CAIR2 Patient Matching: Solving the 25 Million Piece Puzzle

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Solving the 25 Million Piece Puzzle

- Overview
- Approach
- RunMatch Analysis
- Conclusions
- Next Steps







CAIR2 - Patients and Doses*

Measure	0-5 yrs	6-18 yrs	19+ yrs	All Ages
CA Population	2,629,503	5,733,497	26,745,104	35,108,104
Patients In	3,354,573	5,996,008	17,682,549	27,033,130
% of Pop. In	128%	105%	66%	77%
Patients w/ >2 doses	2,077,280	5,373,248	11,700,579	19,151,107
% w/ <u>></u> 2 doses	79%	94%	44%	55%
Vaccine Doses	43,216,228	117,866,058	88,645,241	249,727,527

^{*} As of 7/9/2018. CAIR2 only.

Solving the 25 Million Piece Puzzle

- Problem solving
 - ► Gather information and knowledge
 - Identify the problem
 - Develop Criteria
 - Generate Possible Solutions
 - Analyze Possible Solutions
 - Compare Possible Solutions
 - Make and Implement the Decision







Solving the 25 Million Piece Puzzle

- Matching Algorithm
 - Designed for UI
 - ► Majority of CAIR2 doses coming in through DX
- Pendings
 - ▶ Bug in Migration
 - Unmanageable
- "Ghost" dups
- Collaborate







RunMatch Analysis: Introduction

Objectives:

- **Examine** CAIR's RunMatch source code and documentation to identify possible inefficiencies, functional shortcomings, or areas for improvement
- Experiment with RunMatch and its capabilities to determine if configuration or functional issues could be causing person-matching issues for CAIR

Inputs:

- RunMatch Design document
- RunMatch Logic and scoring flowcharts
- ► RunMatch source code (14,000 lines of C)







RunMatch Analysis: High-level Observations

- Generally: Deterministic, Probabilistic, Machine learning approaches
- Many real-world matching engines are hybrid
- RunMatch has both Deterministic & Probabilistic attributes
- Advantages and disadvantages to each approach
- Common challenge: Keeping up with changing data characteristics







RunMatch Analysis: Testing Strategy

- Compile RunMatch from source
- Create Oracle database with CAIR tables for RunMatch operation
- Create custom RunMatch client with CSV interface
- Configure Febrl (open source probabilistic matching engine) for comparison
- Run tests against RunMatch and Febrl using:
 - ► ONC Patient Matching Challenge dataset
 - Custom test cases based on observations from the results.







RunMatch Analysis: Findings

- Strengths
 - Very Fast
 - Relatively low resource requirements (CPU, RAM, etc.)
 - Very good at handling common typos, transpositions, many special cases
 - ▶ Good overall match performance compared to Febrl
 - ▶ Token configuration can be customized without recompiling
- Weaknesses
 - Complex rule-based model with numerous exceptions / special rules
 - Name string matching algorithm has some specific weak areas compared to editdistance algorithms such as Jaro-Winkler
 - ► Lacks built-in deduplication functionality







RunMatch Analysis: Potential Improvements

- In the CAIR installation:
 - Update names and frequencies in token files
 - Add local cities to token files
 - Use result messages and scores from RunMatch to tweak configuration files
- In the RunMatch software
 - Redirect RunMatch Server output to database to facilitate post-match analysis
 - Human review feature for batch imports
 - Incorporate edit-distance algorithm(s) into RunMatch string-near-matching







Moving Forward - Collaboration and Planning

- Review Results, Evolution of RunMatch Improvement vs. Replacement
- Maximizing Results, Dual Path

State-Specific Changes, Scoring Adjustments

RunMatch Enhancement Project Launch









Project Goals

- > Improve access to algorithm results
- Reduce manual intervention (multiple matches)
- > Improve algorithm maintainability while
- sustaining performance
- Additional matching criteria



Working together through joint development







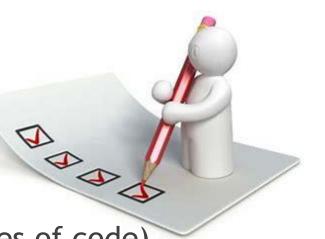
Project Highlights

- Project commencement March 2018
- DXC funded client driven
- Replacing C code with Java (>14K lines of code)
- Improvements Include:
 - Configurability Scoring Adjustments
 - Data Availability, Human Readable Logs
 - Enhanced Ethnic Logic, Calculations based on IIS Population
 - Chart # Logic
 - Matching Test Suite, Test Rules and Scoring Changes









Next Steps/Conclusions

Pilot Testing (CA/NE - In Flight)

Continued Criteria Improvement

- Near name matching
- Addressing address
- Exact match enhancements
- Key Lessons
- Matching is complex, no easy answers
- > Adjusting for volume of submissions and data patterns is critical
- > Access and understanding key to making informed decisions
- Better together!!!









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