Visual analytics is an emerging and fast-developing field that combines the strengths of graphical visualization with the power of analytical reasoning.

Today, many algorithmic and mathematical solutions exist for analyzing large datasets such as biomolecular data or complex software source code. Gaining new insights from such data requires the ability to specify what we are looking for, from clusters of patients exhibiting similar gene expression to bugs in software systems.

But what if we do not know what we expect to find?

AN EMERGING FIELD

Consider an example. A still unsolved problem is identifying the genomic alterations and processes that lead to particular cancer subtypes. Because biologists lack sufficient understanding, they are not able to formulate algorithms that analyze biomolecular data properly.

Visual analytics is an emerging and fast-developing field that combines the strengths of graphical visualization with the power of analytical reasoning. It supports discovering new and unknown insights by finding relations, patterns, trends, or outliers in potentially large and complex data. Because human analysts’ unique sense-making skills are tightly coupled with interactive visualization techniques, visual analytics can lead to discoveries that neither a computer nor a human could make alone. Pairing both in an efficient way is the key to future analysis—and discovery.

IN THIS ISSUE

This issue of Computer presents the potential benefits, and current and future challenges, of visual analytics with five articles by leading scientists in the field.

The first article, Jean-Daniel Fekete’s “Visual Analytics Infrastructures: From Data Management to Exploration,” lays the technological foundation for this issue. The author elaborates on the three essential layers of infrastructure that must be integrated with one another to create effective visual analytics solutions—data management, visualization, and analytics—each with different requirements in terms of software and hardware.

Intelligence analysis has been a key application domain of visual analytics since the field’s inception in 2004. In “Visual Analytics Support for Intelligence Analysis,” Carsten Görg and his colleagues describe what it takes to aid investigators in not only understanding past events but also going one step further and uncovering future threats. In a hypothetical usage scenario based on data from the 9/11 terrorist attacks, the authors demonstrate how a visual analytics system can support investigators to understand the connections among events, people, places, and organizations.

Large graphs are omnipresent in real-world networks: examples are the network of Wikipedia articles with millions of cross-references, social networks with billions of relations and communications, or the power distribution
network of whole countries. In “Large-Scale Graph Visualization and Analytics,” Kwan-Liu Ma and Chris W. Muelder describe the visual analytics approach to gaining knowledge from such large and dynamic graphs. The article demonstrates what can be done beyond just showing the graph as a giant hairball.

Online sources, such as news sites or social media platforms, produce an ever-growing, continuous amount of text data. Analyzing such data can be very valuable, for instance, in finding out what kind of help is needed most urgently in the case of a natural disaster, or for a company to find out when customers started to complain about a specific product. In “Real-Time Visual Analytics for Text Streams,” Daniel Keim and his colleagues describe the process of interactively exploring streaming data to gain new insights. Besides providing concrete examples, the article also discusses the challenges posed in terms of data management, data processing, and visualization.

What makes an insight relevant is highly dependent on the domain context and cannot be predicted in a general way. So how can you evaluate a solution without knowing its desired result? In “Evaluation: A Challenge for Visual Analytics,” Jarke van Wijk discusses why evaluation is an inherently hard problem in visual analytics and how researchers try to address this issue. The author argues that it is necessary to consider all ingredients of the evaluation progress together: the data, the tasks, the users, and the artifacts, all of which are heterogeneous on their own. After elaborating on the progress the community has already made, the article closes with a summary of concrete next steps needed to finally evaluate complex visual analytics solutions in all their facets.

Visual analytics is highly interdisciplinary and requires the interplay of a multitude of scientific fields, such as visualization, data management, statistics, cognitive and perceptual sciences, interaction, and many more. We hope that readers of this issue not only learn what visual analytics is all about but also get inspired to contribute to and collaborate with this lively community.

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Big and complex data will change how we live in both small and large ways.