

# VECTOR SEARCH

Evaluation only.

Created with Aspose.Slides for Python via .NET 25.2.

EBSCO Information Services  
Copyright 2004-2025 Aspose Pty Ltd.



Erica Lesyshyn



Max Irwin

# AGENDA

- SEARCH ECOSYSTEM
- PROBLEM STATEMENT
- PREVIOUS FAILURES
- CHOSEN SOLUTION
- IMPLEMENTATION
- NEXT STEPS

Created with Aspose Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

# EBSCO Clinical Decisions



Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

DynaMed

DynaMedex

DynaMed Decisions

Dynamic Health

# SEARCH ECOSYSTEM

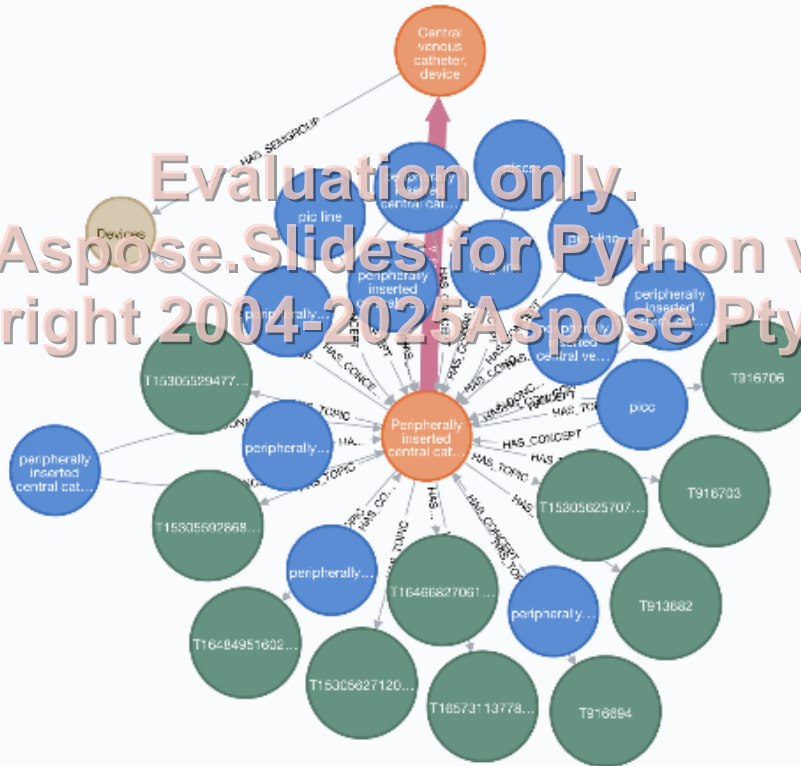


# MEDICAL KNOWLEDGE GRAPHS

# CONTENT CENTRIC\*

CONCEPTS: 68,000

TERMS: 430,000



# UMLS CENTRIC

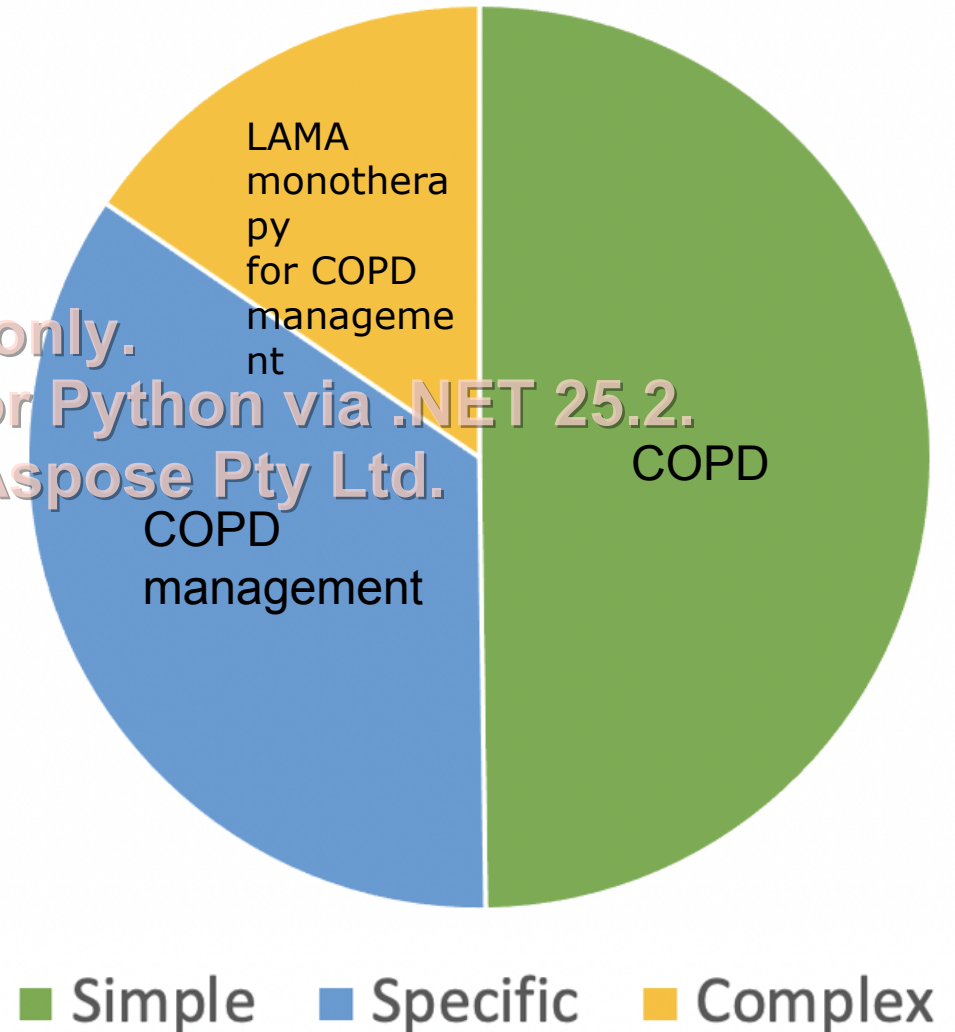
19. CONCEPTS: 355,000

TERMS: 1,400,000

- \* Using NLP to harvest UMLS entities from the content

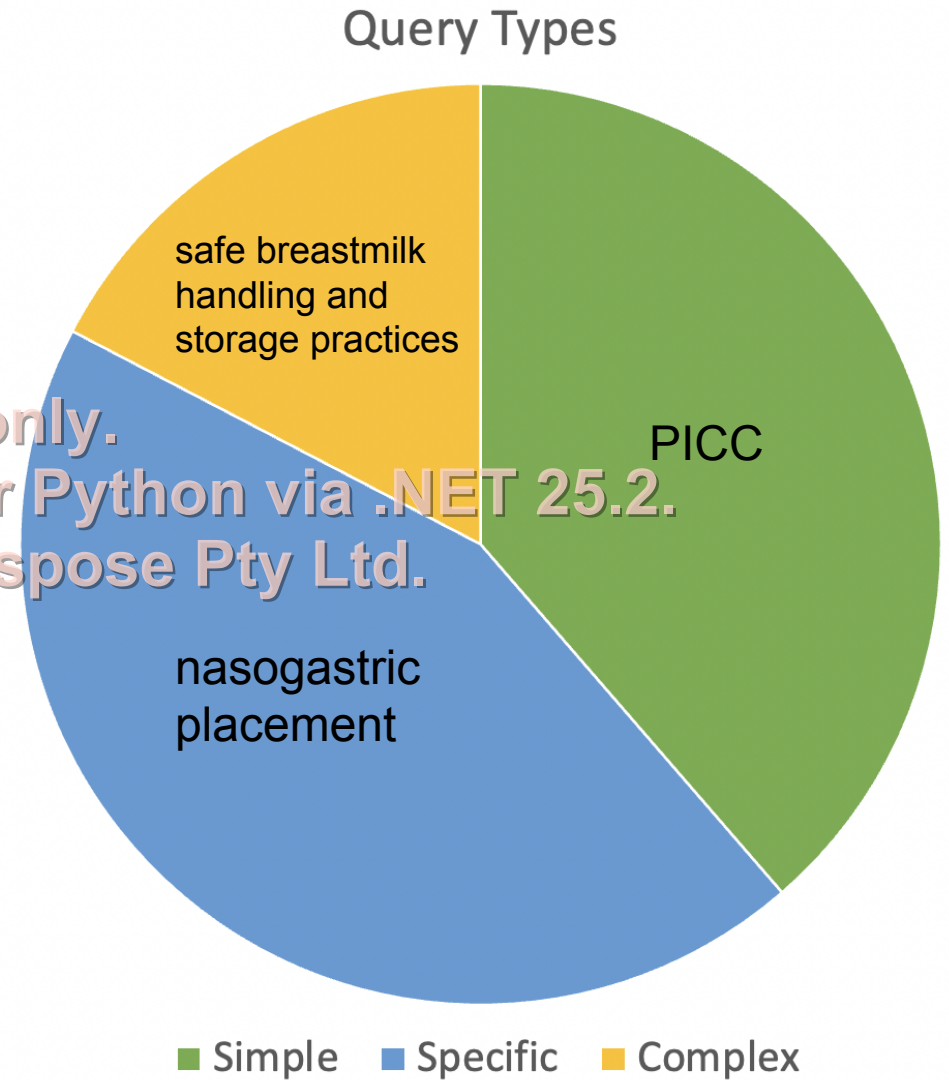
# HOW ARE USERS SEARCHING IN DYNAMED?

Query Types



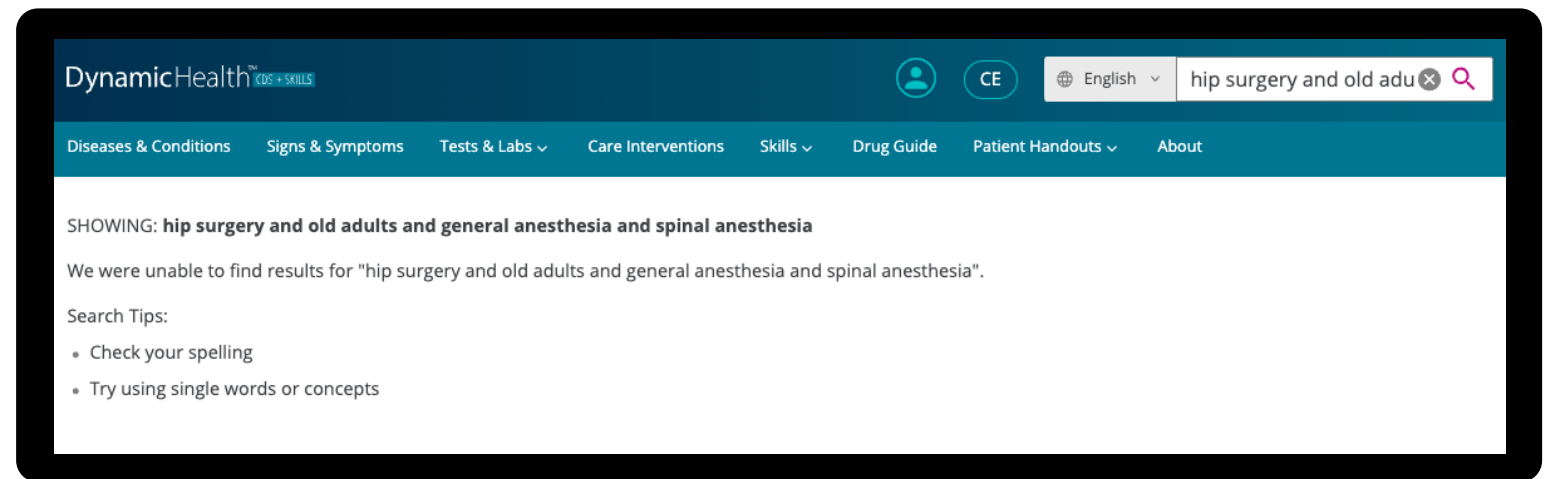
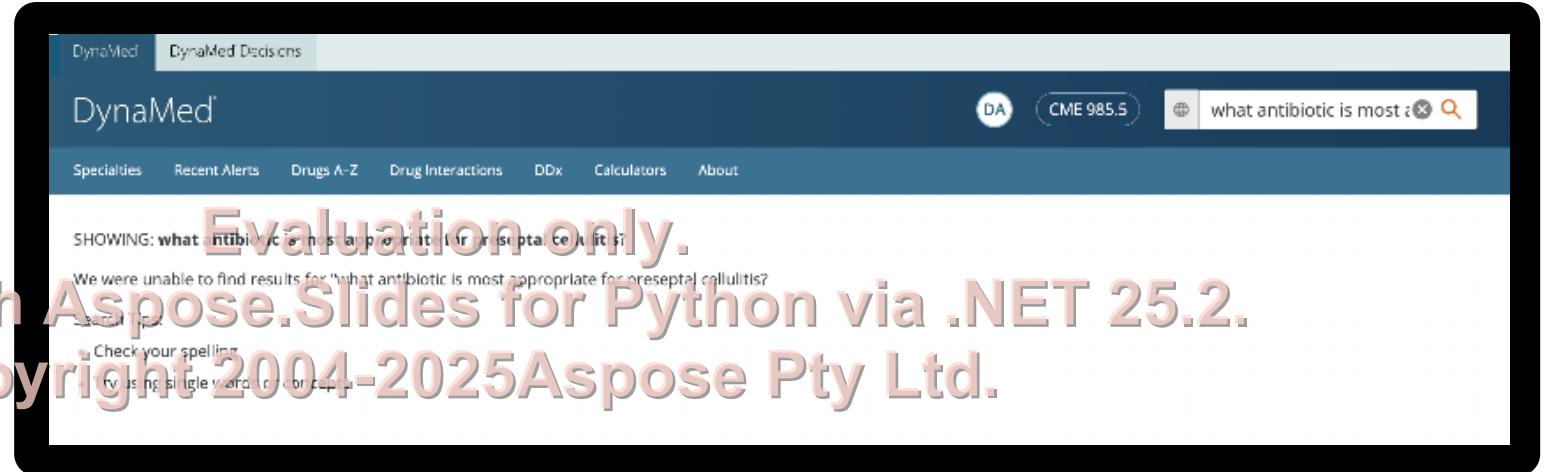
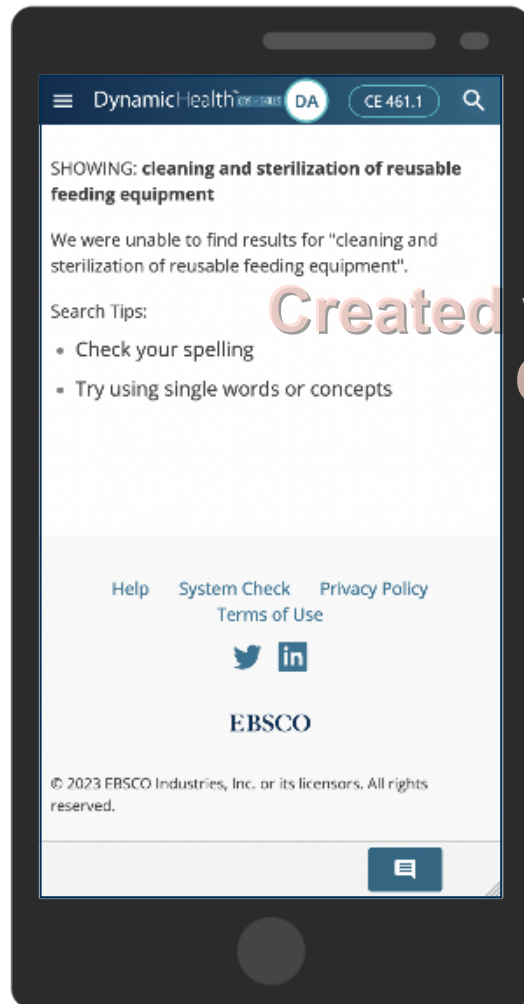
# HOW ARE USERS SEARCHING IN DYNAMIC HEALTH?

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.



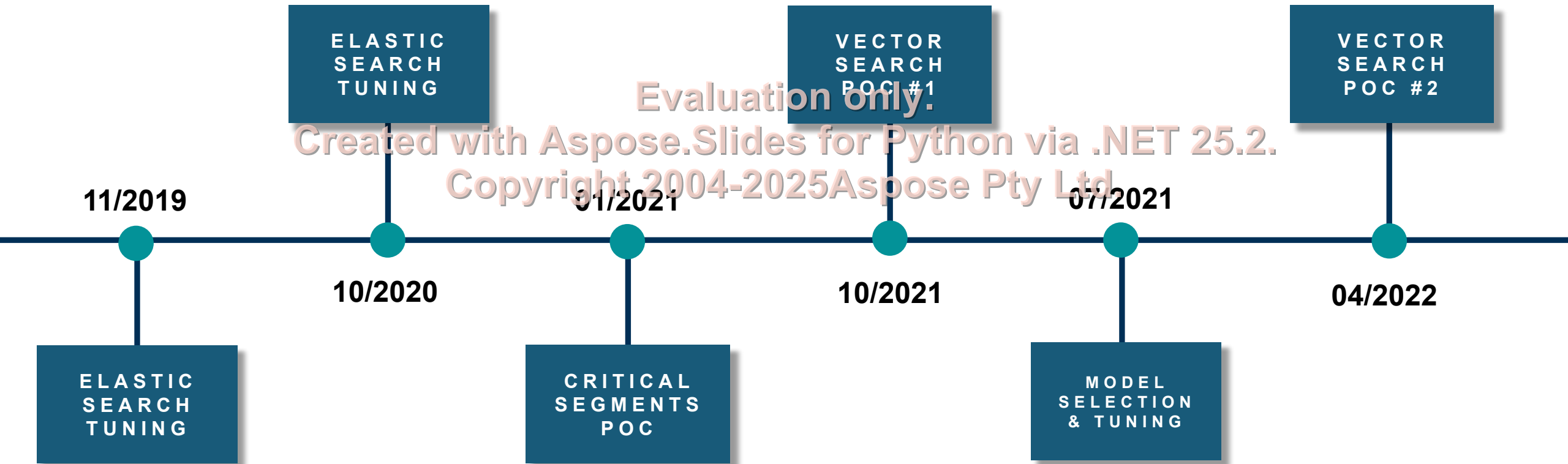


# COMPLEX QUERIES

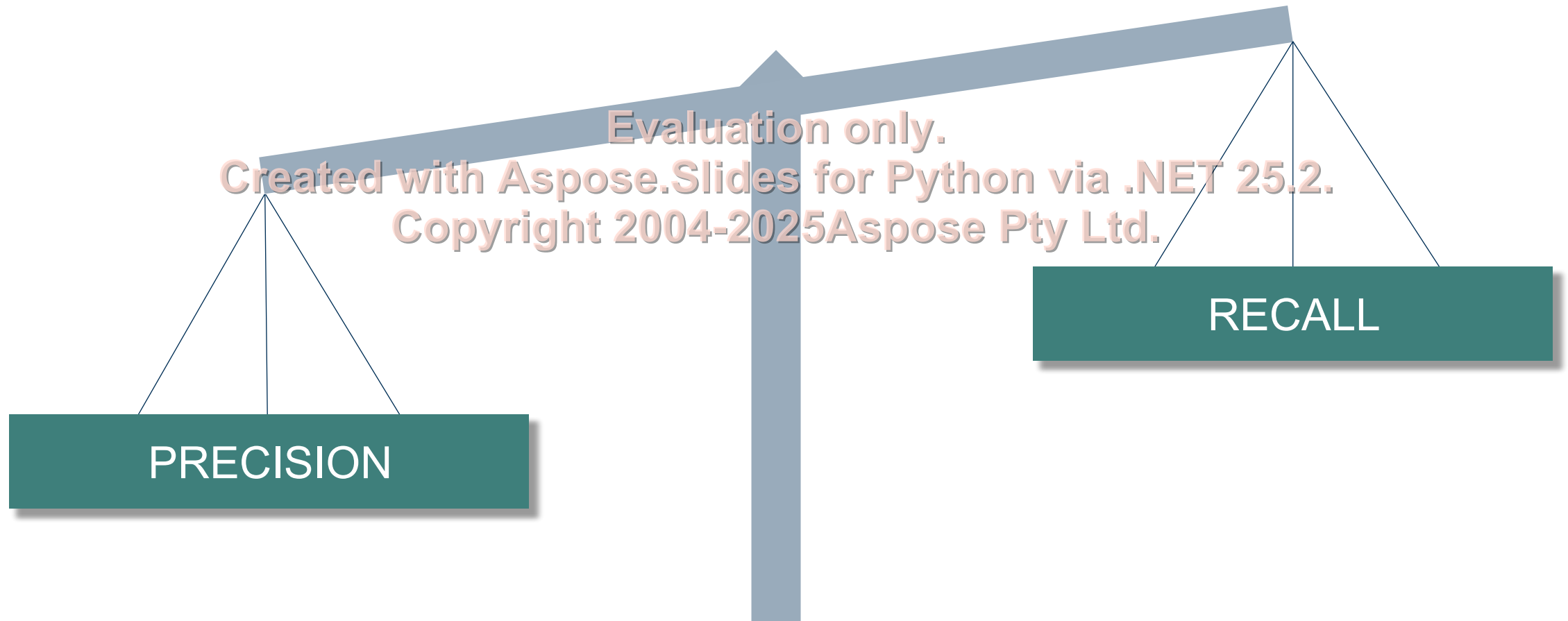




# PREVIOUS ATTEMPTS



# ELASTIC SEARCH TUNING



## SEARCH RESULTS

## diagnostic techniques for lateral ankle sprain

ALL (2)

## CONDITION

## Ankle Sprain

An injury of 1 or more ligaments of the ankle, that is typically associated with a twisting motion of the foot.

History and Physical > Physical

For lateral

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

DIAGNOSTIC AND LATERAL AND ANKLE SPRAIN

includes information on the nonoperative and operative management of these

## SEARCH RESULTS

## diagnostic techniques for lateral ankle sprain

**ALL (5455)**

IMAGES (70)

## EVALUATION

## Cushing Syndrome - Diagnostic Approach

Results from a prolonged multiorgan exposure to excessive concentrations of

## MANAGEMENT

## Management

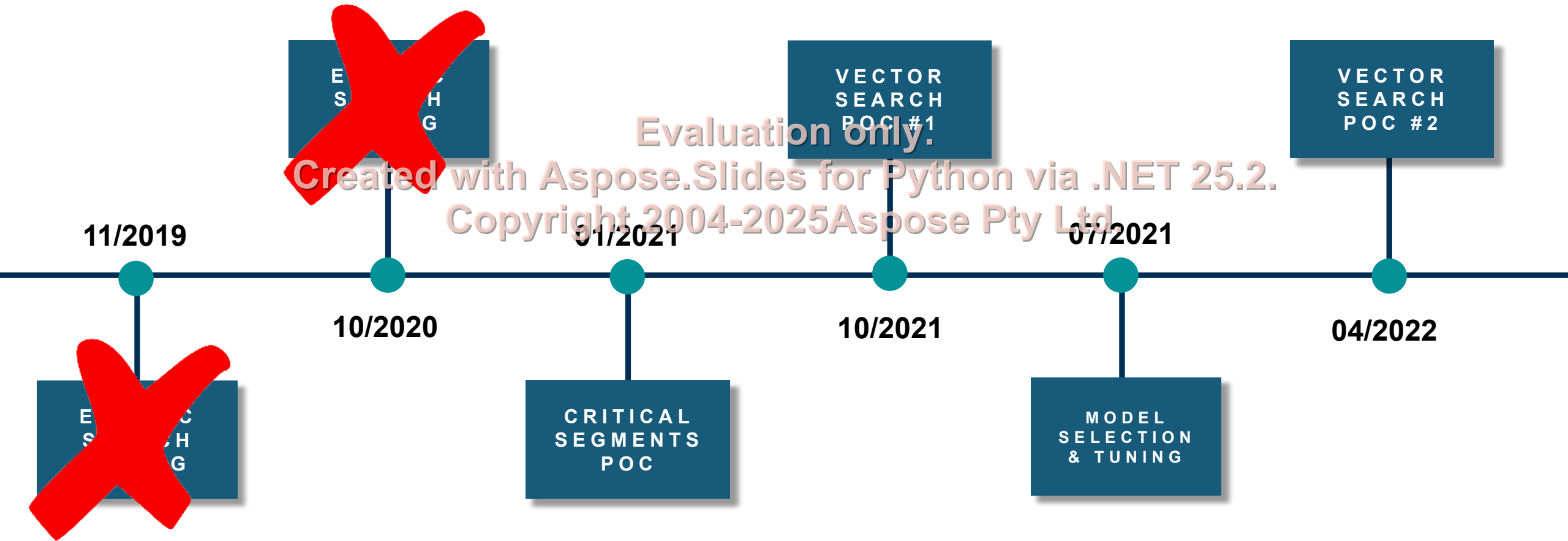
one of these

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

DIAGNOSTIC OR TECHNIQUES OR LATERAL OR ANKLE SPRAIN

MINIMUM SHOULD MATCH

# PREVIOUS ATTEMPTS



# CRITICAL SEGMENTS

diagnostic

techniques

for

lateral

ankle sprain

Evaluation only.

Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

diagnostic

techniques

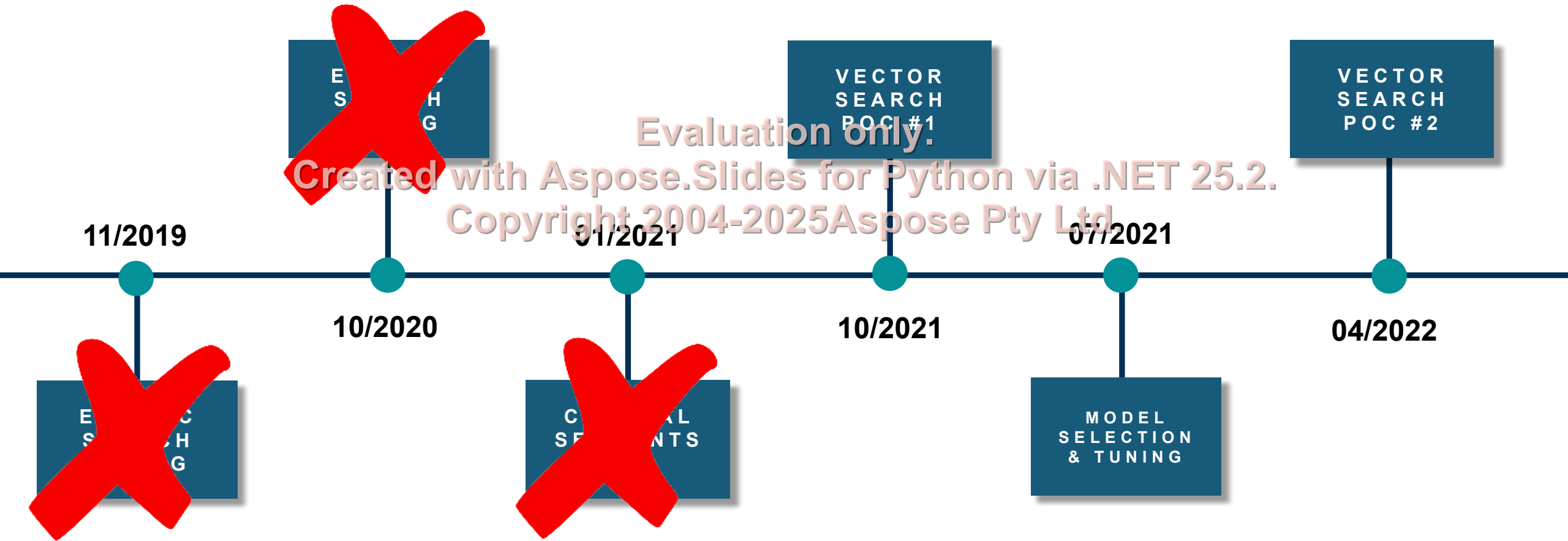
lateral

ankle sprain

RANKING CRITERIA

MATCHING CRITERIA

# PREVIOUS ATTEMPTS





INGESTING

DOCUMENT



SEARCHING

USER QUERY



Evaluation only.  
MODEL

Created with Aspose.Slides for Python via .NET 25.2.

Copyright 2004-2025 Aspose Pty Ltd.



DOC VECTOR



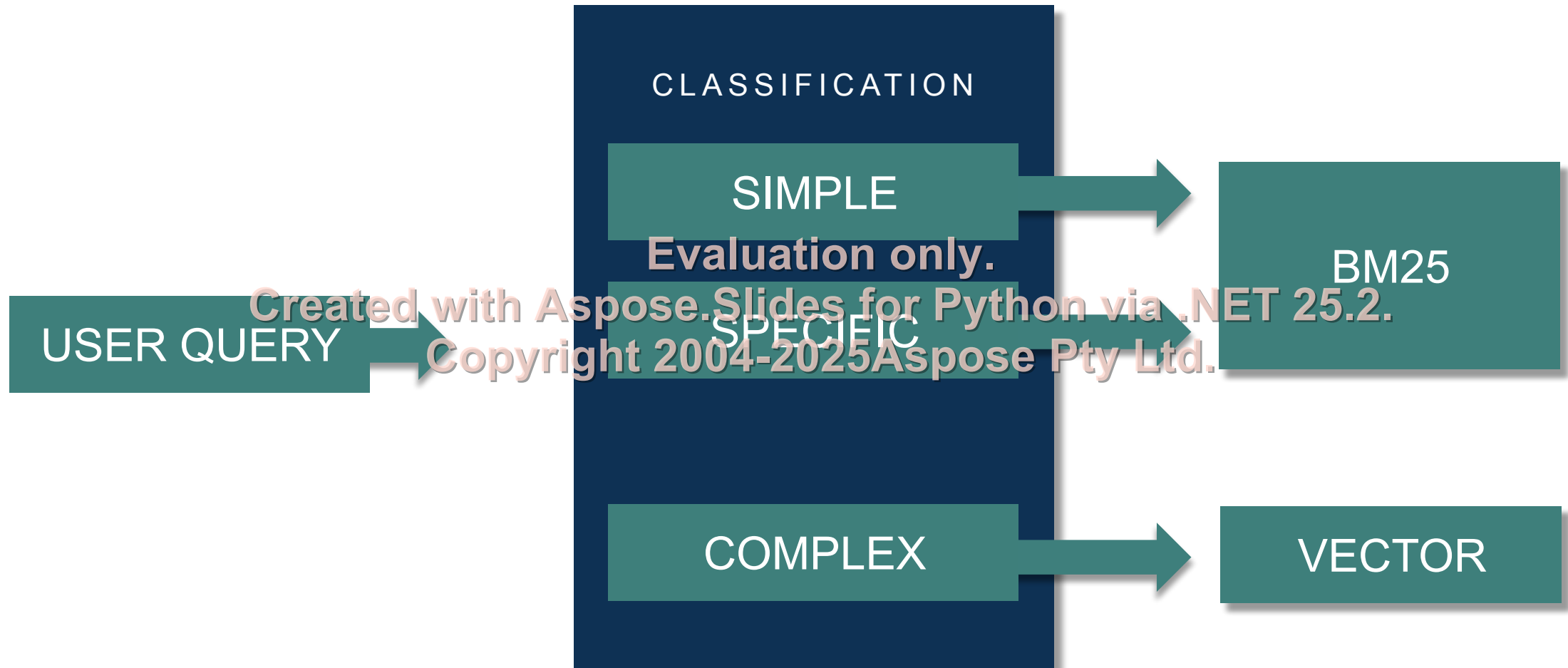
QUERY VECTOR



INDEX

Index the vector and  
document metadata

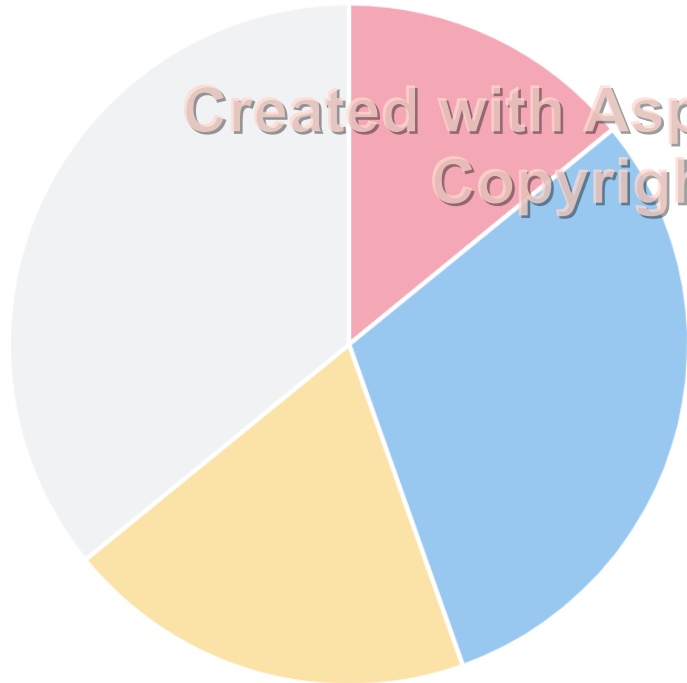
Search the index for  
the nearest vectors



# VECTOR SEARCH POC #1 RESULTS

## Survey Statistics

Both Good Both Bad dm dm\_qe



Evaluation only.

Created with Aspose.Slides for Python via .NET 25.2.

Copyright 2004-2025Aspose Pty Ltd.

Survey / View Results

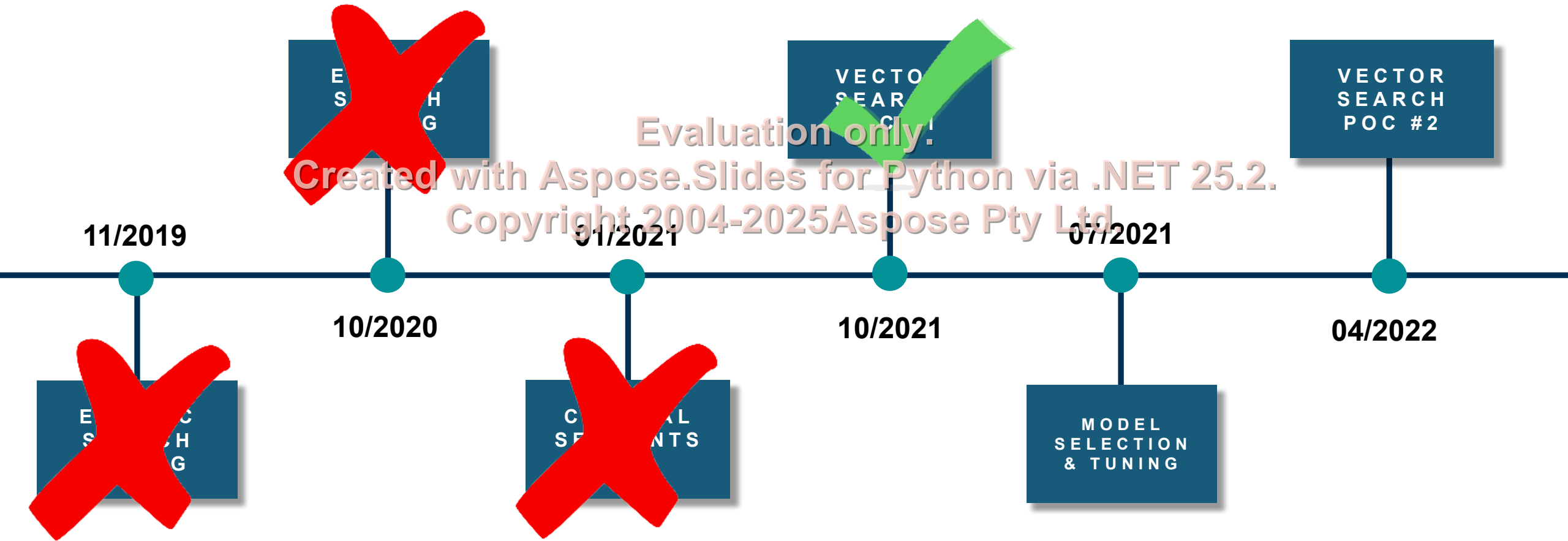
Survey: Query\_Embedding\_v1

Download

Search: by Query

	Total Responses	dm	dm_qe	Both Good	Both Bad
Delayed complications of cranial irradiation	4	1	0	0	3
Epidemiology, clinical manifestation, and diagnosis of brain metastases	4	0	4	0	0
Central and branch retinal artery occlusion	4	0	0	4	0
Stupor and coma in adults	4	0	1	0	3
Post-traumatic seizures and epilepsy	4	3	0	0	1
Interstitial lung disease in dermatomyositis and polymyositis: Clinical manifestations and diagnosis	4	0	3	0	1
Diagnosis and differential diagnosis s of dermatomyositis and polymyositis in adults	4	0	4	0	0
Evaluation and management of elevated intracranial pressure in adults	4	2	0	2	0

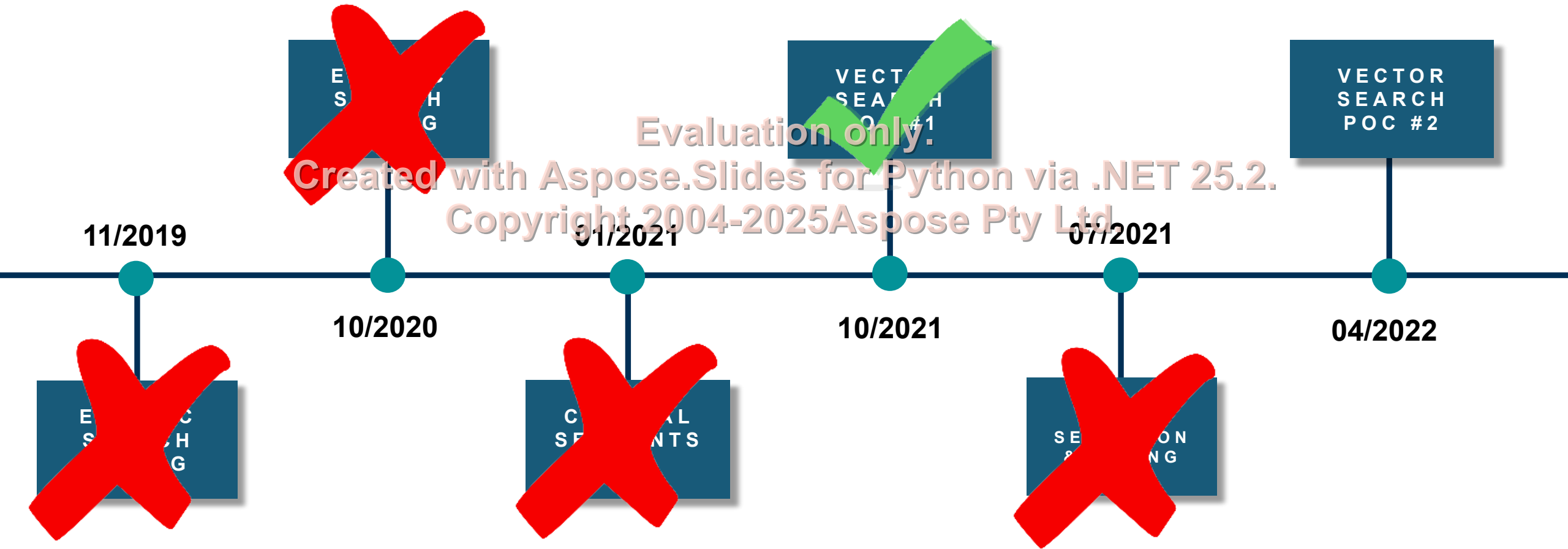
# PREVIOUS ATTEMPTS



# MODEL SELECTION & TUNING

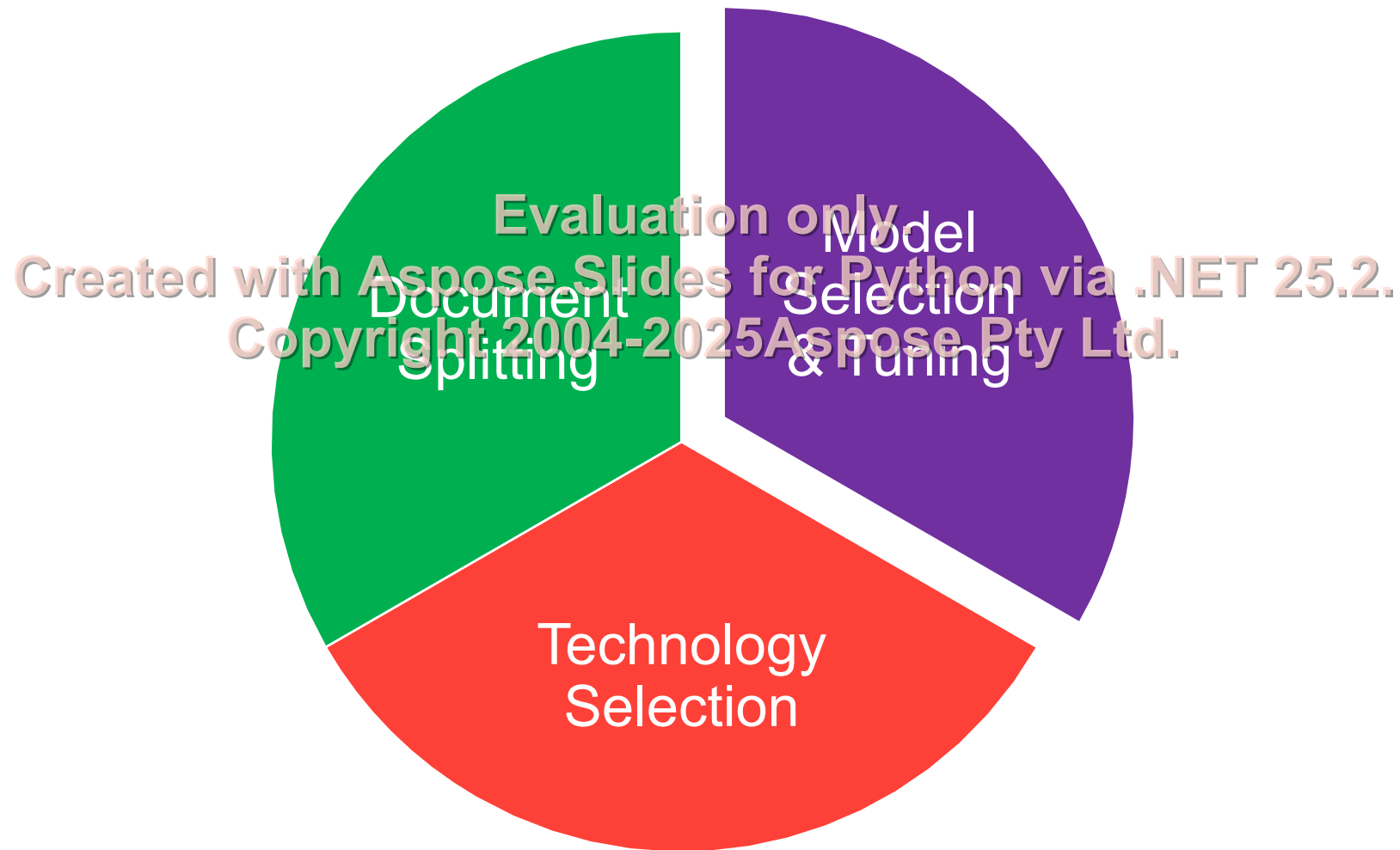
ATTEMPT	OUTCOME
<p>Find a pretrained model to help us:</p> <ul style="list-style-type: none"><li>• SnomedBERT</li><li>• BioBERT</li><li>• PubMedBERT</li></ul>	<p>Evaluation only.</p> <p>Word embeddings, not sentence embeddings</p>
<p>Use these models with a sentence transformer class</p>	<p>These models were not fine-tuned for sentence similarity, made the output worse</p>
<p>Add our vocabulary to the pretrained models (using exBERT architecture)</p>	<p>Couldn't get this to work, made the output worse</p>

# PREVIOUS ATTEMPTS



Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd

# VECTOR SEARCH





# TECHNOLOGY SELECTION

## Elasticsearch 7.8

### Pros

- Familiar

### Cons

- Not available as managed Services
- Two different versions to manage
- Quality & performance unknown
- No monitoring dashboards

## AWS Open Search

### Pros

- Available as managed Services

### Cons

- AWS for search repo
- Recent updates
- Two different versions to manage
- No monitoring dashboards

## Qdrant

### Pros

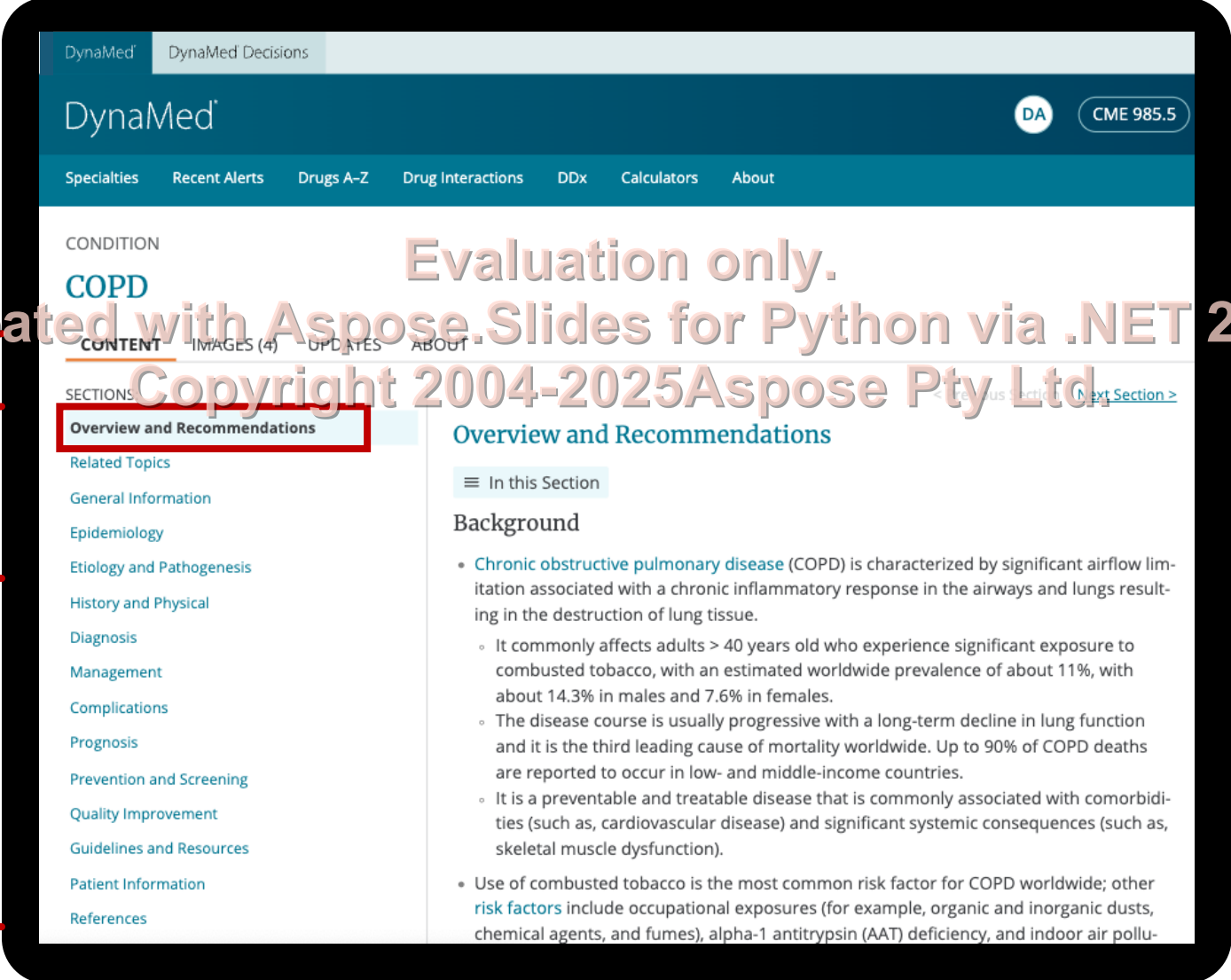
- Supports pre-filtering for approximate nearest neighbors
- Quality & performance known

### Cons

- Recent updates to manage
- No monitoring dashboards

# DOCUMENT SPLITTING

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.



The screenshot displays the DynaMed website interface. The top navigation bar includes 'DynaMed' and 'DynaMed Decisions' tabs, a 'DA' logo, and a 'CME 985.5' badge. Below this is a secondary navigation bar with links for 'Specialties', 'Recent Alerts', 'Drugs A-Z', 'Drug Interactions', 'DDx', 'Calculators', and 'About'. The main content area is titled 'CONDITION' and 'COPD'. A 'CONTENT' tab is active, showing 'IMAGES (4)', 'UPDATES', and 'ABOUT'. The 'SECTIONS' list on the left includes 'Overview and Recommendations' (highlighted with a red box), 'Related Topics', 'General Information', 'Epidemiology', 'Etiology and Pathogenesis', 'History and Physical', 'Diagnosis', 'Management', 'Complications', 'Prognosis', 'Prevention and Screening', 'Quality Improvement', 'Guidelines and Resources', 'Patient Information', and 'References'. The main content area displays the 'Overview and Recommendations' section, which includes a 'Background' subsection and a list of bullet points describing COPD.

**Overview and Recommendations**

**Background**

- **Chronic obstructive pulmonary disease (COPD)** is characterized by significant airflow limitation associated with a chronic inflammatory response in the airways and lungs resulting in the destruction of lung tissue.
  - It commonly affects adults > 40 years old who experience significant exposure to combusted tobacco, with an estimated worldwide prevalence of about 11%, with about 14.3% in males and 7.6% in females.
  - The disease course is usually progressive with a long-term decline in lung function and it is the third leading cause of mortality worldwide. Up to 90% of COPD deaths are reported to occur in low- and middle-income countries.
  - It is a preventable and treatable disease that is commonly associated with comorbidities (such as, cardiovascular disease) and significant systemic consequences (such as, skeletal muscle dysfunction).
- Use of combusted tobacco is the most common risk factor for COPD worldwide; other **risk factors** include occupational exposures (for example, organic and inorganic dusts, chemical agents, and fumes), alpha-1 antitrypsin (AAT) deficiency, and indoor air pollu-

# DOCUMENT SPLITTING

- DynaMed
- 4,500 long documents, split into 240,000 sections.
- Sections further split due to model input max length.
- Total: **400,000** vectors

- Dynamic Health
- 4,800 short documents, split into 50,000 sections
- Sections further split due to model input max length.
- Total: **64,000** vectors

Ultrasound

- duplex ultrasound
  - recommended as an option for detecting RAS
  - advantages of ultrasound<sup>1,4,5</sup>
    - provides information regarding kidney structure, size, location (unilateral/bilateral) of disease, and detects occlusion; also useful for follow-up after metallic stents
    - may repeat ultrasound to assess progression and hemodynamic effects of stenosis, such as flow velocity and vascular resistance
    - high-sensitivity may help rule out disease
    - not impacted by any medications, renal function, or extent of disease (unilateral, bilateral, solitary functioning kidney) and does not require IV contrast
  - disadvantages of ultrasound<sup>1,4</sup>
    - challenging in patients who are overweight or with abdominal gas; large body habitus will reduce accuracy of ultrasound
    - does not provide complete visualization of renal artery and accessory arteries
    - highest peak systolic velocity tracing may be missed
    - may overestimate degree of stenosis
    - increased time required for testing (generally 45-60 minutes)
    - requires operator experience ([Curr Hypertens Rep 2018 Apr 10;20\(4\):35](#))
  - criteria that may correlate with RAS include<sup>1,4,5</sup>
    - renal artery peak systolic velocity > 180 cm/second or > 200 cm/second; reported to have 85% sensitivity and 92% specificity to detect angiographically significant stenoses
    - renal aortic ratio (defined as ratio of renal artery peak systolic velocity to adjacent aorta peak systolic velocity) > 3.5
    - resistive index (RRI) < 0.6 may be indicative of RAS > 70%
    - RRI is defined as (peak systolic velocity - end diastolic velocity)/peak systolic velocity ratio

$$\text{RRI} = (\text{peak systolic velocity} - \text{end diastolic velocity}) / \text{peak systolic velocity ratio}$$

- measured in an intrarenal artery by Doppler ultrasound
- normal RRI 0.6-0.7
  - low RRI following revascularization may predict successful recovery of renal function and stabilization of blood pressure
  - low RRI < 60 may be due to
    - intrarenal cause of low RRI includes RAS > 70%; progression of chronic kidney disease (CKD) increases RRI, potentially masking diagnosis and hemodynamic effects of significant of RAS
    - extrarenal causes of low RRI include valvular aortic stenosis, thoracic or suprarenal abdominal aortic stenosis, tachycardia, hypervolemia, and

Section splitting is basic and sometimes happens mid-word. Fixing this will improve quality.

- in patients with renal or systemic arterial involvement, such as CKD, RRI is a marker of systemic atherosclerosis/arteriosclerosis (not renal damage), and is predictive of outcomes

outcome  
is, or increased  
cardia, or in-  
stiffening  
abnormalities or  
ty, hy-  
renal damage

# FRAGMENTED TEXT

DynaMed<sup>®</sup> DynaMed<sup>®</sup> Decisions

DynaMed<sup>®</sup> DA CME 991.5 copd

Specialties Recent Alerts Drugs A-Z Drug Interactions DDx Calculators About

CONDITION

**COPD**

CONTENT PLACES (4) UPDATES ABOUT

SECTIONS:

- Overview and Recommendations
- Related Topics
- General Information
- Epidemiology
- Etiology and Pathogenesis
- History and Physical
- Diagnosis
- Management
- Complications**
- Prognosis
- Prevention and Screening
- Quality Improvement
- Guidelines and Resources
- Patient Information
- References

Previous Section Next Section

**Complications**

In this Section

**All Complications**

- disease exacerbation (see also [Acute Exacerbation of COPD](#))<sup>1</sup>
- respiratory failure<sup>1</sup>
- pulmonary hypertension<sup>1</sup>
- general disability<sup>1</sup>
- panic, anxiety, and depression (see also [Anxiety and Depression in COPD](#))<sup>1</sup>
- complications in severe disease include<sup>1</sup>
  - rib fractures (may be asymptomatic) from prolonged coughing attacks
  - anorexia
  - fatigue
  - weight loss and cachexia
  - syncope during coughing
- other systemic complications initiated or worsened by circulating inflammatory mediators include

TOPIC EDITOR  
Linda Nici MD

RECOMMENDATIONS EDITOR  
Allen Shaughnessy PharmD, M Med Ed, FCCP

RECOMMENDATIONS EDITOR  
Esther Jolanda van Zuuren MD

DEPUTY EDITOR  
Terence K. Trow MD, FACP, FCCP

ACP REVIEWER  
Russell G. Buhr MD, PhD, FACP

Produced in collaboration with American College of Physicians

ACPP

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2  
Copyright 2004-2025 Aspose Pty Ltd.

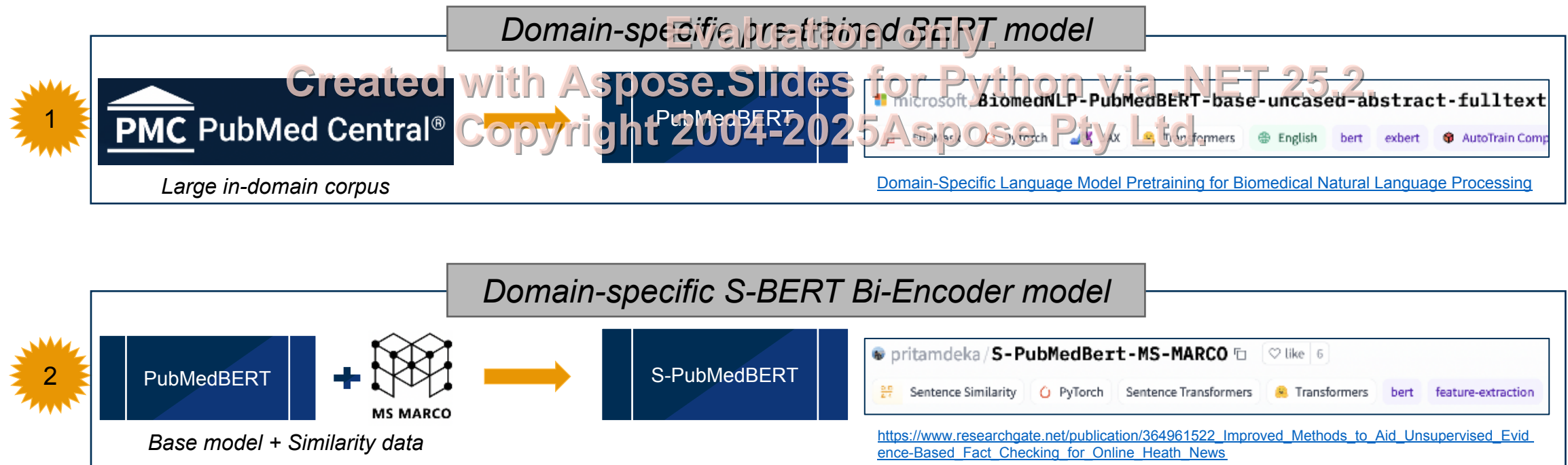
Researching Large Language Models (LLM) to summarize text before vectorizing it.

# USING AN IN-DOMAIN MODEL IS CRITICAL TO SUCCESS

1. PubMedBERT Pre-trained on PubMed central (full text)
2. Fine-tuned with MS-MARCO as a Sentence Transformer
3. Next Steps: fine-tuning this model beyond MS-MARCO

Table 8. Fine-tuned model evaluation results

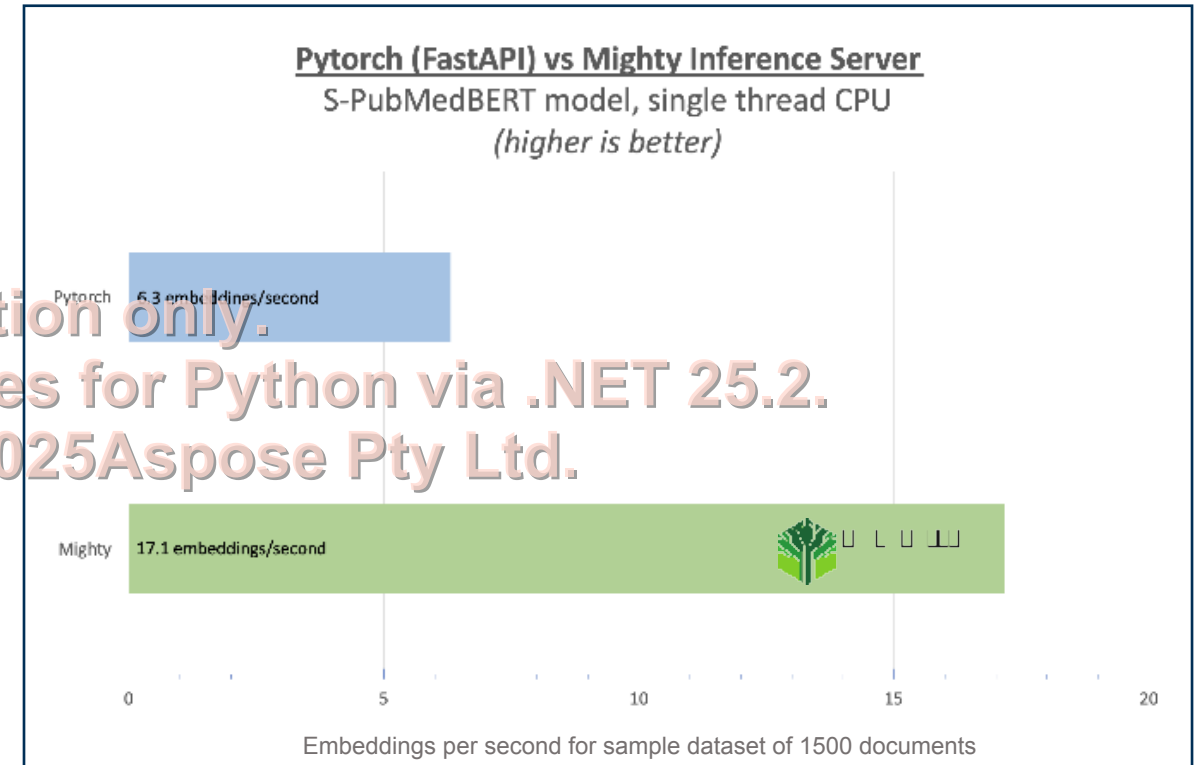
Model	recall@3	recall@5	recall@10
Fine-tuned S-PubMedBERT	<b>0.870</b>	<b>0.910</b>	<b>0.943</b>
Fine-tuned ANCE	0.731	0.755	0.787
Fine-tuned DPR	0.651	0.678	0.735
Fine-tuned TCT-Colbert	0.742	0.764	0.791
Fine-tuned Distibert-TAS-B	0.755	0.771	0.795
Fine-tuned SPLADE-v2	0.739	0.755	0.771



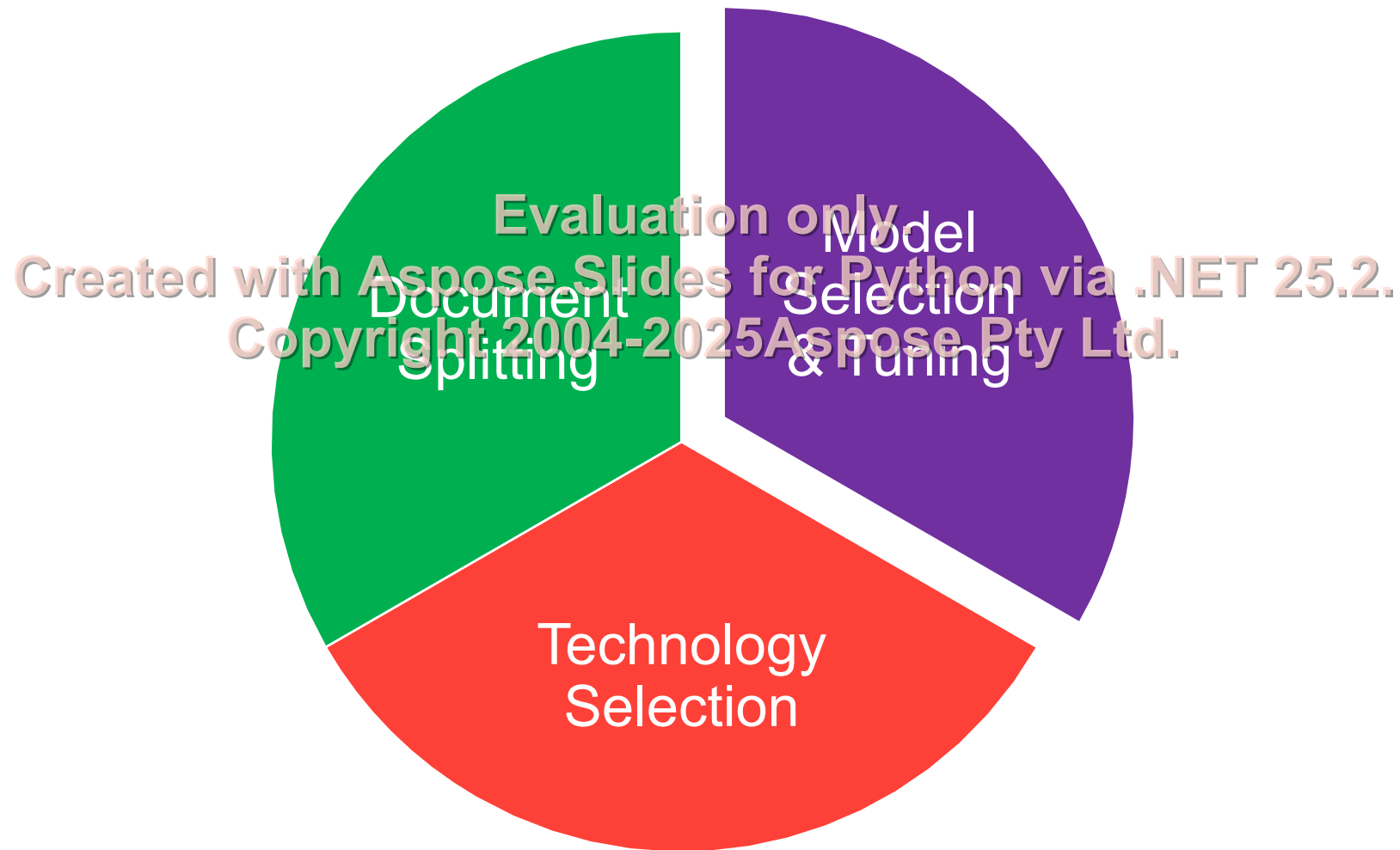
# MIGHTY INFERENCE SERVER

## FOR FAST AND CONCURRENT INFERENCE

- AWS c6i.4xlarge
  - 16 threads & concurrent requests
  - Ingestion AND Queries
- Custom reverse proxy
  - Handle all requests concurrently
  - Queues with minimal overhead
- Very fast
  - Content vector: 200 to 500ms
  - Query vector: 30 to 50ms
- High Throughput
  - All 460,000 embeddings in < 6 hours
  - Up to 500 queries per second



# VECTOR SEARCH





*“what antibiotic is most appropriate for preseptal cellulitis?”*

Created with Aspose.Slides for Python via .NET 25.2.  
Copyright 2004-2025 Aspose Pty Ltd.

**SEMANTIC SEARCH**

**VECTOR SEARCH**

**DynaMed**

DynaMed Decisions

Specialties Recent Alerts Drugs A-Z Drug Interactions DDx Calculators About

SHOWING: what antibiotic is most appropriate for preseptal cellulitis?

We were unable to find results for "what antibiotic is most appropriate for preseptal cellulitis?"

Search Tips:

- Check your spelling
- Try using single words or concepts

**DynaMed**

DynaMed Decisions

DA CME 985.5 what antibiotic is most appropriate for preseptal cellulitis?

HOW TO: what antibiotic is most appropriate for preseptal cellulitis?

MAIN (10)

Filter Results

CONTENT TYPE

- ☐ Condition (8)
- ☐ Management (2)

Preseptal Cellulitis

Preseptal cellulitis is an infection of soft tissues surrounding the eye, limited to tissues anterior to the orbital septum.

Overview and Recommendations

Management

Management overview

CONDITION

Cellulitis

Cellulitis refers to an acute infection of the dermis and subcutaneous tissue typically occurring after a skin breach.

Overview and Recommendations

Management

Management > Antibiotics

Comparative efficacy in general population

Management > Antibiotics

Comparative efficacy in areas of high MRSA prevalence or in patients at risk for MRSA infection

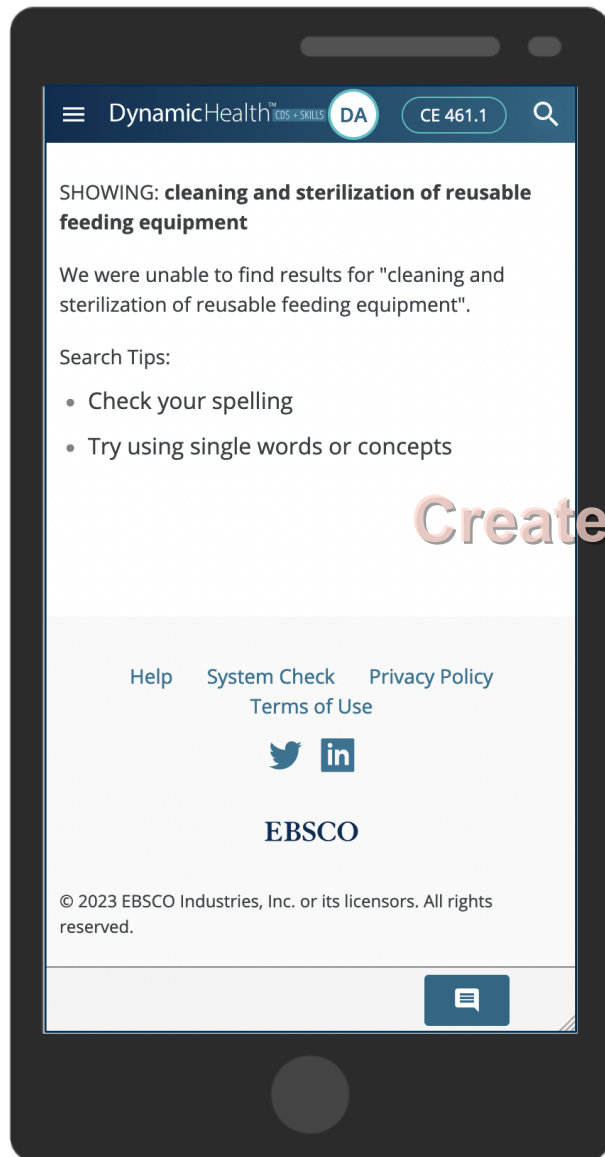
CONDITION

Erysipelas

Erysipelas is an acute bacterial infection of the dermis and hypodermis which may also involve cutaneous lymphatics.

Management > Medications

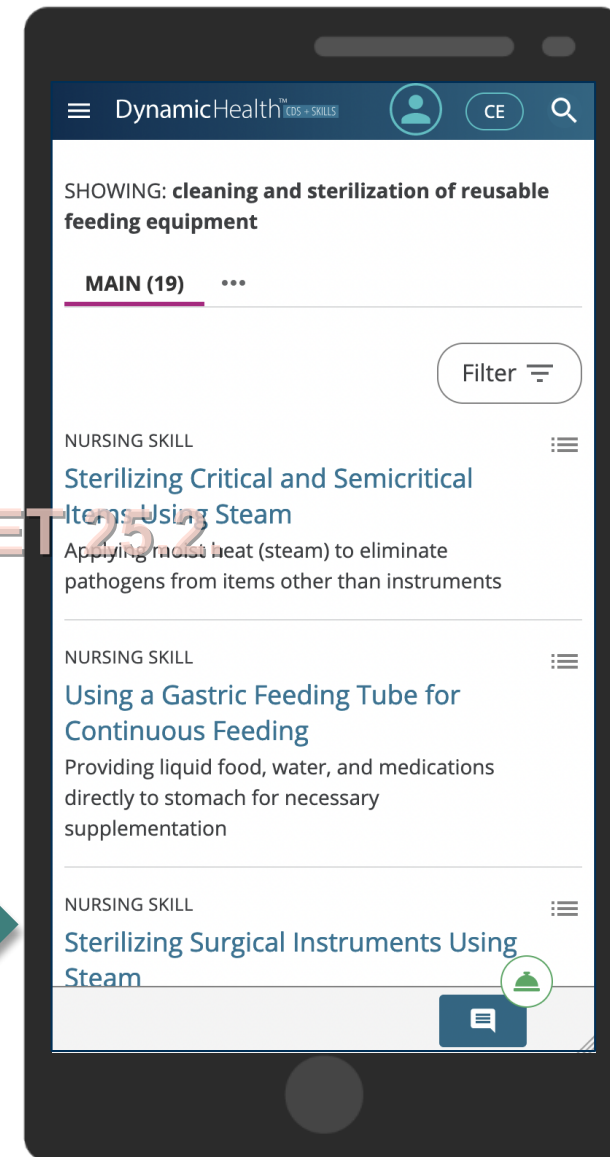
Antibiotics



SEMANTIC SEARCH

Evaluation only.  
Created with Aspose Slides for Python via .NET 25.2  
Copyright 2004-2025 Aspose Pty Ltd.  
"cleaning and sterilization of reusable feeding equipment"

VECTOR SEARCH



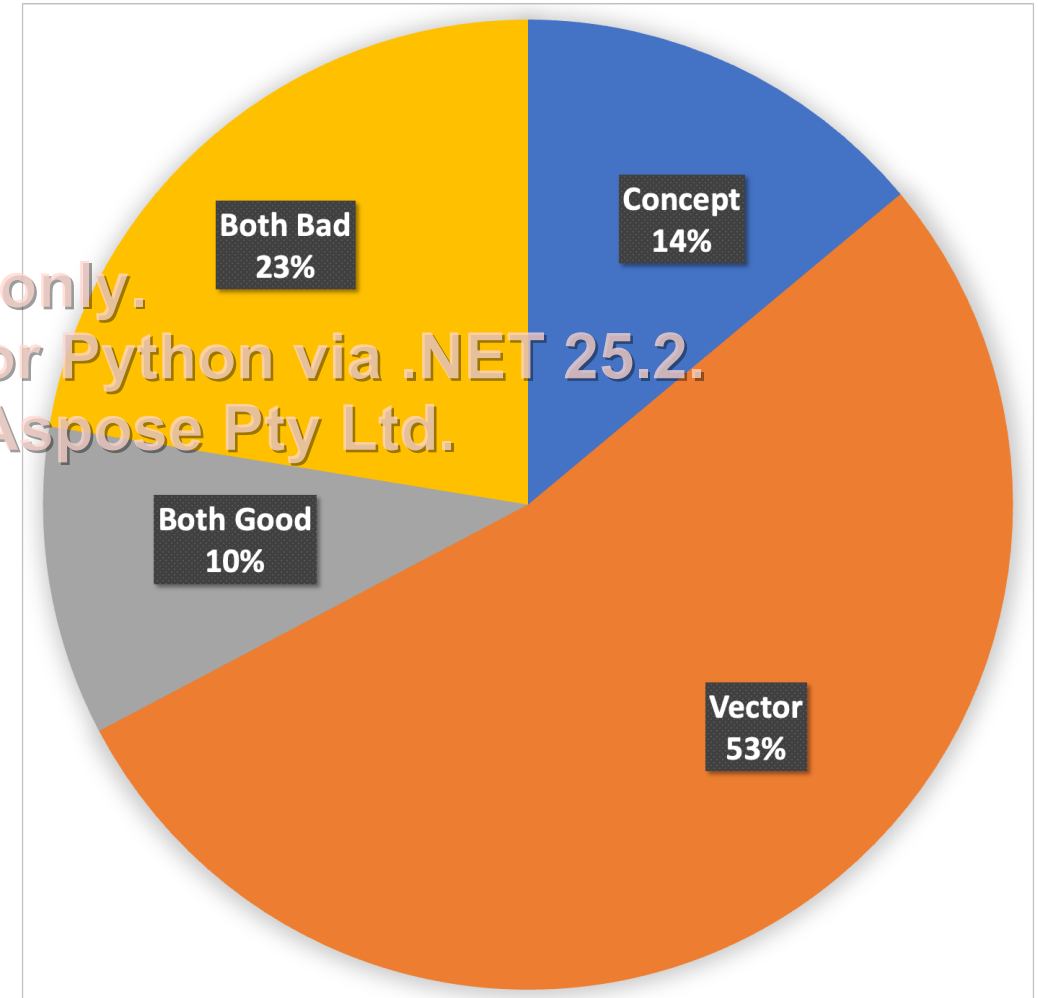
# SUBJECT MATTER EXPERT FEEDBACK

- 3 experts, each rating the same 55 queries
- Side-by-side result sets (random and blind)
- Pick one or the other, or say both are good or both are bad

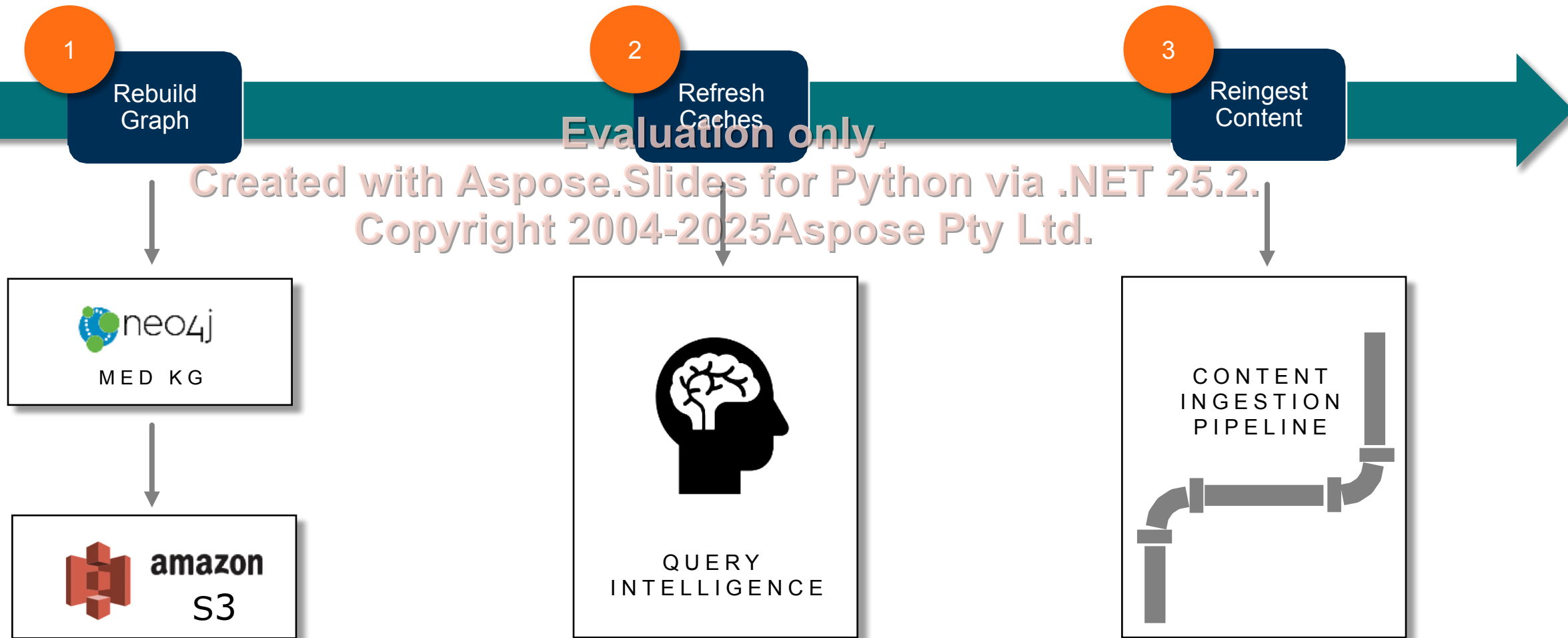
The screenshot displays the 'Search Evaluation Tool' interface. On the left is a dark sidebar with a 'MAIN MENU' containing links to Home, Search Quality, Golden Sets, Medical, Question Answer, and Admin Management. The main content area shows a search query: 'nonpharmacologic versus pharmacologic treatment adults patients major depressive disorder'. Below the query, there are two columns of search results. The left column shows results for 'Major Depressive Disorder (MDD)' with a snippet mentioning 'Guidelines and Resources / Guidelines / United States guidelines'. The right column shows results for 'Persistent Depressive Disorder' with a snippet mentioning 'Management / Medications / Antidepressants / Antidepressant efficacy'. Above the results, there are three buttons: 'Both are Good' (blue), 'Both are Bad' (blue), and 'Right Results' (green). A large, semi-transparent watermark is overlaid on the center of the image, reading 'Evaluation only. Created with Aspose Slides for Python via .NET 25.2. Copyright 2004-2025 Aspose Pty Ltd.' The bottom of the interface shows 'EBSCO Information Services 2022'.

# SUBJECT MATTER EXPERT FEEDBACK

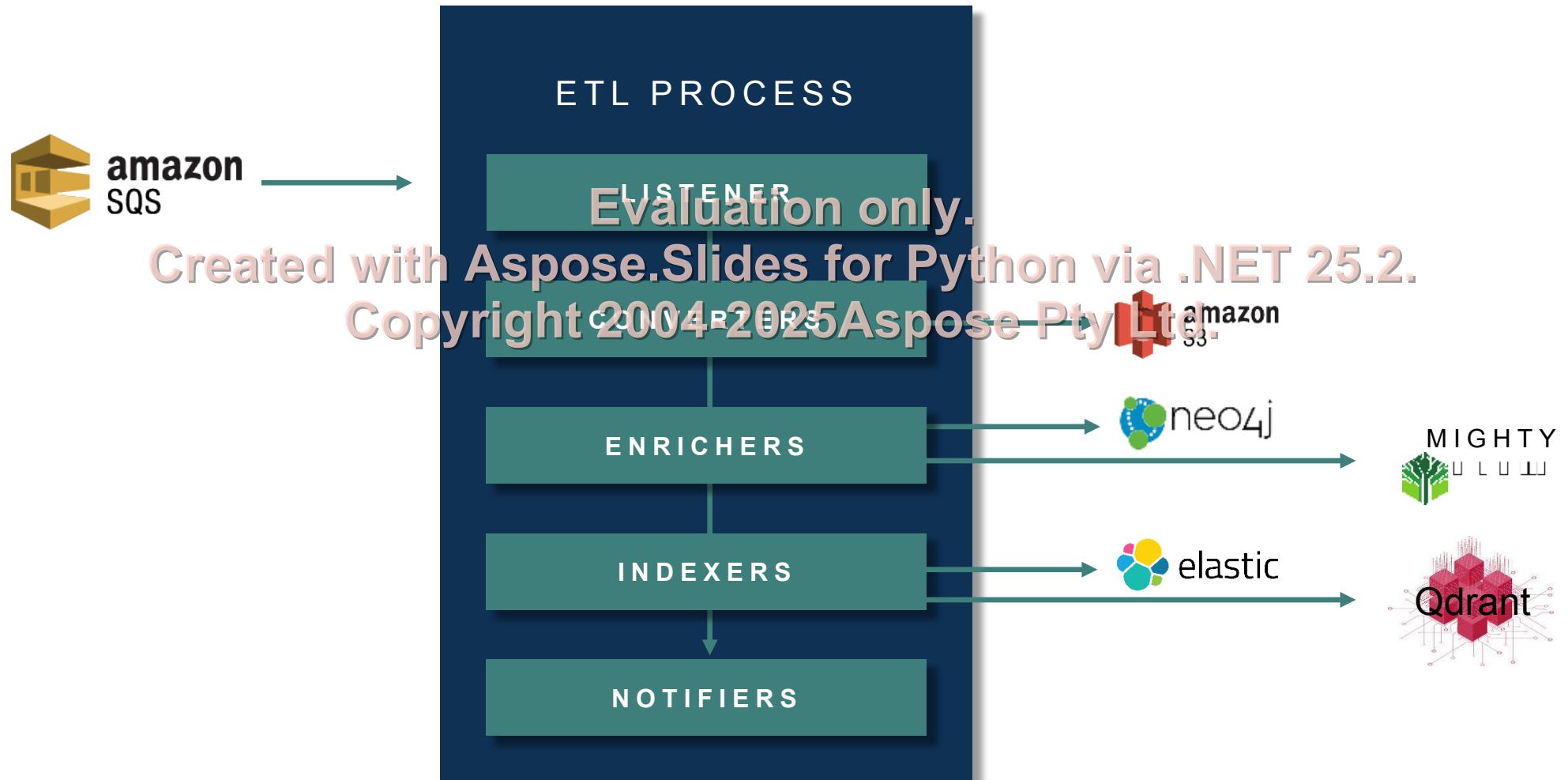
- Rater Majority Consensus: 89%
- Results
  - 53% preferred vector search
  - 14% preferred concept search
  - 10% said both were good
  - 23% said both were bad



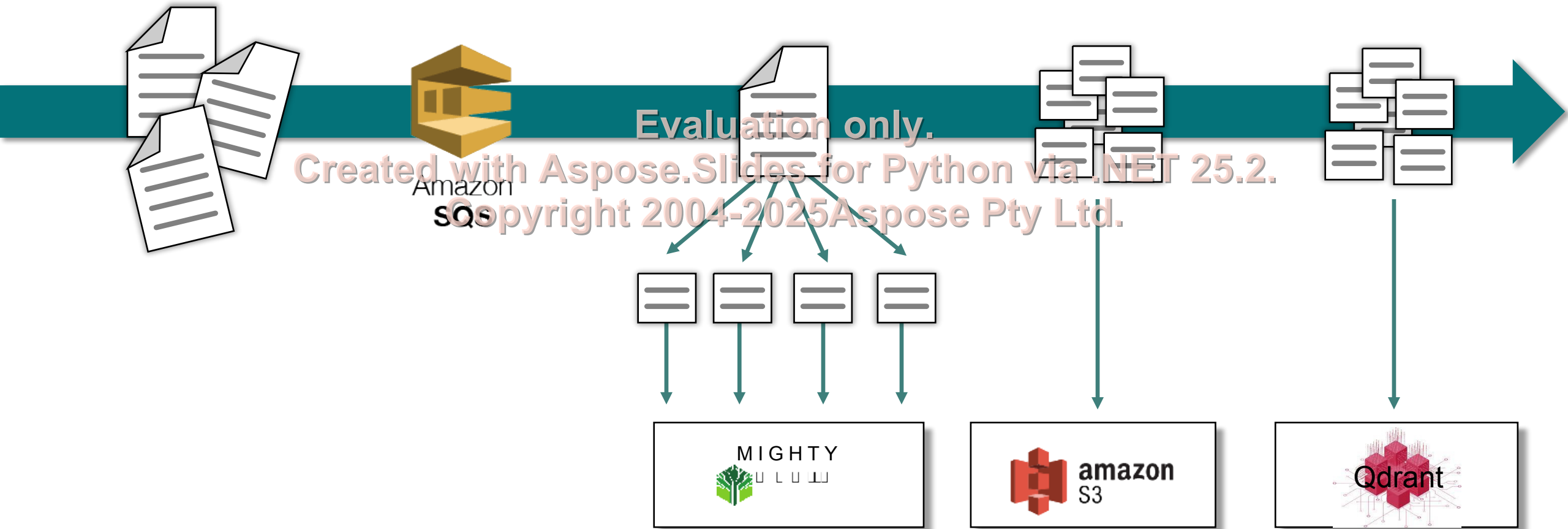
# DAILY CONTENT REFRESH



# CONTENT INGESTION PIPELINE

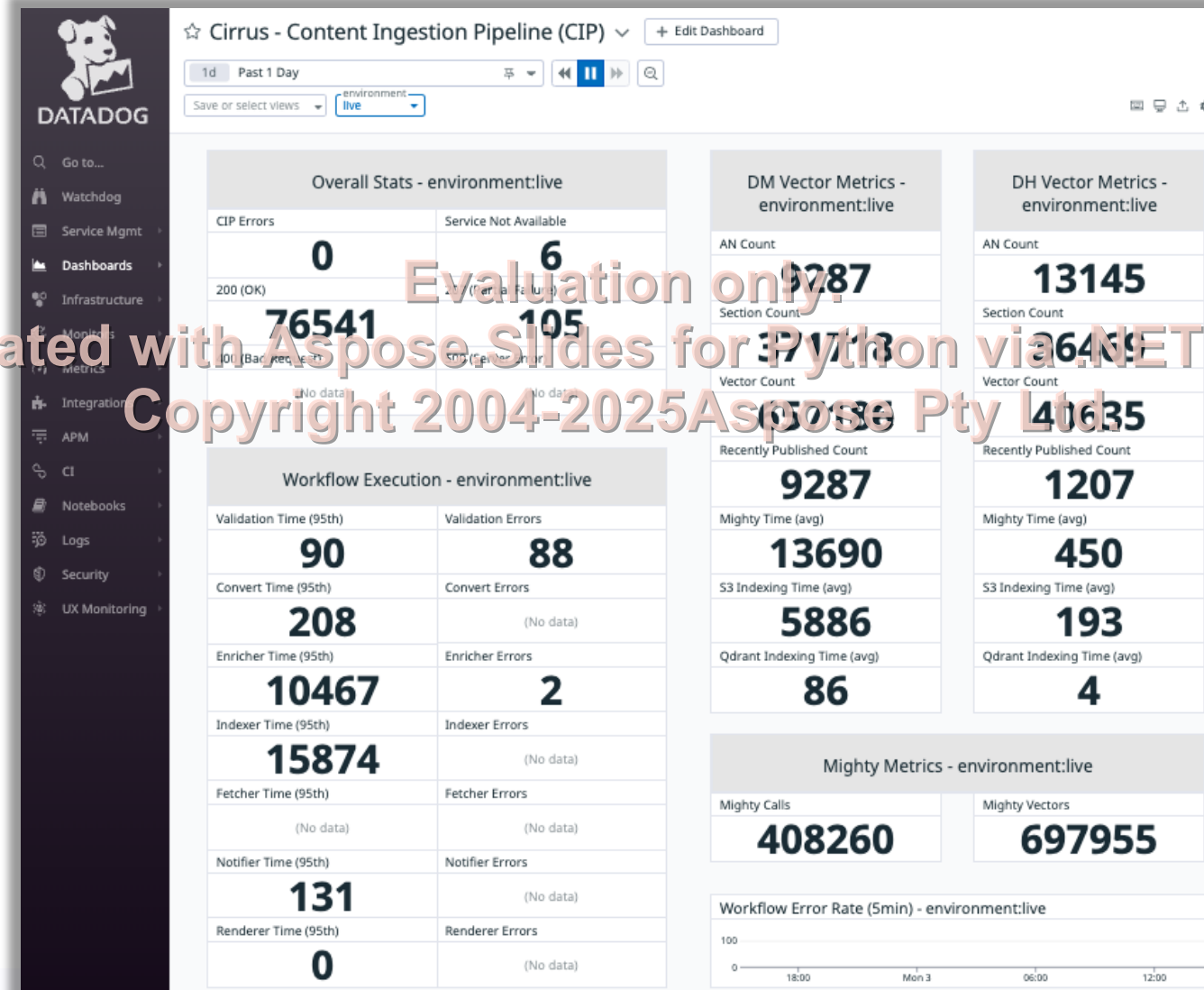


# CONTENT INGESTION PIPELINE

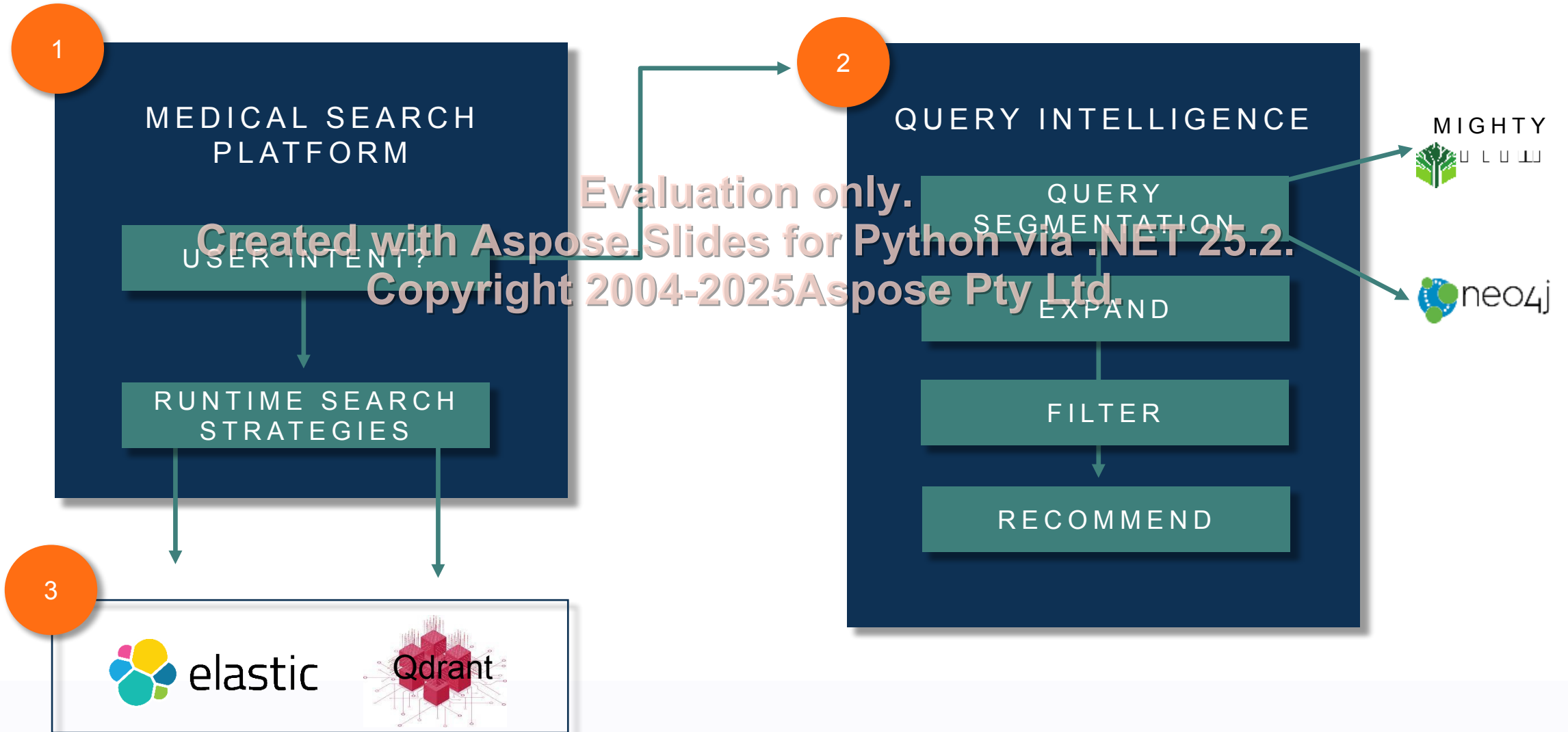




# CONTENT INGESTION PIPELINE

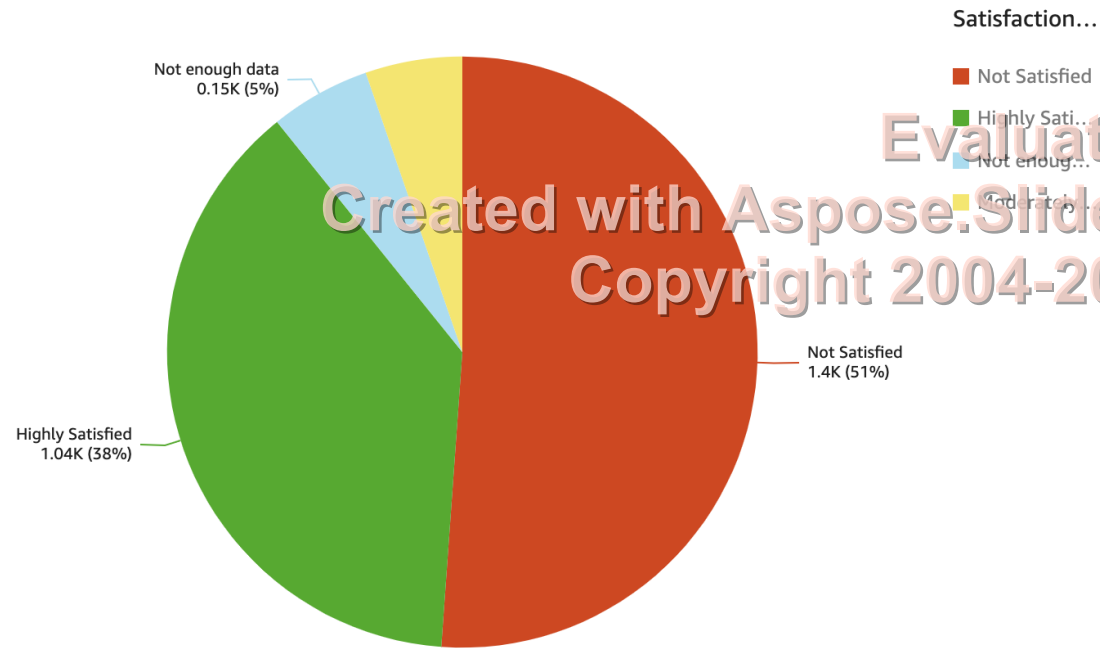


# SEARCH RUNTIME



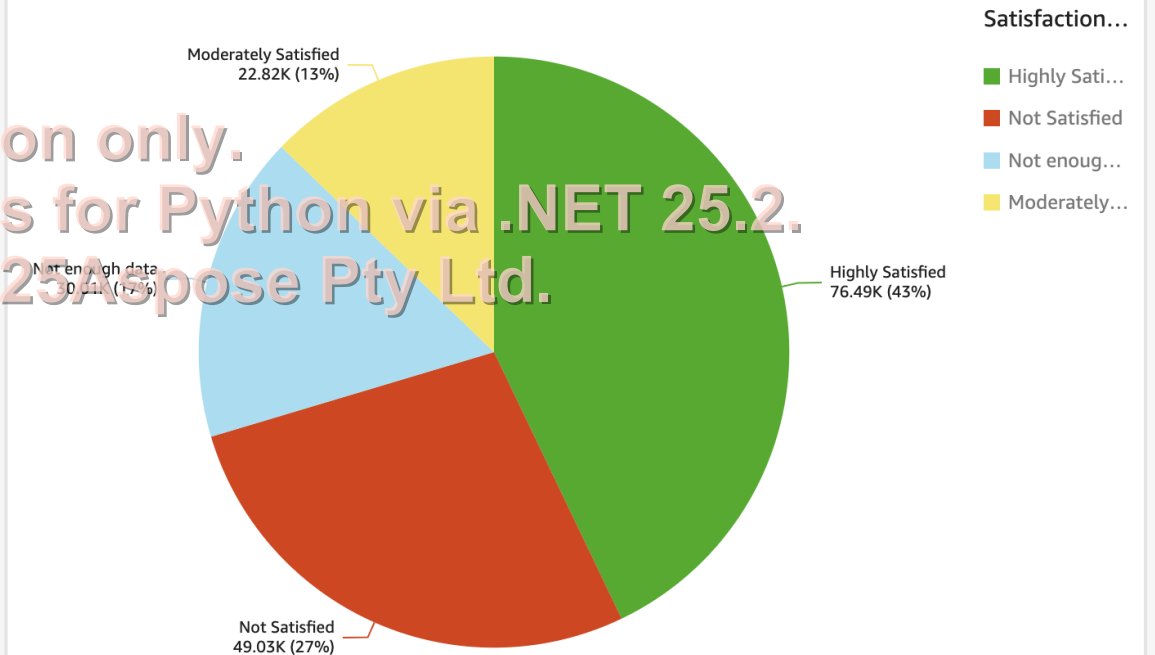
# KEY PERFORMANCE INDICATORS

Vector Search Satisfaction



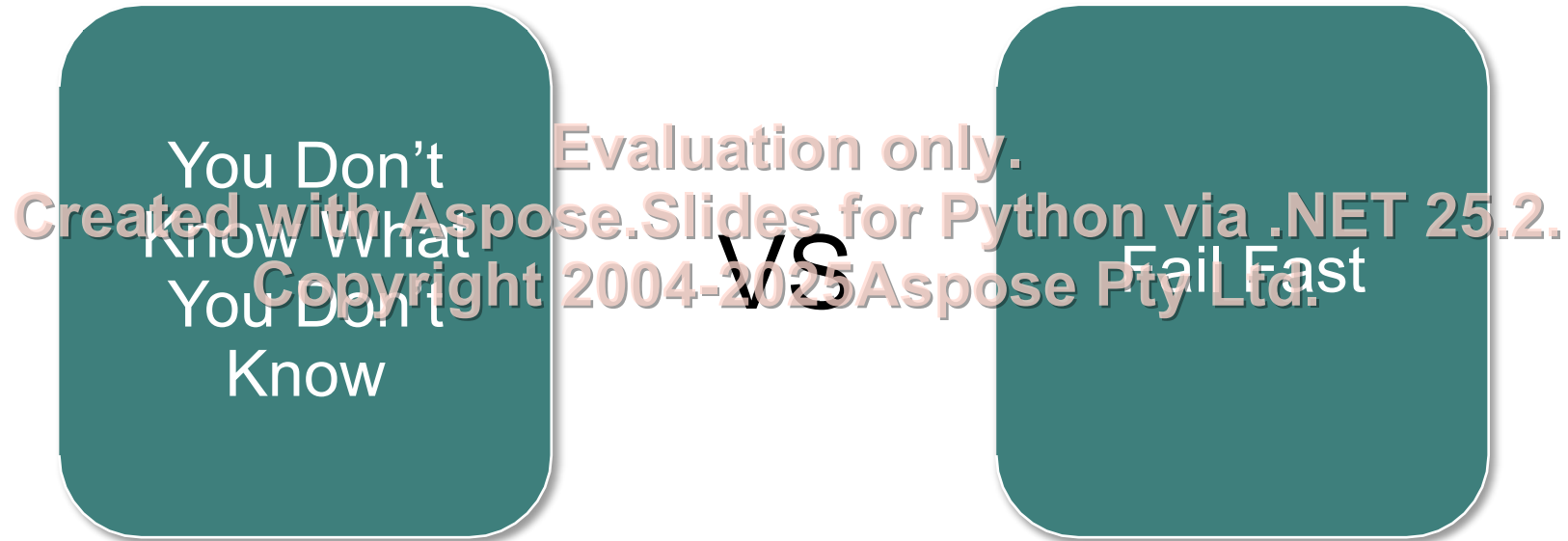
Group By: satisfactionCategoryUpdated  
Size: satisfactionCategoryUpdated (Count)

Regular Search Satisfaction



Group By: satisfactionCategoryUpdated  
Size: satisfactionCategoryUpdated (Count)

# LESSONS LEARNED



# LESSONS LEARNED



# NEXT STEPS

## ITERATE TO IMPROVE QUALITY

1

### Measure

- Click log analysis
- Similarity data mining

2

### Improve models

- Tune with newer content
- Tune with similarity data

3

### Single Search Engine

- Investigate combined BM25+ANN capable engine

Evaluation only.  
Created with Aspose.Slides for Python via .NET 25.2.3  
Copyright 2004-2025 Aspose Pty Ltd.