

Final Seminar Report for

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A. Title: Design Science Research in Entity Resolution and Entity Identity Information Management

Speaker: Dr. John R. Talburt

Acxiom Chair of Information Quality

1. Motivation and research focus

Entity Resolution (ER) is the process of determining whether two references in an information system are referring to the same real-world object or to different objects (Talburt, 2011). It is the task of disambiguating manifestations of real-world entities in various records or mentions by linking and grouping. For example, there could be different ways of addressing the same person in the text, different addresses for businesses, or photos of a particular object. This clearly has many applications, particularly in government and public health data, web search, comparison shopping, law enforcement, and more.

Additionally, as the volume and velocity of data grow, inference across networks and semantic relationships between entities becomes a greater challenge. Entity Resolution can reduce the complexity by proposing cannibalized references to particular entities and deduplication and linking entities.

2. Significance of the issue investigated

Entity Resolution is becoming an important discipline in Computer Science and in Big Data and Entity resolution is becoming an increasingly important task as linked data grows, and the requirement for graph-based reasoning extends beyond theoretical applications. With the advent of big data computations, this need has become even more prevalent. Entity Resolution is often part of bigger inference applications, there needs to be a joint approach to information extraction, and a characterization of how the success (or errors) affects larger reasoning quality. Similarly, there is a need for large, real-world datasets with ground truth to establish benchmarks for performance.

3. What kind of approach is taken?

One of the approaches is Truth Set Evaluation. It compares your links against a set of true links (truth set, golden records, and certified matches). This is not a tedious but a one-time effort. This method randomly selects seed records from a set and try to find all true positive matches then a separate set of “true” links is given to clusters, finally apply ER process, then compare differences between ER links and

true links.

Another approach is Inferred (Statistical) Measures, which can find false positives by inspecting clusters of linked records. Then collect in 'bins' by entropy using 'stratified sampling' by bins to estimate overall rates.

4. The conclusion and outcomes.

Entity resolution is about determining when references to real-world entities are equivalent (refer to the same entity) or not equivalent (refer to different entities). Linking is appending a common identifier to reference instances to denote the decision that they are equivalent. Identity resolution, record linking, record matching, record deduplication, merge-purge, and entity analytics all represent particular forms or aspects of ER. In its broadest sense, ER encompasses five major activities: entity reference extraction, entity reference preparation, entity reference resolution, entity identity management, and entity relationship analysis. Exact and approximate matching are important tools used in all five ER activities, but the direct matching of references is not the only method for determining reference equivalence. Other methods include transitive linking, associative linking, and asserted linking.

B. Title: Virtual Reality Based Surgery Simulation

Speaker: Acxiom Assistant Professor Tansel Halic

1. Motivation and the research focus

The annual deaths due to medical error are 440,000 in the US. Training is extremely important, especially for surgical training! There are many reasons for utilization Virtual Surgery Simulations in Surgical Training and current limitations in surgery training include apprenticeship model, cadavers, animals, mannequins. It is the necessity to have quantitative feedback. What we need now is content-based learning other than skill learning. Also, surgical procedure based certification is required. The usage of animal is going to be minimized. Testing of new procedures and instruments is necessary. Patient-specific scenarios need to be in our consideration. Utilization Virtual Surgery Simulations can help to complete simulation of the operating room, team training e.g. immersive simulations. Like James, John T. said: "A new, evidence-based estimate of patient harms associated with hospital care." Journal of patient safety 9.3 (2013): 122-128

2. Significance of the issue investigated

Virtual reality (VR) based surgical simulator systems offer very elegant possibilities to both enrich and enhance traditional education in endoscopic surgery. However, while a wide range of VR simulator systems have been proposed and realized in the past few years, most of these systems are far from able to provide a reasonably realistic surgical environment. The use of virtual simulation also improved the time required to perform procedures for those who were trained. Errors for the simulation-trained group were six times less likely to occur. The use of virtual simulation improved the overall outcome for the patient.

3. What kind of approach is taken?

Virtual surgery simulators often support various 3D scenarios that enable physicians to practice with difficult or not common cases. The development of these scenarios often require manual design labor and entails long and tedious process. Generative Anatomy Modeling Language (GAML) framework is the solution for Virtual reality (VR) based surgical simulator. GAML allows modification of 3D base anatomy models using human-readable and simple commands and incorporates non-linear optimization model for constraints solution. GAML was used to create 3D difficult anatomical scenarios for virtual simulation of airway management techniques such as Endotracheal Intubation (ETI) and Cricothyroidotomy (CCT). Difficult scenarios for each technique were defined and the model variations procedurally created with GAML.

4. The conclusion and outcomes.

Design, Development, and Validation of surgery simulation is a long process; for design, we need more surgeons involvement in the design process; for rubrics, generation of valid metrics, learning objectives is difficult. For development, we need more rapid development software frameworks, high fidelity haptic devices, and visual displays, parallel algorithms for physics simulation, collision detection, and computational resource optimization. For validation, we need more predefined/generalized set of validation studies applicable to all simulators.

C. Title: FitAware: Promoting Group Fitness Awareness Through Smartwatches, Smartphones and Web
Speaker: Andrey Esakia
Ph.D. Candidate in Computer Science Virginia Tech

1. Motivation and the research focus

When people first join a gym, they're often unsure what they should do once they step inside the building. Some struggle to determine which exercises to do, others simply don't know how to do them.

Whether you're a beginner at the gym or you just don't have much fitness knowledge, group fitness classes may be your solution. Joining a class can help build a foundation and structure that you can use to fuel your personal health journey for years to come. There is eighty percent of American adults do not meet the government's national physical activity recommendations for physical activity. And we pay \$117 billion in healthcare costs. To reduce the healthcare cost and get healthy weight, lower risk of depression and lower risk of heart disease, diabetes, and cancer.

2. Significance of the issue investigated

It's inspiring and motivating to be surrounded by dedicated, like-minded individuals. It doesn't get much more empowering than a class with an encouraging instructor and supportive people all working hard together. Group fitness is a great way to help motivate yourself and others to dig deeper and push harder in workouts.

3. What kind of approach is taken?

In community intervention behavioral strategies, we can combine 'individual' and 'interpersonal'. There are some individual-level behavioral strategies, for instance, Self-monitoring (ex. tracking steps), Goal setting (ex. setting a daily steps goal) and Feedback line Informs about performance or number of steps walked. The approaches we can take including the following:

- FitAware which is a smartwatch centered system to channel group dynamics in the context of a community physical activity intervention.
- Group formation which is forming small, tight-knit groups.
- The conceptual model of group dynamics
- Face to face community interventions works well in the classroom setting.
- Computers
- Wearables in individual level which has fitness trackers lead to awareness

of steps & daily activity.

- Wearables in Interpersonal level which can be a wearable based UI alleviate low-engagement and high dropouts.

4. The conclusion and outcomes.

Participants benefit from teams with more active captains: Stronger team rank awareness, increased physical activity levels and higher degrees of competitiveness. Participants from connected groups had a higher adherence to smartwatch use. Designed, developed and evaluated FitAware can leverages opportunities for free attention and facilitates group cohesion. It also increases awareness of Group Process through glanceable feedback and discovered that group structure plays a significant role. CS Education & outreach can create an adaptable model for teaching mobile app development and integrate emerging technology throughout curriculum. It is also able to identified guidelines and moving towards research to practice partnership.