



# 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

# Graph Algebra Representation of Formally Defined Programs in Z

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# Lists

1 Berlin

2 Hannover

3 Freiburg im Breisgau

4 Heidelberg

5 Hamburg

1 Leipzig

2 Dresden

3 München

4 Köln

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 Cheking and theorem proving are viable paths.

When the neet 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.

# 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 subje**tc**.

# 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)
```

Code: Haskell code fragment.

# 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

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

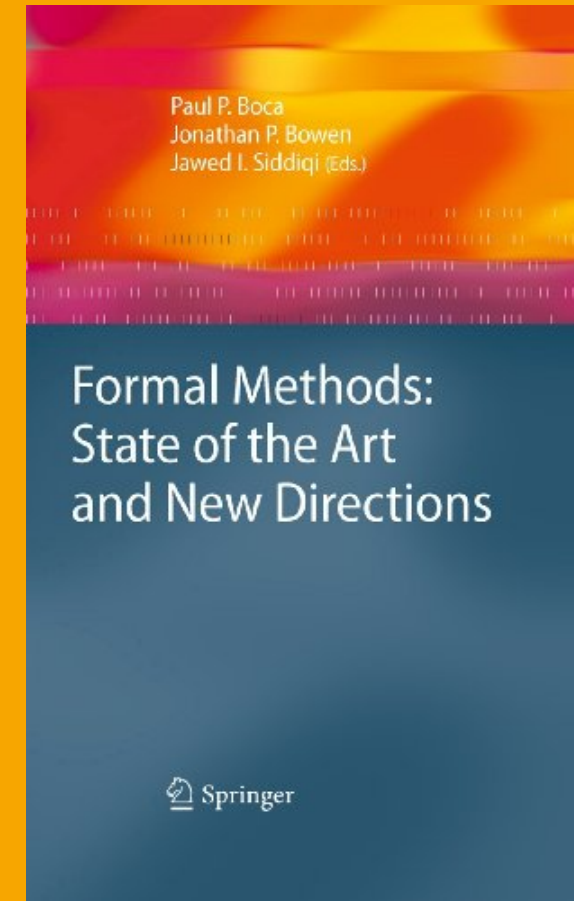
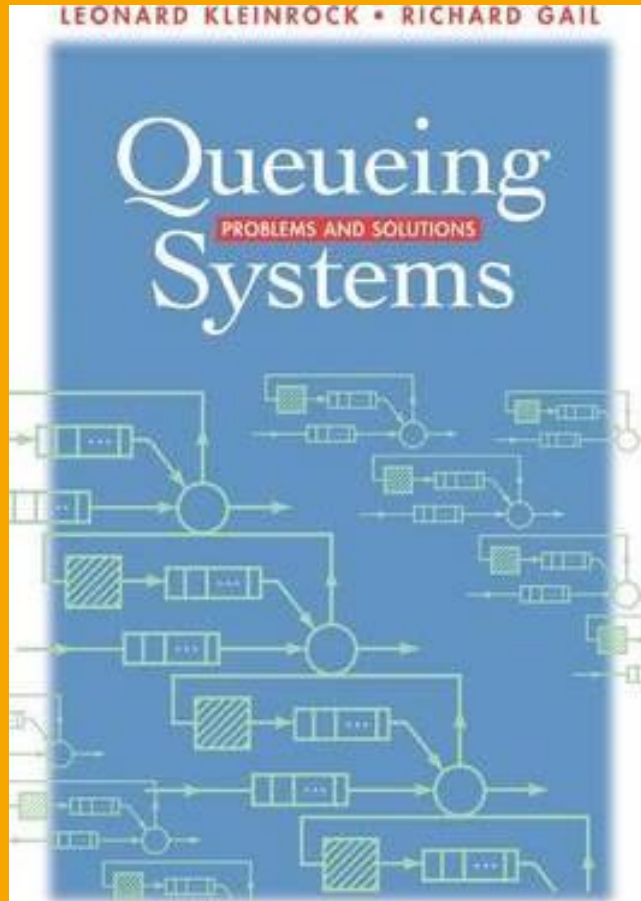
$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}$$

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

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



# Images in Two Columns



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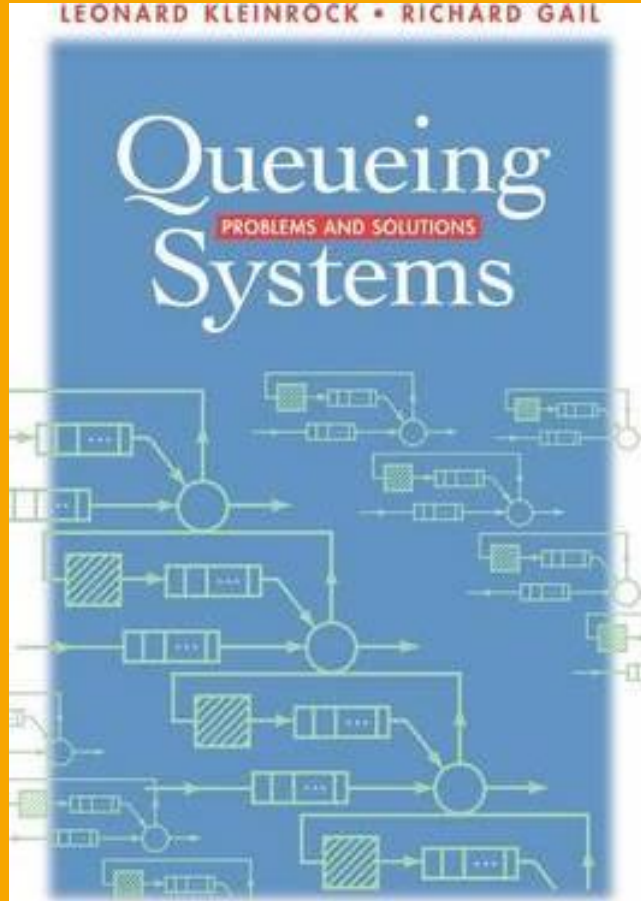


Figure: Kleinrock, Gail (1979).

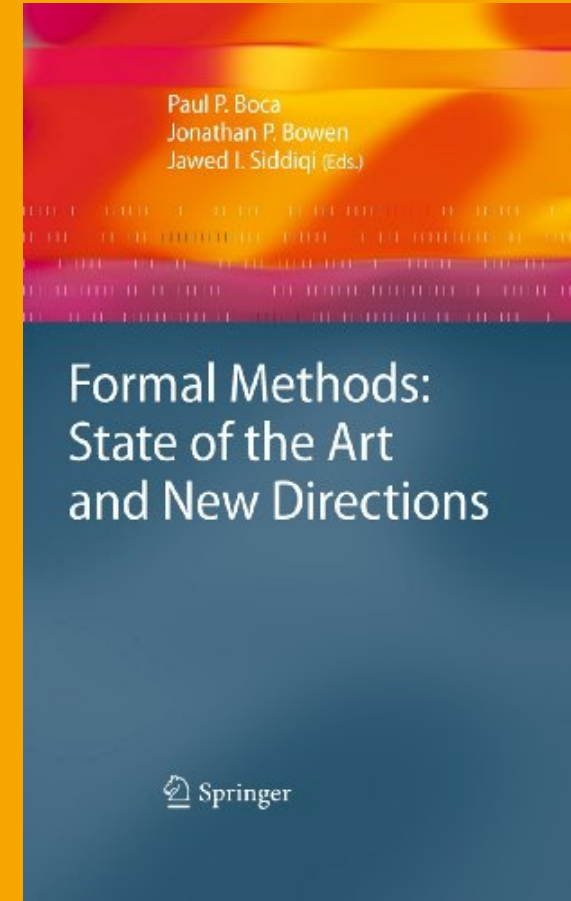


Figure: Springer Verlag (1979).

# Image and text

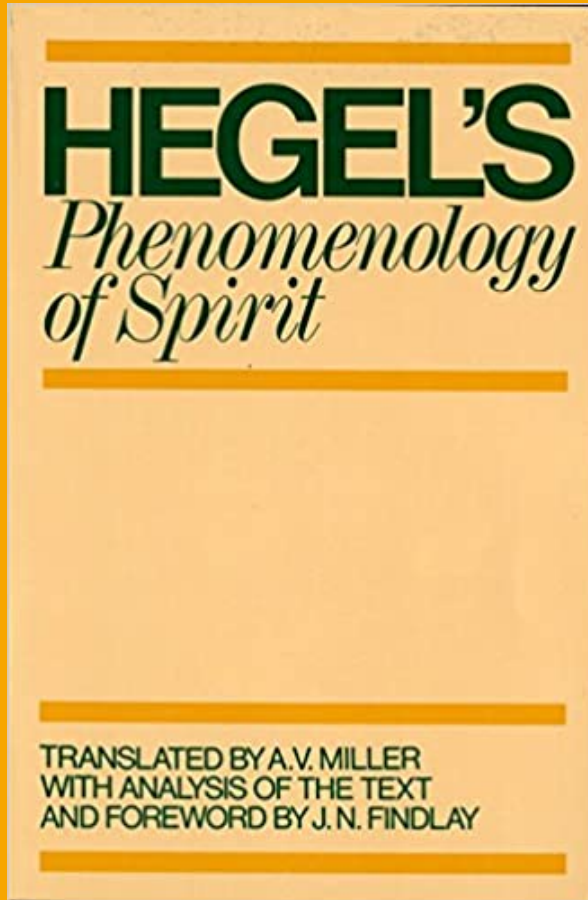


Figure: Oxford edition (1979).

## 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

"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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5. HEGEL, Georg Friederich Wilhelm. **Hegel's Phenomenology of Spirit**. Tradução: A. V. Miller. New York: Oxford University Press, 2004.



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2. ARISTOTELES. **Nikomachische Ethik**. Berlin: Akademie Verlag, 2010. (Klassiker Auslegen).v. 2
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