COGNITIVE AUTOMATION ROBOTS (CAR)

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ABSTRACT

Modern day-to-day operations, even in large-scale enterprise, still involve manual data entry, manual verification of information, and manual handover of information from one party to the next party to be processed. This current method of working very much leaves gaps in the process chain resulting in incompleteness, inaccuracy and inconsistency of information. It also leaves loopholes for information theft and misuse as well as involve a lot of time and effort in the form of manual repetitive non-value-added work to verify and correct information before information can be used. In this study, the authors present a novel idea and practical methods to automate the input and process the flow of enterprise information by using robotic process automation (RPA). This platform is to be referred to as Cognitive Automation Robots (CAR), developed by the National Applied R&D Centre of Malaysia, MIMOS Berhad. Rule-based task software robots form a digital workforce to automate business processes in interacting with systems and applications. The cognitive trait of these robots performs self-learning on baseline information and continue to improve processes to optimal levels on their own; the robots use natural language processing, machine learning and reasoning for expert decision making. Business insights such as statistics from the real-time digital trail of the robots' activities are then generated to measure effectiveness to be feedback into the system as operational analytics. CAR improves enterprise operations that have historically required human intelligence, experience and situational reasoning.

***Field of Research**: Robotic process automation, RPA, digital workforce, cognitive automation, decision making, business insights, operational analytics, self-learning, natural language processing, machine learning, process automation, machine intelligence, digital labor.*

Introduction

Multitudes of time and effort is consumed in capturing the right data from multiple systems across disparate databases factoring in the data explosion of 2 million calls on Skype, 156 million emails and 3.8 million Google searches, all of that every 60 seconds, as cited by Go-Globe. The vast information explosion thanks to the Internet and availability to mobile devices made robotic process automation (RPA) necessary and critical in every day usage (Forbes, 2018). By 2020, automation and artificial intelligence will reduce employee requirements in business shared-service centers by 65 percent, according to Gartner, which says the RPA market will top $1 billion by 2020. By that time, 40 percent of large enterprises will have adopted an RPA software tool, up from less than 10 percent today (4). RPA is an emerging business process automation technology utilizing software robots or artificial intelligence (AI) workers. RPA technology allows users to configure a "robot" to process a transaction, trigger responses and communicate with other systems. In comparison to traditional IT solutions, RPA allows organizations to automate at a fraction of the cost and time as compared to historically (Treichl, 2018).

Modern day-to-day operations, even in large-scale enterprise, still involve manual data entry, manual verification of information, and manual handover of information from one party to the next party to be processed. This current method of working very much leaves gaps in the process chain resulting in

incompleteness, inaccuracy and inconsistency of information. It also leaves loopholes for information theft and misuse as well as involve a lot of time and effort in the form of manual repetitive non-value-added work to verify and correct information before information can be used. In this study, the authors present a novel idea and practical methods to automate the input and process the flow of enterprise information by using RPA. This platform is to be referred to as Cognitive Automation Robots (CAR), developed by the National Applied R&D Centre of Malaysia, MIMOS Berhad. Rule-based task software robots form a digital workforce to automate business processes in interacting with systems and applications. The cognitive trait of these robots performs self-learning on baseline information and continue to improve processes to optimal levels on their own; the robots use natural language processing, machine learning and reasoning for expert decision making. Business insights such as statistics from the real-time digital trail of the robots' activities are then generated to measure effectiveness to be feedback into the system as operational analytics. CAR improves enterprise operations that have historically required human intelligence, experience and situational reasoning.

CAR exists as part of a "cognitive ecosystem" that enhances accuracy and quality of relayed information within the enterprise organizational processes. CAR joins predictive analytics leveraging on advanced analytical techniques to assess the impact of data outliers when compared with historical transactions and cognitive technologies (also known as artificial intelligence). These technologies will allow the analysis of organizational transactions in day-to-day operations which makes CAR not limited only to document data automation but a new gateway to new insights and automate real-life processes (Forbes, 2018).

Methodology

This chapter introduces the CAR solution for real-time book recommendations then explains the system and components of CAR.

CAR Solution

The CAR system is robotic process automation (RPA) is the use of software with cognitive computing which combines artificial intelligence and natural language processing to enable computers (machines) to understand data, generate insights and use them as a learning experience in the future. It is coupled with machine learning capabilities to handle high-volume and repetitive tasks that previously only humans could perform. (Rouse, 2010)

This summarized or knowledge flow of CAR is as follows:

- Recording tool for browser and desktop application (macro recorder)
- Document extractor (office files, PDF, e-mail, etc.)
- Optical character recognition (OCR engine)
- Universal RDBMS database/NOSQL database connector
- Flow engine (GUI/script)
- Network tools
- Integration to device driver etc. such as for Windows
- Artificial intelligence component (additional component)

1. The system processes information as shown by a use case in **Figure 1**. This can be achieved via following method:
    - Traffic data from internet convert to PDF a store to file system.
    - Application of general machine learning (ML) model.
    - Extraction of the relevant fields in the PDF attachments into a database.
    - Values entered into PUTTY application.

2. **Figure 2** show some example information flow in CAR while doing automated way to get road traffic data, do some extract, process information and the final output as information dashboard. Detail of the flow describe below:
    - Road traffic data from the Internet convert to PDF then uploaded to a drive.
    - The PDF reader, which will extract the rule-based data from PDFs.
    - ML model, which is used to extract unstructured data from PDFs.
    - The data interface used to display data and statuses, make corrections.
    - Recipient systems like Putty and Mainframe, where data is fed in.
    - Dashboarding system will consume data from mainframe.

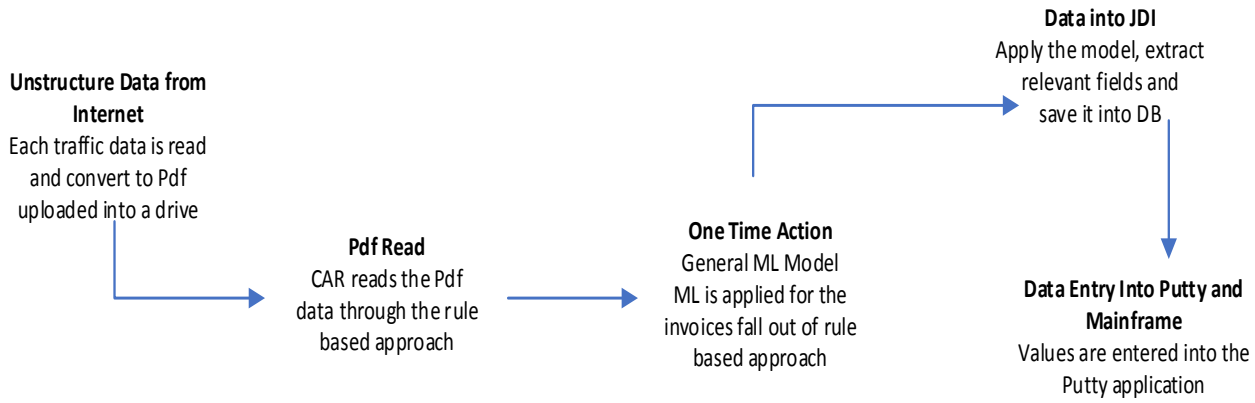


Figure 1: Cognitive traffic processing using CAR

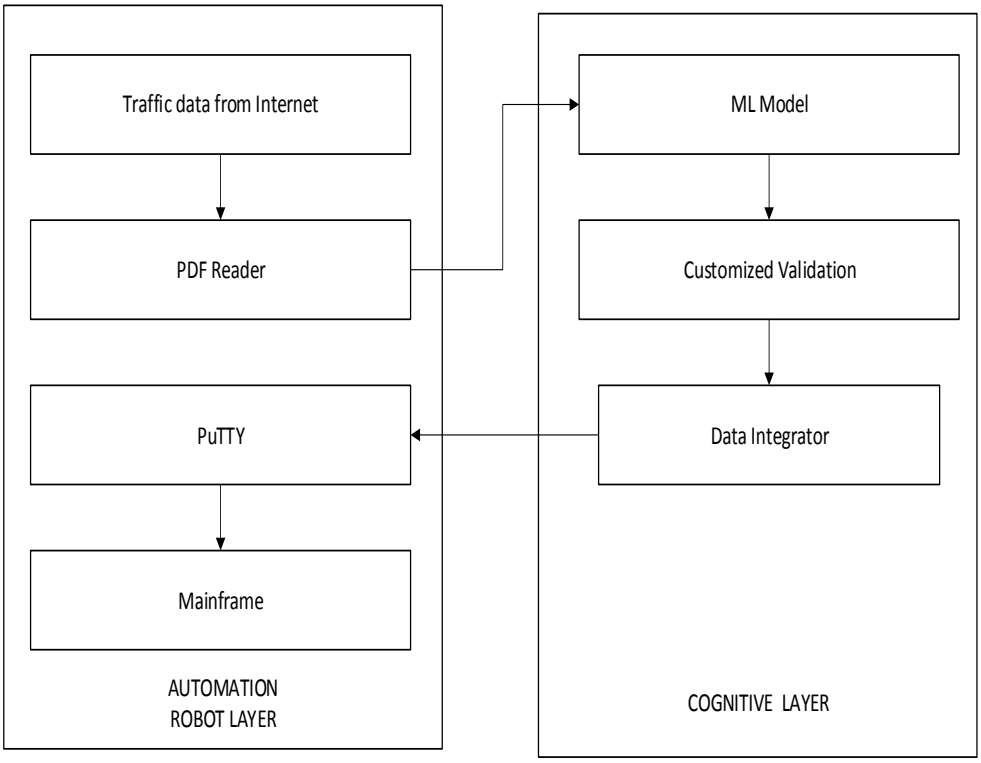


Figure 2: CAR information flow

CAR Components

The CAR application uses low-level Hypertext Transfer Protocol (HTTP) through PHP scripting language and PostgreSQL database to enable developers to configure a web robot. Developers can use the bot to extract content from the web, to perform extraction processes on websites and desktop, and to store the data into a database based on categories. Based on the data collected by CAR, developers can filter the data by defining the source websites, deciding how the information is extracted, and choosing how the grabbed data is presented and used for automation of processes.
CAR offers the following:

- HTML UI which offers greater performance, flexibility, and compatibility (works on Windows and Linux).
- CAR comes with the Command Prompt bot execution feature which allows for bot execution. CAR runs as a backend process thus improving the overall performance.
- The CAR engine has been heavily optimized to offer a better performance and user experience compared with the previous version. CAR web robot harvests information and performs automation from the desktop system and the Internet.
- Cognitive analytics engine to analyze the information harvested (MIMOS Mi-Intelligence).
- OCR analytics engine to analyze pictures from the information harvested (MIMOS Mi-SP).
- Extract, Transform and Load tool to transform the information harvested into intelligible nuggets of information (MIMOS Mi-Morphe).
- Visualisation and visual automation of the intelligible nuggets of information (MIMOS Mi-Flash).
- Governing of the permissions and actions for the users and processes in the system (MIMOS Mi-ARMC).
- Securing and authenticating the levels of information and access within the system (MIMOS Mi-UAP).

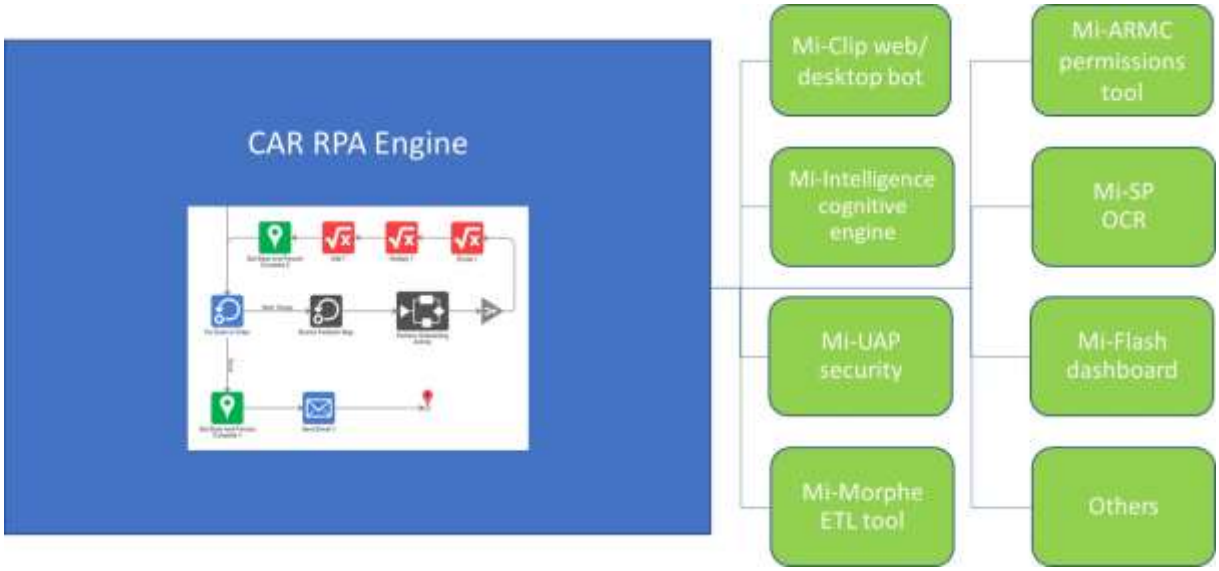


Figure 3: CAR RPA engine

The CAR sequence comprises a set of syntax instruction to do automation for browser to do certain task. It produces algorithms based on widget format, widget-based flow visual flow format and then the format will generate a robot language code based on how it visualizes the widget based visual flow format. It can become the base foundation to create a widget based visual robot language code generator which it still not available. Meaning, the developer can produce robot language code

without knowledge on it. It comprises the following components a web bot, a code generator which works in a workflow housed in a web-based application.

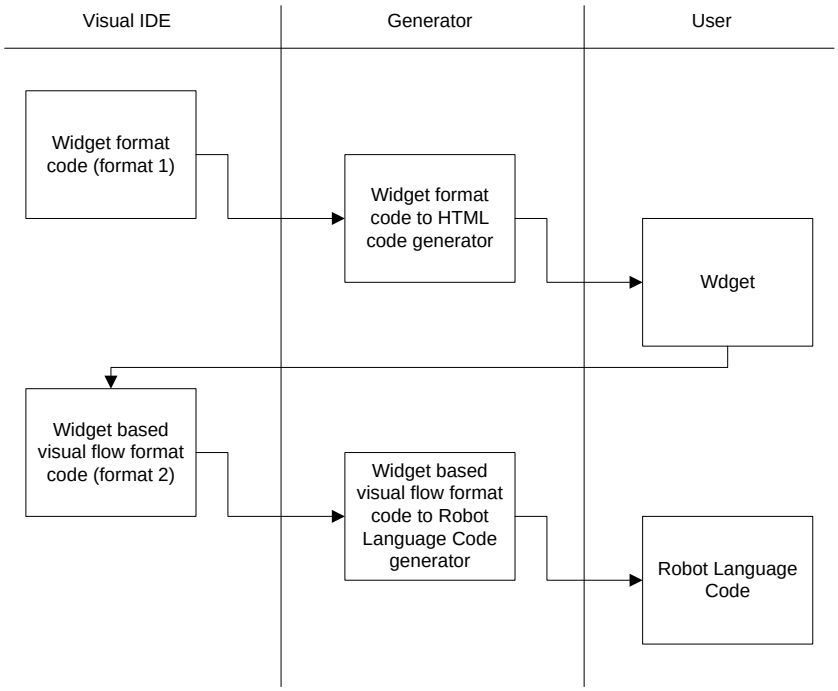


Figure 4: Overall process flow

```
<widget>
        <name>Start</name>
        <container>
          <type>FormContainer</type>
          <fields>

                {"inputParams": {"label": "Item", "name": "Item", "required": true, "size": 25 } },
                {"inputParams": {"label": "Start Tag", "name": "Start_Tag", "value":""} },
                {"inputParams": {"label": "End Tag", "name": "End_Tag", "value":""}}

          </fields>
          <terminals>

                {"name": "in", "direction": [0,-1], "offsetPosition": {"left": 82, "top": -15 }, "ddConfig": {
                 "type": "input",
                 "allowedTypes": ["output"]
                },
                 "nMaxWires": 1
                },


                {"name": "out", "direction": [0,1], "offsetPosition": {"left": 86, "bottom": -15}, "ddConfig": {
                 "type": "output",
                 "allowedTypes": ["input"]
                },
                 "nMaxWires": 1
                },

           </terminals>
        </container>
</widget>
```

Figure 5: Widget format code

<module>{"config":{"position":[-1,14]},"name":"Start","value":{}}</module>
<module>{"config":{"position":[335,568]},"name":"End","value":{}}</module>
<module>{"config":{"position":[286,146]},"name":"Robotec Element Inside","value":{"End_Tag":"</title>","Item":"title","Start_Tag":"<title>"}}</module>
<module>{"config":{"position":[63,91]},"name":"Load HTML","value":{"Method":"GET","URL":"http://thestar.com.my/rss/nation.xml"}}</module>
<module>{"config":{"position":[514,106]},"name":"Robotec Element Inside","value":{"End_Tag":"</link>","Item":"link","Start_Tag":"<link>"}}</module>
<module>{"config":{"position":[440,311]},"name":"Robotec Element Inside","value":{"End_Tag":"</desc>","Item":"description","Start_Tag":"<desc>"}}</module>
<module>{"config":{"position":[83,383]},"name":"Database Store","value":{"Content":"description","Link":"link","Title":"title"}}</module>
<module>{"config":{"position":[520,427]},"name":"Comment","value":{"comment":"RSS 2 DATABASE EXAMPLE"}}</module>
<wire>{"src":{"moduleId":0,"terminal":"out"},"tgt":{"moduleId":3,"terminal":"in"}}</wire>
<wire>{"src":{"moduleId":3,"terminal":"out"},"tgt":{"moduleId":2,"terminal":"in"}}</wire>
<wire>{"src":{"moduleId":2,"terminal":"out"},"tgt":{"moduleId":4,"terminal":"in"}}</wire>
<wire>{"src":{"moduleId":4,"terminal":"out"},"tgt":{"moduleId":5,"terminal":"in"}}</wire>
<wire>{"src":{"moduleId":5,"terminal":"out"},"tgt":{"moduleId":6,"terminal":"in"}}</wire>
<wire>{"src":{"moduleId":6,"terminal":"out"},"tgt":{"moduleId":1,"terminal":"in"}}</wire>
<properties>this example is how to convert rss and then insert it to database.</properties>
<properties>RSS 2 DATABASE</properties>

Figure 6: Widget-based visual flow format code

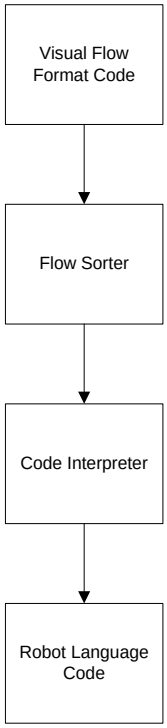


Figure 7: Visual flow format code to robot language code process

Automation Capabilities

CAR automation capability covers all standard RPA features; but CAR includes extra capabilities that make the difference in comparison with other standard RPA in the market in which it has a Cognitive computing component that has many routine actions that are not rule-based and requires human involvement such as thinking. A cognitive bot is a self-learning bot that learns patterns and applies them continuously. The CAR and standard RPA comparison is shown in **Table 1** bellow:

Automation Capability	CAR	Standard RPA
Recording tool for browser and desktop application (macro recorder)	√	√
Document extractor (office files, PDF, e-mail, etc)	√	√
Optical character recognition (OCR engine)	√	√
Universal RDBMS database/NOSQL database connector	√	√
Flow engine (GUI/script)	√	√
Network tools	√	√
Integration to device driver etc. such as for Windows	√	√
Cognitive computing component (additional component)	√	X

Table 1: Automation capabilities of CAR versus Standard RPA tools

Monitoring RPA Deployments

Part of the challenge of monitoring RPA deployments will be understanding what the robot (RPA client) can do in comparison to other robots. CAR applies tags to RPA hosts, processes, containers and services. The tags enable differentiation and organizes the type robots and what the robots are supposed to be doing. CAR captures each dynamic request from remote robots. These requests are automatically ranked according to the speed of task completion.

The health of the robot process and for many technologies such as .NET, Java, NGINX and Node.JS, can provide higher visibility to the methods being run. CAR discovers and baselines RPA transactions on both client and server side. It also gets visibility into log files being generated.

CAR uses deterministic Artificial Intelligence to automatically create an entity model of a BotFarm. It also utilizes a machine learning algorithm and natural language processing algorithm to automatically baseline transactions to look for anomalies that may impact end users or service calls.

Application & Visualisation

Based on the details of this problem an organization could use CAR to (Jones, 2017):

1. Generate alerts which could be pushed out into chat operations channels.
2. Create service tickets in JIRA.
3. Trigger an automation event to drive Chef or Puppet to react to the problem during service deployment.

CAR visualizes the dynamic interaction of the automated processes such as for traffic distribution in large cities as well as visualizes the harvested feedback from social channels on the public amenities in a city as follows (**Figure 8** and **Figure 9**):

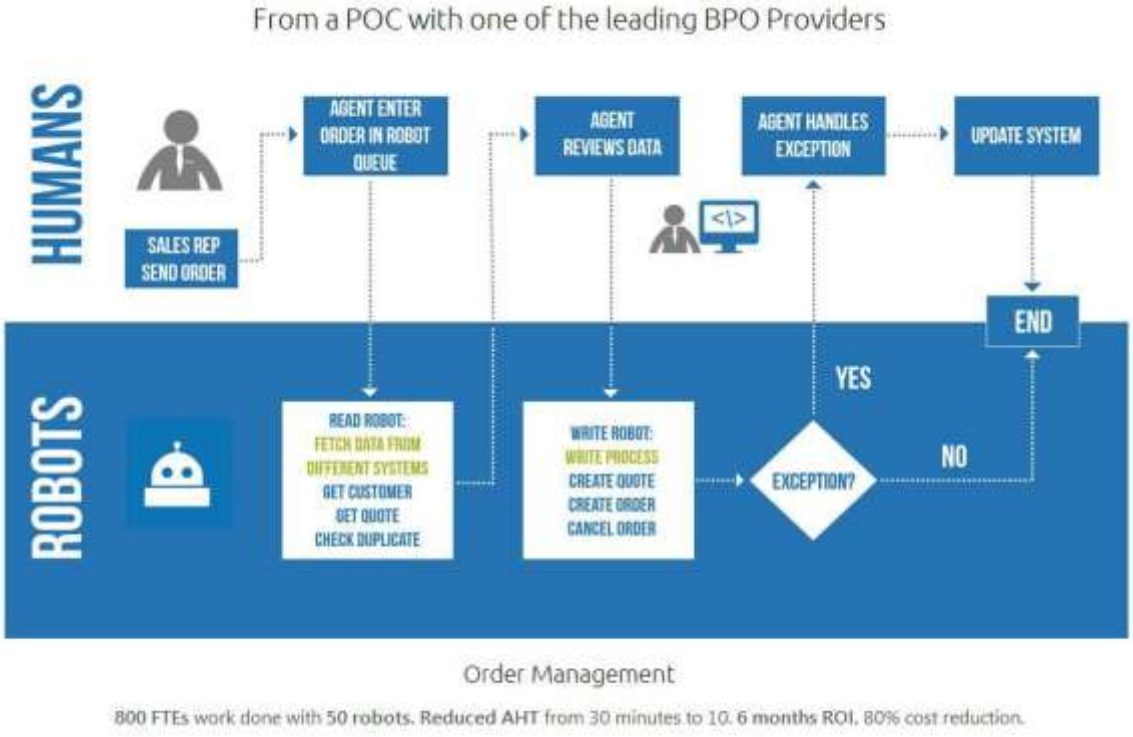
- Centralised information network base containing multiple data sources such as highway and public transport reports, traffic (e.g. Waze) data and CCTV data for traffic for accident and congestion management and traffic redirection store in mainframe.
- Crowdsourced social information is used to quickly address road and public amenities' disruption of service so accurate and effective repairs and maintenance are carried out.

Figure 8: Automated traffic distribution using robots

Figure 9: Automated social channels compliant resolution using robots

Conclusion

The benefits for organizations are substantial. It was found that the work of 800 FTEs could be done by 50 robots leading to an 80% cost reduction. Robots automate the performance management of RPA deployments and BotFarms (Jones, 2017). In an organization context, it frees your teams from having to manage tedious RPA deployments and ensures that your organization optimizes resources on actual projects. In a social sciences context, RPA is able to harvest social data to complement structured reports to enable the real-life automation of public infrastructure such as highway traffic, public facilities maintenance and safety surveillance. This gives rise to the potential of smart and liveable cities which are community centric and sustainable in terms of cost and operational effort (Jones, 2017).



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