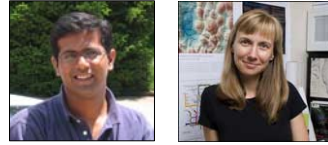


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5th International Conference on
Coordinated & Multiple Views in Exploratory Visualization



Computational Diagnostics: A Novel Approach to Viewing Medical Data

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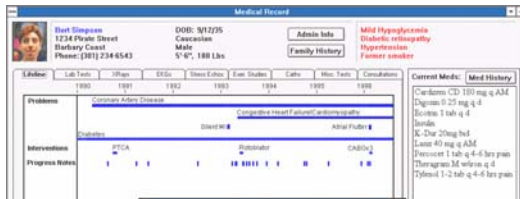
Presented by: Bruce Herr

Outline

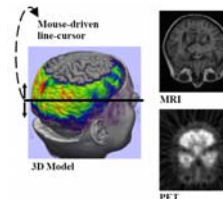
- Motivation
- Dataset – Acute Lymphoblastic Leukemia
- Computational Diagnostic Tool
- Conclusion

Motivation

- Electronic Health Record (EHR) Initiative – digitally store patient medical records
 - Challenge – 1) Combine data from different sources
 - 2) Make sense of data for analysis
 - 3) Acquire implicit knowledge
- Existing EHR include -
 - Reproduce ‘electronic view’ of a paper record – for data entry
 - Display patient medical history in graphical time-series format
 - Add 2D/3D images to patient profile, link images for interaction



LifeLines showing time-series information



2D / 3D linked images

Computational Diagnostics - Dataset Details

Diagnostic data variables from medical records for Acute Lymphoblastic Leukemia (ALL) patients are categorized into:

- Outcome**
Patient Variables: relapse, relapse site, alive/death status, and LDKA
- Biology**
Patient Variables: immunophenotype, genetic condition, WBC, Hgb, platelets, and CNS
- Host**
Patient Variables: diagnostic age (ageDx), gender, and race
- Treatment**
Patient Variables: BM 7 and BM 14
- Social Factors**
Patient Variables: MFI-class, education level, %single family members, and % family employment

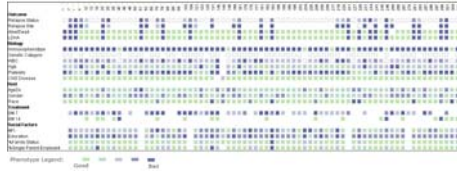
All data was provided by Dr. Susanne Ragg, Julie Haydon and Jada Pane at IUPUI

Computational Diagnostics – Tool

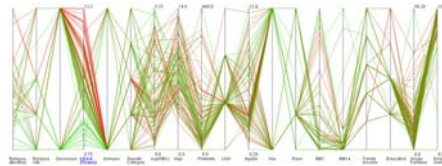
Coupling of different interactive visualizations such as

Matrix visualization

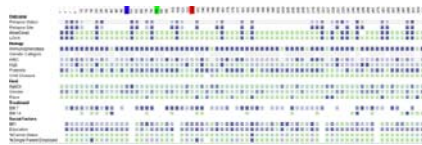
phenotype, prognosis and combined view.



Parallel Coordinate Visualization

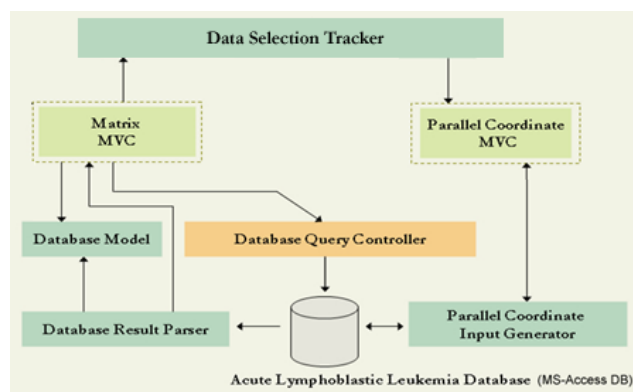


Coupled Windows



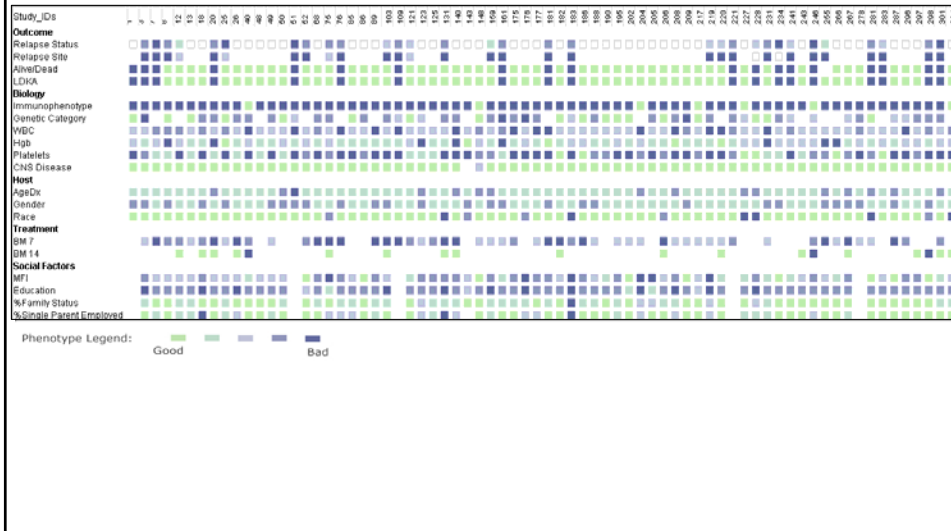
Computational Diagnostics – Interactive Visualization

System Architecture



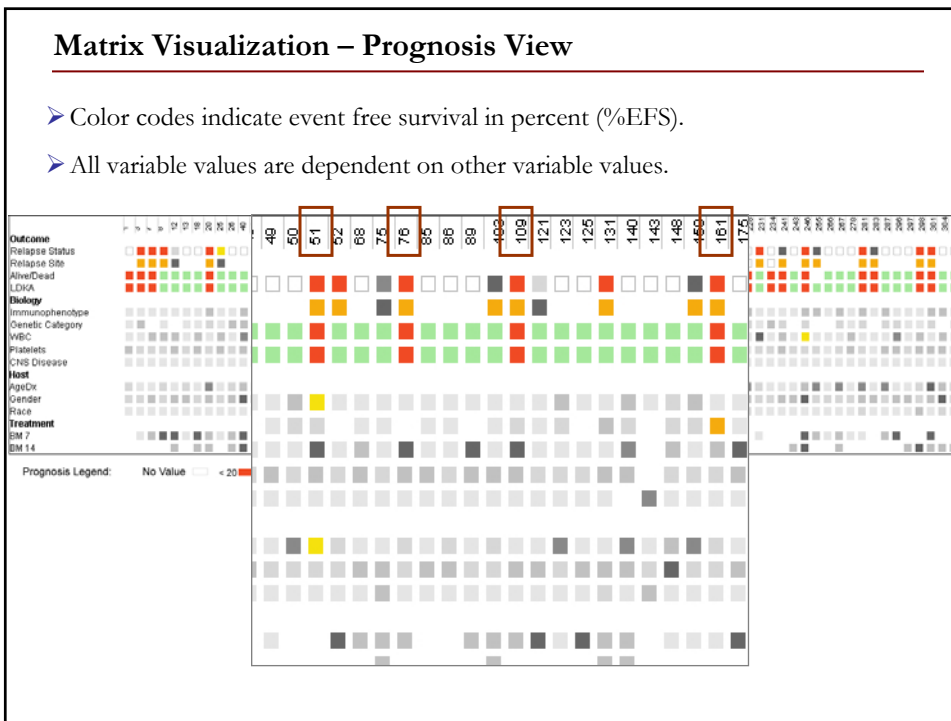
Matrix Visualization – Phenotype View

- Data is shown independent of other variables.
- Color codes help to provide a quick insight into patient medical condition.



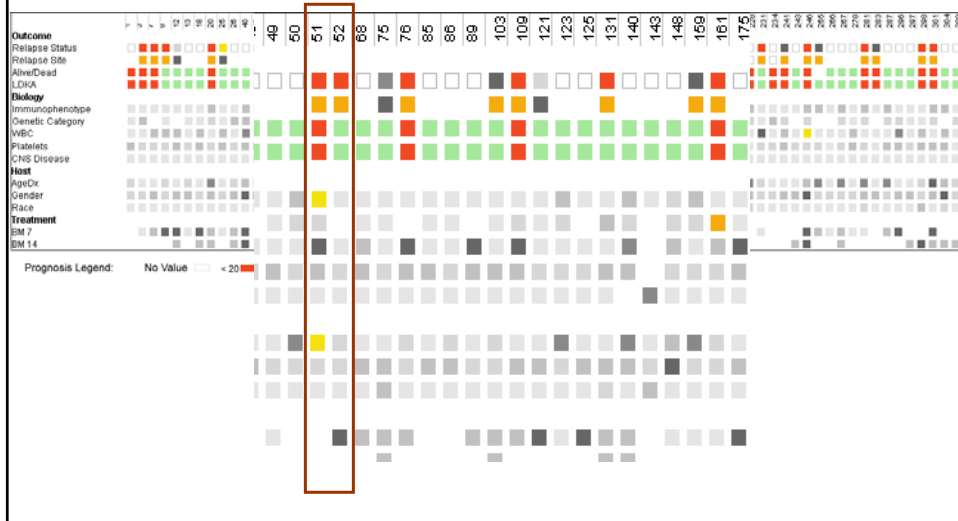
Matrix Visualization – Prognosis View

- Color codes indicate event free survival in percent (%EFS).
- All variable values are dependent on other variable values.



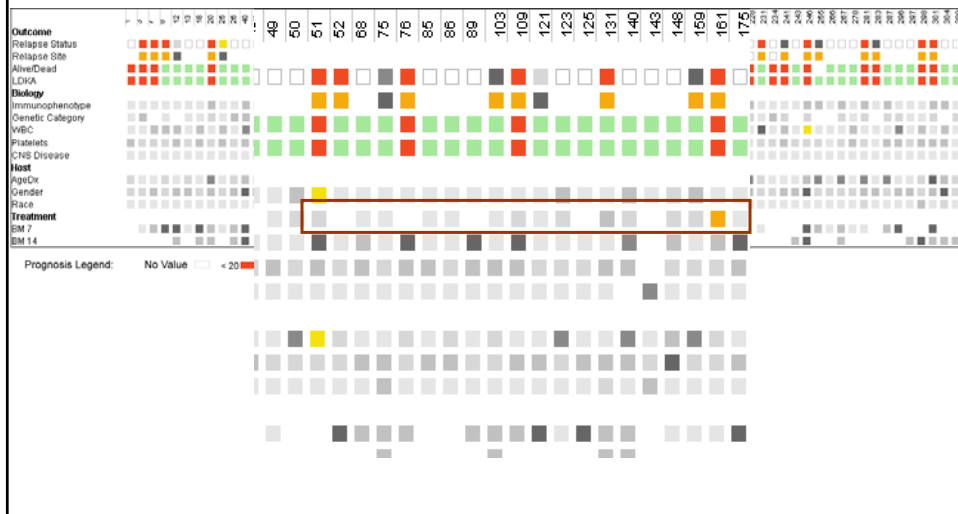
Matrix Visualization – Prognosis View

- Color codes indicate event free survival in percent (%EFS).
- All variable values are dependent on other variable values.



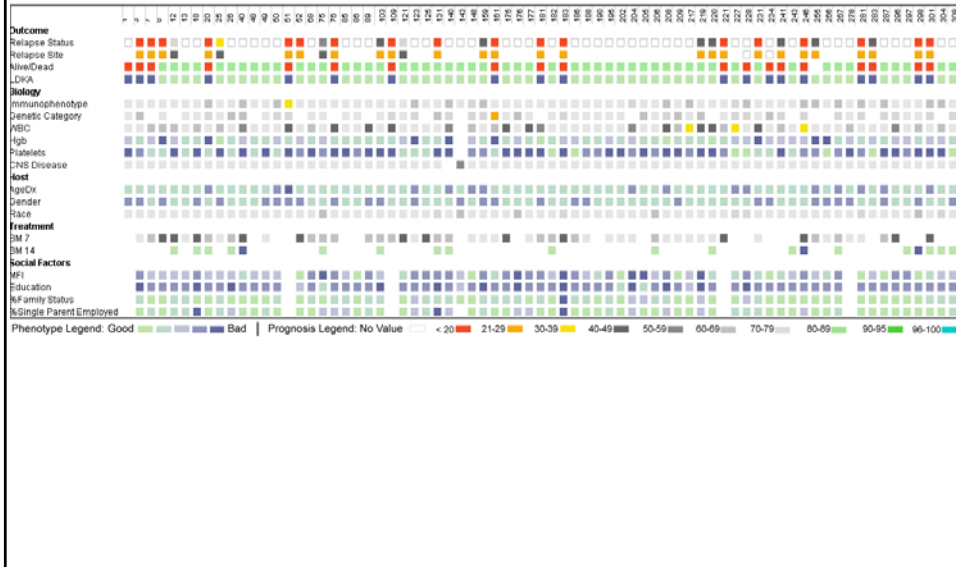
Matrix Visualization – Prognosis View

- Color codes indicate event free survival in percent (%EFS).
- All variable values are dependent on other variable values.



Matrix Visualization – Combined View

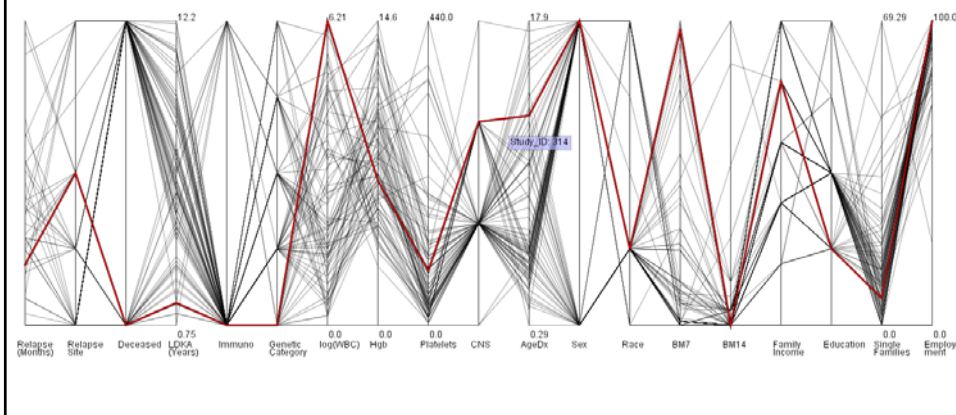
- Facilitates selection of phenotype/prognosis view for individual diagnostic variables.



Parallel Coordinates Visualization

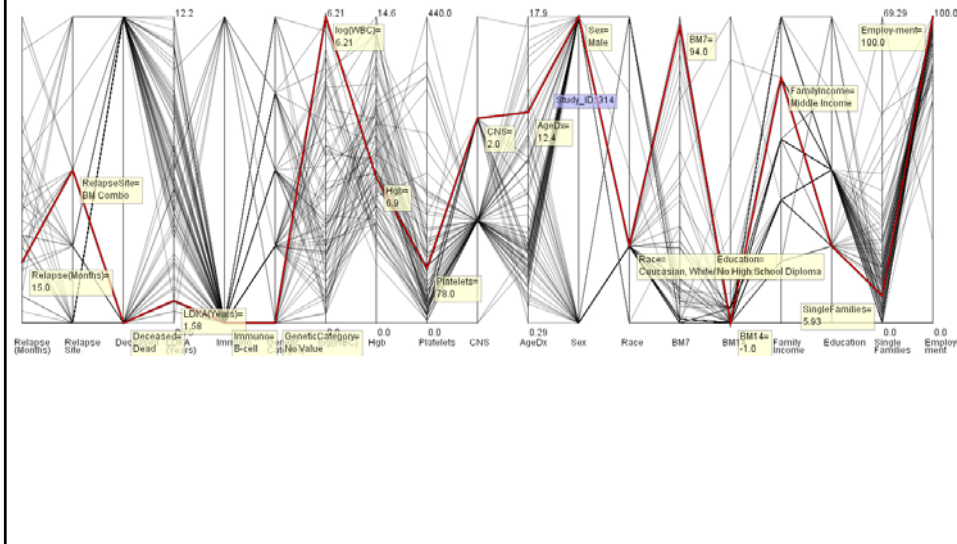
- Uses one axis for each data variable.
- For each patient, all data values on different parallel axis are connected.
- All patient graphs are shown here.

Single or multiple patients can be selected and studied in detail.



Parallel Coordinates Visualization

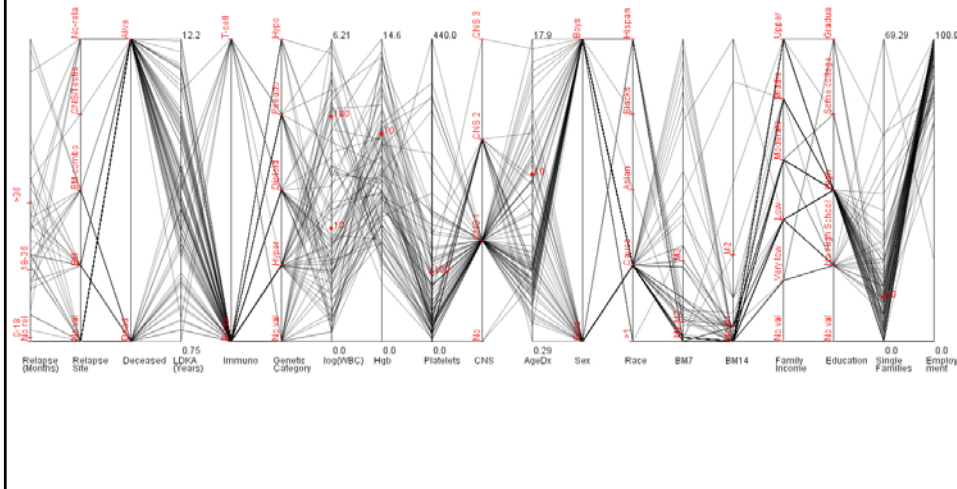
Tool-tip display to show diagnostic values of selected patient



Parallel Coordinates Visualization – User Interactions

Display axes-labels to mark different regions/values along axes

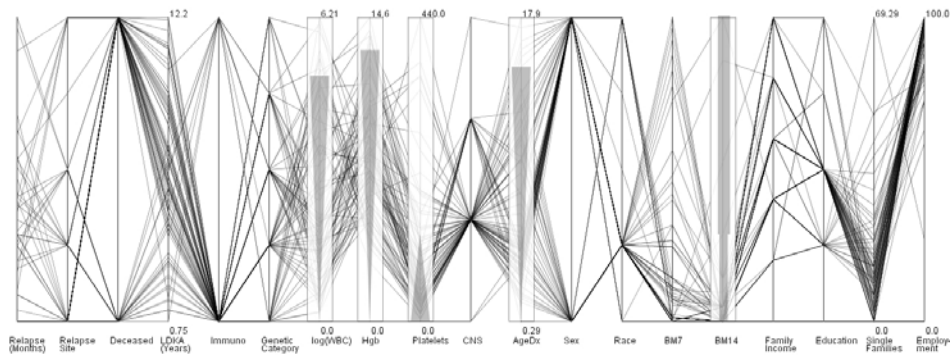
- Numerical landmarks along axes showing values for quantitative variables.
- Category labels used along axes show values for nominal variables.



Parallel Coordinates Visualization – User Interactions

Display zones to show severity values for different variables

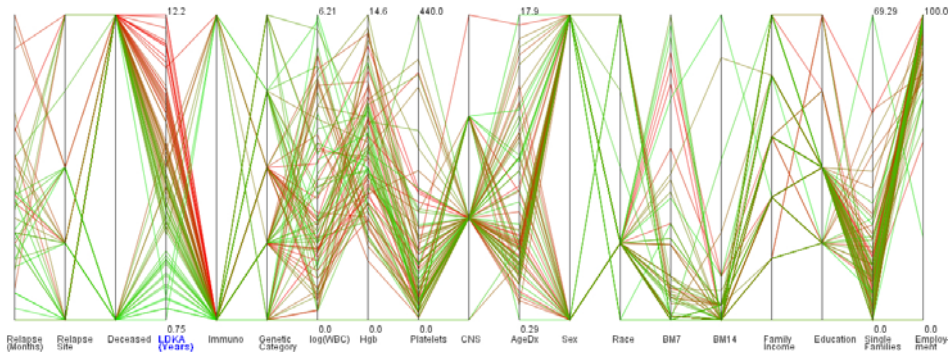
- Triangular zones indicate variables with quantitative values.
- Rectangular zones are used for variables with nominal values.



Parallel Coordinates Visualization – User Interactions

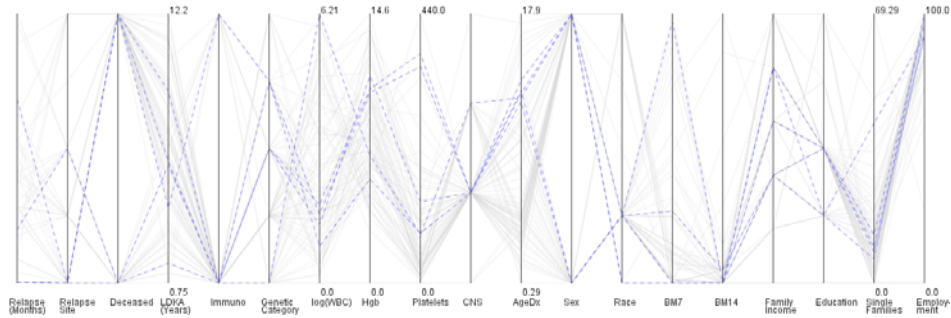
Axis selection to study global variations in patient values

- Single axis can be selected to study the trend in patient values.
- Red-to-green gradient used to indicate values along the selected axis.
[Red = High value, Green = Low value]



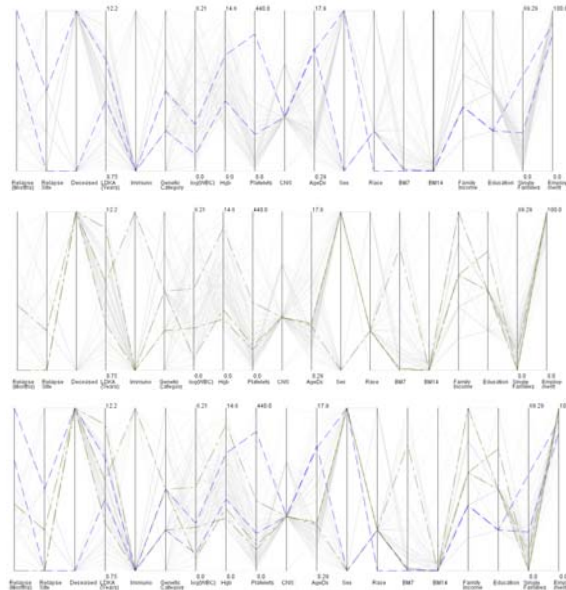
Parallel Coordinates Visualization

A subset of patents can be selected and examined as a group



Parallel Coordinates Visualization

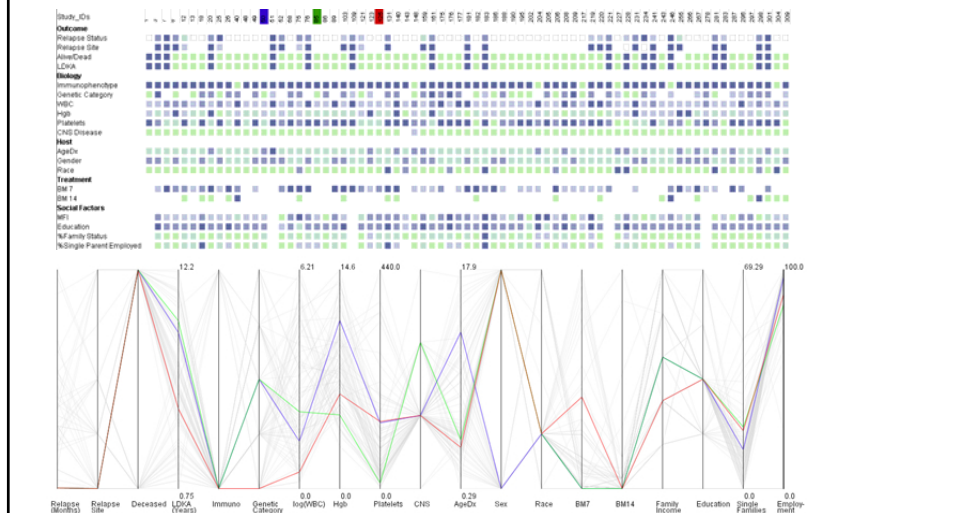
Simultaneous display of patient groups to study differences



Parallel Coordinates Visualization

Multiple Coordinated Views

- Patient can be selected and color coded in matrix view.
- Corresponding patient lines are highlighted in parallel coordinate view.



Conclusion

- Computational Diagnostic Tool provides –
 - Quick overview of patients medical condition
 - Color visual cues (in matrix view) provide global dataset overview and help to -
 - Identify patients with worst values for different variables
 - Compare patients to identify overlaps and differences in values
 - Line patterns (in parallel coordinates view) show data trends and help to –
 - Reveal patient profile
 - Compare patients profile within a group or among groups
- Multiple coordinated view – both view complement each other
 - Matrix view – helps identify patterns and worse case conditions
 - Parallel coordinates – helps identify patient groups and compare trends

Acknowledgements

- All the work was done when at Indiana University, Bloomington
- Thanks to Dr. Susan Ragg for her insights on the Acute Lymphoblastic Leukemia dataset and also to Julie Hayden and Jada Pane for making the ALL dataset available.

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Thank You !!!

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