# Integration Business Intelligence and Artificial Intelligence

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# What is Business Intelligence(BI)?

Multidimensional Analyses and Rich Visualization

Definition: Set of tools and processes to collect, analyze, and visualize data for decision-making

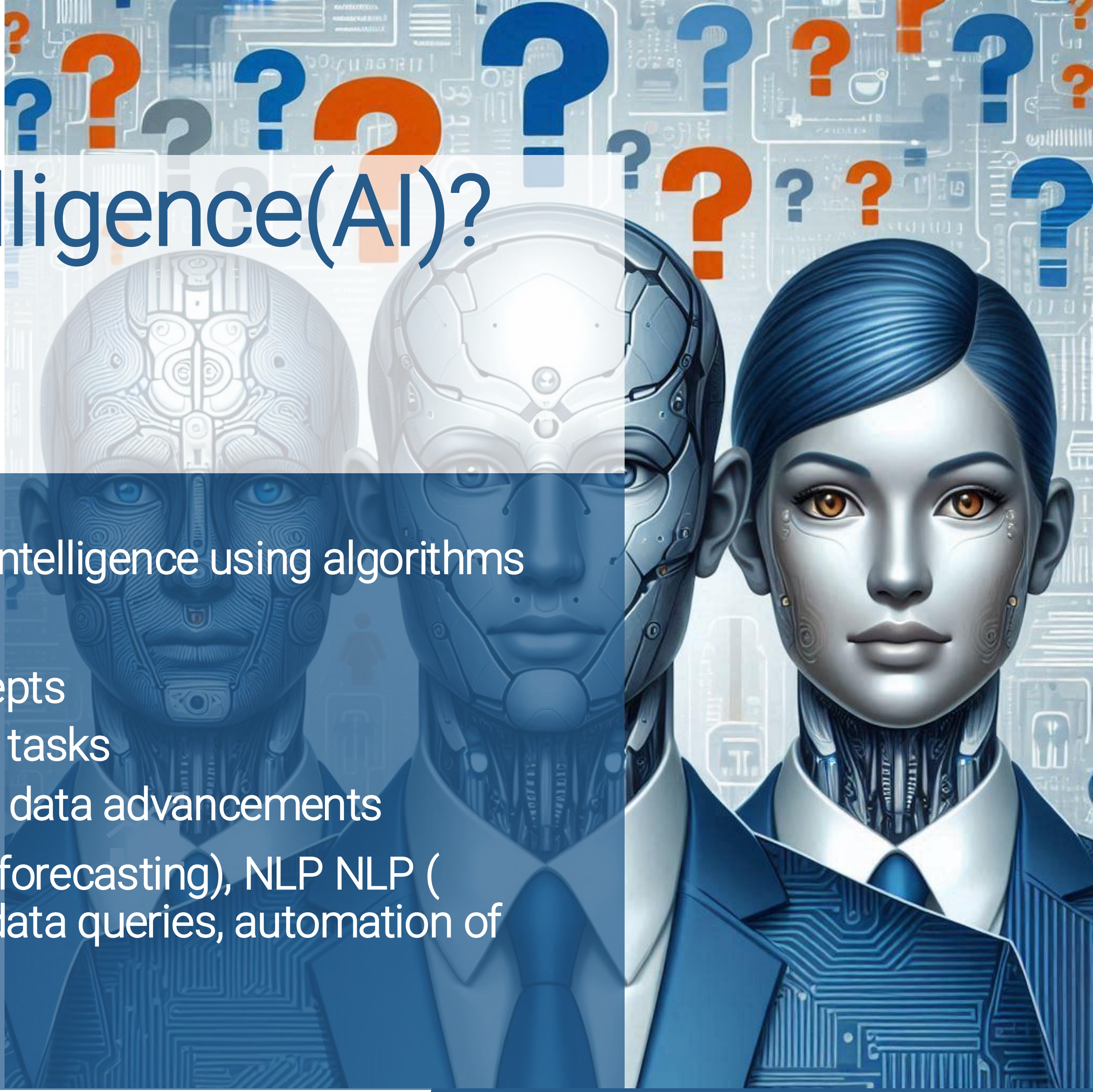
History:

- 1960s: Early decision support systems
- 1990s: Data warehousing and OLAP
- 2000s-Present: BI, cloud-based BI

Usage: Reporting (e.g., multidimensional statistical indicator), dashboards (e.g., population indicators), data-driven policy planning

# What is Artificial Intelligence(AI)?

A computer like a very smart human



Definition: Technology that mimics human intelligence using algorithms

History:

- 1950s: Turing Test and early AI concepts
- 1980s: Expert systems for rule-based tasks
- 2010s-Present: Deep learning and big data advancements

Usage: Predictive modeling (e.g., economic forecasting), NLP NLP ( Natural Language Processing) for data queries, automation of statistical tasks

# Using BI in Statistics

Highly effective platform for statistical production

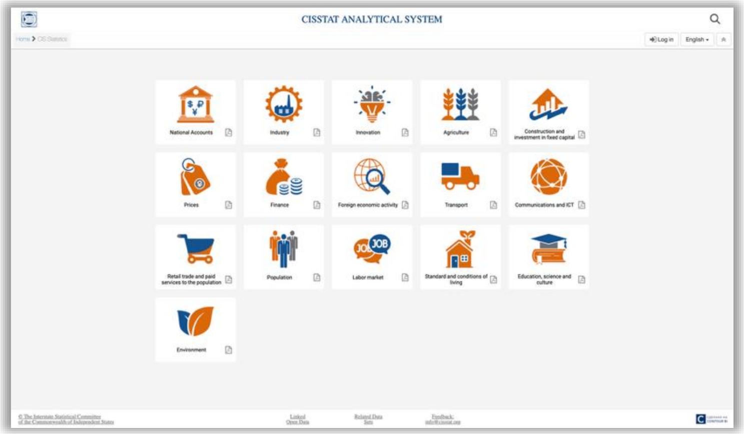
- □ Data collection and storing
- □ Data validation and harmonization
- □ Publication and dissemination
- □ Multidimensional analysis and rich visualization

# Using BI in CISStat

Huge International statistical hub

- ❑ Connectors with dozens of international data sources
- ❑ BIG Data Warehouse
- ❑ Multilingual Statistical Portal
- ❑ Hundreds of multidimensional dashboards
- ❑ Open Data Catalog

# BI based Analytical System of CISStat


CISSTAT ANALYTICAL SYSTEM
Log in
English
National Accounts
Industry
Innovation
Agriculture
Construction and investment in fixed capital
Prices
Finance
Foreign economic activity
Transport
Communications and ICT
Retail trade and paid services to the population
Population
Labor market
Standard and conditions of living
Education, science and culture
Environment
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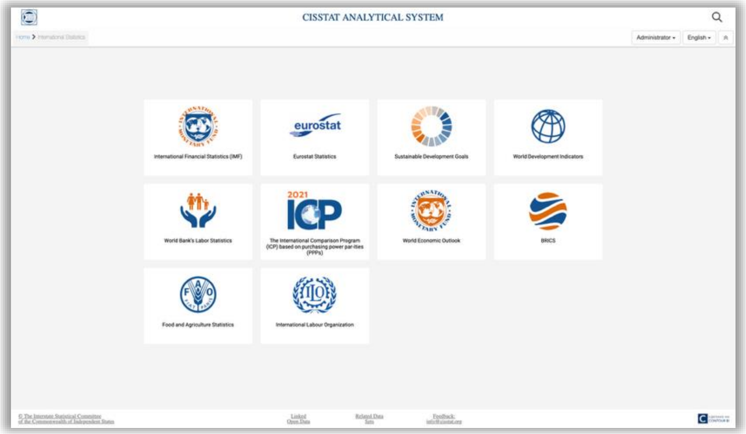
Linked Open Data
Related Data Sets
Feedback: info@cisstat.org


CISSTAT ANALYTICAL SYSTEM
Administrator
English
International Financial Statistics (IMF)
Eurostat Statistics
Sustainable Development Goals
World Development Indicators
World Bank's Labor Statistics
The International Comparison Program (ICP) based on purchasing power par-ities (PPPs)
World Economic Outlook
BRICS
Food and Agriculture Statistics
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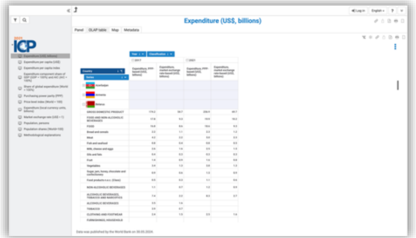
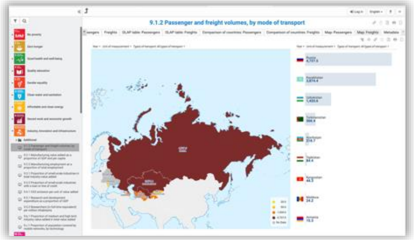
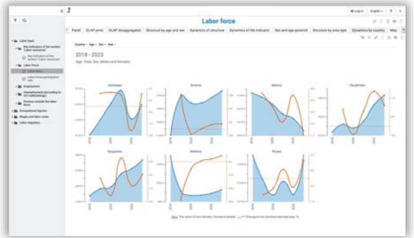
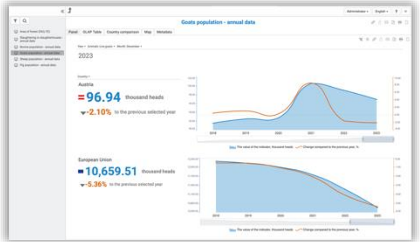
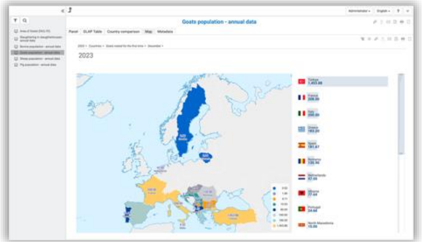


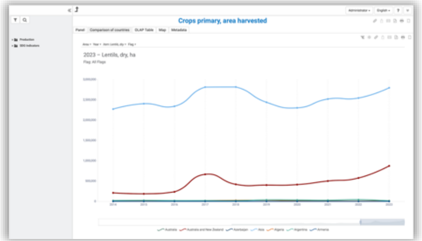


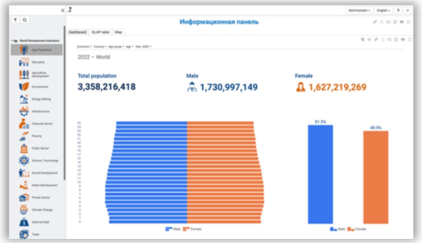


Валовой внутренний продукт, текущие цены, в национальной валюте


Goats population - annual data
2023
Austria
96.94 thousand heads
-2.10% to the previous selected year
European Union
10,659.51 thousand heads
-5.36% to the previous selected year







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# BI + AI = BI-AI

## BI

- Data Warehouse
- OLAP
- Visualization

## AI

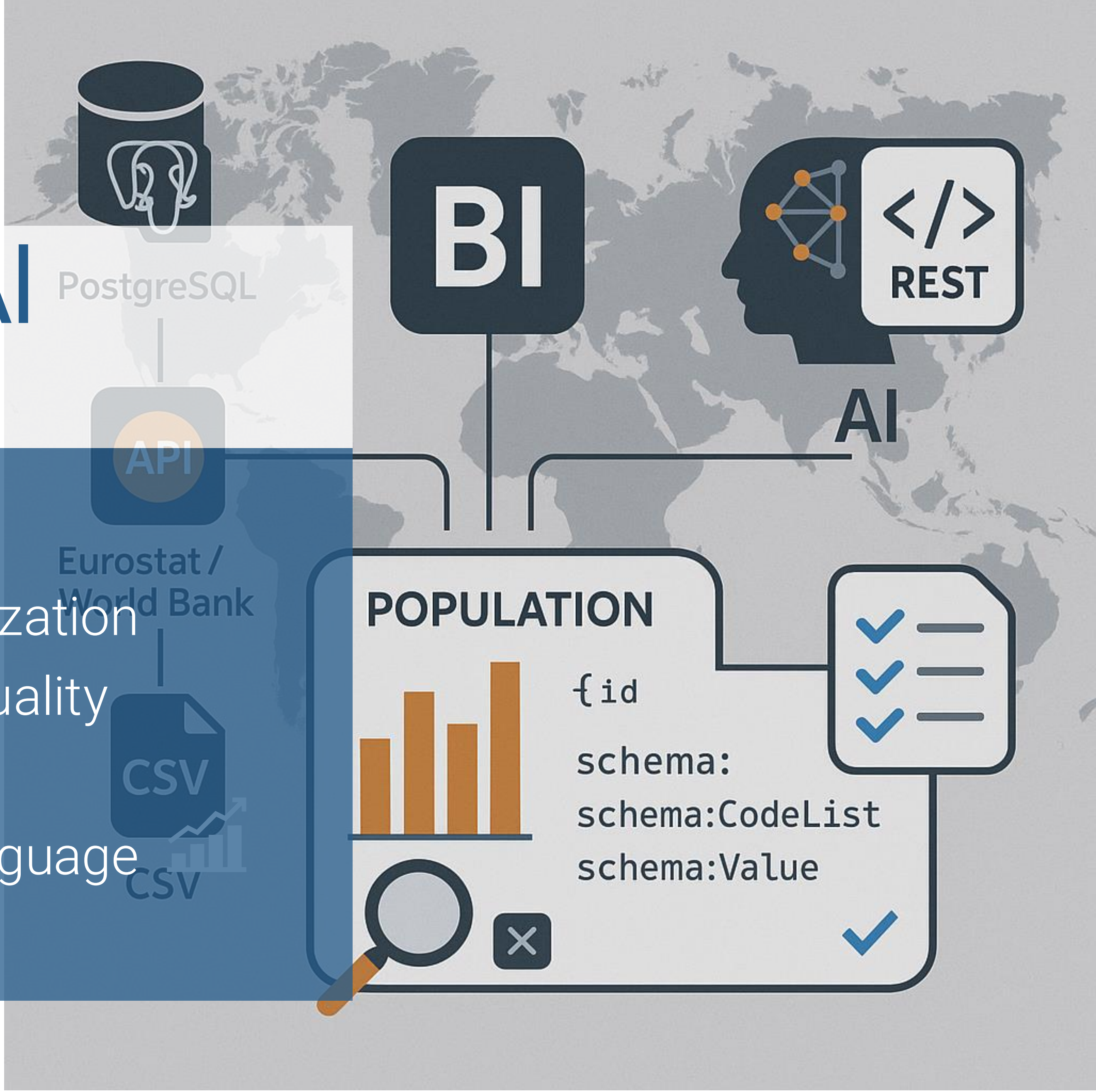
- NLP
- Model
- Text and voice query

## BI-AI

- Something totally new

# Applications of BI-AI

- □ Connecting to data sources
- □ Metadata extraction and harmonization
- □ Information modeling and data quality
- □ Generation of visualizations
- □ Advanced AI features: Natural language queries, interpretations



# Generating Connectors to Data Sources

Develop connectors to various statistical sources:

❑ Analysis data source API, documentations and formats

❑ Support SDMX, APIs, SQL, CSV, and web scraping

❑ Obtain and understand structure definitions

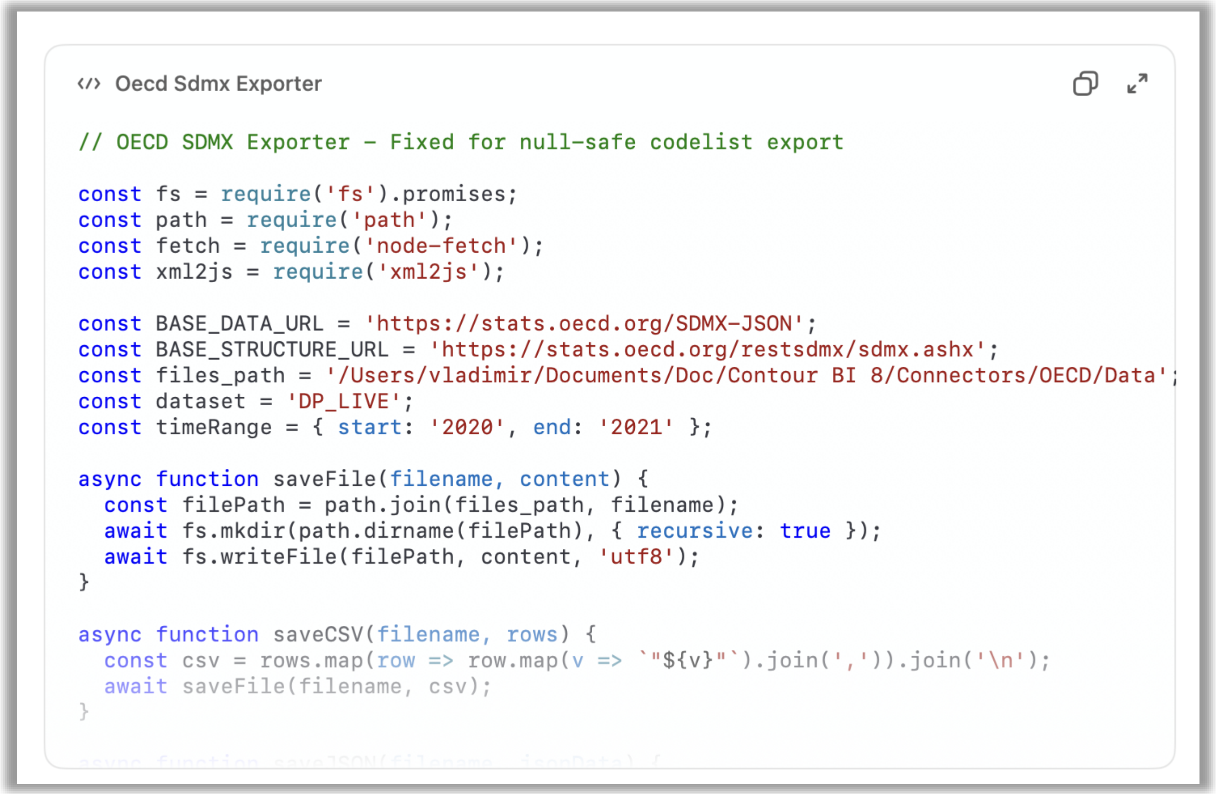
❑ Expand Data Warehouse model

❑ Import metadata and data into Data Warehouse initially and regularly

# Example: Connector for OECD database

Connector developed by AI

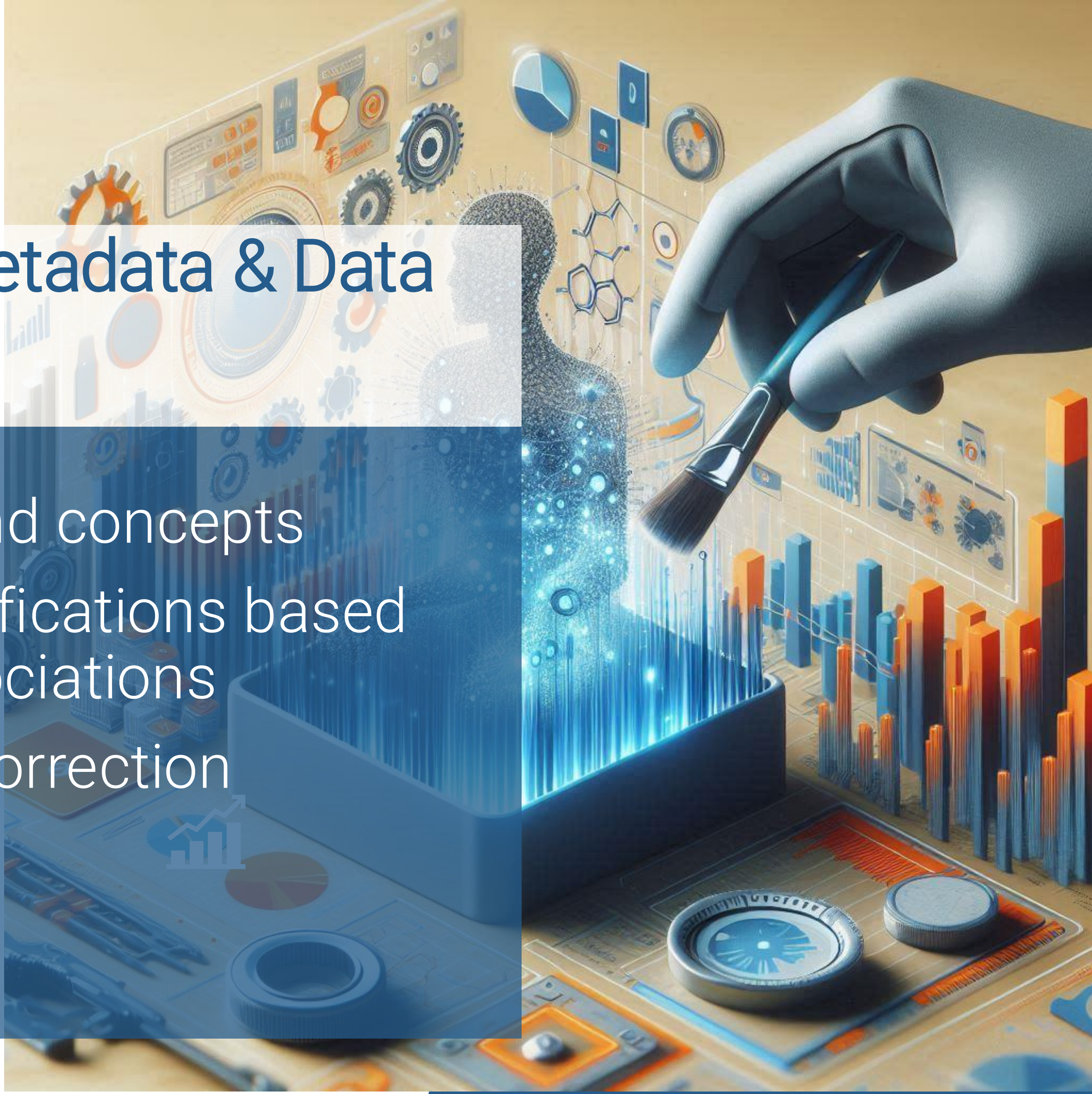
- Language: JavaScript
- Method: iterative series of prompts



```javascript
// OECD SDMX Exporter – Fixed for null-safe codelist export

const fs = require('fs').promises;
const path = require('path');
const fetch = require('node-fetch');
const xml2js = require('xml2js');

const BASE_DATA_URL = 'https://stats.oecd.org/SDMX-JSON';
const BASE_STRUCTURE_URL = 'https://stats.oecd.org/restsdmx/sdmx.ashx';
const files_path = '/Users/vladimir/Documents/Doc/Contour BI 8/Connectors/OECD/Data';
const dataset = 'DP_LIVE';
const timeRange = { start: '2020', end: '2021' };

async function saveFile(filename, content) {
  const filePath = path.join(files_path, filename);
  await fs.mkdir(path.dirname(filePath), { recursive: true });
  await fs.writeFile(filePath, content, 'utf8');
}

async function saveCSV(filename, rows) {
  const csv = rows.map(row => row.map(v => `"${v}"`).join(',')).join('\n');
  await saveFile(filename, csv);
}

async function saveJSON(filename, jsonData) {
```

# Harmonize And Validation Metadata & Data

- □ Standardize terminology and concepts
- □ Map local and global classifications based on transition keys and associations
- □ Apply error detection and correction



# AI vs a programmer

## Programmer

- **2 days per a version**
- **Increasing code complexity slows down development**

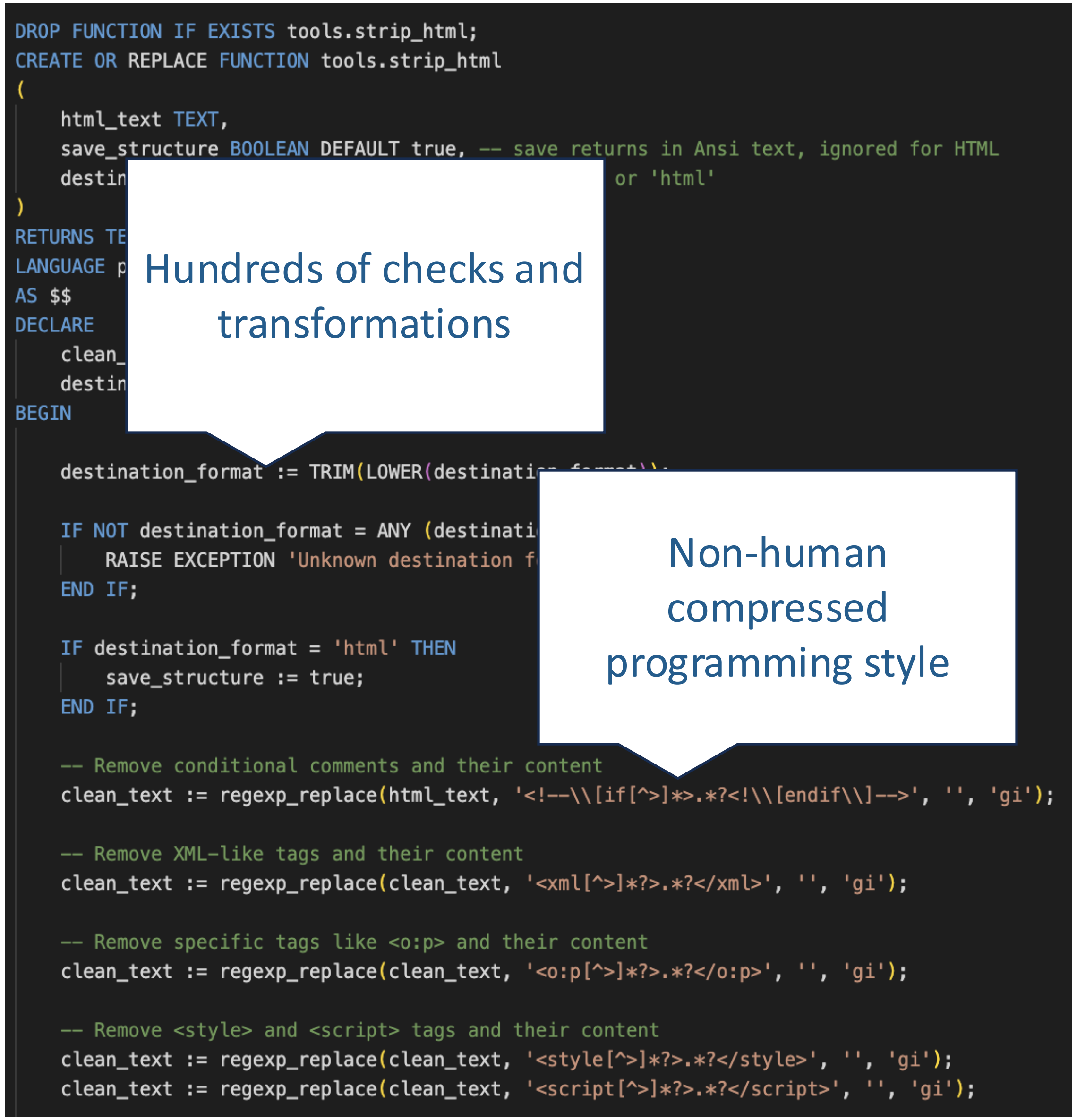
**3 iteration per week**

## AI

- **2 seconds per a version**
- **Increasing code complexity does not affect development speed**

**30 iteration per hour**

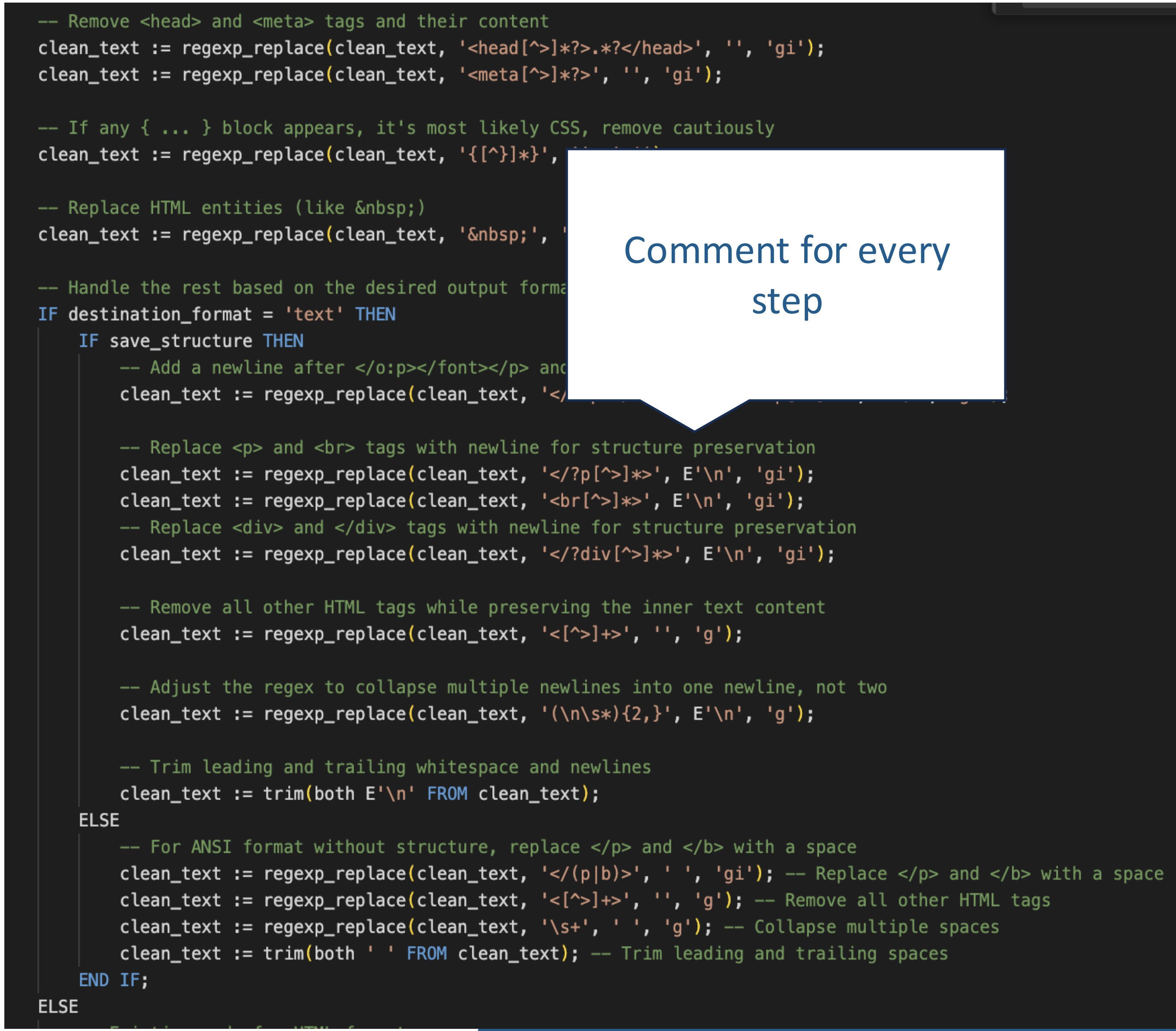
# AI created function for data cleaning



```
DROP FUNCTION IF EXISTS tools.strip_html;
CREATE OR REPLACE FUNCTION tools.strip_html
(
    html_text TEXT,
    save_structure BOOLEAN DEFAULT true, -- save returns in Ansi text, ignored for HTML
    destin                                          or 'html'
)
RETURNS TE
LANGUAGE p
AS $$
DECLARE
    clean_
    destin
BEGIN

    destination_format := TRIM(LOWER(destinati

    IF NOT destination_format = ANY (destinati
        RAISE EXCEPTION 'Unknown destination f
    END IF;

    IF destination_format = 'html' THEN
        save_structure := true;
    END IF;

    -- Remove conditional comments and their content
    clean_text := regexp_replace(html_text, '<!--\\[if[^>]*>.*?<!\\[endif\\]-->', '', 'gi');

    -- Remove XML-like tags and their content
    clean_text := regexp_replace(clean_text, '<xml[^>]*?>.*?</xml>', '', 'gi');

    -- Remove specific tags like <o:p> and their content
    clean_text := regexp_replace(clean_text, '<o:p[^>]*?>.*?</o:p>', '', 'gi');

    -- Remove <style> and <script> tags and their content
    clean_text := regexp_replace(clean_text, '<style[^>]*?>.*?</style>', '', 'gi');
    clean_text := regexp_replace(clean_text, '<script[^>]*?>.*?</script>', '', 'gi');
```

Hundreds of checks and transformations

Non-human compressed programming style



```
-- Remove <head> and <meta> tags and their content
clean_text := regexp_replace(clean_text, '<head[^>]*?>.*?</head>', '', 'gi');
clean_text := regexp_replace(clean_text, '<meta[^>]*?>', '', 'gi');

-- If any { ... } block appears, it's most likely CSS, remove cautiously
clean_text := regexp_replace(clean_text, '{[^}]*}',

-- Replace HTML entities (like &nbsp;)
clean_text := regexp_replace(clean_text, '&nbsp;', '

-- Handle the rest based on the desired output forma
IF destination_format = 'text' THEN
    IF save_structure THEN
        -- Add a newline after </o:p></font></p> and
        clean_text := regexp_replace(clean_text, '</

        -- Replace <p> and <br> tags with newline for structure preservation
        clean_text := regexp_replace(clean_text, '</?p[^>]*>', E'\n', 'gi');
        clean_text := regexp_replace(clean_text, '<br[^>]*>', E'\n', 'gi');
        -- Replace <div> and </div> tags with newline for structure preservation
        clean_text := regexp_replace(clean_text, '</?div[^>]*>', E'\n', 'gi');

        -- Remove all other HTML tags while preserving the inner text content
        clean_text := regexp_replace(clean_text, '<[^>]+>', '', 'g');

        -- Adjust the regex to collapse multiple newlines into one newline, not two
        clean_text := regexp_replace(clean_text, '(\n\s*){2,}', E'\n', 'g');

        -- Trim leading and trailing whitespace and newlines
        clean_text := trim(both E'\n' FROM clean_text);
    ELSE
        -- For ANSI format without structure, replace </p> and </b> with a space
        clean_text := regexp_replace(clean_text, '</(p|b)>', ' ', 'gi'); -- Replace </p> and </b> with a space
        clean_text := regexp_replace(clean_text, '<[^>]+>', '', 'g'); -- Remove all other HTML tags
        clean_text := regexp_replace(clean_text, '\s+', ' ', 'g'); -- Collapse multiple spaces
        clean_text := trim(both ' ' FROM clean_text); -- Trim leading and trailing spaces
    END IF;
ELSE
```

Comment for every step

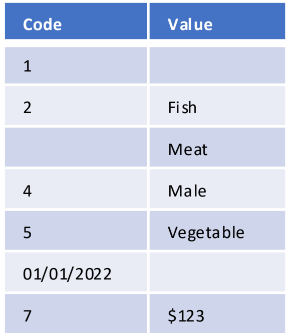
# Cleaning statistical metadata

## Errors in code lists

- □ Missed codes
- □ Missed values
- □ Wrong values
- □ Duplicates
- □ Wrong data types
- □ …

# Checking code list

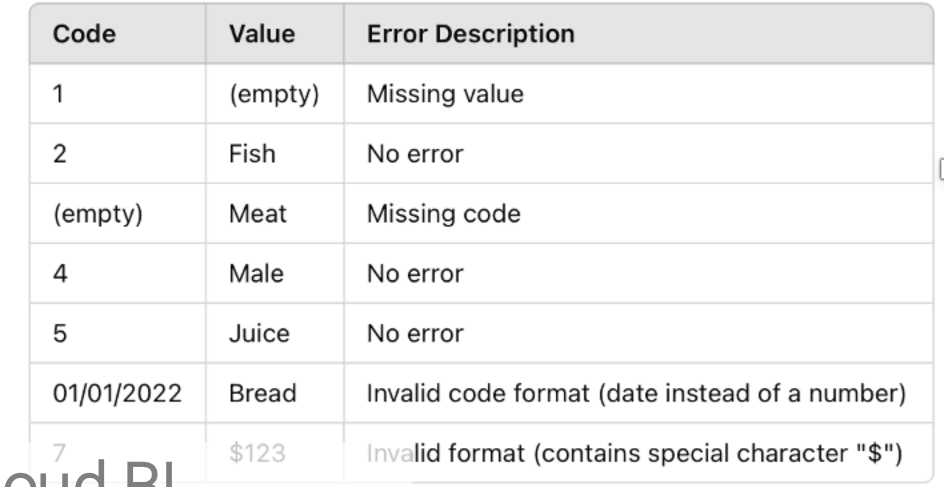
Code List



| Code | Value |
|---|---|
| 1 | |
| 2 | Fish |
| | Meat |
| 4 | Male |
| 5 | Vegetable |
| 01/01/2022 | |
| 7 | $123 |

AI created procedure

Error Report



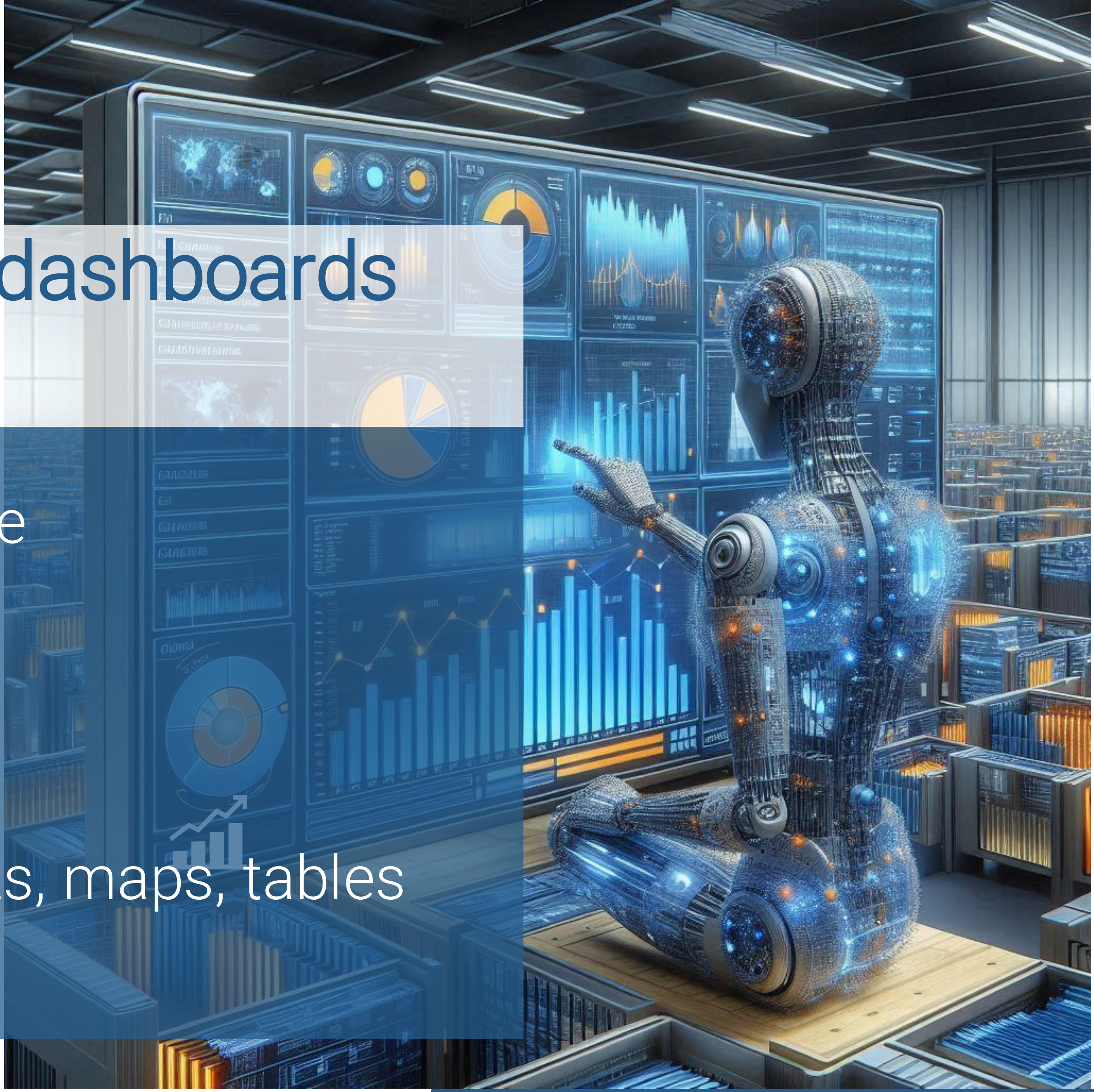
| Code | Value | Error Description |
|---|---|---|
| 1 | (empty) | Missing value |
| 2 | Fish | No error |
| (empty) | Meat | Missing code |
| 4 | Male | No error |
| 5 | Juice | No error |
| 01/01/2022 | Bread | Invalid code format (date instead of a number) |
| 7 | $123 | Invalid format (contains special character "$") |

## Benefits of programming with BI vs querying Cloud BI

- ❑ Free: We do not use ChatGPT to process data
- ❑ Speed: We use our own servers and databases
- ❑ Convenience: The created function is built into the application

# Create visualizations and dashboards

- □ Connect to Data Warehouse
- □ Set Data Dictionary
- □ Generate Queries
- □ Define OLAP cube
- □ Select and setup best charts, maps, tables



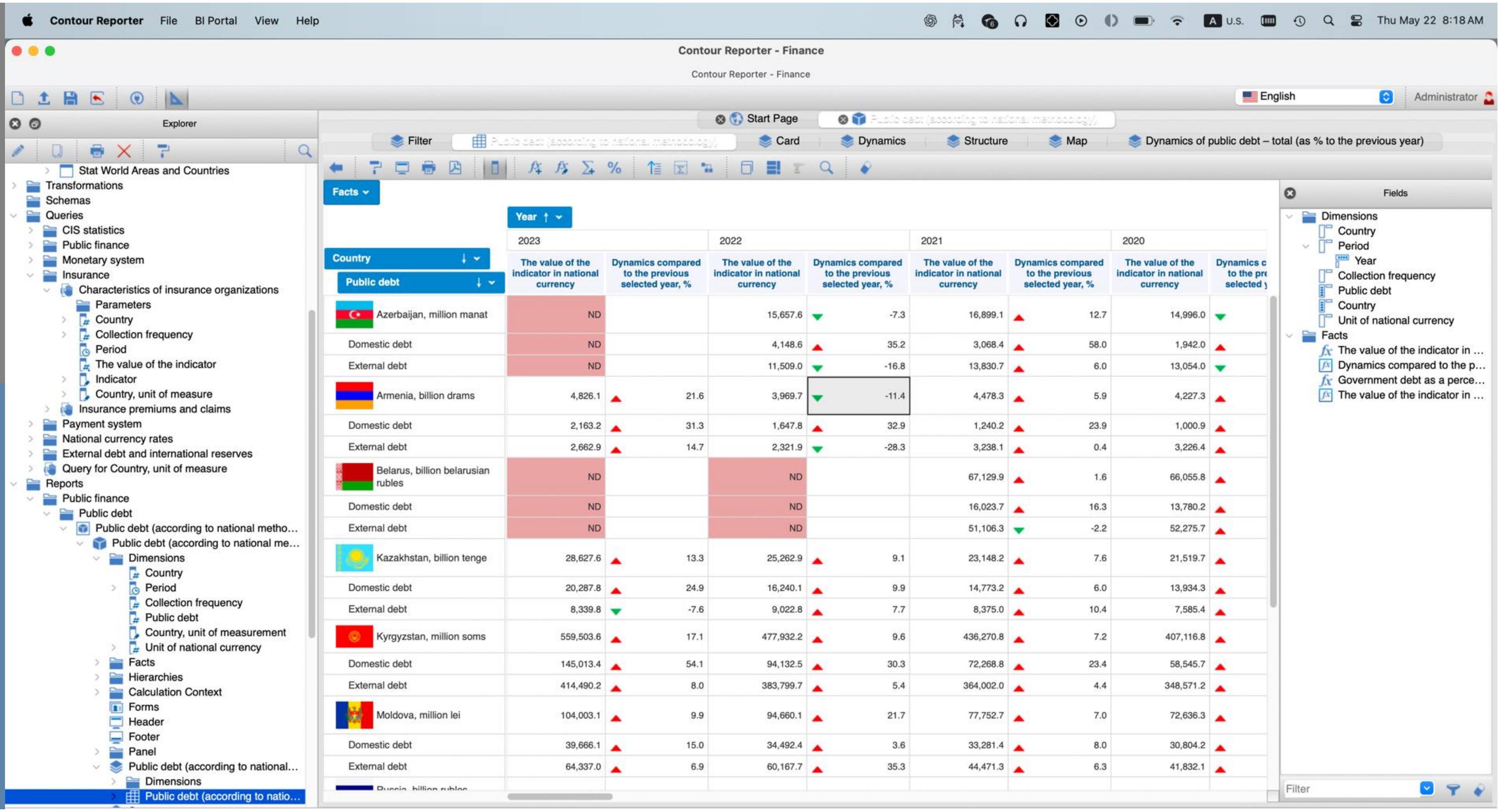
# Routine operations – transfer of analysts' experience
# Creativity – cooperation with a human

Routine:

- Rename Fields
- Set Queries
- Calculation algorithms
- …

Creativity:

- Choice of colors
- Adding images
- Choosing chart types
- Dashboard structure
- …


Contour Reporter
File
BI Portal
View
Help
Thu May 22 8:18 AM
Contour Reporter - Finance
English
Administrator
Explorer
Stat World Areas and Countries
Transformations
Schemas
Queries
CIS statistics
Public finance
Monetary system
Insurance
Characteristics of insurance organizations
Parameters
Country
Collection frequency
Period
The value of the indicator
Indicator
Country, unit of measure
Insurance premiums and claims
Payment system
National currency rates
External debt and international reserves
Query for Country, unit of measure
Reports
Public finance
Public debt
Public debt (according to national metho…
Public debt (according to national me…
Dimensions
Country
Period
Collection frequency
Public debt
Country, unit of measurement
Unit of national currency
Facts
Hierarchies
Calculation Context
Forms
Header
Footer
Panel
Public debt (according to national…
Dimensions
Public debt (according to natio…
Start Page
Filter
Card
Dynamics
Structure
Map
Dynamics of public debt – total (as % to the previous year)
Facts
Year
Country
Public debt
Fields
Dimensions
Country
Period
Year
Collection frequency
Public debt
Country
Unit of national currency
Facts
The value of the indicator in …
Dynamics compared to the p…
Government debt as a perce…
The value of the indicator in …
Filter

| Country / Public debt | 2023 The value of the indicator in national currency | 2023 Dynamics compared to the previous selected year, % | 2022 The value of the indicator in national currency | 2022 Dynamics compared to the previous selected year, % | 2021 The value of the indicator in national currency | 2021 Dynamics compared to the previous selected year, % | 2020 The value of the indicator in national currency | 2020 Dynamics c… to the pre… selected y… |
|---|---|---|---|---|---|---|---|---|
| Azerbaijan, million manat | ND | | 15,657.6 | ▼ -7.3 | 16,899.1 | ▲ 12.7 | 14,996.0 | ▼ |
| Domestic debt | ND | | 4,148.6 | ▲ 35.2 | 3,068.4 | ▲ 58.0 | 1,942.0 | ▲ |
| External debt | ND | | 11,509.0 | ▼ -16.8 | 13,830.7 | ▲ 6.0 | 13,054.0 | ▼ |
| Armenia, billion drams | 4,826.1 | ▲ 21.6 | 3,969.7 | ▼ -11.4 | 4,478.3 | ▲ 5.9 | 4,227.3 | ▲ |
| Domestic debt | 2,163.2 | ▲ 31.3 | 1,647.8 | ▲ 32.9 | 1,240.2 | ▲ 23.9 | 1,000.9 | ▲ |
| External debt | 2,662.9 | ▲ 14.7 | 2,321.9 | ▼ -28.3 | 3,238.1 | ▲ 0.4 | 3,226.4 | ▲ |
| Belarus, billion belarusian rubles | ND | | ND | | 67,129.9 | ▲ 1.6 | 66,055.8 | ▲ |
| Domestic debt | ND | | ND | | 16,023.7 | ▲ 16.3 | 13,780.2 | ▲ |
| External debt | ND | | ND | | 51,106.3 | ▼ -2.2 | 52,275.7 | ▲ |
| Kazakhstan, billion tenge | 28,627.6 | ▲ 13.3 | 25,262.9 | ▲ 9.1 | 23,148.2 | ▲ 7.6 | 21,519.7 | ▲ |
| Domestic debt | 20,287.8 | ▲ 24.9 | 16,240.1 | ▲ 9.9 | 14,773.2 | ▲ 6.0 | 13,934.3 | ▲ |
| External debt | 8,339.8 | ▼ -7.6 | 9,022.8 | ▲ 7.7 | 8,375.0 | ▲ 10.4 | 7,585.4 | ▲ |
| Kyrgyzstan, million soms | 559,503.6 | ▲ 17.1 | 477,932.2 | ▲ 9.6 | 436,270.8 | ▲ 7.2 | 407,116.8 | ▲ |
| Domestic debt | 145,013.4 | ▲ 54.1 | 94,132.5 | ▲ 30.3 | 72,268.8 | ▲ 23.4 | 58,545.7 | ▲ |
| External debt | 414,490.2 | ▲ 8.0 | 383,799.7 | ▲ 5.4 | 364,002.0 | ▲ 4.4 | 348,571.2 | ▲ |
| Moldova, million lei | 104,003.1 | ▲ 9.9 | 94,660.1 | ▲ 21.7 | 77,752.7 | ▲ 7.0 | 72,636.3 | ▲ |
| Domestic debt | 39,666.1 | ▲ 15.0 | 34,492.4 | ▲ 3.6 | 33,281.4 | ▲ 8.0 | 30,804.2 | ▲ |
| External debt | 64,337.0 | ▲ 6.9 | 60,167.7 | ▲ 35.3 | 44,471.3 | ▲ 6.3 | 41,832.1 | ▲ |
| Russia, billion rubles | | | | | | | | |

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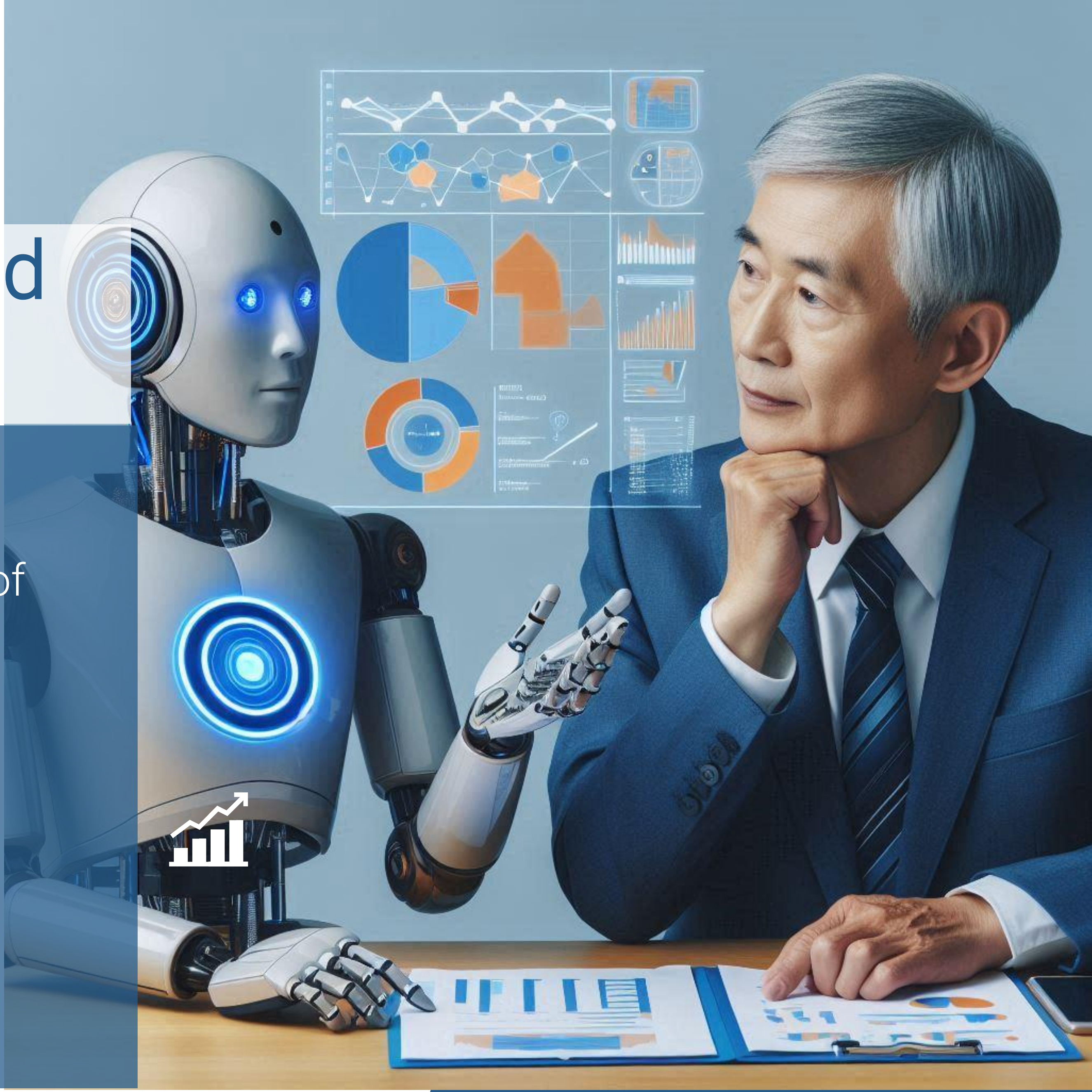
# Text and Voice Query Interface

Natural Language Processing for queries:

- ❑ Text and voice queries for data
- ❑ Instant visual and text responses
- ❑ One exact number instead of a table

# Provide Interpretations and predictions



- ❑ AI-generated textual summaries
- ❑ Evaluation of the values and structure of statistical indicators
- ❑ Explanations of trends and predictions

# Conclusion

- ❑ AI-powered BI transforms official statistics with accuracy and quality
- ❑ AI integrated in BI gives a user a new, more natural way to access data
- ❑ AI can help better understand the data

# Thank you!

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