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Cloud, Containers, and Discovery

GRID June 1, 2022

Vic Baker, Kelly Rose, Joe Obradovich, Dan McFarland

```
    plt.
Run Cell | Run Abo
    #%%# Split-out va
    array = dataset.value
    X = array[:,0:4]
    Y = array[:,4]
    validation_size = 0.20
    seed = 7
    X_train, X_validation, Y_train, Y_validati
```

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Multi-Cloud (...really means Multi-Environment)

- ‘Cloud’ is where you’re ***not*** at
  - Cloud Service Providers
  - On-Prem Compute
  - Edge computing (sensors, cell phone, etc)
- Leverage APIs for service-to-service communications
- Networking:
  - peered networks
  - commodity networks
  - dedicated / shared interconnects
  - consider egress fees (leverage compute where data lives)
- Utilize cloud-native concepts

YOU ARE HERE
aws
Cloud Service Providers
On-Prem
EDX
Energy Data eXchange
Remote Services

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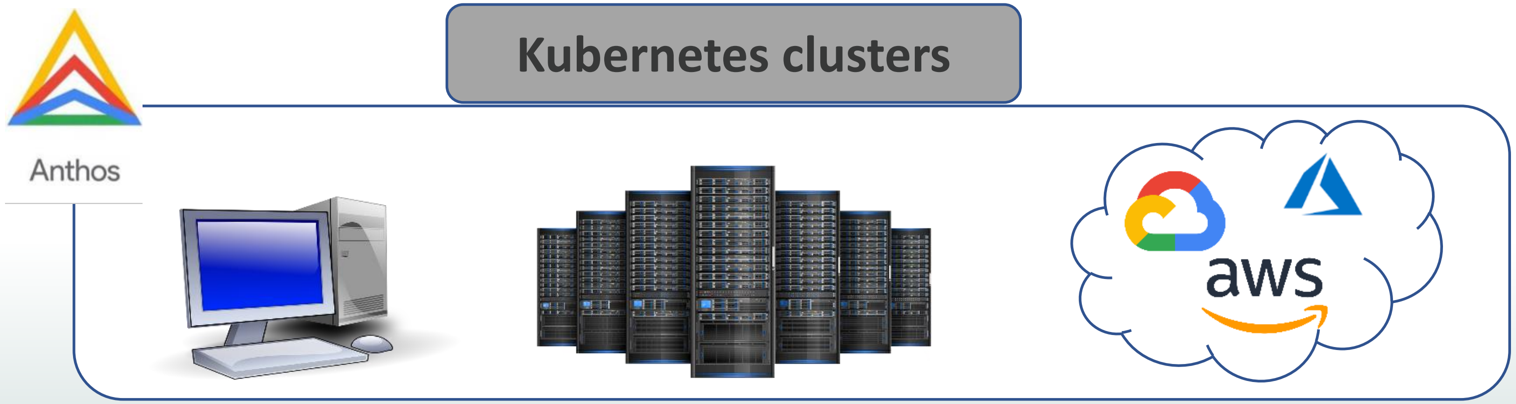
Navigating on-prem to cloud (and local dev)

- One of the biggest challenges: migrating from an “on-prem” development / deployment environment to cloud – HOW???
- Utilize “cloud native” concepts
  - Containerization
  - Microservices
  - Scalability
- Leverage enabling tools:
  - Deployment:
    - Kubernetes
    - Helm
    - Terraform
  - Development:
    - VS Code
    - Containerized environments

Kubernetes

- Supported by all major cloud providers
- Configurable autoscaling based on load thresholds (CPU, RAM usage)
    - Services
    - Nodes
- Managed service deployments via Helm
- Seamless local, on-prem, cloud deployments via kubectl
- Manage multi-environment clusters via GCP Anthos



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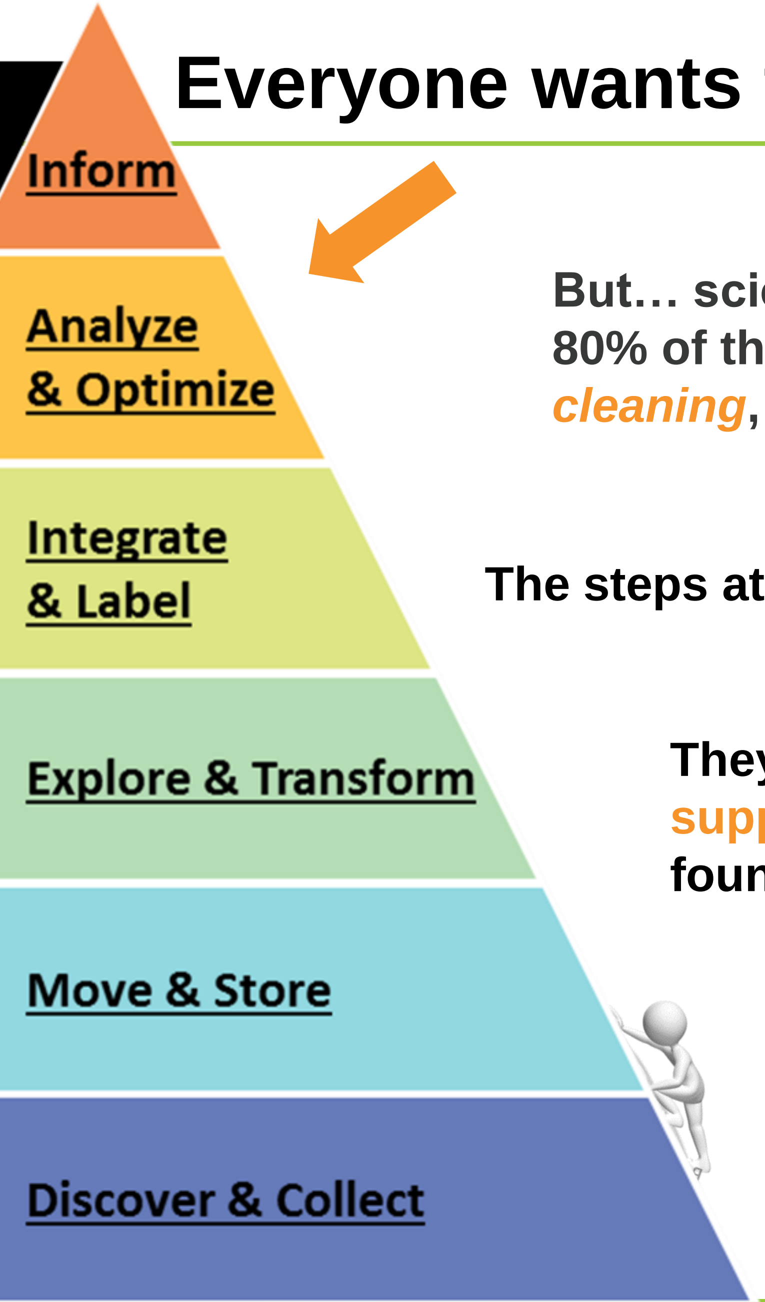
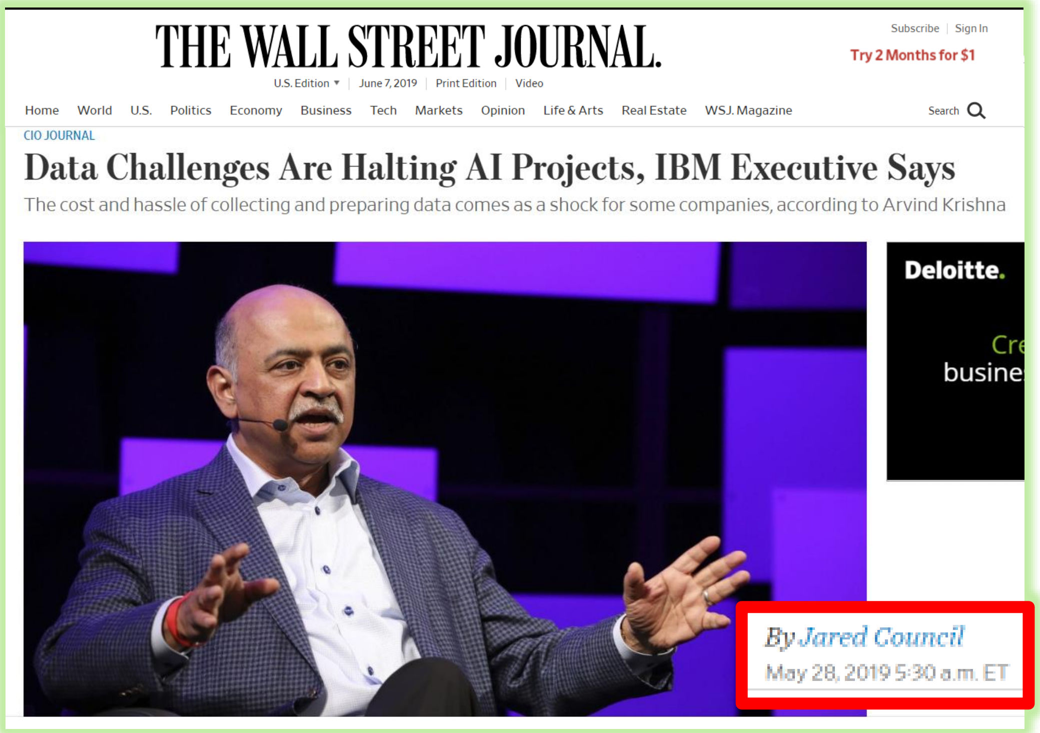
Everyone wants to jump to the top of the pyramid…



But… scientists still spend nearly 80% of their time *acquiring*, *cleaning*, and *organizing* data

The steps at the *bottom* must come first

They require leadership & support to ensure a solid data foundation for future R&D



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CIO JOURNAL

Data Challenges Are Halting AI Projects, IBM Executive Says

The cost and hassle of collecting and preparing data comes as a shock for some companies, according to Arvind Krishna

Deloitte.

Cre
busine

By Jared Council
May 28, 2019 5:30 a.m. ET

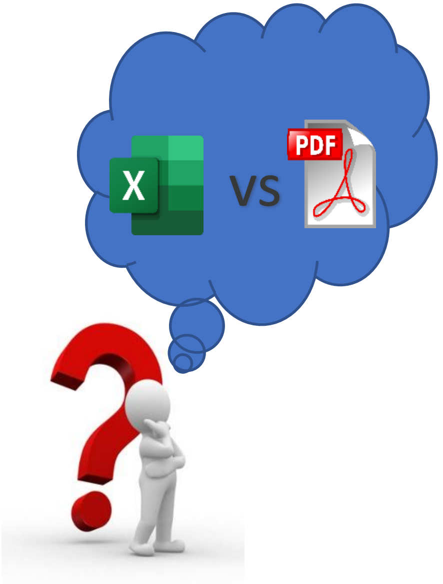
"Invest 5% of research funds in ensuring data are reusable. Funders hold the stick: they should disburse no further funding without a data stewardship plan."
- *Nature*, February 2020

nature
International weekly journal of science

Data are the energy for AI and analysis

SmartSearch©: Conquering the Data Avalanche

- **How do you currently search?**
  - Type in a few keywords
  - Skim the top few results
  - Type in more keywords and try again



- **How do you find and connect to something relevant?**
  - Open a file / web page
  - Read it (skim it)
  - Decide if it’s relevant

What is SmartSearch©?

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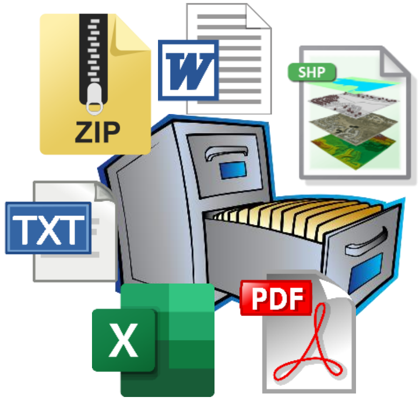
Problem:

You like these files.

You want to find more data relevant to the content of these files



Solution:

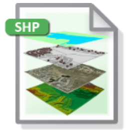
NETL SmartSearch©

SmartSearch automates data discovery by …

1) **Analyzing** content you like

2) **Finding** new content via www, local, enterprise data stores

3) Telling you **how relevant** the discovered data is to what you like



Input

Discovered

Benefits of SmartSearch©

- **Infinitely Scalable (Automated) Data Discovery**
  - Analyze millions+ of files and generate comparison metrics
  - Generate topic models, categorization, recommendations
  - Desktop, cluster, cloud

- **Treat geospatial data like a document**
  - Automatically extract text from geospatial data (shapefiles, geodatabases)
  - Compare textual vs geospatial data to identify relevancy
- **Search for meta tags within HTML body of discovered web sites**
  - i.e., find map tags
- **Analyze archive files – even archives within archives (zips within zips, etc)**
  - Process every file – docs, spatial, etc

AI/ML in SmartSearch©

NETL SmartSearch

- SmartSearch built via cloud native design principles
- Combines 'cluster of clusters', Spark, Kubernetes, and data lakes for massively scalable compute infrastructure
- Natural Language Processing via SparkNLP
    - Distributed NLP processing via the Spark framework
    - Implemented via SparkML Pipelines
    - Provides thousands of pretrained models and pipelines (Glove, Bert, Onto, etc)
    - Custom models can be implemented and trained within same distributed framework
- Machine Learning via SparkML
    - Distributed ML processing via the Spark framework
    - SmartSearch Recommendation Engine
    - LDA Topic Modeling
    - Named Entity Recognition (NER)
    - Question Answering
    - Summarization

SmartSearch© In-Use

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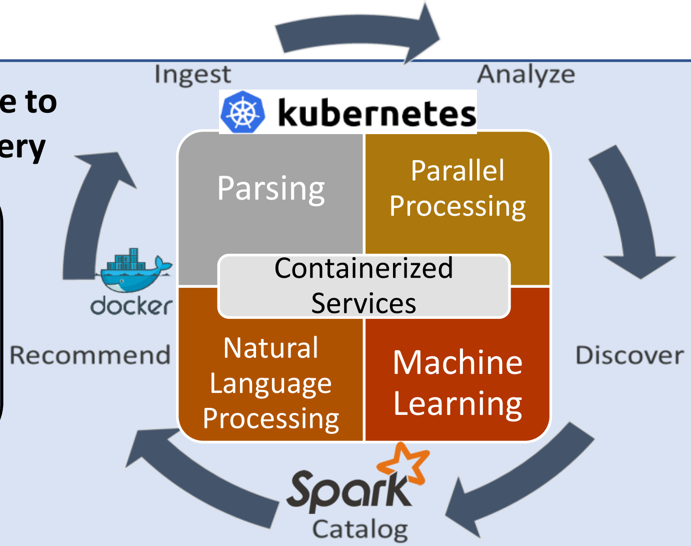
AI informed approach

Challenge: data infrastructure to AI/ML enhanced data discovery

Employing AI/ML tools to find open resources

NETL SmartSearch



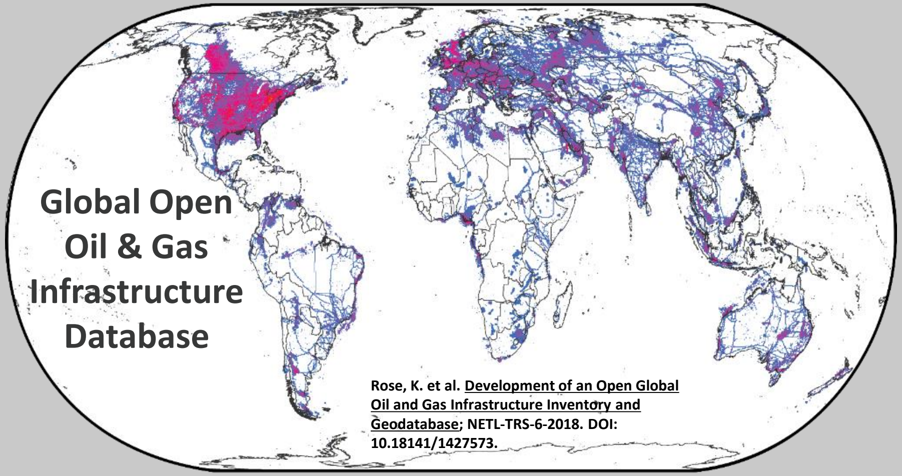
SmartSearch leverages ML+NLP to:

1) **Analyzing** content you like
2) **Finding** new content via www, local, enterprise data stores
3) Telling you **how relevant** the new data is to what you like

Opportunity:

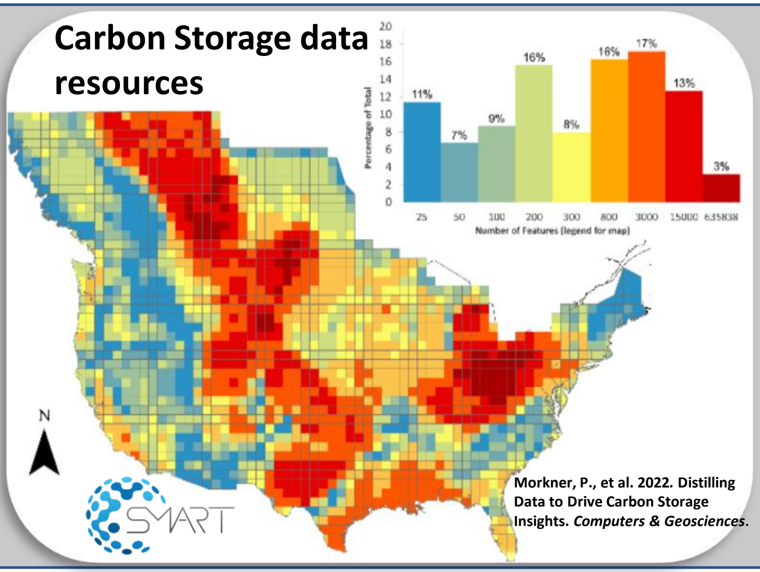
Infinitely scalable to return text, graphical, tabular, image, html, spatial, etc result

Example applications to date



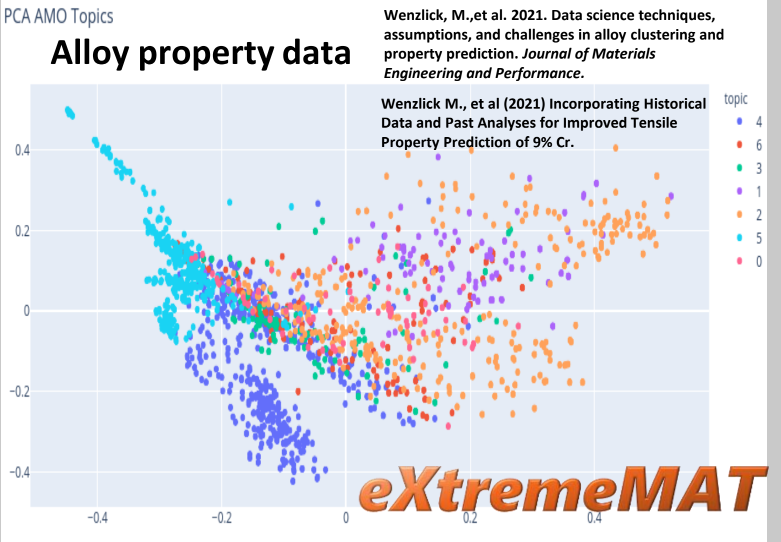
Global Open Oil & Gas Infrastructure Database

Rose, K. et al. Development of an Open Global Oil and Gas Infrastructure Inventory and Geodatabase; NETL-TRS-6-2018. DOI: 10.18141/1427573.



Carbon Storage data resources

Morkner, P., et al. 2022. Distilling Data to Drive Carbon Storage Insights. *Computers & Geosciences*.



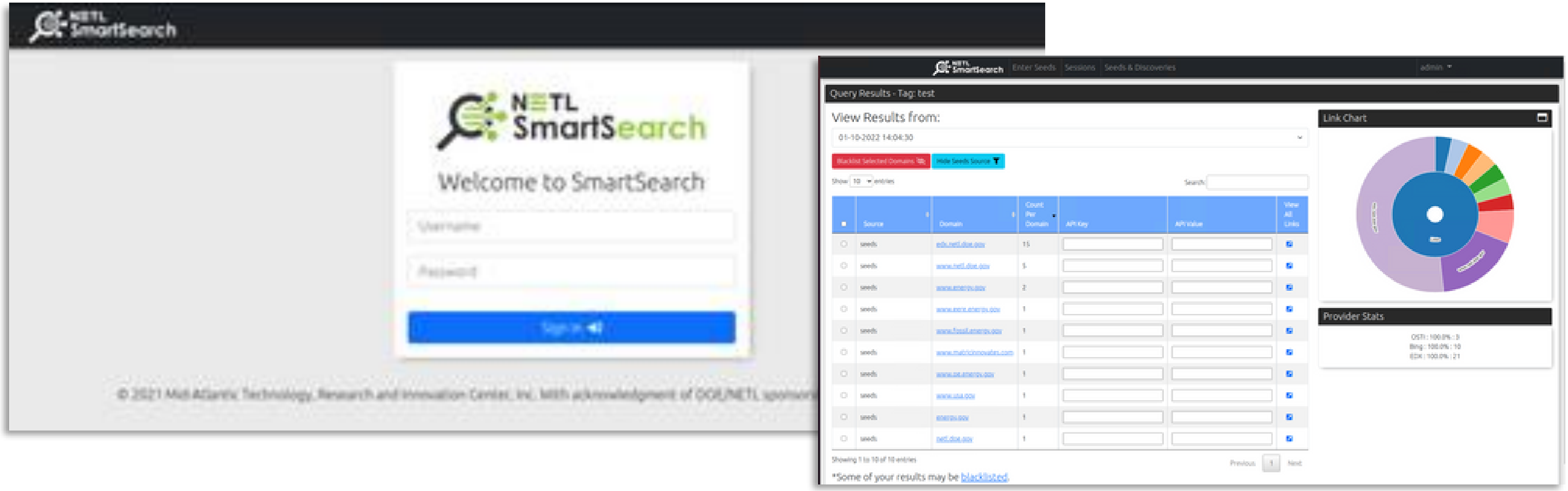
Alloy property data

Wenzlick, M.,et al. 2021. Data science techniques, assumptions, and challenges in alloy clustering and property prediction. *Journal of Materials Engineering and Performance.*

Wenzlick M., et al (2021) Incorporating Historical Data and Past Analyses for Improved Tensile Property Prediction of 9% Cr.

Summary

- SmartSearch© automates the data discovery process by using a scalable compute environment coupled with NLP and ML
- Will be integrated within EDX
- SmartSearch supports ongoing research projects
- SmartSearch used to evaluate cloud providers (GCP, AWS, Azure)



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Query Results - Tag: test

View Results from: 01-10-2022 14:04:30

Show 10 entries   Search:

	Source	Domain	Count Per Domain	API Key	API Value	View All Links
○	seeds	edx.netl.doe.gov	15			
○	seeds	www.netl.doe.gov	5			
○	seeds	www.energy.gov	2			
○	seeds	www.eere.energy.gov	1			
○	seeds	www.fossil.energy.gov	1			
○	seeds	www.matricinnovates.com	1			
○	seeds	www.ne.energy.gov	1			
○	seeds	www.usa.gov	1			
○	seeds	energy.gov	1			
○	seeds	netl.doe.gov	1			

Showing 1 to 10 of 10 entries

*Some of your results may be blacklisted.

OSTI : 100.0% : 3
Bing : 100.0% : 10
EDX : 100.0% : 21

https://edx.netl.doe.gov/sami/

Thank you!

References:

- Morkner, P., et al. 2022. Distilling Data to Drive Carbon Storage Insights. *Computers & Geosciences*.
- Rose, K. et al. Development of an Open Global Oil and Gas Infrastructure Inventory and Geodatabase; NETL-TRS-6-2018. DOI: 10.18141/1427573
- Wenzlick, M.,et al. 2021. Data science techniques, assumptions, and challenges in alloy clustering and property prediction. *Journal of Materials Engineering and Performance.*
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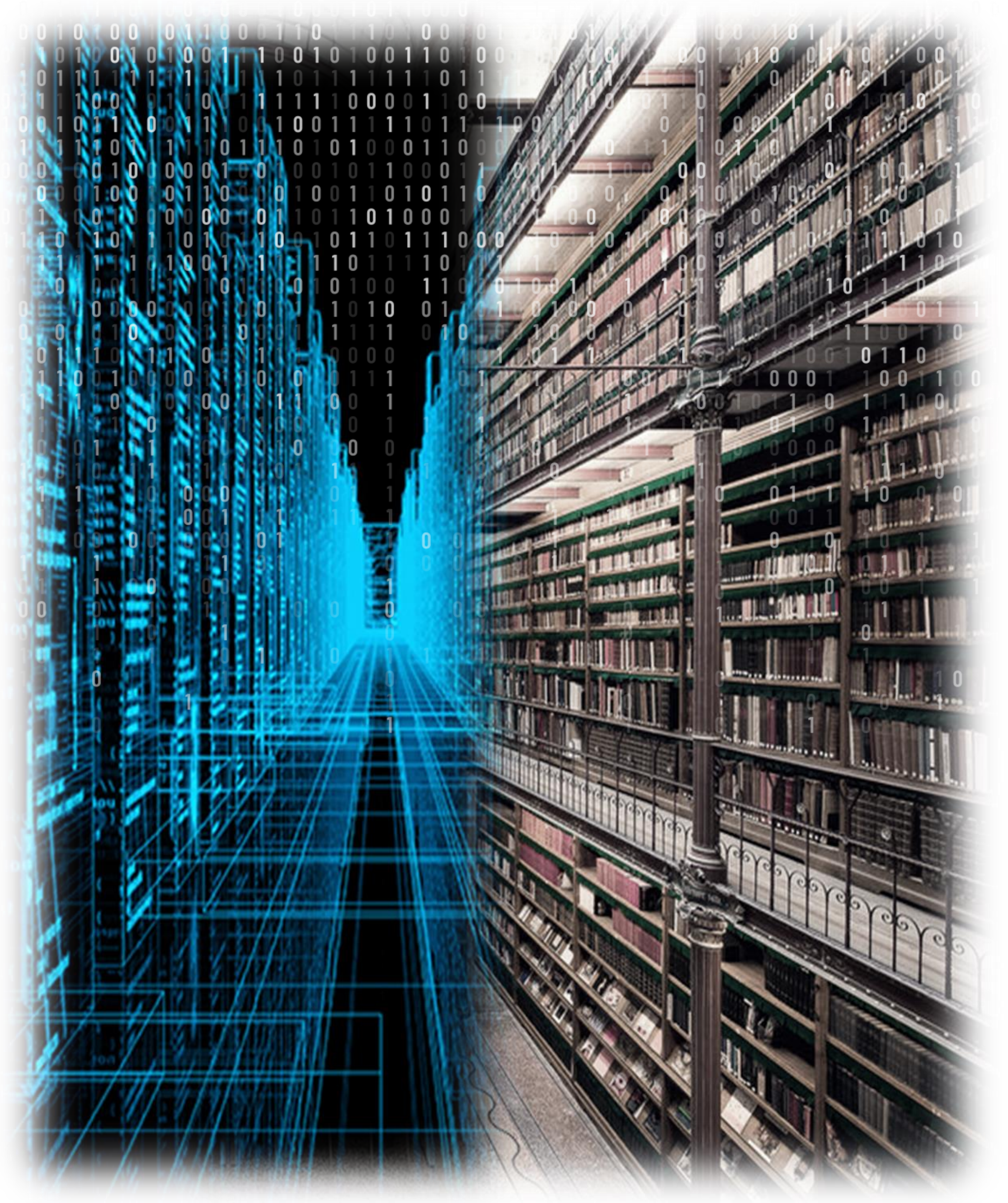

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