كلية علوم الحاسب والمعلومات
Blockchain 101

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Learning Objectives

1. Understand some key blockchain fundamentals.

2. Summarize some key blockchain applications beyond cryptocurrency.

3. Describe a scientific blockchain use-case for global patients.

4. Outline a real-world blockchain use-case for fundraising.

5. Know how to get started with blockchain training and career planning.
Shada @ a Glance
Blockchain Fundamentals
Blockchain- So what is blockchain?

• A **distributed ledger** technology holds/ tracks transaction data (**a bookkeeper not a database solution**)

• Shared over **decentralized network of nodes** (parties)
Blockchain- More about it

• Enables a peer-to-peer communication without the need for an intermediary

• Allows for a new generation of transactional applications between the parties
Blockchain- Development

Blockchain 1.0

Blockchain 2.0

Blockchain 3.0
Blockchain - How the blockchain would looks like?
Blockchain - How a block would look like?

- **Block Header**
  - Block ID and address
  - Previous block address
  - Proof of Work (consensus protocol)
  - Time stamp

- **Block Content**
  - Asset transaction data

- **Block Signature**
  - Private/public keys

- **Asset Transition**
Blockchain- Benefits

• Digitally **tracks asset transaction** between a group of **parties**.

• Provides a **tamper-proof trail time-stamps** of **block** sequence.

• Establishes **transparency** and **trust between parties**.
Blockchain Concepts:

**Permissionless**
- **Private**: (Public Polls)
- **Public**: (Bitcoin / Ethereum)

**Permissioned**
- **Private**: (Medical Records)
- **Public**: (Food Supply Chain)

**Visibility**
Who can view (read permission) it?

**Accessibility**
Who can contribute (write permission) to it?
Blockchain Use-Cases in Digital Sectors

Blockchain technology is a digital system that is popularly known as the backbone technology of the digital ecosystem that makes it possible to manage the integrity of information data. The technology is a decentralized, distributed ledger technology that allows for secure and transparent transactions. This paper explores the various use cases of blockchain technology in the digital sector.

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Blockchain Keyword in The Literature

Collated keywords for each digital sector and the number of occurrences in the literature.
Most Fully-Developed Blockchain Solutions are in 4 Digital Sectors

- Supply Chain
- Government
- Healthcare
- Internet of Things applications
Use Case 1: *HealthyBlockchain*
For Global Patients
Global Healthcare Systems Modernization Movement

PopulationPyramid.net
Population: 7,953,952,576

WORLD - 2022

May 23, 2022
Blockchain 101
Shada Alsalamah
#Envision2030 Sustainable Development Goals
#Envision2030 Goal 3: Good Health and Well-being

- Goal 3: Ensure healthy lives and promote well-being for all by having access to quality essential health-care services
Global Modernization Efforts - **UK & K.S.A**
Global Modernization Efforts - United Kingdom
• 0-14 years (children): 17.63%

• 15-24 years (early working age): 11.49%

• 25-54 years (prime working age): 39.67%

• 55-64 years (mature working age): 12.73%

• 65 years and over (elderly): 18.48%
United Kingdom - Population Pyramid

- 70.88% is old population
- Comorbidity is more common in older patients
- Needs holistic care
- Aim: Move from re-active to pro-active
Global Modernization Efforts - K.S.A
Kingdom of Saudi Arabia - Population Pyramid

- 0-14 years (children): 24.84%
- 15-24 years (early working age): 15.38%
- 25-54 years (prime working age): 50.2%
- 55-64 years (mature working age): 5.95%
- 65 years and over (elderly): 3.63%
Kingdom of Saudi Arabia- Population Pyramid

- **91.53%** is **young** population

- Needs to be **kept out of hospitals** (Pre-patient phase)

- **Aim**: make the person **responsible for their health** and the main **driver** of their healthcare choices & outcomes
Global Healthcare Sector Modernization Movement

Holistic care that considers co-morbidities

United Kingdom - 2022

Make the person responsible for their health and keep them out of hospitals

Saudi Arabia - 2022
Blockchain Contribution to Global Modernization Movement

Modernizing healthcare delivery

(Healthy Blockchain)
Healthy Blockchain: Modernizing Healthcare Delivery Using Blockchain
Breast Cancer Treatment Scenario - Wales, UK

1. GP/ family doctor for examination
2. Specialist for further examination and history check
3. Radiologist for Ultrasound/mammogram
4. Pathologist for a biopsy
5. Initial MDT review - treatment plan
6. Surgeon for an operation
7. Post operation MDT review
8. Oncologist for chemotherapy
9. Palliative care for end-of-life care
Multiple Discrete Information Systems

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Modern Healthcare- “Shared Care”

- Integrated (holistic) care
- Care teams
- Shared informed decisions
- Pro-active systems
Patient-Centered Care Movement

A collaborative effort [...] where patients and the healthcare professionals collaborate as a team, share knowledge and work toward the common goals of optimum healing and recovery.

Modern Healthcare Models

eHealth *(electronic health)*

mHealth *(mobile health)*

uHealth *(ubiquitous healthcare)*

Virtual healthcare

Tele-medicine

...
Healthcare Models - share a common goal

... to facilitate seamless information sharing for informed decisions.
Why informed-decisions are important?

A patient’s **history** is as **important** as their **symptoms**. It is what helps us **decide** if **heartburn** is a **heart attack**, or a **headache** is a **tumor**.

~ Dr. Thame Nouh, 2017

**Trauma Surgeon**

Trauma and Acute Care Surgery Unit, Department of Surgery, College of Medicine, KSU, KSA
Data Sharing Dilemma- Balancing Act

Sharing VS. Protecting

More harm is done to the patient if his information is not available to the care team member when needed than it falling into the wrong hands.

~ Dr. Tom Crosby, 2013

Caldicott Guardian for the Cancer Centre,
Clinical Director of the Velindre Cancer Centre, Velindre Cancer NHS Trust
Healthcare Legacy Systems Sickness

Block information flow
Healthcare Legacy Systems Sickness

Disease-Centered Healthcare

Endocrinologist

Patient

Patient

Patient

Patient-Centered Healthcare

Endocrinologist

General Practitioner (GP)

Oncologist

Surgeon

Patient

Patient

Patient
Healthcare Legacy Systems Sickness

- Designed as information silo
- Incompatible information policies
- Cannot be enforced outside their physical premises
- Lack of unified information security policy to govern patient-centered data across legacy systems
The right information is available to the right person, at the right time.
Healthy Blockchain - Proposal

.. to allow a **seamless** cross-systems information **flow** to each **treatment point**.
Healthy Blockchain— Block Anatomy and Granularity

Anatomy

Block Sequence No.

Block Header
- Blockchain ID
- Patient ID
- Timestamp
- Previous Block no.
- This Block no.

Block Content
(Medical information transaction at each treatment point)
- Patient Medical Information
  - Description
- Treatment
  - Pathway no.
  - Plan no.
  - Point no.
- Care Team
  - Team ID
  - Member ID
  - Role ID

Hospital Information System
- Hospital ID
- Local Information System ID

Public/Private Keys
- Public Lock Script
- Private Lock Script

Granularity (8 Levels)
- Hospital
- Information system
- Care team
- Care team member
- Treatment pathway
- Treatment plan
- Treatment point
- Patient
  - Medical Information
  - Description
Healthy Blockchain—How it Works

New treatment point

New block (transaction)

Transaction validation

Transaction added to the sequence

Oncologist's discrete information system

Blockchain in Healthcare

Shada Alsalamah, Ph.D.

November 16, 2017

New treatment point

Transaction validation

Healthy Blockchain—How it Works

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Transaction added to the sequence
Healthy Blockchain - Putting it all together

- Unified, neutral, conflict-free information policy (smart contracts)
- Govern a fine-grained patient-centered, comorbid-friendly, and decentralized ledger across healthcare legacy systems.
Healthy Blockchain - Putting it all together

Healthy Blockchain for Patient ID 004501

- **General Practitioner**: Medical history and physical examination
- **Surgeon**: Operation report.
- **Oncologist**: Chemotherapy report
- **Palliative care**: End-of-life care.

Ledger
Going Beyond Legacy Systems?

• Use case 1.0: **Unified** patient-cantered record (*with Legacy Systems*)
• Use case 2.0: **IoT** wearables, and **mobile** healthcare **applications**.
• Use case 3.0: **Big data** decentralised analytics (*with OPAL*).
• Use case 4.0: Patient **informed consent** (*EU GDPR compliance*)
• Use case 5.0: Health **insurance**.
• Use case 6.0: **Organ** procurement, transplant list, donors registry.
• Use case 7.0: **Pharmaceutical**, drug research, and **trials**.
Use Case 2: *Patchwork Kingdoms of Data-Driven Digital Tokens*
Giga Project- Patchwork Kingdoms Background
The Kingdom’s Architecture- Grouping & Placing the Schools

Schools with unavailable data are placed in the sky.

All schools **connected** to the internet.

All schools **NOT connected** to the internet.
Intended Future vs Stark Reality

An all-connected-schools Kingdom

A completely-disconnected Kingdom
1000 Non-Fungible Token (NFT) Kingdoms from 283’000 Schools Data
Non-Fungible Token (NFT)

non-fungible token (NFT) noun

non-fun·gi·ble token |ˌnän-ˈfən-je-bəl-ˈtō-kən|

A unique digital identifier that cannot be copied, substituted, or subdivided, that is recorded in a blockchain, and that is used to certify authenticity and ownership of a specific digital asset (such as the original version of an online photo or video).
Non-Fungible Token (NFT)

• As the world becomes more digitized, there is a need to replicate the properties of physical items - scarcity, uniqueness, and proof of ownership.

• Non-fungible digital assets have been around since the beginning of the internet, and NFTs solve for digital ownership.
“We as humanity can fundamentally shift things using technology as the energy behind that shift.”
How to Get Started?
Getting Started Today with The 8 Best Free Blockchain Development in 2022
More Learning Portals

Blockchain.com is the first digital asset platform in American football. Read more

Blockchain 101

101 Blockchains

SHAPING THE FUTURE OF BLOCKCHAIN

101 Blockchains is the world’s leading online independent research-based network for Blockchain Practitioners.
Building a Career in Blockchain with Blockchain Online Programs Offered at 54 Universities Around the World

So, is it all about technical majors and minors? Educational facilities offer comprehensive online activities. This allows you to learn about blockchain from the same course you will be taking in any branch and manage it for your personal needs. There are several major schools that offer degrees in blockchain that can help you learn what you will need.

1. Amity University Online: A school that offers a course in blockchain technology and management.
2. Jaihlink University: A school in Australia that offers a blockchain-related course in the Business Department.
3. University of Economics: A school in Hong Kong that offers courses in blockchain and digital currency.
4. Dicle University: A school in the United States that offers a course in blockchain, fintech, and policy.
5. Blockchain Research Lab: A school in the UK that offers a course in blockchain.
6. Blockchain School: A school in the UK that offers a course in blockchain.
7. Hong Kong University of Science & Technology: A school in Hong Kong that offers courses in blockchain, fintech, and policy.
8. Management of Technology: A school in Hong Kong that offers courses in blockchain and digital currency.
10. University of Sheffield: A school in the UK that offers a course in blockchain and digital currency.
15. University of California: A school in the United States that offers a course in blockchain and digital currency.
17. University of Texas: A school in the United States that offers a course in blockchain and digital currency.
27. University of California: A school in the United States that offers a course in blockchain and digital currency.
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