

# Adapting LifeLines to Army Officer Personnel Processes

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## ABSTRACT

Visualizing personal histories requires a tool that can present users with multiple time intervals along with supporting information. The Human-Computer Interaction Lab (HCIL) at the University of Maryland created LifeLines, a visualization tool for personal histories in 1994 to visualize youth records [7]. The software was re-coded in 2003 to facilitate easy zooming, but not all of the original functionality was incorporated. Our work implements some of the original functionality in the new coding structure, corrects errors which became apparent with a new data set, and adapts LifeLines for use by the United States Army in officer assignments, promotions, and selections. At this time, the Army is reviewing the software for integration into their personnel processes.

## Keywords

Personal histories; Information visualization; Decision Support Systems; United States Army

## 1. INTRODUCTION

Temporal data, such as a history of events in an individual's life, requires specialized visualization tools. These tools must take into account events that occur only once or repeatedly, and which span any length of time. A successful visualization tool must present multiple events in a single display but still allow users to interact with events to access additional information. While general principles for visualizing temporal data cross disciplines, truly effective visualization tools need to be customized to their specific domain. This paper discusses the adaptation of LifeLines 2.0, a tool developed by the University of Maryland Human-Computer Interaction Lab HCIL for visualizing event histories, to the United States Army assignment, promotion, and selection processes.

Section 2 describes U.S. Army Officer assignment, promotion, and selection processes to provide context for the rest of the paper. Section 3 reviews previous literature about event histories and other applications for event visualization. Section 4 reviews the history of LifeLines. Section 5 describes corrections and improvements made to the LifeLines interface. Section 6 describes how LifeLines was then adapted to meet Army needs. Section 7 wraps up by reviewing the future work required to integrate LifeLines into the Army's review processes.

## 2. ARMY OFFICER ASSIGNMENT AND PROMOTION

Officer assignment, promotion, and selection processes in the United States Army require leaders to make important decisions in little time using data from several sources.

With regard to assignments, the goal of the Army's Director of Officer Personnel Management is to optimize officer manning by assigning the right officers, at the right place, at the right time. In a recent message [19], the director outlined the following assignment consideration priorities: Army requirements come first, professional development comes second, and individual preference comes third. Additionally, the Army attempts to maximize an officer's dwell time, time at home station with families, and also leverage deployment experience throughout key places, two goals which may be at odds with each other. For example, an operationally experienced officer who would be key to resetting a unit after deployment may also be the right officer for the Army to send to a training center or a key joint billet prior to battalion command. To balance these tasks, it is imperative that the Army's assignment managers have the ability to not just examine an officer's career history but also make meaningful comparisons between officers to ensure that the "right officer, right place, right time" goal is met.

When selecting officers for promotion or attendance at higher-level education and training courses, the U.S. Army uses a centralized promotion board of approximately 18-21 officers to review personnel records [14]. The information used to determine selection includes:

- A one-page tabular display of an officer's career history, qualifications, education, and experience called an Officer Record Brief (ORB) [17], as shown in Figure 1;
- Performance evaluations:
  1. Officer Evaluation Reports (OER) which rate officers against army values and leadership skills and provide a final performance and potential evaluation of outstanding, satisfactory or unsatisfactory [16], or
  2. Academic Evaluation Reports (AER) which describes the officers' studies, contributions to their field, participation,

and if the evaluator would recommend them for further studies [18];

- Background documentation including a ¾ - length photograph of the officer, award certificates given for outstanding service or achievement [5].

**Figure 1: A traditional Officer Record Brief (ORB) is a one-page tabular display of an officer's career history, qualifications, education, and experience. LifeLines 3.0 is being adapted to visually represent the career history and education sections of this information.**

According to the Army's Human Resources Command web site [14], the promotion selection system is to "select for promotion those officers who have demonstrated that they possess the professional and moral qualifications, integrity, physical fitness, and ability required to successfully perform the duties expected of an officer in the next higher grade." Each member of the promotion board must review all of the documents for each officer being considered for promotion and the maximum amount of time available to view each file is about 5 minutes [15]. While temporal visualization cannot present all the necessary information, an effective visualization tool can present an officer's professional history and links to supporting documents to facilitate making an informed assessment.

The need to compare personal history information and comprehend a high volume of information in a short amount of time makes these processes good candidates for visualization techniques.

### 3. EVENT HISTORY VISUALIZATIONS

Visualizations for event histories assist decision-making in a number of disciplines, including management, medical, and legal disciplines. The visualization techniques used for one domain apply, with some modification, to the others. Many event history visualizations chart time on the x-axis and use lines to represent the length of the event, referred to here as the event period. Francis and Fuller present a variation on this by extending lexis diagrams using three-

dimensional, pencil-like objects instead of lines to represent event histories. Length still represents time, but each face of the "pencil" represent a different time variable, such as age or time elapsed [6]. This variation allows for multiple time variables.

Depending on the domain and the information being presented, each event period may have one or more qualitative variables associated with it. For example, treatment levels or white blood cell counts in the medical history domain. Plaisant et al. use color and thickness of each line to allow for the representation of two qualitative variables [10]. Bade, Schlechtweg, and Miksch suggest combining the bars with line graphs, which chart qualitative data on the y-axis to represent more complicated variations in levels [2].

Schneiderman presents a visualization mantra that many visualization tools have followed: Overview first, zoom and filter, then details-on-demand [13]. This type of interaction has been implemented in LifeLines by allowing users to view all the information at once, then zoom into specific time periods, search against keywords and finally select items to view supporting documents for further information. KNAVE provides additional interaction capability of this type through semantic navigation capabilities [4].

While other tools have been created that provide additional capability than LifeLines currently includes, this tool was selected for adaptation to the Army assignment, promotion, and selection processes for three reasons. First, the code for this tool was made available by the HCIL at the University of Maryland. Second, the additional navigation and multivariate functionality of other tools was not necessary for this particular visualization situation. Third, LifeLines has been designed to be easily customizable to new domains.

### 4. LIFELINES

The HCIL at University of Maryland, College Park developed LifeLines 1.0 in 1994 in conjunction with the Maryland Department of Juvenile Services to "provide a general visualization environment for personal histories that can be applied to medical and court records, professional histories and other types of biographical data [10]." To accomplish this, LifeLines provides a single screen view of events over a span of time. Icons represent single occurrence events while timelines represent events spanning a period of time. The length of the line indicates the time covered while color and thickness indicate other qualitative variables such as importance or type. The use of color and thickness are both coded into the application. Supporting documents can be accessed by selecting the icon or timeline.

LifeLines 1.0 was rebuilt in 2003 to incorporate Piccolo, a monolithic toolkit designed by HCIL to facilitate building

zooming interfaces [3]. Piccolo.java provides a top layer in Java 2 based on the Java2D API [3]. This recoding created LifeLines 2.0 which provides a more flexible base on which to build new graphical functionality.

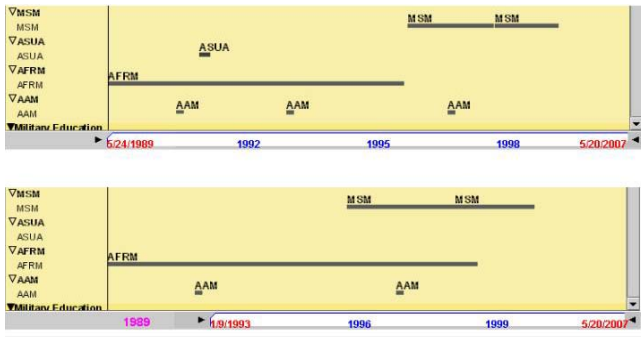
The potential benefits of LifeLines include reducing the chance of missing information, facilitating spotting anomalies and trends, and streamlining access to details. At the same time, LifeLines was designed to be easily tailored and transferred between applications [10]. A controlled experiment comparing LifeLines with a tabular interface found that LifeLines better facilitated a correct first impression of the data and better recall of the data than the tabular display [9].

LifeLines is built on a personal history data structure described in [12] and designed to allow data to be exported into the structure from an existing database. This facilitates adapting LifeLines to new applications. Collaboration between University of Maryland and IBM Research explored adapting LifeLines for use by Kaiser Permanente Physicians to view patient history records [11]. This project adapts it again to provide officer's personal history records for review during the assignment, promotion, and selection processes.

## 5. LIFELINES 3.0

### 5.1 Bug Fixes

Several glitches in LifeLines 2.0 became apparent with the different data used in this project. In 2.0, when the left side of the slider was moved to the right, the length of event lines leaving the viewable section of the timeline would not shorten, and moved to the right rather than exiting the screen space. This caused an inaccurate overlap between mutually exclusive events (See Figure 2).



**Figure 2: LifeLines 2.0 with Army Data. When the slider at the bottom is moved to the right, events at the left edge, extend causing inaccurate overlap.**

Because the labels' positions were fixed in 2.0, they would disappear off the screen too soon when the right side of the time slider was adjusted.

Calendar time is shown in LifeLines by the slider at the bottom of the screen. In LifeLines 2.0, the intermediate years displayed on the slider were incorrectly computed. With relatively short histories this was not noticeable; it only became apparent when viewing longer (20+ year) career history data. All of these problems have been corrected in LifeLines 3.0.

### 5.2 Additional Functionality

Figure 3 shows the LifeLines 3.0 interface with career history sample data. Events are listed in chronological order from left to right, and top to bottom. Colors and height can be used to indicate qualitative variables. The Army implementation requires the representation of only a single variable and color was selected to represent this. A key located in the upper right corner of the screen provides users with a quick reference.

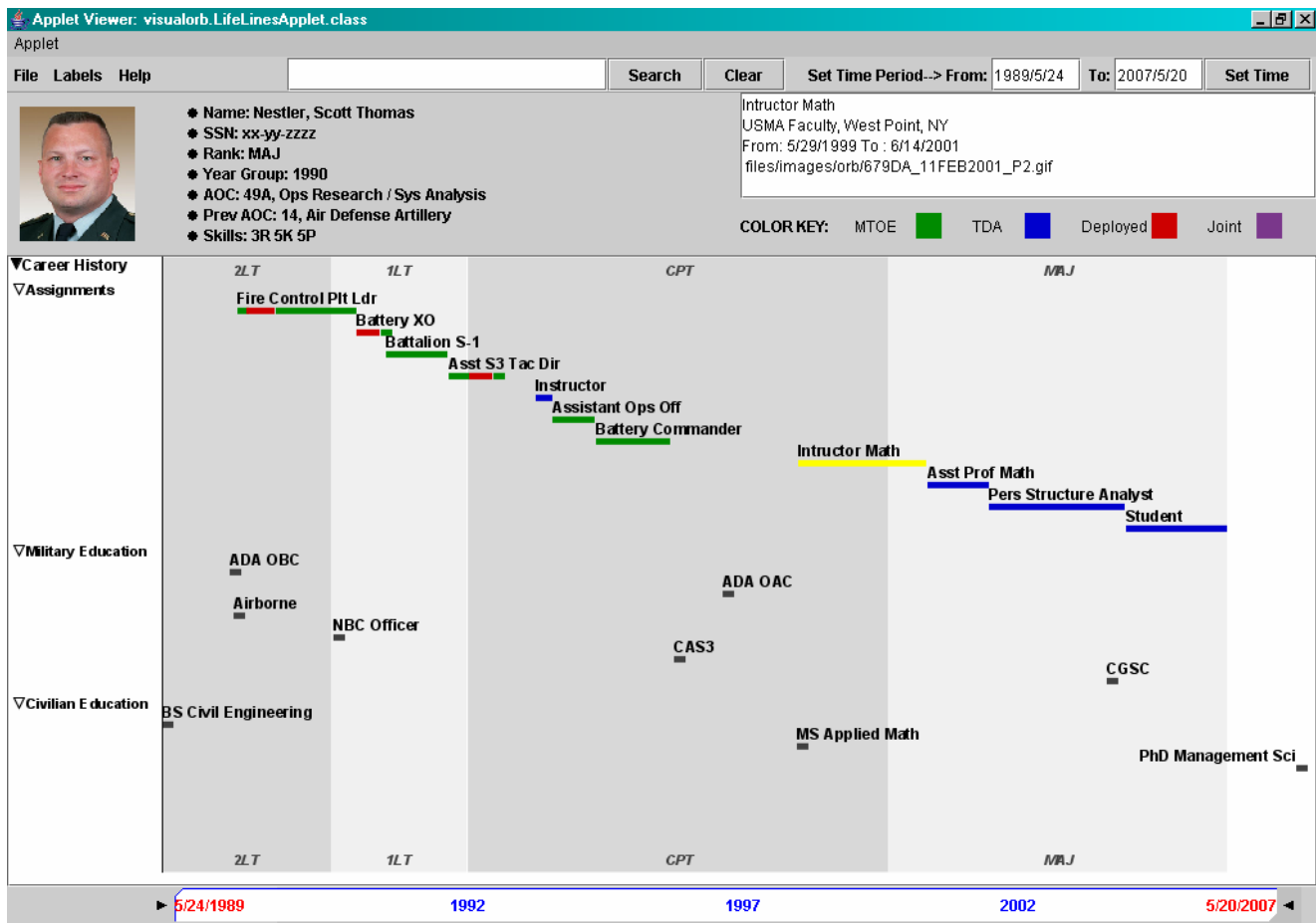
Events are divided and grouped, with the groups listed on the left hand side. This grouping provides two levels of categorization, with top-level groups indicated by a filled triangle and second level groups indicated by an outlined triangle. These groups can be collapsed into a single line by clicking on the triangle to the right of the group name (See Figure 4).

Scrolling over an event with the mouse highlights the event in yellow and provides additional details in the text box in the upper right hand corner of the screen. Events can also be searched using a text search box at the top of the screen. The Clear function has been moved from a drop down menu to besides the search button. This change visually groups the related functions. The clear button was recoded to clear the search box as well as the selections.

A slider at the bottom of the interface represents the time shown. The slider can be adjusted to reduce the time shown in the history to a segment of interest (See Figure 5). The resulting area can also be dragged left and right, to explore changes over time.

LifeLines 2.0 did not incorporate all features of the original version. After reviewing the missing capabilities the only critical loss was the ability to increase and decrease the labels' font size. The ability to increase font size allows use by those with limited vision or for screen presentation from a distance and so has been added to 3.0. The ability to decrease the font size is also important as standard-size labels can take over the screen for longer histories that may contain a large number of events.

LifeLines 2.0 allowed users to toggle text on and off and also provided additional tool tips, which appear when they scroll over the event. Because the text is the same as the labels, LifeLines 3.0 now provides either the labels or the tool tips, such that if the labels are toggled off, the tool tips appear and if the labels are toggled on, they do not. This simplifies the interface when navigating through events.



**Figure 3: LifeLines 3.0 With Sample Army Data.** Events are presented chronologically from left to right and top to bottom within three groups: Assignments, Military Education, and Civilian Education. Color represents assignment type. When users scroll over an event, the event is highlighted in yellow and additional information appears in the text box in the upper right hand corner.

The font size of standard and pop-up labels can now be controlled through the Labels drop down menu (See Figure 4). This was preferable to a slider to reduce the screen real estate needed.

When supporting documents are available, Lifelines 2.0 loaded supporting image and text files into a segment of the screen. While this allowed users to continue to see the timeline while also viewing the document, the size allocated to the document was insufficient to view a document of practical size. LifeLines 3.0 opens the document in a new, automatically sized window that can be adjusted, repositioned or scrolled through. Users can easily switch between the document(s) and the timeline view.

The length of time an event spans is indicated by the length of the line used to represent the event. LifeLines 3.0 also provides a means of showing an additional time variable through the use of background colors to represent periods of the personal history. This allows users to see how events fall within the periods, which can

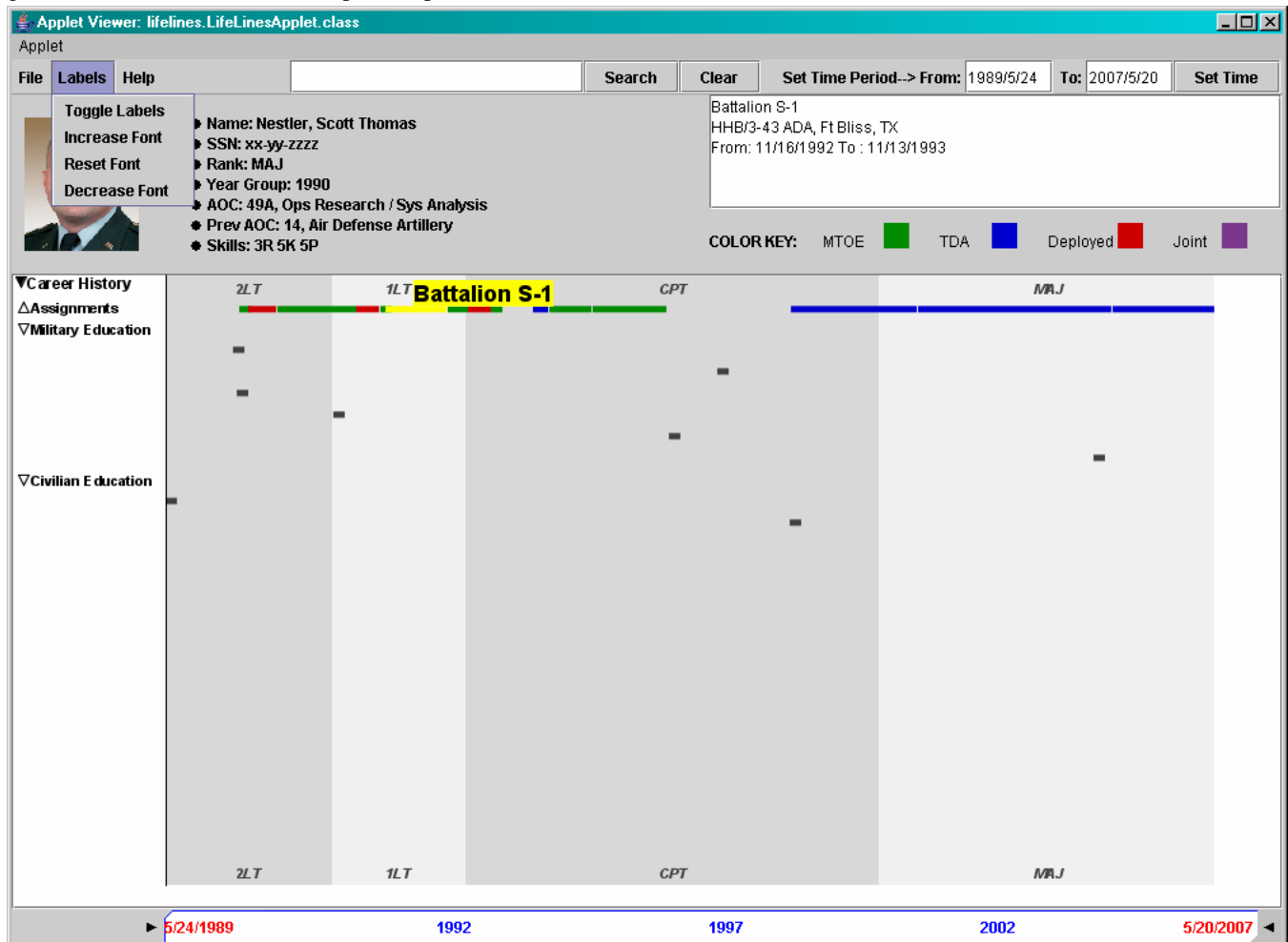
be important in some situations, as described by Allen [1]. For example, in Figure 7, the event highlighted in yellow spans the end of the dark gray period and the beginning of the light gray period while the next event (the first one in blue) is entirely contained within the latter period.

Finally, the help files were updated to reflect the changes in the application. After making these additions and corrections, LifeLines 3.0 was then customized for use by the Army in their assignment, promotion, and selection processes.

## 6. CUSTOMIZING LIFELINES TO ARMY NEEDS

This implementation of LifeLines 3.0 will be a component in a new, interactive version of the ORB called WS-ORB (for Web Services ORB). LifeLines consolidates several tables from the ORB into a single visual representation which will show the officer's Assignment History, Military Education, and Civilian Education on one timeline. This will allow for a one

glance overview of the most important parts an officer's career.



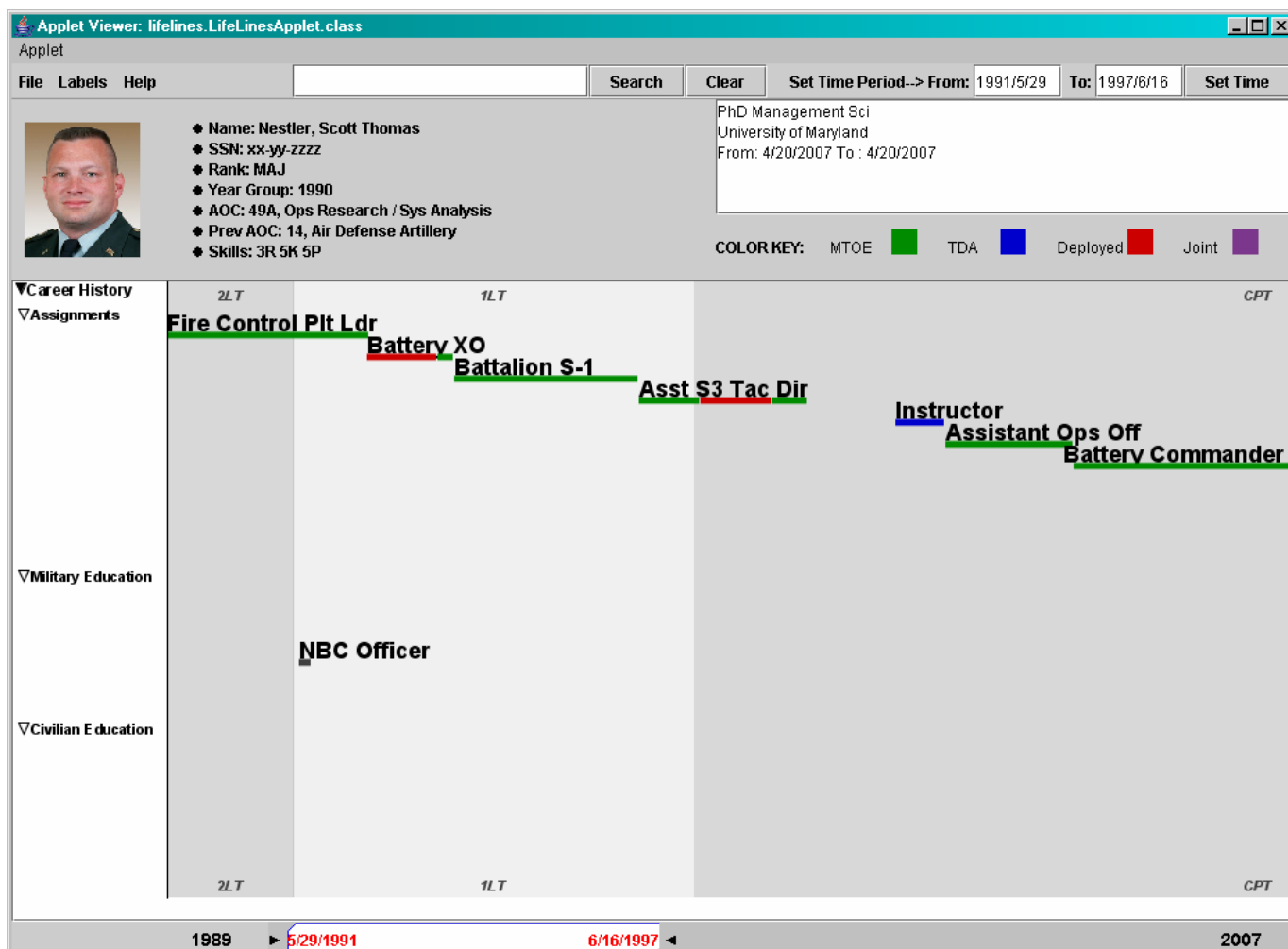
**Figure 4: LifeLines 3.0.** The groups on the left side can be collapsed into a single line, as shown by the Assignments group above. The labels can be toggled on and off and the font size adjusted using a drop down menu.

The interactive ORB is based on an XML file generated from the Army's personnel database. An Extensible Style Language Translation (XSLT) file was developed to produce a LifeLines-compatible XML file from the Army's source XML file. Events in the Assignment History group are color coded to represent whether the assignment was MTOE (warfighting), TDA (administrative), Deployed (overseas) or Joint (with other services). The colors were chosen as much as possible for associations commonly known to Army personnel: green, the color of most Army uniforms, was selected to represent MTOE units, the Army's raison d'être (reason to exist); red was selected for deployed units to indicate the danger they are in; and purple typically represents joint units. Blue was assigned solely for its aesthetic value. The pre-attentive nature of color allows a board member or assignment manager to quickly form a snapshot of the officer's career with regard to these important types of assignments.

The background period represents the individual's military rank and allows a quick assessment of the individual's rank(s) at the time a job was held. Assignments in the Army are "graded" to be filled by a person of a particular rank. The ability to compare rank and assignment provides important information on whether an individual was working at, above, or below their rank. For example, an officer is usually a company commander while a Captain. If he/she had instead been chosen to command a company while only a First Lieutenant, this is likely indicative of confidence in their leadership abilities at an early stage.

### 7. DISCUSSION AND FUTURE WORK

While the work completed to date accomplished the objectives for the Information Visualization semester project, integrating the LifeLines timeline into the Army's interactive ORB application remains to be done. HRC leaders favorably received WS-ORB during recent demonstrations. Upon reviewing LifeLines 3.0, one



**Figure 5: LifeLines 3.0. The slider at the bottom can be shortened to zoom the view into smaller periods of time.**

recent promotion board member stated, “The timeline project enables rapid understanding and assessment of the whole OMPF (Official Military Personnel File). I wish I would have had it for the board I was on, and I think it should be made available to future board members ASAP.” However, some legal and implementation challenges still remain to be addressed. To be incorporated into the promotion board process, the application must undergo a legal review. The timeline portion should not be an obstacle, as it simply provides a more convenient and accessible version of what board members currently see in an officer’s records. Incorporating the LifeLines applet into the secure application framework necessary for handling Army personnel data will take some time. Once that is done, the quality control process will likely take several months before implementation is complete and the application is rolled-out to the Army personnel community.

It is worth noting that there is some uncertainty associated with the data used for color-coding overseas and deployed assignments. Generally speaking, all

deployments are overseas, but not all overseas assignments involve a deployment. A Soldier can be overseas (e.g. in Europe) but with his/her family. However, deployments and “dependents restricted” overseas assignments mean time away from his/her family. In the past, the Army attempted to balance overseas assignments among Soldiers. Recently, the Army has focused more on equity in deployments. Although the Army has good location (i.e. country and state) data, deployment data is often incomplete because units do not always make database transactions. Currently, LifeLines shows both overseas and deployed assignments in the same color. This is not ideal; it is a compromise for the time being until an acceptable scheme is developed. Nearly all of the other data used in constructing the LifeLines representation has been regularly reviewed by the officer for correctness; however, the deployment type is not currently visible on the tabular ORB and has therefore not gone through a review process. Because of this, some validation process will have to be developed to ensure this data is correct.

The education data contains a second, more complicated, type of uncertainty. The civilian education data includes only the completion year rather than a fully qualified date. To correct for this, LifeLines assumes a June 1 completion for all civilian education. While this will clearly not be correct in all instances, when viewed across a career timeline, even the maximum error of six months will be difficult to discern. Also, the actual date of graduation is not the critical piece of information. Possession of a degree is what matters; when it was earned is of secondary importance, and only in a general sense. Military education on the other hand includes a full completion date, but fails to include a start date. Since military education courses can vary in length, a two-week course appears the same as a six-month course on the timeline. Rather than attempting to visualize the uncertainty (perhaps with the use of texture or outlines), we use an icon to show the completion date only since it is the only known date. Also, most officers looking at the timeline will have an idea of the length of most courses from experience. Again, this is a compromise based on limitations in the underlying data behind the visualization.

With regard to accurately depicting overseas and deployed assignments, the use of texture (i.e. cross-hatching) is proposed to represent deployments. This would allow overseas assignments, represented by color, and deployments, represented by texture, to be distinguished from one another. However, before this can happen, the Army needs to develop a process to validate existing data and add missing deployment data from their database. LifeLines has the capability to adapt once the supporting data is in place.

Besides being used by HRC, LifeLines is also under consideration to be part of a larger decision support system by the Army's Senior Leader Development (SLD) Office for assigning Colonels and Generals. Senior Army leaders often need to compare 3-5 job candidates and make an assignment decision in a matter of minutes. In combination with a graphical representation of geographic experience and a visual comparison of the requirements of a position and those competencies possessed by officers under consideration, the timeline view will aid in making timely assignment decisions.

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