

# Demystifying AI, ML and Natural Language Processing

RESEARCH INNOVATION



**Sharang Phadke**  
Product Manager



**Peter Larson**  
Software Engineer



WSJ



# The AI Doctor Will See You Now

Artificial intelligence comes to the doctor's office, helping identify disease, monitor heart activity, stave off seizures



Global



***No longer science fiction, AI and robotics are transforming healthcare***

**NEW YORK POST**

## Google AI teaches itself to be smarter than doctors

By Mike Wehner, BGR

November 30, 2016 | 1:57pm



CIVIC

## Artificial Intelligence Continues to Change Health Care

Clinicians are getting smart new virtual partners to improve care.

By U.S. News Staff

# Objectives

- Walk away with a better understanding of the terms:
  - Artificial intelligence (AI)
  - Machine learning (ML)
  - Natural language processing (NLP)
- Feel more prepared to make informed decisions around the use cases of AI, ML, and NLP in your practice

# Agenda

- Terms & Definitions
- Guiding Principles
- Machine Learning @ Flatiron
- Takeaways
- Q&A

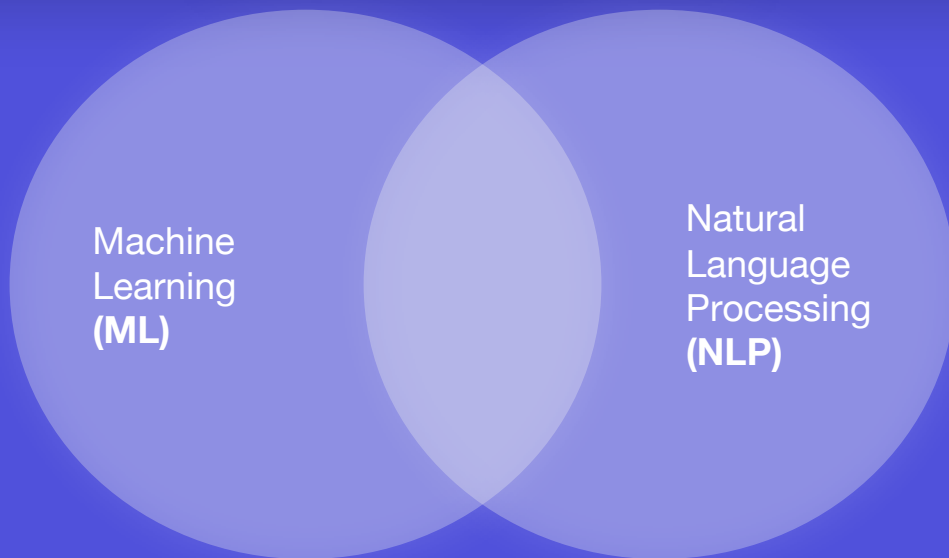


# Agenda

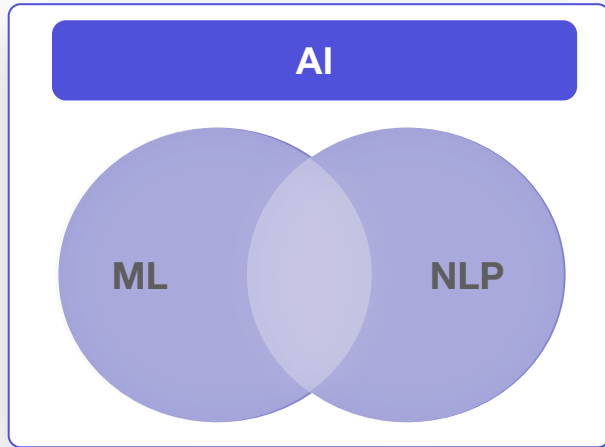
- **Terms & Definitions**
- Guiding Principles
- Machine Learning @ Flatiron
- Takeaways
- Q&A

# Definition of Terms

Artificial Intelligence **(AI)**



# Definition of Terms



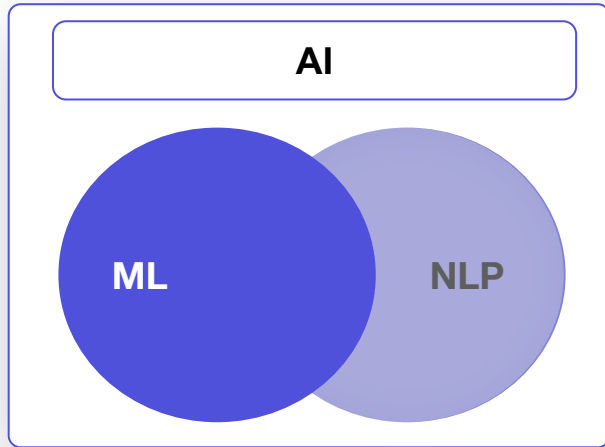
## Artificial Intelligence (AI):

the theory and development of computer systems **able to perform tasks that normally require human intelligence**, such as visual perception, speech recognition, decision-making, and translation between languages.

# Deep Blue



# Definition of Terms



## Machine Learning (ML):

the field of study that uses statistical techniques to give computers the **ability to learn without being explicitly programmed.**

# Machine Learning: Recognizing Faces

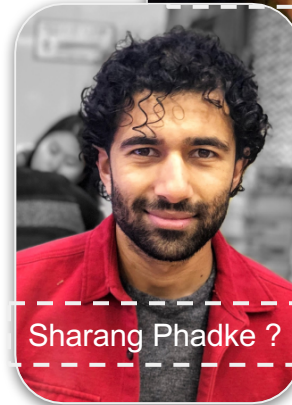
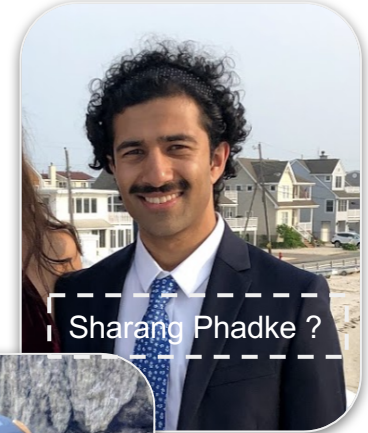
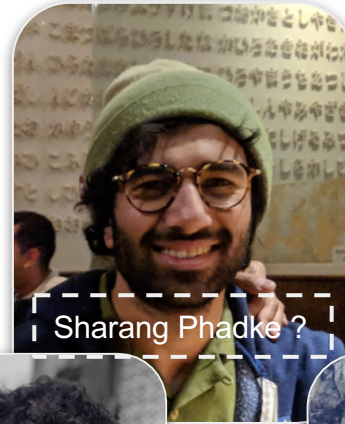
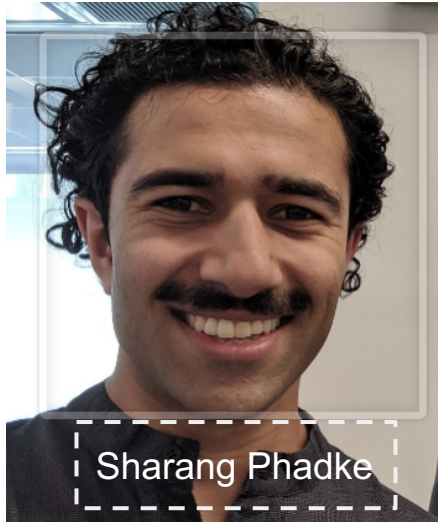


# Machine Learning: Recognizing Faces





# Machine Learning: Recognizing Faces







Same or different person?



Same



Different



Not sure

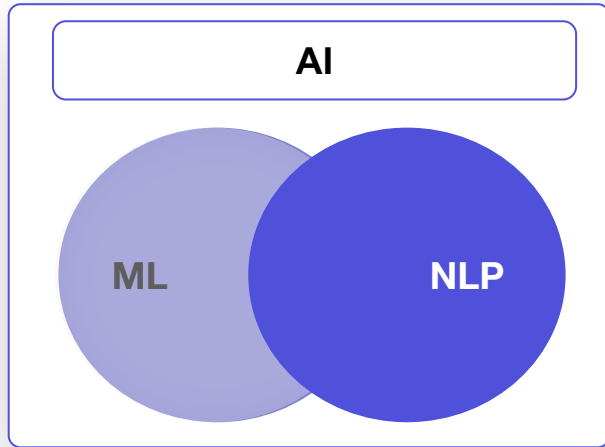
[Previous](#)

[Done](#)



Sharang Phadke  
~10 years ago

# Definition of Terms



## Natural Language Processing (NLP):

a collection of computational techniques that enable computers to analyze, understand, **derive meaning from and make use of human language.**

# NLP: Identifying Sentence Structures

## Visit note

Abd pain, nausea of unclear etiology.  
Diarrhea.  
Loss of appetite and weight loss.

MRI brain negative.

CT reviewed, progression of disease in the lungs, no abdominal pathology to explain nausea.

C diff (-).

### Recommendation/Plan:

Discussed disease progression with [redacted] and his family today.

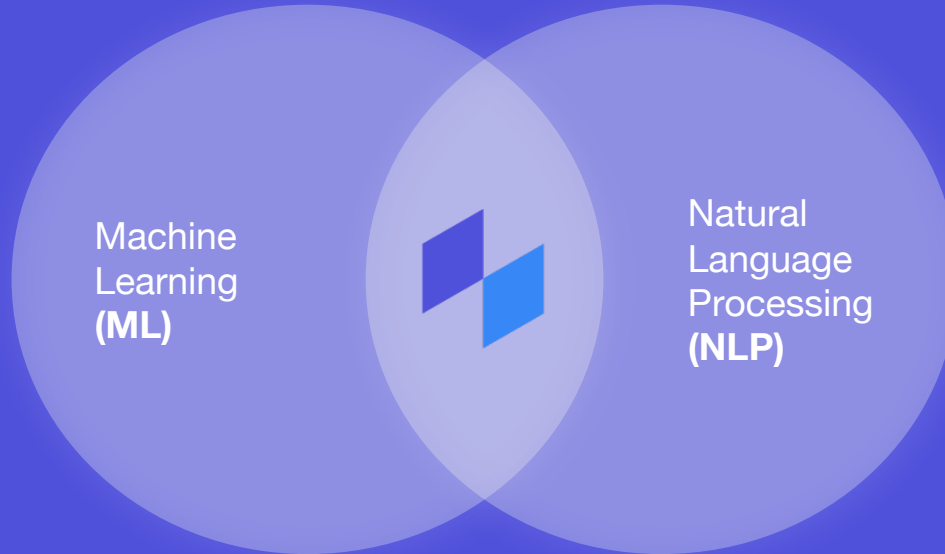
He does not want to pursue chemotherapy.

With progressive weakness and hemoptysis, will arrange for hospice at home.

He does not want to  
pursue chemotherapy

# Definition of Terms

## Artificial Intelligence (**AI**)



# Agenda

- Terms & Definitions
- **Guiding Principles**
- Machine Learning @ Flatiron
- Takeaways
- Q&A

# Guiding Principles for Machine Learning at Flatiron Health



**ML is math,  
not magic.**

ML is built on a series of mathematical formulas, and understanding the errors these formulas make is important



**ML is a tool,  
not a product.**

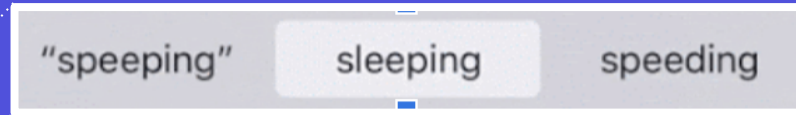
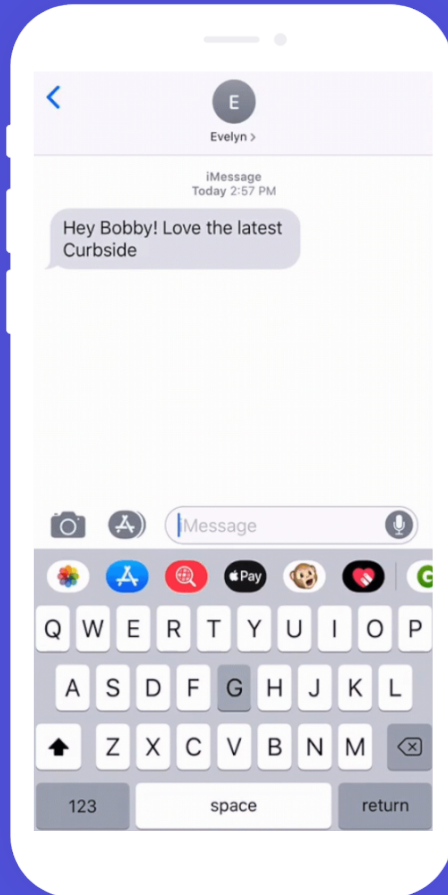
It can enable new features, but ML is not a product we can use alone



**ML will empower humans,  
not replace them.**

ML can make humans faster and more accurate, but it can't do everything.

# ML is math, not magic

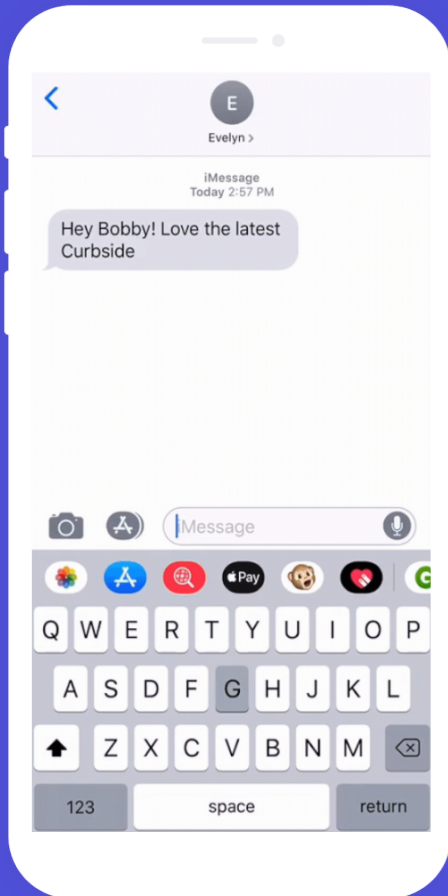


# ML is math, not magic

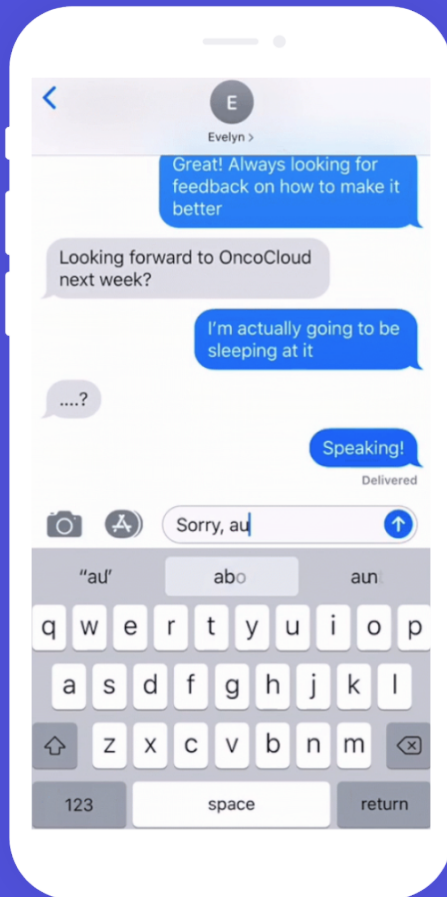




# ML is math, not magic



# ML is a tool, not a product

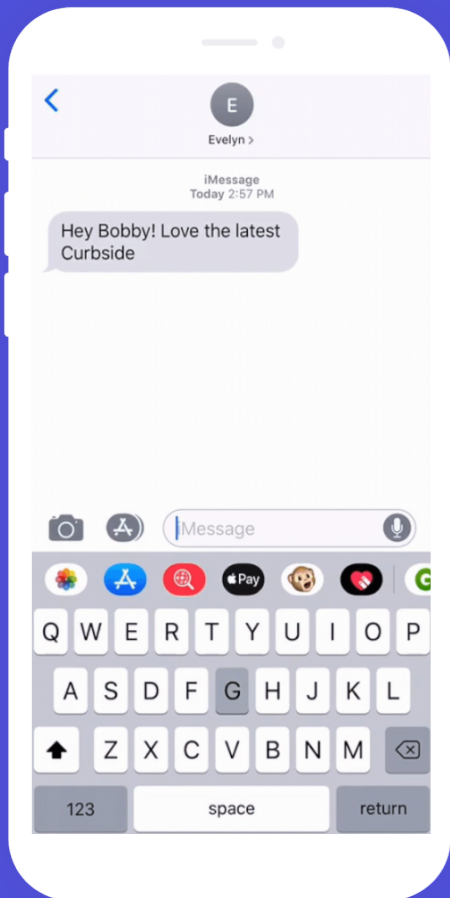


● — **User interface**

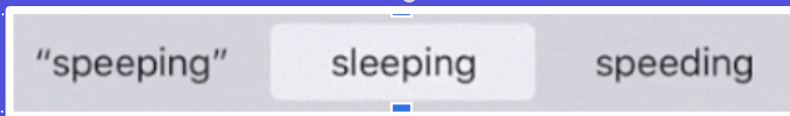
● — **Prediction bar**

● — **Keyboard**

# ML will empower humans, not replace them



**Suggestions, opportunities  
for human input**



# ML will empower humans, not replace them



## ML is great at

- Sifting through lots and lots of examples
- Recognizing tiny patterns in data



## Humans are great at

- Synthesizing information
- Applying domain-specific knowledge
- Adapting to new information

---

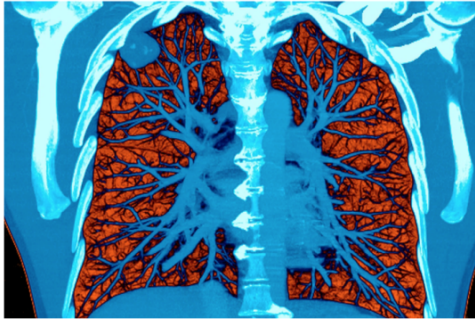
## Humans will always be necessary for

- Generating data for the model to learn from
- Evaluating the performance of ML models

# Consider ML on a case by case basis

## ***A.I. Took a Test to Detect Lung Cancer. It Got an A.***

Artificial intelligence may help doctors make more accurate readings of CT scans used to screen for lung cancer.

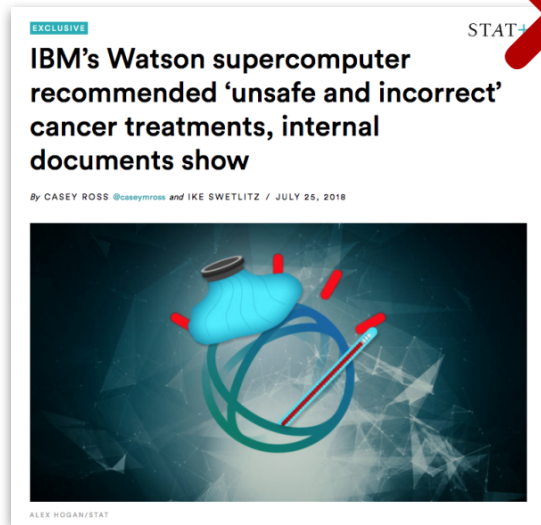


A colored CT scan showing a tumor in the lung. Artificial intelligence was just as good, and sometimes better, than doctors in diagnosing lung tumors in CT scans, a new study indicates. Voisin/Science Source

## **ML performs well today when ...**

- The question is a simple problem statement
- The question involves pattern recognition
- There are a lot of examples available to learn from

# Consider ML on a case by case basis



## ML is a challenging fit when ...

- The problem requires synthesis and reasoning
- There is a large and complex knowledge base to learn
- There are many exceptions to the rule
- For those exceptions, there are few examples to learn from

# Inform your decision making



## Understand the math:

What kinds of **examples** will be fed into the system to help it learn patterns?



## Identify the use case:

What **question** are we asking the ML model to answer for us?

How will ML be **part of a larger product** for my practice?



## Make ML work for you:

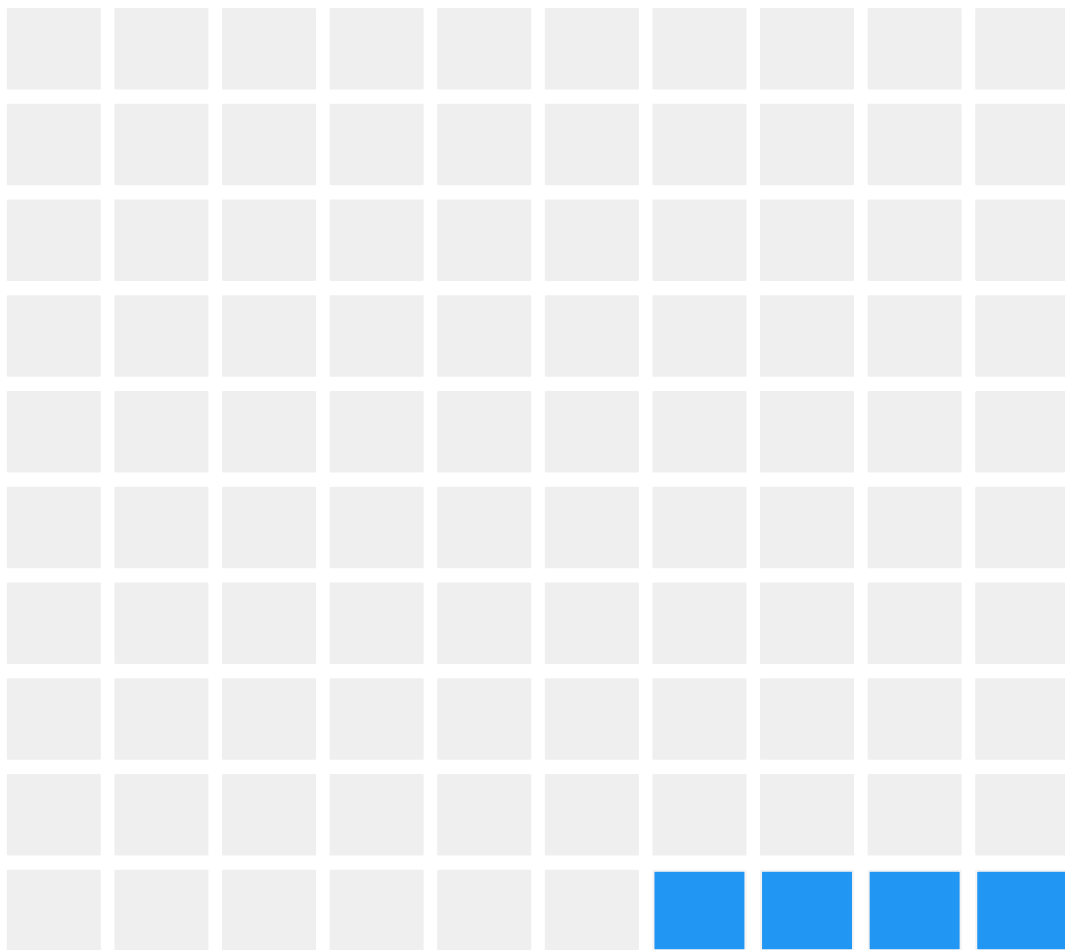
How will this use case of ML **help with my day-to-day** work?

How will the system deal with cases where the ML **prediction is wrong**?

# Agenda

- Terms & Definitions
- Guiding Principles
- **Machine Learning @ Flatiron**
- Takeaways
- Q&A





Today, roughly  
4% of all adult  
cancer patients  
enroll in clinical  
trials.

Data updated 08/13/2019

Filter by name All trial statuses Select diseases All lines of therapy

Add clinical trial

Filtered by: None.

Showing 14 of 14 rows

Trial name	Trial description	Status	Disease	Line of therapy
A7471042: Pfizer	Study Of Dacomitinib (PF-00299804) In Advan...	Pending	Breast Cancer Non-Small Cell Lun...	
BRE-1205	A Phase III Randomized Double-blind, Placebo...	Closed	Breast Cancer	None selected
BRE-2252	A Randomized Phase III Trial of CDK Inhibitors...	Pending	Non-Small Cell Lun...	Adjuvant
BRE-2321	Anastrozole In Preventing Breast Cancer in Po...	Pending	Breast Cancer	Metastatic: 1st line
CRC-11182	A Phase II Study of the Combination of VEGF...	Active, Recruiting	Colon Cancer	Metastatic: 1st line
CRC0101	Phase III, multicenter, open-label, three-arm, ra...	Active, Recruiting	Colon Cancer Rectal Cancer	Metastatic: 3rd line and beyond
GU0002	A Phase 3 Randomized, Double-blind, Multi-ce...	Active, Recruiting	Bladder Cancer	Adjuvant
NCI-2014-00746	A Randomized Phase III Trial of Endocrine The...	Active, Recruiting	Breast Cancer	Metastatic: 2nd line
NCI-2014-02674	Randomized Phase II/III Study of Nivolumab Pl...	Active, Recruiting	Non-Small Cell Lun...	Induction Maintenance
NCI-2016-01595	A Randomized, Phase III Trial to Evaluate the ...	Active, Recruiting	Breast Cancer	Adjuvant
NSCLC-1890	A Phase II Trial of Concurrent Chemoradiation ...	Active, Not Recruiting	Non-Small Cell Lun...	Consolidation
PANC-0001	Randomized Study of TMP1101 in Combination...	Active, Recruiting	Pancreatic Cancer	Metastatic: 2nd line
REBECCA II: Danish Cancer Soci...	Rehabilitation After Breast Cancer	Pending	Breast Cancer	Metastatic: 1st line
V3-MOMMO-01: Immunitor LLC	Open Label Immunotherapy Trial for Breast Ca...	Pending	Breast Cancer	Metastatic: 1st line Metastatic: 2nd line

# Screen patients using the visit list

ONCOTRIALS
Trials
Patients
Feasibility
Reports

Search
Flatiron Demo

Data updated 08/13/2019

Filtered by: None.
Showing 14 of 14 rows

Trial name	Trial description	Status	Disease	Line of therapy
A7471042: Pfizer	Study Of Dacomitinib (PF-00299804) In Advan...	Pending	Breast Cancer Non-Small Cell Lun...	
BRE-1205	A Phase III Randomized Double-blind, Placebo...	Closed	Breast Cancer	None selected
BRE-2252	A Randomized Phase III Trial of CDK Inhibitors...	Pending	Non-Small Cell Lun...	Adjuvant
BRE-2321	Anastrozole In Preventing Breast Cancer in Po...	Pending	Breast Cancer	Metastatic: 1st line
CRC-11182	A Phase II Study of the Combination of VEGF-...	Active, Recruiting	Colon Cancer	Metastatic: 1st line
CRC0101	Phase III, multicenter, open-label, three-arm, ra...	Active, Recruiting	Colon Cancer Rectal Cancer	Metastatic: 3rd line and beyond
GU0002	A Phase 3 Randomized, Double-blind, Multi-ce...	Active, Recruiting	Bladder Cancer	Adjuvant
NCI-2014-00746	A Randomized Phase III Trial of Endocrine The...	Active, Recruiting	Breast Cancer	Metastatic: 2nd line
NCI-2014-02674	Randomized Phase II/III Study of Nivolumab Pl...	Active, Recruiting	Non-Small Cell Lun...	Induction Maintenance
NCI-2016-01595	A Randomized, Phase III Trial to Evaluate the ...	Active, Recruiting	Breast Cancer	Adjuvant
NSCLC-1890	A Phase II Trial of Concurrent Chemoradiation ...	Active, Not Recruiting	Non-Small Cell Lun...	Consolidation
PANC-0001	Randomized Study of TMP1101 in Combination...	Active, Recruiting	Pancreatic Cancer	Metastatic: 2nd line
REBECCA II: Danish Cancer Soci...	Rehabilitation After Breast Cancer	Pending	Breast Cancer	Metastatic: 1st line
V3-MOMMO-01: Immunitor LLC	Open Label Immunotherapy Trial for Breast Ca...	Pending	Breast Cancer	Metastatic: 1st line Metastatic: 2nd line

Waiting for oncotrials.flatiron.com...

© 2013- Flatiron Health, Inc. All rights reserved.  
Privacy Policy | Acceptable Use Policy

# Screen patients using the visit list

ONCOTRIALS Trials Patients Feasibility Reports

Search Flatiron Demo

GENERAL

Notifications 1

Visit schedule

PATIENT RECRUITMENT

New to practice

Recent scans/pathology

Suggested trials

ON-STUDY PATIENTS

Active patients

Follow-up patients

Requires consent

Suggested trials Show description

Wed., 08/14/2019 < > All physicians All locations Hide viewed appointments Print

Search by name or MRN All Diagnoses All visit types All trials All statuses

Filtered by: None.

Wed., 08/14/2019 Showing 1-50 of 86 patients << >>

Patient	Diagnosis	Visit Type	Physician	Location	Current status on trial(s)
Della Torphy A035101	Breast Cancer and 6 others	Treatment	8:00 am -	Kelliview Cancer Specialists	NCI-2016-01595 V3-MOMMO-01: I... A7471042: Pfizer 2 trials ● Active ● Watching ● In Consenting Process ● Deemed Ineligible
Vuon Kub A073496	Breast Cancer Fallopian Tube Cancer and 3 others	Treatment	8:15 am -	Cancer Specialists of Lake ...	NCI-2016-01595 A7471042: Pfizer 2 trials ● Candidate ● In Pre-screening ● Deemed Ineligible
Mary Jane Ryan A017528	Breast Cancer and 3 others	Office Visit	8:45 am Erser, Alessia	Cancer Center of Jaedenburgh	NCI-2016-01595 2 trials ● In Pre-screening ● Deemed Ineligible
Greta L. Sleuber A088526	Breast Cancer Mucosal Melanoma and 5 others	Treatment	9:00 am -	Lake Danykaside Cancer Cli...	NCI-2014-00746 2 trials ● In Pre-screening ● Deemed Ineligible
Claudette Homenick A023684	Breast Cancer and 4 others	Treatment	9:15 am -	Cancer Specialists of South ...	NCI-2014-00746 A7471042: Pfizer 2 trials ● Active ● Candidate ● Deemed Ineligible
Genelle Larson A056174	Breast Cancer	Office Visit	9:15 am Kloko, Dagmar	South Aletha Cancer Clinic	NCI-2014-00746 BRE-2321 NCI-2016-01595 ● Watching ● In Pre-screening ● Deemed Ineligible
Ollie X. Stiedemann A023408	Breast Cancer and 7 others	Office Visit	9:15 am Barrows, Aurelia	Cancer Specialists of South ...	REBECCA It: Dan... BRE-2321 NCI-2014-00746 NCI-2016-01595 ● Signed Main Study Consent ● In Pre-screening ● Screen Fail ● Deemed Ineligible
Christina Weissnat A050334	Breast Cancer and 3 others	Treatment	9:15 am -	Kelliview Cancer Specialists	NCI-2016-01595 2 trials ● In Consenting Process ● Deemed Ineligible
Renae M. Gottlieb A010295	Breast Cancer and 3 others	Office Visit	9:30 am Abbott, Nona	South Aletha Cancer Clinic	BRE-2321 NCI-2014-00746 NCI-2016-01595 ● Discontinuation ● Discontinuation ● Watching
Curtis P. Herman	Colon Cancer	Office Visit	9:30 am Dibbert, Lucy	South Aletha Cancer Clinic	CRC-11182 CRC0101 ● Watching ● Deemed Ineligible

https://oncotrials.flatiron.com/oncotrials/#

# A patient snapshot is shown in the sidebar

ONCOTRIALS

Trials

Patients

Feasibility

Reports

GENERAL

Notifications

Visit schedule

PATIENT RECRUITMENT

New to practice

Recent scans/pathology

Suggested trials

ON-STUDY PATIENTS

Active patients

Follow-up patients

Requires consent

Suggested trials

Show description

Wed., 08/14/2019

All physicians

All locations

Hide viewed appointments

Print

Search by name or MRN

All Diagnoses

All visit types

All trials

All statuses

Filtered by: None.

Wed., 08/14/2019

Patient	Diagnosis	Visit Type
Della Torphy A035101	Breast Cancer and 6 others	Treatment
Vuon Kub A073496	Breast Cancer Fallopian Tube Cancer and 3 others	Treatment
Mary Jane Ryan A017528	Breast Cancer and 3 others	Office Visit
Greta L. Steuber A088526	Breast Cancer Mucosal Melanoma and 5 others	Treatment
Claudette Homenick A009684	Breast Cancer and 4 others	Treatment
Genelle Larson A056174	Breast Cancer	Office Visit
Ollie X. Stiedemann A023408	Breast Cancer and 7 others	Office Visit
Christina Weissnat A050334	Breast Cancer and 3 others	Treatment
Renae M. Gottlieb A010295	Breast Cancer and 3 others	Office Visit
Curtis P. Herman A025105	Colon Cancer and 4 others	Office Visit

Della Torphy

# A035101

DOB: 04/28/1982 (37 years old)

Set reminder

Mark unviewed

Close

Notifications:

08/13/2019: A7471042: Pfizer: check scan results

Set on 08/05/2019 by Caroline Nightingale

Edit

Delete

Patient Note

Add note...

Last edited by demo@falcon.com on 10/10/2018

Patient Clinical Info

Open OncoEMR Documents

Diagnosis

Encounter for Chemotherapy/Immunotherapy	10/10/2019
Other Disease Conditions	
Osteoporosis	08/09/2019
Other Disease Conditions	
Other Anemia	08/09/2019
Anemias   Red Blood Cell Disorders	
Fever	08/03/2019
Other Disease Conditions	
Disease of blood and blood-forming organs, unsp...	06/27/2019
Benign hematologic condition	
Edema	06/27/2019
Other Disease Conditions	
Encounter for Chemotherapy/Immunotherapy	04/27/2019
Other Disease Conditions	
Nausea with/without Vomiting	04/16/2019
Other Disease Conditions	
Breast Cancer	03/07/2019
Stage IIB (04/14/2019)	

Biomarkers

Trial

Search from all trials

Active Trials

NCI-2016-01595

All sites: active, recruiting

Show More

Active

Trials to evaluate (3)

Trials in screening (0)

Archived Trials (2)

V3-MOMMO-01: Immunitor LLC

pending

Watching

Breast Cancer

HER2 neg

A7471042: Pfizer

pending

In Consenting Process

Breast Cancer

HER2 neg

REBECCA II: Danish Cancer S...

pending

Breast Cancer

HER2 pos

# A patient snapshot is shown in the sidebar

The screenshot displays the ONCOCLOUD interface. On the left, a sidebar contains a navigation menu with sections: GENERAL (Notifications, Visit schedule), PATIENT RECRUITMENT (New to practice, Recent scans/pathology, Suggested trials), and ON-STUDY PATIENTS (Active patients, Follow-up patients, Requires consent). The 'Suggested trials' section is active, showing a table of suggested trials for the date 08/14/2019. The table has columns for Patient, Diagnosis, and Visit Type. The first row is highlighted, showing Delta Torphy with Breast Cancer and a Treatment visit type. The main area of the interface shows the patient record for Delta Torphy, including a header with patient information, a Notifications section, a Patient Note section, a Patient Clinical Info section, and a Trials section. The Patient Clinical Info section lists various conditions and their dates. The Trials section lists active trials and their status.

**Suggested trials** Show description

Wed., 08/14/2019 < > All physicians All locations Hide viewed appointments Print

Search by name or MRN All Diagnoses All visit types All trials All statuses

Filtered by: None.

Wed., 08/14/2019

Patient	Diagnosis	Visit Type
Delta Torphy A035101	Breast Cancer and 6 others	Treatment
Vuon Kub A073496	Breast Cancer Fallopian Tube Cancer and 3 others	Treatment
Mary Jane Ryan A017528	Breast Cancer and 3 others	Office Visit
Greta L. Steuber A088526	Breast Cancer Mucosal Melanoma and 5 others	Treatment
Claudette Homenick A003684	Breast Cancer and 4 others	Treatment
Genelle Larson A056174	Breast Cancer	Office Visit
Olie X. Stiedemann A023408	Breast Cancer and 7 others	Office Visit
Christina Weissnat A050334	Breast Cancer and 3 others	Treatment
Renae M. Gottlieb A010295	Breast Cancer and 3 others	Office Visit
Curtis P. Herman A025105	Colon Cancer and 4 others	Office Visit

**Delta Torphy** # A035101 DOB: 04/28/1962 (37 years old)

Set reminder Mark unviewed Close

**Notifications:**

08/13/2019: A7471042: Pfizer: check scan results Set on 08/05/2019 by Caroline Nightingale Edit Delete

**Patient Note** Search from all trials

Add note...

Last edited by demo@fatiron.com on 10/10/2019

**Patient Clinical Info** Open OncoEMR Documents

**Diagnosis**

Encounter for Chemotherapy/Immunotherapy	10/10/2019
Other Disease Conditions	
Osteoporosis	08/09/2019
Other Disease Conditions	
Other Anemia	08/09/2019
Anemias   Red Blood Cell Disorders	
Fever	08/03/2019
Other Disease Conditions	
Disease of blood and blood-forming organs, unsp...	06/27/2019
Benign hematologic condition	
Edema	06/27/2019
Other Disease Conditions	
Encounter for Chemotherapy/Immunotherapy	04/27/2019
Other Disease Conditions	
Nausea with/without Vomiting	04/16/2019
Other Disease Conditions	
Breast Cancer	03/07/2019
Stage IIB (04/14/2019)	

**Trials** Search from all trials

**Active Trials**

NCI-2016-01595  
All sites: active, recruiting  
Active

Trials to evaluate (3) Trials in screening (0) Archived Trials (2)

V3-MOMMO-01: Immunitor LLC  
pending  
Watching

Breast Cancer  
HER2 neg

A7471042: Pfizer  
pending  
In Consenting Process

Breast Cancer  
HER2 neg

REBECCA II: Danish Cancer S...  
pending

Breast Cancer  
HER2 pos

**Biomarkers**



# Metastatic status is usually only in visit notes

OCSA Oncology and Hematology  
1522 Hillview Drive Suite 420, Los Altos, CA 94024-5300  
Phone: (650) 559-6040 Fax: (650) 559-1772

Patient Name: Young, Elizabeth Theresa  
Patient Number: 12488

Date: 8/23/2019  
Date Of Birth: 1/12/1957

## FOLLOW UP VISIT Oncology

### Chief Complaint

Elizabeth is a lovely 62 year old female with a history of breast cancer that was treated in 2013. She had done well following adjuvant therapy she was only able to complete 3 years of armdex secondary to fatigue and body aches. She has a 3 month history of lower back pain. She had been hiking the Inca trail and initially attributed the pain to exercise. A Xray followed by scan indicates disease at L4 5 and 6. She underwent a bi which is positive for metastatic breast cancer morphology consistent with the primary breast disease.

### History of Present Illness

Stage II breast cancer in 2013 w/ lumpectomy with chemo re the lumbar spine. No other complaints back pain at 1-3 cont

### Past Medical History

### Allergies

TETRACYCLINES

### Medications

Inside	Drug	Script Date	Qty	Rfts	Instructions
	CLONIDINE HCL 0.2MG TABLET	8/22/2004	30	1	1 p.o. q. day while awake pm
Y	Lasix 20 mg tablet	5/26/2015	30	0	1 p.o. q. day
	LOTENSIN 10MG TABLET	8/22/2004	30	1	1 p.o. q. day while awake pm
	TETRACYCLINE 500MG CAPSULE	8/22/2004	30	0	1 p.o. q. day while awake pm
	ZANTAC 150MG GELDOSE CAP	8/22/2004	30	1	1 p.o. q. day while awake pm

### Review Of Systems

**Pain (Onset):** A slow or weak pain, not very sudden or strong Patient stated pain level - No pain. A 10 point review of systems is otherwise negative except as mentioned. **Fatigue:** No fever. No rigors. No weight loss. No night sweats. No generalized weakness. Appetite good. No sleep disturbance.

**HEENT:** Patient reports No blurred vision. No double vision. No hearing loss. No mouth sores.

**Respiratory:** Patient reports No difficulty breathing reported. No wheezing. No cough. No hemoptysis.

**Gastrointestinal:** Patient reports No nausea. No vomiting. No dysphagia. No heartburn. No abdominal pain. No diarrhea. No constipation.

No melena. No hematochezia.

**Genitourinary:** Patient reports No hematuria. No dysuria. No urgency. No incontinence. **back pain.** No limited range of motion. **bone pain.**

**Integumentary:** Patient reports No rash. No pruritis.

**Neurological:** Patient reports No headache. No focal weakness. No paralysis. No paresthesias. No speech impairment.

**Hematologic:** Patient reports No excessive or spontaneous bleeding or bruising.

**Mental Health:** Patient reports No anxiety. No depression. No insomnia. No panic disorder.

Young, Elizabeth Theresa DOB: 1/12/1957 (12488)

Page 1 of 1

### Patient is excluded from depression screening for the following reason:

Patient Refused

### Vital Signs

Vitals on 1/1/2007 1:07:51 PM: Height=67in, Weight=112lb, Temp=97F, Pulse=57, Resp=16, SystolicBP=122, DiastolicBP=79

### Physical Examination

General:

Skin: No ecchymosis. No petechiae. No jaundice. No Rash.

**Skin:** No abnormal skin lesions noted.

**Head:** Not assessed. Pupils are equal. **ECOMI PERLOA.**

**Ears, Nose, Throat, and Mouth:** Normal oral mucosa and oropharynx.

**Neck:** Neck is supple. No cervical masses present. Trachea is midline. No thyromegaly.

positive for metastatic breast cancer morphology

ONCOTRIALS

Trials

Patients

GENERAL

Notifications

Visit Schedule

PATIENT RECRUITMENT

New patients

Recent scans / pathology

Suggested trials

ON STUDY PATIENTS

Active patients

Follow-up patients

Requires reconsent

Active Patients

Wed. 07/01/18

Search by name or

Patient

Clara Gomez  
81942

Verna Frank  
88886

Cecelia Gibbs  
15154

Einora Lee  
94375

Tula Simpson  
34232

Maria Sanchez  
11244

Tony Amier  
32223

Rei Arthur  
49923

Verna Frank

#A12345

DOB: 06/23/1947 (72 years old)

Set reminder

Deem ineligible

Close

Notification:

07/01/18: Document requires signature. [Download document, version 2.000.](#)

Edit Delete

Add patient note

Patient Clinical Info

Open in OncoEMR

Diagnoses

Essential (primary) hypertension01/21/14

Non-small cell lung cancer  
Stage IIa (10/05/16)11/04/11

Polycythemia vera09/23/13

Disease status

NSCLC model  
Metastatic disease  
Likely  
last updated: 09/21/2017

⊖ Patient's disease is confirmed to be: metastatic non-metastatic

Biomarkers

ROS102/15/2017: Positive

PD-L101/27/2017: Positive

EGFR02/15/2017: Negative

ALK02/15/2017: Negative

Drug order history

Ado-trastuamab emtansineFirst Order: 02/01/2017

Trials

Search from all trials

Active trials

NSCLC - PDL1- 32342  
All sites: active, recruiting  
● Active by janedoe@flatiron.com.

Show more

Trials to evaluate (3)

Trials in screening (3)

Archived trials (15)

NSCLC-1234

Active, recruiting  
● Watching by janedoe@flatiron.com. "Waiting on scan"

Lung cancer✓

Metastatic✓ Likely

PD-L1 positive✓

CA209-345: ABCDE

Active, recruiting  
● Watching by janedoe@flatiron.com. "Waiting on scan"

Lung cancer✓

Metastatic✓ Likely

LUN - 34235

Active, recruiting  
Not statuses

Lung cancer✓

Metastatic✓ Likely

NTRK fusionⓂ

BRAF positiveⓂ

On NivolumabⓂ

[Hide unknown / not tested criteria](#)



# Why did we choose to use ML for this application?

## Recognizing documented evidence of metastatic status in a patient's chart

OCSA Oncology and Hematology  
1522 Hillview Drive Suite 420, Los Altos, CA 94024-5300  
Phone: 650-559-6040 Fax: 650-559-1772

Patient Name: Young, Elizabeth Theresa Date: 8/23/2019  
Patient Number: 12498 Date Of Birth: 1/12/1957

**FOLLOW UP VISIT**  
Oncology

**Chief Complaint**  
Elizabeth is a lovely 62 year old female with a history of breast cancer that was treated in 2013. She had done well following adjuvant therapy she was only able to complete 3 years of arimidex secondary to fatigues and body aches. She has a 3 month history of lower back pain. She had been taking the lincal and initially attributed the pain to exercise. A Xray followed by scan indicates disease at L4-5 and 6. She underwent a biopsy which is positive for metastatic breast cancer morphology consistent with the primary breast disease.

**History of Present Illness**  
Stage II breast cancer in 2013 w/ lumpectomy with chemo radiation followed by three years of Arimidex. Recent evidence of disease in the lumbar spine. No other complaints back pain at L4-5 controlled with OTC motrin.

**Past Medical History**

**Allergies**  
TETRACYCLINES

**Medications**

Inside	Drug	Script Date	Qty	Rfts	Instructions
	CLONIDINE HCL 0.2MG TABLET	8/22/2004	30	1	1 p.o. q. day while awake pm
Y	Lasix 20 mg tablet	5/30/2015	30	0	1 p.o. q. day
	LOTENSIN 10MG TABLET	8/22/2004	30	1	1 p.o. q. day while awake pm
	TETRACYCLINE 500MG CAPSULE	8/22/2004	30	0	1 p.o. q. day while awake pm
	ZANTAC 150MG GELDOSE CAP	8/22/2004	30	1	1 p.o. q. day while awake pm

**Review Of Systems**  
Pain Description: A slow or weak pain, not very sudden or strong Patient stated pain level: No pain. A 10 point review of systems is otherwise negative except as mentioned: **fatigue**. No fever. No rigors. No weight loss. No night sweats. No generalized weakness. Appetite good. No sleep disturbance.

**HEENT**: Patient reports no blurred vision. No double vision. No hearing loss. No mouth sores.  
**Respiratory**: Patient reports no difficulty breathing reported. No wheezing. No cough. No hemoptysis.  
**Gastrointestinal**: Patient reports no nausea. No vomiting. No dysphagia. No heartburn. No abdominal pain. No diarrhea. No constipation. No melena. No hematochezia.  
**Genitourinary**: Patient reports no hematuria. No dysuria. No urgency. No incontinence. **back pain**. No limited range of motion. **bone pain**.

## ML performs well today when ...

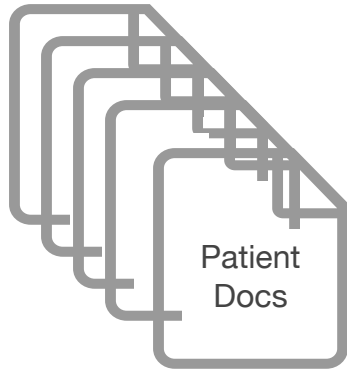
- The question is a simple problem statement ✓
- The question involves pattern recognition ✓
- There are a lot of examples available to learn from ✓

# Magic? Math!



# How is the model trained?

**Step 1:** Extract snippets of text from patient documents



## Text Snippets

Patient is early stage

Bone mets present

Recurrence

Patient is a sports fan

Local disease

**Step 2:** Record how frequently each snippet is in metastatic patients' document vs. non-metastatic patients.

## Text Snippets

Patient is early stage

Bone mets present

Recurrence

Patient is a sports fan

Local disease

# How does the model make inferences?

**Step 1:** Extract snippets of text from patient documents

**Step 2:** Use the recorded information about the importance of each snippet to make an inference



Bone mets present

Recurrence

Patient is a sports fan



**Highly Likely Metastatic**

How do we measure success?

> 90% accuracy

when an inference is surfaced

# How does the model handle instances when it's not correct?

Is clear when it doesn't know - surfaces the inference as "Unknown"

**Disease status** ⓘ

**NSCLC model**  
Metastatic disease

Unknown  
last updated: 09/21/2017

⊗ Patient's disease is confirmed to be: [metastatic](#) [non-metastatic](#)

Leaves room for human input

**Disease status** ⓘ

**NSCLC model**  
Metastatic disease

Unknown  
last updated: 09/21/2017

⊗ Patient's disease is confirmed to be: [metastatic](#) [non-metastatic](#)

# Inform your decision making



## Understand the math:

The OncoTrials feature uses **examples of patients we know are metastatic or not**



## Identify the use case:

Determines **“Is there documented evidence that the patient is metastatic?”**

Enhances the overall patient **matching workflow in OncoTrials**



## Make ML work for you:

**Narrows down** the list of patients to review for trials

The model has an **“Unknown” category** when uncertain, and allows room for **human input**

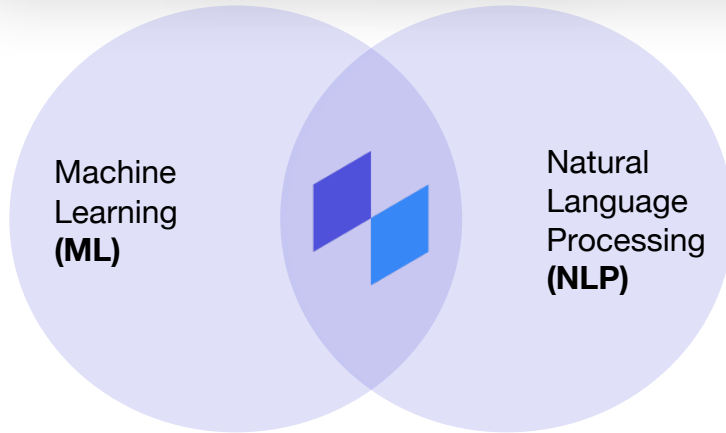
# Agenda

- Terms & Definitions
- Guiding Principles
- Machine Learning @ Flatiron
- **Takeaways**
- Q&A



# Takeaways

## Artificial Intelligence (AI)



## Ask the key questions



Understand the math



Identify the use case



Make ML work for you

# Questions

We want to hear from you!



Questions, comments, product feedback?

Come visit us at the **New Features** booth