Northwestern | McCORMICK SCHOOL OF ENGINEERING

REFIT

PREDICTIVE MACHINE LEARNING AIDS BUSINESSES WITH AI-BASED DATA STREAMING ANALYSES

Created by Northwestern's Center for Deep Learning, REFIT capitalizes on Internet of Things infrastructure

Applications for Internet of Things (IoT) ecosystems are everywhere—**agriculture, manufacturing, healthcare**—and more are coming. By 2025, there will be 41.6 billion connected IoT devices, generating 79.4 zettabytes, according to the International Data Corporation. That means speed and efficiency are paramount, not only to process but also to act on IoT data.

REFIT, developed by Northwestern University's Center for Deep Learning and built by the Departments of Computer Science and Industrial Engineering and Management Sciences, offers assurance to industries, ranging from agriculture to health care to manufacturing. REFIT's system is built to consume and capitalize on IoT infrastructure. Using machine learning with state-of-the-art artificial intelligence (AI), REFIT's predictive results and ease of use allow users to quickly develop, experiment, and deploy a robust, powerful, feature-rich IoT framework, making work more efficient with the same resources. The design allows it to evolve and continuously improve its predictive abilities, while not disrupting the deployment of the current machine-learning or deep-learning approaches.

PREDICTIVE

HOW **REFIT** WORKS

Built on open source components, **REFIT** is a platform geared toward data scientists and engineers in companies with limited in-house resources. **REFIT** ingests device data or real-time business data and employs modern machine learning approaches to infer the status of various IoT system components.

Traditionally, IoT-like systems leverage propositional logic from various components to take action on the data received. While effective, this requires a great deal of time and engineering effort to make systems that scale to meet demand.

REFIT, however, differs from other IoT systems, like Google Cloud Platform Stream Analytics. For instance, **REFIT**:

- relies on recently released, powerful open-source components
- does not use proprietary tools
- employs Northwestern's machine learning research while enabling specified features through a flexible logic
- propagates logic throughout architectural components
- uses various Enterprise Integration Patterns for these types of tasks

REFIT decouples workload management and hardware from the software layer by using Kubernetes and docker containers. The system handles many use cases with minimal customization and offers data source authentication to prevent spoofing and other attacks.

REFIT allows data injection through low latency streaming. The streamed data is stored in a high-throughput persistent storage database, which is augmented with other static data sources in order to train predictive AI models. The current trained model is pushed to the main processing unit that conducts predictions on real-time data. The various data streams and predictions are stored in a persistent storage and can be visualized in real time in a dashboard. Batching imports from static datasets into **REFIT** also are supported.

> "DEMOCRATIZATION OF DATA SCIENCE IN IoT HAS JUST ARRIVED."

DIEGO KLABJAN
DIRECTOR
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REFIT

FROM AGRICULTURE AND MANUFACTURING TO 5G AND INFRASTRUCTURE MONITORING

REFIT's data streaming architecture ensures the seamless deployment of new predictive models to the stream processing pipeline. Any entity collecting data in real time with a need for predictive modeling and/or visualization with low latency and high throughput would benefit from **REFIT**.

FARMING

Modern agricultural equipment is connected with various sensors connected wirelessly to the internet. **REFIT** can capture information near each sensor such as wind speed, temperature, and atmospheric pressure, as well as add a time-stamp and a unique sensor identification number. Other sensors can measure the mechanical state of the equipment. **REFIT** can be used to enable preventive maintenance or to control use of pesticide or fertilizer. In such a volatile industry, having sophisticated automated solutions in place means survival during a downturn and prosperity in a positive economic environment.

HEALTH CARE

Monitoring and predicting the malfunction of medical devices is vital. Patients are routinely monitored during their hospitalization or stay at home for signs of anomalies. **REFIT** has been evaluated on predictions of development of certain medical conditions, such as incubation, based on real-time monitoring of vital signs of patients.

MANUFACTURING

Supply chains are increasing in complexity and customers are more demanding as competition is on the rise. The COVID-19 pandemic calls for further agility, requiring manufacturers and distributors to act and adjust in real time. Trucks, warehouses, and other relevant equipment are becoming robots in disguise. **REFIT** can be used to monitor the status of shipments, equipment, and market conditions taking preemptive actions based on predictive solutions.

WORRY-FREE

Organizations and companies worried about vendor or cloud lockdown or considering a transition to an end-to-end IoT software stack using state-of-the-art AI methodologies would benefit from REFIT's unique capabilities. Its open-source nature and flexibility mixed with ease of use are distinguishing factors.

Additionally, all components of REFIT are distributed which provides resilience to system failures.

EXPERTISE

CENTER FOR DEEP LEARNING AT NORTHWESTERN UNIVERSITY

The Center for Deep Learning provides technical capacity and expertise to companies seeking to establish or improve access to AI. Its leaders are Northwestern University world-class researchers, academic directors, and alumni with long established and current experience in industry.

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The center acts as a resource to members, who can access the expertise of Northwestern faculty, student interns, and graduates to achieve proof of concept or deployment.

Membership funds the development of open-source software produced with member input. It also provides high visibility with Northwestern students and access to faculty for closed-source projects.

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