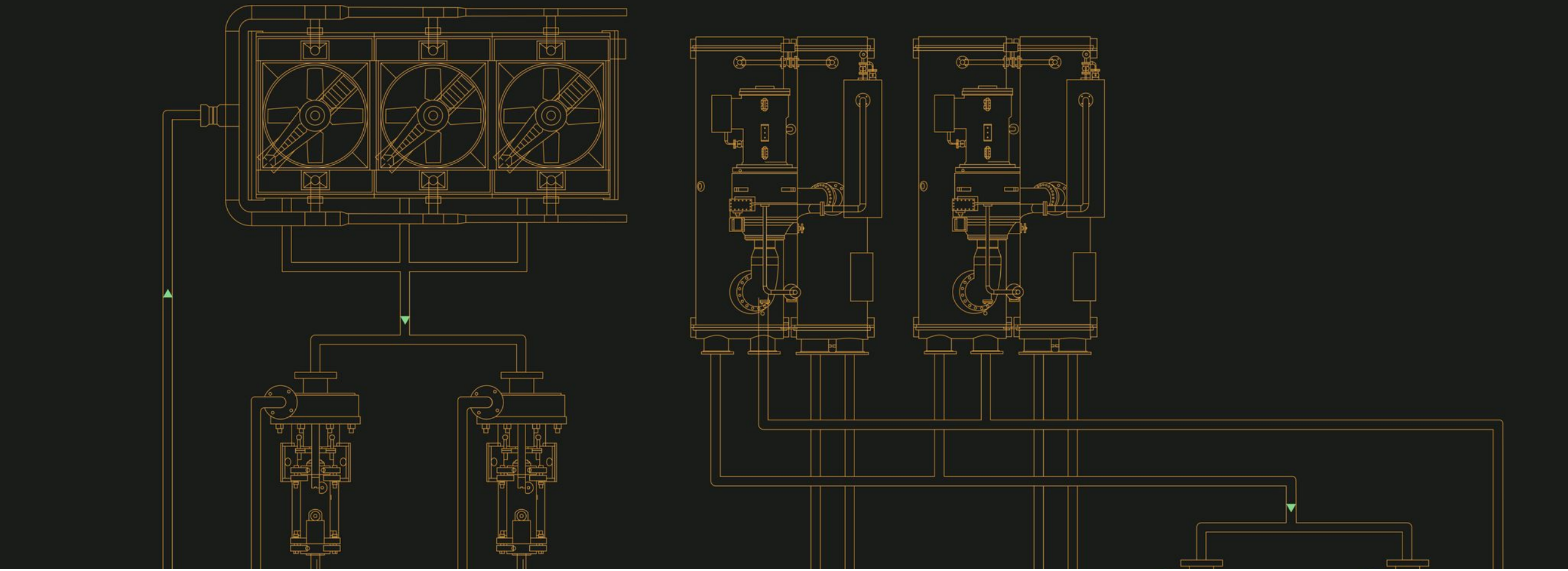

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AI-powered industrial control systems

IDEA Webinar Series - 02.01.23

Prepare your District Energy Systems for AI Integration

Housekeeping

Webinar and Q&A Format

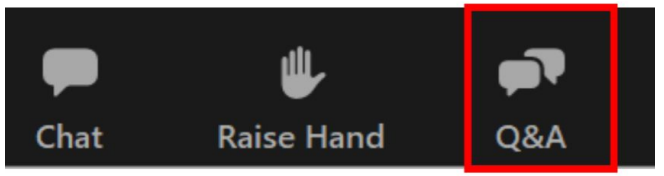
This webinar is scheduled for one hour, including the presentation and approximately 15 minutes for Q&A, which will take place throughout the webinar. If needed, the webinar will extend past the hour to answer as many audience questions as we can.

This webinar will be recorded

and streamed on the IDEA website within 24 hours of the conclusion of this webinar. Registrants will also be sent a follow-up email with links to the recording and presentation slides. A link to the presentation slides is also provided in the chat box if you want to print out and follow along.

How to Submit Questions

Please submit questions via the “Q&A” box during the presentation portion of the webinar. The Q&A icon can be found in the menu bar at the bottom of your screen. Questions will be reviewed by IDEA and posed to the presenters by the host at the conclusion of their presentation.



If you are having audio or video issues, please send a note via the Chat Box to our host, Jason Beal.

INTERNATIONAL DISTRICT ENERGY ASSOCIATION

Phaidra Leadership

Jim Gao

Co-Founder
Chief Executive Officer

Google

Veda Panneershelvam

Co-Founder
Chief Technology Officer

DeepMind

Katie Hoffman

Co-Founder
Chief Operating Officer

TRANE

Robert Locke

President
Chief Strategy Officer

Johnson Controls

*logos represent previous employers

Speakers Today

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Co-Founder
Chief Technology Officer

Chris Vause

Head of Product and Solutions

Ben Tacka

Strategic Account Manager

AI in Media


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ALPHAGO
AlphaGo
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AlphaGo


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ALL SYSTEMS GO


INTERNATIONAL
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Google just gave control over data center cooling to an AI
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MIT Technology Review
Aug 17, 2018


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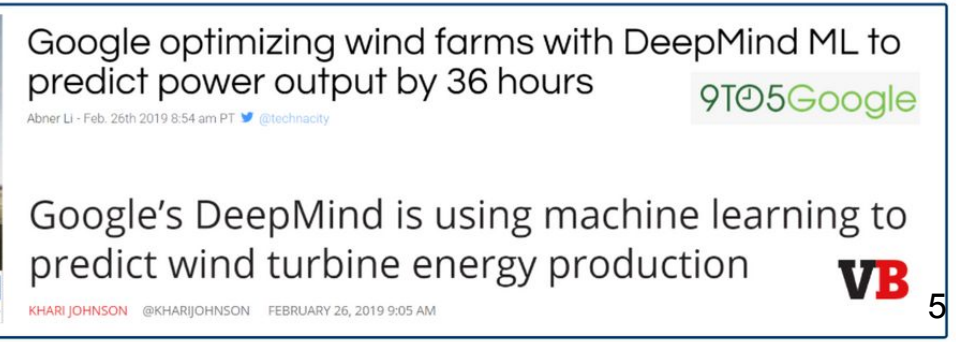
Google optimizing wind farms with DeepMind ML to predict power output by 36 hours
9TO5Google
Abner Li - Feb. 26th 2019 8:54 am PT @technacity
Google's DeepMind is using machine learning to predict wind turbine energy production
VB
KHARI JOHNSON @KHARIJOHNSON FEBRUARY 26, 2019 9:05 AM

AI Applications in Industry

Here Now

- Predictive Maintenance
- Energy Demand Anticipation
- Logistics - Supply Chain routing
- Workforce Planning
- Product Design
- Model predictive control
- Equipment & System Analytics
  - ID areas of inefficiency (rear view/hindsight)
- Digital Twin

Coming Soon

- Fully Autonomous Production
- Process Controls Optimization
- Batch Process Catalyst Degradation Prediction

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AI Vocabulary

Model
A mathematical representation of a particular component in a system (a pump, a chiller, etc.) Where data transformation occurs → x+y = z | Can predict output given certain input (a setpoint change)

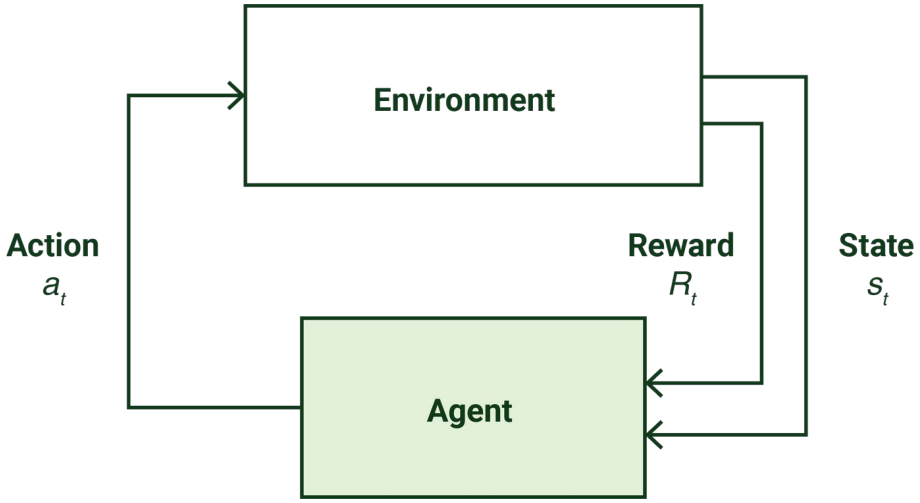
Neural Network
A model that requires large amounts of high-quality data. Most effective means of capturing system dynamics

Algorithm
A set of specific rules and commands | Collection of If…Then… statements

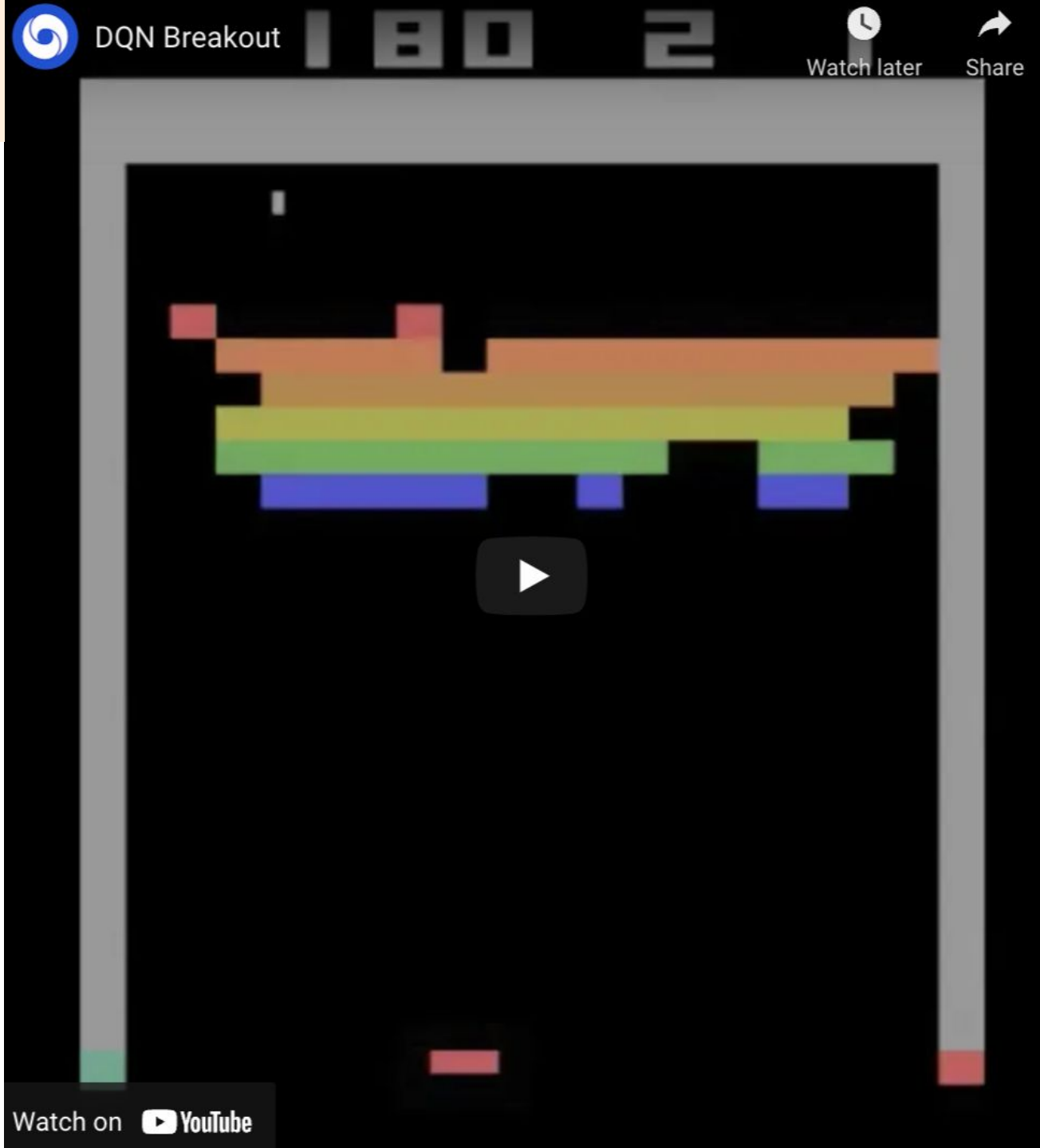
Digital Twin
A mathematical representation of an entire system (within a defined boundary). Provided with certain inputs, it will output predictions of future state of system. Full Simulation

Reinforcement Learning

The only branch of machine learning that produces **actions** (not just predictions).



$$V(s) = \max_a \left(R(s,a) + \gamma \sum_{s'} P(s,a,s') V(s') \right)$$



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Phaidra's mission is to enable a future of radical efficiency.

A future where human prosperity does not come at the cost of environmental degradation. A future that is fundamentally less dependent on the consumption of finite resources.

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Phaidra is an AI control service for large cooling systems (e.g chiller plants)

We enable radical improvements in energy efficiency, sustainability, and control stability.

Intelligent

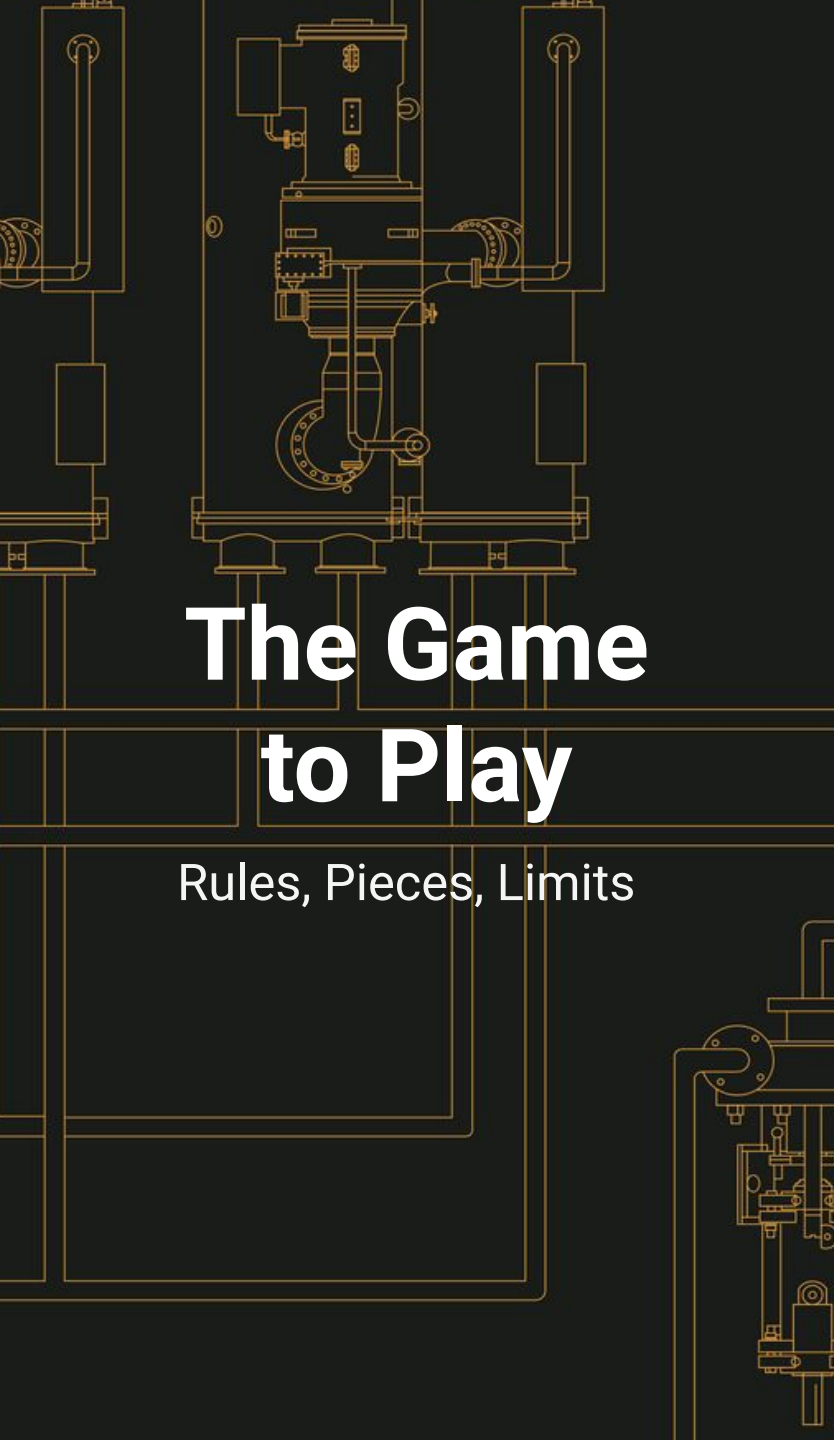
AI learns, adapts, and gets better.
Unlike traditional control systems.

Configurable

Domain experts define what they want the AI to do. Then the AI does it.

Autonomous

AI autopilot for your facility.
No oversight required.



The Game to Play

Rules, Pieces, Limits

Define

Define the AI sandbox.

KPI

The measurable optimization objective.

Power usage (kW)

Actions

The “knobs and levers” that can be adjusted.

Number of chillers

Number of pumps

Number of cooling towers

Chiller Setpoints

...

Constraints

The boundaries for optimization.

System constraints (temp, pressure, ...)

Equipment constraints (chiller start/stop, ...)

Pristine Data Matters

Data Collection Best Practices

How frequently should data be collected?

Higher Resolution = Higher Value

- 1 min timestamps ideal
- 5 min timestamps ok
- 15+ min timestamps = bare min value (dynamics missed with anything >15min)

Lower your Change of Value Thresholds

- temp → 0.5 degF
- flow → 1 gpm
- CoV >= margin of error on sensor

Tips for sensor calibration & quality?

- Frequent calibration is critical
- Treat sensors as equipment
- Increase budget for sensor quality and coverage
- Critical Sensor Redundancy

Tip: combine polling with CoV to ensure all sensor changes are captured

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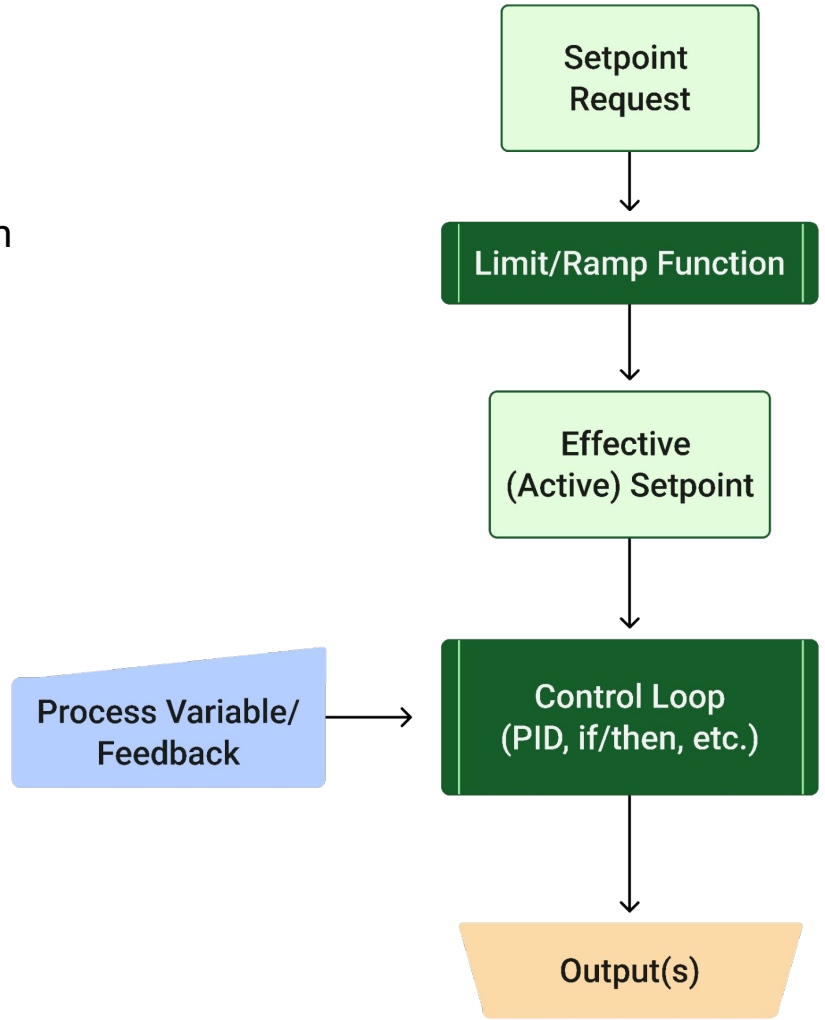
Control Considerations

Control Loop Points

- **Setpoint Request** - intended state of the system
- **Active/Effective Setpoint** - what the system is actively trying to do
- **Process Variable/ Feedback** - a sensor or value that represents the actual state of the system



Learning the Dynamics from Data

- Delta between Setpoint Request and Active Setpoint tells us the limits of your system
- Time delta between Active Setpoint and Feedback describes the time constant or lag of your system
- Proximity of Feedback to Active Setpoint over time can highlight quality of loop tuning

Record all of these critical points at high frequency!

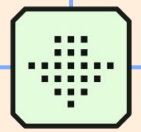
Data Storage Best Practices

Storage Considerations

- 12 months minimum, the more the better
- Ideal data historian has API options for data access
- Storage is cheap, take advantage

Meta-Data Standards

- Standardized meta-data tagging system
  - eg Project Haystack
- Review and consider incorporating
- Enable 3rd party analytics system



Data Quality Management

- Consider keeping maintenance logs for sensor calibration & replacement
- Establish naming conventions: document and enforce them
  - Trends, equipment, sensors, points, etc..

Actionable Next Steps

Collection

- Increase sensor coverage
  - eg meter power consumption for individual equipment
- Sensor redundancy
- Increase storage space and length

Collaboration

- Document tribal knowledge
- Centralized ledger of occurrences in plant
- Update SOO documents
- Select/upgrade to data historian with API connectivity available

Cleanliness

- Create trends
- Normalize naming conventions
- Plan for more frequent and regular sensor calibration

Part 2 - AI Controls Integration: Prep for Receiving Commands

Let’s Connect

at **AHR Expo** and/or **IDEA**

Campus Energy in Feb

Energy savings

Sustainability

Process stability

Safety

Operator assist

phaidra

Contact:

ben.tacka@phaidra.ai

What's Next at IDEA?

CampusEnergy2023 is less than one month away - register before February 17 and save up to $300 at https://bit.ly/Campus23IDEA-Reg.

Visit https://www.districtenergy.org/campusenergy2023/home for details on speakers, sessions, booking your hotel and more.

We expect over 1000 attendees – if you're not yet registered, please do so ASAP.

The Latest Issue of District Energy Magazine is Now Online!

The First Quarter 2023 Issue of our world-renowned publication, *District Energy* magazine, is now online.

Visit https://www.districtenergy.org/resources/district-energy-magazine and read it for free now!

IDEA2023 114th Annual Conference

We're getting ready for IDEA2023, taking place in Chicago, Illinois, from June 5-8 at the Chicago Hilton.

We're anticipating an international gathering in Chicago to meet under the theme "Empowering the Next Generation". Registration will open soon!

Stay connected at:
https://www.districtenergy.org/idea2023/home

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