bpx energy

- High quality US onshore position

- Portfolio positioned in the core of the Permian, Eagle Ford and Haynesville shale plays

- Driving operational excellence through our focus on safety and environmental stewardship

Denver, CO
bpx energy Headquarters

Haynesville
537k net acres[1]

Permian
84k net acres

Houston, TX
bpx energy Office

Eagle Ford
371k net acres

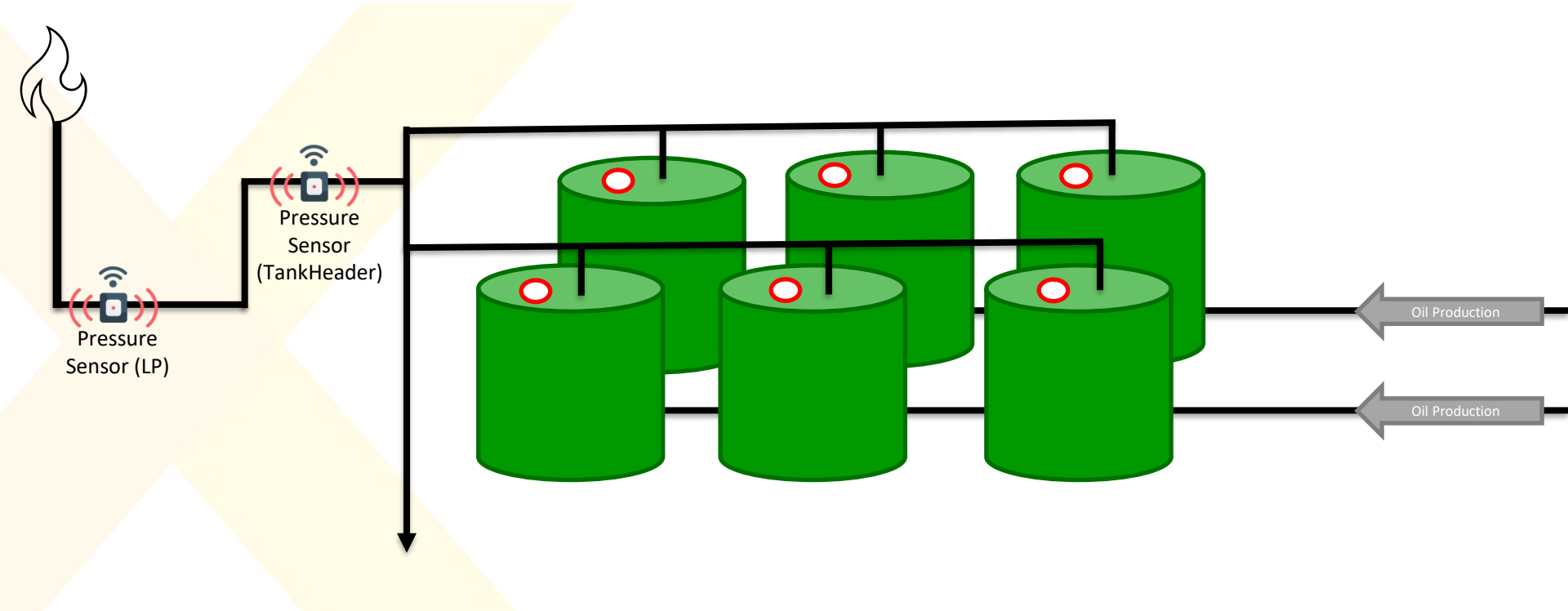Acreage data as of YE21 [1] Excludes mineral leasehold

What a Thief Hatch Is and How It Works

- *In the oilfield, a thief hatch is a closable aperture in a tank or vessel. They are normally used on low pressure and atmospheric tanks. They are used to take samples of the tank's contents, determining the level of the tank and protect the tank from over pressure and excessive vacuum.*

- *When working with oil tanks, it's important to close the thief hatch after finishing tasks to avoid safety and environmental hazards. If the hatch is left open for extended period, it can increase the risk of fire and harm to workers due to the presence of combustible gases.*

- *Additionally, it may result in environmental damage and fines or penalties from regulatory bodies. Thief hatches may also be opened from process events, such as an event where higher than standard operating pressure is pushed to the tanks.*
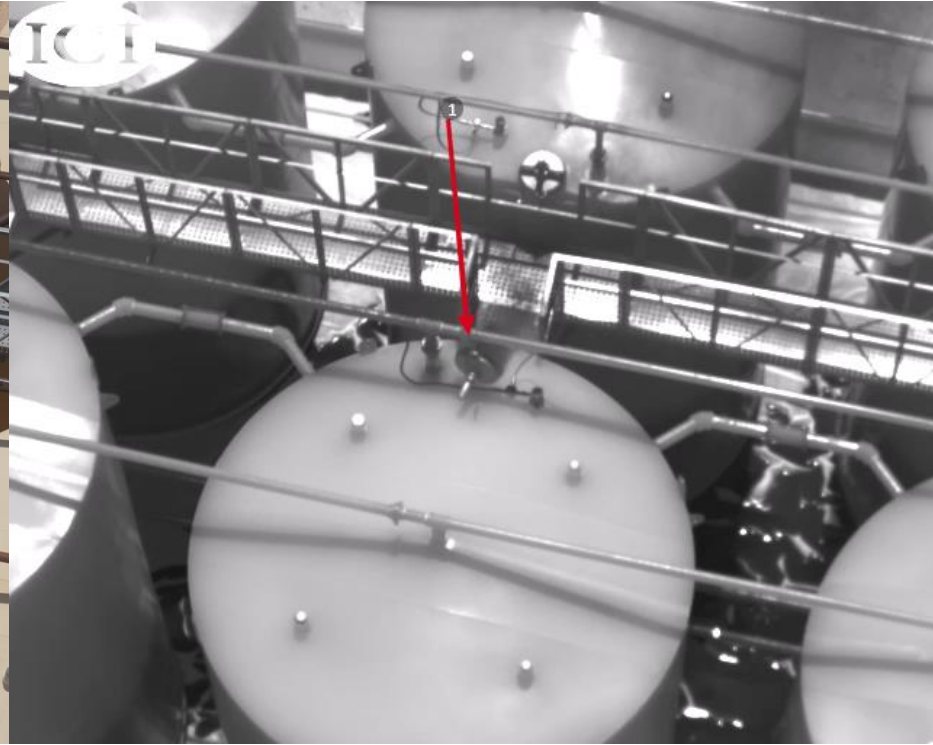
Oil Tank and Thief Hatch

Oil Tank and Thief Hatch

FlareLPheaderPressureCurr is mounted close to the Flare.
FlareTankHeaderPressureCurr is mounted in the header for all of the
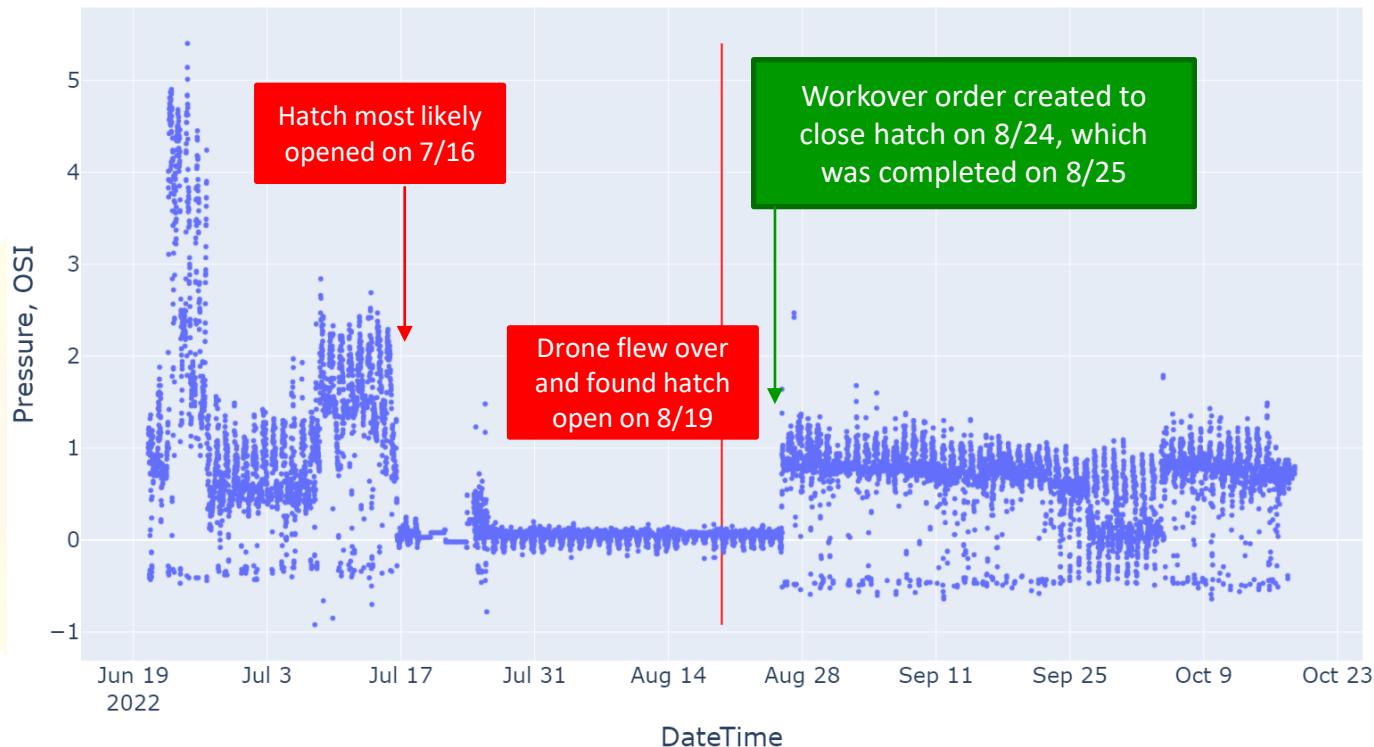tanks above them, could be closer to either the 1st or the last tank.

What does an open thief hatch look like?

Open Thief Hatch Event Example - 1

Facility ID: 10085460, STATE TUNSTILL 56-T2-6, hatch open: 2022-08-19T13:49:00.000
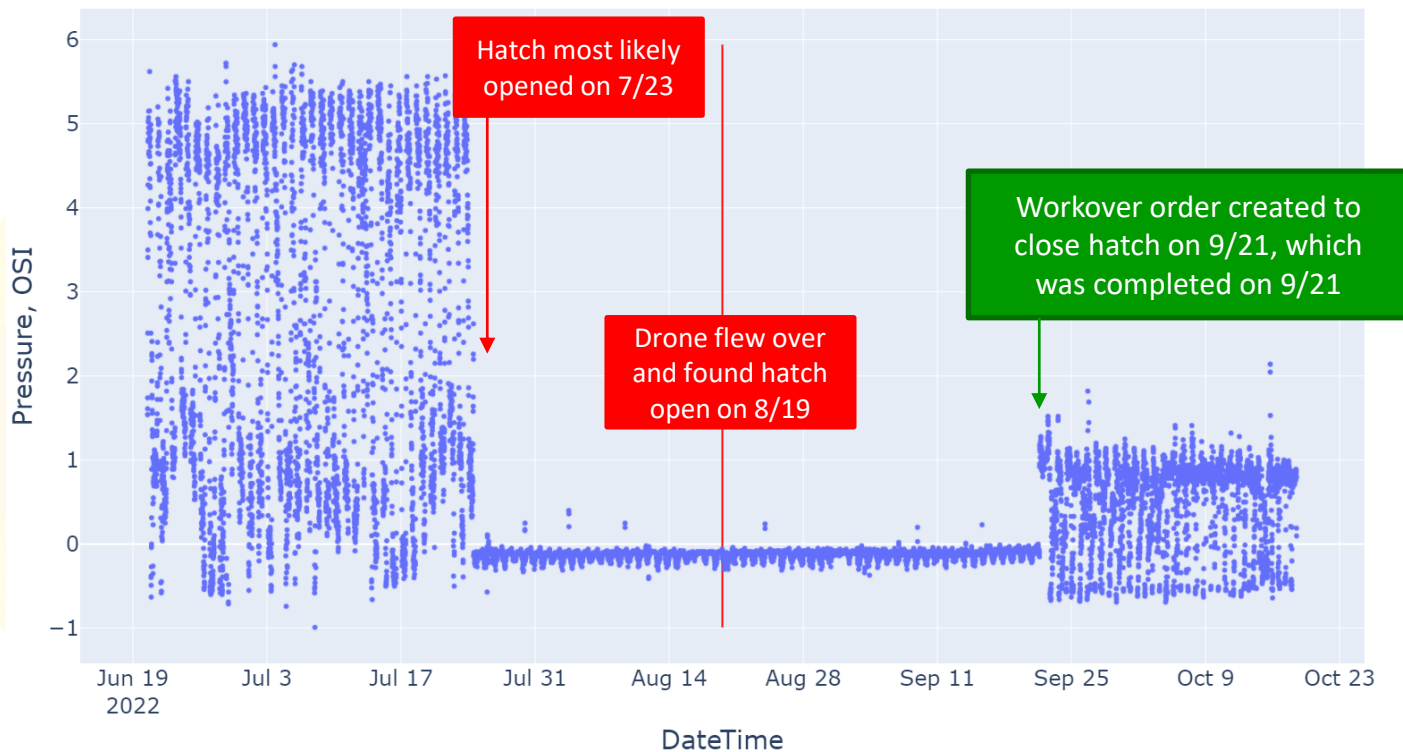

Hatch most likely opened on 7/16

Drone flew over and found hatch open on 8/19

Workover order created to close hatch on 8/24, which was completed on 8/25

created_date	enbase_asset_id	assetType	sourceSystemId	facility_id	corp_id	workOrderDescription	workOrderResolutionDescription	workOrderActualsStartDate	workOrderActualeEndDate
2022-08-24	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Got a drone finding indicating there's an open thief hatch, need air crew to close it	Thief hatch has been closed.	NULL	2022-08-25
2022-12-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Troubleshoot EPA finding	Didn't find any thief hatch venting or flare issues. EPA finding was an open thief hatch that was closed shortly after	NULL	2022-12-09
2020-07-08	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Kairos Identified Methane Emissions during flyover. Please utilize FLIR/OGI camera and check for leaks	Eddie performed a test with the FLIR camera "WATER TANK 801 & 802 & OT 701 LEAKING THRU THIEF HATCH". I will move a WM to maintenance	2020-07-19	2020-07-29
2020-12-28	Asset-Facility-10085460	Facility	10085460	10085460	NULL	EPA - Tank hatch emissions identified. Examine facility for blowby condition from separators and compressors. Inspect / clean thief hatches and replace gaskets as necessary. Record findings in resolution.	replaced the thief hatch gaskets and cleaned surfaces, they had significant build up of scale/corrosion.	2021-01-04	2021-01-04
2021-12-12	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Enardo thief hatch center aluminum piece is corroded will need replaced and new gaskets.	thief hatches have been cleaned, inspected and all gaskets replaced.	2021-12-30	2021-12-30
2022-02-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Please replace all thief hatch gaskets both vacuum and pressure side and clean mating surfaces while site is down for vent header cleanout	replaced all thief hatch gaskets both pressure and vacuum sides, cleaned mating surfaces.	2022-02-27	2022-02-09
2023-01-11	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Inspect tanks and flare	Flare and thief hatches look good.	2023-01-11	2023-01-11
2023-02-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	TCEQ site inspection	Identified packing leak on Axip's V5797 and reported to Axip for repairs. Thief hatches closed, did not identify any other leak/venting after inspecting location	2023-02-09	2023-02-09

Open Thief Hatch Event Example - 2

bp

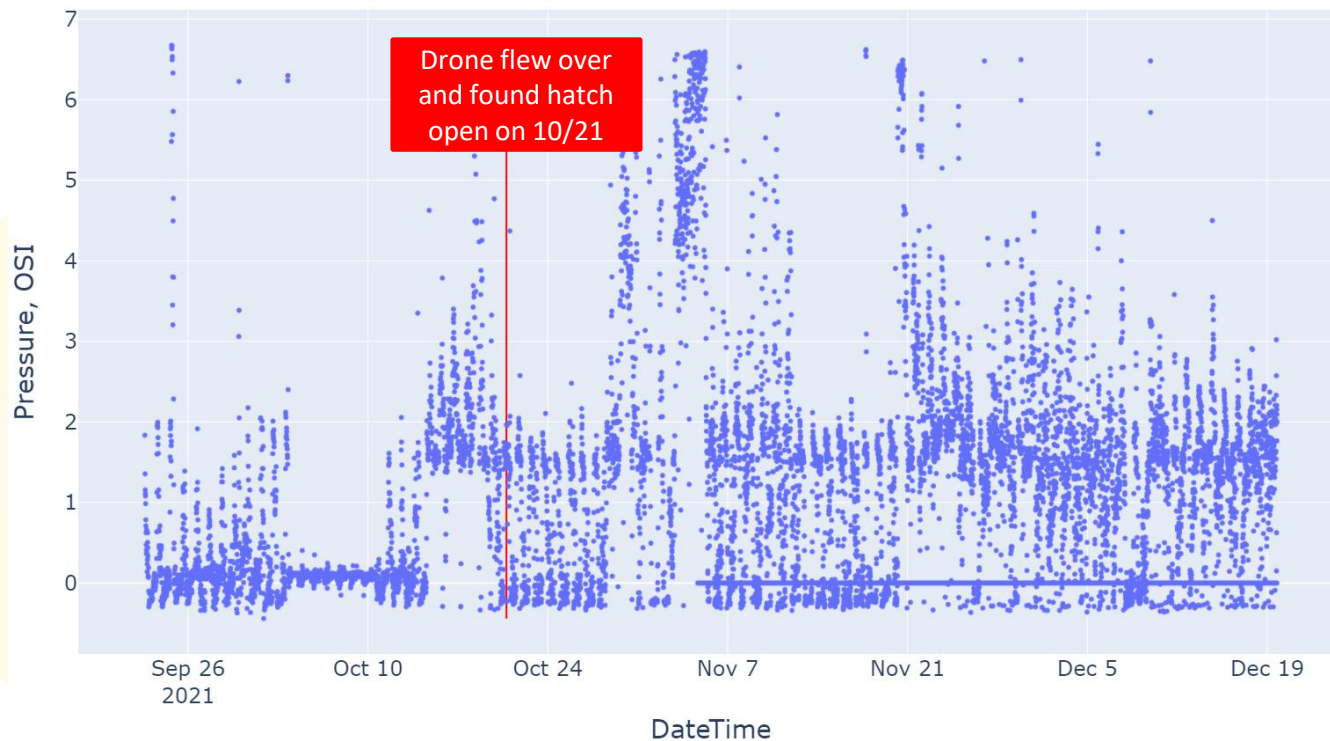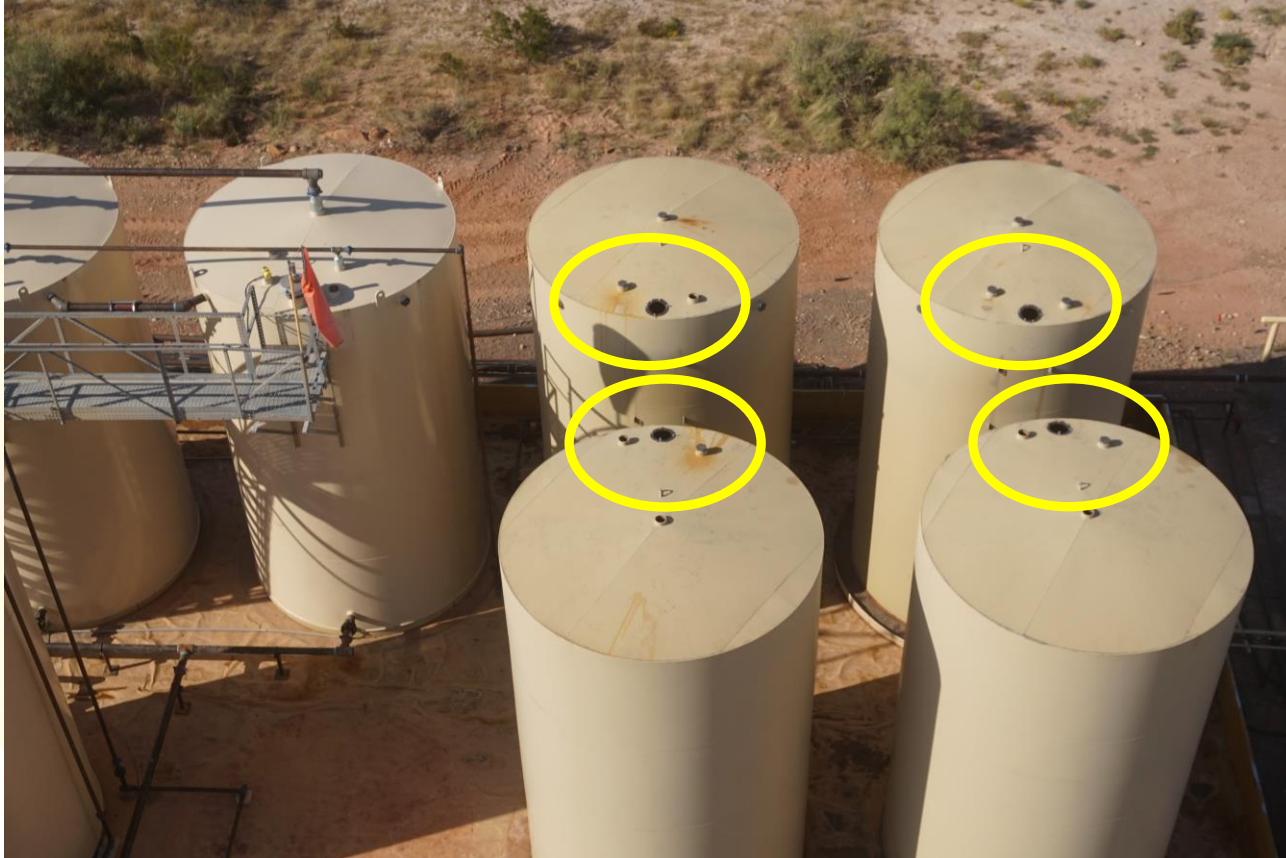Facility ID: 10086098, BOLD BLAKE STATE 57-T2-2, hatch open: 2022-08-19T13:11:00

Open Thief Hatch Event Example - 3

Facility ID: 10085941, DELA STATE 58-T2-48, hatch open: 2021-10-20T18:42:17.00000

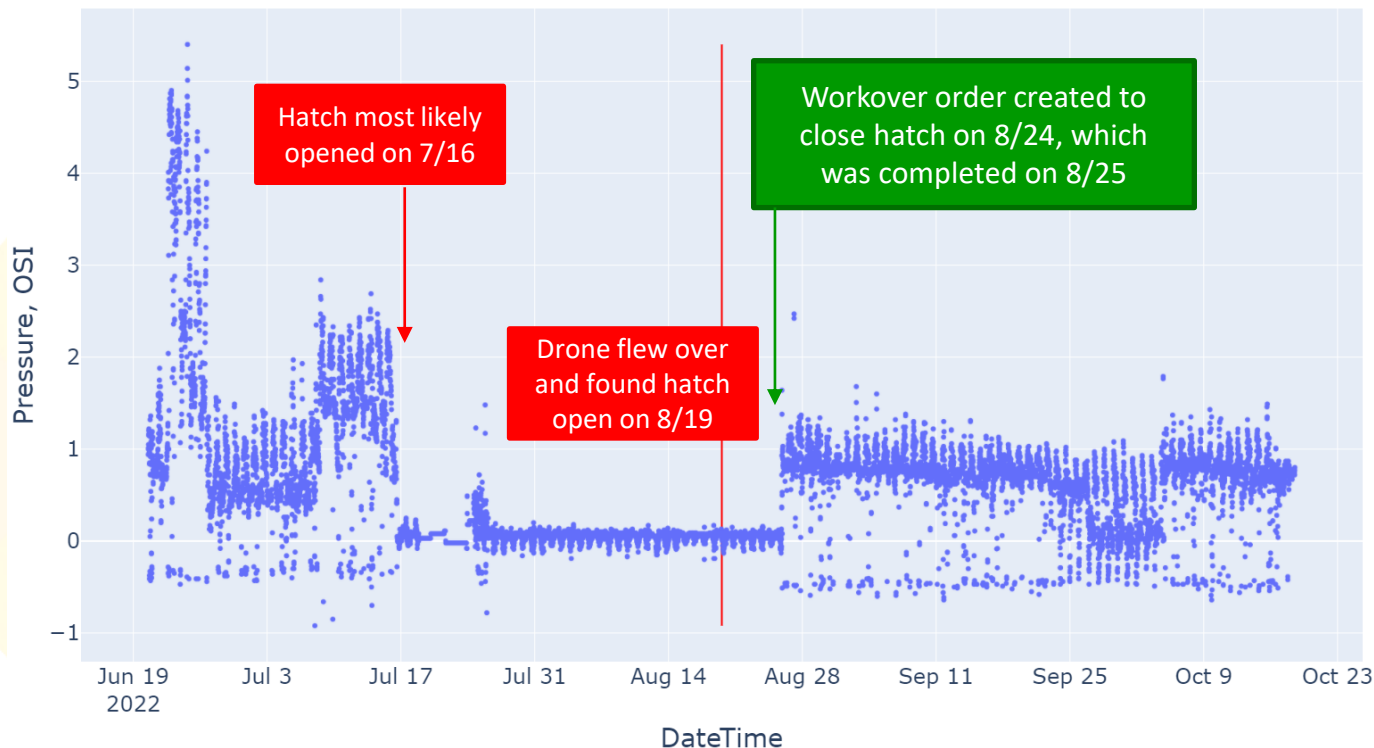Drone flew over and found hatch open on 10/21

Open Thief Hatch Event Example - 3

Challenge 1: Manually identify open thief hatch cases: time series data with evidence of drone or work order records to show hatches were open

Facility ID: 10085460, STATE TUNSTILL 56-T2-6, hatch open: 2022-08-19T13:49:00.000

Hatch most likely opened on 7/16

Drone flew over and found hatch open on 8/19

Workover order created to close hatch on 8/24, which was completed on 8/25

created_date	enbase_asset_id	assetType	sourceSystemId	facility_id	corp_id	workOrderDescription	workOrderResolutionDescription	workOrderActualsStartDate	workOrderActualeEndDate
2022-08-24	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Got a drone finding indicating there's an open thief hatch, need air crew to close it	Thief hatch has been closed.	NULL	2022-08-25
2022-12-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Troubleshoot EPA finding	Didn't find any thief hatch venting or flare issues. EPA finding was an open thief hatch that was closed shortly after	NULL	2022-12-09
2020-07-08	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Kairos Identified Methane Emissions during flyover. Please utilize FLIR/OGI camera and check for leaks	Eddie performed a test with the FLIR camera "WATER TANK 801 & 802 & OT 701 LEAKING THRU THIEF HATCH". I will move a WM to maintenance	2020-07-19	2020-07-29
2020-12-28	Asset-Facility-10085460	Facility	10085460	10085460	NULL	EPA - Tank hatch emissions identified. Examine facility for blowby condition from separators and compressors. Inspect / clean thief hatches and replace gaskets as necessary. Record findings in resolution.	replaced the thief hatch gaskets and cleaned surfaces, they had significant build up of scale/corrosion.	2021-01-04	2021-01-04
2021-12-12	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Enardo thief hatch center aluminum piece is corroded will need replaced and new gaskets.	thief hatches have been cleaned, inspected and all gaskets replaced.	2021-12-30	2021-12-30
2022-02-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Please replace all thief hatch gaskets both vacuum and pressure side and clean mating surfaces while site is down for vent header cleanout	replaced all thief hatch gaskets both pressure and vacuum sides, cleaned mating surfaces.	2022-02-27	2022-02-09
2023-01-11	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Inspect tanks and flare	Flare and thief hatches look good.	2023-01-11	2023-01-11
2023-02-09	Asset-Facility-10085460	Facility	10085460	10085460	NULL	TCEQ site inspection	Identified packing leak on Axip's V5797 and reported to Axip for repairs. Thief hatches closed, did not identify any other leak/venting after inspecting location	2023-02-09	2023-02-09

Challenge 2: Develop algorithm to classify time series data to determine whether thief hatch is open or not at any given time

Facility ID: 10085460, STATE TUNSTILL 56-T2-6, hatch open: 2022-08-19T13:49:00.000

Hatch: open

Hatch: open
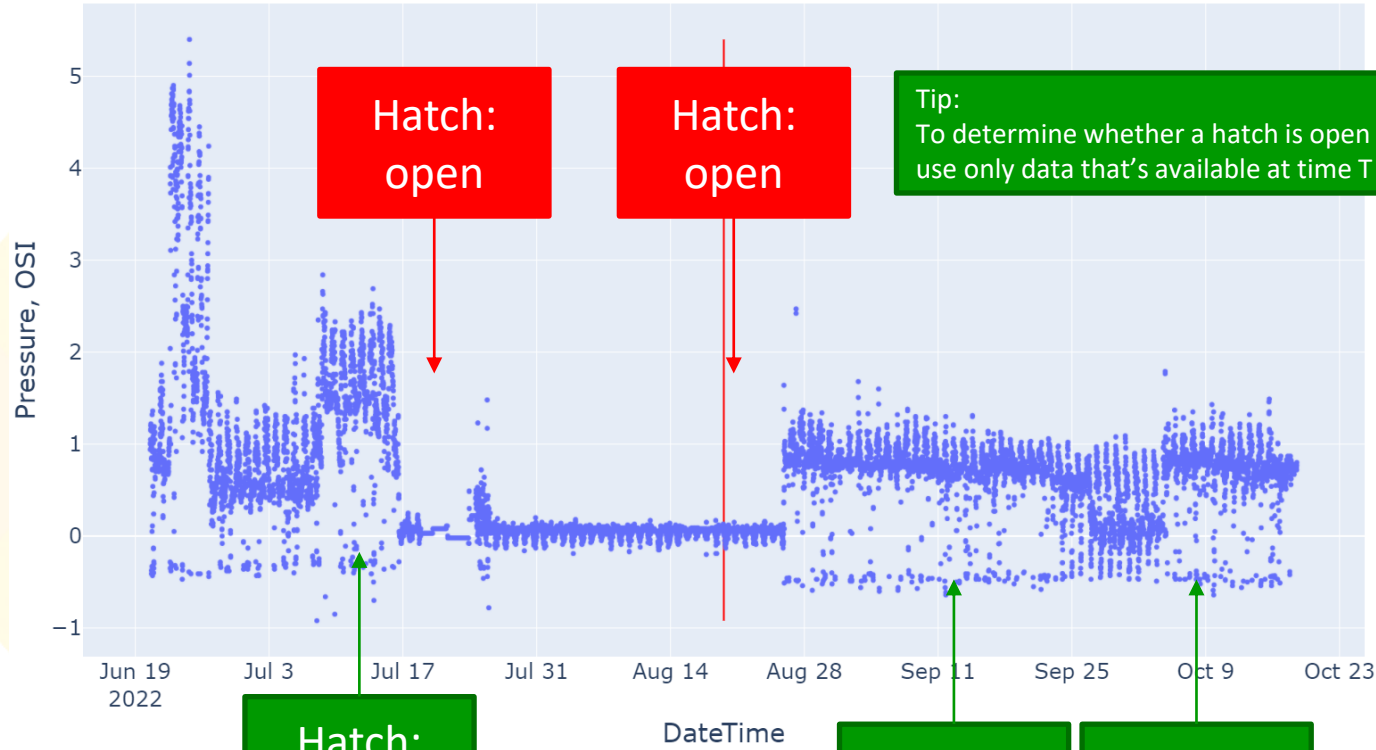
Tip:
To determine whether a hatch is open or not at time T, use only data that's available at time T

Hatch: closed

Hatch: closed

Hatch: closed

Challenge 3: Use the algorithm you developed or new algorithm to identify retrospectively open thief hatches in the past that's not detected by drone

Facility ID: 10085651, OLYPHANT 57-T1-43 A, hatch open: 2021-10-20 18:42:17

Bonus: find drone/work order records to prove your prediction is correct.
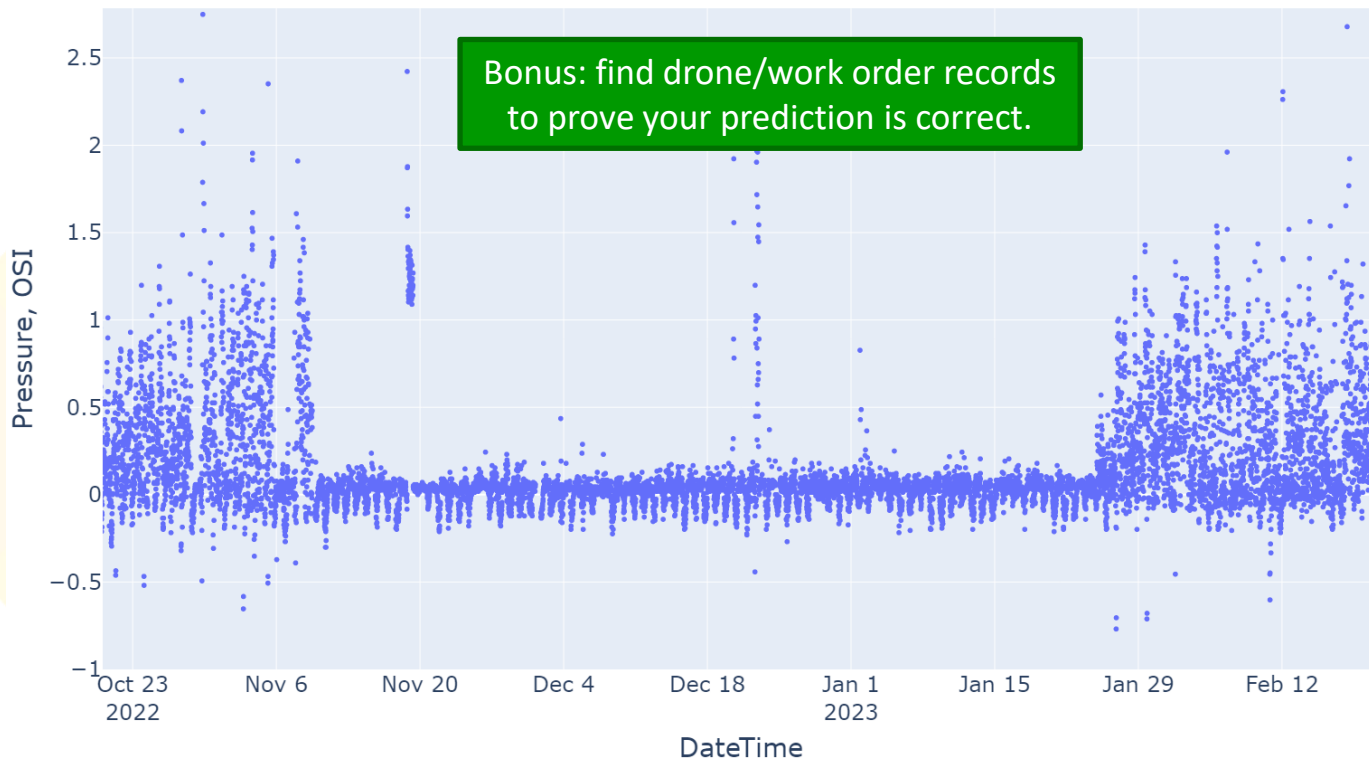
Classification Metrics

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN} = \frac{\text{Correct Predictions}}{\text{Total Predictions}}$$

$$\text{Precision} = \frac{TP}{TP + FP} = \frac{\text{Predictions Actually Positive}}{\text{Total Predicted positive}}$$

$$\text{Recall} = \frac{TP}{TP + FN} = \frac{\text{Predictions Actually Positive}}{\text{Total Actual positive}}$$

$$\text{F1-Score} = 2 * \frac{(\text{Recall}*\text{Precision})}{(\text{Recall} + \text{Precision})}$$

The predicted value is positive and its positive

Type I error : The predicted value is positive but it False

Type II error : The predicted value is negative but its positive

The predicted value is Negative and its Negative

ACTUAL VALUES

PREDICTED VALUES

	Positive	Negative
Positive	TP	FP
Negative	FN	TN

Reference: https://medium.com/analytics-vidhya/what-is-a-confusion-matrix-d1c0f8feda5

Time Series Data (Tank Header Pressure) Example

	frequency	method	timestamp	TagType	FACILITY_ID	FACILITY_NAME	numeric_value
0	10 minute	Spot	2022-05-11 13:59:34.096	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.699997
1	10 minute	Spot	2022-05-11 14:14:34.082	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.779999
2	10 minute	Spot	2022-05-11 14:29:34.204	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	-0.250000
3	10 minute	Spot	2022-05-11 14:44:34.426	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.860001
4	10 minute	Spot	2022-05-11 14:59:34.409	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.940002
...	...	...	...	...	...	...	...
17730	hourly	Spot	2022-09-06 22:14:33.667	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.959999
17731	hourly	Interpolated	2022-09-06 23:00:00.000	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.938255
17732	hourly	Spot	2022-09-06 23:14:34.554	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.879997
17733	hourly	Maximum	2022-09-06 23:44:33.895	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.919998
17734	hourly	Interpolated	2022-09-07 00:00:00.000	FlareTankHeaderPressureCurr	10085460	STATE TUNSTILL 56-T2-6	0.820291

Name	Description
Frequency	How often the measurement is polled
Method: Spot	Actual measurement
Method: Interpolated	Actual measurement was from a different time but the result is interpolated at the frequency in question. Note: Interpolated results can be meaningless sometimes as it could simply duplicate of the last known value in many cases when the interpolated result comes back NULL
FlareLPHeaderPressureCurr	Pressure sensor is mounted close to the Flare
FlareTankHeaderPressureCurr	Pressure sensor is mounted in the header for all of the tanks above them, could be closer to either the 1st or the last tank.
TankHeaderPressure**1**Curr	Pressure sensor is mounted in the header for all of the tanks above them, could be closer to either the 1st or the last tank.
TankHeaderPressure**2**Curr	

Work Order Data Example
(when work was done related to thief hatch)

created_date	enbase_asset_id	assetType	sourceSystemId	facility_id	corp_id	workOrderDescription	workOrderResolutionDescription	workOrderActualsStartDate	workOrderActualsEndDate
2022-05-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	No issues were observed	Normal Operations	2022-05-07	2022-05-07
2022-05-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	GLC is currently down	Will return at a later date	2022-05-07	2022-05-07
2022-05-13	Asset-Facility-10085460	Facility	10085460	10085460	NULL	OOOOa inspection.	OOOOa inspection completed.	NULL	2022-05-13
2022-06-24	Asset-Facility-10085460	Facility	10085460	10085460	NULL	OOOOa inspection.	OOOOa inspection completed.	NULL	2022-06-24
2022-07-08	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Shut in for BWTI	Waiting on construction for BWTI	2022-07-08	2022-07-08
2022-07-11	Asset-Facility-10085460	Facility	10085460	10085460	NULL	OOOOa inspection.	OOOOa inspection completed.	NULL	2022-07-11
2022-07-23	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Line power brought to location. Please remove generator and all associated equipment	Gen has been removed from location.	NULL	2022-07-23
2022-07-23	Asset-Facility-10085460	Facility	10085460	10085460	NULL	POL following power upgrade	POL following power upgrade	2022-07-23	2022-07-23
2022-07-30	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Compressor suction solenoid	Changed SOV 11-30-22 DP	NULL	2022-07-30
2022-07-30	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Start compressor	Tried to start compressor - suction solenoid needs replaced	2022-07-30	2022-07-30
2022-07-31	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Start compressor after suction solenoid replacement	Started compressor	2022-07-31	2022-07-31
2022-08-22	Asset-Facility-10085460	Facility	10085460	10085460	NULL	OOOOa inspection.	OOOOa inspection completed.	NULL	2022-08-22
2022-08-24	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Got a drone finding indicating there's an open thief hatch, need air crew to close it	Thief hatch has been closed.	NULL	2022-08-25
2022-09-04	Asset-Facility-10085460	Facility	10085460	10085460	NULL	OOOOa inspection.	OOOOa inspection completed.	NULL	2022-09-04
2022-09-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Secondary containment needs cleaned. Water build up from rain.	Complete	NULL	2022-09-07
2022-09-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Insufficient covering on piping and electrical wires.Dirt has washed out. Please repair	Put new base material in eroded areas	NULL	2022-09-07
2022-09-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Facility oil deferment	Site check completed. Dewatering.	2022-09-07	2022-09-07
2022-09-12	Asset-Facility-10085460	Facility	10085460	10085460	NULL	oil deferment	increased buyback, gaslift rate holding steady at 550, compressor running but...	2022-09-12	2022-09-12
2022-09-15	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Troubleshoot deferral	Routed due to deferral caused by a low 24 hour volume. Choke was open, c...	2022-09-15	2022-09-15
2022-09-16	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Fill methanol tanks, check pumps and pump rates	methanol filled. Complete	2022-09-26	2022-09-16
2022-09-17	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Site check	Decreased BB setpoint 30psi and increased GL 50mcf.	2022-09-17	2022-09-17
2022-09-19	Asset-Facility-10085460	Facility	10085460	10085460	NULL	HP Separator water dump line has a 1" vent. This pipe needs to be rotated so the 1" ...	Complete	NULL	2022-09-19
2022-09-21	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Winterization checklist	Winterization checklist. Louvers did not close, methanol tank 3 needs 400 gal...	NULL	2022-09-21
2022-09-21	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Need 400 gallons of methanol for tank 3 by compressor	delivered 400 gals of meoh on 9/23	2022-09-23	2022-09-21
2022-09-22	Asset-Facility-10085460	Facility	10085460	10085460	NULL	shut in for Offset frac	shut in for off-set frac	2022-09-22	2022-09-22
2022-10-03	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Flare camera not functioning (IP 10.66.17.148) - Send Jameson Keating updated IP a...	Both cameras are fried. The IP of the flare camera is 10.66.17.147. A replac...	NULL	2022-10-03
2022-10-04	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Site check to confirm flare	Site check to verify flare was lit, got approval to open well back up being flare...	2022-10-04	2022-10-04
2022-10-05	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Facility deferment-Post RTP check	Frac hit mitigation. Site check completed. Chokes are full open.	2022-10-05	2022-10-05
2022-10-07	Asset-Facility-10085460	Facility	10085460	10085460	NULL	Check flare	Flare is lit. Not smoking. 0mcf	2022-10-07	2022-10-07

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Drone Data Example
(dates when drone detected open thief hatch)

Row	ID	BUSINESS_UNIT	ASSET	LATITUDE	LONGITUDE	DTM	FACILITY_ID	ENBASE_ASSET.	MISSION_NUM..	ANOMALY_TYPE	ANOMALY_DESC
1	1732	LaHa	LaHa	32.34489517	-93.47162681	2023-01-06 14:57:...	20000009	Asset-Well-1...	130	1	Thief Hatch Open
2	1731	LaHa	LaHa	32.3221465	-93.58032563	2022-12-21 10:10:...	20000032	Asset-Well-2...	130	1	Thief Hatch Open
3	1730	EAST	SOHA	31.38042396	-94.5072353	2022-12-09 10:50:...	10084684	Asset-Well-1...	128	1	Thief Hatch Open
4	1729	LaHa	LaHa	32.36763163	-93.45728627	2022-11-28 13:02:...	20000059	Asset-Well-2...	130	1	Thief Hatch Open
5	1728	Eagle Ford	Hawkville	28.30240266	-98.92957779	2022-11-11 11:47:0...	10085492	Asset-Well-1...	124	1	Thief Hatch Open
6	1727	LaHa	LaHa	32.36766964	-93.45725413	2022-11-08 10:21:...	20000059	Asset-Well-2...	126	1	Thief Hatch Open
7	1726	LaHa	LaHa	31.99162187	-93.39904997	2022-11-07 15:12:...	10085667	Asset-Well-1...	126	1	Thief Hatch Open
8	1725	LaHa	LaHa	32.28048206	-93.53509927	2022-11-07 10:48:...	10085624	Asset-Well-1...	126	1	Thief Hatch Open
9	1724	LaHa	LaHa	32.35290046	-93.50651199	2022-11-03 13:01:...	10085632	Asset-Well-1...	126	1	Thief Hatch Open
10	1723	LaHa	LaHa	32.50044676	-94.00944481	2022-11-02 12:02:...	10086027	Asset-Well-1...	126	1	Thief Hatch Open
11	1722	EAST	SOHA	31.31703757	-94.51661954	2022-10-30 13:24:...	10107214	Asset-Well-1...	123	1	Thief Hatch Open
12	1721	EAST	SOHA	31.40453135	-94.61958723	2022-10-29 12:02:...	10093961	Asset-Well-1...	123	1	Thief Hatch Open
13	1720	LaHa	LaHa	32.06516701	-93.4527157	2022-10-15 10:08:...	10085780	Asset-Well-1...	126	1	Thief Hatch Open

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Code Repo and Instructions

- Github repo with starter code
  - https://github.com/julianliu-bpx/open-thief-hatch-detection

- Follow this instruction for forking a repo.

- Each team creates a branch with its team name and submit code by deadline
  - readme file: your team member name and email

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Key Dates

- Info session and problem framing
  - Tuesday, Feb 28th, 4:00-5:30pm, Metals Hall

- Office hours (ask questions, gain clarity, etc. with BPX)
  - Friday, March 3rd, 12:00-12:30pm, Virtual
  - Monday, March 6th, 12:00-12:30pm, Virtual

- Presentation review (with Mines faculties)
  - Monday, March 6th: Draft presentation submitted to Canvas.
  - Tuesday, March 7th: Feedback on presentation returned to teams.

- Code and presentation submit by(for bpx to review code and evaluate solutions)
  - Wednesday, March 8th, 11:59pm

- Pitch presentations
  - Thursday, Mar 9th, 3:00-5:00pm, Marquez Atrium

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Scoring Rubrics

Criteria	Points (Total 100)
TECHNOLOGY-Challenge 1 (how many events identified)	10
TECHNOLOGY-Challenge 2 (does model classifies events accurately)	30
TECHNOLOGY-Challenge 3 (does model identifies events retrospectively well)	20
DESIGN (is solution easy to adapt)	15
PRESENTATION (is presentation clear)	15
CREATIVITY (is the solution creative)	10

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FAQ

- Programming language: Python preferred

- Recommended IDE: Jupyter notebook (describe what you did and why) with python script

- Presentation time: 10 minutes + 2 minutes for questions

- Non-Disclosure Agreement (NDA):
  - Everyone must sign NDA ('misc/Form BPX NDA (9.6.22).docx') and upload to your branch

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Prizes

- **1st place:**
  - $2500
  - Internship offer at bpx or interview for full time job at bpx
- **2nd place:**
  - $1500
  - Interview for internship at bpx
- **3rd place:**
  - $1000
  - Interview for internship at bpx