Hybrid and Custom Data Structures: Evolution of the Data Structures Course

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ABSTRACT

The topic of data structures has historically been taught with two major focuses: first, the basic definition and implementation of a small set of basic data structures (e.g. list, stack, queue, tree, graph), and second, the usage of these basic data structures as provided by a data structures framework in solving larger application problems. We see a further evolution of data structures to include new generations of hybrid and custom data structures, implying that our students must not only understand how to use these new data structures but that they continue to understand low-level implementation issues so that they can develop the next generation of data structures needed in the future. We suggest that the data structures course evolve to reflect these new generations of data structures.

1 Introduction

The content of data structures courses have changed over the last twenty years. The first major generation of this course focused on describing the basic data structures (e.g. list, stack, queue), implementing these data structures in various ways (e.g. array-based structures or pointer-based structures), and then implementing some simple examples using these structures. The second generation of this course focused on using these basic data structures to solve meaningful problems, either implementing the data structures or using them from libraries such as the Standard Template Library (STL) [11] for C++, the Java Collections Framework (JCF) [6], or the Microsoft .NET Framework [7].

Mathematical expressions are intruduced in standard way as in `$x^2$` that appears as x^2. Unnumbered expressions like

$$ax^2 + bx + c = 0$$

can be introduced as

```
$$a x^2 + b x + c = 0 $$
```

Numbered equations

$$E = mc^2 \tag{1}$$

are introduced as

```
\begin{equation}
    E=mc^2 \label{eq:Einstein}
\end{equation}
```

and can be referenced (**??**) using `\eqref{eq:Einstein}`. Multiline expressions

$$\begin{aligned} A &= \int_{-\infty}^{\infty} dx e^{-ax^2} \\ &= \sqrt{\frac{\pi}{a}}. \end{aligned} \tag{2}$$

can be introduced, for instance, with the align envoronment,

```
\begin{align}
A&=\int_{-\infty}^\infty dx e^{-a x^2}
 ↪   \nonumber\\
&=\sqrt{\frac{\pi}{ a}}. \label{eq:Gaussian}
\end{align}
```

Wide expressions

Name	age	date
sabbir	22	02jun 2000
mehedi	21	01 february 2001
fahim	20	03 march 2002

Table I: Caption