



## Web Science

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► **To cite this version:**

Stefano A. Cerri, Hugh C. Davis, Thanassis Tiropanis, Mark Weal, Su White. Web Science. Encyclopedia of the Sciences of Learning, Part 23, Springer, pp.3447-3450, 2012, 10.1007/978-1-4419-1428-6\_63 . lirmm-00670646

**HAL Id: lirmm-00670646**

**<https://hal-lirmm.ccsd.cnrs.fr/lirmm-00670646>**

Submitted on 16 Feb 2012

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## Metadata of the chapter that will be visualized online

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Copyright Holder	Springer Science+Business Media, LLC		
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## 2 Web Science

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## 11 Synonyms

12 Science for the Internet; Science for the Web

## 13 Definition

14 The Web is the largest human information construct in  
15 history and it is transforming society (O'Hara and Hall  
16 2008). Understanding what the Web is, engineering its  
17 future, and ensuring its social benefit necessitate new  
18 interdisciplinary approaches and research methodologies.  
19 Web Science (<http://webscience.org/webscience.html>) is  
20 a new interdisciplinary field that studies the Web as  
21 both a piece of engineering and infrastructure (micro  
22 level) and a phenomenon that impacts society and  
23 human activity (macro level).

24 Web Science employs interdisciplinary research  
25 approaches (Berners-Lee et al. 2006, Hendler et al. 2008).  
26 Due to the size and the dynamicity of the Web, we may  
27 consider it as a complex natural phenomenon that  
28 deserves to be studied as such, with the help of all classical  
29 means used by the natural sciences (observations, experi-  
30 ments, simulations, models, abstractions, generalizations,  
31 interpretations, forecasts). At the same time, the Web  
32 represents also the first realistic natural laboratory for  
33 controlled experiments on human behavior especially  
34 when humans (and machines) perform the highest intel-  
35 lectual activities of information processing; studying the  
36 ways in which the Web transforms society and human  
37 activity thus requires the use of interpretative approaches  
38 found in social sciences. Modeling and analysis of the Web

also requires formalisms from computer science, mathe- 39  
matics, and statistics. 40

## Theoretical Background 41

Web Science was launched in November 2006 by scientists 42  
affiliated to the Massachusetts Institute of Technology and 43  
the University of Southampton in order to introduce 44  
a holistic approach to researching the Web as an infra- 45  
structure; and a phenomenon that affects society and 46  
human activity. Other institutions soon expanded that 47  
effort (Shadbolt and Berners-Lee 2008; Hendler et al. 48  
2008). The scale of the impact that technical innovation 49  
on the Web can have on society, e.g., the societal impact of 50  
the growth of blogosphere, established the need for Web 51  
Science. 52

The study of such impact on a macro level needs new 53  
methods of analysis different to those that have so far been 54  
employed on the micro level to study or engineer the 55  
introduction of technical changes in systems, applications, 56  
or protocols. Continuing innovation on the Web that 57  
involves the rise of semantics (Shadbolt and Berners-Lee 58  
2008) and linked data (O'Hara and Hall 2009) is expected 59  
to lead to a similar impact on society rapidly expanding 60  
from a micro level to a macro or global level. 61

Web Science draws from a set of complementary dis- 62  
ciplines and brings together aspects of Computer Science, 63  
Sociology, Psychology, Biology, and Economics (Shadbolt 64  
and Berners-Lee 2008) but in terms of research activities it 65  
is seen as more than the intersection of these research areas 66  
and less than their union. The basic premise is that the 67  
combined Web-related research efforts from these disci- 68  
plines will have an effect larger than its parts: the notion of 69  
emergence of constructive patterns from interconnected 70  
autonomous agents, be them human or artificial. 71

The main expectations of Web Science are that it will 72  
enable a more thorough study of the Web ecosystem where 73  
simple rules can give rise to complex phenomena and that 74  
it will address the need for a holistic approach to 75  
researching the Web infrastructure integrating both social 76  
and technical methodologies. It is thus expected to address 77  
needs for the Web to be both engineered and understood 78  
and to thereby gain an insight into what phenomena may 79

80 be coming with the Web and how they may impact society  
81 and human activity (Shadbolt and Berners-Lee 2008).

## 82 Learning About the Web

83 The question of what forms the curriculum of the subject  
84 of Web Science is under active debate (<http://webscience.org/curriculum.html>). The chosen areas should contrib-  
85 ute to understanding, engineering, and ensuring the social  
86 benefit of the Web. In the previous section we show that  
87 Web Science is an interdisciplinary subject, and research in  
88 Web Science will require contributions from a wide range  
89 of subjects including Mathematics, Sociology, Computer  
90 Science, Law, Ecology, Artificial Intelligence, and Econom-  
91 ics. This provides particular challenges for the design of  
92 Web Science courses as it becomes necessary to take a truly  
93 integrated interdisciplinary approach rather than teaching  
94 about each of the contributory subjects in isolation.

95  
96 The initial pass at the Web Science curriculum  
97 emerged after the Network for Web Science Workshop  
98 on Web Science Curriculum in September 2008 in Athens  
99 which suggested six topics:

- 100 1. The History of the Web. This covers the history of the  
101 Internet and the work of the pre-Web hypertext  
102 visionaries, as well as the Web timeline.
- 103 2. Building the Web. This covers the technologies, stan-  
104 dards, and algorithms that are used to engineer the  
105 Web as well as aspects of governance and community  
106 inclusion in the process.
- 107 3. The Web in Society. This covers the coevolution of  
108 society and the Web, and will include issues of privacy,  
109 IP and copyright, and collective intelligence.
- 110 4. Deploying the Web – Operationalizing Web Science  
111 for a World of International Commerce. This covers  
112 the basics of information systems, online markets, and  
113 E-Commerce as well as the associated technologies.
- 114 5. Analyzing the Web. The study of methodologies to  
115 analyze the Web graph and data mining the informa-  
116 tion it contains.
- 117 6. Understanding Web Users. The study of methodolo-  
118 gies to analyze the behavior of users on the Web.

119 While these topics create a coherent curriculum that  
120 addresses the objectives of Web Science, the interdisciplin-  
121 ary nature of such courses presents issues both in finding  
122 suitably qualified teachers and learning resources, and in  
123 coping with the diversity of students when they may also  
124 come from a range of disciplinary backgrounds. Conse-  
125 quently many Web Science courses have tended to con-  
126 centrate on building the Web and be attended by those  
127 with a technical background.

## Learning on the Web

128 Although not incorporated into the early visualizations of  
129 Web Science, there is a strong case for learning technolo-  
130 gies claiming a place in its Universe. Learning technologies  
131 typically incorporate components of computer science  
132 and Web engineering (the technological aspect) plus psy-  
133 chology and sociology (the educational aspect). The devel-  
134 opment and effective delivery of learning on the Web  
135 requires both educational and technological insight. In  
136 addition, such applications necessarily have to encompass  
137 affordances and epistemologies derived from different  
138 disciplines and fields of study in which they seek to oper-  
139 ate. These demands speak for the inherent interdisciplin-  
140 arity of learning technologies and make a clear argument  
141 to place learning technology as an obvious member of the  
142 Web Science universe very profoundly interconnected and  
143 synergic with business, work, and entertainment  
144 technologies.  
145

## Important Scientific Research and Open Questions

146 Web Science will model the Web infrastructure and its  
147 architectural principles and research the relationship  
148 between computer-mediated human interactions and  
149 social conventions.  
150

151 It is anticipated that a number of research challenges  
152 will be addressed (Shadbolt and Berners-Lee 2008) includ-  
153 ing the following:  
154

- 155 • Innovation on Web infrastructure to foster and drive  
156 social interactions by extending it with social proper-  
157 ties and policies
- 158 • Analysis of the Web as an ecosystem that is related to  
159 population dynamics, consumers and producers, busi-  
160 ness activity, journalism, and government
- 161 • Provenance of information on the Web and challenges  
162 for a Web of trust
- 163 • Legal challenges related to Intellectual Property Rights  
164 on the Web
- 165 • The Web as a network of data on which information  
166 can be linked, interpreted, and related to human  
167 activity
- 168 • Affordances and challenges of the Web in collaborative  
169 innovation and collective intelligence processes
- 170 • Affordances and challenges of the Web in addressing  
171 social or cultural divides
- 172 • Architectures and pedagogy for learning on the Web

173 Web Science has an ambitious research vision in terms  
174 of bringing together research methodologies from differ-  
175 ent disciplines. This presents a significant challenge, as  
176 research in the field needs to be evaluated rigorously on

177 the combination of research methodologies that it  
178 employs and on its impact on Web Science and related  
179 disciplines. In addition, training Web scientists requires  
180 significant effort in terms of building Web Science curric-  
181 ular, Web Science knowledge bases, and modeling and  
182 analysis instruments. Addressing these challenges success-  
183 fully will enable further research in the field and provide  
184 new insights on the Web evolution and its impact.

### 185 **Cross-References**

- 186 ▶ [Advanced Learning Technologies](#)
- 187 ▶ [Information Gathering and Internet Learning](#)
- 188 ▶ [Interdisciplinary Learning](#)
- 189 ▶ [Network Communities](#)
- 190 ▶ [Online Learning](#)
- 191 ▶ [Social Networks](#)

### **References**

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|--|-----|
|  | 192 |
| Berners-Lee, T., Hall, W., Hendler, J., Shadbolt, N., & Weitzner, D. J.        | 193 |
| (2006). Creating a science of the Web. <i>Science</i> , 313(5788), 769–771.    | 194 |
| Hendler, J., Shadbolt, N., Hall, W., Berners-Lee, T., & Weitzner, D. J.        | 195 |
| (2008). Web science: an interdisciplinary approach to understanding            | 196 |
| the web. <i>Communications of the ACM</i> , 51(7), 60–69.                      | 197 |
| O'Hara, K., & Hall, W. (2008). Web science. <i>Association of Learning</i>     | 198 |
| <i>Technologies Newsletter</i> , 12.   | 199 |
| O'Hara, K., & Hall, W. (2009). Semantic web. In J. M. Bates, M. N. Maack,      | 200 |
| & M. Drake (Eds.), <i>Encyclopedia of library and information science</i>      | 201 |
| (2nd ed.). New York: Taylor & Francis.   | 202 |
| Shadbolt, N., & Berners-Lee, T. (2008). Web science emerges. <i>Scientific</i> | 203 |
| <i>American</i> , 8, 32–34.  | 204 |

Uncorrected Proof