Association Analysis
Cardiac SPECT Diagnosis

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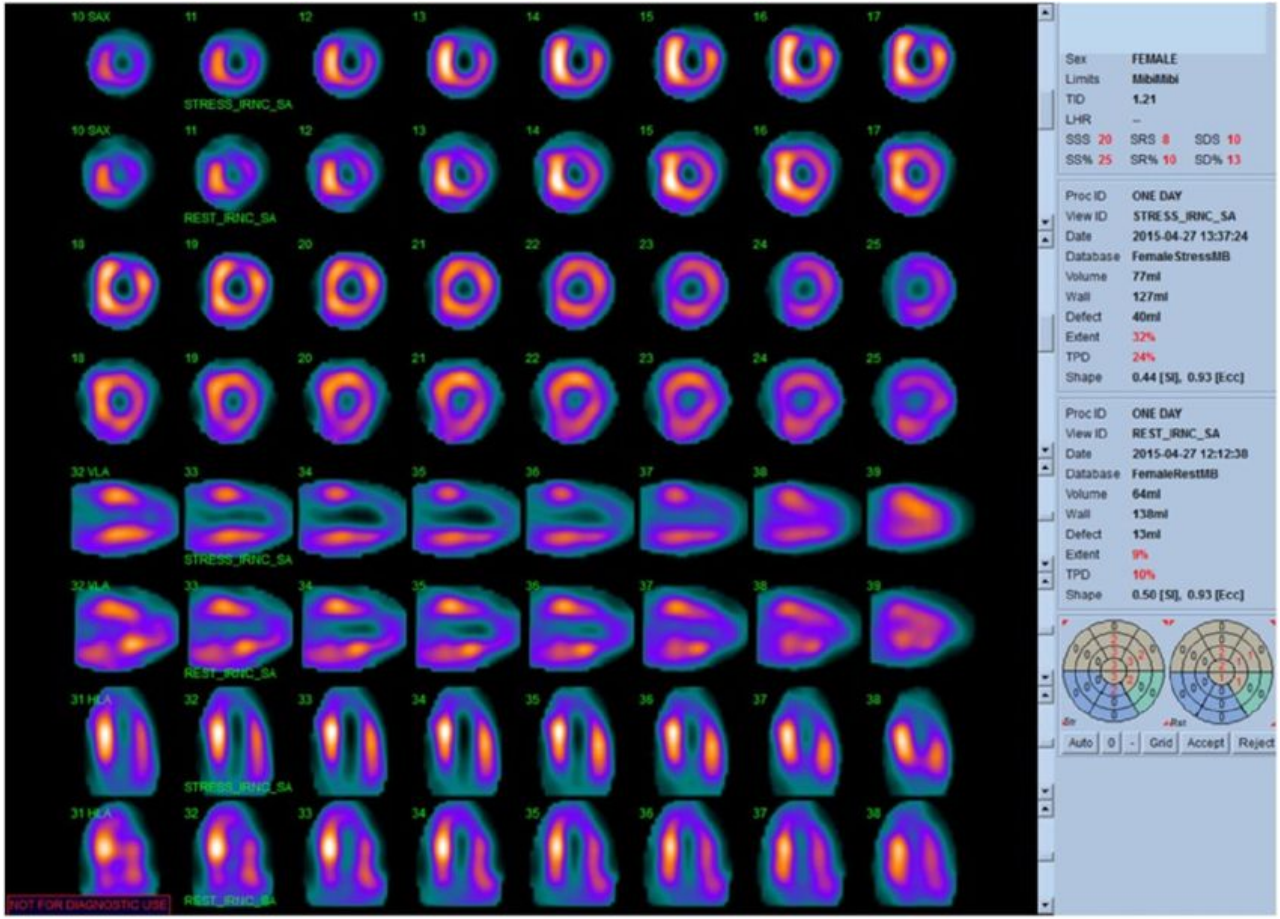
Agenda

- Introduction
- Methodology - Association Rule Learning
- Rules Interpretation
- Conclusion
- Q&A

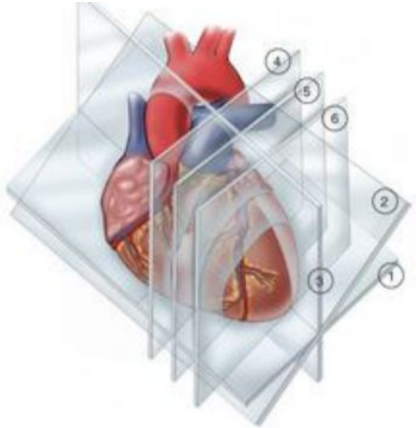
Introduction

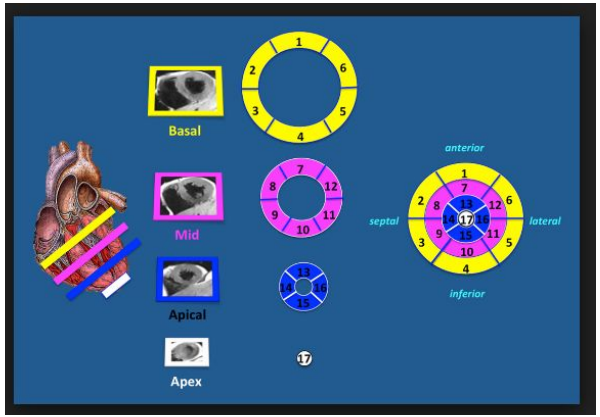

10 SAX
STRESS_IRNC_SA
REST_IRNC_SA
32 VLA
31 HLA
[NOT FOR DIAGNOSTIC USE]
Sex FEMALE
Limits MibiMibi
TID 1.21
LHR --
SSS 20 SRS 8 SDS 10
SS% 25 SR% 10 SD% 13
Proc ID ONE DAY
View ID STRESS_IRNC_SA
Date 2015-04-27 13:37:24
Database FemaleStressMB
Volume 77ml
Wall 127ml
Defect 40ml
Extent 32%
TPD 24%
Shape 0.44 [SI], 0.93 [Ecc]
Proc ID ONE DAY
View ID REST_IRNC_SA
Date 2015-04-27 12:12:38
Database FemaleRestMB
Volume 64ml
Wall 138ml
Defect 13ml
Extent 9%
TPD 10%
Shape 0.50 [SI], 0.93 [Ecc]
Auto
0
-
Grid
Accept
Reject

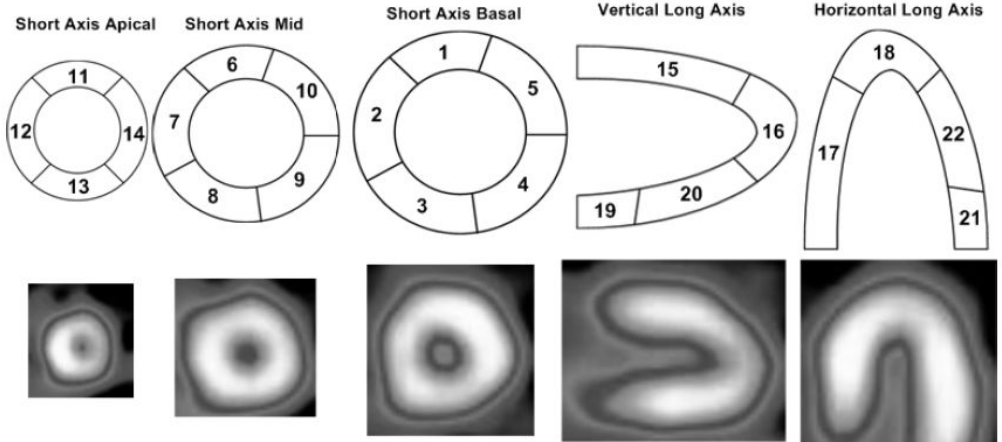
Background

- 267 patients were diagnosed and categorized into two classes
  - Normal heart
  - Abnormal heart
- 2 datasets
  - 80 SPECT.train
  - 187 SPECT.test
  - Machine learning algorithms CLIP3
- Total 23 attributes
  - No missing values
  - Binary attributes
  - 1st attribute : healthy heart (0), unhealthy heart (1)
  - 2nd - 23rd attributes: high perfusion (0), poor perfusion (1)

Perfusion - how well blood flows through heart muscle







1. basal anterior
2. basal anteroseptal
3. basal inferior
4. basal inferolateral
5. basal anterolateral
6. mid anterior
7. mid anteroseptal
8. mid inferior
9. mid inferolateral
10. mid anterolateral
11. apical anterior
12. apical septal
13. apical inferior
14. apical lateral
15. anterior
16. apical
17. septal
18. apical
19. basal
20. inferior
21. basal
22. lateral

Methodology - Association Rule Learning

Run Apriori algorithm

- Perform Apriori association analysis on each type of patients
- Remove first attribute
- Use 22 attributes
- Set the minimum threshold on support to be 0.5
- Set the minimum threshold on confidence to be 0.9

Python Implementation

- The algorithm starts by searching the frequent patterns that occurs more than minimum support value. Then, function joinSet is used for generating the list of joint item. The association rule is generated form frequent itemset. The association rule is of the form

LHS => RHS

- The confidence is also calculated by the following formula:

confidence(LHS, RHS) = support(LHS, RHS) / support(LHS)

Rule generating

Rule: ('F11_0', 'F2_0') ==> ('F17_0', 'F6_0') , 0.900
Rule: ('F15_0', 'F9_0') ==> ('F14_0',) , 0.900
Rule: ('F2_0', 'F12_0') ==> ('F18_0',) , 0.902
Rule: ('F19_0', 'F18_0') ==> ('F17_0',) , 0.903
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Rule: ('F4_0',) ==> ('F15_0',) , 0.923

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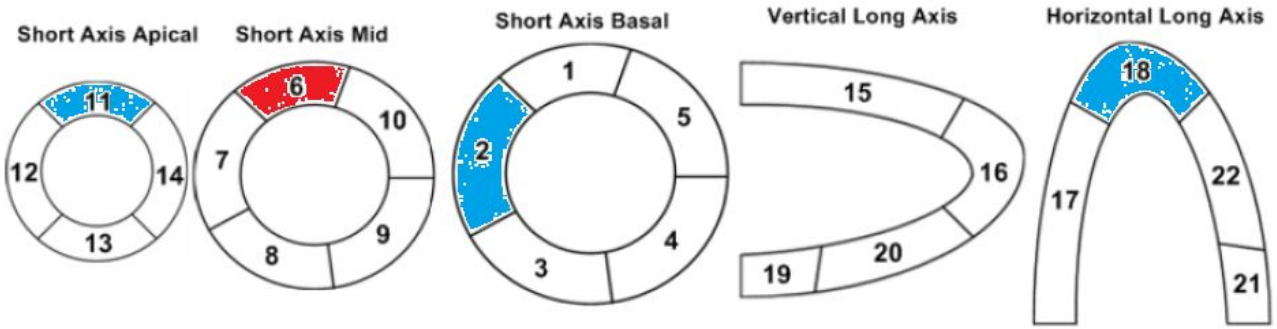
Rule: ('F4_0', 'F14_0') ==> ('F9_0',) , 0.983
Rule: ('F11_0', 'F18_0', 'F2_0') ==> ('F6_0',) , 0.991

Rules Interpretation

Healthy_SPECT Dataset

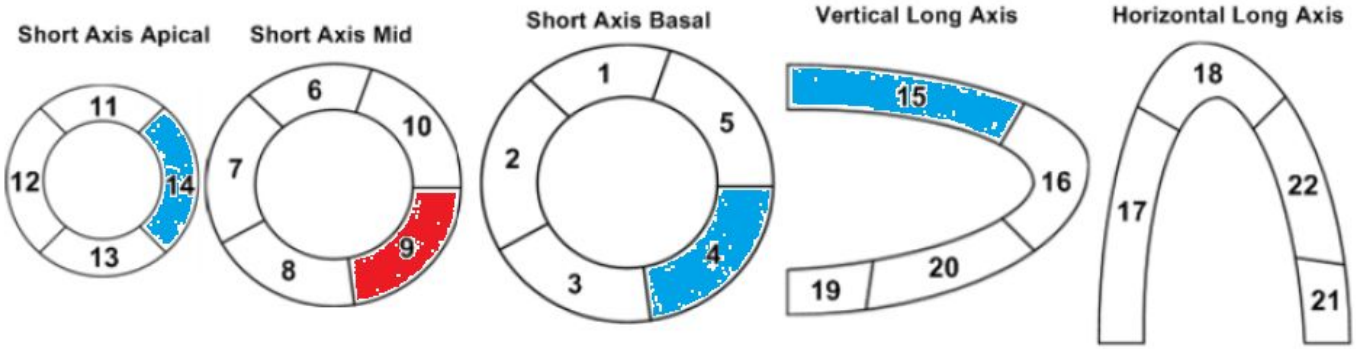
Rule : ('F11_0', 'F18_0', 'F2_0') ==> ('F6_0',) with confidence value = 0.991



For confidence value is around 0.991, there is about 99% chance that if apical anterior (F11), apical (F18) and basal anteroseptal (F2) have poor perfusion, then mid anterior (F6) will also have poor perfusion too.

Unhealthy_SPECT Dataset

Rule: ('F4_0', 'F15_0', 'F14_0') ==> ('F9_0',) with confidence value = 0.982

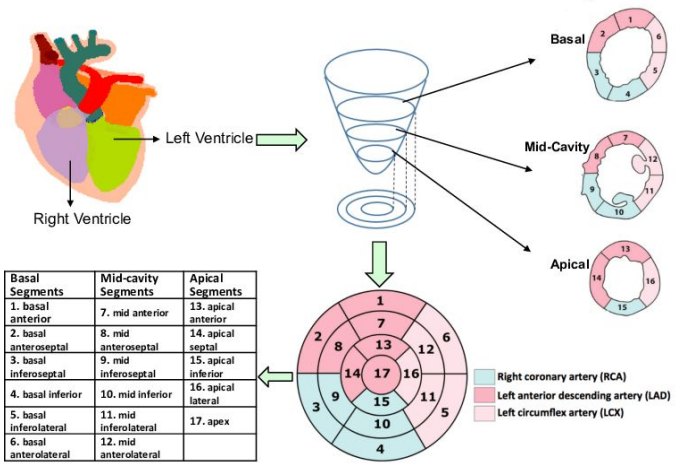


For confidence value is about 0.982, there is around 98% chance that if basal inferolateral (F4), anterior (F15) and apical lateral (F14) have poor perfusion, then mid inferolateral (F9) will also have poor perfusion too.

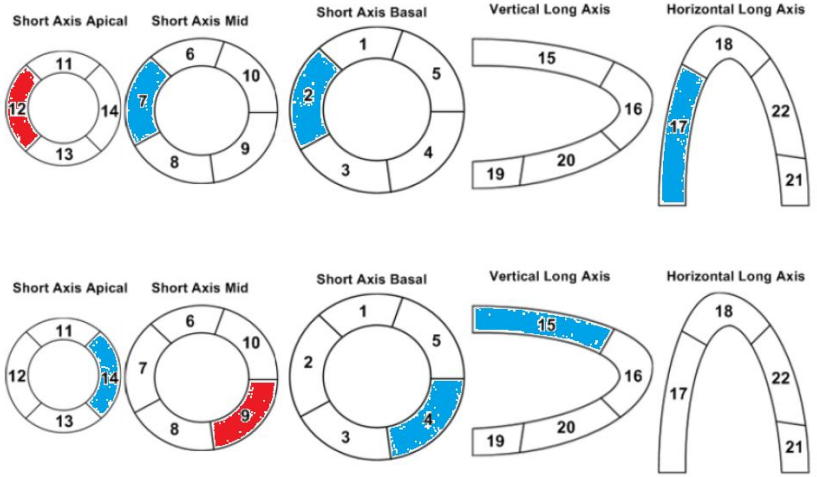
Conclusion

Conclusion

After running the Apriori algorithm, it could be seen from generated rules that if there is a poor perfusion occured in any segments, other nearby neighbors are likely to have the same condition as well.



Basal Segments	Mid-cavity Segments	Apical Segments
1. basal anterior	7. mid anterior	13. apical anterior
2. basal anteroseptal	8. mid anteroseptal	14. apical septal
3. basal inferoseptal	9. mid inferoseptal	15. apical inferior
4. basal inferior	10. mid inferior	16. apical lateral
5. basal inferolateral	11. mid inferolateral	17. apex
6. basal anterolateral	12. mid anterolateral	



Q&A

Thank you