

# Historia de la Informática y la Metodología Científica

*-Apuntes del curso 2003/2004-*

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# Índice general

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<b>Índice general</b>	<b>3</b>
<b>1. Metodología de la ciencia</b>	<b>5</b>
1.1. La ciencia como conocimiento derivado de los hechos . . . . .	5
1.2. La observación . . . . .	5
1.3. El experimento . . . . .	6
1.3.1. La deducción . . . . .	6
1.3.2. La inducción . . . . .	6
1.4. Introducción al falsacionismo . . . . .	7
1.5. El falsacionismo sofisticado . . . . .	7
1.6. Las limitaciones del falsacionismo . . . . .	7
1.7. Los paradigmas de Khun . . . . .	8
1.8. Los programas de investigación . . . . .	8
1.9. La teoría anarquista de Feyerabend . . . . .	9
<b>2. Caracterización de la informática</b>	<b>11</b>
2.1. La Informática como disciplina . . . . .	11
2.2. División de subáreas . . . . .	11
<b>A. GNU Free Documentation License</b>	<b>13</b>
<b>Bibliografía</b>	<b>19</b>



# 1. Metodología de la ciencia

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## 1.1. La ciencia como conocimiento derivado de los hechos

Para los empiristas el conocimiento científico es *especial* porque se basa en hechos que son comparables,. Esta concepción del conocimiento científico conlleva las siguientes implicaciones para los empiristas:

1. Los hechos se dan a observadores cuidadosos.
2. Los hechos son anteriores a la teoría.
3. Los hechos constituyen un fundamento firme del conocimiento.

Obviamente estas afirmaciones conllevan ciertos inconvenientes, todos ellos dados en la observación.

## 1.2. La observación

Supongase un experimento tal que se trata de definir que elementos define la siguiente imagen. Pues bien los resultados dependeran de la observación además de parametros tales como, por ejemplo, sociales, culturales, etc ...



Tal vez un sujeto indique que se compone de dos machas, una azul y otra roja. separadas por una C; o tal vez otro sujeto proponga que esta formada por un triángulo rojo y una flecha azul. Así vemos que la observación no es el único camino para deducir hechos y llegamos a que las anteriores implicaciones poseen los siguientes inconvenientes:

- Dos personas que observan el mismo suceso no tienen por que necesariamente interpretar los mismos resultados *Véase el ejemplo anterior.*
- Según los empiristas no es necesaria la teoría para la correcta interpretación de los hechos luego toda hechos que observemos queda influenciado por los conocimientos que se poseen.

- A lo largo del tiempo numerosas leyes y teorías son rebatidas, por tanto, no es posible afirmar que los hechos constituyen un fundamento firme de conocimiento.

Existen dos tipos de observación:

- Privada**, todo fenómeno estudiado en este ámbito queda accesible para todo aquel perteneciente a la entidad privada.
- Pública**, la ciencia ha de perseguir este tipo de observación. En la cual se comparte toda nueva aportación al saber general, y ésta es accesible a todo aquel que desee.

### 1.3. El experimento

Para los empiristas resulta innecesario realizar experimentos que corroboren las teorías formuladas. Aún así, poseen dos herramientas útiles para conseguir información al respecto. La deducción y la inducción.

#### 1.3.1. La deducción

Llamado así al sistema lógico, también llamado *Modus Ponendo Ponens*, formado por un conjunto de premisas y la conclusión que se obtiene de ellas. Este sistema será válido, si y sólo si, de premisas verdaderas se obtiene una conclusión verdadera.

$$\frac{A \rightarrow B \quad A}{B}$$

Ejemplo:

$$\frac{\begin{array}{l} \text{Sea, todos los perros son peludos} \\ \text{Whiskey es un perro} \end{array}}{\text{Whiskey es peludo}}$$

#### 1.3.2. La inducción

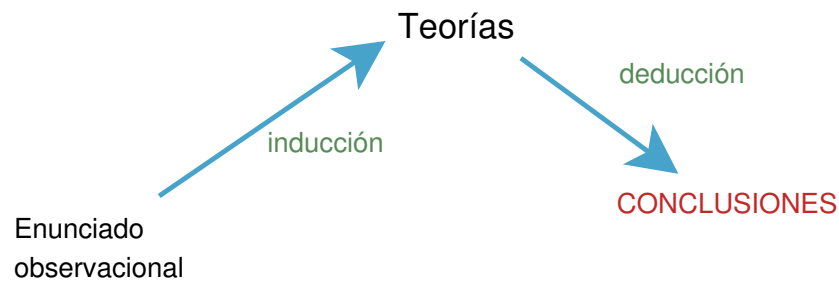
Llamado así el proceso mediante el cual se obtiene un suceso general a partir de varios casos particulares, del modo:

$$a_1, a_2, a_3, \dots \longrightarrow a, \forall a_n, n \in \mathbb{N}$$

La inducción, no es matemáticamente justificable, pero sólo se verá justificada si el proceso inductivo lo es. El empirista acepta la inducción cuando:

1. El número de observaciones es elevado.
2. todos los resultados del experimento son similares.
3. No hay resultados que entren en contradicción.

En resumen, la ciencia vista por un empirista podría esquematizarse como:



## 1.4. Introducción al falsacionismo

Planteado por *Karl Popper* quien mantjene que:

1. El empirismo no produce verdades universales, ya que es tan generalista que no excluye nada.
2. Toda observación está impregnada de teoría.
3. La ciencia avanza por el ensayo y error.

Popper propone **la falsabilidad**, es decir, que se debe encontrar un fenómeno observable que entre en contradicción con la teoría para que ésta sea válida.

Ejemplo:

- *Los miercoles llueve* → FALSABLE
- *Los miercoles a veces llueve* → NO FALSABLE

Según Popper, la ciencia debe predecir aquellas teorías que siendo falsables no lo hayan sido. De hecho, una teoría general tiene más falsadores potenciales

## 1.5. El falsacionismo sofisticado

Sigue la corriente de Popper planteando la evolución de la ciencia como confrontación de teorías falsables. Según este paradigma la ciencia avanza gracias a:

- Falsación de teorías audaces.
- Verificación de conjeturas prudentes.

## 1.6. Las limitaciones del falsacionismo

Cabe decir que el falsacionismo sofisticado excluye modificaciones *ad hoc* como veremos a continuación.

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### Ejemplo. Galileo y La Luna:

En tiempos de Galileo, las lunas eran esferas perfectas. Galileo tras sus estudios y observaciones determinó que en la superficie de la Luna existía una infinidad de cráteres. Los sabios contrarios a Galileo incluyeron a la discusión modificaciones ad hoc tales como “*en caso de que la luna poseiese cráteres seguiría siendo perfectamente esférica porque la cubría una sustancia invisible llama éter*”. Galileo por su parte lo refuto manteniendo que el éter se repartía igual por La Luna, por tanto, debido a las imperfecciones del satélite. Concluyendo que debía tener cráteres.

Basicamente los problemas del falsacionismo sofisticado derivan del propio sistema deductivo.

Tengase en cuenta que:

1. Falsar una teoría no implica que sea incorrecta.
2. Todas las teorías son falsadas en sus inicios.

## 1.7. Los paradigmas de Khun

La metodología científica de Kuhn mantiene que el conocimiento científico avanza gracias a la necesidad de establecer nuevos paradigmas debido a que los existentes entran en crisis produciéndose lo que Kuhn denomina *revoluciones científicas*. Es decir, por definición; una ciencia investiga, observa y establece hipótesis y teorías a partir de los axiomas pertenecientes al paradigma en cual se basan. Y sólo se producen cambios de paradigma cuando no se encuentran explicaciones convincentes para sucesos que hacen que se produzca una contradicción.

En el caso de la metodología científica de Kuhn la mera existencia de problemas sin resolver dentro de un paradigma no constituye una crisis, solamente las anomalías que afecten a los propios fundamentos del paradigma son las que pueden hacer entrar en crisis al mismo.

## 1.8. Los programas de investigación

Planteado por *Imre Lakatos* discípulo de Popper. Su tesis define la ciencia como el desarrollo programático de unos principios fundamentales, que llamó *programas de investigación*. O sea, que la ciencia se forma en torno a estas estructuras<sup>1</sup>, formadas por:

- A. *Centro firme*: Conjunto de teorías que forman el nuevo paradigma. Sobre él se forma el estudio de su validez.
- B. *Cinturón protector*: Conjunto de teorías aceptadas, Todas ellas nos permiten continuar investigando.

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<sup>1</sup>Teoría o paradigma vigente

Si se falsa B no pasa nada, además Precisamente B permite que el programa se expanda. El problema aparece cuando se falsa A. esta estructura es típica de Popper, ya que el programa será falsable si el centro firme está a salvo de ser falsado. Por su parte, Lakatos, añade el concepto de *Heurística*<sup>2</sup>, en función de estas reglas evolucionará el proyecto. Lakatos define los dos siguientes tipos de heurística:

- **Heurística negativa**, conjunto de reglas que indican las modificaciones que nunca se deben hacer al programa de investigación ya que se pondría en duda el centro firme.
- **Heurística positiva**, conjunto de posibles proposiciones a añadir al programa con tal de agrandar el cinturón protector.

Lakatos reinterpreta el concepto de revolución científica. La define como la sustitución de un programa de investigación regresivo por otro progresivo. Khun y Lakatos tienen en común el estudio de la ciencia para que la filosofía de la ciencia juzgue correctamente. Por su parte, esta concepción de la ciencia posee los siguientes inconvenientes:

1. No está muy bien definido el concepto de centro firme y cinturón protector.
2. No existe una delimitación concreta para el centro firme.
3. Se continua con el relativismo en el cambio de programa de investigación.
4. No informa de cuando se cambia de un programa de investigación regresivo a otro progresivo.

## 1.9. La teoría anarquista de Feyerabend

Paul Feyerabend propuso este radical cambio frente a las anteriores concepciones de la ciencia. Feyerabend mantenía que realmente no existe un método científico debido a que no existe en realidad un criterio de demarcación científica. Demuestra que los métodos anteriores no son correctos.

Afirma que la ciencia sólo avanza debido a que la ciencia moderna se ha institucionalizado, como una religión en la edad media. Según Feyerabend esto estrangula otras formas de conocimiento ya que la *ciencia oficial* se impone obsorviendo estos conocimientos.

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<sup>2</sup>Conjunto de reglas para resolver un determinado problema

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## 2. Caracterización de la informática

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### 2.1. La Informática como disciplina

La disciplina de la ciencia de los computadores nació a principios de 1940 con la confluencia de la teoría algorítmica, la lógica matemática y la invención del ordenador electrónico de programa almacenado. Ejemplos son los trabajos de Alan Turing y Kurt Godel en la década de 1930 sobre algoritmos y su implementación como máquinas o sistemas de reglas, los algoritmos creados por Ada Lovelace sesenta años antes, los ordenadores analógicos contruidos por Vannevar Bush en los años 1920 y los ordenadores electrónicos contruidos por Howard Aiken y Konrad Zuse en 1930. Anteriormente los computadores realizaban trabajos concretos para medios mecánicos o eletromecánicos, pero no imaginados como máquinas de propósito general.

Por ejemplo, tenemos el caso de Jacquard que utilizó tarjetas perforadas en el siglo XIX para mecanizar el procesor de tejido en unos telares. Y a finales de este mismo siglo en EEUU se utilizaron tarjetas perforadas para realizar el computo del censo. O el caso de Charles Babbage que diseño un ingenio mecánico ideado para el cálculo.

Pero la revolución ideológica llegó de manos de *Claude Sannon* cuando en 1948 publicó su tesis doctoral, basada en la **Teoría de la Información**. Donde demostro que utilizando el álgebra de Boole se podían diseñar circuitos electrónicos. Más tarde el ocncepto de *Máquina de Turing*, de mano de Allan Turing revolucionó la teoría de autómatas e inteligencia artificial. Y ya por la década de los 60 se forman los primeros departamentos de Ciencias de la Computación en EEUU, cuyo acceso era muy restringido y dividido en dos campos:

- A. **Software.** Matemáticos y lógicos preocupados principalmente en el desarrollo lógico y formal de las disciplinas informáticas.
- B. **Hardware.** Ingenieros en su mayoría preocupados por el diseño físico más que en el lógico.

### 2.2. División de subáreas

En 1991 se publica el *Computer Curricula* dando a conocer las propuestas de la ACM<sup>1</sup> y la IEEE<sup>2</sup> para encaminar el estudio de la informática, de hecho en 2004 popusieron las

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<sup>1</sup>Associaton for Computer Machinery

<sup>2</sup>Institute of Electrical and Electronics Engineers

cuatro siguientes divisiones:

1. Informática
2. Arquitecturas
3. Ingeniería de Software
4. Sistemas de información

Teniendo como núcleo que cada persona formada en Informática debe de haberse instruido en:

- a) Pensamiento algorítmico
  - b) Representación de la Información
  - c) Diseño
  - d) Programación
-

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