



مدیریت فناوری‌های دیجیتال در صنعت ساخت

(بر اساس سندی از انجمن مدیریت ساخت آمریکا (CMAA))

ارائه‌دهندگان:

سیدمحمد رضا علوی‌پور (PhD, PMP, CMIT) از دانشگاه Illinois Tech آمریکا

نریمان درافشان

هانیه طباطبایی

زمستان ۱۴۰۳

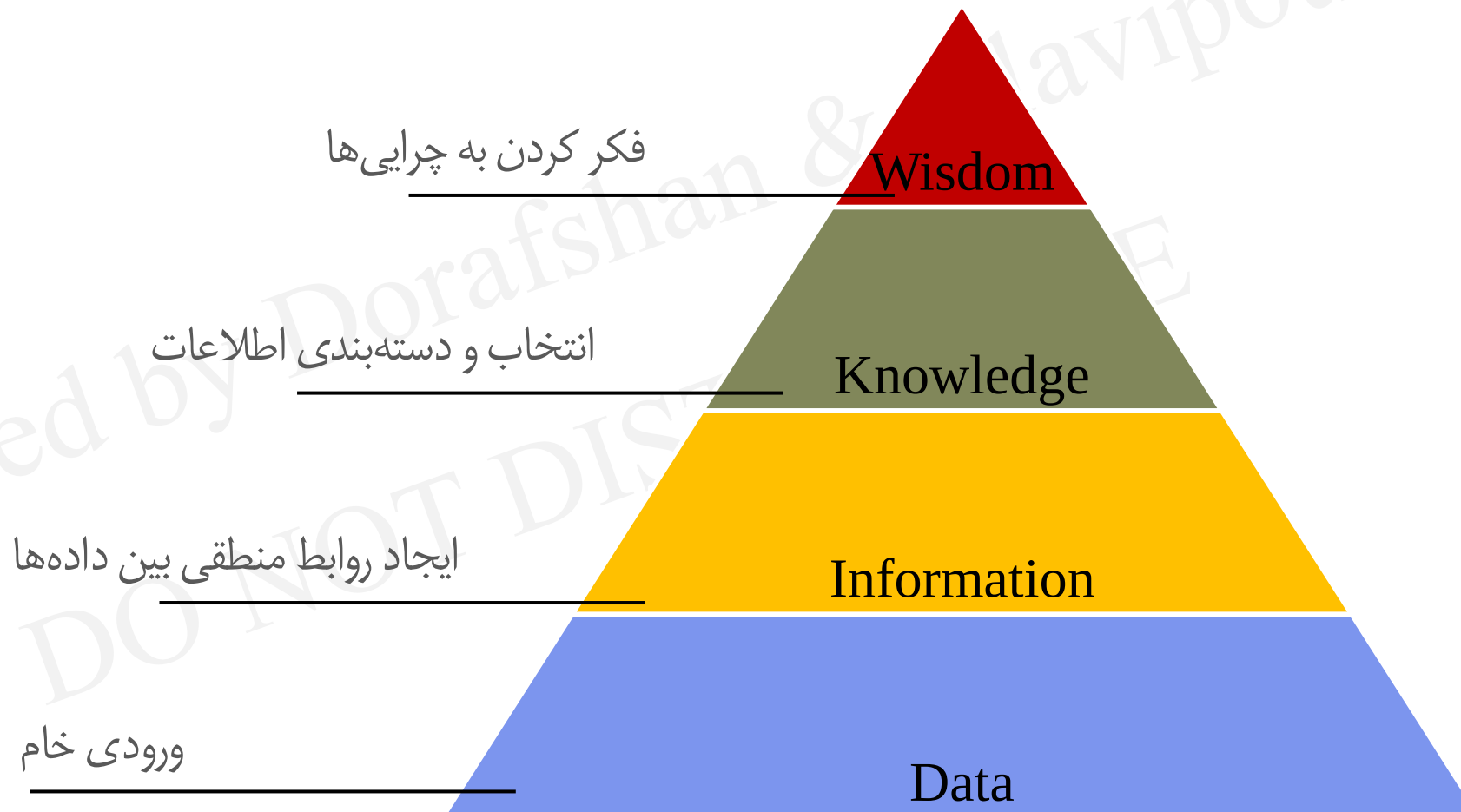
مرور جلسهٔ ۳

قسمت ۱/۲

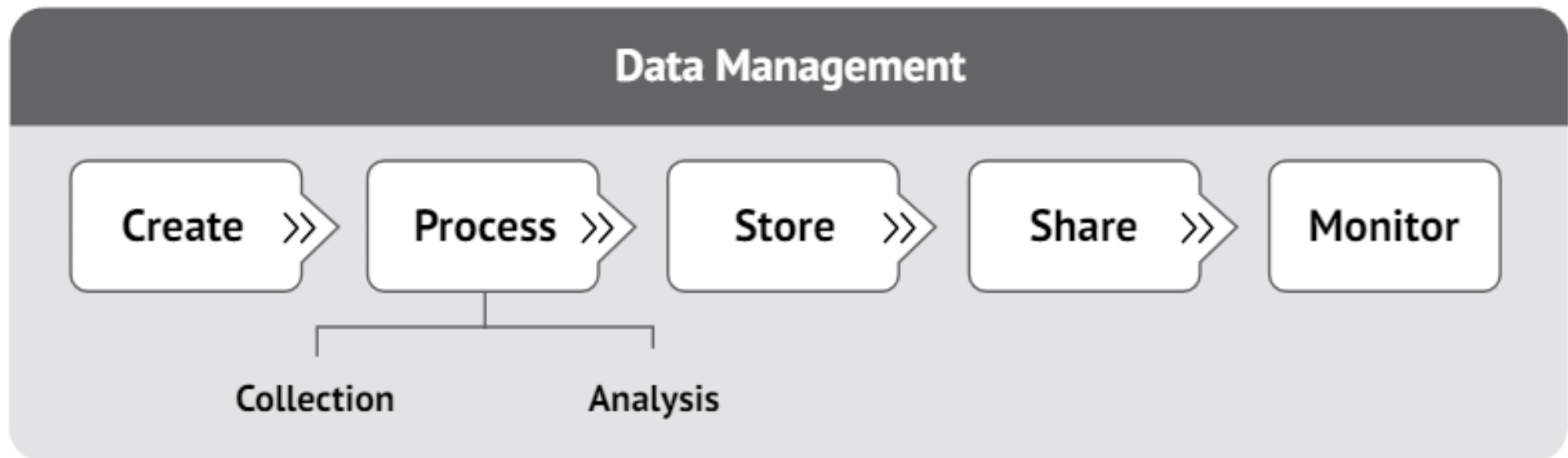
فصل اول: فناوری‌های دیجیتال در صنعت ساخت

قسمت دوم: داده

هرم DIKW



Data Management Flow



۵. ذخیره داده

Data Storage

Data storage

- ❑ Data storage refers to **recording information** for later use.
- ❑ Data storage frequently **overlaps** with other data management activities.
 - ❖ For example, BI tools may access stored data and record their analysis simultaneously.
- ❑ Data storage is also **important at the end** of a project or program when the team should archive data to **preserve** it for future reference.

Referring to Data

- ❑ The owner, CM, or other stakeholders may need to reference the data for
 1. O&M,
 2. Claims, or
 3. Improve future delivery

From what you've learned in other courses, what we need to ensure that we'll be able to refer to the data at a later date?

CM and Data Storage

- ❑ The CM must **realize** that there are now **many options** to store data reliably, so the CM must **consult** with and **advise** the owner to find the **best solution**.
- ❑ **DaaS/cloud storage** is **more efficient** but **may not be appropriate** for **certain owners**.

Cloud Storage

Local Data
Storage

Some Technical Considerations

Server Type

Accessibility

High Availability

Pricing

Storage Topology

Storage Device
Technology

RAID

DATA LAKE

vs

DATA WAREHOUSE



Raw

Data Lakes contain unstructured, semi structured and structured data with minimal processing. It can be used to contain unconventional data such as log and sensor data

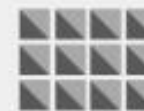
Large

Data Lakes contain vast amounts of data in the order of petabytes. Since the data can be in any form or size, large amounts of unstructured data can be stored indefinitely and can be transformed when in use only

Undefined

Data in data lakes can be used for a wide variety of applications, such as Machine Learning, Streaming analytics, and AI

Data



Structured

Users



Business Analysts

Use cases



Batch Processing,
BI, Reporting

Refined

Data Warehouses contain highly structured data that is cleaned, pre-processed and refined. This data is stored for very specific use cases such as BI.

Smaller

Data Warehouses contain less data in the order of terabytes. In order to maintain data cleanliness and health of the warehouse, Data must be processed before ingestion and periodic purging of data is necessary

Relational

Data Warehouses contain historic and relational data, such as transaction systems, operations etc



۶. اشتراک‌گذاری و پایش داده

Data Sharing and Monitoring

Data sharing and monitoring

□ Data sharing is **distributing data** to users
without harming the **data's integrity**.

□ Data monitoring is **checking data** to

1. **Ensure** project/program **quality** and
2. **Evaluating variances**.

Data sharing and monitoring

❑ **Useful information** helps no one if the **team does not**

1. **Share** it with **appropriate stakeholders** or

2. **Monitor** it for **variances**,

so data sharing and monitoring are necessary for the team

to **turn useful information** into **knowledge** about the project or program.

❑ The CM should recognize that the **team often performs** these **data management practices** **simultaneously**.

Management information systems

❑ The CM should **understand**

1. **Where data** in the digital MIS **comes from** and
2. **Basic concepts** for **deploying** the system,

but may **delegate** the **setup and administration** to other team members.

❑ If the CM **delegates** setting up and running the MIS,
the CM should still

1. **Monitor** the team's work and
2. **Respond** to the owner's questions about the MIS.

Management information systems

□ The CM should

1. **Understand** the **owner's needs** and
2. **Help evaluate** the advantages and disadvantages of different systems

Prepared by Dorafshan & Alavipour
DO NOT DISTRIBUTE

Systems integration

- ❑ As a system becomes **more complex**,
the risk grows that it will **isolate or duplicate** data in **silos**.
- ❑ This complexity creates **inefficiencies** that may include
 - ❖ Manual data **re-entry**,
 - ❖ **Duplication** of business functions, and
 - ❖ **Reliance on paper** to duplicate and exchange data.

Systems integration

□ Systems integration

1. **Supports** data sharing and
2. **Creates** a common data environment (CDE), i.e., A “single source of truth” to monitor data.

□ **Software** from different manufacturers

1. Exchange information and
2. Work together
for project/program success.

Systems integration

❑ This **interoperability**

- ❖ Speeds up **delivery**,
- ❖ Reduces infrastructure **vulnerability**,
- ❖ Decreases supply chain **costs**, and
- ❖ Improves **value** for the owner.

How can we cope with different software islands?

The CM manages the team to meet the owner's cybersecurity requirements but does not need to be a cybersecurity expert.

Q.

What are **roles and responsibilities** of CM during Data Management Flow stages?

فصل اول: فناوری‌های دیجیتال در صنعت ساخت

قسمت سوم: بررسی تفصیلی چند فناوری کاربردی در صنعت ساخت

۲. اینترنت اشیا و کاربردهای آن در صنعت ساخت

Internet of Things and Construction Industry

The Internet of Things (IoT)

- Internet of Things refers to
 - a **network** of **physical devices**, **vehicles**, **appliances**, and other physical objects
 - that are **embedded** with **sensors**, **software**, and **network connectivity**,
 - allowing them to **collect** and **share** data.

IoT devices

- IoT devices—also known as “**smart objects**”—can range from
 - simple “**smart home**” **devices** like smart thermostats,
 - **wearables** like smartwatches and RFID-enabled clothing,
 - complex **industrial machinery** and **transportation systems**.

IoT in enterprises

- In an enterprise context, IoT devices are used to **monitor a wide range of parameters** such as temperature, humidity, air quality, energy consumption, and machine performance.
- This data can be analyzed in real time to identify **patterns, trends, and anomalies** that can **help businesses optimize their operations** and improve their bottom line.

Some Core Benefits of IoT in Construction

1. Improving Jobsite Productivity
2. Safety
3. Cost-savings
4. Improved Reporting
5. Data-driven decision-making

The technologies that make IoT possible

Sensors and
Actuators

Connectivity
Technologies

(Cloud)
Computing

(Big) Data
Analytics

Security and
Privacy
Technologies

Risks and challenges in IoT

Security and
Privacy risks

Interoperability
Issues

Data Overload

Cost and
Complexity

Regulatory and
legal challenges

How should businesses approach IoT?

1. Plan your IoT strategy
2. Choose Secure IoT products
3. Monitor and maintain devices
4. Manage data effectively
5. Build an ecosystem

۲. مدلسازی اطلاعات ساختمان

Building Information Modeling (BIM)

Building information modeling

- Building information modeling (BIM) is a **method** to **create** a **digital representation** of a facility's physical and functional characteristics that a team can **virtually**
1. Analyze,
 2. Document, and
 3. Assess, then
 4. Revise iteratively
- throughout the design and construction process.

Building information modeling

- ❑ BIM is an **important concept** for project/program controls.
- ❑ Throughout a **structure's lifetime**,
the model serves as a shared knowledge resource that forms a reliable basis for **decisions**,
from inception through design to construction, use/occupancy, operations, renovation, and eventual demolition.

Many owners require BIM to manage delivery, so the CM should **generally understand the concepts** in this section and **advise** the owner, when applicable.

Remember, the CM **does not necessarily need to be a technology expert**, but a CM should **understand a technology well enough to manage it**.

Building information modeling

- ❑ BIM allows for qualitative and quantitative **engineering analyses** to reveal the properties and state of the project/program.
- ❑ Projects and programs that use BIM **benefit** from improved coordination during the design, **resulting** in higher-quality designs that **reduce** rework, delays, and changes during construction.

Building information modeling

□ BIM should

1. Increase the **builder's confidence** in the design and
2. Reduce trade **coordination delays** during construction.
 - ❖ For example, a BIM design can allow the team to use more pre-fabricated materials and assemblies, which reduces jobsite labor and costs.

Building information modeling

□ BIM should also

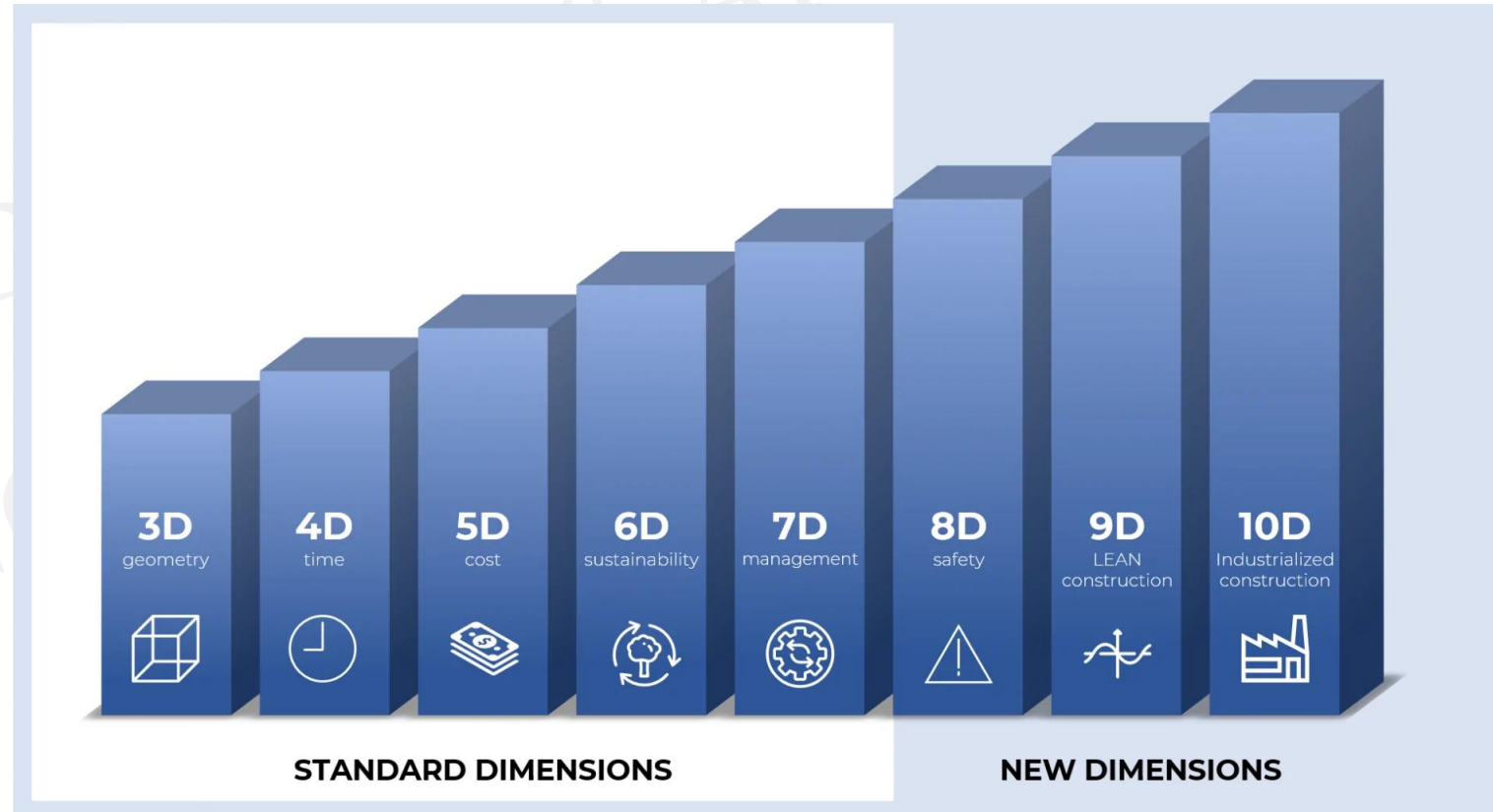
- ❖ **Increase** the **owner's visibility** of the design and
- ❖ **Access** to as-built information, streamlining the turnover, startup, and facility management processes.

□ BIM **virtual models** can help the owner

- ❖ **“Watch”** the construction process and
- ❖ **Better understand** the completed design.

BIM dimensions

- A BIM model includes **multiple dimensions**, such as:
 - 3D (Spatial)
 - 4D (Time/duration)
 - 5D (Cost)
 - 6D (Sustainability)
 - 7D (Facility management)
 - 8D (Safety)
 - 9D (Lean construction)



BIM execution plan

- ❑ A **BIM execution plan** (BEP, sometimes abbreviated as BxP) is a written document
 - that provides a **framework** for the team to
 - determine the **most effective BIM** application throughout a facility's lifecycle.
- ❑ The BEP may be
 - ❖ Part of the PMP/pgmp, CMP, or
 - ❖ A separate document on larger or more complex projects/programs.

BIM execution plan

- The BEP continues to evolve throughout the project/program. A BEP includes:
 - » BIM requirements;
 - » BIM roles and responsibilities;
 - » BIM platform/software specifications;
 - » BIM templates;
 - » File naming, content, and sharing policies;
 - » Data storage, access, updating, ownership, and protocols;
 - » Quality control and quality assurance;
 - » Level of development in each phase; and
 - » Intended use of the model(s) in each phase.

قسمت ۱/۳

فصل اول: فناوری‌های دیجیتال در صنعت ساخت

قسمت سوم: بررسی تفصیلی چند فناوری کاربردی در صنعت ساخت

۱. اینترنت اشیا (IoT) و کاربردهای آن در صنعت ساخت

۲. مدلسازی اطلاعات ساختمان (BIM)

۳. بلاک چین و کاربردهای امکان پذیر آن در صنعت ساخت

۴. اتوماسیون فرایند رباتی (RPA)

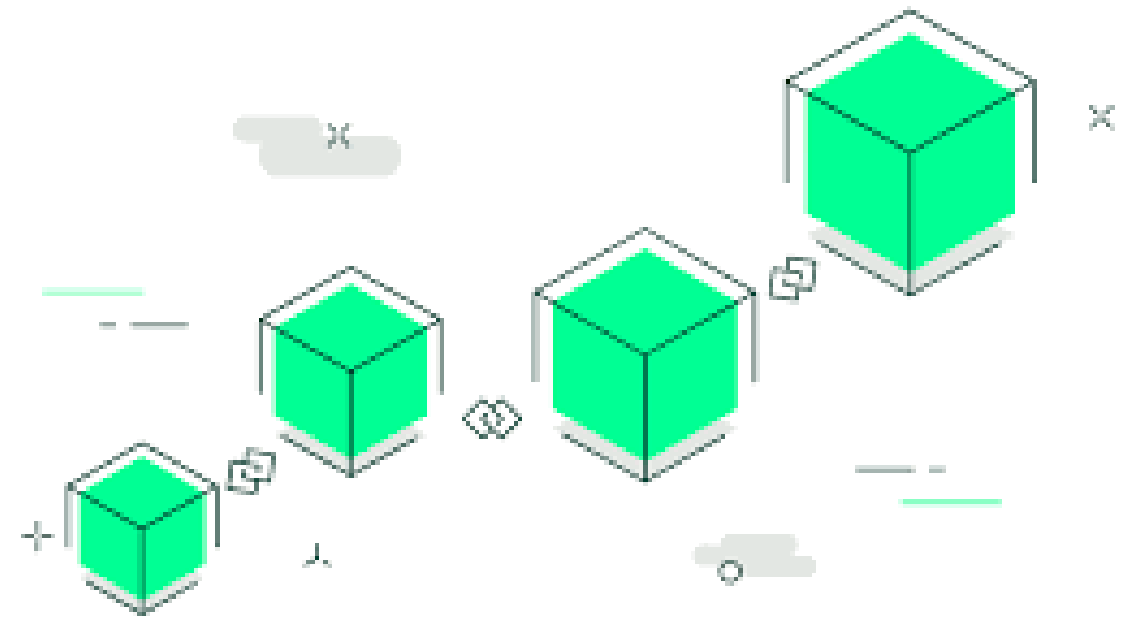
چند فناوری دیجیتال
کاربردی در صنعت
ساخت

۳. بلاک چین و کاربردهای امکان پذیر آن در صنعت ساخت

Blockchain and Construction Industry

Q.

What is Blockchain?



Blockchain enables peer to peer transfer of digital assets
without any intermediaries

Q.

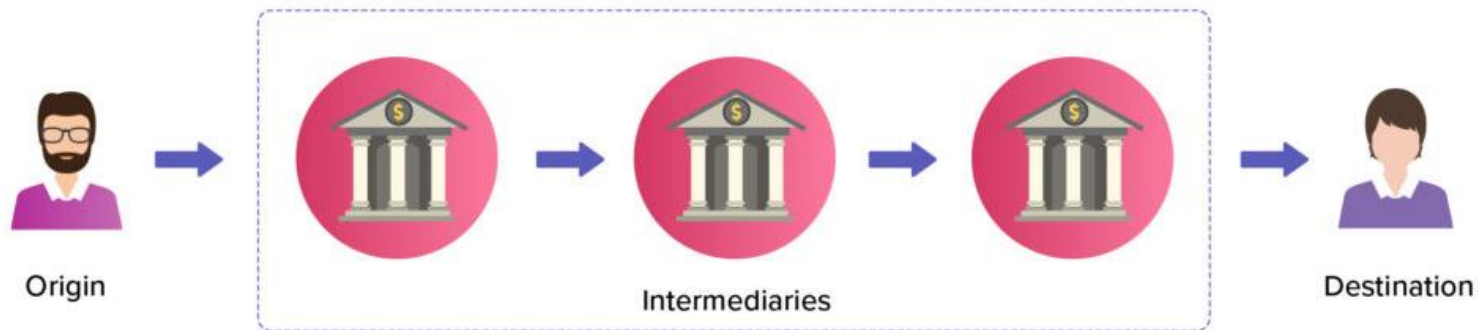
How do we usually transfer assets ?

How do we resolve issues regarding ownership?

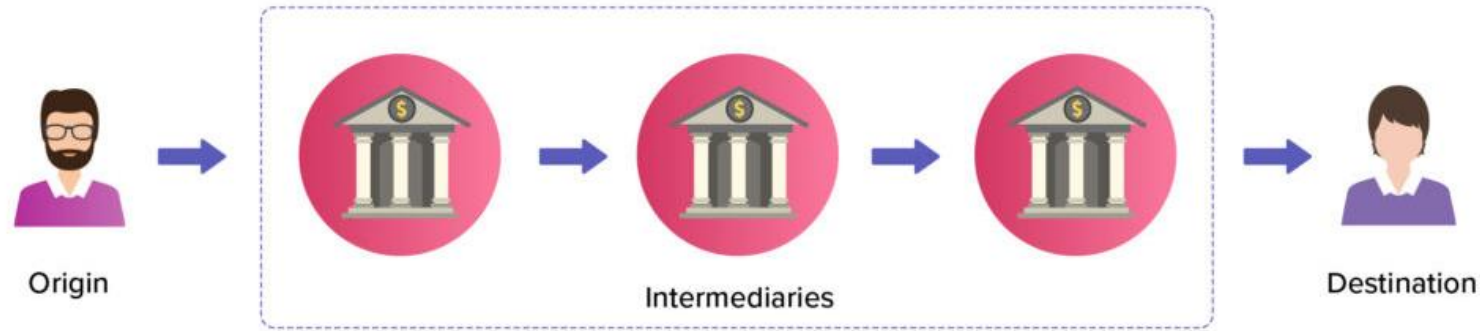
[illegible]

Inventory of Slave Stock V ⁶ on the Estate of the							
Late Col. Richard Barnes in Washington County on the 15 th May 1804							
R ^d	"	Names	age	Names	age	R ^d	
Dead	"	Wilson . . . 1 . . .	78	" Peter . . . 45 . . .	10		
	"	Ben 2 . . .	57	" Jack 46 . . .	9		
	"	Mad 3 . . .	66	" Jack (of J) . . . 47 . . .	8		
	"	Gillup 4 . . .	59	" Dick 48 . . .	8		
	"	Billy Carpenter . . . 5 . . .	58	" Isaac 49 . . .	8		
	"	Peter Smith 6 . . .	50	" Ben 50 . . .	8		Papers
	"	Charles 7 . . .	47	" Oial 51 . . .	8		Papers
	"	Douglas 8 . . .	45	" Jack 52 . . .	8		Papers

Traditional System of Asset Transfer



Traditional System of Asset Transfer



Trusted
Intermediaries

Centralized
Institutes

Documented in
Centralized Ledgers

Regulation

Authority

Monitoring

Conflict Resolution

Blockchain Transfer



With no central authority, how does blockchain realize trust and security?

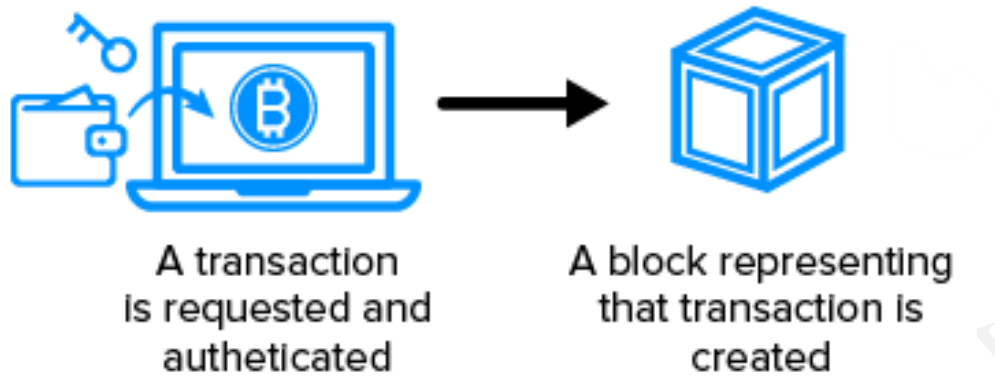
How does a transaction get into the blockchain? (1/8)



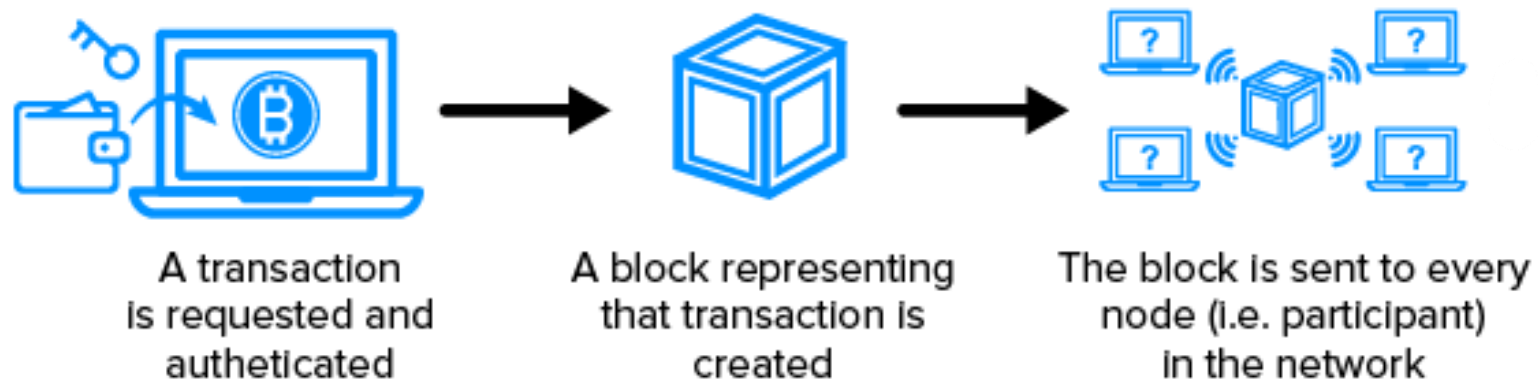
A transaction
is requested and
authenticated

Prepared by Alavipour & Dorafshan
DO NOT DISTRIBUTE

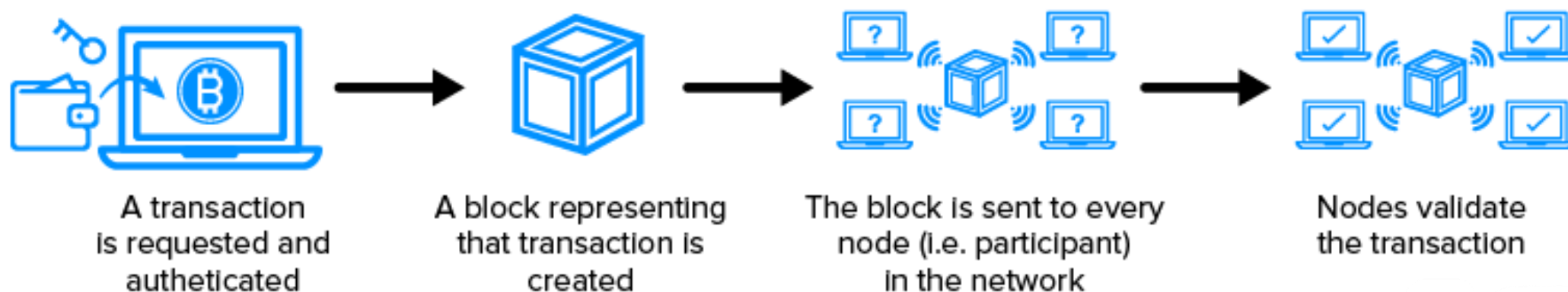
How does a transaction get into the blockchain? (2/8)



How does a transaction get into the blockchain? (3/8)

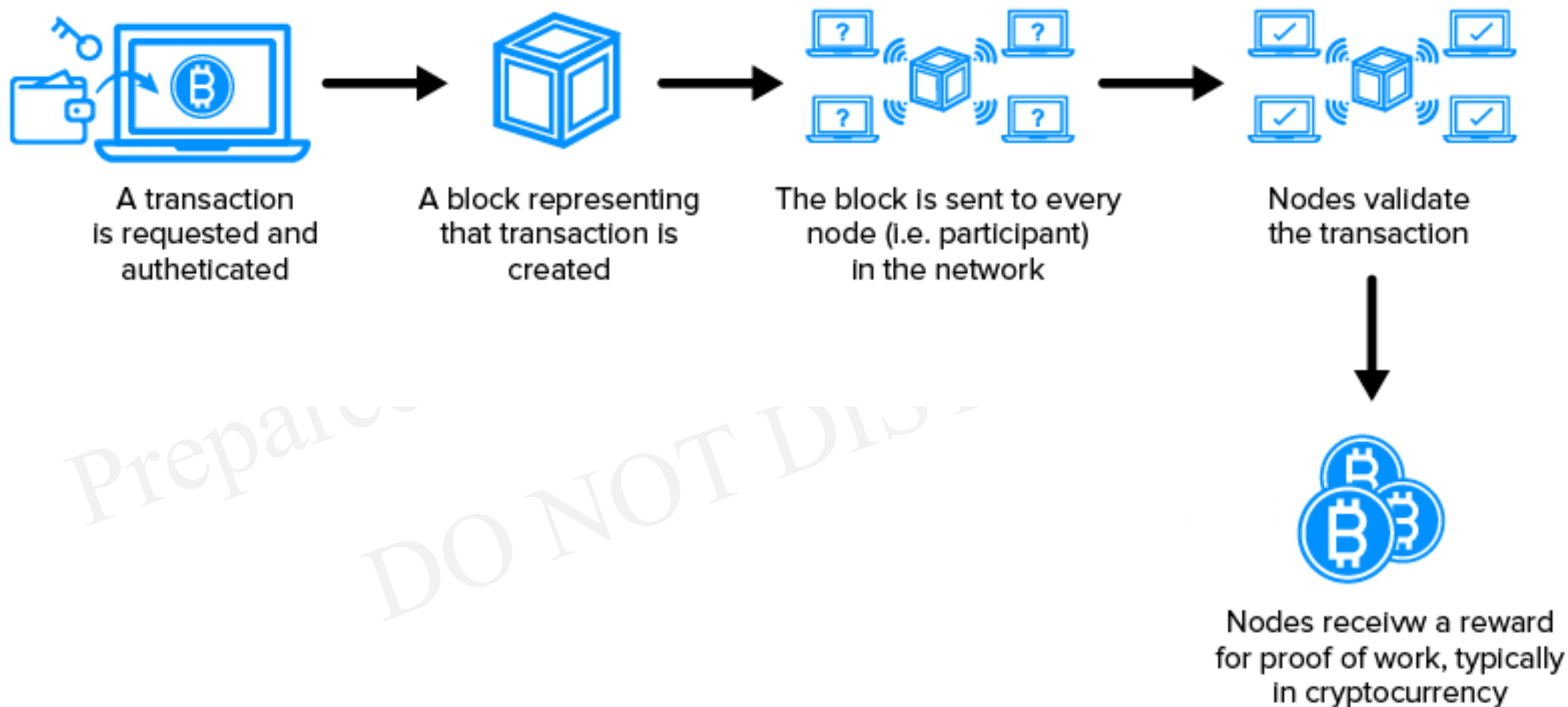


How does a transaction get into the blockchain? (4/8)

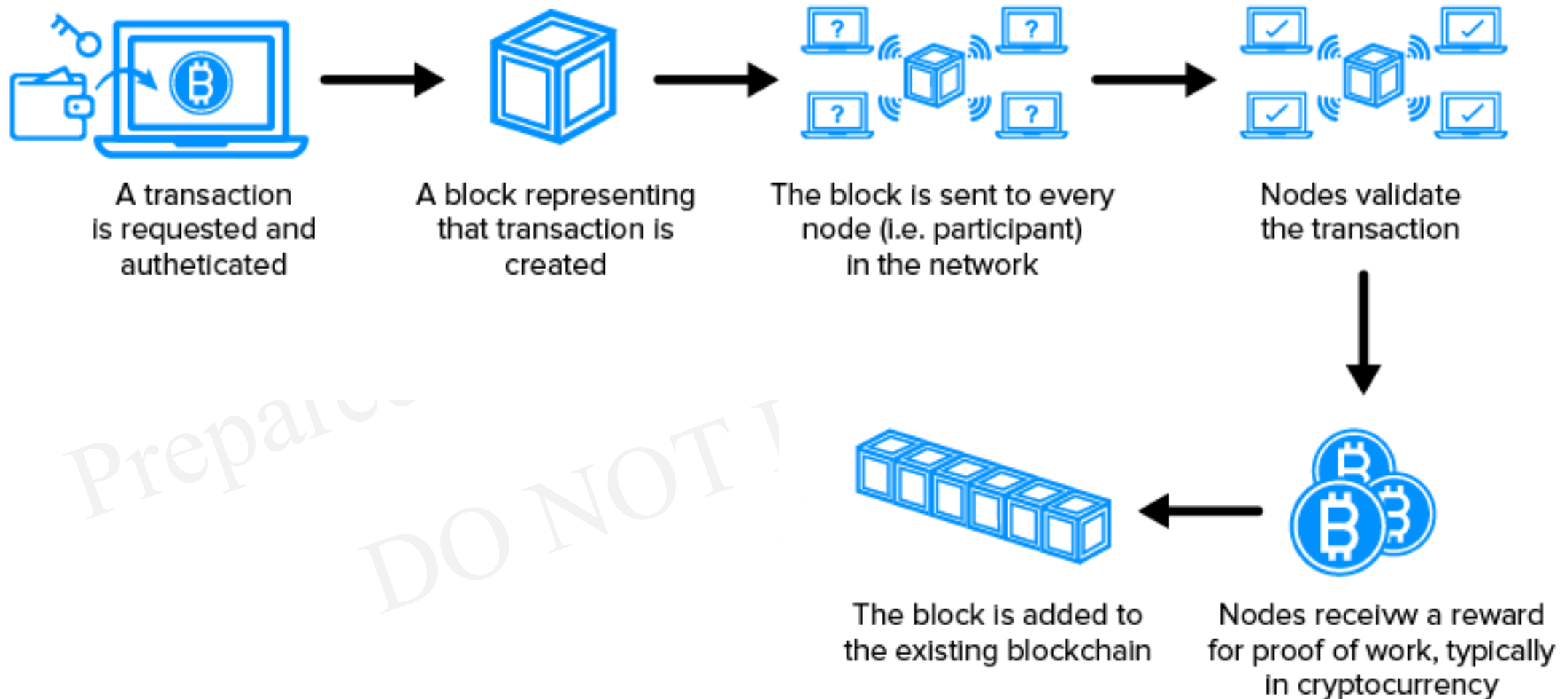


Prepared by
DO NOT DISTURB

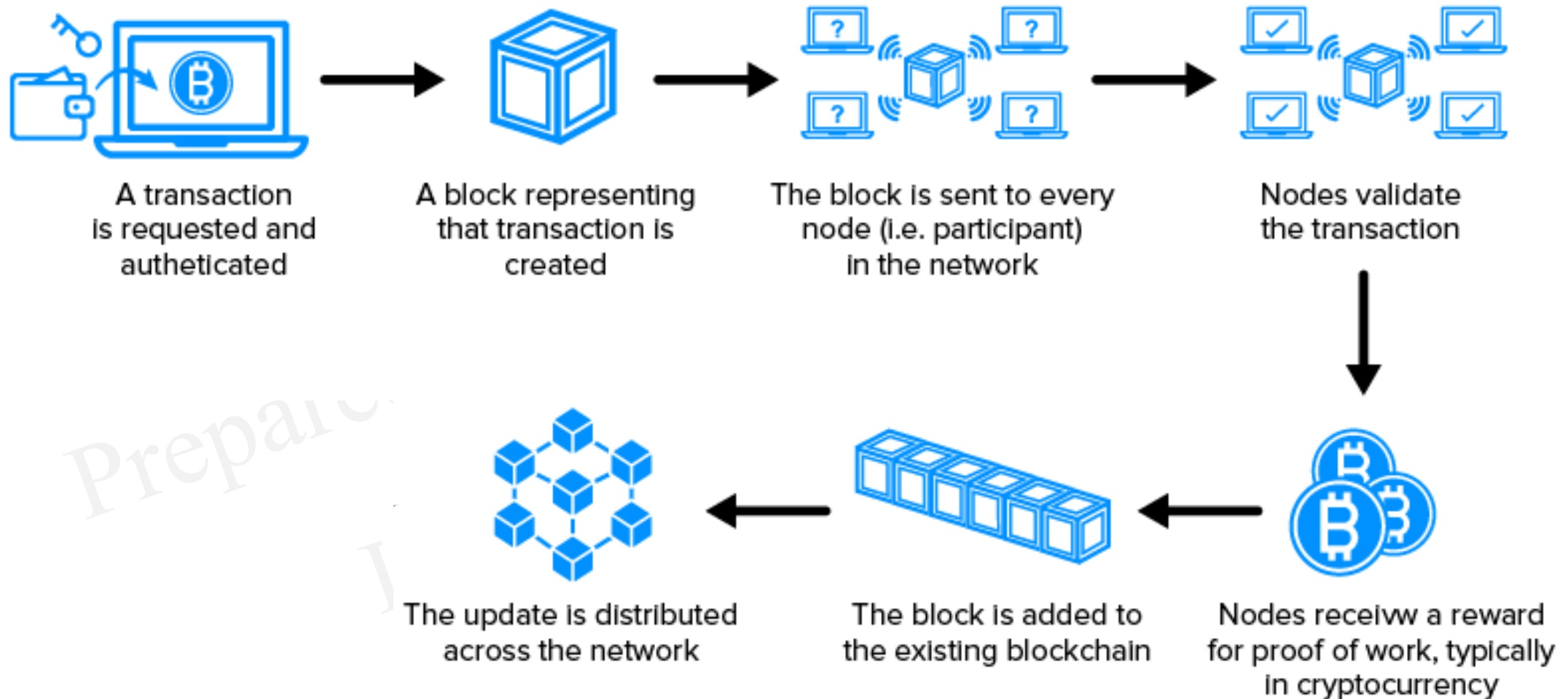
How does a transaction get into the blockchain? (5/8)



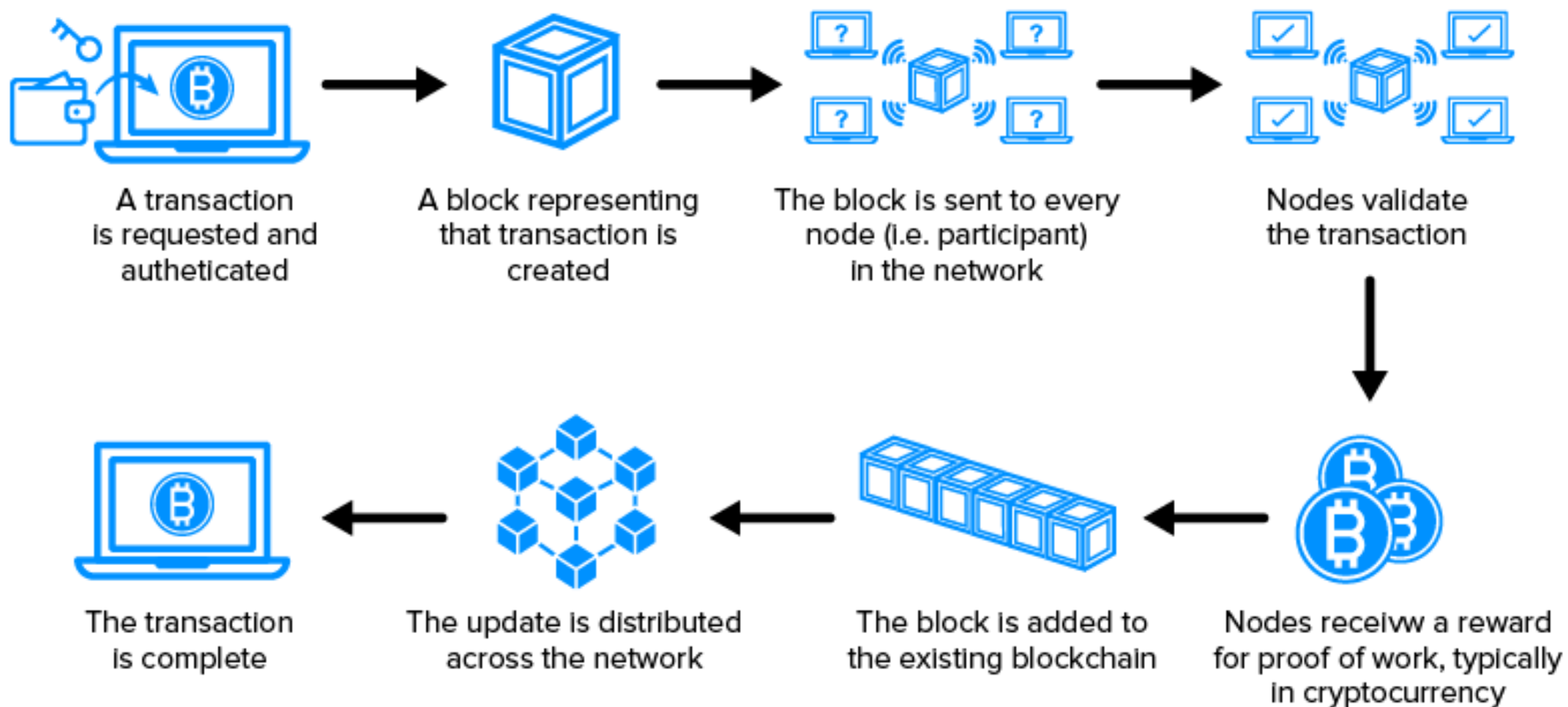
How does a transaction get into the blockchain? (6/8)



How does a transaction get into the blockchain? (7/8)



How does a transaction get into the blockchain? (8/8)



Blockchain as

an **Immutable** Distributed Ledger

Prepared by Alavipour & Dorafshan
DO NOT DISTRIBUTE

Blockchain as a Historical Fabric

- We generate a tremendous amount of data.
- Think of blockchain as a **historical fabric** underneath recording everything that happens—every digital transaction; exchange of value, goods and services; or private data—exactly as it occurs.
- Then the chain **stitches** that data into **encrypted blocks** that **can never be modified** and **scatters the pieces** across a worldwide network of distributed computers or "**nodes**."

Why Blockchain is a revolutionary idea?

The way of tracking and storing data.

Creating trust in the data.

No more intermediaries

Blockchain Types

Public Blockchain

Private Blockchain

Hybrid Public-
Private Blockchain

Smart Contract

- A piece of code deployed in the blockchain node.
- Execution of a smart contract is initiated by a message embedded in the transaction
- Digital currency transfer request simple addition and subtraction.
- Ethereum enables transaction that may carry out more sophisticated operations.
- For example, a transaction could require a conditional transfer, it may require some evaluation, it may need more than one signature for transfer of assets, or it may involve waiting for a specific time or date.

Q.

What are the **notable uses** of blockchain
in Construction Industry?

1.

Project Finance

Tokenized Assets

2.

Supply Chain Management

Document
Validation

3.

Data Transfer (Digital Media)

Ownership

Antifraud
Detection

4.

Document Submittals and Validation

Authentication

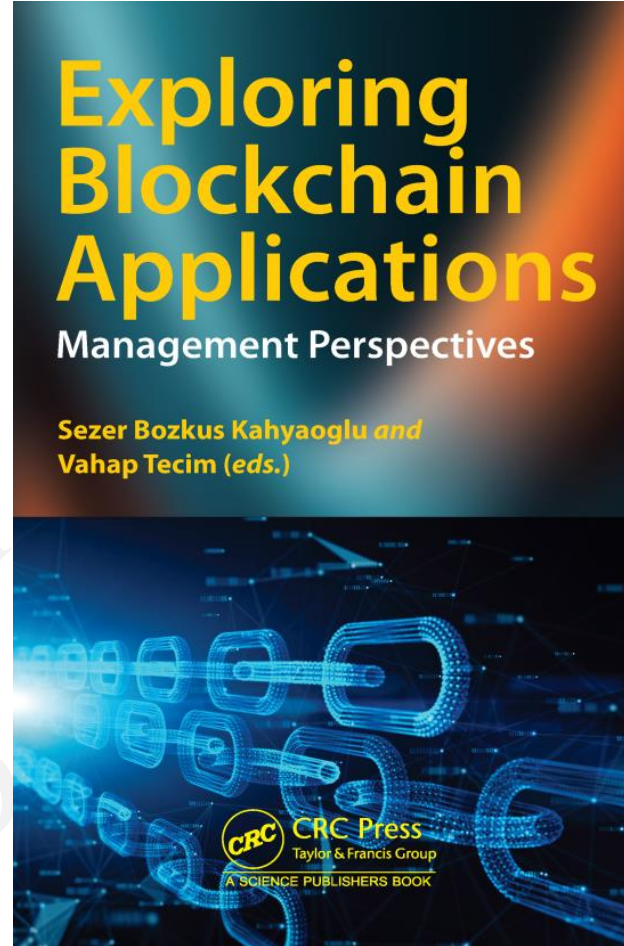
Forgery Detection

5.

Identity Management

One ID Card for
everywhere

Further Reading



 University at Buffalo

Blockchain Specialization

Innovate with the Next Frontier in Technology. Learn how the blockchain is leading to a paradigm shift in decentralized application programming



Instructor: [Bina Ramamurthy](#)

coursera

۴. اتوماسیون فرایند رباتی

Robotic Process Automation (RPA)

Q.

What is Automation?

Prepared by Alavipour & Dorafshan
DO NOT DISTRIBUTE

Q.

What are the benefits of Automation?



What is Automation?

- Automation, in essence, involves
 - leveraging technology, software, or machinery
 - to carry out tasks that would typically require human effort.
- Its beauty lies in its ability to minimize or eliminate the need for constant human intervention, allowing processes to run smoothly and efficiently

Why automation is such a game-changer?

- Because it revolutionize the way businesses and individuals operate.
- Leads to increased efficiency and improved accuracy by reducing human errors and streamlining processes,
- Allows organizations to cut costs, enhance scalability, and provide 24*7 operations
- By automating repetitive tasks, employees can focus on more strategic and creative responsibilities, leading to higher job satisfaction.

Main Automation Categories (1/4)

- Task Automation

Targets **repetitive and mundane tasks**, such as data entry, data extraction, file management, and document processing.

By automating these **routine activities**, you not only save valuable time and resources, but also **minimize the risk of errors**, allowing you to dedicate your focus on the most critical tasks.

Main Automation Categories (2/4)

- **Business Process Automation**

By connecting multiple tasks and systems seamlessly, it automates the entire process.

Results in streamlined workflows, enhanced operational efficiency, and consistent execution of processes.

Main Automation Categories (3/4)

- **Robotic Process Automation (RPA)**

It makes possible to create **software robots** that **mimic human actions** and effortlessly engage with digital systems.

It enables organizations to automate tasks across a **diverse range of applications** and systems, including legacy systems, web applications, and desktop applications

Main Automation Categories (4/4)

- **AI and Machine Learning Integration**

By integrating automation with AI and machine learning services, users can incorporate **intelligent automation** into their workflows.

This includes leveraging natural language processing, digital image processing, and predictive analysis.

How can automation help workers?

1. Job Satisfaction
2. Skill development
3. Enhanced Opportunities
4. Reduced Stress

How can automation help workers?

1. Saved Cost
2. Improved Accuracy
3. Increases Efficiency
4. Enhanced Compliance
5. Improved Scalability
6. Optimizing Resource Allocation

Robots execute automations that people build.

They are basically a series of steps that tell robots exactly what to do

RPAs, fastest growing enterprise software

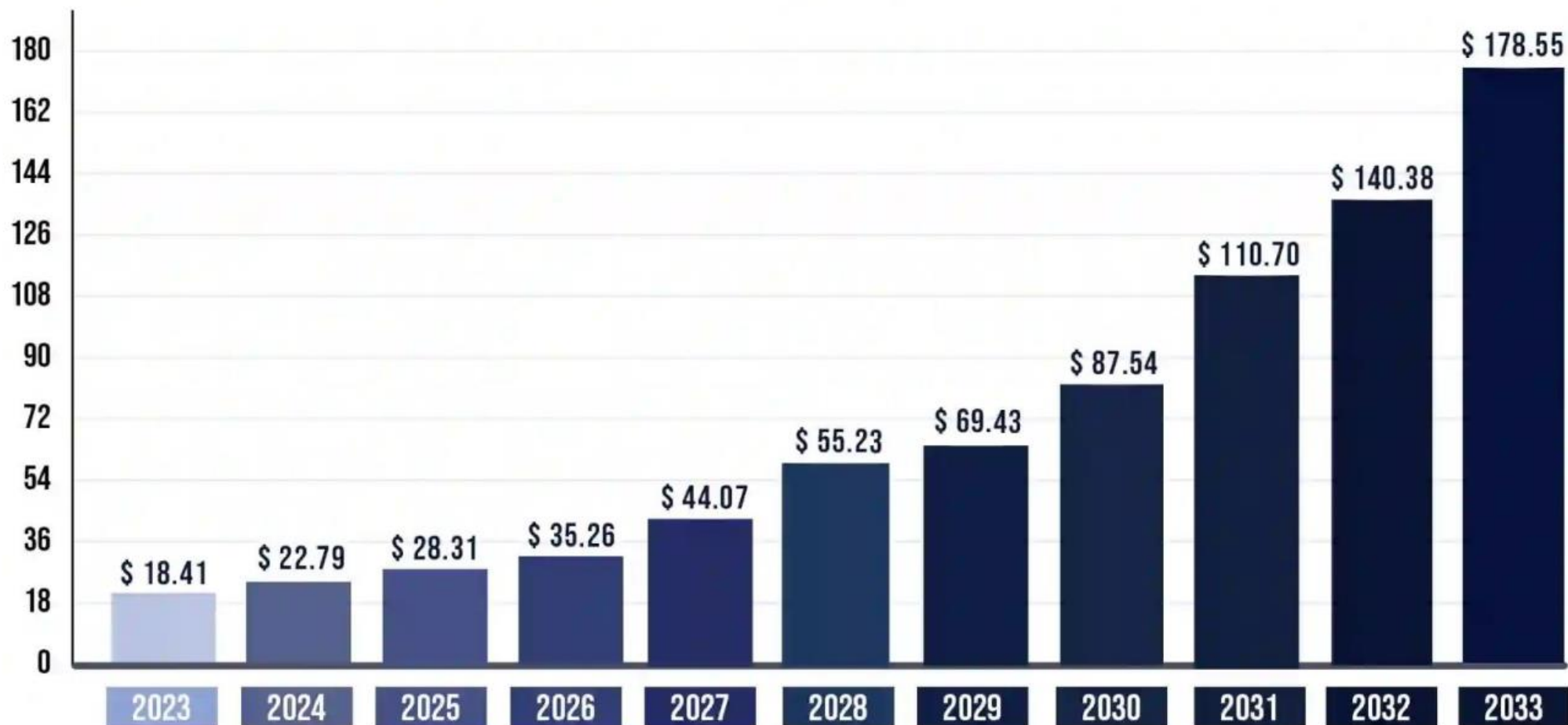
Great ROI

Minimum
Expenditure

Code-less
Environment

No Infrastructure
Disruption

ROBOTIC PROCESS AUTOMATION MARKET SIZE 2023 TO 2033 (USD BILLION)



Source: <https://www.precedenceresearch.com/robotic-process-automation-market>

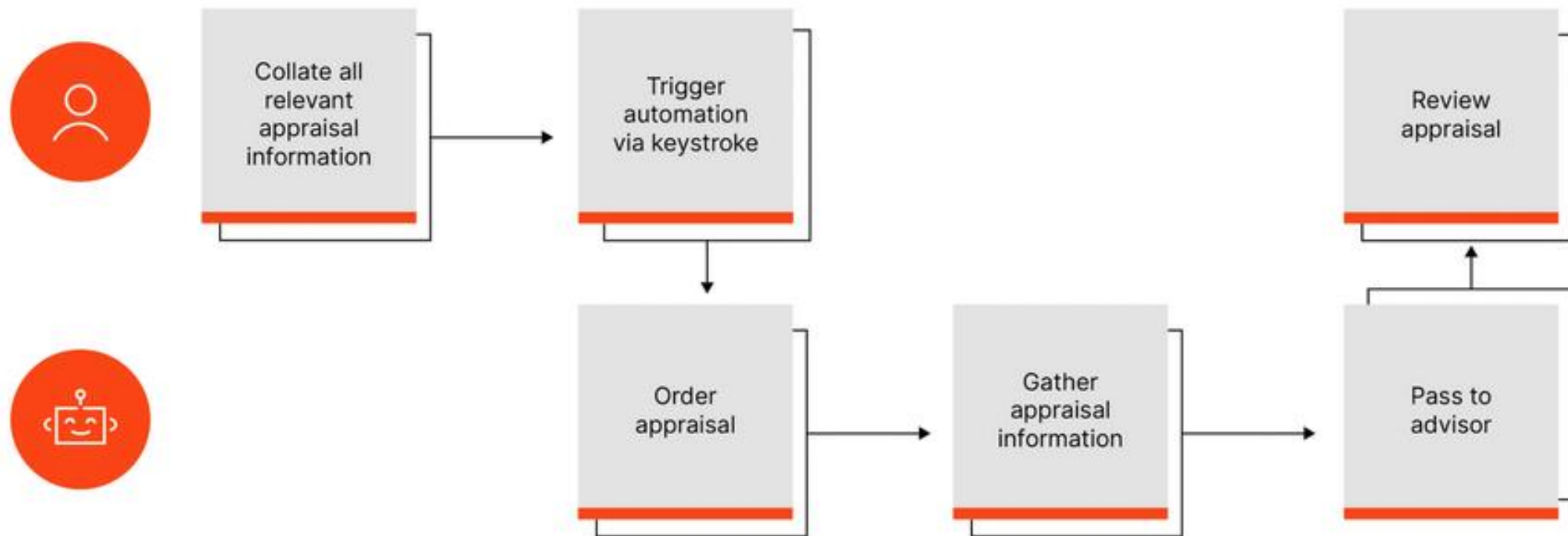
How to work with a Robot?

	Unattended	Attended
What it is	Operates with minimal human intervention Executing fully automated processes with high-volume transactions Typically, in task-intensive back-end environment	Operates on your computer Becoming a trusted assistant Takes charge of repetitive tasks, accelerates processes
Where	On dedicated workstations, servers, or web services	On PC, laptop, departmental server
Trigger Types	• Via an automation management tool • Based on a set schedule • By an activity or event • By another robot	• By the user • By certain events on the user's machine

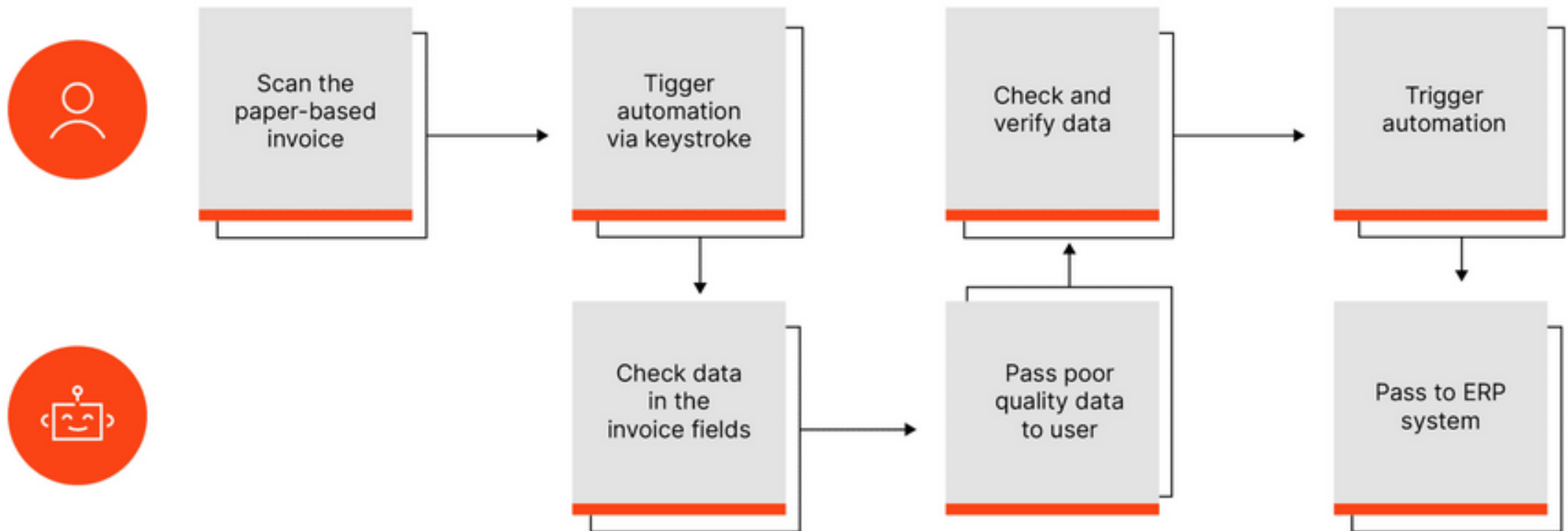
Automation Model (1/6): Fully Unattended



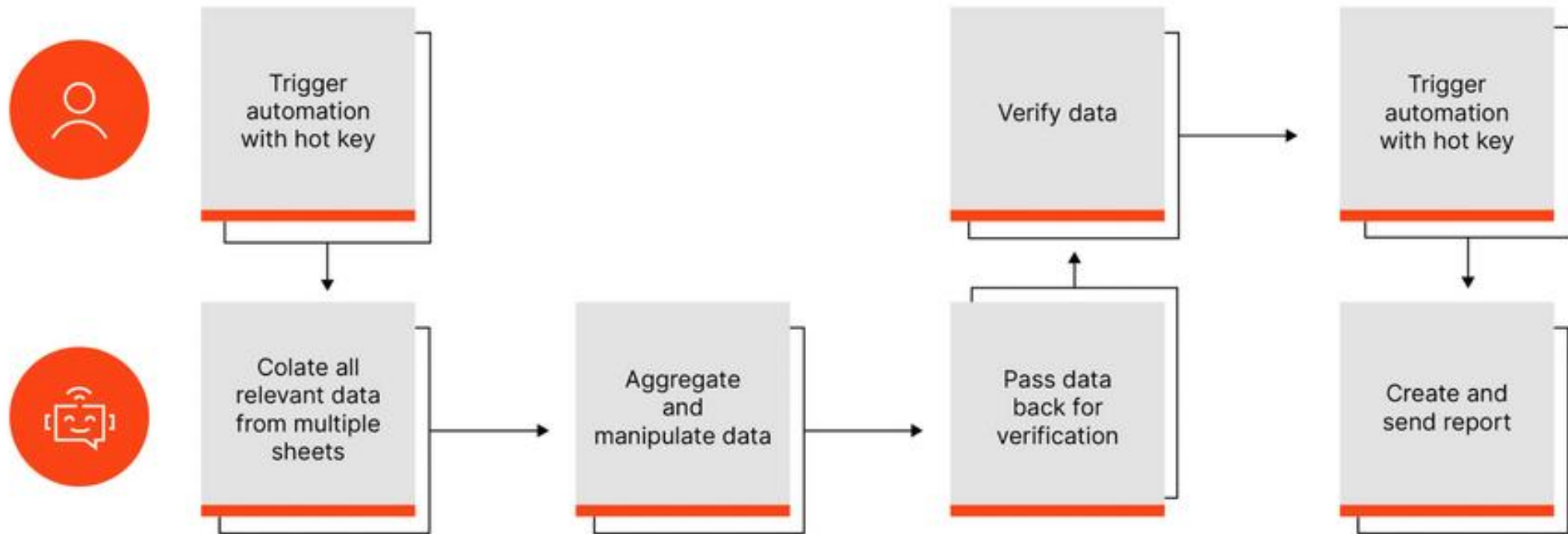
Automation Model (2/6): Partially Unattended



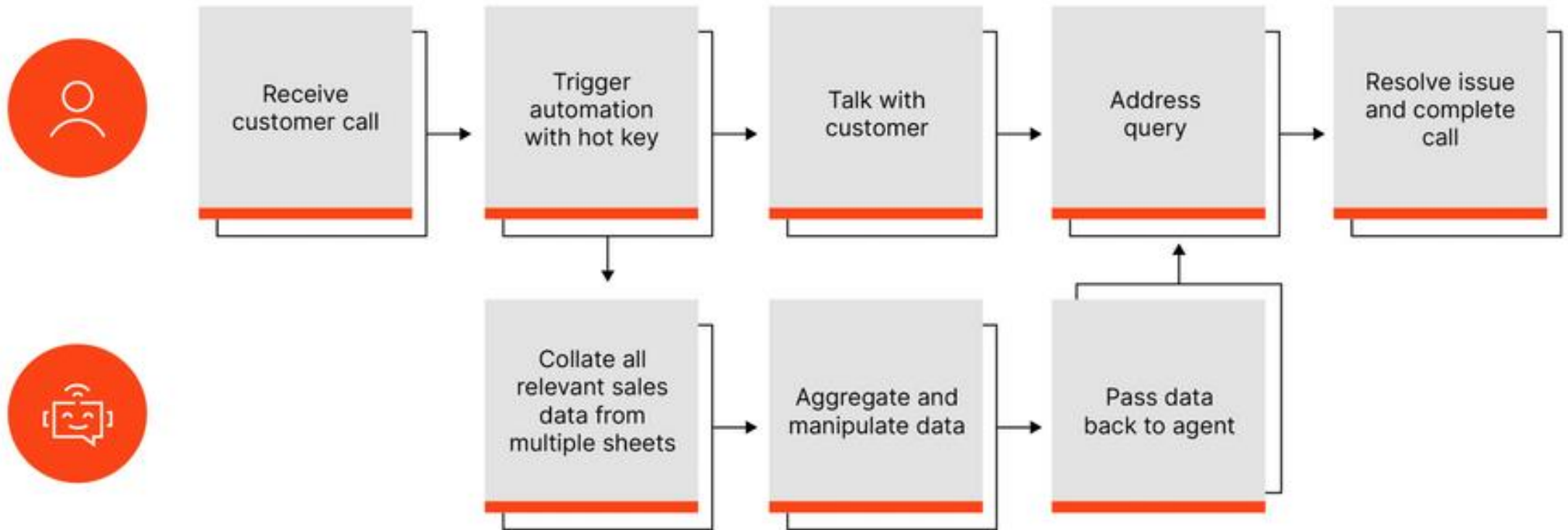
Automation Model (3/6): Human in the Loop



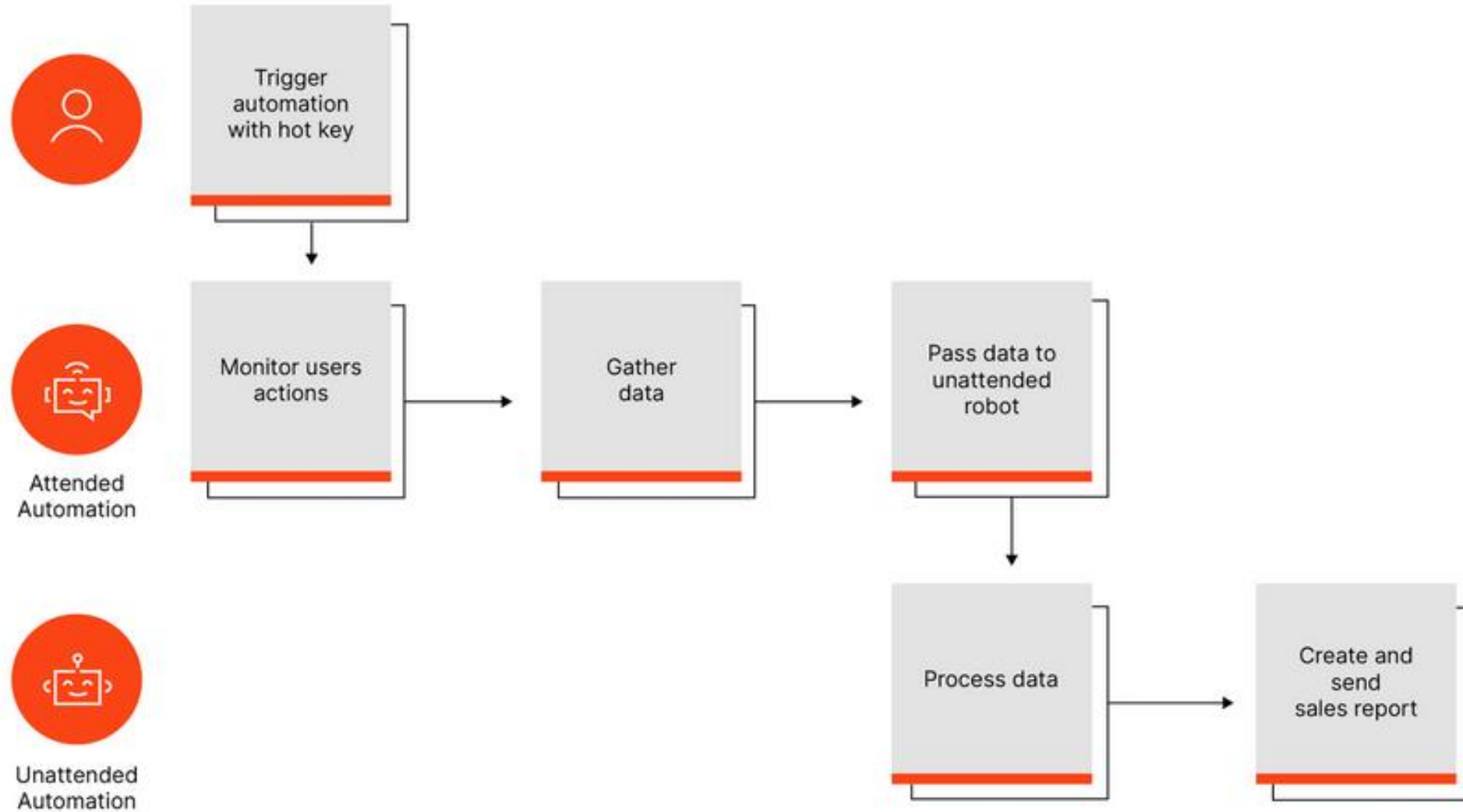
Automation Model (4/6): Attended, Interval



Automation Model (5/6): Attended in tandem



Automation Model (6/6): Hybrid Automation



Connections

Templates > Create project from template

Table Data Extraction for

to Google Sheets

Created by: UiPath

Used for: 5662 automations



Take data from
via Gmail.

write it to a new Google Sheets spreadsheet, and send the spreadsheet to your Inbox

Let's configure this **template** ⓘ

☐ Advanced configuration



Google Drive connection

ndorafshan@gmail.com #2 [default]



Google Sheets connection

Connect to Google Sheets



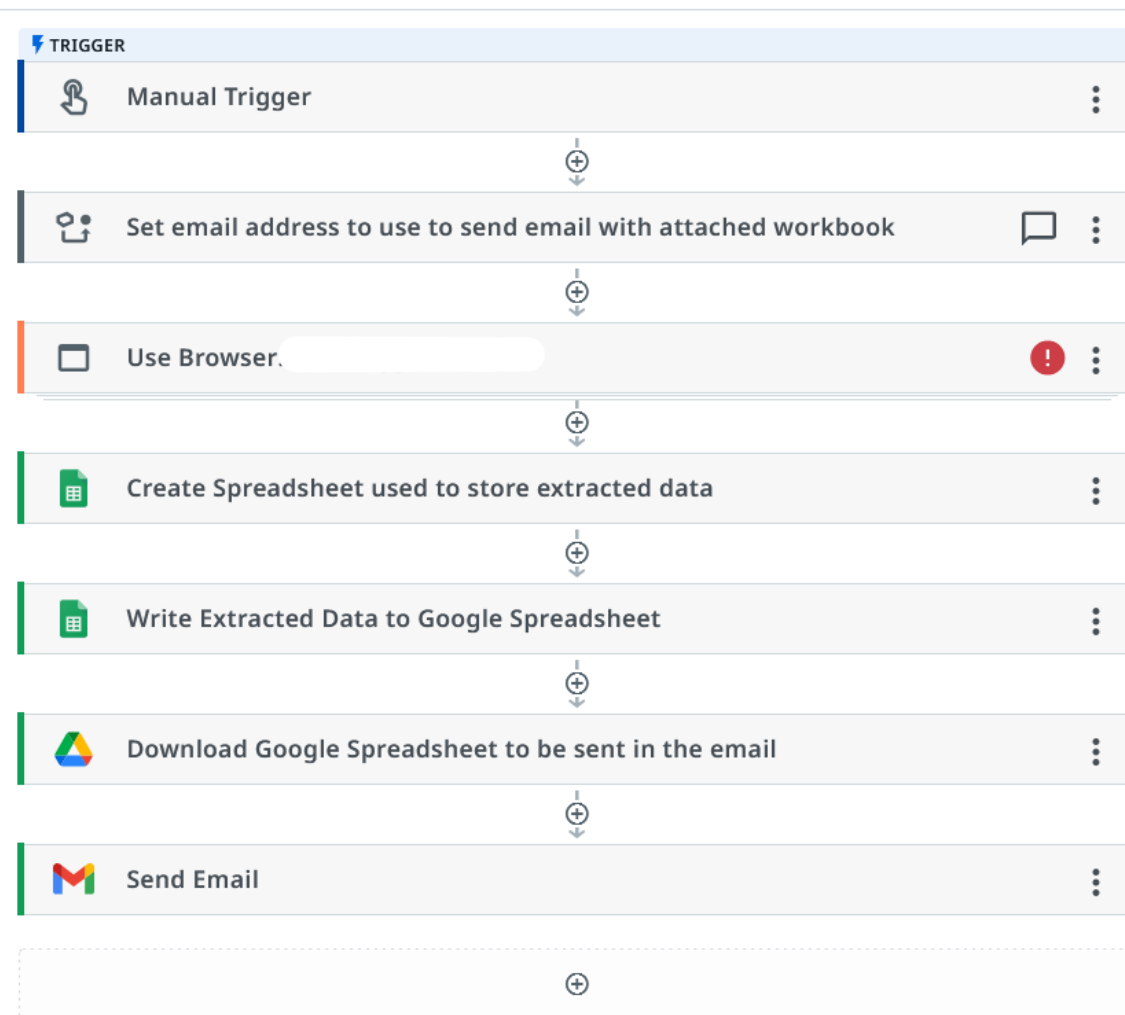
Gmail connection

Connect to Gmail

Back

Use template

Automation Steps



Email Text

Send Email

Gmail connection *

ndorafshan@gmail.com #2 [default]

Save as draft

☒ True ☐ False

To *

`Enumerable.Repeat(emailAddress, 1).ToList()`

Subject

Extracted [redacted] Data

Body

B I U

This is the automated extraction process of the [redacted] data from rpassamples.com/suppliers .

You can find attached the [redacted] Google spreadsheets.

Attachment(s)

`Enumerable.Repeat(_out_DownloadFileConnections_1_Result, 1).ToList()`

Show additional properties

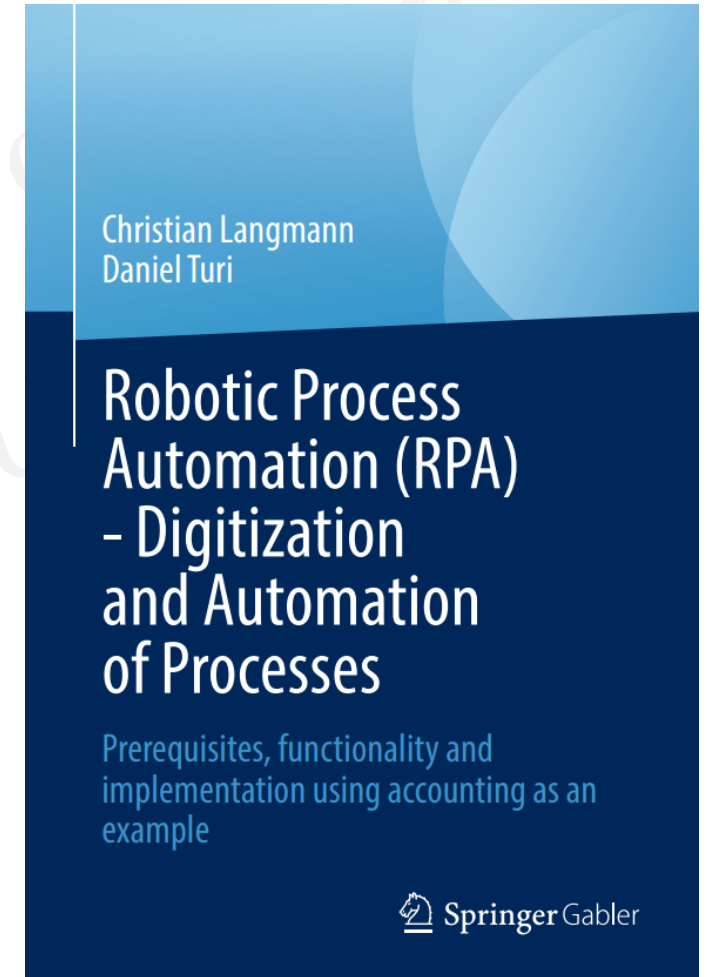
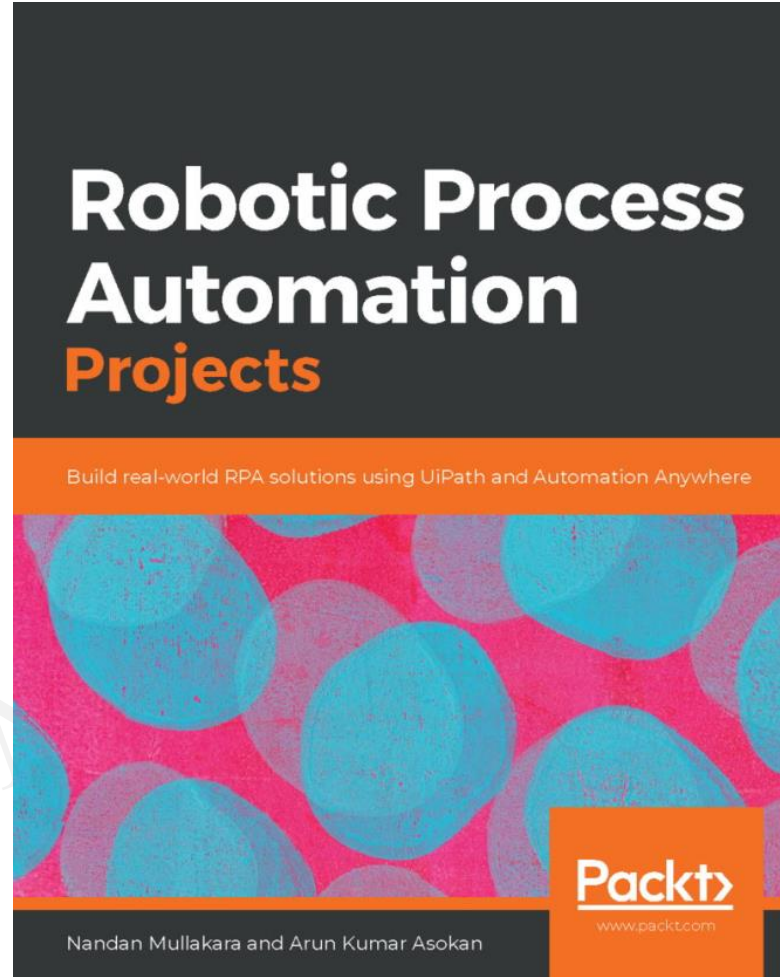
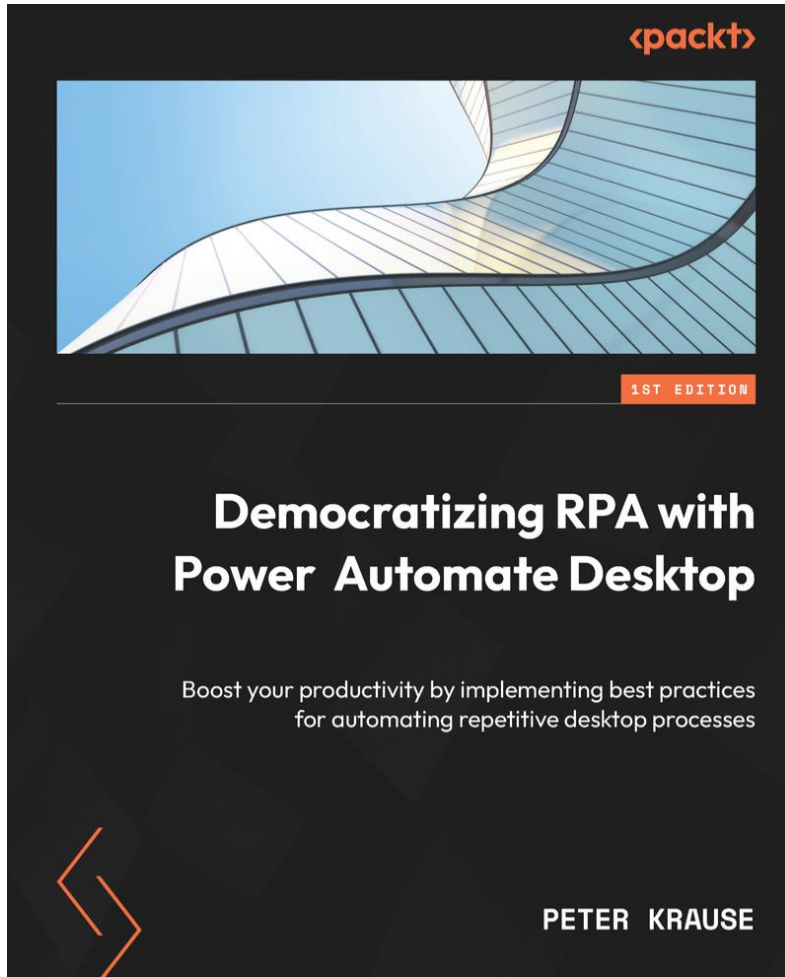
Q.

What can be **roles** involved in designing RPAs?

Q.

What can be **opportunities** to use RPAs in your work?

Further Reading



UIPath Academy



Automation Developer

US Average Salary: \$87,000

Does software development for RPA, API, and other automation initiatives.

[Develop robust automations](#)



Automation Business Analyst

US Average Starting Salary: \$80,000

Documents and improves business processes, and discovers automation opportunities.

[Evaluate automation opportunities](#)



Specialized AI Professional

US Average Starting Salary: \$95,000

Leverage AI capabilities to build automation projects involving digitized documents and unstructured communications data.

[Automation with Specialized AI](#)



Automation Infrastructure Engineer

US Average Starting Salary: \$90,000

Designs, deploys, and maintains automation infrastructures.

[Deploy automation solutions](#)



Automation Solution Architect

US Average Starting Salary: \$140,000

Designs automation solutions and oversees the development.

[Design complex automation projects](#)



Test Automation Engineer

US Average Starting Salary: 101,324.75

Designs, develops, and maintains test cases to enhance software and automated process reliability.

[Create test-automation scripts](#)



Process Mining Developer

A Process Mining Developer creates process mining applications to mine process data.

[Create Process Mining Applications](#)

قسمت ۴/۱

فصل اول: فناوری‌های دیجیتال در صنعت ساخت

قسمت چهارم: بررسی تفصیلی هوش مصنوعی با نگاهی به صنعت ساخت

هوش مصنوعی

۱. تعریف هوش مصنوعی

۲. مقدمات یادگیری ماشینی و شناسایی آماری الگو

۳. شبکه‌های عصبی مصنوعی

۴. هوش مصنوعی مولد

۵. نگاهی به اجرای یک پروژه هوش مصنوعی بر مبنای LLM برای کار با مستندات پروژه

۱. هوش مصنوعی چیست؟

س.

هوش مصنوعی چیست؟

Artificial Intelligence

س.

اصلا هوش چیست؟

بهره هوشی (ریاضی)

هوش چندگانه

هوش عاطفی

...

VOL. LIX. No. 236.]

[October, 1950

MIND

A QUARTERLY REVIEW

OF

PSYCHOLOGY AND PHILOSOPHY



I.—COMPUTING MACHINERY AND INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words 'machine'

۱۹۵۰، مقاله آلن تورینگ

سنگ بنایی برای فهم جدید انسان

از هوش، تفکر و ماشین

- (با ساده‌سازی) به جای آنکه پرسیم: آیا ماشین‌ها قادر به فکر کردن هستند،

- بیایید بررسی کنیم:

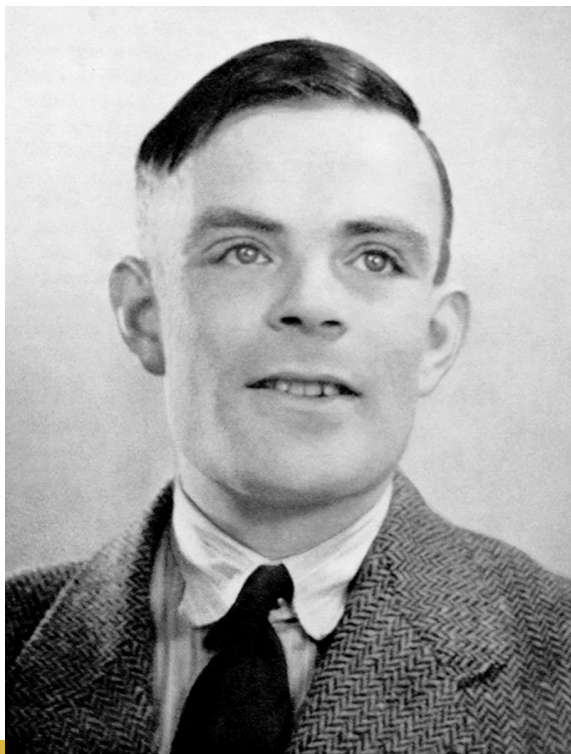
آیا ماشین‌ها می‌توانند به گونه‌ای رفتار کنند که بتوانیم تفاوتی بین آن‌ها و انسان‌ها

قائل شویم؟

تست تورینگ

بازی تقلید

- تلاش برای ارائه یک تعریف سنجش‌پذیر



Alan Turing
(1912-1954)

1956 Dartmouth Conference: The Founding Fathers of AI



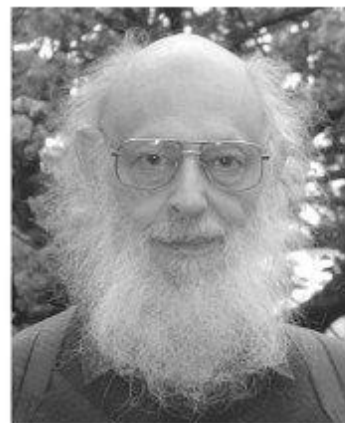
John MacCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



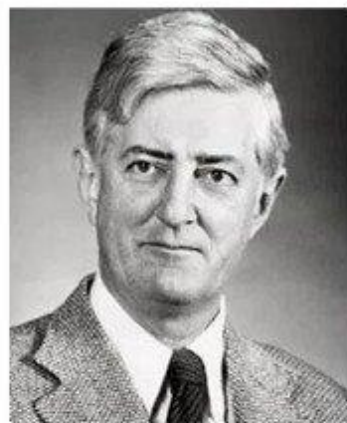
Alan Newell



Herbert Simon



Arthur Samuel



Oliver Selfridge

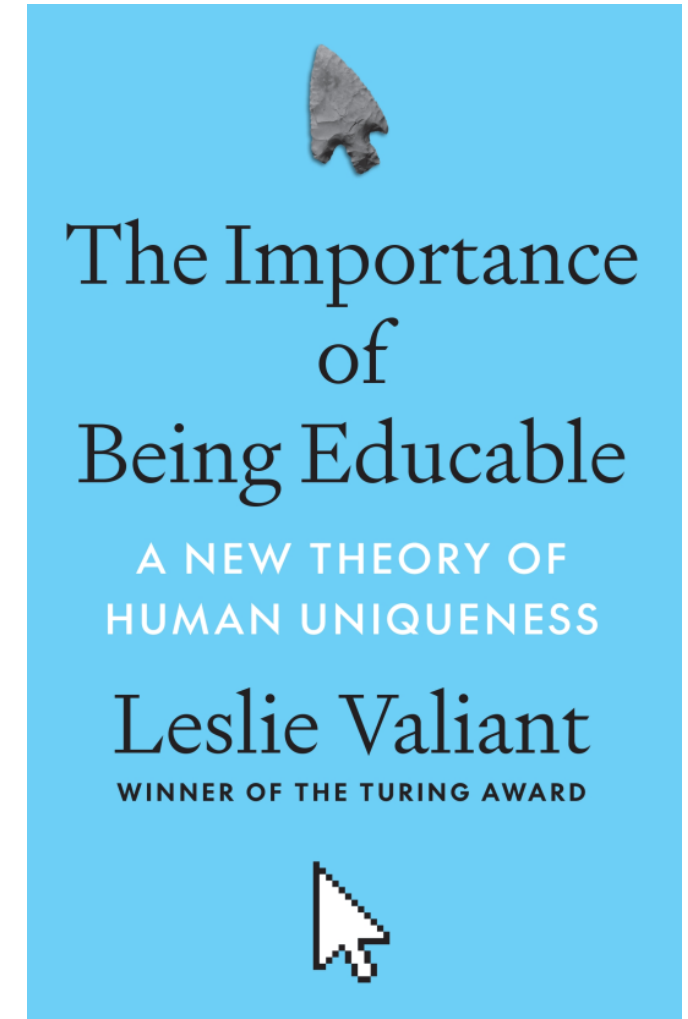
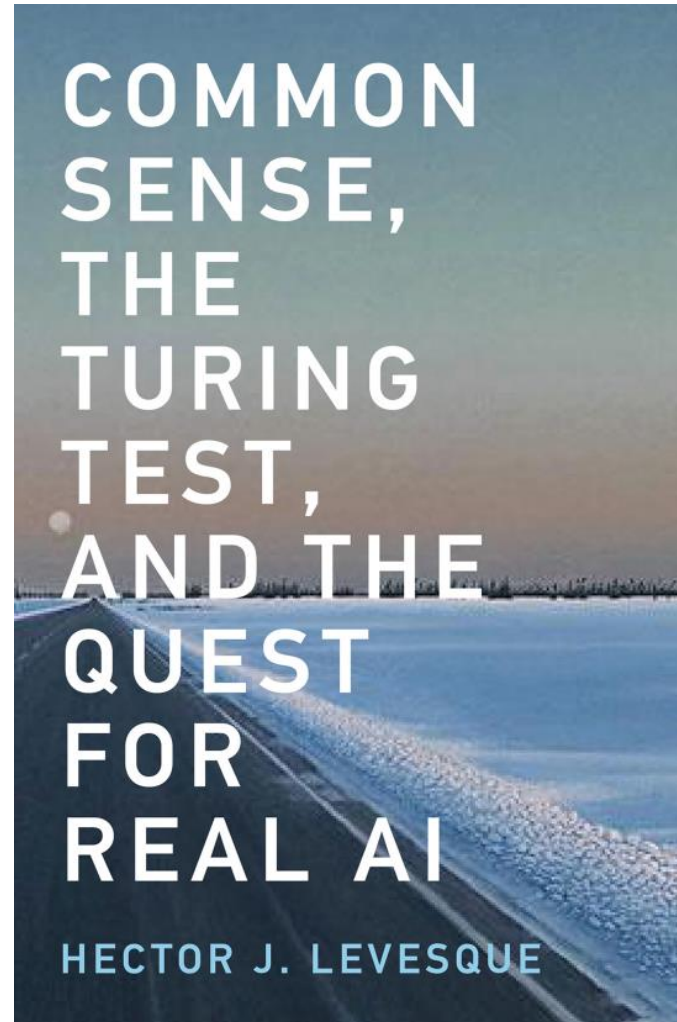
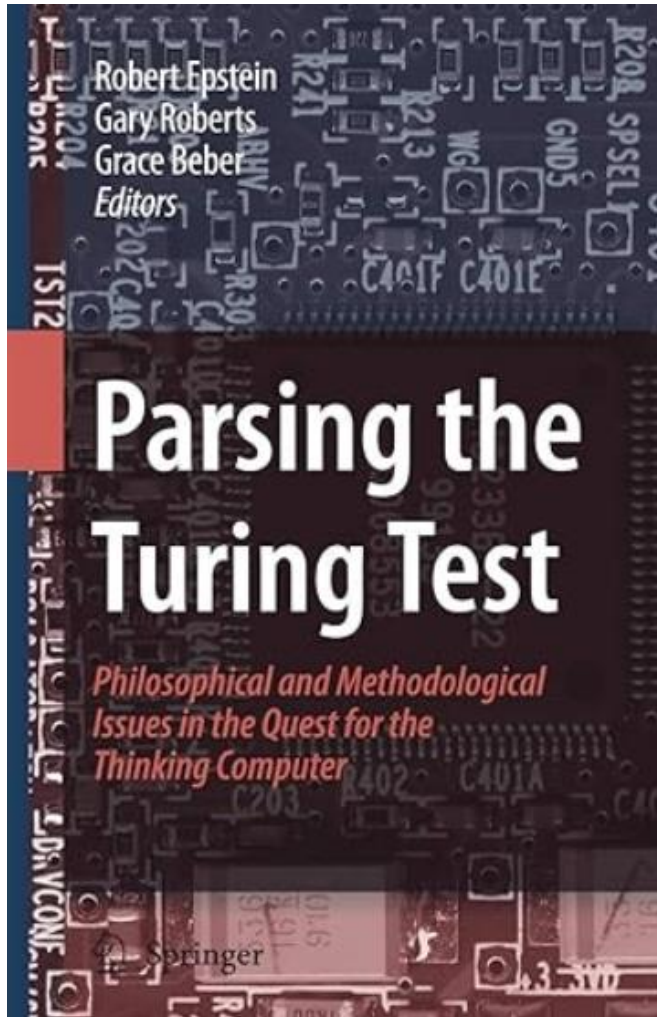


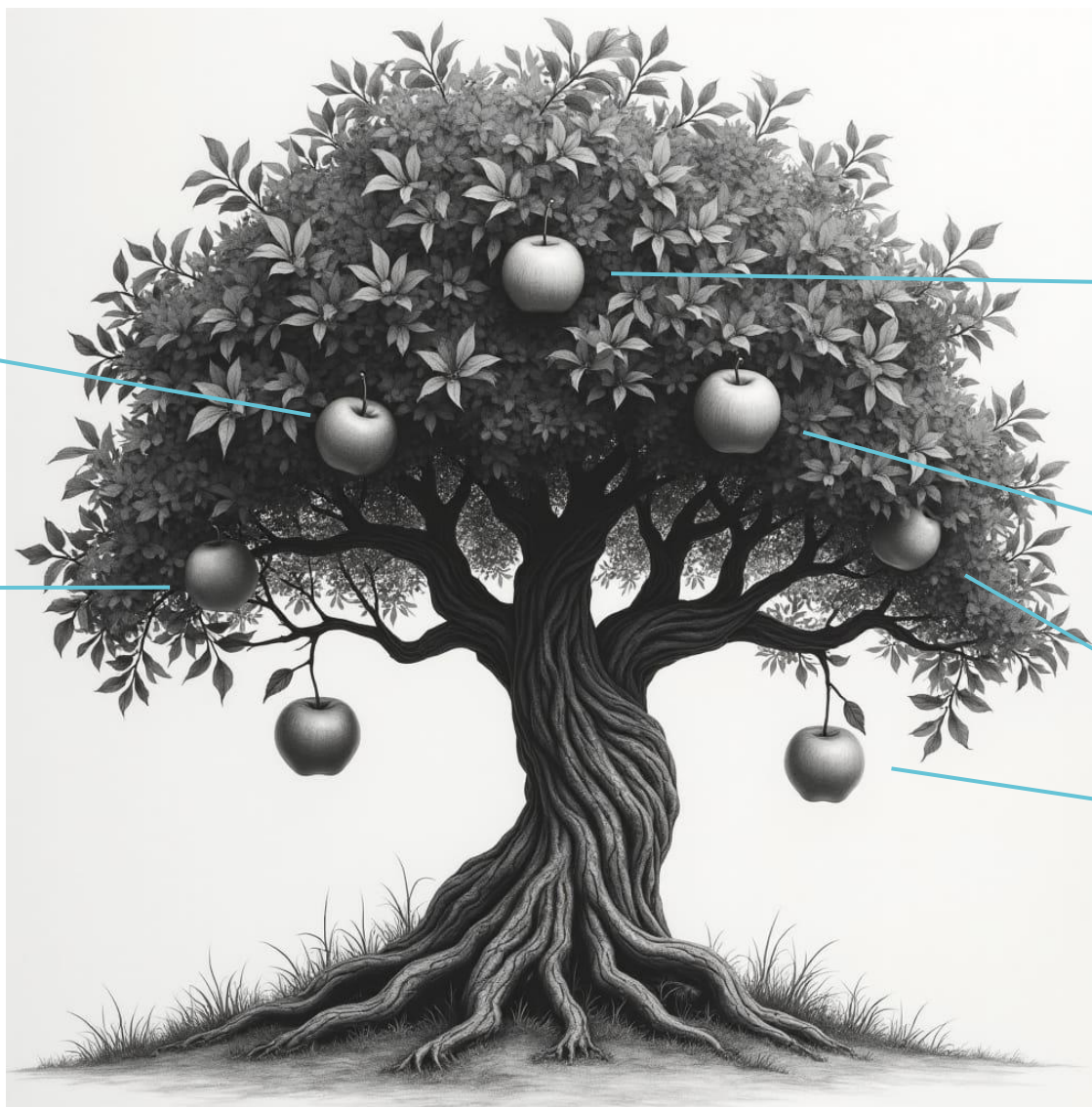
Nathaniel Rochester



Trenchard More

۱۹۵۶، کنفرانس
دارتموث





Natural Language
Processing (NLP)

Expert Systems

...

Machine Learning
(ML)

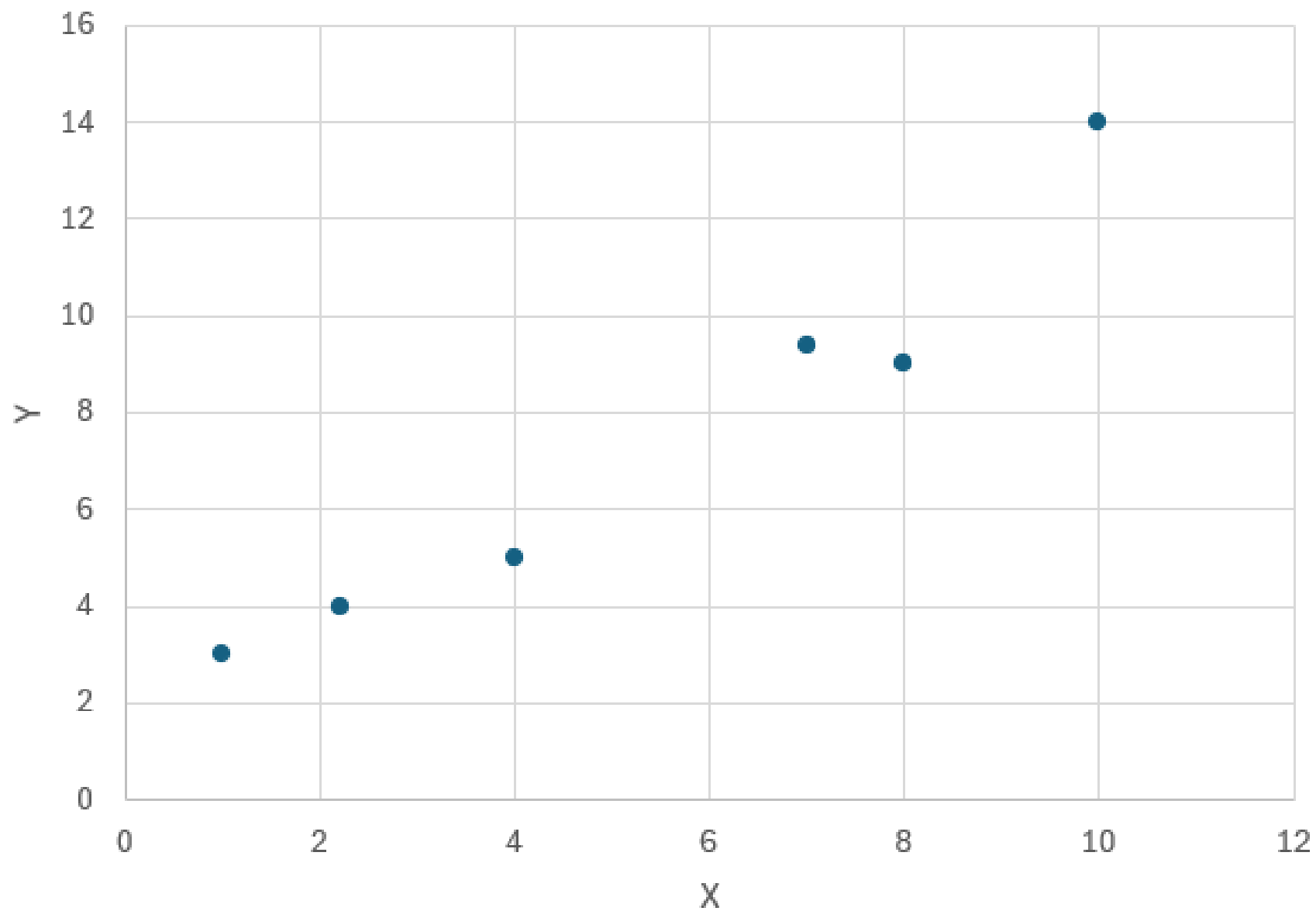
Pattern Recognition

Speech Recognition

Computer Vision

هوش مصنوعی
چیست؟

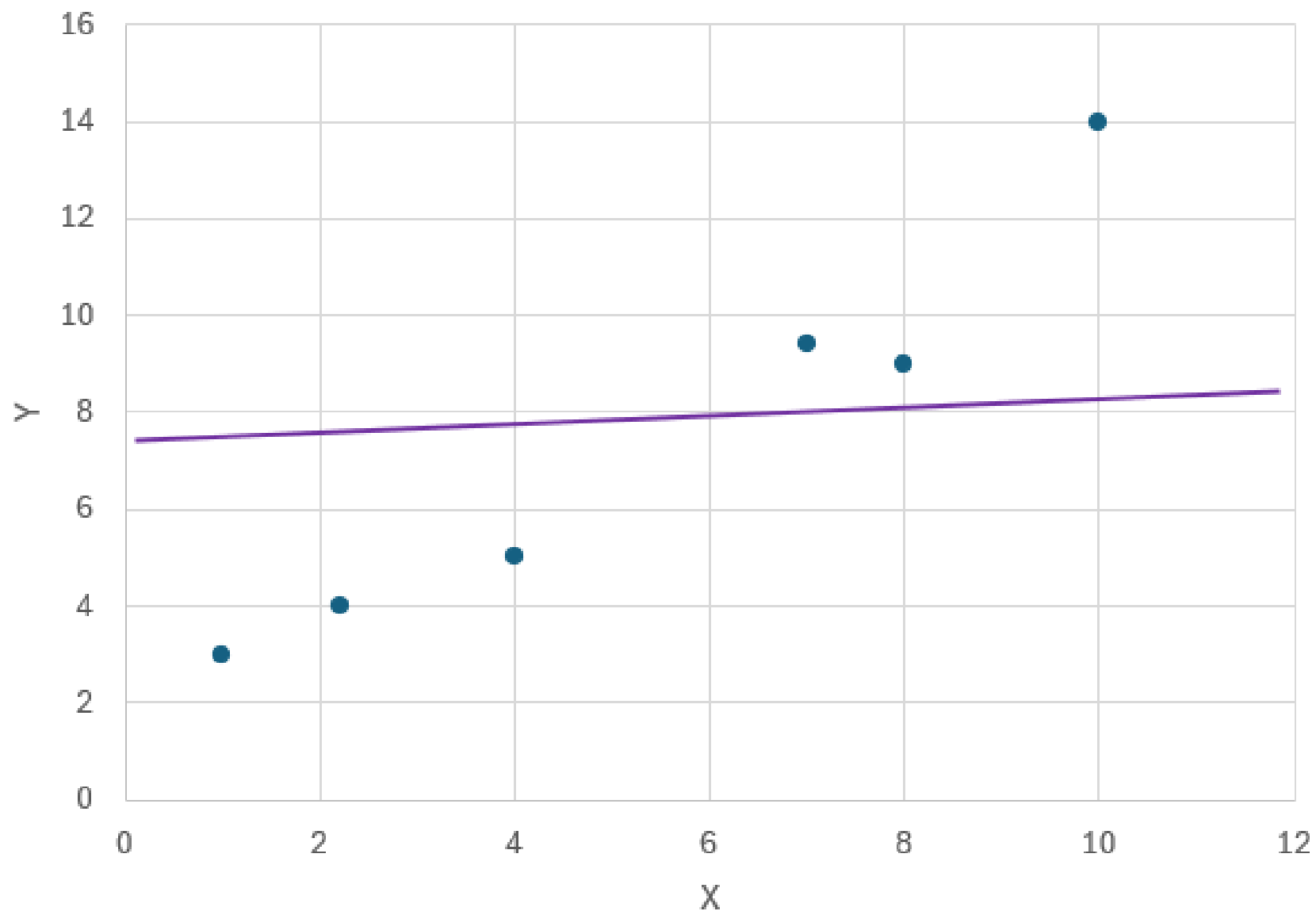
۲. مسئلهٔ رگرسیون



چگونه خط رگرسیون

را ترسیم کنیم؟

$$Y = a * X + b$$

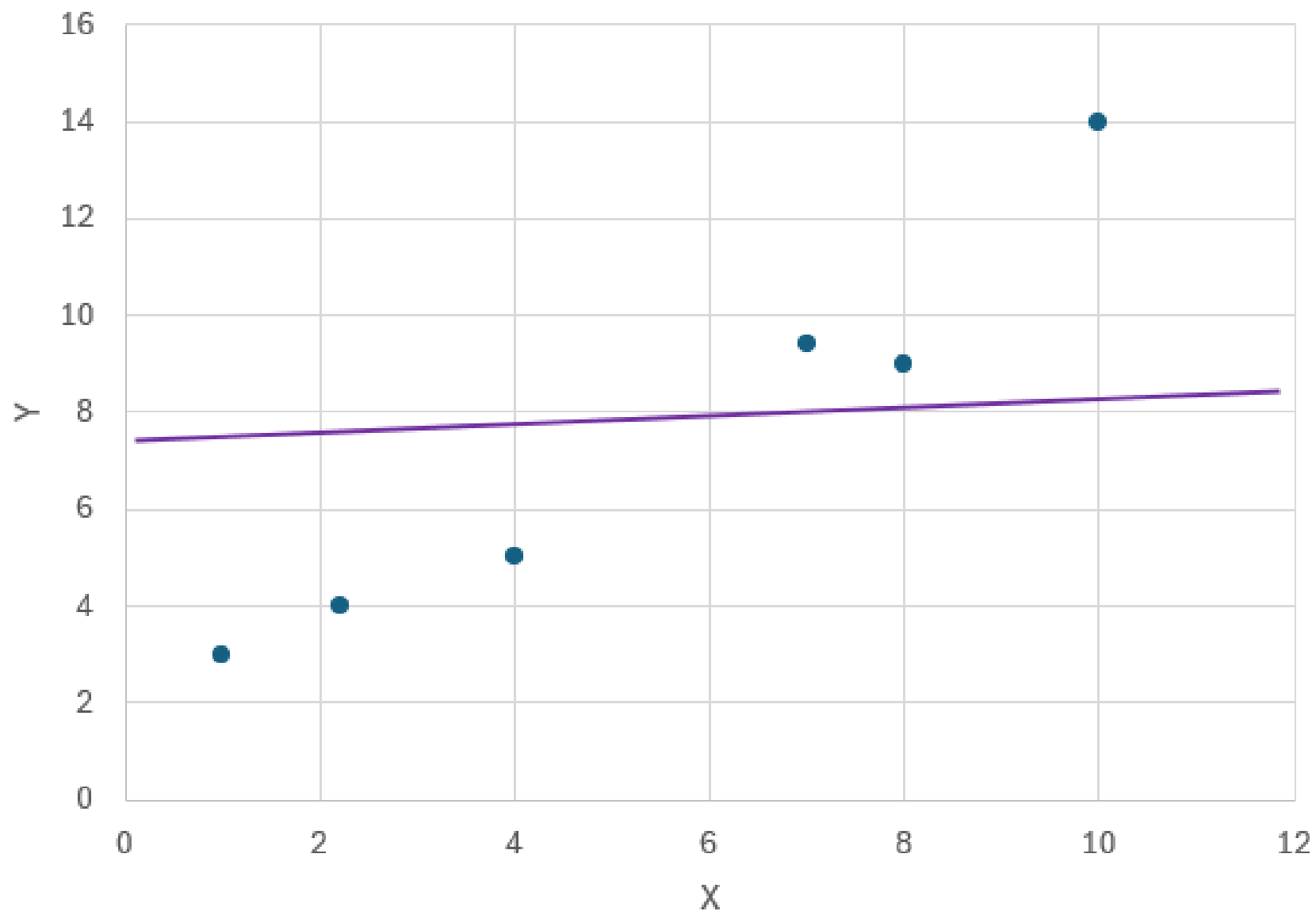


$$Y = a * X + b$$

a و b مقدار تصادفی می گیرند

مثلا اینجا:

$$a = 0.05, b = 7.7$$

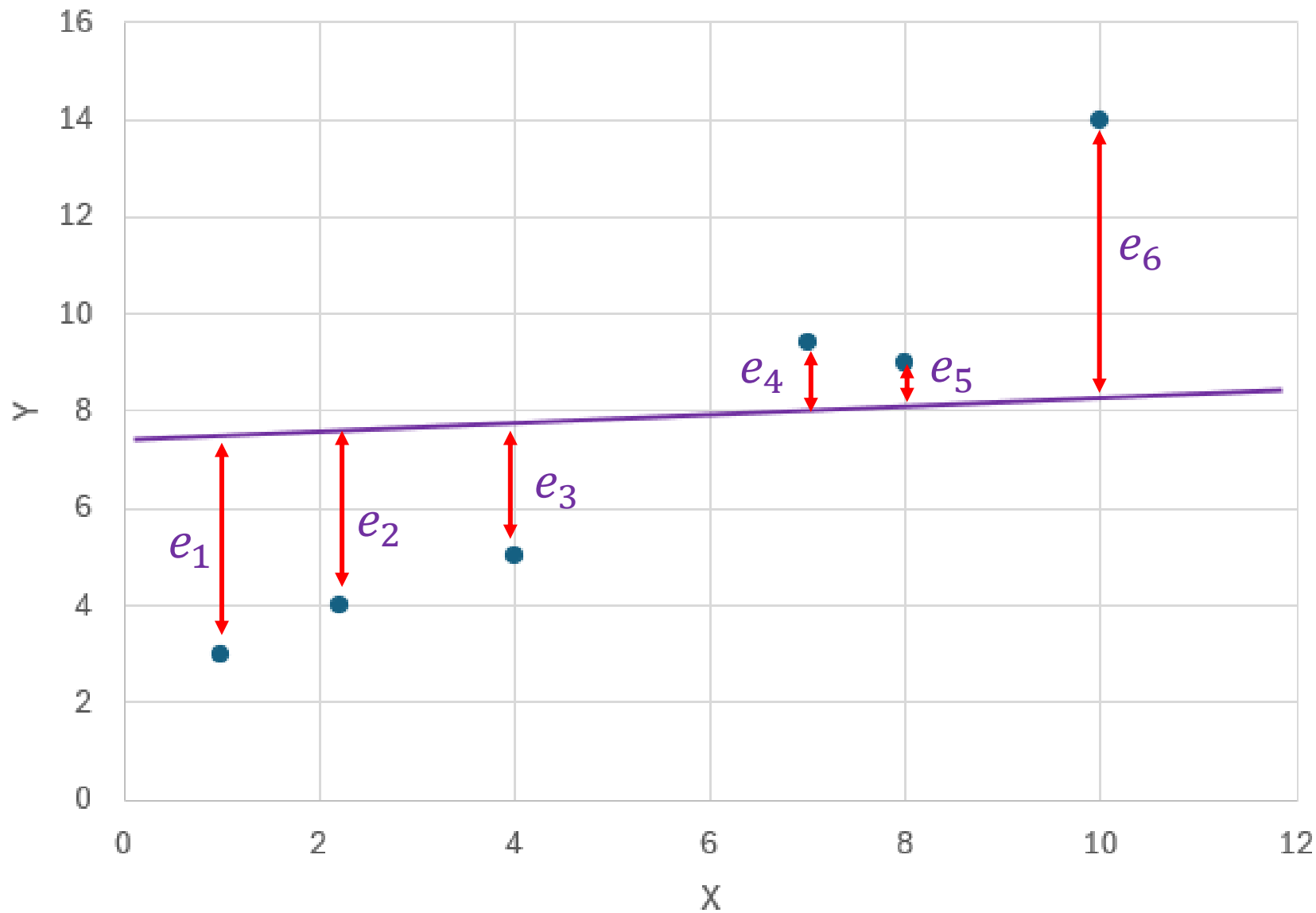


$$Y = a * X + b$$

$$a_1 = 0.05, b_1 = 7.7$$

از کجا بفهمد **چقدر اشتباه** است؟

چگونه اشتباهش را **تصحیح** کند؟

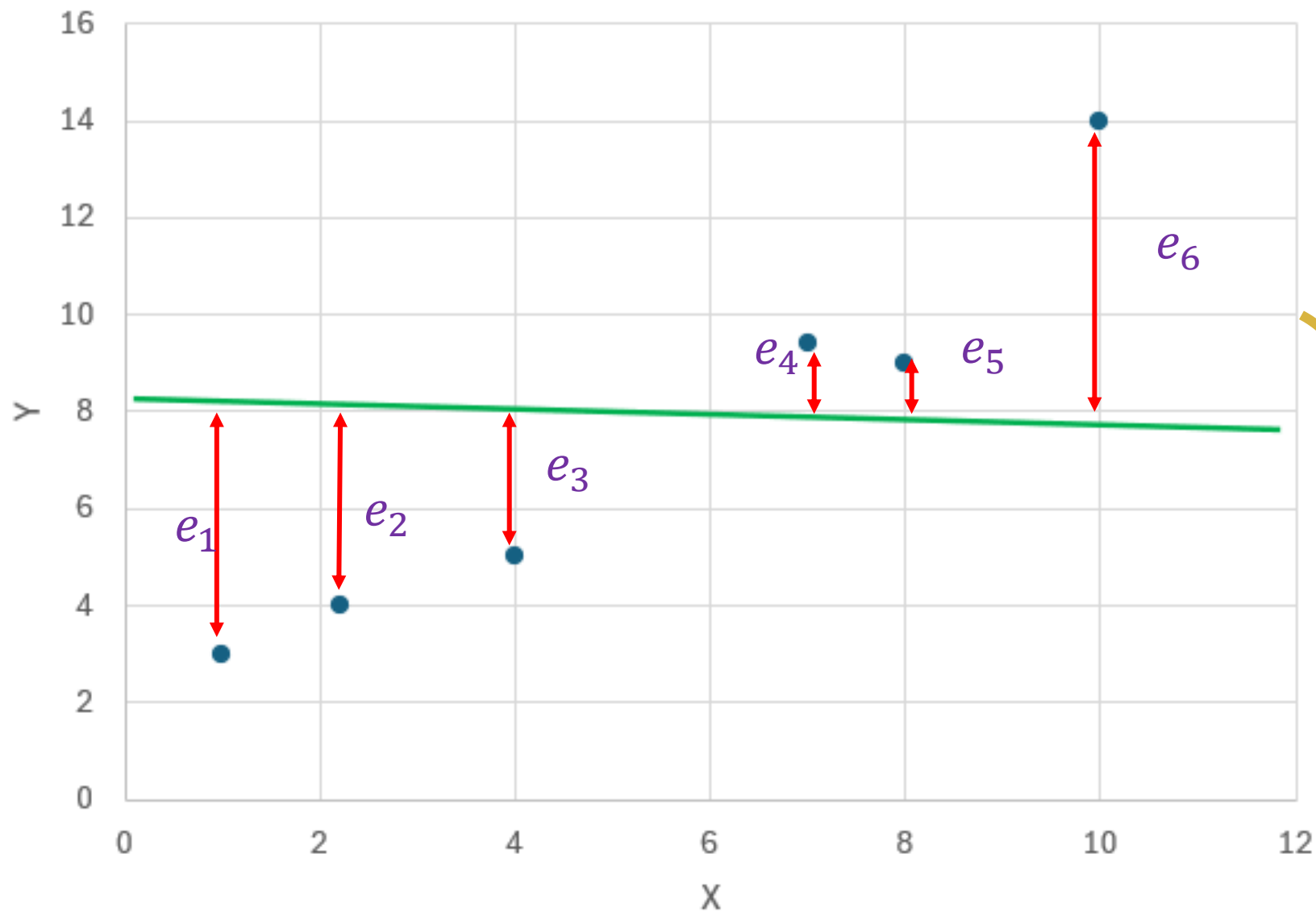


$$Y = a * X + b$$

$$a_1 = 0.05, b_1 = 7.7$$

از کجا بفهمد چقدر اشتباه است؟

$$Error = \sum (e_i)^2$$



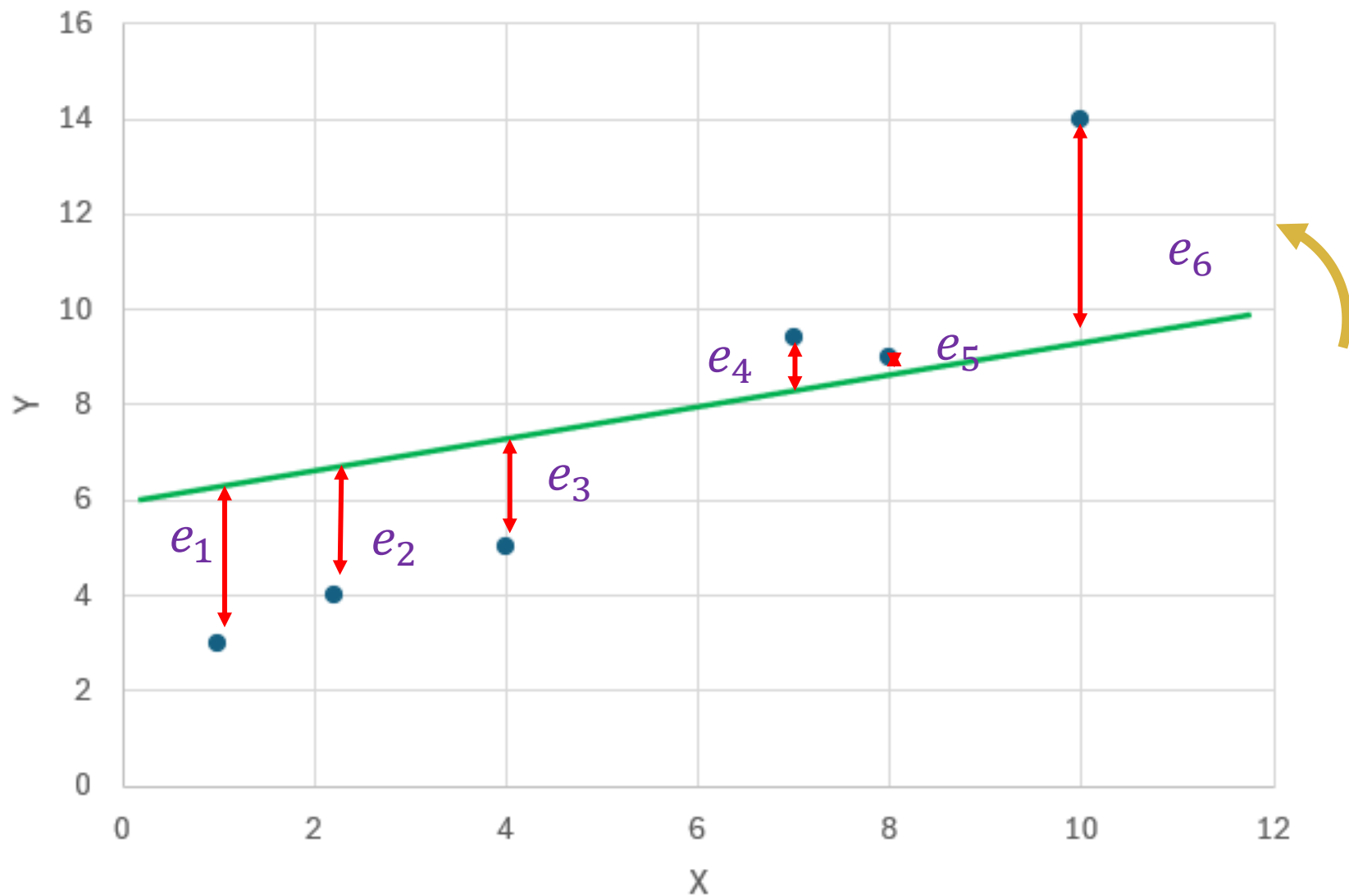
$$Y = a * X + b$$

$$(a_2, b_2)$$

مقادیر را در یک جهت تغییر دادیم

و خطا افزایش یافت

$$\uparrow Error = \sum (e_i)^2$$



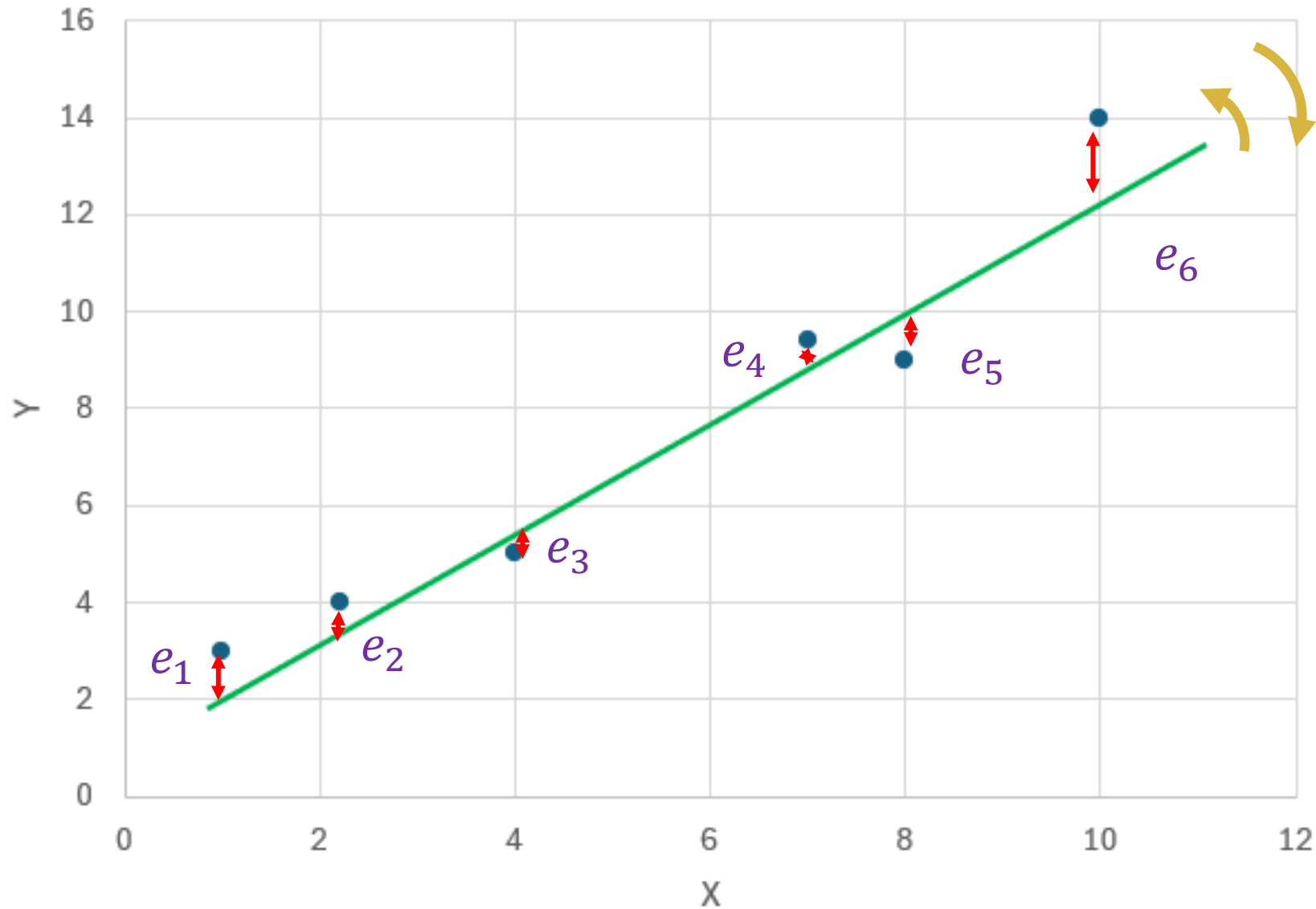
$$Y = a * X + b$$

$$(a_3, b_3)$$

مقادیر را در جهت دیگر تغییر

دادیم و خطا کاهش یافت

$$\downarrow \text{Error} = \sum (e_i)^2$$



$$Y = a * X + b$$

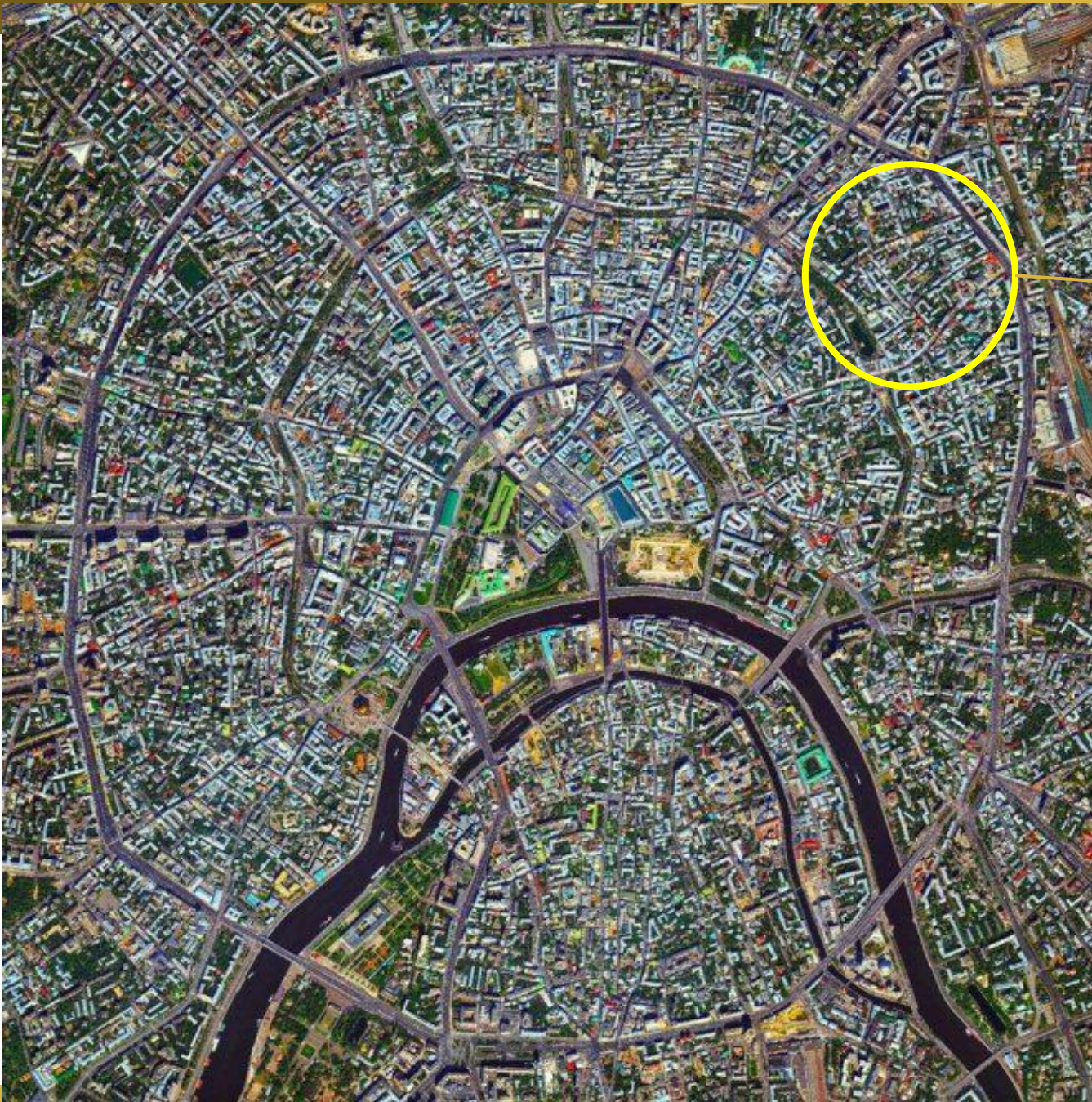
$$(a_n, b_n)$$

آنقدر تغییر کرد که به مقداری رسید

که هر تغییر دیگری، خطا را بیشتر

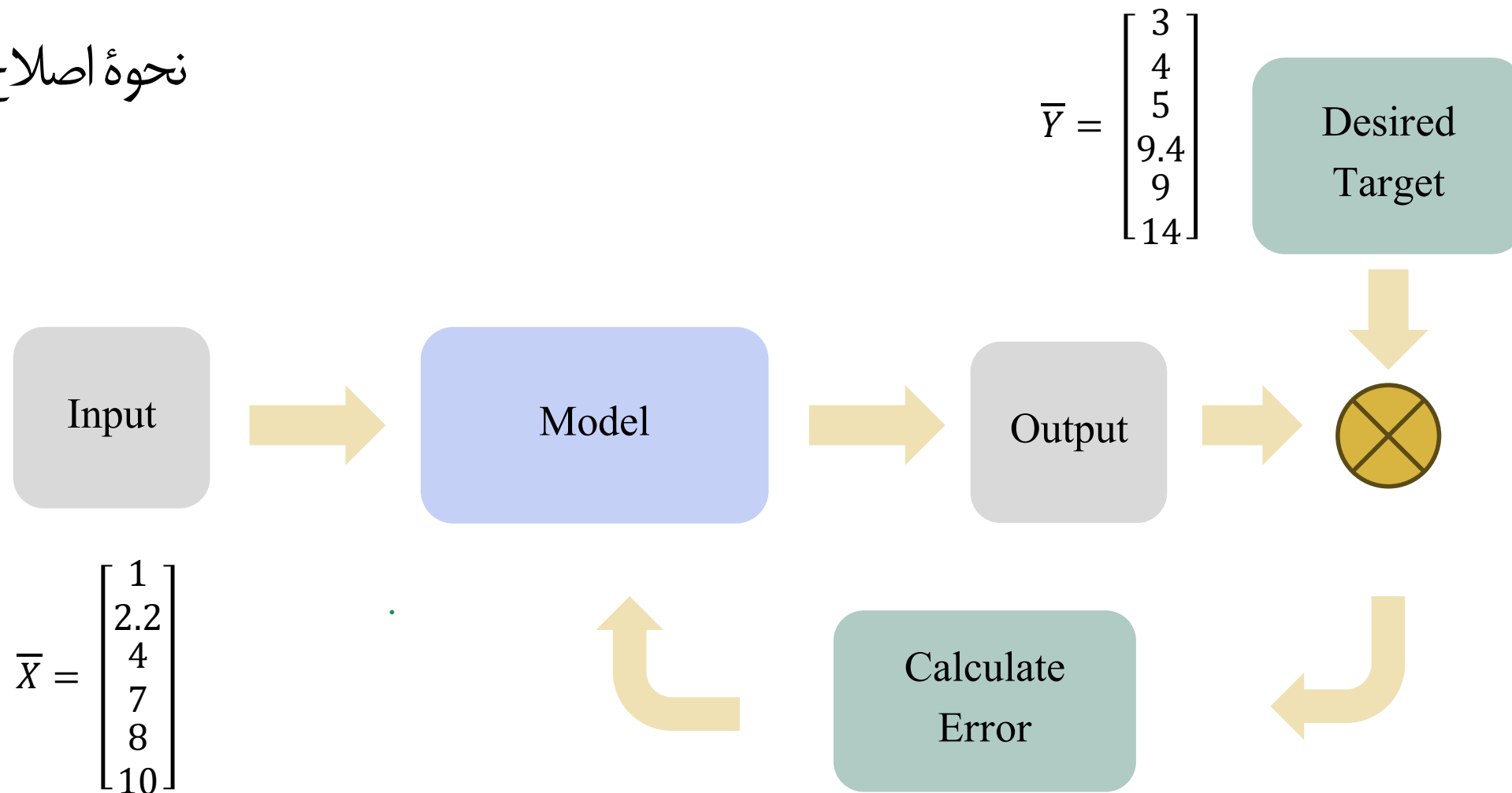
می کند

$$\min \left\{ \sum (e_i)^2 \right\}$$



فرض کنید کارشناس رسمی دادگستری هستید و ملکی
در محله مشخص شده را باید قیمت گذاری کنید.
چه معیارهایی بر قیمت گذاریتان تاثیر دارد؟

نحوه اصلاح

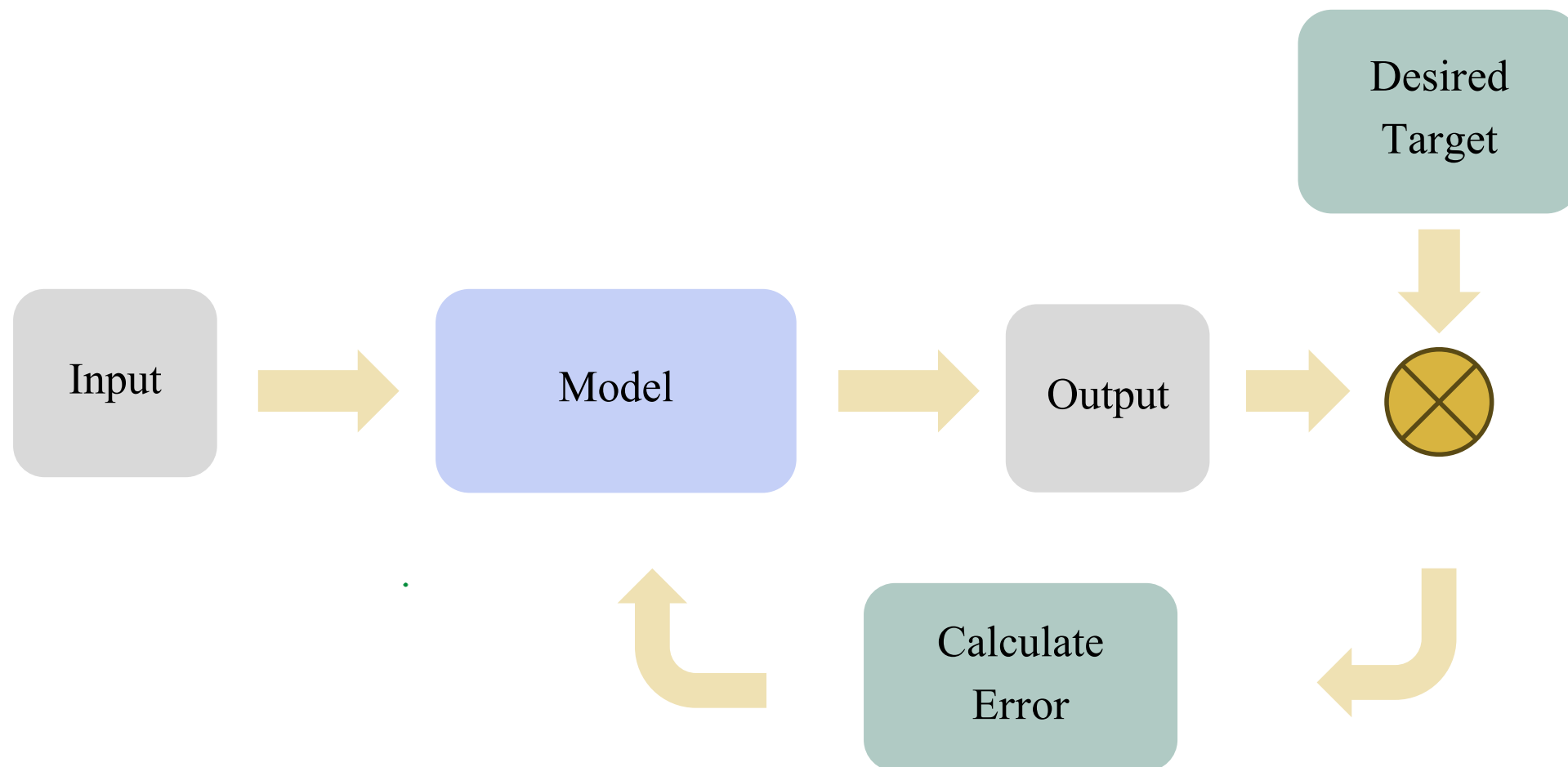


یادگیری با سرپرست
Supervised Learning

تابع هزینه
Cost Function

تعریف / انتخاب ویژگی
Feature Definition /
Selection

یادگیری با سرپرست (Supervised Learning)



صورت‌بندی فنی تر روش رگرسیون خطی

Hypothesis

$$h_{\theta}(x) = \theta_0 + \theta_1 x$$

Parameters

$$\theta_0, \theta_1$$

Cost Function

$$J(\theta_0, \theta_1) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)})^2$$

m: تعداد کل نمونه‌های آموزشی

Goal

$$\underset{\theta_0, \theta_1}{\text{minimize}} \quad J(\theta_0, \theta_1)$$

Hypothesis

$$h_{\theta}(x) = \theta_1 x$$

Parameter

$$\theta_1$$

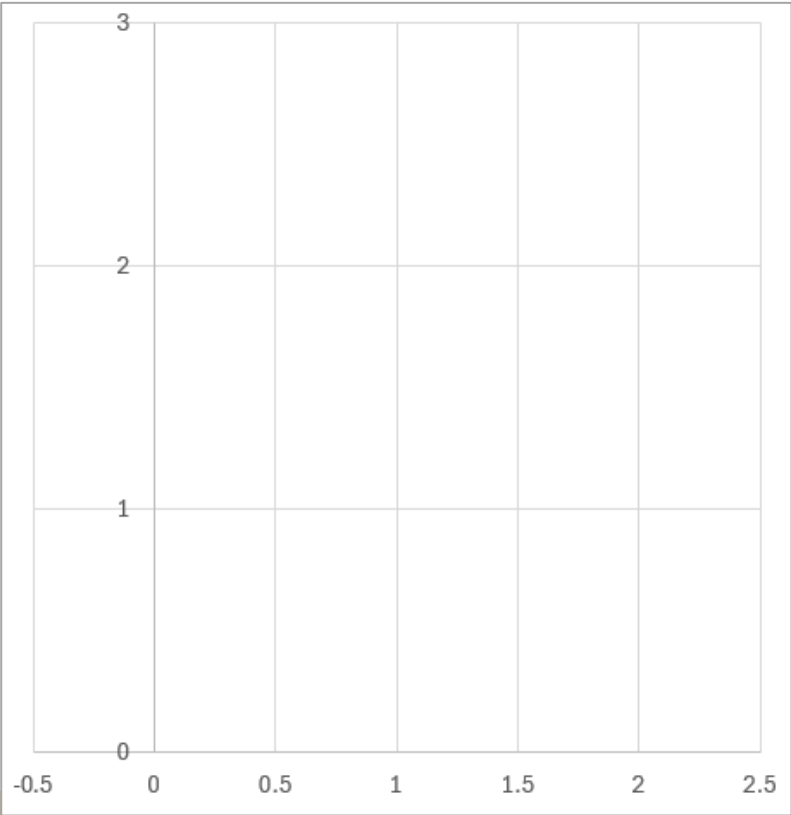
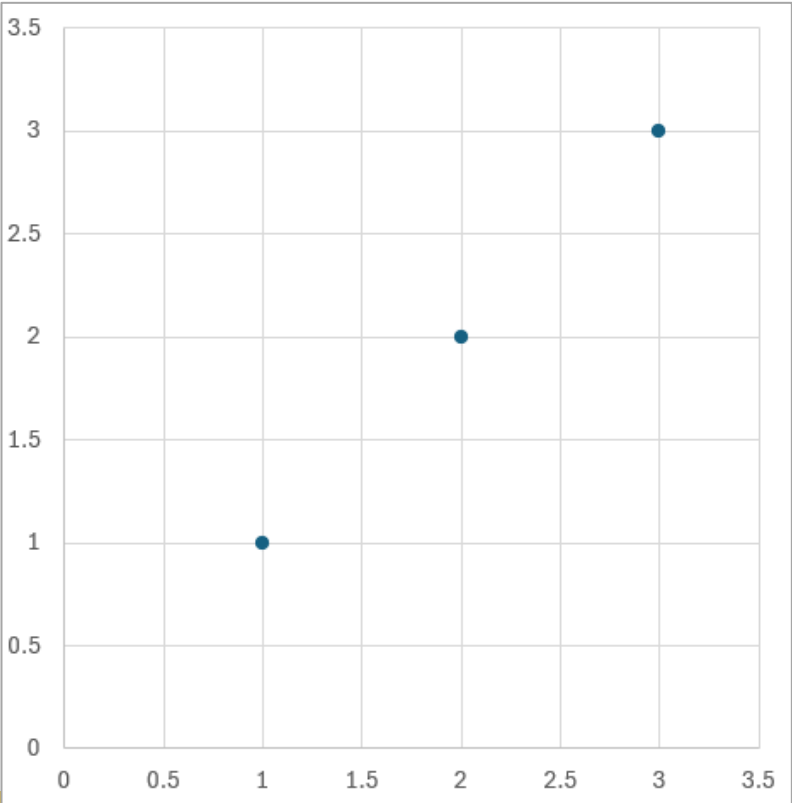
Cost Function

$$J(\theta_1) = \frac{1}{2m} \sum_{i=1}^m (h_{\theta}(x^{(i)}) - y^{(i)})^2$$

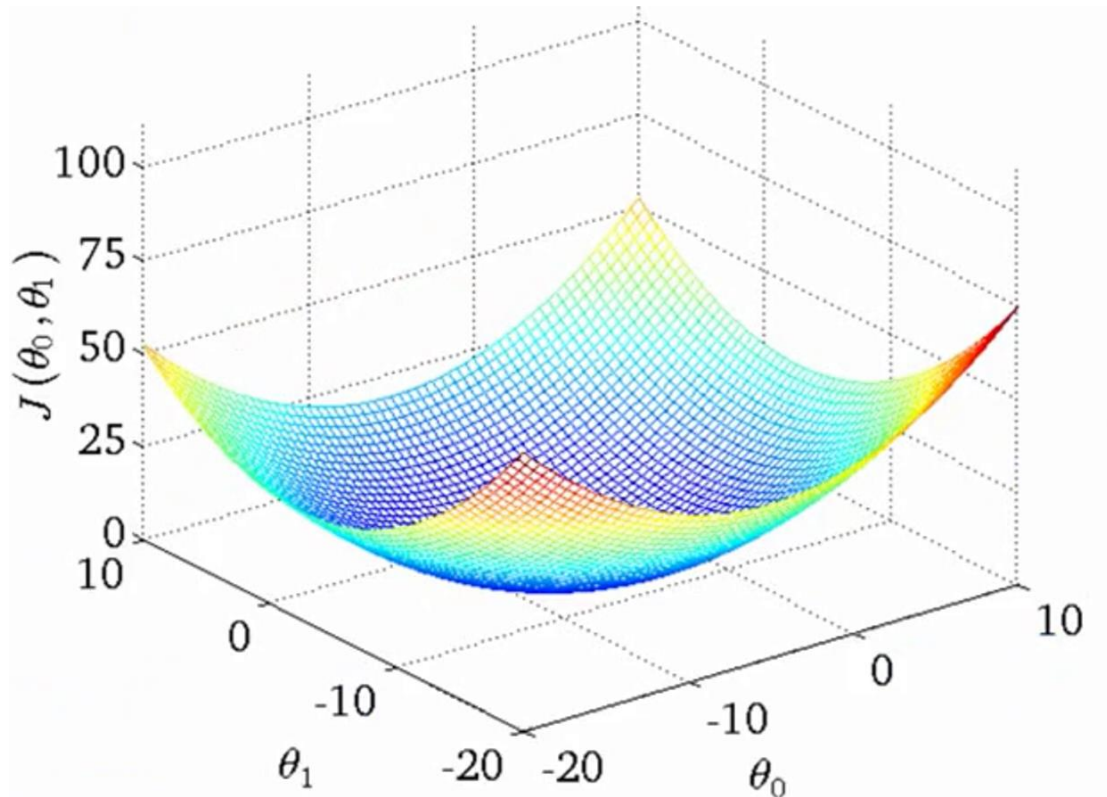
Goal

$$\underset{\theta_1}{\text{minimize}} \quad J(\theta_1)$$

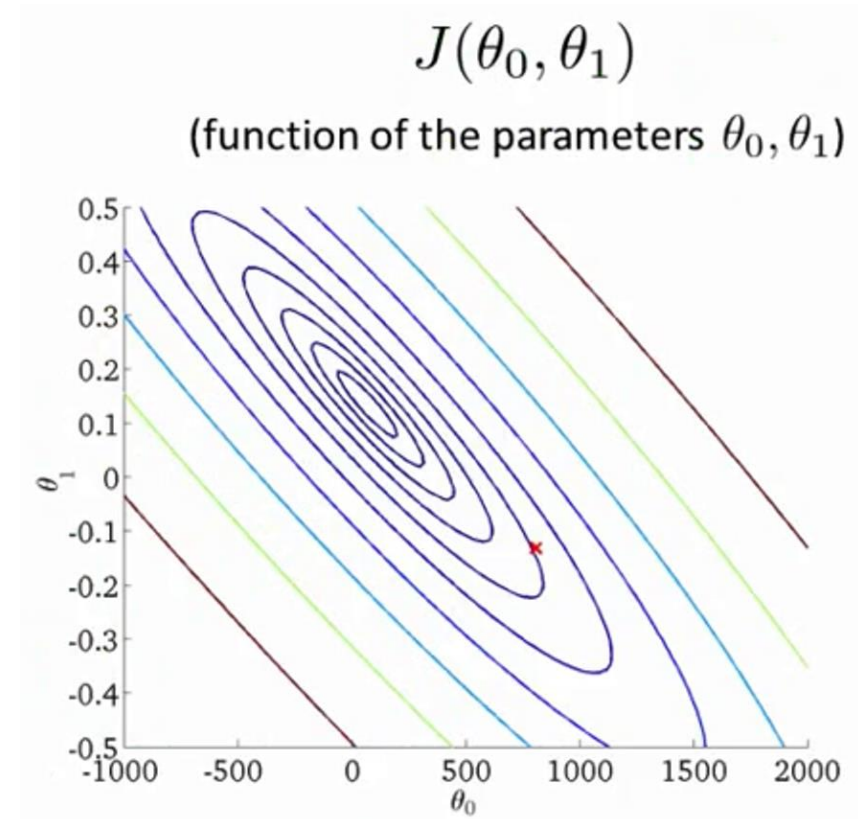
حالت ساده شده



تابع هزینه - حالت ۲ پارامتره



Convex Function
Bowl-shaped

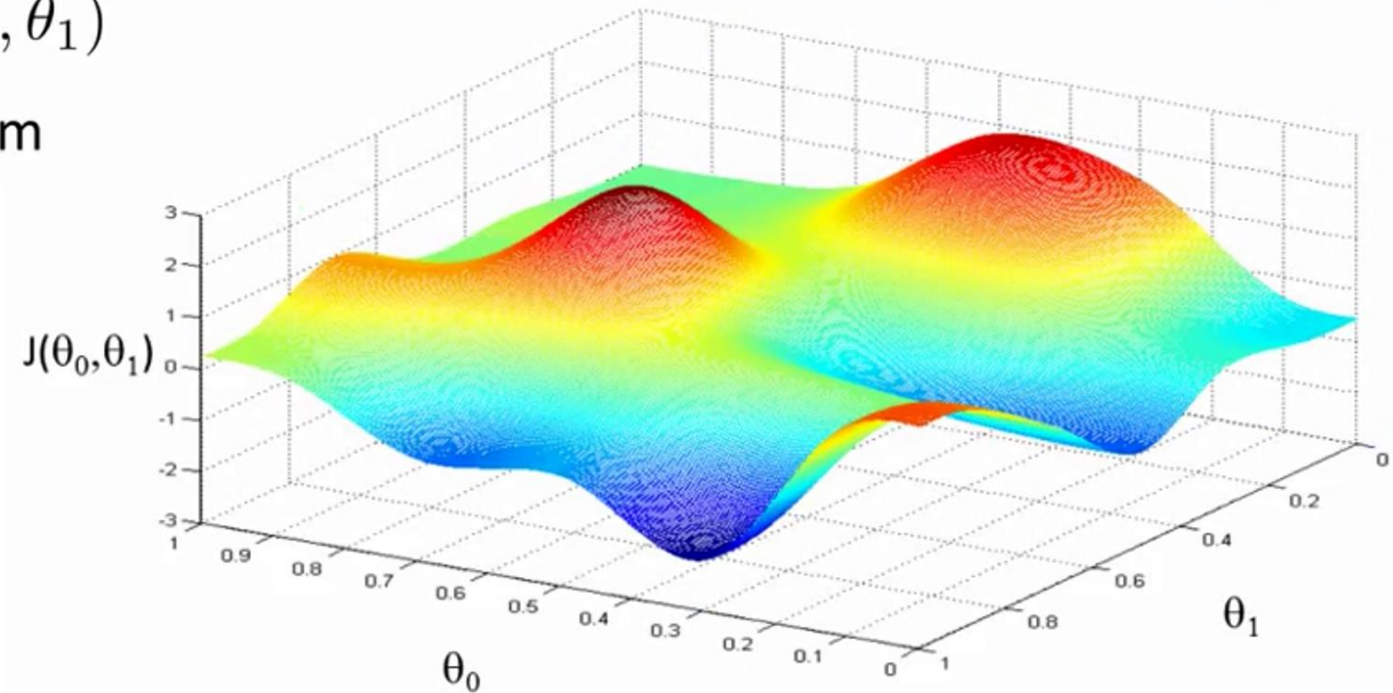


Have some function $J(\theta_0, \theta_1)$

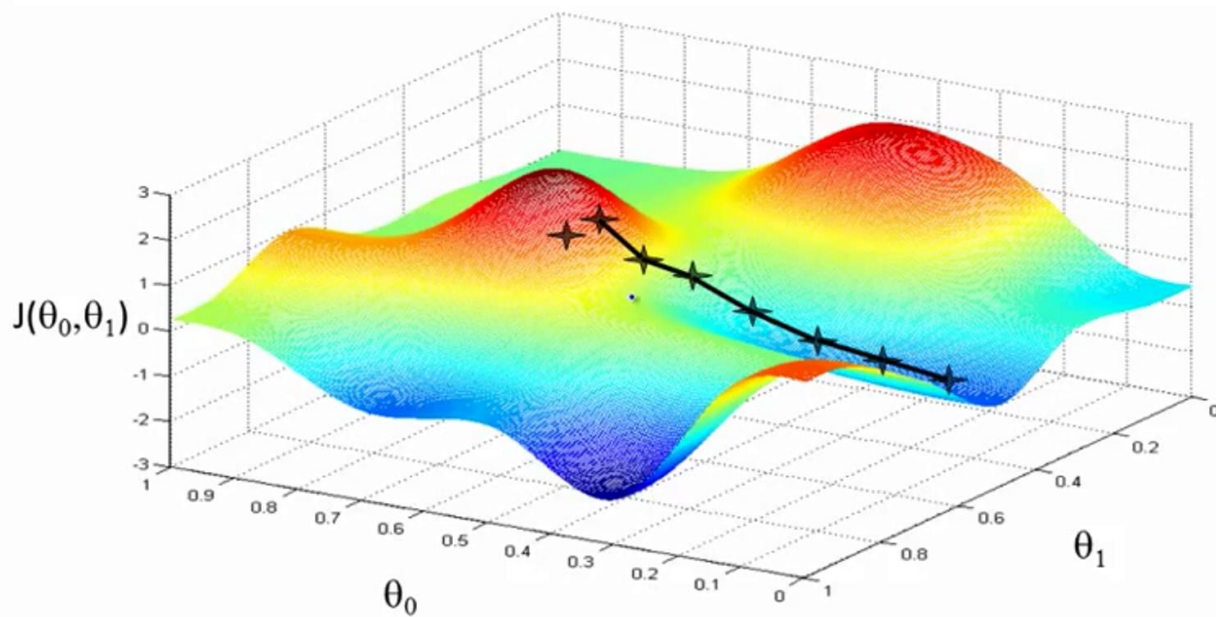
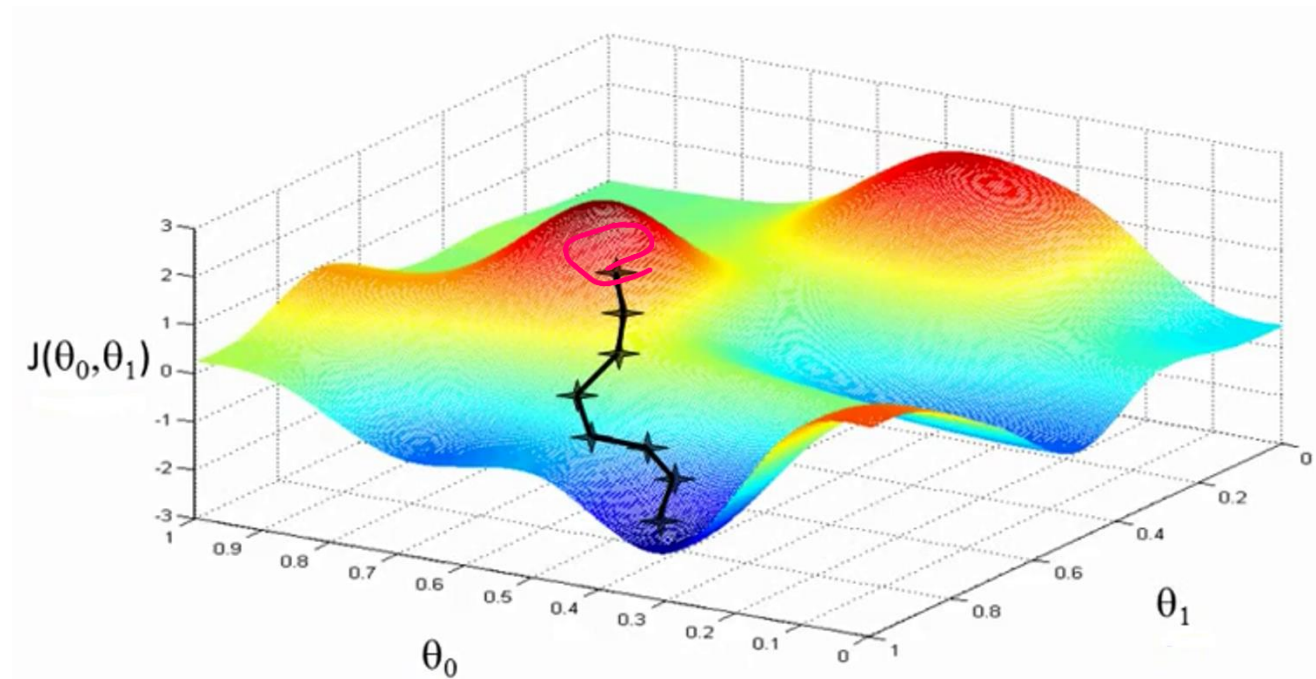
Want $\min_{\theta_0, \theta_1} J(\theta_0, \theta_1)$

Outline:

- Start with some θ_0, θ_1
- Keep changing θ_0, θ_1 to reduce $J(\theta_0, \theta_1)$ until we hopefully end up at a minimum

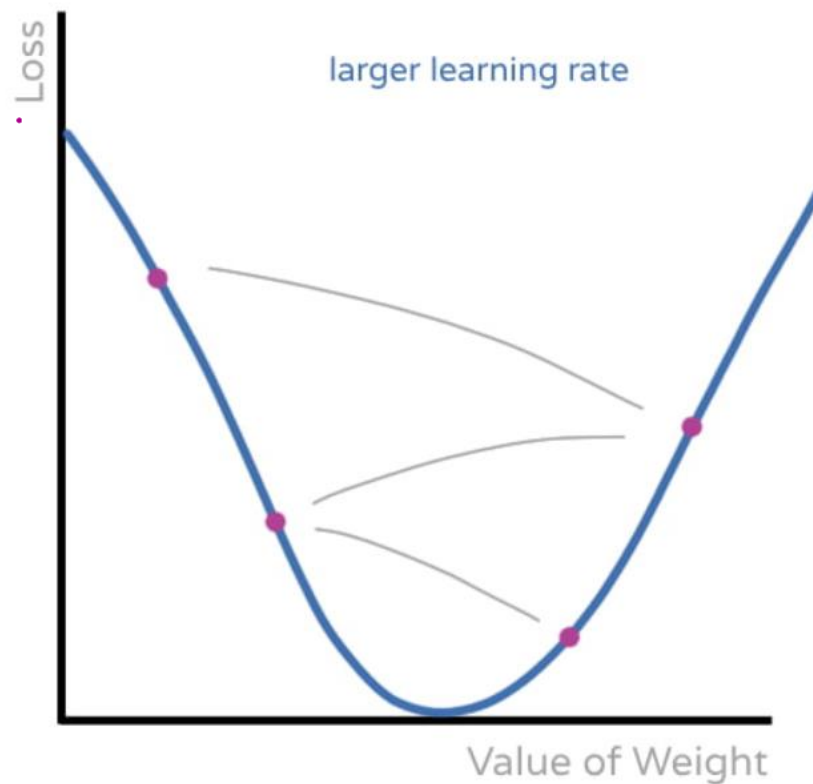
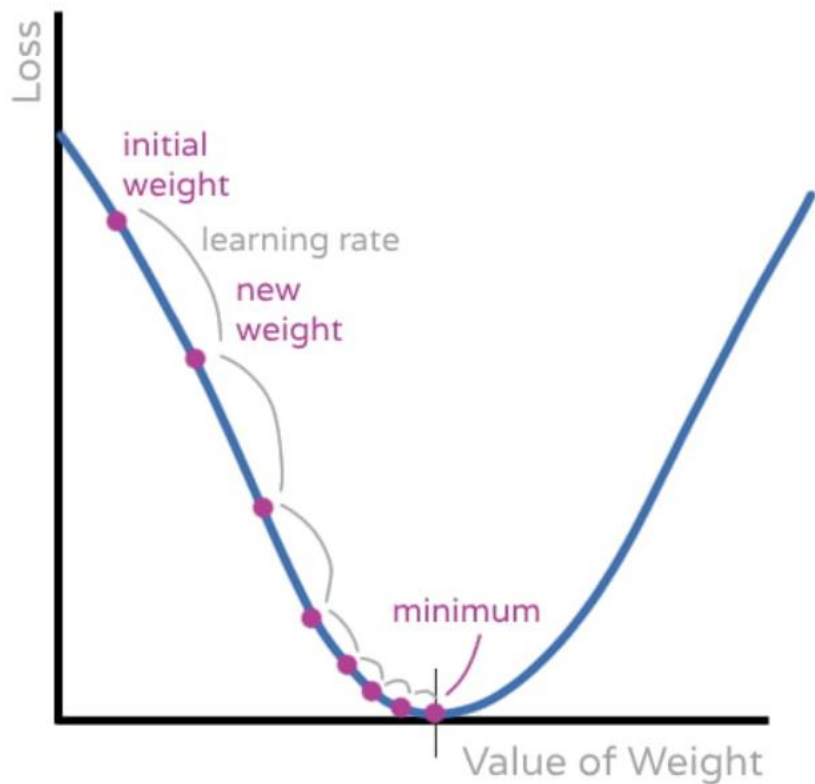


دو نتیجه متفاوت گرادینان نزولی



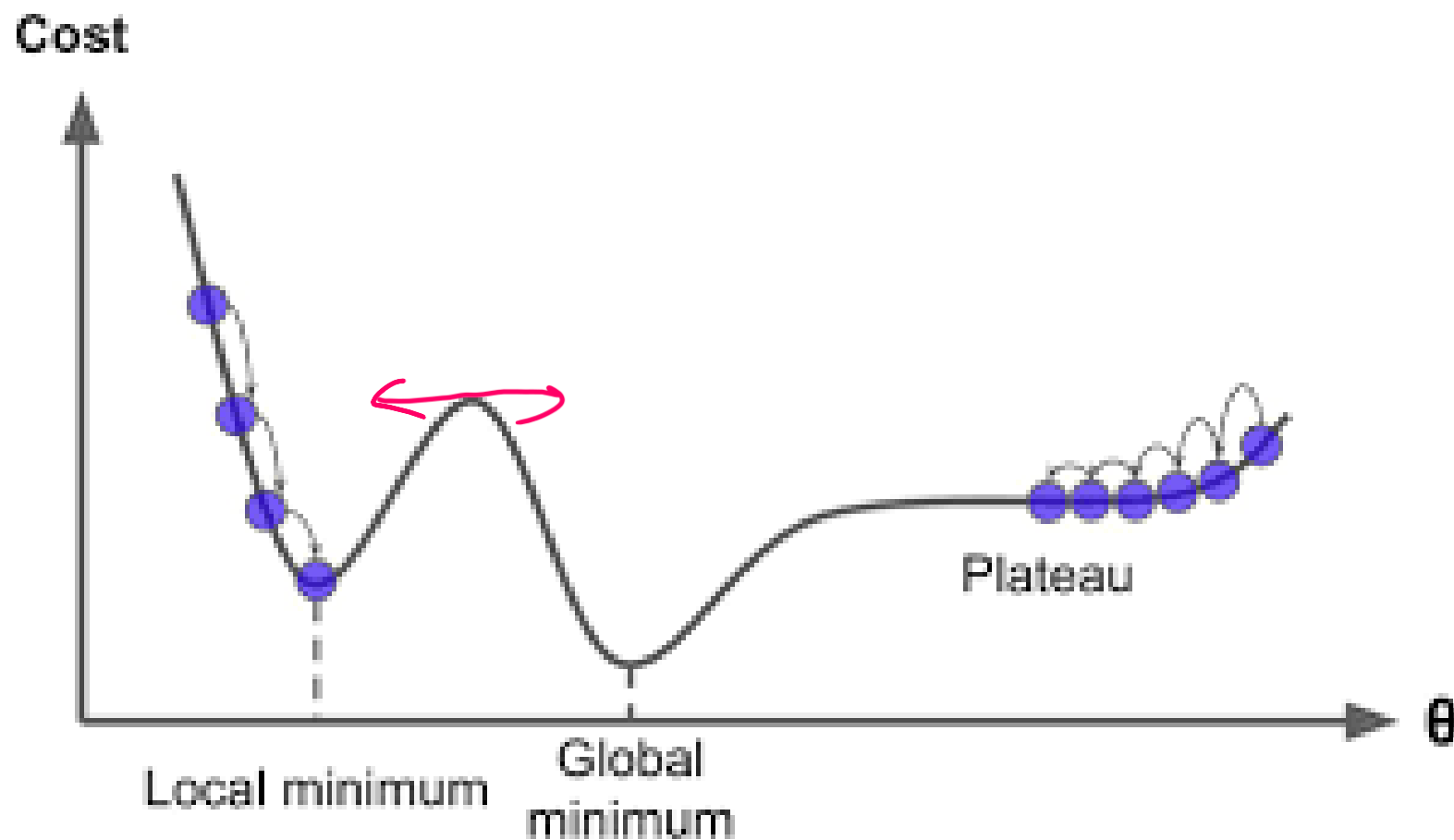
چه کنیم؟

گرادیان نزولی - ضریب بزرگی و کوچکی گام‌ها



نقاط قوت و ضعف
هر کدام کدام است؟

نقطه کمینه را چگونه پیدا کنیم؟



بهینه‌سازی
(Optimization)

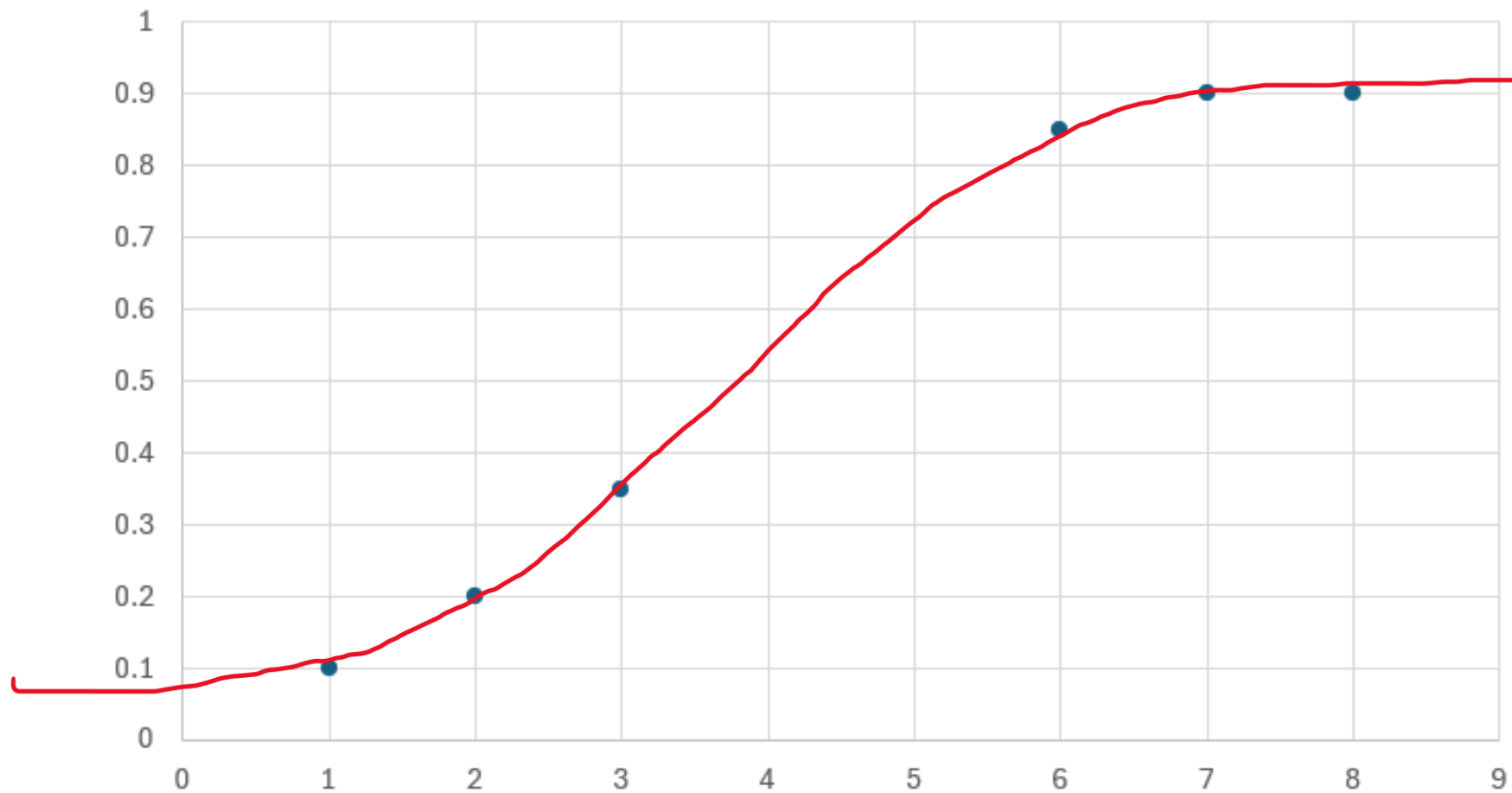
الگوریتم گرادیان نزولی

repeat until convergence {
 $\theta_j := \theta_j - \alpha \frac{\partial}{\partial \theta_j} J(\theta_0, \theta_1)$
}

آلفا: نرخ یادگیری
(learning rate)



رگرسیون لجستیک (Logistic Regression)



الگوریتم‌های
بهینه‌سازی

روش‌های قطعی

جست‌وجوی
تصادفی

برنامه‌ریزی خطی و
غیرخطی

برمبنای گرادیان

...

روش‌های اکتشافی

روش‌های
فرااکتشافی

یادگیری ماشینی (Machine Learning)

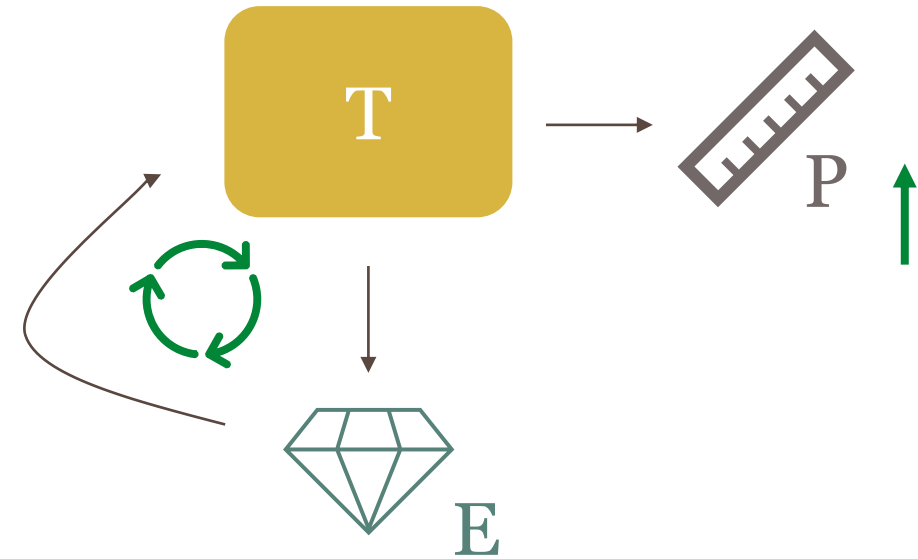
حوزه مطالعاتی ای که به کامپیوتر توانایی یاد گرفتن می دهد، بی آنکه **صراحتاً** این دانش در آن ها برنامه نویسی شده باشد

آرتور ساموئل (۱۹۵۹)

Field of study that gives computers the **ability to learn without explicitly programmed**

Arthur Samuel (1959)

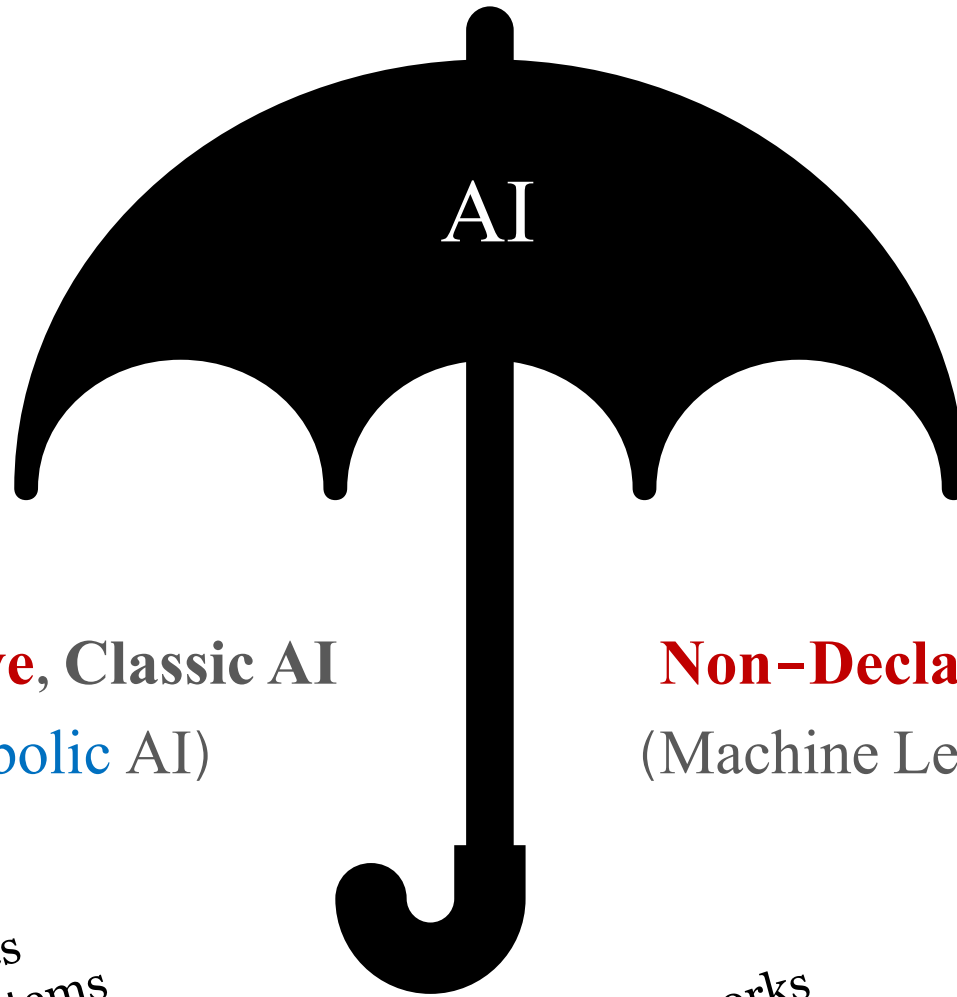
Well-posed Learning Problem



A computer program is said to

learn from **experience** E with respect to some **task** T and some performance **measure** P ,
if its **performance** on T , as measured by P , *improves* with experience E .

Tom Mitchell (1998)



Declarative, Classic AI
(Symbolic AI)

Non-Declarative
(Machine Learning)

Expert Systems
Business Rules
Management Systems

Neural Networks
Bayesian Networks
Decision Tree Learning
Support Vector Machines

۳. شناسایی (آماري) الگو

این ۲ چه هستند؟



س.

از کجا متوجه شدیم با هم فرق دارند؟

س.

برچه اساسی آن‌ها را طبقه‌بندی کردیم؟

Classification

طبقه‌بندی:

اختصاص برچسب به اشیا و اجزای ناشناخته در داده‌های ورودی

الگو (Pattern)

تشخیص چهره

