



Graph Algebra and Formally Defined Programs in Z

Using Haskell to Reason and Verify Programs

Leonard Kleinrock

01.jan.2022

Formal Methods International Congress



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Lists

- | | | | |
|---|----------------------|---|----------------------|
| 1 | Berlin | 1 | Leipzig |
| 2 | Hannover | 2 | Dresden |
| 3 | Freiburg im Breisgau | 3 | München |
| 4 | Heidelberg | 4 | Köln |
| 5 | Hamburg | 5 | Königsberg und Praga |

Is Algebraic Graph Knowledge possible?

Research has been conducted in order to evaluate the possibility of reaching meaningful knowledge from Algebraic Graph transformations.

- Model Checking and theorem proving are viable paths.

When the need to make strong assertions becomes inevitable:

- This is the first way: **outstanding assertion!**
- Even greater impact comes from: **hilight text!**

* **Note** : This is a very long footnote line intended to test the layout of two lines.

H1

H2

H3

H4

H5

H6

- This is a fragment o normal text written here in order to exemplify the use of several featrues in CSS.
- This is a fragment o normal text written here in order to exemplify the use of several featrues in CSS.
 - This is one **feature**
 - This is another subjetc.

Lists

1. One
2. Two
3. Three
 - i. abc
 - ii. def
4. End of list

```
primes = filterPrime [2..]
where filterPrime (p:xs) =
      p : filterPrime [x | x <- xs, x `mod` p /= 0]

seqLength :: Num b ⇒ Sequence a → b
seqAppend :: Sequence a → Sequence a → Sequence a

seqLength Nil = 0
seqLength (Cons _ xs) = 1 + seqLength xs

seqAppend Nil ys = ys
seqAppend (Cons x xs) ys = Cons x (seqAppend xs ys)
```

Tables

Column A	Column B	Column C	Column D
A1	B1	C1	D1
A2	B2	C2	D2
A3	B3	C3	D3

Table: Exemple of use of tables.

LaTeX Equations

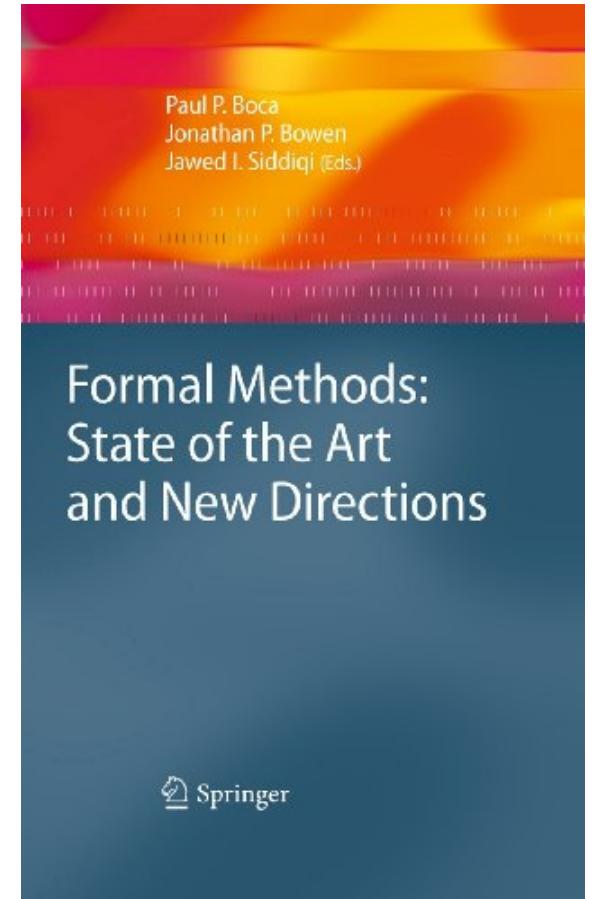
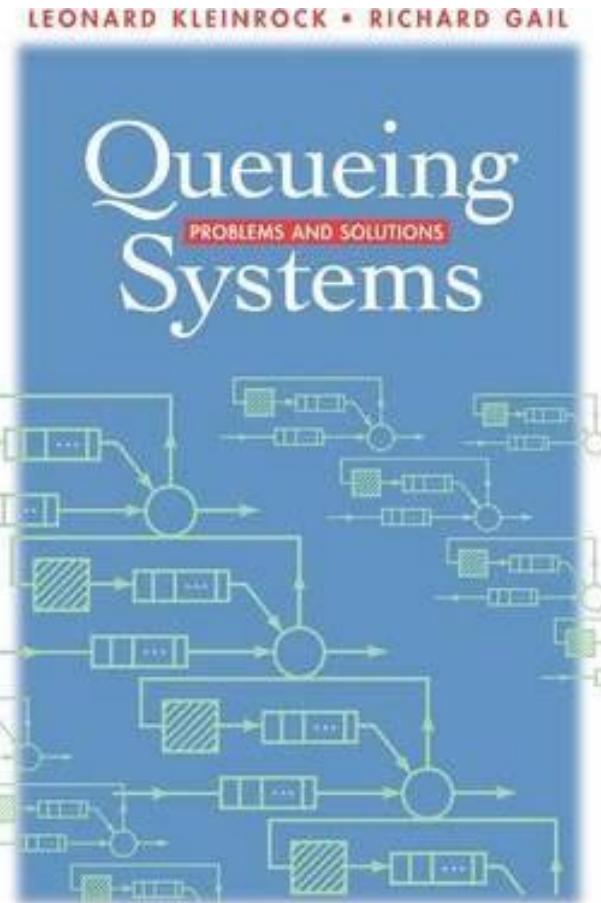
$$\frac{1}{c^2} \frac{\partial^2 \psi}{\partial t^2} = \nabla^2 \circ \psi$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

$$\nabla^2 \mathbf{E} = \mu\epsilon \frac{\partial^2 \mathbf{E}}{\partial t^2}$$

$$c = \sqrt{\frac{1}{\mu\epsilon}}$$

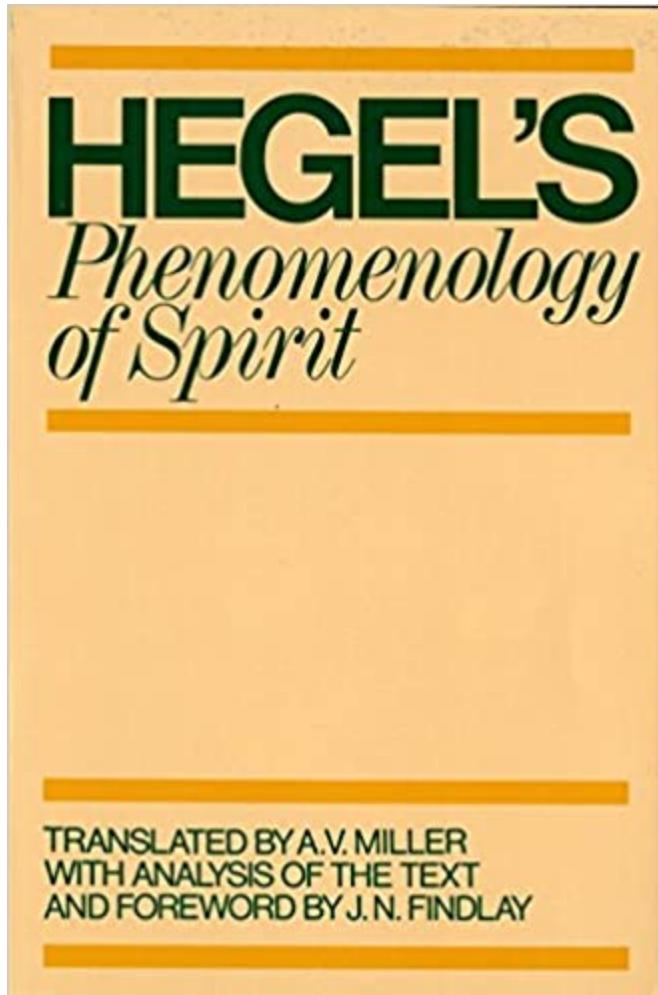
Images in Two Columns



Formal Methods:
State of the Art
and New Directions

Springer

Image and text



Hegel's Phenomenology

The book was originally entitled "Phänomenologie des Geistes" by its author, G.W.F. Hegel.

- Published in 1807, marked a significant development in German idealism after Kant.
- In this book Hegel develops his concepts of dialectic.

Price at Amazon: \$ 17.83

Figure: Oxford edition (1979).

"There is an **increasing** demand of current information systems to incorporate the use of a higher degree of formalism in the development process. **Formal Methods** consist of a set of tools and techniques based on mathematical model and formal logic that are used to **specify and verify** requirements and designs for hardware and software systems."

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- Mona Batra -

Transition Slide

References

1. Boehm B. W.: **Software Engineering Economics** . Prentice Hall, 1981.
2. Pressman Roger S: **Software Engineering - A Practitioner's Approach** , McGraw Hill, 5th edition. 2000.
3. Rushby John: **Formal Methods and the Certification of Critical Systems** . Tech. Rep. SRI-CSL-93-7, Computer Science Laboratory, SRI International, Menlo Park, CA, Dec. 1993.



References

1. Boehm B. W.: **Software Engineering Economics**. Prentice Hall, 1981.
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