NLP Cell

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Outline

- NLP overview
- HITEx overview
- Use cases
- NLP cell in the hive
Rule out *polymyalgia rheumatica* versus early inflammatory arthritis versus diffuse osteoarthritis. She will continue on Tylenol as needed. I have urged her to start Aleve, 1 tablet twice a day with usual precautions. I have sent today for sedimentation rate, CRP, rheumatoid factor, ANA, and CBC. She is quite reluctant to have a blood drawn, but I have told her it is very important to help guide her treatment. I will be in touch with her when results are available, and we briefly discussed the possibility of starting steroids. I will arrange office follow up in 1 month.
Typical Steps in Natural Language Processing (NLP)

- Morphological analysis (tokenizing)
- Syntactic analysis (transforming linear sequences/sentences of words into structures, usually trees)
- Semantic analysis (assigning meaning to the syntactic structures)
- Discourse integration (interpreting a sentence in the context of adjacent sentences)
- Pragmatic analysis (to understand the actual meaning of a piece of text)
I have sent today for sedimentation rate, CRP, rheumatoid factor, ANA, and CBC. She is quite reluctant to have a blood drawn, but I have told her it is very important to help guide her treatment. I will be in touch with her when results are available, and we briefly discussed the possibility of starting steroids.

Lab Test Order:
- Patient Name: xxxx
- Physician Name: xxxx
- Date: 01/01/1999
- Test: Sedimentation Rate
NLP Approaches

- Symbolic
- Empirical
Symbolic Approach

- Tokenization
- Lexical Analysis
- Syntactic Analysis
- Semantic Analysis
- Pragmatic Analysis

{Finding: Infiltration  
Certainty: High  
Distribution: Patchy  
Time of Appearance: New  
Location: Left Lower Lobe}
Empirical (Statistical) Approach

- Corpora
- Supervised learning
- Unsupervised learning

New (ADJ) patchy (ADJ) infiltrate (N) is (AUX) found (V) in (PREP) left (ADJ) lower (ADJ) lobe (N).

The (DEF) patient (N) complains (V) of (PREP) chest (N) Pain (N).

...........

The cardiovascular exam is regular.

Probability ((DEF)(ADJ) (N) (V) (ADJ)) > Probability ((N) (ADJ) (PREP) (V) (N))
NLP Applications in the Biomedical Domain

- Information extraction of clinical data
- Text mining of literature
- Free text query and retrieval
- Automated question answering
- Speech recognition
- Report generation
- Decision support, adverse event detection, knowledge discovery, tailored health communication

……
MetaMap Transfer (MMTx) - NLM

- Syntactic parsing and lexical matching
- Extraction UMLS concepts from free text
Sub-language semantic grammar

Its ability to detect clinical conditions in chest X-ray reports evaluated

“"The natural language processor was not distinguishable from the physicians and was superior to all other comparison subjects. “

ANY DECISION TO BIOPSY A PALPABLE MASS SHOULD BE MADE ON CLINICAL GROUNDS.

problem:mass
certainty>> moderate certainty
problemdescr>> palpable
code>> UMLS:C0746412^mass palpable
syntactic + semantic (Bayesian Network)

“In extracting pneumonia related concepts from chest x-ray reports, the performance of the natural language processing system was similar to that of physicians and better than that of lay persons and keyword searches.”
Statistical Natural Language Processing of Medical Report - UCLA

- Statistical parser and semantic interpreter
- “Recall and precision reached a percentile in the mid 80's from a little over one hundred training sentences and reached recall 90% at precision 89% by one thousand training sentences.”
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- HITEx overview
- Use cases
- NLP cell in the hive
Rationale

- Why another NLP system?
  - There lacked open source and easy-to-adopt solutions
HITEx Overview

- Builds on top of GATE NLP Framework
- Consists of:
  - Collection of NLP components specifically created to extract clinical information.
  - Runtime environment management module
  - UMLS database
  - Supporting libraries
- Uses GATE document for inter-component communication
- Components are assembled into task-specific NLP pipeline applications that parse the unstructured text records
Currently, there are 12 components that are part of HITEx:

- Tokenizer
- Part-of-Speech Tagger
- Sentence Splitter
- Noun Phrase Splitter
- Sectionizer
- UMLS Concept Finder
- Smoking Status Finder
- Regular Expression Concept Finder
- Family History Finder
- Temporal Finder
- Negation Finder
- N-gram Finder
HITEx Pipeline

- Dynamically created from HITEx components
- The order of components is configurable
- Individual component’s parameters are configurable
- The input of the pipeline is the unstructured report text
- Each component’s may use the output of the previous component(s) as its input
- The application’s output is a GATE document that contains task-specific results of NLP parsing
The principal diagnosis, co-morbidity and smoking status extracted by HITEx from a set of 150 discharge summaries were compared to an expert-generated gold standard.

- The accuracy of HITEx was 82% for principal diagnosis, 87% for co-morbidity, and 90% for smoking status extraction, when cases labeled "Insufficient Data" by the gold standard were excluded.
Evaluation 2

- The diagnosis and family history-related diagnoses extracted by HITEx from a set of 350 sentences were compared to a human rater.
  - The precision and recall of extracting all diagnoses were 85.12% and 86.93%, respectively. The precision and recall of differentiating family history from patient history diagnoses were 96.30% and 92.86%, respectively. Both the precision and recall of exact family member assignment were 92.31%.
Outline

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- Use cases
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Typical Work Flow

- Define task
- Obtain text files from the data mart
- Design a HITEx pipeline
- Iteratively test and refine
  - Change configuration of the pipeline or individual modules
  - Develop new modules
- Evaluation
  - Review results on the sentence level
  - Evaluate information retrieval performance on the report/patient level
Case 1: Identify co-morbidities

- **Problem**: Identify patient’s co-morbidities in the unstructured medical report. Co-morbidities are all findings that are not principal diagnoses.

- **NLP Solution**:
  - Identify document sections; *exclude* all sections that are categorized as principal diagnoses related.
  - Identify findings in the relevant sections, apply negation.

- The main task is performed by the UMLS Concept Finder component.
- Section identification and filtering is performed by the Sectionizer component.
- Negation is performed by the Negation Finder.
- All components are part of the HITEx core.
Co-morbidities Pipeline Application

Input Text → Tokenizer → Sentence Splitter →
Part-of-Speech Tagger → Noun Phrase Finder → Sectionizer →
UMLS Concept Finder → Negation Finder → Co-morbidities →
Regular Expression Concept Finder → N-gram Finder → Smoking Status Finder → Negation Finder
Case 2: Identify smoking status

- **Problem:**
  - Identify patient’s smoking status (Current, Past, Denies, Non-smoker) using the unstructured medical report data.

- **NLP solution:**
  - Build the classification model using manually annotated sentences (gold standard)
  - Plug in the model into the NLP pipeline application to determine smoking status of each sentence that mentions smoking

- The main task is performed by the **Smoking Status Finder** component (part of HITEx)
Smoking Status Pipeline Application

Input Text → Tokenizer → Sentence Splitter → N-gram Finder → Smoking Status Finder → Smoking Status

- Part-of-Speech Tagger
- Noun Phrase Finder
- Sectionizer
- UMLS Concept Finder
- Negation Finder

- Regular Expression Concept Finder
- Negation Finder
Case 3: Identify Erosion

- **Problem:**
  - Identify erosion in the unstructured medical records

- **Solution**
  - Use regular expression matching to capture all occurrences of erosion-related keywords.
  - Use negation detection to exclude all negated erosions.

- The main task is performed by the **Regular Expression Concept Finder** component (part of HITEx), configured with special rules to capture erosions.

- **Negation Finder** is used to identify negated erosions.
Erosions Pipeline Application

- Input Text
- Tokenizer
  - Part-of-Speech Tagger
  - Noun Phrase Finder
  - Sectionizer
  - UMLS Concept Finder
  - Negation Finder
- Sentence Splitter
  - N-gram Finder
  - Smoking Status Finder
- Regular Expression Concept Finder
  - Negation Finder
- Erosions
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NLP Cell Overview

- NLP Cell uses HITEx core as a back end
- Installs as an optional cell in the I2B2 Hive
- Communicates with the clients using SOAP protocol
- Provides the following services to its clients:
  - **getDiagnoses**: returns a list of principal diagnoses codes.
  - **getDischargeMedications**: returns a list of discharge medications.
  - **getSmokingStatus**: returns the smoking status (e.g., current smoker).
  - **getAllConcepts**: returns a list of all available concepts from a document (i.e., principal diagnoses, discharge medications and smoking status)
  - **getCustomConcepts**: returns a list of custom concepts, given a custom task configuration.
Clients communicate with the cell using standard, pre-defined I2B2 XML request and response messages.

Client sends
- the type of operation to perform
- the unstructured text to perform operation on
- Custom pipeline configuration (optional)

Cell returns
- Status of the request
- Actual results in the form of concept codes, if request was successful
NLP Cell Client

- Available as Eclipse plug-in
- Installs into the I2B2 workbench
- Provides an interface to run standard NLP pipelines on the user-specified report.
- Allows advanced users to build custom pipelines to solve complex NLP tasks
- Provides graphical interface for individual component configuration
Co-morbidities Pipeline Application

Input Text → Tokenizer → Sentence Splitter → Part-of-Speech Tagger → Noun Phrase Finder → Sectionizer → UMLS Concept Finder → Negation Finder → Co-morbidities

Original unstructured text:

NAME: DOE, JOHN
UNIT NUMBER: 000-00-00
ADMISSION DATE: 01/01/1999
DISCHARGE DATE: 01/02/1999
PRINCIPAL DIAGNOSIS:
Bilateral lower extremity deep venous thrombosis.
ASSOCIATED DIAGNOSIS:
1. Lower gastrointestinal bleed.
2. Anemia.
3. History of atrial fibrillation.
4. Ventricular ectopy.
PRINCIPAL PROCEDURE: None.
HISTORY OF PRESENT ILLNESS: This forty-four-year-old male underwent a restorative proctocolectomy on December 20, 1998 for ulcerative colitis. Two days preoperatively he was found to have a left lower extremity deep venous thrombosis and had an inferior vena cava filter placed. Postoperatively, he
Co-morbidities Pipeline Application

- Input Text
- Tokenizer
- Part-of-Speech Tagger
- Noun Phrase Finder
- Sentence Splitter
- Regular Expression Concept Finder
- Sectionizer
- UMLS Concept Finder
- Negation Finder

Tokens and space tokens

NAME: DOE, JOHN
UNIT NUMBER: 000-00-00

ADMISSION DATE: 01/01/1999
DISCHARGE DATE: 01/02/1999

PRINCIPAL DIAGNOSIS:
Bilateral lower extremity deep venous thrombosis.

ASSOCIATED DIAGNOSIS:
1. Lower gastrointestinal bleed.
2. Anemia.
3. History of atrial fibrillation.
4. Ventricular ectopy.

PRINCIPAL PROCEDURE: None.

HISTORY OF PRESENT ILLNESS: This forty four year old male underwent a restorative proctocolectomy on December 20, 1998 for ulcerative colitis. Two days preoperatively he was found to have a left lower extremity deep venous thrombosis and had an inferior vena cava filter placed. Postoperatively, he...
Co-morbidities Pipeline Application

Input Text → Tokenizer → Sentence Splitter → Part-of-Speech Tagger → Noun Phrase Finder → Sectionizer → UMLS Concept Finder → Negation Finder → Co-morbidities

Regular Expression Concept Finder

Sentences

NAME: DOE, JOHN
UNIT NUMBER: 000-00-00

ADMISSION DATE: 01/01/1999  DISCHARGE DATE: 01/02/1999

PRINCIPAL DIAGNOSIS:
Bilateral lower extremity deep venous thrombosis

ASSOCIATED DIAGNOSIS:
1. Lower gastrointestinal bleed
2. Anemia
3. History of atrial fibrillation
4. Ventricular ectopy

PRINCIPAL PROCEDURE: None

HISTORY OF PRESENT ILLNESS: This forty-four year old male underwent a restorative proctocolectomy on December 20, 1996 for ulcerative colitis. Two days preoperatively he was found to have a left lower extremity deep venous thrombosis and had an inferior vena cava filter placed. Postoperatively, he
Co-morbidities Pipeline Application

**Input Text** → **Tokenizer** → **Part-of-Speech Tagger** → **Sentence Splitter** → **Regular Expression Concept Finder**

- **Noun Phrase Finder**
- **Sectionizer**
- **UMLS Concept Finder**
- **Negation Finder**

Part-of-speech tags associated with tokens:
Co-morbidities Pipeline Application

Input Text → Tokenizer → Sentence Splitter → Part-of-Speech Tagger → Noun Phrase Finder → Sectionizer → UMLS Concept Finder → Negation Finder → Co-morbidities

Regular Expression Concept Finder

NAME: DOE, JONH
UNIT NUMBER: 000-00-00
ADMISSION DATE: 01/01/1999
DISCHARGE DATE: 01/02/1999
PRINCIPAL DIAGNOSIS:
Bilateral lower extremity deep venous thrombosis.
ASSOCIATED DIAGNOSIS:
1. Lower gastrointestinal bleed.
2. Anemia.
3. History of atrial fibrillation.
4. Ventricular ectopy.
PRINCIPAL PROCEDURE: None
HISTORY OF PRESENT ILLNESS: This forty-four year old male underwent a restorative proctocolectomy on December 20, 1996 for ulcerative colitis. Two days preoperatively he was found to have a left lower extremity deep venous thrombosis and had an inferior vena cava filter placed. Postoperatively, he
Co-morbidities Pipeline Application

Input Text → Tokenizer → Sentence Splitter

- Part-of-Speech Tagger
- Noun Phrase Finder
- Sectionizer
- UMLS Concept Finder
- Negation Finder

Regular Expression Concept Finder

[Text sample: NAME: DOE, JONH UNIT NUMBER: 000-00-00
ADMISSION DATE: 01/01/1999 DISCHARGE DATE: 01/02/1999
PRINCIPAL DIAGNOSIS:
Bilateral lower extremity deep venous thrombosis.
ASSOCIATED DIAGNOSIS:
1. Lower gastrointestinal bleed
2. Anemia
3. History of atrial fibrillation
4. Ventricular ectopy.
PRINCIPAL PROCEDURE: None.
HISTORY OF PRESENT ILLNESS: This forty four year old male underwent a restorative proctocolectomy on December 20, 1996 for ulcerative colitis. Two days preoperatively he was found to have a left lower extremity deep venous thrombosis and had an inferior vena cava filter placed. Postoperatively, he]
Co-morbidities Pipeline Application

- **Input Text**
- **Tokenizer**
- **Sentence Splitter**
- **Part-of-Speech Tagger**
- **Noun Phrase Finder**
- **Sectionizer**
- **UMLS Concept Finder**
- **Negation Finder**

**Co-morbidities**

**Negation status:** not negated
Co-morbidities Pipeline Application

1. [C0024050] Lower gastrointestinal hemorrhage (disorder)
2. [C0002871] Anemia
3. [C0004238] Atrial Fibrillation
4. [C0151636] Premature ventricular contractions
ATROVENT INHALER (IPRATROPIUM INHALER) 2 PUFF INH QID
PRN Shortness of Breath
ENALAPRIL MALEATE 20 MG PO QD
Alert overridden: Override added on MM/DD/YY by :
POTENTIALLY SERIOUS INTERACTION: POTASSIUM CHLORIDE and
ENALAPRIL MALEATE Reason for override: aware

DIET: House / Low chollow sat. fat
DIET: House / ADA 2100 cals/dy

RETURN TO WORK: Not Applicable

FOLLOW UP APPOINTMENT(S):
Schedule an appointment to be seen by Dr ABC within 3 days,

No Known Allergies
ADMIT DIAGNOSIS:
asthma
PRINCIPAL DISCHARGE DIAGNOSIS:
Asthma exacerbation
ASSOCIATED DIAGNOSIS:

Asthmatic bronchitis

OPERATIONS AND PROCEDURES:
OTHER TREATMENTS/PROCEDURES (NOT IN O.R.)
cardiac MIBI exercise tolerance test
BRIEF RESUME OF HOSPITAL COURSE:
\*\*\* HCT h/o asthma, HTN p/w SOB x 1 day

This pt was in her USCH until 2 days PTA when she developed cough
productive of tan sputum, mild SOB and mild wheezing. She felt as
<patient_id>1234567</patient_id>
<concept_cd>DSG-NLP:cl319018</concept_cd>
<start_date>2008-04-04T17:43:23.108-04:00</start_date>
<observation_blob>
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    <cui>cl319018</cui>
    <umlsName>Asthmatic bronchitis (disorder)</umlsName>
    <semanticTypes>
      <semanticType name="Disease or Syndrome" tui="T047" />
    </semanticTypes>
    <mappedTerm><![CDATA[Asthmatic bronchitis]]></mappedTerm>
    <modifiers>
      <modifier name="negationStatus" value="Actual" />
    </modifiers>
  </concept_cd>
  <section>
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  </section>
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</observation>
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</ns3:patient_data>
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</ns3:response>
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<thead>
<tr>
<th>Code</th>
<th>DSG-NLP:c1319018</th>
</tr>
</thead>
</table>

**Request type setup:**

- Switch to basic mode...

- Options:
  - Smoking Status
  - Diagnoses
  - Discharge Meds
  - All Concepts
  - Custom Concepts

- Buttons:
  - Clear results
  - Get results!
Smoking Status Pipeline Application

Smoking status: "Current Smoker"

BRIEF RESUME OF HOSPITAL COURSE:
xx y F c hlo asthma, HTN plw SOB x 1 day

This pt was in her USOH until 2 days PTA when she developed cough productive of ten sputum, mild SOB and mild wheezing. She felt as though she 'had a cold'. No FIC. She is a smoker. Sx initially responded to inhalers, and were stable until day of admission when she developed worsening wheezing and SOB. No CF, orthoonea, edema, PND. In ED: peak flow 190. Pt felt better p nebs, but pk flow unchanged.

In the ED she received Predisone 60 and Guafenesin. Pt then c new ST depressions in anterolateral leads in the setting of HR > 100s with bronchodilator use

.....
ADMIT DIAGNOSIS:
asthma
PRINCIPAL DISCHARGE DIAGNOSIS (Responsible After Study for Causing Admission)
Asthma exacerbation
OTHER DIAGNOSIS/Conditions Infections, Complications, affecting Treatment/Stay
SEASONAL ALLERGIES; CLUSTER HA; ANEMIA WALDENSTROM'S MACROGLOBULINEMIA
OPERATIONS AND PROCEDURES:
OTHER TREATMENTS PROCEDURES (NOT IN O.R.)
cardiac MIBI exercise tolerance test
BRIEF RESUME OF HOSPITAL COURSE
xy f ch no asthma, HTN p/w SOB x 1 day
-----
This pt was in her USOH until 2 days PTA when she developed cough productive of tan sputum, mild SOB and mild wheezing. She felt as though she had a cold. No F/O. Pt initially responded to inhalers, and were stable until day of admission when she developed worsening wheezing and SOB. No CP, orthopnea, edema, PND in ED, peak flow 180. Pt felt better p/n, but pk flow unchanged.
In the ED she received Prednisone 60 and Guan_icons. Pt th c new ST depressions in anterolateral leads in the setting of HR > 100s with bronchodilator use
-----
Hospital Course by System
1. CV Ischemia: Patient w Peak Troponin of 0.45 and was started on Lopresor, ASA and Levofox likely has heart-related demand ischemia seen on EKG in the anterolateral leads, unclear if these were old (but had similar intermittent changes in 8/08). Remained chest pain free, subsequent sets of enzymes were n. Echocardiogram showed no wall motion abnormalities and EF=55-56%. ETT MIBI n. Odc on ACEI + BB only for BP control
2. Pulm: Pt presented with asthma exacerbation improved with

Clear text | Load sample | Main Discharge Summary...
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  <result_status>
    <status type="DONE">NLP Processing completed</status>
  </result_status>
</response_header>
<message_body>
  <ns2:patient_data>
    <ns2:observation_set>
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        <patient_id>1234567</patient_id>
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        <start_date>2008-04-04T17:01:04Z</start_date>
        <observation_blob>
          <concept_cd type="smokingStatus">
            <code>BSC-NLP:current_smoker</code>
          </concept_cd>
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            <sectionName><![CDATA[HOSPITAL COURSE:]]></sectionName>
            <sectionCats>
              <sectionCat name="PROC" />
            </sectionCats>
            <section>
            </section>
          </section_blob>
        </observation>
      </observation>
    </ns2:observation_set>
  </ns2:patient_data>
Lungs: Clear to auscultation bilaterally with mild right lower lobe crackles. Abdomen: Soft, nontender, nondistended, active bowel sounds. No hepatosplenomegaly. Extremities: Trace edema bilateral lower extremity edema, right necrotic-appearing plantar ulcer at the base of big toe, left large necrotic ulcer at mid lateral feet, also area of erosion and drainage proximally, left medial thigh induration/erythema, and left ankle inversion. Neurologic: Cranial nerves II-XII grossly intact, nonfocal.
Erosion detection rules

xml version="1.0" encoding="ISO-8859-1" ?
<concepts>
  <concept>
    <def>
      <![CDATA[(?i)(?m)(\W+|\d+)(ero[a-zA-Z]+)(\W+|\d+)]>]
    </def>
    <capt_group_num>2</capt_group_num>
    <type>RegEx</type>
    <name>Erosion Keyword</name>
    <features>
      <feature>
        <name>code</name>
        <value>
          <![CDATA[LCS-l2B2:erosion]]>
        </value>
      </feature>
    </features>
  </concept>
  ........
</concepts>
no fevers, chills, nausea, vomiting or changes in p.o., some mild increase in her baseline cough, nonproductive. No shortness of breath. She also thinks her urine might be very smelly.

PHYSICAL EXAMINATION ON ADMISSION: Vital signs: Temperature 99.9, pulse 74, blood pressure 120/60, breathing at 20, satting 98% on 2 L. General: No acute distress, alert and oriented x3, comfortable appearing. Head and neck: FERRLA, EOMI. Neck supple, JVP flat. No neck lymphadenopathy. Cardiac: Regular rate and rhythm, normal S1, S2, soft systolic murmur at left upper sternal border radiating to left carotid.

Lungs: Clear to auscultation bilaterally with mild right lower lobe crackles. Abdomen: Soft, non tender, nondistended, active bowel sounds. No hepatosplenomegaly. Extremities: Trace edema bilateral lower extremity edema, right necrotic appearing plantar ulcer at the base of big toe, left large necrotic ulcer at mid lateral feet, also area of erosion and drainage proximally, left medial thigh induration/erythema, and left ankle inversion.

Neurologic: Cranial nerves II-XII grossly intact, nonfocal.
the medial thigh area a few days prior to admission. On the morning of admission, she was going to the bathroom and had a fall secondary to decreased ability to bear weight on her left side. No lightheadedness. No dizziness. No chest pain, shortness of breath, or loss of consciousness. Afterwards, the patient had difficulty rising, despite help from her husband and so was brought by EMS to an outside hospital Emergency Room, where she received one dose of Unasyn and gentle hydration. The patient had some fevers on the morning of admission to 102.6. She had nausea and bilious emesis x1, one episode of loose stool. She attributes this to sick exposure. Her granddaughter who lives with her having a recent URI. Prior to admission, she had no fevers, chills, nausea, vomiting or changes in p.o., some mild increase in her baseline cough, nonproductive. No shortness of breath. She also thinks her urine might be very smelly.

PHYSICAL EXAMINATION ON ADMISSION: Vital signs: Temperature 96.9, pulse 74, blood pressure 120/60, breathing at 20, sitting 95% on 2 L. General: No acute distress, alert and oriented x3, comfortable appearing. Head and neck: PERRLA, EOMI. Neck supple. JVP flat. No neck lymphadenopathy. Cardiac: Regular rate and rhythm, normal S1, S2, soft systolic murmur at left upper sternal border radiating to left carotid. Lungs: Clear to auscultation bilaterally with mild right lower lobe crackles. Abdomen: Soft, nontender, nondistended, active bowel sounds. No hepatosplenomegaly. Extremities: Trace edema bilateral lower extremity edema, right necrotic appearing plantar ulcer at the base of big toe, left large necrotic ulcer at mid lateral feet, also area of erosion and drainage proximally, left medial thigh induration/erythema, and left ankle inversion. Neurologic: Cranial nerves II-XII grossly intact, nonlocal.
Use Regular Expression Concept Finder:

- Section filter setup
  - Use default section filtering
  - Do not filter sections
  - Merge default section filter with expressions below
  - Replace default section filter with expressions below

- Section filter editor

- Regular expression definitions
  - Use default regular expression expressions
  - Merge default regular expression definitions with definitions below
  - Replace default regular expression definitions with definitions below

- Regular expression editor

  (?i)erosion @@ RegEx Concept@@ type=Erosion Synonym

- Request type setup
  - Switch to basic mode...
  - Smoking Status
  - Diagnoses
  - Discharge Meds
  - All Concepts
  - Custom Concepts

  Clear results
  Get results!
<processing_id>
  <accept_termination_type>AL</accept_termination_type>
  <accept_termination_type>AE</accept_termination_type>
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</message_header>
$response_header>
  <result_status>
    <status type="DONE">NLP Processing completed</status>
  </result_status>
</response_header>
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    <ns2:observation_set>
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            <code>DSG-NLP:erosion</code>
          </concept_cd>
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      </observation>
    </ns2:observation_set>
  </ns2:patient_data>
</message_body>