media Literacy Council. (2018). *Cyber-bullying*. https://www.betterinternet.sg/Resources/Resources-Listing/Youth---cyber-bullying

INFORMATIONAL PRIVACY

Informational Privacy

- Digital and online technologies have a major impact on one's ability to secure privacy.
- In particular, these technologies affect what the philosopher Anita L. Allen describes as **informational privacy:** "confidentiality, anonymity, data protection, and secrecy of facts about persons" (Allen, 2005).

Allen, A. L. (2005). Privacy. In H. LaFollette (Ed.), *The Oxford handbook of practical ethics*.Oxford University Press.

Informational Privacy

- Consider this incident where some researchers released the personal profile details of 70,000 users on OkCupid, a dating website:

Brian Resnick, "Researchers just released profile data on 70,000 OkCupid users without permission," *Vox* (12 May 2016).

- Critics maintained that the (informational) privacy of the OkCupid users was violated by the researchers, because the researchers stored and re-deployed the personal information of the users without their consent.

Informational Privacy

- A right to privacy is recognised in all international and regional human rights instruments, including Article 12 the Universal Declaration of Human Rights:

> No one shall be subjected to arbitrary interference with his privacy, family, home or correspondence, nor to attacks upon his honour and reputation. Everyone has the right to the protection of the law against such interference or attacks.

United Nations. (2021). *Universal Declaration of Human Rights (Article 12)*. https://www.un.org/en/about-us/universal-declaration-of-human-rights

Informational Privacy

QUESTION 3:

What's so bad about not having informational privacy? What negative outcomes could befall someone who loses informational privacy?

WHISTLE-BLOWING

Whistle-Blowing

- In large organisations, it can be difficult to hold people accountable for unethical or illegal acts.
    - Law enforcement and regulators are not able to constantly monitor the internal operations of organiaations. Such constant surveillance isn’t even desirable.
    - Leadership within the organisation may cover up any corrupt activities.

Whistle-Blowing

- There are many examples of misconduct in organisations not being brought to light until much damage has already been done, or only after a private citizen reported it at great personal cost.
  - The 1986 Challenger Disaster is a memorable case where something catastrophic happened as a result of internal mismanagement.
  - A more recent case involving Wirecard, an electronic payment company, was reported in Singapore.
  - Data analytics firm Cambridge Analytica crossed many ethical lines.

Whistle-Blowing

- Sometimes it is up to ordinary, low-level people to “blow the whistle” on unacceptable conduct in their organisations.

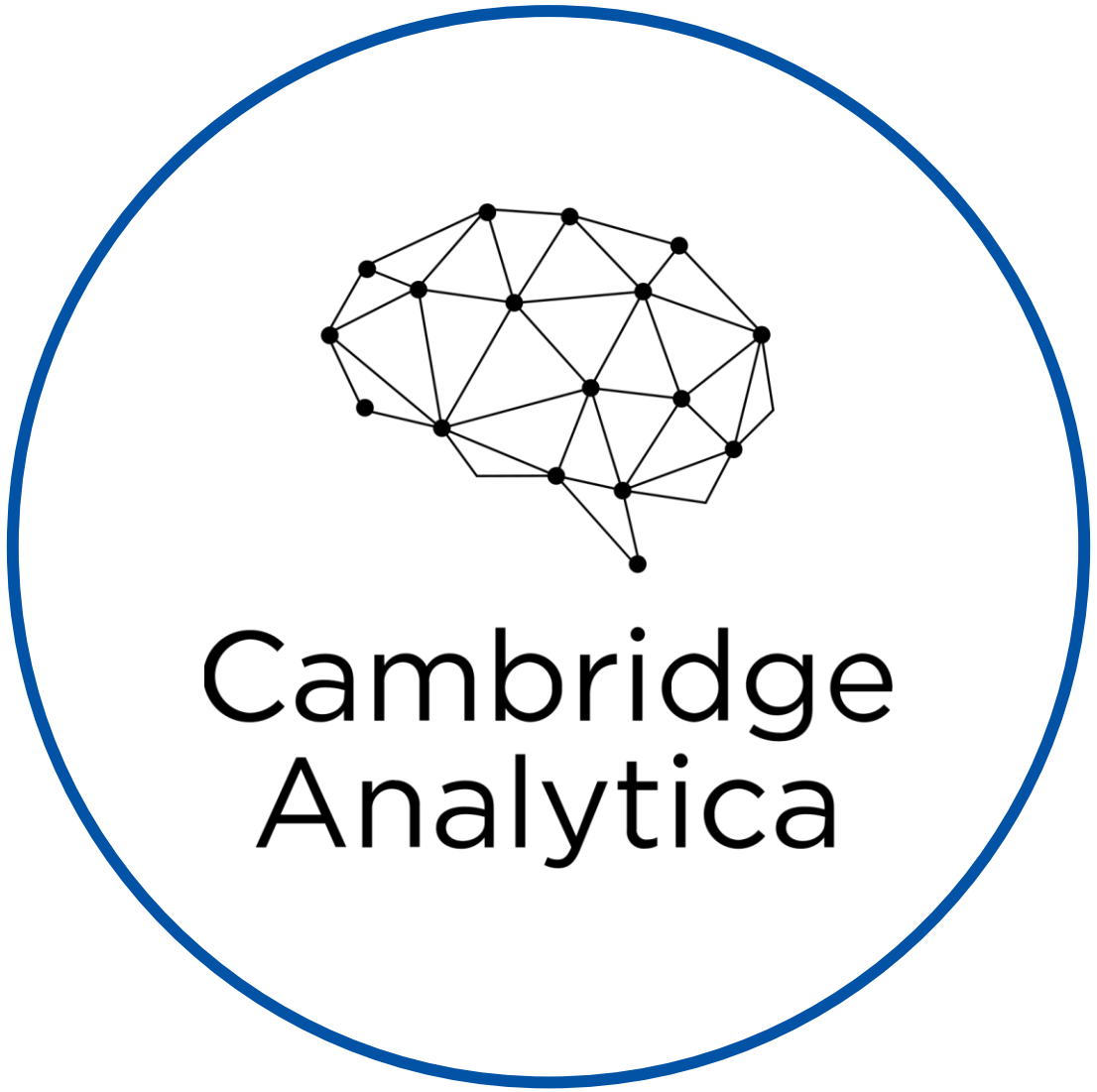
- “A **whistle-blower** is someone who breaks ranks with an organization in order to make an unauthorized disclosure of information about a harmful situation after attempts to report the concerns through authorized organizational channels have been ignored or rebuffed.” (Quinn, 2019, emphasis added)

  - The question of whether to “blow the whistle” can arise in any organisation—not just in government agencies and private businesses.

  - NTU has its own dedicated whistle-blower channel, which is taken very seriously.

Quinn, M. J. (2019). *Ethics for the information age* (8th ed.). Pearson.

Whistle-Blowing



Whistle-Blowing

- But when should one whistle-blow? In his well-known textbook on business ethics, Richard T. De George proposed that whistle-blowing is **morally permissible** when three conditions are fulfilled (De George, 2006; Brenkert, 2009):

    1. The firm…will do [or has done] serious and considerable harm to employees or to the public;
    2. Once employees identify a serious threat to the user of a product or to the general public, they should report it to their immediate superior and make their moral concern known;
    3. If one's immediate supervisor does nothing effective about the concern or complaint, the employee should exhaust the internal procedures and possibilities within the firm.

De George, R. T. (2006). Business ethics (6th ed.). Pearson. | Brenkert, G. G. (2019). Whistle-blowing, moral integrity, and organizational ethics. In G. G. Brenkert (Ed.), The Oxford Handbook of Business Ethics (pp. 564–601). Oxford University Press, Inc. https://doi.org/10.1093/oxfordhb/9780195307955.003.0020

Whistle-Blowing

- De George went on to suggest that if two *additional* conditions are met, then it would be **morally obligatory** for someone to whistle-blow (De George, 2006; Brenkert, 2009):

    4. The whistle-blower must have, or have accessible, documented evidence that would convince a reasonable, impartial observer that one's view of the situation is correct; and

    5. The employee must have good reasons to believe that by going public the necessary changes will be brought about. The chance of being successful must be worth the risk one takes and the danger to which one is exposed.

De George, R. T. (2006). Business ethics (6th ed.). Pearson. | Brenkert, G. G. (2019). Whistle-blowing, moral integrity, and organizational ethics. In G. G. Brenkert (Ed.), The Oxford Handbook of Business Ethics (pp. 564–601). Oxford University Press, Inc. https://doi.org/10.1093/oxfordhb/9780195307955.003.0020

Developing Digital/Online Tools: Whistle-Blowing

- First objection to De George's criteria (Quinn, 2019): **The criteria are too stringent.** It can be morally *permissible* to whistle-blow, even when not all of conditions 1 through 3 are met.
  - For instance, it may be morally permissible to whistle-blow when you know that serious harm will be done to the public, but there is not enough time to lobby supervisors and exhaust all internal reporting procedures.
  - By itself, the effort to prevent serious harm may be enough to make whistle-blowing morally permissible.

Quinn, M. J. (2019). *Ethics for the information age* (8th ed.). Pearson.

Whistle-blowing

- Second objection to De George's criteria (Quinn, 2019): **The criteria are not demanding enough.** It can be morally *obligatory* to whistle-blow even when conditions 4 and 5 have not be fulfilled.
  - For instance, a single employee may have satisfied conditions 1 through 3, but still be unable to acquire enough documented evidence to convince an impartial observer that any wrongdoing has been done.
  - However, it may still be morally obligatory to whistle-blow, if one is confident that another organisation, such as law enforcement or the media, would be able to persuade an impartial observer of the organisation's wrongdoing.

Quinn, M. J. (2019). *Ethics for the information age* (8th ed.). Pearson.

Whistle-blowing

EXERCISE 2:

Read about the Cambridge Analytica Debacle (suggested articles are in the Notes section below).

- As far as you can tell, did Christopher Wylie fulfil conditions 1 through 3 of De George's criteria before he blew the whistle?
- Do you think it was morally permissible for Wylie to whistle-blow? Explain.

Christopher Wylie
Cambridge Analytica Whistle-blower

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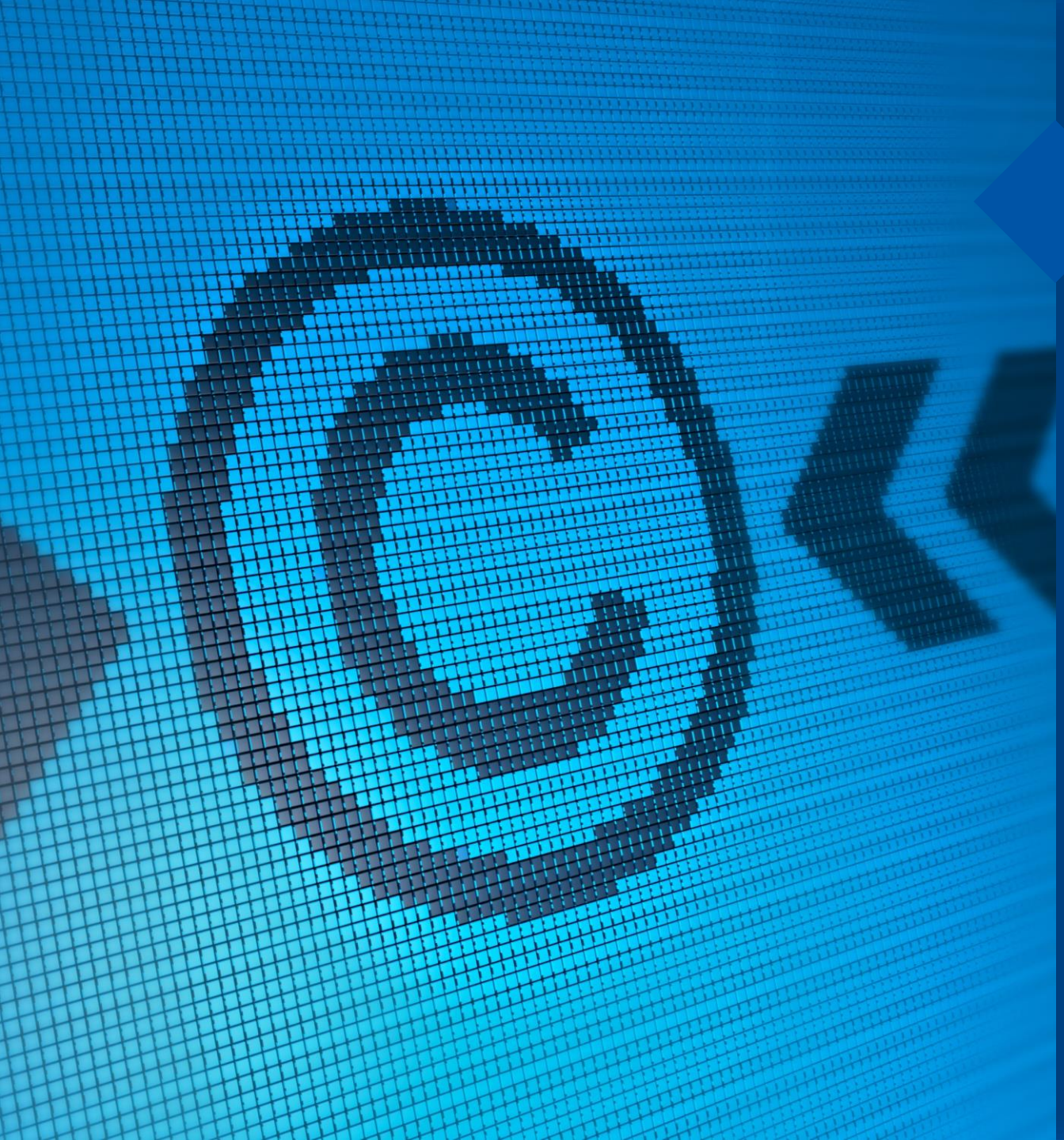
Module 6:

Intellectual Property and Rights Licensing

Presented by Teo Yi-Ling



Overview

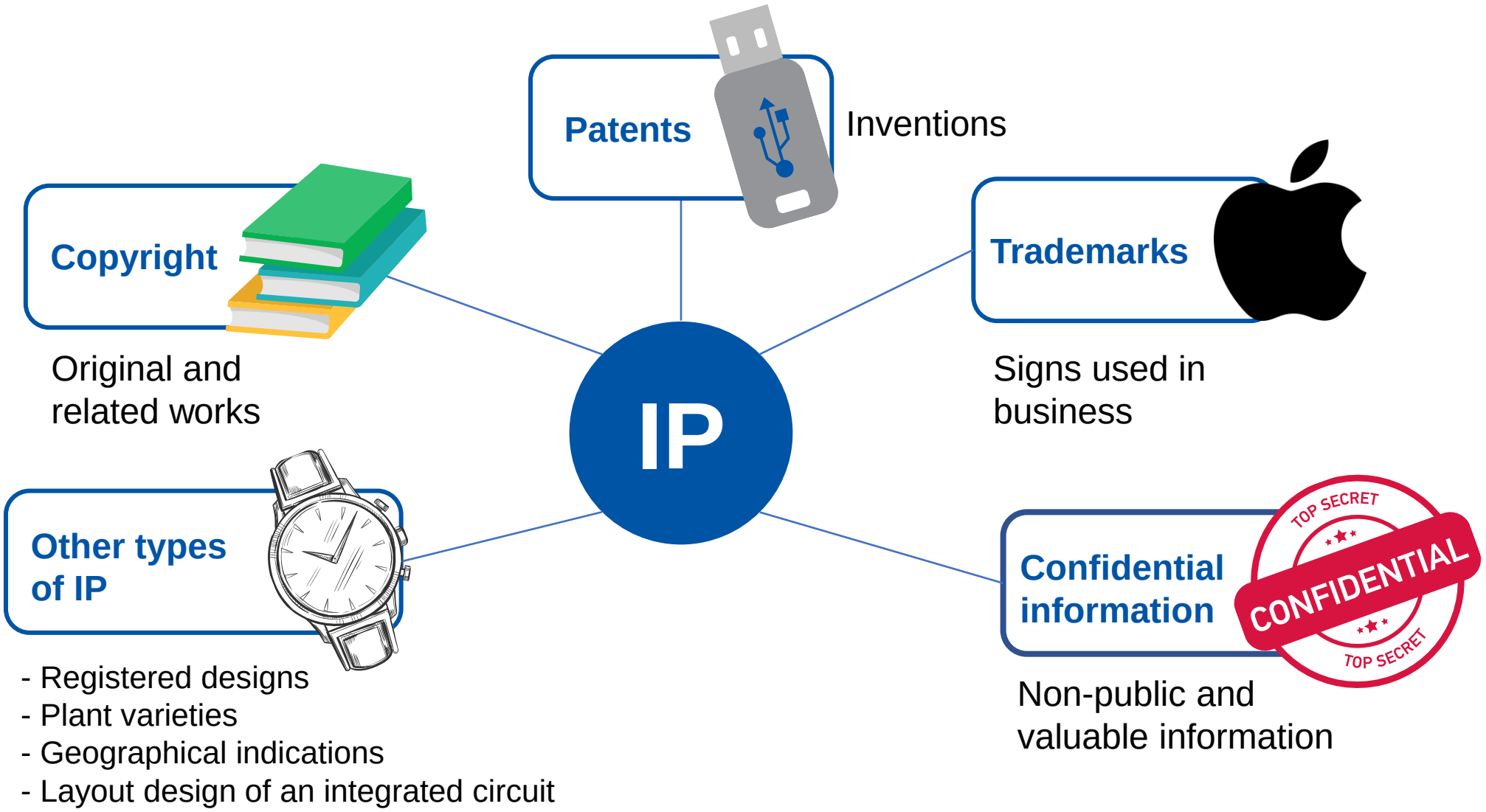
- Overview of intellectual property rights and copyright law
- Basics of contract law
- Dealing with IP/copyright contractually: Licensing and assignment

OVERVIEW OF DIFFERENT IP RIGHTS

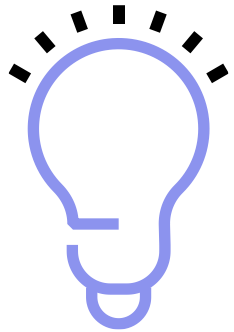
What is Intellectual Property (IP)?

- Creations resulting from the exercise of the human brain
  - Examples include inventions, designs, ideas, plant hybrids, music, poems, paintings, photographs, logos, books, films, cartoon characters, trade secrets.
- Bundle of legal rights protecting such creations, i.e., intellectual property rights (IPRs)
- IP law recognises that creators have the right to protect their work.
  - IP law gives legal rights to IP creators, allowing them to control and exploit the use of their IP for a specific period of time.

Different Types of IP



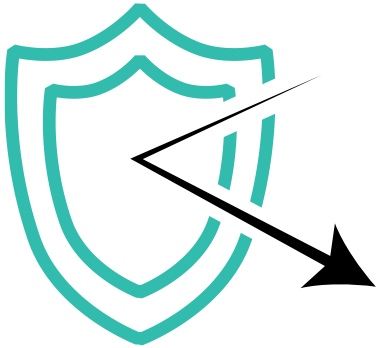
Why Protect IP?



Provides motivation for creators

Encourages constant creation and innovation

Allows creators to exploit their works for commercial gain



Allows creators to defend their works from infringement

COPYRIGHT BASICS

A Quick Exercise!

- Draw a tropical island including
  - a palm tree,
  - the sun,
  - the sea, and
  - sand!
- Write your name, the © symbol and the year on it.
- We will discuss fundamental copyright concepts as you are drawing.

What is Copyright?

- Copyright is the right to prevent the unauthorised **copying** of the **tangible form** in which a person has chosen to express his ideas, for example in a:
  - Short story, musical composition, theatre script, painting, computer programme, photograph, movie or video game
- It can be described as a ***bundle of exclusive rights belonging to the copyright owner***.
  - Allows owners to enforce their rights against infringement
- Singapore's copyright law is governed by the Copyright Act.

Criteria for Protection

Copyright protection arises automatically by operation of law, so long as certain basic criteria are satisfied:

- Falls within the categories of protection
- Fixed in tangible form
- Original
    - Work was created independently by the author.
- Author/creator is a Singapore citizen or PR

How Does Copyright Protect?

Form of expression, and not the idea or information itself.

Idea or information is protected by different means.

Many different media or forms of expression can be protected.

Expression must, as a general rule, be original.

No need for registration formalities.

Copyright arises “as soon as the ink dries”.

The Idea–Expression Dichotomy

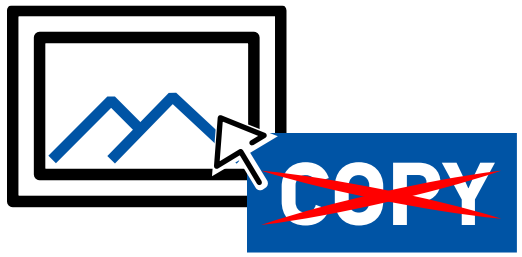
- Copyright protects the "**form**" of an idea and **NOT the idea itself**.
- No need for novelty so long as there is independent creation.
- Artistic merit is not a requirement for copyright to attach to a work—too subjective.

Let's think about your tropical island drawings!

1

2

3



4

5

Ideas and concepts

Discoveries
(e.g., a research finding)

Procedures
(e.g., steps in applying for a grant)

Methods
(e.g., solution to a mathematical problem)

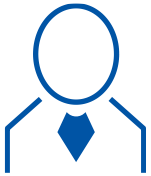
Any subject matter that has not been reduced to a tangible form

Works in the public domain

Unprotectable Matter

Exclusive Rights in Copyright

Exclusive rights applicable to different types of subject matter:



Literary, dramatic or musical works

- Reproduce the work in a material form
- Publish the work if the work is unpublished
- Perform the work in public
- Communicate the work to the public
- Make an adaptation of the work
- Do any of the above in relation to an adaptation of the work

Sound Recordings

- Make a copy of the sound recording
- Enter into a commercial rental arrangement in respect of the recording
- Publish the sound recording if it is unpublished
- Make available to the public a sound recording by means of, or as part of, a digital audio transmission

Cinematograph films

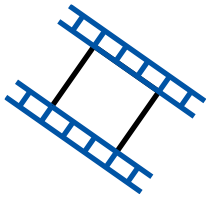
- Make a copy of the film
- Cause the film, insofar as it consists of visual images, to be seen in public
- Communicate the film to the public

Artistic Works

- Reproduce in material form
- Publish the work if the work is unpublished
- Communicate to the public

Exclusive Rights in Copyright

Exclusive rights applicable to different types of subject matter:

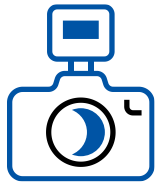


TV and sound broadcasts

- Make a cinematograph film of TV broadcast or a copy of film
- Make a sound recording of TV/sound broadcast or a copy of recording
- Cause it to be seen/heard in public by paying audience
- Communicate the work to the public

Cable programmes

- Make a film of visual images, or a copy of such film
- Make a sound recording of the work or a copy of such sound recording
- Cause work to be seen or heard by paying audience
- Communicate to the public



Published editions

- Make a reproduction of the edition, including by way of a photographic process

Duration of Protection

Literary, dramatic, musical and artistic works	Life of author plus 70 years from the end of the year in which the author died
Published editions	25 years from the end of the year in which the edition was first published
Sound recordings and films	70 years from the end of the year of release
Broadcasts and cable programmes	50 years from the end of the year of first broadcast
Performances	70 years from the end of the year of the performance

Overlapping Copyright

- One product may contain a variety of copyright works

MUSIC ALBUM with SONGS

→ Lyrics

→ Musical work

→ Sound recording

- Purchasing a physical product does not give rights to underlying copyright work(s) (e.g., purchasing an original music CD does not give right to make copies)

Who Owns the Copyright?

Person who creates/authors the work automatically owns it from the moment of creation

EXCEPT:

Employment: If the work is created by an employee pursuant to the terms of his employment, the employer owns the copyright in the work.

By agreement: The author can agree to transfer some or all of his rights.

Who Owns the Copyright?

Joint authors:
Where work is created jointly by more than one author, the authors are all co-owners of the copyright in the work

Concept of joint authorship:
Where more than one author creates inseparable or interdependent parts of a whole work
E.g., two trainers involved in creating the training materials for a course

Contributions must be original material expression, not just ideas or non-copyrightable materials.

BASICS OF CONTRACT LAW

What is a Contract?

- Definition of a contract:

  “An agreement giving rise to obligations which are enforced or recognised by law”
- It is a voluntary agreement between two or more parties.
- The law exists to *govern and regulate* the parties’ relationship in such agreements.
- It can be verbal or written, simple or complicated.

Function of Contracts

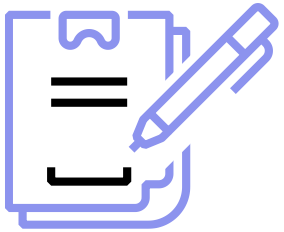
All these go towards overall risk management of the situation that is the subject of the contract:

- Set out extent of agreement
- Identify and clarify rights and obligations
- Allocate risk
- Provide certain guarantees
- Set performance standards
- Provide how non-fulfillment of obligations should be dealt with

What the Law of Contract Covers

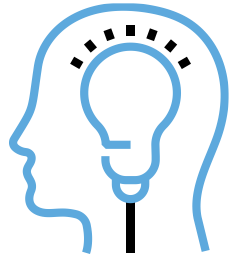
- Formation of contracts
  - *Elements required for a contract to exist*
- Contents (*terms*) of a contract
- Performance of terms of the contract by its parties
- Remedies when there is non-fulfillment of either party's obligations (*breach*)

Elements of a Contract



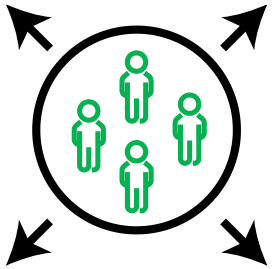
OFFER
Indication by offeror of willingness to contract

ACCEPTANCE
Absolute and unqualified—must be communicated to offeror



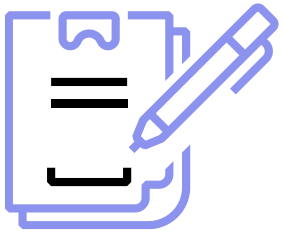
CONSIDERATION
Usually indicated by price or the carrying out of an act in return for the benefit

INTENTION TO CREATE LEGAL RELATIONS
Reasonable to conclude from conduct of parties of their intention to be legally bound



CAPACITY
- Parties must have the capability to enter a contract
- Issue of minors (below age of 18) and impaired mental capacity

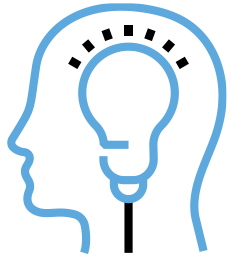
Elements of a Contract



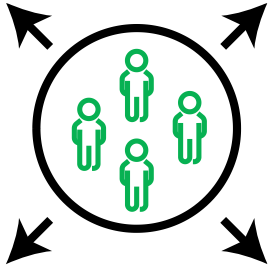
OFFER

ACCEPTANCE

CONSIDERATION



INTENTION TO CREATE LEGAL RELATIONS

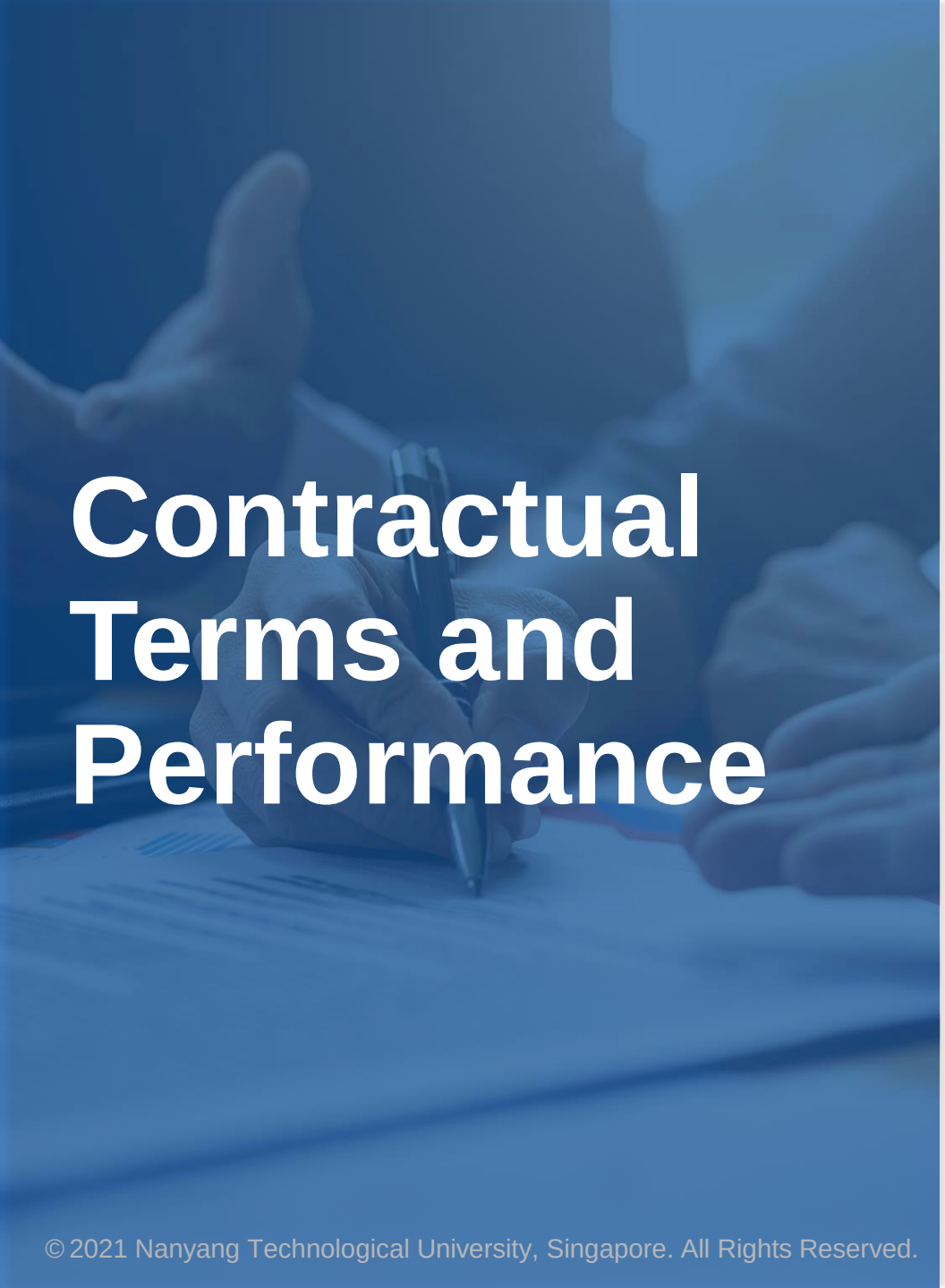


CAPACITY

Once all these elements are in place, a contract is deemed to be **FORMED**.

Absence of any one of these means that no contract is in existence.

Contractual Terms and Performance



- Set out and determine the rights and obligations of respective parties
- Provide for how obligations are to be performed
- Provide for how risks are to be allocated
- Provide for how the contractual relationship is to be regulated
  - How it begins, carries on, ends or is renewed

Common Terms in Contracts

- **Purpose of contract/description of collaboration**
  - What is the aim of the contract?
- **Payment/Fees**
  - How much and how is payment to be made?
- **Rights and obligations of each party**
- **Duration/Termination**
  - How long is the contractual relationship going to last? How will the contract end?
- **Warranties (fundamental promises)**
  - Basic assurance that the contract can be carried out effectively
- **Dispute resolution**
  - How will disagreements be resolved?

Breach and Remedies

- Contract is breached when there is non-performance of a term.
- Does not automatically terminate contract!
- Breach entitles the wronged party to demand cure of the breach from the other party, as well as financial compensation (damages) if there is loss.
  - May also be entitled to terminate contract

DEALING WITH IP AND COPYRIGHT

Using Contracts With IP

You already have an understanding of the law of contract.

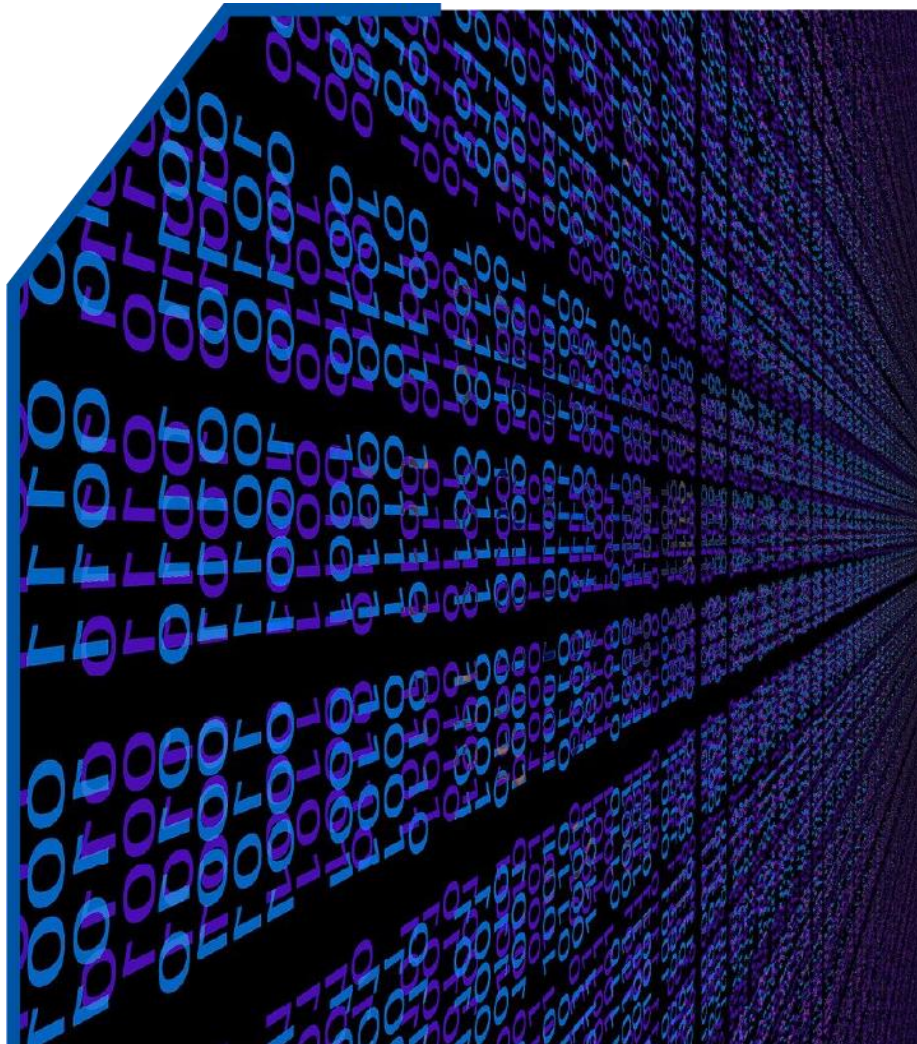
You now have a general understanding of IP, and copyright.

Contracts combined with IP enables you to transact/deal with IP usage.

Words you need to be familiar with: Permission, release, licence, assignment, clearance

Dealing With IP

- The law regards intellectual property as a type of personal or movable property
- IP is capable of being owned and dealt with as other types of personal property.
- In other words, you can buy, sell, lease/hire out, or give away IP.
  - It has commercial value.



Dealing With IP

Two KEY methods that are used in dealing with IP:

License (verb)
Licence (noun)

Assign (verb)
Assignment (noun)

Licence: Definition

- A licence is a type of contract that gives permission to the holder/recipient to carry out a certain act, which would be infringing in nature otherwise.
- A licence gives the owner the ability to use or exploit intellectual property commercially, most commonly requiring a fee in return for the grant of the licence.

Licence: Types and Uses

- Non-exclusive licence
  - Granted to more than one person
- Exclusive licence
  - Granted to one person only
- Where do you see licences being used?
  - All social media platforms
  - All SaaS platforms
  - All media aggregation platforms where works can be accessed for use

Assignment: Definition

- An assignment is another type of contract.
  - Legal meaning of “assign”: To regard as belonging to
  - Must be in writing and signed by or on behalf of the assignor

Assignment: Legal effect

- Under the assignment, the assignor (person making the assignment) transfers all entitlement and ownership rights that are the subject of the assignment to the assignee (the person receiving these rights).
- The assignee is now the new owner of the property.

Licensing

Grants someone else (other than the IP owner) the right to use the IP
Less costly
IP owner remains in control

VS

Assignment

Transfers the entire title and interest in someone’s IP to another
More costly
IP owner gives up control

Licensing vs. Assignment

- Consider at the outset if you want to own or license (“hire”).
  - Remember the difference between assignment and license of IP rights.
- If someone is creating something new for you, and you wish to have complete control over it, you may want to take an assignment of the IP rights in the thing created.
- If there is an IP already created by someone else that you wish to USE for a specific reason, you may want to just license the IP.
- There will be cost differences!

Assignment of Rights

> The Writer hereby assigns to the Company all copyright, title, interest and all other rights (including all vested future and contingent interests and rights) concerning the Story, the characters depicted in it and all other output of the Writer's Services conferred under the laws of any country throughout the world (whether now in force or which may be enacted, promulgated or come into effect in the future) for the use and benefit of the Company fully for the entire period or periods of copyright protection including all reversions, renewals and extensions, provided by the laws of any country throughout the world.

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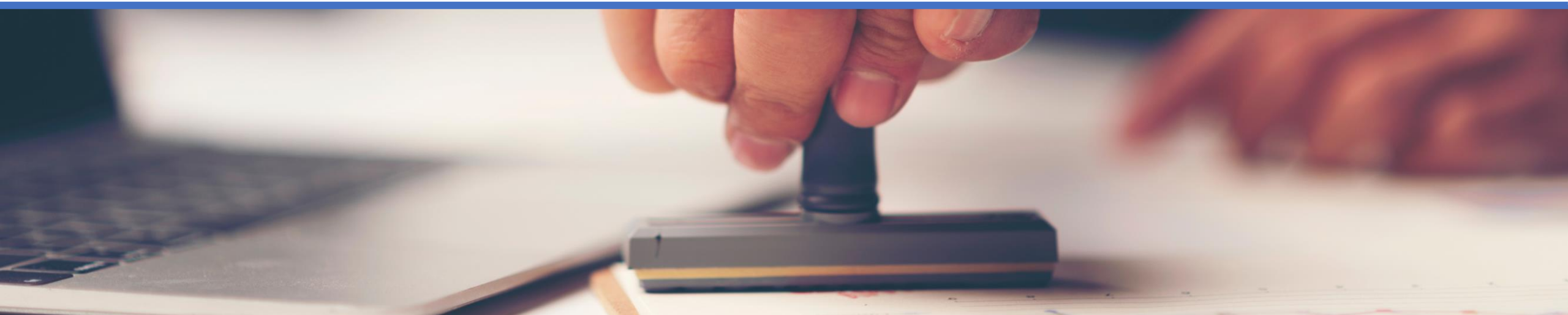
In consideration of the Publisher paying the Advance Payment and the Royalty to the Author, the Author grants to the Publisher for a period of _____ years, beginning on _____ or date of this Agreement] until _____, the sole and exclusive right to publish, use, and license the Work and any parts of it in all media now known and yet to be invented, including but not limited to all methods of publication and reproduction including hardback, paperback, e-book/digital, serialization, translations, anthologies, quotations, mechanical reproduction, television, radio, theatre, film, media merchandising and the Internet in the Territory for the entirety of the Licence Period.

Please Note…

- The way a licence is worded can make it almost as strong or effective as an assignment
- Thus, it is important to understand the language used in licences and assignment agreements.

Licensing and Assignment IRL

- Now that you understand IP rights, licensing, and assignment, find out more from the following sites how IP rights are managed online as well as offline:
  - Creative Commons licences: https://creativecommons.org/
  - Collective Management Organisation: https://www.wipo.int/copyright/en/management/



NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

CC0002 Navigating the Digital World

Module 6:

Intellectual Property and Rights Licensing

Presented by Teo Yi-Ling

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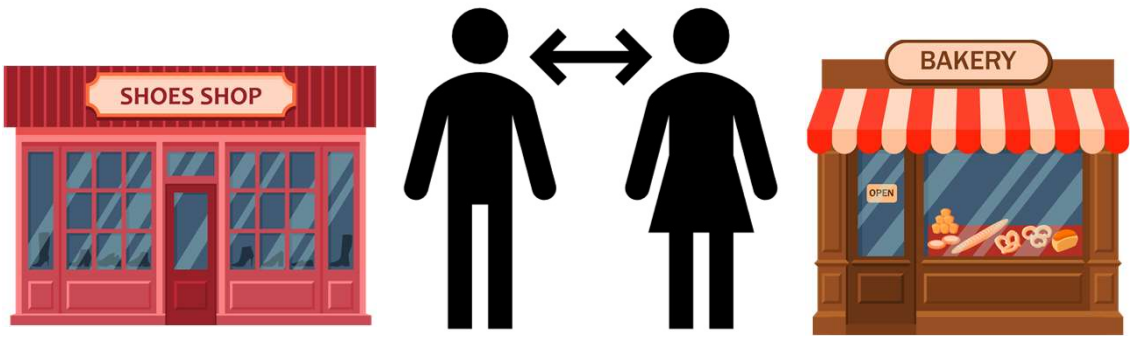
- Icons: M. Style (n.d.). *Icons* [Vector]. Shutterstock, Inc. https://www.shutterstock.com/image-vector/collection-vector-line-icons-education-natural-1337548016
- fatido. (2017). *Blue copyright on digital background* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/blue-copyright-on-digital-background-gm895629292-247436540
- relif. (2019). *Intellectual property law concept* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/intellectual-property-law-concept-gm1168367636-322574095
- macrovector. (n.d.). *Stack of books* [Vector]. Freepik. https://www.freepik.com/free-vector/school-books-elements-set_9387094.htm#page=1&query=school%20books%20elements%20set&position=0
- Apple Inc. (2019). *Apple logo* [Vector]. Wikipedia. https://en.wikipedia.org/wiki/File:Apple_logo_black.svg. In the public domain.
- macrovector. (n.d.). *Watch* [Vector]. Freepik. https://www.freepik.com/free-vector/business-clothing-sketch-set_10156324.htm
- malerapaso. (2012). *Box with question marks* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/vote-ballots-with-question-mark-in-the-box-gm185284873-19918409
- Bulat Silvia. (2019). *Hands holding paper with copyright symbol* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/hands-hold-paper-with-copyright-symbol-international-legal-rights-intellectual-gm1153091214-313065546
- inmoon. (2014). *Map of Singapore* [Illustration]. iStockphoto LP. https://www.istockphoto.com/vector/cartoon-map-of-asean-gm486312765-38720298
- Cecilie_Arcurs. (2020). *Two businesswomen having a meeting* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/when-you-work-together-you-can-expect-results-gm1257428538-368506512
- Yok_Piyapong. (2017). *Businesswoman signing a contract document* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/business-woman-signing-a-contract-document-on-office-teamwork-successful-meeting-gm856634504-143277991
- weerapatkiatdumrong. (2015). *Stethoscope and lock on keyboard* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/checking-computer-security-system-gm483815772-70854667
- Motortion. (2019). *Copyright licence agreement* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/copyright-license-agreement-lying-on-table-pen-and-eyeglasses-on-document-gm1158250272-316331651
- damircudic. (2020). *Woman working from home* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/young-woman-working-from-home-gm1221479375-358071663
- greenleaf123. (2018). *Close-up of a person's hand stamping a document* [Photograph]. iStockphoto LP. https://www.istockphoto.com/photo/close-up-of-a-persons-hand-stamping-with-approved-stamp-on-document-at-desk-gm1007078074-271753444

Today, let's talk about blockchain. At the mention of blockchain, the first thing that comes to your mind would probably be bitcoin. Bitcoin is a type of cryptocurrency that is an example of blockchain application. For this class, we will use bitcoin as the focus for you to better understand how a blockchain works. But before we get into that, let's discuss the history and evolution of money and payment.



While money is something that we use almost every day, the exact meaning of money can be quite abstract. Imagine you make shoes for a living and need to buy bread to feed your family. You would like to trade your shoes for bread with a baker, but he does not need that many pairs of shoes. Unless you find another baker who needs that many pairs of shoes, this trade cannot be carried out. This is so called barter economy.

In the early days, people use commodities as a mode of payment. One example are the Aztecs, People in central Mexico, they used cocoa beans for trading. However, using such commodities for trading has its disadvantages as their size and shelf-life matter.

Hence, we use currency (or money) as a solution.

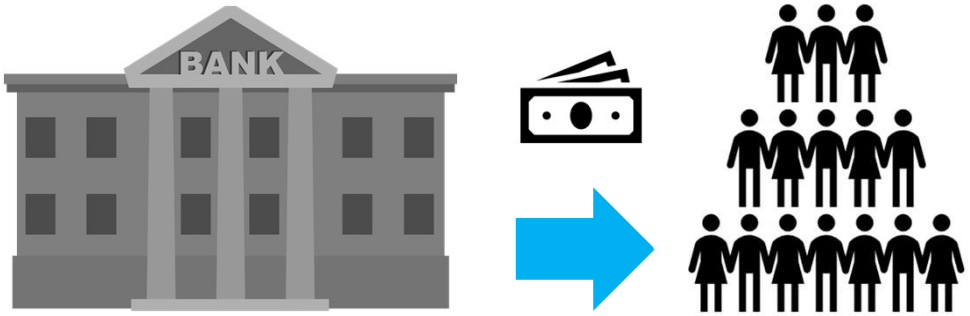
According to mainstream economics, money relieves the issues arising from commodity trading as it is a universal store of value that can be readily used by anyone.

This allows faster transactions as sellers have an easier time finding a buyer with whom they want to do business with. By transacting with currency, a seller can simply sell his or her goods and in turn pay their trading partners with the money earned.

There are other important benefits of currency too. For instance, it is much easier to bring currency around as compared to bringing bags of cocoa beans each time you need to buy something. Furthermore, coins and papers last longer than most commodities used for trading. For example, if a farmer relies on direct trade using his corns, he will only a few weeks to trade before his corns become rotten. Currency, on the other hand, can be accumulated and stored.

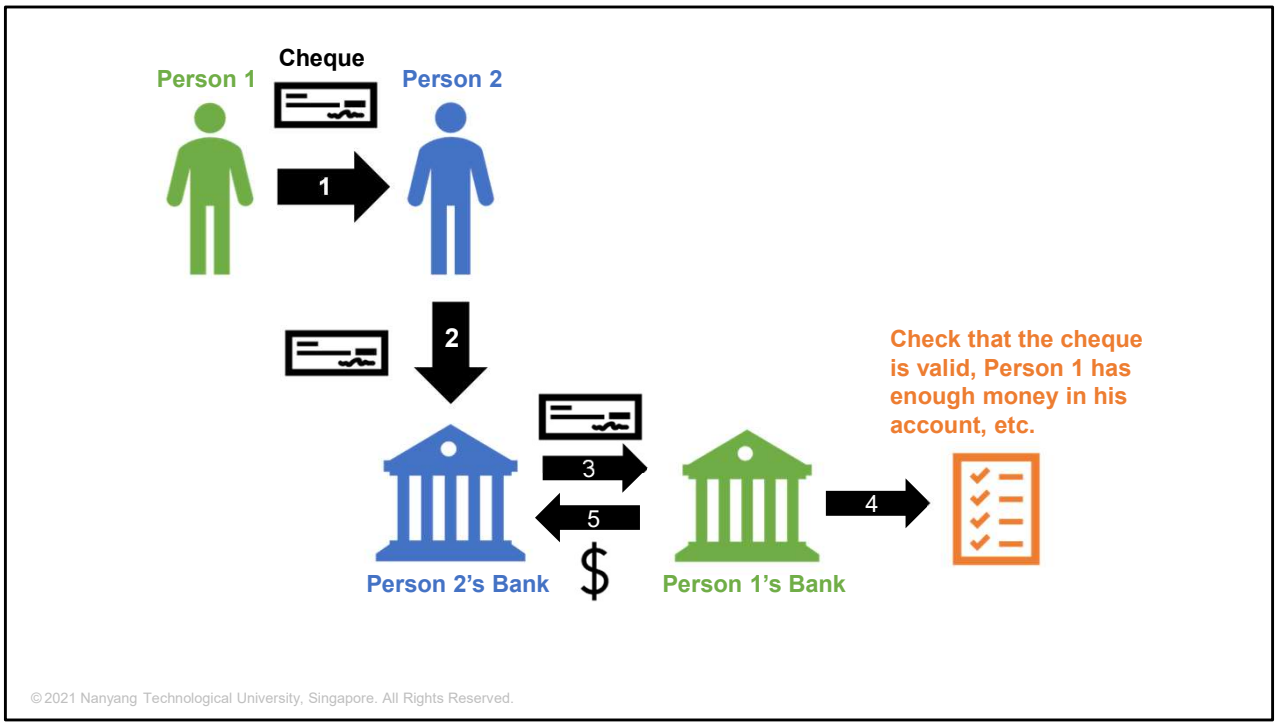
This is why minted currency was such an important innovation. As far back as 2500 B.C., Egyptians created metal rings to use as money. Then actual coins made from precious metals such as gold, silver, or copper appeared around 700 B.C..
The problem is the metallic coins were quite heavy to carry for daily transactions.

So, we have paper money. The first recorded use of paper money was purported to be in China during the 7th century A.D. It worked quite similar as modern-day banking. Individuals would deposit their coins with a trustworthy party and receive a note denoting how much coins they had deposited. The note could then be redeemed for currency at a later date.

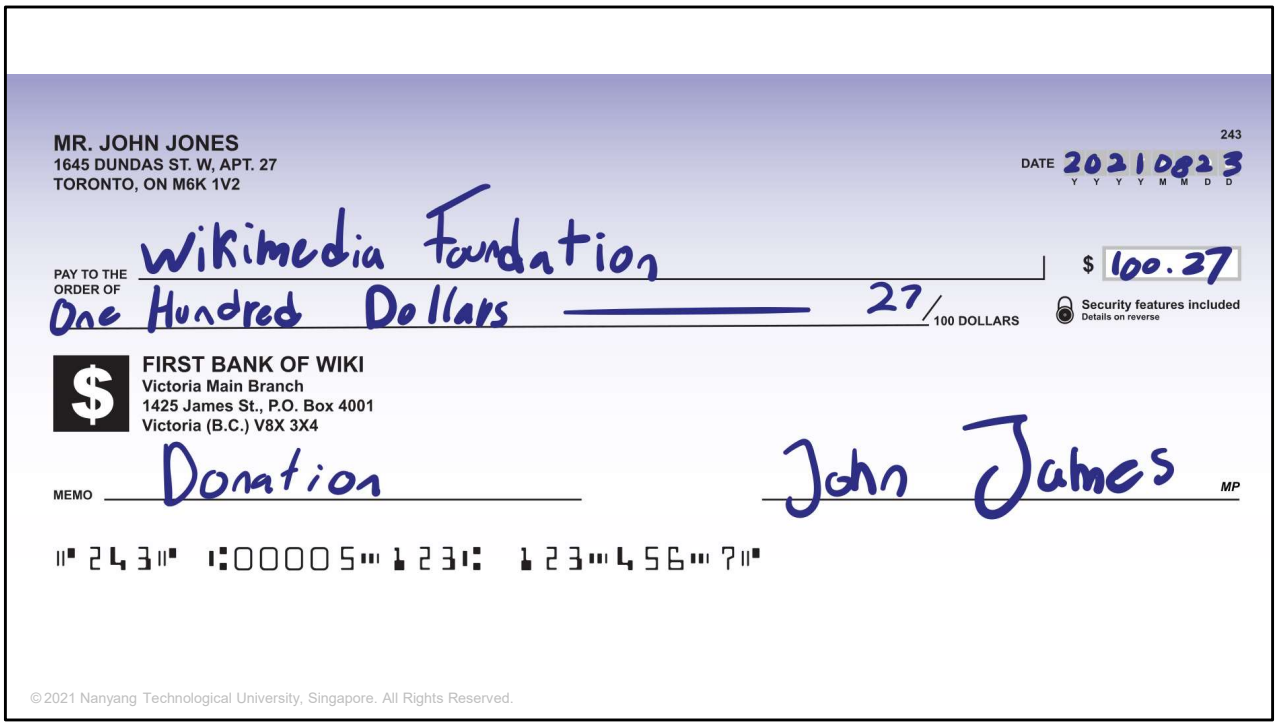


When we talk about paper money, we have to discuss a modern money related key concept—Central Bank. As we know, paper money is a country's official paper currency that is circulated and accepted for the transactions of goods and services. It is the country's central bank that authorises and regulates the printing of paper money, ensuring that the flow of funds aligns with the monetary policy.

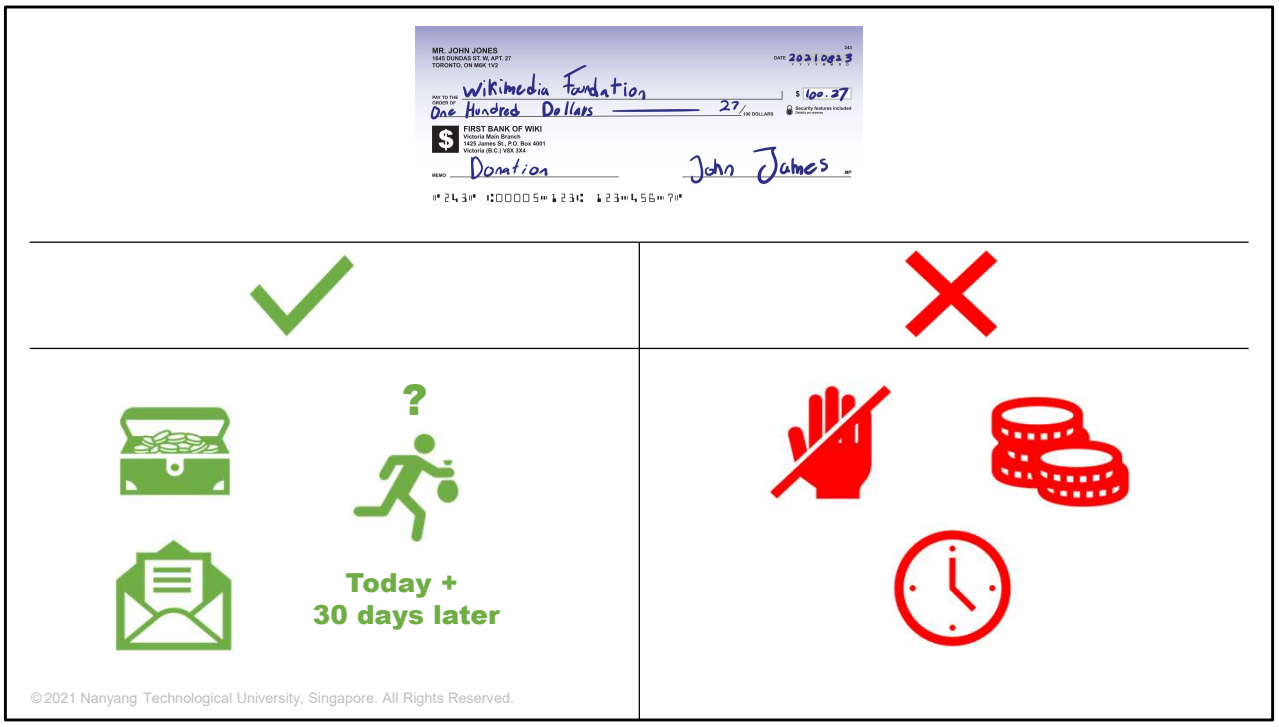
Paper money used to be backed by a certain amount of gold and later on government-issued currency is purely based on a country's government, so called fiat currency. The relationship between supply and demand of the fiat money, and the stability of the issuing government, defines the value of fiat money.



In 20th century, cheque becomes a very popular non-cash method for making payments. A cheque is a document that orders a bank to pay a specific amount of money from a person's account to the person in whose name the cheque has been issued. The person writing the cheque, known as the drawer, has a transaction banking account where the money is held. Say for example, person 1 issues a cheque to person2. When person2 drop cheque at the deposit box, person 2's bank will send the relevant information to person 1's bank. After person1's bank check that the cheque is valid and person 1 has enough money in his account, person1's bank will transfer the money to person2's bank account.



This is how a cheque looks like.

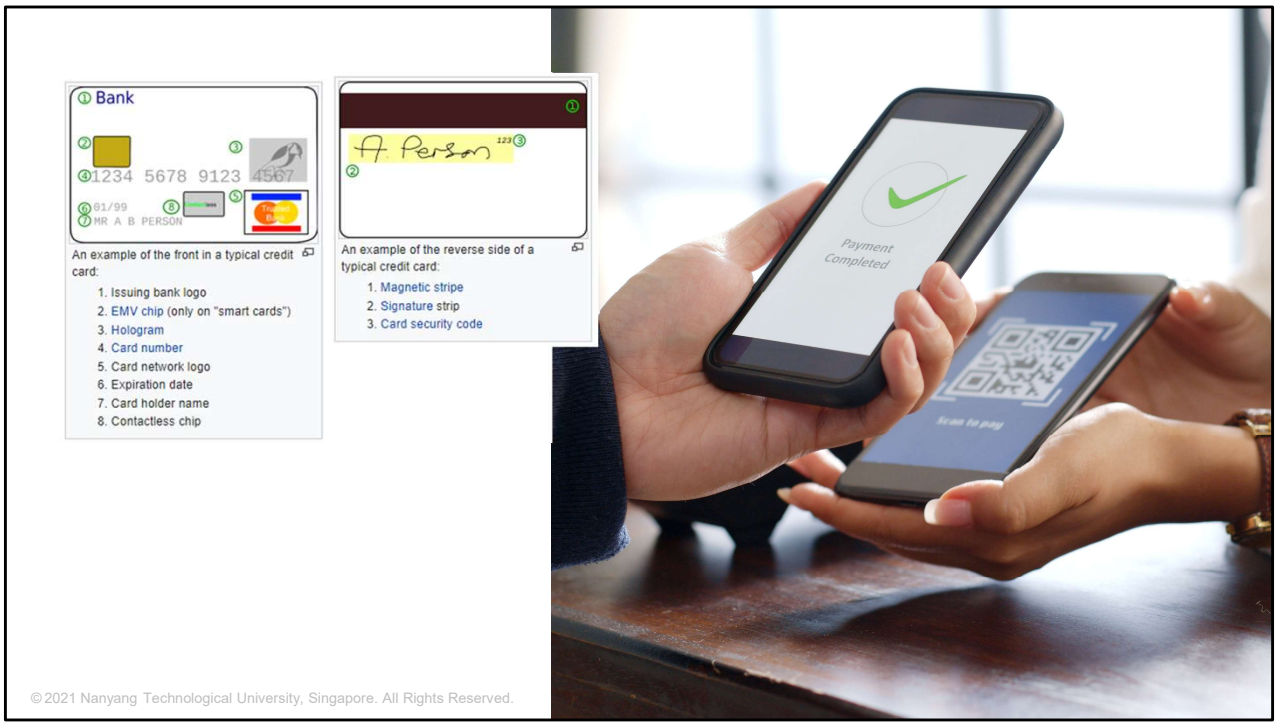


Advantages of cheque:

- It is more convenient than carrying a large amount of cash around.
- Cheques are safer than cash when carrying them around since a thief can't do much with your cheque book.
- They can be post-dated.
- They can be posted.

Disadvantages of cheque:

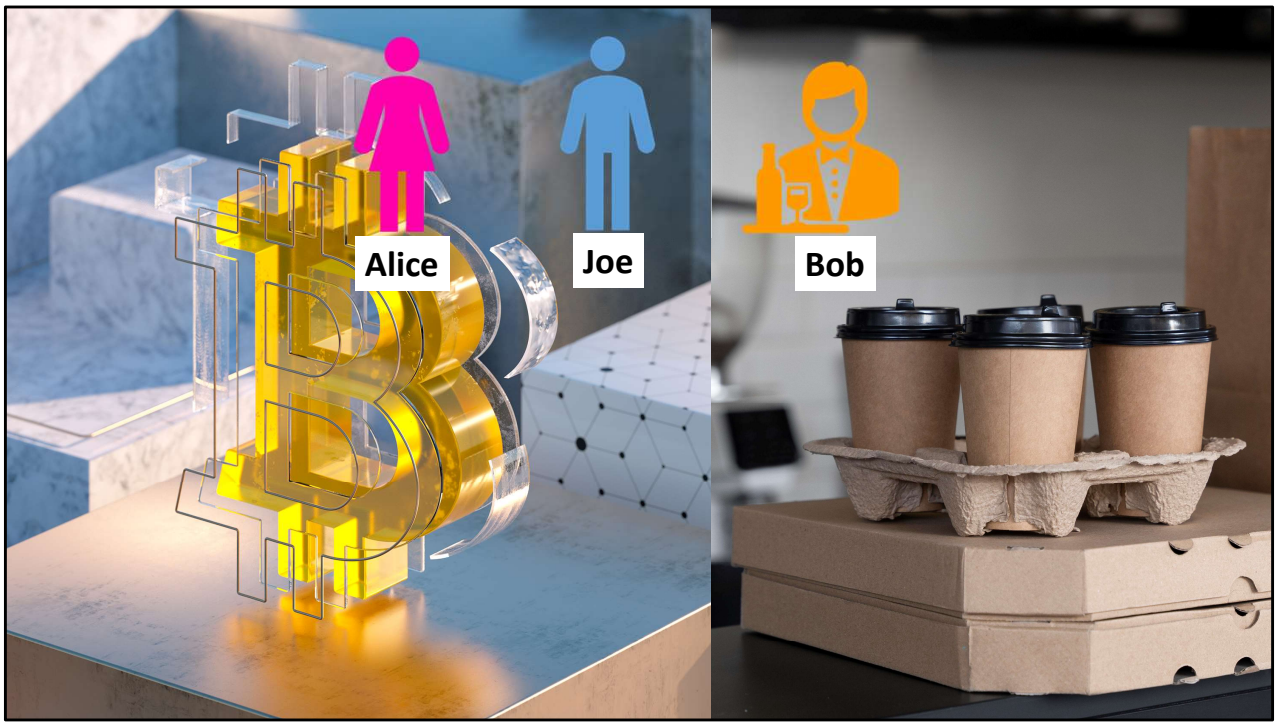
- Cheques are not legal tender; creditors can refuse to accept them.
- Cheques are valueless if drawer has not enough funds in their account.
- There is a lead time from posting to drawing a cheque.



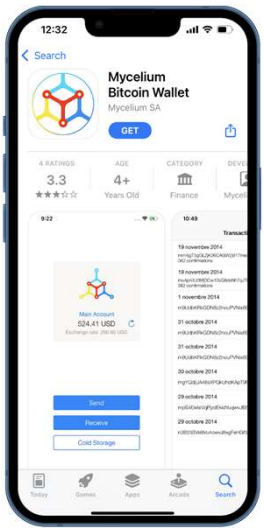
Another payment method is credit card. The card issuer creates a bank account for the cardholder, from which the cardholder can borrow money (with a limit) for payment to a merchant or as a cash advance.

More recently, contactless payment or mobile payment has become the main tool to transact in our everyday life. We generally do not carry cash, cheques or credit cards around nowadays. We simply use our mobile phone to make a payment.

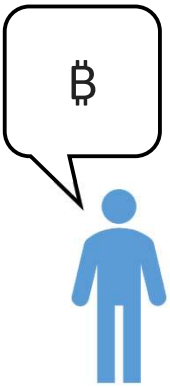
Now, let’s get into the details of bitcoins.



Let's consider a real-life use case. Alice lives in California's bay area. She has heard about bitcoin from her techie friends and wants to start using it. We will follow her story as she learns about bitcoin, acquires some, and then spends some of her bitcoin to buy a cup of coffee at Bob's cafe. This story will introduce us to the software, the exchanges, and basic transactions from the perspective of a retail consumer.



Alice



Joe

Alice, is not a technical user and only recently heard about bitcoin from her friend Joe. While at a party, Joe is enthusiastically explaining bitcoin to everyone around him and is offering a demonstration.

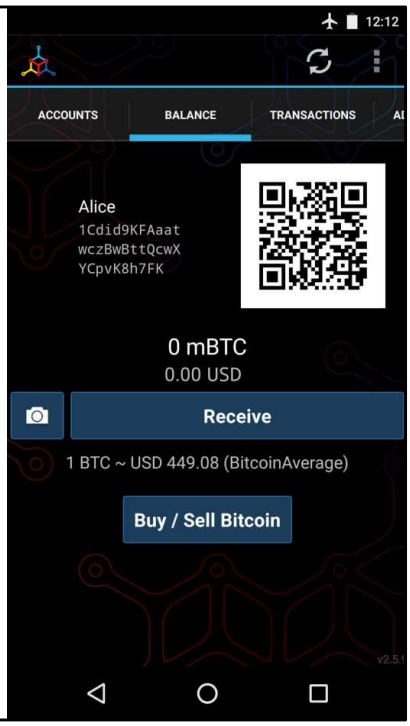
Alice finds it really interesting and asks how she can get started with bitcoin. Joe suggests that new users begin with a mobile wallet and recommends a few of his favourite wallets. Alice downloads “Mycelium” for Android on her phone.

The most important part of this screen is Alice's bitcoin address. On the screen it appears as a long string of letters and numbers:

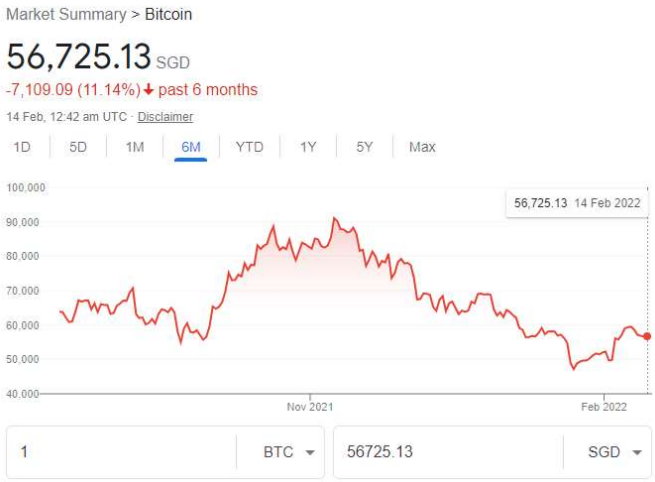
1Cdid9KFAaatwczBwBttQcwXYCpvK8h7FK

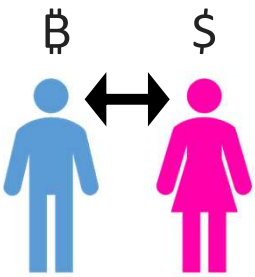
Next to the wallet's bitcoin address is a QR code, a form of barcode that contains the same information in a format that can be scanned by a smartphone camera.

Alice is now ready to use her bitcoin wallet.



After she installs the wallet, this is how her screen looks like.





Next, we will look at how she buys bitcoin from her friend Joe and how Joe sends the bitcoin to her wallet.

Before Alice can buy bitcoin from Joe, they have to agree on the exchange rate between bitcoin and US dollars. This brings up a common question for those new to bitcoin: “Who sets the bitcoin price?”

The short answer is that the price is set by markets. Bitcoin, like most other financial assets, has a floating exchange rate with fiat currency. That means that the value of bitcoin fluctuates according to supply and demand in the market.

Alice has decided to exchange USD10 for bitcoin, so as not to risk too much money on this new technology. She gives Joe USD10 in cash, opens her Mycelium wallet application, and selects Receive. This displays a QR code with Alice's first bitcoin address. Joe then selects Send on his smartphone wallet and is presented with a screen containing two input:

1. A destination bitcoin address
2. The amount to send, in bitcoin (BTC) or his local currency (USD).

Let's make the math simple and assume that the current bitcoin price is USD100. MBTC is milliBTC and 1 bitcoin = 1000 mbtc. We input 100 milliBTC or USD10.

100 mBTC or 0.1 BTC

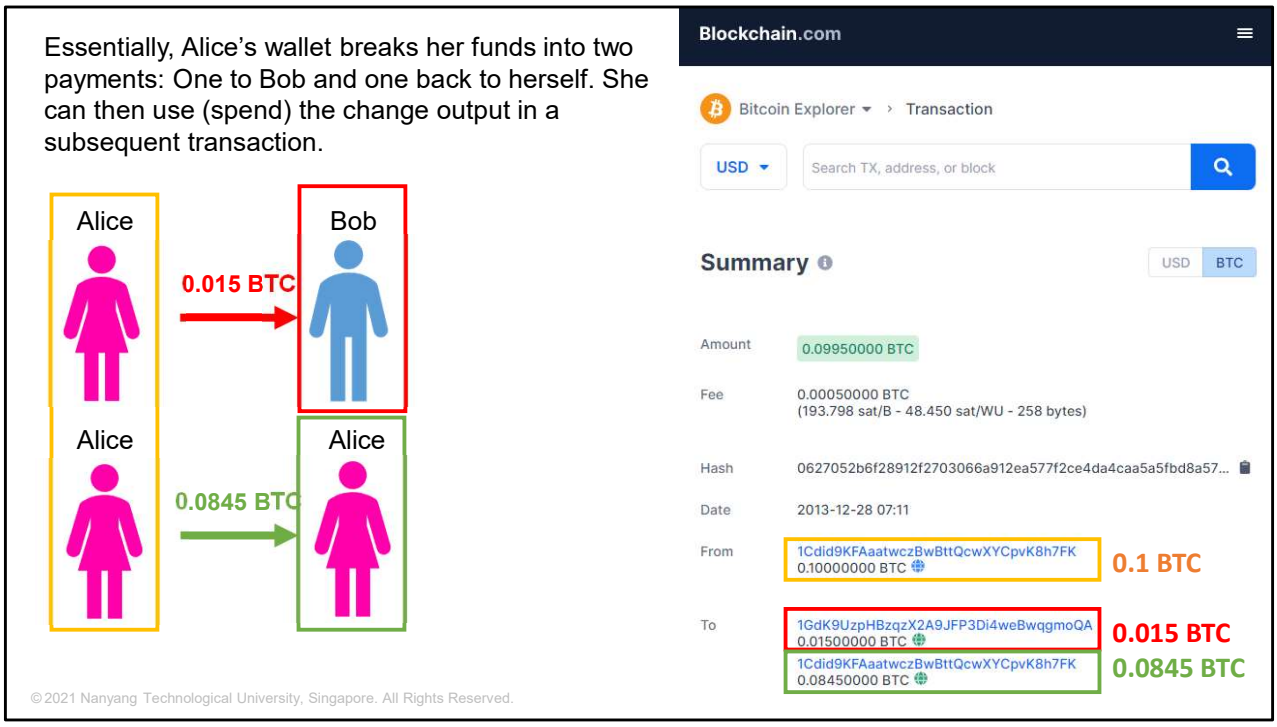
After buying bitcoins from Joe, Alice is now the proud owner of 100 mBTC or 0.1 BTC and she is ready to buy a cup of coffee using bitcoin from Bob's Café to further experience how it works.

Bob's Cafe recently started accepting bitcoin payments by adding a bitcoin option to its point-of-sale system. The prices at Bob's Cafe are listed in US dollars, but at the register, customers have the option of paying in either dollars or bitcoin.

Alice places her order for a cup of coffee and Bob enters it into the register, as he does for all transactions. The point-of-sale system automatically converts the total price from US dollars to bitcoin at the prevailing market rate and displays the price in both currencies:

Total:
$1.50 (USD)
0.015 BTC

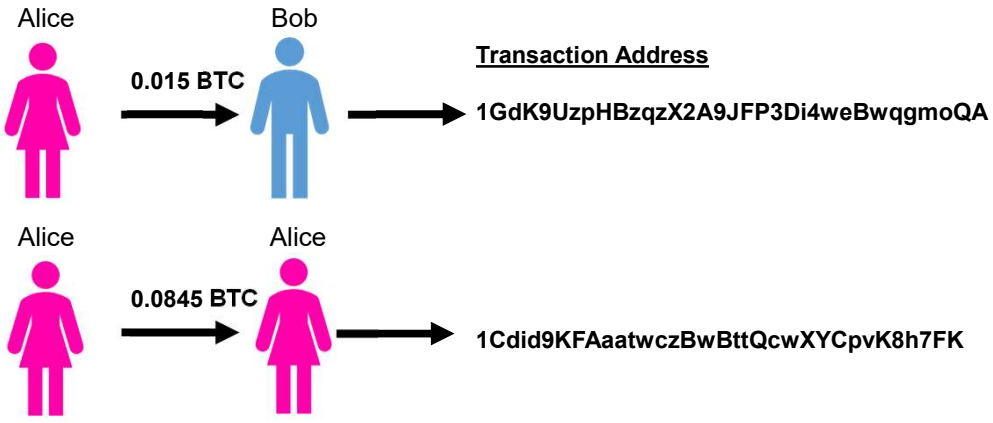
Bob says, "That's one-dollar-fifty, or 0.015 BTC."



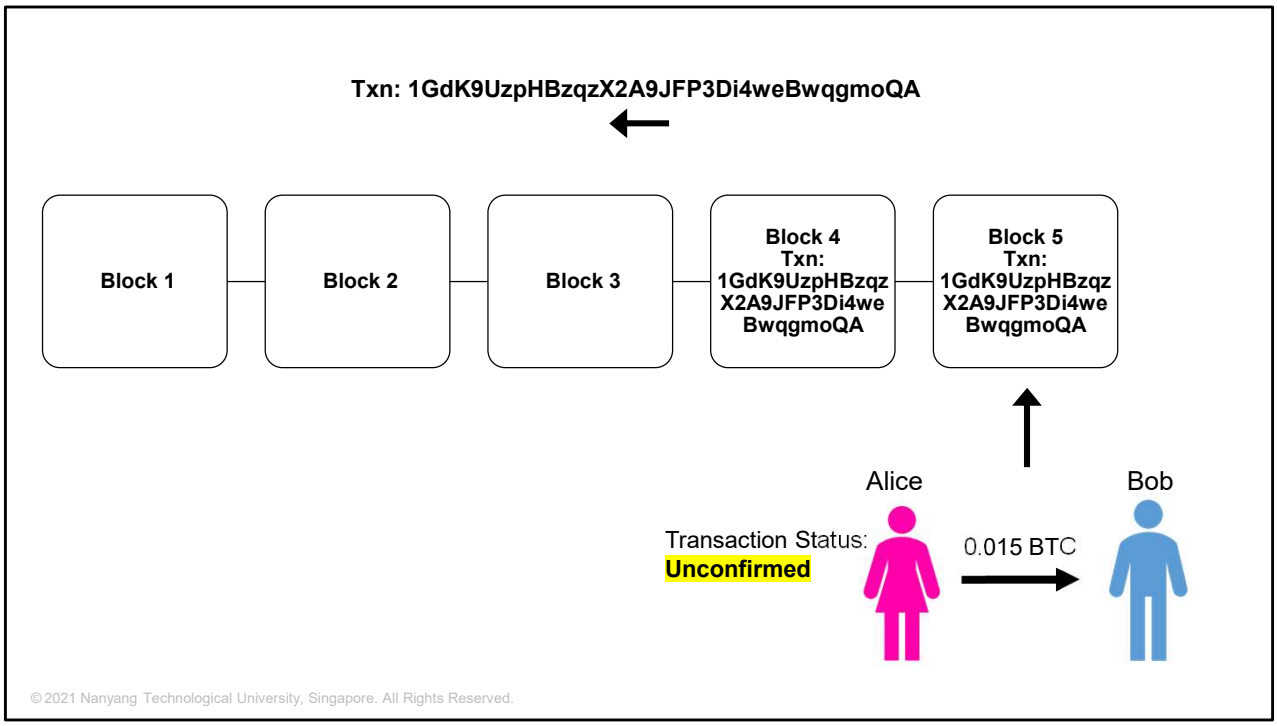
Essentially, after Alice makes the payment with bitcoin for her coffee, Alice's wallet breaks her bitcoin funds into two payments: One to Bob and one back to herself. She can then use (spend) the change output in a subsequent transaction. This is called the UXTO unspent transaction output. The transactions will be recorded on the bitcoin blockchain. The transaction ledger can be checked by anybody through various bitcoin explorer. The screenshot on the right is one example.

Alice's wallet application contains all the logic for selecting appropriate inputs and outputs to build a transaction to Alice's specification. At Bob's café, Alice only needs to specify destination and amount, and the rest happens in the wallet application without her seeing the details.

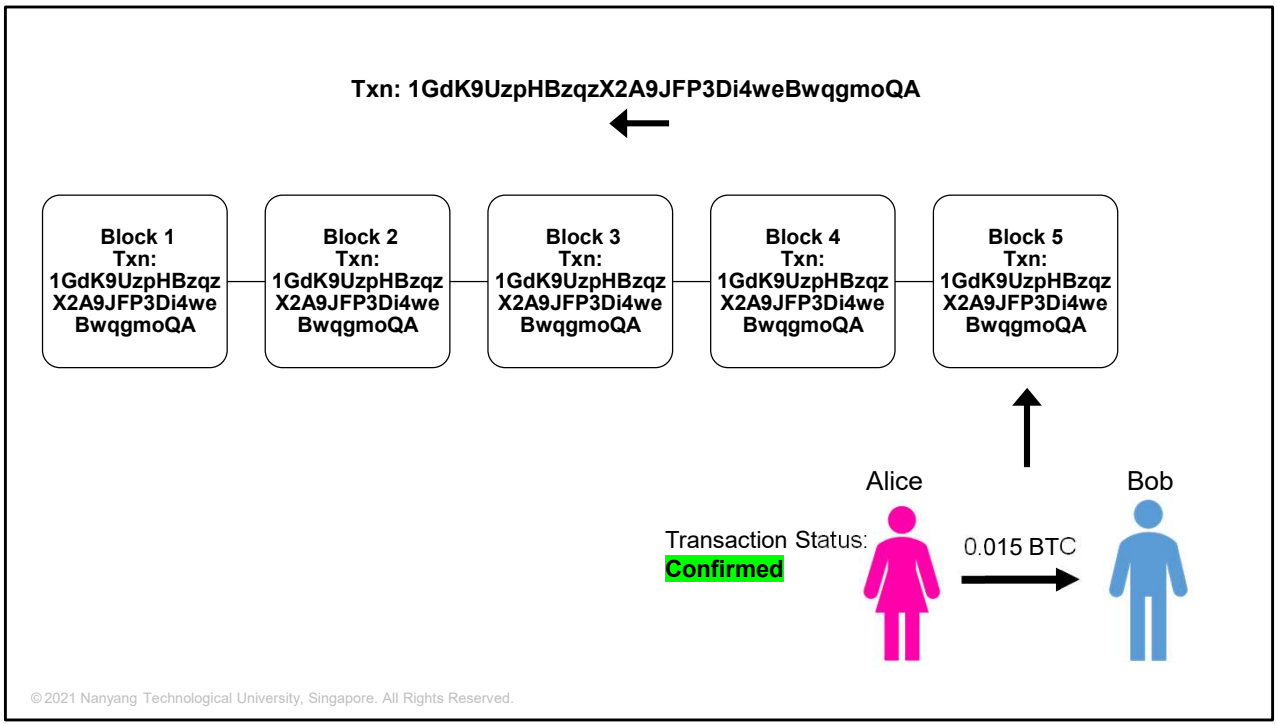
Alice's funds are in the form of a 0.10 BTC output, which is too much money for the 0.015 BTC cup of coffee. Alice will need 0.845 BTC in change. The difference of 0.0005 will be treated as transaction fee to reward the miner, who is the ledger keep of the transactions.



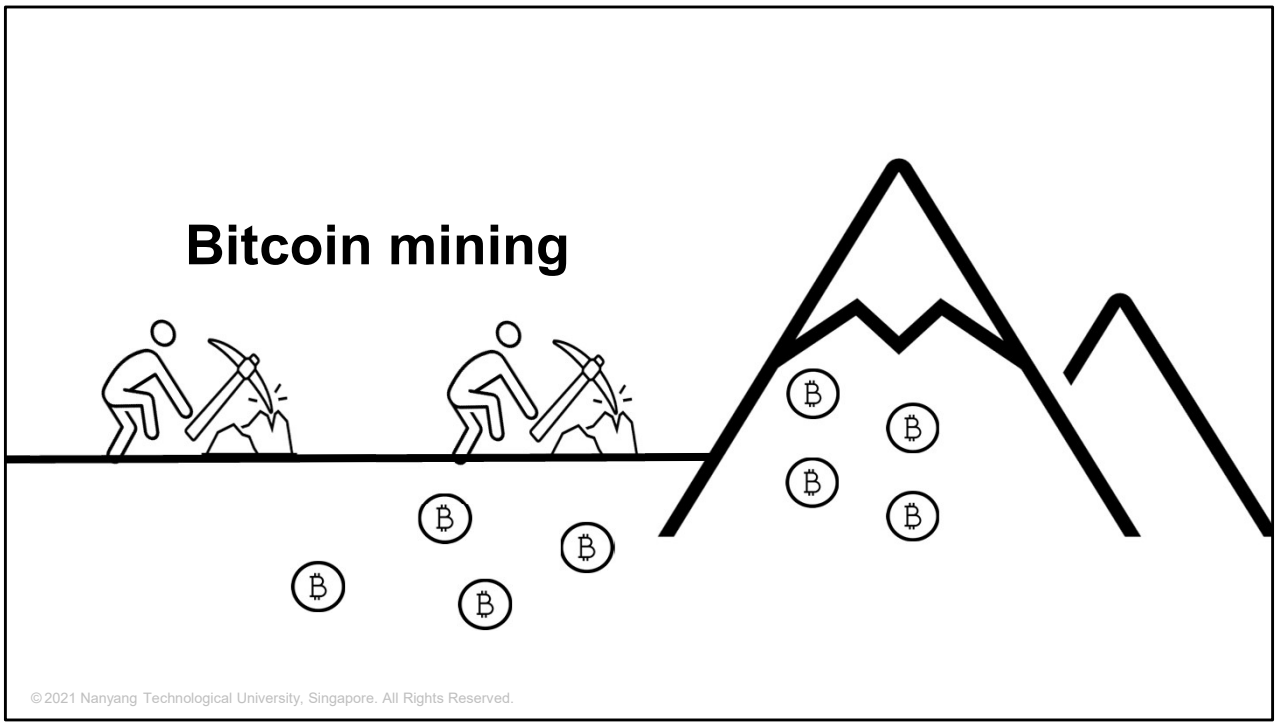
The transaction created by Alice's wallet application is 258 bytes long and contains everything necessary to confirm ownership of the funds and assign new owners. Now, the transaction must be transmitted to the bitcoin network where it will become part of the blockchain.



When the transaction is in the process of propagating to the blockchain network, the transaction status remains unconfirmed. Now, there is a chance that Alice's bitcoin might be fake and be rejected by the network. Hence, Bob should not give her the coffee until the transaction is confirmed. This is similar to how a cheque works.

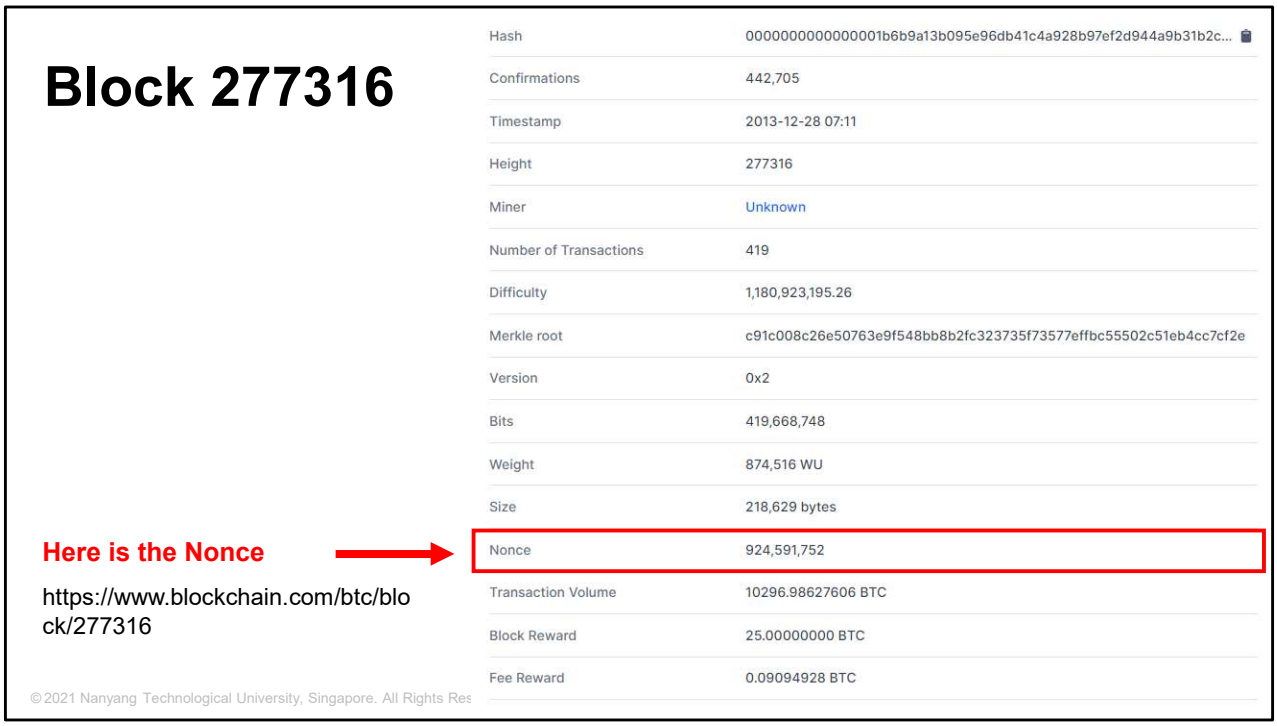


Once the transaction has been propagated to every block and accepted in the network, Alice's transaction is confirmed and Bob can give her the coffee. For small transactions such as this, usually Bob will simply give the coffee even before the transaction is confirmed. Besides, confirmation only takes a few seconds.



Besides buying bitcoin from someone, you can also mine it, like how miners did with gold and other precious metals. This is also known as the bitcoin mining process. This is similar to how Central Bank issues money in the modern world.

Block 277316

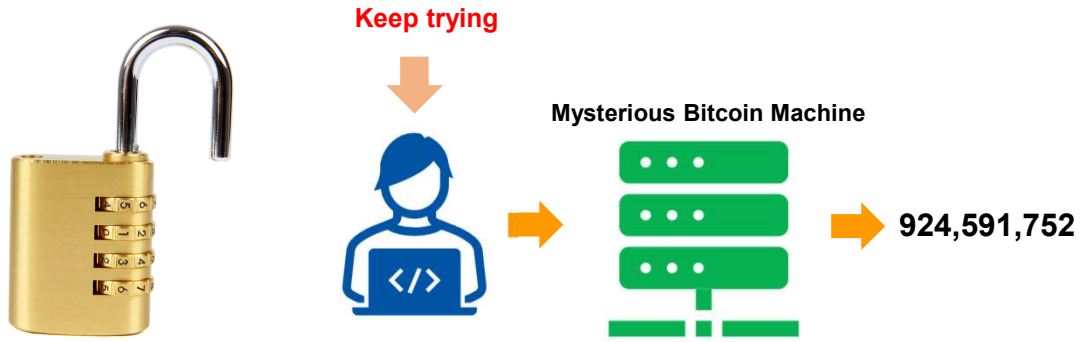


Hash	0000000000000001b6b9a13b095e96db41c4a928b97ef2d944a9b31b2c...
Confirmations	442,705
Timestamp	2013-12-28 07:11
Height	277316
Miner	Unknown
Number of Transactions	419
Difficulty	1,180,923,195.26
Merkle root	c91c008c26e50763e9f548bb8b2fc323735f73577effbc55502c51eb4cc7cf2e
Version	0x2
Bits	419,668,748
Weight	874,516 WU
Size	218,629 bytes
Nonce	924,591,752
Transaction Volume	10296.98627606 BTC
Block Reward	25.00000000 BTC
Fee Reward	0.09094928 BTC

Let's use Block 277316 as an example, which also contains Alice's transaction, for bitcoin mining.

The key to bitcoin mining is the "nonce" value. Nonce is an abbreviation for "number only used once", which is a unique random generated number. The nonce is the number that blockchain miners are solving for, in order to receive bitcoin reward.

Bitcoin Hash Puzzle

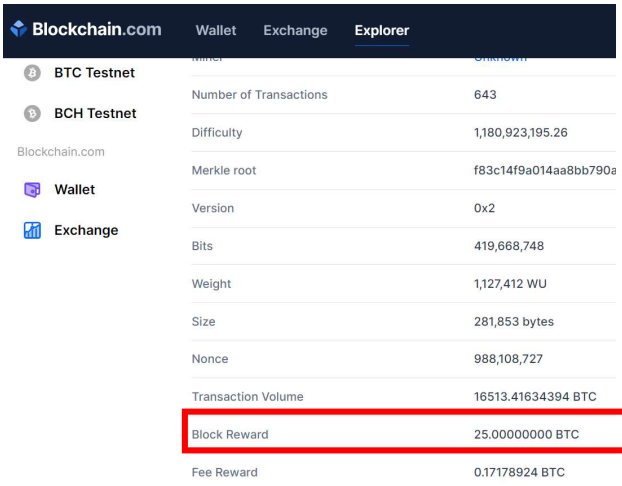


Imagine the mining process as a competition where all the miners compete to open the lock without knowing the password. How? It's not the same as solving a complicated math problem. What you can do is keep trying different combinations of these four digits. The search for a nonce is similar, it's done by sheer brute-force use of processing power. Just keep trying, to solve this so-called hash puzzle set by the network of bitcoin blockchain.

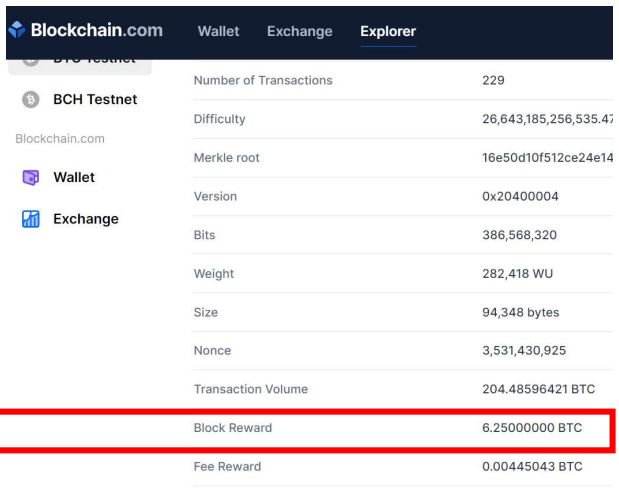
Given the above example, you must find the correct nonce **924,591,752** to get the reward for mining the block 277316.

You can consider this as you have a mysterious bitcoin mining machine, like the miner or ledger keeper who records all transactions between Alice and Bob, the machine will search for this nonce that can be combined with all transaction records and generate a hash value that meets the pre-determined requirement.

Block 277317

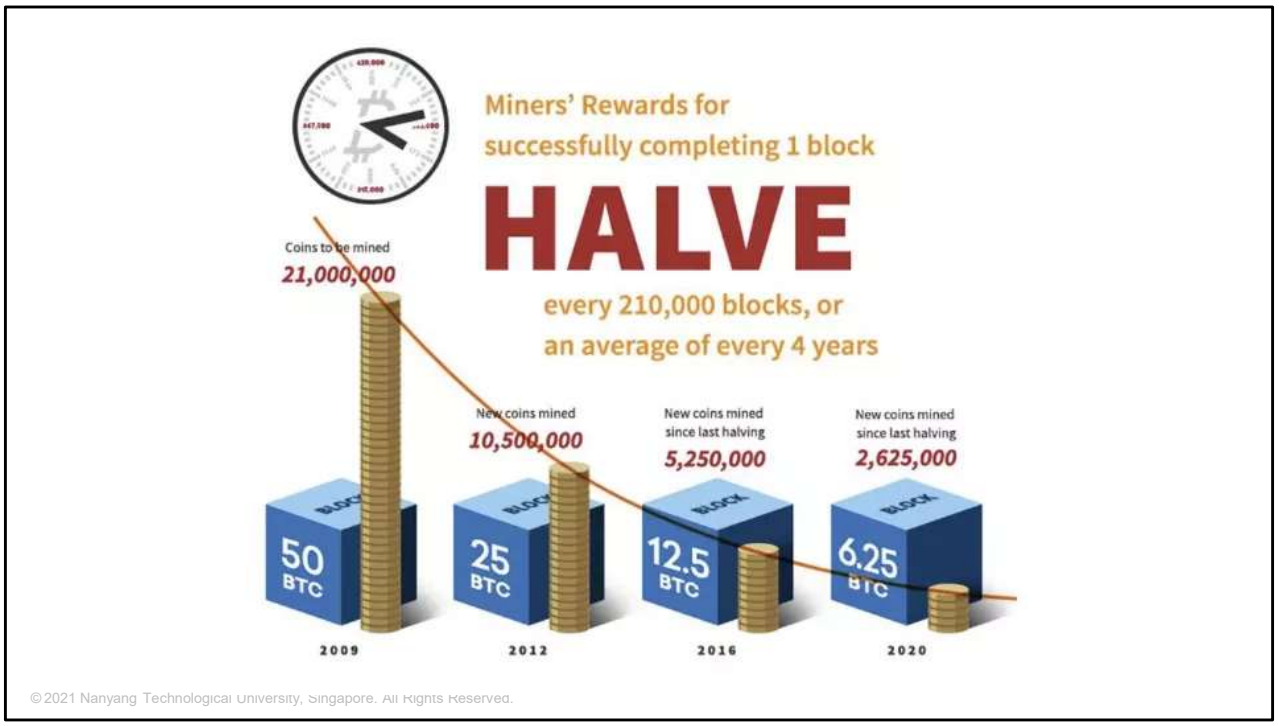


Block 720041



How much are the bitcoin rewards? Answer is, it depends.

You would be rewarded with 25 BTC (slightly over $1,200,000 SGD) if you successfully mined Block 277317, but you would only get 6.25 BTC (slightly over $300,000 SGD) if you successfully mined Block 720041 (the latest block in the chain as at 23 January 2022, 10:08pm Singapore time).



This is because miners' rewards for successfully completing 1 block halve every210,000 blocks or an average of every 4 years. The supply of bitcoins is capped at 21 million, which is forecasted to be all mined by the year 2140.

The mining sounds like a good deal? Think of the electricity and telecommunication bills you have to pay for while mining the bitcoins. Also, think of the competition around the world. After all the effort and expenses, there is a chance that you might get nothing.

Original:
Sounds like a good deal? Think of the electricity and telecommunication bills you have to pay for while mining the bitcoins. Also, think of the competition around the world. There is a block generated every 10 minutes, and the supply of bitcoins is capped at 21 million, which is forecasted to be all mined by the year 2140.

After all the effort and expenses, there is a chance that you might get nothing.

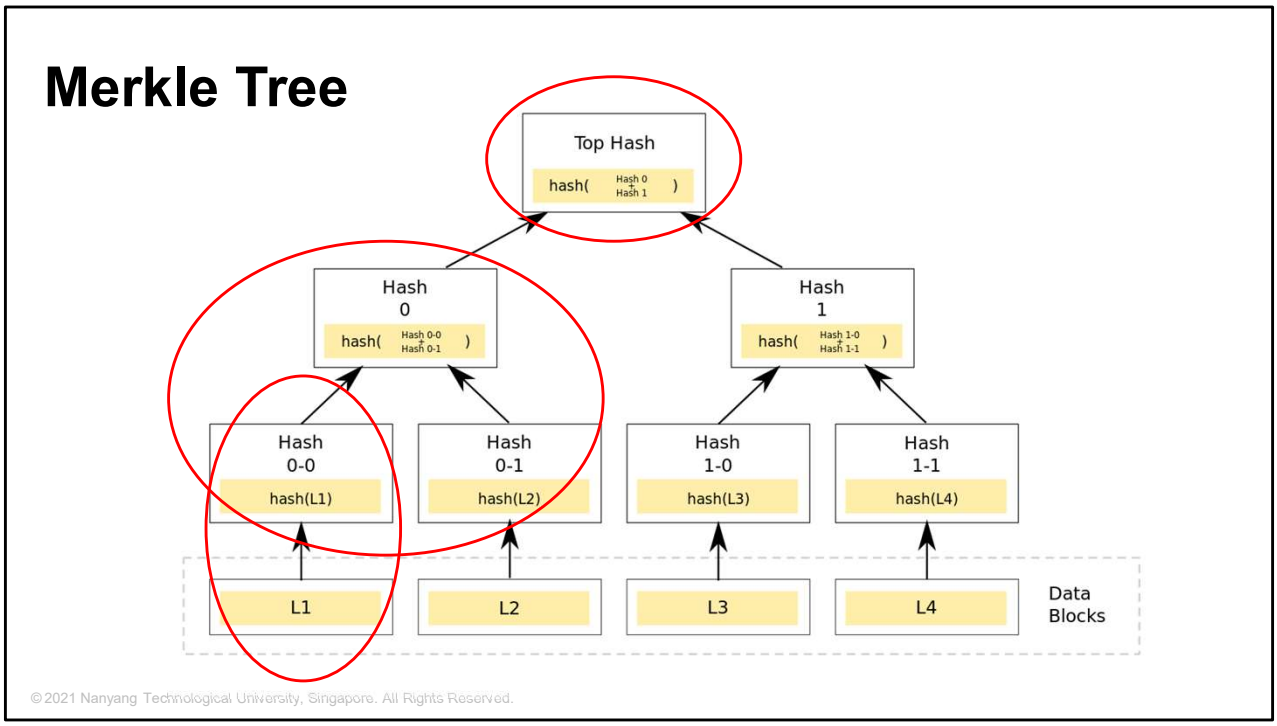
Hash Function

- The mathematical algorithm that transforms any kind of message into a bit array of a fixed size (the "hash value"), regardless of the size of the input message. It is a one-way function and infeasible to invert.
- Example:
  - SHA256(Blockchain) = 625da44e4eaf58d61cf048d168aa6f5e492dea166d8bb54ec06c30de07db57e1
  - SHA256(blockchain) = ef7797e13d3a75526946a3bcf00daec9fc9c9c4d51ddc7cc5df888f74dd434d1

Now let's take a look at how blockchain structures and records data.

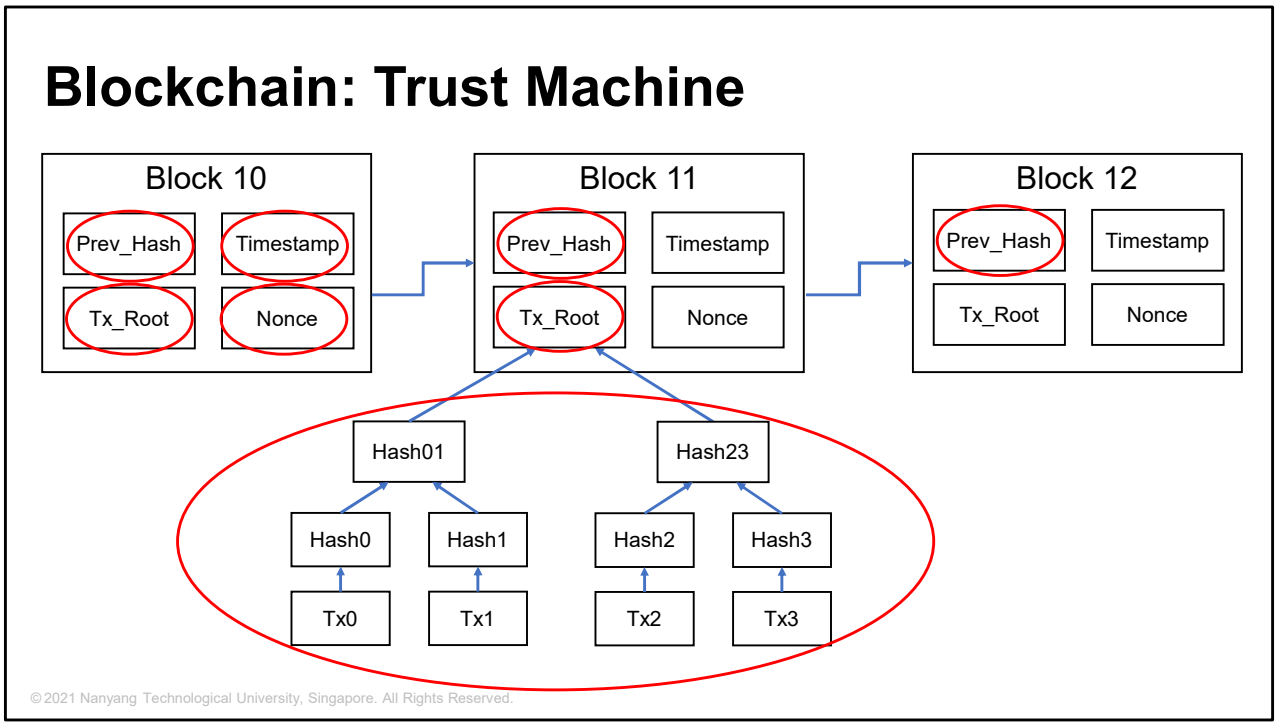
The first step is to hash the information. Hash is a mathematical algorithm that transforms any kind of message into a bit array of fixed size (that is, the "hash value"), regardless of the size of the input message. It is a one-way function and is infeasible to invert.

Take the hash function SHA256 for example. It generates a unique, fixed size 256-bit hash. A tiny change of the input information, say changing uppercase B to lowercase b in the word "Blockchain", leads to a completely different output.



After converting individual transaction message into hash values, a pair of hash values can be hashed again. We keep doing so until we have one single hash value on the top. By doing so, we bundle up transactions in a tree-like manner, deriving a single hash value at the top, which is known as the Merkle tree root. Any small change in original information will lead to a completely different Merkle tree root.

As we can see, the Merkle tree is a data structure used for efficiently summarising and verifying the integrity of large sets of data. It is constructed by recursively hashing pairs of nodes until there is only one hash, the root.



Now let's zoom in on the blockchain data structure.

A block first collects information together. These transactions are aggregated into the Merkle tree root. Each block stores the Merkle tree root for the transactions , as well as nonce, timestamp, and the hash value of the previous block, that is the hash value of the block information. Blocks are then linked using the hash value of the previous block.

In this way, any change in a single transaction will result in a change in the Merkle tree root. It will then change the hash value of that block and result in a change for all the following blocks. It is not possible to manipulate the earlier record without changing the following. This is how blockchain makes the data tamper proof.

Step 1: Hash the Five Highlighted Components

Block 277315

Hash	0000000000000002a7bb
Confirmations	442,733
Timestamp	2013-12-28 06:57
Height	277315
Miner	Unknown
Number of Transactions	40
Difficulty	1,180,923,195.26
Merkle root	5e049f4030e0ab2debb92

Block 277316

Hash	0000000000000001b6b9a13b095e96db41
Confirmations	442,705
Timestamp	2013-12-28 07:11
Height	277316
Miner	Unknown
Number of Transactions	419
Difficulty	1,180,923,195.26
Merkle root	c91c008c26e50763e9f548bb8b2fc323735
Version	0x2

Next, we'll look at the hash value of a block in BTC implementation, which is the identity of the block. Note that other implementations (such as ETC) might use other methods to achieve similar outcomes.

The block header is created with six fields:

1. Version number
2. Hash of the previous block
3. Timestamp
4. Difficulty
5. Merkle root computed in the previous step

Note:
A Merkle root is created by hashing together pairs of Transaction IDs, which gives you a short yet unique fingerprint for all the transactions in a block.

Height is simply the "serial number of the block" where first block is 1 and so on.

Difficulty is a measure of how hard it is to find a valid block to mine. For example, if a previous block is mined in less than 10 minutes, then the next block would be

targeted at more than 10 minutes to be mined by increasing the number of bits as a “password” and so on. BTC targets 1 block to be mined every 10 minutes.

Step 2: Hash the Current Block Header

Block 277315

Hash	0000000000000002a7bbc
Confirmations	442,733
Timestamp	2013-12-28 06:57
Height	277315
Miner	Unknown
Number of Transactions	40
Difficulty	1,180,923,195.26
Merkle root	5e049f4030e0ab2debb92

Block 277316

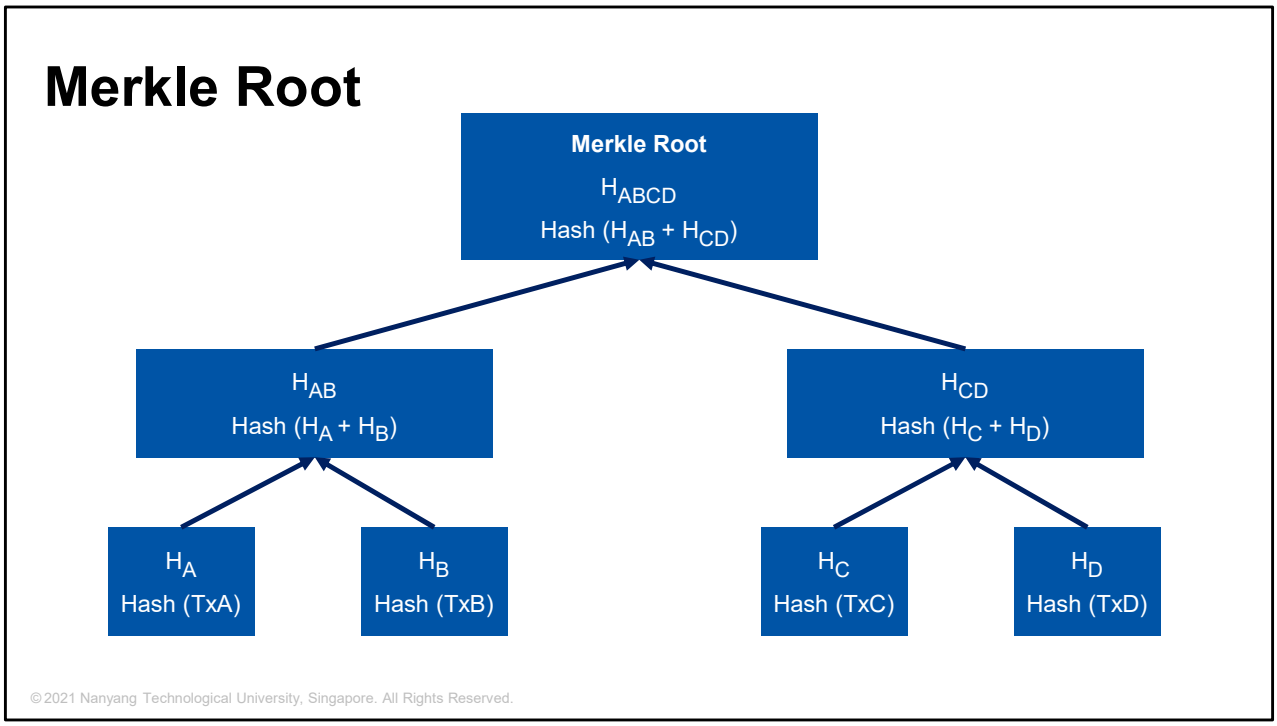
Hash	0000000000000001b6b9a13b095e96db41
Confirmations	442,705
Timestamp	2013-12-28 07:11
Height	277316
Miner	Unknown
Number of Transactions	419
Difficulty	1,180,923,195.26
Merkle root	c91c008c26e50763e9f548bb8b2fc323735
Version	0x2

The block header (which contains the Merkle root) is hashed, resulting in the block hash.

Step 3: Hash Values in Steps 1 and 2

Hash a and b =

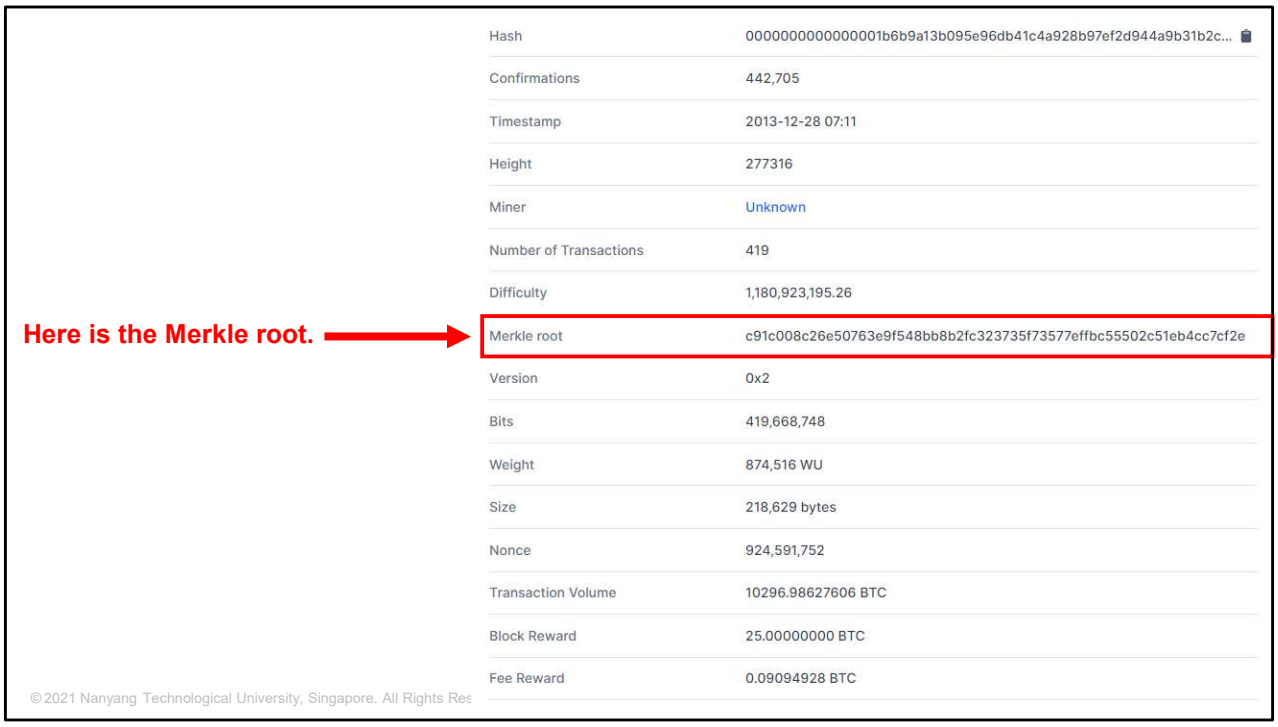
Hash	0000000000000001b6b9a13b095e96db4
Confirmations	442,705
Timestamp	2013-12-28 07:11
Height	277316
Miner	Unknown
Number of Transactions	419
Difficulty	1,180,923,195.26
Merkle root	c91c008c26e50763e9f548bb8b2fc323735
Version	0x2



Merkle Root

Each block in the bitcoin blockchain contains a summary of all the transactions in the block using a Merkle tree. A Merkle tree, also known as a binary hash tree, is a data structure used for efficiently summarising and verifying the integrity of large sets of data. Merkle trees are binary trees containing cryptographic hashes.

A Merkle tree is constructed by recursively hashing pairs of nodes until there is only one hash, called the root, or Merkle root.


Here is the Merkle root.
Hash
0000000000000001b6b9a13b095e96db41c4a928b97ef2d944a9b31b2c...
Confirmations
442,705
Timestamp
2013-12-28 07:11
Height
277316
Miner
Unknown
Number of Transactions
419
Difficulty
1,180,923,195.26
Merkle root
c91c008c26e50763e9f548bb8b2fc323735f73577effbc55502c51eb4cc7cf2e
Version
0x2
Bits
419,668,748
Weight
874,516 WU
Size
218,629 bytes
Nonce
924,591,752
Transaction Volume
10296.98627606 BTC
Block Reward
25.00000000 BTC
Fee Reward
0.09094928 BTC
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What Makes the Bitcoin Blockchain Safe?

After the discussion on the real-life use case, let's discuss several questions.
First, what makes the bitcoin blockchain safe?
Well, the cryptographic system makes transactions irreversible, which means once a block is created on the chain, it cannot be modified. You can, however, can add information to it. This restricts people from reversing any transaction that has already taken place.

Second, the bitcoin blockchain is public which may make it seem unsafe—but in the case of bitcoin, it helps to make it safe. Despite the anonymity of the user, all transactions on the network are accessible to the public, making it difficult to hack or cheat the system.

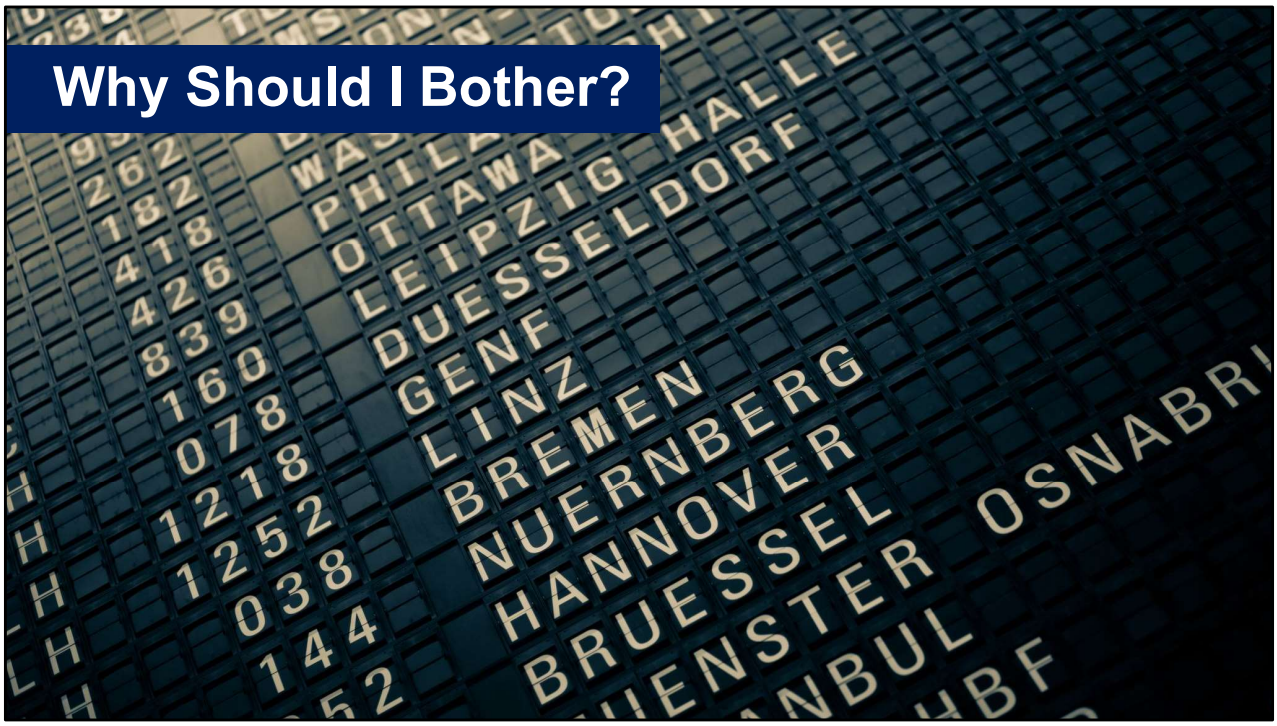
Finally, the decentralization contribute to the security as well. The bitcoin network is distributed and has thousands of nodes all over the world that keep track of all transactions happening on the system. This ensures that in case something goes wrong on one server, there are others to back up. This makes it meaningless to hack any one server.

So, what's the big deal about bitcoin? No, I don't mean the price. I mean how does that help the society?

If you want to trade bitcoin, the lowest unit you can trade is called Satoshi, which is the name of its founder, Satoshi Nakamoto. 1 unit of bitcoin is equivalent to 100 million Satoshi. Assume a bitcoin is worth 42,500 SGD now, a unit of Satoshi will be worth 0.000425SGD. 1SGD will give you about 2353 units of Satoshi.

If you go and buy a coffee that costs 1SGD today, you can use cash, credit card or one of the most popular instant payment systems, PayNow. PayNow is easy to use, and you just need to have your phone and not have to worry about carrying your wallet around. Imagine paying for the cup of coffee with 2353 units of Satoshi using a PayNow equivalent system. As of the current moment, we don't have such a system. For convenience sake, let's imagine a term and call it SatoshiNow. So, you go and buy a cup of coffee using SatoshiNow. You might think, erm, why do I bother since I already have PayNow?

Why Should I Bother?



You are correct. You don't have to bother. But if you are travelling overseas for a holiday, for example, visiting Seoul and checking out its iconic observation tower, or Switzerland for its famous and beautiful Chapel Bridge, and you wanted to buy a cup of coffee. What do you do? You'd either have gone to a money changer to get the local currency with the risk of under or overspending before the trip; or you can solve that issue by paying with a credit card which usually has highly unfavourable exchange rate. Either way puts you at a losing end.

Now, imagine the whole world is accepting bitcoin and its equivalent subunits Satoshi and you have SatoshiNow app on your phone. You want to go for holiday tomorrow? You'll just need to book a ticket and pack your luggage.

Is it just for the finance industry? There are definitely more possibilities. Imagine one day, someone creates a reliable Covid-19 test app that can securely identify you as the one being tested, and at the same time, link the result with it. After which, this information is propagated throughout the world using blockchain technology. You won't have to go to the doctor for a Covid positive or negative certification when you travel.

Once the platform is available, you can simply walk into a mall and travel on a flight with the secure app. And if, what if, the implementation of this technology is you? Stay tuned for the more discussion on blockchain in other courses. We are expecting your big invention.

Here brings to the end of my presentation for this module. Hope you enjoyed and thank you.

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CC0002 Navigating the Digital World

Module 7: Latest Technology Trends

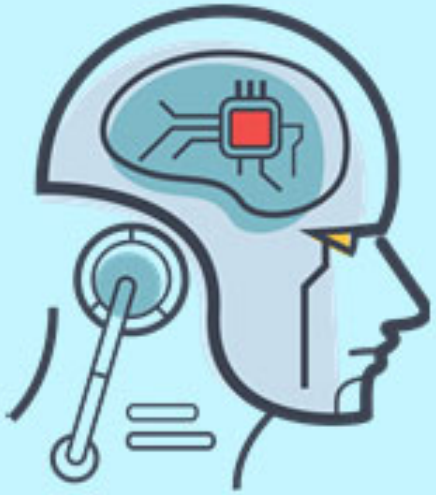
Introduction to Artificial Intelligence

Presented by Assoc Prof Nicholas Vun WCH0

AI History and its Renaissance

SHT0

ARTIFICIAL INTELLIGENCE: Machines that are capable of performing tasks that typically require human intelligence



1950: 'Artificial Intelligence' was first coined
LISP programming language and computers

1973: The first AI Winter

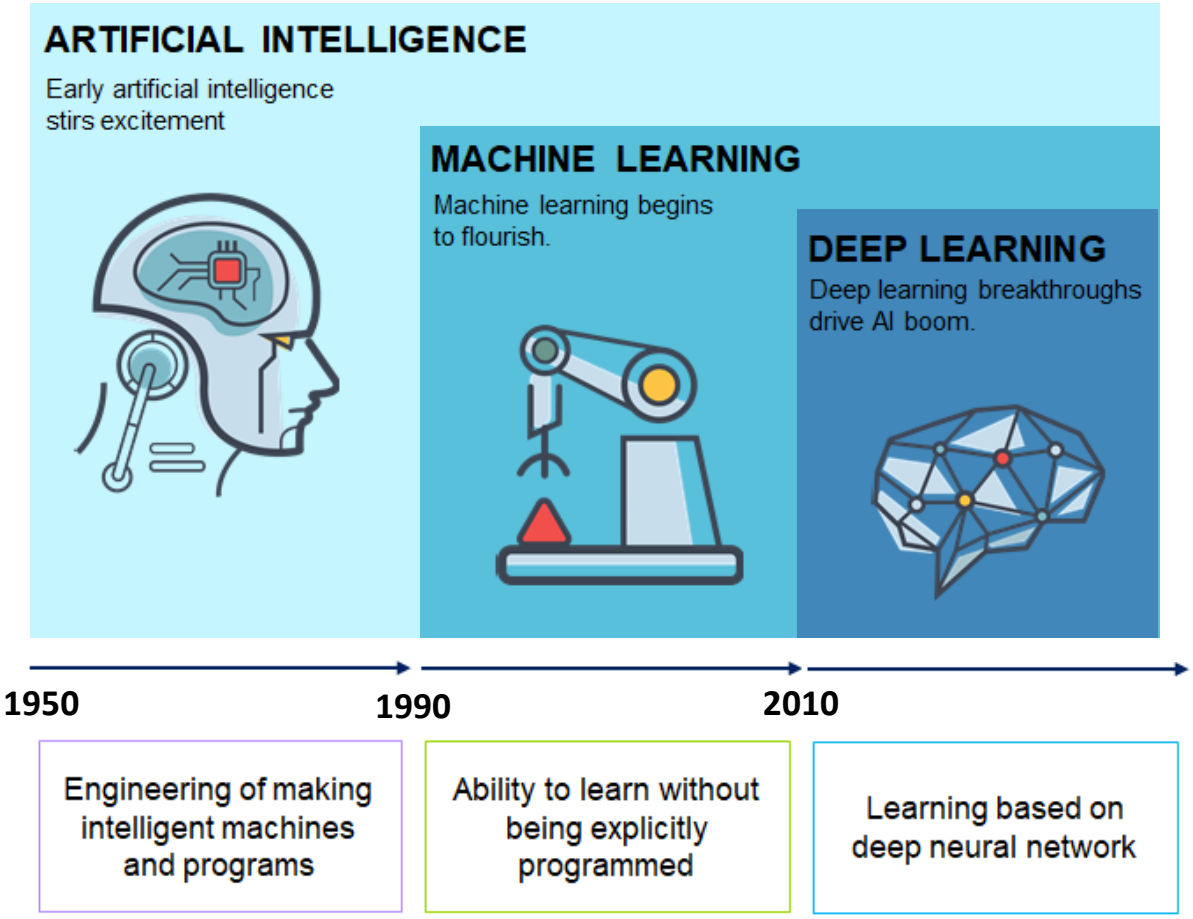
1982: The second Spring
Japan's Fifth Generation Computer Project

1985: The second Winter

2000: The Renaissance

Present: The Golden Age?

AI Present Day Renaissance



Powerful computers:

Become widely available, such as

Cloud computing and GPU

Big Data:

Availability of large amount of data due to internet and smart mobile phones

Software Algorithms:

Machine Learning, Deep Learning

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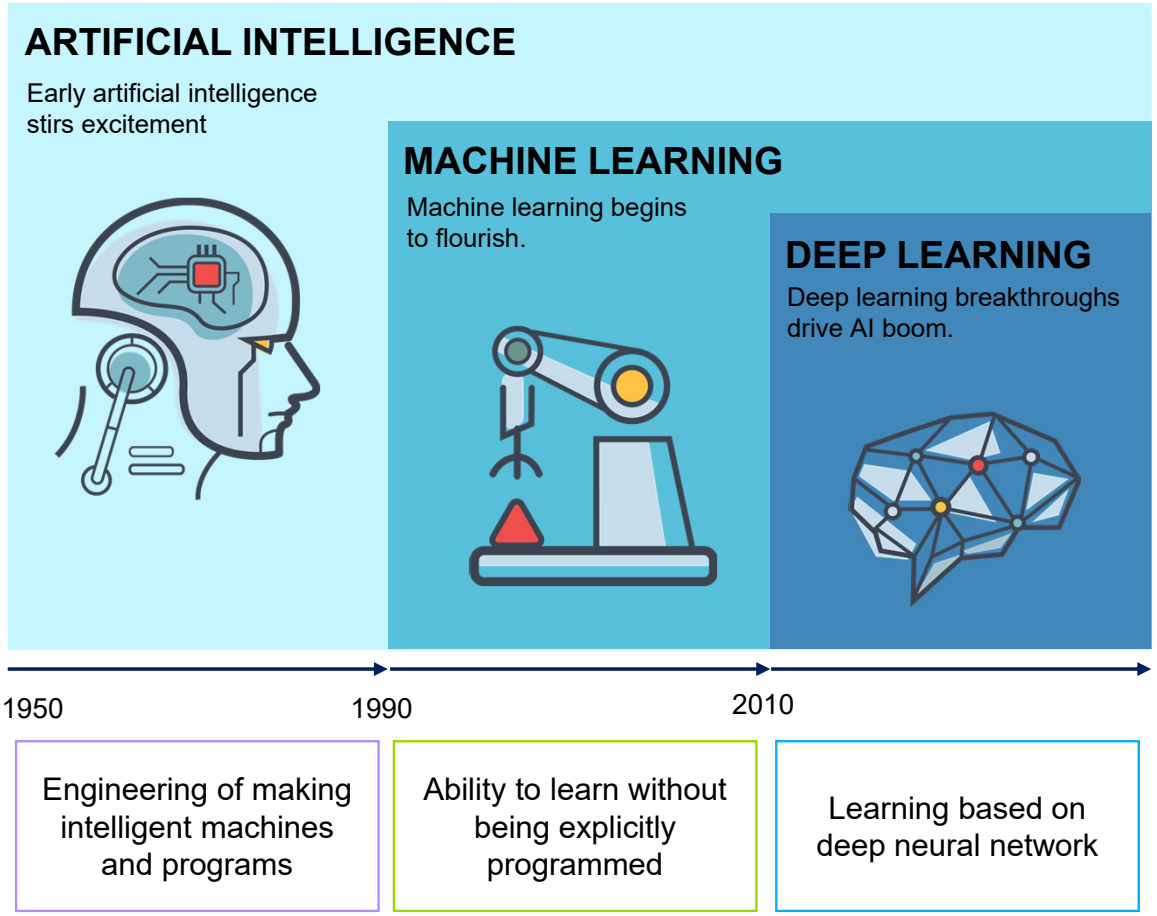
Overviews of AI Technologies

WCH0

AI Implementations



Rule-based expert systems
Fuzzy logic

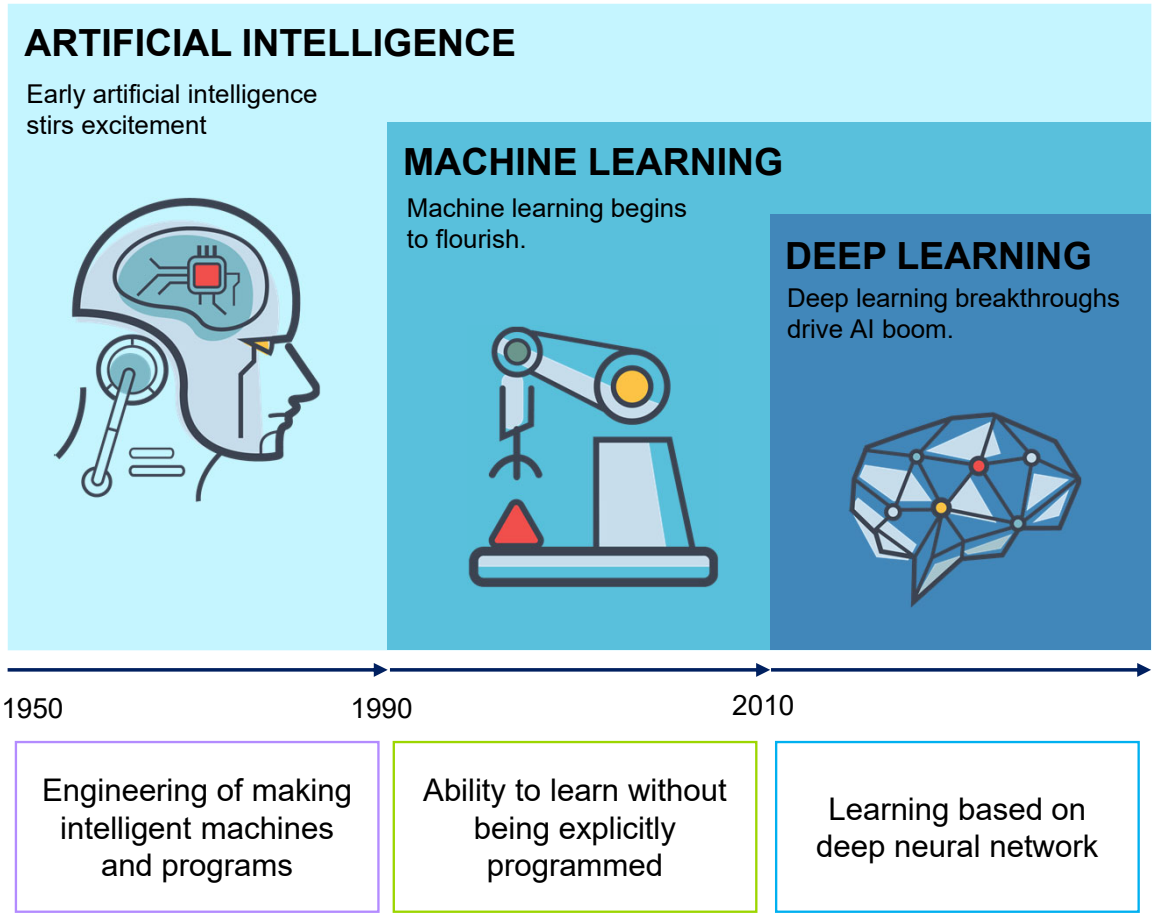
Need data

Supervised Learning with labelled data (e.g., regression and classification)

Unsupervised Learning without labelled data (e.g., clustering)

Reinforcement Learning with the use of 'agent' that learns to maximise 'reward' in an environment

AI Implementations – Deep Learning



Source: https://ai.plainenglish.io/

Implementation of ML based on **Deep Neural Network** that mimics the human brains

Artificial Neural Network (ANN)
Classifying numbers-based data

Convolution Neural Network (CNN)
Classifying images

Recurrent Neural Network (RNN)
Time series data (e.g., audio)

Deep Reinforcement Learning

Transfer Learning

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Basics of Deep Learning

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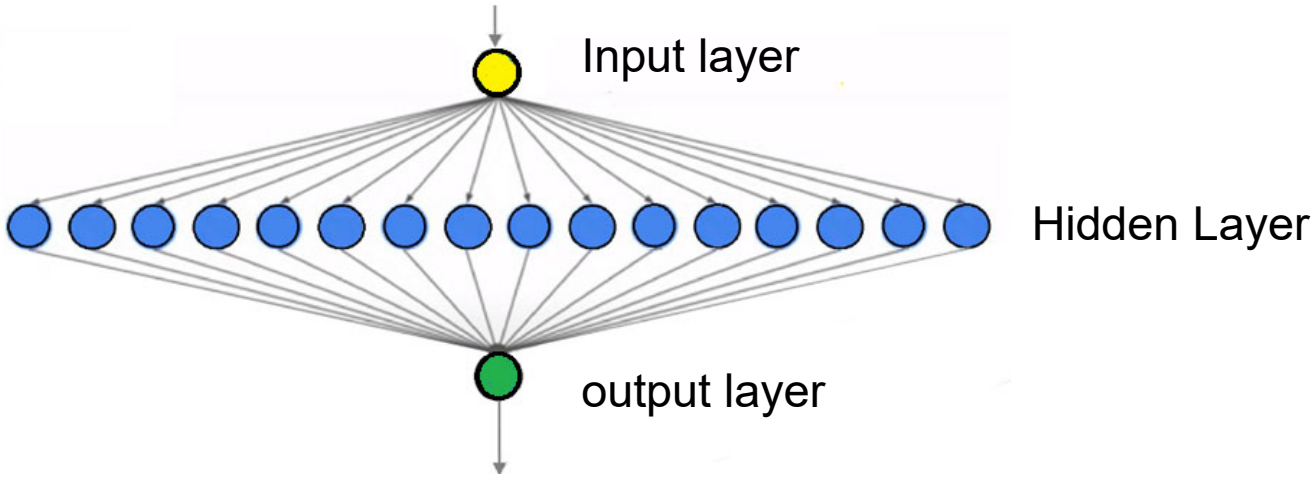
Neurons and Neural Network

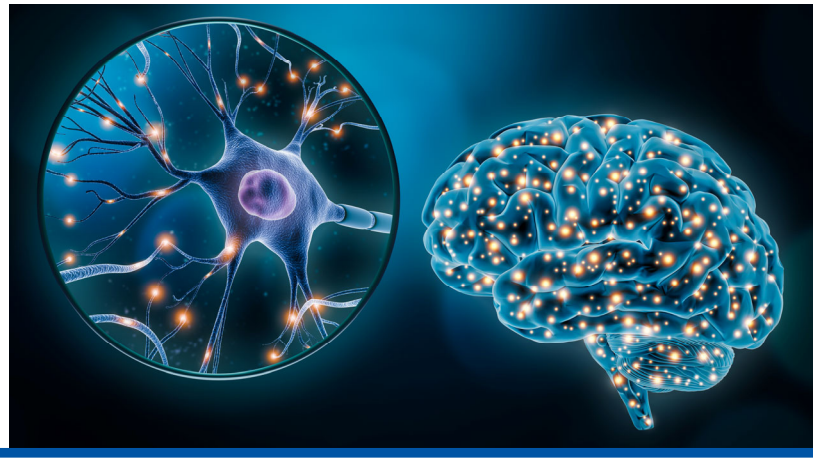


Hidden Layer

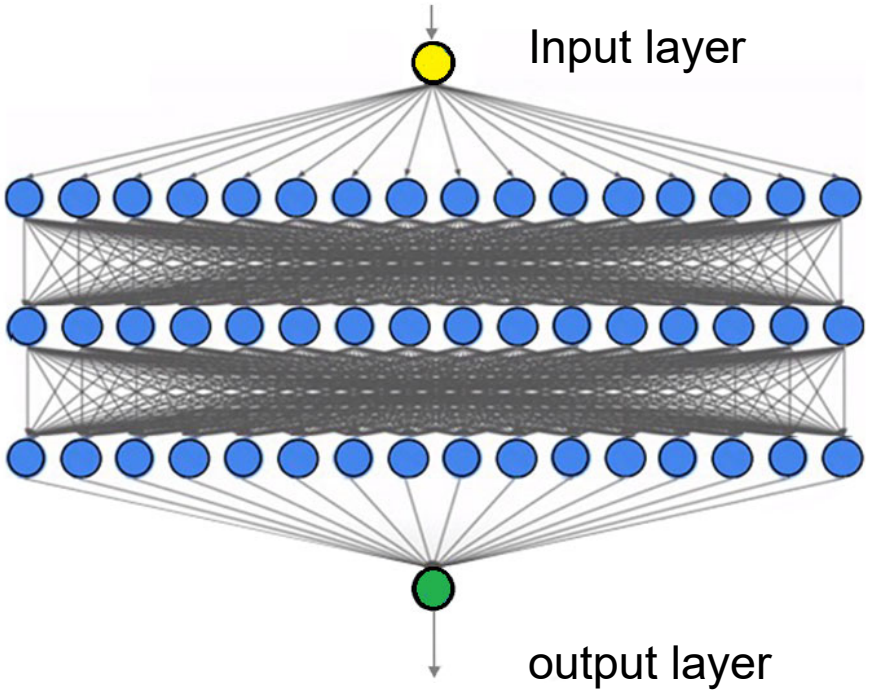
- consists of learnable parameters
- the ‘algorithm’ that can learn and improve by itself

Mimics the human brain to recognize pattern

- ability to learn

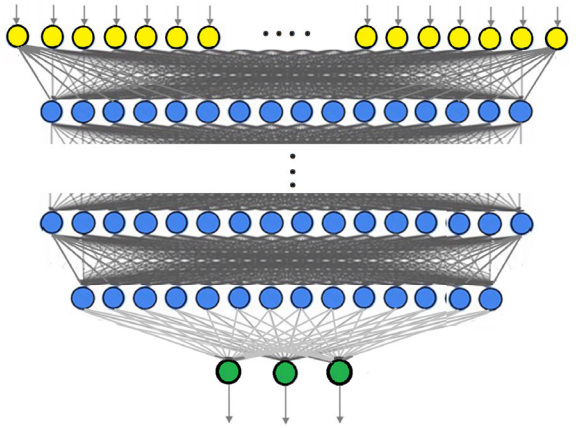


Deep Neural Network for Deep Learning



Deep Neural Network

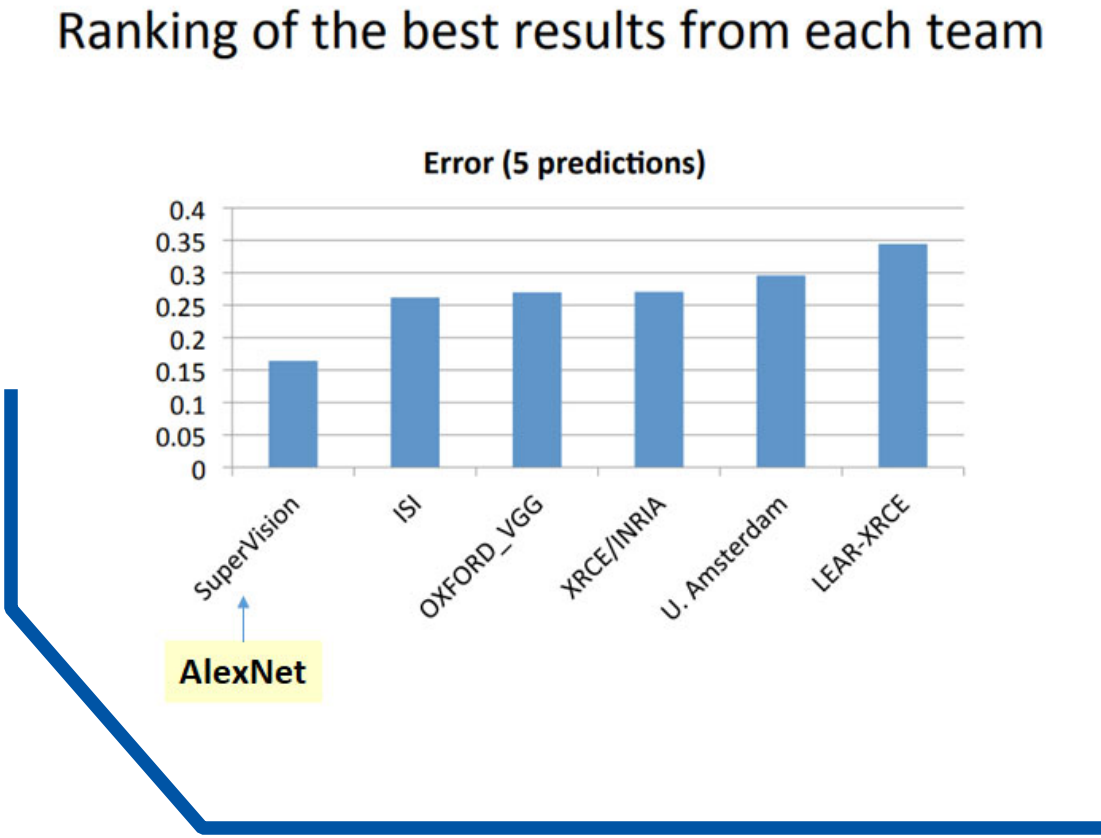
- multiple layers of hidden layers
- much more sophisticated algorithms can be learnt



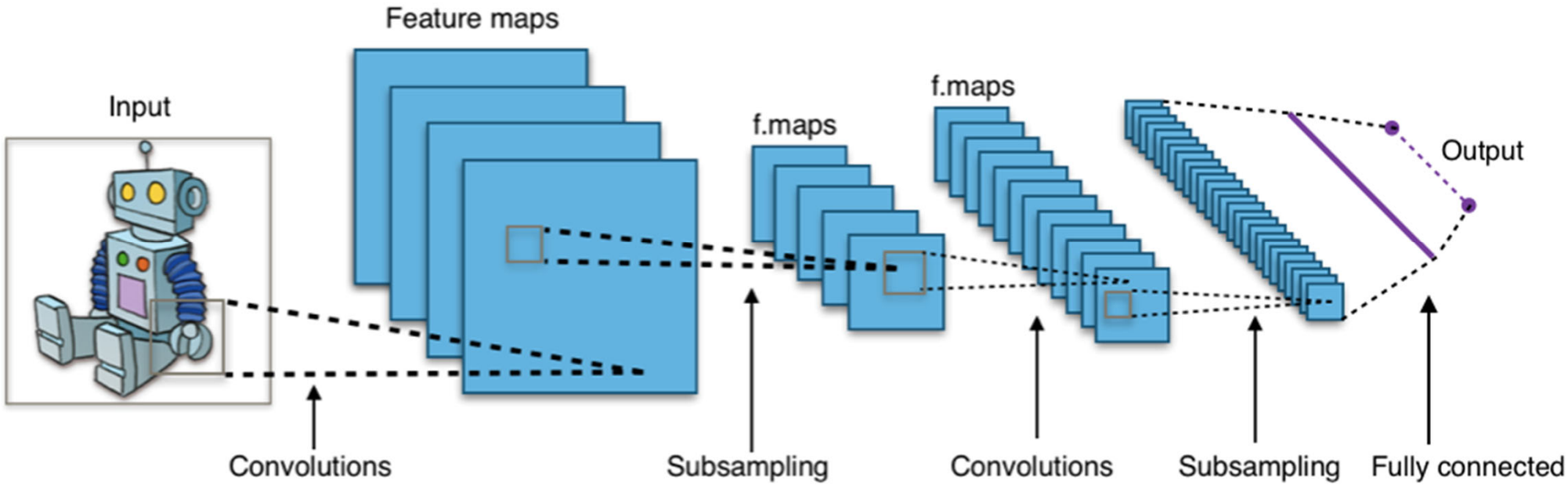
AlexNet

At the 2012 ImageNet computer image recognition competition:

- Alex Krizhevsky used machine to implement machine learning based deep learning algorithm (CNN).
- First time that machine learning based algorithm beat, by a huge margin, handcrafted software written by computer vision domain experts.

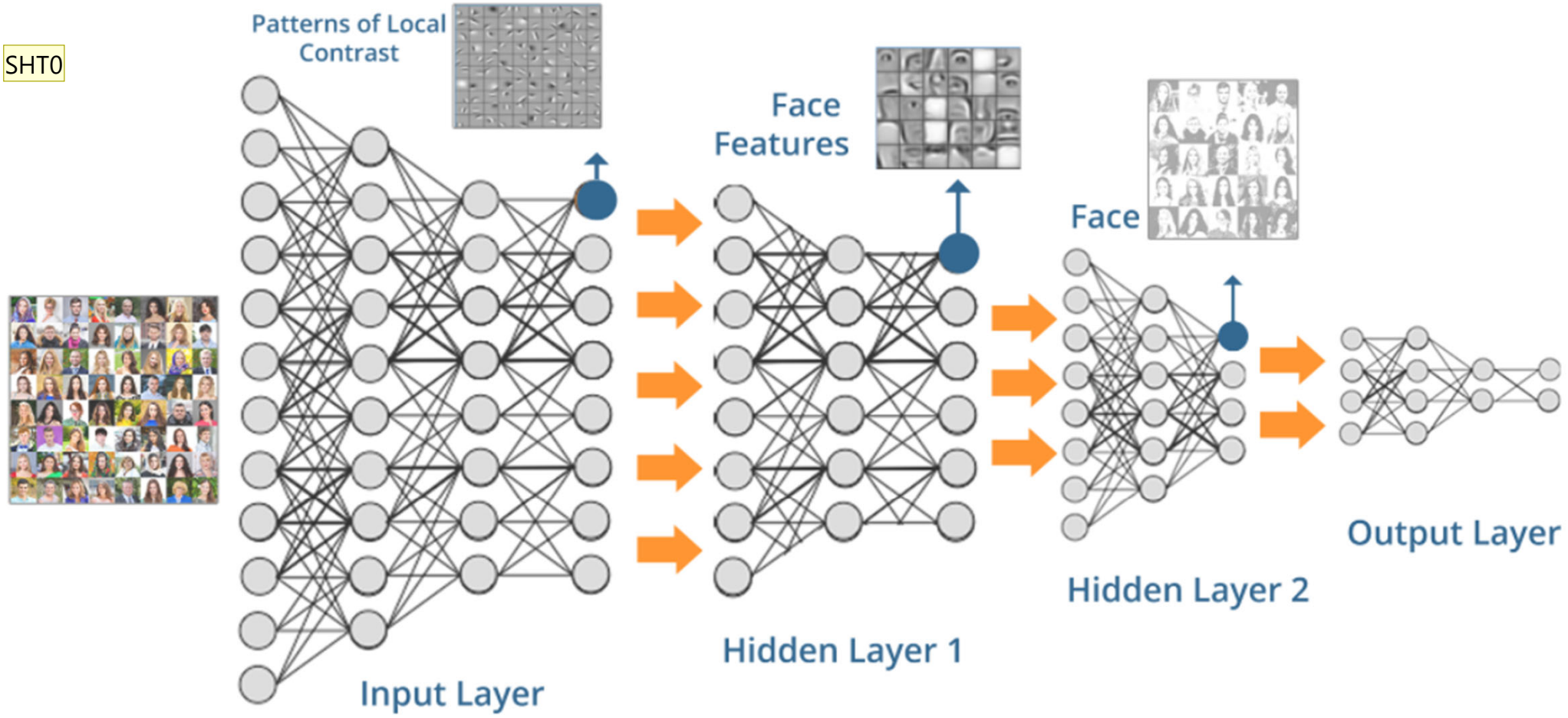


CNN for Image Recognition



Face Detection Training and Inference

SHT0



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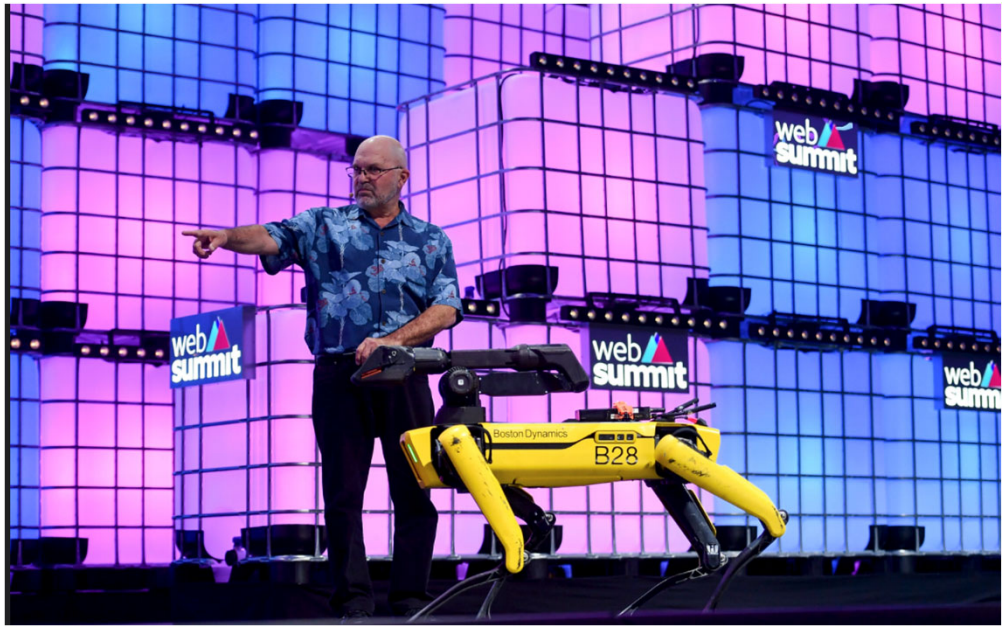
AI Applications

WCH0

Application: Robotics

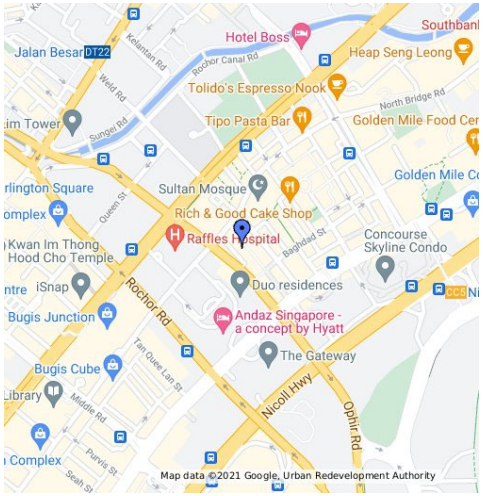
Boston Dynamics

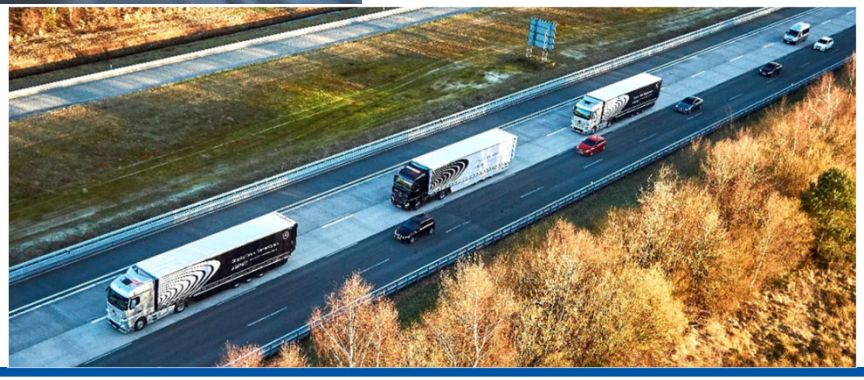


SHT0

SHT0

Application: Autonomous Automotive and Navigation





Application: Social Media

Facebook

Instagram

Twitter

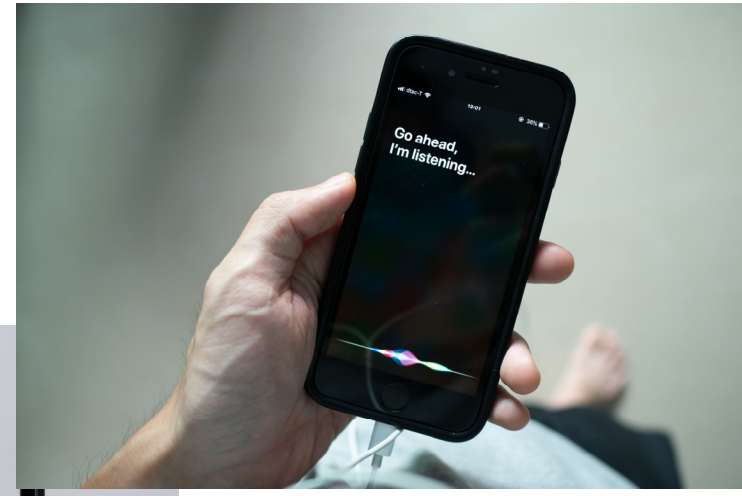
WCH0

Google Discover

SHT0

Application: Consumer Electronics

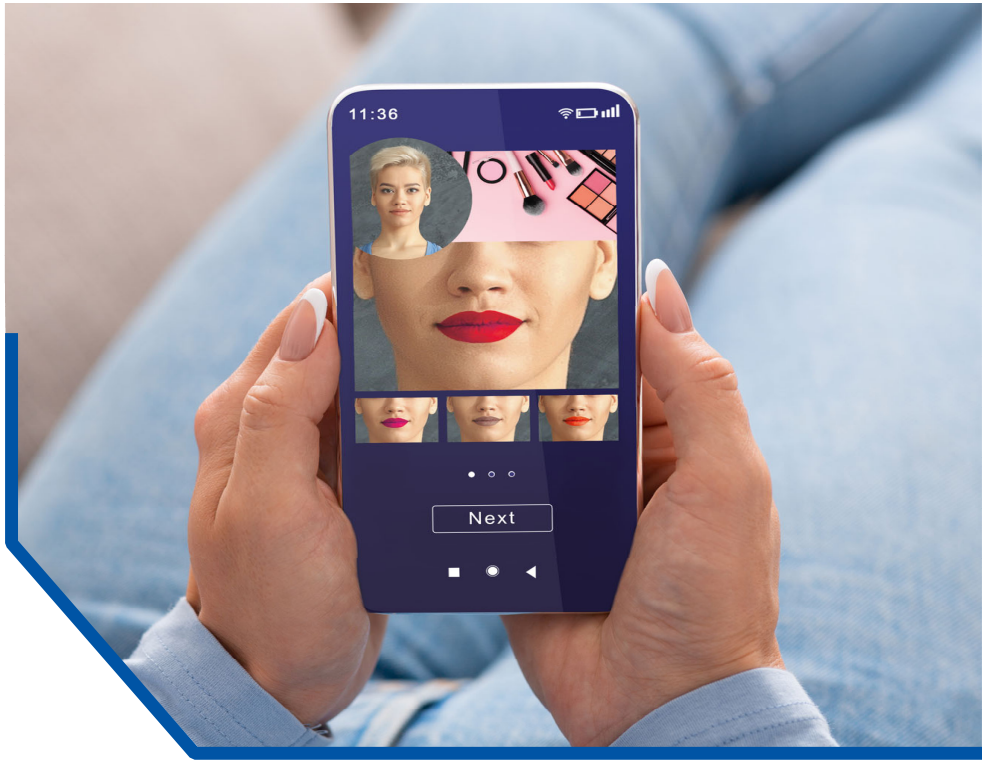
- Smartphone with AI-driven apps such as Siri, Google Assistant, Alexa, Cortana
- Smart household devices such as TV, refrigerators, ovens
- Smart Floor vacuum cleaners
- Smart security camera



SHT0

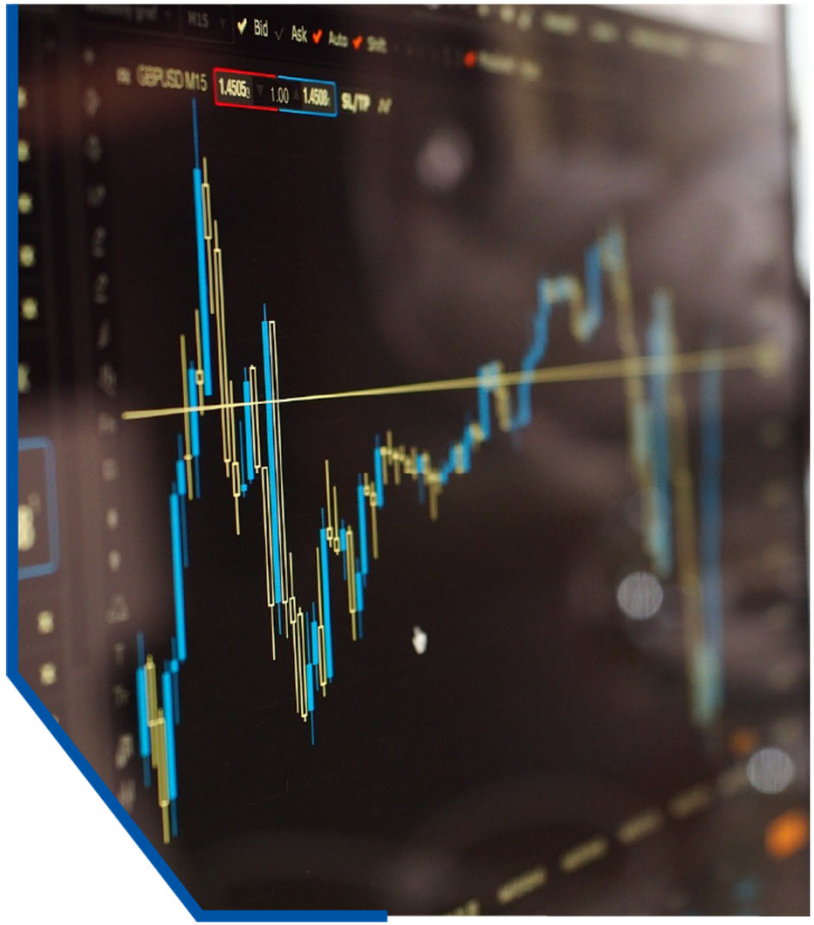
Application: Business and E-Commerce

- Inventory management
- Demand forecasting
- Personalised merchandising
- Chatbots
- Improve customer experience



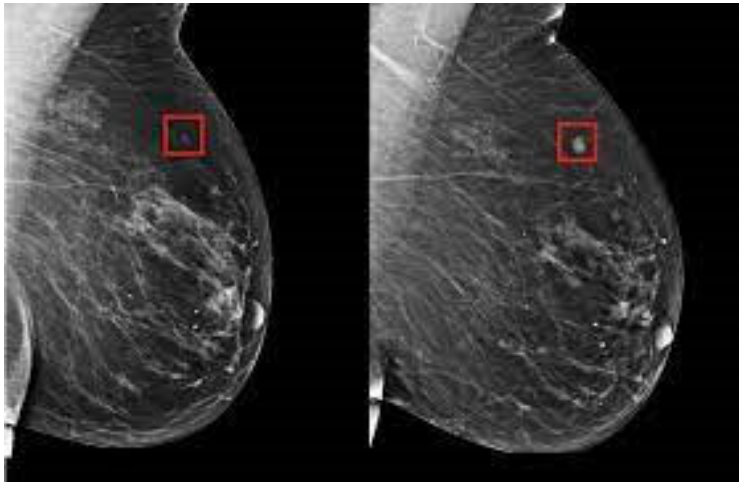
Application: Banking and Finance

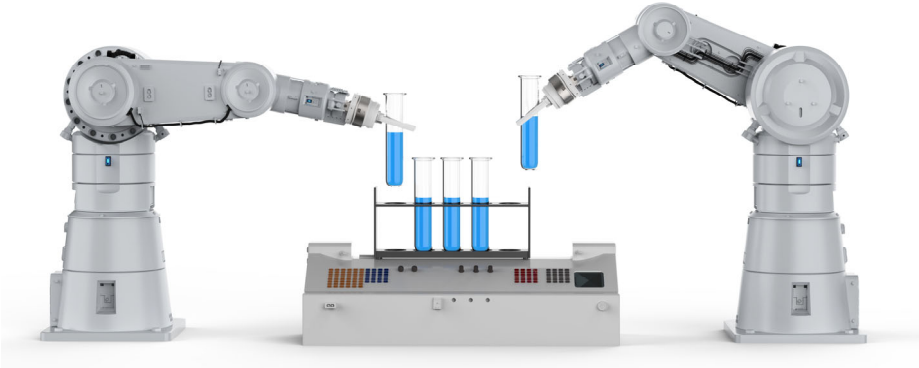
- Better Business Analytics
- Algorithm Trading
  - execute trades at optimal prices
- Credit Risks Assessment
- Wealth Management
  - automated portfolio manager
- Fraud detection



Application: Healthcare

- Analyse medical images
- Early detection (e.g., cancer)
- Develop new drugs
- Genomic profiling





Application: Farming and Precision Agriculture

- Nutrient and water management
- Detect pests and diseases in plants
- Detect weeds
- Analyse crop health (e.g., by drones)
- Improve harvest quality and accuracy

Application of AI: Education

- Improve teaching and learning strategies
- AI e-tutors
- Automatic grading
- AI based e-proctoring

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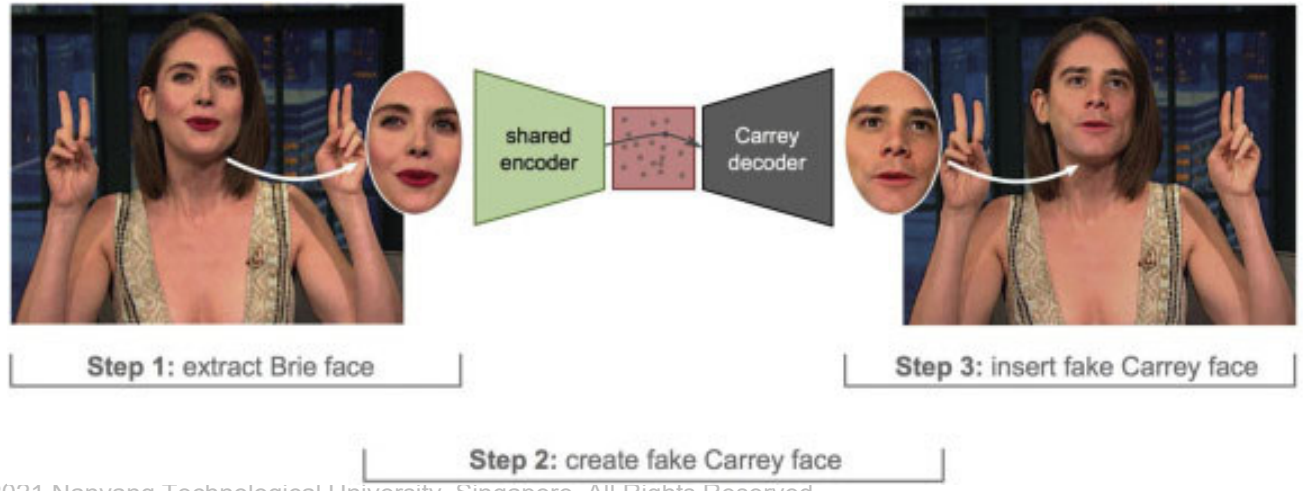
AI Concerns

WCH0

Concerns About AI

- Job loss
- Misuse of AI (e.g., Deepfake)
- AI explainability
- AI bias
- AI ethics in decision making (e.g., weapon)



Summary

- AI is rapidly transforming the way we live:
  - Helps to makes things run more efficiently
  - Improves safety and work productivity
  - Frees up time for human to do more creative things
  - Enables better quality of life
- Current generation of AI technologies are still considered as Artificial Narrow Intelligence (ANI)
  - Goal is to eventually achieve Artificial General Intelligence (AGI)
- But there are also many concerns about the potential risk that we need to be aware of
  - Responsible AI