



# Graph Algebra and Formally Defined Programs in Z

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Using Haskell to Reason and Verify Programs

Leonard Kleinrock

01.jan.2022

Formal Methods International Congress

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# Lists

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- |   |                      |   |                      |
|---|----------------------|---|----------------------|
| 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?

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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!**

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

# H1

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## 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

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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

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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

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

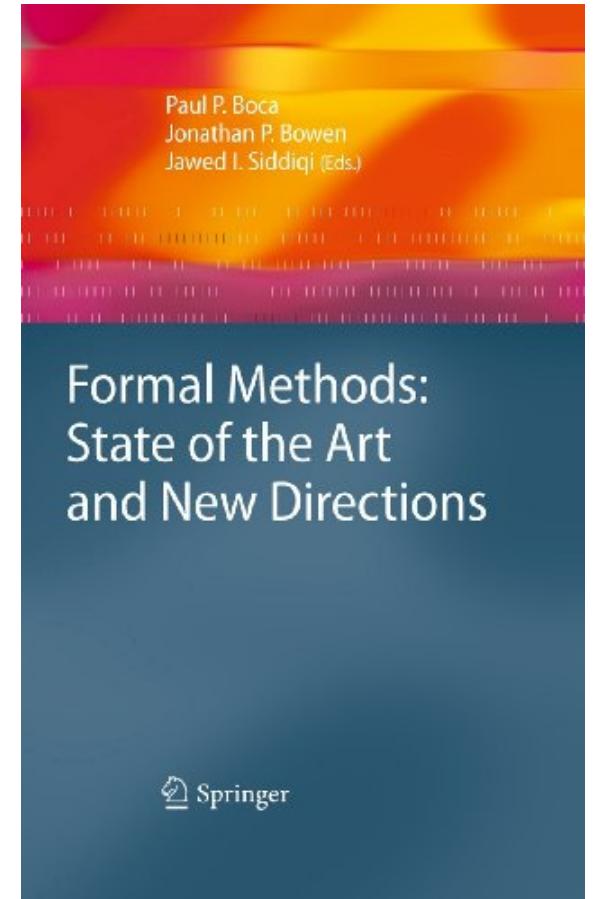
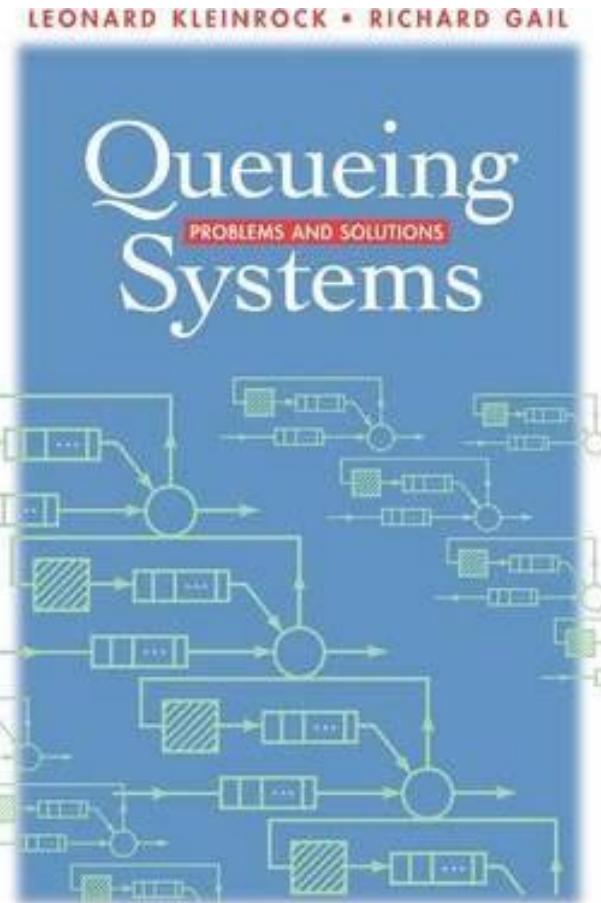
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

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

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

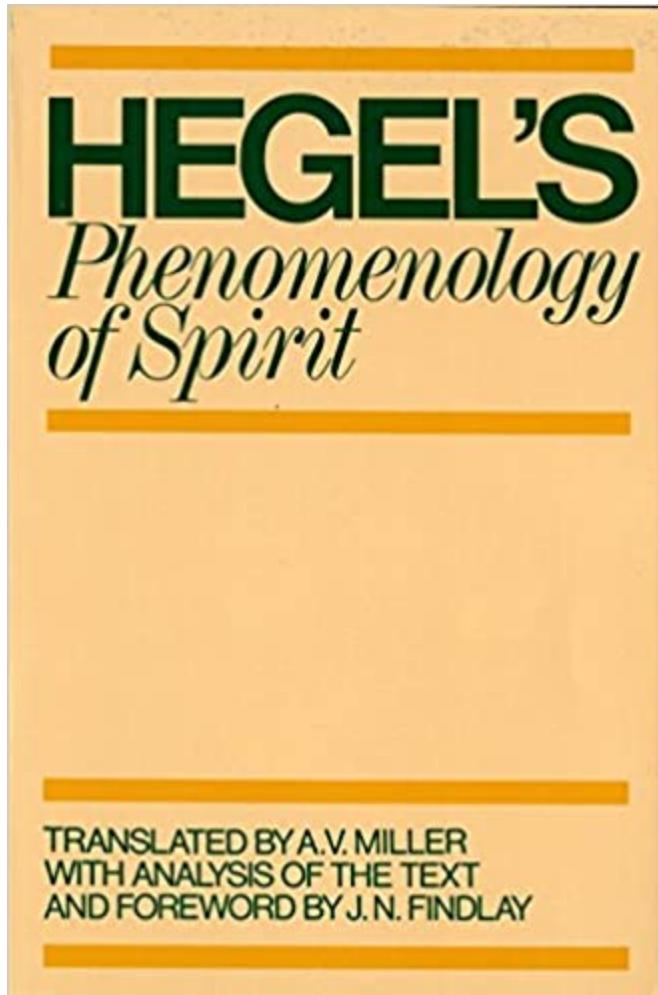
# Images in Two Columns

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# Image and text

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## 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

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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

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